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**HEALTH ECONOMICS AND ANIMAL PRODUCTION**

**Integrated evaluation of livestock health programs:  
a contribution based on the case of public-private partnerships**

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# Abbreviations

<b>Cirad</b>	The French Agricultural Research Centre for International Development (Centre de coopération internationale en recherche agronomique pour le développement)
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FMD</b>	Foot and mouth disease
<b>NGO</b>	Non-governmental organisation
<b>OIE</b>	World Organisation for Animal Health
<b>PPP</b>	Public-private partnership
<b>PVS</b>	Performance of veterinary services
<b>SDG</b>	Sustainable Development Goals
<b>SENACSA</b>	Public Veterinary Services of Paraguay (Servicio Nacional de Calidad y Salud Animal)



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# Summary

Although public-private partnerships (PPPs) in public health have been studied since the 1980s, few have been evaluated in the veterinary domain. However, many PPPs in this field are being implemented around the world. These PPPs represent joint approaches in which public veterinary services and private actors, such as private veterinarians, producer associations or private companies, work together to address complex animal health challenges. This thesis focuses on PPPs for the surveillance, prevention and control of infectious animal diseases. While there are advantages to these forms of collaboration, there are also risks. The objective of this thesis was to develop an integrated evaluation framework by focusing on the attributes and properties of these PPPs. These would inform the evaluation of the process and outcomes of these PPPs to limit the risks and favor positive effects.

This thesis work is based on pre-existing frameworks (realistic approach in public health and sustainability), on a literature review, and on the themes emerging from the analysis of four case studies, which were put into dialogue to arrive at an evaluation framework. Participatory approaches were mobilized in the case studies, allowing for the consideration of the plurality of viewpoints of stakeholders involved or impacted by these PPPs. Nuanced and diverse opinions, perceptions, and interpretations were thus collected. These approaches have made it possible to understand the organization of PPPs and their effects as perceived by these stakeholders, allowing a systemic vision of the PPP.

First, a review of the literature on the evaluation of PPPs in the veterinary domain and public health allowed us to identify the different methodologies and evaluation criteria that exist. This review allowed us to propose a first draft of an evaluation framework for PPPs centered on the concept of sustainability. The proposed evaluation framework can be divided into context analysis, process analysis and outcome analysis of PPPs. In a second part of the thesis, in order to be able to operationalize the context analysis, two methodologies are proposed. A historical perspective of a PPP in Paraguay traces the emergence of the collaboration between the public and private sectors for the control of foot and mouth disease, and identifies the different factors that influenced the structuring of this PPP. A mapping of stakeholders in Laos, from an ex-ante perspective of a potential PPP for the management of antimicrobial resistance, allows us to identify the connections between stakeholders, to understand how they influence each other, and to explore their interests and constraints.

In a third part of this thesis, in order to be able to analyze the operating process of a PPP, a tool for assessing the quality of the PPP process was developed. This development was made possible thanks to the criteria identified in the literature review, an elicitation of expert opinions (from the public and private sectors) and two case studies. This tool focuses on the coordination, collaboration and governance functioning of PPPs. This tool was then applied to a PPP in Tunisia corresponding to the veterinary health mandate. Finally, in the fourth part of this thesis, a participatory application of the impact pathway on a PPP in Ethiopia in the poultry sector focused on the outcomes and impacts enabled by the PPP, as well as the contribution of the PPP to achieving these impacts. Stakeholders identified a variety of impacts that were characterized by indicators.

The integrated evaluation framework developed in this thesis aims to identify points of improvement in the processes and outcomes of PPPs in terms of human, animal and ecosystem health, from a territorial sustainability. These objectives are therefore explicitly integrated into a One Health approach, understood as belonging to the sciences of sustainability. Several difficulties related to the operationalization of the evaluation have been identified, including consideration of the environmental dimension and the participation of stakeholders negatively impacted by PPPs. These difficulties may limit the implementation of changes in the PPPs evaluated and therefore the chances of promoting a trajectory towards a more sustainable territory. To overcome these operational difficulties, this evaluation framework can be used in a long-term support perspective by an interdisciplinary team of evaluators. This work deserves to be continued, and this framework to evolve. For example, it would be interesting to consider other scales of evaluation such as the individual scale or the scale of stakeholder networks. It would also be interesting to propose risk analyses, to deepen the analysis of power games, and to reflect on a real consideration of the environmental dimension in the evaluation of PPPs in animal health.

# Preamble

Work on this thesis began in September 2018 as part of the ‘Public-Private Progress’ project run by the World Organisation for Animal Health (OIE) in collaboration with the French Agricultural Research Centre for International Development (CIRAD). The thesis was financed for 3 years and 4 months by CIRAD and the OIE as part of the project. The project is financed by the Bill and Melinda Gates Foundation. One part of the project focuses on the evaluation of Public-Private Partnerships (PPP) in the veterinary domain and it is to this section that work on this thesis contributed. I was hosted by the ASTRE unit of CIRAD while I carried out the work, and I was able to spend time at the University of Liège and the OIE.

The thesis was carried out under the supervision of the Doctoral College of Veterinary Sciences in the Faculty of Veterinary Medicine at the University of Liège. I am a veterinarian by training, and have a Master’s degree in integrated approaches to health risks, but I nevertheless benefited from interdisciplinary supervision while preparing this thesis (epidemiology, socio-economics and anthropology). The main focus of the thesis is animal health, particularly the management of programmes for the control of infectious animal diseases, but the evaluation approaches led me to use theoretical frameworks from different disciplines.

Different data sources were used, including four cases studies. Before work on the thesis began, an online survey had been carried out as part of the project, which identified 97 PPPs involving public Veterinary Services, at national or local level, and various private actors. I took part in the process of publishing this survey, notably through process of bibliographic contextualisation, and the principal results of this survey are presented in the introduction (part 2.2 of the introduction). The four case studies concerned Ethiopia, Tunisia, Paraguay and Laos. As part of the project, a participatory impact pathways analysis had been initiated for a PPP in Ethiopia. The field data had been collected by a Master’s student from March to June 2018. I organised and analysed these data and supplemented them with quantifiable data gathered through an analysis of the company’s internal reports. This student and I, alongside the associated research team, worked together to write an article about this analysis (chapter 4). From January to June 2021, another Master’s student did their internship as part of the same project, during which time I acted as their co-supervisor. Their internship focused on an evaluation of a PPP in Tunisia, using an evaluation tool developed as part of the work on this thesis. I present a summary of this study in the manuscript (chapter 3).

I had the chance to go to Paraguay in the first quarter of 2020 to test and improve the previously developed evaluation framework (chapter 2 and discussion). A second three-month field mission had been due to take place in Paraguay in the summer of 2020, but it couldn’t go ahead because of the Covid-

19 pandemic. Finally, a summary of a study carried out in Laos during my six-month Master's internship is also presented (chapter 2). This internship was supervised by CIRAD and the Food and Agriculture Organization of the United Nations (FAO) in conjunction with the National University of Laos. I finalised the analysis of these data and published them while working on this thesis.

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# General introduction

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## **Preamble to the introduction**

This introduction presents the concepts around which this thesis is centred, namely: public-private partnerships (part 2 of the introduction), evaluation (part 3 of the introduction), and integrated approaches (part 4 of the introduction). To begin with, the introduction will look at animal health programmes and their management by Veterinary Services and the private sector (part 1 of the introduction). Thus, this introduction will allow us to define the objectives and the framework of this thesis.

## **1. Management of animal health programmes**

### **1.1 National Public Veterinary Services**

To ensure that livestock are in good health, there must be programmes in place for the surveillance, prevention and control of contagious animal diseases, some of which may also be zoonotic. It is the job of national Veterinary Services to establish and coordinate these programmes in order to ensure the early detection of animal disease outbreaks, to provide a rapid response and, if possible, to control these outbreaks in their countries. All governments have a clear mandate to invest in Veterinary Services in order to monitor and manage the spread of animal diseases at national and international level (World Organisation for Animal Health, 2020a).

The OIE, the intergovernmental organisation previously known as the International Office for Epizootics, was created in 1924 following an international agreement signed by 28 States. They recognised the need to control animal diseases across the world and, more specifically, to control rinderpest, which was running rampant at that time. The OIE was involved in the development of national Veterinary Services across the world, and since 1928 it has stipulated that only health documents *‘from nations with correctly organised Veterinary Services’* could give sufficient guarantees to importers. Since 1998, the standards established by the OIE have been recognised as international reference standards by the World Trade Organization (World Organisation for Animal Health, 2020). In some countries, such as France, Veterinary Services were established in the early 1900s (Portail National des Archives, 1984), while in others they developed much later. In Paraguay, for example, they were established in 1967. One of the main missions of the OIE is to support national Veterinary Services in strengthening their capacity to prevent and control animal diseases (World Organisation for Animal Health, 2019).

Since 2007, through formal evaluations of the performance of Veterinary Services (PVS), the OIE has been helping to set priorities and to prepare action plans that the Veterinary Services of OIE Member



Countries must implement (World Organisation for Animal Health, 2019a). Today, all 182 Member Countries of the OIE have Veterinary Services.

Ensuring good animal health requires significant funding and human resources (Knight-Jones and Rushton, 2013). According to the Food and Agriculture Organization of the United Nations (FAO), publicly funded Veterinary Services must be able to maintain the health of the national herd (Food and Agriculture Organization of the United Nations, 1997). However, for all countries, it is challenging to fund Veterinary Services properly, that is, to provide sufficient funds to enable them to carry out their missions, meet the expectations of their governments, and conform to OIE standards. There is a notable lack of public and international investment in livestock production and Veterinary Services, and this is despite the fact that livestock make a significant contribution to the economy in many countries (World Organisation for Animal Health (OIE), 2019). The importance of well-functioning Veterinary Services has increased over the last few years with the establishment of programmes to develop effective and coordinated responses to the emergence of contagious diseases that have serious economic consequences and severe health impacts (bovine spongiform encephalopathy, new forms of avian influenza, foot and mouth disease) (Stemshorn and Zussman, 2012).

## **1.2 The role of the public and private sectors in animal health management**

Collaboration between the public and private sectors is often needed for a number of different functions, such as the surveillance, prevention or control of contagious diseases. For example, the support of civil society organisations, paraprofessionals and community groups is often required to ensure the provision of veterinary services in remote areas (Ahuja, 2004a). The OIE has long recognised the role of the private sector in the effective operation of veterinary services.

The OIE defines Veterinary Services as ‘the governmental and non-governmental organisations that implement animal health and welfare measures [...]. Private sector organisations, veterinarians, veterinary paraprofessionals or aquatic animal health professionals are normally accredited or approved by the Veterinary Authority to deliver the delegated functions’. In addition, the OIE’s guide to formal evaluations of the performance of Veterinary Services (PVS) consists of 4 sections, one of which is dedicated to interactions with non-governmental stakeholders (World Organisation for Animal Health, 2019a).

From a financial standpoint, the involvement of the private sector in public Veterinary Services, through health mandates and other forms of collaboration, can be seen as a way of improving efficiency and reducing the cost to government (Stemshorn and Zussman, 2012). Collaboration with the private sector can also enable public Veterinary Services to draw on non-governmental expertise and to provide support for the protection of animal health and the country’s markets on the basis of stakeholder needs (World Organisation for Animal Health, 2019a).

Although it is widely accepted that the public and private sectors both have a role to play in the provision of veterinary services, the balance between their roles has been debated since the 1980s. In general, public Veterinary Services' support for animal health and animal production is needed to regulate activities when the market does not allow for the optimal allocation of resources and to ensure the fair and equal treatment of all groups in society, particularly the poor and disadvantaged (van Veen and de Haan, 1995). Establishing Veterinary Services is a core responsibility of the State and one which it cannot delegate; however, when doing so, the State can draw on strategies that ensure complementarity between the public and private sectors (Dehove et al., 2012). In its seventh strategic plan for the period 2021–2025, the OIE recognises that responding to future health and animal production challenges will require the involvement of multiple stakeholders, including public-private partnerships (World Organisation for Animal Health, 2020b). However, collaborations between public and private sectors are difficult to implement on the ground and there have been few studies on the topic, which shows the need for continued efforts to develop a conceptual framework for collaboration in the veterinary domain (Ahuja, 2004a).

## **2. Public-private partnerships**

In the veterinary domain, public-private partnerships (PPP) have only been officially defined by the OIE since 2019. PPPs are 'a joint approach in which the public and private sectors agree on responsibilities and share resources and risks to achieve common objectives that deliver benefits in a sustainable manner' (World Organisation for Animal Health, 2019b).

This definition was developed as a result of work that identified 97 PPPs currently being implemented around the world (Galière et al., 2019a). Before this, there had been few studies on PPPs in the veterinary domain.

In contrast, PPPs in the public health domain have been studied since the 1980s (Roehrich et al., 2017). A parallel can be drawn between the public health and veterinary domains, as they both have the same missions, namely, the surveillance, prevention and control of infectious diseases and the protection of the health of a population. Lessons learned from studying PPPs in the public health domain could be used as a guide for the study of PPPs in the veterinary domain.

### **2.1 Public-private partnerships in public health**

In public health, there has always been interaction between the public and private sectors, but this interaction became an increasingly dominant topic in the discourse on public sector reform in the 1980s (Martin and Halachmi, 2012).

Throughout these years, the predominant trend was the privatisation of certain areas of the public sector in the name of greater efficiency and cost saving, notably in public health (Johnston and Finegood, 2015). PPPs were accepted as a way of creating new opportunities by leveraging resources – financial, human and technological – that would not be available if the government acted alone (Martin and Halachmi, 2012). National governments and international economic organisations began to turn to the private sector to improve health systems and the popularity of PPPs in public health increased (D.A. Barr, 2007). The restructuring of the British National Health Service under the direction of Margaret Thatcher is one example (Al-Hanawi and Qattan, 2019; D.A. Barr, 2007). Over the last thirty years or so, public health PPPs have grown in number and diversity, promoted by the World Health Organization (Nishtar, 2004; Guillbaud, 2015). Thus, the public sector’s responsibility for maintaining systems that promote health and welfare as originally imagined in the United Nation’s Declaration of Human Rights has been diluted (Johnston and Finegood, 2015).

In public health, PPPs include a range of different stakeholders, with at least one from (i) the public sector: national or local government agencies or international organisations controlled by governments, such as the WHO, and (ii) the private sector: for-profit private sector, civil society, and non-profit organisations, such as NGOs and philanthropic institutions (Widdus, 2005). There are a variety of PPPs in public health. Some are the result of a public policy to build infrastructure (e.g. hospitals) with private funding (Barlow et al., 2013). For some, the aim is to develop new medicines or vaccines. For others, the objective is to control disease (infectious and non-transmissible) (Johnston and Finegood, 2015; Salve et al., 2018) or improve access to products and services among targeted populations (Widdus, 2005). There are also hybrid PPPs that cover several objectives. Some PPPs involve international organisations such as multinationals or the World Health Organization (‘PPP for global health’ or ‘global PPP’). These global PPPs have existed since the 1990s (Buse and Wazman, 2001) and are heavily financed by private foundations (notably the Bill and Melinda Gates Foundation) (Reich et al., 2003). These PPPs have changed the policies and practices of the World Health Organization (WHO), which has given rise to debates on the distribution of power, conflicts of interest, and the global health agenda (Buse and Harmer, 2004; Buse and Waxman, 2001; Guilbaud, 2015b).

The public health literature highlights the recurring risks of PPPs, such as conflicts of interest and the distortion of national priorities and policies (Buse and Harmer, 2004). Like all contractual relationships, PPPs, which involve a contract between the public and private sectors, can be considered a ‘principal–agent’ relationship. The public partner (public Veterinary Services) is the principal, and the private partner is the agent whose services it uses. The various partners involved in the contract do not necessarily share exactly the same objectives and can try to take advantage, to the detriment of the other partner, of uncertain situations or situations of information asymmetry, thus posing certain risks (Maatala et al., 2017a). The risk of weakening the role of the public sector in its missions is often cited in the public health literature.

For example, in India, the increase in the number of PPPs in the 1990s influenced the structure of public health services and redefined the roles of the public and private sectors. The public and private sectors were considered to be equal partners and the public sector had to adhere to regulations defined in the formal agreements of the PPP, which reduced the public sector's influence on programme design (Baru and Nundy, 2008). In addition, by supporting and financing PPPs, whose design is often based on the concept of market efficiency, external donors (such as the World Bank) can influence national public health policy, thus reducing the role of the public sector (Baru and Nundy, 2008). This reduction of the responsibility of the public sector and of its influence in shaping public health policies can erode public values, e.g. democratic participation in health-policy choices, or equal access to care (Baru and Nundy, 2008; Vrangbaek, 2008). Finally, public and private partners run the risk of entering into PPP contracts that prove to be sub-optimal or problematic in the long run, notably because of the complexity of setting up PPPs and because of transaction costs (such as the costs of negotiating the contract and of monitoring and tracking the partner's activities) (Vrangbaek, 2008).

On a more positive note, PPPs are also seen as a way of improving practices within public bureaucracies, opening the decision-making process to previously marginalised groups, such as civil society organisations, and promoting good governance in the health sector (Buse and Harmer, 2004). Some PPPs are also recognised for their importance in significantly increasing access to essential public health services in some countries (Salve et al., 2018) and improving the expertise of the different partners through their complementary skill sets (Albis et al., 2019).

There is such variation between PPPs in terms of their aims, their design and their composition that it is difficult to assess their overall merit and their effectiveness in improving health outcomes (Hernandez-Aguado and Zaragoza, 2016).

## **2.2 Public-private partnerships in the veterinary domain**

In animal health, very few studies have analysed the PPPs that have been implemented, so it has not been possible to analyse the successful and less successful examples or assess the benefits and risks. As part of the OIE 'Public-Private Progress' project, members of the public and private sectors in all 181 OIE Member Countries completed an online questionnaire about their experiences of PPPs. This survey identified a total of 97 examples in 76 countries of PPPs involving public Veterinary Services (national or local) and various private actors. Given the limited information available on PPPs in the animal health sector, work on this thesis was largely structured around the data from this survey (**Appendix 1**, (Galière et al., 2019a)).

A questionnaire was sent to the delegates of the 181 Member Countries of the OIE (who are usually the Heads of the Veterinary Services) and to 47 private contacts identified by the OIE delegates. The various

questions identified 36 variables that characterise PPPs: the aim of the PPP, the partners involved, the implementation period, the type of interaction between partners, the financial mechanisms, the governance mechanism, the activities implemented, the evaluation data (if available) and the strengths and weaknesses.

Data from this questionnaire were used to develop the definition of a PPP in the veterinary domain that is given at the beginning of part 2 of this introduction, meaning that this definition is based on an analysis of existing field initiatives. The goal of the majority of the 97 PPPs was to prevent and control infectious animal diseases and/or extend the area covered by the Veterinary Services. These PPPs had been set up because these objectives were considered to be unachievable without the involvement of the public and private sectors. The PPPs were initiated either by the public sector (25% of cases) or by the private sector (15% of cases) or by the two sectors at the same time (55% of cases). The PPPs identified are implemented in Africa (22 countries), Europe (22 countries), North and South America (17 countries), Asia and Oceania (9 countries) and the Middle East (6 countries).

The public stakeholders were national Veterinary Services (96%) or provincial Veterinary Services (4%). The majority of private stakeholders were for-profit (91%), with the remainder being non-profit (9%). The for-profit private stakeholders were independent private veterinarians (usually represented by veterinary associations) (29%), producer organisations or cooperatives (23%), private enterprises (15%) or consortiums representing several types of for-profit private partners (24%). The non-profit stakeholders were NGOs, private foundations or para-public agencies (9%).

Most of the PPPs that involved private veterinarians (independent or represented by associations) were in Europe and Africa, and almost all of them involved a health mandate. Most of the PPPs that involved private enterprises were in Africa, often motivated by development goals, with a few in Europe. Most of the PPPs that involved producer organisations were in the Americas, particularly Central America and Latin America.

Goal alignment and partner engagement were the key success factors most often cited. The other key success factors were communication and trust between partners, transparency in decision-making and activities, the level of involvement of each partner, and the setting of common goals and mutual benefits. The obstacles most frequently reported were a lack of resources, particularly a lack of sustainable funding, the limited availability of skilled human resources, a lack of legislative support for PPPs, and administrative complexity. The survey did not collect any data on the potential or existing risks associated with the PPPs. However, we can assume that the risks are likely to be the same as those identified in public health.

The analysis of this survey, following multifactorial analyses, led to the development of a typology that differentiates 3 types of PPP in the veterinary domain. The three types are distinguished primarily on

the basis of who the private partners are, what action is taken, and what type of governance is in place (**Table I**).

Type 1 are ‘Transactional PPPs’. This type of PPP is motivated by the need to develop veterinary services/provision at local level and they are initiated and financed by the public sector. The private actors involved include veterinarians or veterinary paraprofessionals, veterinary enterprises, or veterinary associations. The private partner is contracted to provide the service or is given a health mandate. Farmers who benefit from the service may have to pay for it. Type 2 are ‘Collaborative PPPs’. This type of PPP is motivated by commercial interests and/or the desire to export. They are initiated by public Veterinary Services and the private sector at the same time. The private actors involved are usually farmer associations. These PPPs are based on a joint commitment to implement mutually agreed policies and outcomes. Their governance arrangements range from informal agreements to legal regulations. Decision-making is shared between the two sectors. Type 3 are ‘Transformative PPPs’. This type of PPP is centred on commercial development objectives. They are initiated and financed by the private sector (national or multinational businesses) but controlled and sanctioned by public Veterinary Services in collaboration with them. These major programmes would otherwise be unachievable. These PPPs may initially benefit from international aid or help from the charity/philanthropic sector in order to obtain commercial profit in the long term. Governance is joint and can be exercised through, for example, a memorandum of understanding.

**Table 1. The three types of PPP in the veterinary domain identified following an analysis of the descriptions of 97 PPPs in 76 countries.** This table has been adapted from Galière and colleagues.

	Type 1, ‘Transactional’ PPP	Type 2, ‘Collaborative’ PPP	Type 3, ‘Transformative’ PPP
Private, for-profit partners	Private independent veterinarians and veterinary associations	- Producer organisations and cooperatives - Consortiums of private actors	Private companies
Type of interaction	Accreditation	- Accreditation - Participation in joint programmes - Consultation	Participation in joint programmes
Governance	Health mandate	- Legislation - Agreement/convention	Agreement/convention (often in the form of a memorandum of understanding)
Principal region	Europe and Africa	- Americas - Asia/Pacific	Africa
Funding provider	Public sector	Public and private sectors	Private sector
Initiator	Public partner	Public and private partners	Private partner

Objective	Multiple: infectious diseases, food security, animal welfare, etc.	Infectious diseases: prevention, control, eradication	Infectious diseases: control and prevention Antimicrobial resistance Commercial aims International partners from the public sector or foundations/NGOs
Additional partners	None	None	

The breadth of private partners identified in the survey broadens the traditional understanding of PPPs involving Veterinary Services, which tended to equate PPPs with health mandates and nothing else. This study confirms that numerous PPPs are being implemented in the veterinary domain and that they involve a wide variety of actors, initiatives and aims.

### 3. The importance of evaluation in health programmes

#### 3.1 Programme evaluation: definition, aims and methods

A number of disciplines have taken an interest in evaluation (e.g. management, policy analysis, education, sociology, social anthropology and health) and this has resulted in a number of different theoretical frameworks and definitions (Peyre et al., 2021a). For example, evaluation in the public health sector is a combination of economic evaluation, evaluation based on epidemiology and clinical practice and, increasingly, evaluation from the social sciences (Champagne et al., 2011a). We use a definition of evaluation used in public health: ‘to evaluate is to make a value judgement about an intervention by using a tool capable of providing valid and socially legitimate scientific information about it, or any of its components’ (Champagne et al., 2011a). We can make a distinction between assessment and performance monitoring. Assessment is the collection and analysis of data for a defined indicator. It is a technical step in the evaluation process. Performance monitoring is carried out on an ongoing basis, and results are used internally by the system’s stakeholders. Performance monitoring is carried out with the help of performance indicators (Peyre et al., 2021a).

##### 3.1.1 The aims of evaluation

According to Champagne et al., (2011a), evaluation can be carried out to (i) help plan and develop a programme i.e. it has a *strategic aim*; (ii) provide information to improve a programme and contribute to informed decision-making and better-informed change, i.e. it has a *formative aim*; (iii) determine the effects of a programme to decide whether it should be maintained, altered or abandoned, i.e. it has a *summative aim*; (iv) contribute to the advancement of knowledge and the development of theories, i.e. it has a *fundamental research aim*; or (v) use the results of the evaluation to advocate for a certain course

of action, i.e. it has a *tactical aim* or a political aim. Evaluation can also be a means of strengthening partnerships and the collaborative process by ensuring dialogue, transparency and trust between partners (Allen, 2019).

The aims of the evaluator and/or the stakeholders that request the evaluation are not always explicit or transparent, so it is essential to be aware of the implicit aims and the strategies of the different stakeholders (Champagne et al., 2011a).



The evaluation can be carried out *ex ante*, *in itinere* or *ex post*. *Ex ante* evaluation, that is, evaluation carried out before the programme is implemented, is strategic and provides the elements needed to improve the value of the planned programme, its design and its planning. *In itinere* evaluation, that is, evaluation carried out when the programme is up and running, aims to be either formative, that is, show where any adjustments may be needed, or summative, that is, for the purposes of informing decision-makers. The timing of an *in itinere* evaluation will depend on its aim, which itself will depend on the aim of the programme and on external factors, such as the evolving disease situation. It can be carried out to evaluate the performance and the added value of the programme. *Ex post* evaluation, that is, evaluation carried after the programme has ended, is implemented to identify what we can learn from the finished intervention or project. It can be carried out to identify the lessons we can learn from how it was set up and how the programme operated (Peyre et al., 2021a).

### **3.1.2 The principles of evaluation**

If evaluations are to generate change, they must be transparent, objective and evidence-based, as this ensures that stakeholders can have confidence in the results and will therefore be more likely to implement the recommendations. The recommendations will only be accepted if they are seen to be genuinely useful for improving the programme and do not unfairly benefit certain stakeholders. The evaluation process must therefore be clear and transparent for all stakeholders, as should the results and recommendations; it is especially important to be transparent about the way in which the results and recommendations were drawn up (Peyre et al., 2021a). The American Evaluation Association has five ethical principles that it recommends evaluators use. These principles, which are interdependent, are: systematic enquiry, competence, integrity, respect for people, and common good and equity (American Evaluation Association, 2011). Other ethical principles mentioned in the literature are reflexivity, humility and honesty (Apgar and Allen, 2021).

### **3.1.3 The importance of participation in the evaluation process**

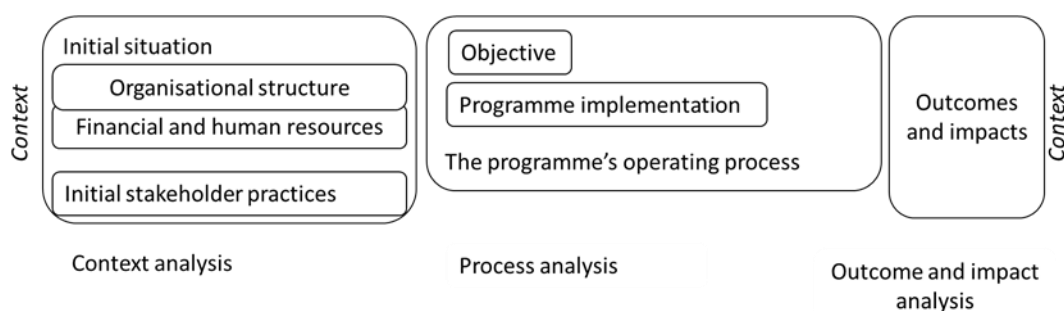
Some authors underline the importance of stakeholder participation in evaluation. Participatory evaluation is an approach that involves the stakeholders of a programme/policy in the evaluation process. This involvement can come at any stage in the evaluation process, from the design of the evaluation to the collection and analysis of data and the writing of the evaluation report. The level of participation in the evaluation can vary according to the place stakeholders are given at the different stages of the evaluation and the implementation of the recommendations; for example, they may simply be consulted or power may be delegated to them (Arnstein, 1969; Cornwall, 2008). Participatory evaluation can include individual interviews, participatory mapping, scoring, identification of causal links between a programme's components, and brainstorming workshops on the strengths and weaknesses of a programme (BetterEvaluation, 2012a).

The aim of participatory approaches, which became popular in the 1990s, is to enable communities and stakeholders to find their own solutions to the particular problems they face (Aluma et al., 2009). These approaches favour bottom-up methods as opposed to top-down methods in the decision-making process, as they aim to give people a greater sense of ownership over the strategies and activities to be implemented (Debevec et al., 2019). The benefits of using participatory approaches in evaluating health programmes have been demonstrated by the national cystic echinococcosis control programme in Morocco (Saadi et al., 2021).

Participatory evaluation can help formulate locally relevant evaluation questions, provide context-specific recommendations, and support collective learning (Bryson et al., 2011; Taut and Brauns, 2003). Programme evaluators can face resistance from those affected by the evaluation, as the latter may see evaluation as an exercise in external power. To improve the implementation of the evaluation and reduce stakeholder reticence, it is important that stakeholders are actively involved in the entire evaluation process and that the evaluation adapts to existing organisational structures. This is key in establishing trust between stakeholders and the evaluator (Taut and Brauns, 2003). If stakeholders have some control over the evaluation process and its results, they are more likely to accept them. Taking into account the variety of individual opinions, and trying to understand them, makes it more likely that any decisions taken will be useful for the group. However, if stakeholders, particularly dominant stakeholders, have too much control over the results of an evaluation, it can create a conflict of interest, as the actors are both the judge and the judged (BetterEvaluation, 2012a; Taut and Brauns, 2003).

### 3.1.1 Evaluation approaches

All programmes have five components: resources (human resources, financial resources, organisational structure), stakeholders and stakeholder practices, procedures for running the programme, at least one aim, and, finally, a context (Figure 1). What stakeholders (and groups of stakeholders) do, and how they do it, is central to any programme. It is their characteristics, their intentions, their interests and their beliefs that shape the programme (Champagne et al., 2011a).



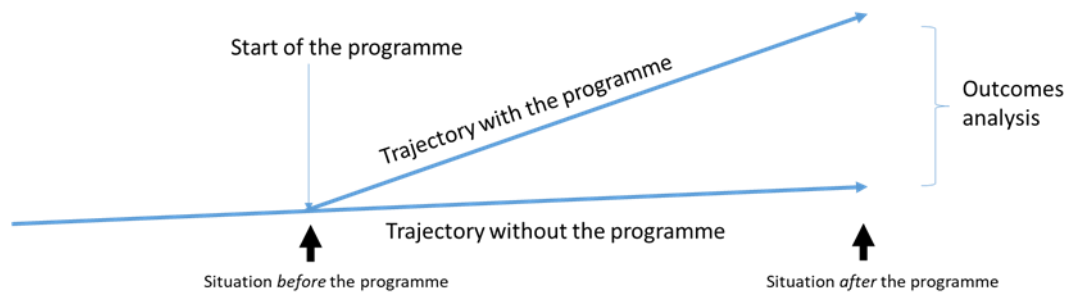
**Figure 1:** Programme components. Adapted from Champagne and colleagues (2011).

We will look at two different evaluation approaches: normative evaluation and the realist approach to evaluation (Champagne et al., 2011a; Robert and Ridde, 2013). *Normative evaluation* seeks to assess each of the components of the intervention against criteria and standards. It is part of a process of checking that the programme components conform to previously established benchmarks (Champagne et al., 2011a). The realist approach focuses on understanding the causal relationships between the different components of a programme. Evaluations based on the realist approach seek to highlight and understand the complexity of a programme and of these different components: the context, the stakeholders and their decisions and wishes, the programme's implementation process (finance arrangements, administration, monitoring and evaluation measures), time (the programme's history influences the process), the influence that other programmes implemented at the same time have on the outcomes, the programme outcomes, and the things that happen as a result of the interactions between the stakeholders that modify their behaviour and so transform the programme. It is an evaluation approach based on theoretical assumptions about the mechanisms at work, i.e. 'theory-based evaluation' (Robert and Ridde, 2013). It answers not only the classic question, 'Is the programme effective at achieving a particular outcome?', but, above all, questions such as 'Why does a programme work/not work?', 'How does it work?', 'Who does it work for and in what context?' (Brousselle and Buregeya, 2018).

### 3.1.2 Evaluation processes

There are hundreds of different evaluation methods and processes. A combination of methods and processes may be used, depending on the evaluation question and on what needs to be evaluated (BetterEvaluation, 2010). The data gathered can be quantitative and/or qualitative.

It is important to note that in evaluations, programme outcomes must not be compared to the situation before the programme started. It is important, therefore, to make a distinction between the situation *with* the programme, *without* the programme and *before* the programme. Indeed, even without a programme, a situation evolves over time. The analysis of the outcomes must assess the difference between the situation *without* the programme (not *before*) and the situation *with* the programme (**Figure 2**). This difference is what indicates the actual impact of the programme (European Union Capacity4dev, 2018). As PPPs are just one way of achieving objectives, they must show that collaboration has advantages, i.e. PPPs must bring added value and be better at achieving results and having an impact than a programme that does not involve a PPP (Bryson et al., 2015).



**Figure 2: Outcome analysis in programme evaluation.**

*Outcomes are usually analysed on the basis of the additional situation, that is, the difference between the situation without the programme (which can be analysed by creating a counterfactual) and the situation with the programme.*

However, it is not easy to measure the added value of collaboration. One way of doing it would be to compare the outcomes of a PPP with the outcomes of an existing or modelled ‘counterfactual’ of a situation without a PPP. In other words, they could be compared with what would have happened in the same context if there had been no programme at all or if there had been a purely public or a purely private alternative.

### 3.2 Evaluations of animal health programmes

In general, evaluations of animal health programmes are still under-used in the decision-making processes of programme stakeholders and decision-makers (Peyre et al., 2021a). Programme evaluations in the veterinary domain are mainly technical evaluations or effectiveness evaluations. A programme’s effectiveness is often defined in terms of the animal production losses avoided. Evaluations in animal health also address efficiency by considering outcomes and advantages in relation to a programme’s cost (Rushton, 2007). These analyses do not address socio-economic or socio-ecosystem factors which would provide a holistic view of the programmes evaluated.

For example, these evaluations are rarely based on institutional analyses of mechanisms of collaboration and coordination between stakeholders, which are important if the successes and failures of the PPP are to be analysed in terms of the which aspects of the programme’s implementation led to these results.

However, over the last 20 years, methodologies have been developed to implement process evaluations for animal health programmes. Process evaluation is the assessment of the conditions in which a system operates and of the aspects of its organisation and implementation that will affect its performance. Process evaluation can, for example, enable us to better understand the reasons for poor performance. Several process evaluation methodologies have been developed for animal health programmes. They include two specific tools for evaluating animal health surveillance systems: *OASIS* and the *One Health*

*surveillance matrix* (Bordier et al., 2019; Hendrikx et al., 2011). More-comprehensive evaluations that incorporate assessments of efficacy, the programme's scope, and the elements that affect its performance have also been developed. These evaluations have highlighted the importance of the private sector in animal health surveillance programmes (Delabougliise et al., 2015) and the importance of trust between the stakeholders involved and their acceptability in the system (Calba et al., 2015a; Pham et al., 2017). Evaluation methodologies that focus particularly on programmes involving integrated One Health approaches have also been developed. These evaluations look at, among other things, the programme's context, the objectives, the action implemented (the programme's process) and the outcomes and impact (NEOH, 2020). These evaluations consider social, environmental and economic factors and employ methodologies with multiple components, such as the theory of change (Rüegg et al., 2017).

However, none of the evaluations mentioned explicitly address PPPs in the veterinary domain. Moreover, it is still challenging for evaluations to take into account the context, the multiplicity of stakeholders, the numerous different reasons behind their decisions, the complexity of the links between stakeholders, and the multiple objectives of a particular action (Peyre et al., 2021a). Finally, while evaluations are increasingly taking socio-economic factors into account, environmental issues, although one of the pillars of sustainability, are often neglected. There is a methodological development challenge around the evaluation of PPPs in the veterinary domain, and, in this thesis, evaluation is considered an object of research.

## 4. Integrated approaches

Animal health programmes, including PPPs, can influence every aspect of livestock production, which, in turn, can influence the sustainability of the area in which animals are produced. Consequently, it is interesting to look at the outcomes of PPPs not only in terms of animal health but also in terms of respecting planetary boundaries and contributing to greater sustainability. The latest report from the Intergovernmental Panel on Climate Change confirms that crossing the threshold of +1.5°C would have an irreversible impact on human and ecological systems and that while ‘life on Earth can recover from a drastic climate shift by evolving into new species and creating new ecosystems; humans cannot’ (Masson-Delmotte et al., 2021). Given that ‘we need a radical transformation of processes and behaviours at all levels: individuals, communities, businesses, institutions and governments’ (Masson-Delmotte et al., 2021), planetary boundaries and the environment should be taken into account in all areas of research.

### 4.1 Sustainability

Sustainability is a process characterised by a set of behaviours and practices that seeks to preserve a common good in time and space. Sustainability means meeting the needs of the current generation without compromising the ability of future generations to meet theirs (White, 2013).

Sustainability is usually considered to have three components: economic development, social development and environmental protection (Adams, 2006). It has been noted that multisectoral approaches and community engagement are important in finding solutions to complex problems (Bloom, 2007), and governance is sometimes considered the fourth dimension of sustainability (James et al., 2015). Governance is defined as any form of coordination between actors and the diversity of rules and frameworks that influence actor behaviour (James et al., 2015).

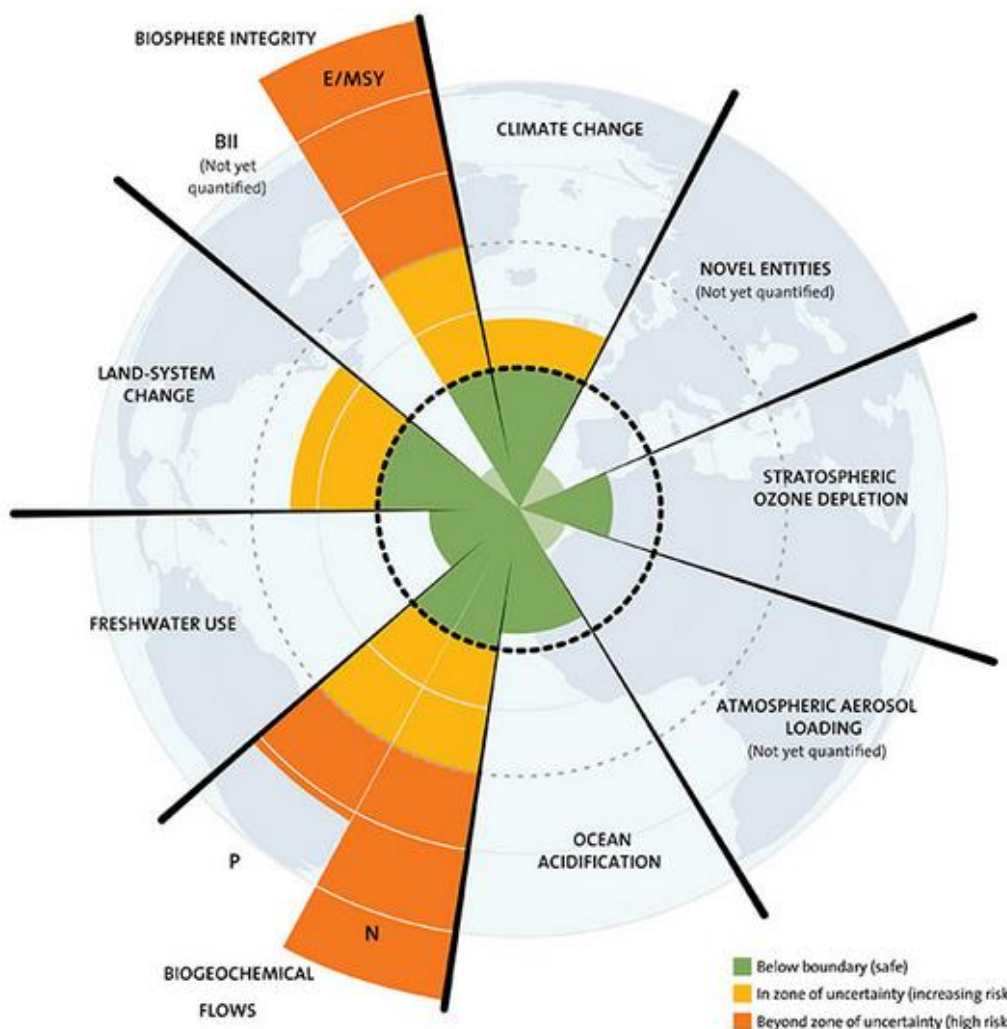
#### 4.1.1 The sustainable development goals and planetary boundaries

As early as 1972, the Meadows Report, which was based on a correlation model that used a range of different data (ecological consequences of economic growth, resource limitations and demographic growth), put forward the hypothesis that the global trajectory of demographic and industrial growth was not sustainable (Meadows et al., 1972). Since then, the outlook has worsened and, at global level, there is no longer any doubt that we are consuming more resources than are being generated and that the environment is rapidly deteriorating.

At international level, in September 2015, all Member Countries of the United Nations adopted 17 Sustainable Development Goals. Development and environmental goals finally recognised as being inextricably linked (United Nations, 2015). However, this framework is struggling to demonstrate

operational results, and the drastic changes needed to meet the sustainability agenda are not being implemented. For example, none of the industrialised countries that signed the Paris Agreement are meeting the targets set by the Agreement (United Nations Environment Programme, 2017).

The Stockholm Resilience Center suggests that we should consider economies and societies as integral elements of the biosphere, which then becomes the basis of everything (Stockholm Resilience Center, 2018). There are nine planetary boundaries within which humanity can continue to develop and prosper for generations to come (**Figure 3**). Surpassing these limits increases the risk of generating dramatic and irreversible environmental changes on a large scale. Four of the nine planetary boundaries have been breached as a result of human activity: climate change, disruption of the biogeochemical cycles (phosphorus and nitrogen), land use change and biodiversity loss. The other five boundaries are chemical pollution, stratospheric ozone depletion, atmospheric aerosol loading, ocean acidification and freshwater consumption (Steffen et al., 2015; Stockholm Resilience Center, 2015).



**Figure 3: The nine planetary boundaries within which humanity can continue to prosper for generations to come.**

*Figure of Stockholm Resilience Center adapted from Steffen and colleagues (2015).*

Several western countries are exceeding planetary boundaries (O'Neill et al., 2018). It is, of course, essential to take into account the fact that there are many countries and individuals for whom the notion of 'development' refers to many other considerations. For example, **690 million people** are currently suffering severe famine and are in a situation of **chronic undernourishment**, that is, they do not have regular access to sufficient quantities of food to cover their basic needs (Food and Agriculture Organization of the United Nations, 2020).

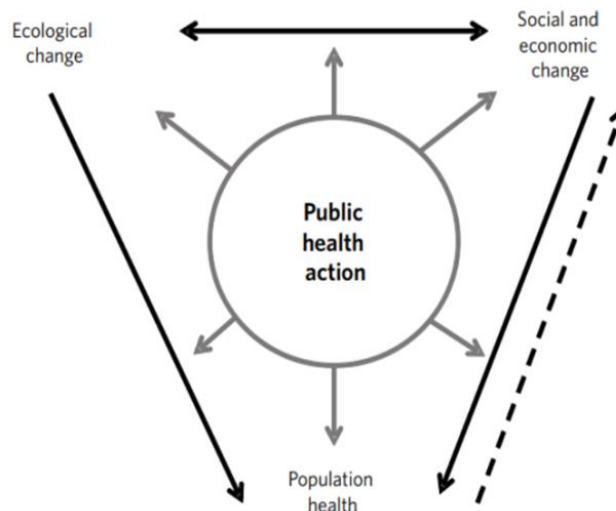
#### **4.1.2 Sustainability science and sustainable health**

Sustainability science is a field of research defined by the problems that it tackles rather than the disciplines it uses. Research relating to the sustainable development goals has long been carried out by separate disciplines, including geography, ecology, economics, physics and political science. Sustainability science seeks to move beyond the specific concerns of particular disciplines. It concentrates on understanding the complex dynamics that result from interactions between humans and the environment in order to participate in needs-based problem-solving efforts. Sustainability science is primarily driven by complex problems and a commitment to transform knowledge into societal action (Kates, 2011).

One aspect of sustainability science is sustainable health. Sustainable health highlights the importance of multisectoral approaches and community engagement in finding sustainable solutions to complex health problems (Bloom, 2007). While there have been major advancements in public health over the last few decades, the effects of the impact of humans on the environment (which is the primary determinant of human health) has been neglected. Thus, some researchers argue that current environmental challenges require us to rethink the concept of public health and to take an ecological approach to it (Brousselle and Butzbach, 2018; Brousselle and Guerra, 2017).

As human existence cannot be disassociated from planetary and biological dynamics, these researchers invite us to accept, understand and influence the ecological relationships between humans and the natural environment, which is made up of living beings, in order to ensure good public health for everyone (Lang and Rayner, 2015). They invite us to consider sustainability as the first criterion when designing and evaluating public health programmes and when establishing their priorities (Brousselle and Butzbach, 2018; Brousselle and Guerra, 2017). Thus, public health action is located at the intersection between population health, ecological change, and social and economic change intersect (Figure 4) (Canadian Public Health Association, 2015). The need to take sustainability into account when evaluating public health PPPs and to reflect on their longer-term impacts has also been highlighted (Nishtar, 2004).





**Figure 4: The sustainable public health framework**  
Adapted from the Canadian Public Health Association (2015)

The term global health and eco-social approaches to health resonate with the concepts of One Health and EcoHealth, which have already been widely adopted by international organisations. EcoHealth approaches are approaches which ‘seek to understand and promote health and wellbeing (of humans, animals and ecosystems) in the context of complex interactions between health, social inequalities and ecosystem sustainability’ (Community of Practice in Ecosystem Approaches to Health [COPEH-Canada], 2013). We recognise that there are similarities between these different concepts, but to be consistent in the use of vocabulary, I will primarily talk about sustainability in the rest of the manuscript.

## 4.2 Animal health programmes and sustainability

### 4.2.1 The impact of animal health programmes on sustainability

The outcomes of an animal health programme can influence the entire livestock system (for example, by increasing productivity or by increasing the national herd). Changes to the livestock system will influence the socio-economic structure within which it is situated and affect governance mechanisms and the environment.

Livestock production and animal health represent both an opportunity and a challenge for sustainability in terms of public health, food security, socio-economic stability, and interactions with the environment. Approximately 70% of emerging human diseases are of animal origin (Jones et al., 2008), and millions of people in the world depend on agriculture and animal production to survive (HLPS, 2016). Livestock systems can support efforts to achieve the Sustainable Development Goals (SDGs), such as the eradication of poverty (SDG 1), zero hunger (SDG 2), good health and wellbeing (SDG 3), gender equality (SDG 5), decent work (SDG 8), action against climate change (SDG 13), and the sustainable use of land (SDG 15) (Müller, Jean-Pierre et al., in press). But this balance is fragile, and livestock can have a significantly negative impact on these SDGs. Furthermore, livestock production has a range of effects on processes that can result in either exceeding planetary boundaries or remaining within them (Alders et al., 2021).

From an economic standpoint, livestock provide livelihoods and direct economic benefits for at least 1.3 billion producers and retailers around the world. Livestock farming ensures food security for millions of families and is also an important part of international trade in some countries (Bennett, 2012; Dury et al., 2019). From a social standpoint, livestock play an important cultural role, and animal products also have a high cultural value in several countries (Bertrand Duont et al., 2019; Dury et al., 2019). Women and vulnerable people (children and the elderly) play an essential role in managing several livestock systems. Often, livestock serve as a capital reserve for farming households, providing a strategic reserve that reduces risks and brings stability to the whole household (Steinfeld et al., 1997).

With regard to the environment, in a context of growing resource scarcity, and faced with the need to reduce greenhouse gases, several studies have identified livestock farming as a key area of action (HLPE, 2016). Some pasture-based livestock systems provide ecosystem services such as carbon capture on a global scale (Soussana et al., 2010). Livestock grazing can enrich soil microflora and fauna and improve water infiltration, groundwater recharge, and soil fertility (Steinfeld et al., 1997). However, livestock also have a negative impact on the environment. The 2006 FAO report 'Livestock's long shadow' warned of the threat to the future posed by the development of livestock farming, weighing the growing demand for animal protein against the climate and environmental damage associated with livestock farming (Steinfeld et al., 2006). Livestock farming is the human activity that requires the most land (HLPE, 2016). Livestock farming can have a negative effect on natural biodiversity and soil fertility (Cavicchioli et al., 2019; Hoffmann, 2010) and contributes approximately 14.5% of the total anthropogenic greenhouse gas emissions that are responsible for global warming.

At the same time, some livestock systems are among the most vulnerable to climate change (particularly in dry areas). It is also important to note that, for some smallholders, who often have a very small environmental footprint, livestock farming is one of the few options they have for increasing their income and maintaining their livelihoods (Herrero et al., 2009).

#### **4.2.2 The role of Veterinary Services in supporting sustainability at national level**

To date, it would seem that public veterinary policies still do not focus enough attention on the interaction between livestock and the environment and that few studies address the environmental impacts of animal health programmes. However, animal health programmes implemented by Veterinary Services, particularly by means of PPPs, have the potential to reduce or, conversely, to increase pressure on planetary boundaries. For example, it has been noted that, if the national strategies of Veterinary Services focus solely on increasing market production, they can have a negative impact on planetary boundaries (Debnath et al., 2021). In 2011, the OIE identified the impact of animal production systems on climate change as one of its areas for action in its 5<sup>th</sup> Strategic Plan (World Organisation for Animal Health, 2020). Moreover, a recent OIE Review entitled ‘Veterinary Services in a changing world: climate change and other external factors’ has highlighted the importance of an integrated approach when designing animal health programmes, particularly public-private partnerships (Smith et al., 2021).

Promoting sustainable livestock production, health, and soil biodiversity, by, for example, implementing extensive and semi-intensive agro-ecological livestock production systems, is part of the One Health and EcoHealth frameworks, which many national Veterinary Services are already familiar with. Veterinary systems could engage in intersectoral and interdisciplinary collaboration in order to monitor, analyse and promote farming systems that are adapted to local conditions and contribute to sustainability (Debnath et al., 2021). In addition, in line with the SDGs, animal health programmes should ideally take into account the needs and interests of the most vulnerable (which generally include women, children, migrants and native peoples) (High Level Panel of Experts on Food Security and Nutrition, 2016). By engaging in genuine collaborations with the private and civil sectors, which would allow for participatory and inclusive forms of governance, Veterinary Services would promote the proper management of animal health programmes and make it possible to hold reflective discussions with people with a range of different opinions and expertise (Antoine-Moussiaux et al., 2017). Thus, Veterinary Services could have responsibility for taking into account the contribution of livestock farming to sustainability and for contributing to national and international discussions about the transformation of livestock production systems.

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# Objectives and framework

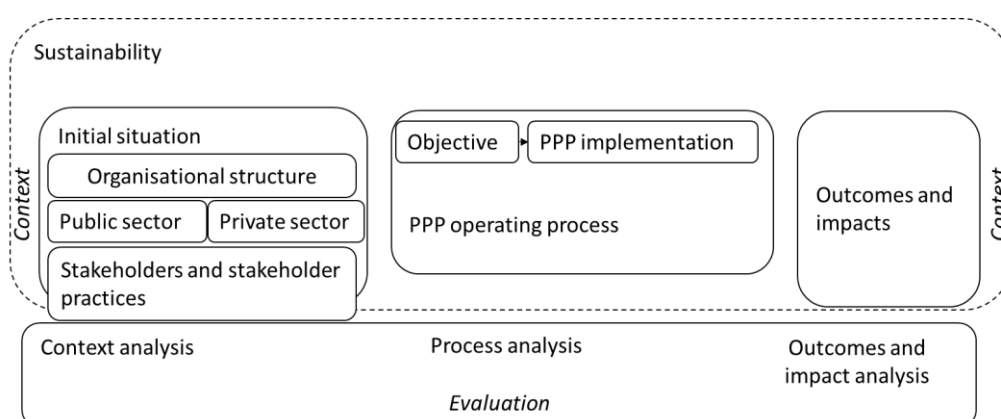
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# 1. The evaluation approaches on which this thesis is based and the definition of integrated evaluation

Work on this thesis was based on realist approaches to evaluation, which seek to understand the how and the why of results. We propose a simplified classification of the components of realist approaches to evaluation (Champagne et al., 2011a; Robert and Ridde, 2013). **Context analysis** focuses on the organisational context within which the programme's stakeholders work (their practices and strategies, their influence outside the programme). It looks at the relevance of the programme to the context and to the problem, and the influence of the context on the programme. **Process analysis** focuses on the quality of the programme's operating processes at the time of the evaluation. It focuses on the links between the resources used and the outcomes. **Outcome and impact analysis** includes both outcome analysis and logic analysis. Outcome analysis focuses on the desired outcomes and the unexpected outcomes. Logic analysis examines the causal pathway between aims, means and outcomes (**Figure 1**).

It is important to consider the components of a PPP, and therefore these different analyses according to the theory of change methodology. This methodology focuses on understanding the way in which activities carried out as part of a programme give rise to a chain of outcomes in a given context. We must therefore be able to check that the outcomes observed have definitely been caused by the activities implemented by the programme. The results of a process analysis give us a deeper understanding of how the programme operates, and this information helps improve future programme activities and thus improves the outcomes (Breuer et al. 2016).

In this thesis, we use evaluation approaches that are based on integrated approaches. Like public health researchers, we will try to argue that sustainability should be the criterion that underpins evaluations of animal health PPPs (Brousselle and Butzbach, 2018). Evaluations of animal health PPPs should be able to look at the contribution that these PPPs make to sustainability (**Figure 1**).



**Figure 1: PPP components that will be considered in this thesis and the types of programme evaluation used**

In this thesis, evaluation is seen as way of improving the process and outcomes of PPPs in order to contribute to sustainability. The solutions sought will be contextualised and varied and will not rely on the use of a universal model. Evaluation is seen as a tool to help work with complexity rather than try to reduce it (Mahoney et al., 2009). To do this, as with sustainable public health approaches, we recognise the importance of multi-sectoral approaches and the involvement of different stakeholders in PPP evaluations (Bloom 2007). Consequently, we will use participatory research practices in evaluating PPPs to help us integrate different disciplines and different perspectives.

We suggest the following definition of integrated evaluations: evaluations that focus on different components of a programme and the causal links between them. They evaluate not only the programme's outcomes but also two key factors that influence the outcomes, namely, the programme's context and the process through which the results were achieved. They are based on knowledge from different disciplines and on the variety of opinions of the stakeholders that are involved in, or are affected by, the programme being evaluated. These evaluations focus on the programme's effect on the four dimensions of sustainability: society, the economy, governance and the environment.

## 2. Animal health PPPs considered in this thesis

The subject of this thesis is national PPPs in the veterinary domain that focus on the surveillance, control and management of infectious animal diseases and zoonoses and access to veterinary products and services. The public partners are public Veterinary Services at national or local level. Private partners may include, for example, private veterinarians with a health mandate (PPP Type 1: ‘transactional’), producer associations (PPP Type 2: ‘collaborative’) or national enterprises (PPP Type 3: ‘transformative’).

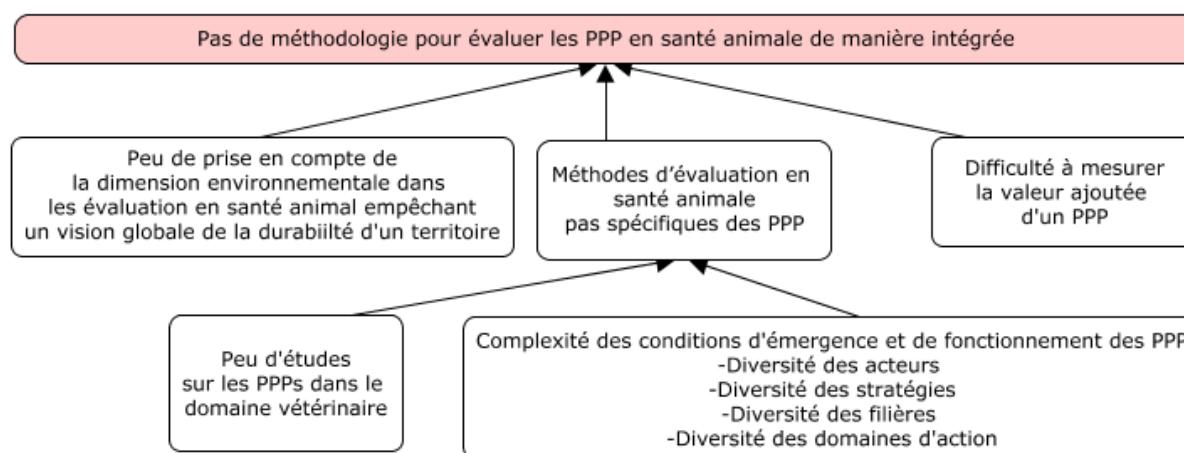
There are several types of PPP that will not be considered in this thesis:

- (i) PPPs for the construction and maintenance of infrastructure, as they involve specific evaluation requirements: contracts are for several decades and often include very technical terms and conditions for construction, maintenance and the payment of rent between the different partners;
- (ii) international PPPs involving international organisations, as they require specific knowledge of international regulations and intergovernmental governance;
- (iii) PPPs that do not correspond to the scope of the project, such as PPPs for the development of new products, PPPs that are in the veterinary domain but do not include Veterinary Services, PPPs for companion animals or horses (the economics of which are very different from that of PPPs for the control of infectious animal diseases in livestock), PPPs for veterinary education and PPPs for product development.

We take our inspiration from the evaluation methodologies developed for public health PPPs. We felt it was relevant to investigate this field, given the similarity of their missions (prevention and control of infectious diseases and access to public health services), compared with, for example, the missions of the agriculture sector. In agriculture, a large number of PPPs focus on the construction and maintenance of large-sale infrastructure (Maatala et al., 2017b).

## 3. The problem

The general aim of this thesis is to contribute to the development of a framework and methodologies for integrated evaluation of animal health PPPs. To do that, we will seek to identify the attributes and properties of animal health PPPs that would inform the evaluation of the process and the scope of these PPPs. Several difficulties that hinder integrated evaluation of PPPs in the veterinary domain were noted in the introduction (**Figure 2**).



**Figure 2: Problem tree for the evaluation of animal health PPPs**

The general research question of this thesis is as follows: **Which attributes and properties of animal health PPPs should be taken into account in an integrated evaluation of these PPPs?** This question can be divided into four other questions, each of which is associated with a different hypothesis (**Figure 3**):

1) *Which elements of the context should be considered when evaluating animal health PPPs?*

The health, social, political, economic and environmental contexts influence the strategies of the different stakeholders and thereby affect the organisation of a PPP. Understanding the context is essential for providing relevant recommendations at the end of the evaluation process.

2) *Which attributes and properties of the operating process of an animal health PPP should be considered in the evaluation?*

It is important that the evaluation takes into account how the PPP's operating processes produced its results (successes or failures), as this will make it possible to identify ways of improving how the PPP functions and thereby improve its outcomes.

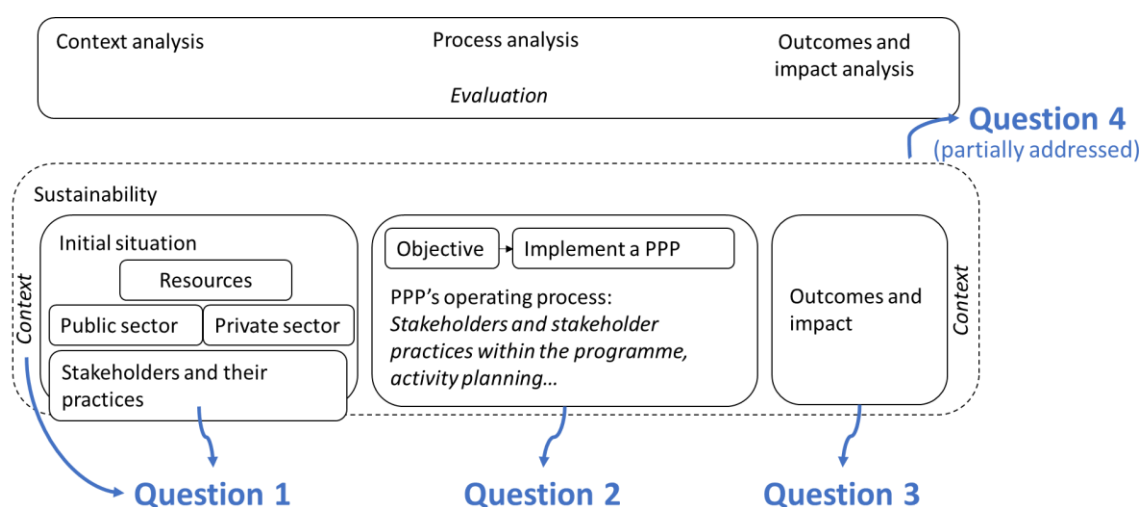
3) *What are the outcomes (benefits and risks) of the PPP and what impacts does it have, and is it possible to evaluate the extent to which the PPP contributed to these outcomes and impacts?*

The impacts of a programme are its positive and negative effects, whether direct or indirect, intentional or unintentional. Livestock production affects public health, the environment and socio-economic stability, so an animal health intervention through a PPP can have varied and wide-ranging effects. In view of the complicated array of factors that can influence the outcomes and the importance of the context in which the PPP is being implemented, modelling or finding an existing counterfactual is almost impossible. One way of overcoming this problem would be to describe the causal links between the means and the outcomes in order to understand the PPP's contribution to these outcomes.



4) *What influence do PPPs have on a country's livestock production system and sustainability?*

This question overlaps with the other questions. An integrated evaluation must take a holistic view of PPPs. We must think about the influence that livestock farming has on the areas where it takes place. The long-term objective of a livestock health PPP should be to help achieve greater sustainability in these areas by influencing animal production systems. In other words, their aim should be to help protect animal health, public health, the economy and society and ensure animal production is well governed, while at the same time respecting planetary boundaries and protecting the environment. However, we would like to point out that this question will be only partially addressed in the various studies. We will return to this question in the general discussion and in the section on recommendations for future research.



**Figure 3: The research questions address the different components of PPPs that are taken into account in a realist approach to evaluation.**

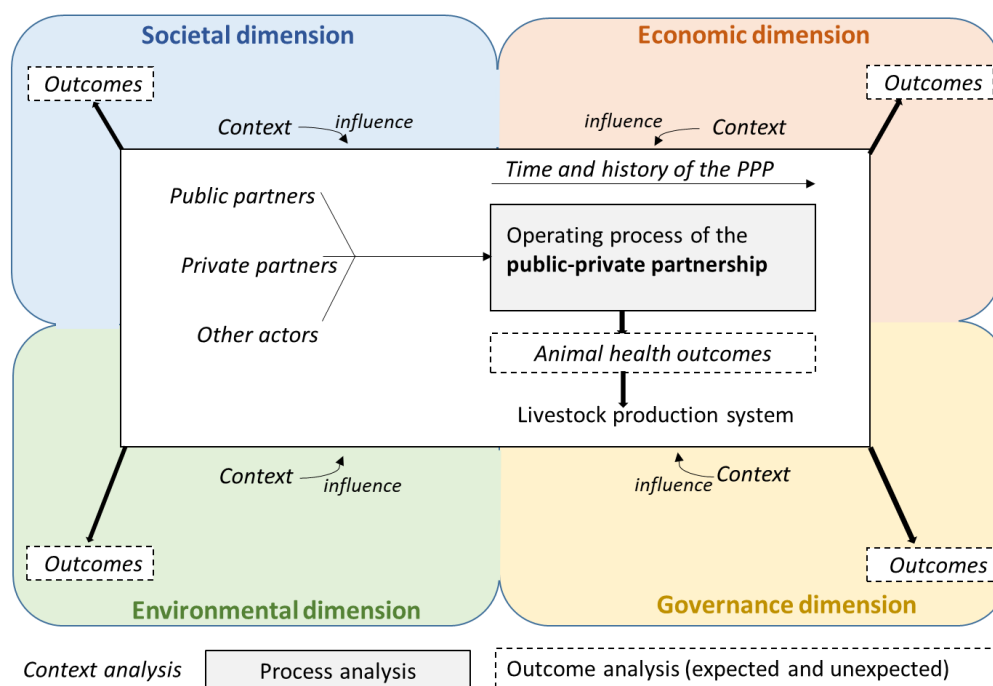
## 4. The analysis model

To answer these questions, we will use the analysis model presented in Figure 4. This model analyses the context (in italics), the PPPs operating process (grey rectangles) and its outcomes (white rectangles with dotted borders).

In the context analysis, we try to understand which factors have influenced the emergence, implementation and structure of the PPP. These could be social factors, e.g. stakeholder practices (blue rectangle), economic factors, e.g. the availability of financial resources (orange rectangle), environmental factors, e.g. the availability of land (green rectangle) or governance factors, e.g. the organisational structure of the stakeholders and their influence on each other (yellow rectangle). The programme's history is also included in the context analysis.

In the process analysis, the analysis model focuses on the elements of the PPP that influence its organisation and operation.

Finally, in the outcome analysis, the model focuses on the animal health outcomes that are the direct result of the PPP. As the animal health outcomes can influence the entire livestock production system, the model also considers the PPP's indirect effects on the country's socio-economic structure (blue and orange rectangles), the environment (green rectangle) and national governance mechanisms (yellow rectangle).



**Figure 4: The analysis model used in this thesis**

We'd like to point out that, unfortunately, environmental factors were not explored in detail in any of the different studies that make up this manuscript. This can be explained, in part, by the fact that the second period of fieldwork in Paraguay, when environmental issues were due to be addressed explicitly, could not go ahead because of the Covid-19 pandemic. In the discussion, we present other difficulties associated with taking environmental considerations into account when evaluating PPPs, and animal health programmes in general, and in the section on future research we suggest ideas for overcoming these difficulties.

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# General methodology

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## 1. The approach

As this thesis forms part of an OIE project, the work had a dual purpose: to meet the needs of the OIE and to set out a research approach.

The thesis is based on a literature review, pre-existing frameworks (the realist approach in public health and sustainability, both of which were presented in the introduction), and four case studies from which the evaluation themes emerged.

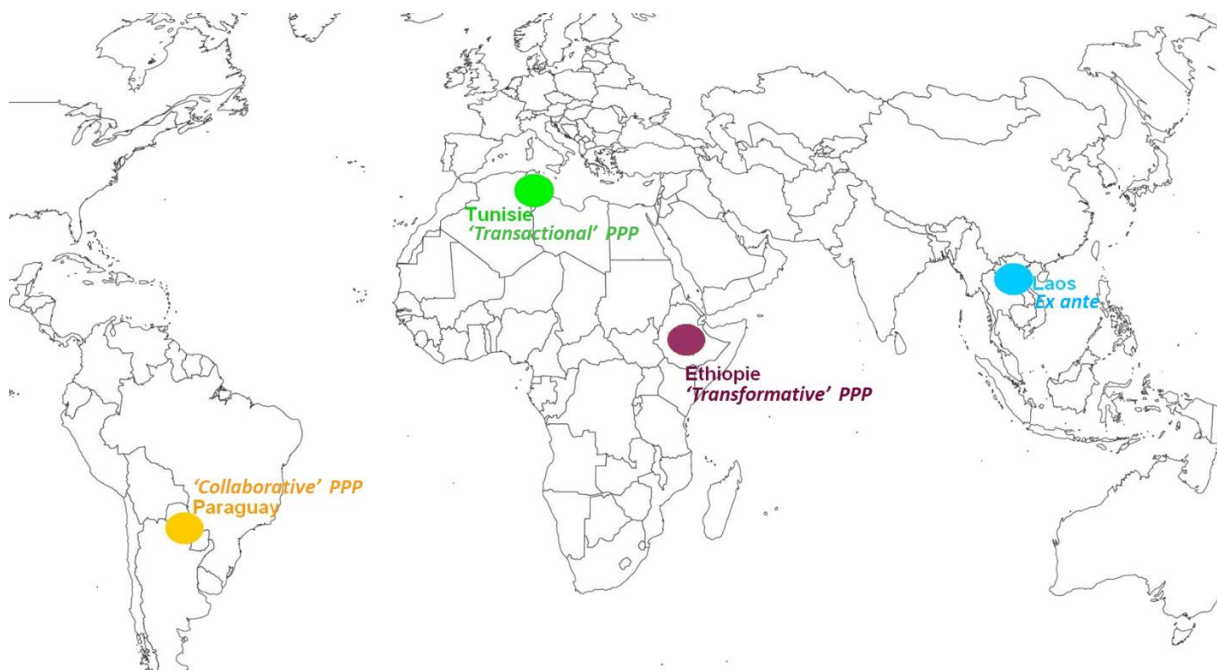
A review of the literature on evaluations of PPPs in animal health and public health, following the guidelines of the Prisma Extension for Scoping Reviews (Tricco et al., 2018), identified the existing methodologies and evaluation criteria. Four case studies were chosen to explore how the different types of evaluation can be implemented (context, process and outcome): in Paraguay, Laos, Tunisia and Ethiopia. Case studies allow for a more detailed, in-depth study of a particular example of something – in our case a PPP – in a real-world situation and they therefore enable us to extend our knowledge about these things. Using case studies can be particularly useful in understanding how different elements of the PPP fit together and how the different elements (implementation, context or other factors) produced the outcomes (Balbach, 1999; Flyvbjerg, 2006; Morra and Friedlander, 1998). For each case study, we looked at one type of analysis or evaluation. For one of the case studies (Paraguay), an integrated evaluation combining different types of evaluation was planned. However, this was not possible, as the second field visit in Paraguay could not take place because of the Covid-19 pandemic. In the end, to finalise the development of a tool to evaluate PPP processes, an expert elicitation was conducted.

## 2. Case study selection

As stated above, work on this thesis included an examination of four case studies in Paraguay, Laos, Tunisia and Ethiopia (**Figure 1**). Two of the studies, namely those on PPPs in Ethiopia and Paraguay, were explicitly chosen by the OIE because they were considered good examples of successful PPPs. It was decided that the project should begin by looking at PPPs that had been in operation for a long time and that were successful. The assumption was that analysing successful PPPs would give us an indication of the important criteria to consider in evaluation. Indeed, in evaluation, analysing success stories (like PPPs) can be a useful approach for understanding the factors that promote successful outcomes and impacts and those that hinder them (BetterEvaluation, 2019). These two cases were identified through an online survey of 97 PPPs in different parts of the world and through internal OIE contacts.

An evaluation was carried out of the PPP in Ethiopia, but not of the PPP in Paraguay. As the second field visit in Paraguay could not go ahead, there will be no discussion of an evaluation for this case

study. It is worth noting that in neither case did the PPP's stakeholders request an evaluation. They were, however, interested. They agreed that we could come and they took steps to implement some evaluation activities to analyse their PPP using the participatory approach. The case study in Tunisia has been included because the stakeholders of this PPP submitted an evaluation request to the OIE and CIRAD. A process evaluation was carried out for this PPP. The Laos case study was included because the data collected during by Master's internship provided the opportunity to explore the use of the stakeholder mapping technique for context analysis. Our decision to use four different case studies was motivated by our desire to develop an integrated evaluation framework that can be used for a variety of PPPs. The case study in Paraguay looked at a PPP between the public Veterinary Services and a producer association to control foot and mouth disease in cattle. This PPP is an example of a 'collaborative' PPP (Type 2). The Laos case study looked at the introduction of new regulations on the use of veterinary antibiotics from an ex ante perspective of a potential PPP between the public Veterinary Services and the vendors and users of antibiotics. The Tunisian case study was an example of a health mandate, through which public Veterinary Services delegate tasks to approved private veterinarians to control priority animal diseases. This PPP is an example of a 'transactional' PPP (Type 1). The case study in Ethiopia looked at a collaboration between public Veterinary Services and a poultry business. This PPP is an example of a 'transformative' PPP (Type 3).



**Figure 1: The four case studies that underpin this thesis.**

### 3. Data collection

#### 3.1 Methods common to each case study

We carried out two evaluations (the PPP in Ethiopia and the PPP in Tunisia) and two other analyses (in Paraguay and Laos). In each case study, we were interested in the opinions of the stakeholders involved in, or affected by, these PPPs. We were interested in their opinions, perceptions and interpretations as we wanted to gain an understanding of how they perceived the PPP's organisation and its effects and thereby obtain a systemic view of the PPP in question. We used qualitative methods and, to a lesser extent, quantitative methods (Robert and Ridde, 2013).

The quantitative methods involved online questionnaires (to elicit expert opinion). The qualitative methods primarily consisted of observation, semi-structured interviews, group interviews, workshops and written sources (Olivier de Sardan, 2012b). Direct observation looked at, for example, how meetings of the PPP's executive council were organised and how vaccination was implemented in Paraguay (**Figure 2**). Individual semi-structured interviews were carried out to capture individual opinions. They were semi-directed in the sense that they were not completely open-ended, but neither did they include a large number of precise questions; instead, they used pre-prepared interview guides (Mariner and Paskin, 2000). Semi-structured interviews were also carried out in groups, principally because of time constraints. Group interviews can mask individual opinions (Mariner and Paskin, 2000), but the groups were made up of similar stakeholders so that information could be validated through consensus (Campenhoudt et al., 2017a). The interviews were carried out respectfully. Researchers tried to create a good atmosphere and were careful to remain as neutral as possible.



**Figure 2: Observing the foot and mouth vaccination campaign in Paraguay**

For the two evaluations carried out (Tunisia, Ethiopia), we will talk about participatory evaluation in the sense that the evaluation questions were drawn up together with the PPP stakeholders and the evaluation outputs were co-constructed with them (BetterEvaluation, 2012a). In the Laos case study, we will talk

about participatory stakeholder mapping, because the map was co-constructed with the stakeholders concerned. Participatory workshops were held in Ethiopia and Laos to facilitate co-construction, for example, the co-construction of recommendations for improving the PPP in Ethiopia. The case study in Tunisia was carried out during the Covid-19 pandemic and workshops could not be organised. In Paraguay, we used qualitative approaches, but we do not talk about participatory approaches, because, due to time constraints, we were not able to co-construct the outcomes with the stakeholders.

Finally, the data were supplemented by collecting and analysing written sources such as scientific journals, legal documents, archives, and documents related to the PPP (so-called secondary sources, as they were collected by people other than the researchers and for purposes unrelated to the aim of the research). The PPP-related documents included contracts between the two parties, internal analyses of the PPP's technical outcomes, and reports from the organisations.

### 3.2 Context analysis

To carry out the context analysis, in a first study, we looked at the history of the PPP in Paraguay. We did not use a pre-existing methodology. The data consisted of the semi-structured interviews and the analyses of reports and archives (**Figure 3**). We also looked at the health context, the governance context, and the socio-economic context, which could have influenced the PPP's history. The environmental context and its influence on the PPP were not explored explicitly.

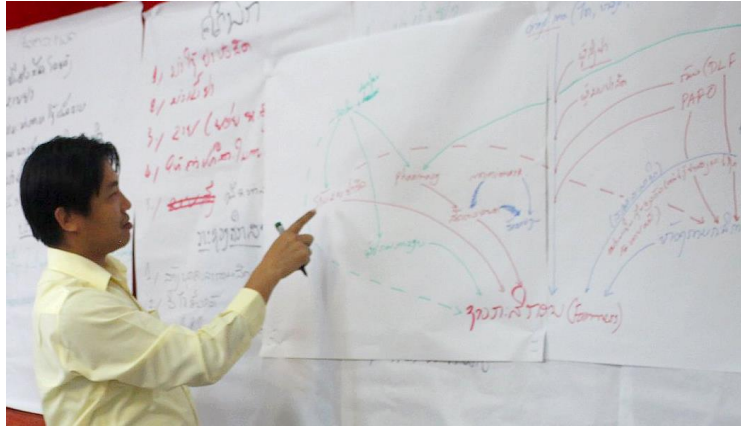


**Figure 3: Collecting data in Paraguay to gain a historical perspective**

In a second study in Laos, we used the stakeholder analysis methodology (Schmeer, 1999) to identify existing stakeholder practices and connections and consider how they might influence the development and structure of a potential PPP. Stakeholder analysis is a process of collecting and analysing qualitative information in order to determine the interests that must be taken into account when developing and/or



implementing a programme (Schmeer, 1999). However, it should be noted that a central component of stakeholder analysis is an analysis of stakeholder resources and of the power relations between stakeholders, and as this was only touched on briefly in this study, we refer to stakeholder mapping and not stakeholder analyses (**Figure 4**).



**Figure 4: Mapping stakeholders during a participatory workshop in Laos**

We are conscious that in the context analysis, other elements could have been explored, such as the influence of international trade agreements or of environmental factors. These two studies are just examples of the different ways that context analysis can be implemented.

### 3.3 Development of a process evaluation tool

To implement process analysis, we developed a tool that was specific to PPPs. It was based on pre-existing tools (Border et al., 2019; Hendrikx et al., 2011), on the case studies in Paraguay and Ethiopia, and on expert elicitation (Bojke et al., 2021).

### 3.4 Outcome and impact evaluation

For the impact evaluation in Ethiopia, we used the impact pathway methodology (Douthwaite et al., 2003). Therefore, this study looks at context analysis and process analysis as well as outcome evaluation, because it sought to highlight the links between the different components of the PPP. Impacts were identified by the stakeholders involved in the PPP and those affected by it, and so sustainability was not referred to explicitly.

### 3.5 Evaluation approaches not explored in this thesis

While the literature review identified the potential risks of PPPs in livestock health, we did not carry out risk analyses for these case studies, which would have made it possible to identify, and remain alert to, different types of risk linked to the PPP. We recognise that risk analyses would have given us a deeper understanding of the PPPs we studied and we will come back to this in the discussion.

We could have explored a PPP's environmental impact using lifecycle analyses, but such analyses were not possible because of the Covid-19 pandemic. We will revisit this issue in the discussion, and a suggested protocol for implementing these analyses in Paraguay has been included in the appendix to the discussion.

It is also worth noting that, even though we will discuss PPP finance mechanisms as part of the process analysis, we will not be looking at the evaluation of PPP costs in any depth. We will look at cost analysis in the general discussion. Neither do we propose to analyse PPP contracts. The OIE has a service that specialises in providing veterinary legislation support and developing contracts for national Veterinary Services (World Organisation for Animal Health, 2020a).

Finally, we did not compare the outcomes of the PPPs to counterfactuals, even though we recognise the importance of counterfactuals. Given the complexity of the factors that influence outcomes and the importance of the context in which a PPP is implemented, modelling a counterfactual would have taken up too much time in the preparation of this thesis, so the decision was taken not to address this problem. Consequently, we cannot be sure what would have happened in the case studies if the PPPs had not been implemented. However, in the chapter 'Evaluation of PPP outcomes and impacts' we used the impact pathway methodology, which, by seeking to highlight the links between the different components of the programme, allowed us look at establishing causal links between the programme and the impacts. This methodology, which does not rely on counterfactuals, can still identify the impact of a programme. We will return to this point in the general discussion.

## 4. Participant selection

In the case studies, we tried to capture the variety of opinions of not just the stakeholders involved in the PPP but also those affected by it. This enabled us to gain a system-wide view of the PPP and its effects. However, it is important to note that it was stakeholders from the central Veterinary Services and/or key private partners of these services that we interviewed first (due to the fact that this thesis forms part of an OIE project). The first people interviewed in a case study influence the choice of people who should be included in the study and we will return to this in the discussion. The sampling methods used in each case study are included in the relevant chapters. In Paraguay and Tunisia, principally due to time constraints, only the stakeholders involved in the PPPs were included, from the public and private sectors at both central and regional level. In Ethiopia, the stakeholders affected by the PPP, including its opponents, were included, allowing a system-wide view of the PPP.

The experts who participated in the expert elicitation that was conducted to support the development of a process evaluation tool are from various backgrounds and are involved, directly or indirectly, in long-term PPPs. An invitation to take part in this study was sent to the group of 42 experts that had been established by the OIE to develop a good practice guide (World Organisation for Animal Health, 2019b). These experts had been identified through an online survey of 97 PPPs across the world. Among the 42 invited experts, 27 agreed to take part in the first round of the survey, and 25 of the 27 agreed to take part in the second round. Among these 27 experts, 8 were private partners (for example, private businesses, private veterinarians or veterinary associations, producer organisations), 3 were from official public Veterinary Services, and the majority (n = 16) were indirect partners of the PPP from international organisations such as the OIE, the Food and Agriculture Organization of the United Nations (FAO) and the International Fund for Agricultural Development (IFAD). Among these 27 experts, 8 were linked to a 'transactional' PPP (type 1); 5 to a 'collaborative' PPP (type 2), and 5 to a 'transformative' PPP (type 3). Nine were linked to several PPPs. Ten of the 27 experts were linked to PPPs in Africa, 7 to PPPs in Asia and the Pacific, 4 to PPPs in Europe, 2 to PPPs in the Americas (South America only), and 5 experts were linked to several PPPs in different regions. It is important to note that these experts are PPP stakeholders at central level, not at regional level, and they are not impacted, either positively or negatively, by the PPP.

## 5. Scale of analysis

In this manuscript, the scale of analysis considered is the national scale. Indeed, the thesis forms part of an OIE project that aims to strengthen national Veterinary Services. The livestock health PPPs that are evaluated operate within the organisational structures of the countries in which they are implemented (Vigne et al., 2017). We will look at PPPs and livestock systems without taking into account other actors in the country. In other words, the country itself is not the object of study, it is the context within which multiple PPP stakeholders with divergent interests and asymmetrical power work together. It is the context in which stakeholders can negotiate, with the aim of ensuring consistency between the objectives of PPPs and related public policies (Caron, 2017). The case studies included several regions (4 in Paraguay, 5 in Laos, 2 in Tunisia and 4 in Ethiopia), but regional specificities were not explored and the results were ‘smoothed out’ to national level.

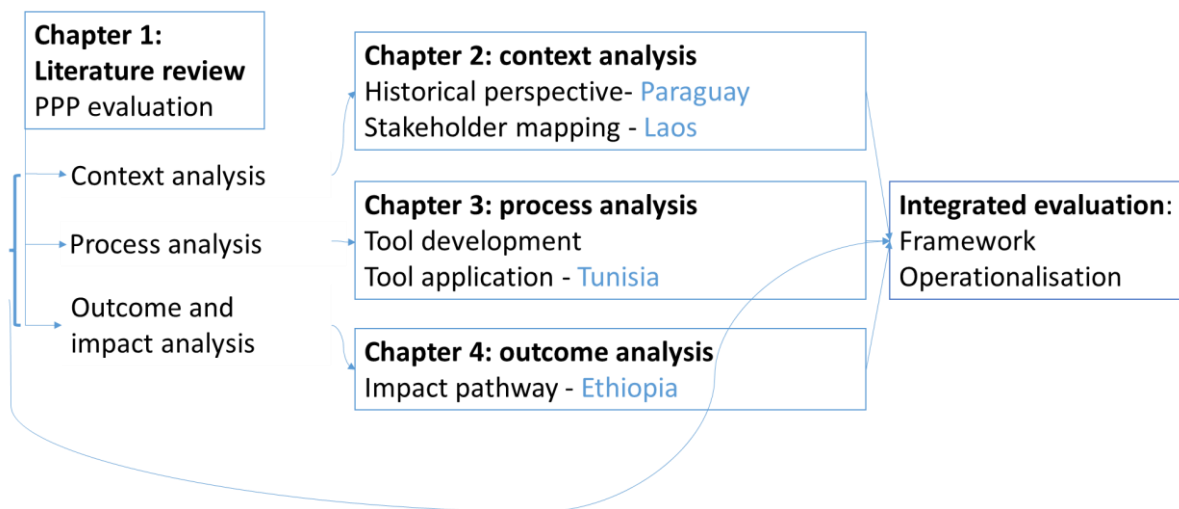
However, it would have been interesting to explore other scales of analysis, and we will discuss this further in the general discussion.

## 6. Data analysis

All the interviews and workshops were recorded and then transcribed verbatim. This stage is particularly time-consuming, but it is very important in ensuring rigorous data classification and data analysis. The case study analysis was principally carried out by analysing the content, focusing on the themes that were raised, the way in which the interviews spoke about them and how often they came up. Content analysis provides a methodical way of processing information and statements from interviews and workshops. In some cases, the content analysis revealed new ideas. In other cases, we used thematic content analysis to group data by theme according to our working hypothesis and organised them in a way that made sense of them (e.g. the impact pathway structure in the Ethiopia case study) (Campenhoudt et al., 2017a).

## 7. Manuscript structure

The manuscript is organised into four chapters (Figure 5). **Chapter 1** presents an exploratory literature review looking at frameworks and methodologies for PPP evaluations in public health and the veterinary domain. **Chapter 2** proposes two context analyses: an historical perspective of a PPP in Paraguay and a summary of stakeholder mapping in Laos carried out from an ex ante perspective of a potential PPP. **Chapter 3** develops a tool for evaluating the quality of PPP processes. This tool was then applied to a PPP in Tunisia. **Chapter 4** describes the use of a participatory impact pathway analysis to identify the outcomes and impacts of a PPP in Ethiopia.



**Figure 5: The structure of the manuscript divided into four chapters.**

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# Study section

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# Chapter 1

## **Chapter 1. PPP Evaluation: existing methods**

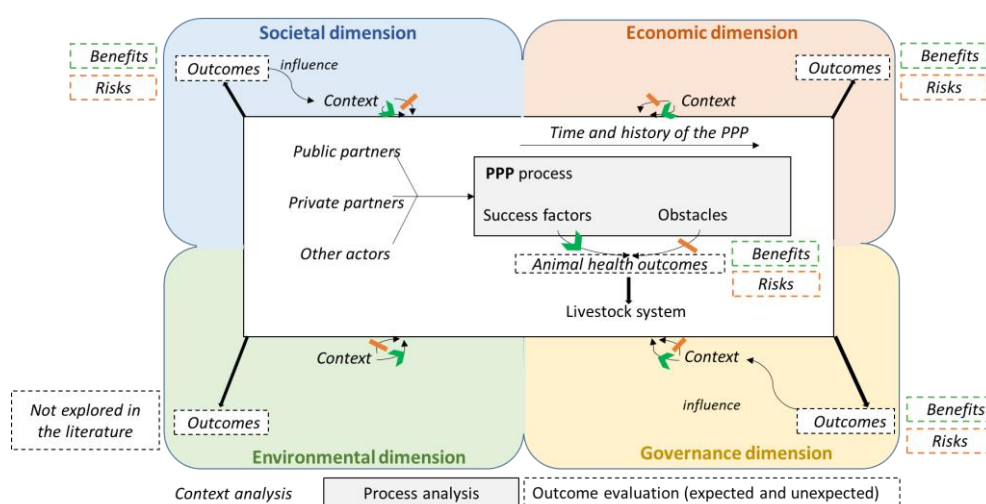
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*This study has been submitted to a peer-reviewed journal*

## Preamble to chapter 1

As the ultimate objective of this thesis was to develop an integrated evaluation framework for PPPs in the veterinary domain, it was important to look at the literature on the subject. We carried out an exploratory literature review following the guidelines of the Prisma methodology for scoping reviews. An initial search showed that there were very few articles on PPPs for livestock health. We therefore extended the search criteria to include public health, on the assumption that, given the similar aims of the two sectors, the lessons learned from PPP evaluations in the public health sector would be transferable to those in the livestock health sector. We identified theoretical models, evaluation methods and evaluation criteria used for context analysis, process analysis and outcome analysis in both the public health and veterinary domains.

The literature review identified the key success factors (green arrows) that facilitate the establishment of PPPs and enable them to be implemented effectively so as to achieve positive outcomes, and it identified the obstacles (orange bars) which, on the contrary, are a hindrance to achieving positive outcomes (**Figure 1**). Success factors and obstacles can be associated with the context of the PPP or with the PPP's operating processes. We identified health outcomes, societal outcomes, economic outcomes and governance outcomes. These results can be positive (benefits), but also negative (risks) (**Figure 1**). Some societal results (for example, creating trust between partners) and governance results (for example, the evolution of the legislative environment) can influence the context and facilitate or prevent the implementation of other PPPs (**Figure 1**). Environmental issues were not explored in the documents analysed in this review.



**Figure 1: Summary of the main results of the literature review**



## **Title: Evaluation of public-private partnerships for livestock health: a scoping review**

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### **Abstract**

Livestock represents an opportunity and a challenge for sustainability of a territory in terms of public health and food security, socio-economic stability, and interaction with the environment. Public and private actors work together to improve livestock health management. These collaborations can lead to public-private partnerships (PPPs). PPPs for livestock health are being implemented worldwide but few have been evaluated. The main objective of this work was to identify evaluation criteria of PPP for livestock health, considering the influence of these PPP on the contribution of the livestock system to the sustainability of a country or territory. A scoping review was conducted using three databases (Medline, CAB abstracts, Embase). Out of 881 documents screened, 37 were selected. The present study, through a rigorous scoping review, represents solid data summarizing methods and outcomes of evaluation of PPPs for livestock health. This work mapped not only livestock health outcomes but also social, economic, governance outcomes as well as evaluation criteria for context analysis and the quality of the PPP process. The environmental dimension of sustainability was not considered in the evaluation criteria of the documents analysed. Based on this scoping review, we discuss the need and the challenge to develop an evaluation framework that could be used by decision-makers and partners to assess the needs, added value and ways to improve PPPs and minimize their risk, and guide public policies to favour the contribution of PPPs to the sustainability of a territory.

**Keywords:** Evaluation, Animal Health Programs, Sustainability, Public-Private Partnership, veterinary domain

## 1. Introduction

Livestock and animal health represent both opportunities and challenges for the sustainability of many territories worldwide. 70% of emergent human diseases are of animal origin (Jones et al., 2008) while millions of people around the world depend on agricultural and livestock activities for their livelihoods (HLPE, 2016). With regards to environment, livestock can provide ecosystem services (such as fertility of soil and carbon sequestration), but this balance is fragile and global livestock production contributes also to negative impacts such as global warming (B. Dumont et al., 2019; Steinfeld et al., 2006).

To ensure good livestock health through surveillance, prevention, and control of zoonotic or contagious animal diseases, public and private actors may collaborate within livestock health programmes. These collaborations can lead to public-private partnerships (PPPs) for livestock health programme, defined as “a joint approach in which the public and private sectors agree responsibilities and share resources and risks to achieve common objectives that deliver benefits in a sustainable manner” (World Organisation for Animal Health, 2020c). Galière et al. provided in 2019 the first census of PPPs for livestock health, analysing 97 examples of PPPs implemented worldwide. This work highlighted the various type of private actors- such as private veterinarians, producer associations or private companies producing or distributing veterinary products- and the various type of governance (e.g. formal contract or informal collaboration) of PPPs (Galière et al., 2019a). This work also highlighted the fact that PPPs for livestock health are diverse and go beyond the classic veterinary sanitary mandate whereby the public sector contracts the private sector to implement a sanitary action (e.g. vaccination campaign) (Galière et al., 2019a).

Evaluation is an important step in any programme cycle, including health programs, in order to plan, redefine strategies, initiate appropriate corrective actions, optimize resources and help to ensure the effectiveness of actions. Evaluation can focus on different aspects of the programmes such as the context, the process and/or the outcomes of the programme (Brousselle and Champagne, 2011). Evaluations of livestock health programme have mainly focused on efficiency by comparing the benefits (e.g. avoidance of productivity losses) with the costs of a programme (Rushton, 2007). These evaluations did not include any analysis of the collaboration and coordination mechanisms between the actors involved, which seem to be particularly decisive elements for the success of a PPP. Over the past 20 years, methodologies have been developed to allow other type of evaluations of livestock health programmes. Such evaluations highlighted the importance of the private sector in animal health surveillance programmes (Delabouglise et al., 2015) as well as the importance of trust between the actors involved and their acceptability in the system (Calba et al., 2015a; Pham et al., 2017). However, none of these evaluations focused explicitly on the PPPs for livestock health.

PPPs in public health have been studied since the 1980s (Roehrich et al., 2014). A parallel between programmes in public health field and livestock health programmes can be established, as both are concerned with surveillance, prevention and control of infectious diseases, and protection of the health of a population. Knowledge about evaluation of PPPs developed in the public health could provide guidance for developing an evaluation framework for PPPs for livestock health programmes. Literature reviews on PPPs in public health have been performed, but they did not focus on the evaluation itself (Johnston and Finegood, 2015; Roehrich et al., 2014).

In public health, the need to consider sustainability in evaluation has been mentioned, with an underlying assumption that PPP may contribute to increasing health inequalities, thus inviting reflection on the long term impact of the PPP (Nishtar, 2004). The concept of sustainability is indeed important to mobilize in the evaluation of PPPs to be able to take into account the long-term socioeconomic or environmental implications of the public-private interactions (Mahoney et al., 2009). Usually, three dimensions of sustainability are considered: economic development (e.g. creating value), social development (e.g. promoting equity), and environmental protection (e.g. limiting greenhouse gases and protecting biodiversity) (Adams, 2006). The importance of multi-sectoral approaches and community engagement in providing solutions to complex public health problems was highlighted (Bloom, 2007), underlying the importance to consider governance as a pillar of sustainability (Food and Agriculture Organization, 2013; James et al., 2015). Governance can be defined as all forms of coordination between actors, the diversity of explicit and implicit rules influencing the behaviour of actors. In this paper, we will consider governance as the fourth dimension of sustainability (James et al., 2015).

The main objective of this work was to identify evaluation criteria of PPP for livestock health programme, considering the influence of these PPP on the contribution of the livestock system to the sustainability of a country or territory. This paper focuses on PPPs for livestock health such as infectious disease prevention and control and access to services, that involve national or local veterinary services. Indeed, this study is part of a project from the World Organisation for Animal Health (OIE) that aims to understand the interaction between public veterinary services and the private sector. Therefore, we reviewed the existing literature about evaluations of PPPs for livestock health. Because little information was available, we also reviewed the existing literature for PPPs in public health with similar missions (i.e the prevention and control of infectious diseases and access to services). In this study, we have reviewed the existing PPP evaluations frameworks and methodology and identified the evaluation criteria to evaluate the context, process and outcomes of PPPs for livestock health and public health. This study allowed us to provide initial elements on how to carry out an evaluation of PPPs for livestock health and to identify avenues of research to be invested in to enable an evaluation framework of those PPPs.

## 2. Material and methods

### 2.1 Protocol

We followed the scoping review methodology to be able to summarize findings from a body of knowledge that is heterogeneous in methods or discipline and identify gaps in the literature to aid the planning and commissioning of future research (Tricco et al., 2018). Supplementary information on the protocol is available in **Appendix 1**. No protocol has been pre-published elsewhere. The article was written according to the PRISMA-ScR guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) (Tricco et al., 2018).

### 2.2 Identifying the research questions and relevant documents

**Inclusion criteria.** The literature search included documents published up to April 2021 in the English language. We considered PPPs for livestock health and PPPs in public health with objective(s) related to surveillance, prevention or control of human, zoonotic or animal contagious diseases; and/or for better delivery of veterinary/health products or animal/human health services. In this paper, PPP for livestock health programme was considered to indicate intersectoral relationships between the public veterinary services and private actors (private individuals such as veterinarians, farmers or private organizations such as producers, private companies, NGOs).

Documents were included in the scoping review if: (i) they described an evaluation of PPPs, (ii) they proposed a framework/methodology of evaluation of PPPs, (iii) they mentioned criteria for the evaluation. For the third inclusion criterion in public health, given the large number of documents, only documents offering theoretical perspectives (e.g overview article) or synthesis (e.g literature review) were included (descriptions of specific PPPs in public health were excluded). Evaluation framework is defined as general framework for evaluations of different PPPs by providing principles to guide the planning, management, and conduct of evaluations, and may include guidance on data sources and data management processes (BetterEvaluation, 2012b).

**Data source.** Three online scientific databases (Medline via Pubmed, CAB abstracts via Ebsco, and Embase) were used in this study to identify documents. A grey literature document was also included : a database, describing 97 PPPs for livestock health, retrieved in the context of the work undertaken between OIE and Cirad on PPP in the veterinary domain between 2017 and 2019 (World Organisation for Animal Health, 2020c) (**Figure 1**). The methodology for collecting information in this OIE database is described elsewhere (Galière et al., 2019a). For each PPP, the database contains information on the objectives of the PPP, the private partner, the public partner, the country, the source of funding, the key success factors, the obstacles, the evaluation performed, the outcomes (benefits and risks) of the PPP.

Some criteria (the key success factors and obstacles of PPPs) of this database were analyzed in the article by Galière et al. (2019) and are also included in this scoping review, while other criteria (methodologies of evaluation, benefits and risks of PPPs) were specifically analyzed for this study.

**Literature Search.** Three concepts were included in the search: ‘public-private partnership’, ‘veterinary domain’, and ‘public health’. In this article, veterinary domain was restricted to programmes for livestock health such as delivery of services or products for surveillance, prevention, or control of zoonotic or animal contagious diseases (according to the topic of interest of the OIE project in which this study takes place). Therefore, public health was restricted to delivery of services or products for surveillance, prevention, or control of zoonotic or human contagious diseases. The concept ‘evaluation’ was not written in the search, as it would have excluded articles not dealing with evaluation but mentioning important elements to be taken into account in an evaluation process. The full search equation is available in **Appendix 1**. All documents retrieved from the scientific databases were imported into Zotero® version 5.0 and duplicate documents were removed (**Figure 1**).

### **2.3 Document selection**

The documents were selected through two screening phases: i) a first screening using titles and abstracts; ii) a second screening based on full text analysis (**Figure 1**). For both screening phases, the following four exclusion criteria were applied to stay within the scope of the OIE project:

- 1) documents not corresponding to the inclusion criteria (e.g: PPPs in the veterinary domain not including veterinary services, PPPs for the construction and maintenance of health facilities or infrastructure such as hospital, PPPs for food safety, PPPs for pets, PPPs for veterinary or public health education, PPPs for product development).
- 2) documents not addressing PPPs as their main study object and only briefly mentioning PPPs in the conclusion or as a recommendation.
- 3) global or international PPPs involving international organization, or multinational companies, because they require a particular study of international regulations. and intergovernmental operations.
- 4) PPPs to build infrastructure such as hospitals; because they imply specific evaluation requirements: the contract signed for several decades often includes very specific terms and conditions for the construction, maintenance, and rent payment of the infrastructure between the different partners.
- 5) opinion paper, commentary, letter to the editor and conference abstract.

A flow chart diagram of the selection process for this study was developed based on the PRISMA approach (**Figure 1**). One author (MPo) screened all titles and abstracts of retrieved documents. For the second screening phase, two authors (MPo and MG) screened 50% of the selected document using full text. Since the selection of document was similar between the two authors, MPo continued the screening of the other 50% of the documents using full text.

## **2.4 Data charting process**

Two authors independently allocated 30% of the selected documents between the two databases and categorized their content. The distribution between the two databases and the categorization were similar between the two authors. Then, one author continued the allocation and categorization for the other documents.

The analysis of the documents was based on content analysis. Two different database templates, developed in Microsoft Excel® version 2007, were used to classify: i) the data from the documents describing a type of evaluation, ii) the important criteria to take into account in the evaluation process from all the documents (**Appendix 1**). The definitions of the concepts used in this study are given in **Appendix 1**.

## **2.5 Data items**

Two different database templates, developed in Microsoft Excel® version 2007, were used to classify: i) the data from the documents describing an evaluation case study, ii) the criteria to take into account in the evaluation process from all the documents (**Appendix 1**). The analysis of the documents was based on content analysis. The categories used in each database were pre-determined.

Documents were classified as evaluation case-studies if they were presenting methodologies for setting and designing the evaluation, analyzing the data, and/or presenting the results of the evaluation (Brousselle and Champagne, 2011).

For the first database (evaluation case-studies) the categories were: goal of evaluation, methodology for data collection, type of data analysis, type of evaluation, challenges and recommendations of evaluation and evaluation criteria used (Brousselle and Champagne, 2011).

We defined the types of evaluation as context analysis, process evaluation, outcomes evaluation and/or cost analysis. Indeed, in a given context (which may influence the emergence and outcomes of the PPP), a PPP is implemented through an organizational process (which also influences the outcomes of the PPP). This PPP can lead to expected and unexpected outcomes, which can be positive (benefits) or negative (risks). The implementation of this PPP has a certain financial cost, and the benefits or risks of this PPP can also be financial.

Context analysis involves considering different elements of the context in which the PPP operates. As we considered the sustainability of the territory/country where the PPP is implemented, the subcategories were defined as societal context, economic context, governance context and environmental context.

Process evaluation is about assessing the conditions under which the PPP is performing, the elements of the organization and function of the PPP that will affect its performances (Peyre et al., 2022, p. 2). Process evaluation subcategories emerged from the reading and analysis of the documents. These subcategories were analysis of the objective(s) of the PPP, analysis of the governance mechanism of the PPP, analysis of the planning of activities implemented in the PPP, and analysis of the collaboration mechanism between the PPP partners. The analysis of the objective(s) of the PPP focused on the definition and understanding of the objective by the partners. The analysis of the governance mechanism focused on the contract and decision-making process. The analysis of the planning of activities implemented in the PPP focused on the roles and responsibilities in various activities as well as the finances. The analysis of the collaboration mechanism analyzed the interaction between the PPP partners (power, equity, satisfaction).

Outcomes evaluation is the measurement of the results of the PPP. Outcomes evaluation attempts to answer the question of whether and to what extent the objectives of a PPP are/were achieved, but also looks at the unintended outcomes of PPPs (Peyre et al., 2022).

Cost analysis focuses on the financial aspect of the PPP such as the total cost of the PPP, the cost per unit of benefit, and/or the distribution of cost-burden among partners, funders and beneficiaries (Schröter, 2012).

For the second database, the pre-defined categories were: obstacles, key success factors, positive outcomes (benefits), negative outcomes (risks). Key success factors are defined as criteria of the context or the process that favour the achievement of PPP objectives. Obstacles are defined as criteria of the context or the process that limit the implementation and success of the PPP. Outcomes are the results of an intervention (BetterEvaluation, 2015). As we considered the sustainability of the territory/country where the PPP is implemented, the sub categories of outcomes were health, societal, economic, governance, and environmental outcomes.

## **2.6 Synthesis of the results**

Selected documents were used to describe the existing case studies PPP evaluations, and to identify and classify the evaluation criteria of PPPs. To summarize the results we have divided the evaluation into four parts: context analysis, process evaluation, outcomes evaluation and cost analysis.

## **3. Results**

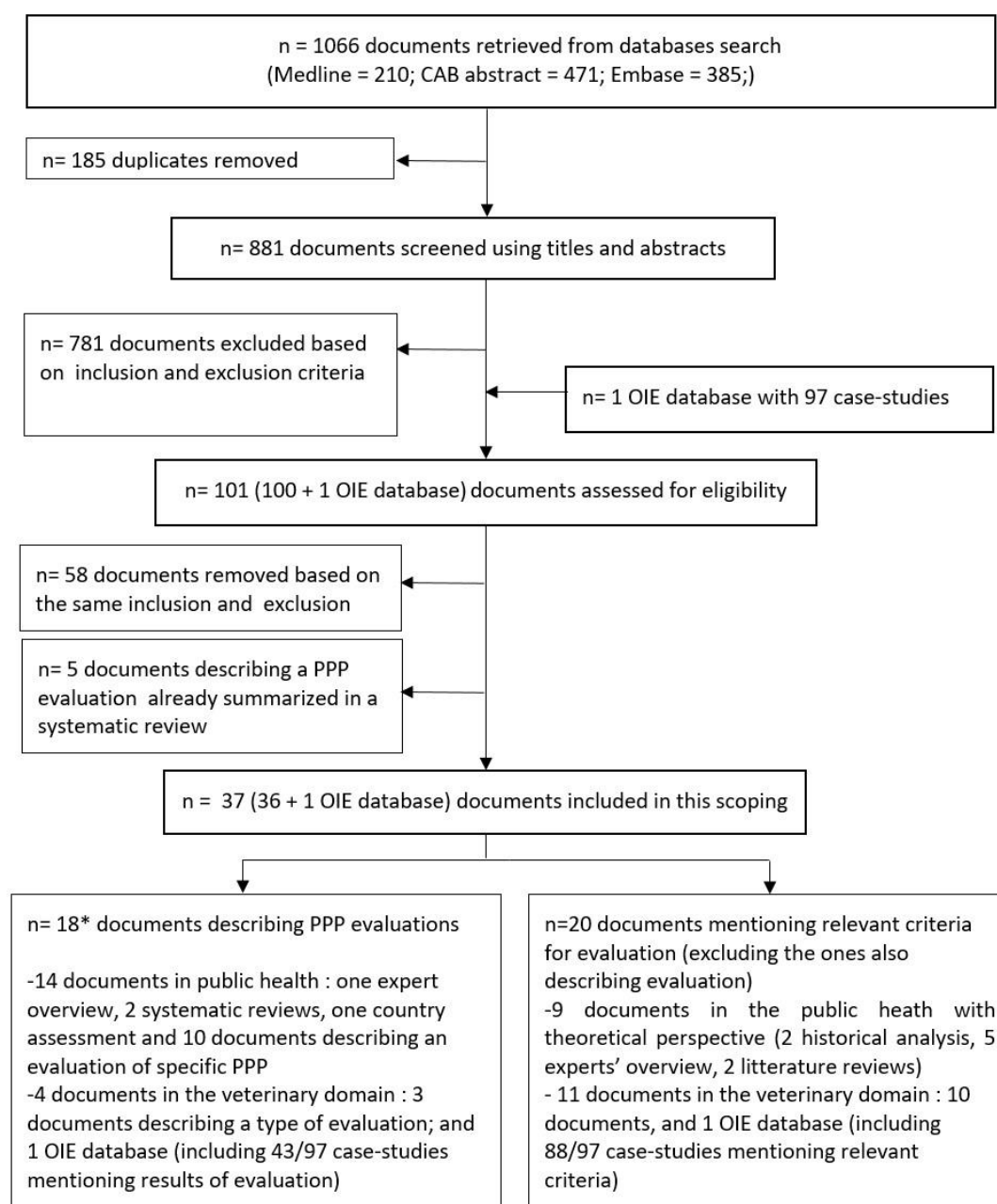
### **3.1 Data selection**

This study retrieved 1066 documents from the databases including 185 duplicates removed (**Figure 1**). In total, 881 documents and 1 OIE database (which described 97 case studies of PPPs in livestock health) were screened. Among the 37 documents selected for this scoping review, 18 documents described PPP evaluation case-studies and 20 documents mentioned evaluation criteria (the PPP case-studies from the OIE database described both evaluation and criteria). The documents were published between 2000 and 2021. The list of references of the 37 documents selected for this study and presented in the results is provided in **Appendix 2**.

A total of 23 documents focused on PPP in public health: 14 describing PPP evaluation case-studies, including 3 presenting an evaluation framework, and 9 mentioning evaluation criteria. A total of 14 documents focused on PPPs for livestock health: 3 documents describing an evaluation case-study, 1 OIE database, 10 documents presenting evaluation criteria. The 14 documents focusing on livestock health described 109 different PPPs around the world.

The main objectives of the PPPs described in the documents analyzed are presented in **Appendix 3**.





**Figure 1. PRISMA flow chart diagram of documents selection process to include in the scoping review.** OIE: World Health Organisation for Animal Health. \*the OIE database describes PPP case study evaluations and evaluation criteria.

### 3.2 Summary of the results of the scoping review: elements to consider for PPP evaluation

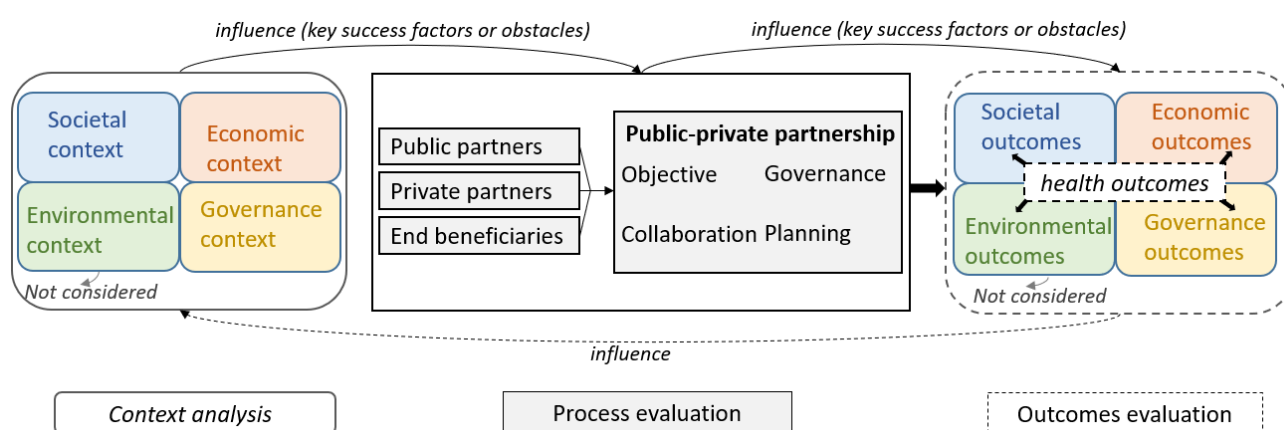
The results of this scoping review underlined the importance of analysing the context, the process, and several outcomes of the PPP. Indeed, among the 18 documents describing PPP evaluation case-studies, some focused on the context of implementation (n=11/18), on the process (n=11/18), on the outcomes of the PPPs (n=17/18) and on the cost of the PPP (n=6/18) (**Table 1**).

The PPP evaluation goals, the way to collect data (e.g. documents reviews, interviews) and the type of analysis (e.g. descriptive, measurement of indicators) used during the evaluation process of those PPP evaluation case-studies are described in the (**Appendix 4**). A document noted that there is a burden of evaluation due to complex PPP arrangements (Barr, 2007) leading to limited conceptualization and empirical evidence on the effectiveness of PPP (Vrangbæk, 2008; Roehrich et al., 2014). The existing PPP evaluation case-studies lack of detailed information on how to implement the evaluation in practice. Some studies highlighted that PPP evaluation could include a comparison with a control (e.g. full public initiative, PPP in another area) but also pointed out the difficulties of setting the control (Lei et al., 2015; Vrangbæk, 2008). In general, PPP evaluation case-studies have been conducted to inform PPP policies at the macro level (such as risk management, access to resources, appropriateness of PPPs), to propose strategies for improving of PPP practices at the meso and micro levels, and to assess the progress of PPPs in achieving their objectives and assess outcomes (Roehrich et al., 2014). One document warned of a potential positive bias due to the fact that successful PPPs are more often mentioned in the literature (Barr, 2007). To avoid this bias, it has been proposed to consider the causes of failures of different PPPs as well as their risks in the evaluation and not to only focus on the successful PPPs (Vrangbæk, 2008; Roehrich et al., 2014).

Some evaluation criteria of the economic, societal, and governance contexts were identified (see **Table 2**). From the results of this scoping review, the environmental dimension was not considered for the context analysis, and environmental context criteria still needs to be defined. Elements of the context were identified as either obstacles or as key success factors regarding the implementation of the PPP and its outcomes.

The PPP process evaluation focused on the mechanism of the PPP itself. The importance of asking “how” PPP works (PPP process) in a given context rather than "do things work" (outcomes), in order to provide useful recommendations for partners and policymakers was emphasized (Prashanth, 2011). The PPP process evaluation considered the analysis of the objective(s) of the PPP, analysis of the governance mechanism of the PPP, analysis of the planning of activities implemented in the PPP, and/or analysis of the collaboration mechanism among the PPP partners (**Figure 2**). Elements of the PPP process were identified as either obstacles or key success factors (see **Table 2**). The evaluation of the PPP process also focused on the type of partners involved and their power relationship, as well as the decision and adhesion mechanism of partners and end-beneficiaries (**Figure 2**).

Finally, the outcomes evaluation considered direct or indirect outcomes and positive and negative outcomes of the PPP and did not focus solely on health outcomes. Evaluation criteria of the economic, societal, and governance outcomes were also identified (**Figure 2**, and see **Table 3**). In the OIE database, 92 case studies out of the 97, mentioned one or several outcomes of their PPP on health (71/97), economy (56/97), governance (56/97) and society (14/97) (see **Table 3** and **Appendix 6**). Environmental outcomes have not been not considered in any of the documents and have yet to be defined. Vrangbaek (2008) advised to map all the negative outcomes (risks) for both private and public partners during the evaluation.



**Figure 2: Summary of the results of the scoping review elements to consider for PPP evaluation.**

*The documents consider analysis of the context in which the PPP is implemented (italic writing) and the process evaluation (grey rectangle). In addition to health outcomes, some documents also consider indirect outcomes related to societal (blue), economic (orange), environmental (green), and governance (yellow) outcomes. Environmental context and environmental outcomes are not considered in any of the documents.*

**Table 1. Evaluation case-studies presented in documents analysed in the scoping review (n=18), of PPPs in public health (n=18) and PPPs for livestock health (n=4).** In this study, PPP is restricted to services or product delivery for surveillance, prevention, or control of human, zoonotic, or animal contagious diseases. The list of references of the 37 documents selected for this study is provided in **Appendix 2.**

Domain and reference of the articles	Context	Process				Outcomes					Cost
		objective	governance	planning	collaboration	health	economy	society	governance	environment	
<b>Public Health</b>											
Albis et al., (2019)	✓					✓	✓				
Alonazi, (2017)	✓	✓		✓		✓					
Baig et al. (2014)				✓		✓		✓			
Bakibinga et al., (2014)	✓					✓					✓
Barr (2007)	✓	✓	✓	✓	✓	✓		✓			
Biermann et al. (2016)	✓			✓	✓	✓					
Gharaee et al (2019)	✓		✓	✓	✓	✓	✓	✓	✓		
Kempe et al., (2014)					✓	✓	✓		✓		✓
Lei et al., (2015)						✓		✓			✓
Laktabai et al., (2017)	✓					✓					✓
Roehrich et al. (2014)	✓	✓	✓	✓	✓	✓	✓		✓		✓
Salve et al. (2018)	✓		✓	✓	✓						
Sutton, (2010)						✓		✓			✓
Vrangbæk (2008)	✓		✓	✓		✓	✓	✓			✓
<b>Livestock Health</b>											
Dione et al. (2019)	✓	✓	-	✓	✓	✓		✓			
Hamill et al. (2017)						✓					
Maiti et al. (2011)						✓					
OIE PPP database (43/97case-Studies)					✓	✓	✓	✓			
Total by sub-categories		4	5	8	8	17	5	7	3	0	
<b>Total by categories</b>	<b>11</b>	<b>11</b>				<b>17</b>					<b>6</b>

### **3.3 Context analysis: what elements of the PPP context are considered, and how are they evaluated?**

The analysis of the societal context mainly looked at the social acceptability of the PPP by the civil society.

The economic context was mainly about the infrastructure and the organisation of the market system in the territory/country where the PPP operates. The lack of these elements was identified as an obstacle and their availability as a key success factor. Some analysis of the economic context also looked at the justification for the PPP through complementarity of the partners or by analysing if a purely public or purely private initiative was considered but seemed limiting (**Table 2, Appendix 5**).

The governance context was mainly about the legislative and political environment of the territory/country where the PPP operates. The most mentioned obstacles related to governance context and were the lack of policy to guide PPPs, lack of transparency of the governance of one sector, or administrative barriers. One framework mentioned that an analysis of the governance context such as the regulatory environment could explain the limited use of PPP in a country (Vrangbæk, 2008). For PPPs for livestock health, a lack of effectiveness of the public veterinary services or a weakness of the Veterinary Authority have also been identified as external obstacles (Galière et al., 2019). Favourable political environment with policy and legislative frameworks shaping PPPs within countries was identified as key success factors.

### **3.4 Process evaluation: what elements of PPP process are considered, and how are they evaluated?**

Regarding the definition of the objective(s) of the PPP, it was advised assessing whether the objective(s) of the PPP is clearly defined and corresponds to a common goal of the partners and whether each partner had identified the expected benefits (Donald A. Barr, 2007).

Regarding the governance mechanism of the PPP, the key success factors were: clearly defined nature of the agreement between partners (memorandum of understanding, letter of association, terms of references, contracts, etc.), participatory decision-making and shared decision-making with equality of power between partners, a plan to allocate resources and availability of human and financial resources from both sides, a transparent governance system, and adaptability and flexibility of the PPP structure. Lack of those elements were identified as obstacles (**Table 2**).

Regarding the planning of activities implemented in the PPP, two evaluation frameworks specific to PPP mentioned that evaluation should focus on the regular identification of the risks and challenges faced by the partners, the steps taken to mitigate these challenges and on identifying which partner is most susceptible to risks (Barr, 2007; Vrangbæk, 2008). PPP evaluations recommended analysing the roles and responsibilities of the different partners (Barr, 2007; Salve et al., 2018). Different key success factors related to the planning of activities implemented in the PPP such as identification and discussion about the potential risks and conflicts of interest before the implementation, or an open and frequent channel for communication between partners and transparency of action of each partners. The lack of these elements and the administrative complexity of the initiatives has been identified as obstacles (**Table 2**).

Regarding the collaboration mechanism among the PPP partners, the analysis of the strategies of the actors involved in the creation of PPPs and the relationships between partners, including their power relationships, was encouraged (Barr, 2007; Roehrich et al., 2014; Salve et al., 2018). A systematic review underlined that an intermediary role between the private and public sector with sufficient power (played by NGO for example) can be essential to improve the governance of the PPP and avoid asymmetry of power (Lei et al., 2015). A PPP evaluation advised analysing the inclusiveness of the various partners in the different phases of the partnership (definition of objective, decision-making process, protocol writing, etc.). The success of PPPs would depend on an inclusive network to build social capital, on the recognition of the importance of all stakeholders and on understanding the culture of the partner (Salve et al., 2018). Growing mistrust between partners was proposed as unseen obstacles to PPP while satisfaction of the PPP experience, and trust between partners would be a key success factor for good functioning of the PPP process (Lei et al., 2015). Obstacles related to the collaboration process were: partner's relationship such as power relationships between the partners, cultural barriers such as difficulties in taking local communities into consideration, a lack of involvement of the partners. In some conditions, the interactions between partners were also represented as key success factors: where partners have a mutual understanding of their respective culture, previous experience in partnership or a good level of engagement (**Table 2**).

**Table 2.** Criteria to evaluate the context and the process of public-private partnerships (PPP) mentioned in all documents analysed during the scoping review. The documents describe PPPs in public health (n= 23) and PPPs for livestock health (n=14). All associated references are presented in the **Appendix 5**.

Categories		Key success factors				Obstacles			
		Public (n=23)	Health	Livestock (n=14)	Health	Public (n=23)	Health	Livestock (n=14)	Health
Context analysis	Societal context: PPP socially acceptable	2		0		0		0	
	Economic context: PPP justification (added value), infrastructure, market system	2		1		2		2	
	Governance context: Legislative and political framework	10		3		7		1	
	Environmental context	0		0		0		0	
	<b>Total (context)</b>	<b>11<sup>1</sup></b>		<b>3<sup>1</sup></b>		<b>8<sup>1</sup></b>		<b>2<sup>1</sup></b>	
Process evaluation	Objective	Common goal	1		1		1		0
		Mutual benefits	2		1		1		0
		Alignment with national priorities	1		0		0		0
		<b>Total (process, objective)</b>	<b>3<sup>1</sup></b>		<b>1<sup>1</sup></b>		<b>1<sup>1</sup></b>		<b>0</b>
	Governance	Nature of agreement, negotiation contract	6		0		5		0
		Inclusiveness in decision-making process	6		0		4		1
		Funding and human resources availability and repartition	5		1		5		2
		Transparency of decision and activities implemented	1		2		1		0
		Adaptability of the PPP	1		0		1		0
		<b>Total (process, governance)</b>	<b>13<sup>1</sup></b>		<b>2<sup>1</sup></b>		<b>9<sup>1</sup></b>		<b>2<sup>1</sup></b>
	Planning of the	Regular risk identification and analysis	3		0		2		0
		Communication between partners	5		2		0		2
		Dissemination of knowledge, information sharing with external actors	4		1		1		0
		Role and responsibility of partners	5		2		6		1
		Planning of activities	1		0		2		0

		Distribution and efficiency of administrative tasks	0	1	2	1
		Distribution of ownership of PPP outputs	0	1	0	0
		Capacity building, training of actors involved in the PPP	3	1	2	1
		Evaluation of the PPP	2	1	0	1
		<b>Total (process, planning)</b>	<b>11<sup>1</sup></b>	<b>3<sup>1</sup></b>	<b>9<sup>1</sup></b>	<b>2<sup>1</sup></b>
	Collaboration	Power relationship between partners	3	0	3	0
		Inclusiveness	2	0	1	0
		Understanding of partner culture	2	0	2	0
		PPP structure	1	0	1	0
		Partners' satisfaction/ trust between partners	0	0	1	0
		Partner's involvement	1	1	1	1
	<b>Total (process, collaboration)</b>	<b>6<sup>1</sup></b>	<b>1</b>	<b>7<sup>1</sup></b>	<b>1</b>	

<sup>1</sup>Some documents mentioned several key success factors or obstacles categories.



### **3.5 Outcomes evaluation: what positive (benefits) and negative (risks) outcomes of PPPs are considered, and how are they evaluated?**

Difficulties in monitoring the added value of PPP and in identifying the outcomes that are actually the result of PPP activities have been identified (Donald A. Barr, 2007; Vrangbæk, 2008). It was pointed out that ideally, an evaluation of PPP in public health should include a counterfactual (such as comparisons with a purely public alternative) but also mentioned the difficulty in modelling potential alternative paths (Vrangbæk, 2008). The evaluations of outcomes were based on longitudinal study design (Bakibinga et al., 2014; Lei et al., 2015), or cross-sectional study (pre and post comparison of the PPP intervention) (Kempe et al., 2014; Lei et al., 2015; Laktabai et al., 2017; Albis et al., 2019). In order to set a counterfactual, studies compared a PPP with a non-PPP (Baig et al., 2014; Kempe et al., 2014; Laktabai et al., 2017), studies compared different PPPs (in different areas or for different interventions) (Lei et al., 2015), and studies compared an area with a PPP and an area without a PPP (Albis et al., 2019). Some studies compared the public with the private sector performance in the PPP. Most of these studies were based on secondary data provided by the PPP (Bakibinga et al., 2014; Kempe et al., 2014), and a minority on data from field survey (Lei et al., 2015).

#### *Health outcomes*

The health outcomes were the most mentioned (**Table 3, Appendix 6**). They were, for example, service coverage (such as the rate of vaccine coverage), or the quality of actions such as decreasing the incidence or prevalence of a disease. The positive health outcomes of PPPs were also linked to the improvement of expertise of different partners through complementary skill. Regarding livestock health, three case studies of the OIE database mentioned benefits in food security through the improvement of livestock health (**Table 3, Appendix 6**). The negative health outcomes were the long-term erosion of health competencies of the public partners by delegating activities to the private sector and the risks of service failure (**Table 3, Appendix 6**).

#### *Societal outcomes*

Regarding societal outcomes, a PPP evaluation framework encouraged assessing the outcomes for vulnerable groups and assessing the equity of outcomes for each partner (Donald A. Barr, 2007). Another evaluation framework mentioned to focus on the creation of public value by the PPP, as PPP may erode public values because public sector organizations consider a broader set of demands and values (democratic participation, social responsibility, openness, equity) compared to private organizations (Vrangbæk, 2008). For PPPs for livestock health, case studies from the OIE database mentioned that one of the benefits was women's empowerment (through their important role in poultry farming) and the improvement of the livelihood of communities (through the increase of household profits or the availability of animal products for example). The capacity of defining new regulations,

which can improve the animal health services, has been mentioned as a benefit. The loss of public sector responsibility and the decrease of public sector influence in defining standards and norms, policies and priorities as been reported as a risk (**Table 3, Appendix 6**).

#### Economic outcomes

Regarding economic outcomes, an evaluation framework mentioned economic risks faced only by the private or public partners: private partners may face changes in contextual factors and political strategies or changes in regulatory framework and policies, which may decrease the economic outcomes; public partners may face economic risk in case of insolvency of the private partner (Vrangbæk, 2008). Both public and private partners run the risk of entering contracts that prove sub-optimal or problematic in the long term (**Table 3, Appendix 6**).

Additional resources, better allocation and stability of resources, reduction in financial cost of the process have been identified as benefits improving operationality of the PPP. Reduction of risk and risk allocation between partners and timely execution of activities are other benefits identified. For livestock health management, economic benefits were improved market access thanks to eradication or control of a disease, and increasing employment. Risks pointed out in the documents was the cost and inefficiency due to complex PPP assembly, the transaction cost (negotiating the contract and monitoring the partner), and the risk of monopolies or oligopolies by strengthening one specific private enterprise (**Table 3, Appendix 6**).

#### Outcomes on the governance of the PPP.

Governance was also considered a potential outcome of the PPP if the PPP process influence the governance mechanism of the PPP it self or of a broader governance structure (such as public policy).

PPP evaluation case-studies mentioned that PPP can lead to trust between partners, resulting to better response to challenges faced during the PPP implementation, and better stability of the PPP (Voss et al., 2012). For livestock health, the improved trust between partners was mentioned as a benefit in 52/97 case studies of the OIE database (**Table 3, Appendix 6**). The quality of the process of the activities implemented and accountability (improved legitimacy and fairness of decision making, transparency, and administration) were identified as potential positive outcomes of the PPP.

Negative governance outcomes were also identified, the complex PPP procedure leading to a lack of transparency, unclear accountability structures or the exclusion of some actors from decision making. A risk of erosion of trust between partners in the event of repeated failure, misconduct or use of regulatory interventions by the public partners, conflicts of interests and increasing corruption risk were the risks most often mentioned. An evaluation framework raised concerns about potentially restricting the flexibility to make decisions about the delivery of PPP services in a democratic manner, given that the PPP creates a long-term contractual obligation. (Vrangbæk, 2008) (**Table 3, Appendix 6**).

**Table 3.** Potential positive outcomes (benefits) and negative outcomes (risks) of public-private partnerships mentioned in documents analysed during the scoping review. The documents describe PPPs in public health (n= 23) and PPPs for livestock health (n=14). All associated references are presented in **Appendix 6**.

Outcomes categories		Benefits / positive outcomes		Risks / negative outcomes	
		Public health	Livestock Health	Public health	Livestock Health
Health	Service coverage	8	3	0	0
	Quality of actions: case detection and management / treatment outcomes	4	5	1	0
	Expertise, skills of the partners	4	2	1	0
	Food security	0	1	0	0
	<b>Total (health)</b>	<b>10<sup>1</sup></b>	<b>6<sup>1</sup></b>	<b>1<sup>1</sup></b>	<b>0</b>
Society	Considering vulnerable groups, and creation of public value	2	2	1	0
	Definition of regulations related to (livestock) health	0	1	0	0
	Public sector responsibilities	0	0	2	0
	Equity of outcomes	5	0	1	0
	<b>Total (society)</b>	<b>6<sup>1</sup></b>	<b>2<sup>1</sup></b>	<b>4<sup>1</sup></b>	<b>0</b>
Economy	Resources and cost of the PPP (including transaction cost)	3	1	1	0
	Reduction of risks	0	1	0	0
	Timely execution of activities	3	1	2	0
	Market access	0	2	0	0
	Employment	3	1	0	0
	Oligo/monopolies	0	0	1	0
	<b>Total (economy)</b>	<b>7<sup>1</sup></b>	<b>3<sup>1</sup></b>	<b>2<sup>1</sup></b>	<b>0</b>
Governance	Quality of the process and trust between partners	3	2	1	1
	Accountability and corruption	1	0	2	1
	Merging of interest or conflict of interest	0	1	2	1
	<b>Total (governance)</b>	<b>4</b>	<b>2<sup>1</sup></b>	<b>4<sup>1</sup></b>	<b>3</b>
Env	<b>Total (environment)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **3.6 How is evaluated the cost of a PPP?**

Two documents mentioned that costs can be underestimated in PPP projects because of transaction costs for both the public and the private partner in entering a tendering procedure (Vrangbæk, 2008; Roehrich et al., 2014). Vrangbaek et al. (2008) recommended distinguishing two phases: (i) the initial phase, where transaction and investment costs may be high for PPPs; (ii) and a lifetime perspective, where the benefits of mutual learning may result in better and more cost-effective practices (Vrangbæk, 2008).

Some studies analysed cost by focusing on the patient and considered cost spent on treatment, fees per patients, and lost income due to work delay. Some studies focused on the annual operational costs of the PPP. A cost-effectiveness studies focused on the cost per patient tested positive and successfully treated. In some studies, the cost was compared to similar programmes without PPP or to the situation before the implementation of the PPP (Lei et al., 2015).

Overall, the lack of data on the estimated costs and cost-effectiveness of PPP intervention was highlighted (Konduri et al., 2017).

## **4. Discussion**

The present study, through a rigorous scoping review, represents solid data summarizing the evaluation criteria used to evaluate PPPs for infectious disease prevention and control, and for access to services in public health and livestock health. While the health outcomes of the PPP were the most mentioned, this study showed the importance of considering the context analysis, process evaluation, and societal, economic and governance outcomes. Many PPPs for livestock health were identified but few of them have been evaluated and no evaluation framework or methodology has been developed for these specific programmes. None of the documents reviewed consider the environmental dimension of sustainability in their evaluation criteria, either for context analysis or for outcome evaluation. The concept of sustainability is not yet used in the evaluation of PPPs for livestock health, and we argue that future research should address this issue.

#### **4.1 The need for an integrated evaluation framework for PPP for livestock health**

This scoping review highlighted different examples of PPPs for livestock health programmes, illustrating the large number of such initiatives around the world. However, only in a limited instance, good practices of PPPs for livestock health have been analysed (Ahuja, 2004b; Bennett, 2012; Lubroth et al., 2007). Only three documents have presented practical examples of evaluations of PPPs for livestock health, most of them focusing on livestock health outcomes (Dione et al., 2019; Hamill et al., 2017; Maiti et al., 2011). Only Dione and al (2019) also focused on context analysis, engagement and interaction between partners.

The lack of evaluation of PPPs for livestock health emphasizes the need to develop an evaluation framework to ensure good PPP practices and minimize potential risks. This study also shows us that the evaluation framework for PPPs for livestock health should not only focus on their key success factors and positive outcomes, but also on their potential obstacles and risks (Donald A. Barr, 2007; Martin and Halachmi, 2012). Researchers working on PPP evaluation for livestock health can build on the identified evaluation criteria and evaluation methodologies to develop this evaluation framework. This evaluation framework should address the context analysis, the quality of the PPP process, and the multiple outcomes of PPPs. The development of such a framework would then allow for the development of tools for the practical implementation of the evaluation, such as defining indicators to measure the different evaluation criteria.

#### **4.2 Specificity of public-private partnership evaluation**

The different evaluation criteria of the context, the process and the outcomes identified in this scoping review, could be applied for the evaluation of livestock health programmes other than PPPs. However, we believe that the specificity of a PPP evaluation is not especially based on specific criteria or outcomes to be evaluated but more on their prioritization and relative importance. For example, the analysis of the governance context was found to be particularly important for the context analysis of PPPs. Evaluation criteria related to the PPP process, such as the power relationship or the governance system, were identified as essential to consider.

This scoping review underlined the importance and the challenges in assessing the added value of the PPP. Identifying the causal relationship between the PPP process and the outcomes is necessary for the evaluation but was identified as a challenge. In some documents this has been done through a counterfactual (such as a purely public or purely private alternative, a territory without PPPs, or another PPP). But in other cases, it may be difficult to find an existing counterfactual. In such cases, the focus may be on identifying PPP-related elements in the context and process that may explain the outcomes. This can be done by linking the inputs of the PPP, the PPP process and outcomes in the logic model

based on the theory of change, as proposed by an evaluation framework for partnership for research (Breuer et al., 2016; Rieker, 2011). A another way to demonstrate the added value of a PPP, could be to engage in dialogue and deliberation with the different partners to assess the added value of the collaboration, as has been highlighted in Public Affairs domain (Bryson et al., 2015). In the same vein, evaluating partners' perceptions of the added value of PPPs has been proposed to overcome the difficulty to assess the added-value of global PPP in public health (Kamya et al., 2016). These elements emphasize the value of participatory evaluations. For example, a participatory impact pathway methodology would allow public partners, private partners and actors impacted by the PPP to identify the cause-and-effect relationships between inputs of PPPs, PPP process, and outcomes (Blundo-Canto et al., 2020).

### **4.3 Limits of this study**

Most of the documents about livestock health included were describing specific examples of PPP, whereas most of the studies included in the public health were articles with theoretical perspectives (overview article) or summarizing the evidence (review of literature). The inclusion of different types of studies may lead to heterogeneity of synthesis results. However, the objective was not to provide new knowledge in the field of public health, but rather to compare the criteria that emerged from public health knowledge with criteria from evaluation case studies of PPPs for livestock health management.

The concept of PPP was included as a key word in the literature search process. As this concept is not yet well developed nor used for livestock health programmes some articles describing a PPP without naming it a PPP might have been missed. However, our study included the OIE database which describes 97 examples of PPP for livestock health management worldwide, representing an important source of data.

PPPs related to livestock health were not included in this study if they do not work through veterinary services, in order to remain within the scope of the OIE project. However, we recognize that other PPPs, including for example agricultural organizations, are important in the livestock health sector. Another study could focus on these other types of PPPs related to livestock health and their evaluations. The evaluation of other PPPs, for example those specialized in agricultural infrastructures, construction, management and administration were not included in this review. However, we believe that the choice to focus on the field of public health, in particular PPPs seeking to prevent and control infectious diseases, was interesting given the similarity of missions with PPPs for livestock health. Investigating how PPPs in different domains are evaluated could be an interesting way to complement further this work in the future.

As with all evaluation research studies, an important limitation is the lack of publications or access to completed evaluations. Indeed, this scoping was mainly based on scientific databases. The grey literature was limited, and for example we did not have access to evaluations that could have been done in the context of public policy by the countries themselves. It would be interesting to think about how to integrate these evaluations from the grey literature into another study. However, we believe that with the inclusion of the OIE database describing 97 PPPs around the world, we have had access to a large number of case studies and that our results remain robust.

#### **4.4 Challenges identified for PPP evaluation in livestock health to be addressed in future research**

This scoping review underlined the importance of evaluating the PPP process, i.e. the quality of the mechanism and functioning of PPP, and the identification of those criteria were used to develop an evaluation tool of the quality of the PPP process (Poupaud et al., 2021). Some PPP evaluation underlined the importance of considering the nature of interaction and power relationship between partners (Donald A. Barr, 2007; Salve et al., 2018). Depending on the type of PPP for livestock health programmes, differences in terms of unequal power relationship can be expected. The power relationship can be expected to represent a disadvantage for the private sector in PPPs between the public veterinary services and private veterinarians or producers' associations. It could represent a disadvantage for the public sector in PPPs between the public veterinary services and a national private company. This indicates that the evaluation of PPPs needs to take into consideration the institutional capacity of the public and private partners, with regards to their own objectives and interests, which will influence the governance process. Particular attention needs to be paid to the contract between partners, when relevant and required, to ensure that the partners do not take advantage of contract incompleteness, as underlined in other domains. In regards to the institutional capacity of each partner, the contract should be "*clear, comprehensive*" and "*create certainty for the contracting parties*" (World Bank Institute, 2017).

Regarding outcome evaluation, we believe that outcomes of PPPs for livestock health could be similar to others programmes. This scoping review showed that the outcomes of PPPs for livestock health are various and go beyond livestock health outcomes. Indeed, livestock health outcomes of a PPP can influence the whole livestock system. The evolution of the livestock system, which is embedded in a country/territory, will then bring indirect outcomes. Economic and societal outcomes have been mentioned in PPPs for livestock health within this scoping review. Indeed, livestock can represent one of a limited number of options to increase incomes and sustain the livelihoods, especially for smallholders (Herrero et al., 2009) and plays an important cultural and heritage role (Dury et al., 2019). Although environmental outcomes were not mentioned in any of the documents, we believe that future evaluation should consider them, as the implementation of a livestock health programme may result in indirect environmental outcomes. For example, the control of foot and mouth disease in Brazil, allowing livestock export, is indirectly linked with an expansion of Amazonia deforestation (Nepstad et al., 2006).

Other indirect negative outcomes of PPPs that change the livestock system could be related to land resource use, loss of soil biodiversity and fertility, and the production of greenhouse gas emissions (Cavicchioli et al., 2019; HLPE, 2016; Soussana, et al., 2010). Outcomes could also be positives as some livestock systems can play ecosystemic services such as carbon sequestration (Soussana, et al., 2010), or soil fertility improvement through manure (Steinfeld et al., 2006). To our knowledge, few evaluation of livestock health programmes have considered the environmental outcomes of the programme- but now a number of initiative are calling for including environmental and biodiversity aspect within livestock health programme evaluation (Peyre et al., 2021b). As for food and agriculture programmes, we believe that future evaluation should consider the interaction of livestock health programmes and indirect societal, environmental, environmental and governance outcomes (Food and Agriculture Organization, 2013). Further work should focus on developing sustainable indicators to measure the various outcomes of a PPP for livestock health identified in this study and identifying additional outcomes (Bell and Morse, 2008).

Finally, regarding cost evaluation, few PPP evaluations focused on the cost of the initiative. This could be explained by the fact that PPPs for infrastructure construction, for which cost analyses are well documented, were excluded from this scoping review. To assess the relevance of a PPP compared to another option, it would be necessary to establish the costs of setting up and running the PPP (Hellowell, 2019). Future research should focus on cost-effectiveness or cost-benefit analysis of PPPs for livestock health, taking into account the transaction cost of implementing PPP. The evaluation of the cost of PPPs for livestock health management will face the same challenges as the assessment of the added value of the PPP: identifying the costs related to the PPP mechanism, and comparing such costs with an alternative (e.g. all the activities implemented by one sector only). Another important point of the evaluation will be to look at the distribution of the financial benefits created by the PPP between the public veterinary services, the private partners and the beneficiaries.



## **4.5 Conclusion**

Livestock health represent both opportunities and challenges for sustainability of a country/territory. Public and private actors collaborate to implement programmes to improve livestock health, sometimes leading to PPPs. In order to promote good practices and positive impacts and minimize potential risks of such PPPs, integrated evaluations are needed. This scoping review identified the evaluation criteria used to evaluate PPPs for infectious disease prevention and control, and for access to services in public health and livestock health. This work mapped not only livestock health outcomes but also social, economic, governance outcomes as well as evaluation criteria for context analysis and the quality of the PPP process. This work represents a milestone upon which to build an evaluation framework for PPPs for livestock health. The evaluation frameworks, in addition to evaluation criteria identified would need to consider the environmental dimension in the context analysis and outcome evaluation. This framework would be useful for the development of indicators and tools for practical implementation of the evaluation. Evaluation of PPPs for livestock health would enable decision-makers and partners to assess the needs, added value and ways to improve PPPs and minimize their risk, and guide public policies to favour the contribution of PPPs to the sustainability of a territory.

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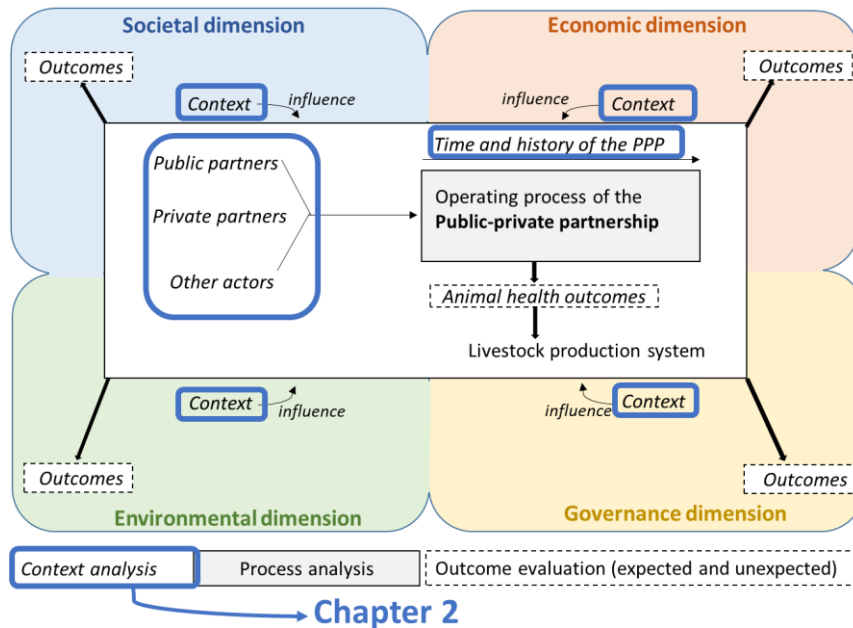
# Chapter 2

## **Chapter 2. Context analysis**

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## Preamble to chapter 2

Chapter 2 deals with the context analysis section of the analysis model (**Figure 1**). The literature review showed that a context analysis is needed to formulate applicable and relevant recommendations following the evaluation of a PPP. We propose two methodologies for implementing the context analysis: analysis from a historical perspective, and stakeholder mapping. However, these methods are just two examples of the many context analysis methodologies that exist.

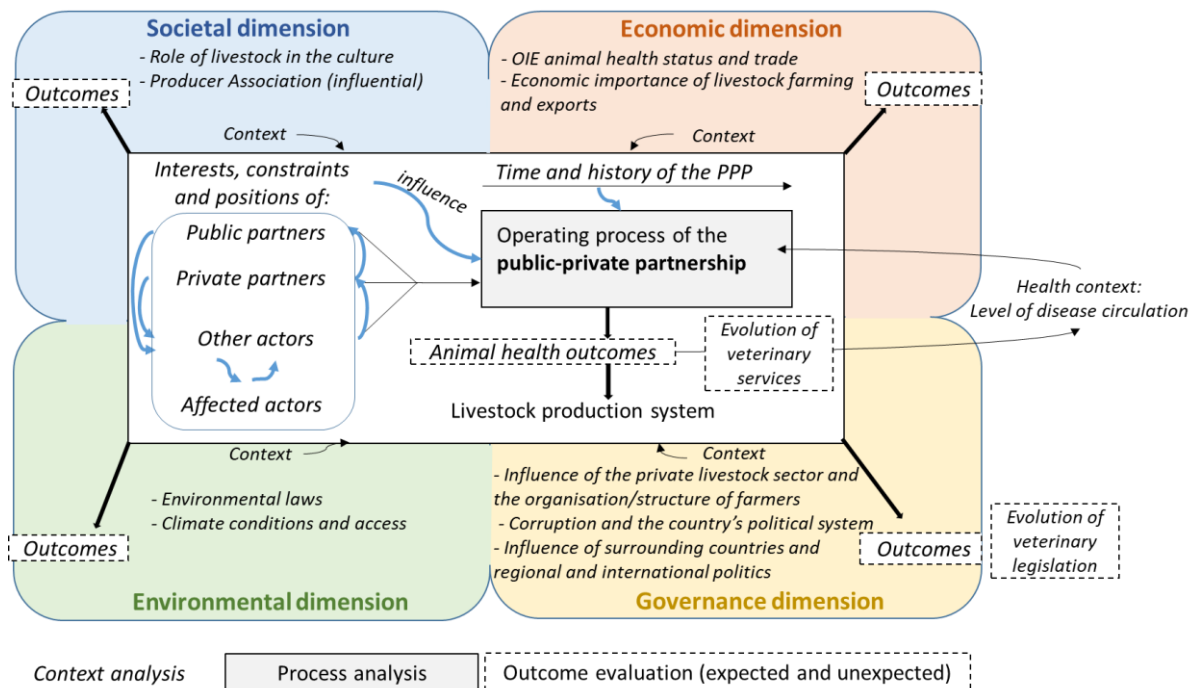


**Figure 1: Chapter 2 explores ways of operationalising context analysis (blue rectangles), which is one component of the analysis model**

In the first part of this chapter, we look at the history of a PPP in Paraguay. As stated above, this case study was not ‘evaluated’ as such, as the second phase of the fieldwork could not be carried out due to the Covid-19 pandemic. However, since the PPP has been running for a long time, and given the development of its structure and organisation, we decided to look at the factors that have influenced its history. By conducting semi-structured interviews and collecting and analysing documents (reports, archives), we were able to trace the development of the collaboration between the public and private sectors for the control of foot and mouth disease. This historical perspective also enabled us to identify the characteristics of the context that influenced the PPP’s structure. This study could be instructive for other PPPs that operate in similar contexts (particularly in South America).

We think that understanding a PPP’s history, by, for example, using the methodology presented in this study, is important in a context analysis, as it helps in formulating relevant recommendations once the evaluation has been completed.

In the second part of the chapter, we summarise stakeholder mapping in Laos, carried out from an *ex ante* perspective of a potential PPP. This study allows us to consider the usefulness of the stakeholder mapping methodology for PPP context analysis. It seems to us that this methodology would also be useful for analysing PPPs during their implementation (*in itinere* analysis). It makes it possible to identify the connections between stakeholders, understand how they influence each other, and explore their interests and constraints linked to the PPP’s objective.



**Figure 2: Chapter 2 looks at two methodologies for implementing context analysis.** A historical perspective showed the influence of the PPP’s history on its current structure and processes and highlighted the influence of certain elements of the context on the PPP. Stakeholder mapping explores the stakeholder interests, constraints, position and connections that can influence the PPP process.

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## *Chapter 2. Part 1: Historical perspective of a PPP*

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*This study was sent as a report to the Paraguayan partners.*

### **Abstract**

Foot and mouth disease control in Paraguay requires a massive vaccination campaign of the national cattle herd. To implement it, the Public veterinary services of Paraguay are collaborating with an association of private producers in a public-private partnership. In order to provide relevant recommendations in the evaluation of this PPP, this study focuses on the analysis of its context of the implementation. The history of the FMD control program in Paraguay is analyzed through the lens of the collaboration between the public veterinary services and the private sector. Semi-structured interviews were conducted with the main actors of the FMD control program (n=10), both from the public and private sectors. Records, laws and regulations of the Statistics Department of the veterinary services, the Central Bank of Paraguay, the National Institute of Statistics, and the Pan-American Foot and Mouth Disease Center were analyzed. Cattle ranching began in 1545 in Paraguay, and some of the ranchers joined to form the Asociación Rural del Paraguay (ARP) in 1885. The North American impulse for FMD control in the continent, after the outbreaks in Mexico, Venezuela and Colombia around 1950, through the creation of the Pan-American Foot and Mouth Disease Center. USA financial loans allowed the emergence of Public veterinary services and the beginning of the control program in Paraguay in 1967. The establishment of an official status related to FMD by the World Organization for Animal Health in 1994 gave an impetus to the FMD control program and the evolution of Paraguayan regulations. Although the collaborative structure and governance system between the public and private sectors, through the producers' association of Paraguay, has evolved, the control program has always involved both sectors. Today, 100% of the cattle population is vaccinated, and the vaccination operation is entrusted to the private sector, through a foundation recognized as a legal entity, and is supervised and evaluated by the Public veterinary services. The FMD program has enabled the expansion of veterinary coverage throughout the country and the emergence of a traceability system. The FMD-free status since the last outbreak in 2012 has allowed an increase in the volume of beef product exports.

## 1. Introduction

Ensuring good animal health requires animal disease surveillance, prevention and control programmes. It also requires funding and human resources, for example to ensure massive vaccination campaign (Knight-Jones and Rushton, 2013). Actors from both the private sector (producers, veterinarians, companies) and the public sector (such as veterinary Services) need to collaborate in the implementation and maintenance of these animal disease management programmes. These collaborations can lead to public-private partnerships (PPPs) (World Organisation for Animal Health, 2020c).

For example, in order for Paraguay, the sixth largest exporter of beef in the world, to obtain the status of foot and mouth disease (FMD) “free country with vaccination” from the World Organization for Animal Health (OIE), all 14 million head of cattle in the country must be vaccinated. To implement this massive vaccination campaign, the public veterinary services of Paraguay collaborate with a private producer association. The private sector is responsible for the practical implementation of vaccination campaign and the public sector assesses and ensures that it is carried out to the required standards. This PPP corresponds to the “collaborative” category of PPP in the veterinary domain (Galière et al., 2019a). This category corresponds to PPPs driven by exports and/or commercial interests, initiated by both the public veterinary services and the private sector. FMD is a contagious viral disease of cattle, swine, sheep, goats and other cloven-hoofed ruminants (World Organisation for Animal Health (OIE), 2021). This disease affects the production of livestock and has an economic impact through direct losses (reduced livestock production) and indirect losses (costs of FMD control, poor access to markets) (Knight-Jones and Rushton, 2013). Effective control of FMD with vaccination requires high levels of vaccine coverage to develop herd immunity (Le Gall and Leboucq, 2004). It was the first disease for which the World Organisation for Animal Health (OIE) established official status recognition in 1994 (World Organisation for Animal Health (OIE), 2021). All countries that have eradicated FMD exclude beef imports from exporting countries whose herds show evidence of FMD. The control of FMD has therefore a strong commercial stake for meat exporting countries (Knight-Jones and Rushton, 2013).

Paraguay is a landlocked country in South America with a population of 7.13 million people. Income inequality has declined since 2003, but it is still high and 23.5% of the population living below the national poverty line. In 2020, the agriculture, forestry, and fishing, represented 11% of the national gross domestic product (World Bank, 2020). Informal economy, including rural activities related to livestock, could account up to 40% of GDP (World Bank Group, 2018). More than 14 million cattle are raised in the country and 70% of the meat produced is exported (Servicio Nacional de Calidad y Salud Animal, 2020b). The national cattle herd increased by 40.6% between 2006 and 2020.

There are approximately 140,000 livestock owners, and many formal and informal workers directly or indirectly employed by the livestock production system (241,000 people directly and 450,000 indirectly) (World Wildlife Fund Paraguay and Germany, 2016). The social status of the livestock owner is highly variable, going from the subsistence farmer to the livestock owner-investor with up to 500,000 cattle. Among the livestock owners, the 15% with the largest herds own the equivalent of 85% of the cattle in the country. The livestock system is almost always extensive, pasture-based, and feedlot fattening is almost never used.

Evaluation is important for any programs, including PPPs in the veterinary domain, to plan, redefine strategies, initiate appropriate corrective actions, optimize resources and help to ensure the effectiveness of actions (Brousselle and Champagne, 2011). Evaluation can focus on the analysis of the context, of the process of the PPP (such as governance or collaboration), and of the results and impacts. A review of literature about evaluation of PPPs, underlined the importance to analyse the context of implementation to provide relevant recommendations (Poupaud et al., Under publication).

In this study, we propose to conduct a historical review as a way to operationalize the context analysis, focusing on the emergence of PPP in Paraguay for the control of FMD. The purpose of this study is to try to understand what elements of the context influenced the emergence and implementation of the PPP, but also to try to understand the influence of the history of the PPP on its operating process.

## **2. Methodology**

The researcher (MP) was introduced to public and private actors at national level by the OIE delegate present in Paraguay. The fieldwork took place from January to March 2021. At the beginning of the study, a meeting introducing the researcher, the project and the evaluation framework was held with the researcher and key actors of the PPP from the public and private sector.

The study was conducted in the capital of Paraguay, Asuncion, and in four regions of Paraguay, corresponding to animal health commissions: Neembucu sur, Paraguari, Amanbay and Consanzo 17 (**Figure 1**). These regions were chosen because they correspond to different geographical situations. Three of the regions (Neembucu sur, Paraguari, Amanbay) are located in the eastern zone of Paraguay (located east of the Paraguay River), where 97% of the total population lives. Consanzo 17 is located in the western zone of Paraguay (located west of the Paraguay River), where 3% of the population lives, characterized by low rainfall and extreme temperatures, but which contains 50% of the cattle population. The Neembucu region shares a border with Argentina, Amanbay with Brazil, and Consanzo 17 with Bolivia, while Paraguari is a central region.



**Figure 1: The four regions of Paraguay included in this study. Paraguay shares borders with Bolivia, Brazil and Argentina.**

Ten semi-structured interviews using an interview guide were conducted with key actors of the FMD control program from Public veterinary services (n=4) and from the private sector (n=6) (foundation for animal health) at national level and regional level following an interview guide (**Appendix 1**). The key actors were the OIE delegate, the manager of the FMD program from the public veterinary services at central and regional levels (in four regions), the national directors (technical and executive directors) of the private foundation, and the regional directors of the private foundation in four regions. The researcher had been previously trained in qualitative approaches. All semi-structured interviews were conducted in Spanish. Interviews took place in the office of public or private partners. The interviews lasted from 40 to 90 minutes. The discussions were recorded and transcribed in Spanish.

A unique number was given to each of the transcripts to ensure the anonymity of the interviewees. The transcripts were read, and were analyzed through content analysis. We coded the information in this way: the history of the collaboration (events classified by date if the date was mentioned), history of the legal framework, elements of the context influencing the history of the PPP. The interviews allowed us to have a first outline of the history of the PPP and to highlight important dates.



Next, a search of the grey literature allowed us to triangulate the data provided by the interviews, but also to detail them and to obtain various types of numerical monitoring. These figures relate to the size of the herd, the number of producers, the number of vaccinated cattle, the level of beef exports (in volume and price), the coverage of veterinary services (number of veterinarians in the public veterinary services, number of offices in the regions and localities).

The annual report from 1967 to 2020 of the Pan American Health Organisation and Pan American Foot and Mouth Disease Center were consulted<sup>1</sup>, as well as the different laws and regulation<sup>2</sup>. The statistical data from the department of statistics of the Public veterinary services SENACSA, which contain data from 2007 to 2020 were analyzed<sup>3</sup>. With the help of this department, archive (Anuarios Estadísticos del Paraguay) from 1967 to 1997 of the national institute of Paraguay (Instituto Nacional de Estadísticas), established by the Finance Ministry (Dirección General de Estadística y Censo) were obtained and analyzed. Foreign trade bulletin published by the central bank of Paraguay, from 1961 to 2021, were also analyzed<sup>4</sup>. A detailed report was sent to key actors of the program in october 2021 to check the validity of the results.

### **3. Results**

#### **3.1 The history of the public-private partnership for FMD control in Paraguay (1545-2021)**

##### ***3.1.1 The beginning of livestock raising and implementation of FMD control strategy in South America and in Paraguay and the creation of the private rural association (1545-1965)***

Cattle were introduced in 1545 in Paraguay (Asociación Rural del Paraguay, 2011). FMD was first detected in 1870 in South America. By the end of the 19th century, FMD had spread to many countries including Paraguay (Correa Melo and Lopez, 2002; Rosenberg and Goic, 1973). In 1885, the rural association of Paraguay (ARP), a private non-profit organization, was founded in order to brings together agricultural producers from all over the country, and which seeks to make livestock production an instrument for Paraguay's development, (Asociación Rural del Paraguay, 2011).

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<sup>1</sup> available on <https://iris.paho.org/>;

<sup>2</sup> available on <https://www.bacn.gov.py/leyes-paraguayas>

<sup>3</sup> available on <https://www.senacsa.gov.py/index.php/informacion-publica/estadistica-pecuaria>

<sup>4</sup> available on <https://www.bcp.gov.py/boletin-de-comercio-exterior-trimestral-i400>

In 1917, Paraguay began exporting meat in the form of corned beef, for example through the Liebig company (Asociación Rural del Paraguay, 2011). In 1917, a livestock Service was established in Paraguay, under the Ministry of Agriculture and Livestock, in order to guarantee the quality and health of meat, and the first Animal Health Law, Law 269, was drawn up. The first Animal Health Unit was created in the same year (Facultad de Ciencias Veterinarias, 2021). In 1950, the four first health regions (zona sanitaria) were created as well as the first rural medicine centre in the country (zonal unit) with a veterinarian. In 1954, the Faculty of Agronomy and Veterinary Medicine was created under the Ministry of Agriculture and Livestock. The Faculty of Agronomy and Veterinary Science became part of the National University of Asunción on 1956 (Facultad de Ciencias Veterinarias, 2021).

In 1938, the first effective FMD vaccine was developed in Germany. The vaccine was produced in South America in 1940 (Argentina, Brazil, Chile, Peru, Uruguay) (Rosenberg and Goic, 1973). The introduction of FMD into Mexico in 1946, and then into Venezuela and Colombia in 1950, marked the beginning of the development of the control of the disease throughout the Americas. In 1951, the United States, through the Organization of American States, initiated the establishment of the Pan-American FMD Centre (PANAFTOSA = “Centro Panamericano de Fiebre Aftosa”). The Pan-American FMD Centre was created through an agreement between the Organisation of American States, the Pan American Sanitary Bureau of the WHO and the Government of Brazil (Correa Melo and Lopez, 2002).

### ***3.1.2 Creation of veterinary Services (1965-1994)***

In 1965, the Inter-American Development Bank offered financial loans for the development of FMD control plans in South American countries (PANAFTOSA, 2018). With this loan, the veterinary Services of Paraguay were created in 1967 (Law 1267/1967) and followed guidelines of the Pan-American FMD Centre PANAFTOSA for their FMD control programs (Rosenberg and Goic, 1973; Servicio Nacional de Calidad y Salud Animal, 2020a). The main objective of the Public veterinary services was FMD control and they were initially called “SENALFA” for National FMD Control Services (“Servicio Nacional de Lucha contra la Fiebre Aftosa”) (Servicio Nacional de Calidad y Salud Animal, 2020a). Law 1267/1967 announced the start of the campaign to control FMD. This law created a tax imposed on farmers when selling their cattle to finance the national campaign against FMD (Gobierno Nacional de Paraguay, 1967).

In 1969, vaccination campaigns began in the eastern part of the country and in 1972 in the western part. From the beginning, the private sector has played a major role in the implementation of FMD vaccination. Indeed, at first, owners were responsible for vaccinating their cattle, and the Public veterinary services staff vaccinated a minority of the cattle. The rural association of Paraguay was in favor of this vaccination campaign since the beginning, and thanks to its presence in the whole country encouraged the breeders to vaccinate their livestock. In 1970, one third of the cattle were vaccinated (Organizacion panamerica de la salud, 1970).

Since 1970, Paraguay has been producing its vaccines in one public and one private laboratory (Organizacion panamerica de la salud, 1970). In 1972, the FMD programme had more than 60 veterinarians, most of them distributed in the countryside (Rosenberg and Goic, 1973). The programme had difficulties such as lack of resources and lack of personnel to cover producers, especially small producers who were less motivated to vaccinate their cattle (Organizacion panamerica de la salud, 1970).

In 1977, the public veterinary services' activities were extended to the control of rabies, brucellosis and bovine tuberculosis, and they were renamed SENACSA for "National Animal Health and Quality Service" ("Servicio Nacional de Calidad y Salud Animal") by Law 675/1977. This law defines the Public veterinary services SENACSA as an institution with technical and administrative autonomy and legal standing (Gobierno Nacional de Paraguay, 1977). Since 1981, the Public veterinary services SENACSA's budget is fully covered by the institution's own income and do not depend from financial loans from abroad such as of the Inter-American Development Bank.

Since its creation in 1951, the Pan-American FMD Centre PANAFTOSA has been influencing the different national FMD control programmes in South America, especially in Paraguay, by establishing guidelines that these programmes should follow. In 1972, the South American Commission for the control of FMD (COSALFA) was created, composed of the directors of animal health services and representatives of the production sector of the South American countries, a collaboration between the public and private sectors in South America. In 1988, the Hemispheric FMD Eradication Programme of the Pan-American FMD Centre PANAFTOSA and its first action plan (1988-2009), were created, establishing guidelines for national programmes for the eradication of the disease in the different countries (P. Centro Panamericano de Fiebre Aftosa, 2018).

In 1994, the OIE developed standards to allow a system of official recognition of FMD-free member countries with animal health status (World Organisation for Animal Health, 2020b).

### ***3.1.3 The beginning of the official collaboration between the Public veterinary services and the private sector (1996-2001)***

The FMD status creation from OIE gave a new boost to the program. In 1996, Law 808 declared the national FMD eradication programme mandatory throughout the country. This law officially initiated the collaboration of the veterinary Services with the private sector through the creation of inter-institutional commission (Articles 7 and 8). This commission, composed of representatives of the public sector and the private sector through the rural association of Paraguay, were intended to support the Public veterinary services SENACSA in the execution of vaccination. This law also established the resources of the inter-institutional commission by imposing on producers a percentage of the estimated value of each animal marketed (Gobierno Nacional de Paraguay, 1996). This tax now represents about 60% of the Public veterinary services SENACSA's funds.

“Some of this money was used by the programme workers, and some was kept in a savings bank so that in case of an emergency, the money was immediately available. And not to be dependent on the state.” [semi-structured interview, public actor at national level of the PPP]

In May 1997, Paraguay was certified as an FMD-free country with a vaccination regime by the OIE (Servicio Nacional de Calidad y Salud Animal, 2020b). In August 1999, vaccination against FMD was abolished, with the aim of achieving "FMD-free and vaccination-free status". Mass vaccination resumed in 2001 following reports of animals with lesions consistent with FMD (Organización Panamericana de la Salud, 1999).

### ***3.1.4 Restructuration of the FMD programme and start of the official PPP (2002-2012)***

In 2002, the OIE certification was suspended due to the reintroduction of the disease (Servicio Nacional de Calidad y Salud Animal, 2020b). This FMD outbreak highlighted the need to better organize the program.

“There was a lot of FMD and we wanted to export... but we had to stop lying and saying we didn't have the disease! We had no guarantee that the producer was doing his job properly, and that the cold chain was respected... “ [semi-structured interview, private actor at national level of the PPP]

The Public veterinary services SENACSA and rural association of Paraguay (ARP) looked for another organizational system to improve their program and were inspired by the Argentinian model.

“We saw experts from Argentina to help us. In Argentina, the Public veterinary services delegated the work to a private foundation for animal health.” [semi-structured interview, private actor at national level of the PPP]

In 2003, the rural association of Paraguay, which was already well structured throughout the country and had offices at the local level, decided to create non-profit animal health commissions in each of the 20 health regions of the country. The Public veterinary services SENACSA then relied on the organised rural association of Paraguay network and its animal health commissions for the implementation of the vaccination (Antonio Esteban Vasconsellos Portas, 2008).

"The Rural Association of Parguary is the mother of all this programme... the animal health commissions were part of it". [semi-structured interview, private actor at national level of the PPP]

Law 2426/2004, which established the current Public veterinary services SENACSA, clearly defined the competent authority and chain of command, and gave them full powers to exercise control and enforcement mechanisms, including penalties and sanctions (Gobierno Nacional de Paraguay, 2004; World Organisation for Animal Health, 2014). This law made vaccination against FMD mandatory (Article 50). It formalised the relationship with the rural association of Paraguay (ARP) and its Animal Health Commissions by giving the possibility to carry out vaccination by third parties (Article 54) and to create Animal Health Commissions (Article 78).

"This law [2426] is the basis of the PPP." [semi-structured interview, public actor at national level of the PPP]

While the collaboration between the private sector and Public veterinary services SENACSA exists since the beginning, the PPP officially began in 2004. The animal health commissions, which replaced the interinstitutional commissions, are public-private, non-profit auxiliary bodies that collaborate on the FMD eradication programme and other programmes that the Public veterinary services SENACSA deem appropriate (Comisiones de Salud Animal, Mesa Coordinadora, 2012).

Since 2004, the animal health commissions were responsible for the planning and control of vaccination campaigns, by employing officials who received training and accreditation as a prerequisite for their accreditation.

In January 2005, Paraguay regains the OIE status of "Freedom of FMD with vaccination" (Servicio Nacional de Calidad y Salud Animal, 2020a). In 2006, in order to demonstrate the absence of virus circulation on its territory, the Public veterinary services SENACSA set up an epidemiological surveillance programme and initiated serological sampling for the evaluation of the level of immunity to FMD vaccination. Following the recommendations of an OIE audit, zones called "high surveillance zone" were defined, comprising a 15 km wide strip on either side of the border with neighbouring countries (Argentina, Brazil, Bolivia) (Organización Panamericana de la Salud, 2007). In 2010, the second action plan (2011-2020) of the Hemispheric FMD Eradication Programme of the Pan-American FMD Centre PANAFTOSA was approved (P. Centro Panamericano de Fiebre Aftosa, 2018).

In 2010, rural association of Paraguay created a new commission, the animal health commission coordination (ACONASA), to unify the 20 animal health commissions, to centralise resources and to unify decisions related to FMD control. The animal health commission coordination was a legally registered non-profit civil entity (Antonio Esteban Vasconsellos Portas, 2008). In 2011, the "high surveillance zone" was also recognized as free from FMD by OIE and record export levels were at their highest, with almost 70 markets open (Antonio Esteban Vasconsellos Portas, 2008).

### ***3.1.5 The last FMD outbreak (2012-2017)***

On September 2011 and January 2012, FMD outbreaks occurred, and the official status granted by the OIE was lost. The social and economic cost of these outbreaks were high, with thousands of direct jobs lost, exports down by 29% (in 2010 the volume of meat and by-products exported corresponded to 918 million dollars, and in 2011 to 750 million dollars), and the indirect impact still difficult to determine (Servicio Nacional de Calidad y Salud Animal, 2011; Food and Agriculture Organization of the United Nations, 2012).

After this outbreak, the resolution 2031/12 of the Public veterinary services SENACSA officially approved the organisation of the 20 animal health commissions and extended their functions. Since this resolution, the official role of these commissions was to be the operational managers of FMD vaccination throughout the country. The entire vaccination process, from planning, vaccination, issuing of documents such as work orders, recording of vaccination records, is controlled by the Public veterinary services SENACSA (Centro Panamericano de Fiebre Aftosa, 2012).

In 2014, the OIE Scientific Commission concluded that the two zones of Paraguay meet the requirements for the reinstatement of FMD free status with vaccination "Country with two FMD free zones where vaccination is practised" (Servicio Nacional de Calidad y Salud Animal, 2020).

### ***3.1.6 Actual situation (2017-2021)***

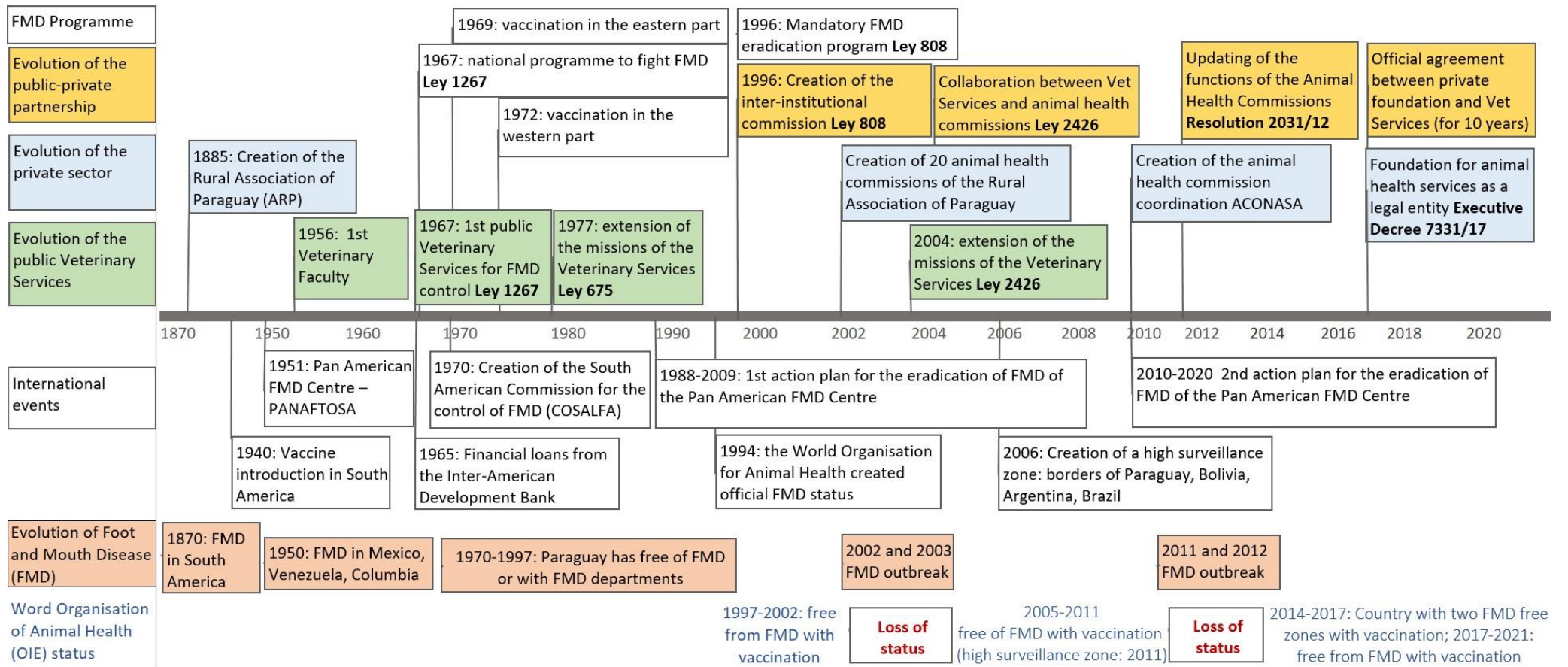
In 2017, the OIE has recertified the entire country with the sanitary status of "Country free of FMD with Vaccination", maintaining this status at present (Servicio Nacional de Calidad y Salud Animal, 2020a). The same year, the private foundation for animal health services (Fundación de servicios de salud animal =FUNDASSA) was created, replacing the private animal health commissions from rural association of Paraguay. The creation of the foundation was motivated to make the private animal health commissions less vulnerable to political changes.

"We [the animal health commissions] were handling a lot of money and the politicians wanted to get their hands on it... they wanted to do something political and not technical. We were very vulnerable." [semi-structured interview, private actor at national level of the PPP].

"ACONASA [the animal health commission coordination] was directly under the control of SENACSA [the Public veterinary services]. A president of SENACSA could decide from one day to the next day that the commission no longer exists. " [semi-structured interview, private actor at national level of the PPP]

The foundation for animal health services FUNDASSA was recognised as a legal entity by Executive Decree No. 7331/2017 (Gobierno Nacional de Paraguay, 2017). A cooperation agreement is signed between the Public veterinary services SENACSA and the foundation for animal health services FUNDASSA for a 10-year collaboration (SENACSA y FUNDASSA, 2017). All the obligations that the animal health commissions had assumed in support of the Public veterinary services SENACSA are maintained, including those related to vaccination against FMD. The foundation "may collaborate, coordinate, develop and carry out the activities necessary for the prevention, control and eradication of contagious animal diseases in the field of animal health, especially those carried out to comply with the country's FMD eradication programmes and others within the framework of the National Animal Health Plan" (SENACSA y FUNDASSA, 2017). In 2018, Paraguay started using a bivalent vaccine (A and O strains) instead of the trivalent vaccine (A, O, C strains) previously used, as the C strain is no longer circulating in the country (Centro Panamericano de Fiebre Aftosa, 2018).

The foundation for animal health services FUNDASSA structure is officially separate from the rural association of Paraguay, but often at the local level the chair of the animal health commission of the foundation is also the local chair of the rural association of Paraguay. The President of the rural association of Paraguay is also present at all weekly meetings at national level and participates fully in decision-making. Today, the Paraguayan private sector is actively involved in regional and global animal health issues both as rural association of Paraguay and the foundation for animal health services FUNDASSA, and international organisations recognise the participation of the private sector in animal health programmes. For example, the private sector is invited, together with the Public veterinary services, to the annual conference of OIE, to the annual meetings of the South American Commission for the control of FMD (COSALFA), or to support the implementation of the hemispheric FMD eradication plan of Panamericano FMD Centre PANAFTOSA (Antonio Esteban Vasconsellos Portas, 2008).



**Figure 3: History of the foot-and-mouth disease (FMD) programme (top white squares) and of the public-private partnership (yellow square) in Paraguay from 1870 to 2020.** The evolution of the private sector is described in the blue squares, and of the Public veterinary services in green squares. The international event which influenced the programs are described in down white squares. The evolution of the disease is described in red squares. The statuses of the FMD situation in Paraguay given by the World Organisation for Animal Health (OIE) are in blue and red text.



### ***3.2 Evolution of the governance system of the PPP and consequence on the process of PPP***

The forms of governance of collaboration between public and private systems for FMD control have evolved over time. The private sector, in particular through the rural association of Paraguay, which has been created since 1885, before the Public veterinary services existed, has been involved in the FMD programme from the very beginning, notably through participation in the meetings and programme of the Pan-American FMD Centre PANAFTOSA. Indeed, in South America, the private sector through producers' association became interested in FMD control, first for zootechnical reasons to improve the productivity of their livestock, and then for commercial reasons, especially since the creation of the OIE status in 1994. They realized that being part of a FMD disease-free circuit would improve their profit (Astudillo, 1997).

The vaccination against the FMD became compulsory by law in 1996, following the creation of the OIE status. The official governance of the collaboration between the rural association of Paraguay and the Public veterinary services, started in 1996 with the creation of a law (law 808), legitimising the inter-institutional commission and the support of the rural association of Paraguay for the implementation of vaccination. The inter-institutional commission ensured that money for the FMD program, mainly from a levy paid by farmers, and payment for vaccines, did not flow through the ministries. Stakeholders said this was an important step for the management of the program, denouncing the risks of government corruption.

In 2003, following an outbreak of FMD and the loss of OIE "free from FMD with vaccination" status, the implementation of the FMD control programme was accelerated thanks to the creation of the 20 animal health commissions of rural association of Paraguay (ARP), which were easily set up because the association was already well structured throughout the country. The collaboration with these animal health commissions of the rural association of Paraguay and the Public veterinary services was legitimised two years later by Law 2426 of 2004. The rural association of Paraguay network has enabled the Public veterinary services to ensure vaccination at the local level, and to develop their own network at the local level. The local units of the Public veterinary services have almost always developed alongside the offices of the animal health commissions of the rural association of Paraguay (which are now the commissions of the Animal Health Services Foundation FUNDASSA). In a need to homogenise the ways in which the different health commissions operated, and to homogenise the financial resources per commission, the animal health commissions coordination ACONASA was created in 2010. This coordination has enabled greater solidarity between the commissions, redistributing financial resources and supporting certain commissions that are in deficit (mainly because they are made up of small farmers which increases the number of farms to be vaccinated and makes logistics more difficult). Finally, the current structure, the Animal Health Services Foundation FUNDASSA, officially separated from the rural association of Paraguay, was only created in 2017.

Indeed, the actors of the health commissions felt vulnerable to a political change and being recognised as a legal person by a decree of the executive branch (decree 7331/2017) protects them for 10 years. Once again, the legislation followed the needs of actors on the ground. In 2018, an official agreement was then signed between the Public veterinary services SENACSA and the private foundation for 10 years. It is therefore not the legal environment that allowed the emergence of this PPP, but rather the networks of actors that influenced the legal evolution according to the needs identified to strengthen the program.

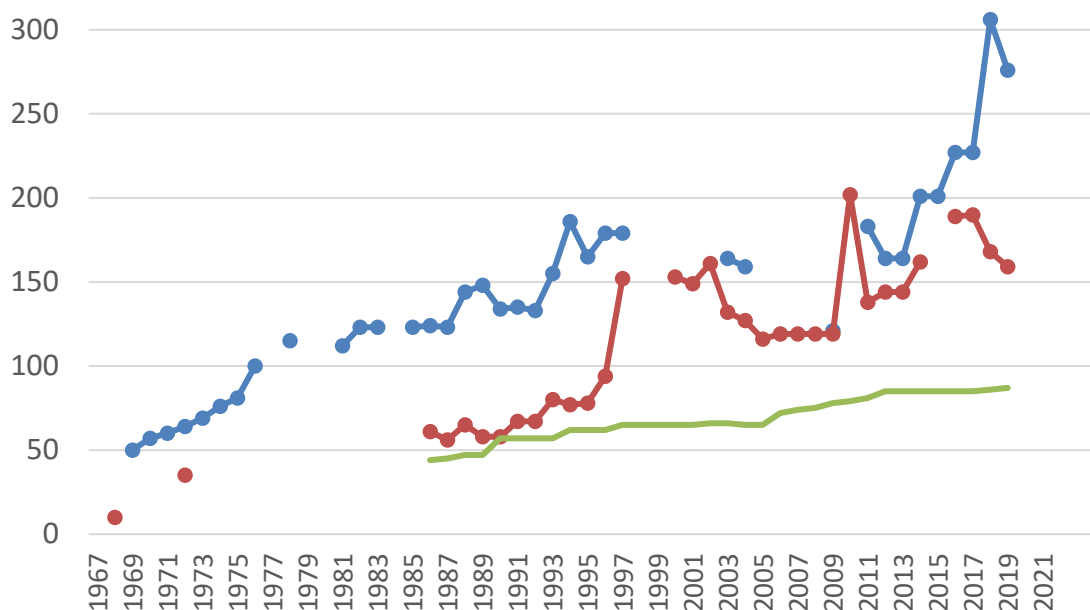
### ***3.3 PPP's outcome on the animal health system: evolution of the veterinary services***

Until 1939 there were only 5 veterinarians in the country. If there was a livestock service and an animal health unit since 1917, it was only to guarantee the quality of the meat and there was no support for animal health at field level in any part of the country (Facultad de Ciencias Veterinarias, 2021). Before 1968, there were about a dozen of veterinarians working in the interior of the country. The Public veterinary services of Paraguay really emerged in 1969 at the beginning of the control of FMD in South America, thanks to a loan from the Inter-American Development Bank. The Public veterinary services of Paraguay were created specifically for the control of FMD, and was called “National FMD control services”, and only 10 years after, in 1977, the missions of the veterinary Services were extended to other diseases. In 1969, Public veterinary services had 50 veterinarians in the FMD programme. In 2020, the Public veterinary services have 1620 employees including 400 veterinarians, 276 of which belong to the FMD programme. In 2021 the veterinary Services have competence in animal health and food safety, and are responsible for 9 sanitary programmes (FMD, bovine spongiform encephalopathy, avian influenza, classical swine fever, bovine brucellosis, bovine rabies, bovine tuberculosis, equine infectious anemia, newcastle disease) (Servicio Nacional de Calidad y Salud Animal, 2020c). The bovine brucellosis control programme officially started in 2016, and the strategy is to rely on the same system as the FMD control programme and to entrust the operation of vaccination to the private animal health foundation FUNDASSA.

#### ***3.2.1 PPP's indirect outcome on the animal health system: veterinary health coverage in the country***

Local veterinary coverage of the Public veterinary services has expanded over the years, mainly in order to carry out the FMD control programme. The extension of this coverage was also made possible by the presence of the private sector, and in particular the rural association of Paraguay, which was already structured at the country level. Thus, the local offices of the public sector were built next to or in front of the association's offices. In 1950, the first five sanitary regional zone and the first local veterinary unit supervised by a private veterinarian were created (Facultad de Ciencias Veterinarias, 2021).

In 1989, there were 12 sanitary regional zones and 47 local veterinary units and 58 veterinarians from the Public veterinary services (SENACSA) in the field (Centro Panamericano de Fiebre Aftosa, 1989). In 2016 a new post of "head of zonal unit" of the Public veterinary services was created, and 50 professionals were recruited at field level (veterinarians, administrative staff). In 2020, there are 20 sanitary regional zones, 13 regional coordination units, 87 local veterinary units, and 159 veterinarians of the Public veterinary services SENACSA at local level (Servicio Nacional de Calidad y Salud Animal, 2020b) (**Figure 4**).



**Figure 4: Evolution of the veterinary services coverage in Paraguay from 1968 to 2020.**

Number of veterinarians of the public Veterinary Services for the foot-and-mouth disease program (blue line), number of veterinarians of the public Veterinary Services in the field (red line) and number of the local rural veterinary unit (green line). Broken lines mean that data for these years were not found.

### 3.2.2 PPP's outcome on the animal health system: evolution of the animal traceability system

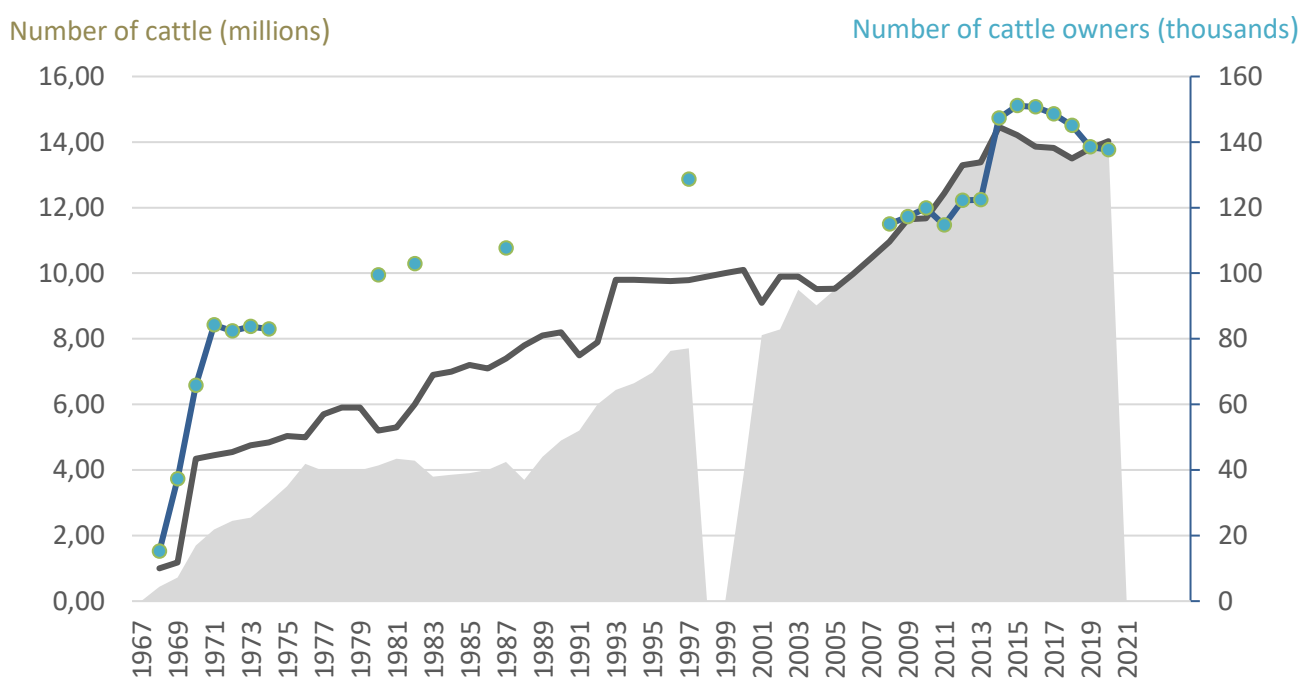
To enable the FMD programme to function properly, the country's traceability system has been developed, also through a partnership with the rural association of Paraguay. There are two traceability systems in Paraguay: the systems SITRAP (Paraguay Traceability System – “*Sistema de Trazabilidad del Paraguay*”) and SIGOR (Computerised Management System for Regional Offices – “*Sistema Informático de Gestión de las Oficinas Regionales*”).

The Paraguay Traceability System, SITRAP, governed by decree 2504/2004 and resolution 1578/2008, is a traceability system which requires individual identifications with coded ear tags. This system is not compulsory by national legislation, but it is necessary for demanding markets (such as the European Union). This system brings together the most technically advanced and export-oriented farmers (Jori, 2012). The rural association of Paraguay is responsible for the implementation of Paraguay traceability system SITRAP under the authority of the Public veterinary services SENACSA, with coordination through a technical traceability commission. The rest of the animals in the country are not individually identified, except for the cattle holding fire brand which identifies them as property of a specific cattle holding.

The system Computerised Management System for Regional Offices, SIGOR, is a network where all owners must be registered to declare their livestock, the movements and the health information of their bovines, in particular regarding FMD. Before every vaccination campaign every livestock owner must update information on his cattle population. This system is key to the success of the FMD control programme because until the herd is vaccinated against FMD, the livestock holding is blocked in the system and then the owner is not able to perform any cattle transaction until the situation is clarified (Jori, 2012). This system, initially developed for the control of the FMD, in addition to allowing a census of the number of vaccinated bovines, it is also used to make a census of other species, number of owners and other livestock holding data (geographical location, epidemiological coordinates, infrastructure). The first version of this system was developed in 2000, corresponding to a single non-connected computer with a software, followed by the second version in 2003, connected to the network (in the form of distributed data) that was set up in different local units (Centro Panamericano de Fiebre Aftosa, 2003). In 2009, 99% of local units were equipped with this system. The third and actual version of this system, developed in 2010, connects all the computer of the local veterinary unit with the central networks of the Public veterinary services SENACSA (centralised database) (Jori, 2012). Since 2013 (resolution 2031), the entire vaccination process, from the planning to the recording of vaccination records, is carried out using Computerised Management System for Regional Offices SIGOR.

### 3.4 PPP's outcomes on the livestock system and on the economy: evolution of the cattle and of the meat exportation

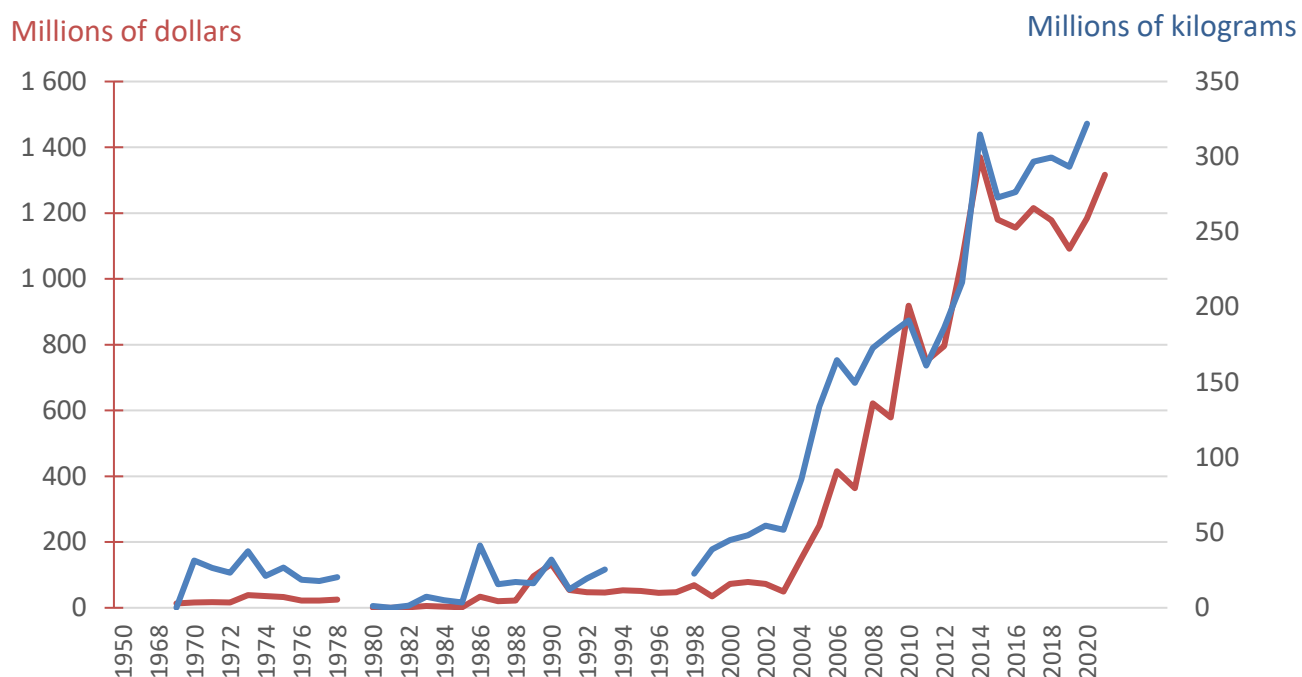
Cattle breeding was introduced in Paraguay in 1545, and in 1800 there were 500,000 head of cattle. In 1969 there were 1.18 million head of cattle and this figure increased rapidly within a year to 4.34 million in 1970. The number of owners also increased rapidly, from 0.44 million in 1968 to 1.7 million in 1970. Thereafter, the increase remains more or less constant to reach 14.03 million cattle in 2020 and 137,409 owners. Between 2016 and 2020 the number of owners decreased from 150,689 owners to 137,409 owners, showing that some large owners have more and more cattle (Figure 5). For example, in 2020, the top 15% of owners own 85% of cattle.



**Figure 5: Evolution of the number of cattle and cattle owners in Paraguay from 1950 to 2020.**

The black line corresponds to the number of cattle in millions and the top of the grey area to the numbers of vaccinated cattle (the corresponding figures are on the left). The blue line corresponds to the number of cattle owners in thousands (corresponding figures are on the right).

The volume of exports (which is represented in millions of kg of and in millions of dollars in the Figure 5) increases sharply from 2004, corresponding to the year of Paraguay's FMD-free status granted by the OIE. A decrease can be seen in 2011 after the outbreak of FMD. In 2020, the volume of exports reached 321,962 tons corresponding to USD 1,184 millions (Figure 6).



**Figure 6: Evolution of the volume of meat offal, by-products and processed products exports and the corresponding financial value.** The red line corresponds to the export value in millions of dollars. The blue line shows the export volume in millions of kilograms.

#### 4. Discussion and conclusion

This historical perspective showed that the private sector always collaborated with the Public veterinary services in the FMD programme, but the collaboration evolved through time in terms of organization and governance because of various factors. It seems that the FMD program could not have been implemented without the collaboration of these two sectors. The rural association of Paraguay, the private producer association, was created in 1885, before to the public veterinary services. Since its creation, the veterinary services have been supported by the producers' association which had already existed for several decades and was already well structured throughout the country. From the beginning, the private sector has played a major role in the implementation of FMD vaccination, notably through its participation since the beginning in the meetings and programme of the Pan-American FMD Centre PANAFTOSA. The private sector, thanks to its structure, its human resources, and its influence and motivation to implement an efficient immunization program, has always been responsible for the operational implementation of vaccination, assessed by the public veterinary services. Today, 100% of the cattle population is vaccinated, and the vaccination operation is entrusted to the private sector, through a foundation recognized as a legal entity, and is supervised and evaluated by the Public veterinary services.

Elements of the governance context (regulations and policies) and the economic context (trade standards for the import of meat products), at an international level, have influenced the FMD control program in Paraguay and the PPP. The United States, fearing the introduction of FMD into their country, influenced FMD control in South America by creating PANAFTOSA. Through international loans from Inter-American Development Bank, Paraguay was enabled to create its Public veterinary services in 1967 (as many other countries in South America). The mission of Public veterinary services was only FMD control until 1977, then their missions were extended to other diseases. The creation of official OIE status led to the 1996 law that made the FMD control program mandatory. The influence of the international level, such as the influence of the policies carried out by the veterinary services in Argentina or Brazil (neighboring countries) or by the Pan-American Foot and Mouth Disease Center (PANAFTOSA), or the influence of the European Union and its sanitary requirements for the import of meat, or of the OIE and its performance evaluations and the issuance of statuses, could have been considered in more detail.

This study highlights several contextual elements that influenced the PPP. In terms of the sanitary context, which itself is influenced by the PPP and its results on animal health, we have seen that the various disease outbreaks have led to the restructuring of the PPP and to organizational changes. In terms of the social context, we can mention the important cultural place of livestock breeding in the country, and therefore the influence of the breeders' associations. In terms of the economic context, the importance of livestock in the country's economy has greatly influenced the implementation of the PPP. Indeed, the export of beef to certain countries is conditional on obtaining the health status issued by the OIE.

Several elements of the governance context influenced the PPP. We have already mentioned the influence of the policies of neighboring countries and interregional organizations such as PANAFTOSA, or the OIE health statutes. At the national level, governance among different actors has influenced the PPP. Indeed, the implementation of this PPP results from arbitrations and social choices involving various actors, public and private. The role that the producers' association has played in this PPP is very important. It should be noted that it was the more powerful livestock producers who had a commercial interest in the country's FMD-free status and who were able to influence the program. The non-export-oriented smallholders' farmers did not have any influence on the evolution of the program, but they are directly concerned, as they are now obliged to vaccinate their herds. In addition, it can be mentioned that the country's political system, which appears to be quite corrupt, was a source of motivation for the establishment of a PPP able to manage its own funds for the implementation of vaccination.

The environmental context was rarely mentioned in the interviews conducted during this study. It was mentioned particularly in the southern region of Neembucu, which is a wetland area, partly flooded. This region suffers from increasingly regular flooding, which makes it difficult to access the farms during vaccination campaigns and has an influence on the organization of the PPP (for example, actors are forced to travel on horseback rather than on foot or by car). Little information was available in the grey literature consulted that was related to livestock or PPP. However, given the interaction between livestock and land use, land availability, deforestation and environmental legislation, it would have been interesting to look at other sources of grey literature. We encourage people who want to analyze the influence of the context on the PPP to consider the environmental dimension.

We have also highlighted the influence of the history of the PPP on the results produced by the PPP, which leads to an evolution of the context. The networks of actors involved in the PPP have led to indirect governance outcomes: the evolution of legislative governance and regulations, resulting in the current system between FUNDASSA and SENACSA. In 2017, the animal health commissions of the producer's association created a foundation, recognized as legal entity, because they were afraid to disappear because of political changes, leading to the actual PPP for FMD control. The FMD program in Paraguay, based on collaboration between the public and private sectors, has result in outcomes on the animal health system. It has result in the emergence of a structured public veterinary service with a developed network at the local level. Today, the program provides 100% vaccination coverage of the herd. Paraguay has not experienced an outbreak of FMD since 2012. This review also showed that the FMD program allowed to develop the veterinary infrastructures such as offices at local level with computers and connected management system.

The review allowed for an understanding of the interactions between the public and private sectors, the evolution of forms of organization and collaboration, the evolution of the legislative system, and the systems of governance that we believe are necessary to formulate relevant recommendations in a PPP evaluation process. For these reasons, we think it is interesting to implement a historical perspective when evaluating PPPs. This will allow for a deeper understanding of the PPP process and the reasons for its current functioning, and thus be able to provide relevant recommendations. From a methodological point of view, the mix of semi-structured interviews with key informants who have been directly or indirectly involved in the PPP for a long time, seems interesting. However, we are aware that access to grey literature and archives is sometimes very limited in some countries. In Paraguay, and more broadly in South America, given the importance of the cattle sector in the national economy, data are numerous and accessible. In other contexts, it will be necessary to consider how to overcome this lack of access to data.



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## *Chapter 2. Part 2: summary of a stakeholder mapping study*

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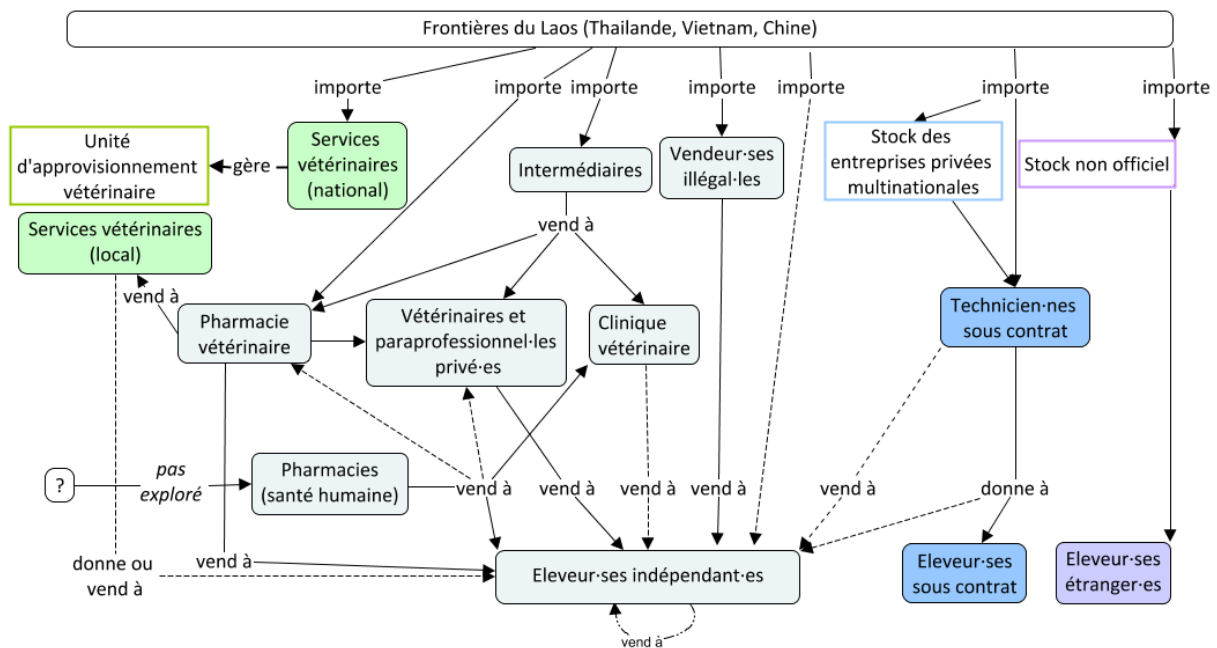
*This study was published in the journal Acta Tropica (Appendix 2)*  
<https://doi.org/10.1016/j.actatropica.2021.105943>

In 2018, in response to international demands to reduce the risks associated with antimicrobial resistance, the government in Laos developed new regulations on access to, and use of, veterinary antibiotics. This study sought to assess, from an ex ante perspective, the potential of the new regulations to reduce the risks associated with antimicrobial resistance.

We used a methodology based on participatory stakeholder mapping. The analyses were carried out in three stages. Stage 1 was a participatory workshop with 10 participants, which identified the different actors in the veterinary antibiotic supply chain, their roles and their interaction. Stage 2 sought to determine the position (legitimacy, resources, connections) of the stakeholders as well as their interests and constraints as regards the new regulations. Semi-structured interviews were carried out with 27 people. Finally, Stage 3 involved a questionnaire that sought to identify how veterinary antibiotics were used and to gather opinions about their use (36 antibiotic suppliers, 96 chicken producers, 96 pork producers).

The practices of the 23 stakeholders identified have the potential to influence the risk of antibiotic resistance. They included representatives from the public sector (Veterinary Services) and the private sector (multinationals, antibiotic wholesalers and independent antibiotic users and non-Lao farmers). We examined the interactions between these stakeholders. Foreign stakeholders and representatives from multinationals (technicians and producers under contract) had little interaction with other stakeholders. Foreign stakeholders use antibiotics directly imported from their country, e.g. China. Public Veterinary Services and independent stakeholders from the private sector that sell or use antibiotics are connected through the sale of antibiotics and the provision of advice on their use (**Figure 1**). Most antibiotics on the farms of independent producers, which came from different sources, were critically important antibiotics used in human medicine.

The practices of one group of stakeholders influence those of other groups. For example, the owners of veterinary pharmacies have an important role to play in providing advice to producers on antibiotic use. Finally, the interests and constraints associated with new regulations, including restrictions on the use of veterinary antibiotics, are different for different stakeholders. They are linked to their position, their resources (financial and knowledge resources), their legitimacy (which is dependent on their actions being legal and known to the government), and their connections with other stakeholders. For example, obtaining a veterinary prescription before buying antibiotics seemed impossible for some producers living in remote areas without access to animal health services.



**Figure 1: Mapping stakeholders, and the connections between them, in the veterinary antibiotic supply chain in Vientiane (the capital of Laos) and in the province of Vientiane, in 2018.** Stakeholders are from the public sector (green rectangles) and the private sector (dark blue rectangles: private multinationals, purple rectangles: foreign producers, light blue rectangles: independent suppliers and consumers of antibiotics)

Although the new regulations are promoted by the Lao government and the public Veterinary Services, the implementation of these regulations will not necessarily change the practices of private stakeholders. The constraints brought about by these regulations could push stakeholders to disregard them. Given the number of stakeholders and their connections (their influence on each other), the government will have great difficulty in controlling the entire veterinary antibiotic supply chain.

Thus, private stakeholder buy-in for an antimicrobial resistance management plan is essential. Mechanisms for stakeholder dialogue and engagement, within the framework of a public-private collaboration, for example, should be encouraged. These mechanisms would allow for a common understanding of the problem of antimicrobial resistance and the interests and constraints of the different stakeholders and would facilitate the co-construction of objectives.

Mapping the stakeholders involved in the sale and use of veterinary antibiotics proved useful in identifying the obstacles that the Lao government may face when implementing new regulations. This also made it possible to suggest levers to promote the implementation of an antimicrobial resistance management plan. This study touched only briefly on analysing the position of stakeholders and identifying their constraints and interests. Therefore, we refer to stakeholder mapping (and not stakeholder analysis), as these stages are central to the stakeholder analysis methodology. Thus, we think that the stakeholder mapping methodology (as presented in this study), which can be extended to a stakeholder analysis (see Schmeer [1999] and Varvasovszky and Brugha [2000]), would be useful for PPP context analysis. The analysis should consider not only the stakeholders involved in the PPP but also those that influence it and are impacted by it. If implemented *ex ante*, that is, before the establishment of a potential PPP (as in this study), this methodology can identify and anticipate the interest and constraints of stakeholders as regards participating in a PPP. An analysis of the position of stakeholders will, therefore, make it possible to be more attentive to some of the risks associated with the influence of certain actors in the PPP or groups of actors that will be impacted by it, thus making it possible to propose adjustments for the future PPP. For the same reasons, we believe it would be useful to use this methodology when analysing the context of a PPP during its implementation (*in itinere*). In addition, this analysis could, for example, identify any missing actors, such as the actors needed to ensure the smooth implementation of the PPP or to increase the chances of achieving certain outcomes. This methodology, even if it is part of a context analysis (in the sense that the actors, linkages and influences outside the PPP are also considered), can shed new light on how the PPP works and help formulate recommendations that will improve the process. Implementing this methodology during the evaluation may also make it possible to initiate dialogue between the different groups of stakeholders and increase the transparency of the PPP's implementation process.

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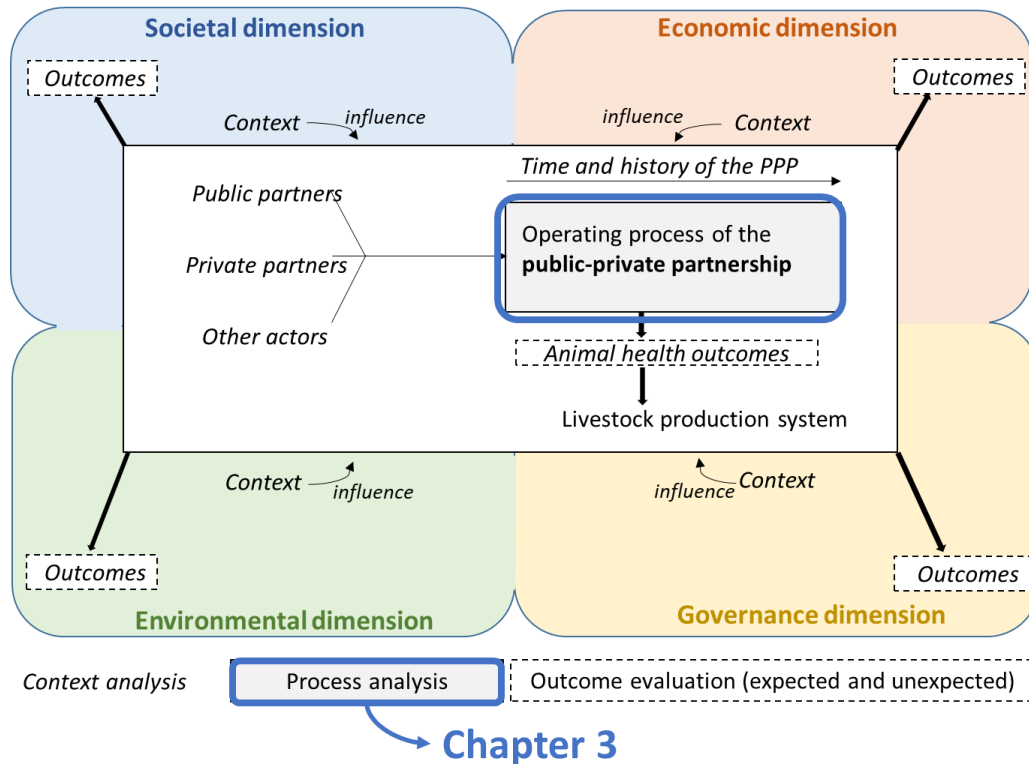
# Chapter 3

## **Chapter 3. Process analysis for public-private partnerships**

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## Preamble to chapter 3

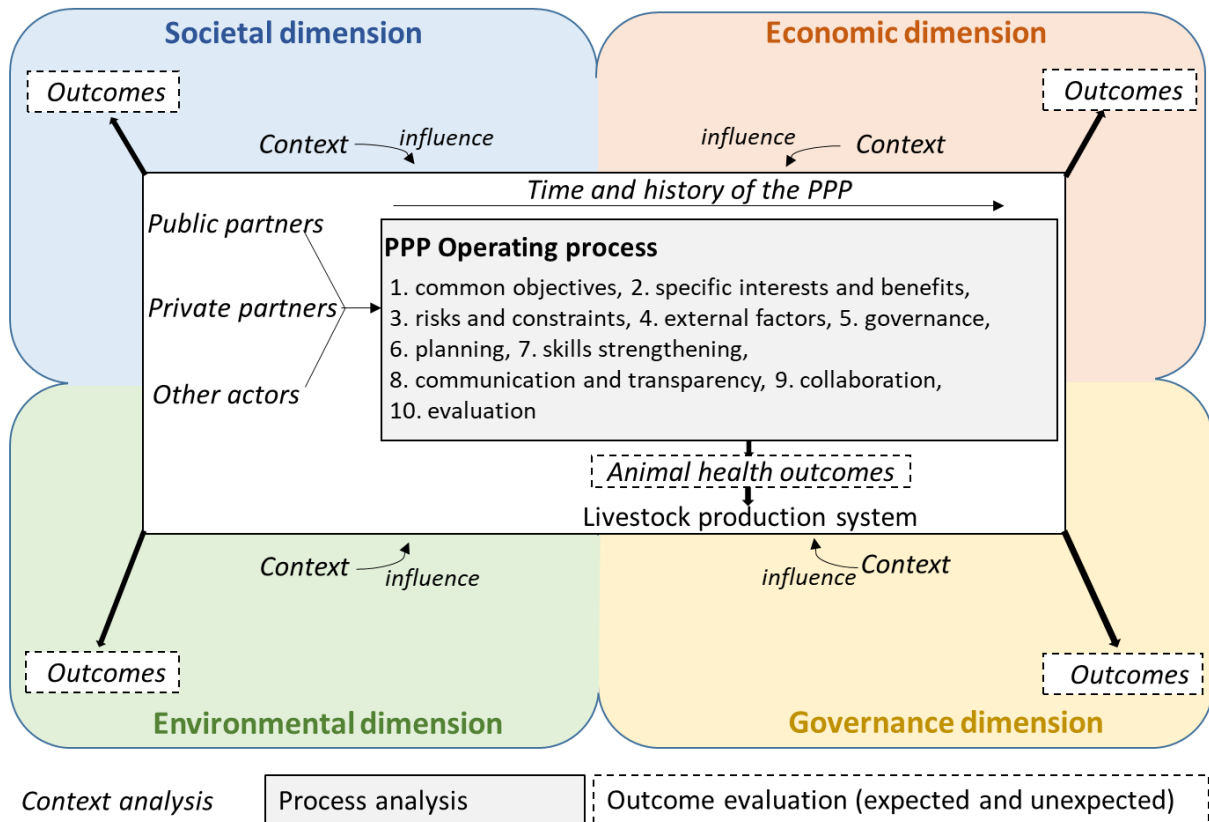
Chapter 3 looks at the PPP process analysis component of the analysis model (Figure 1).



**Figure 1: Chapter 3 looks at PPP process analysis (blue rectangles), which is one component of the analysis model**

The literature review highlighted the importance of considering a PPP's operating processes (objective-setting, governance mechanisms, activity planning, collaboration). An evaluation tool was developed to analyse processes and identify their strengths and weaknesses. The development of this tool is presented in the first part of this chapter. Its development was based on the process analysis criteria identified in the literature review, an expert elicitation (public and private sectors) and two case studies. The evaluation criteria identified in this chapter can be grouped under 10 main headings: 1. setting objectives common to both parties, 2. identifying the interests and benefits specific to each party, 3. identifying risks and constraints, 4. taking external factors into account and developing strategies, 5. governance mechanisms, 6. PPP activity planning, 7. strengthening skills and training, 8. communication and transparency, 9. collaboration mechanisms, 10. follow-up and evaluations (Figure 2)

This tool was developed with the aim of facilitating the implementation of participatory evaluations. Improving PPP implementation would increase the chances of positive outcomes and limit risks and negative outcomes. In the second part of this chapter, we present a summary of how this tool was used to evaluate a PPP in Tunisia. The tool is a ‘semi-quantitative’ tool that requires each evaluation criteria be given a score from 0 to 3 by the stakeholders involved in the PPP. It enables easy-to-interpret graphs to be created, which facilitates the co-construction of recommendations for improving the way in which the PPP operates. However, while it is a useful addition, it does not replace other approaches, notably qualitative approaches (such as in-depth interviews). The combination of these approaches would allow for a detailed understanding of PPP operating processes, thus providing an explanation of how, why, and under what conditions a PPP can lead to good outcomes.



**Figure 2: Chapter 3 enabled us to identify the important factors to consider in PPP process analysis**

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## ***Chapter 3. Part 1: Presentation of a process evaluation tool***

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### **Title: An evaluation tool to strengthen the collaborative process of the public-private partnership in the veterinary domain**

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### **Highlights**

- A tool was developed to evaluate public-private partnership processes in the veterinary domain
- The viewpoints of public and private partners, catalyzers and actors impacted were captured
- This tool helps to promote good practices, strengthen the collaborative process and formulate recommendations for improvement of the public-private partnerships
- This tool helps to limit the potential risks and improve the outcomes and impacts of public-private partnerships

## **Abstract**

Public-private partnerships (PPPs) in the veterinary domain are widely implemented worldwide and can help to strengthen the capacities of veterinary services. Few analyses have been made of these initiatives. This study is aimed at developing an evaluation tool based on participatory approaches and focusing on the quality of PPP processes in the veterinary domain.

The tool was divided into ten sections relevant to PPP process organisation and activities. The 44 evaluation criteria and six quality attributes (operationality, relevance, acceptability, inclusiveness, adaptability, and stability) were identified based on literature review and case-study application. The tool was adjusted during four regional PPP training workshops bringing together stakeholders from both public and private sectors. Finally, the tool was validated through an experts' elicitation process and applied in the field in Paraguay.

The tool was developed in a non-normative perspective to help the partners adapt the PPP to their specific context, to maximize the opportunities and minimize the risks of such collaborations, and to formulate adapted recommendations to strengthen and improve the PPP collaborative process and thus the outcomes. In an ex-ante perspective, this tool would also help public and private actors to engage and develop a PPP process following the best possible practices. The aim of this tool is to help decision making in terms of PPP development and implementation in the veterinary domain to ensure the added value and relevance of such a collaborative approach in different countries worldwide.

**Key words:** evaluation, participatory approaches, co-learning, public-private partnership, veterinary domain



## 1. Introduction

Public-Private Partnerships (PPPs) in the veterinary domain (as defined in the *Terrestrial Animal Health Code* (World Organisation for Animal Health, 2019c)) are "a joint approach in which the public and private sectors agree on responsibilities and share resources and risks to achieve common objectives that deliver benefits in a sustainable manner" (World Organisation for Animal Health, 2019b). The Performance of veterinary services (PVS) Pathway, a flagship program proposed by the World Organisation for Animal Health (OIE) for evaluating and advising on policies and strategies to strengthen national veterinary services (as defined in the *Terrestrial Animal Health Code* (World Organisation for Animal Health, 2019d)), recognises PPPs as a potential tool for such strengthening (World Organisation for Animal Health, 2019a).

From the analysis of 97 initiatives implemented across the world, Galière et al. (2019) highlighted that PPPs in the veterinary domain involve a diversity of actors, mechanisms and objectives and can be grouped into 3 main clusters (Galière et al., 2019a). Cluster 1, "transactional PPP" are often initiated and financed by the public sector and the services come from private veterinarians or paraprofessionals who are contracted or given a sanitary mandate. Cluster 2, "collaborative PPP", corresponds to PPPs usually motivated by trade, exports and/or commercial interests, initiated by both the private sector, often represented by producer associations, and the public sector. Finally, Cluster 3 "transformative PPP" corresponds to PPPs focused on establishing capability and development objectives, initiated and financed by the private sector (local or international companies). Ahuja (2004), analysing the economic rationale of sector roles in the provision of animal health services, stressed the importance of a division of labour between the public and private sectors. For example, with regard to animal health services in remote areas, it encourages working through civil society organisations, and using para-professionals and community-based animal health service delivery systems (Ahuja, 2004b).

Despite many examples of PPPs implemented in the field in the veterinary domain, few studies have evaluated the initiatives in place (Poupaud et al., Under publication). Evaluation is a means to reinforce partnerships and the process of collaboration. It helps in planning, redefining strategies, taking appropriate corrective actions, ensuring trust between partners, optimizing resources and finally ensuring the effectiveness of actions (Allen, 2019; Rieker, 2011).

However, no evaluation framework of PPPs in the veterinary domain has been formulated (Poupaud et al., Under publication). The evaluation frameworks in Public Health highlight the importance of evaluating the PPP process and not only its outcomes, by analysing the quality of the mechanism and functioning of PPP. Analysis of these evaluation frameworks has identified the important steps in evaluating the PPP process: analysing the PPP objective(s), the governance process, the planning process and the collaboration process between partners (Poupaud et al., Under publication).

For example, they emphasized the need for partners to understand their respective motivations and objectives (National Academies of Sciences, 2016). The quality of PPP outcomes will depend on the quality of its organization. Hence, the evaluation of the PPP process is crucial to providing recommendations on how to improve the PPP's outcomes. Evaluation of animal health programs does not usually include an analysis of the process. To our knowledge, the only two existing tools focusing on the process are specific to surveillance programs. The Oasis tool assesses the functional parts of a surveillance system (Hendrikx et al., 2011) and the One Health matrix assesses the multi-sectorial collaboration in One Health surveillance programs (Bordier et al., 2019). The Oasis tool model has been used to evaluate many surveillance systems and has demonstrated its ease of use.

The PPP process evaluation frameworks in Public Health provide a robust basis, but need to be adapted to the veterinary domain by including specific key success factors and obstacles identified in PPPs in this domain, and could be expanded towards a more integrated approach.

PPPs represent a means to achieve objectives and can be transitional; they need to be adapted to their own context and they cannot be reduced to “a formula” to be applied and followed (National Academies of Sciences, 2016). This is why we argue that PPP evaluation should mobilize an evaluative research approach that seeks to understand the how and why of the results, rather than a normative evaluation approach that seeks to compare the components of the intervention to standards (Champagne et al., 2011a). There is general agreement in the literature that PPPs need to present collaborative advantages; that is, they should represent an added value compared to a program that does not involve PPPs (Poupaud et al., Under publication). However, it is not easy to measure the benefits of collaboration. It is recognised that the best way to do so is to engage in deliberation among partners about this potential added value, using participatory approaches (Bryson et al., 2015). Furthermore, participatory approaches to evaluation have proven very useful in ensuring the adaptability and acceptability of the evaluation outputs, facilitating the implementation of corrective actions to improve process quality (Calba et al., 2016, 2015a). To the best of our knowledge, no tool has yet been developed to allow a participatory evaluation of the quality of the PPP process in the veterinary domain.

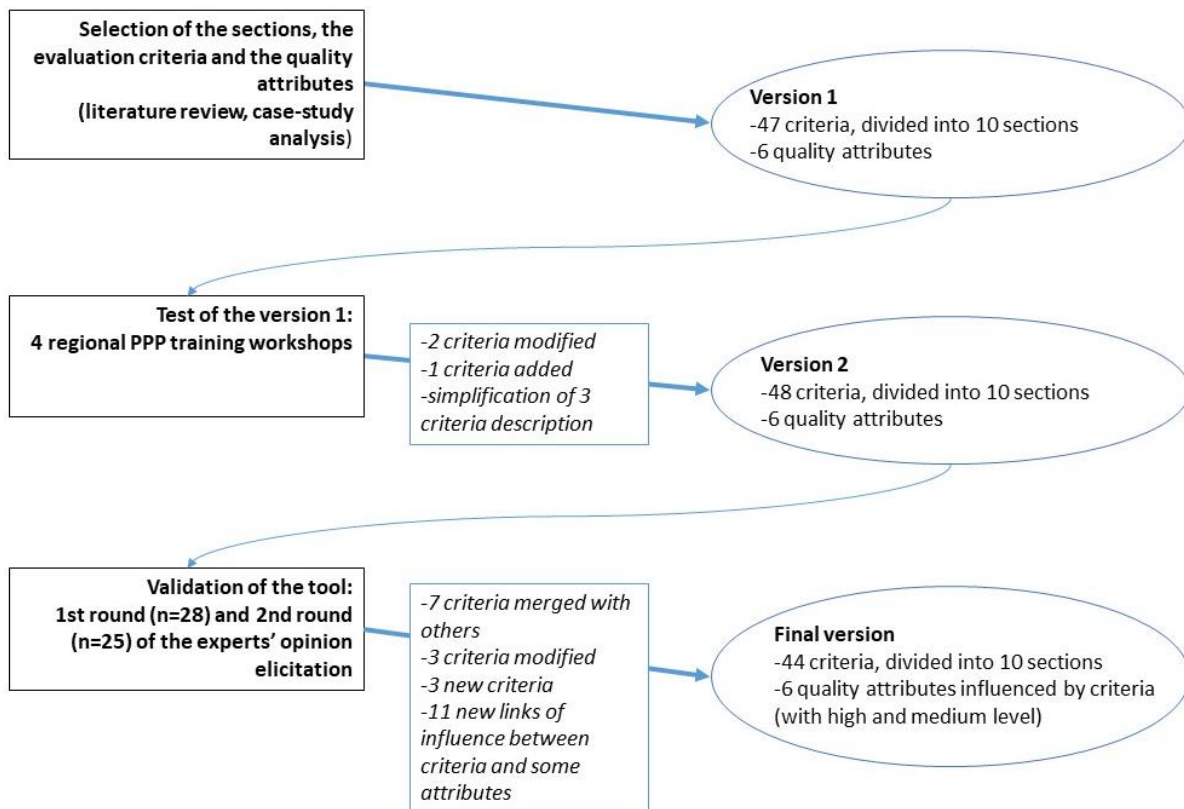
The aim of this study is to create a participatory tool that focuses on the PPP process in the veterinary domain. The intended tool would help in formulating recommendations to strengthen the collaborative process and thus improve the outcomes. In an ex-ante perspective, this tool would also help to anticipate a collaborative process.

## 2. Material and methods

### 2.1 Tool organisation and development

The tool was developed on the basis of existing tools – such as the Oasis tool which aims to evaluate the quality of the animal health surveillance system process (Hendrikx et al., 2011) and Survtool (Peyre et al., 2019) which assesses the strengths of collaborations within One Health surveillance systems. The tool is comprised of sections, representing PPP process organisation and activities. Each PPP process section is assessed using a set of evaluation criteria, each evaluation criterion being scored on a four grades scale from 0 to 3. The influence of the PPP process on its performance is assessed using quality attributes.

The PPP process sections, evaluation criteria to assess each PPP process section and the quality attributes which represent overall PPP performance were defined according to the literature review and PPP case-study analysis. The first version of the tool was tested during 4 regional PPP training workshops organised by the OIE in Africa and Asia, and the tool was amended based on user feedback. The revised version (version 2) of the tool was validated through an experts' elicitation process (**Figure 1**).



**Figure 1. The process of the tool development.** The different steps of this study captured the viewpoints of public and private partners, catalyzers and actors impacted by the public-private partnerships. *PPP: public-private partnership.*

In parallel, a checklist was created to support the collection of useful information to be used for the scoring of the evaluation criteria, together with a scoring guide to help the evaluators correctly understand the evaluation criteria and facilitate the scoring process. Finally, a spreadsheet was developed to integrate the evaluation criteria scores and automatically process calculation of the PPP process sections and quality attributes (Hendrikx et al., 2011).

## **2.2 Literature review and case study analysis to define the sections of the public-private partnership process, evaluation criteria and quality attributes**

The sections of the PPP process and evaluation criteria, identified in a scoping review that analysed the existing evaluation frameworks of PPPs in the veterinary domain and public health, were used to construct the first version of the tool (Poupaud et al., Under publication). In addition, the OIE PPP Handbook of best practices, co-constructed with actors involved in PPPs or catalysers of PPPs (individuals or organisations whose activities support or enable the implementation of PPPs), was used to identify the PPP process sections of the tool (World Organisation for Animal Health, 2019b). Evaluation criteria used in the Oasis tool and One Health matrix to evaluate the process of surveillance programs were also analysed to identify additional evaluation criteria to include in the PPP tool (Bordier et al., 2019; Hendrikx et al., 2011). Indeed, as for PPP, surveillance systems are a collaboration of multiple actors from different sectors and with different perspectives.

Finally, in order to select the quality attributes of the PPP performance, the attributes from the One Health matrix were compared to the theoretical framework developed by Bryson and collaborators (2015) on cross-sectoral collaboration that includes public-private partnerships in the Public Affair domain .

The evaluation criteria were also defined using the results of a PPP evaluation case study performed within the framework of the OIE PPP initiative (World Organisation for Animal Health, 2016). This case study addressed a long-term public-private partnership in the veterinary domain, between a poultry producing company and the Ethiopian Ministry of Livestock and Fisheries, aiming at developing the poultry sector in Ethiopia (Poupaud et al., 2019). This evaluation case study was conducted with the participation of the different categories of actors involved, i.e. public and private actors from national and local levels. Semi-structured individual interviews (n=33) addressed the topics of the context of implementation, organisation and process of the PPP, the strengths and weaknesses of the system, the actors involved, the missing actors, and the prospects for improvement. In addition, two participatory workshops were held with the different stakeholders to validate the results obtained, compare the different viewpoints of stakeholders and co-develop improvement scenarii (n=26 and 53). Every discussion that took place during the workshops or individual semi-structured interviews was recorded and transcribed.

The transcripts were read, and categories emerged from the reading, corresponding to the functional process of the PPP (such as type of private partner, type of public partners, training organization etc). During a second reading of the transcripts, the qualitative data were classified into these categories in a spreadsheet file. Actors' narratives were used to identify which evaluation criteria selected from the literature were applicable to this case study and which evaluation criteria were missing.

### **2.3 Public-private partnership regional training workshops to test version 1 of the tool**

Version 1 of the tool was tested and improved during four regional training workshops on PPPs organized by OIE. One workshop was held in Ethiopia for English-speaking African countries, another in Tunisia for French-speaking African countries, another in Nepal for South Asian countries and the last one in Thailand for South-East Asian countries. The four workshops involved around 200 public and private stakeholders who were engaged in PPPs or who were planning to set up a PPP initiative. Participants were from national veterinary services, producer associations, private veterinary workforce associations, private industry (meat, dairy or veterinary products) and non-governmental organizations. The tool was tested by groups of 5 to 10 people, mixed between public and private sectors, during a one-hour session. Participants were asked while implementing the tool to review the relevance of the evaluation criteria used, the clarity of evaluation criteria description, to identify any missing evaluation criteria, to comment on the usefulness of the tool, and how easy it was to use. Participants' feedback was collected and analysed to produce Version 2 of the tool and a revised list of evaluation criteria and associated definitions.

### **2.4 Experts' elicitation process to validate the tool (version 2)**

The tool was validated by experts' elicitation in a two-round process, consisting of two online-questionnaires developed with the SurveyMonkey® tool that experts have to fill in. The aims of this experts' elicitation process were: 1) to validate the evaluation criteria (relevance, definition, exhaustiveness) used to assess the strengths and weaknesses of each section of the PPP process and 2) to validate the influence of each criterion on quality attributes of the PPP performance. The first questionnaire was sent on the 15<sup>th</sup> of September 2020 to 37 experts, and closed on the 1<sup>st</sup> of October; 27 experts responded to it with a mean time of 43 minutes (from 21 min to 2 hours and 25min). The 27 experts were private partners (e.g. private companies, private veterinarians or veterinary associations, producer organizations) (n=8), public partners from the official veterinary services (n=3) and catalysers from international organizations such as OIE, Food and Agriculture Organization of the United Nations (FAO), and the International Fund for Agricultural Development (IFAD) (n=16). The experts had been involved in PPPs or supporting PPPs for less than 2 years (n=6), from 2 to 5 years (n=7), from 5 to 10 years (n=9), or for more than 10 years (n=6).

The results were analysed and any discrepancies between experts were reviewed during a second round. The second questionnaire was sent to the same 27 experts on the 28<sup>th</sup> of October and closed on the 13<sup>th</sup> of November; 25 experts (two experts from the catalysers did not answer during the second round) responded with a mean time of 24 minutes.

The questionnaires from the two rounds included four main parts: (i) background information on the experts, (ii) review of the PPP process sections and evaluation criteria, (iii) review of the quality attributes, and (iv) review of the influence of the evaluation criteria on the quality attributes. The two questionnaires were tested through one pilot interview each. In parts 2 and 3, the experts were asked to review the relevance of the evaluation criteria (yes/no) and if they could identify missing ones. In part 4, the experts had to review the level of influence (no influence/ low level/ medium level/high level of influence) of the evaluation criteria on the quality attributes and to provide the level of confidence in their answers (0= not confident; 0.5 = quite confident; 1 = very confident). Experts' answers were then uploaded into a spreadsheet, a descriptive quantitative analysis was conducted for each answer, open comments and justifications about their selection of evaluation criteria and attributes were analysed.

The evaluation criteria and the quality attributes were validated if 85% or more of the experts considered them to be relevant. Experts' comments were used to improve or clarify the evaluation criteria definitions. The evaluation criteria not validated according to this threshold, were revised based on experts' comments and included in the second round. The percentage of experts who selected each levels of influence of the evaluation criteria on the quality attributes (high, medium, low, no influence) were weighted according to the level of confidence of the expert in their answers (**Table 1**).

**Table 1. Calculation of the weighted percentage of experts used for the analysis of the experts' elicitation.** The weights represent the level of confidence of the experts in their answers. This calculation was used to validate the level of influence of evaluation criteria on the six quality attributes.

Level of influence of an evaluation criterion on a quality attributes	Percentage of experts	Weight = level of confidence (from 0 to 1)	Weighted percentage of experts
High	a1	w1	$= a1*w1 / \sum ai*wi$
Medium	a2	w2	$= a2*w2 / \sum ai*wi$
Low	a3	w3	$= a3*w3 / \sum ai*wi$
No influence	a4	w4	$= a4*w4 / \sum ai*wi$

The level of influence was validated when the agreement between experts reached more than 50% of the weighted percentage. If not, they were included in the second round. If no agreement was reached after the second round, the intermediary level of influence was selected.

## **2.5 Field testing of the tool in Paraguay**

The tool was implemented in a PPP in Paraguay for the control of foot-and-mouth disease (FMD). The tool was implemented through an external actor who is part of the research team, with groups of 3 to 7 people who were public and private partners. This was done at national level (n=3) with actors in charge of the national program and at local level, in two different localities (n=5 and n=7), with actors in charge of the program implementation in their localities. For each evaluation criterion, the actors had to agree on a grade. If they did not agree, they were asked to explain why they selected such a grade. They were then asked to find a consensus (e.g., a score of 1 if some had initially put 0 and the other 2). Each discussion lasted between 1 and 2 hours and was recorded and transcribed.

## **2.6 Ethics statement**

This study does not concern human health and medical research or animal research, hence, no ethics committee was consulted for study approval.

For the case-study in Ethiopia, the approval to implement the participatory study was obtained from the managing director of the private poultry producing company and, the delegate of the OIE in Ethiopia, who is also the Chief Veterinary Officer at the Ministry of Agriculture. The semi-structured interviews and the workshops were carried out after presenting the study objectives and obtaining verbal informed consent from all volunteer participants. The results obtained from this evaluation case-study were presented and validated by the volunteer participants of the second workshop.

For the PPP regional training workshops, the workshops in the four regions were organised in collaboration with the respective regional representation of the OIE (of Africa for the workshops organized in Tunisia and Ethiopia, and of Asia and the Pacific for the workshops organized in Thailand and Nepal), and a permission was asked from each OIE Delegate, often also the Chief Veterinary Officer, of the involved country. In each workshop, when implementing the first version of the tool, explanation were given on the goal of this exercise to the volunteer participants.

For the experts elicitation, a first email was sent to 45 pre-selected experts (from the private sector, the public sector and catalyser groups), based on personal contacts of CIRAD and OIE, mentioning the goal of the study and asking if they were interested in participating. The first questionnaires was sent only to those who mentioned their interest (n=37), and the second questionnaire only to those who answered to the first questionnaire (n=27). Feedback from the analysis of the answers given to the two questionnaires was sent to all 27 experts.

For the field testing in Paraguay, the approval to implement the participatory evaluation of the PPP was obtained from the regional representative of the OIE of the Americas, the Delegate of the OIE of Paraguay, the Chief Officer of the veterinary services in Paraguay and the director of the private foundation of the bovine producers. The implementation of the evaluation tool was carried out after presenting the study objectives and obtaining verbal informed consent from all volunteer participants.

No personal information about volunteer participants was requested in any of the studies (Ethiopian case-study, PPP regional training workshops, experts' elicitation and the field testing in Paraguay), the privacy rights of participants were fully protected, and all data were anonymized. Any of the studies included minors.

### **3. Results**

#### **3.1 Public-private partnership process evaluation tool organisation**

The final version of the tool is composed of 10 sections of the PPP process, representing the organisational process of a PPP and its activities, 44 evaluation criteria and 6 quality attributes, assessing the influence of the public-private partnership process on its performance (**Table 2 and 3**).



**Table 2. Presentation of the tool validated by the experts' elicitation: 10 sections of the public-private partnership process, 44 evaluation criteria, and 6 quality attributes.**

*The sections represent the public-private partnership process organization and activities. Each section is composed of a set of evaluation criteria. The six quality attributes assess the influence of the public-private partnership process on its performance. The evaluation criteria and the quality attributes were validated if 85% or more of the experts considered them to be relevant.*

PPP: public-private partnership

PPP process sections	Evaluation criteria	Influence on the quality attributes
<b>Section 1: Objective(s) of the PPP</b>	1.1 Common objective(s)	<b>Operationality</b>
	1.2 Formalization of the common objective	<b>Stability</b>
	1.3 Position of the partners regarding this common objective	<b>Acceptability</b>
	1.4 Added value of the PPP	<b>Stability, Relevance</b>
<b>Section 2: Specific interest and benefits</b>	2.1 The specific interest of the different partners	<b>Relevance, Acceptability</b>
	2.2 Allocation of benefits and other outputs (ownership)	<b>Relevance, Acceptability, Inclusiveness</b>
	2.3 Achievement of goal(s) of the veterinary services	<b>Relevance</b>
	2.4 Achievement of goal(s) of the private sector	<b>Relevance</b>
<b>Section 3: Risks and constraints</b>	3.1 Risks and constraints of getting involved in the PPP	<b>Stability, Adaptability</b>
	3.2 Allocation of the constraints	<b>Acceptability, Inclusiveness</b>
	3.3 Change of practices	<b>Operationality, Adaptability</b>
	3.4 Negative cost to the society	<b>Stability, Relevance</b>
	3.5 Conflicts of interest	<b>Stability, Acceptability</b>
<b>Section 4: Analysis of the context and external factors</b>	4.1 Relevance of common objective and of the strategy regarding the context	<b>Relevance</b>
	4.2 International, regional, national, and local laws	<b>Operationality</b>
	4.3 Potential threats of the PPP and mitigation	<b>Stability, Operationality</b>
	4.4 Organisation of private and public sectors	<b>Stability, Operationality</b>
	4.5 Analyses of pre-existing PPPs	<b>Relevance</b>

<b>PPP process sections</b>	<b>Evaluation criteria</b>	<b>Influence on the quality attributes</b>
<b>Section 5: Governance of the PPP</b>	5.1 Formalization of the PPP	<b>Stability, Acceptability</b>
	5.2 Knowledge of the terms of the partnership (contract) and endorsement by all the partners	<b>Stability, Acceptability</b>
	5.3 Shared decision making process	<b>Acceptability, Adaptability, Inclusiveness</b>
	5.4 Opportunities of private parties' involvement	<b>Adaptability, Inclusiveness</b>
	5.5 Funding and human resource availability	<b>Stability, Operationality</b>
	5.6 Funding and human resource allocation	<b>Acceptability</b>
	5.7 Adequacy with the veterinary services mandate	<b>Relevance</b>
<b>Section 6: Planning and responsibilities of the PPP</b>	6.1 Division of roles and responsibilities	<b>Operationality, Acceptability</b>
	6.2 Potential other partners	<b>Stability, Adaptability, Inclusiveness</b>
	6.3 Inclusion of vulnerable group	<b>Adaptability, Inclusiveness</b>
	6.4 Defined duration	<b>Stability, Operationality</b>
	6.5 Modalities of implementation of the PPP activities	<b>Stability, Adaptability</b>
	6.6 Joint work plan	<b>Operationality, Adaptability</b>
<b>Section 7: Competencies and trainings</b>	7.1 Confidence in other partners' competencies and satisfaction of partners about their own competencies	<b>Acceptability, Inclusiveness</b>
	7.2 Organisation of training and reinforcement of capacities	<b>Operationality, Relevance, Adaptability</b>
	7.3 Accessibility and frequencies of trainings	<b>Operationality, Inclusiveness</b>
<b>Section 8: Communication and transparency of the PPP</b>	8.1 Internal communication	<b>Operationality, Acceptability, Adaptability, Inclusiveness</b>
	8.2 Agreement in resolution modalities in case of conflict	<b>Stability</b>
	8.3 Communication with other parties, politics, and with end users	<b>Acceptability, Adaptability, Inclusiveness</b>
	8.4 Transparency	<b>Stability, Inclusiveness</b>
<b>Section 9: Collaboration in the PPP</b>	9.1 Willingness to collaborate and partners' acceptance of their own roles	<b>Acceptability, Inclusiveness</b>
	9.2 Level of involvement of partners/mobilisation	<b>Acceptability</b>
	9.3 Willingness for capacity building in PPPs (existence of a champion?)	<b>Operationality, Adaptability</b>
<b>Section 10: Monitoring and evaluation of the PPP</b>	10.1 Internal monitoring of the PPP	<b>Operationality, Stability, Adaptability</b>
	10.2 Agreed indicators for joint internal monitoring	<b>Acceptability, Adaptability</b>
	10.3 External evaluation	<b>Operationality, Acceptability, Adaptability</b>

**Table 3. The six quality attributes of the public-private partnership process and their definition.**

Those six quality attributes assess the influence of the public-private partnership process on its performance, and are influenced by different evaluation criteria. The high (score of 10) and medium (score of 5) level of influence of the evaluation criteria on the six attributes were validated during the experts' elicitation as the agreement between experts reached more than 50% of the weighted percentage of experts (see Table 1). The levels of influence that did not reach 50% of the weighted percentage of experts' consensus were between medium and high level and a score of 7,5 was given. *PPP: public-private partnership*

The six quality attributes and their definition	Evaluation criteria with a level of influence:		
	<i>high (10)</i>	<i>between medium and high (7,5)</i>	<i>medium (5)</i>
<p><b>Operationality</b> (influenced by 16 evaluation criteria) The quality attribute of operationality includes the technical aspects of the program (governance, trainings, implementation of activities) and resource management. The governance of PPP is operational, and collaboration is effectively implemented to meet the main objective. Trainings are organised to be sure that stakeholders can fit their roles. The mechanisms for resource allocation are defined. The resources are appropriate and available for the effective implementation of activities.</p>	1.1, 4.2, 4.3, 4.4, 4.5, 5.5, 6.1, 6.6 7.3, 8.1, 9.3, 10.1, 10.3 (n=13)	6.4 (n=1)	3.3, 7.2 (n=2)
<p><b>Relevance</b> (influenced by 9 evaluation criteria) PPP strategy, modalities and activities are relevant regarding the main objective. The main objective is relevant and useful regarding the context (epidemiological, institutional, environmental, societal). The PPP represents a clear added value to achieve the objective.</p>	1.4, 2.1, 2.2, 2.3, 2.4, 4.1, 5.7 (n=7)	3.4 (n=1)	7.2 (n=1)
<p><b>Acceptability</b> (influenced by 17 evaluation criteria) All relevant stakeholders demonstrate trust in the system, mutual understanding and willingness to collaborate. The objectives and outputs of the PPP meet the stakeholder's expectations. Actors are satisfied with the distribution of resources. The PPPs have societal legitimacy.</p>	1.3, 2.1, 2.2, 3.2, 3.5, 5.1, 5.2, 5.3, 5.6, 7.1, 8.1, 8.3, 9.1, 9.2, 10.2, 10.3 (n=16)	(n=0)	6.1 (n=1)
<p><b>Inclusiveness</b> (influenced by 13 evaluation criteria) Relevant actors participate in governance mechanisms. Roles in PPP are adequately allocated to actors with regard to their mandates and competencies. At the relevant level, corresponding actors and data sources are considered to meet the collaborative objective(s). PPP provide a trustworthy environment where stakeholders can freely express their views and be heard, creating mutual understanding. The vulnerable group are take into consideration.</p>	2.2, 3.2, 3.4, 5.3, 5.4, 6.3, 7.1, 7.3, 8.1, 8.3, 8.4, 9.1. (n=12)	(n=0)	6.2 (n=1)
<p><b>Adaptability</b> (influenced by 15 evaluation criteria) PPP can adapt and evolve upon changes in governance modalities, knowledge and context in order to best suit the changing environment. PPP should be flexible to resist over time. PPP activities should be flexible to meet the partners' expectations. The</p>	5.3, 5.4, 6.5, 6.6, 7.2, 8.1, 8.3, 9.3, 10.1, 10.2, 10.3 (n=11)	3.1, 3.3, 6.3 (n=3)	6.2 (n=1)

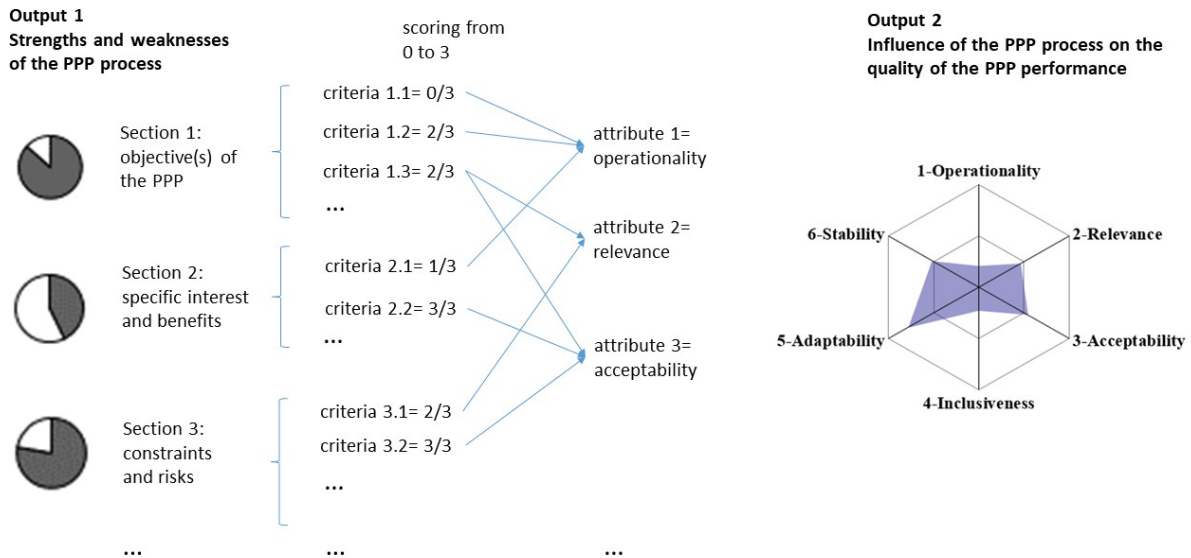
decision-making process should allow for changes within the PPP to enable improvement of the process if deemed necessary.

**Stability** (influenced by 16 evaluation criteria)

PPP is stable in the time defined by the stakeholders. This means that the PPP is strong enough to withstand external threats, such as changing environment, and continue to operate during the defined duration. The formalisation and endorsement of the agreement satisfied all relevant stakeholders.

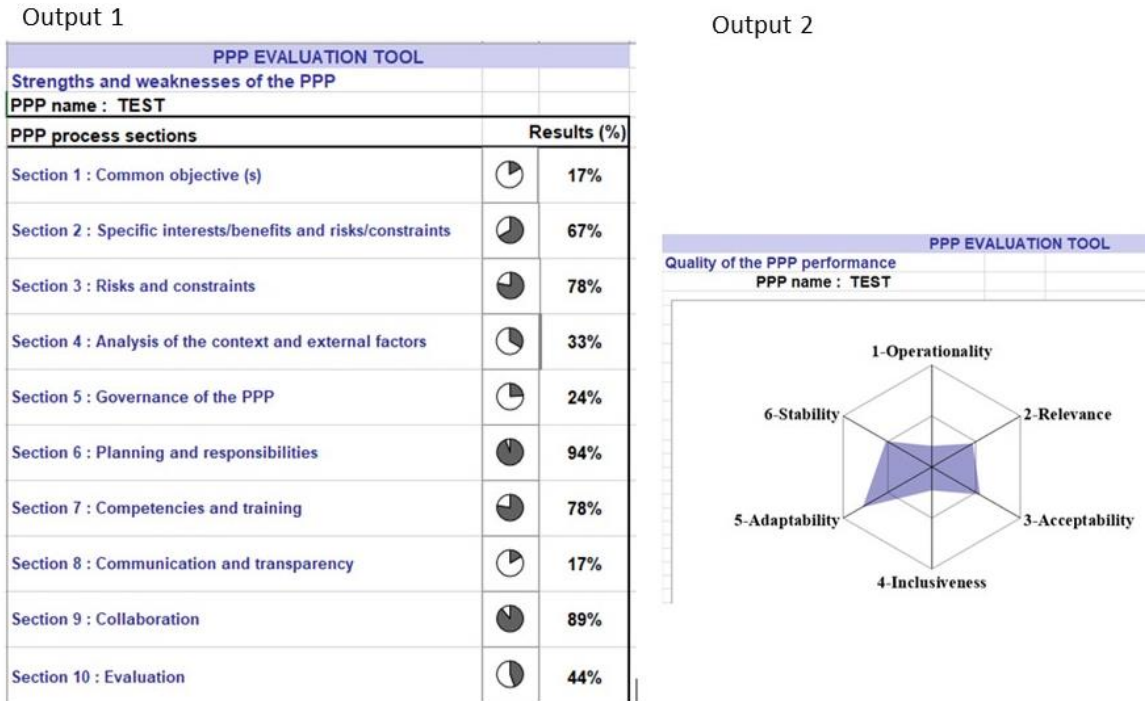
1.2, 1.4, 3.1, (n=0) 6.2, 6.4  
 3.4, 3.5, 4.3, (n=2)  
 4.4, 5.1, 5.2,  
 5.5, 6.5, 8.2,  
 8.4, 10.1  
 (n=14)

The scoring guide is presented in **Appendix 1**. Four grades were defined for each evaluation criterion: grade 3 indicates that partners are fully satisfied with the criteria, while grade 0 indicates a total absence of satisfaction and ‘not applicable’ indicates that this criterion is not relevant to the PPP considered. Like the Oasis tool, the spreadsheet comprises three sheets. The grade of the 44 evaluation criteria, once selected, should be captured in the first spreadsheet. The second sheet displays the graphic output 1, a set of pie charts which represent the result of the scores obtained by all the evaluation criteria for each of the corresponding PPP process sections (**Figures 2 and 3**). Graphic output 1 is considered as a general view of the structure of the PPP process, helping to identify its strengths and weaknesses easily. The third sheet presents the graphic output 2, a spider chart which is the assessment of the six quality attributes. Graphic output 2 represents the influence of the process on the quality of the PPP performance. The result of each quality attribute is the result of the combination of the score of each corresponding evaluation criterion (**Figures 2 and 3**).



**Figure 2. Principle of the scoring process used in the tool, allowing two graphic outputs.** The graphic output 1 (the strengths and weaknesses of the structure of the process) represents the assessment of the ten sections using a set of evaluation criteria. The graphic output 2 (the influence of the process on the quality of the public-private partnership performance) represent the assessment of the six quality

attributes, influenced by evaluation criteria. The scores of the evaluation criteria have been randomly assigned. PPP : public-private partnership.



**Figure 3. The two graphic outputs of the evaluation tool for the public-private partnership process.** Graphic output 1 is a set of pie charts (the assessment of the sections), making it easy to identify the strengths and weaknesses of the process. Graphic output 2 is a spider chart (the assessment of the quality attributes), representing the influence of the process on the quality of the public-private partnership performance. The scores of the evaluation criteria have been randomly assigned.

### 3.2 Selection of public-private partnership process sections, evaluation criteria and quality attributes

Ten PPP process sections, and 47 evaluation criteria were retrieved from the literature analysis.

Two additional evaluation criteria were identified from the Ethiopian case study. The veterinary services in Ethiopia have limited numbers of veterinarians specialized in poultry production and many farmers reported having limited knowledge about poultry management.

- “We have general veterinarians; we don’t have poultry veterinarians who have good background in poultry. We have few but it’s not enough.” (interview, poultry production director of the public veterinary service)

This lack of capacity may limit the involvement of some actors in this PPP on poultry production, and an evaluation criterion “confidence in other partners’ competencies and satisfaction of partners about their own competencies” was added.

The smallholder farmers mentioned their fear of losing their local poultry breed, explaining why some of them are reluctant to get involved in this program involving an improved chicken breed.

- “There is no consideration in preserving the local genotypes” (interview, Ethiopian farmer)
- “[...] smallholders have preference for the local breeds based on their culture. They are used for adoration of ancestors, or for ceremony to solve disputes. [...]” (interview, social scientist in International Livestock Research Institute in Ethiopia)

Also, the private poultry producers not involved in the PPP were afraid of losing the production market. They do not allow the private actors of the PPP to access the poultry association.

An evaluation criterion “negative cost to the society” was added. This case study confirmed that it is important to consider all the potential results of the PPP, including the negative ones, which can weaken the initiative.

Six quality attributes (operationality, relevance, acceptability, inclusiveness, adaptability, and stability) were selected based on the functional attributes used in the One Health matrix (Bordier et al., 2019). Although those attributes are applied to a multi-sectoral surveillance system, they focus on a collaborative process and it appeared appropriate to employ the same vocabulary for the PPP process tool.

However, not all of them were appropriate; and to select the most relevant attributes for the PPP process, we compared them to the Bryson framework on cross-sector collaboration that includes public-private partnerships in the Public Affairs domain. This framework emphasizes that “collaborating parties should design processes, structures, and interactions in such a way that desired outcomes will be achieved”, which is implied by the **operationality** quality attribute. This framework emphasizes that partners must be sure that “there is a clear collaborative advantage to be gained by collaborating”, which is tackled in the quality attribute **relevance**. This framework recommends “use inclusive processes to develop inclusive structures”, which relates to the quality attribute **inclusiveness**. Finally, this framework stresses the need to “view collaborations as complex, dynamic, multilevel systems” and to “adopt flexible governance structures”, in line with the **adaptability** quality attribute. The need for adaptability is also acknowledged for PPPs in health system strengthening (National Academies of Sciences, 2016). Two other attributes presented in the One Health matrix were also selected. **Stability** represents the evaluation criteria necessary to ensure the partnership lasts the time defined by the partnerships. The final quality attribute was **acceptability**, which has been recognized as an essential attribute for collaboration, as for example in a surveillance system (Calba et al., 2015b).

Version 1 of the tool was improved thanks to the stakeholders' feedback from the PPP training workshops organized by OIE. Stakeholders pointed out that the evaluation criterion "achievement of goal(s) of the Veterinary Service" should be supplemented by another evaluation criterion on the goal(s) of the private service. They advised joint consideration of the funding and human resources, which constitute complementary inputs. Two evaluation criteria were then modified to "funding and human resource availability" and "funding and human resource allocation". They asked for clarification/simplification of some words, for example the term "externalities" which was revised to "cost to the society". They expressed the need for a self-assessment tool for implementation of the PPP field. The stakeholders perceived the tool as useful both to assess the quality of existing PPPs but also to assist them in planning new PPPs.

### **3.3 Validation of the tool through the experts' elicitation process**

In the first round of experts' elicitation, 45 out of the initial 48 evaluation criteria were validated. It was underlined that, even if relevant, the evaluation criteria may not be appropriate for all PPPs:

- "an early collaborative PPP in a country with little PPP uptake may be enabled by the absence of a degree of formality that would put off potential partners" (comment from a public expert during the 1<sup>st</sup> round of the experts' elicitation)

Only 3 out of the 48 evaluation criteria were not considered as relevant by the experts: "shared decision making", "potential other partners" and "modalities of implementation of the PPP activities". Modifications and/or clarifications of those evaluation criteria were proposed based on the analysis of the experts' comments and included in the second round. Seven evaluation criteria were merged with other evaluation criteria based on the expert's comments. Two new evaluation criteria were proposed and included in the second round ("joint work plan", "conflict of interest").

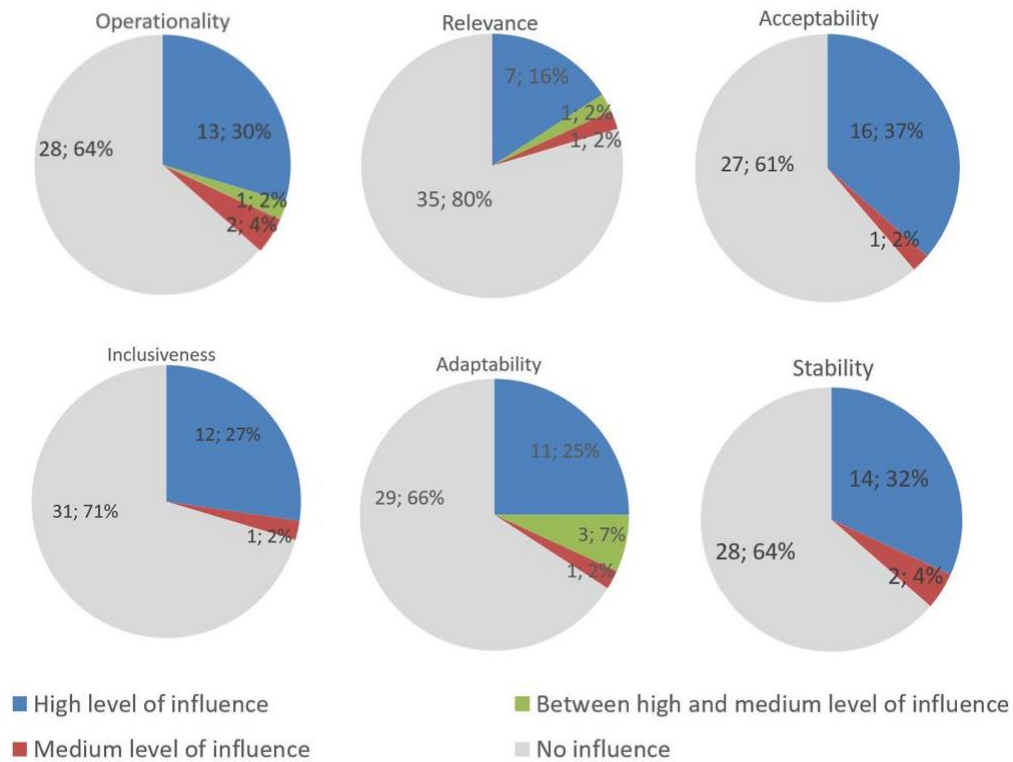
The six quality attributes were validated. Some of the levels of influence of evaluation criteria (which can influence more than one quality attribute) on the six quality attributes were validated (12/15 for operationality attribute, 6/8 for relevance attribute, 15/17 for acceptability attribute, 11/12 for inclusiveness, 7/8 for adaptability attribute and 14/16 for stability attribute). The levels of influence not validated were included in the second round. The experts also suggested adding some influence links between evaluation criteria and certain quality attributes; these proposals were also included in the second round (11 new influence links).

All the modifications and clarifications of the evaluation criteria (3/3) were validated in the second round. Three experts still mentioned that the evaluation criterion "shared decision-making process" was not relevant:

- “how can we say that all decisions must be made in consultation with all PPP partners? Which level of decisions? Collaboration is time-consuming and costly and should be used when necessary, but not for all decisions” (comment from a catalyser expert during the 2<sup>nd</sup> round of the experts’ elicitation).

The two new evaluation criteria were validated. Commenting on the question on the evaluation criterion “conflict of interest”, one expert expressed concern that the tool may not pay sufficient attention to issues related to corruption, favoritism, unfair competition, consideration of the common good and the best interests of the population, as these risks could involve either private or public sector actors. A new evaluation criterion, “analysis of pre-existing PPP” was proposed during the second round and was included in the tool after validation by 4 members of the research team.

Almost all levels of influence of the evaluation criteria on the quality attributes were validated (15/19). The levels of influence that did not reach consensus were all between medium (score of 5) and high level (score of 10), therefore an arbitrary intermediate score was given to them (score of 7.5) (**Figure 4.**).



**Figure 4. Each of the six quality attributes are influenced by some evaluation criteria.** The level of influence of those evaluation criteria can be high (pie chart area in blue), between medium and high (pie chart area in green), medium (pie chart area in red). Some evaluation criteria do not influence the quality attribute (pie chart area in grey). The number and percentage of evaluation criteria per level of influence that influence each of the quality attributes are entered in the corresponding pie chart area.



Overall, 41 evaluation criteria were considered to highly influence at least one quality attribute; only 3 evaluation criteria influence the quality attributes with a medium or intermediary level only (3.3 “change of practices”, 6.2 “potential other partners”, 6.5 “modalities of implementation of the PPP activities”) and none were considered not to influence the quality of the PPP performance at all (Table 3). The high level of influence of the evaluation criteria “change of practices” on the attribute “operationality” was selected by only 25% of the catalyser experts and 33% of the public partners, whereas it was selected by 50% of the private partners, and a medium level of influence was attributed.

### **3.4 Application of the tool on a public-private partnership in Paraguay for the control of the foot-and-mouth disease.**

This PPP has existed since 2003 between the public veterinary services and a private foundation created by bovine producers. The private sector is a foundation recognized by a decree of the executive power and is responsible for coordinating and vaccinating the 15 million head of cattle. All these activities are supervised by the veterinary services.

The PPP has evolved over the years, in terms of the partners involved and the type of governance. This PPP allowed Paraguay to obtain the status *FMD free with use of vaccination* from OIE. Paraguayan stakeholders, who have long experience of being involved in this PPP, found this tool comprehensive and the questions easy to understand. They acknowledged that, by implementing the tool, the group involved in the assessment process was able to address all the activities of the PPP.

It also raised important points, such as the future of this collaboration if vaccination stops (through the evaluation criteria 7.1 “Confidence in other partners’ competencies and satisfaction of partners about their own competencies”, 9.1 “Willingness to collaborate and partners’ acceptance of their own roles”, and 9.3 “Willingness for capacity building in PPPs”). Evaluation criterion 8.2 “agreement in resolution modalities in case of conflict between partners” had not been raised and the partners felt it was important to include it in their legal agreement. They revealed that the PPP represented a means to achieve their goal in a complex institutional environment (through evaluation criterion 4.2 “International, regional, national and local laws” and 4.3 “Potential threats of the PPP and mitigation”).

The public partners of the veterinary services were afraid of losing influence by letting a private foundation take care of the vaccination campaign (this was captured in evaluation criterion 3.1 “Risks and constraints of getting involved in the PPP” and 5.7 “Adequacy with the veterinary services mandate”). Meanwhile, the private foundation feared its status might be erased in case of a change of political regime (evaluation criterion 3.1 “Risks and constraints of getting involved in the PPP”). Therefore, they reconsidered the status of the foundation, clarifying its roles and its range of action at the legislative level (this was captured in evaluation criterion 5.1 “Formalization of the PPP”).

The PPP implemented for FDM vaccination enabled trainings for technicians at local level, resulting in an extension of the stakeholder network for the animal health value chain (captured in evaluation criterion 7.2 “Organisation of trainings and reinforcement of capacities” and 7.3 “Accessibility and frequency of trainings”). This network has, for example, led to reporting cases of bovine rabies in a village with rapid feedback of the information to veterinary services at the national level. The services provided by the PPP therefore exceed the initial objective of vaccination against FMD by reinforcing the veterinary services, and the tool was able to capture this element.

## **4. Discussion**

This study presents the development of a tool to evaluate the PPP process through the participation of relevant actors directly or indirectly involved in PPPs in the veterinary domain worldwide. To our knowledge this work is original and provides an assessment of the quality of the PPP process in the veterinary domain, addressing the question: "how, why and under which conditions does the PPP work?". This tool can help to evaluate and improve an ongoing PPP initiative but also to plan a new PPP under development. The tool can be used in an *ex ante* evaluation- during the PPP design phase, to help raise collective awareness of the challenges of PPP collaborations and to promote a more coordinated approach to collective actions (Allen et al., 2014). The tool can also be used *in itinere*, when an initiative is already implemented, to promote partners' communication, good collaboration and to strengthen the PPP. The tool is freely accessible and placed under creative commons licence.

### **4.1 Enabling dialogue between public-private partnership partners**

The tool was developed in the same format as the Oasis tool, which demonstrated its ease of use, an important aspect to ensure its implementation in the field (Peyre et al., 2011). This format can also be compared to the Rubric tool, an easy-to-use tool for collaborative performance assessment (Oakden, 2013). The Rubric tool is constructed with the same two key components: a list of evaluation criteria and gradations of the quality of those evaluation criteria by people involved in the collaboration (Oakden, 2013). It was initially employed in educational sciences but has also demonstrated its effectiveness in other fields such as pest management (Allen et al., 2014).

This specific tool format facilitates the sharing of diverse perspectives and is adaptable to varied programs (Allen et al., 2014). Like Rubric, the PPP evaluation tool developed here differs from a simple checklist, as each evaluation criterion requires gradations (from 0 to 3), involving discussion and precise justification of the expectations of the different stakeholders (Allen et al., 2018). Asking the partners from the Paraguayan PPP to justify their choice of a score for each evaluation criterion indeed implied

a process of dialogue between them, which facilitated reflection and analysis of the PPP. The use of the tool helped to clarify partner's expectations about various aspects of the PPP. This kind of tool allows stakeholders to make reliable judgements about their own work and identify room for improvement (Reddy and Andrade, 2010). The scores given to each evaluation criterion are not as important as the dialogue between stakeholders during the evaluation. This tool can be seen as a means of mediation, helping to identify points of disagreement between partners, but also to clarify stakeholders' expectations and ways of improving. These are essential aspects in PPP best practices to ensure performances and impact of collaboration (World Organisation for Animal Health, 2019b).

The tool can be used both for internal and external evaluation. A trained external evaluator expert can use this tool to evaluate any PPP process, but it is critical – as for any assessment - that the evaluation request arises from the stakeholders of the PPP themselves. The evaluator also needs to follow best evaluation practices, including objectivity and integration of multiple viewpoints (BetterEvaluation, 2012a) . This implies following a proper stakeholder mapping approach to ensure engagement with all the relevant stakeholders during the participatory interviews to capture diverse and representative viewpoints (Fusch and Ness, 2015; Saadi et al., 2021; Schmeer, 1999). Mapping may include stakeholders who will use the evaluation results directly, who will support or maintain partnerships or who will be affected by the partnership's activities or assessment results (Rieker, 2011). Stakeholder mapping is therefore a pre-requisite step before implementing the tool. To ensure objectivity in the evaluation, the external evaluator would need to ensure the involvement of the stakeholders during the scoring process, rather than simply reflecting the prevailing expert view (Oakden, 2013). This tool can also be used during an internal evaluation process by the partners involved in the PPP for self-assessment of the quality of their PPP, also ensuring the involvement of all the relevant stakeholders. This approach has the advantage of being inclusive; however, we argue that it would require either a previous training or a facilitation process for the partners by an evaluation expert to ensure proper use of the tool.

When using this tool, the evaluator should bear in mind that participatory approaches, including evaluation, cannot erase pre-existing social inequalities which may hamper the capacity of actors to express themselves freely. Genuine participation of all stakeholders may not be fully achieved, since power structures, inherent to social groups, will limit the free expression of marginalised people. Indeed these people may not be able to risk taking positions that run counter to those of power groups (Cooke, 2001). Trying to represent the diversity of viewpoints from stakeholders who influence, who are involved in or impacted by the PPP during the evaluation process is a real challenge. The use of this tool as well as participatory approaches can be a way to achieve this, but we argue that the limits of the evaluation process and results should be critically analyzed, emphasized, and expressed in a transparent manner by the evaluator. The risk of not doing so, would be to reinforce pre-existing power relations between stakeholders by only representing the dominant viewpoint (Mansuri, 2004).

## **4.2 A generic tool to evaluate the quality of the process across different public-private partnership clusters**

As mentioned before, three main clusters of PPP (transactional, collaborative and transformative) have been identified in the veterinary domain, depending on the type of private partner involved and the governance process (Galière et al., 2019a). However, some PPPs are at the crossroad between clusters. The FMD control PPP in Paraguay, for example, is a mix between transactional PPP - private veterinarians and technicians are mandated and evaluated by the Veterinary Service to carry out the vaccination - and collaborative PPP – with the strong involvement of the producer association. Even though previous work has highlighted differences in obstacles depending on the PPP clusters, e.g. - the type of governance can represent an obstacle for collaborative and transformative PPPs, while the transactional PPP obstacles are mainly linked to lack of funding and human resources. Key success factors were not associated with any particular PPP type in the veterinary domain (Galière et al., 2019a). This indicates that the critical elements of the PPP process captured in this tool are similar across the clusters, which implies that PPP process evaluation could be generic across the different PPP types (Poupaud et al., Under publication).

## **4.3 The need for flexibility in public-private partnership evaluation**

Each PPP in the veterinary domain, regardless of PPP cluster, needs to be adapted to the context; the evaluation process therefore needs to be flexible to ensure its relevance. This tool should not be used in a normative evaluation approach, and the evaluation criteria should not be seen as target objectives to be achieved.

For example, several evaluation criteria are linked to PPP formalization and naming the collaboration can increase the willing consent of partners (Koschmann et al., 2012) and support accountability (Babiak and Thibault, 2009). However, several experts mentioned that too much formalization may hamper the development of the collaboration. Depending on the PPP to be evaluated, these evaluation criteria may not be relevant. Regarding the evaluation criteria related to the planning of PPP (section 6), planning can be done as a “deliberate approach”, meaning that formal planning is carried out in advance, or as an “emergent approach”, whereby precise planning emerges over time (Bryson et al., 2015). One approach is no better than the other. Another example is the evaluation criterion linked to law and regulation (evaluation criterion 4.2): institutional and political environment as well as other external factors are important for the PPP process and can strongly influence the initiative (Bryson et al., 2015); however, in accordance with the testimonies of Paraguayan stakeholders, the external environment will not always determine collaborative action, and PPP may be a means to achieve objectives in a complex environment.

Finally, an evaluation criterion related to inclusion of vulnerable groups in the planning process (6.3), and an evaluation criterion targeting shared decision making (5.3) were included in the tool. The protocol for PPP evaluation in Public Health also has a section targeting vulnerable groups, as a crucial aspect of World Health Organization programs is to enhance equity in health and well-being (Donald A. Barr, 2007). However, one expert mentioned that inclusion is not always the most appropriate way to take decisions and that shared decision making should be used when necessary. These examples demonstrate that flexibility in the evaluation process in adapting to the specific PPP context is essential to providing useful recommendations.

The tool presents a predefined list of evaluation criteria, allowing the users to review and challenge some aspects/elements of their collaboration process that they might not have considered *a priori*. For example, after mentioning the evaluation criterion "mechanism in place in case of conflict", the Paraguayan partners discussed the possibility of creating such a mechanism. Indeed, the aim of the tool is to be as complete as possible to cover the multiple types of PPP process which exists worldwide (Galière et al., 2019a). However, some evaluation criteria may not always be relevant in all situations and the tool allows for the use of 'not applicable' to remove evaluation criteria from the scoring process. This option further enhances the flexibility of the tool and limits its normative aspect.

It is also interesting to note that in the experts' elicitation, a smaller proportion of catalyzer and public experts, compared to private experts, considered that the evaluation criterion highly influence quality attribute operationality. This may be due to the fact that private actors in the veterinary domain (such as private veterinarians, producers) are those who are impacted by the change in practices in the field, whereas the catalyzers are actors operating in international organizations, and public actors, from the veterinary services in our sample, often operate at a central level. However, this result should be interpreted with caution in the case of public actors, as only three of them participated in the experts' elicitation. For some actors not operating in the field, it may be difficult to anticipate the difficulties encountered by actors in the field in implementing the modalities decided at central level. This underlines the importance of considering multiple points of view in our methodology for the development of the tool.

#### **4.4 The need to anticipate the risks of being involved in public-private partnerships**

The OIE PPP handbook and the PPP reference guide from the World Bank both emphasize the need to compile a complete list of all risks associated with the project and to think about risk allocation (World Bank Institute, 2017; World Organisation for Animal Health, 2019b). The different steps of this study (literature review, PPP regional training workshop and experts' elicitation) confirmed that partners need to clearly identify those risks in order to be able to limit them.

The “negative cost to the society” (criterion 5.4) deals with the negative consequences of PPP, assuming that if the partners anticipate and undertake corrective action to prevent negative consequences of their partnership, the PPP will be more stable over time and its legitimacy in the eyes of society will be increased. Similarly, the Food and Agriculture Organisation guidelines to ensure good PPP practices within agricultural value chains proposes integrating the risks linked to the negative cost of a program (externalities) in the planning process to ensure sustainable value chains (Neven, 2014). The risks of potential conflicts of interest were recurrently highlighted during this study (literature review, experts’ elicitation). According to the World Bank, PPPs can represent a risk of corruption i.e. the misuse of public office for private gain (World Bank Institute, 2017). Corruption seems to be favoured when privatizing certain state-owned enterprises (Reinsberg et al., 2019). Moreover, PPPs, like any contractual relationship, can be seen as a "principal-agent" relationship in which the principal is the public partner (the public veterinary services) using the service of an agent, the private partner. This type of relationship involves differences of interest and asymmetrical information between the two contracting parties, with the practical impossibility for contracts to cover all possible cases and prevent all types of misconduct. Hence, partners having different interests are likely to develop opportunistic behaviour, taking advantage of asymmetries of information and loopholes in the contract (Maatala et al., 2017b). Therefore, for some PPPs, the contract between the two parties, the legislative environment and the governance structure will require particular attention to limit such risks. In addition, the evaluation of the PPP process needs to take into account the institutional capacity of both public and private partner. Indeed, depending on the type of PPP in the veterinary domain, unequal power relations can be expected (representing a disadvantage for the public or the private sector) that will influence the governance process. For example, it is most important that both partners are able to clearly defend their own interests without any opportunistic behaviour while having the necessary degree of information symmetry during the negotiation phase (Maatala et al., 2017b). When relevant and appropriate, PPPs should have a contract that is “clear, comprehensive” and that “creates certainty for the contracting parties” (World Bank Institute, 2017). Given the complexity and uncertainty of the environment, the contract will also require flexibility to enable changing circumstances to be dealt with (World Bank Institute, 2017) and to provide modalities for the renegotiation of contracts (Maatala et al., 2017b).

Such issues are taken into account by the evaluation tool proposed in this study and its implementation can help identify weaknesses in the PPP process that would need to be deeply analyzed. For example, experts in legal frameworks from the OIE Veterinary Legislation Support Program can deeply analyse the legal framework and the Performance of veterinary services evaluation can identify the potential weaknesses of the institution and help to prevent risks (World Organisation for Animal Health, 2020a, 2019a).

The tool helps to identify the strengths of the PPP process, as well as helping to promote partner engagement, transparency and trust, thereby limiting these risks. Regular PPP evaluations, e.g. using this tool, from the planning stage (*ex-ante* perspective), during the PPP (*in itinere*) until the end of the PPP (*ex post*), make it possible to promote good practices, improve the performance of PPPs and limit the potential risks associated.

#### **4.5 Conclusions**

The PPP process evaluation tool developed in this study represents a necessary milestone for a more comprehensive evaluation of PPPs. The tool does not replace other types of evaluation such as context analysis, economic, or impact assessment. It enables, with limited financial means, stakeholder engagement bringing out discussions that help to identify the strengths and weaknesses of the PPP process. It is also intended that this tool will serve as a basis for developing targeted support on PPP in the veterinary domain in the context of the OIE PVS Pathway. Recommendations following the implementation of this tool may include the need for further evaluation or analysis by implementing other methods, such as deeper investigation of the legal framework, or the analysis of institutional capacities. An evaluation of the impacts of the PPP may also be pertinent to define relevant indicators to monitor the progress of the initiative and motivate the partners involved, to advocate for additional resources from investors, or to ensure trust. This can be done for example with impact pathway methodology, using the theory of change (Barret et al., 2018; Douthwaite et al., 2003).

PPP in the veterinary domain are widely implemented worldwide and are often complex, dynamic, multilevel systems (Bryson et al., 2015). This PPP process evaluation tool represents a straightforward approach to provide direction or positive changes by strengthening the partnership

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## *Chapter 3. Part 2: using the tool to evaluate a PPP in Tunisia.*

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### **Summary**

In Tunisia, a public-private partnership (PPP) for controlling priority contagious animal diseases has been in place since 2006. Through this PPP, private veterinary practitioners are given a mandate by the public veterinary services to carry out vaccination campaigns on their behalf (health mandate). The Directorate General of the Tunisian Veterinary Services sent a request to the OIE and CIRAD seeking an evaluation of this PPP in order to identify possible ways of strengthening its effectiveness. In response to this request, a participatory evaluation of the PPP was carried out from January to June 2021 as part of the internship of a Master's student.

The evaluation focused on the processes of the health mandate for the control of foot and mouth disease and sheep pox. It followed the guide to evaluating PPP processes in the veterinary domain. The process evaluation was carried out at central level and in two governorates in the centre of Tunisia: Sfax and Sidi Bouzid. The selection of these regions was based on the size of the sheep and cattle herds, the number of veterinarians with a health mandate, the presence of vaccinators from the public Veterinary Services, and vaccine coverage. The stakeholders involved in the evaluation were veterinarians from the public sector and the private sector. At national level, the public-sector veterinarians were those responsible for the health mandate, and the private-sector veterinarians were from the organisation that represents the profession or the national body that regulates the profession. At regional level, the public-sector veterinarians were veterinary inspectors, and the private-sector veterinarians were those veterinarians who had been given a health mandate.

Nine individual semi-structured interviews were carried out and 6 group discussions were organised (consisting of 4 to 8 people from the same category of stakeholders). Each one lasted between 1.5 hours and 2 hours. The scoring grids of the PPP process evaluation tool were completed by each stakeholder category, and 4 evaluation grids are considered in the results (public veterinarians at central level, private veterinarians at central level, public veterinarians at regional level, private veterinarians at regional level). Initially, the scoring grids for the Sfax and Sidi Bouzid regions were to be kept separate, but given the similarity of the responses from both public and private veterinarians in the two regions, the results were combined. A score of between 0 and 3 was attributed to each criterion.

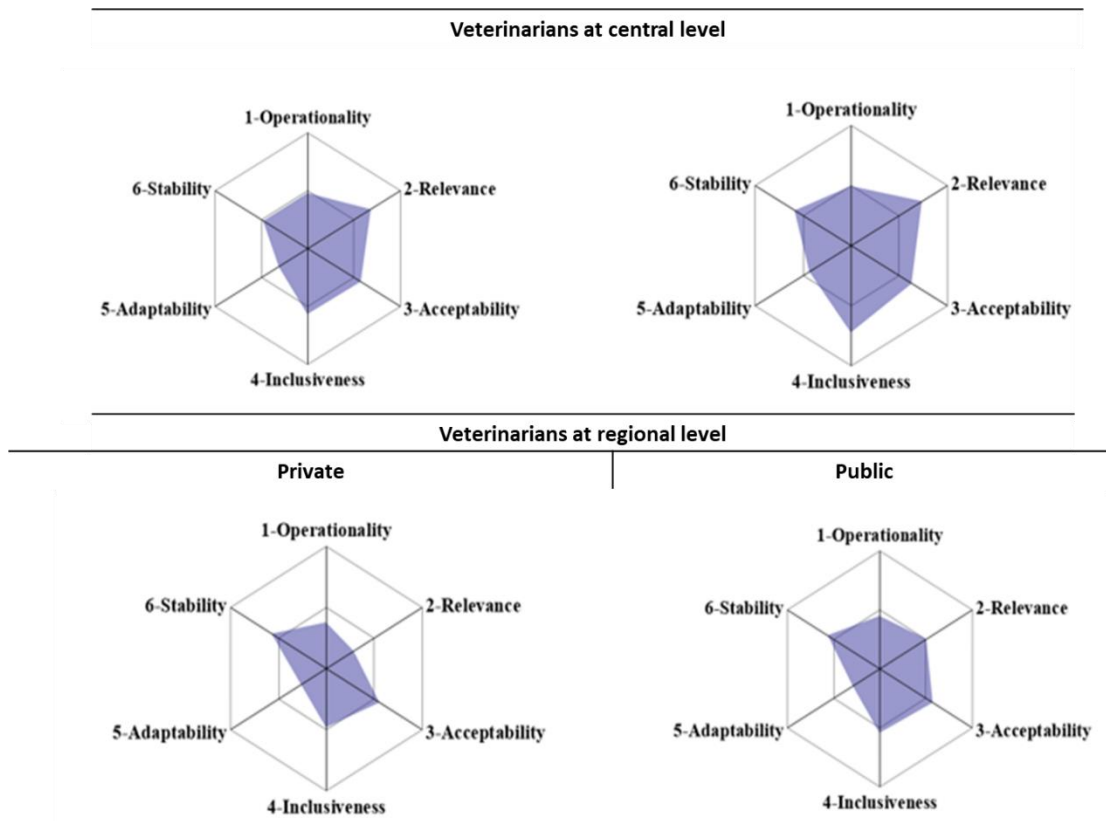
This evaluation highlighted some of the strengths and weaknesses of the PPP process. The health mandate is considered essential for implementing the strategies of public Veterinary Services. The



objectives of this mandate are well defined and correspond to the strategies of the national public Veterinary Services. It was noted that the PPP's objectives could be extended to include the control of other diseases (such as tuberculosis or peste des petits ruminants). The evaluation also showed where there was consensus among stakeholders regarding their perception of the strengths and weaknesses of the PPP process, and where there was divergence (**Figure 1**). For example, it was unanimously agreed that there was a lack of communication between health mandate stakeholders, particularly between public veterinarians and veterinarians with a mandate at regional level (section 8). Satisfaction with regards to the decision-making mechanisms of this PPP differed between regional and national stakeholders (section 5). The scoring of the criteria of the different organisational sections of the PPP also influenced the results for the quality attributes of PPP performance (**Figure 2**). Perceptions of these performance attributes are broadly similar across the different stakeholder groups, but there are differences. For example, public veterinarians have a more positive view of the inclusivity of the PPP process than private veterinarians.

PPP process sections	Veterinarians at central level				Veterinarians at regional level			
	Private		Public		Private		Public	
	Results (%)		Results (%)		Results (%)		Results (%)	
Section 1 : Common objective (s)		75%		83%		81%		79%
Section 2 : Specific interests/benefits		67%		85%		42%		67%
Section 3 : Risks and constraints		22%		61%		83%		78%
Section 4 : Analysis of the context and external factors		53%		42%		50%		54%
Section 5 : Governance of the PPP		90%		81%		79%		89%
Section 6 : Planning and responsibilities		83%		89%		83%		83%
Section 7 : Competencies and training		83%		83%		67%		67%
Section 8 : Communication and transparency		50%		67%		46%		52%
Section 9 : Collaboration		75%		78%		75%		67%
Section 10 : Evaluation		0%		0%		0%		0%

**Figure 1: Strengths and weaknesses of the health mandate process – the opinions of public and private veterinarians at central and regional level**



**Figure 2: Quality attributes of PPP performance, influenced by the PPP’s operating process, from the viewpoint of public and private veterinarians at central and regional level**

A full participatory evaluation would have included a debate on these different opinions so that recommendations for improving the process could be developed jointly. Although this was not possible, largely because of the Covid-19 epidemic, the results were nevertheless reported at central level, which involved the OIE Delegate for Tunisia. The tool helped to identify areas for improvement and to formulate recommendations. These recommendations included creating an animal health fund to provide long-term funding for the health mandate, developing a communication plan that includes inter-sectoral meetings, and increasing the training period for private veterinarians at regional level (mandated veterinarians).

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# Chapter 4

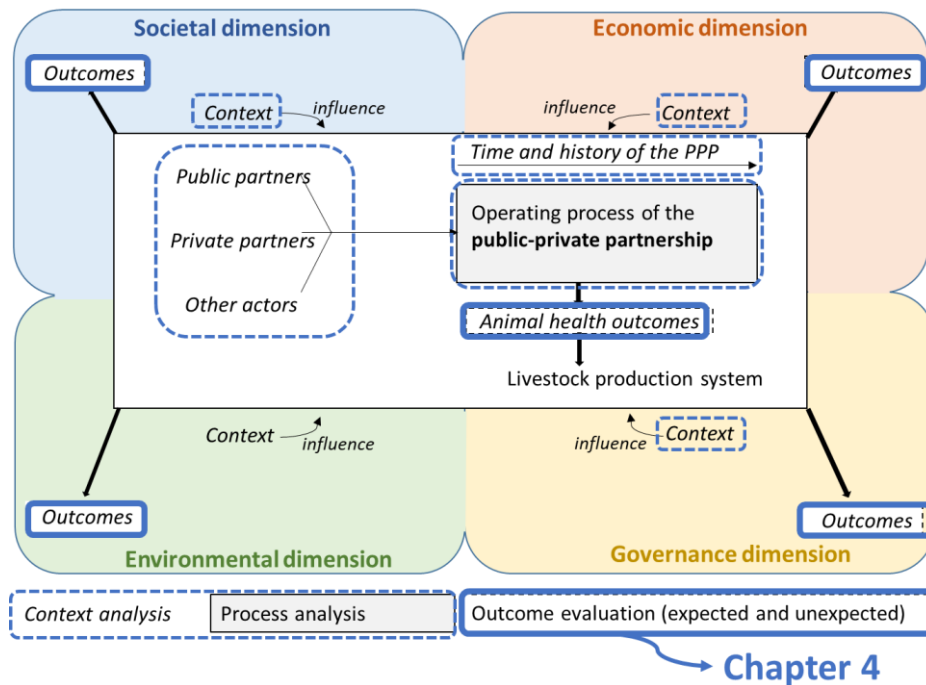
## **Chapter 4. Evaluation of PPP outcomes and impacts**

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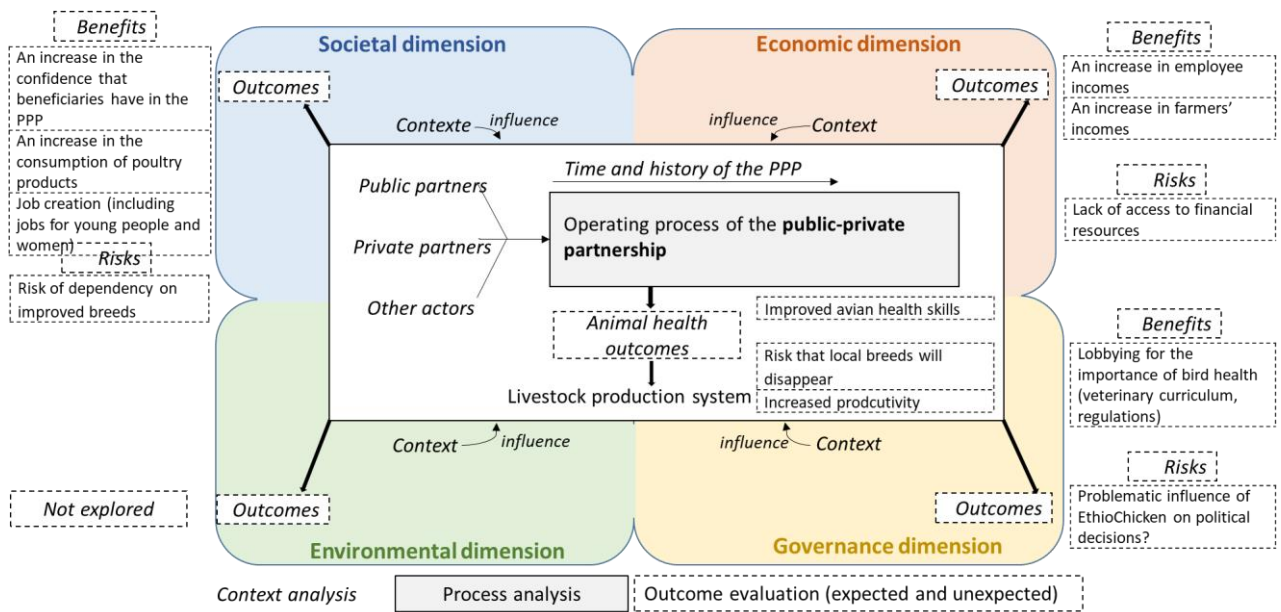
## Preamble to chapter 4

This chapter looks at PPP outcome evaluation (benefits, risks, impact) (**Figure 1**). The importance of evaluating not only health outcomes (benefits, risks and impact) but also socio-economic outcomes has been highlighted in the literature, as has the difficulty of determining a PPP’s actual contribution to outcomes. To overcome this difficulty, used the impact pathway methodology to carry out a participatory evaluation of a PPP in Ethiopia. This approach seeks to identify the connections between the PPP and its outcomes and impact. To do this, we also carried out a brief context evaluation (PPP history and stakeholder mapping) and a brief process evaluation (by identifying the inputs needed for the PPP to function and by looking at the activities of the PPP) (**Figure 1**). The process evaluation tool presented in chapter 3 was not used to collect data for this study as it had not yet been developed.



**Figure 1: Chapter 4 focuses on the outcome evaluation section of the analysis model (blue rectangles): evaluation of the of PPP’s direct and indirect outcomes. This chapter also looks at, to a lesser degree, context analysis and process analysis**

Stakeholders identified different outcomes and impacts (Figure 2) and the causal links between the outcomes and the PPP were identified. The outcomes were then characterised by measuring indicators. These indicators are just examples; outcomes and indicators should be adapted for each PPP evaluated. The indirect environmental outcomes were not mentioned by stakeholders in this case study (Figure 2). The energy and water costs of running large farms that produce day-old chicks and farms that rear chickens from 1 to 45-days old could have been explored. One outcome that was mentioned was the risk of local chicken breeds disappearing and the risk of becoming dependent on genetically improved breeds whose genetics come from large industries (Figure 2). Unfortunately, this outcome was not explored in detail in this study, but this point should be kept in mind for future evaluations and could be systematically included in risk analyses.



**Figure 2: Chapter 4 identified different risks and benefits that were measured using indicators that could serve as examples for evaluating other PPPs**

## **Title: Evaluation of public-private partnership in the veterinary domain using impact pathway methodology: in-depth case study in the poultry sector in Ethiopia**

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### **Abstract**

Public-private partnerships (PPPs) in the veterinary domain are joint approaches in which public veterinary services and private actors such as private veterinarians, producers' associations or private companies work together to address complex animal health challenges. They are implemented worldwide and can help to strengthen the capacities of veterinary services, but few have been evaluated. None of the evaluations developed in the veterinary domain explicitly addressed PPPs, their complex programme design, their evolving governance, and coordination system, and their impacts. This work represents the first application of the participatory impact pathway methodology for the evaluation of a PPP in the veterinary domain. The public-private partnership evaluated aimed at developing the poultry sector in Ethiopia and improving poultry health service coverage, particularly in remote areas. The combination of semi-structured interviews (n = 64) and collective reflection during three workshops (n participants = 26, 48, 18), captured the viewpoints of public and private partners, actors who influenced the partnership and actors impacted by it. The context of the public-private partnership was analysed and the causal relationships between the PPP and its impacts were investigated. This work showed that collaboration between the public and private sector occurred at several administrative levels. The actors considered a variety of impacts, on the economy, business, trust and health, which were then measured through different indicators. The actors also identified the added-value of the PPP to enrich those impacts. The participatory impact pathway methodology helped to strengthen the engagement of actors in the public-private partnership and to formulate recommendations at the policy level to favour positive results. This case study represents a milestone in building a participatory evaluation framework of public-private partnership in the veterinary domain.

## 1. Introduction

Public-Private Partnership (PPP) in the veterinary domain<sup>5</sup> is defined by the World Organisation for Animal Health (OIE) as “a joint approach in which the public and private sectors agree responsibilities and share resources and risks to achieve common objectives that deliver benefits in a sustainable manner” (World Organisation for Animal Health, 2020c). Through PPPs, the public veterinary services and private actors, such as private veterinarians, producers’ associations or private companies, work together to address complex animal health challenges. PPPs may represent a means of strengthening the veterinary services<sup>6</sup> and improving animal health programmes (World Organisation for Animal Health, 2019b). The establishment of effective PPPs can contribute to more efficient use of available resources or extension of veterinary health coverage, particularly in remote areas (Ahuja, 2004b; World Organisation for Animal Health, 2020c). Examples of risks of PPPs include conflict of interests, administrative burden, or lack of funding availability (Galière et al., 2019a). Galière et al. (Galière et al., 2019a), analysed 97 PPPs implemented across the world, described in detail through an online questionnaire. Three PPP clusters were identified. These clusters are largely conditioned by the type of private actor (Galière et al., 2019a). Cluster 1, ‘transactional PPPs’ are often initiated and financed by the public sector and the services come from private veterinarians or paraprofessionals who are contracted or given a sanitary mandate. Cluster 2, ‘collaborative PPPs’, corresponds to PPPs usually motivated by trade, exports and/or commercial interests. These PPP are initiated by both the private sector, often represented by producer associations, and the public sector. Finally, Cluster 3 ‘transformative PPPs’, corresponds to PPPs focused on establishing the capability to deliver otherwise unattainable major programmes. They are initiated and financed by the private sector (local or international companies) but sanctioned by, and working with, the national veterinary services (World Organisation for Animal Health, 2020c).

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<sup>5</sup> As defined in article 3.4.2 of the *Terrestrial Animal Health Code* of the OIE ([https://www.oie.int/index.php?id=169&L=0&htmfile=chapitre\\_vet\\_legislation.htm](https://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_vet_legislation.htm)): “Veterinary domain means all the activities that are directly or indirectly related to animals, their products and by-products, which help to protect, maintain and improve the health and welfare of humans, including by means of the protection of animal health and animal welfare, and food safety.”

<sup>6</sup> As defined in the glossary of *Terrestrial Animal Health Code* of the OIE “Veterinary Services means 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.”

One of the PPPs described in the article by Galière et al. (Galière et al., 2019a), belonging to the "transformative" cluster, is implemented in Ethiopia since 2010, with the aim of developing the poultry sector. This PPP represents a collaboration between a company raising day old chicks and producing feed, EthioChicken, and the public veterinary services of Ethiopia. EthioChicken raises poultry parental stock and produces genetically improved day-old-chicks (hybrid breed for meat and egg production) in Ethiopia. The day-old-chicks are then raised to 45 days old by agents. The grower agents are trained by EthioChicken, and they provide the chicks with poultry health care, such as vaccination. These 45 days old chickens are delivered to smallholder farmers via a distribution network developed through PPPs between EthioChicken and the national and regional public veterinary services, under the supervision of the Ministry of Livestock and Fisheries<sup>7</sup>. The public veterinary services also provide poultry health services at the local level (Galière et al., 2019a).

In Ethiopia, more than 22 million people, representing 20% of the total population, live below the national poverty line (Trading Economics, 2019). The Ethiopian economy is primarily based on agriculture which provides 85% employment and contributes to around 45% of Gross Domestic Product and 62% of total exports (Trading Economics, 2019). In 2018, the total poultry population was estimated to be about 57 million (Central Statistical Agency Of Federal Democratic Republic Of Ethiopia, 2021). Rural poultry production is mainly based on the traditional family poultry system with indigenous breeds which represent 78.8% of the total poultry population (Central Statistical Agency Of Federal Democratic Republic Of Ethiopia, 2021). The average consumption of poultry meat is relatively low (600gr/person/annum) compared to other African countries (average of 2kg/person/annum), which is partly due to a low poultry production in the country. Since 2006, there has been a growing demand for chicken meat in urban areas in Ethiopia due to the increase of beef and sheep meat prices (USDA Foreign agricultural service, 2017). The Ethiopian government plays a role in the development of agriculture in order to reduce the poverty and malnutrition rate. Since 2015, the Ethiopian government, through the Ethiopian Livestock Master Plan 2015-2020, aims at increasing Ethiopians' production and consumption of poultry meat and eggs by developing improved family poultry production systems and specialized layer and broiler production systems (Ministry of Agriculture, Livestock Resources Development Sector, 2015). As an example, the exotic breed in Ethiopia produces 128 eggs of the eggs per hen and per period, while the hybrid breed produces 48 and the indigenous 13 (Central Statistical Agency Of Federal Democratic Republic Of Ethiopia, 2021). The government planned to meet these targets "by providing incentives to the private sector for poultry investment, strengthening research to select productive indigenous breeds, and by developing breeds suitable for improved family poultry production systems" (Ministry of Agriculture, Livestock Resources Development Sector, 2015).

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<sup>7</sup> The Ministry of Livestock and Fisheries has merged with the Ministry of Agriculture since April 2018



The PPP between EthioChicken and the public veterinary services aimed to help increase poultry production in Ethiopia by providing 45 days old chicken and poultry health support to smallholder farmers.

Despite many examples of PPPs implemented in the veterinary domain, few studies have evaluated the initiatives in place. Evaluation is an important step for any programmes: it helps in planning, redefining strategies, taking appropriate corrective actions, and optimizing resources (Allen, 2019). Evaluation is also a means of reinforcing partnerships and the process of collaboration and ensuring trust between partners (Rieker, 2011). Most evaluations mobilized in the veterinary domain are technical or efficiency evaluations, characterized for example by avoided losses in animal production (Rushton, 2007). Some evaluations, particularly those applied to surveillance programmes, have also focused on the process (or functioning) of the programmes by examining the conditions under which the programme operates and the organizational elements (Delabouglise et al., 2015; Hendrikx et al., 2011). However, none of the evaluation in the veterinary domain explicitly addressed PPPs and their impacts. In the case of PPPs, involving multi-actor collaboration, complex programme design, an evolving governance and coordination system, uncertain programme evolution, and a diversity of possible impacts, the evaluations mobilized to date in the veterinary domain do not appear to be fully adequate. Impact pathway methodology has been developed in agricultural development evaluation. The idea is to complement existing economic impact assessment methods and to gain insight into the non-linear mechanisms leading to impacts. This methodology analyses how programmes are built, and attempts to make explicit the complex causal relationship between the programmes and the impacts. The methodology also assesses and measures impacts, normally several years after the programme has finished, as the impacts are what remain after the programme's ending (Douthwaite et al., 2003). To our knowledge, this methodology had never been previously used to evaluate public-private partnerships in the veterinary domain, nor to evaluate other programmes in the veterinary domain.

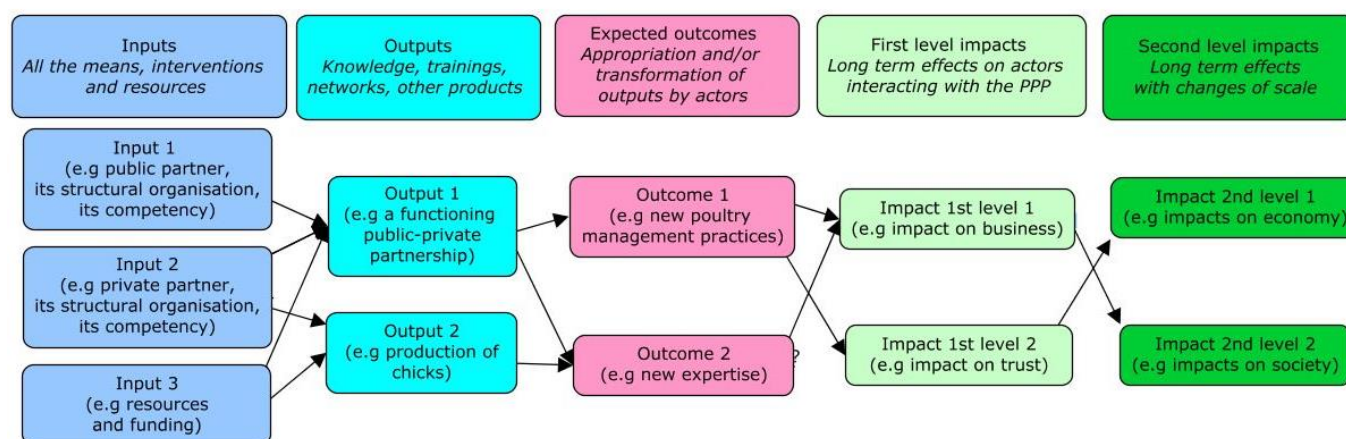
The general objective of this study is to discuss the interest and challenges of the participatory impact pathway methodology for evaluating a PPP in the veterinary domain. To do so, we applied this methodology to evaluate the PPP between EthioChicken and the public veterinary services of Ethiopia. Seeking to understand the contribution of PPPs to impacts, the mapping of actors was described, the causal relationships between the inputs of the PPP and the impacts clarifying, and then the impacts measured.

## 2. Material and methods

### 2.1 The participatory impact pathway

In order to evaluate a PPP in the veterinary domain, we adapted the participatory impact pathway methodology “ImpresS”, developed to evaluate research projects by the French Agricultural Research Centre for International Development (Cirad) (Barret et al., 2018), itself inspired by pre-existing methodologies (de Janvry et al., 2010; Douthwaite et al., 2003; Springer-Heinze et al., 2003). As the PPP evaluated is still active, we used the guidelines for *in itinere* evaluation (ex post evaluation takes place when the programme is completed). ImpresS methodology is a participatory evaluation method (BetterEvaluation, 2012a). Participatory evaluation considers a plurality of viewpoints, thereby improving understanding a complex, multi-stakeholder program such as the PPP. The participatory evaluation also promotes the formulation of locally relevant evaluation questions, support for collective learning, and enhances the acceptability of evaluation recommendations by targeted stakeholders (Bryson et al., 2011; Calba et al., 2015a; Taut and Brauns, 2003).

**The definition of impact pathway.** The Impact Pathway is based on a programme theory, which is an explicit model of how a programme will, or has, brought about impacts. Impact Pathway makes it possible to determine the complex cause-and-effect relationships between a programme such as PPP and its impacts. The main objective of developing the impact pathway is to demonstrate the extent to which a programme contributes to impacts by looking at the change that it brings for actors and then the economic, social, environmental and other impacts that these changes produce. The Impact Pathway distinguishes between outputs (activity or products that result directly from the programme) and outcomes, which correspond to the appropriation and/or transformation of the outputs by the actors, these outcomes being translated into impacts (see box 1 for a more precise definition) (**Figure 1**).



**Figure 1. Simplified graph of an impact pathway.** Some hypotheses were made on the potential inputs, outputs, outcomes and impacts of the PPP evaluated to illustrate the impact pathway.

**Box 1. Definition of inputs, outputs, outcomes and impacts**

*Inputs* encompasses all the means (interventions and resources) that make it possible to undertake a programme (human and material resources, budget, information, tacit or pre-existing knowledge, other activities, etc.) and thus generate results (outputs).

*Outputs* can take the form of knowledge, professional or academic training, expertise, technology, network or other forms of products.

*Outcomes* correspond to an appropriation and/or transformation of programme outputs by stakeholders leading to new practices (agricultural or managerial), new organizations, or new rules (Barret et al., 2018).

*Impacts* are the long-term effects induced by a programme. They are what remains after the programme is completed. The impacts could be of multiple natures (e.g. economic, social, sanitary, political), at various levels (e.g. individual, institutional, regional, national, global) and of different types (positive or negative; direct or indirect) (Barret et al., 2018). For PPPs in the veterinary domain, they can be of different types: economic, societal, related to business, health or trust and can be measured by indicators (World Organisation for Animal Health, 2019b).

The impacts can be characterized by intensity and magnitude through indicators. Intensity reflects the degree of change attributed to the programme and observed for a given impact, while magnitude reflects the extent or spread of the change (ex: number of producers affected by the change).

First level impacts are measured on actors interacting directly or indirectly with the programme and can be evaluated with these actors. Second level impacts result from changes of scale (e.g. from local to national) (Barret et al., 2018).

***The participatory impact pathway methodology.*** The ImpresS methodology is divided into five phases: (i) preparation of the case study; (ii) dialogue with the actors to define hypotheses on the context of the programme and the nature of the impacts during a first participatory workshop; (iii) construction of the narrative of the context and history of the programme and of the impact pathway; (iv) characterization and measurement of the impacts and (v) validation with the actors during a second participatory workshop (Barret et al., 2018)

## 2.2 Study area

This study was conducted in the four regions of Ethiopia where EthioChicken operated in 2018: Tigray, Amhara, Oromia and the Southern Nations, Nationalities, and People's region (**Figure 2**). The four regions are among the most populated regions in Ethiopia, accounting for more than 80 percent of the Ethiopian population. Those four regions accounted for 95.3% of the total poultry population in 2018 (Central Statistical Agency Of Federal Democratic Republic Of Ethiopia, 2018) with 31.8% coming from EthioChicken. In 2018, the poultry production of EthioChicken was highest in the region Southern Nations, Nationalities, and People's (37%), followed by Oromia (31%) (**Appendix 1**).



**Figure 2.** Map of Ethiopia (bold line) and the four regions included in this study (in grey). The capital of Ethiopia, Addis Ababa (black circle), is surrounded by the Oromia region.

## 2.3 Methodology and research tools used for this case study

As the programme evaluated was a PPP in the veterinary domain (and not a research programme), and as the PPP evaluated was still active and we wanted to provide recommendations to improve the PPP, we adapted ImpresS methodology (remaining close to it). Our methodology was divided into 6 steps:

*Step 1.* Preparation of the case study with key PPP actors from public veterinary services and EthioChicken managers by identifying the actors to be involved;

*Step 2.* Dialogue with the actors to map the actors directly or indirectly involved or impacted by the PPP, to identify elements of the context and the history of the PPP, to identify the different inputs, outputs, outcomes or impacts of the PPP, and to identify the potential limits of the PPP;

*Step 3.* Co-construction of the mapping of the actors, the narrative of the context and history of the PPP, and the impact pathway. Discussion of the added value of the PPP to reach these impacts;

*Step 4.* Co-selection of the limits of the PPP that can be improved and co-construction of the improvement scenarios;

*Step 5.* Validation of the final results and co-construction of the final recommendations;

*Step 6.* Measurement of impacts identified based on grey literature, and internal data from EthioChicken.

This methodology used different participatory tools such as individual semi-structured interviews or grouped semi-structured interviews (=focus group), workshops, depending on the results the research team expected, the resources available and the availability of the actors (Alders et al., 2020).

For step 2 ‘dialogue with the actors’, semi-structured interviews, following a previously prepared checklist, were conducted in the four regions. These were mainly individual interviews to facilitate the capture of individual points of view (Mariner and Paskin, 2000). Due to the time constraint, two semi-structured interviews were conducted in groups (focus group discussions) in two regions. The focus groups may obscure individual opinions, but in order to favour consensually validated information, we homogenized the two groups of actors (one group of 4 growers of 45-day-old chickens, and one group of 8 smallholder farmers). Two different checklists were prepared: one for the actors at the conception of the PPP, one for the other actors. The themes covered by the checklist for the actors at the conception of the PPP were: (i) building of the PPP (inputs), (ii) functioning of the PPP (structure, governance, collaboration), (iii) outputs of the PPP. The themes covered by the other checklists were: (i) poultry production, (ii) involvement in the PPP and the EthioChicken model, (iii) interaction with other stakeholders, (iv) benefits of the PPP, and (v) limits of the PPP and scenario of improvement (**Appendix 2**). Furthermore, two proportional piling exercises were conducted with two groups of actors following the focus group discussions. The proportional piling is a semi-quantitative method that classifies elements by stacking small objects (such as seeds) on circles representing the different elements to classify (Mariner and Paskin, 2000). In this case, the elements to be classified were the benefits brought by getting involved in this model of poultry production.

For each of steps 3, 4 and 5, a workshop was organised (three workshops in total). The main goal of these three workshops was to construct the different elements of the evaluation and the recommendations in a collaborative manner. Unlike the focus groups, which were held with homogeneous groups of actors, the workshops should involve representatives of the different groups of actors directly or indirectly involved in the PPP as well as representatives of the actors impacted by the PPP: public and private, national and local actors.

For each workshop, a maximum of 50 persons was tolerated in order to conduct group work and allow participants to express themselves (according to the facilitation skills in the team, we were able to divide the participants into 3 working groups per workshop). The goal of the first workshop, conducted during step 3, was to present, improve and validate results obtained during step 2, based on the drafts prepared by the research team, regarding: (i) mapping of actors, (ii) elements of the context and the history of the PPP, and (iii) the impact pathway. The goal of the second workshop, conducted during step 4, was to explore the limits of the PPP between EthioChicken and the Ethiopian government, and to co-construct improvement scenarii. For the discussion of limits and improvement of the PPP evaluated, in this second workshop, a wide range of actors, including potential opponents was wanted. The goal of the third workshop, conducted during step 5, was to present and validate the final report with the actors directly involved in the PPP.

For step 6 ‘measurement of impacts’, results of the previous steps were used, as well as grey literature and internal data from EthioChicken such as company profile, and results of their client surveys.

#### **2.4 Period, target population, and sampling strategy**

**Period.** The first field investigation including individual and grouped interviews, proportional piling and the first two workshops was conducted between March and June 2018. The measurement of impacts was done from September to December 2018. The third workshop was conducted in August 2019.

**Target population.** Participants should represent a variety of stakeholders from national and local levels directly or indirectly involved in the PPPs between EthioChicken and the public veterinary services. Participants should correspond to public and private partners involved in the PPP, actors who influence the PPP, or actors impacted by the PPP. Defining the target population was an iterative process. As we moved forward with mapping of the actors, we identified new categories of actors to include in the participatory evaluation. We sought to include grower agents representative of this category, i.e. 30% women and with flocks of 1,300 chicks per cycle time on average (the numbers do not differ significantly between the four regions). We also sought to include smallholder farmers representative of this category, i.e. 90% of women raising 5 to 40 chicken on average (the numbers do not differ significantly between the four regions). Actors from almost every category of the target population were interviewed (see the results section 3.1 and **Appendix 4** presenting the participants of this study).

**Sampling strategy.** The main goal was to capture a diversity of points of view, representing the different categories of actors of in the target population. First, individual semi-structured interviews were conducted at the national level with actors at the conception of the PPP. Then, in the four regions, areas where grower agents operate and villages where smallholders’ farmers buy chickens from grower agents were selected. The first list of participants was composed of purposively selected actors, thanks to the help of the EthioChicken manager and village leaders.

Then, a non-probability snowballing sampling was used in the four regions, and the initial participants list was enlarged through the identification, by participants, of other actors that could be included in the study (Sadler et al., 2010). The number of interviews for each category of actors was determined by adapting the concept of saturation. Saturation in a category of actors was considered to be reached when additional interviews provided no new information compared to previous interviews (Fusch and Ness, 2015). The sample size was therefore not predefined. However, given the time and resource constraints, certain categories of actors were privileged to reach this level of saturation. These categories included actors at the conception of the PPP (actors from EthioChicken, actors from the public veterinary services, other actors from the Ministry of Livestock and Fisheries) and actors who adopted the PPP model (growers of 45-day-old chickens, also called grower agents, and smallholder farmers).

## **2.5 Data collection**

**Individual and grouped semi-structured interviews.** The individual semi-structured interviews lasted from 20 to 30 minutes. The two focus group discussions lasted 45 minutes and 1 hour. Individual semi-structured interviews and focus group discussions were performed by teams of one Ivorian male researcher (**BN'g**), one Ethiopian male sales manager at EthioChicken (**FT**), three male staff of EthioChicken, and one Ethiopian male veterinarian. All had a veterinary medicine or epidemiology degree and were previously trained in participatory approaches. Only the regional sales members had a relationship with the interviewees as part of their activities. The interviews were conducted in English or local languages (Amharic, Oromifa, Tigrinya and Wolaytinya) depending on the interviewee. All the discussions were recorded, once the interviewee had agreed to participate in the study and be recorded.

**Proportional piling.** These exercises were done right after each of the two focus groups (**BN'g** and **FT**). Circles were drawn on a large white sheet of paper, representing the benefits mentioned during the two previous focus group discussions. For the group of growers of 45-day-old chickens, 3 circles were drawn as 3 benefits were mentioned ('better life', 'job opportunity', 'low investment in terms of land and capital'). For the group of 4 smallholder farmers, 4 circles were drawn as 4 benefits were mentioned ('women's empowerment', 'profit', 'easy to manage', 'low investment in terms of land and capital'). Then, 100 beans were given to each group and the actors were asked to stack the beans. The more the benefit was important to them, the more beans they had to put in. Once the distribution of beans among the different benefits was completed, the research team counted the beans, recorded the scores in percentage (e.g. if 29 beans were put on the circle 'profit' then it was noted "profit is 29% of total benefits perceived"), and took photos.

**Workshops.** Two researchers (**MPe**, a French female veterinarian and **BN'g**, an Ivorian male veterinarian) and four facilitators (**FT**, one Ethiopian male sales manager at EthioChicken, and **YT.A** and two other Ethiopian male researchers from the International Livestock Research Institute) conducted the three participatory workshops. The facilitators were trained to moderate, observe and take notes during the workshop. One observer took extensive notes (**IDL**). Two different groups were set up for each of the workshop: one for English speakers and the other for Ethiopian (Amharic) speakers. The discussions were conducted in English and Amharic, ensuring that all stakeholders took part in the discussions (Glenn, 2003). The three workshops lasted around 4 hours each and extensive notes were taken.

**Measurement of impacts.** Potential indicators of impacts were identified during the second workshop when constructing the impact pathway. Then, the results of the two proportional piling exercises conducted after the two focus groups with smallholder farmers and growers of 45 days old chickens, grey literature and internal data of EthioChicken were screened to quantify the impacts through indicators (**MPo**). The results from individual and grouped semi-structured interviews were also used to measure the impacts in a qualitative manner (**MPo**).

## **2.6 Data processing and analysis**

The recorded discussions (i.e, the individual semi-structured interviews, the two focus group discussions), and the manual notes (taken during individual and grouped semi-structured interviews and during the three workshops), were transcribed into English. An unique number was given to each of the transcripts to ensure the anonymity of the interviewees. The transcripts were read, and themes (represented by codes and subcodes) emerged from the reading, corresponding to the functional process of the PPP (**Appendix 3**). A spreadsheet containing these codes and subcodes was prepared. During a second reading of the transcripts, the qualitative data was classified in the spreadsheet according to its corresponding themes (code/ sub-codes) (Campenhoudt et al., 2017b). A second spreadsheet database was prepared to draw the impact pathway, using different categories: inputs, outputs, outcomes and impacts. During another reading of the transcripts we classified the data in this second spreadsheet database. The results of the two proportional pilings were documented using photographs, and were reported in a word document.

Workshop results such as drawings and notes were documented using photographs. The notes from the three workshops were faithfully transcribed and classified in the same spreadsheet databases as for semi-structured interviews. The drawn impact pathway developed during the first workshop was reproduced on the CIRAD Impress tool (<https://impress-impact-recherche.cirad.fr/resources/impress-knowledge-management-system>).



All the data and recommendations were validated during the third workshop, except the measurement of impacts. The impact measurement results were sent to the actors of the conception of the PPP and discussed through email exchanges.

## **2.7 Ethics**

The approval to implement this participatory evaluation was obtained from the managing director of the EthioChicken and the director of the poultry production department of the Ministry of Livestock and Fisheries. The semi-structured interviews and the workshops were carried out after presenting the study objectives and obtaining verbal consent from all volunteer participants. The interviewees could stop the interview whenever they wished. Names and contact details of interviewees were kept in a secured database only accessible to the research team, the privacy rights of participants were fully protected, and all data were anonymized.

## **3. Results**

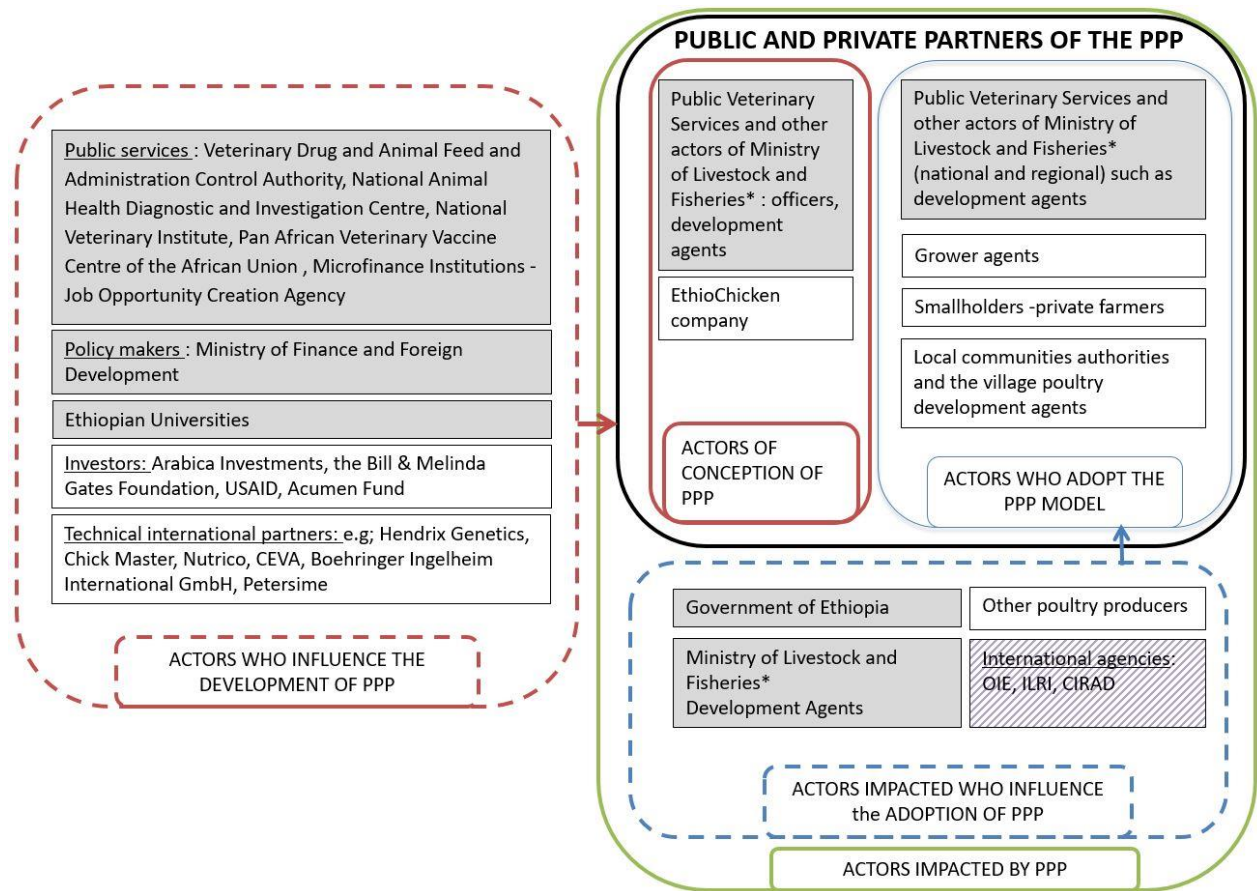
### **3.1 Mapping of the actors and participants involved in this study**

Different actor categories were distinguished: actors of conception of the PPP, actors who adopted the PPP model, actors impacted by the PPP and also influencing the adoption, and actors who influence the development of the PPP. The actors can belong to several categories. Actors positively or negatively impacted by the PPP could either be the public and private partners and could also influence the adoption of the PPP model (**Figure 3**).

The actors who played a major role in conception of the PPP were the public veterinary services and other actors of the Ministry of Livestock and Fisheries and EthioChicken company (**Figure 3**).

The actors who adopted the model on the public side were the public veterinary services and other actors of the Ministry of Livestock and Fisheries (livestock officers and public development agents) at regional and national level. The public development agents were public actors who distributed the 45 days old chickens produced by the grower agents at local level to smallholder farmers. The actors who adopted the model on the private side were grower agents, smallholders' farmers, local communities and the village poultry development agents (**Figure 3**). The grower agents (independent private actors) raised day-old chicks supplied by EthioChicken until 45 days, provided poultry health care such as vaccination programme and were assisted by EthioChicken. The village poultry development agents (independent private actors) were actors elected by the local communities to deliver the 45 days old chickens from the grower agents to the smallholder farmers, operating in two regions due to the non-availability of public development agents.

The actors who influenced the adoption of the PPP model were the government of Ethiopia (public services structures and availability, laws and regulations), especially the Ministry of Livestock and Fisheries, international agencies and other poultry producers. The actors who influenced the development of the PPP model (intentionally or unintentionally) did not play a direct role in the conception. On the public side, they were actors of the public services, policy makers or actors of the Ethiopian Universities. On the private side, they were investors or technical international partners (Figure 3).



**Figure 3. Mapping of categories of the actors involved directly or indirectly in the public-private partnership between EthioChicken and the public veterinary services.** The dark grey rectangles indicate the public actors. The white rectangles indicate the private actors. The light grey rectangle indicates international agencies. \*The Ministry of Livestock and Fisheries has merged with Ministry of Agriculture since April 2018. *CIRAD: French Agricultural Research Centre for International Development, OIE: World Organisation for Animal Health, PPP: Public-private partnership, USAID: United States Agency for International Development.*

A total of 64 semi-structured interviews were conducted. Almost all group of actors identified in the mapping of actors have been included, with the exception of some actors that influenced the development of PPP: investors and technical partners (due to their non-availability on the field, being international actors) and Ministry of Finance and Foreign Development (due to resource and time constraints) (**Appendix 4**). Participants were from different administrative levels: international (n=4), national (n=12), regional (n=7), district (n=13) and ward level (n= 28). All the interviews at international and national level were given in English, while interviews given at regional, district and ward level were given in local language. On the 48 interviews conducted at regional, district and ward level, more interviews were conducted in Oromia (n=19, 39%), Southern Nations, Nationalities, and People's (n=17, 35%) as the EthioChicken production was higher than in the two other regions (**Appendix 4**). The actors involved in the interviews represented public (n=20) and private actors (n=44). The individual semi-structured interviews involved 52 participants; while the two focus groups (followed by proportional piling) gathered 8 grower agents and 4 women smallholder farmers. The 8 grower agents involved in the focus group were women (25%, n=2) and men (75%, n=6) and possessing flocks of 605 chicks per cycle in average. The 23 smallholder farmers included in individual and groups interviews were women (74%, n=17) and men (26%, n=6), and they were raising an average of 27 chickens.

The first workshop had 26 participants, the second 48 participants representing a wide diversity of actors (Supplementary Table 2). The third workshop, gathered 18 participants, mainly actors directly involved in the PPP (actors from EthioChicken and actors from public veterinary services and other actors from the Ministry of Livestock and Fisheries) (**Appendix 4**).

### **3.2 The context of implementation of the public-private partnership between EthioChicken and the public veterinary services: history**

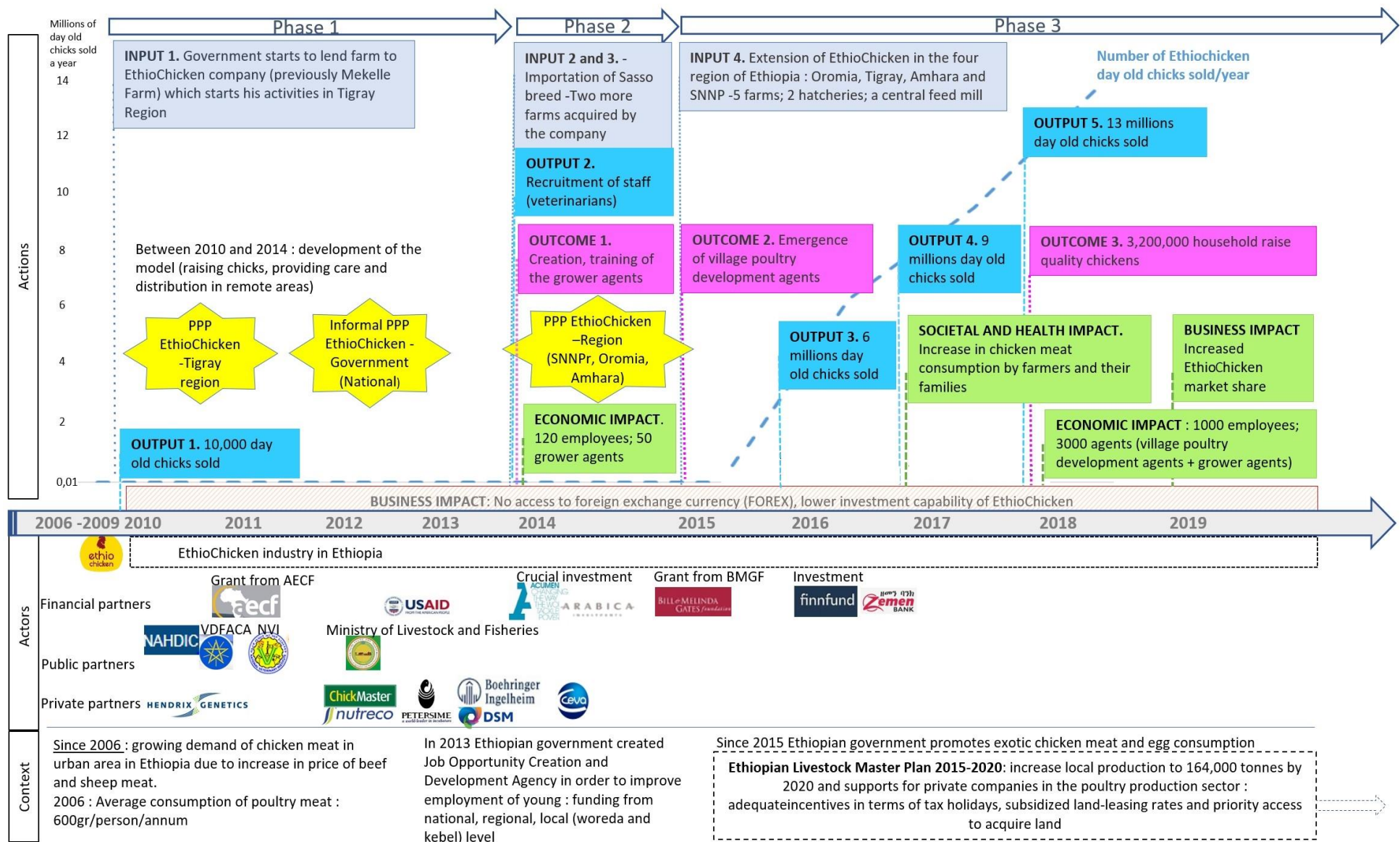
The first phase of the development (2010 – 2014) of the PPP began in the Tigray region. In 2010, EthioChicken co-founders took charge of a government poultry farm, through an agreement with the Tigray regional government, which was underperforming at that time (*input 1 and first star*, **Figure 4**). Thanks to the PPP, EthioChicken had access to the extension services of public veterinary services of the Ministry of Livestock and Fisheries in Tigray region (first and second stars, **Figure 4**). Public development agents, public actor from the Ministry of Livestock and Fisheries, distributed chickens at local level to smallholder farmers who could raise them for meat and for eggs.

During a second phase of development (2014-2015), the success of the farm in Tigray led the government to recommend that they expand their model to three more regions, thereby expanding the PPP activities (*third star, Figure 4*). EthioChicken started to import dual-purpose improved genetic breed (*input 2, Figure 4*). Since then, the EthioChicken staff has been raising the parental stock (which was imported) and produce day old chicks in the three regional farms. Grower agents, who were private independent actors contracted by EthioChicken, were created in the four regions to raise the chickens from 1 to 45 days old and to ensure a vaccination program (*outcome 1 and economic impact, Figure 4*). The public development agents continued to deliver the chickens (45 days old) to smallholders' farmers. EthioChicken started to employ young graduate veterinarians from Ethiopian Universities (*output 2 and economic impact, Figure 4*).

During a third phase of development (2015-2019), the capacity of EthioChicken expanded into four regions of Ethiopia. Currently, EthioChicken manages five poultry farms (and four belonging to the government), two hatcheries and one feed mill production plant (*input 4, Figure 4*). In two regions, due to the low-availability of public development agents, EthioChicken, in agreement with the local communities, has developed village poultry development agents to deliver the 45 days old chickens from the grower agents to the farmers (*outcome 2, Figure 4*).

During the development of the model, EthioChicken received a crucial investment from different funds and foundations (*financial partners, Figure 4*)

At the time of the study, EthioChicken continued to produce improved breed day old chicks, that were distributed to smallholder farmers through the public veterinary services network. This model allowed smallholder farmers and their families to increase their consumption of meat (*societal and health impact, Figure 4*). Since 2010, the PPP has increased the number of days old chicks sold per year (*output 1, 3, 4 and 5, Figure 4*) which were distributed in 2018 to 3.2 million households of smallholder farmers (*outcome 3, Figure 4*). However, the PPP faced important issues linked to access to foreign exchange currency (*business impact, Figure 4*).



**Figure 4. History of the public-private partnership development in three main phases (2010-2019) and impacts; capturing elements of context, actors and actions.** The light blue rectangles indicate inputs, turquoise ones indicate outputs, pink ones indicate outcomes and green ones indicate positive impacts and red ones negative impacts. The stars indicate the building of public-private partnerships at national level (second star) and regional level (first and third stars). The actors represented are the financial partners, who have invested in the company EthioChicken, the public partners, and the other private partners. Elements of context are given at the bottom of the figure. The Ministry of Livestock and Fisheries was merged with Ministry of Agriculture since April 2018. AECF: Africa Enterprise Challenge Fund, BMGF: Bill and Melinda Gates Foundation, NAHDIC: National animal health diagnostic and investigation centre, Forex: foreign exchange currency, NVI: National Veterinary Institute, PPP: public-private partnership, SNNPr: Southern Nations, Nationalities and Peoples' region, VDFACA: Veterinary drug and animal feed and administration control Authority, USAID: United States Agency for International Development

### **3.3 Impact pathway**

#### **3.3.1 Inputs**

The inputs included the political enabling environment: the Growth and Transformation Plan II, and the promotion of exotic chicken meat and egg consumption by the Ministry of Livestock and Fisheries. In 2013, the Ethiopian government created the Job Opportunity Creation and Development Agency Creation, which aims to improve the employment of young people through funding (they can access loans and start to manage a poultry farm) with the collaboration of the private Microfinance Institution (**Figure 5**).

The inputs also included (i) public services which provide the authorization of importation and control of the quality of poultry feed and vaccines from other countries, (ii) animal disease surveillance, (iii) investigation of animal diseases, (iv) production and control of national vaccines, and (v) extension service network down to ward (kebele) level with technical livestock offices, and regional governmental farms (**Figure 5**). Other inputs are represented by competencies of EthioChicken and their business partners and public partners in chicken production and health (**Figure 5**).

Finally, inputs included quality products made available in Ethiopia: improved chicken breeds imported by EthioChicken, quality national vaccines, quality feed produced by local crop producers, quality feed supplies from other countries, and health supplies from abroad. EthioChicken imported two different improved genetic breeds (Sasso and Bonvans breed) from two foreign companies to build up their parental stocks of chickens which they raise in Ethiopia and which produce day old chicks. EthioChicken imported feed from other countries only when the quantity of local feed was insufficient (this accounted for 6% of the total feed purchased by EthioChicken), as well as poultry health supplies (they imported poultry vaccines only when national production was not sufficient). Those inputs were bought in dollars sourced through various means by EthioChicken such as local importers who had access to USD, bank supply agreements and letters of credit from the banks or investor USD (**Figure 5**).

#### **3.3.2 Outputs**

National communication campaigns to promote poultry meat were organized by the Ethiopian government. A non-formalized PPP was initiated between EthioChicken and the Government of Ethiopia through the different public actors (**Figure 5**). Official PPPs, through a Memorandum of Understanding at regional level started between EthioChicken and regional and district livestock offices. These PPPs conditioned the outputs in terms of employment and training and the production of quality products (**Figure 5**).

### **3.3.3 Outcomes**

The business outcomes included the increased sale of national veterinary institute vaccines and of products from local crops, since the demand for vaccines and feed by EthioChicken was high. Grower agent had access to new business with the increased numbers of smallholder farmers willing to buy the 45 days old chickens produced by EthioChicken genetics (**Figure 5**).

They were outcomes on employment and training. The creation of village poultry development agents in two regions (where the availability of public development agents was low), to deliver chickens to smallholder farmers, created employment opportunities. These actors were trained in poultry health and management by EthioChicken, and through them and the public development agents, smallholder farmers could receive advices and trainings related to chicken health and production. Actors from the public veterinary services (such as the Veterinary Drug and Animal Feed and Administration Control Authority) also received trainings from EthioChicken in poultry production and health practices (**Figure 5**).

Finally, there were outcomes on production and consumption of quality poultry products. Thanks to the PPP model, smallholder farmers raised healthy chickens (received at 45 days old) and produced quality eggs and meat and they and their families consumed more eggs and more chickens (**Figure 5**). These 45 days old chickens are produced by private grower agents who purchased day old chicks from EthioChicken, as well as vaccines. The grower agents managed the vaccination programme indicated by EthioChicken. They also received technical assistance from EthioChicken.

### **3.3.4 Impacts**

This PPP has led to impacts related to public health, economy and business (at individual but also regional and national levels), as well as societal impacts such as improved education (farmers can send their children to school), women's empowerment and job employment opportunities (**Figure 5**).

#### ***3.3.4.1 Economic impact***

There was a positive economic impact on the improvement of local and regional economies due to: (1) the rental of government farms to EthioChicken (20% of the profit from EthioChicken sales goes to the government in one region, and in two regions EthioChicken paid a monthly rent to use these government farms); (2) the increase of employment with the creation of grower agents who also employed paid staff in order to help them on their farm, the creation of village poultry development agents, and EthioChicken employed Ethiopian staff; (3) new incomes for many actors due to PPP.

There were also second level economic impacts: increased chicken production in Ethiopia, improved national economy thanks to improved local and regional economy, and new incomes for farmers outside EthioChicken as this PPP encouraged egg and meat consumption in Ethiopia (**Figure 5**). Regarding increase poultry production, in 2018, EthioChicken produced 13 million of day old chicks, representing 32.9% of the total chicks and layer hens production in Ethiopia (n=39.4 million).

### **3.3.4.2 Business impact**

There was a positive business impact for EthioChicken with the new income generated from the sale of day old chicks to grower agents. There was also a negative business impact on EthioChicken due to the non-availability of foreign exchange currency which threatened EthioChicken activity: they had lower investment capability (**Table 1, Figure 5**).

There was a positive business impact for the National Veterinary Institute and national crops producers who sell their products to EthioChicken in large quantities (**Table 1, Figure 5**).

- *“We have a contract with EthioChicken, in their annual plan they give us a list of vaccines and their quantity, and on this basis, we deliver the number of doses. They are developing our business plan because their demand is very high; millions of vaccines are ordered.”* [Interview, head of department of the National Veterinary Institute]

There was a positive business impact for the smallholder farmers and grower agents who produce and sell quality chickens. The four smallholder farmers who participated in proportional piling about the benefits of participating in this PPP model, ranked the statement “profit” in 2nd place (representing 29% of the total benefit).

- *“I raise awareness in the communities that buy the chickens, so they are aware how to rear chicken, how to manage and how to benefit from chicken farming”.* [Interview, village poultry development agent]
- *“There is a high demand in credit by young people those days compared to years before, and a huge amount of microfinance institution money has been given to poultry producers [the grower agent] which are getting successful. They call their business “printing money” because they get profit in a short time”* [Interview, agent of Microfinance Institution]



**Table 1. Indicators of business impacts related to different stakeholders generated by the public-private partnerships between the Ethiopian government and EthioChicken.** Intensity reflects the degree of change attributed to the PPP and observed for a given impact, and magnitude reflects the extent or spread of the change.

1. Internal report made by Research Support Services (Collins O, O., Christopher, C.K., Meseret, M.B., Merihun, N.W.): “Verification study for Africa Enterprise Challenge Fund, Africa agribusiness project: AGFlow poultry’ Ethiopia, 2017.

2. Internal data from EthioChicken: “EthioChicken lean data” Ethiopia, 2016.

3. Internal data from EthioChicken: “EthioChicken internal statistics” Ethiopia, 2019.

\*Among the farmers who adopted this PPP model, 79% of households live below 2.50 USD per person per day and 93% reported agriculture as their primary source of income

\*\* In Ethiopia, the average salary per year in 2018 was about 3 652 USD and the minimum salary were about 495 USD (source: <http://www.salaryexplorer.com/salary-survey.php?loc=69&loctype=1>)

Indicator: New incomes			
Actors	Measure		Results
Farmers	Intensity 1.	Mean annual net benefit per household breeding Sasso chickens	~250 USD <sup>1*</sup>
	Intensity 2.	Net benefit (USD) for meat sold per year for flock of 100 heads: EthioChicken breed compared local breed revenue	Increase rate: 2.16 EthioChicken breed: 1017 USD <sup>(calculation from 1)</sup> Local breed: 470 USD <sup>(calculation from 1)</sup>
	Intensity 2.	Net benefit (Ethiopian Birr) for eggs sold per year for flock of 100 heads: EthioChicken breed compared local breed revenue	Increase rate: 3.8 EthioChicken breed: 20.5 USD <sup>(calculation from 1)</sup> Local breed: 5.4 USD <sup>(calculation from 1)</sup>
	Magnitude 3.	% of household which perceived increased income streams after they started rearing chickens from EthioChicken	74.7% <sup>2</sup> (of 3,000,000 household <sup>3</sup> )
Agent	Intensity	Mean annual net benefit per agent for rearing EthioChicken breed	~2,376.84 USD <sup>1**</sup>
	Magnitude 1.	% of agents who said that profitability is what made the poultry business through EthioChicken stand out from other options	64% <sup>1</sup> (of 3,000,000 household <sup>3</sup> )
	Magnitude 2.	% of agents who perceived that their income had increased since they start this business	81.4% <sup>1</sup> (of 3,000,000 household <sup>3</sup> )

### 3.3.4.3 Societal impact

The 8 grower agents who participated in the proportional piling about the benefits brought by this PPP ranked the statement “better life” in 1<sup>st</sup> place (representing 51% of the total benefit), and “job opportunity” in the 3<sup>rd</sup> place (representing 23% of the total benefit).

- “[the]Majority of our staff are Ethiopian, we only have two expatriate staff based in Ethiopia [...] we are the largest private employers of veterinarians in the country; we contact the Universities in order to interview and nominate students for our training program”. [Interview, manager of EthioChicken]
- “We do not have jobs so we want to work, and also chicken rearing can be an optional job”. [Interview, public development agent]

The four women smallholder farmers who participated in the proportional piling about the benefits brought by this PPP model, ranked the statement “women’s empowerment” in 1<sup>st</sup> place (representing 46% of the total benefit). Women, in most households, were the ones who take care of chicken rearing and in some households, they were the ones who decided what to do with the revenues from the sale of the eggs and the chickens. EthioChicken had a gender policy in their employment scheme (**Table 2, Figure 5**).

- “As women we have to take care of our children and stay at home for our household, and poultry farming doesn’t need any huge job so we can do it easily ... we can use the money that we earn for ourselves and the kids. Empower women equals empower the community because if the living level of women grows, the community will grow”. [Discussion during proportional piling, woman smallholder farmer who adopted PPP model]

Young people were able to create small micro enterprises and start their activities as grower agents.

There were also second level societal impacts: thanks to new incomes, smallholder livelihood was improved and the families were able to send their children to school (**Table 2, Figure 5**).

- “I am financially independent and I am fulfilling my house in term of furniture and materials. And I also support my young kid in terms of education tools and money for living expenses”. [Interview, village poultry development agent]
- “We want to change our life, from poultry production we profit in terms of money by selling, and we also enjoy meat and egg consumption. [...] With a small land and small capital, we can do chicken rearing so we like it”. [Interview, farmer]

However, there were also farmers who fear to lose their biodiversity of local breed.

- “There is no consideration in preserving the local genotypes” [Interview, farmer]
- “[...] smallholders have preference for the local breeds based on their culture. They are used for adoration of ancestors, or for ceremony to solve disputes. [...]”. [Interview, social scientist in International Livestock Research Institute Ethiopia]

**Table 2. Indicators of societal impacts related to different stakeholders generated by the public-private partnerships between the Ethiopian government and EthioChicken.** Intensity reflects the degree of change attributed to the PPP and observed for a given impact and magnitude reflects the extent or spread of the change.

1. Internal data from EthioChicken: “EthioChicken internal statistics” Ethiopia, 2019.
2. Internal report made by Research support services (Collins O, O., Christopher, C.K., Meseret, M.B., Merihun, N.W.): “Verification study for AFRICA ENTERPRISE CHALLENGE FUND Africa agribusiness project: AGFlow poultry’ Ethiopia, 2017.
3. Internal data from EthioChicken. “EthioChicken customer satisfaction survey” Ethiopia, 2017.

\*NB: In Ethiopia, the average salary per year in 2018 was about 3 652 USD and the minimum salary was about 495 USD (source: <http://www.salaryexplorer.com/salary-survey.php?loc=69&loctype=1>)

Indicators	Actors	Measure	Results
Direct created job	EthioChicken employees	Magnitude	Number of employees at EthioChicken 1200 <sup>1</sup>
	Qualified EthioChicken employees	Magnitude	Number of veterinarians 100 <sup>1</sup>
	Agent	Intensity	Mean salary agents per year ~2,376.84 USD* <sup>2</sup>
Indirect created job	Paid staff by the agents	Magnitude	Number of agents 5,000 <sup>1</sup> (among them only 10% where farmer before <sup>2</sup> )
		Magnitude	Number of paid staffs by the agents ~4,200 (estimation of 0.84 paid staff/agent <sup>2</sup> )
	Feed crop business	Magnitude	Number of feed companies from which EthioChicken buys crops 82 <sup>1</sup>
Satisfaction of improved livelihood	Farmers	Magnitude	% of farmers saying that their life improved since raising EthioChicken chicken ~ 84% <sup>3</sup>
Women’s employment opportunities	EthioChicken employees	Magnitude	Number of women employees at EC 400 <sup>1</sup>
Women’s role in chicken raising	Farmers	Magnitude	% of household with EthioChicken breed where women farmers take care of the chickens 57% <sup>2</sup>
		Magnitude	% of household with EthioChicken breed where women make the main decision on the use of income from chicken products 28.6% <sup>2</sup>

#### ***3.3.4.4 Poultry and public health impact***

Poultry health was improved by reducing poultry disease circulation due to improved health supplies and health training delivered to grower agents, village poultry development agents, and farmers. Protein intake was improved for smallholder farmers within the PPP model and their families by increased consumption of better-quality chicken products (**Table 3, Figure 5**).

*-“For us EthioChicken is one of the companies which are contributing to improvement of chicken productivity in Ethiopia”.* [Interview, researcher at International Livestock Research Institute in Ethiopia]

Second level impacts on public health were linked to the strengthening of veterinary services and improved nutrition. veterinary services were strengthened by the positive impact on poultry health and the increased trust between farmers and veterinary agents (**Table 3, Figure 5**).

*-“We get some trainings from EthioChicken about important poultry diseases”.* [Interview, staff from the veterinary services, veterinary drug and animal feed and administration control authority]

Improved nutrition through better access to protein was another public health second level impact. This impact was due to the consumption of improved chicken quality and increased availability of chicken products. A governmental study (an internal communication) showed that the rate of stunting due to malnutrition in infants in the Tigray region decreased from 51% in 2015 to 38% in 2017. This study showed also that the increased of products from chickens raised in rural area and delivered by EthioChicken played an important role in the decrease of the infants’ stunting (**Table 3, Figure 5**).

**Table 3. Indicators of public health impact related to different stakeholders generated by the public-private partnerships between the Ethiopian government and EthioChicken.** Intensity reflects the degree of change attributed to the PPP and observed for a given impact and magnitude reflects the extent or spread of the change.

1. Internal data from EthioChicken. “EthioChicken customer satisfaction survey” Ethiopia, 2017.
2. Internal data from EthioChicken: “EthioChicken lean data” Ethiopia, 2016.
3. Internal data from EthioChicken: “EthioChicken internal statistics” Ethiopia, 2019.
4. USDA Foreign agricultural service. Ethiopia’s demand for chicken meat is expected to grow. 2017 (accessible here: <https://www.fas.usda.gov/data/ethiopia-ethiopias-demand-chicken-meat-expected-grow> )
5. Internal report made by Research support services: “Verification study for Africa Enterprise Challenge Fund Africa agribusiness project: AGFlow poultry’ Ethiopia, 2017.

Indicators	Actors	Measure	Results	
Improvement in poultry health management	Agents	Intensity	% of grower agents satisfied with EthioChicken sales manager’s advice	84 <sup>1</sup>
		Magnitude	% of grower agents who received a visit by the EC sales manager	83 <sup>1</sup>
	Farmers	Magnitude	% of farmers confirmed that they had participated in a training organized by EC	21.6 <sup>2</sup>
Total meat production by EthioChicken	EthioChicken	Intensity	Increased production meat (tons of kg/year) from 2010 to 2018	From 67.5 to 110,700.0 tons kg/year <sup>3</sup>
		Magnitude	Increased participation of EthioChicken meat out of total meat production in Ethiopia from 2010 to 2018*	From 0.15% to 6.9% <sup>1,4</sup>
Chicken product consumption	Farmer	Intensity 1.	Delta number of EthioChicken and local eggs eaten / week / household	9 <sup>1</sup>
		Intensity 2.	Delta number of EthioChicken and local chicks eaten / week / household	3 <sup>1</sup>
		Magnitude	Number of households	3,200,000 <sup>3</sup>
Meat productivity	Farmers	Intensity	Increased production of meat (ton kg meat/year for flock of 100 heads): EthioChicken breed compared to local breed	47.06 (56,36 - 9,3) <sup>(calculation from 5)</sup>
Egg productivity	Farmers	Intensity 1.	Increased number of eggs/ years for flock of 100 heads: EthioChicken breed compared to local breed	130 (190-60) <sup>(calculation from 5)</sup>

**3.3.4.5 Impact on trust**

Farmers' and consumers' trust in the veterinary services increased thanks to the improved competencies of veterinary services in poultry health. Consumer trust increased with the quality of the chicken produced within the PPP model. The trust of farmers and other actors to start a low-risk business related to poultry production was increased thanks to the quality of the chicken produced within the PPP model (**Table 4, Figure 5**).

- “So when you walk around, it’s common to see rural people rearing improved chickens from EthioChicken; they have 50, 100 or 200 chickens. That was not so easy previously”. [Interview, regional staff from Ministry of Livestock and Fisheries, Addis Ababa]

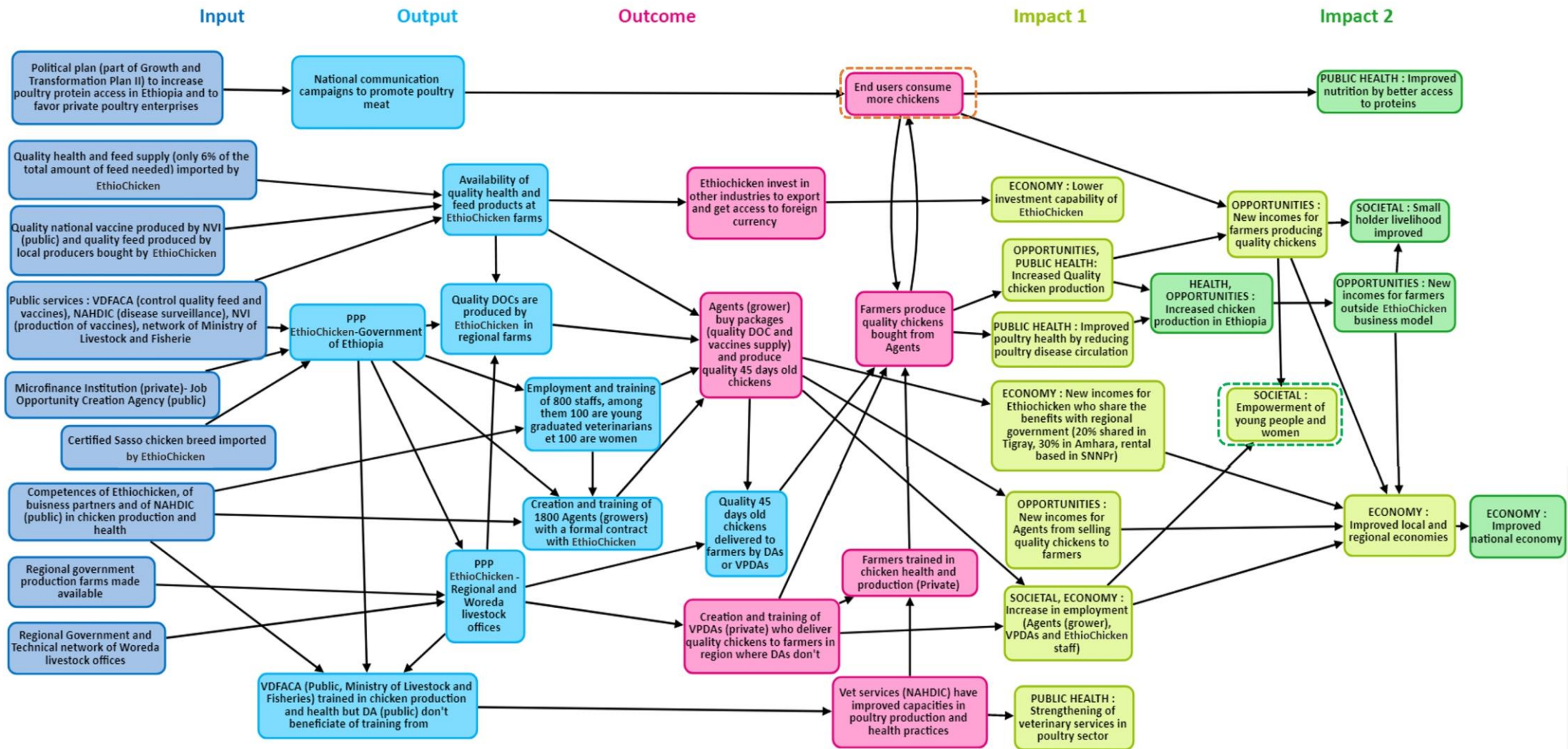
However, there was also a fear of disease outbreak due to a sense of the fragility of the improved breed compared to the local one.

- “Talking about disease surveillance, what type of disease can be transported to the farmers because of these improved chickens? I would like a project focus on this aspect. Right now we do not have big problems of disease but disease stays as a biggest challenge; parental stock comes from abroad, so how can we regulate this one more efficiently?”. [Interview, staff from Pan African veterinary vaccine centre of the African union]

**Table 4. Indicators of impact on trust related to different stakeholders generated by the public-private partnerships between the Ethiopian government and EthioChicken.** Intensity reflects the degree of change attributed to the PPP and observed for a given impact and magnitude reflects the extent or spread of the change.

1. Internal data from EthioChicken. “EthioChicken customer satisfaction survey” Ethiopia, 2017.
2. Internal data from EthioChicken: “EthioChicken internal statistics” Ethiopia, 2019.

<b>Indicators</b>	<b>Actors</b>	<b>Measure</b>	<b>Results</b>
Quality chicken	Farmers	Magnitude	% of farmers satisfied with the quality of chicken 91% <sup>1</sup>
Increase demand for the product (2014 to 2019)	Grower agents	Intensity	Increased number of day old chicks produced/ year by EthioChicken (2014 to 2019) 10 thousand to 16.4 million <sup>2</sup>
		Magnitude 1	Increased number of grower agents (2014 to 2019) 100 to 5,000 <sup>2</sup>



**Figure 5. Impact pathway of EthioChicken innovative model and public-private partnership involved in this model:** inputs (dark blue); outputs (light blue); PPP at national level (star with N), PPP at regional level (start with R); outcomes (pink) and impacts level 1(light green), impacts level 2 (dark green). The impacts can be negative (rectangle with dotted red border) or positive (the others). *DA: public development agents, DOC: day old chicks, EC: EthioChicken, NAHDIC: National animal health diagnostic and investigation centre, NVI: National veterinary institute, PANVAC: Pan African Veterinary Vaccine Centre of the African Union, VDFACA: Veterinary drug and animal feed and administration control authority, VPDA: Village poultry development agents, Woreda: regions*

### 3.4 Added-value of the public-private partnership to reach the different impacts

The added value of the PPP to reach the different impacts on poultry sector was mentioned by both public and private partners.

- *“We have good relation with this private company, we work with them very closely. EthioChicken have impact on poultry sector, and also, they encourage other private sectors. [...] We want increase poultry production, and EthioChicken are working smoothly, they support our work!”*. [Interview, staff from Ministries of Livestock and Fisheries, regional level, Addis Ababa]
- *“We want to increase the market share of poultry meat (on total livestock meat) from 5% to 30% up to 2030. We have an ambitious plan office, and we want to involve private sectors to achieve our target. [...] Private sector give us eggs and day old chicks and increase the poultry production of the country”*. [Interview, staff from Ministries of Livestock and Fisheries, national level]
- *“Without this partnership with the government we wouldn't have this distribution network in place. So definitively, the channel of distribution is the added value. It is the strongest aspect of this relationship. [...] We both have a common goal which is to distribute more chicken within Ethiopia”*. [Interview, initiator of EthioChicken]

### 3.5 Limits of the public-private partnership model and improvement scenarii

Several difficulties and limits of the PPP were mentioned. In Ethiopia, the poultry industry is a recent development. The competency of the public veterinary services was limited in the poultry sector because of limited training in poultry science during veterinary studies. The feed and health supplies required for the improved breed of EthioChicken were expensive and difficult to access due to low availability. Finally, the end-consumer market of poultry products was unstable representing a challenge for the stability of the PPP model. Indeed, this is mainly due to religious and cultural practices in Ethiopia: the existing of different fasting periods, up to 200 days per year, during which a significant part of the population does not consume livestock or poultry products in Ethiopia. During those periods all the different actors of the PPP are affected by the decline in the sale of chicks or chickens. Improvement scenarii of the PPP and recommendations emerged during the second stakeholder workshops.



### **3.5.1 Issues about access to foreign exchange currency**

During the time of the study, poultry sector was not a priority for the financial and trade part of the Ethiopian Government, and did not have access to foreign exchange currency. There were also difficulties related to access to land; indeed, the government distributed the land depending on their production development priority (not poultry sector).

There was a disconnection between the Ministry of Trade for import permits and the Veterinary Authority leading to difficulties for delivery of import permits related to veterinary products. This was a limitation for the public veterinary institute (for import of reagents for national production of vaccines, and diagnostic kit test supplies from abroad) and for EthioChicken for the import of premix feed, vaccines when local ones are not sufficient, and of improved parental chicken stock. In 2018, the Ministry of Livestock and Fisheries was developing a draft poultry policy to improve the situation.

One solution proposed was to promote the benefits of poultry sector at national and regional level, so to encourage the government to put products related to the poultry sector on the list of permitted imports and exports. This would allow access to foreign exchange currency and access to the export market. Large production companies like EthioChicken can help promote the poultry sector to the government.

### **3.5.2 Access to capital for grower agents and farmers**

The access to loans and capital for youth employment was limited in terms of the number and amount to be able to start a poultry production activity such as grower agents. Indeed, when grower agents had access to a small amount of financial loan, they had to start with a small number of chicks to raise until chicks were 45 days old and their profit was low. Some of them they were unable to reimburse their credit.

A solution proposed consisted on the demonstration to loans institutions the benefits and the financial requirements for poultry production, in order to convince these institutions to be more inclined to issue credit. Moreover, it would be better to deliver credit directly to young grower agents, according to their needs for poultry production: currently the credits being lent through youth associations (**Appendix 5**).

### **3.5.3 Poultry management**

Many farmers reported having limited knowledge about poultry management and in-some occasions the local veterinary services, through their public development agents, had limited capacity to help them. At the time of the study, veterinary services in Ethiopia had limited numbers of veterinarians specialized in poultry management, the veterinary curriculum in universities not focusing on the poultry sector.

A solution proposed was to improve the knowledge of the local veterinary services on poultry health., Specialized veterinarians would be able to support the smallholder farmers. The curriculum of the veterinary degree could incorporate more courses on poultry management, and the international universities and the private poultry sector could help the government doing so. Also, the government could propose training in poultry management for the public development agents who are already part of the Veterinary Service. Another solution is that the public development agents could be included in the training given by the coordinator from EthioChicken (currently, only the private village poultry development agents are trained). Finally, another solution could be to have a partnership between veterinary public institutions and private actors like EthioChicken to organize trainings on poultry management in national, regional and local veterinary services down to the village (**Appendix 5**).

#### **3.5.4 Limited dual genetics available in the country creating a competitive environment**

EthioChicken holds the exclusive right to distribute one improved genetic breed (the Sasso breed) in Ethiopia through a contract with a French poultry genetics company, producers of the breed in question. This exclusive right has led to stigmatisation of EthioChicken by other Ethiopian poultry producers including day old chicks (from other breeds) for sale to farmers. Because of this stigmatisation, EthioChicken did not have access to the association of poultry producers in Ethiopia, limiting its market access. The absence of EthioChicken in the association also decreased the strength of the latter and its lobbying option, EthioChicken being an important actor in poultry production in Ethiopia. The functioning model of other poultry producers was different from EthioChicken's, as they sell chickens at any stage to farmers (not necessarily at 45 days) without the intermediary of grower agents nor the package of vaccines and trainings. This explains the reason farmers tended to adopt the EthioChicken model compared to other models, and to become contracted grower agents. This increased the stigmatisation of EthioChicken by others Ethiopian poultry producers.

One solution would be to promote the access of alternative improved genetic to other Ethiopian poultry producers. However, if other poultry producers provide improved genetics without the full model (health, feed supplies and post-sale services and trainings) this could lead to limited improved production. Without the full model, in the long term, the success of other poultry producers could decrease. The solution would be to promote the 'transfer' of a similar model (the EthioChicken model) through PPPs to other competitors to guarantee the quality and impact of the actions, as is already the case for two poultry producing companies (**Appendix 5**).

## **4. Discussion**

The results of this study describe (i) the history, (ii) the complex process of the public-private partnership between EthioChicken and Ethiopian government, and (iv) societal, economic, and health impacts brought by this collaboration. The participatory impact pathway methodology captured the viewpoints of public and private partners of the PPP, actors who influenced it and actors impacted by it, enabling the transparency of the interests, benefits and constraints of each actors.

### **4.1 The importance of participatory impact evaluation methodology**

The main strength of this study lies in the involvement of different actors in the evaluation process. The participatory approaches allowed the recording of viewpoints from a large number of actors from both public and private sector, actors influencing the PPP and actors impacted by the PPP, including vulnerable actors such as young people and women. The importance of capturing viewpoints of the vulnerable groups to enhance equity in health and well-being is enhance in the protocol for PPP evaluation in public health of the World Health Organization (Donald A. Barr, 2007).

Another strength of the impact pathway methodology lies in the integrated evaluation of a PPP in the veterinary domain. Indeed, this methodology enabled evaluation of the context (thanks to the analysis of the history), evaluation of the process (thanks to the mapping of actors, the identification of inputs and outputs), and evaluation of the results (thanks to the identification of outcomes and identifications and measurement of impacts). Until recently, a limited number of studies have evaluated PPPs in the veterinary domain. As the quality of PPP outcomes and impacts will depend on the quality of its process organization, evaluation frameworks of PPPs in public health advise describing and analysing PPP mechanism.

Elements such as relationships between the two sectors, the financial arrangement, governance structure, and functions of the PPP should be taken into account in the evaluation, in addition to the impacts of the PPP (Donald A. Barr, 2007; Rieker, 2011). The impact pathway methodology that we mobilized allowed us to look at the context, the process of the PPP and its outcomes and impacts (Barret et al., 2018; Douthwaite et al., 2003). PPPs represent a means to achieve objectives and can be transitional, they need to be adapted to their own context and there is no best way to manage them (National Academies of Sciences, 2016). This is why it is important to mobilize an evaluative research approach, such as impact pathway methodology, that seeks to understand the how and why of the results, rather than a normative evaluation approach that would seek to compare the components of the intervention to pre-established standards (Champagne et al., 2011a). The evaluation we conducted of both PPP process and PPP impacts was crucial in order to provide appropriate recommendations on how to improve the PPP.

There is general agreement that PPPs should represent an added value compared to a programme that does not involve PPPs. However, difficulties in monitoring the added value of PPPs have been identified. Indeed, comparing the results of a PPP with an existing or modelled "counterfactual", such as a territory without a PPP or a purely public or purely private alternative, is not an easy task. The multiple factors influencing outcomes, and the marked influence of the context make it almost impossible to perform modelling or find an existing counterfactual (Barlow et al., 2013; Vrangbæk, 2008). The best way to overcome this difficulty is to use participatory approaches and to rely on the opinions of public and private partners and for them to discuss together on this potential added value (Bryson et al., 2015; Kanya et al., 2016), which is what we did. In order to overcome the difficulty of measuring the added value of a PPP, it was important to focus on understanding the causal relation between the implementation of a PPP and its outcomes and impacts, which is what we did using the impact pathway. The representation of the impact pathway also made it possible to visualise which outcomes (and related impacts) depended directly or indirectly on the PPP and to hypothesise that these outcomes in the current situation, without the PPP, would not have been possible.

#### **4.2 The importance of considering the different types of impact**

Animal health represents a challenge in terms of public health (Jones et al., 2008), food safety, socio-economic stability (HLPE, 2016) and interaction with the environment (B. Dumont et al., 2019; Steinfeld et al., 2006). We argue that the sanitary as well as economic, business, social and environmental impacts of animal health programs implemented via PPPs or otherwise, must be taken into consideration to promote a sustainable livestock system. The methodology of participatory impact pathway by capturing a diversity of viewpoints allowed to gain a systemic understanding of the PPP evaluated and its contribution to impacts. The positive and negative impacts mentioned by the participants of this study relate to economic, business, and societal aspects (livelihood, women's empowerment, education) and to public health (poultry disease control, strengthening of veterinary services, improving nutrition). Our study showed that the outcomes/impacts of this PPP varied and went beyond the sanitary and animal productivity range. For example, it is interesting to note that two other Ethiopian poultry producers have already adopted the same model as EthioChicken (intermediary grower agents who raise and care for the chicks until they are 45 days old and collaboration with public actors for the distribution of chickens) but with other improved genetic breeds, which can potentially provide second-level impacts. Another example, is the strengthening of the veterinary services, as was captured in this case-study through the trainings of the different actors linked to the veterinary services in poultry health. Bryson et al. (Bryson et al., 2015) argues that PPP should result in "public value" that could not be created without the PPP. In the veterinary domain, one public value would be the strengthening of the veterinary services.

However, we did not investigate further the fear expressed by some farmers of the decrease of their local breeds and of the immune fragility of improved genetic breeds. These elements might have deserved attention. Indeed, the genetic diversity of domesticated animals is also on the list of biodiversity indicators by the European Academies' Science Advisory Council (European Academies' Science Advisory Council, 2004) and the loss of livestock biodiversity is raising sustainability issues (Tisdell, 2003). It is recognized that there is a need to maintain a broader range of animal genetic resources to be able to deal with future uncertainties, such as climate change and zoonotic diseases (Seré et al., 2008). It is normal for any programme to have externalities, consequences not foreseen in the planning and implementation of the program. However, the Food and Agriculture Organisation proposes integrating the externalities as of the planning process to achieve a sustainable programme (Neven, 2014).

Taking account of externalities, by anticipating them and undertaking corrective action of the negative ones, may help the PPP to be stable over time and increase its legitimacy in society. For this case study, the adaptation of this model (which includes training in poultry health care and a distribution model to remote areas) to local breeds rather than or in addition to genetically improved breeds could have been discussed in the workshops. This would also avoid dependence on imports from other countries of genetically improved poultry.

### **4.3 Importance of collaboration at different levels and trust between partners**

The study showed that the PPP between EthioChicken and the Ethiopian governments takes place at different administrative levels: national and regional. This allows EthioChicken and the State to develop the poultry sector in marginal areas. Indeed, as mentioned by Ahuja (Ahuja, 2004b), in their analysis of the economic rationale of sector roles in the provision of animal health services, which stressed the importance of a division of labour between the public and private sectors, the collaboration between the private and public sector is particularly important to reach remote areas.

We showed that each actor derives his own benefit from participating in PPP. However, there are associated constraints, and the participatory workshops allowed the partners to co-develop scenarios to overcome such constraints. The PPP reference guide from the World Bank emphasize the need to compile a complete and transparent list of risks associated with the PPP and to think about risk allocation (World Bank Institute, 2017). The participatory approaches allowed the partners to clearly identify those risks, and thus to be able to limit them.

Finally, participatory evaluation has benefits in itself. Involving the different stakeholders during the evaluation brings out the benefits and constraints of different stakeholders, to increase transparency between the partners, thereby increasing trust and collaboration (BetterEvaluation, 2012a). The literature on PPPs in public health emphasizes the need for partners to understand their mutual motivations and objectives (National Academies of Sciences, 2016), and this exchange during the participatory evaluation helped to clarify people's expectations about various aspects of the PPP. Participatory approaches in evaluation have also proven to be very useful in ensuring the adaptability, acceptability, and relevance of the recommendations and therefore ease the implementation of corrective actions (Calba et al., 2015a). Indeed, actors can share their perception of the PPP and co-design the corrective actions needed to ensure the reach of expected impacts (Barret et al., 2018). The different workshops with the various stakeholders facilitated reflection and analysis of the system in which they are involved.

#### **4.4 The difficulty to differentiate outcomes and impacts**

The difference between outcomes and impacts is not easy to determine. The impacts are what remains after the project is completed. In the literature on the evaluation of PPP in the public health and veterinary domain, the difference between outcomes and impacts was established in only one reference (Poupaud et al., Under publication). The framework of the Centers for Disease Control and Prevention (Rieker, 2011) proposed writing the logic model of the partnership by collecting information on a partnership's inputs, activities, outputs, outcomes and impacts and by linking these different elements together, which has been done during this study. However, no further information was given to differentiate the outcomes and impacts. In this case-study, this difficulty was accentuated by the fact that our evaluation was made "in-itinere", as the PPP was not over. So, to be sure that what we called impacts correspond to the long-term results of the PPP, an ex-post evaluation should be done to analyse what remains after the PPP is over (as the PPP can be transitional).

#### **4.5 Limitations**

We are aware that some results might have been distorted by several factors and then should be interpreted with caution. The translation of the different records is the first possible limitation, as this may have introduced a certain misinterpretation of opinions. Another limitation of the participatory approach is the subjective form of the method, as it depends on the stakeholders' willingness to respond to questions and interact with researchers (Schmeer, 1999). Stakeholders belonging to the same category may express divergent opinions, and therefore several stakeholders should be included in the interviews.

Due to time constraints, we may not have succeeded in reaching the saturation level for each category of stakeholder (such as actors who influence the development or the adoption of the PPP). However, for the actors at the conception of the PPP and the actors who adopted the PPP we are confident in saying that we reached saturation level. The grower agents included in this study were representative in terms of the proportion of women (25%), and though the average flock size per cycle (n=605) was lower than the average for this category (n=1300), this is unlikely to have influenced the results obtained. Due to time and resource constraints, the grower agents involved were all from the same region (Oromia). Ideally, grower agents should have been from the 4 different regions, but as the system is the same in all 4 regions for this category of actors, this is unlikely to have influenced the results obtained. The smallholder farmers included in this study were representative in terms of the proportion of women (74%), and of the average number of chickens raised (n=27).

Another limit of our study relies on the fact that participatory approaches cannot erase pre-existing social conditions which may hamper the capacity of actors to express themselves freely. Representing the diversity of viewpoints from stakeholders who influence, who are involved in or impacted by the PPP during the evaluation process, was a challenge. The genuine participation of all stakeholders may not have been fully achieved, especially during the workshops, since power structures limit the free expression of marginalised people (Cooke, 2001). However, we believe that the creation of several small groups during the workshops, and the conducting of several individual interviews, limited this self-censorship. Women play an important role in rural areas and especially in poultry raising. We paid attention to respecting the ratio of women for the grower agents and for smallholders during the semi-structured interviews in order to hear their voices. However, the researchers that interviewed them were male, which could have influenced their responses, although they were careful to limit this bias (one of the researchers was Ethiopian and was careful to respect cultural practices).

#### **4.6 Application and perspective**

This study allowed us to provide recommendations at policy level. Indeed, the Ministry of Livestock and Fisheries and the Ministry of Finance and Economic Development were present during the workshop. The recommendations related for example (i) to foreign exchange currency access for stakeholders involved in poultry production, (ii) to the need for training in poultry production to be included in the veterinary curriculum, and (iii) to the increase of access to loans to young agents or farmers for the start of a poultry business.

The results of this evaluation, together with other documents and in collaboration with stakeholders involved in PPPs worldwide, were used to develop the OIE PPP Handbook (World Organisation for Animal Health, 2019b) in order to provide a model that could potentially be scaled-up in other countries, when and if relevant, to be able to improve the performance of veterinary services.

This represent an in-depth case study, which can contribute to the scientific discipline of evaluation applied to PPPs in the veterinary domain. This case study represents an in-depth analysis of a PPP corresponding to the cluster 3 “transformative” category in the typology from Galière and al. (Galière et al., 2019a). It would be interesting to have other case-studies related to PPPs in cluster 1 “transactional”, and cluster 2 “collaborative”.

#### **4.7 Conclusion**

The diverse impacts (economic, business, society and health) linked to the poultry sectors identified in this study have been made possible by PPPs at the different administrative levels of the country. Further work should be done on PPPs in the veterinary domain to better characterise the respective responsibilities, risks and benefits for each actor involved. Indeed, PPPs in the veterinary domain are spread all over the world and are often complex, dynamic, multilevel systems. The constraints and limits identified during this study require strong communication between public and private actors from different sector, to be solved. This impact pathway methodology, based on participatory evaluation, applied for the first time in the evaluation of a PPP in the veterinary domain, helped to formulate recommendations to improve public-private partnerships. This case study provides context-dependent evaluation outputs of a PPP related to cluster 3 “transformative”, and represents a milestone in building an evaluation framework of PPP in the veterinary domain.



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# General discussion

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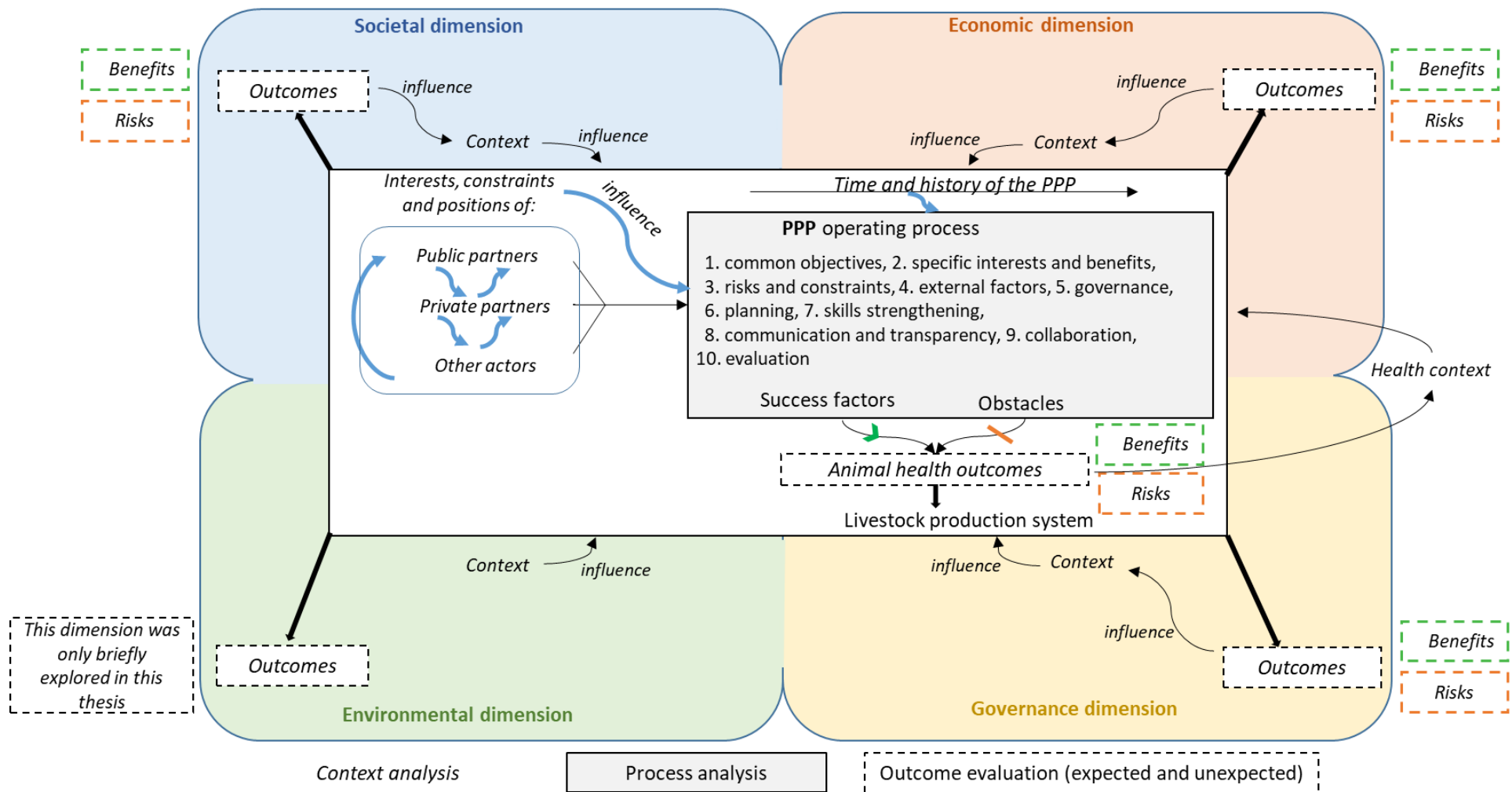
# 1. Overview of the work undertaken

## 1.1 Development of an operationalisable theoretical evaluation framework

The ambition of this thesis was to develop an integrated evaluation framework for PPPs for livestock health. This framework aimed to identify areas of improvement in PPP outcomes in terms of human health, animal health and ecosystem health, with a view to promoting sustainability. So, while the case studies presented in this thesis concerned livestock health PPPs and not PPPs with One Health objectives, we believe that the objectives of the evaluation framework are relevant to the One Health approach (Rüegg et al., 2017), which is understood as belong to the sustainability sciences (Clark, 2007; Sidikou et al., 2021). We drew on both pre-existing frameworks and the themes that emerged from the analysis of the 4 case studies to develop the integrated evaluation framework presented in **Figure 1**. The frameworks we used were principally those of the realist approaches to public health evaluation, and sustainability. Field studies were particularly important in informing the context analysis, the process evaluation criteria and the types of impact considered. The case studies, which examine the situation in detail, enabled us to develop an understanding of what motivates partners to set up a PPP, the evolution of PPPs (structure, organisation) and their effects. While they focus on specific situations, these case studies, through a process of abstraction, nevertheless aim to enrich theoretical thinking and help create a PPP evaluation framework for general use (Flyvbjerg, 2006).

The evaluation framework was developed for use in the field by PPP stakeholders or for action research purposes. To develop such a framework, it was essential to consider the varying opinions of all PPP stakeholders. Participatory approaches, mostly qualitative, were considered the most appropriate, as they can collect diverse and nuanced opinions, perceptions and interpretations. These approaches made it possible to understand the organisation of PPPs and their effects, as perceived by the stakeholders involved, thus providing a system-wide view of the entire PPP. However, the goal of taking into account the wide range of opinions of the stakeholders involved in the PPP and those impacted by it was only partially achieved. In most of the case studies, and in the expert elicitation, only the opinions of the partners involved in the PPP at central level and, to a lesser extent at regional level, were considered. We will come back to this point later in the discussion. It is likely that this framework will evolve following the implementation of future studies that consider the opinions of stakeholders who are impacted by PPPs.

In the end, although we do not think that our research questions have been fully answered yet, the work has brought the operational elements sought (**Figure 1**). Through the literature review presented in chapter 1, we were able to use existing expertise in public health and the veterinary domain to develop an initial evaluation framework. In chapter 2, two context analysis methodologies were implemented and discussed: a stakeholder analysis in Laos and an examination of the history of the PPP in Paraguay. This addressed our first research question: ‘Which elements of the context should be considered when evaluating PPPs in livestock health?’ Chapter 3, which covered the development of a process evaluation tool, addressed our second research question: ‘Which attributes and properties of the operating process of a livestock health PPP should be considered in an evaluation?’ In chapter 4, the impact pathway methodology was used to carry out a participatory evaluation in order to address the third research question: ‘What are the outcomes and impacts of the PPP and how can we measure the extent to which the PPP contributed to these outcomes?’ By looking at a range of benefits, risks and impacts, this chapter, which complements chapter 1, enabled us to begin answering the fourth research question: ‘In what ways does the PPP influence livestock systems and sustainability?’, although the environmental dimension of sustainability was not addressed.



**Figure 1: A integrated evaluation framework for livestock health PPPs based on realist approaches to evaluating health programmes and the sustainability framework.** Context analysis considers the societal, economic, governance and environmental elements of the context. It examines the influence of stakeholders, their interests, constraints, position and relationships, and the effect of time on PPP implementation. Process analysis focuses on different aspects of how the PPP works, and it can be grouped into 10 sections. Outcome evaluation looks at the PPP’s direct effects (benefits and risks) on livestock health and its indirect effects on society, the economy, governance and the environment. The outcomes can influence the PPP’s context and process. We make suggestions about implementation throughout the manuscript. The environmental elements of the context have not been explored in detail, and this would be a useful topic for future research.

## 1.2 Difficulties and limitations: sharing experience

Evaluative approaches use theoretical frameworks from different disciplines depending on the evaluation questions, the policy that the evaluation is part of, and the evaluation criteria. Consequently, our research benefited from the help and constructive criticism of researchers from different disciplines. A number of difficulties are often encountered with interdisciplinary practices (Kivits et al., 2013). It seems to us that the position of doctoral students in this interdisciplinarity is unique and comes with its own requirements and difficulties. As doctoral students are just starting out in the research profession, it is essential when approaching new disciplines to invest time in overcoming the inevitable gaps in knowledge about methodologies and, sometimes, even basic frameworks. There are also problems in approaching the literature, knowing which journals are the most relevant and choosing which journal to publish in, and there can also be general feelings of ‘discomfort’, a feeling of not being a specialist in anything, and feelings of illegitimacy (Chassé et al., 2020). In my case, these feelings were alleviated by talking to members of the thesis committee, to peers in different disciplines using interdisciplinary practices, and other PhD students experiencing the same difficulties.

The use of interdisciplinary and participatory approaches meant that there were difficult decisions to make when choosing and prioritising the factors to consider in evaluation. Participatory approaches are time consuming, because they involve looking at a variety of individual opinions, going to meet stakeholders (sometimes in remote places), creating a climate of trust, and conducting interviews that can last several hours. It was not always possible to collect the maximum variation of responses, and reaching data saturation for each category of stakeholder proved difficult (Fusch and Ness, 2015). Similarly, given the broad framework used, it was difficult to triangulate all the data across different sources and different interviews (Mariner and Paskin, 2000). For example, in Paraguay, the decision was made to prioritise the stakeholder categories for whom data saturation had to be reached and the data triangulated. For the other categories of stakeholder and data, this limitation was acknowledged when the results were presented. In Paraguay, the type of data obtained may have been influenced by the fact that I was introduced to the PPP stakeholders by the OIE representative for Paraguay. My labels, particularly my ‘OIE’ label, introduced a considerable amount of bias. Given that it is the OIE that provides official recognition of disease status for FMD, and that the stakeholders associated me with this process, they were reluctant to talk to me about the PPP’s limitations. I did not hesitate to say that I was not employed by the OIE and that I was a student. As a result, little by little, a climate of trust was established, and this reduced their reticence.

However, even though I tried to adopt a neutral position during the interview, my professional and cultural background certainly had an influence on the responses of the interviewees. The interview process is an

interaction between interviewee and researcher, and these two parties influence each other. The interviewee may, for example, try to please the researcher by saying what they think s/he wants to hear. My professional and cultural background may also have influenced the analysis of the data. This is why, ideally, colleagues who do not conduct the interview should analyse the data. As they are not involved in the interview, these colleagues are far enough removed to be in a better position to understand what happened during the interview and therefore to draw out the lessons that are relevant to the research topic (Olivier de Sardan, 2009). This was the approach taken for the case study in Ethiopia, for which I analysed data that was collected by a Master's student. However, for the interviews I carried out for the case studies in Paraguay and Laos, I analysed the data myself, owing to a lack of human resources.

As most of the interviewees were men, it was difficult to minimise gender bias. Women play an important role in livestock farming, but the key stakeholders of the PPP we studied were from livestock farming representative bodies that are highly male-dominated, such as public Veterinary Services or producer associations. Time constraints meant that I had to focus on talking to the key PPP stakeholders, which prevented me from gaining a true picture of the reality of livestock farming and how it is affected by the PPP. Finally, the decision to use several case studies meant that time spent in the field in each country was limited, and this reduced our opportunity to gain an in-depth knowledge of local issues. These time constraints also prevented us from being able to help implement the changes recommended by the evaluation.

## **2. The concept of public–private partnerships in animal health**

Before the OIE's 'Public-Private Progress' project in 2017, there was no official definition of a PPP in animal health. In public health, some authors suggest that when the WHO institutionalised the use of PPPs at the end of the 1990s, it was seen as them supporting the idea of reducing the role of governments in health. This is thought to have influenced public health policy at both local and national levels (Baru and Nundy, 2008). It is possible, therefore, that the OIE's institutionalisation of animal health PPPs has had a substantial influence on Veterinary Service policies in Member Countries. Consequently, this part of the discussion aims to highlight the challenges of mobilising the PPP concept in animal health, particularly the challenges faced by an organisation such as the OIE. It also highlights the potential risks this entails, and the ways in which these risks can be prevented or limited through, for example, evaluation.

## 2.1 The range of initiatives that fall under the PPP concept

The PPP concept is widely used in a variety of different sectors covering a range of situations. In public health, the PPPs most often considered are global partnerships that involve the WHO and/or multinational enterprises that develop products such as new medicines or vaccines (Buse and Waxman, 2001; Guilbaud, 2015b). In agriculture, most PPPs involve the State outsourcing certain tasks, with the State entrusting the design, construction and maintenance of public infrastructure to large private companies (Maatala et al., 2017a). These types of PPP were not included in the OIE's 2017 census of PPPs involving Veterinary Services (Galière et al., 2019a). This is understandable, given that the duties of Veterinary Services do not generally include developing new products or building infrastructure (World Organisation for Animal Health, 2021).

Consequently, in the OIE's definition, PPPs in the veterinary domain include a variety of initiatives that can be categorised as type 1 'transactional', type 2 'collaborative' or type 3 'transformative', as illustrated by the four case studies in this thesis. In Paraguay, the primary driving force behind the PPP was the producer association<sup>8</sup>, which was involved in controlling foot and mouth disease for commercial reasons. The producer association existed before the creation of the Veterinary Services, which were established for the same principal reason, namely, to control foot and mouth disease. In Tunisia, the health mandate PPP was created in 2005, driven by the Veterinary Services, which wanted to improve vaccination coverage for priority animal diseases. In Ethiopia, the PPP is relatively new (2010), and the private sector uses the network of the local Veterinary Services to deliver vaccinated 45-day-old chicks to remote areas. This PPP contributes to the Ministry of Agriculture's objective of increasing the production and consumption of poultry in Ethiopia. It is also worth noting that, while in Paraguay, and more generally in South America, the term PPP (*alianza publica-privada*) is widely used in the veterinary domain, the term may make less sense in other social and political contexts. In the OIE database, it is possible that some initiatives may not be included, because the country concerned does not consider them to be a PPP. Similarly, in the literature review, only 14 PPPs were identified, but it is highly probable that some relevant initiatives were missed because the authors did not refer to them as a PPP.

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<sup>8</sup> The PPP stakeholders in Paraguay were almost exclusively men.

Finally, in the OIE definition, independent veterinarians are considered private partners in the same way as private companies. There is probably a risk in categorising all these different initiatives using the term PPP, because their power dynamics are very different. In public health, it has been highlighted that using the term PPP automatically implies that there are equal power relations between the organisations involved in the partnership. However, PPPs could have the potential to ‘disguise unequal power relations’ (Buse and Harmer, 2004). The term PPP can also imply that the objectives are neutral, obscuring the trade-offs and social choices that are required to implement the PPP. The history of the PPP in Paraguay showed that export-oriented cattle farmers (who represent only 15% of producers) played a major role in setting up the foot and mouth disease control programme.

We should also consider the effects of the institutionalisation of the PPP concept in the veterinary domain, notably by the OIE. In public health, authors point out that the World Health Organization’s endorsement of PPPs at the end of the 1990s affected the planning and implementation of public health policies at local and national level (Baru and Nundy, 2008). Therefore, in the animal health sector, it is possible that PPP endorsement by an organisation such as the OIE could influence the structure of Veterinary Services in Member Countries. It would be preferable, therefore, for the OIE to be careful not to create a ‘win-win’ narrative around PPPs, and that it remains attentive to the potential risks of these PPPs.

These differences between sectors and the wide variety of PPPs within the veterinary domain mean that we must be particularly careful to be precise when describing the PPPs under evaluation. At this stage in our research, even though the aim was to develop an evaluation framework for general use, we are not in a position to say that the integrated evaluation we propose in this manuscript is suitable for all types of PPPs for livestock health. It is possible that future studies will show that, for certain types of PPP, some of the criteria are not suitable or that other criteria need to be added.

## **2.2 PPP risks**

Through the literature review and case studies, this manuscript has shown the benefits of PPPs, and the risks. However, we did not carry out risk analyses for the cases studies, so it is possible that we did not identify some of the risks associated with the PPPs studied or that the risks that were identified were not given enough consideration.



### **2.2.1 The PPP risks that were identified in the case studies but not explored in detail**

In the Ethiopian case study, some farmers expressed concern that one of the PPP's indirect consequences for the livestock system would be the decline of local breeds in the national herd and a weakening of the fragile immunity of genetically improved breeds. We did not look at this concern in any further detail. However, it is important to maintain the genetic diversity of domestic animals in order to deal with future uncertainties, such as climate change and epidemics (Seré et al., 2008). Similarly, the risk of becoming dependent on international inputs, such as poultry genetics from large companies, was not explored.

In Paraguay, largely because the second round of field studies could not go ahead, two important risks could not be examined further. Firstly, the environmental risk associated with the pressure that livestock farming exerts on land use and deforestation. Thanks to the PPP, Paraguay has obtained OIE 'FMD-free with vaccination' status, which allows it to export its cattle products to several countries and makes livestock farming a financially attractive activity, and, as a result, the livestock population has reached 15 million, which puts pressure on land use and has consequences for the level of deforestation. The second risk is a societal risk, as the pressure on land use has consequences for the indigenous communities and smallholder associations that have been evicted from certain areas.

### **2.2.2 Risks identified in the literature review but not in the case studies**

The literature review identified risks for the private partner, risks for the public partner and the risk of promoting the interests of a few people to the detriment of the public interest.

The risk to the public partner is the potential weakening of the role of the public sector in its missions. In the case studies, the weakening of the public sector's role in formulating animal health policies was not addressed explicitly. In Paraguay, it seems that the private sector has always influenced animal health policies, even before the emergence of the public Veterinary Services. From an operational standpoint, the PPP in Paraguay has enabled the development of Veterinary Services at the local level, building on the structure of the local producer association. The PPP in Ethiopia has enabled Veterinary Services to build capacity in the field of avian health. While it seems that PPPs are certainly useful in improving the implementation of programmes, it is important to keep in mind when evaluating PPPs that they can also weaken the public sector's role in designing these programmes and that there are potential consequences for the public interest.

It is also important to ask ourselves if PPPs might increase the existing risk that Veterinary Services will falsify animal health data. Each OIE Member Country agrees to report the animal diseases that it detects on

its territory, including those that are transmissible to humans (the OIE has a list of approximately 120 notifiable diseases). Reporting outbreaks can have consequences in terms of obtaining a specific health status and thus has consequences for trade in animal products. Consequently, potential conflicts of interest within PPPs may mean that some disease outbreaks go unreported.

It has been pointed out that, in public health, donors can influence public policy and thus reduce the role of the public sector (Baru and Nandy, 2008). The indirect influence of donors could have been explored further in the case study in Ethiopia. EthioChicken is largely supported by external funding, such as that received from the Bill and Melinda Gates Foundation, and it is likely that its model reflects the ideology of these donors. Thanks to this support, EthioChicken has become a powerful player in the Ethiopian poultry industry. Through the PPP, it has links with the State, and it therefore has the power to influence public policy in the poultry sector. Consequently, by financing the PPP or the private partner, outside investors can influence a country's policies.

There can also be risks for private partners. In the PPP in Tunisia, veterinarians with a health mandate were not able to negotiate pay that they thought fair. In Paraguay, until very recently, the private sector could easily be excluded from the programme if there was a change in policy, thus preventing them from reaping the benefits of the financial and human resources they invested. This motivated the private sector to create a foundation, legally recognised, protecting them for 10 years.

Finally, there is the risk that conflicts of interest will influence the distribution of benefits in a way that is advantageous to a few individuals and detrimental to the public interest. The weakening of the public sector's role in veterinary services through the PPP could mean that powerful private actors could take on certain animal health activities. This is all the more likely because, over the last two decades, different livestock sectors have seen an increase in vertical integration, whereby the same company manages production, slaughter and sales. The poultry and pig sectors, for example, have seen an increase in economic concentration (HLPE, 2016). Through PPPs, these companies would be in an even better position to influence public policy for their own benefit, possibly to the detriment of the public interest. PPPs can also create conflicts of interest in the selection of projects, as they provide the means for private actors to access ring-fenced public funding (World Bank Institute, 2017).

In addition, according to the World Bank, PPPs come with the risk of corruption, that is, the use of public power for personal gain. This can happen if, for example, there is a lack of transparency in decision-making within the PPP (World Bank Institute, 2017). In Paraguay, the OIE Evaluation of the Performance of Veterinary Services in 2009 warned against the risk of the private sector having too great an influence on decision-making in the public sector (OIE, 2009). It is interesting, however, that for the Paraguayan partners in the PPP, this was seen as a means of fighting against the corruption of state actors, which appeared to be

endemic in the country (Miyamae, 2003). For example, the PPP enabled the creation of a fund for the foot and mouth disease programme that was not channelled through state structures, which, according to the PPP stakeholders, prevented funds from being diverted by politicians.

## **2.3 Risk prevention**

To counter these risks, it is vital to work towards ensuring the good governance of Veterinary Services. However, PPPs are established for the very purpose of strengthening the operation of Veterinary Services. However, the operational weaknesses to be addressed are often accompanied by governance deficits. It is, therefore, particularly important that process evaluation considers conflicts of interest, corruption, and the risk of weakening the public sector. Regular use of the process evaluation tool developed in chapter 3 could help to identify and mitigate these risks. However, a process of evaluation and gradual improvement will obviously not correct major power asymmetries between partners. To combat these asymmetries, the weaker partner would need support from outside the PPP framework, ideally before the PPP is implemented. Additional ways of preventing or correcting these risks were looked at in the discussion in chapter 3: in-depth analyses of the institutional capacity of each partner, the contract between the two parties, the legislative environment and the governance structure of the PPP. Complementary tools and resources can help with these analyses, particularly those of the OIE. The OIE Tool for the Evaluation of the Performance of Veterinary Services can identify the potential weaknesses of national Veterinary Services and help to prevent risks before and during the implementation of a PPP (World Organisation for Animal Health, 2019a).

The legal experts of the OIE Legislative Support Programme can carry out an in-depth analysis to make recommendations about how to strengthen the legal framework of a PPP (World Organisation for Animal Health, 2020a). While it is sensible to formalise the PPP with a contract, it is, for example, essential that the two parties are able to clearly defend their own interests by having the necessary degree of information symmetry during contract negotiations (Maatala et al., 2017a). Experts from the Veterinary Legislation Support Programme could also help Veterinary Services when a contract is being drawn up.

In general, in the veterinary domain, it is important to ensure that the idea that PPPs are ‘natural’, ‘inevitable’ or necessarily ‘win–win’ does not become the dominant discourse, which is what happened in public health (Buse and Harmer, 2004). In view of the issues mentioned above about the use of the term ‘partnership’, some forms of collaboration would benefit from replacing the idea of ‘public-private partnership’ with that of ‘public-private interaction’. This would prevent unequal power relations being hidden behind the term ‘partnership’, which implies a win-win relationship, and would encourage greater consideration of the diverging interests of each partner and of the opportunities, costs and risks of the collaboration (Buse and Harmer, 2004). Similarly, it would be more precise to use the term ‘global PPP’ when referring to PPPs involving international actors such as the OIE or multinational enterprises. These collaborations call for the development of specific evaluation frameworks and a suitable legal framework, taking into account the new power relations.

Given the public action dimension of PPPs, it is important to consider whether a PPP creates value for the public in relation to investment, but also to consider the distribution of this value among the different PPP stakeholders and, possibly, the industry concerned. In the veterinary domain, strengthening Veterinary Services can create public value. Consequently, strengthening Veterinary Services could be the first evaluation criteria in PPP evaluation. Similarly, when evaluating a PPP, it is always important to check that the PPP is in line with the priorities of the country’s Veterinary Services.

Finally, it will be necessary to continue the work undertaken in this manuscript, notably by continuing to identify potential risks associated with PPPs (health, economic, societal, environmental and governance risks) and by examining whether some risks are more common with certain types of PPP than with others. Identifying these risks could serve as the basis for developing an analysis grid that would facilitate risk analyses as part of the evaluation. If a risk analysis is carried out in advance of an evaluation, it can help draw attention to these critical points during the evaluation.

## **3 Evaluating PPPs in the veterinary domain**

### **3.1 Elements specific to PPP evaluations**

In the evaluation framework we propose, only the process analysis (chapter 3), for which we developed a tool, is specific to PPPs. Indeed, the context analyses (chapter 2) and the outcome and impact analyses (chapter 4) could very well be applied to other programmes that do not include PPPs. Our work can therefore be used as part of a broader evaluation framework for animal health programmes.

One other distinctive feature of PPP evaluation could be the analysis of added value. As mentioned in the introduction, the studies did not include the modelling of counterfactuals, and we will discuss these approaches in the section on recommendations for future research. However, we have nevertheless tried to address the issue of the added value provided by the PPPs in these studies. Two ways of doing this were proposed. The first was by looking the history of a PPP (chapter 2). Focusing on the different stages of the implementation of the programme in Paraguay showed that the PPP has always existed, even if its organisation and governance has evolved. All stakeholders, both public and private, said that the FMD control programme in Paraguay, and therefore its achievements, would not have been possible without the PPP. In this case, the added value and the benefits of the programme merge together. The second way of analysing added value was by using the impact pathway method (chapter 4). This focuses on understanding the causal relationships between the PPP's implementation and the outcomes and impacts. These causal links, identified by the stakeholders involved in the PPP and those impacted by it, provide assurance, to a certain extent, that the impacts identified are indeed attributable to the PPP.

### **3.2 Implementing the integrated evaluation framework**

We identified several difficulties in implementing the integrated evaluation framework. These difficulties can be illustrated using the case study of the PPP in Paraguay.

#### **3.2.1 Using the integrated evaluation framework**

The evaluation framework proposed in this manuscript can be used to carry out an integrated evaluation of livestock health PPPs. The first difficulty to mention is that implementing an integrated evaluation using the proposed framework is time consuming. For example, in none of our case studies was an integrated

evaluation carried out to completion, due to a lack of time and resources. Although we think that integrated evaluations are important for gaining a system-wide view of a PPP and thus being able to consider the interests of the different stakeholders, they may not always be possible. One of the purposes of programme evaluation is to meet the needs of the stakeholders concerned and it is completely possible that, depending on the evaluation questions set with the stakeholders, only one part of the analysis framework will be needed (for example, only a process evaluation or only an outcome evaluation).

We think this framework could serve as the basis for evaluating other PPPs, such as PPPs that are part of a One Health approach or PPPs for companion animals. Future research could use this framework for other PPPs and develop it to meet the specific needs of the PPPs being studied (for example, the need for financial profitability in companion animal programmes). However, for other PPPs, such as those that include international actors or those that involve the construction of infrastructure, this framework should be used with caution, as it does not address elements that are essential for these types of PPP (international legal framework, alignment of objectives with national priorities, long-term contracts, etc.).

### **3.2.2 Difficulties in considering environmental issues**

It is important to note that, in the case studies, PPP stakeholders rarely (if at all) mentioned the environment. For example, in Ethiopia, where the researchers did not bring up the issue of sustainability, no environmental impact was ever mentioned. In Paraguay, environmental considerations were only discussed if I mentioned them and, if I did, it aroused little interest. In fact, mentioning them caused most PPP stakeholders to become reticent and/or distrustful. The feeling that the countries in the Global North ‘persecuted’ countries in the Global South was mentioned several times. Following a UN tweet in March 2020 which said that we need to reduce our meat consumption to combat climate change, an ‘emergency’ meeting was organised in Paraguay’s capital to discuss ‘the truth about the bovine production sector and climate change’. It is notable that the Minister of Agriculture and the Head of the Veterinary Services were both in attendance.

Participants spoke of being ‘betrayed by the UN’ and referred to the ‘international lie about meat’. They also said ‘it is developed countries that are responsible for climate change, owing to their industrialisation’, and that it is the countries of the Global South that are ‘vulnerable and that suffer the consequences of climate change’. It is clear, then, why the attitude adopted by the evaluator, particularly if they come from a country in the Global North, is so important in ensuring that the stakeholders intended to benefit from the evaluation do not reject it. In this context, I thought it risky to organise co-construction workshops with stakeholders with totally opposing views (for example, PPP stakeholders and representatives from organisations campaigning for ‘zero deforestation’ laws). However, we think it is essential that the problem

of deforestation due to the expansion of cattle farming, along with other risks, is considered in an evaluation. We present ways of overcoming these difficulties in the recommendations for future research.

### 3.2.3 Participatory evaluation: Who participates? Who benefits?

The participatory element of the evaluation means that the results of this evaluation are influenced by the stakeholders who are evaluated and thereby by the power dynamics of these stakeholders. The question of whose opinions about the PPP are to be considered is crucial in participatory evaluation. Depending on who sets the PPP's boundaries – spatial, temporal and social – the answer to this question will be very different (Mathevet and Bousquet, 2014). The key stakeholders interviewed at the beginning of the evaluation can greatly influence the choice of who should be considered. In the Paraguay case study, it was the OIE delegate from the Veterinary Services that introduced me to the key actors in the PPP, and this had an influence when setting the boundaries for the system to be studied. For example, indigenous communities and poor farmers, including 'small farmers' could have been indirectly impacted by the PPP, because 'large farmers' play a role in the unequal distribution of land (Larrouqué et al., 2020), but it was difficult to include the former in the participatory approach, because the key stakeholders were reluctant to consider their views. It would not have been diplomatic to go beyond the boundaries that the PPP stakeholders had imposed on me, albeit implicitly, and I did not feel it was appropriate; at least, I did not feel that I had the necessary resources to do so.

Consequently, in the case of Paraguay, a participatory evaluation was not appropriate for several reasons (as mentioned in the introduction, we do not discuss evaluation for this case study)<sup>9</sup>. Firstly, the stakeholders themselves did not ask for an evaluation. They agreed to host us in order to show us how their PPP, which is considered a success by the OIE, functions. In addition, evaluation results that ignored the views of certain stakeholder groups would probably have reinforced the position of power held by the dominant stakeholders. Some authors suggest that participatory approaches that do not take account of the power structures in place risk reinforcing the existing power relations and thus legitimising the dominant groups of stakeholders (Hildyard et al., 2001; Rigon, 2014). This would mean that the latter would be able to exert even greater influence over the results of the participatory evaluation, to the detriment of marginalised groups (Barnaud and Van Paassen, 2013). For example, if it had been possible to organise a co-construction workshop (which

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<sup>9</sup> Although a participatory evaluation was not carried out, the numerous individual interviews with public and private actors, at national, regional and local levels, allowed us to test the evaluation framework and to look critically at the challenges and opportunities it presents. The report on the PPP's history has been sent to the stakeholders and we intend to send the the results of the analysis of the interviews in February.

had been due to take place during a second field visit), which would have been difficult diplomatically, it would have been necessary to consider how useful it would really be to invite groups of vulnerable stakeholders. In the context of land use in South America, and particularly in Paraguay, the weakest members of society are subjected to violence and extreme pressure (Larrouqué et al., 2020). With such asymmetry of power, disadvantaged groups impacted by the PPP (e.g. ‘small farmers’) have limited ability to voice their interests or have them addressed, which leads these groups to censor themselves during workshops. The risk would have been that only the opinions of dominant groups would have been captured (Rigon, 2014).

Furthermore, the participatory element of the evaluation, which attributes value to the perceptions of the stakeholders involved in and impacted by the PPP, may be met with some resistance from certain stakeholders, notably Veterinary Services, who are more used to quantitative approaches. Consequently, if the results of the evaluation do not go their way, PPP stakeholders may reject them, citing a lack of rigour or the presence of bias. Qualitative data do not have the same power of persuasion as quantitative data, despite being collected with the same level of rigour. In one of the case studies, after the initial results were reported, there was resistance on the part of key stakeholders at central level. The assumption is that the latter did not see the point in considering the opinions of regional stakeholders, let alone in co-constructing recommendations with them.

### **3.2.4 The normative elements of the evaluation framework**

The last few points highlight the tensions that can arise when the normative elements of the proposed evaluation procedure come into conflict with the power dynamics of the stakeholders involved in the evaluation. The evaluation procedure proposed in this thesis has two important normative elements. Firstly, the sustainability framework chosen to orient PPP evaluation may reveal tensions between economic issues on the one hand and social justice and environmental issues on the other. It should be noted that the sustainability framework was not a requirement of the project that this thesis forms part of, but it was used by the research team, primarily for the purpose of responding to the challenges of the One Health approach, of which the OIE is a proponent. It should also be noted that the PPPs in the case studies, which had been in place for several years, probably like most PPPs, concluded agreements on health issues outside the sustainability framework

Secondly, the systemic participatory approach appears normative in that it seeks to address the system’s different power levels (Chambers, 1997). It is also normative in that it attributes value to what the stakeholders say and, therefore, to their feelings and their perceptions of situations.



It is essential that the evaluation be voluntary and that the request should come from the PPP's stakeholders. The role of the evaluator is to bring an outside eye to the PPP to enable PPP stakeholders to identify areas for improvement. If the sustainability framework is used, it is possible that stakeholders will not ask for evaluation, which would be a negative thing in terms of achieving health goals. This raises the question of the extent to which the evaluator will use certain principles in the participatory evaluation (e.g. the sustainability framework or taking vulnerable people into account).

### **3.2.5 The ethical dimension of evaluation**

However, from an ethical point of view, it is important that PPP evaluations find a way to consider the environmental and social impact on vulnerable groups.

It is important to note that, if the request for an evaluation is made to the OIE, the beneficiaries of the evaluation will be public Veterinary Services and their private partners. The latter may be in a position of power in relation to vulnerable or marginalised groups, or simply regional and local-level actors. Consequently, the evaluator has choices to make regarding the evaluation frameworks used, the boundaries of the PPP, the stakeholders who should be considered in the evaluation and the implementation procedures, all of which will influence the evaluation outputs. The initial phase of the context analysis and the process of setting the boundaries of the PPP is, therefore, crucial in ensuring that, on the one hand, the evaluator is not exploited, and, on the other, that s/he does not makes any diplomatic errors. In some contexts, it could be that a participatory evaluation is not appropriate. It seems to me that even if participatory approaches are used to take into account the views of the most vulnerable (for example, through individual interviews with these groups), there is a risk that the recommendations of these evaluations will be rejected and that, ultimately, they will not bring about change. For ethical reasons, some researchers reject the idea of taking a neutral stance; instead, they choose to help strengthen the capacities of the most vulnerable, hoping to promote equity and sustainability (d'Aquino, 2002). However, if they do this, there is a risk that the results of the evaluation will not be accepted at central level, and so it is critical that evaluation be used as part of a longer-term process, perhaps as a support tool. This is referred to in the section on the possible uses of evaluation in the future.

## 4 Applying the research

As this thesis was part of an OIE project, the organisation put it to use straightaway. The literature review and the case study in Ethiopia informed the development of certain sections of the OIE PPP Handbook (World Organisation for Animal Health, 2019b). The process evaluation tool enabled the OIE to respond to a request for an evaluation from the Tunisian Veterinary Services. This tool was presented in an online course developed by the OIE and the European Commission for the Control of Foot-and-Mouth Disease (EuFMD)<sup>10</sup>. Data from this thesis was also used to develop the second phase of the project, which was led by the OIE in collaboration CIRAD.

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<sup>10</sup> The course is called ‘Public-Private Partnerships: Opportunities for Progressive Control of Transboundary Animal Diseases’, and it includes a module on PPP evaluation: <https://rr-europe.oie.int/en/online-training-e-learning/>

One of the ambitions of this project is to provide help to countries who, following an evaluation of the performance of their Veterinary Services, have been advised to strengthen PPPs. The Tool for the Evaluation of the Performance of Veterinary Services (PVS Tool) is an OIE flagship programme. A PVS evaluation is carried out following a request from countries wishing to strengthen their Veterinary Services. Targeted support for PPPs can take the form of an evaluation of a PPP already underway or an evaluation designed to provide support for planning a new PPP. The evaluation framework put forward by this thesis could be used to provide this support. Work on another thesis began in November 2021 as part of the second phase of the project. This thesis will look at PPP cost analysis and the quantification of the benefits, risks and impacts of PPPs. Initial ideas for indicators have been proposed at the end of chapter 4, but they do not cover environmental factors. Example indicators should be provided, but they must be able to be adapted for each PPP, depending on the local context. It will also be interesting to think about how impacts can be linked to the quality of the process and how we can provide recommendations at organisation level in order to improve impacts.

In addition, a database, hosted by the OIE website, is being developed. This database aims to catalogue the different PPPs around world, starting with those already identified in the 2017 online survey, and to share various elements. It will be freely accessible and could be a source of inspiration for anyone thinking about implementing a PPP or looking for ideas as to how to improve a PPP. The case studies in this thesis provide detailed descriptions of different PPPs that could be useful for stakeholders in other PPPs. However, it is possible that, for some case studies, partners will oppose the publication of PPP evaluation results if they mention any risks or other negative points. There is often a conflict between, on the one hand, the need to share evaluation results so that lessons can be learned more widely and, on the other, the need to ensure confidentiality for those who asked for the evaluation.

It could also be envisaged that any actor, even if not involved in a PPP, could contribute to this database, providing information about the PPPs in their localities and the perceived benefits and risks.

## 5 Recommendations

### 5.1 Possible uses of evaluation: evaluation as a support tool

Our work has highlighted several difficulties in operationalising the integrated evaluation framework, and, while internal evaluations aim to bring about changes to the evaluated PPPs, change does not happen automatically. It would seem that ‘one shot’ evaluations have very little chance of resulting in change. Consequently, the role of evaluation, requested by PPP stakeholders, could be one of ongoing support.

This support could be led by an interdisciplinary team of evaluators and researchers, ideally involving local people. It would be difficult for a single evaluator to provide a system-wide view of the PPP, even if using participatory approaches. This interdisciplinary team could regularly use the integrated evaluation framework, not to provide ‘turnkey’ solutions, but to be able to provide rigorous data on the PPP’s contribution to sustainability, and to discuss them with stakeholders (Papazian et al., 2017). In addition, evaluation as a means of long-term support will make it easier to allow for an exchange of views between stakeholders from different hierarchical levels with asymmetrical power, both those involved in the PPP and those affected by it. Thus, evaluation could include an element of conflict management (ComMod, 2005). Instead of promoting a non-confrontational approach, this could allow for a genuine consideration of the challenges faced by the most vulnerable groups and could potentially have an influence on the organisation of the PPP being evaluated. The evaluation could then be a vehicle for change towards greater sustainability (Brousselle and Butzbach, 2018; Brousselle and Guerra, 2017).

The OIE could also consider creating regional networks of actors involved in PPPs, based on the OIE Regional Representations (Africa, Americas, Asia and the Pacific, Europe, Middle East). These networks would encourage countries to carry out evaluations of each other’s PPPs. For example, stakeholders from the PPP in Paraguay, trained in participatory approaches in advance, could evaluate the FMD-control PPP in Bolivia, and vice versa. These evaluations could be guided by the framework proposed here. For example, the process evaluation tool criteria could help stakeholders share their experiences as regards PPP organisation and structure. This co-learning approach could benefit both countries concerned.

## **5.2 Recommendations for future research: improving the integrated evaluation framework for PPPs**

### **5.2.1 Testing the evaluation framework on other PPPs, developing the framework further and analysing risks**

In this thesis, only PPPs implemented in countries of the Global South were studied. It will be interesting to study animal health PPPs in countries in the Global North. We will then be able to check if the criteria used by the process evaluation tool remain relevant and comprehensive enough and if the impacts are similar. It could also be that participatory approaches are received differently in these countries, which could influence the evaluation process.

In addition, the PPPs in the case studies in Ethiopia and Paraguay were already considered to be successful, and this may have influenced the criteria selected in the process evaluation tool and affected the impacts identified. In public health, it has been shown that successful PPPs are more likely to be mentioned in the literature, creating a positive bias in PPP analysis (Donald A., Barr, 2007). It will be important to also look at PPPs that were created but stopped. Similarly, it will be important to look at those that did not achieve their objective and to consider the cause of their failure. Studying these PPPs could identify new evaluation criteria, particularly new obstacles and risks, and could lead to further development of the framework proposed in this manuscript. As mentioned previously, a grid to facilitate a risk analysis before the PPP evaluation could be developed.

### **5.2.2 Combining the framework with evaluations at local level, individual level and at the level of stakeholder networks**

The evaluation approach proposed in this thesis focuses on effects at national level, that is, it focuses on the effects on society or a group of people across a country. Thus, in Paraguay, the evaluation was at national level, that is, the level at which the PPP was implemented. However, socio-ecosystems in the Chaco region (wooded plain on the borders of Bolivia and Brazil) is very different from that of the Neembucu Sur region (humid zone on the border with Argentina). The way in which livestock farming is integrated into these systems is therefore very specific to each region. It should be noted that, taking regional specificities into account in the evaluation would have required more resources and more time. However, it is something that could be envisaged, particularly in view of the OIE's zoning and compartmentalisation policies, which make it possible to recognise the official health status of a specific region within a country.

International-level influence could also be examined in more depth. For example, for the case study in Paraguay, it would be interesting to look at the influence of the policies of the Veterinary Services in Argentina and Brazil (neighbouring countries) or the policies of the Pan American Center for Foot and Mouth Disease (PANAFTOSA). It would also be interesting to consider the influence of the European Union and its health requirements for meat imports or the influence of the OIE and its performance evaluations and its role as the organisation that provides official recognition of disease status.

We were able to record the perceptions of individual groups of stakeholders, and this enabled us to form a global picture of the scope of the PPPs in question, but this systemic approach could overlook the importance of the decision-making processes of PPP stakeholders and the importance of the factors that influence them, such as the power relations between them. It is important, however, to look at the individual level in an evaluation, because stakeholders are the heart of any PPP, and their decision-making processes influence its organisation and its scope. For example, for a PPP to succeed, it is essential that producers adopt and use the measures put forward in the context of a programme such as an animal health PPP (Chilonda and Van Huylenbroeck, 2001). Therefore, to be able to make recommendation for improving a PPP, it is important to try to understand how farmers decide whether or not to get involved in a PPP. Looking at the individual level is not only important for farmers, it is important for all stakeholders involved in the PPP, whether directly or indirectly. In order to do this, we think it would be useful to use the livelihoods approach, which is a person-centred approach (United Nations Development Programme, 2015) (**Appendix 2**).

A stakeholder's decisions are also influenced by interactions with other stakeholders whose objectives, perceptions, knowledge and power are different (Mathevet and Bousquet, 2014). A stakeholder's involvement in a livestock health PPP depends on their involvement in the network of animal health stakeholders (for example, their confidence in the veterinary structure, the influence of other farmers, etc.). In PPP evaluation, it would be interesting to look at the social relationships and power dynamics of the stakeholders, which were only partially addressed in this thesis. An evaluative analysis of social networks would also be interesting (**Appendix 3**).

In public health, it has been highlighted that the power dynamics within PPPs were rarely analysed, as it was assumed that the PPP's stakeholders and organisations were equal in power. As we mentioned previously, analyses resulting from participatory approaches can have a tendency to 'flatten' the power relations between PPP stakeholders. Analyses that focus on power dynamics could inform evaluation. In PPPs, power can be exercised on the basis of coercion (political or financial), authority or legitimacy. One way of analysing the distribution of power is by looking at the agreements and contracts between partners or the composition of management committees and boards of directors, who are often the principal decision-makers (Buse and Harmer, 2004).

### **5.2.3 Cost analysis**

This thesis did not address PPP cost evaluations or budgetary analyses. Future research could look at the different operating costs of the PPP, where the finance comes from, and how the PPP creates financial value. It will be important to consider creating value in terms of the resources invested, but also to look at the distribution of financial benefits between the public and private partners. The World Bank has published detailed guidelines on how to identify the true costs of collaboration and to weigh these costs against the benefits (World Bank Institute, 2017). It is likely that, depending on the type of PPP being evaluated and the type of private partners involved (private veterinarians, producer associations or businesses), specific cost evaluations will need to be developed. For example, in the case of type 3 PPPs, known as ‘transformative’ PPPs, it will be necessary to carry out a parallel analysis of the industry that the PPP is concerned with. This industry analysis will make it possible to calculate the costs and benefits of the PPP and the financial margin for each type of actor in the industry, both those from the public sector and those from the private sector, and to determine the distribution of the costs and benefits between these actors.

### **5.2.4 Taking into account knowledge of PPPs in other domains and counterfactuals**

This thesis took inspiration primarily from the criteria and methodologies developed to evaluate PPPs in public health. However, future research could look at frameworks used in other sectors, particularly agriculture. As mentioned in chapter 1, an important limitation in the field of evaluation research is that evaluations are not always published, so researchers should consider carrying out a study of the grey literature on unpublished animal health PPPs.

We did not develop counterfactuals for any of the studies in this thesis. However, other authors consider it essential to include a counterfactual to carry out an impact evaluation. Using a counterfactual makes it possible to compare the outcomes observed with the outcomes we might have expected if the intervention had not been carried out (the counterfactual). This helps us understand what caused these outcomes.

There are three groups of options for developing counterfactuals. Experimental options involve developing a counterfactual using a control group, as in a randomised control trial. To do this, we need to ‘allocate’ participants randomly to either a group where the intervention is implemented or to a control group. However, we do not consider this an option for evaluating PPPs that have been in place for a long time.

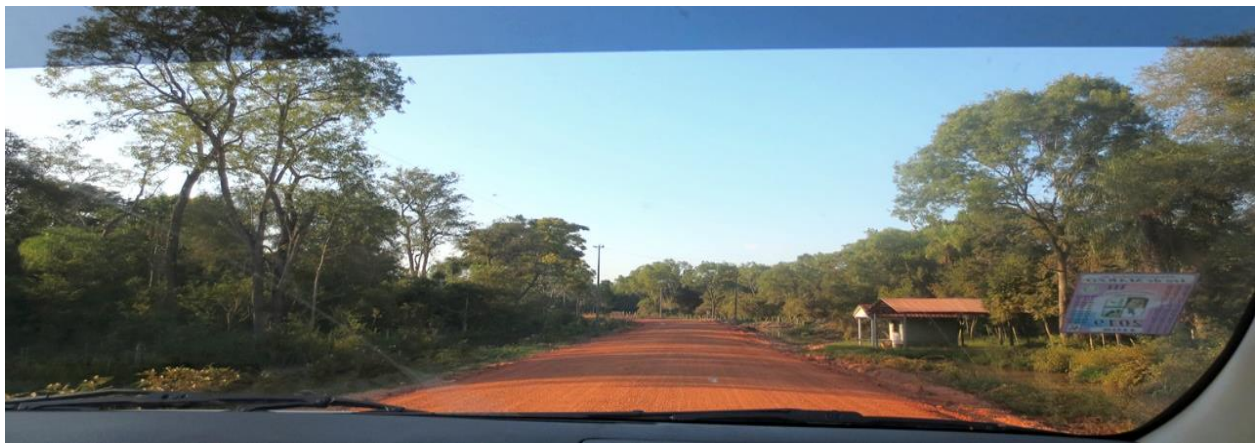
Quasi-experimental options develop a counterfactual by using a comparison group that has not been created at random. For example, the ‘difference in difference’ technique compares the before and after differences for the group where the PPP intervention was implemented and those for the group where the intervention was not implemented. For these options, there need to be people who do not benefit from the interventions of a PPP. In Paraguay, this was not the case, because vaccination is obligatory and all farmers must vaccinate their cattle.

Finally, the non-experimental options use a hypothetical prediction about what would happen in the absence of a PPP. This prediction can be made by key informants or from a logically constructed counterfactual that uses a baseline as an estimate of the counterfactual.

### **5.2.5 Taking environmental considerations into account in PPP evaluation**

Environmental considerations were not looked at in detail in this thesis. To consider environmental factors in the evaluation of animal health PPPs, it would be useful to carry out lifecycle analyses (Bennett et al., 2019). These analyses would provide elements and indicators that could be used to co-construct recommendations for the PPP, with the aim of reducing its potentially negative indirect effect on the environment. **Appendix 1** uses the case study in Paraguay to propose a draft protocol and imagine what data would have been necessary, but also the challenges that this might have presented, particularly for the co-construction of recommendations. Environmental issues could also be considered in *ex ante* evaluations, for example, before implementing animal health programmes, including PPPs, in order to look at the long-term effects of these programmes. If it is researchers or the OIE that suggest these *ex ante* evaluations, it will be important to take care not to exacerbate tensions and feelings of inequity between **countries of the Global North and those of the Global South**.





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# Parallel activities and dissemination of the research

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## *Parallel activities*

### **Projects related to the environmental impact of research**

While the environmental costs of research would seem to be quite a departure from the topic of this thesis, I would like to consider them in relation to research practices. Although the fight against global warming is at the heart of sustainability sciences, the environmental impact of research is rarely considered (Scerri et al., 2020; Verdier et al., 2020). However, to have a chance of limiting global warming to 2°C, each individual must not ‘spend’ more than 2 tonnes of carbon dioxide equivalent per year (IPCC, 2018). If they do, it will be at the expense of the most disadvantaged people and to the detriment of future generations (Carbone4, 2019). In the course of preparing this thesis, there was sometimes a clash between my research objectives and my desire to reduce my environmental impact.<sup>11</sup> I am not an isolated case. For example, while carrying out their research, staff at CIRAD spend an average of 7 tonnes of CO<sub>2</sub>-equivalent per year. If there is to be any hope of significantly reducing greenhouse gas emissions, change must be collective (Carbone4, 2019), but research institutions have taken little action to improve the way they operate (Anderson, 2013). But different people from the world of research are coming together to reduce the carbon footprint of their work (Labos 1point5, 2019). It would seem that there are several questions that must be debated collectively: How can we work together to reduce the environmental impact of research? Which journeys are really necessary? How do we promote equality between young members of the academic community and older academics? And, how can we use new practices to reduce the power asymmetry between researchers in the Global North and those in the Global South.

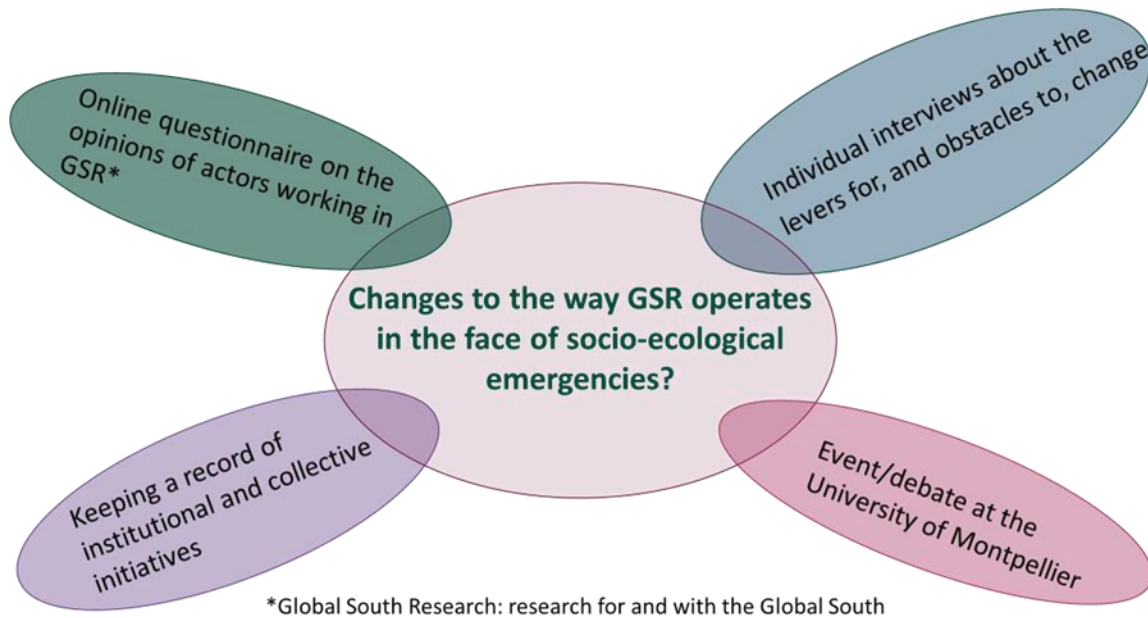
At the University of Montpellier, an interdisciplinary research project is being conducted to better understand the different individual opinions and the collective and institutional positions on these issues. The aim is to support the emergence of a scientific community capable of problematising the role of research in the face of these environmental challenges, particularly research carried out in conjunction with developing and emerging countries in the Tropics (DiFUSE, 2021).

- Co-leader of the DiFUSE project ‘understanding the variety of viewpoints in research carried out in conjunction with the Global South as a lever for change in the face of socio-ecological emergencies’ - Maison des Sciences de l’Homme (MSH), SUD, CIRAD, IRD (*Institut de recherche pour le développement* – the National Research Institute for Sustainable Development), University of

<sup>11</sup> Was it necessary for me to go to Guinea to take part in a training course on participatory approaches (2.25 tonnes of CO<sub>2</sub>), to Indonesia to help implement a participatory PPP workshop (7.3 tonnes of CO<sub>2</sub>), to New Orleans to take part in a conference (4.5 tonnes of CO<sub>2</sub>), to Tunisia to the regional workshop on PPPs organised by the OIE (2.1 tonnes of CO<sub>2</sub>), or to Paraguay in 2020 for a 3-month field mission (7 tonnes of CO<sub>2</sub>)?

Montpellier. A budget of €10,000. <https://www.mshsud.org/recherche/equipes-projets-msh-sud/239-difuse>.

**Figure 1: Activities of the DiFUSE project**



- Led 3 sessions on the collaborative serious game ‘My planet in 180 minutes’, and conducted training for future facilitators after having been trained myself. This game has been created by actors from the academic world to develop scenarios for reducing its carbon footprint: <https://materre.osug.fr/>
- Participated in a working group of CIRAD’s RSO Unit to develop a mobility charter [the RSO Unit focuses on the social responsibility of organisations].

### **Participation in preparing the ‘Resilience of Wallonia’ congress**

I was involved in preparing and leading working groups at a congress on the ‘Resilience of Wallonia in the face of environmental risks’. The congress was organised at the request of the Walloon Minister for Sustainable Development, Céline Tellier, and was jointly presided over by Professors Maria Mancilla Garcia (Free University of Brussels) and François Gemenne (University of Liège). I was in charge of working group no. 1, ‘The role of advanced preparation’. In addition, together with a representative from the Directorate for Sustainable Development of the Government of Wallonia, I prepared and led meetings of a dozen or so actors from the public and private sectors, from the academic world and from civil society. These three meetings produced a working document containing suggested recommendations for the Walloon government regarding methodologies and governance. These were presented and debated at the congress on 3 December. The report can be accessed from this website: <https://developpementdurable.wallonie.be/congres-resilience>

# ***Publications***

## **Scientific Publications**

### Published articles:

- **Poupaud M**, Putthana V, Patriarchi A, Caro D, Agunos A, Tansakul N, et al. Understanding the veterinary antibiotics supply chain to address antimicrobial resistance in Lao PDR: Roles and interactions of involved stakeholders. *Acta Tropica*. 2021;220: 105943. doi:10.1016/j.actatropica.2021.105943
- **Poupaud M**, Antoine-Moussiaux N, Dieuzy-Labaye I, Peyre M. An evaluation tool to strengthen the collaborative process of the public-private partnership in the veterinary domain. Aslam B, editor. *PLoS ONE*. 2021;16: e0252103. doi:10.1371/journal.pone.0252103
- N’Guessan BN\*, **Poupaud M\***, Dieuzy-Labaye I, Asfaw YT, Wieland B, Tesfu F, et al. Evaluation of public-private partnership in the veterinary domain using impact pathway methodology: in-depth case study in the poultry sector in Ethiopia. *Front. Vet. Sci*. doi: 10.3389/fvets.2022.735269 \* ***These authors contributed equally to this work have and share first authorship.***
- Galière M, Peyre M, Muñoz F, **Poupaud M**, Dehove A, Roger F, et al. Typological analysis of public-private partnerships in the veterinary domain. Clegg SR, editor. *PLoS ONE*. 2019;14: e0224079. doi:10.1371/journal.pone.0224079

### Article submitted for peer review:

- **Poupaud M**, Galière M, Dieuzy-Labaye I, Antoine-Moussiaux N, Peyre M. Evaluation of public-private partnerships in the veterinary domain: a scoping review.

## **Non-peer-reviewed publication**

- **Poupaud, M.**, N’Bocho Guessan, B., Dieuzy-Labaye, I., Peyre, M., 2019. Engaging the actors to ensure impacts of public-private partnerships. *OIE Bull.* URL <https://oiebulletin.com/?panorama=03-6-2019-3-impact-evaluation>

**Institutional reports and reports for partners**

- Report on the history of a PPP for the control of foot and mouth disease in Paraguay « La historia de la asociación público-privada para el control de la fiebre aftosa en Paraguay », November 2021, **M. Poupaud**. *Report sent and presented to public (veterinary services) and private (producer association) stakeholders*
- Evaluation Report of a PPP for Poultry Sector Development in Ethiopia « Impact assessment of Ethiochicken innovative business model », December 2019, **M. Poupaud**, M. Peyre, B.N'guessan, I. Dieuzy-Labaye, B.Wieland. *Report sent and presented to public (Ministry of Health and Agriculture) and private (poultry producers) stakeholders*
- Participation in the report “The OIE PPP Handbook : Guidelines for Public-Private Partnerships in the veterinary domain”, October 2019, coordinated by Isabelle Dieuzy-Labaye (OIE), with the help of Nigel Gibbens (Itinerant Vets), Marisa Peyre (CIRAD) and the participation of 42 experts from the public and private sectors.
- Report of the Food and Agriculture Organization of the United Nations (FAO) “Baseline review of practices of veterinary antibiotics use in Lao PDR, including gap analysis and stakeholder mapping, march 2018- august 2018”. Contractor: Flavie Goutard; Research team: **M Poupaud**, V Phouthana, T Lacksivy, S Keopaseuth, N Soulinthone, K Phomvixay, M Vangxeng.

## *Oral communications*

### **International conferences in oral presentation**

- “**International Society for Economics and Social Sciences of Animal Health (ISESSAH) Conference 2021**”, November 2021, Malaysia, online edition. “Participatory evaluation to strengthen public-private partnerships in the veterinary domain”
- “**4th Global food security**” conference, September 2020, Montpellier, online edition. « Participatory evaluation to strengthen public-private partnerships related to animal health ».
- “**Society for social studies of science-4S annual meeting 2019: innovations, Interruptions, Regenerations**”, New Orleans, USA, September 2019. « *The diversity of impacts brought by sound implementation of public-private partnerships in the Veterinary Domain* ».
- “**Society for social studies of science-4S annual meeting 2019: innovations, Interruptions, Regenerations**”, New Orleans, USA, September 2019. « *Mapping and analysis of stakeholders involved in the supply chains of antibiotics in Lao* ».
- “**5th Food Safety Zoonoses Symposium for Asia Pacific**”, Chiang Mai, Thailand, 2018. “*Use of stakeholders mapping and analysis to explore the food animal drugs supply chain in Lao PDR*”

### **Participation in the facilitation of a workshop at a conference**

- Conference: “**Society for Veterinary Epidemiology and Preventive Medicine SVEPM Annual conference, online 2021**”. Workshop: “Exploring drivers of change in Antimicrobial Usage through participatory methods”. Presentation: “Stakeholders mapping and analysis: application in Laos” (M. Poupaud, V. Phouthana)

### **National conference, oral presentation**

- Printemps de baillarguet, Montpellier, France, 2019 « The diversity of impacts enabled by the implementation of public-private partnerships in the veterinary field»



## ***Experience sharing and mentoring***

### **Interventions in master courses**

Sharing experiences on the mobilisation of interdisciplinary and participatory approaches in Aurélie Binot's course modules "anthropology of health" and "integrated approaches to health":

-for students in the specialised master's degree in 'Integrated Management of Tropical Animal Diseases' (GIMAT) at CIRAD and the Toulouse National Veterinary School in 2020 and 2021

-for students of the master's degree in 'Integrated Management of Health Risks in Southern Countries' (GIRISS) from the University of Liège in 2019 and 2020

- for students of the master's degree 'Management and surveillance of Parasitic and Infectious Emergencies' of the University of Montpellier in 2021

### **Co-supervision of trainees**

-Anissa Dhaoui, OIE-Cirad project, evaluation of veterinary health mandate in Tunisia

-Abdoulaye Baradji, Di-FUSE project, analysis of survey data

### **Participation in a jury for the defence of a Master 2 thesis**

-Master 2 InterRisk, University of Kasetsart-Faculty of Veterinary Sciences and National Polytechnic Institute of Toulouse-National Veterinary School of Toulouse « *effectiveness of pork safety intervention at traditional markets in Cambodia* »

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# Appendices

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## *Appendices to Chapter 1*

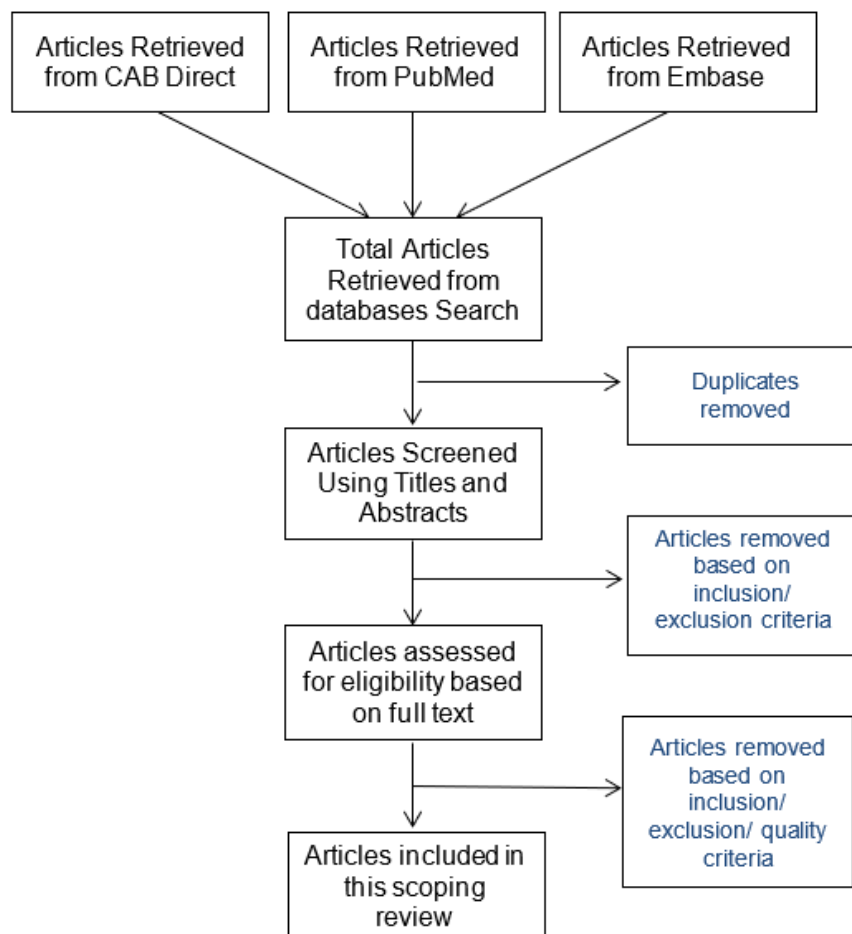
### Appendix 1. Protocol of the review process

#### a. *Search of Online Databases*

- Choosing keywords for search strings
- Search using three databases: Medline via PubMed, Cab Abstract via Ebsco, and Embase
- Include also the database of the World Organisation for Animal Health

#### b. *Steps to review*

- Use equation request for searches in PubMed, CAB Abstract, and Embase
- Import references into reference manager
- Delete duplicates
- Screen articles based on title and abstracts according to inclusion/exclusion criteria
- Remove excluded articles
- Retrieve full papers of “included articles”
- Documents are then assessed based on the full text by researchers according to inclusion/exclusion criteria
- Data extraction using template



**Figure 1 of Appendix 1.** Flow diagram representing the different steps for the identification of relevant studies



**c. Concepts used in the search equation**

Three concepts should be mobilized:

1. Public-private partnership
2. Veterinary domain (restricted to services or product delivery for surveillance, prevention, or control of zoonotic or animal contagious diseases)
3. Public health (restricted to services or product delivery for surveillance, prevention, or control of zoonotic or human contagious diseases).

Data base	<b>1. Public-Private Partnerships</b>
PubMed <i>(thesaurus based on MesH® terms)</i>	"Public-Private Sector Partnerships"[Mesh]
CAB abstract <i>(free language)</i>	"Partnership, Public-Private Sector" OR "Partnerships, Public-Private Sector" OR "Public Private Sector Partnerships" OR "Public-Private Sector Partnership" OR "Public Private Sector Partnership" OR "Partnership, Public Private" OR "Partnerships, Public Private" OR "Private Partnership, Public" OR "Private Partnerships, Public" OR "Public Private Partnerships" OR "Public-Private Partnership" OR "Partnership, Public-Private" OR "Partnerships, Public-Private" OR "Public-Private Sector Cooperation" OR "Cooperation, Public-Private Sector" OR "Public Private Sector Cooperation" OR "Public-Private Sector Cooperations" OR "Public-Private Cooperation" OR "Cooperation, Public-Private" OR "Public Private Cooperation" OR "Public-Private Cooperations"
Embase <i>(thesaurus based on Emtree® term)</i>	'public-private partnership'/exp
Data base	<b>2. Public Health (services or product delivery for surveillance, prevention, or control of zoonotic or human contagious diseases)</b>
PubMed <i>(thesaurus based on MesH® terms)</i>	Zoonoses[Mesh] OR "Epidemiology"[Mesh] OR "Preventive Medicine"[Mesh] OR "Disease Eradication"[Mesh] OR "Disease Transmission, Infectious"[Mesh] OR "Endemic Diseases"[Mesh] OR "Communicable Disease Control"[Mesh] OR "Population Surveillance "[Mesh] OR "Primary Prevention"[Mesh] OR "Secondary Prevention"[Mesh]
CAB abstract <i>(free language)</i>	"public health" OR "community health" OR "community health program" OR "community health programme" OR "health, public" OR "international health" OR "national health" OR "national health programmes" OR "national health programs" OR "national health project" OR "Health, Community" OR "Epidemiology" OR "Social Epidemiology" OR "Epidemiologies, Social" OR "Epidemiology, Social" OR "Social Epidemiologies" OR "Preventative Medicine" OR "Medicine, Preventative" OR "Medicine, Preventive" OR "Preventive Care" OR "Care, Preventive" OR "Preventative Care" OR "Care, Preventative" OR "communicable disease control" OR "disease elimination" OR "disease re-emergence" OR "mandatory testing" OR "mass immunization" OR "Disease Eradications" OR "Eradication, Disease" OR "Eradications, Disease" OR "Disease Eliminations" OR "Elimination, Disease" OR "Eliminations, Disease" OR "infectious disease medicine" OR "Disease Transmission, Infectious" OR "Pathogen Transmission" OR "Transmission, Pathogen" OR "Transmission, Infectious Disease" OR "Infectious Disease Transmission" OR "Communicable Disease Transmission" OR "Disease Transmission, Communicable" OR "Transmission, Communicable Disease" OR "Infection Transmission" OR "Transmission, Infection" OR "Transmission of Infectious Disease" OR "Infectious

	Disease Transmission, Horizontal” OR “Horizontal Transmission of Infectious Disease” OR “Pathogen Transmission, Horizontal” OR “Horizontal Transmission of Infection” OR “Infection Horizontal Transmission” OR “Infection Transmission, Horizontal” OR “Community Transmission” OR “Community Transmissions” OR “Transmissions, Community” OR “Community Spread” OR “Person-to-Person Transmission” OR “Person to Person Transmission” OR “Transmission, Person-to-Person” OR “Droplet Transmission of Infectious Disease” OR “Droplet Transmission, Infectious Disease” OR “Infectious Disease Droplet Transmission” OR “Autochthonous Transmission” OR “Autochthonous Transmissions” OR “Transmission, Autochthonous” OR “Transmissions, Autochthonous” OR “Close-Contact Transmission” OR “Close Contact Transmission” OR “Close-Contact Transmissions” OR “Transmission, Close-Contact” OR “Close-Contact Infectious Disease Transmission” OR “Close Contact Infectious Disease Transmission” OR “Endemic Diseases” OR “Disease, Endemic” OR “Diseases, Endemic” OR “Endemic Disease” OR “” OR “Public Health Practice[Mesh]” OR “Communicable Disease Control, Population Surveillance, Primary Prevention, Secondary Prevention, “ OR “Health Practice, Public” OR “Health Practices, Public” OR “Practice, Public Health” OR “Practices, Public Health” OR “Public Health Practices” OR “Mass drug administration” OR “” OR “Zoonosis” OR “Zoonoses” OR “Zoonotic Infectious Diseases” OR “Disease, Zoonotic Infectious” OR “Diseases, Zoonotic Infectious” OR “Infectious Disease, Zoonotic” OR “Infectious Diseases, Zoonotic” OR “Zoonotic Infectious Disease” OR “Zoonotic Infections” OR “Infection, Zoonotic” OR “Infections, Zoonotic” OR “Zoonotic Infection” OR “Zoonotic Spillover” OR “Spillovers, Zoonotic” OR “Zoonotic Spillovers” OR “Zoonotic Diseases” OR “Disease, Zoonotic” OR “Diseases, Zoonotic” OR “Zoonotic Disease”
Embase (thesaurus based on Emtree® term)	'public health'/exp OR 'epidemiology'/exp OR 'preventive medicine'/exp OR 'disease control'/exp OR 'infectious disease medicine'/exp OR 'primary prevention'/exp OR 'secondary prevention'/exp OR 'mass drug administration'/exp OR 'zoonosis'/exp
Data base	<b>3. Veterinary domain (services or product delivery for surveillance, prevention, or control of zoonotic or animal contagious diseases)</b>
PubMed (thesaurus based on MeSH® terms)	"veterinary" [Subheading] OR "Animal Diseases"[Mesh] OR "Pets"[Mesh]OR "Animals, Wild"[Mesh] OR "Veterinarians"[Mesh]
CAB abstract (free language)	“Veterinary Practice Management” OR “Practice Management Services, Veterinary” OR “Practice Management, Veterinary” OR “Practice Management Services, Veterinary” OR “animal care hospital” OR “animal hospital” OR “hospitals, animal” OR “military veterinary service” OR “veterinarian clinic” OR “veterinarian hospital” OR “veterinary care clinic” OR “veterinary care hospital” OR “veterinary hospital” OR “veterinary practice” OR “veterinary service” OR “veterinary service, military” OR “veterinary medicine” OR “Medicine, Veterinary” OR “legislation, veterinary” OR “Veterinary Legislation” OR “Legislations, Veterinary” OR “Veterinary Legislations” OR “Societies, Veterinary” OR “Veterinary Society” OR “Society, Veterinary” OR “Veterinary Societies” OR “Veterinary Hospital Societies” OR “Hospital Societies, Veterinary” OR “Hospital Society, Veterinary” OR “Societies, Veterinary Hospital” OR “Society, Veterinary Hospital” OR “Veterinary Hospital Society” OR “Veterinarian” OR “veterinarians” OR “animal disease” OR “Animal Diseases” OR “Diseases, Animal”
Embase (thesaurus based on Emtree® term)	'veterinary clinic' OR 'veterinary medicine' OR 'legislation, veterinary' OR 'veterinarian' OR 'animal disease'

**d. Search equations for the different databases**

Database	Search equation syntax
PubMed	((("Zoonoses"[Mesh] OR "Epidemiology"[Mesh] OR "Preventive Medicine"[Mesh] OR "Disease Eradication"[Mesh] OR "Disease Transmission, Infectious"[Mesh] OR "Endemic Diseases"[Mesh] OR "Communicable Disease Control"[Mesh] OR "Population Surveillance "[Mesh] OR "Primary Prevention"[Mesh] OR "Secondary Prevention"[Mesh]) OR ("veterinary" [Subheading] OR "Animal Diseases"[Mesh] OR "Veterinarians"[Mesh])) AND "Public-Private Sector Partnerships"[Mesh])
CAB abstracts	( ("public health" OR "community health" OR "community health program" OR "community health programme" OR "health, public" OR "international health" OR "national health" OR "national health programmes" OR "national health programs" OR "national health project" OR "Health, Community" OR "Epidemiology" OR "Social Epidemiology" OR "Epidemiologies, Social" OR "Epidemiology, Social" OR "Social Epidemiologies" OR "Preventative Medicine" OR "Medicine, Preventative" OR "Medicine, Preventive" OR "Preventive Care" OR "Care, Preventive" OR "Preventative Care" OR "Care, Preventative" OR "communicable disease control" OR "disease elimination" OR "disease re-emergence" OR "mandatory testing" OR "mass immunization" OR "Disease Eradications" OR "Eradication, Disease" OR "Eradications, Disease" OR "Disease Eliminations" OR "Elimination, Disease" OR "Eliminations, Disease" OR "infectious disease medicine" OR ""Disease Transmission, Infectious" OR "Pathogen Transmission" OR "Transmission, Pathogen" OR "Transmission, Infectious Disease" OR "Infectious Disease Transmission" OR "Communicable Disease Transmission" OR "Disease Transmission, Communicable" OR "Transmission, Communicable Disease" OR "Infection Transmission" OR "Transmission, Infection" OR "Transmission of Infectious Disease" OR "Infectious Disease Transmission, Horizontal" OR "Horizontal Transmission of Infectious Disease" OR "Pathogen Transmission, Horizontal" OR "Horizontal Transmission of Infection" OR "Infection Horizontal Transmission" OR "Infection Transmission, Horizontal" OR "Community Transmission" OR "Community Transmissions" OR "Transmissions, Community" OR "Community Spread" OR "Person-to-Person Transmission" OR "Person to Person Transmission" OR "Transmission, Person-to-Person" OR "Droplet Transmission of Infectious Disease" OR "Droplet Transmission, Infectious Disease" OR "Infectious Disease Droplet Transmission" OR "Autochthonous Transmission" OR "Autochthonous Transmissions" OR "Transmission, Autochthonous" OR "Transmissions, Autochthonous" OR "Close-Contact Transmission" OR "Close Contact Transmission" OR "Close-Contact Transmissions" OR "Transmission, Close-Contact" OR "Close-Contact Infectious Disease Transmission" OR "Close Contact Infectious Disease Transmission" OR "Endemic Diseases" OR "Disease, Endemic" OR "Diseases, Endemic" OR "Endemic Disease" OR "" OR "Public Health Practice[Mesh]" OR "Communicable Disease Control, Population Surveillance, Primary Prevention, Secondary Prevention, " OR "Health Practice, Public" OR "Health Practices, Public" OR "Practice, Public Health" OR "Practices, Public Health" OR "Public Health Practices" OR "Mass drug administration" OR "" OR "Zoonosis" OR "Zoonoses" OR "Zoonotic Infectious Diseases" OR "Disease, Zoonotic Infectious" OR "Diseases, Zoonotic Infectious" OR "Infectious Disease, Zoonotic" OR "Infectious Diseases, Zoonotic" OR "Zoonotic Infectious Disease" OR "Zoonotic Infections" OR "Infection, Zoonotic" OR "Infections, Zoonotic" OR "Zoonotic Infection" OR "Zoonotic Spillover" OR "Spillovers, Zoonotic" OR "Zoonotic Spillovers" OR "Zoonotic Diseases" OR "Disease, Zoonotic" OR "Diseases, Zoonotic" OR "Zoonotic Disease" ) )

OR ( (“Veterinary Practice Management” OR “Practice Management Services, Veterinary” OR “Practice Management, Veterinary” OR “Practice Management Services, Veterinary” OR “animal care hospital” OR “animal hospital” OR “hospitals, animal” OR “military veterinary service” OR “veterinarian clinic” OR “veterinarian hospital” OR “veterinary care clinic” OR “veterinary care hospital” OR “veterinary hospital” OR “veterinary practice” OR “veterinary service” OR “veterinary service, military” OR “veterinary medicine” OR “Medicine, Veterinary” OR “legislation, veterinary” OR “Veterinary Legislation” OR “Legislations, Veterinary” OR “Veterinary Legislations” OR “Societies, Veterinary” OR “Veterinary Society” OR “Society, Veterinary” OR “Veterinary Societies” OR “Veterinary Hospital Societies” OR “Hospital Societies, Veterinary” OR “Hospital Society, Veterinary” OR “Societies, Veterinary Hospital” OR “Society, Veterinary Hospital” OR “Veterinary Hospital Society” OR “Veterinarian” OR “veterinarians” OR “animal disease” OR “Animal Diseases” OR “Diseases, Animal”) ) AND ( (“Partnership, Public-Private Sector” OR “Partnerships, Public-Private Sector” OR “Public Private Sector Partnerships” OR “Public-Private Sector Partnership” OR “Public Private Sector Partnership” OR “Public-Private Partnerships” OR “Public Private Partnership” OR “Partnership, Public Private” OR “Partnerships, Public Private” OR “Private Partnership, Public” OR “Private Partnerships, Public” OR “Public Private Partnerships” OR “Public-Private Partnership” OR “Partnership, Public-Private” OR “Partnerships, Public-Private” OR “Public-Private Sector Cooperation” OR “Cooperation, Public-Private Sector” OR “Public Private Sector Cooperation” OR “Public-Private Sector Cooperations” OR “Public-Private Cooperation” OR “Cooperation, Public-Private” OR “Public Private Cooperation” OR “Public-Private Cooperations”) )

Embase ('public health'/exp OR 'epidemiology'/exp OR 'preventive medicine'/exp OR 'disease control'/exp OR 'infectious disease medicine'/exp OR 'primary prevention'/exp OR 'secondary prevention'/exp OR 'mass drug administration'/exp OR 'zoonosis'/exp OR 'veterinary clinic' OR 'veterinary medicine' OR 'legislation, veterinary' OR 'veterinarian' OR 'animal disease') AND 'public-private partnership'/mj

**e. The two databases used to classify and analyze the documents in this scoping review.**

*Documents were classified as evaluation if they were presenting methodologies for setting and designing the evaluation, analyzing the data, and/or presenting the results of the evaluation (Brousselle and Champagne, 2011). The categories used in each database emerged as an iterative process during the reading of the full text of documents. Once the categories had been determined, the documents were read once more to classify the corresponding criteria of each document into categories.*

Databases	Categories
First database for documents describing PPP evaluations	<ul style="list-style-type: none"> <li>-goal of evaluation</li> <li>-methodology for data collection</li> <li>-type of data analysis</li> <li>-challenges and recommendations of evaluation</li> <li>-type of evaluation: <ul style="list-style-type: none"> <li>evaluation of the context</li> <li>evaluation of the process</li> <li>evaluation of the outcomes</li> <li>evaluation of the cost</li> </ul> </li> </ul>

	-evaluation criteria used
Second database for documents presenting important criteria to consider in the evaluation process	<ul style="list-style-type: none"> <li>-obstacles</li> <li>-key success factors</li> <li>-positive outcomes (benefits)</li> <li>-negative outcomes (drawbacks)</li> <li>-impacts</li> </ul>

**f. Definitions of the concepts used in this study.**

-Key success factors are defined as criteria of the context or the process that favour the achievement of PPP objectives.

-Obstacles are criteria that limit the implementation and success of the PPP. Internal obstacles are linked to the collaboration process, planning or governance process of the PPP. External obstacles are linked to the context of implementation or to the evaluation.

-Outcomes are the results of an intervention (BetterEvaluation, 2015); the *benefits* of PPPs are the positive outcomes of PPPs, and the *drawbacks* are the negative outcomes of PPPs.

## Appendix 2. List of references of the 37 documents selected for this study and presented in the results

### A. Documents describing PPP evaluation (n=18)

#### • Public Health (n=14)

1. Bakibinga, P. et al. The effect of enhanced public-private partnerships on maternal, newborn and child health services and outcomes in Nairobi-Kenya: the PAMANECH quasi-experimental research protocol. *BMJ Open* 4, (2014).
2. Baku, R. V. & Madhurima Nundy. Blurring of boundaries: public-private partnerships in health services in India. *Econ Polit Wkly* 43, 62–71 (2008).
3. Biermann, O., Eckhardt, M., Carlford, S., Falk, M. & Forsberg, B. C. Collaboration between non-governmental organizations and public services in health - a qualitative case study from rural Ecuador. *Glob Health Action* 9, 32237 (2016).
4. Gharaee, H. et al. Analysis of Public-Private Partnership in Providing Primary Health Care Policy: An Experience From Iran. *J Prim Care Community Health* 10, 215013271988150 (2019).
5. Kaboru, B. B. Uncovering the potential of private providers' involvement in health to strengthen comprehensive health systems: A discussion paper. *Perspect. Public Health* 132, 245–252 (2012).
6. Kempe, A. et al. Effectiveness of primary care-public health collaborations in the delivery of influenza vaccine: A cluster-randomized pragmatic trial. *Prev. Med.* 69, 110–116 (2014).
7. Konduri, N., Delmotte, E. & Rutta, E. Engagement of the private pharmaceutical sector for TB control: Rhetoric or reality? *J. pharm. policy pract.* 10, (2017).
8. Kulshrestha, N. et al. Public-private mix for TB care in India: Concept, evolution, progress. *Indian J Tuberc* 62, 235–238 (2015).
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11. Prashanth, N. S. Public-private partnerships and health policies. *Econ Polit Wkly* 46, 13–15 (2011).
12. Roehrich, J. K., Lewis, M. A. & George, G. Are public-private partnerships a healthy option? A systematic literature review. *Social Science & Medicine* (1982) 113, 110–119 (2014).
13. Widdus, R. Public-private partnerships for health: their main targets, their diversity, and their future directions. *Bull World Health Organ* 79, 713–720 (2001).
14. Widdus, R. Public-private partnerships: an overview. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 99, 1–8 (2005).

- **Veterinary domain (n=4)**

1. Dione, M. M. et al. Integrated approach to facilitate stakeholder participation in the control of endemic diseases of livestock: the case of peste des petits ruminants in Mali. *Front Vet Sci* 6, (2019).
2. Hamill, L. et al. Evaluating the impact of targeting livestock for the prevention of human and animal trypanosomiasis, at village level, in districts newly affected with *T. b. rhodesiense* in Uganda. *Infectious Diseases of Poverty* 6, 16 (2017).
3. Maiti, S., Jha, S. K. & Garai, S. Performance of public-private-partnership model of veterinary services in West Bengal. *Indian Res. J. Ext. Edu* 11, 1–5 (2011).
4. The OIE data base describing 97 PPP case studies in the veterinary domain, retrieved in the context of the collaborative work undertaken between OIE and Cirad on PPP in the veterinary domain between 2017 and 2019. The methodology for collecting information in this OIE database is described elsewhere (Galière et al., 2019a)

**B. Documents mentioning relevant criteria for evaluation (excluding the ones also describing evaluation), n=20**

- **Public health, n=9**

1. Albis, M. L. F., Bhadra, S. K. & Chin, B. Impact evaluation of contracting primary health care services in urban Bangladesh. *BMC Health Serv Res* 19, 854 (2019).
2. Alonazi, W. B. Exploring shared risks through public-private partnerships in public health programs: a mixed method. *BMC Public Health* 17, (2017).
3. Baig, M. B., Bhuputra Panda, Das, J. K. & Chauhan, A. S. Is public private partnership an effective alternative to government in the provision of primary health care? A case study in Odisha. *J Health Manag* 16, 41–52 (2014).
4. Barr, D. A. A research protocol to evaluate the effectiveness of public-private partnerships as a means to improve health and welfare systems worldwide. *Am J Public Health* 97, 19–25 (2007).
5. Hellowell, M. Are public-private partnerships the future of healthcare delivery in sub-Saharan Africa? Lessons from Lesotho. *BMJ Global Health* 4, e001217 (2019).
6. Lei, X. et al. Public-private mix for tuberculosis care and control: A systematic review. *Int. J. Infect. Dis.* 34, 20–32 (2015).
7. Salve, S., Harris, K., Sheikh, K. & Porter, J. D. H. Understanding the complex relationships among actors involved in the implementation of public-private mix (PPM) for TB control in India, using social theory. *Int J Equity Health* 17, 73 (2018).
8. Sutton, B. S. Evaluation of the public-private mix: how economics can contribute to tuberculosis control. *Expert Rev Anti Infect Ther* 8, 489–491 (2010).
9. Vrangbæk K 2008. Public-private partnerships in the health sector: the Danish experience. *Health Economics, Policy and Law* 3, 141–163.

- **Veterinary domain, n=11**

1. Ahuja, V. The economic rationale of public and private sector roles in the provision of animal health services. *Rev Sci Tech* 23, 33–45 (2004).
2. Asseldonk, M. A. P. M. van & Bergevoet, R. H. M. Cost and responsibility sharing arrangements in the EU to prevent and control notifiable veterinary and phytosanitary risks. *CAB Reviews* 9, 1–10 (2014).
3. Bardosh, K. L. Deadly flies, poor profits, and veterinary pharmaceuticals: sustaining the control of sleeping sickness in Uganda. *Med Anthropol* 35, 338–352 (2016).
4. Bennett, R. Economic rationale for interventions to control livestock disease. *Eurochoices* 11, 5–11 (2012).
5. Black, P. F. Good governance of animal health systems and public-private partnerships: an Australian case study. *Rev Sci Tech* 31, 699–708 (2012).
6. Donado-Godoy, P. et al. The establishment of the Colombian Integrated Program for Antimicrobial Resistance Surveillance (COIPARS): a pilot project on poultry farms, slaughterhouses and retail market. *Zoonoses and Public Health* 62, 58–69 (2015).
7. Galière, M. et al. Typological analysis of public-private partnerships in the veterinary domain. *PLoS ONE* 14, e0224079 (2019).
8. Lubroth, J. et al. Veterinary vaccines and their use in developing countries. *Rev Sci Tech* 26, 179–201 (2007).
9. The OIE database describing 97 PPP case studies in the veterinary domain, retrieved in the context of the collaborative work undertaken between OIE and Cirad on PPP in the veterinary domain between 2017 and 2019. The methodology for collecting information in this OIE database is described elsewhere (Galière et al., 2019a)
10. Voss, S. J. et al. Incorporating risk communication into highly pathogenic avian influenza preparedness and response efforts. *Avian Diseases* 56, 1049–1053 (2012).
11. Waiswa, C. & Wangoola, M. R. Sustaining Efforts of Controlling Zoonotic Sleeping Sickness in Uganda Using Trypanocidal Treatment and Spray of Cattle with Deltamethrin. *Vector Borne Zoonotic Dis.* 19, 613–618 (2019).



**Appendix 3. Objectives of the PPPs described in the documents analyzed in this scoping review in the public health (n=23) and livestock health (n=14). The list of references of the 37 documents selected for this study is provided in Supplementary file S2.**

\*Some documents present one PPP with multiple objectives or present multiple PPPs.

<b>Main objective of the PPP</b>	<b>Documents from public health (n=23)*</b>	<b>Documents from livestock health (n=14)*</b>
Livestock or zoonotic or human infectious diseases control (vaccination, eradication program)	7 (Widdus, 2005; Sutton, 2010; Kaboru, 2012; Lei et al., 2015; Kulshrestha et al., 2015; Konduri et al., 2017; Salve et al., 2018)	6 (Lubroth et al., 2007b; Bennett, 2012; Voss et al., 2012; Black, 2012; Waiswa and Wangoola, 2019; Galière et al., 2019; Dione et al., 2019) + OIE db (49/97 CS)
Livestock or zoonotic or human infectious diseases surveillance (including antimicrobial resistance)	2 (Sutton, 2010; Lei et al., 2015)	6 (Voss et al., 2012; Black, 2012; Asseldonk and Bergevoet, 2014; Donado-Godoy et al., 2015; Galière et al., 2019) + OIE db (30/97 CS)
Better veterinary or health services delivery (for any type of mission)	17 (Widdus, 2001, 2005; Nishtar, 2004; Barr, 2007; Baku and Madhurima Nundy, 2008; Vrangbæk, 2008; Prashanth, 2011; Kaboru, 2012; Baig et al., 2014; Bakibinga et al., 2014; Roehrich et al., 2014; Biermann et al., 2016; Alonazi, 2017; Salve et al., 2018; Hellowell, 2019; Gharaee et al., 2019; Albis et al., 2019)	5 (Ahuja, 2004; Maiti et al., 2011; Bardosh, 2016; Galière et al., 2019) + OIE db (37/97 CS)
Better veterinary or health product access	5 (Nishtar, 2004; Widdus, 2005; Barr, 2007; Kempe et al., 2014; Laktabai et al., 2017)	6 (Lubroth et al., 2007b; Bardosh, 2016; Hamill et al., 2017; Galière et al., 2019; Dione et al., 2019) + OIE db (14/97 CS)

#### Appendix 4. Description of the evaluation case studies of public-private partnerships for public health and livestock health, presented in documents analysed in the scoping review (n=18).

In this study, PPP was restricted to services or product delivery for surveillance, prevention, or control of human, or zoonotic or animal contagious diseases. The list of references of the 37 documents selected for this study is provided in Appendix 2.

	Type of articles	Framework	Evaluation goal	Collection of data	Type of analysis
<b>Public Health</b>					
(Albis et al., 2019)	Research article: evaluation of specific PPP	Health outcomes evaluation	-Assess the progress	-Questionnaires -Documents reviews	-Measure of indicators -Comparative (alternative strategies)
(Alonazi, 2017)	Research article: evaluation of specific PPP	Individual centered-risk (clinical and non-clinical consequences for individuals)	-Guide policies	-Documents reviews -Participatory approaches	-Descriptive -Measure of indicators
(Baig et al., 2014)	Research article: evaluation of specific PPP	Health outcomes evaluation and perception of end-users	-Assess the progress	-Documents review -Interviews -Direct observation	-Measure of indicators -Comparative (alternative strategies)
(Bakibinga et al., 2014)	Research article: evaluation of specific PPP	Health outcomes; Cost effectiveness; Access and demand	-Assess the progress	-Interviews -Direct observation -Documents review	-Descriptive -Measure of indicators
(Barr, 2007)	Overview article	Specific to PPP: research protocol	-Assess progress	Not mentioned	-Descriptive -Measure of indicators
(Biermann et al., 2016)	Research article: evaluation of specific PPP	Perception of outcomes by beneficiaries	-Assess the progress	-Interviews	-Descriptive (content analysis)
(Gharaee et al., 2019)	Research article: evaluation of specific PPP	Perception of PPP policy by stakeholders	-Guide policies	-Documents review -Interviews	-Descriptive (content analysis) -Measure of indicators
(Kempe et al., 2014)	Research article: evaluation of specific PPP	Health outcomes evaluation and barrier for collaboration	-Assess the progress -Lobbying	-Questionnaires -Interviews	- Measure of indicators -Descriptive -Comparative (alternative strategies)
(Lei et al., 2015)	Research article: systematic review	Health outcomes evaluation	-Assess the progress -Propose strategies for improvement	-Documents reviews (systematic review of evaluations)	-Measure of indicators
(Laktabai et al., 2017)	Research article: evaluation of specific PPP	Health outcomes evaluation	-Assess the progress -Propose strategies for improvement	-Questionnaires	-Descriptive - Measure of indicators

(Roehrich et al., 2014)	systematic review	Specific to PPP : Multi-dimensional framework	-Research -Guide policies	Not mentioned	-Documents review
(Salve et al., 2018)	Research article: evaluation of specific PPP	Bourdieu's "theory of practice" to understand the relationship between partners	-Research -Strategies for improvement -Strengthen the PPP -Guide policies	-Participatory approaches	-Descriptive -Sociological
(Sutton, 2010)	Research article: overview article	Microeconomic theory based on externalities	-Guide policies	Not mentioned	Not mentioned
(Vrangbæk, 2008)	Research article: PPPs assessment in a country	Specific to PPP : Risk-based	-Guide policies -Lobbying	Not mentioned	-Descriptive -Comparative (alternative strategies) -Assessment of risk factors

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**Livestock Health**

(Dione et al., 2019)	Research article: evaluation of specific PPP	Innovative platform framework to address complex agricultural problems	-Assess the progress -Lobbying	-Documents reviews -Participatory approaches -Interviews -Sampling	-Descriptive - Measure of indicators -Vaccination coverage
(Hamill et al., 2017)	Research article: evaluation of specific PPP	Not mentioned	-Assess the progress -Lobbying	-Sampling	-Prevalence
(Maiti et al., 2011)	Research article: evaluation of specific PPP	Not mentioned	-Propose strategies for improvement	-Questionnaires	-Grading
OIE database	Grey literature, evaluation of specific PPPs (43/97 case-studies)	Not mentioned	Not mentioned	Not mentioned	-Descriptive -Measure of indicators

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**Appendix 5. Criteria to evaluate the context and the process of public-private partnerships mentioned in all documents analysed during the scoping review.** The documents are related to PPPs in public health (n= 23) and to PPPs for livestock health (n=14). All associated references are presented in the supplementary file S2. \*Some documents mentioned several key success factors or obstacles categories.

		Categories	Key success factors		Obstacles	
			Public Health	Livestock health	Public Health	Livestock health
Context		Societal context: PPP socially acceptable	2 (Baru and Nundy, 2008)	-	-	-
		Economic context: PPP justification (added value), Infrastructure, market system	2 (Donald A. Barr, 2007) (Widdus, 2001)	1 (Galière et al., 2019b)	2 (Donald A. Barr, 2007; Kulshrestha et al., 2015)	2 (Bardosh, 2016; Galière et al., 2019b)
		Governance context: Legislative and political framework	10 (Baig et al., 2014; Donald A. Barr, 2007; Baru and Nundy, 2008; Kaboru, 2012; Konduri et al., 2017; Kulshrestha et al., 2015; Lei et al., 2015; Nishtar, 2004; Salve et al., 2018; Vrangbæk, 2008)	3 (Dione et al., 2019; Donado-Godoy et al., 2015; Galière et al., 2019b)	7 (Alonazi, 2017; Baig et al., 2014; Donald A. Barr, 2007; Nishtar, 2004; Prashanth, 2011; Salve et al., 2018; Vrangbæk, 2008)	1 (Bardosh, 2016)
		Environmental context <b>Total (context)</b>	0 <b>11*</b>	0 <b>3*</b>	0 <b>8*</b>	0 <b>2*</b>
Process	Objective	Common goal	1 (Donald A. Barr, 2007)	1 (Galière et al., 2019b)	1 (Donald A. Barr, 2007)	-
		Mutual benefits	2 (Donald A. Barr, 2007; Hamill et al., 2017)	1 (Galière et al., 2019b)	1 (Donald A. Barr, 2007)	-

	Alignment with national priorities <b>Total (process, objective)</b>	1 (Nishtar, 2004) <b>3*</b>	- <b>1*</b>	- <b>1*</b>	- <b>0</b>
Governance	Nature of agreement, negotiation contract	6 (Donald A. Barr, 2007; Baru and Nundy, 2008; Kaboru, 2012; Kulshrestha et al., 2015; Lei et al., 2015; Roehrich et al., 2014)	-	5 (Donald A. Barr, 2007; Baru and Nundy, 2008; Kulshrestha et al., 2015; Lei et al., 2015; Roehrich et al., 2014)	-
	Inclusiveness in decision-making process	6 (Alonazi, 2017; Baru and Nundy, 2008; Kaboru, 2012; Roehrich et al., 2014; Salve et al., 2018; Vrangbæk, 2008)	-	4 (Nishtar, 2004; Roehrich et al., 2014; Salve et al., 2018; Vrangbæk, 2008)	1 (Dione et al., 2019)
	Funding and human resources availability and repartition	5 (Baig et al., 2014; Donald A. Barr, 2007; Lei et al., 2015; Roehrich et al., 2014; Salve et al., 2018)	1 (Galière et al., 2019b)	5 (Donald A. Barr, 2007; Lei et al., 2015; Nishtar, 2004; Roehrich et al., 2014; Salve et al., 2018)	2 (Dione et al., 2019; Galière et al., 2019b)
	Transparency of decision and activities implemented	1 (Nishtar, 2004)	2 (Black, 2012; Galière et al., 2019b)	1 (Lei et al., 2015)	-
	Adaptability of the PPP <b>Total (process, governance)</b>	1 (Alonazi, 2017) <b>13*</b>	- <b>2*</b>	1 (Alonazi, 2017) <b>9*</b>	- <b>2*</b>
Pla	Regular risks identification	3	-	2	-

		(Donald A. Barr, 2007; Nishtar, 2004; Vrangbæk, 2008)		(Donald A. Barr, 2007; Vrangbæk, 2008)	
	Communication between partners	5 (Alonazi, 2017; Biermann et al., 2016; Kaboru, 2012; Lei et al., 2015; Roehrich et al., 2014)	2 (Donado-Godoy et al., 2015; Galière et al., 2019b)	-	2 (Dione et al., 2019; Galière et al., 2019b)
	Dissemination knowledge, information sharing with external actors	4 (Biermann et al., 2016; Kaboru, 2012; Lei et al., 2015; Roehrich et al., 2014)	1 (Donado-Godoy et al., 2015)	1 (Roehrich et al., 2014)	-
	Role and responsibility of partners	5 (Donald A. Barr, 2007; Kaboru, 2012; Lei et al., 2015; Salve et al., 2018; Widdus, 2001)	2 (Black, 2012; Galière et al., 2019b)	6 (Donald A. Barr, 2007; Baru and Nundy, 2008; Biermann et al., 2016; Kulshrestha et al., 2015; Lei et al., 2015; Salve et al., 2018)	1 (Galière et al., 2019b)
	Planning of activities	1 (Lei et al., 2015)	-	2 (Baru and Nundy, 2008; Kempe et al., 2014)	-
	Distribution and efficiency of administrative tasks		1 (Galière et al., 2019b)	2 (Baru and Nundy, 2008; Kempe et al., 2014)	1 (Galière et al., 2019b)
	Distribution of ownership of PPP outputs	-	1 (Donado-Godoy et al., 2015)		-
	Capacity building, training	3 (Johnston and Finegood, 2015; Kulshrestha et al., 2015; Lei et al., 2015)	1 (Galière et al., 2019b)	2 (Alonazi, 2017; Kulshrestha et al., 2015)	1 (Dione et al., 2019)

	Evaluation of the PPP	2 (Lei et al., 2015; Nishtar, 2004)	1 (Galière et al., 2019b)		1 (Galière et al., 2019b)
	<b>Total (process, planning)</b>	<b>11*</b>	<b>3*</b>	<b>9*</b>	<b>2*</b>
Collaboration	Power relationship between partners	3 (Donald A. Barr, 2007; Roehrich et al., 2014; Salve et al., 2018)		3 (Baru and Nundy, 2008; Nishtar, 2004; Salve et al., 2018)	
	Inclusiveness in planning, in the implementation of activities	2 (Konduri et al., 2017; Salve et al., 2018)		1 (Salve et al., 2018)	
	Understanding of partner culture	2 (Prashanth, 2011; Salve et al., 2018)		2 (Lei et al., 2015; Salve et al., 2018)	
	PPP structure	1 (Biermann et al., 2016)		1 (Biermann et al., 2016)	
	Partners' satisfaction/trust between partners			1 (Kulshrestha et al., 2015)	
	Partner's involvement	1 (Roehrich et al., 2014)	1 (Galière et al., 2019b)	1 (Roehrich et al., 2014)	1 (Galière et al., 2019b)
	<b>Total (process, collaboration)</b>	<b>6*</b>	<b>1</b>	<b>7*</b>	<b>1</b>

**Appendix 6. Potential positive outcomes (benefits) and negative outcomes (drawbacks) of public-private partnerships mentioned in documents analysed during the scoping review.**

The documents are related to PPPs in public health (n= 23) and to PPPs for livestock health (n=14). All associated references are presented in Appendix 2.

CS: case studies; OIE db: database form World Organization for Animal Health. \*Some documents mentioned several outcomes categories

	Outcomes categories	Benefits / positive outcomes		Risks / negative outcomes	
		Public health	Livestock health	Public health	Livestock health
Health	Expertise, skills	4 (Albis et al., 2019; Bakibinga et al., 2014; Gharaee et al., 2019; Widdus, 2001)	2 (Maiti et al., 2011) + OIE db (18 CS)	1 (Vrangbæk, 2008)	
	Quality of actions (case detection, case management, treatment outcomes)	4 (Albis et al., 2019; Baig et al., 2014; Gharaee et al., 2019; Lei et al., 2015)	5 (Ahuja, 2004b; Hamill et al., 2017; Maiti et al., 2011; Voss et al., 2012) + OIE db (16 CS)	1 (Vrangbæk, 2008)	
	Coverage of the services	8 (Albis et al., 2019; Baig et al., 2014; Biermann et al., 2016; Gharaee et al., 2019; Kempe et al., 2014; Konduri et al., 2017; Kulshrestha et al., 2015; Lei et al., 2015)	3 (Ahuja, 2004b; Dione et al., 2019) + OIE db (76 CS)		
	Food security		1 OIE db (3 CS)		
	Total documents	10 *	6*	1*	
Society	Vulnerable groups, externalities and public value	2 (Donald A. Barr, 2007; Sutton, 2010)	2 (Dione et al., 2019) + OIE db (3 CS)	1 (Donald A. Barr, 2007)	



	Regulations and public responsibilities		1 OIE db (11 CS)	2 (Baru and Nundy, 2008; Vrangbæk, 2008)	
	Equity of outcomes	5 (Baig et al., 2014; Donald A. Barr, 2007; Gharaee et al., 2019; Kaboru, 2012; Lei et al., 2015)		1 (Donald A. Barr, 2007)	
	Total documents	6*	2*	4*	0
Economy	Resources and cost of the PPP	3 (Gharaee et al., 2019; Vrangbæk, 2008; Widdus, 2001)	1 (Black, 2012)	1 (Vrangbæk, 2008)	
	Reduction of risks		1 OIE db (22 CS)		
	Timely execution of activities	3 (Albis et al., 2019; Kempe et al., 2014; Roehrich et al., 2014)	1 OIE db (24 CS)	2 (Roehrich et al., 2014; Vrangbæk, 2008)	-
	Market access		2 (Ahuja, 2004b) + OIE db (4 CS)		
	Employment	3 (Gharaee et al., 2019; Kaboru, 2012; Roehrich et al., 2014)	1 OIE db (13 CS)		
	Oligo/monopolies			1 (Vrangbæk, 2008)	
	Total documents	7*	3*	2*	0
Governance	Quality of the process and trust between partners	3 (Gharaee et al., 2019; Kempe et al., 2014; Roehrich et al., 2014)	2 (Voss et al., 2012) + OIE db (52 CS)	1 (Nishtar, 2004)	1 (Asseldonk and Bergevoet, 2014)

Accountability and corruption	1 (Kaboru, 2012)		2 (Baru and Nundy, 2008; Roehrich et al., 2014; Vrangbæk, 2008)	1 (Ahuja, 2004b)
Merging of interest or conflict of interest		1 OIE db (15 CS)	2 (Roehrich et al., 2014; Vrangbæk, 2008)	1 (Bardosh, 2016)
Total documents	4	2*	4*	3

## *Appendices to Chapter 2*

### **Appendix 1. Interview guide for the semi-structured interviews with key actors of the PPP in Paraguay**

#### **Introducción**

Me llamo Mariline Poupaud, soy veterinaria y estoy haciendo una tesis en evaluación de programas de salud animal con el centro de investigación CIRAD y la universidad de Lieja. Mi tesis es parte de un proyecto que se llama progreso público-privado de la OIE. Es una iniciativa de tres años (nov. 2016-2019).

Mi trabajo en este proyecto consiste en hacer una evaluación participativa de los impactos del programa de la erradicación de la fiebre aftosa y el valor añadido de la APP para alcanzar esos impactos. Me gustaría aprender más sobre el programa y la APP, su historia, cómo funciona y cuáles son sus percepciones de sus impactos.

Tengo permiso de SENACSA y FUNDASSA para hacer esta investigación. Todo lo que me digas será anónimo. Bajo ninguna circunstancia diré su nombre públicamente, ni a otros miembros de los proyectos.

La entrevista debería durar alrededor de una hora, pero por favor, hágame saber si desea interrumpirla en cualquier momento. ¿Puedo grabar la conversación?

#### **Información general sobre la entrevista**

<b>Código de la entrevista:</b>	Nivel (N: Nacional; R: Regional; L: Local) / Número único	<b>Fecha de la entrevista:</b>	
<b>Nombre del entrevistador:</b>		<b>Nombre del tomador de notas:</b>	
<b>Grabado</b>	<input type="checkbox"/> Yes / <input type="checkbox"/> No	<b>Nombre del archivo de grabación:</b>	

#### **General información sobre el entrevistado**

<b>Nombre, apellido:</b>		<b>Posición:</b>	
<b>Datos de contacto</b>	<b>correo:</b>	<b>Celular:</b>	<b>Ubicación (comisione)</b>

TEMAS	PREGUNTAS
<b>Contexto del país: ganadería / salud animal</b>	
Ganadería organización: mayor/ menor productores Leche/ Carne Exportación / mercado interno	¿Puede describirme las características de la ganadería en su región?
¿Se han producido cambios en la organización del sector ganadero en los últimos años? ¿Sabes por qué?	
Ración típica de alimento para el ganado	
Importancia de la ganadería en esta comisión	
desafíos de la ganadería	
¿Veterinarios? ¿Zootécnicos? ¿Otros?	1- ¿Puede describirme las características de la organización de la salud animal? 2- ¿Cómo está estructurada y funciona la Fundassa/Senacsa?
¿Se han producido cambios en la organización del sector de la salud animal? ¿Sabes por qué?	
Estructura y organización de la Fundassa/Senacsa Funcionamiento	
<b>Programa de fiebre aftosa y el APP historia</b>	
Nacimiento del proyecto de erradicación	¿podría presentarse y contarme su historia con el programa de la fiebre aftosa en su región?
Motivo(s) del proyecto: ¿obligación? ¿Motivación de los ganaderos?	
¿Objetivo(s) del proyecto (desde el principio hasta ahora si se ha modificado en el tiempo)?	
¿Motivo(s) de la alianza?	¿Sobre el nacimiento del APP?
¿Objetivo de la alianza?	
Recursos humanos y cualificaciones	1-Podría decirme más sobre sus recursos humanos? 2-¿cómo se le paga? ¿Cómo se paga a los técnicos?
<b>CREACIÓN DE ALIANZAS</b>	
Reclutamiento de actores que trabaja para el programa? ¿cómo se seleccionan entre los que han pasado la evaluación?	¿Cómo se organiza la alianza?
Motivaciones para participar	
Organización de la colaboración público-privada: relación con el senacsa	
Funciones y responsabilidades	
Identificación de riesgos	¿Tenía usted algunas aprensiones antes de comprometerse con este programa? ¿Esta asociación? ¿Por qué?
indicador de resultado	¿Cómo sabrás que esta asociación funciona bien? ¿Por qué?
<b>FUNCIONAMIENTO DE LA ASOCIACIÓN</b>	

Colaboración	<p>1-Háblame del funcionamiento de esta APP?</p> <p>2- ¿Cuál es su percepción de este funcionamiento?</p> <p>3-¿Hay algo que pueda sugerir para hacerlo más eficiente?</p>
Comunicación	
Gobierno	
Transparencia	
Participación de los actores	
Puntualidad	
Confianza y respeto entre actores	
Gestión del riesgo	
<b>Resultados del proyecto y participación de la colaboración de la APP</b>	
Impactos sociales (orgullo/ cambio en la organización del sector ganadero/problema de acceso a la tierra ) ¿Indicadores?	<p>1-Puede decirme cuáles son los resultados de este proyecto?</p> <p>2-Como ayuda la APP a lograr esos resultados?</p>
Impactos económicos (empleo, productividad) ¿Indicadores?	
¿Impactos por el gobierno sobre la salud animal? (¿más confianza, mejor comunicación en la salud animal? cambio de política?) ¿Indicadores?	
¿Impactos sobre el medio ambiental? (¿cambio en la organización del sector ganadero?) ¿Indicadores?	
Desafíos	<p>¿Cuáles son los retos de este proyecto? ¿De esta APP?</p> <p>¿Por qué?</p>

## Appendix 2. Article “Understanding the veterinary antibiotics supply chain to address antimicrobial resistance in Lao PDR: roles and interactions of involved stakeholders”

*Cette étude a été publiée dans la revue Acta Tropica  
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### Highlights

- Qualitative and quantitative methods captured perception of stakeholders of the veterinary antibiotics supply chain
- Simplified theory of change was used to explore opportunities to adapt and reduce antibiotics use under the new regulations
- 23 categories of stakeholders forming various legitimacies, connections and resources were identified
- Majority of antibiotics on farms were classified as critically important antibiotics for human medicine
- Mitigating AMR risks require dialogue and engagement between stakeholders from public and private sector

### Abstract

In response to the global call to mitigate risks associated with antimicrobial resistance (AMR), new regulations on the access and use of veterinary antibiotics are currently being developed by the Lao government. This study aims to explore how the implementation of these new regulations might effectively reduce and adapt the sale, distribution and use of veterinary antibiotics in Lao PDR. To this end, we used the theory of change, framing the AMR issue within the context of the stakeholder groups involved in the veterinary antibiotics supply chain.

Qualitative and quantitative methods were used to collect data, based on questionnaires (n=36 antibiotic suppliers, n=96 chicken farmers, n=96 pig farmers), and participatory tools such as a workshop (n =10 participants), semi-structured interviews (n=20), and focus group discussions (n =7 participants). The stakeholders’ understanding of the AMR issue and potential challenges related to the implementation of new regulations regarding access and use of antibiotics, were also investigated.

We mapped the veterinary antibiotic supply chain in Lao PDR, and analysed the roles and interactions of its stakeholders. Twenty-three groups of stakeholders representing the private and the public sectors were identified. Many informal and formal links connected these stakeholder groups within this supply chain. The lack of veterinarian-farmer interaction and the evolving nature of the veterinary antibiotics supply chain accentuated the challenges of achieving behaviour change through regulations. Most of the antibiotics found on farms were categorized by the World Health Organisation's as critically important antibiotics used in human medicine. We argue that AMR risk mitigation strategy requires dialogue and engagement, between private and public sectors, involved in the importation, distribution, sale and use of veterinary antibiotics. This study further highlighted that AMR is a complex adaptive challenge requiring multi-sectoral approach. We believed that a sustainable approach to reduce and adapt veterinary antibiotics use should be prepared in collaboration with stakeholders from private and public sectors, in addition to the new regulations. This collaboration should start with the co-construction of a common understanding of AMR issue and of the objectives of new regulations.

## 1. Introduction

Antimicrobial resistance (AMR) partly originates from the use of antimicrobials, such as antibiotics, in terrestrial and aquatic animals. The use of antibiotics on animals exerts a selection pressure on bacteria, favouring the selection of resistant genes in the food chain (Bennani et al., 2020). Some studies suggests that interventions to reduce antibiotic use in food animals are associated with a decrease of antibiotic-resistant bacteria in human populations, particularly population in proximity to food animals (Tang et al., 2017). Antibiotics are pervasively used in food animal in Southeast Asia, where AMR is widely prevalent (Boeckel et al., 2015). In Southeast Asia, potential drivers of increasing AMR include weak or non-existent regulatory frameworks on antibiotic usage, weak enforcement guidelines and low levels of AMR awareness among both vendors and users. AMR mitigation measures in the veterinary sectors are lagging far behind those implemented in the human health sector (Goutard et al., 2017).

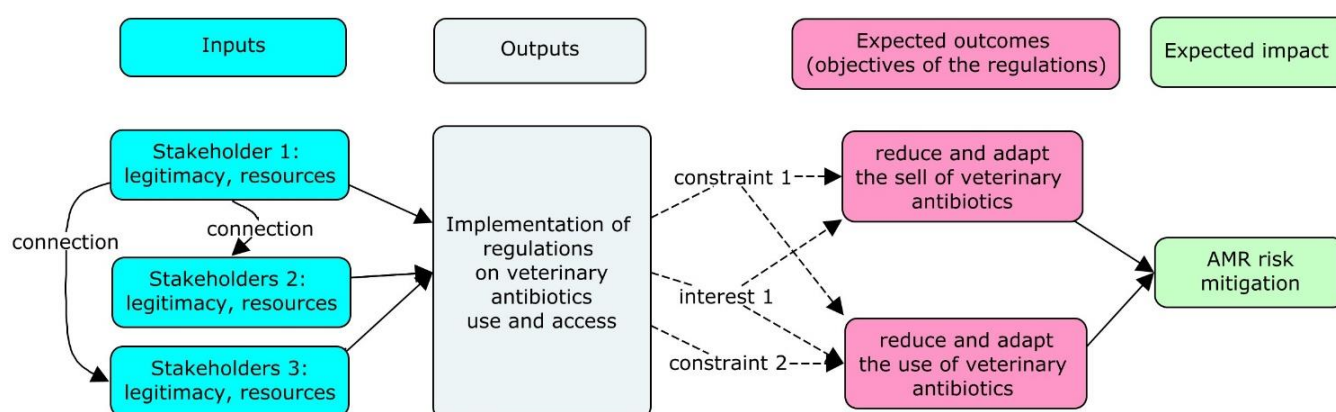
In Lao People's Democratic Republic (Lao PDR), the livestock sector shows significant growth potential. Livestock production also plays an important role in the household economy of poor rural populations (The World Bank Group, 2017). Most livestock producers are smallholders (more than 85%) and subsistence farming remains widespread despite the increasing demand for livestock and livestock products (Ministry of Agriculture and Forestry, 2011). In Vientiane City, the country's capital, the demand for animal products is increasing (Burgos et al., 2008). The private sector is responding to market demands for pigs and poultry, with a number of them setting up farms close to cities (Burgos et al., 2008). This increase in demand, is often associated with an increased demand for antibiotics for prophylactic or treatment uses. The high impact of infectious disease on the livestock population (World Organisation for Animal Health, 2018) and limited access to veterinary services compounds the problem of antibiotic misuse. The veterinary governmental authorities may not cover all relevant aspects of regulations on veterinary antibiotics (i.e the authorization, registration, import, production, labelling, distribution, sale and use) (Bastiaensen et al., 2011). While human antibiotics may only be purchased with a doctor's prescription, as mandated by law (Food & Drug Department, Ministry of Health, Lao PDR, 2011), there are no specific laws or guidelines on the use of veterinary antibiotics (Ministry of Agriculture and Forestry, 2016). Although quantitative data on AMR are scarce in Lao PDR, bacteria isolated from pigs and humans in Lao PDR have been found to carry different AMR genes in Vientiane capital city (Thu et al., 2019). These issues highlight the importance of addressing the AMR problem in Lao PDR by considering access and use of antibiotics in food animal.

In 2015, the World Health Assembly of the United Nations declared AMR to be a global threat and urged all countries to develop multi-sectoral National Action Plans on AMR, including a plan for food animals (World Health Organization, 2015). In 2018, the Lao PDR government developed a new decree that includes new regulations on usage and access to veterinary antibiotics, part of the National Action Plan (Ministry of Health and Ministry of Agriculture and Forestry, 2019).

This decree, part of the Law on Livestock production and Veterinary matter, was signed by the Lao Prime Minister in 2020 (Ministry of Agriculture and Forestry, 2020). At the time of the study, the decree was not implemented and not enforced.

The international AMR Global Action Plan provided recommendations acknowledging that people, including farmers, are using antibiotics irresponsibly. These recommendations aim at mitigating the spread of AMR by changing farmer behaviour, through regulation and awareness raising (Food and Agriculture Organization of the United Nations, 2016; World Health Organization, 2015). However, these approaches are struggling to deliver effective results (Hinchliffe et al., 2018). Regulations on antibiotics do not systematically give rise to appropriate use. For example, the regulation about the prescription request for the sale and purchase of human antibiotics from “National Drug Policy” faced challenges in its implementation. It was adopted by the Ministry of Health in 1993 in response to the increasing number of private pharmacies, and have gone through successful policy formulation (Jönsson et al., 2015). However, the medical prescription law has been undermined because it is not strictly followed or implemented (Paphassarang et al., 2002). Indeed, the interests and power of different stakeholders can influence the implementation of regulations. This occurs namely when stakeholders are asked to change their practices despite the dissonance between their interests and the new regulations (Gilson and Raphaely, 2008; Zimmermann and Maennling, 2007). The Lao PDR government may face challenges in the implementation and enforcement of new veterinary antibiotics regulations on usage and access it is developing.

To assess the potential of AMR risk-reduction strategies, the AMR frame can be broadened to consider the perspective of stakeholder groups, where key relations operate and influence individual strategies (Hinchliffe et al., 2018). Groups are composed of interconnected stakeholders, some of whom have strong connections with certain stakeholders, while being poorly connected with others. The AMR issue is thus considered as a complex adaptive challenge (Hinchliffe et al., 2018). A complex adaptive system is “a collection of individual agents with freedom to act in ways that are not always predictable, and whose actions are interconnected so that one agent’s actions changes the context for other agents” (Plsek and Greenhalgh, 2001). For this reason, to explore the opportunities toward adaptation and reduction of the sale and use of veterinary antibiotics under new regulations, it is interesting to use the “theory of change” (Brest, 2010; Breuer et al., 2016). This consists of elucidating the causal links between inputs, outputs, outcomes and impacts in a given context (i.e., the impact pathway), while providing an explicit understanding of the assumptions underlying these links (**Figure 1**).



**Figure 1: Using a simplified theory of change to develop an impact pathway to explore the opportunities of effectively adapt and reduce the sale and use of veterinary antibiotics.** The inputs (turquoise blue) are the stakeholder groups involved in the veterinary antibiotics supply chain and their existing interactions. The outputs (light blue) are the implementation of the new regulations on access and use of veterinary antibiotics. The expected outcomes (pink) are the objectives of new regulations: the reduced and appropriate sale and use of veterinary antibiotics. The expected impact (green) is the AMR risk mitigation. The constraints and interests of the stakeholders, related the new regulations to be implemented, might hamper the causal link between outputs and expected outcomes. The causal link between expected outcomes and expected impacts will not be explored in this study.

The theory of change is part of the logic of place-based governance. Place-based governance is a type of governance that takes into account the uncertainty of the evolving situation, and that seeks the best possible participation of



stakeholders in collective action and the adaptation of decision-making according to the evolving situation (Chhotray and Stoker, 2009). One of the starting points of the theory of change, within our context, is to identify all the stakeholders related to the veterinary antibiotics supply chain. The theory of change also implies that all stakeholders share the same objective (expected outcomes) and the same vision of expected impacts.

In this paper, we explore opportunities for effectively reducing and adapting sale and use of veterinary antibiotics by implementing new regulations on access and use of veterinary antibiotics. For this, we propose to (i) identify the stakeholders and their existing interactions within the veterinary antibiotics supply chain (the inputs), (ii) and investigate their perceptions of the AMR issue (expected impact) and objective of the new regulations (expected outcomes), including the potential constraints and interests regarding the implementation of the new regulations (the outputs). The causal link between expected outcomes and expected impacts will not be explored in this study. This paper also aims to demonstrate the interest of analysing the AMR issue as a complex adaptive system.

## 2. Materials and methods

A methodological approach based on participatory stakeholder mapping and analysis was used (Saadi et al., 2021; Schmeer, 1999; Zimmermann and Maennling, 2007).

### 2.1 Study area

The study was conducted in two provinces, Vientiane Capital and Vientiane Province. Both provinces were selected for their high number of farms, according to data from the Ministry of Agriculture and Forestry (2017) (Department of Livestock and Fisheries office, Ministry of Agriculture, 2017). These provinces are near Vientiane City, the country's capital.

### 2.2 Research instrument and sampling strategy

The study was conducted from March to July 2018 using a mixed method (qualitative and quantitative approaches). Our analyses were conducted in three different steps: (i) step 1, the “mapping of the supply chain”, in which we identified the different groups of stakeholders in the veterinary antibiotics supply chain and their role and interactions, (ii) step 2, determination of “stakeholder positions”, in which we analysed stakeholders interests and constraints regarding two new planned regulations, (iii) and step 3, identification of “opinions and practices”, in which we explored the opinions and practices of public sector, independent private antibiotic suppliers and farmers regarding AMR and the use of antibiotics.

#### **Box 1. Rationale for the selection of two new regulations for step 2 of this study.**

A decree\* “decree on veterinary medicine, No 199/GoL” was developed in 2018, as part of the National action plan on AMR. Several regulations were developed as part of the implementation of the decree. It was signed and approved in 2020. At the time of the study, the decree was not finalized. In order to identify and understand the planned regulations, a semi-structured interview with a key informant from national veterinary government authorities, responsible of veterinary legislation in Lao PDR was realized. Two planned regulations mentioned by the key informant were selected and used in step 2 of this study. This selection allowed stakeholder analysis focused on a specific and “definable” policy (Schmeer, 1999). One of the regulation selected related to prescription requirement for the sale of veterinary antibiotics. A second regulation related to the need of veterinarian to oversee the agricultural retail outlet or veterinary pharmacies. The selected regulations affected antibiotics suppliers and farmers who were deemed to have important roles in the veterinary antibiotics supply chain.

\*The decree is now accessible for people who have created a free account on the Lao trade portal website: <https://www.laotradeportal.gov.la/index.php?r=site/display&id=1945>

**Table 1** summarises the research tools used and the sampling strategies. Overall, purposive sampling, non-probability snowballing sampling and multi-stage cluster sampling were used to select study participants. Government ministers and village leaders were asked to assist in identifying study participants. Tools included a participatory workshop, semi-structured interviews, focus group discussions and survey questionnaires. The original questionnaires and focus group discussion guides were in English. These were translated into Lao and translated back into English to confirm context and clarity.

**Table 1. Research tools and sampling strategies of the three different steps of the study: mapping of the supply chain, stakeholders' positions and opinions and practices steps.**

<sup>1</sup>*Legitimacy* was defined according to the type of channel the stakeholder was using to import and/or sell antibiotics: or formal i.e., controlled and monitored by the government and for which stakeholders pay taxes, or informal. Their level of *resources* was described by their level of knowledge on antibiotic use, good practices and AMR, their qualifications (e.g., education, training, area of expertise) and their ability to provide advice on good practices for antibiotic use. The *connection* was defined by the number of interactions they had within the veterinary antibiotics supply chain at the time of the study.

<sup>2</sup>The two regulations investigated were : (1) Regulation concerning the sale of veterinary antibiotics - it states that vendors are not allowed to sell veterinary antibiotics without a prescription from veterinarian/veterinary village worker officials (veterinary village workers are local technicians with some training provided by the government on drug dispensation and who provide animal health extension services to farmers). (2) Regulation concerning the business license for veterinary antibiotic retail outlets - it requires that veterinary pharmacies/agricultural retail outlets selling veterinary antibiotics, need to have at least one veterinarian or veterinary village worker approved by the government to oversee that retail outlet.

	<b>Step 1: Mapping of the supply chain</b>	<b>Step 2: Stakeholder positions</b>	<b>Step 3: Opinions and practices</b>
Goal	-To identify the different groups of stakeholders in the veterinary antibiotics supply chain -To understand their roles and interactions	-To crosscheck our previous results -To analyse stakeholder positions regarding two new planned regulations <sup>2</sup>	-To crosscheck our previous results -To explore the opinions on AMR and practices regarding the use of antibiotics
Method	Qualitative	Qualitative	Quantitative
Research tool	Participatory workshop following a previously-prepared guide covering: (i) the identification of stakeholders, (ii) the mapping of the supply chain, (iii) scoring of the level of legitimacy, resources and connections <sup>1</sup> of each category of stakeholder (23) ( <b>Supplementary Table 1</b> )	-Semi-structured interviews, following a previously-prepared checklist covering: (i) the use of antibiotics and awareness of AMR; and (ii) the stakeholder's position regarding the two new regulations ( <b>Supplementary Table 2</b> ) -Focus group discussions, following previously-prepared checklist ( <b>Supplementary Table 3</b> )	Questionnaire containing closed and open-ended questions (36 questions for suppliers, 42 for farmers) with dichotomous (yes/no) and categorical outcomes; covering the following areas: (i) socio-demographics, (ii) farm characteristic (only for farmers), (iii) opinions toward antibiotic use and antibiotic resistance, (iv) and practices regarding antibiotic use and antibiotic resistance. The questionnaires were pre-tested among farmers (N = 5) and antibiotic suppliers (N=2), they were simplified according to the results of the pre-test.
Target population	Key informants based on their knowledge of the veterinary antibiotics supply chain	Nine groups of stakeholders, based on their level of legitimacy, connection and resources <sup>1</sup> they were given in step 1: private foreign farmers, technicians and private multinational company farmers, independent farmers, independent antibiotics suppliers (middlemen, owners and staff of agricultural retail outlet, veterinary village workers, private veterinarians, human pharmacists), and public provincial veterinarian	-Independent antibiotics suppliers (owners and staff of agricultural retail outlet, veterinary village workers, private veterinarians) -Independent poultry and pig farmers in backyard and semi-intensive systems. These systems represent up to 85% of the existing farms in Lao (Ministry of Agriculture and Forestry, 2011) and according to staff from the veterinary governmental authorities the highest level of antibiotic use is found in poultry and pigs (Department of Livestock and Fisheries office, Ministry of Agriculture, 2017)

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Location</p>	<p>-The workshop took place in the capital city</p>	<p>-In retail outlets, offices or households of two districts in Vientiane Capital (Xaythany and Naxaythong) and three districts in Vientiane Province (KeoOudom, Thoulakom and Phonhong) because of logistical constraints -The focus group discussion took place in the capital city</p>	<p>-Two districts in Vientiane Capital (Xaythany and Naxaythong) and three districts in Vientiane Province (KeoOudom, Thoulakom and Phonhong) were selected because of logistical constraints; these districts have a large number of farms (Department of Livestock and Fisheries office, Ministry of Agriculture, 2017)</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Sampling</p>	<p>Purposively selected with the help of members of the ministry of agriculture and two researchers of the faculty of agriculture</p>	<p>-Directly identified by the key informants of step 1; and -Non-probability snowball sampling, i.e., some interviewees assisted the researchers in identifying the next set of interviewees. -Several stakeholders of the same group to crosscheck information and to reach a saturation level (Fusch and Ness, 2015)</p>	<p>A multistage cluster sampling method was used: 1 to 15 villages were randomly selected for each of the 5 districts. The village chiefs helped us identify relevant respondents meeting the selection criteria. Participants included in the survey were above the age of 18 and gave their oral consent.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Participants</p>	<p>10 participants : -representatives from veterinary governmental authorities who supervise livestock production and health in their administrative level (2 at national, 2 at provincial and 4 at district level) -informants directly involved in the veterinary antibiotics supply chain (one private veterinarian and one veterinary pharmacy owner)</p>	<p>-20 (5 females and 15 males) individual semi-structured interviews, including: 1 public veterinarian, 3 members of staff from private companies, 3 private foreign farmers, 11 independent suppliers, 4 independent farmers, <b>(Supplementary Table 4)</b> -focus group discussion among 7 persons from private sector (1 female and 6 males), including: 2 members of staff from private companies, 2 independent farmers, 3 independent antibiotic suppliers <b>(Supplementary Table 4)</b></p>	<p>-36 antibiotics suppliers: 4 public veterinarians, 17 owners or staff from agricultural retail outlets, 4 private veterinarians, and 11 veterinary village workers -96 chicken farmers and 96 pig farmers</p>

### 2.3 Data collection

Data collection was conducted in three different steps.

**Step 1: mapping of the supply chain:** Two researchers (a French female veterinarian and a Lao male veterinarian) and four facilitators (three female and one male, all veterinary lecturers) conducted the participatory workshop. The facilitators were trained to moderate, observe and take notes during the workshop. Discussions were conducted in Lao language, ensuring that all stakeholders took part in the discussions. The meeting lasted around 3 hours.

**Step 2: stakeholders' positions:** The semi-structured individual interviews lasted from 15 to 35 minutes. Two research assistants conducted the interviews, one in Chinese and one in Lao. A focus group discussion, which lasted around three hours, was also conducted to review and verify the veterinary antibiotics supply chain. Participants also reviewed categories of stakeholders and their level of legitimacy, resources and connections within the supply chain. The stakeholders' interest and constraints regarding the two new regulations were discussed and compared.

**Step 3: opinions and practices:** Two principal investigators and 11 students interviewed antibiotics suppliers and farmers and entered answers on electronic devices with Sphinxdeclic® (Le Sphinx) software. They were previously trained on interviewing study participants and entering answers on their electronic devices. Photos were taken of products (e.g., veterinary drugs and feeds) that independent farmers were willing to show during the field interviews.

### 2.4 Data processing and analysis

Workshop outputs such as drawings and notes were documented using photographs. Recorded discussions during group or individual semi-structured interviews (Lao or Chinese) were transcribed and translated into English. To improve reliability of the interpretations, another researcher reviewed the transcripts before analysis.

The drawn schema of the veterinary antibiotics supply chain developed during the *step 1: mapping of the supply chain* was reproduced on CmapTools® (IHMC) software. Depending on the level of legitimacy, resources and connections, the research team selected the groups of stakeholders to include in the step “stakeholder positions” (Schmeer, 1999).

The transcripts from *step 2: stakeholder positions* (semi-structured interviews and focus group discussions) were coded. Two themes were identified: (i) improvement of supply chain mapping, (ii) and stakeholders' positions regarding the two new regulations. The data related to improvement of supply chain mapping allowed us to confirm the mapping of the veterinary antibiotics supply chain as well as the level of legitimacy, resources and connections of nine categories of stakeholders involved in this step. The data related to stakeholder's positions were analysed using content analysis. Two codes were identified in relation to their opinion on two new regulations: the informant's potential interest and their potential constraints. The stakeholder constraints were further classified into three sub-codes:

- (a) possible lack of knowledge on the effectiveness of the new regulations, or regarding their potential for AMR reduction;
- (b) possible lack of capacity, such as lack of alternatives or lack of human or material resources enabling the implementation and enforcement of the new regulations;
- (c) possible lack of will to apply the new regulations for economic (such as the competitiveness of their business or their farm products), trust (such as lack of trust in the government or the accessibility of veterinary services) or personal reasons (Schmeer, 1999).

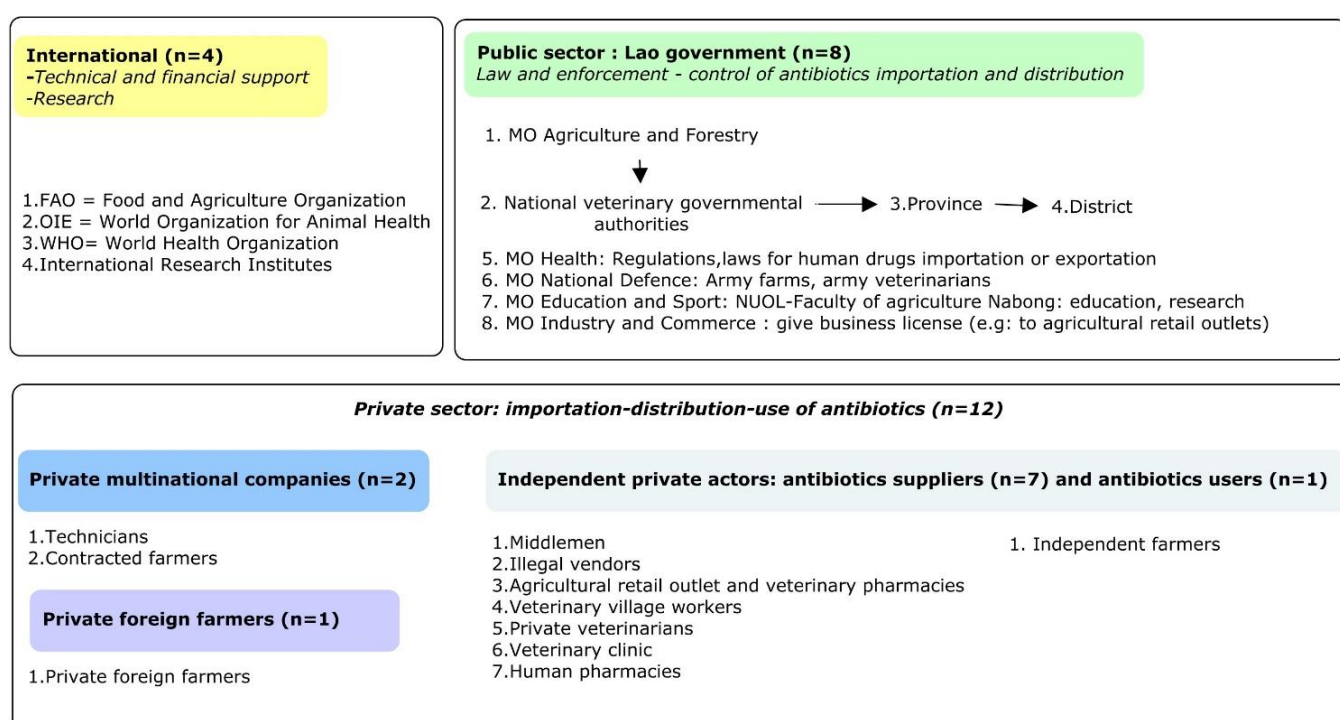
Codes and sub-codes were assigned manually by the first author of this study without using a computer program.

The questionnaires were analysed using descriptive statistics with R(x64, 3.5.1)®. Statistical association between variables were explored performing chi-square tests; statistical significance being set at p-value of 0.05.

### 3. Results

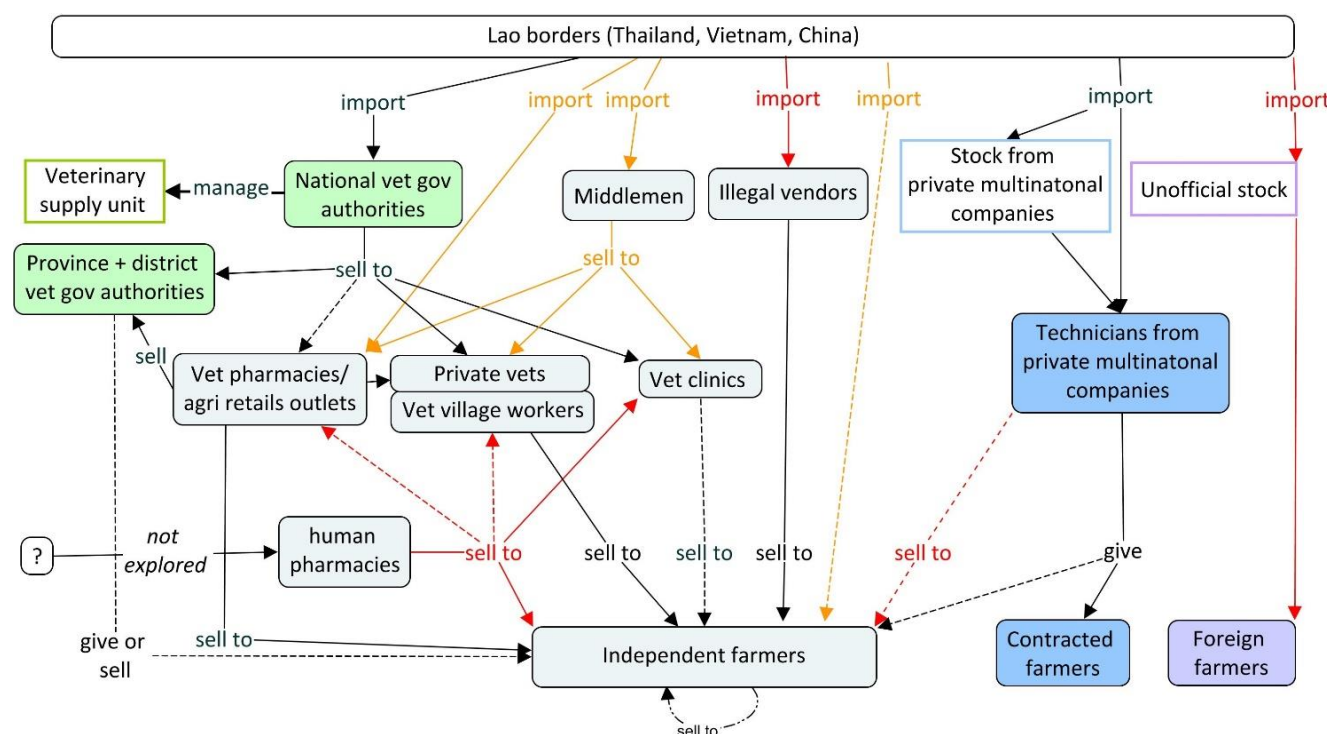
#### 3.1 The veterinary antibiotic supply chain in Lao PDR

We identified 23 categories of stakeholders belonging to the veterinary antibiotics supply chain in Lao PDR. “International stakeholders” (n=4) played a role in technical, financial and legislative support; they also played a role in AMR-related research. The stakeholders from the “public sector: Lao government” group (n=8) were from different Ministries. They were responsible for laws and enforcement, control of antibiotics importation and distribution, education of future stakeholders (such as veterinarians) and AMR research projects. The national veterinary governmental authorities were part of the Ministry of Agriculture and Forestry and oversaw the government veterinary authorities at province and district levels. The stakeholders of the private sector were involved in the importation, distribution and use of veterinary antibiotics (n=12), and could be split into three main groups: “private multinational companies”, “private foreign farmers” and “independent private actors: antibiotics suppliers and antibiotics users” (Figure 2).



**Figure 2: Presentation of the different groups of stakeholders involved in the veterinary antibiotics supply chain in Lao PDR in 2018.** Stakeholders belong to international organization (yellow square), public sector (green square) and private sector (dark blue, light blue and violet squares). MO=Ministry of.; NUOL=National University of Laos

Lao PDR did not produce any veterinary antibiotics, so these antibiotics were mostly imported from Thailand, Vietnam and China, with a few imports from South Korea (Figure 3). National veterinary governmental authorities controlled the veterinary supply unit, a public inventory of antibiotics, and provided antibiotics to the province and district veterinary governmental authorities and sold antibiotics to the private sector. The National veterinary governmental authorities would appear to import only around 20% of the veterinary antibiotics entering the country, while the rest were imported by the private sector (Figure 3). The payment of taxes to the government at the Laotian border was the sole legal obligation related to veterinary antibiotics, and corresponded to the formal channel. Many of the stakeholders did not pay taxes when importing antibiotics (informal channel), which indicated non-regulated activity. Human antibiotics from some human pharmacies were sold for veterinary usage, without prescription, which was forbidden by law (informal channel) (Figure 3).



**Figure 3: Mapping of veterinary antibiotics supply chain in Vientiane capital and Vientiane Province, Lao PDR in 2018.** Stakeholders were from public sector (green squares) and private sector (dark blue square=private multinational companies, violet squares=private foreign farmers, light blue squares=independent private antibiotics suppliers and users). Formal channels (black arrows) correspond to the supply chain of the stakeholders who paid the veterinary antibiotics taxes to the government, in contrast to informal channels (red arrows). Other informal channels were the sale of human antibiotics from human pharmacies for veterinary usage or the sale of veterinary antibiotics from private companies to independent farmers. Stakeholders could alternate between formal and informal channel (orange arrow). Dotted arrows correspond to infrequent supply chain. The provenance of human antibiotics has not been explored. Vet= veterinary. Vet gov= veterinary governmental.

Different level of legitimacy, resources and connections were attributed to stakeholders (Table 2). The public sector, Lao government group, was not further investigated because it was rated as legitimate and well-resourced, and its connection in the supply chain was weak.

The private sector stakeholders were involved in the importation, distribution and use of antibiotics. The private sector stakeholders represented three weakly connected groups operating in parallel, which were further investigated (Figure 3):

- (1) Technicians from private multinational companies working with contracted farmers of the same company and using antibiotics from parent companies.
- (2) Private foreign farmers with few contacts with other stakeholders, importing antibiotics directly from their home country.
- (3) Independent private actors such as independent antibiotics suppliers and independent users (farmers), representing another group linked to the government veterinary authorities.

**Table 2. Classification of stakeholders of the veterinary antibiotics supply chain from the public and private sector in Lao PDR in 2018, according to their legitimacy, resources, and connections.**

“+++” = strong; “+” = medium; “-” = weak; “?” = undetermined.

Legitimacy was defined according to the type of channel the stakeholder was using to import and/or sell antibiotics: or formal i.e., controlled and monitored by the government and for which stakeholders pay taxes, or informal. Their level of resources was described by their level of knowledge on antibiotic use, good practices and AMR, their qualifications (e.g., education, training, area of expertise) and their ability to provide advice on good practices for antibiotic use. The connection was defined by the number of interactions they had within the veterinary antibiotics supply chain.

Stakeholders of the veterinary antibiotics supply chain	Positions and core functions of the stakeholders		
	Legitimacy	Resources	Connections
<b><i>Public sector-Lao government</i></b>			
-Ministry of Agriculture and Forestry	+++	+++	+
-National veterinary governmental authorities	+++	+++	+
-Province and district veterinary governmental authorities	+++	+++	+
-Ministry of Health	+++	+++	-
-Ministry of Education	+++	+++	+
-Ministry of National Defence (army farms and army veterinarians)	+++	+++	+
<b><i>Private sector</i></b>			
<b><i>Private multinational companies:</i></b>			
-technicians	+++	+++	+
-contracted farmers	+++	+	-
<b><i>Private foreign farm owners:</i></b>			
-private foreign farmer	-	?	-
<b><i>Independent private antibiotics suppliers</i></b>			
-middlemen	+ or -	-	+++
-illegal vendors	-	-	+
-owner or staff of agricultural retail outlet	+	+	+++
-veterinary village workers	+	+	+++
-private veterinarians	+	+++	+
-veterinarians in veterinary clinics	+	+++	+
-human pharmacists	-	+	+++
<b><i>Independent private antibiotics users</i></b>			
-independent farmers	+	+	+++



### 3.2 *Private multinational companies*

Three private multinational companies were identified. They had large-scale swine and poultry farms that imported veterinary antibiotics from their parent company (e.g., Thailand and China). One multinational company had several inventory of veterinary antibiotics in Lao PDR. The antibiotics were imported through formal channels and private multinational companies declared their inventory. These companies were scored with a strong level of legitimacy and resources (**Table 2**).

Contracted farmers working for private multinational companies obtained antibiotics from technicians employed by the company. They claimed that they followed the company's recommendations for the use of antibiotics. Farmers within these integrated systems were not allowed to use any other antibiotics than those provided by their contracting company. They mentioned that they had good access to advice from technicians during disease outbreaks. They appeared indifferent to the new regulations (**Supplementary Table 5**). The technicians interviewed had completed post-secondary education and had benefited from AMR awareness actions led by their companies. Some companies already had internal policies on AMR mitigation (Charoen Pokphand Foods, 2017).

“I don't sell the antibiotics; I only support the farmer by giving advice and treatment if needed. I only take care of pigs. [...] I don't earn more if I treat the pigs, and I have a fixed salary. I have a Master's degree in Animal Production. In Lao, there are only seven people employed in this company who are authorised to give advice on antibiotics usage. [...] I am not worried about AMR because my company already encourages farmers to use only small quantities of antibiotics, it has a project for decreasing the ABU for every farm. [...] The Lao government should apply these regulations, so the pigs will be drug-free! [Interview, a male technician from a multinational company, Vientiane Capital province]

This integrated group seemed isolated from other actors, however, antibiotics from these companies could be sold by the technicians to independent farmers outside the integrated system, through informal channels.

“Another way to gain access to antibiotics is through the employees of multinational companies that also have private businesses and resell antibiotics to other farmers. But they did not give advice or anything. The drugs may have been thrown away by the company as the expiry date was close and the staff take them. But the company is not aware of this.” [Interview, a male independent Lao fish farmer, Vientiane Province]

### 3.3 *Private foreign farmers*

Private foreign farmers were classified as informal stakeholders with a weak level of legitimacy among other stakeholders, who perceived them as big antibiotic users (**Table 2**).

“Those farmers do not eat their own pigs but eat the pigs from [Lao] local production. Their pigs are toxic food as they use too many drugs!” [Interview, a male member of province staff within the veterinary government authorities]

Foreigners, mostly from China, invested in the country and were involved into pig and freshwater fish production. They contributed to the overall production of meat/fish in the country.

“These foreign farmers have been widely present in my district for approximately 10 years and produce up to 80% of the total number of pigs in this district.” [Interview, female staff of the veterinary governmental authorities at district level, Vientiane Capital province]

While production data, number of farms, and volume of antibiotics imported and used were largely unknown, some Lao farmers claimed that foreign farms affected the market prices of animal products.

“We are in conflict with these farmers because they decrease the price of fish and pig products on the market!” [Interview, an independent male Lao fish farmer, Vientiane Province]

The three Chinese fish-farmers interviewed reported that they imported veterinary antibiotics directly from China. This was another informal channel of veterinary antibiotics entering Lao PDR. They also mentioned that Chinese farmer groups had their own feed company in Vientiane Capital. It was unclear if veterinary antibiotics were used in the feeds they produce. The Chinese farmers were aware of AMR but did not consider it to be a problem. They claimed that their overall use of antibiotics was negligible. They never relied on services provided by the district or provincial government veterinary authorities. They expressed objections to the new regulation on prescription requirement to buy antibiotics. They claimed that inaccessibility of antibiotics will impact negatively on fish mortality and overall business performance (**Supplementary Table 5**).

“(if this regulation is applied) I will stop my business! Here, the vets don’t know anything about fish disease and can’t give me advice! I totally disagree with the need of a prescription to buy medicine! [...] In my farm, AMR is not a problem because I only use a little [...]. I only use enrofloxacin, amoxicillin and vitamins,” [Interview, a female foreign fish farmers, Vientiane Capital province]

These farmers were not directly linked with other actors in the antibiotics supply chain. Most of the antibiotic leaflets were in Chinese and there were no Lao translations. Lao farmers did not use these antibiotics because they could not read the labels or instructions.

### **3.4 Independent antibiotics suppliers (connected with public sector)**

Seven types of independent antibiotic suppliers were identified: middlemen, illegal vendors, owners and staff of agricultural retail outlets or veterinary pharmacies, private veterinarians, veterinary village workers, veterinary clinic and human pharmacies (**Figure 1**)

Two groups, the middlemen and illegal vendors, were scored with a medium level of legitimacy and were identified by the other stakeholders as potential opponents to the two new regulations, as they were difficult to monitor. Illegal vendors were mentioned as never paying taxes and mainly selling veterinary antibiotics to farmers through direct marketing. The sale of antibiotics could be their only source of income. A middleman was an individual who imported veterinary antibiotics deemed for his “own use” but would subsequently sell them to veterinary pharmacies, agricultural retail outlets and farmers. The profiles of these middlemen were multi-fold, such as fully employed by a shop, occasional importers, or independent farmers. Middlemen seemed to be the key stakeholders who interacted with most of the other stakeholders and privileged informal channels (i.e., not paying tax), failing to declare the antibiotics at the border control point (**Supplementary Table 5**).

“Middlemen are like an army of ants bringing veterinary antibiotics into Laos” [Participatory workshop – step 1, private veterinarian]

Four groups of the independent antibiotic suppliers: the owners of agricultural retail outlets, private veterinarians, veterinarians in veterinary clinics and veterinary village workers, were scored with a medium level of legitimacy, and they reported that they supported the new regulations (**Supplementary Table 5**). Among the 36 surveyed (4 public veterinarians and owner and staff of agricultural retail outlets, private veterinarians and veterinary village workers), almost half started their activity less than 5 years ago, showing the dynamics of these activities and the evolving nature of the veterinary antibiotics supply chain (**Table 3**). A large majority were male, having a high school or higher education, and about half were between 30 and 50 years old (**Table 3**). Most of them stated that antibiotics were essential for farmers, and about 20% of them even declared that antibiotics were required as growth promoters. A large majority were concerned about AMR and recognised that they have a role to play in AMR mitigation and that news regulations were needed (**Table 3**).

**Table 3. The socio-demographic characteristics of the private independent antibiotics suppliers and the public veterinarians surveyed in the step “opinions and practices”, their statement on the need of antibiotics in food animals and their concern for AMR, N=36.**

Antibiotics suppliers' characteristics	%	Antibiotics suppliers' characteristics	%
<b>1. Gender</b>		<b>2. Age</b>	
Male	83.3	Young (15 – 30 years)	13.9
Female	16.7	Middle (31 – 50 years)	44.4
<b>3. Education</b>		Old (51 – 65 years)	
Completed master's	16.7	<b>4. Careers</b>	
Completed technical studies or bachelor's	33.3	Public veterinarian from district governmental authorities	11,2
High School	30.6	Agricultural retail outlets	41,7
Middle School	11.1	Private veterinarians	16,7
No school or elementary school	8.4	Veterinary village workers	30.6
<b>5. Experience in selling antibiotics</b>			
Less than 5 years	44.4		
More than 5 years to 10 years	22.2		
Over 10 years	33.3		
Statement about the need of antibiotics in food animals	%	Statement about their concern for AMR	%
1. They are necessary for disease prevention	80.6	1. I am concerned by AMR problems	69.5
2. It is not possible for a farmer to raise animals without antibiotics	61,1	2. I have a role to play in the fight against AMR	91.7
3. Antibiotics are necessary as growth promoters	19.4	3. New regulations need to be implemented in Lao	80.6

The agricultural retail outlets surveyed stated that they obtained antibiotics through middlemen (2/17), foreigner distributor antibiotics companies (6/17) and other agricultural retail outlets (9/17) (**Figure 4**). None declared to buy antibiotics from the public sector (veterinary government authorities). During the interviews, some of them declared that they ordered antibiotics to be delivered to the Thai border, or that they owned a store of antibiotics in Thailand. These stakeholders stated that they sold veterinary antibiotics over the counter without a prescription or veterinary supervision. They generally thought that farmers used too many antibiotics to treat their animals and that it was necessary to control the quantity of antibiotics used by each farmer. The interviewees were mainly in favour of the new regulations, viewing them as a business opportunity:

“If I employ a veterinarian, it will be really good [*sic*] for my shop, I will earn more reputation, high credit. There will be a one-hour queue to get into my shop! It would be better, because I have been working for a long time, so I have experience, but I don't have any proper qualifications, sometimes I don't know how to help farmers! [...] I am not afraid about spending money to employ a vet because I am sure I will have many more clients. I even thought about doing this before the regulations.” [Interview, owner of an agricultural retail outlets, Vientiane Capital province]

The veterinary village workers were technicians trained by the public sector (provincial or district veterinary governmental authorities). They stated that they treated animals and sold veterinary products such as vaccines to farmers, but few antibiotics. During the questionnaire survey, they stated that they obtained antibiotics from the public sector (veterinary supply unit, 1/11), or the private sectors such as agricultural retail outlets (8/11), private veterinarians (1/11), or middleman (1/11) (**Figure 4**). They declared that they had another job at the same time (e.g., farming, business). They reported their limited ability to provide advice to producers. They mentioned that they were aware of AMR thanks to their own experience in the field and various information sessions (e.g., in the University of Agriculture). They thought it was a good idea that veterinary governmental authorities start to fight against AMR and hoped to receive training to be able to write prescriptions.

“I don’t earn much money by helping farmers, and I give my own treatment, I never sell antibiotics to them. Most of the time I am a farmer, I grow rice. [...] I would be really interested in receiving some training from veterinary governmental authorities to have the right to write a prescription. I am too isolated at the moment, I don’t receive any help from the government. [...] 3 or 4 years ago, there were about 100 cows in my village, but now they are about 400 cows. Last year, there was a disease outbreak and I was left alone to deal with it. I couldn’t help everybody!” [Interview, a veterinary village worker, Vientiane Capital province]

The private veterinarians surveyed stated that they obtained antibiotics from the private sector, such as agricultural retail outlets (1/4), middleman (2/4), and human pharmacies (1/4) (**Figure 4**). The owner of the veterinary clinic interviewed appeared to be supportive of the anticipated changes in veterinary antibiotics laws and its enforcement. He believed that it would not affect his business, seeing an opportunity to increase his legitimacy to sell antibiotics.

The independent private antibiotics suppliers interacted with the public sector (**Figure 3 and 4**). The public veterinarians from the district governmental authorities surveyed obtained antibiotics from the national governmental authorities (veterinary supply, 2/4), agricultural retail outlets (1/4) and human pharmacies (1/4) (**Figure 4**).

The independent antibiotics suppliers interacted with the independent users (farmers) by selling them antibiotics or advising them on the use of antibiotics (**Figure 3**).

### **3.5 Independent antibiotic users, farmers (connected with public sector)**

Most of the surveyed farmers were full-time, which showed that they relied solely on livestock production for their income. Most of the farmers were female, with a level of education split between no school, primary school, secondary school or high school (**Table 4**). Most chicken farmers were more than 50 years old, while many pig farmers were between 30 and 50 years old. About a third of the pig farmers had less than 10 years of experience in the business while about quarter of them started less than two years ago. This shows the diversity of livestock experience among the survey participants and the dynamics of farm activities.

**Table 4. The socio-demographic characteristics of the independent chicken and pig farmers surveyed in the step “opinions and practices”; N (chickens)= 96, N (pigs)=96**

Population	Chicken farmers (%)	Pig farmers (%)
	%	%
<b>1.Location</b>		
Vientiane Capital	80.2	52.1
Vientiane Province	19.8	47.9
<b>2.Gender</b>		
1.Male	36.8	37.5
2.Female	63.2	62.5
<b>3.Age</b>		
Young (15 – 30)	6.2	10.5
Middle (31 – 50)	41.2	63.2
Old (51 – 65)	51.5	26.3
<b>4.Education</b>		
Illiterate/no school	16.7	11.6
Primary school	38.5	25.3
Secondary school	18.8	24.2
High School or vocational studies	21.9	31.9
University or above	4.2	7.4
<b>5.Careers</b>		
Full time farmers	68.7	68.7
Independent worker	10.3	13.7
Governmental staff	10.3	8.4
Retired, housewife	10.3	9.5
<b>6.Age of this activity</b>		
Less than 2 year	14.4	25.5
More than 2 years to 10 years	22.6	37.5
Over 10 years	62.5	37.5

Surveyed independent farmers had flocks of between 7 and 200 chickens (mean of 57 heads) and herds between 2 and 160 pigs (mean of 20 heads). Most of farmers (60%) also kept other animals (**Table 5**). Most of the chicken flocks were free range or both caged and free-range while most of the pig herds were kept in pens or stables. Indigenous breeds were predominant for chickens, whereas pigs were equally distributed between indigenous, exotic, and cross breeds. Some of the farmers used commercial feed, however no antibiotics figured in the ingredients of the commercial feed found in the farms surveyed (**Table 5**).

About half of the farmers declared that a health problem had occurred in their flock within the past 12 months. Only a few of the farmers could name the disease: avian influenza, fowl cholera, Newcastle disease, acute death and enteric disease in chickens; and enteric disease and classical swine fever in pigs. A minority declared that they vaccinate their chicken flocks (19.6%) or pig herds (44.6%) (**Table 5**).

**Table 5. The farm characteristics, and opinion and practices on antibiotic use and antimicrobial resistance of the independent chicken and pig farmers surveyed in the step “opinions and practices”; n (chickens)= 96, n (pigs)=96**

Farm characteristic, opinion and practices	Chickens (%)	Pigs (%)	Farm characteristic, opinion and practices	Chickens (%)	Pigs (%)
<b>1. How the animals are kept?</b>			<b>2. Other animals kept at the farm (several answers possible)</b>		
- Pens or stable	17.4	75.50	-None	32.6	27.4
- Mix: pens and free range	38	20.2	- Pigs	10.5	-
- Free-range	42.7	1.1	- Chickens	-	20
- Cage	2.1	-	- Ducks	47.4	55.8
			- Buffaloes/cows	23.2	20
			- Other	7.4	10.5
<b>3. Use of antibiotics or vaccines</b>			<b>4. Species of animal kept</b>		
Antibiotics	48.9	60.0	- Indigenous	94.8	33.7
Vaccination	19.6	44.6	- Exotic	5.2	28.4
			- Cross breed	4.1	36.8
<b>5. Health problem in the flock/herd last 12 months</b>			<b>5.2 If yes, name of the last disease</b>		
Yes	58.8	46.9	-Acute death	35.3	-
<b>5.1 If yes, how many disease events during the last 12 months?</b>			- Fowl cholera	4.9	-
à1	86.0	80.6	- Newcastle	5.9	-
à2	5.3	16.7	- Avian Influenza	5.9	-
à3 or more	8.8	2.8	-Diarrhoea (E.coli, salmonellosis)	4.9	47.6
			-Classical swine fever	-	9.5
<b>6. When facing a disease, what do you first do?</b>			<b>7. Opinion on the need of antibiotic use in their livestock</b>		
-Isolate the sick animals	56.2	24.5	-When they have any abnormal symptoms	81.2	85.9
-Treat the sick animals with antibiotics by themselves	31.2	25.5	-When they do not show any improvement in growth	44.3	34.5
-Call a veterinarian or a veterinary village worker	13.5	41.5	-When the animals in other farms within the village start to get sick	75.0	86.6
-Ask relatives or other farmers for advice	6.2	9.6	-When farmers or a relative advises them to use it	62.6	61.3
<b>8. Seek advice before using antibiotics?</b>			<b>9. Source of antibiotics (for those who used them)</b>		
1.yes	81.4	89.0	-Agricultural retail outlets	67.6	43,2
<b>8.1 If yes, to whom?</b>			-Human pharmacies	22.1	35.8

-Veterinarians or veterinary village workers	37.1	68.5	-Veterinarians/ veterinary village workers	8.9	21.0
-Agricultural retail outlets	31.4	21.9	-Illegal vendor	1.5	0.0
-Relatives or other farmers	18.5	21.9			

In the event of disease outbreak, a minority of the farmers declared that they first called a veterinarian or a veterinary village worker, and about a quarter said that they treated their sick animals with antibiotics by themselves. Around half of the farmers declared that they used antibiotics for their animals (more in pig farms than chicken farms). The utilisation of antibiotics was associated to the breed of the pigs: farmers who kept indigenous pigs used less antibiotic than farmers who kept exotic breeds (p-value <0.01). It was also correlated to the number of chickens kept; chicken farmers with less than 10 chickens tended to use less antibiotic (p<0.01) (**Table 5**). The majority of the antibiotics found at the farms (16/29 in chicken farms and 54/73 in pig farms) were critically important antibiotics used in human medicine, such as amoxicillin, ampicillin, gentamicin, enrofloxacin, norfloxacin, ciprofloxacin, tylosin, or combinations of spiramycin-tylosin-colistin and penamicillin-streptomycin (World Health Organization, 2019) (**Table 6**).

**Table 6. Classification of the antibiotics found in the surveyed chicken and pig farms at the time of the farm visit.** Classification was done according to the list of critically important antimicrobials for human medicine from World Health Organization (**World Health Organization, 2019**). This classification relies on two criteria C1 and C2. C1: The antibiotic class is the sole, or one of limited available therapies, to treat serious bacterial infections in people. C2: The antibiotic class is used to treat infections caused by bacteria possibly transmitted from non-human sources, or with resistance genes from non-human sources. The critically important antibiotics for human medicine are antibiotics classes which meet both C1 and C2. The highly important antibiotics for human medicine are antibiotics classes which meet either C1 or C2. \*Some of the antibiotics found in the farms surveyed could not be identified, either because they were written in Chinese or because the photos taken were of poor quality.

<b>Grouping of antibiotics</b>	<b>Antibiotic class</b>	<b>Antibiotic agent</b>	<b>Chicken farms (n)</b>	<b>Pig farms (n)</b>
<b>Critically important</b>	Penicillin	<b>Amoxicillin</b>	4	17
		<b>Ampicillin</b>	5	0
	Aminoglycosides	<b>Gentamicin</b>	1	9
	Fluoroquinolones	<b>Enrofloxacin</b>	1	9
		<b>Norfloxacin</b>	2	1
		<b>Ciprofloxacin</b>	0	1
	Macrolides	<b>Tylosin</b>	0	2
Macrolides and polymyxins combination	<b>Spiramycin-tylosin-colistin</b>	1	0	
Combination of <i>highly critically important</i> Penicillin and aminoglycosides combination	<i>Penamecillin-streptomycin</i>	2	15	
<i>Highly important</i>	Tetracyclines	<i>Oxytetracycline</i>	10	14
		<i>Chlortetracycline</i>	2	0
	Amphenicols and tetracyclines combination	<i>Thiamphenicol-oxytetracycline</i>	0	2
-	Undetermined*	Undetermined *	1	3
		Total (N)	29	73

The farmers stated that antibiotics were necessary for their livestock for several reasons: presence of abnormal signs, growth problems, sick neighbouring animals, or depending on advice from relatives.

Most of the farmers surveyed mentioned that before using antibiotics, they sought advice from veterinarians or veterinary village workers (mainly the pig farmers), agricultural retail outlets, or relatives/other farmers (**Table 5**). In some districts, there were commodity-specific associations, such as the broiler farmers' association or the fish farmers association. Within these associations, farmers mentioned that they were able to better market their products (e.g., restaurants, hotels, local market), to discuss strategies to optimise profits (i.e., strategic marketing such as scheduled marketing of products ensuring a consistent supply that matches the local demand), to share their experiences of diseases and to give advice on how to treat animals.

“We (members of the broiler group) share the restaurants where we sell the meat. We always discuss our experience of a disease and how to treat it. In this group, we have a big farm owner and he has a great deal of knowledge, he is an unofficial veterinary village worker: he goes to the farms and give advice. [...] Those regulations are not a good idea. The antibiotics are really helpful for the farms, if we don't use them, the chicken will die, or grow slowly!” [Interview, broiler farmer and chief of the broiler group of one district, Vientiane Province]

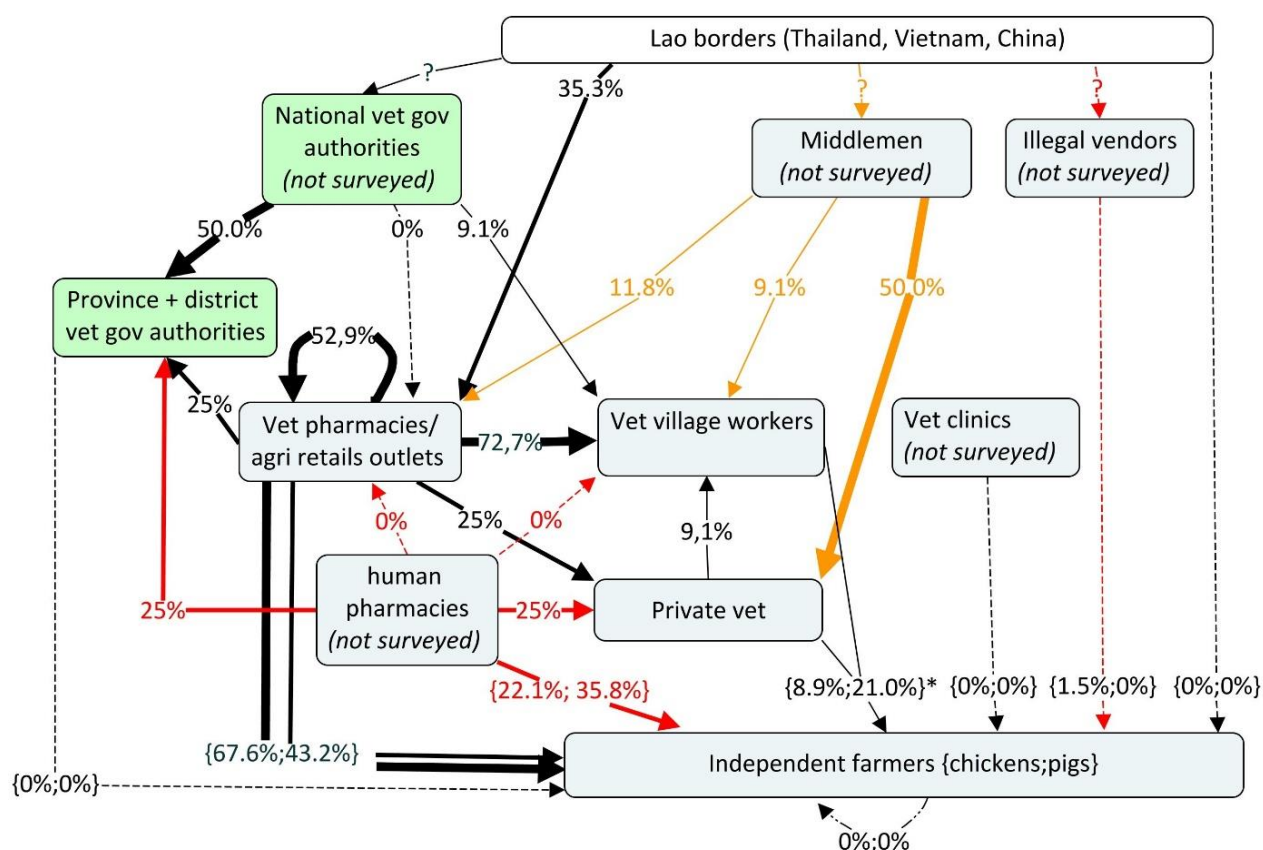


There were many ways for an independent farmer to obtain antibiotics. The most common practices mentioned during the survey were the purchase of antibiotics from agricultural retail outlets, then human pharmacies and then from a veterinarians or veterinary village workers (Table 5, Figure 4). A farmer might also sell his antibiotics within his network (e.g., neighbours, other farmers). Current regulations on access to antibiotics was unclear amongst farmers. There was a general lack of awareness as to whether they were using antibiotics in line with the regulations.

“I don’t really know if what I am doing is legal or not because the regulations are not at all clear for me”  
 [Focus group discussion, independent pig farmers]

Almost all the farmers interviewed had heard about AMR. They all agreed that new regulations were needed and they wanted to improve their antibiotic use practices by having access to veterinary diagnostics. However, farmers interviewed stated that they had poor access to veterinarian advice. They reported that veterinarians and staff from the veterinary governmental authorities were difficult to reach and seem concerned that this new regulation would lead to restricted access to antibiotics.

“I think it will be really difficult to apply this law [...] I am really afraid that this process will take a really long time and that veterinarians will not be available. Vets are difficult to reach, they don’t answer the phone, especially in rural area. A few farmers have already had a bad experience where the vet never came to their farms. [...] That’s why most of the time we try to treat sick animals by ourselves, if not, our animals die, and the disease can spread really quickly.” [Interview, independent poultry farmer, Vientiane Capital province]



**Figure 4. Quantification of supply chain of the public sector and independent private actors groups based on the data obtained from the questionnaires.** Those data were obtained during the step 3 opinions and practices: N = 4 public veterinarians at district level, N = 17 agricultural retail outlets, N = 4 private veterinarians, N = 11 veterinary village workers. The percentage results should be interpreted with caution, as the number of actors surveyed was relatively small. Only the farmers who mentioned buying antibiotics were included: N = 73/96 chicken farmers, and N = 83/96 pig farmers. The interrogation points mean that the data were not investigated. Dotted arrow: <2% of related survey participant mentioned this channel, thin arrow: 3-21%, intermediate arrow: 22-49%, thick arrow: >50. For the colors of the arrows and squares, see Figure 3. \*the private veterinarians and veterinary village workers were not differentiated in the questionnaires for farmers as the farmers did not always distinguish them

## 4. Discussion

The nature of this study was exploratory, with the aim of obtaining an overall picture of the stakeholder groups related to the issue of AMR in food animals in Lao PDR (Hinchliffe et al., 2018). This study brought some understanding of the inputs of this complex adaptive system, i.e. the stakeholder groups within the veterinary antibiotic supply chain and their interactions. This study also explored the stakeholder's perception of AMR and AMR mitigation (expected impact) and of the objective of new regulations (expected outcomes). This study also investigated the stakeholders' interests and constraints they would face if the new regulations on access and use of antibiotics were implemented (the outputs) in relation to their livelihood strategies.

### 4.1 The stakeholder groups (inputs) and their vision of the expected outcomes and expected impact

The inputs of this complex adaptive system were composed of 23 categories of stakeholders involved in the veterinary antibiotics supply chain, with different level of legitimacy and resources. These stakeholders operated in four main groups which were weakly connected.

The stakeholders from the group "public sector" were poorly investigated.

The stakeholders from the group "private multinational companies" shared the objective of AMR mitigation. The stakeholders from the group "private foreign farmers" were not concerned with the issue of AMR. The foreign farmers also showed a general mistrust towards veterinary government authorities. As there is very little data on private foreign farmers, it would be important to organise a census of them. This would enable a better investigation of the dynamics of this group (i.e., farmers practices and strategies, group of influence) and further investigation of the overall role of the importation channel (estimated quantity, quality of products, other players involved). Even if this group appears to be completely independent from other stakeholders, their farm products are sold in Lao PDR markets and seem to influence the local economy and demand. We may draw the hypothesis that this "informal channel" influences the strategies of local farmers in their attempt to remain competitive, and thus, influencing their decision making related to antibiotics use.

The stakeholders from the private independent group were independent antibiotics suppliers and independent farmers. They shared the objective of AMR mitigation but also mentioned the important need to use antibiotics in food animals, including those that are deemed as critically important to human medicine.

### 4.2 The potential interest and constraints among stakeholders that might influence the causal link between the output and the expected outcomes

The stakeholders involved in the "private multinational companies" group stated that they were supportive of the anticipated changes in AMU regulations. They appeared to have the capacity and experience to adapt to regulatory changes. Their economic strategies would be strengthened by increasing their legitimacy in the food chain in Lao PDR. The advantageous position that multinationals can take in the implementation of new regulations was studied in the pig sector during changing governance of AMR in Denmark (Food and Agriculture Organization of the United Nations, 2019; Jacobsen et al., 2006) and during the avian influenza episode in Vietnam in 2003 (Figuié et al., 2013). The private foreign farmers positioned themselves clearly against the new regulations. Our study also highlighted the crucial role of middlemen in the veterinary antibiotics importation process. Middlemen were hard to monitor and were potential opponents of new regulations.

The owners of agricultural retail outlets were supportive of new regulations and claimed that they would employ qualified veterinarians. This might only be true for big shops. Smaller shop owners may continue selling antibiotics illegally because of the cost of hiring a full-time licensed veterinarian.

Independent farmers were not opposed to new regulations, but they were concerned and have doubts as to the feasibility of implementing them (e.g., asking for a prescription to buy antibiotics). In line with the framework proposed by Lhermie et al. (2017), we have highlighted several elements that influenced the farmers' decision-making process to buy and use antibiotics. These elements may concern the farmer, for example, his appreciation of the risk of disease in his environment, his experiment and his attitude towards risk (Lhermie et al., 2017). Indeed, the treatment strategies of farmers depended on contextual elements, such as the disease outbreak among their flocks/herd or in neighbouring flocks/herds. Others elements may concern the institutional environment, such as the multi-national companies with contracted farmers, the presence of veterinary governmental authorities or veterinary village workers (Lhermie et al., 2017). Farmers mentioned the weak presence of veterinary services in rural area, and depending on their perceptions of epidemic risks and on their past experience, farmers felt forced to treat their animals. It would be necessary to provide veterinary extension services and training of veterinary village workers to support the farmers. This represents a needed additional output, in parallel to the development of the new regulations.

In our study, the decision-making process to buy and use antibiotics among independent farmers was also influenced by their relatives/family groups and farmers' association groups (Masud et al., 2020) and by the need for high productivity ("otherwise our chickens will not grow"). The need of productivity may be linked to the competitiveness of their products on the market. The need to remain competitive to survive in the economic market was not proposed in the framework of Lhermie et al. (2017), but we assume that in our study this element was important. A better understanding of the strategies of farmers, their groups of influence and their rearing practices (e.g., multi-species production, free-range production, and waste management) would help to construct a sustainable AMR mitigation plan.

### **4.3 Limitations of the study and perspectives**

We are aware that some results might have been distorted by several factors and should hence be interpreted with caution. The translation of the different recordings and the subjective form of the method, which is based on stakeholders' willingness to respond to questions and interact with researchers, limits the reliability of our results (Schmeer, 1999). The categorisation of the key, primary and secondary stakeholders is somewhat subjective and could differ according to the composition of the research team. However, this should not affect the main conclusions regarding the stakeholders investigated. We only interviewed 2 "middlemen" stakeholders: as their activity is informal, most people interviewed denied that they acted as "middlemen". For private foreign farmers, we only interviewed fish farmers as the Chinese pig farmers refused to be interviewed. Language was a clear barrier for the research team in understanding the role of the private foreign farmers and importers because most of them do not speak Lao. The opinion of other stakeholders on private foreign farmers and the visit of their farms would lead us to believe that their position is similar to that of the fish farmers. Finally, the survey area is close to the border of Thailand and may not be reflective of the other provinces of Lao PDR, such as provinces bordering China, where the composition of multinational private companies could be different. This limited study nevertheless illustrated the highly dynamic and heterogeneous nature of stakeholders involved in the veterinary supply chain in Lao PDR.

The provenance of human antibiotics sold by human pharmacies and accessed by farmers has not been explored. Furthermore, the public sector has not been fully investigated (semi-structured interview=1, questionnaires=4), and future studies should focus on veterinary governmental authorities at different levels (national, district, local). The questionnaire survey did not include contracted farmers from private companies, private foreign farmers, neither fish nor bovine farmers and those population should be investigated.

### **4.4 Governance of AMR mitigation**

By considering the AMR issue in the light of stakeholder groups, this study identified some key elements that might influence the success of the implementation of new veterinary antibiotic regulations. Beyond the description of the veterinary antibiotics supply chain, we investigated three groups of stakeholders, and the relations and connections

that influenced their decision-making on antibiotics. We also highlighted that these groups are dynamic and evolve with the context. Consistent with other low-income countries with weak enforcement of veterinary regulations, the sales of veterinary or human antibiotics for veterinary use, were largely over the counter (Mutua et al., 2020; Shryock, 2012). We believe that under current conditions in Lao PDR, relying solely on regulatory enforcement of veterinary antibiotic sales and use may not be enough. Several stakeholders indicated accessing human antibiotics in human pharmacies without prescription, including staff of district veterinary governmental authorities, even if it is forbidden by law. Furthermore, our study highlighted the lack of farmer knowledge regarding current regulations on access to antibiotics; low awareness of existing laws and regulations among the population of Lao PDR is also reported in another study (Jönsson et al., 2015).

We believed that an appropriate AMR governance system should be based on place based governance that takes into account the uncertainty around changes and builds upon multi-stakeholder inputs to establish an effective AMR risk reduction strategy (Chhotray and Stoker, 2009; Hinchliffe et al., 2018). Moreover, a study for the health sector reform in Lao PDR showed that diverse stakeholder groups should be involved in policy design and implementation in order to increase the probability of a sustainable and successful reform (Phillips et al., 2016).

Indeed, it would seem that policies would be more successful if it were recognised that they require the active participation of stakeholders and if the latter were actively involved in the process of drafting and implementing the policies (Salve et al., 2018). A place based governance would allow the construction a common understanding of AMR strategy (the expected impact) by truly involving the stakeholders identified, engaging them in dialogue about the objective of new regulations. It would be interesting to learn from similar experiences (Zaidi et al., 2015). We argue that stakeholders involved in the veterinary antibiotics supply chain should be included in developing an AMR strategy, including stakeholders from the public and private sector, involved in the importation and in the sale of antimicrobials such as antibiotics. To expect successful implementation of the new regulations, we believe that the public sector (i.e the Lao government and the veterinary government authorities), would have to collaborate with the private sector (private multinational companies, independent antibiotics suppliers, independent farmers) and monitor the informal stakeholders. Other studies have shown the important role played by the private sector in veterinary program, such as in the surveillance of Highly Pathogenic Avian Influenza in Vietnam (Delabouglise et al., 2015). Since 2019, studies have focused on collaboration between public and private sector to manage animal health programs. These collaborations are called public-private partnerships in the veterinary field (Galière et al., 2019a). It would be interesting to identify public-private partnerships that aim to adapt and reduce the sale and use of veterinary antibiotics in Southeast Asian countries, to learn from their collaborative experiences.

#### **4.5 Theory of change**

The use of theory of change is becoming increasingly popular in the public health field, but, to our knowledge, has not been applied to an AMR mitigation program (Breuer et al., 2016). In particular, theory of change has not yet been applied to an AMR mitigation program in the veterinary sector, although its value has been noted (Mutua et al., 2020). This study represents the first attempt to use the theory of change for AMR mitigation in the veterinary domain. However, we used a simplified theory of change, as the link between outcomes and impacts was not explored. Furthermore, the impact pathway was not made explicit during the study and was drawn by the researchers during data analysis. It would be necessary to co-develop the impact pathway and co-explicit the causal links between inputs, outputs, outcomes and impacts with stakeholders identified in this study. Our study represent an ex-ante analysis of the situation, and the theory of change can be mobilized in itinere or ex post, to have a follow-up of the intervention program (Blundo Canto et al., 2018).

#### **4.6 Conclusion**

Contrary to studies focusing on the irrational use of antibiotics by farmers, this study adopted the perspective of multiple stakeholders, seeking to anticipate difficulties in the implementation of new regulations related to access and use of veterinary antibiotics. By applying a simplified theory of change we were able to analyse the situation as a

complex adaptive system and thus to reinforce the consideration of the different stakeholders. Further participatory methods would be required to obtain a more complex theory of change, which would reflect the issues at stake and elicit ways of overcoming the obstacles to the desired changes. We believed that a sustainable strategy to reduce AMR risks should be co-constructed with the stakeholders identified. The dialogue and engagement of identified public and private sector stakeholders, would allow for the development of context-specific strategies. We also argue that research teams should use of the theory of change to support governments and stakeholders in implementing AMR mitigation plans, such as the reduced and appropriate use and sale of veterinary antibiotics.

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## *Appendices to Chapter 3*

### Appendix 1. The scoring guide of the evaluation tool for the public-private partnership process.

#### **Section 1: objective(s) of the PPP**

Criteria	Quality attribute
Scoring the criteria	Score & comment
<b>1.1 Common objective(s)</b>	<b>Operationality</b>
<p>All partners (public and private actors) must co-construct and define the overall objective(s) to be achieved and the service to be delivered.</p> <p>Score 0: The partners do not agree on the definition of the common objective(s) to be achieved or the services to be provided. These objectives have not been co-constructed.</p> <p>Score 1: The partners do not agree on the definition of the common objective(s) to be achieved (which have not been co-constructed) or on the services to be provided.</p> <p>Score 2: The partners partly agree on the definition of the common objective(s) to be achieved but not on the services to be delivered</p> <p>Score 3: All partners agree on the common objective(s) to be achieved which was co-constructed and on the services to be delivered.</p>	
<b>1.2 Formalization of the common objective</b>	<b>Stability</b>
<p>Level of formalization of the common objective of the PPP (MoU, Letter of Agreement, Oral consent etc.).</p> <p>Score 0: Absence of formalization or lack of formalisation, which hinders the proper process of PPPs.</p> <p>Score 1: Formalized objectives warrant significant additional details.</p> <p>Score 2: Formalized objectives warrant minor additional details.</p> <p>Score 3: Well-detailed, fully formalized objectives of the PPP are written in a document recognized by all the partners.</p>	
<b>1.3 Position of the partners regarding this common objective</b>	<b>Acceptability</b>
<p>The common objective should be transparent and understood by each partner. It should satisfy each partner regarding his/her own strategies, needs and benefits.</p> <p>Score 0: Some of the partners are not satisfied with the common objective which lacks transparency.</p> <p>Score 1: Only one type of partner is satisfied with the common objective.</p> <p>Score 2: All types of partners are partly satisfied with the common objective and each partner understands the common objective.</p> <p>Score 3: All types of partners are fully satisfied with the common objective which is transparent.</p>	
<b>1.4 Added value of the PPP</b>	<b>Stability; Relevance;</b>
<p>The PPP should represent an added value to reach the common objective(s) of the program (it has been considered that only one sector conduct this program, but in this case the objective could not be reach or would entail more difficulties).</p> <p>Score 0: This PPP does not provide a clear added value; on the contrary it represents a constraint to reach the common objective(s) of the program.</p> <p>Score 1: The PPP is not a clear added value to reach the common objective.</p> <p>Score 2: The PPP is an added value to reach the common objective even if this common objective can be reach by one partner alone.</p> <p>Score 3: The PPP is a clear added value for the program and the common objective cannot be reached without the partner(s).</p>	

## **Section 2. Specific interest / benefits**

2.1. The specific interest of the different partners	<b>Relevance; Acceptability</b>
<p>The different partners have specific interest and expected benefits in enrolling in the PPP. These specific interests should be explicit, transparent, formalized (if appropriate) and understood by the other partners. The specific interests shouldn't hinder the achievement of the common objective.</p> <p>Score 0: Lack of identification of the specific interest of the different partners.</p> <p>Score 1: The specific interests of some of the partners are not explicit and transparent.</p> <p>Score 2: The specific interests of all the partners have been identified and discussed between partners.</p> <p>Score 3: All partners' specific interests are identified, formalized (if appropriate) and understood and accepted by the other partners.</p>	
2.2 Allocation of benefits and other outputs (ownership)	<b>Relevance; Acceptability; Inclusiveness</b>
<p>The PPP may have differing benefits for the public and private sectors. The partners should be satisfied with the allocation of benefits and other outputs (such as products, intellectual rights, property rights). The allocation of benefits and outputs should be formalized if appropriate. The profit and loss related to the program of each partner should be transparent.</p> <p>Score 0: One of the partners thinks that the other partner gets many more benefits than they do and is not satisfied with their own benefits. The allocation of PPP outputs has not been specified OR it does not satisfy some partner(s).</p> <p>Score 1: The allocation of the specific benefits and PPP outputs has been partly discussed (not formalized) and does not satisfy some partners.</p> <p>Score 2: The partners are partly satisfied with the allocation of benefits and of the other outputs.</p> <p>Score 3: All partners are highly satisfied with the allocation of benefits and outputs, which is also properly formalized.</p>	
2.3. Achievement of goal(s) of the Veterinary Service	<b>Relevance</b>
<p>The PPP should help to reach the goal(s) previously defined by the veterinary services (VS).</p> <p>Score 0: The PPP does not help the VS to reach one of their goals; on the contrary it represents a constraint to reach one of their goals.</p> <p>Score 1: The PPP does not help the VS to reach one of their goals.</p> <p>Score 2: The goal(s) of the VS has been planned to be achieved through the help of the PPP.</p> <p>Score 3: The goal(s) of the VS has been achieved through the help of the PPP.</p>	
2.4. Achievement of goal(s) of the private sector	<b>Relevance</b>
<p>The PPP can help to reach the goal(s) previously defined by the private sector.</p> <p>Score 0: The PPP does not help the private sector to reach one of their goals; on the contrary it represents a constraint to reach one of their goals</p> <p>Score 1: The PPP does not help the private sector to reach one of their goals.</p> <p>Score 2: The goal(s) of the private sector has been planned to be achieved through the help of the PPP</p> <p>Score 3: The goal(s) of the private sector has been achieved through the help of the PPP</p>	

## **Section 3. Risks and constraints**

3.1. Risks and constraints of getting involved in the PPP	<b>Stability, Adaptability</b>
<p>The different partners could have specific constraints/risks (financial, societal, etc.) in engaging in this PPP: these should be identified, discussed and understood by the partners.</p> <p>Score 0: Lack of identification of the constraints/risks of the different partners.</p> <p>Score 1: A minority of partners have identified their potential constraints/risks.</p> <p>Score 2: A majority of partners have identified their potential constraints/risks.</p> <p>Score 3: All partners have identified their potential constraints/risks.</p>	
3.2. Allocation of the constraints	<b>Acceptability; Inclusiveness</b>
<p>The PPP may have differing constraints (financial, societal, etc.) for the public and/or private sectors, and the partners should be satisfied by the allocation of these constraints.</p> <p>Score 0: One partner thinks that the other partner has fewer constraints or risks than they do and is not satisfied with their own constraints or risks.</p> <p>Score 1: One partner thinks that the other partner has far fewer constraints or risks than they do but is still satisfied with their own constraints or risks.</p> <p>Score 2: The partners are partly satisfied with the distribution of constraints or risks.</p> <p>Score 3: All partners are highly satisfied with the distribution of constraints or risks.</p>	
3.3. Change of practices	<b>Operationality, Adaptability</b>
<p>The achievement of the common objective may require a change in the practices (e.g. change or ban of the use of medicines, change in farming techniques, change in vaccination planning, etc.) of a specific population (veterinarians, technicians, farmers, etc.). These changes should be anticipated, accepted and accompanied if needed. The population concerned by the changes should be consulted from the beginning of the process.</p> <p>Score 0: The potential changes of practices of population(s) have not been anticipated.</p> <p>Score 1: The potential changes of practices of population(s) have been anticipated but not discussed with the concern population.</p> <p>Score 2: The potential changes of practices of population(s) have been anticipated, discussed with the concerned population but not accompanied.</p> <p>Score 3: The potential changes of practices of population(s) have been anticipated, discussed and accepted from the beginning of the process by the concerned population and accompanied if needed.</p>	
3.4 Negative costs to the society	<b>Stability; Relevance</b>
<p>Every initiative can carry some negative societal cost (e.g. constraints on a category of partners), economic cost (e.g. financial competitiveness with other partners, competitiveness for resource) or environmental cost (contamination)/ biodiversity cost (loss of wild or domestic animal or plant biodiversity). These costs should be anticipated in order to be minimized.</p> <p>Score 0: The partners pay no attention to negative costs to the society of the PPP.</p> <p>Score 1: The partners have partly identified negative costs to the society.</p> <p>Score 2: The partners have partly identified negative costs to the society and take them into account in the PPP modalities.</p> <p>Score 3: The partners have identified all the negative costs to the society and found a way to overcome them.</p>	
3.5 Conflicts of interest	<b>Stability, Acceptability</b>
<p>Potential conflicts of interests pose potential risks for a PPP. The potential conflicts of interests should be anticipated and all the procedures should be planned to avoid these potential conflicts of interests.</p> <p>Score 0: Conflicts of interests threaten the PPP.</p> <p>Score 1: Potential conflicts of interests have not been identified.</p> <p>Score 2: Potential conflicts of interests have been identified but a clear procedure to avoid them has not been put in place.</p> <p>Score 3: Potential conflicts of interests have been identified and all the procedures to avoid them are put in place.</p>	

## **Section 4. Analysis of the context and external factors**

4.1 Relevance of common objective and of strategy regarding the context	<b>Relevance</b>
<p>The common objective(s) should be relevant regarding the health (public and animal health, food safety), socio-economic, environmental and institutional (breeding policy, local politics, national politics etc.) context.</p> <p>Score 0: The epidemiological, socio-economic, environmental and institutional contexts have not been analysed.</p> <p>Score 1: The contexts have been analysed but some major contradictions have been identified between the common objective and the contexts.</p> <p>Score 2: Some minor contradictions have been identified between the common objective and the contexts.</p> <p>Score 3: The common objective of the PPP is fully coherent with the all the dimensions of the analysed contexts and serves the common good.</p>	
4.2. International, regional, national and local laws	<b>Operationality</b>
<p>Legal obligations, laws and constraints from international organizations, regions, the country or localities are understood and properly applied by all partners and a public partner is responsible to ensure application of the laws. The public partner should ensure that the PPP is lawful and that any legal obligations or constraints are understood and properly implemented by all parties.</p> <p>Potential need for regulatory and / or policy changes that might be required to implement the PPP should be considered and anticipated.</p> <p>Score 0: International, regional, national and local guidance have not been identified and some guidelines are not respected.</p> <p>Score 1: Some major discrepancies are identified between the objective and purpose of the PPP or the actions of some partners and international, regional, national and local guidance.</p> <p>Score 2: Some minor discrepancies are identified between the objective and purpose of the PPP or the actions of some partners and regional, national and local guidance.</p> <p>Score 3: The objective and purpose of the PPP and the actions of the partners are coherent with the international, regional, national and local guidance.</p>	
4.3 Potential threats of the PPP and mitigation	<b>Stability; Operationality</b>
<p>Some external factors related to the context (epidemiological such as a pandemic, institutional such as political change or insecurity, socio-economic such as fluctuating market or civil society expectations, environmental such as extreme weather risks etc.) can threaten the stability of the PPP. For example, lack of appropriate infrastructures (such as road, water, electricity, etc.) could represent constraints for the proper implementation of the PPP. However, the PPP can also have the power to remediate these failures, to respond to these constraints. These should be anticipated and mitigation strategy for these potential threats put in place.</p> <p>Score 0: The potential threats have not been identified.</p> <p>Score 1: The potential threats have been partially identified but the strategy to overcome them has not been discussed.</p> <p>Score 2: The potential threats have been analysed and a strategy to overcome them has been discussed but not implemented.</p> <p>Score 3: The potential threats have been analysed and the strategy of implementation of PPP activities is based on the prevention of these potential risks.</p>	

4.4 Organisation of private and public sectors	<b>Stability; Operationality</b>
<p>Lack of organization of the private sector (supply chain, market channel, producer association) and/or the public sector (official veterinary services) could represent constraints for the proper implementation of the PPP. However, the PPP can also aim to improve the organization of the public and/or private sector.</p> <p>Score 0: Private and/or public sector organization is a major constraint and the PPP cannot improve this organization.</p> <p>Score 1: Private and/or public sector organization is a minor constraint and the PPP cannot improve this organization.</p> <p>Score 2: Private and/or public sector organization is not a constraint for the PPP OR private and/or public sector organization is a minor constraint and the PPP can improve this organization.</p> <p>Score 3: The PPP is a strength to improve private and/or public sector organization.</p>	
4.5 Analysis of pre-existing PPPs	<b>Relevance</b>
<p>If other PPP in the same geographical area or with similar objectives exist, the analysis of their key success factors, obstacles and outcomes could be helpful for implementing the good process practices of this PPP.</p> <p>Score 0: Other PPP have not been identified.</p> <p>Score 1: Other relevant PPP have been identified but not analysed.</p> <p>Score 2: Other relevant PPP have been identified and analysed.</p> <p>Score 3: Other relevant PPP have been identified, analysed, and the partners from the different PPP shared their experiences about key success factors, obstacles and outcomes.</p>	

## **Section 5. Governance of the PPP**

5.1. Formalization of the PPP (contracts, sanitary mandate)	<b>Stability; Acceptability</b>
<p>The terms of the rationale of the PPP should be formalized if appropriate, either in a formal contract or in an alternative form appropriate to the PPP (MoU, Letter of Agreement, Oral consent etc.). It should be considered that a high level of formalization is not necessarily the most appropriate (for example the high degree of formality of an early collaborative PPP would put off potential partners).                  Score 0: There is no contract/text or agreement and this hinders the proper process of PPP.                  Score 1: There is an unofficial agreement which would warrant a greater level of formalization to favour a better process.                  Score 2: There is an official agreement but it is not signed by all partners                  Score 3: The level of formalization of the PPP is fully adapted and allows for a proper process.</p>	
5.2. Knowledge of the terms of the PPP (contract) and endorsement by all the partners	<b>Stability; Acceptability</b>
<p>The different partners should be aware of the terms of the contract and understand them all. The documents where the terms of the PPP are formalized (if appropriate) are endorsed by all partners from different sectors.                  Score 0: There is no contract/text OR there is a contract/text but some partners are not aware of it, and it is endorsed by none of the partners or only from one type of partner.                  Score 1: The terms of the agreement are understood and endorsed only by some of the partners (less than half).                  Score 2: The terms of the agreement are partially understood by the partners and are endorsed by most of the partners.                  Score 3: The terms of the agreement are fully understood and endorsed by all relevant partners.</p>	
5.3. Shared decision-making process	<b>Acceptability; Adaptability; Inclusiveness</b>
<p>Shared decision making with equality in the power relationship can represent a key success factor of the PPP, recognizing that some decisions can be entirely the responsibility of one partner. However, such decisions should be made in consultation with the other PPP partners and with full transparency and understanding of how that decision impacts all the relevant actors. It should be considered that shared decision making is time-consuming and costly, and may not be necessary for all decisions.                  Score 0: All the decisions are only taken by one type of partner and imposed on the other partners.                  Score 1: Few decisions are taken in collaboration and there is a need to set up a mechanism for shared decision making.                  Score 2: A mechanism for shared decision making is set up but could be improved.                  Score 3: A mechanism for shared decision making is set up and the partners are satisfied with it.</p>	
5.4. Opportunities of private parties' involvement	<b>Adaptability; Inclusiveness</b>
<p>If the proposal is initiated by the public party, it should ensure that relevant private partners have equal opportunities for engagement in a new PPP, respecting the country market rules. The public sector should propose a transparent call for tender process. If a proposal is initiated by the private sector, fair access is still a consideration for the public sector, subject to the specificity of the project and the laws of the country. As a minimum, the public sector should ensure that all relevant private sector actors are aware of the possibility of engaging in a PPP.                  Score 0: There was no call for tender, a direct contract was formed with one private partner previously selected AND/OR the PPP was initiated by the private sector and the public sector did not communicate to other private sector actors.                  Score 1: There was an oriented call for tender and only a few of the relevant private sector actors were aware of the possibility of engaging in a PPP AND/OR the PPP was initiated by the private sector and the public sector communicated in a non-transparent manner to other private sector actors.</p>	

<p>Score 2: There was an oriented call for tender but most of the relevant private sector actors were aware of the possibility of engaging in a PPP AND/OR the PPP was initiated by the private sector and the public sector weakly communicated the possibility of engaging in a PPP to other private sector actors.</p> <p>Score 3: Open transparent call for tender and all relevant private sector actors are aware of the possibility of engaging in a PPP AND/OR the PPP was initiated by the private sector and the public sector communicated the possibility of engaging in a PPP to other private sector actors in a transparent manner.</p>	
<p>5.5. Funding &amp; human resource availability</p>	<p><b>Stability; Operationality</b></p>
<p>Funding and human resources (HR) should be available and sufficient. If an external source is providing money, the PPP should plan how to be autonomous and viable when the other source stops. The stability of human resources must be anticipated, as some people may evolve in their career and no longer be able to fulfil their role in the PPP.</p> <p>Score 0: The question of funding and HR availability <u>is a major constraint</u> for the different partners and hinders the proper conducting of PPP activities.</p> <p>Score 1: The question of funding and HR availability <u>is a regular constraint</u> in conducting the PPP's activities, or they <u>depend entirely on an external source</u> (catalysers e.g. UN, Private foundations etc...) with no plan to become autonomous.</p> <p>Score 2: The conducting of the PPP <u>is only weakly constrained</u> by funding and HR availability or it depends <u>partly on an external source</u> with a plan to become autonomous in the short term.</p> <p>Score 3: The different partners are fully satisfied with the funding and HR availability for conducting their activities in the PPP, <u>the PPP is financially viable</u>.</p>	
<p>5.6. Funding and human resource allocation</p>	<p><b>Acceptability</b></p>
<p>The allocation of funding and HR should be planned in advance and agreed on by the partners.</p> <p>Score 0: The question of funding and HR allocation is a major concern for some partners and hinders the proper conducting of its activities.</p> <p>Score 1: The question of funding and HR allocation is a regular concern for some partners.</p> <p>Score 2: Some partners are not totally satisfied by the funding and HR allocation between the different partners.</p> <p>Score 3: All partners are fully satisfied with the funding &amp; HR allocation between the different partners.</p>	
<p>5.7. Compatibility with the veterinary services mandate</p>	<p><b>Relevance</b></p>
<p>The public partner(s) must ensure that the service(s) to be delivered falls within their VS statutory or political mandate and fulfils the intention of that mandate. The mandate should not be weakened and the public sector must continue to bear full responsibility for the VS mandate with complete independence.</p> <p>Score 0: The services to be delivered go against the intention of the VS mandate or the role of the private encroaches on the role of the public.</p> <p>Score 1: The services to be delivered do not take into account the intention of the veterinary services mandate.</p> <p>Score 2: The services to be delivered are partly aligned and partly help to fulfil the intention of the veterinary services mandate.</p> <p>Score 3: The services to be delivered are totally aligned and help to fulfil the intention of the veterinary services mandate.</p>	

## **Section 6. Planning and responsibilities of the PPP**

6.1. Division of roles and responsibilities	<b>Operationality; Acceptability</b>
<p>The role of each partner should be properly defined. Formalisation of the partner’s areas of action in the PPP should be specified in the contract if appropriate, i.e. the tasks they are assigned regarding collaboration and coordination of PPP. An organizational chart of the PPP can provide a useful element to understand who depends on whom, who decides for whom.</p> <p>Score 0: The role and responsibility of the PPP partners are not properly defined and this hinders the proper process of the PPP.</p> <p>Score 1: The role and responsibility of the PPP partners are partly defined but lack major details.</p> <p>Score 2: The role and responsibility of the PPP partners are set out in a document but the definitions sometimes lack clarity, details or the description of areas of responsibility of some partners.</p> <p>Score 3: The role and responsibility of the PPP partners are framed by a document (official document if appropriate) leaving no ambiguity in the relations between them.</p>	
6.2. Potential other partners	<b>Stability; Adaptability; Inclusiveness</b>
<p>Stakeholder mapping, to ensure that the relevant or impacted (potential blocker) actors have been identified and consulted, should be carried out regularly during the PPP. Some of the identified actors could be involved in the PPP to ensure the stability of the initiative and to favour positive results.</p> <p>Score 0: No stakeholder mapping has been carried out. Some relevant partners are missing but have not been properly identified.</p> <p>Score 1: No stakeholder mapping has been carried out. Some partners have been identified as missing but no plan is designed to integrated them in the partnership.</p> <p>Score 2 : Incomplete stakeholder mapping has been carried out. Some partners have been identified as missing but no plan is designed to integrated them in the partnership.</p> <p>Score 3: Complete stakeholder mapping has been carried out, and is regularly updated. If appropriate, the relevant partners have already been identified and planned to be included in the PPP. Or, the questions has been raised but the partners agree that no other partners are needed.</p>	
6.3. Inclusion of vulnerable group	<b>Inclusiveness; Adaptability</b>
<p>PPPs should enhance equity in terms of their outcomes (economy, health, well-being etc.). This can be done by truly involving all the beneficiaries, including the vulnerable group (indigenous, women, young people, etc.) during the conception phase of the PPP to consider their interest, or at a minimum by inviting them to meetings or workshops.</p> <p>Score 0: The PPP favours the exclusion of vulnerable groups.</p> <p>Score 1: The PPP does not consider the interest of vulnerable groups.</p> <p>Score 2: The PPP considers the interest of vulnerable groups and invites some of their representatives to meetings or workshops.</p> <p>Score 3: The PPP aim to enhance equity in terms of their outcomes (economy, health, well-being etc.) and truly involve all the beneficiaries, including vulnerable groups (indigenous, women, young people, etc.) during the conception phase of the PPP to consider their interest.</p>	



6.4. Defined duration	<b>Operationality; Stability;</b>
<p>The duration of the partnership should be predefined by both types of partner, with the possibility of extending the period or renewing the PPP if appropriate under predefined renewal conditions (e.g. if deemed appropriate following joint evaluation).</p> <p>Score 0: The duration term of the PPP has not been discussed and defined.</p> <p>Score 1: The duration term is partly defined OR the duration term is fixed, without the possibility of extending the PPP.</p> <p>Score 2: The duration of the PPP is predefined and agreed by both partners, but the conditions to extend the period have not been defined or are unclear.</p> <p>Score 3: The duration of the PPP is predefined and agreed by both partners, with the possibility of extending the period under predefined renewal conditions.</p>	
6.5. Modes of implementation of PPP activities	<b>Stability; Adaptability</b>
<p>The implementation modes for PPP activities should be flexible to meet partners' needs. By proposing a diversity of modes of implementation for activities, the PPP can satisfy a higher number of partners.</p> <p>Score 0: A single mode of implementation is proposed to the partners.</p> <p>Score 1: A dominant mode of implementation is proposed to the partners.</p> <p>Score 2: Several modes of implementation are proposed to the partners but still do not satisfy the partners' need.</p> <p>Score 3: Several modes of implementation are proposed to the partners and satisfy the partners' need.</p>	
6.6. Joint work plan	<b>Operationality; Adaptability</b>
<p>A detailed joint work plan for the activities to be implemented and the roles and responsibilities of each partners regarding those activities should be jointly drawn up by the partners. The elements of this work plan should be modifiable to enable PPP adaptability.</p> <p>Score 0: No joint work plan</p> <p>Score 1: There is a work plan but it has been devised by one type of partner and does not satisfy all the partners.</p> <p>Score 2: A work plan has been devised but could be improved.</p> <p>Score 3: A detailed joint work plan has been devised, with elements being modifiable to enable PPP adaptability.</p>	

## **Section 7. Competencies and trainings**

7.1 Confidence in other partners' competencies and satisfaction of partners about their own competencies	<b>Acceptability; Inclusiveness</b>
<p>The partners should feel confident about their partner competencies to fulfil the common objective(s). The different partners should be satisfied with their own competencies to reach the common objective(s); the partners must be able to inscribe their role.</p> <p>Score 0: Partners don't trust their partner competencies to reach the common objective; and the partners are not satisfied with their competencies, nor do they feel confident about their abilities to inscribe the roles.</p> <p>Score 1: Partners don't trust their partner competencies to reach the common objective; <u>or</u> the partners are not satisfied with their competencies and don't feel confident about their abilities to inscribe the roles.</p> <p>Score 2: The partners do not fully trust their partner competencies but are confident that those competencies can improve (through training for example). The partners are partly satisfied with their competencies and are confident that these competencies can improve.</p> <p>Score 3: All the partners trust their partner competencies to reach the common objective(s). The partners fully trust their own competencies to reach the overall objective.</p>	
7.2 Organisation of trainings and capacity building	<b>Operationality, Relevance, Adaptability</b>
<p>Well designed and well planned trainings should be organized for operating partners if needed. An initial capacity assessment can be made to plan the trainings. Funding for trainings should be planned. The Veterinary Service, as well as private technical skills can be reinforced by the PPP through organized training.</p> <p>Score 0: No training for operating partners involved in collaborative activities is planned. The VS do not participate in any training and this hinders the proper process of the PPP.</p> <p>Score 1: Trainings for operating partners involved in collaborative activities are planned but more trainings are required.</p> <p>Score 2: Trainings for operating partners involved in collaborative activities are planned/have been conducted but the partners are not fully satisfied with the content.</p> <p>Score 3: Training for operating partners involved in collaborative activities is fully designed and planned in detail and the concerned partners are fully satisfied with the content. The VS benefit from trainings (if appropriate) which build their capacity and reinforce the trust of its partner.</p>	
7.3 Accessibility and frequency of trainings	<b>Operationality; Inclusiveness</b>
<p>The training organized should be at an appropriate frequency and should be accessible to all operating partners, to all partners that feel the need to improve their competencies.</p> <p>Score 0: Trainings organized are not accessible for the majority of the operating partners.</p> <p>Score 1: Trainings organized are accessible to everyone but only a few of the partners participate and the frequency is not appropriate.</p> <p>Score 2: Trainings are organized in a relevant timeframe and most of the partners participate .</p> <p>Score 3: All relevant partners participate regularly in the trainings.</p>	

## Section 8. Communication and transparency of the PPP

8.1. Internal communication	<b>Operationality; Acceptability; Adaptability; Inclusiveness;</b>
<p>The PPP must have an agreed internal communication strategy. The frequency of meetings is to be assessed according to the need of the partners.</p> <p>Score 0: The partners have <u>no mechanisms</u> for internal communication with each other.</p> <p>Score 1: The partners maintain <u>informal channels</u> for internal communication with each other; meetings are rarely and insufficiently organized for the purposes of the partners.</p> <p>Score 2: The partners maintain a <u>formal internal communication mechanism</u> with each other, meetings are organized but at a frequency that appears insufficient to meet the needs of the partners.</p> <p>Score 3: Meetings are regularly organized, the interested parties maintain a <u>formal internal communication mechanism</u> with each other and <u>actively consult</u> with and solicit feedback regarding proposed and current activities.</p>	
8.2. Agreement in resolution modalities in case of conflict	<b>Stability</b>
<p>A manner to resolve potential conflict(s) between partners should be identified: which partner/jurisdiction to contact, how to resolve this conflict?</p> <p>Score 0: No potential conflict resolution strategy.</p> <p>Score 1: No official potential conflict resolution strategy has been developed but an informal strategy has proved sufficient for the moment.</p> <p>Score 2: A potential conflict resolution strategy has been developed but it is not known by all the partners.</p> <p>Score 3: An official potential conflict resolution strategy has been developed. Every partner knows whom to address, and what to do in case of conflict.</p>	
8.3 Communication with other parties, political entities and end users	<b>Acceptability, Inclusiveness, Adaptability,</b>
<p>The partners should keep other parties informed (such as beneficiaries and end users, actors impacted) in a transparent, effective and timely manner, of PPP activities and results, since the beginning of the process. Furthermore, the partners should inform the executive and political level about PPP activities and results in a transparent, effective and timely manner, in order to be able to discuss the potential need for a change of regulations and to promote the positive results of the PPP.</p> <p>Score 0: The PPP have no mechanism in place to inform other parties of PPP activities and results.</p> <p>Score 1: The PPP have informal communication mechanisms with other parties.</p> <p>Score 2: The PPP maintain an official contact point for communication but it is not always up-to-date in providing information.</p> <p>Score 3: The PPP contact point for communication provides up-to-date information, accessible via the Internet and other appropriate channels, on activities and results.</p>	
8.4 Transparency	<b>Inclusiveness; stability</b>
<p>All parties must ensure that the actions of the PPP are developed with appropriate transparency for all stakeholders at every level (allocation of outputs, of benefits, allocation of risk, modalities of action, activities of each partner etc.).</p> <p>Score 0: The transparency is <u>insufficient</u> at most levels.</p> <p>Score 1: The transparency is sufficient at <u>some</u> levels.</p> <p>Score 2: The transparency is sufficient in <u>most</u> levels.</p> <p>Score 3: The transparency of the actions developed and the process of collaboration in the PPP is appropriate <u>at all levels</u>.</p>	

## **Section 9. Collaboration in the PPP and satisfaction of the partners?**

9.1. Willingness to collaborate and partners' acceptance of their own roles	<b>Acceptability; Inclusiveness</b>
<p>The partners should be happy/satisfied to collaborate with their partners and the PPP must have an agreed stakeholder engagement, which includes an appropriate approval process (formalisation of rationale behind the willingness to collaborate in this PPP).</p> <p>The different partners should be satisfied with their own roles in the partnership and their tasks and with the recognition of their role by the other partners.</p> <p>Score 0: The partners are <u>unsatisfied</u> with collaborating with the other partner(s) and their willingness to collaborate has never been formalized; the partners are really unsatisfied with their own role (either because they seek more responsibilities, because their role is not socially recognized etc.)</p> <p>Score 1: Only <u>some</u> partners are fully satisfied with collaborating with the other partner(s). Some of the partners are satisfied with their own role and with the recognition of their roles by the other partner.</p> <p>Score 2: <u>Most</u> of the partners are fully satisfied with collaborating with the the other partner(s). Most of the partners are satisfied with their own role and with the recognition of their roles by the other partner.</p> <p>Score 3: <u>All</u> the partners are fully satisfied with collaborating with their partners and their willingness to collaborate is formalized. All the partners are satisfied with their own role, and with the recognition of their roles by the other partner.</p>	
9.2. Level of involvement of partners	<b>Acceptability</b>
<p>Partners should be satisfied about the engagement of other partners in their assigned areas of action, role and responsibilities in the PPP.</p> <p>Score 0: None of the partners are satisfied with the involvement of the other partner(s).</p> <p>Score 1: <u>Some</u> partners are satisfied or partly satisfied with the involvement of the other partner(s).</p> <p>Score 2: <u>Most</u> partners are satisfied or partly satisfied with the involvement of the other partner(s).</p> <p>Score 3: <u>All</u> the partners are fully satisfied with the level of involvement of the other partner(s).</p>	
9.3. Capacity building in PPPs and/or existence of champion(s)	<b>Operationality; Adaptability</b>
<p>The existence of senior capacity builder(s) for PPP best practices, and/or champion(s) (individuals with strong communication skills who are knowledgeable and enthusiastic about the PPP), at regional, national, or local level, may help to promote an enabling environment and a good collaboration process.</p> <p>Score 0: There are no champions and no seniors.</p> <p>Score 1: There are no champions and no seniors but a process of recruitment and training has been initiated.</p> <p>Score 2: There is a champion and/or a senior who partly promotes an enabling environment and a good collaboration process.</p> <p>Score 3: Both senior(s) and champion(s) promote an enabling environment and a good collaboration process.</p>	

## **Section 10. Monitoring and evaluation of the PPP**

10.1. Internal monitoring of the PPP	Operationality; Adaptability	Stability;
<p>The different PPP partners should frequently monitor the progress of the program and discuss the main conclusion and ways to improve the PPP. They should be able to adapt the process and activities regarding the results of internal monitoring.</p> <p>Score 0: No internal monitoring has been done, nor is planned.</p> <p>Score 1: Internal monitoring has been done by only one type of partner and the other partners are not kept informed, internal monitoring does not cover all the relevant areas of the PPP.</p> <p>Score 2: Internal monitoring has been done by only one type of partner and the other partners are kept informed, the internal monitoring covers almost all the relevant areas of the PPP.</p> <p>Score 3: Internal monitoring is done regularly by all the relevant partners, and the results allow for positive change.</p>		
10.2. Agreed indicators for joint internal monitoring	Acceptability; Adaptability	
<p>The partners must agree on how the PPP is monitored, and on the choices of indicators for internal evaluation. The indicators should be SMART (specific, achievable, measurable, relevant, time-bound). These results indicators can be linked to the strategies of the country, of the veterinary services or of other private sectors in order to strengthen the visibility of PPP activities (for example livestock development strategies, sustainable development goals, employment).</p> <p>Score 0: Most partners are not satisfied with the indicators developed or no indicators have been developed.</p> <p>Score 1: Indicators have been developed but only one sector is satisfied with the indicators.</p> <p>Score 2: Indicators have been developed and validated by the PPP partners, but not all the partners agree with the methodology of internal evaluation and its frequency.</p> <p>Score 3: The indicators have been developed in conjunction with all the partners. The indicators developed are SMART and address all areas of PPP). All the partners agree with the methodology of internal evaluation and its frequency.</p>		
10.3. External evaluations	Operationality; Adaptability	Acceptability;
<p>External evaluation helps to promote positive changes in the PPP. Partners must agree on how the PPP is evaluated, and on the choices of indicators for external evaluation.</p> <p>Score 0: No external evaluation of the PPP has been performed.</p> <p>Score 1: The PPP has been evaluated but it goes back quite far in time AND / OR the method used is very incomplete or unrecognized and did not help to favour positive change.</p> <p>Score 2: The PPP has already been the subject of several evaluations but their frequency needs to be improved and / or the methodology used is incomplete.</p> <p>Score 3: The PPP is subject to external evaluations according to a recognized and complete methodology which helped to favour positive changes, and the partners are satisfied by the frequency.</p>		

## *Appendices to Chapter 4*

### Appendix 1. Poultry population in Ethiopia, per region, and produced by EthioChicken in 2018.

	Total poultry population *	Poultry population produced by EthioChicken**
Tigray	6,190,640	2,384,858
Amhara	17,705,026	3,058,432
Oromia	19,014,114	5,355,333
Southern Nations, Nationalities, and People's region	10,491,131	6,214,696
Total of the four regions	53,400,911	17,013,319
Ethiopia	56,056,778	17,013,319

\*those data come from:

Central Statistical Agency of Federal Democratic Republic of Ethiopia. Agricultural sample survey 2017/18 [2013 E.C.], volume II, report on livestock and livestock characteristics. (2018) Available at: <https://www.statsethiopia.gov.et/wp-content/uploads/2020/02/Agricultural-Sample-Survey-Livestock-Poultry-and-Beehives.pdf> [Accessed November 2, 2021]

\*\*Internal data from EthioChicken

**Appendix 2. Checklists used for the individual semi-structured interviews of the stakeholders of the case study.**

1. Check list for actors at the conception of the PPP

THEMES	TOPICS	QUESTIONS
BUILDING of the PPP	Recruitment of partners	1-How did you define that a partner is good to work with? 2-What are you expectations from each partner?
	Motivations to participate	
	Commitment of partners	Is there a formal document about all your partnerships process?
	Organization of the public-private partnership	
	Roles and responsibilities	
	Time commitment	
	legality of the partnership	1-Did you have some apprehensions before weaving this partnership? Why? 2-What attitude do you have in front of these kinds of apprehensions?
	Risk identification	
	Risk awareness	
	Risk allocation	How will you know that this partnership run well? Why?
Performance indicators		
FUNCTIONING of the PPP	Collaboration	1-Tell me about the functioning of this PPP? 2-how do you make it work? What is your perception of this functioning?
	Communication	
	Management /Leadership	3-Is there something that you could suggest to make it more efficient?
	Governance structure	
	Transparency	
	Actors involvement	
	Promptness	
	Trust and respect	
Risk management		
OUTPUTS of the PPP	Action plans and interventions	Could you please tell me what these partnerships brought (output) to your Enterprise?
	Partnership's goals	Did these contributions from these partnerships meet your expectation? Why?
	Impact (what, where, how, whom and when)	What are the benefits, chages or impacts bought by this PPP?
	Perceived efficiency (resource efficiency to meet objectives)	
	Benefit and sustainability	
	Policy changes	
	Changes in the physical environment	
	Changes in the social environment	
	Changes in health indicators	
	Changes in financial income	
Others changes		

2. Check list for the operational public and private partners of the PPP

Themes	Questions
Poultry production	1) Could you tell me about the importance of poultry production? 2) Could you tell me about any issues in poultry farming? - <i>Could you tell me about the situation before?</i> - <i>Why is it better/ worse now?</i>
Role in the PPP and in EthioChicken mode,	3) What is your involvement in the PPP between EthioChicken and the Ethiopian government ? - How does the PPP works? EthioChicken model? What do they do exactly? - What is your role? Who are you in contact with? - Why did you accept working with them? - Do you have any agreement with the different people you work with in the program? With the poultry producers? Which kind of agreement? (check for any written agreement)
Interactions with other stakeholders	4) Could you tell me about your relationship with the farmers, the government, the development agents and the village poultry development agent? - Who do you work with the most? Why? How?
Benefits of the PPP	5) What do you get (as benefit) from this model of EthioChicken and Ethiopian government? Comparing to the past? 6) What does this program brings to your community? The poultry producers? Others? (e.g. women groups?)
Limits and scenario of improvement	7) Is there any issue? Which services do you want EthioChicken or Ethiopian government to improve? - Why? - How? 8) If you had a message to address to EthioChicken Company, what will you say to them? Why?



3. Checklist for the actors who adopted the model (farmers)

Themes	Questions
Poultry production	<p>1) Could you describe your poultry production activity? Who is taking care of your production? Could you tell me about any issues you have with your poultry farming? What difficulties do you encounter?</p> <p>2) Could you tell me about the importance of poultry production for you? What do you get from breeding chickens? Why is it important for you? what do you do with this money? (e.g. get children to school; buy school furniture's; buy things for the house...)</p>
Participation in the EthioChicken model	<p>3) Could you tell me about your involvement with EthioChicken?</p> <ul style="list-style-type: none"> <li>- How does it work for you (EthioChicken program)? Who are you in contact with (who sell them the chickens and help them with their production)?</li> <li>- What do they do exactly?</li> <li>- Why did you accept working with them?</li> <li>- Do you have any written agreements? Which ones? Other type?</li> </ul>
Interactions with other stakeholders	<p>4) Are you involved in producer association? Which ones?</p> <p>5) Could you tell me about your relationship with the agents/ the development agents and the village poultry development agent?</p> <ul style="list-style-type: none"> <li>- Who do you work with the most? Why?</li> </ul>
Benefits of the PPP	<p>6) What do you get (as benefit) from this program of EthioChicken? Comparing to the past (or before)?</p>
Limits and scenario of improvement	<p>7) Is there any issues? What do you want EthioChicken to improve as service?</p> <ul style="list-style-type: none"> <li>- Why?</li> <li>- How?</li> </ul> <p>8) If you had a message to address to EthioChicken Company, what will you say to them? Why?</p>

**Appendix 3. The different codes that emerged from the reading of the transcripts and used for the data analysis. PPP: public-private partnership**

<b>Codes</b>	<b>Sub codes</b>
Context	Poultry production in Ethiopia Story of the public-private partnership
Partners of the PPP	Ethiopian Government Business partner Independent private actors
Functioning of the PPP	PPP process and contracts
Importation of inputs	Importation and input pathway: Chicken Importation and input pathway: Vaccines Importation and input pathway: feed
Trainings organized in the PPP	Training pathway: public veterinarians Training pathway: private veterinarians Training pathway: farmers
Production and delivery of the day old chick and 42 days old chicks	Production Pathway (AGENT) Delivery pathway to grower agents and intermediary Delivery at farmers' level
Benefits of the PPP	Women empowerment/livelihood Employment Competencies; improvement of services Food security; livestock productivity; disease control Profit/revenue; optimisation/efficiency Collaboration / trust between government and private
Limits and solutions proposed	Problem of importation Solution proposed / recommendation: importation Low considering of poultry sector by the government Solution proposed / recommendation: government Problem of capital (farmers; agent) Solution proposed / recommendation: capital Problems of poultry consumption/ market Solution proposed / recommendation: consumption market Problems of poultry production Solution proposed / recommendation: production Problem of transportation ; input Solution proposed / recommendation: input Problem between actors Solution proposed / recommendation: problem between actors Solution proposed / recommendation: other
Added value of the PPP	Private and Public Point of view Public Point of view Private Point of view Farmers Point of view
Key success factors of the PPP	Conditions for success/ key success factors

**Appendix 4. Number of participants of the participatory impact pathway evaluation are stakeholders from different administrative levels of the public-private partnership between EthioChicken and the Ethiopian government:** public and private partners of the partnerships, actors who influence it and actors impacted by it.

Categories of actors	Actors	Administrative level	Semi-structured interviews (individual and focus group)	Workshops		
				1st	2nd	3rd
<i>Private actors</i>						
Independent actors	Grower agents (growers of 45 days-old chickens)	District	8 in one focus group	3	3	-
	Village poultry development agents	Ward (kebelle)	2	1	6	-
	Smallholders farmers (buyers of 45 days old chickens)	Ward (kebelle)	19 and 4 in one focus group	1	2	-
EthioChicken	Managing director and sales manager	National	2	2	2	12
	Farm hatchery, farm site, farm breeding and sale manager	Regional	4	6	7	-
	Area sales manager, district (woreda) coordinator	District	2	3	2	-
Poultry Producers and Processers Association	Members of the association	National	1	-	2	1
Microfinance Institution	Staff of the Operation department	National and regional	2	2	2	5
<i>Public actors</i>						
Actors from public veterinary services and other actors of Ministry of Livestock and Fisheries*	Poultry production director, and Coordinator of public-private partnerships	National	2	1	2	2
	Regional livestock officer	Regional	1	-	4	4
	Head, vice head and livestock expert of districts	District	3	3	-	-
	Development agents	Ward (kebelle)	3	2	2	-
Ministry of Health	Department of Public Health	National	-	-	2	2
Researchers	Social Scientist	International (ILRI)	1	-	-	-
	Animal genetics and breeding		2	1	1	-
	Veterinary Science, Animal production	National (Ethiopian University)	1	1	1	-

Pan-African Vaccines Control	Diagnostic department	International	1	-	2	-
Job Opportunity Creation Agency	Deputy director of agency Officer in rural department	National	1	-	-	-
		Regional	1	-	2	-
National Animal Health Diagnostic Investigation Center, public veterinary services	Associate researcher in virology, bacteriology and serology	National	2	-	2	1
National Veterinary Institute, public veterinary services	Head of research department	National	1	-	2	-
Veterinary Drug, Animal Feed, Administration Control Authority	Department of veterinary drug quality standard registration	National	1	-	2	1
Total			52 and 12 in focus group	26	48	18
			64			

\*The Ministry of Livestock and Fisheries was merged with Ministry of Agriculture since April 2018.

**Appendix 4. Benefits, limits and solutions proposed during the second workshop for each actor involved in the national and regional public-private partnerships between the Ethiopian government and EthioChicken.**

\*Sasso breed is a dual-purpose improved genetic breed from Hendrix genetics.

Actors	Benefits for the actors	Limits	Solutions (in regards with the partnership)
<b>EthioChicken (private)</b>	<b>PPP National</b> -Access to National Animal Health Diagnostic and Investigation Centre surveillance disease and training of the agents and farmers for free -Loan to agents through Microfinance Institutions and Job opportunity creation agency	<b>PPP National</b> -EthioChicken holds earned exclusivity of Sasso breed: <ul style="list-style-type: none"> <li>• stigmatization and suspicious feeling from competitors</li> <li>• non access to Poultry producer association=limit market access;</li> </ul> - No access to foreign exchange currency threatens the stability of the activity:	<b>PPP National</b> -Exclusivity right of Sasso breed* is an asset to EthioChicken -Access of improved genetics to other producers; Sasso has given improved genetics to farms in one region (which is directly under monitoring of Sasso genetic breeder). -Poultry production needs to become a priority industry for Ministry of Finance and Economic Development to have access to foreign exchange currency /export market ( <b>scenario 1</b> )
	<b>PPP Regional</b> -Increase market access (through development agent; Village poultry development agents); -Increase market demand (satisfaction of the farmers); -Increase reputation from quality products; -Improved profits (chicken sales);	<b>PPP Regional</b> - Instability of the market (fasting period)	-The government is promoting chicken meat consumption
<b>Government (national) (public)</b>	<b>PPP National</b> -Increase in national chicken production (improved national economy) participates to the achievement of the Growth and transformation plan II. -Increase in employment (young veterinarians enrolled by EthioChicken, agents and their paid staff, Village poultry development agents) -Increase in profit through the sales of national vaccines (National veterinary institute) -Increase sales of local crops to EthioChicken.	<b>PPP National</b> -National economy protection (limited foreign exchange currency import) that threat the stability of the actions and therefore its long-term impacts	<b>PPP National</b> -Poultry production needs to become a priority industry for the government to have access to foreign exchange currency/export market;

<p><b>Government (regional) (public)</b></p>	<p><b>PPP Regional</b>          -Increase in national chicken production (improved regional economy)          -Improved trust from poultry consumers (quality chickens + prices regulation)          -Increased in regional budget (from share of business profit with EthioChicken due to the rent of regional farm )          -Improve local employment (Village poultry development agents, grower agents)</p>	<p><b>PPP Regional</b>          -Village poultry development agents threaten the PPP at regional level with livestock offices and development agents (stability of this specific partnership)</p>	<p><b>PPP Regional</b>          -EthioChicken to function more independently at local level could be positive (no influence on the overall impact); this part of the partnership could be seen as transitional (which is already the case in some regions)</p>
<p><b>Government (development agents) (public)</b></p>	<p><b>PPP Regional</b>          -Increase income;          -Improve trust by farmers (higher competences)</p>	<p><b>PPP Regional</b>          -The knowledge of development agents about poultry management is low          -Sort of negative relationship between development agents and agent</p>	<p><b>PPP National and regional</b>          -Training of the development agent</p>
<p><b>Grower agents (45 day old chicken producers) (private)</b></p>	<p><b>PPP Regional</b>          -Improved chicken production (better production; lower mortality);          -Improved employment access (lower investment risks);          -Improved security feeling (lower risks and stress);          -Increased incomes (better production; market access guarantee);          -Improved competences (poultry production and health) trough training</p>	<p><b>PPP National</b>          -Limited access to loan and capital  <b>PPP Regional</b>          - Market unstability (consumption problem due to cultural fasting practices)          -High price of inputs (feed)          -Delay in money collection by development agent and Village poultry development agent</p>	<p><b>PPP National</b>          -Access to more capital          -The government is promoting the consumption of chicken meat</p>
<p><b>Farmers (private)</b></p>	<p><b>PPP Regional</b>          -Increase in chicken production (better production; lower mortality);          -Increased incomes;          -Improve security feeling (lower risks and stress);          -Improve trust by consumer (quality products);          -Improved competences (poultry production and health)</p>	<p><b>PPP National</b>          -Limited access to feed          -Limited access to health service          -Limited access to land  <b>PPP Regional</b>          -Low management capacity          -Low breeding identification (some farmers prefer meat, some eggs)</p>	<p><b>PPP National</b>          -Establishment of feed manufacturing enterprises by private sector with support from government          -Increase poultry feed availability (feed shops in localities) by privates with support from government.          -Access to more capital</p>

		-Market unstability (consumption problem due to cultural fasting practices)	-Improve development agent competencies who can help farmer -The government is promoting consumption of chicken meat
<b>National crop producers (private)</b>	<b>PPP National</b> -Increased market demand and increased income	<b>PPP National</b> -Sustainability of the activity is threatened due to food supply shortage (not enough crops compared to the demand) and problem to land access	<b>PPP National</b> -The government could provide incentives for the sector to grow to increase maize and soya bean production - The government could use prospective crop production estimates to meet the local industry consumption so that only excess product is exported
<b>National Vaccine Institute (public)</b>	<b>PPP National</b> -Increased incomes for National veterinary institute (huge demand of vaccines from EthioChicken)	<b>PPP National</b> - High cold chain constraints and reagents supply issues (no foreign exchange currency access) for National veterinary institute -Local vaccines are expensive (3 to 4x more than international vaccines) -Conflict of interest among different private vaccines producers	<b>PPP National</b> -Poultry production needs to become a priority industry for Ministry of Finance and Economic Development to have access to foreign exchange currency/export market; -National veterinary institute could only produce vaccines that are not global vaccines internationally supplied
<b>Microfinance institutions (public-private) and Job opportunity creation agency (public)</b>	<b>PPP National</b> -Strengthening of their activity and results/impact: higher income. -better results (lower risk business; training supported by EthioChicken)	<b>PPP National</b> -Their knowledge about poultry management is low and the credits give to farmers is low -Sometimes the young agent do not have the capacity to reimburse the loan	<b>PPP National</b> -Increase knowledge of Microfinance Institutions in poultry management and increase the loan amount
<b>Hendrix genetics (private)</b>	<b>PPP National</b> -Improved reputation (from performance of their breed; linked to quality production) <b>PPP Regional</b>	<b>PPP National</b> -Problem of importation because of Avian Influenza in France so EthioChicken have to import from Brazil -Exclusivity contract with EthioChicken = limited Ethiopian market	<b>PPP National</b> -Access of improved genetics to other producers but risk of losing market;

	-Improved trust of their breed by farmers: could lead to other market access (e.g. Kroiler, Hubbard, Tetra, Aviagen Range Red)		
<b>National Animal Health Diagnostic and Investigation center (public)</b>	<b>PPP National</b> -Facilitate National animal health diagnostic and investigation centre agent surveillance and control activity	<b>PPP National</b> - Diagnostic kit test supply issues for National Animal Health Diagnostic and Investigation Centre no foreign exchange currency access	<b>PPP National</b> -Poultry production needs to become a priority industry for Ministry of Finance and Economic Development to have access to foreign exchange currency/export market;
<b>Other poultry producers (private)</b>	<b>PPP National</b> -Possible improvement of the sale of their chicken (growth poultry industry market + consumer demands)	<b>PPP National</b> Loss of production market (higher risk business for agents and farmers), agents goes to EthioChicken because of better breed (faster and more resistant to disease and technical support from Vet)	<b>PPP National</b> -Access of improved genetics to other producers and adoption of EthioChicken model
<b>Poultry producer association (private)</b>	<b>PPP National</b> -Increased power due to stronger poultry industry (through government action and EthioChicken business)	<b>PPP National</b> -EthioChicken is not in the association because other poultry producers have suspicious feeling about EthioChicken and its exclusivity right on Sasso breed; <ul style="list-style-type: none"> <li>• Weakness their power (lower lobbying options)</li> </ul>	<b>PPP National</b> -Both parties agree (public and EthioChicken) that it would strengthen the poultry industry if EthioChicken was part of the poultry producer association - EthioChicken can introduce other producers to other breeding houses with similar genetics but the breeding houses themselves set criteria for supply to a breeder farm.,



## *Appendices of the discussion*

### **Appendix 1: Life cycle analyses for evaluating PPPs in animal health: draft protocol for the PPP in Paraguay**

#### **Preamble**

Life cycle analyses look at the resources consumed and the emissions generated throughout the life cycle of a product (e.g. meat) or a sector (e.g. livestock production) and seek to quantify the product or sector environmental impacts using relevant and understandable indicators (Bennett et al., 2019). In life cycle analysis, each environmental flow generated by a stage in the life cycle of the product in question has an environmental impact. With regard to livestock production, these impacts can arise from any of the different stages of the industry: agriculture, slaughter, transformation, transport, retail sales (Bennett et al., 2019). The environmental impacts can cause damage to the environment and to society. The three ‘areas of protection’ commonly used are (i) human health (expressed in disability-adjusted life years), (ii) the quality of the ecosystem (expressed in terms of species loss per year), and (iii) resource depletion (expressed in dollars). These three areas of protection consist of several different categories of impact. For example, human health will be influenced by the impacts on global warming (such as the levels of methane or carbon dioxide emitted by livestock) or the formation of fine particles in the atmosphere. The quality of ecosystems can be damaged by land use, global warming, eutrophication (which can be linked to an excess of nitrates in animal waste) or water consumption. Resource depletion may involve the depletion of fossil fuels or the depletion of minerals (Dick et al. 2015).

Life cycle analysis generally has four stages: (1) defining the framework for the analysis: general goal, functional unit and the system being studied; (2) taking an inventory of the data: collecting data and examining their quality; (3) assessing the impacts: selecting categories of impact, characterising emissions and consumption, normalising results and weighting impact categories; (4) interpreting results: identifying the major sources of impact and comparing with other analyses. We could also include a fifth stage, which would be (5) communicating the results.

## 1. The analysis framework

The aim of these analyses, in the context of evaluating animal health PPPs, could be to measure the indirect impacts of the programme on the environment. The underlying hypothesis is that animal health programmes, including PPPs, affect livestock systems and therefore affect the impact of livestock production on the environment. There could be changes in the organisation of the industry or in the size of the national herd. In Paraguay, the FMD-free status obtained through the PPP enabled the development of the beef export industry. The size of the national herd increased from around 1 million in 1967 to 14 million in 2019. This increase is primarily associated with the export opportunities that opened up thanks to the FMD-free status. We could put forward the theory that this increase in the cattle population, which is primarily reared extensively, places pressure on land use and affects deforestation levels and the eutrophication of soil. It should be noted that the foot and mouth disease control programme has probably also increased the productivity of animals (foot and mouth disease reduces production and reproductive capacities). This effect is, however, very difficult to measure, given the number of factors that influence productivity, notably genetics and pasture. Two life cycle analyses could be conducted: one using the data from 1967 (before the foot and mouth disease control programme was implemented) and one using the 2020 data. This would give us an idea of the indirect impact of the FMD control programme. These analyses could also be conducted on a regular basis, as a support tool, so that recommendations could be made to PPP stakeholders in order to limit these indirect impacts on the environment. For PPPs that have not yet been established, these analyses can be carried out *ex ante* to try to anticipate (and therefore establish measures to mitigate) the impacts on the environment that the PPP could have on the livestock system.

**The system:** in the context of PPP evaluation, it would seem that the most appropriate system for life cycle analyses is the livestock system at national level. In Paraguay, the herd would be considered at national level. However, the impacts will be looked at not only at national level but also at international level (e.g. greenhouse gas emissions and climate change). Next, it will be necessary to determine where the system ends: at the farm exit or right the way up to the sales point (and therefore to consider transport at national level, slaughterhouses, cold stores '*frigerificos*', sales points and export points).

**The functional unit:** the functional unit would not be 'per kg of meat' or 'by hectare' (as is often the case), but 'by national herd'. In the national herd, several types of livestock production can be considered. In Paraguay, it would be interesting to represent two types of production: 'large producers' ('*ganaderos mayores*' in Spanish) who have more than 100 cattle, and sometimes several thousand, and 'small producers' (*ganaderos menores*' in Spanish) who have fewer than 100 cattle. Meat by-products that can be sold, such as leather or manure, could also be considered. Considering

these by-products would reduce the environmental impact of the herd, as the herd is considered not only in terms of its meat production but also its production of these by-products.

## **2. The data**

In Paraguay, it would have been necessary to start by considering the different industries and the different production practices. It would have been necessary to consider the energy consumption of farms, even if it was probably minimal (cattle graze all year long, farms have very few buildings and little mechanisation, farmers often move from place to place on horseback). Similarly, we would have to have looked at the farm inputs (feed, water). Even if the water used to water the cattle in Paraguay is mostly rainwater, this must be taken into account, because it is water that is not used by the ecosystem. Of course, it would have been necessary to quantify the beef industry's use of land. Cattle in Paraguay are mainly fed on pasture containing native or improved grasses. Over the last few years, a system for fattening cattle has been developed, based on maize and soja, and it would have been necessary to take this into account in the calculations (taking into account the use of fertilisers and/or pesticides in cereal production). As cattle are mainly reared in extensive systems, it would have been interesting to consider the carbon-capture capabilities of the pastureland. And it would have been important to consider the type of pasture (humid prairies, native prairies/planted prairies, etc.). The level of deforestation that took place to allow cattle farming, and the type of forest, would have to have been considered, but so would the level of reforestation (and the type of reforestation). The dynamics of deforestation would also have needed to be considered. Deforestation releases a lot of carbon at once, but new forests store carbon, and after 25 to 30 years, a balance is reached. It is often difficult to obtain quality data in the field. Reference data, for example, on energy production, fertiliser production and pesticide production are accessible from different databases that are available on the Simapro® software.

## **3. Calculating impacts**

As mentioned previously, it would be interesting to present the outcomes in terms of human health, ecosystem quality and resource depletion. The guidelines of the Intergovernmental Panel on Climate Change can be used to calculate impacts on the basis of energy consumption and the flow of products (IPCC, 2006).

## **4. Interpretation**

The environmental impacts will have to be interpreted in relation to the animal health PPP being studied. This will give rise to new research questions. What is the causal pathway between the programme and the trajectory of the livestock system leading to these impacts? To what extent could the PPP have prevented or mitigated these impacts? Moreover, interpretation will have to explicit the

limits of the approach (Has the carbon sequestered by the prairies been considered? Are the deforestation levels considered really caused by cattle production? Do the ‘standardised’ data used correspond to the livestock production system being studied? Have certain externalities, positive or negative, been forgotten?). Finally, the impacts will have to be interpreted with regard to the context of the area being studied. For example, in Paraguay, it will be important to consider that, in certain regions, land used for livestock production is in flood-prone areas and so cannot be used for agriculture or housing. It will also be important to consider the importance of livestock farming for both their formal and informal economy and its importance for their culture. Finally, the impacts of different types of livestock production will not be the same, and so they could be interpreted separately.

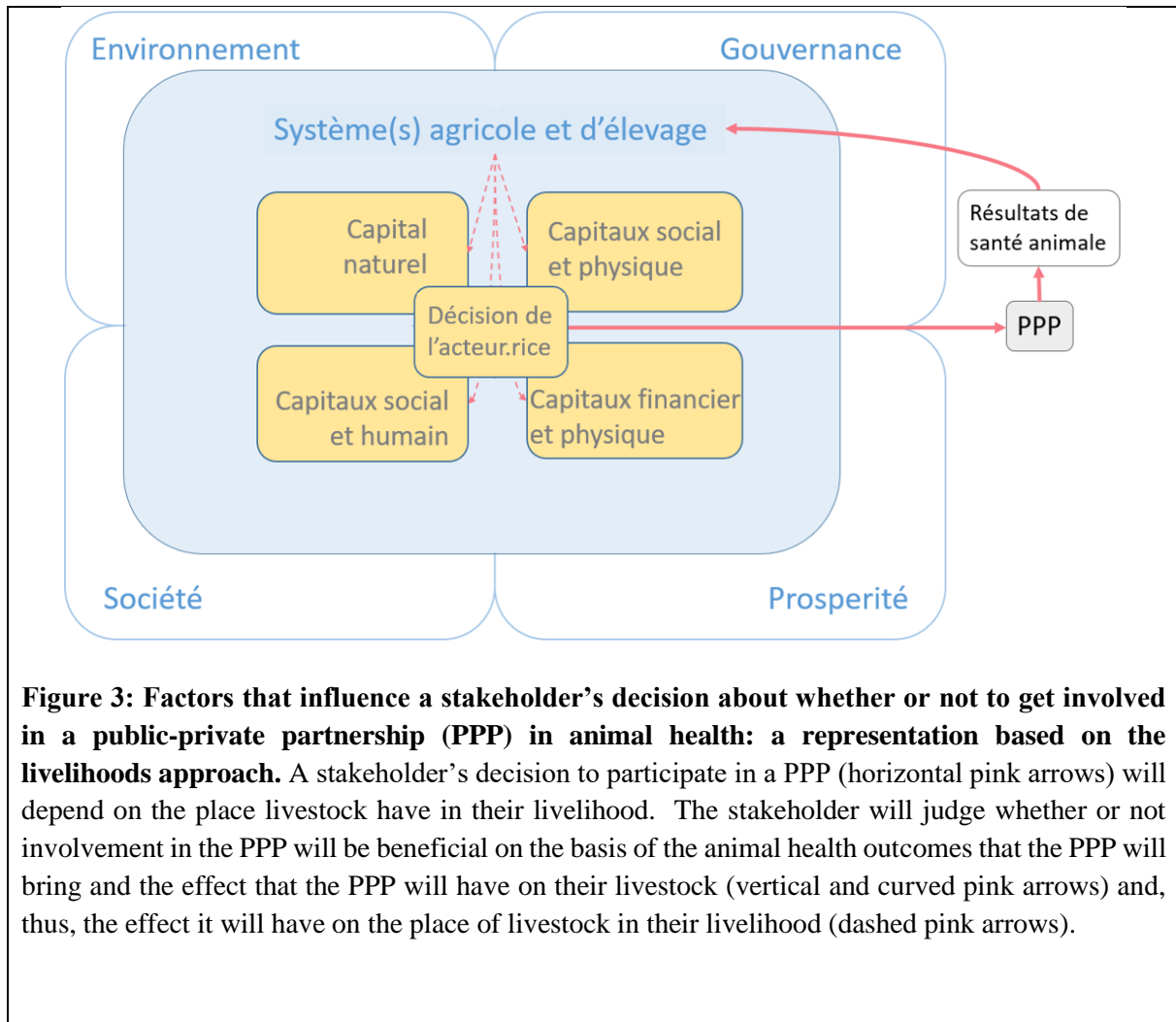
### **5. Communication and recommendations**

Ideally, these analyses will be participatory and requested by the stakeholders. There will be several difficulties to overcome to enable PPPs to consider environment issues in the projected trajectory of the PPP. It is difficult to consider long-term indirect impacts, which are not attributable to any precise cause and which are not necessarily visible at a local level (such as the effects on the livestock system that have an effect on climate change). In addition, the effects of implementing measures to reduce the environmental impacts will be limited and intangible. It will, of course, be necessary to consider everything that already exists in the country. For example, in Paraguay, there is a ‘zero-deforestation’ law in the eastern part of the country, and in the west of the country there is a law limiting deforestation, stipulating that 45% of the forests on a private property must be preserved. An association for sustainable meat, which brings together stakeholders from the public sector, private sector and NGOs, already exists. Recommendations will have to be made to the stakeholders of the animal health PPP. One of the recommendations could be that the PPP work with this sustainable meat association, which could then benefit from the national and local networks of the PPP for foot and mouth disease. It will be essential, therefore, that the recommendations highlight the potential gains for local actors that changing practices, for example, livestock management practices (saving water, restoring their ecosystem) could bring.

## Appendix 2. Evaluations of PPPs in animal health at the individual level based on the livelihoods approached: draft protocol

The livelihoods approach sees livelihoods as associated with the availability of a range of goods and services that vary over time and space and that fall into five categories of capital: human, natural, social, financial and physical. Human capital includes skills, knowledge, the capacity to work and be in good health, and it determines the capacity to use the other four types of capital. Natural capital includes all the natural resources that are available to an actor. Financial capital is the financial resources that people use to achieve their goals. Physical capital includes basic infrastructure and the necessary production assets. Social capital includes the social resources that people draw on and act upon, it includes the concepts of networks and connectivity, membership of formal groups, and relationships of trust, reciprocity and exchange. (Chambers and Conway, 1991; United Nations Development Programme, 2015). The livelihoods strategies that people implement will, therefore, be very different, depending on the types of capital they have, their access to it, and other contextual factors (United Nations Development Programme, 2015).

In the context of evaluating a PPP at individual level, this approach would make it possible to look at the influence of the PPP on the place of livestock in a stakeholder's livelihood. Depending on the place of livestock in the five different categories of capital, the PPP will have different effects for the stakeholder in question. The decision of a stakeholder to participate in a PPP could depend on the place livestock have in their livelihood (**Figure 1**). Individual evaluation, using the livelihoods approach, could have been used for the case study in Paraguay. We could have, for example, focused particularly on stakeholders who were 'reluctant' to vaccinate their animals against foot and mouth disease. A better understanding of the place of livestock in the livelihoods of some farmers would have made it possible to formulate recommendations to encourage them to join the foot and mouth disease control programme. For example, it might be possible to offer another service at the same time as vaccinating their cattle, one that they feel is more immediately beneficial (antiparasitic treatment, advice on feeding, etc.)

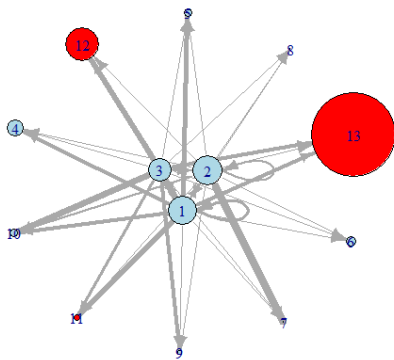


**Figure 3: Factors that influence a stakeholder’s decision about whether or not to get involved in a public-private partnership (PPP) in animal health: a representation based on the livelihoods approach.** A stakeholder’s decision to participate in a PPP (horizontal pink arrows) will depend on the place livestock have in their livelihood. The stakeholder will judge whether or not involvement in the PPP will be beneficial on the basis of the animal health outcomes that the PPP will bring and the effect that the PPP will have on their livestock (vertical and curved pink arrows) and, thus, the effect it will have on the place of livestock in their livelihood (dashed pink arrows).

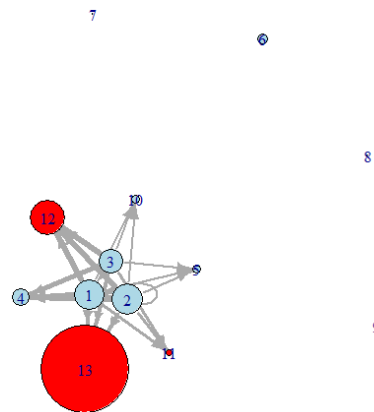
### Appendix 3. Evaluating animal health PPPs at the level of stakeholder networks: draft protocol

In PPP evaluation, it could be interesting to carry out an evaluative analysis of social networks. These analyses make use of graph theory and matrix calculus. The ‘nodes’ could represent groups of PPP stakeholders or those affected by the PPP. The ‘links’ could represent flows of information or services made possible by the PPP (disease declaration, advice on care, etc.). This could enable us to understand the structure of the exchanges between the various interconnected stakeholders in the PPP. In addition, this pictorial representation of the network would have allowed us to better understand the strategic games between actors that could have influenced their decision about whether or not to participate in a PPP: their place in the network, the number of links that connect them to other stakeholders. One of the added values of a PPP could be the creation of links between the different categories of stakeholder, thus allowing the circulation and exchange of information or other exchangeable goods (**Figure 2**).

#### Situation with PPP



#### Situation without PPP



*Figure 4: Diagram of the links between stakeholders from the public Veterinary Services (red nodes) and private stakeholders (blue nodes) in a fictitious PPP in animal health (image on the left). The thickness of the links (the arrows) represents the quantity of information flow. **The image on the right is the model of the links between stakeholders but without the links that were made possible by the PPP***





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