

Evaluation of public-private partnerships for livestock health programmes: a scoping review.

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May 5, 2022

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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. We found the specificity of a PPP evaluation compared to other programmes is not especially based on specific criteria or outcomes to be evaluated but more on their prioritization and relative importance. For example, power relationships between partners or the governance system, were identified as essential to consider. 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. This framework could also guide public policies to favour the contribution of PPPs to the sustainability of a territory.

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

Implication

Public-private partnerships (PPPs) for livestock health programmes are implemented worldwide. Those PPPs? by influencing livestock health, influence the livestock system and have consequences on the sustainability of a territory. Evaluations of those PPPs are needed to 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. Based on this scoping review, an evaluation framework could be developed as well as indicators and tools for the practical implementation of PPP evaluation.

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 (Steinfeld et al., 2006; Dumont et al., 2019).

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 programmes, 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, 2020). 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 types of private actors such as private veterinarians, producer associations or private companies producing or distributing veterinary products and the various types of governance (e.g. formal contract or informal collaboration) of PPPs (Galière et al., 2019). 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., 2019).

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 programmes have mainly focused on efficiency by comparing their benefits (e.g. avoidance of productivity losses) with their costs (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 types of evaluations of livestock health programmes. Such evaluations highlighted the importance of the private sector in animal health surveillance programmes (Delabougli et al., 2015) as well as the importance of trust between the actors involved and their acceptability in the system (Calba et al., 2015; 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 (Roehrich et al., 2014; Johnston and Finegood, 2015).

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 programmes, 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.

Materials and methods

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 **Supplementary file S1**. 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).

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 a case study of PPP evaluation, (ii) they proposed a framework of evaluation of PPPs, (iii) they mentioned criteria for the evaluation (even if they don't describe the evaluation methodology). 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, 2012).

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, 2020) (**Fig. 1**). The methodology for collecting information in this OIE database is described elsewhere (Galière et al., 2019). 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 analysed 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 analysed 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 management 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 elements to be considered in an evaluation. The full search equation is available in **Supplementary file S1** . All documents retrieved from the scientific databases were imported into Zotero® version 5.0 and duplicate documents were removed (**Fig. 1**).

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 (**Fig. 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 food safety, PPPs for pets or horses, 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 for the construction and maintenance of 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 (**Fig. 1**). One author screened all titles and abstracts of retrieved documents. For the second screening

phase, two authors screened 50% of the selected document in parallel, using full text. Since the selection of document was similar between the two authors, one author continued the screening of the other 50% of the documents using full text.

Data charting process

Two authors independently allocated 30% of the selected documents between 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.

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 (**Supplementary file S1**). 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 (Schroter, 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.

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.

Results

Data selection

This study retrieved 1066 documents from the databases including 185 duplicates removed (**Fig. 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 **Supplementary file S2**.

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 analysed are presented in **Supplementary Tables S3**.

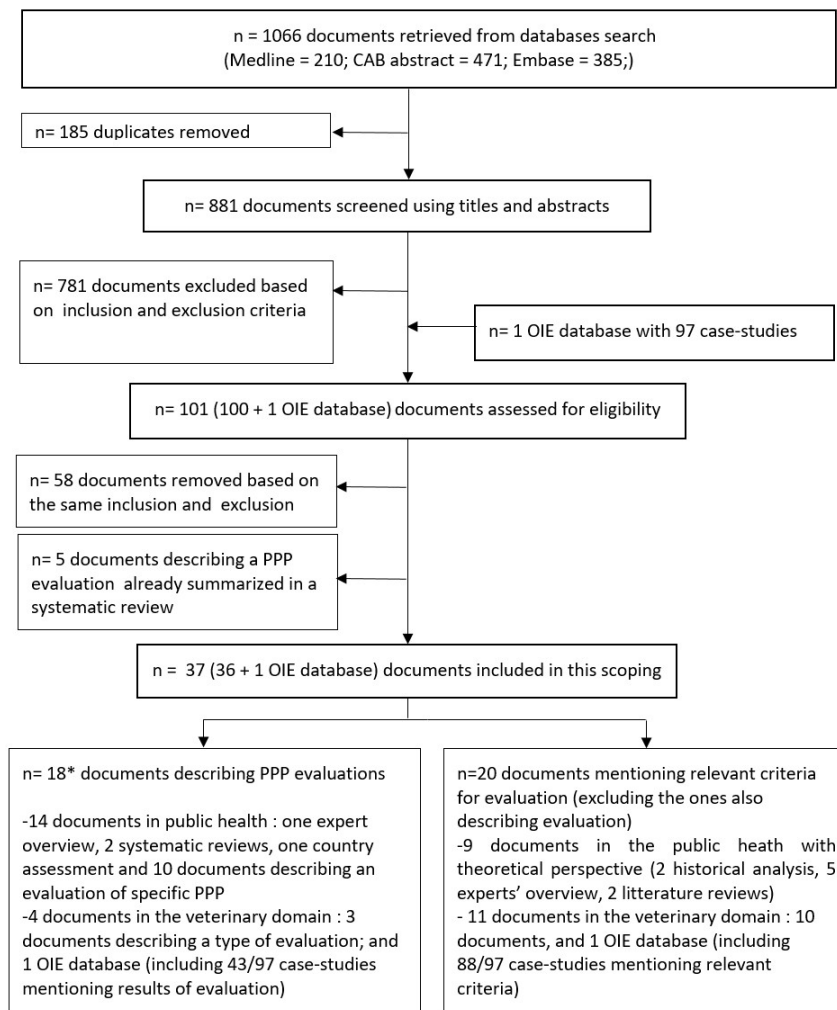


Figure 1: PRISMA flow chart diagram of documents selection process to include in the scoping review. *OIE: World Health Organisation for Animal Health. *the OIE database describes evaluation case studies and evaluation criteria of PPPs for livestock health.*

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 not only 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/or on the cost of the PPP (n=6/18) (**Table 1**).

The importance of PPP evaluations was underlined. 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 PPP evaluation goals, the way to collect data (e.g. documents reviews, interviews) and the type of analysis (e.g. descriptive, measurement of indicators) of the PPP evaluation case-studies analysed were various and are described in the **Supplementary Table S4**. However, 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 counterfactual (e.g. full public initiative, PPP in another area) but also pointed out the difficulties of setting it (Vrangbæk, 2008; Lei et al., 2015). 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 evaluated and 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).

Elements of the context were identified as having the potential to influence the process and outcomes of the PPP, which may be either obstacles or key success factors (**Fig. 2**). Some evaluation criteria of the economic, societal, and governance contexts were identified. 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 PPP process have been identified as having the potential to influence the PPP's outcomes, which may be either obstacles or key success factors. In addition, some risks (such as corruption or conflict of interest) have been identified as a direct result of a poor PPP process. Thus, the importance of asking "how" PPP works (PPP process) in a given context, not just "do things work" (outcomes) was emphasized (Prashanth, 2011). The PPP process evaluation focused on the mechanism of the PPP itself. 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 (**Fig. 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 (**Fig. 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 (**Fig. 2**). 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). Environmental outcomes have not been considered in any of the documents and have yet to be defined. Some outcomes of PPPs (such as increased trust among partners) influence the context by facilitating or hindering the development of other PPPs.

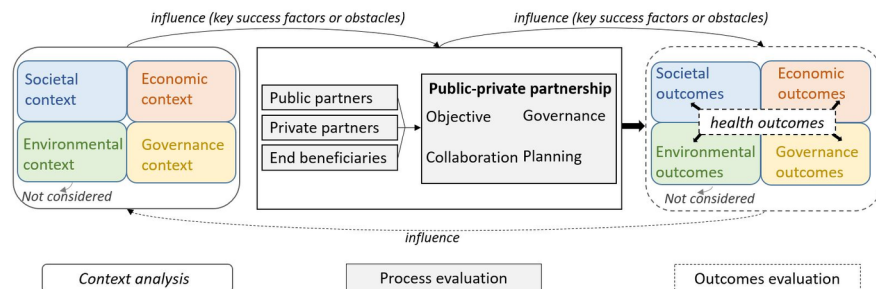


Figure 2: Summary of the results of the scoping review elements to consider for PPP evaluation. *The documents considered analysis of the context in which the PPP is implemented (italic writing) and the process evaluation (grey rectangle). In addition to health outcomes, some documents also considered indirect outcomes related to societal (blue), economic (orange), environmental (green), and governance (yellow) outcomes. Environmental context and environmental outcomes were 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 **Supplementary file S2**.*

Domain and reference of the articles	Context	Process	Process	Process	Process	Outcomes	Outcomes	Outcomes	Outcomes	Outcomes
objective	governance	planning	collaboration	health	economy	society	governance	environment		
Public Health										
Albis et al., (2019)	1	1	1							
Alonazi, (2017)	1	1	1	1						
Baig et al. (2014)	1	1	1							
Bakibinga et al., (2014)	1	1	1							
Barr (2007)	1	1	1	1	1	1	1			
Biermann et al. (2016)	1	1	1	1						
Gharaee et al (2019)	1	1	1	1	1	1	1	1		

Domain and ref- erence of the articles	Context	Process	Process	Process	Process	Outcomes	Outcomes	Outcomes	Outcomes	Outcomes
Kempe et al., (2014)	1	1	1	1	1					
Lei et al., (2015)	1	1	1							
Laktabai et al., (2017)	1	1								
Roehrich et al. (2014)	1	1	1	1	1	1	1	1	1	
Salve et al. (2018)	1	1	1	1						
Sutton, (2010)	1	1	1							
Vrangbæk (2008)	1	1	1	1	1	1	1			
Livestock Health										
Dione et al. (2019)	1	1	1	1	1	1				
Hamill et al. (2017)	1									
Maiti et al. (2011)	1									
OIE PPP database (43/97case- Studies)	1	1	1	1						
Total by sub- categories	4	5	8	8	17	5	7	3	0	
Total by cate- gories	11	11	11	11	11	17	17	17	17	17

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, Supplementary Table S5**).

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.

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 (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 partner. 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 **Supplementary Table S5**.

Categories	Categories	Categories	Key success factors	Key success factors	Obstacles	Obstacles
Public Health (n=23)	Livestock Health (n=14)	Public Health (n=23)	Livestock Health (n=14)			
Context analysis	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		
Total (context)	11¹	3¹	8¹	2¹		
Process evaluation	Objective	Common goal	1	1	1	0
Mutual benefits	2	1	1	0		

Categories	Categories	Categories	Key success factors	Key success factors	Obstacles	Obstacles
Alignment with national priorities	1	0	0	0		
Total (process, objective)	3¹	1¹	1¹	0		
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		
Total (process, governance)	13¹	2¹	9¹	2¹		
Planning of the activities	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		

Categories	Categories	Categories	Key success factors	Key success factors	Obstacles	Obstacles
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		
Total (process, planning)	11¹	3¹	9¹	2¹		
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		
Total (process, collaboration)	6¹	1	7¹	1		

¹ Some documents mentioned several key success factors or obstacles categories.

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 (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, Supplementary Table S6**). 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, Supplementary Table S6**). 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, Supplementary Table S6**).

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 (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, Supplementary Table S6**).

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, Supplementary Table S6**).

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, Supplementary Table S6**).

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 itself 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, Supplementary Table S6**). 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 PPP failure, leading to a disengagement of the different partners for other potential PPPs was mentioned. Conflicts of interests and increasing corruption risk were the risks most often mentioned. An evaluation framework mentioned risks of restricting the flexibility to make decisions in a democratic manner about the services delivery of PPPs, given that the PPP creates a long-term contractual obligation (Vrangbæk, 2008) (**Table 3, Supplementary Table S6**).

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 **Supplementary Table S6** .

Outcomes categories	Outcomes categories	Benefits / positive outcomes	Benefits / positive outcomes	Risks / negative 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	

Outcomes categories	Outcomes categories	Benefits / positive outcomes	Benefits / positive outcomes	Risks / negative outcomes	Risks / negative outcomes
Total (health outcomes)	10¹	6¹	1¹	0	
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	
Total (societal outcomes)	6¹	2¹	4¹	0	
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	
Total (economic outcomes)	7¹	3¹	2¹	0	
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	
Total (governance outcomes)	4	2¹	4¹	3	

Outcomes categories	Outcomes categories	Benefits / positive outcomes	Benefits / positive outcomes	Risks / negative outcomes	Risks / negative outcomes
Environment	Total (environmental outcomes)	0	0	0	0

¹ Some documents mentioned several outcomes categories

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).

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.

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, 2004; Lubroth et al., 2007; Bennett, 2012). Only three documents have presented practical examples of evaluations of PPPs for livestock health, most of them focusing on livestock health outcomes (Maiti et al., 2011; Hamill et al., 2017; Dione et al., 2019). Only Dione et al. (2019) also focused on context analysis, engagement and interaction between partners.

The lack of evaluations of PPPs for livestock health (both evaluation case-studies and evaluation methodologies) 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 (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 an evaluation, such as defining indicators to measure the different evaluation criteria.

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 relationships between partners 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 (Rieker, 2011; Breuer et al., 2016). Furthermore, making these links explicit would allow an impact evaluation that has not been mentioned in any of the documents. Indeed, impacts are the positive and negative long-term outcomes, intended and unintended, direct and indirect, that are attributable to the PPP. This means that an impact evaluation must establish what has caused the observed changes (in this case ‘impacts’), which is called causal attribution (BetterEvaluation, 2015). Thus, impact evaluation, could represent interesting methodology to address on the added value of PPPs. 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 PPPs’ inputs, process, and outcomes (Blundo-Canto et al., 2020).

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 and represents thus 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.

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 relationships between partners (Barr, 2007; Salve et al., 2018). Depending on the type of PPP for livestock health programmes, differences in terms of unequal power relationships can be expected. The power relationships 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 (multi-)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 emission of greenhouse gas (Soussana, et al., 2010; HLPE, 2016; Cavicchioli et al., 2019). Outcomes could also be positives as some livestock systems can provide ecosystemic services such as carbon sequestration (Soussana, et al., 2010), or soil fertility improvement through manure (Steinfeld et al., 2006). To our knowledge, few evaluations of livestock health programmes have considered the environmental outcomes of the programme but now a number of initiatives are calling for including environmental and biodiversity aspects within livestock health programmes evaluation (Peyre et al., 2021). 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 costs of implementing a PPP. The evaluation of the costs 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.

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.

Ethics approval

Not needed (this study does not imply humans or animals)

Data and model availability statement

All data are available in the supplementary material.

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Declaration of interest

None

Acknowledgements

Acknowledgement to Sandrine Vandenput for her methodological help on the scoping review process. Acknowledgement to Angela Kent for English Language editing. We thank Cecile Aenishaenslin and Sybille Mertens for their advices for improvement of this articles. We sincerely thank the editor and the two anonymous reviewers who helped us greatly to improve this article.

Financial support statement

This scoping literature review was carried out as part of a doctoral thesis funded by the French Agricultural Research Centre for International Development (CIRAD) and the OIE *Public Private Progress* project which is supported by the Bill & Melinda Gates Foundation under the grant number: OPP1159705.

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Supplementary Materials

Supplementary file S1 : 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 two databases (for documents describing PPP evaluation case studies and for documents presenting criteria to consider in the evaluation process)

Articles Retrieved from CAB Direct

Articles Retrieved from PubMed

Articles Retrieved from Embase

Total Articles Retrieved from databases Search

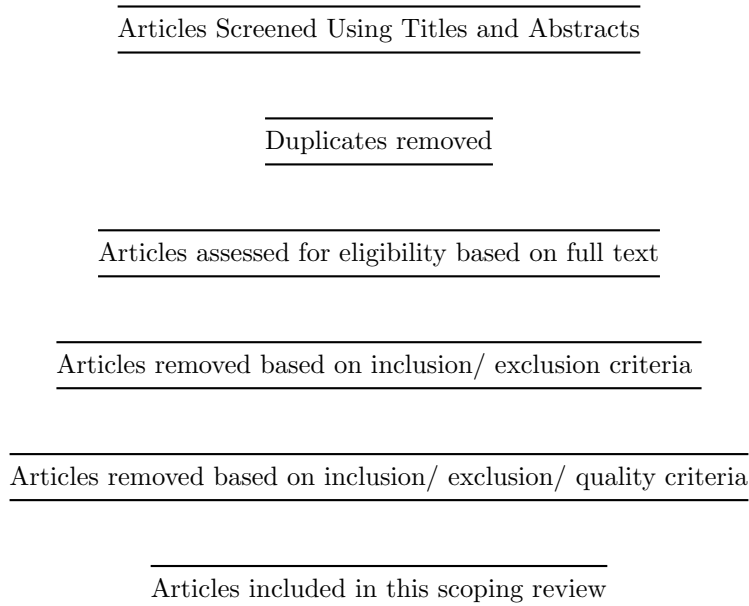


Figure 1. Flow diagram representing the different steps for the identification of relevant studies

c. Concepts used in the search equation

Three concepts were mobilized:

- Public-private partnership
- Veterinary domain (restricted to programmes for livestock health such as services or product delivery for surveillance, prevention, or control of zoonotic or animal contagious diseases)

* In the concept of the veterinary field, we did not include specific species as keywords. Indeed, in a second step, we selected PPPs that were related to the prevention and control of livestock diseases (chickens, pigs, small ruminants and cattle). We do not believe that this affected our research. We did not include the keyword “animal health” because we did not feel that it would have provided any new material in relation to the term “[subheading] veterinary” (used for natural diseases of animals, or for diagnostic, preventive, or therapeutic procedures used in veterinary medicine). We included the word “hospital” because, although rare, small ruminants can be taken to rural veterinary hospitals, or farmers can come to them for advices.
- Public health (restricted to services or product delivery for surveillance, prevention, or control of zoonotic or human contagious diseases).

Data base	1. Public-Private Partnerships
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”
Embase (<i>thesaurus based on Emtree® term</i>)	‘public-private partnership’/exp

Supplementary file S2List 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).
9. Laktabai, J. et al. Innovative public-private partnership to target subsidised antimalarials: a study protocol for a cluster randomised controlled trial to evaluate a community intervention in Western Kenya. *BMJ Open* 7, (2017).
10. Nishtar, S. Public – private 'partnerships' in health – a global call to action. *Health Res Policy Syst* 2, (2004).
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., 2019)

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., 2019)
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).

Supplementary Table S3 Objectives of the PPPs described in the documents analyzed in this scoping review in the public health (n=23) and veterinary domain (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.

Main objective of the PPP	Documents from public health
Livestock or zoonotic or human infectious diseases control (vaccination, eradication program)	7 (Widdus, 2005; Sutton, 2010; Lei et al., 2015)
Livestock or zoonotic or human infectious diseases surveillance (including antimicrobial resistance)	2 (Sutton, 2010; Lei et al., 2015)
Better veterinary or health services delivery (for any type of mission)	17 (Widdus, 2001, 2005; Nishtar, 2004; Widdus, 2005)
Better veterinary or health product access	5 (Nishtar, 2004; Widdus, 2005)

Supplementary Table S4 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 **Supplementary file S2***

	Type of articles	Framework
Public Health		
(Albis et al., 2019)	Research article: evaluation of specific PPP	Health outcomes evaluation
(Alonazi, 2017)	Research article: evaluation of specific PPP	Individual centered-risk (clinical)
(Baig et al., 2014)	Research article: evaluation of specific PPP	Health outcomes evaluation and cost effectiveness
(Bakibinga et al., 2014)	Research article: evaluation of specific PPP	Health outcomes; Cost effectiveness
(Barr, 2007)	Overview article	Specific to PPP: research protocol
(Biermann et al., 2016)	Research article: evaluation of specific PPP	Perception of outcomes by beneficiaries
(Gharraee et al., 2019)	Research article: evaluation of specific PPP	Perception of PPP policy by stakeholders
(Kempe et al., 2014)	Research article: evaluation of specific PPP	Health outcomes evaluation and cost effectiveness
(Lei et al., 2015)	Research article: systematic review	Health outcomes evaluation
(Laktabai et al., 2017)	Research article: evaluation of specific PPP	Health outcomes evaluation
(Roehrich et al., 2014)	systematic review	Specific to PPP : Multi-dimensional
(Salve et al., 2018)	Research article: evaluation of specific PPP	Bourdieu's "theory of practice"
(Sutton, 2010)	Research article: overview article	Microeconomic theory based on rational choice
(Vrangbæk, 2008)	Research article: PPPs assessment in a country	Specific to PPP : Risk-based
Livestock Health		
(Dione et al., 2019)	Research article: evaluation of specific PPP	Innovative platform framework
(Hamill et al., 2017)	Research article: evaluation of specific PPP	Not mentioned
(Maiti et al., 2011)	Research article: evaluation of specific PPP	Not mentioned
OIE database	Grey literature, evaluation of specific PPPs (43/97 case-studies)	Not mentioned

Supplementary Table S5 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
Public Health	Livestock health
Context	Societal context: PPP socially acceptable
Economic context: PPP justification (added value), Infrastructure, market system	2 (Barr 2007) (Widdus 2001)
Governance context: Legislative and political framework	10 (Nishtar 2004; Barr 2007; Baku and
Environmental context	0
Total (context)	11*
Process	Objective
Mutual benefits	2 (Barr 2007; Hamill et al. 2017)
Alignment with national priorities	1 (Nishtar 2004)
Total (process, objective)	3*
Governance	Nature of agreement, negotiation contr
Inclusiveness in decision-making process	6 (Baku and Madhurima Nundy 2008;
Funding and human resources availability and repartition	5 (Barr 2007; Baig et al. 2014; Roehrich
Transparency of decision and activities implemented	1 (Nishtar 2004)
Adaptability of the PPP	1 (Alonazi 2017)
Total (process, governance)	13*
Planning	Regular risks identification
Communication between partners	5 (Kaboru 2012; Roehrich et al. 2014;
Dissemination knowledge, information sharing with external actors	4 (Kaboru 2012; Roehrich et al. 2014;
Role and responsibility of partners	5 (Widdus 2001; Barr 2007; Kaboru 20
Planning of activities	1 (Lei et al. 2015)
Distribution and efficiency of administrative tasks	-
Distribution of ownership of PPP outputs	3 (Lei et al. 2015; Johnston and Fineg
Capacity building, training	2 (Nishtar 2004; Lei et al. 2015)
Evaluation of the PPP	11*
Total (process, planning)	Power relationship between partners
Collaboration	2 (Konduri et al. 2017; Salve et al. 201
Inclusiveness in planning, in the implementation of activities	2 (Prashanth 2011; Salve et al. 2018)
Understanding of partner culture	1 (Biermann et al. 2016)
PPP structure	
Partners' satisfaction/ trust between partners	
Partner's involvement	1 (Roehrich et al. 2014)
Total (process, collaboration)	6*

Supplementary Table S6 to article in Animal “Evaluation of public-private partnerships for livestock health programmes: a scoping review”

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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 the **supplementary file S2**.

CS: case studies; OIE db: database from World Organization for Animal Health. *Some documents mentioned several outcomes categories

	Outcomes categories
Public health	Livestock health
Health	Expertise, skills
Quality of actions (case detection, case management, treatment outcomes)	4 (Albis et al., 2019; Baig et al., 2014; Gharaee et al., 2019)
Coverage of the services	8 (Albis et al., 2019; Baig et al., 2014; Bierman et al., 2019)
Food security	
Total documents	10 *
Society	Vulnerable groups, externalities and public value
Regulations and public responsibilities	
Equity of outcomes	5 (Baig et al., 2014; Barr, 2007; Gharaee et al., 2019)
Total documents	6*
Economy	Resources and cost of the PPP
Reduction of risks	
Timely execution of activities	3 (Albis et al., 2019; Kempe et al., 2014; Roehrich et al., 2019)
Market access	
Employment	3 (Gharaee et al., 2019; Kaboru, 2012; Roehrich et al., 2019)
Oligo/monopolies	
Total documents	7*
Governance	Quality of the process and trust between partners
Accountability and corruption	1 (Kaboru, 2012)
Merging of interest or conflict of interest	
Total documents	4