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Providing a new generation of methodologies and tools for cost-effective risk-based animal health surveillance systems for the benefit of livestock producers, decision makers and consumers

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Case study selection for economic evaluation framework development and validation

WP 5. – Evaluation of epidemiological and economic effectiveness of surveillance systems

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Acronyms

AD	Aujeszky's Disease
AH	Animal Health
AI	Avian Influenza
ASF	African Swine Fever
BHV	Bovine herpes virus
BTV	Blue tongue virus
CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
CSF	Classical Swine Fever
DALYs	Disability-adjusted life years
DM	Decision makers
EC	European Commission
EU	European Union
HPAI	Highly pathogenic avian influenza
MS	Member State
PRRS	Porcine respiratory and reproductive syndrome
QALYs	Quality-Adjusted life years
SS	Surveillance Systems

Summary

During the last year of RISKSUR project, the evaluation tools developed within WP5 will be applied to assess and compare the effectiveness and efficiency of the surveillance system designs developed in WP2-4. During the second year of the project, seven representative case studies were selected to develop and test various aspects of the tool, this included three of the surveillance design case studies selected in the RISKSUR project and a further four case studies from diverse surveillance situation and/or challenging contexts. The applicability of the evaluation attribute selection matrix and the economic analysis framework developed by WP1 and WP5 (D1.3 and D1.4) were also tested using all eight of the surveillance design case studies selected by WP2-4..Following this pilot application of five case studies were further selected in close collaboration with WP2-4 (early detection of avian influenza in UK, freedom from CSF in wild boars in Germany, case detection of salmonella Dublin in cattle in Sweden, BVDV in UK and HPAI in Vietnam) for the final integrated economic and epidemiological evaluation of surveillance comparing current and novel designs developed within RISKSUR. **This report presents the process and criteria behind the selection of the case studies used in each step of the development and testing of the tools and the final evaluation process.**

1 Introduction

1.1 Overview of the RISKSUR project

The aim of the RISKSUR project is to develop and validate conceptual and decision support frameworks and associated tools for designing efficient risk-based animal health surveillance systems. This includes the development of an integrated evaluation support (EVA) tool to facilitate the design of economic and epidemiologic evaluations of animal health surveillance systems, this has been developed in WP5 of the project. The development of a framework for the design of surveillance to address different surveillance objectives is being addressed in WP2-4. This includes the design of surveillance for early detection of exotic or emerging threats (WP2), substantiating freedom from disease (WP3) and estimating the prevalence of or detecting cases of endemic disease to facilitate control (WP4)

1.2 The EVA tool

Following the needs and gaps identified in the evaluation reviews (D1.2), the RISKSUR project team has developed an integrated evaluation support (EVA) tool to facilitate the design of economic and epidemiologic evaluations of animal health surveillance systems. The EVA tool builds on existing evaluation frameworks, methods and tools and aims to provide standardization in the evaluation process without undermining the need for flexibility to account for context and the specific aims of each individual evaluation. The objective of the EVA tool is to provide comprehensive guidance to decision makers (DMs) and their technical advisers to plan evaluations of animal health surveillance systems and/or components. It provides newly elaborated guidance for the selection of evaluation criteria and methods for the epidemiological and economic evaluation of surveillance. Links to tools for carrying out these evaluations and to existing evaluation frameworks such as the OASIS tool and SERVAL, which provide generic assessment of the strengths and weaknesses of a system, are also provided. The EVA tool will provide DMs with simple step by step guidance and options to decide what should be measured and how this can be achieved to evaluate animal health surveillance systems.

1.3 The RISKSUR EVA tool development, testing and application process

Figure 1 presents a summary of the steps and selected case studies within the RISKSUR EVA tool development, testing and application process.

The process consists of three main parts:

A. Development of the evaluation framework and methods for evaluation (Months 1-24) using the "Development case studies"
    - Conceptual design of the evaluation process and EVA tool (Months 1-17)
    - Selection of specific case studies for the development of the EVA tool and the framework (Months 17-24,)

B. Testing of the EVA tool logic and epidemiological evaluation of surveillance designs using all the "surveillance design case studies"

   Integrated epidemiological and economic evaluation of selected case studies to validate the evaluation framework and tool (Months 26-36,) using the "economic evaluation case studies"

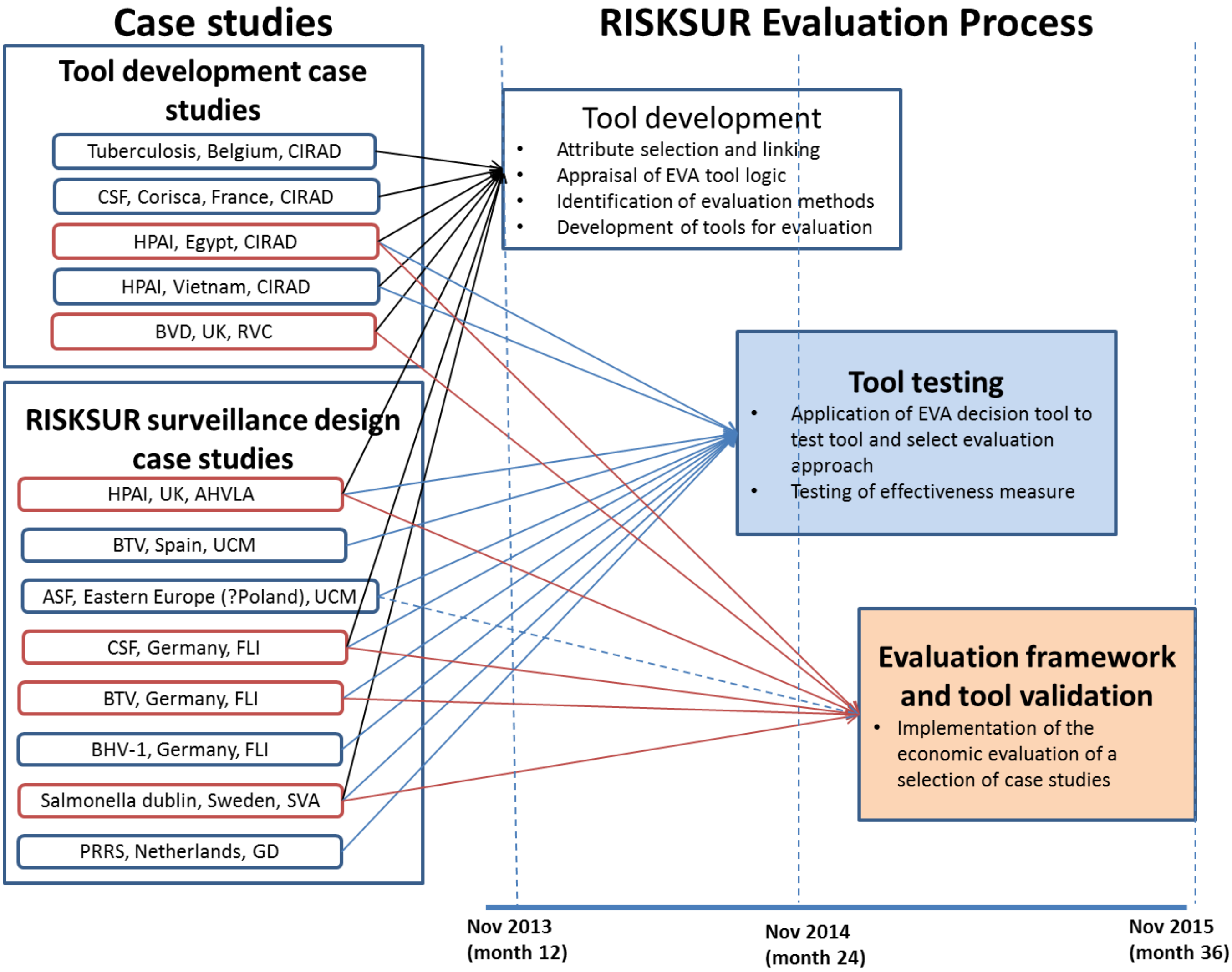

FIGURE 1. CASE STUDIES USED IN THE DIFFERENT STEPS OF THE EVA TOOL DEVELOPMENT, TESTING AND VALIDATION PROCESSES IN THE RISKSUR PROJECT

2 Case study selection for the development of the EVA tool

Eight case studies were selected to further develop the draft EVA tool following the development of the conceptual framework in year 1 of the project. These case studies covered different surveillance objectives, multiple diseases and surveillance contexts (including a developing country context). Case studies considered were the three initial surveillance design case studies selected by WP2-4 as well as five additional case studies building on ongoing (surveillance) projects at the RISKSUR partner institutions. Those additional case studies were selected to include surveillance in challenging contexts (e.g. HPAI surveillance in Vietnam and HPAI surveillance in Egypt) and also in a context where data access and engagement of sanitary authorities will not be an issue to allow for the development of innovative evaluation tools (e.g. BVD surveillance in UK, CSF surveillance in Corsica and Tb surveillance in Belgium). The case studies were applied at different stages of the tool and framework development (Table 1), briefly these were:

- Attribute selection: Validation of the list of primary and secondary evaluation attributes and their selection according to the surveillance context
- Attribute linking: Identification of links between attributes, which attributes are strongly linked to other attributes
- Logic appraisal: checking the conceptual logic of the EVA tool
- Method identification: Provision of expert opinion on the evaluation methods available and their characteristics
- Method development: Development of innovative methods for the assessment of evaluation attributes if not already available

TABLE 1. CASE STUDIES USED FOR THE DEVELOPMENT OF THE RISKSUR EVA TOOL

WP5 development and WP2-4 pilot case studies	Hazard (species)	Surveillance objective	EVA tool development objectives[1]	
			Specific aspects in the development of tools	Specific aspects in the development of assessment methods
WP5.1	ASF and CSF (swine) Corsica, France	Early detection (WP2)	Attribute selection Logic appraisal Method identification	Development of innovative methods for the assessment of qualitative attributes of the surveillance systems (e.g. acceptability, flexibility)
WP5.2	Tb (cattle) , Belgium	Freedom (WP3)	Attribute selection Logic appraisal Method identification	Development of innovative methods for the assessment of qualitative attributes of the surveillance systems (e.g. acceptability, flexibility)
WP5.3 / WP5.4	HPAI (poultry), Egypt and Vietnam	Endemic disease Assessment of prevalence (WP4)	Attribute linking Attribute selection (challenging situations) Logic appraisal Method identification	Development of innovative methods for the assessment of risk based selection criteria
WP5.5	BVD, UK	Endemic disease case detection (WP4)	Attribute selection (challenging situations) Logic appraisal of the conceptual logic of the tool Method identification	None
WP2.1	HPAI (poultry) UK	Early detection (WP2)	Attribute selection Attribute linking, Logic appraisal Method identification	None
WP3.1	CSF (swine and wildlife), Germany	Freedom and endemic (WP3 & WP4)	Attribute selection Logic appraisal Method identification	None
WP4.1	Salmonella (swine and cattle), Sweden	Endemic disease case detection (WP4)	Attribute linking Logic appraisal	None

3 Case study selection for testing of the EVA tool

In Year 2 of the project the EVA tool protocol was applied to all surveillance design case studies (except for the multi-disease objective one) (Table 2) which had been selected by WP2-WP4 using a systematic selection process as described in RISKSUR Deliverables D2.7; D3.11; D4.15. All case studies were included, because they had been selected to cover relevant species, surveillance objectives, and transmission pathways and therefore covered a broad range of potential applications of an evaluation tool. Moreover, due to ongoing design assessments in WPs 2-4, there was good data availability and capacity and synergies could be used. Additional case studies were selected by WP5 to develop and apply the evaluation framework only (no design of risk-based approach), to increase the variety of surveillance contexts and to account for surveillance systems under challenging environments.

TABLE 2. LIST OF CASE STUDIES SELECTED FOR NOVEL SURVEILLANCE DESIGN WITHIN WP2, WP3 AND WP4 (DATA EXTRACTED FROM RISKSUR D2.7, D3.11, D4.15)

WP	Case study code	Hazard (species)	Surveillance objective
WP2.1	2.1	AI (poultry) UK	Early detection
WP2.2	2.2	BTV (small ruminants), Spain	Early detection
WP2.3	2.3	ASF (swine), Eastern Europe (Poland)	Early detection
WP3.1	3.1	CSF (wildlife), Germany	Freedom from disease
WP3.2	3.2	BTV (small ruminants), Germany	Freedom from disease
WP3.3	3.3	BHV-1 (cattle), Germany	Freedom from disease
WP4.1	4.1	Salmonella (swine and cattle), Sweden (SE)	Endemic disease case detection
WP4.2	4.2	PRRS, AD, CSF and SV (swine), NL (intensive pig production); SE (less intensive pig production	Endemic disease multi-objective surveillance

The objectives were to:

1) Further develop and test the EVA tool protocol and associated methods by applying them to practical case studies, this included testing of the effectiveness measure (D1.3) using case studies WP5.3 and WP5.4.
2) Run the case studies with the EVA decision tool to produce relevant evaluation protocol; and
3) Assess the relevance and feasibility of economic evaluation for each case study.

This report present the evaluation protocol produced by the application of the EVA decision tool and the relevance and feasibility of economic evaluation for each case study are presented in this report. Only a brief overview of the principle and structure of the EVA decision tool is presented in text Box 1. For more details on the EVA tool and the application of the evaluation framework please refer to deliverable 5.18 (Evaluation framework).

Text Box 1. EVA decision tool

The EVA decision tool is an integrated evaluation support (EVA) tool to facilitate the design of economic and epidemiologic evaluations of animal health surveillance systems. The EVA decision tool provides a simple step by step guidance and options to decide what should be measured and how this can be achieved to evaluate animal health surveillance systems.

- Step 0: Case study description / general overview
- Step 1: Defining the evaluation question
    - Users choose from the list of set questions or,
    - Complete the evaluation question pathway and then choose from the list of set questions
- Step 2 and Step 3: Selection of priority evaluation attributes and selection of the method(s) to assess the attribute(s)
    - Users are provided with a list of evaluation attributes and economic criteria most relevant to their specific surveillance context and decision making needs. Link to this list the users are asked to select the method they want (or can) use to measure the attributes based on the data and competencies available
    - The tool provides a final list of attributes which can be included in the evaluation along with the attributes that could be evaluated upon collection of additional data.

4 Case study selection for implementation of RISKSUR economic evaluation framework

The criteria defined for the selection of case studies for the economic evaluation were:

- **Inclusion of one case study for the key surveillance objectives** represented in RISKSUR: early detection (WP2), freedom from disease (WP3), case detection and prevalence estimation (WP4). Appropriate coverage of species and disease types considering the most important livestock production species surveyed in Europe as described in D 1.1, namely poultry, pigs and cattle and the most topical hazard types (according to the interests of policy makers and the scientific community), namely zoonosis, highly contagious animal disease, vector-borne disease
- **A easy access to data** and involvement of relevant authorities
- **Application of different economic evaluation criteria** as defined in the EVA tool
- **Comparison of conventional surveillance designs with novel** (modified) designs, giving priority (where applicable) to new risk-based surveillance design
- **Relevance to current policy issues** and potential for implementation of changes as proof of concept (i.e. of interest to decision makers and long term implementation potential).
- **Feasibility of the evaluation** in terms of local partnership and data availability and access; available human resources

All the surveillance design case studies were reviewed according to these criteria, based on EVA tool protocol reports (when available) and discussion with members of the RISKSUR consortium, a summary of this review is provided in Table 3.

TABLE 3. CHARACTERISTICS OF RISKSUR DESIGN CASE STUDIES CONSIDERED AS CASE STUDIES FOR THE ECONOMIC EVALUATION

Case study focus		2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2
Surveillance objective		Early detection	Early detection	Early detection	Freedom from disease	Freedom from disease	Freedom from disease	Endemic disease case detection	Several objectives
Surveillance context	Disease type	**AI**	**BTV**	**ASF**	**CSF**	**BTV**	**BHV**	**Salmonella**	**PRRS, AD, CSF, SV**
	Country	UK	Spain and Portugal	Germany, NL	Germany	Germany	Germany, NL	Sweden	Sweden, NL
	Species	Poultry	Domestic ruminants	Swine	Wild boars	Cattle, sheep, goats, wild ruminants	Cattle	Cattle	Swine
Evaluation question/interest	Economic evaluation Question	CEA, CBA	CEA	CBA	Least cost analysis	Least cost analysis	Least cost analysis	Least cost analysis	CEA
	Evaluation legal requirement	yes	yes	yes	yes	yes	yes	yes	yes
Risk-based		yes	yes	yes	yes	yes	yes	yes	yes
Data available	Flowchart	yes	yes	yes (Germany)	yes	yes	yes	yes	yes
	Action based information	yes	yes	yes	yes	yes	yes	yes	yes
	Cost data	yes	yes	yes (Germany)	yes	yes	yes	yes	yes
	Surveillance data available	yes, model* well advanced	Yes for some of the surveillance components	Model*	yes , model* well advanced	No	No	Not yet, but will be available	NA

*disease introduction and spread in the population simulation models

The eight case studies considered met the surveillance context selection criteria as they covered three surveillance objectives, the three different hazard types and key livestock species of interest. They also covered a sufficient range of economic evaluation questions (3/5).

For all case studies, evaluation was specified as a legal requirement and a risk-based design was considered as an alternative surveillance design.

Early detection of BTV in Spain and Portugal (WP2.2), BTV and BHV-1 surveillance to prove freedom in Germany were excluded, because of limited surveillance data availability. Further, multi-surveillance objective was excluded, because the current version of the EVA tool is directed at a single surveillance objective and additional development would be needed to adapt it to multi-objective surveillance.

Following this analysis, six case studies were selected for economic evaluation in year 3 of the project.

List of selected case studies

For comparative economic evaluation between current and novel design:

- Early detection of AI in poultry and wild birds in UK (2.1)
- Proving freedom from CSF in wild boars in Germany (3.1)
- Providing freedom from BT disease in cattle, sheep, goat and wild ruminants in Germany (3.2)
- Salmonella case detection in cattle in Sweden (4.1)

Additional case studies selected from WP5 case study list for evaluation of current design (including challenging situation)

- BVDV case detection in cattle in UK (5.4)
- HPAI case detection in poultry in Egypt (5.3)

Additional

- Additional potential case study: early detection of ASF in wild boars in Germany (2.3) (note: this case study is considered as a potential candidate but would require feasibility assessment to confirm its inclusion)

The selected case studies cover the three surveillance objectives, three domestic species plus wildlife and consider both highly infectious animal and zoonotic diseases. Moreover they address three different types of economic evaluation methodologies: least cost analysis, cost-effectiveness and cost-benefit analysis.

This selection of the RISKSUR surveillance design case studies (4.1; 3.1; 3.2 and 2.1) that would be used for the economic evaluation was agreed by the consortium during the 2nd annual meeting of the project (Deventer, October, 1-2).

5 Description of the economic evaluation case studies

The EVA decision tool provides a comprehensive report which includes specific details on the context of the surveillance system/components under evaluation along with the final list of the evaluation attributes and economic criteria to be included in the evaluation. Those reports are being provided below to present the 6 case studies select for economic evaluation under RISKSUR project.

5.1 WP2: Early detection of HPAI in wild birds in the UK

TABLE 5. ECONOMIC EVALUATION PROTOCOL FOR EARLY DETECTION OF HPAI IN WILD BIRDS IN THE UK

Date (start-end)	21 October 2014 – 14 January 2015	
Report filled in by (surveillance system expert or coordinator)	Lucy Snow, AHPA	V1: 21 October 2014 V2: 14 January 2014
Report reviewed by (Evaluation experts)	Marisa Peyre, Cirad Barbara Haesler, RVC	V1: 05 January 2015 V2: 28 January 2014
EVALUATION name	***AI UK***	
Characteristic	**Details**	
Case study description	The UK AI surveillance system currently consists of both active and passive surveillance components. The active component involves a serological survey in poultry carried out in accordance with EU specifications. The passive component is comprised of mandatory disease reporting under the scanning surveillance for new and emerging disease in poultry programme and the receipt of wild bird carcasses from the public and designated organisations. The aim of the current passive component is the early detection of notifiable H5 and H7 avian influenza in poultry. While in a general situation an incursion of HPAI will generate a report case, the situation of LP in galliformes (chickens and turkeys) and detection of HP in anseriformes (farmed ducks and geese) is less clear due to the less pronounced clinical presentation of disease in these populations. Due to the potential of LP to become HP in galliformes and the potential for silent spread in anseriformes it is important that the system achieves maximum sensitivity and in order to give the best chances of detecting an incursion early. This case study will therefore use the RISKSUR framework to redesign the current passive surveillance in poultry in order to increase the sensitivity of the passive system. The current and new enhanced passive system will be evaluated to see which performs better. Although the active surveillance component is an important part of the overall surveillance system modifications to it are outside the scope of this case study as is evaluation of the wild bird surveillance due to uncertainties and lack of data. Therefore the description below will focus solely on the passive surveillance/mandatory reporting of H5 and H7 in poultry.	
Hazard	H5/H7 avian influenza (both low and highly pathogenic)	
Target species	Domestic poultry	
Surveillance purpose	Early detection of H5 and H7 Avian influenza	
Study region	UK	
Hazard situation in this region	Absent	
Components	1 (Current): Passive surveillance, mandatory reporting of H5 and H7 in poultry 2. (New design): Enhanced passive surveillance using production monitoring	
Evaluation questions	While in a general situation an incursion of HPAI will generate a report case, the situation of LP in galliformes and detection of HP in anseriformes (farmed ducks and geese) is less clear due to the less pronounced clinical presentation of disease in these populations. Due to the potential of LP to become HP in galliformes and the potential for silent spread in anseriformes there is a need to enhance the sensitivity and timeliness of the passive surveillance in order to maximise the chances of detecting an incursion. And to compare and rank the cost effectiveness and cost-benefit of the 2 surveillance designs. 1. **Evaluation question** 4 (Assess if there is/are (a) surveillance component(s) or system(s) that achieve a higher effectiveness than another one at the same cost)- which option achieves the higher effectiveness target (in terms of sensitivity &	

Characteristic	Details
	timeliness) and at which cost.) 2. **Evaluation question 7.** Identify the surveillance system (out of two or more) that generates the biggest net benefit in monetary terms
Evaluation method(s)	**Assessment criteria**
Comparative effectiveness assessment towards a technical target Net-benefit assessment	Technical target = effectiveness Economic criteria = cost; benefits

Evaluation attribute selected (final list)	Rank	Assessment methods and tools	Data availability	Competence availability
SS organisatin	Highly relevant	System action model (adapted to SS evaluation within RISKSUR)	yes	yes
Sensitivity	1	CRC	to be reviewed	No
		Stochastic scenario tree modelling for novel design	Yes, although some data may be estimated or based on expert opinion	Yes
Timeliness	1	Analysis of the surveillance data Means, medians, and standard deviations	Most of the data required is available and no further collection needed	Yes
		Stochastic modelling for novel design	A simulation model for AI is under development - data needs: population data and data to parameterise model	Yes
Availability and sustainability	1	OASIS Questionnaires / Worksheets	no additional data collection other than filling in the questionnaire	Yes
Acceptability and engagement	1	OASIS Questionnaires / Worksheets	no additional data collection other than filling in the questionnaire	Yes
Benefit	1	Cost-benefit analyses	Yes but need more information on data requirement	No
Economic acceptability	1	Stated preference	Further data collection would be needed - outputs from model, costs?	No
Costs	1	Cost-estimation	Yes	Yes

Advantages of this case study	Much of the data needed is already available APHA has AI expertise and could provide expert opinion when additional data is required. Recent HPAI outbreaks in UK have generated additional recent data that could be used. Simulation model under development by APHA to provide some data to feed in to the evaluation. Interesting to evaluate cost of a passive component where resources are shared with other diseases.
Disadvantages of this case study	There may not be a strong risk based element, but the proposed design is innovative and worth pursuing.

5.2 WP3: Freedom from CSF in wild boar in one German federal state

TABLE 6. ECONOMIC EVALUATION PROTOCOL FOR FREEDOM FROM CSF IN WILD BOAR IN ONE GERMAN FEDERAL STATE (FINAL EVA REPORT)

Date (start-end)	16 October 2014	05 January 2015
Report filled in by (surveillance system expert or coordinator)	Birgit Schauer, FLI Katja Schults, FLI	V1: 16 October 2014 V2: 21 November 2014
Report reviewed by (Evaluation experts)	Marisa Peyre, CIRAD	V1: 19 November 2014 V2: 05 January 2015
EVALUATION name	***CSF Germany***	

Characteristic	**Details**
Case study description	The Federal State Rhineland-Palatinate (RP; Nuts code: DEB) is comprised of 24 districts and 12 municipalities, covering a total area of about 20,000 sq.km. In RP, CSF infection in wild boar has been detected in 1995 and between 1998 and 2009 with the two latest outbreaks occurring in two separate parts in the beginning of 2009. Since 2002, infection in the wild boar population was controlled in few parts of RP by means of oral immunization with vaccination baits. In May 2012, the state was officially declared free from CSF. The total cost was estimated as at least 9.6 Mio Euro for vaccination baits alone and 22 Mio. Euro for the eradication program in RP in total. Following the southern outbreak in RP ("Pfalz") in 2009, the area was classified into a CSF endangered area (3 districts partly covered; 660 sq.km) surrounded by an intensive surveillance area (12 districts; 2378 sq.km). In the remaining districts, general monitoring was carried out using the 59 sample size requirement, based on a 5% design prevalence and 95% confidence. The number and location of origin of tested wild boars, the size and composition of the hunting bag (piglets, 1-2 year olds and adults) and the geographical features are known. The population density of wild boar has traditionally been estimated based on the size of the hunting bag.
Hazard	Classical swine fever
Target species	Wild boar
Surveillance purpose	Demonstrate freedom from disease in an officially free region
Study region	One federal state in Germany (Rhineland-Palatinate; RP; Nuts code: DEB): 36 districts covering a total area of about 20,000 sq.km
Hazard situation in this region	• 1995 and 1998-2009: Several CSF outbreaks in wild boar (two last outbreaks early 2009) • 2002 until 2012: Oral immunization in some parts of RP • May 2012: Declaration of freedom
Components	• Active surveillance (testing of hunted wild boar) • Passive surveillance (testing of wild boar found sick, dead or involved in accidents)
Evaluation questions	Decision makers would like to know 1. How the risk-based approach compares to the conventional approach **Evaluation question No. 3 (current surveillance): Assess the effectiveness of one or more surveillance component(s) or system(s) in relation to a surveillance objective and rank the options accordingly**: how the probability of detecting a simulated infection varies across one year and between areas based on testing 59 wild boars per district according to the EU requirement of detecting a 5% seroprevalence and 95% confidence 2. What difference it makes to the sample numbers when serological testing is not feasible anymore due to the use of non-marker vaccines: **Evaluation question No.** 4 **(Assess if there is/are (a) surveillance component(s) or system(s) that achieve a higher effectiveness than another one at the same cost)** : the difference in the probability of detection and subsequently cost of the surveillance systems for different surveillance

Characteristic	Details			
	approaches, a) exhaustive (testing 100% of the hunting bag), b) current (59 wild boars per district per year) and c) risk-based sampling strategies to detect a seroprevalence of 5% with 95% confidence			
Components under evaluation	**Active surveillance in wild boars:** 1. current design (59 wild boars per district per year) 2. Risk-based design (59 wild boars per at risk district per year) 3. Exhaustive (testing 100% of hunting bags)			
Evaluation method(s)	**Assessment criteria**			
Cost-effectiveness analysis	Technical target= effectiveness Economic criteria= cost-effectiveness ratio			
Evaluation attribute selected (final list	**Relevance**	**Assessment methods and tools**	**Data availability**	**Competence availability**
SS organisation	Highly relevant	System action model (adapted to SS evaluation within RISKSUR)	yes	yes
Sensitivity (detection probability)	Highly relevant	Simulation model	Yes	Yes
Risk criteria selection	Highly relevant	EVARisk (method developed within RISKSUR)	Yes	Yes
Acceptability and engagement	Highly relevant	Participatory assessment	No, to be collected	Yes
Cost	Highly relevant	OASIS cost analysis module	No, to be collected	Yes
Multiple utility	Relevant	Not available	*NA*	*NA*
Robustness	Relevant	Simulation model	Yes	Yes
Availability and sustainability	Relevant	Qualitative: OASIS tool	Yes	Yes
Simplicity	Relevant	Qualitative: OASIS tool	Yes	Yes
Advantages of this case study	Data include testing data for 100% of the hunting bag (CSF infected area); therefore the distribution in time and space of the hunting bag is exactly known			
Disadvantages of this case study	Only animal level risk factors are age and gender; but in addition • Temporal and spatial risk • Contribution by surveillance components (active and passive surveillance) • Calculations possible for consecutive surveys Cost information is difficult to retrieve; however, not many costs are considered relevant for this case study			

5.3 WP3: Freedom from BTV in cattle, sheep, goat and wild ruminants in Germany

TABLE 7. ECONOMIC EVALUATION PROTOCOL FOR FREEDOM FROM BTV IN CATTLE, SHEEP, GOAT AND WILD RUMINANTS IN GERMANY (FINAL EVA REPORT)

Date (start-end)	19 November 2014	05 January 2015
Report filled in by (surveillance system expert or coordinator)	Birgit Shauer, FLI	V1: 19 November 2014
Report validated by	Marisa Peyre, Cirad	V1: 05 January 2015

(Evaluation experts)		
EVALUATION name	***BTV Germany***	
Characteristic	**Details**	
Case study description	Bluetongue virus (BTV) is vector-borne infectious disease, which is transmitted by Culicoides biting midges spp. The disease affects domestic and wild ruminants, but is non-contagious. Twenty-four serotypes exist, six of which have been present in 2013-2014 in the EU (BTV 1, 2, 4, 8, 9 and 16). Each serotype has different dynamics, host preferences and virulence characteristics. The European BTV-8 strain caused disease in sheep (death, weight loss, congenital disorders, disruption in wool growth) and remarkably also in cattle (especially abortion, stillbirth, congenital abnormalities), which for most other strains do not show clinical symptoms (Dal Pozzo et al. 2009). Since BTV is an OIE listed disease, trade restrictions cause additional economic losses to affected countries. BTV8 was first detected in Germany on 21 August 2006, almost simultaneously to outbreaks in Belgium and the Netherlands. By 2008, the disease was widespread in Central Europe, and a compulsory, large scale mass vaccination was initiated in Germany in May 2008. Vaccination remained compulsory in 2009 and was voluntary thereafter. In Germany, the cost for vaccination alone was estimated as 45.5 million in 2008 and 16.5 million Euro in 2009 (Baetza 2014). Since regulation 1266/2007 provides the option to apply output-based standards and risk-based designs, the German Federal Ministry of Food and Agriculture (BMEL) has asked the FLI to compare the conventional surveillance system to demonstrate freedom from Bluetongue virus serotype 8 (BTV-8) with potential alternative strategies in terms of efficiency and cost. The current surveillance system includes active laboratory-based and passive, clinical surveillance in each susceptible species (cattle, sheep, goats, wildlife). The active component is designed to demonstrate absence of BTV8 in an officially free region (Annex I, point 3 of 1266/2007). The geographical unit of reference is defined as a grid of 45 km x 45 km (~2000 km2). However, in Germany the NUTS3 area was chosen as geographical unit. Surveillance is designed to detect a 20% prevalence and 95% confidence per geographical unit (Annex I of Regulation No. 1266/2007). It is possible to choose the testing method (serology or virology) and sampling method (random or risk-based sampling). The passive component aims at detecting possible incursions of bluetongue virus.	
Hazard	Bluetongue virus serotype 8	
Target species	Cattle, sheep, goats, wild ruminant	
Surveillance purpose	Demonstrate freedom from disease in an officially free region	
Study region	Germany	
Hazard situation in this region	• August 2006: BTV8 was first detected in Germany • May 2008-2009: mass compulsory vaccination in Germany • From 2009: volunteer vaccination	
Components	• Passive surveillance surveillance in o Domestic (cattle, sheep and goats) and o Wild ruminants • Active surveillance in o Cattle o Sheep o Goats • Wild ruminants	
Evaluation questions	The German Federal Ministry of Food and Agriculture wants to: 1. Compare the effectiveness of the current and alternative systems 2. Find the least cost solution whilst achieving the same effectiveness This case study shall be used to determine a) the probability of detection based on the current sampling strategy (14 animals per geographical unit) **Evaluation question No. 3** (current surveillance): Assess the effectiveness of one or more surveillance component(s) or system(s) in relation to a surveillance objective and rank the options accordingly b) the difference in the probability of detection and subsequently cost of the surveillance systems for different surveillance approaches, a) random and b) risk-based sampling strategies to detect a prevalence of 20% with 95% confidence	

Characteristic	Details			
	Evaluation question No. 2 (comparison with alternatives): Assess the costs of surveillance component(s) or system(s) that achieve(s) a defined objective (5% prevalence and 95% confidence) and rank them according to costs to identify the least-cost option			
Components under evaluation	The six components will be considered			
Evaluation method(s)	**Assessment criteria**			
Least cost analysis	Technical target= effectiveness Economic criteria= cost-effectiveness			
Evaluation attribute selected (final list)	**Rank**	**Assessment methods and tools**	**Data availability**	**Competence availability**
SS organization process	1	OASIS or SERVAL	yes	yes
Sensitivity (detection probability)	1	Simulation model	Yes	Yes
Risk criteria selection	1	EVARisk (method developed within RISKSUR)	Yes	Yes
Robustness	2	Simulation model	Yes	Yes
Availability and sustainability	2	Qualitative: OASIS tool	Yes	Yes
Acceptability and engagement	2	Participatory assessment	No, to be collected	Yes
Simplicity	2	Qualitative: OASIS tool	Yes	Yes
Cost	1	Cost calculation spread-sheet	No to be estimated, simple information to be collected	Yes
Advantages of this case study	This case study will allow to test the RISKSUR EVA framework with a vector born disease example			
Disadvantages of this case study	Some of the surveillance data might be difficult to access			

5.4 WP4: Case finding of Salmonella Dublin in Cattle in Sweden

TABLE 8. ECONOMIC EVALUATION PROTOCOL FOR CASE FINDINGS OF SALMONELLA DUBLIN IN CATTLE IN SWEDEN (FINAL EVA REPORT)

Date	October 2014	
Report filled in by (surveillance system expert or coordinator)	SVA	V1 October 2014
Report reviewed by (Evaluation expert)	Marisa Peyre, Cirad; Barbara Haesler, RVC	V1 January 2015 V2 January 2015
EVALUATION name	***Salmonella Sweden***	
Characteristic	**Details**	
Case study description	The Swedish control of Salmonella is based on surveillance along the entire food chain, from feed to food including also humans, and on actions taken if Salmonella is detected. The current regime for surveillance and control of Salmonella among cattle herds is based on sampling in case of clinical suspicions, at post-mortems when Salmonella can be suspected, and at slaughter under special conditions (e.g. sanitary slaughter). As a specific EU requirement to provide evidence of the very low salmonella prevalence, other surveillance components are in place: sampling of lymph nodes at the abattoir, carcass swabs and sampling at cutting plants. Any finding of salmonella in feed, animals or food is notifiable in Sweden and any veterinarian is	

	obliged to take actions to verify the suspected case and to prevent further spread. Positive findings (from any surveillance component except carcass swabbing and sampling at cutting plants) are followed by trace back and trace forward in the chain from feed/environment to food. Herds confirmed to be infected are put under restrictions and live animal movements are prohibited. Measures to improve the hygiene, cleaning and disinfection of the holdings and elimination of chronically infected animals (when relevant) are used to eradicate the infection from a herd. Two consecutive whole-herd samplings with negative results are required to consider a herd free from infection and lift the restrictions. The current regime for surveillance and control of Salmonella among cattle herds is expensive, both for the state and for the farmer. Furthermore, the sensitivity of the surveillance system has decreased with the reduction of the number of cattle slaughtered under special conditions. In addition, recent studies have revealed that a significant proportion of infected herds are not detected by the current surveillance strategy. For these reasons, the Swedish Board of Agriculture wanted to evaluate whether the sensitivity and the coverage of the surveillance can be improved and whether a reduction of costs is feasible without increasing the risk for humans. The newly proposed surveillance strategy involves a component of bulk milk sampling of all dairy herds every quarter of a year, as already in place in other countries (e.g. Denmark). In case of a positive serological finding, further investigations and a newly developed control regime, expected to be more cost effective, will be implemented. The strategies for surveillance and control for other types of cattle herds are also under revision. The currently proposed strategy for bulk milk sampling is the same for all dairy herds. It would be interesting to investigate whether a risk-based sampling approach would increase the sensitivity of the system or at least provide the same performance but at a lower cost.			
Hazard	Salmonella Dublin			
Target species	Dairy cattle			
Surveillance purpose	• Detect cases to allow further actions to control the infection/contamination (components a, b, f) • Prevalence estimate (components c, d, e)			
Study region	Sweden			
Hazard situation in this region	Endemic			
Components	a. mandatory sampling of clinically suspected cases b. sampling at necropsy of suspected cases c. lymph node sampling at abattoir d. carcass swabs at abattoir e. meat/environmental samples collection at cutting plants f. bulk milk testing (to be put in place)			
Evaluation questions	It is in the interest of both decision makers and surveillance designers: 3. To find the least cost option assuring the same effectiveness: **Evaluation Question n° 2**. Assess the costs of surveillance component(s) or system(s) (out of two or more) that achieve(s) a defined objective and rank them according to costs to identify the least-cost option(s) 4. To find the more effective option within a fixed budget. **Evaluation Question n° 4**. Assess if there is/ are (a) surveillance component(s) or system(s) that achieve a higher effectiveness than another one at the same cost			
Components under evaluation	**New active surveillance component** 1. bulk milk testing random sampling **2.** bulk milk testing risk-based sampling			
Evaluation method(s)	**Assessment criteria**			
Least-cost analysis	Technical target= effectiveness Economic criteria= least cost			
Evaluation attribute selected (final list)	**Rank**	**Assessment methods and tools**	**Data availability**	**Competence availability**

SS organisation	Highly relevant	System action model (adapted to SS evaluation within RISKSUR)	yes	yes
Sensitivity, Bias	Highly relevant	CRC to estimate the number of infected holdings which are not detected by any of the surveillance methods under consideration	Yes, simulation data for novel design Data from different, partially overlapping and preferably, independent surveillance components	Yes?
Timeliness	Highly relevant	Analysis of the surveillance data to determine median days for disease identification and reporting process	Yes, if simulated data can be applied; No, otherwise Historical data (dates of disease identification and reporting process).	Yes.
Risk criteria selection	Highly relevant	EVARisk (method developed within RISKSUR)	Yes	Yes
Detection fraction	Highly relevant	Case finding capacity	No, data collection possible Stratum-specific sensitivity and coverage	Yes
Acceptability and engagement	Highly relevant	OASIS for the evaluation of animal health surveillance system/process	Yes	Yes
Cost	Highly relevant	cost analysis	Only direct costs of the different surveillance modalities	Yes
Advantages of this case study	This case study has highlighted the need to consider an additional evaluation attribute: detection fraction			
Disadvantages of this case study	None			

5.5 WP4: Case finding of BVDV in cattle in UK

TABLE 9. ECONOMIC EVALUATION PROTOCOL FOR CASE FINDINGS OF BVDV IN CATTLE IN UK (FINAL EVA REPORT)

Date (start-end)	November 2014	January 2015
Report filled in by (surveillance system expert or coordinator)	Betty Bisdorff, RVC	V1: November 2014 V2: February 2015
Report reviewed by (Evaluation experts)	Marisa Peyre, Cirad Barbara Haesler, RVC	V1: January 2015 V2: March 2015
EVALUATION name	***BVDV UK***	
Characteristic	**Details**	
Case study description	Bovine viral diarrhea virus (BVDV) is a non-notifiable endemic disease of cattle in England with significant economic impact. There is therefore a need for wider control within the decision-making process for BVDV elimination. One important element in the decision-making process, apart from benefits and costs of potential control options, is the design of surveillance in a wider sense, an aspect which has been neglected over the past years. In the last 10 years, 5 regional and 5 laboratory managed schemes have been set up. In these schemes, farmers can have their herds tested for BVDV. Unfortunately, data are not being centrally stored and results seem difficult to obtain. Therefore, at present it is not possible to establish a current national prevalence, figures currently used by decision-makers date back to 1998 (Paton et al., 1998). That study showed that for the prevalence of BVDV antibody-positive herds in the national population was estimated at 95 per cent and approximately 65 per cent of the herds had a high level of bulk tank antibody suggestive of recent infection. Albeit, some of the national control schemes are funded by the same bodies, to date there has been little coordination or centralisation between the various schemes leading to a patchy picture of the BVDV situation in England and as a consequence it is difficult to set up an efficient control strategy.	

Characteristic	Details
Hazard	Bovine viral diarrhoea virus (BVDV)
Target species	Cattle
Surveillance purpose	To allow the level of the hazard to be managed or detected or currently present To provide evidence or prompt further investigation to inform the requirement for risk mitigation
Study region	England
Legal basis	No national legal basis
Hazard situation in this region	Endemic
Components	Surveys and voluntary testing as part of schemes
Current issues	No coordinated surveillance (no centralised data collection, no cooperation)
Evaluation questions	To enable and enhance efficient use of resources for surveillance and intervention. To determine which of alternative approaches achieves target effectiveness at least cost **Evaluation question (4): which option achieve the higher effectiveness target (either in terms of sensitivity or timeliness) at the same costs**
Components under evaluation	Surveys and voluntary testing as part of schemes
Evaluation method(s)	**Assessment criteria**
Comparison of cost effectiveness assessments towards a technical target Least cost	Technical target= effectiveness Economic criteria= least cost

Evaluation attribute selected (final list)	Relevance	Assessment methods and tools, data needs	Data availability	Competence availability
SS organisation	Highly relevant	System action model (adapted to SS evaluation within RISKSUR)	yes	yes
Sensitivity	Highly relevant	CRC, number of cases detected by different schemes	Yes	yes
Bias (= accuracy)	Highly relevant	Stochastic modelling, survey results from the different schemes	Probable	yes
False alarm rate	Highly relevant	Evaluation the number of cases prevented by each detection method	Probable	yes
Representativeness	Highly relevant	Spatial evaluation, distribution of holdings in region versus those sampled	Probable	yes
Coverage	Highly relevant	Sample coverage, number of cases included from surveys ie total number that participated, and how they were recruited	Yes	yes
Costs	Highly relevant	Costs linked to setting up the surveillance system, if this cost will not be provided we will work with the diagnosis tests costs.	Yes	yes
Advantages of this case study	**The data are available. Decision makers are interested in the outputs of this evaluation**. It would be interesting to look at this surveillance from a centralized point of view to provide recommendation future BVD eradication strategies in UK. The national BVD strategy under design could benefit from the finding of this study.			

Disadvantages of this case study	**Costing data might not all be available**. If the overall costs of setting up each a scheme cannot be estimated, we could reduce it to the costs of the diagnosis tests. **This case study relies on the acceptability of the data provider to share and participate in the study**.

5.6 WP4: Measuring prevalence of HPAI in Egypt

TABLE 10. ECONOMIC EVALUATION PROTOCOL FOR MEASURING PREVALENCE OF HPAI IN EGYPT (FINAL EVA REPORT)

Date (start-end)	16 October 2014	05 January 2015
Report filled in by (surveillance system expert or coordinator)	Marisa Peyre	V1: 16 October 2014 V2: 21 November 2014
Report reviewed by (Evaluation experts)	Marisa Peyre	V1: 19 November 2014 V2: 05 January 2015
EVALUATION name	***HPAI Egypt***	

Characteristic	**Details**
Case study description	Egypt reported its first occurrence of highly pathogenic avian influenza (HPAI) virus subtype H5N1 in poultry on February 16, 2006, and its first case in a human on March 20, 2006. As of June 2011, Egypt was the country most affected by HPAI (H5N1) outside of Asia. Vaccination of domestic (backyard) and commercial poultry, which began in March 2006, and other measures were implemented to control the disease, but outbreaks among poultry and humans continued to be regularly reported from various districts located mainly in the delta region of the country. In July 2009, vaccination of domestic poultry was stopped. GOVs in collaboration with FAO have implemented 2 active surveillance components along with passive surveillance: active sampling of animals in risk based area and community animal health outreach which is a participatory based surveillance approach. GOVs and FAO are interested to know the relative efficacy of each of the surveillance components to discuss their sustainability.
Hazard	Highly Pathogenic Avian Influenza (HPAI) H5N1
Target species	Domestic poultry
Surveillance purpose	Measuring prevalence
Study region	Nationwide
Hazard situation in this region	• 2006: first introduction • 2007-2015: endemic
Components	• Active participatory surveillance (Community Animal Health Outreach, CAHO)) • Passive surveillance (voluntary reporting of poultry cases) • Active sampling in at-risk areas • Active Investigation of human cases
Evaluation questions	Decision makers would like to compare the effectiveness of the different active surveillance components: Evaluation question : **EVA Q3. Assess the effectiveness of 2 or more surveillance component(s) or system(s) in relation to a surveillance objective and rank the options accordingly**
Components under evaluation	1. Active participatory surveillance (Community Animal Health Outreach, CAHO)) 2. Passive surveillance (voluntary reporting of poultry cases) **3.** Active Investigation of human cases
Evaluation method(s)	**Assessment criteria**
Cost-effectiveness analysis	Technical target= effectiveness Economic criteria= cost-effectiveness ratio

Evaluation attribute	**Relevance***	**Assessment methods and tools**	**Data availability**	**Competence**

selected				availability
SS organisation	Highly relevant	System action model (adapted to SS evaluation within RISKSUR)	yes	yes
Sensitivity and/or Detection fraction **Precision and bias**	Highly relevant	Capture Recapture method	Yes	Yes
Risk criteria selection	Highly relevant	EVARisk (method developed within RISKSUR)	Yes	Yes
Acceptability and engagement	Highly relevant	Participatory assessment	No, would need to be collected	Yes
Multiple utility	Relevant	Not available	*NA*	*NA*
Availability and sustainability	Relevant	Qualitative: OASIS tool	Yes	Yes
Simplicity	Relevant	Qualitative: OASIS tool	Yes	Yes
Advantages of this case study	This case study will allow us to test the evaluation tool under challenging situation (uncertainty in the quality of the data provided by the SS). Strong partnership of Cirad with local FAO-ECTAD Egypt and local institutions in Egypt ensures access to the relevant data. The DMs (GOVs) are interested in ensuring efficacy of the surveillance to ensure its sustainability. FAO would like to prove the added value of CAHO component.			
Disadvantages of this case study	None			

**it is recommended to assess all the attributes considered as "highly relevant" attributes*

6 Conclusion

This report describes how the different case studies used to develop and test the evaluation tools developed in the RISKSUR project were selected and the selection of case studies to be used for application of the epidemiological and economic evaluation tools. Further information about the development of the RISKSUR EVA tool will be provided in D5.18, a comparative economic evaluation of different surveillance designs in D5.22 and the complete validation of the analysis framework for the economic analysis of surveillance in D5.23.

7 References

RISKSUR D1.4, D2.7; D3.11; D4.15