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APPLICATIONS OF PRINCIPLES TO CASE STUDIES FOCUSING ON NON-MONETARY SURVEILLANCE VALUES

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ABSTRACT

A central aspect of economic evaluations of surveillance components or systems is to estimate the value of the information that is being generated by surveillance. Importantly, the value of information is determined by the user of the information. This value is often realised through decisions on interventions that are implemented to manage disease in populations with the associated reduction of disease costs in human and animal populations including effects on the wider society. The economic efficiency of such processes can be measured within a single sector or across sectors (e.g. animal health surveillance creating benefits streams in human populations) applying standard economic evaluation techniques. Depending on the context, people may have different demands and uses for information expressed in distinct information-

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seeking behaviour and willingness to pay for information or knowledge. Hence, private and public stakeholders may attribute different values to surveillance depending on their decision needs. Moreover, cultural and socio-economic factors shape not only the value of surveillance, but also people's decisions around their livelihoods, income generation, prevention, and disease management strategies. Therefore it is important to understand behaviours, processes, motives, and justifications around health management and surveillance. A range of case studies are presented that describe wider benefits of surveillance and illustrate how non-monetary benefits can be assessed using stated preference elicitation methods, such as discrete choice experiment. Moreover, they demonstrate how understanding of local value systems and contexts allows appraising wider surveillance attributes that ultimately affect the performance and economic efficiency of surveillance.

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6.1. Introduction

6.1.1. OVERVIEW

This chapter starts with examples of economic efficiency[1] studies conducted in surveillance and then explores in more detail the challenge of capturing non-market values of surveillance using four case studies. Each case study is self-contained and includes a description of the context, rationale, and research question; an explanation of the methods used; a summary of the key findings; and a short discussion.

6.1.2. EXAMPLES OF ECONOMIC EFFICIENCY STUDIES

The theoretical framework outlined in Chapter 5 provides the foundation for the economic evaluation of surveillance. Several published studies provide evidence of its validity. These studies assess the economic efficiency of surveillance with different methodologies taking into account the relationship of surveillance with intervention and mitigation.

Three levels of criteria for economic efficiency can be described: (1) the leading criterion is optimisation, which defines how the net benefit accruing to society from allocating scarce resources to disease mitigation is maximised; (2) the acceptability criterion concerns whether the benefits stemming from a mitigation policy at least cover its costs, thus making a strategy justifiable from an economic point of view; and (3) the cost-minimisation criterion applies when achieving a technical target for mitigation without quantification of the benefit is the policy objective [1].

In studies striving for *optimal economic efficiency*, the net benefit is maximised or, in other words, resources for surveillance are used in an optimal combination that balances the losses caused by the disease and the expenditures needed for its mitigation [2]. This approach was, for example, used by Kompas *et al.* [3], who identified the optimal level of surveillance activity against a disease incursion and spread by minimising the present value of the major direct and indirect costs of the disease, as well as the costs of the surveillance and disease management and eradication programmes. A similar approach was chosen by Guo *et al.* [4], who kept the intervention fixed (based on the assumption that the intervention and its implementation would be perfect) and used combined simulation and multi-criteria decision models to identify technically and economically efficient surveillance set-ups. However, optimisation approaches for surveillance evaluation are still scarce; more often found are cost–benefit, and cost-effectiveness analyses [5].

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[1] Economic efficiency is interested in using resources in a way that maximises a defined objective relevant to the economic unit under consideration, such as farm, sector, or national level. For example, if national welfare is to be maximised, economic efficiency aims at combining resources in a way to achieve this objective.

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In cost–benefit analysis, the *economic acceptability* is assessed by estimating whether the benefits outweigh the costs of a new strategy or policy compared to the status quo (i.e. the baseline). All surveillance and intervention resources and all benefits of mitigating disease effects must be expressed in monetary units (see Howe, Chap. 5). These costs and benefits of surveillance and intervention, direct and indirect, including market and nonmarket values, are then compared in order to find out if a strategy generates a positive net value (i.e. whether the benefits are larger than the costs). Because the impact of surveillance cannot be measured directly as a mitigation outcome, it is only possible to quantify the loss avoidance resulting from the combination of surveillance and intervention, and to compare it to the expenditure for surveillance and intervention. An illustration of this concept can be found, for example, in Häsler *et al.* [6], where the elimination programme for bovine virus diarrhoea in Switzerland is used to estimate a residual margin over the intervention cost, which constitutes the maximum additional expenditure potentially available for surveillance without the net overall benefit from mitigation becoming zero. This margin can then be compared to the expenditures of various surveillance options. Other cost–benefit analyses of surveillance have, for example, used combined economic–epidemiological simulation models to estimate the positive and negative monetary effects of distinct combinations of surveillance and intervention actions. An application of this concept with explicit costing of zoonotic effects in the human population was presented by Babo Martins [7] for the case of West-Nile virus in Italy where the benefits of the programme were calculated as the avoided costs of hospitalisation and avoided compensation for transfusion-associated disease of human cases. Another example is Tambi et al [8], who used combined epidemiological and economic modelling of rinderpest in Ethiopia to compare the likely costs and benefits of an epidemio-surveillance system with those of other options (including no intervention) in an *ex ante* (i.e. prospective) analysis. The epidemiological part focused on a state-transition SEIR ('susceptible', 'exposed', 'infectious', 'recovered') disease transmission model. The economic part was a social cost–benefit analysis model that focused on welfare changes to consumers and producers in an economic surplus analysis assuming productivity gains related to disease eradication. In studies focusing on cost-effectiveness, the aim is also to assess *economic acceptability* by comparing the costs of surveillance resources with performance (effectiveness) targets, which may be considered a proxy for an outcome of benefit (e.g. timeliness or sensitivity). However, a cost-effectiveness analysis can inform resource allocation meaningfully only if its effectiveness measure has an interpretable value [5]. For example, it should be known what the economic value is (expressed in monetary terms) of a higher probability of disease detection to be able to make a decision on expenditures for surveillance. It is not uncommon for cost-effectiveness studies of surveillance to report the costs of surveillance options in comparison to performance targets and report, for example, results such as the 'costs per percentage increase in probability of detection' or the 'costs per day of earlier detection' without providing an estimate of the economic value of these outcomes. In these cases, it is left to the decision-makers to interpret the effectiveness measure and consider its (economic) consequences or in other words to address the question whether the investment needed for the change in effectiveness is economically worthwhile (i.e. is it worth it?).

When a specified surveillance target (and its value) is accepted as a given, often a *least-cost analysis* is used to identify the cheapest option among different possible options that produce the same outcome. In this type of analysis, the financial cost of the option is the dominant

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determining factor; the outcome or value of the outcome is fixed. This is, for example, the case for surveillance where the design including species, sample type, and sampling frequency is stipulated by national or international legislation. In these cases, the surveillance planner does not have flexibility with the design, but can only think about ways of implementing the required plan in the cheapest way possible.

Box 6.1 Economic Analysis (SurvTools— Peyre et al. [9]—https://survtools.org/)
Economic analysis of surveillance components or systems is an aid to decision-making as it informs the allocation of resources to surveillance. It shows the consequences of resource use for different surveillance options and helps to identify which of these is to be preferred from an economic point of view. A unifying underlying principle is to provide a measure of the relative value attached to competing alternative strategies and thereby make judgements on the economic efficiency. Various economic analysis methods are available with corresponding criteria for decision-making (e.g. least-cost analysis; cost-effectiveness; cost–benefit). They all depend on valuation of the inputs and consequences or effects, both of monetary and non-monetary nature. A breadth of valuation techniques exist; some of them are illustrated in this chapter.

6.1.3. THE CHALLENGE OF CAPTURING NON-MARKET VALUES

It is widely acknowledged that surveillance produces values that go beyond tangible loss avoidance in animal and human populations or wider tangible effects on society, such as loss of tourism in the case of a disease outbreak (see Text Box Chap. 5). These zoonotic and wider externality effects are included in the extended loss function $L = A + Z + E$ (see Howe, Chap. 5).

There are dimensions to the value of surveillance that so far have been explored only marginally. Surveillance has been described to generate intellectual and social capital, technical reassurance and feelings of safety, capacity, contentment, and 'peace of mind' [5, 7]. As mentioned above 'People's personal relationships, social network support, civic engagement and trust, and co-operative norms, are all factors critical to ensuring the technical efficiency frontier and disease mitigation surface can be reached'. In other words, the information generated by surveillance can be heavily influenced by the context within which it occurs and the private actors in the system who make decisions on surveillance activities (e.g. disease reporting) and the use of the surveillance information for disease prevention practices and production strategies. For example, Figuié et al [10] documented informal animal health surveillance networks in Thailand and Vietnam that operate outside conventional surveillance systems as collective action groups that are united by shared values and interests. Depending on the context, the need for public authority-driven surveillance may be an abstract notion to the private actor with limited usefulness and consequently variable compliance. Moreover, there are costs and benefits that are not immediately obvious and consequently difficult to capture (e.g. the social and cultural importance attributed to cockfighting, see below).

Over the past years, progress has been made to identify and measure non-market values of surveillance using either surveys or qualitative approaches (see Part IV – Qualitative Evaluation Approaches). Babo Martins [7] used qualitative interviews with animal and public health policymakers, advisors, and scientists involved in policy design and implementation of

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zoonoses surveillance to explore the benefits of One Health surveillance. Examples in animal health include choice experiments in the UK to assess the UK farmers' willingness to pay for bovine tuberculosis vaccines [11], consumers' willingness to pay for different *Salmonella* infection control methods in pork [12], farmers' willingness to pay for sanitary information at different geographical levels in Corsica [13], and farmers' willingness to report swine diseases in Vietnam [14]. In this chapter, the use of qualitative research methods and stated preference methods is presented to illustrate the potential of their use in surveillance and capture wider perceived benefits that, on the one hand, provide important information for decisions on investments into surveillance and, on the other hand, allow gaining insights into perceptions that influence the behaviour of private actors and consequently the success or failure of mitigation programmes.

6.2. Case Study 1: Evaluation of Costs and Benefits of Passive Surveillance Through Qualitative Surveys: Results of Surveys Conducted in Vietnam and Thailand

6.2.1. INTRODUCTION

Surveillance systems are implemented to produce epidemiological information aimed at informing the planning and implementation of appropriate disease control measures [15]. In the case of passive surveillance, the supply of epidemiological information to government stakeholders is under the control of primary information holders, that is, livestock producers or other actors of animal production systems. It makes the economic evaluation of passive surveillance systems particularly complicated as the expected upward flow of epidemiological information is the result of decentralised choices operated by private actors.

Evaluators of passive surveillance need to identify the costs and benefits perceived by primary information holders as they can substantially depart from societal costs and benefits considered by government planners. Surveys implemented to collect such data are faced with three major issues. First, compliance of private actors to government rules is, by nature, a sensitive issue involving a moral judgement (reporting disease suspicions might be perceived as the right attitude from the society's standpoint) and, as such, questions on disease reporting are vulnerable to obsequiousness bias: interviewees are likely to tell the answer which they feel is expected by the interviewer rather than the truth. Second, passive surveillance can be an abstract notion that does not necessarily make sense as a whole to the viewpoint of private actors: they may be aware of the legal obligation of reporting some specific health events to authorities, but they might not perceive the purpose of the surveillance system and its practical effects (better knowledge of the epidemiological situation of the disease and more efficient implementation of control measures). Finally, perceived costs and benefits are potentially diverse and complex and may vary according to the socio-economic context and the livestock production systems. Standardised data collection (e.g. through questionnaire surveys) are

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difficult to implement without preliminary knowledge of the nature costs and benefits under study.

In consequence, perceived costs and benefits are best addressed through qualitative surveys based on semi-structured interview techniques [16]. Investigators use a checklist of themes to address during interviews but they conduct it like a discussion, using open questions and letting participants talk as much as possible about their opinions, perceptions, and daily practices related to livestock diseases and sanitary information management (see Part IV— Qualitative Evaluation Approaches). Interviewers can use probing questions or interactive tools to encourage participants to think deeper on some aspects of the discussion. They also can use interactive tools like ranking, proportional piling, or matrix scoring to build lists of items (e.g. disease names, list of actors with whom information is exchanged) and rank them according to specific criteria [16]. If necessary, interviews may need to be repeated in order to enhance progressively the confidence of participants. Primary information holders are livestock farmers, but other types of information holders (e.g. slaughterers, feed sellers) can be identified during surveys. Therefore, an adapted snowball sampling method is most appropriate [17].

The interest of these methods is illustrated by a case study on the passive surveillance of Highly Pathogenic Avian Influenza (HPAI) Surveillance in Vietnam [18] and Thailand [19]. Vietnam and Thailand have very different poultry production industries. Poultry products in Thailand are mostly supplied by a limited number of integrated settings of high biosecurity standards managed by private agro-industrial companies [20]. Nevertheless, backyard chicken farming, specialised in native chicken breeds, is still widely practised by rural households for home consumption of chickens, sale of chicken meat, and cockfighting. The survey focused on these backyard native chicken farmers. In Vietnam, on the other hand, most poultry are produced in backyard or small-scale commercial farms with limited investments in biosecurity. The survey focused on households keeping backyard poultry as well as commercial poultry farms of varying size (from 100 to 10,000 birds per production cycle).

6.2.2. MATERIALS AND METHODS

The data collection method is explained in details in [18, 19]; a summary is provided here.

Study areas were subdistricts of Hải Dương (HD) province (North Vietnam), Đồng Nai (DN) and Long An (LA) province (South Vietnam), and Sukhothai (SK) province (North Thailand).

6.2.2.1. PARTICIPATORY APPROACHES AND SNOWBALL SAMPLING METHOD

The sampling strategy followed a snowball sampling pattern. First, several group interviews of poultry farmers were performed in each study area. Participants were contacted with the help of local authorities. Five to twenty poultry farmers were interviewed at once. Each group interview gathered farmers from the same production system and production scale, and one or several group interviews were conducted for each production system. Poultry farmers who displayed willingness to participate in the study were then asked for individual interviews. The number of these individual interviews was determined by adapting the concept of saturation to the objective of the study [21]: saturation was considered to be reached when 10 additional interviews did not provide any new information on costs and benefits compared with all previous interviews. During this first phase of interviews, other categories of actors were

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identified as being targets of information exchanges on HPAI suspicions. Individuals belonging to those additional categories of actors and in contact with individuals from the initial sampling frame were then asked to participate in the study. Those who accepted were interviewed individually. Additionally, group and individual interviews of government veterinarians were conducted.

Topics of focus group interviews were as follows:

i. Actors involved in the poultry value chains (sources of funding and credit, suppliers of feed, breeds and medicines, buyers of farm products) were listed.
ii. Relative importance of general problems affecting poultry farmers and origins of these problems were assessed using simple ranking.
iii. Names used locally for poultry diseases occurring in the area were scored according to their impact on income, rates of mortality and duration using proportional piling (PP) [16]. Reported names of diseases characterised by both high mortality rate (>50% in one poultry flock) and short duration (<5 days in one flock) were used to define HPAI suspicions which were referred to in subsequent interviews.
iv. Farmers were then asked which actions were taken when facing a disease suspicion, and these actions were scored according to their relative likelihood using PP.

Individually interviewed poultry farmers, government veterinarians, and other actors identified by snowball sampling were asked more in-depth and sensitive questions using qualitative semi-structured interviews.

i. They were asked to provide information on the different ways of managing disease suspicion cases when it appeared in poultry farms.
ii. They were asked about the positive and negative consequences of reporting a disease suspicion to authorities.
iii. Impact flow charts were used to identify the negative and positive consequences of disease suspicion reporting for different types of actors. Participants first identified the list of actors impacted by disease suspicion reporting. Then, they assigned different signs and colours to each type of actors to indicate whether the effect was positive or negative.

6.2.2.2. ANALYSIS OF QUALITATIVE DATA

Qualitative data were analysed using thematic analysis [22]. Meaning units, that is, information or judgements expressed in interviews, were attributed specific codes. Codes were then grouped into subthemes and themes. Identified themes corresponded to specific factors influencing the perception of the HPAI passive surveillance system by participants, either positively or negatively. Each subtheme and theme was linked to the number of interviews it was extracted from. Moreover, to be considered as relevant, themes and subthemes that concerned several categories of actors had to be mentioned by participants from all the concerned categories. All statistical analyses were made using R.2.15.3 software [23]. Degree of agreement between interviewees and groups of interviewees' rankings and scores obtained by PP was assessed by non-parametric Kendall test of concordance [24], using the kendall.global function of the vegan package [25]. Statistical significance of the Kendall coefficient was shown by permutation test.

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6.2.3. RESULTS

6.2.3.1. CHOICES OPERATED BY THE DIFFERENT STAKEHOLDERS FACING HPAI SUSPICION

Among names of poultry diseases mentioned in focus group interviews with farmers, several ones matched the HPAI suspicion definition (i.e. caused more than 50% mortality in poultry flocks in less than 5 days), including Newcastle Disease, fowl cholera, Gumboro disease, and duck plague. In the Thailand study area, Newcastle Disease, 'Diarrhoea' (interpreted as 'Fowl cholera'), and 'Plague' (a general word used to qualify a rapid and massive mortality) also matched this definition.

Scores of the different options considered by poultry farmers in response to HPAI suspicion according to their likelihood differed between focus groups and, above all, between study areas. There was a higher agreement (measured through Kendall test of concordance) between groups of interviewees of similar study areas than between groups of similar farming scales. In the Vietnam study areas the main mentioned options were asking support from a private actor (feed seller, veterinary shop, and feed company), rapid sale of the poultry, warning of other farmers, and self-reliance (Fig. 6.1). Reporting of the event to veterinary authorities was never mentioned. In the Thailand study area, the main priority of farmers was to warn other poultry farmers of the disease occurrence, mainly cockfighting practitioners, but reporting to veterinary authorities and village heads was considered as an option in some group discussions.

6.2.3.2. PERCEIVED COST AND BENEFITS OF SHARING HEALTH INFORMATION

In the Vietnam study areas, six themes related to perceived costs and benefits of HPAI passive surveillance were identified from individual interviews.

Theme 1. Benefits associated with government intervention in disease management: Clearance of the poultry farms from the disease, avoidance of disease spread to other farms, avoidance of environmental pollution (due to the release of deadbirds in the rice fields, water ponds, and rivers), protection of public health, and financial indemnities given in compensation of the destruction of affected poultry flocks.

Theme 2. Benefits from the reception of information on HPAI suspicions: Farmers used such information to adapt their prevention measures (biosecurity, vaccination) and anticipate variation in poultry market prices.

Theme 3. Uncertainty about the outcome of HPAI suspicion reporting: From private actors' viewpoint, veterinary authorities were, in most cases, taking no action in response to HPAI suspicions reports and, for this reason, were not trusted as source of help in disease management.

Theme 4. Transaction costs related to HPAI suspicion reports: Farmers reported long waiting times before obtaining support from authorities, including financial indemnities, while they were faced with short delays to refund their credit on feed purchase to feed sellers. Administrative procedures and fees were also reported.

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Theme 5. *Limits of local authorities' resources*: The local government veterinary staffs reported having limited financial and technical resources available to control the disease in case of HPAI confirmation, which limited their willingness to notify the suspicion to the higher administrative level.

Theme 6. *Anticipation of market impacts*: Poultry sale prices were anticipated to successively drop and increase following poultry disease outbreaks notifications and, therefore, HPAI surveillance was perceived as a factor of market instability. The price drop was due to early sale of poultry by farmers afraid of the disease, reluctance of consumers to purchase poultry, implemented movement restriction, and advantage of poultry traders in price negotiation (Fig. 6.2).

In the Thailand study area, six themes were identified:

Theme 1. *Benefits associated with government intervention* in disease management: Veterinary services provided veterinary products for free to farmers in response to a report of HPAI suspicion, even if HPAI was not confirmed, and financial indemnities were given in compensation of the destruction of affected poultry flocks.

Theme 2. *Financial losses associated with the culling of cocks* used for cockfighting: The value of these cocks specially trained for cockfighting competitions was reportedly much higher than the market price of standard birds sold for meat and financial compensations provided by veterinary authorities.

Theme 3. *Loss of selected breeds of cocks* aimed at fighting due to mass culling in affected farms.

Theme 4. *The emotional link* between farmers and their cocks that was disrupted by the mass culling policy.

Theme 5. *The perceived moral fault* of culling healthy animals out of purpose of consumption.

Theme 6. *The fear of causing a conflict* with cockfighting practitioners by reporting HPAI suspicions.

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Figure 6.1 Choices operated by poultry farmers and government veterinarians interviewed in Vietnam when facing avian influenza suspicion (grey arrow: commercial linkage; black arrow: decision). [18]

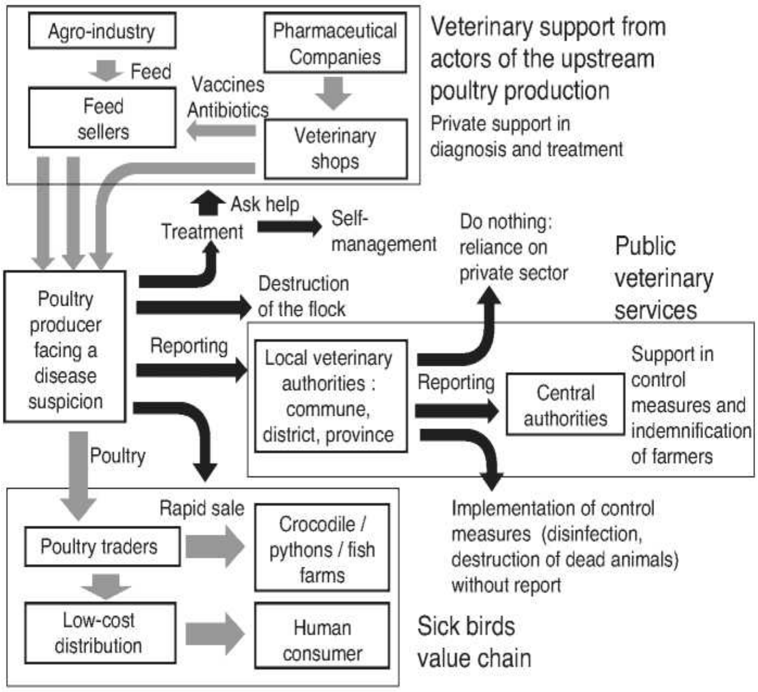
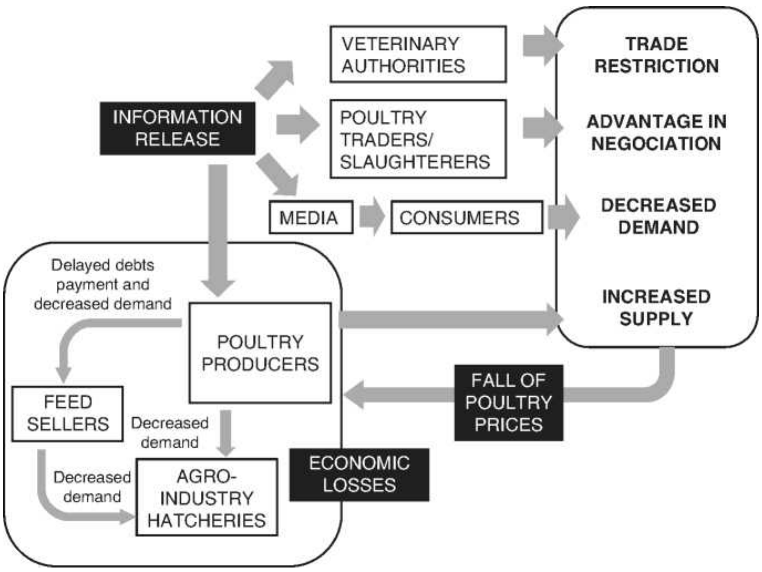


Figure 6.2 Market effects of the release of information on avian influenza suspicions perceived by survey participants in Vietnam. [18]



6.2.4. DISCUSSION

The study illustrates how the perception of passive surveillance by its local stakeholders is affected by the socio-economic context in which it operates and, in particular, the type of

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livestock farming systems it targets. This is demonstrated by the qualitative differences between observation made in Vietnam and Thailand.

Benefits and costs of passive HPAI surveillance identified in Vietnam were strongly linked with the commercial nature of the poultry farming activity practised in the study areas. Large-scale as well as small-scale farmers were mostly concerned by the financial income generated from poultry flocks. Risk aversion, time preference, lack of trust in veterinary services, and compensation policy were key components of their decision-making process. Although the level of compensation might be close to the poultry market price, rapid sale of affected flocks was still perceived as a quicker and safer alternative to reduce income losses. Besides, the potential impact of the spread of disease information on the poultry market also was a major concern for farmers as well as veterinary government staff. Such market disturbances have been well characterised and quantified for avian influenza in several countries by multi-market or even computable general equilibrium models [26]. These impacts are complex and entail many distributional effects, besides the overall loss for society. Some examples may be extracted from the present study. First, consumers may transfer their demand for meat from poultry to swine products, the latter sector then generating more profit. Second, from their use of health information, traders also generate more profit during epizootics at the expense of poultry producers. Third, some poultry farmers adopt alternative strategies such as timing the sale of their flocks in the period of high deficit of poultry supply that just follows the epizootics to generate higher profits.

In the Thailand study area, poultry farming was mainly practised for the purpose of cockfighting. The social, cultural, and political importance of this activity [27] and the perceived brutality of the mass culling policy implemented in the past by the government of Thailand in response to HPAI outbreaks were a major explanation to the defiance of native breed chicken farmers towards the passive surveillance system. Even actors not involved in cockfighting activities were reluctant to report HPAI suspicions out of fear of causing conflicts with cockfighting practitioners. However, no possibility of sale of sick poultry was mentioned, contrary to Vietnam.

Native chickens sold for consumption were considered as quality products, and buyers were reported to check the health status of birds before purchase.

The results highlight the link between implemented disease control measures and effectiveness of passive surveillance. Control actions, being anticipated by actors, influence their decision-making. Farm disinfection, management of dead birds, and supply of veterinary products appear in the same way as compensation scheme as an incentive element of the control policy resulting from reporting.

Private actors of the poultry production expressed a need for early information on occurrences of poultry diseases. A major part of the Vietnamese poultry production is concentrated in small-scale farming systems and most farmers cannot afford constant investments in biosecurity and prevention measures. Information on disease occurrences is especially useful for such farmers who can adapt their choices (preventive measures or early sale of animals) according to the obtained information on disease threats.

Finally, it is notable that some of the perceived costs and benefits of the HPAI surveillance system do not have a market value, such as the social and cultural importance attributed to

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cockfighting, ethical concerns associated with mass culling, or the effect of price drop on other poultry farmers. But the effects of those costs and benefits on the decision-making to report or not a health event should be taken into consideration when defining disease management policies

6.2.5. IMPLICATION IN TERMS OF DISEASE MANAGEMENT POLICY

The effectiveness of passive surveillance systems depends on the decentralised decision-making of actors of livestock value chains who are the primary holders of animal health information. In consequence disease management policies need to be adapted to the specific needs and constraints of the private and local actors they rely upon. This study identifies some ways for improvement such as reducing the administrative burden associated with disease reporting and tailoring disease management intervention to answer farmers' needs. For instance, it appears that farmers would greatly benefit from a rapid support in cleaning and disinfection of farms upon reporting suspicions and without waiting for HPAI confirmation. In general, coconstruction of surveillance and disease control strategies with local actors and endusers of health information should be an objective of surveillance systems development programmes, through the use of participatory approaches or specific methods like companion modelling (see Part IV).

6.3. Case Study 2: The Economic Value of One Health Surveillance—An Assessment of the One Health Approach to *Campylobacter* Surveillance in Switzerland

6.3.1. INTRODUCTION

In Switzerland, and in response to the observed increasing trend in human campylobacteriosis cases, the animal and the human health authorities enhanced collaborative disease surveillance and intervention efforts for *Campylobacter* with the intention of improving the disease management. For this, the *Campylobacter* platform, a stakeholder group composed by the poultry industry, researchers, and public health and animal health national and cantonal authorities, was formed [28]. A regular surveillance system in broiler chicken was also implemented.

The *Campylobacter* platform and the increased surveillance efforts constituted a shift from the previously instituted system, which was essentially based on the monitoring of human cases. In such One Health approach to surveillance [29, 30] it is of interest to explore whether overall resources are used more efficiently by collaborative or integrated approaches to surveillance than by a surveillance system with disconnected, sector-specific components. Using a previously developed framework to guide the assessment [31], this study investigated how surveillance activities across the two sectors linked to public health and animal health decision-making and triggered activities and interventions, and explored costs and benefits of the two

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approaches to surveillance and disease mitigation. More details on the study can be found in Babo Martins et al. [32].

6.3.2. METHODS

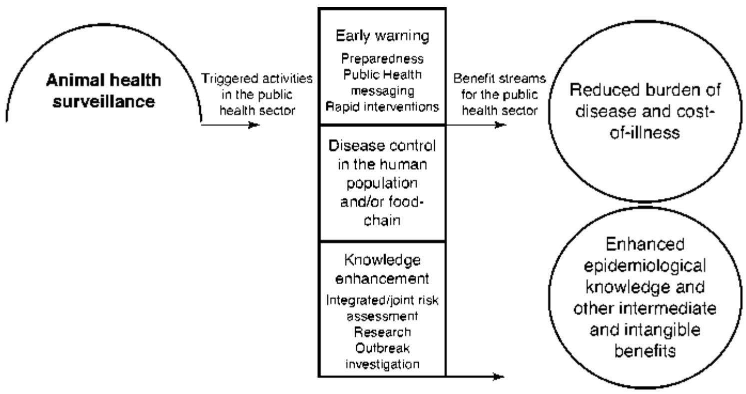
The data collection method is explained in details in Babo Martins et al. [32]; a summary is provided in the following paragraphs.

Figure 6.3 summarises the conceptual framework of the links between surveillance of zoonoses in the animal population, the wider public health disease mitigation system, and benefit components associated, used as a basis for this study.

In this study, the One Health approach to *Campylobacter* mitigation was considered as the system in place since 2009 and up to 2013, where information generated by surveillance efforts in the poultry population and in the human population was integrated in the *Campylobacter* platform.

The steps proposed in the above-mentioned framework were as follows: an initial conceptualisation of the links between surveillance and triggered interventions, the identification of costs and benefits, and a final step of valuation of costs and of potential benefits. Based on discussion with experts involved in the activities and literature review [28], information on the type of surveillance activities, integration mechanisms and activities, and interventions prompted by the information generated in both the animal and the human health sectors was identified. A cost estimation model was developed and populated with data provided by the Swiss Federal Food Safety and Veterinary Office (FVO) and Federal Office of Public Health (FOPH). The cost model included all relevant labour costs and expenses accrued by surveillance activities, running costs of the *Campylobacter* platform, and costs of interventions and activities triggered by surveillance information across both sectors in the timeline of the analysis. From the benefit streams identified, potential changes in the impact of disease in the human population were explored by calculating disability-adjusted life-years (DALYs) [33] for 2008 and 2013, building upon the stochastic model used in Denmark for the estimation of the burden of foodborne disease [34].

Figure 6.3 Conceptual framework of the links between surveillance of zoonoses in the animal population, the wider public health disease mitigation system, and associated benefit components



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6.3.3. RESULTS

In the One Health approach, the information generated by surveillance in the animal population and by human cases monitoring shared in the *Campylobacter* platform triggered activities concerning biosecurity messaging in poultry farms and public health messaging on hygienic measures for chicken meat handling and prevention of cross-contamination. Integration of surveillance information was also used to perform cross-sectorial risk assessments and identify gaps in the knowledge base for *Campylobacter* infection in the country and research needs. Three main benefit streams were identified. A first benefit stream linked to the potential to generate a reduction in the direct and indirect impacts of the disease in the human population, namely on the burden of disease or cost of illness. This potential benefit stream was further explored in the study. The potential to reduce the direct and indirect impacts of disease in the animal population, ultimately contributing to a reduction in human infection, was identified but not assessed. The final benefit stream related to a set of intermediate or intangible benefits, connected to enhanced knowledge, performance of risk assessments and triggering of research, such as intellectual capital, and to social capital, generated through the intrinsic value of multi-sectorial collaboration and networking.

The One Health approach represented a marginal cost when compared to the uni- sectorial system, with almost half (48%) of the total expenses in 2009–2013 being absorbed by commissioned research on *Campylobacter* in Switzerland, followed by the surveillance and monitoring activities in poultry and humans, respectively. In the same timeline, a 3.4–8.8% increase in the average total burden of disease of campylobacteriosis was estimated, from 1609 (95% CI: 1330, 1947) to 2756 (95% CI: 2412, 3140) DALYs in 2008 to 1751 (95% confidence interval (CI): 1478, 2069) to 2852 (95% CI: 2520, 3227) DALYs in 2013, in the best- and worst-case scenarios considered, respectively.

6.3.4. Discussion

This study provides an example of how costs and benefits of surveillance conducted in a One Health approach can be identified. The framework used as the basis for economic assessment allowed the identification of cross-sectorial cost items and benefits streams, associated to *Campylobacter* in Switzerland in the period in analysis, through the conceptualisation of its links to activities and intervention. The study also demonstrates the challenges surrounding the valuation of costs and benefits of One Health surveillance approaches, particularly those generated in system at an early stage of implementation such as the One Health approach to *Campylobacter* mitigation in the time frame of this analysis.

In the first five years of the system, the level of the expenditure increased with a cross-sectorial approach to surveillance and intervention for *Campylobacter* in the country, particularly in research funding and surveillance activities in poultry. In line with the nature of these activities, information generated contributed mainly to the assessment of trends, to perform risk assessments, and to shape research efforts. Accordingly, in these initial 5 years, the nature of benefits was intangible, including the generation of intellectual capital. Such intellectual capital created by surveillance can later generate monetary value when it is used to inform control measures that mitigate the impact of the disease and generate a measurable health effect. Cost-effectiveness or cost–benefit tools can, at that stage, be used to estimate how One Health

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approaches to surveillance and mitigation compare in economic terms with uni-sectorial approaches.

6.3.5. IMPLICATION IN TERMS OF DISEASE MANAGEMENT POLICY

Gains in information and knowledge have been recognised as benefits from wider One Health approaches [35, 36]. However, for surveillance activities, such benefits are rarely incorporated into economic assessments [37]. To understand the overall added value of One Health surveillance, the assessment of these assets should be an integral part of the analysis, particularly in surveillance systems that are mainly informing assessments and producing knowledge. Stated preference elicitation methods, such as conjoint analysis, presented and further explored in other case studies in this chapter, could be a useful tool to gain further insight into this set of benefits of One Health surveillance approaches.

6.4. Case Study 3: Quantifying the Perceived Benefits and Costs of Surveillance Through Discrete Choice Experiments: A Pilot Study in North Vietnam

6.4.1. INTRODUCTION

The method explained in Chap. 5 is useful for identifying and understanding the costs and benefits associated with passive surveillance from the viewpoint of its primary information holders. However, it does not allow to quantify the effect of each factor on the actor's decision-making, and so, does not allow to measure the relative effect of each of the identified attributes on the effectiveness of surveillance.

To answer this gap, a quantification method based on stated preferences was built and tested, using the example of reporting of Highly Pathogenic Avian Influenza (HPAI) suspicions by poultry farmers to veterinary authorities in Vietnam. The method was composed of two phases with distinct objectives: first, quantifying the value attributed by survey participants to the reception of information on poultry diseases occurring in their area, using contingent valuation; second, quantifying the value of attributes of passive surveillance (anticipated costs and benefits of HPAI suspicion reporting) based on their relative effect on the reporting likelihood of survey participants, using choice-based conjoint analysis.

This section introduces the method of data collection and data analysis as well as preliminary results of the pilot study implemented in Hải Dương province (North Vietnam). A more detailed description of the method can be found in [18, 19]).

6.4.2. MATERIALS AND METHODS

6.4.2.1. CONTINGENT VALUATION TO ESTIMATE THE BENEFITS OF HEALTH INFORMATION SHARING

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The benefits considered by the individuals from receiving information on poultry disease outbreaks were estimated by contingent valuation [38]. All types of poultry diseases were included, not only HPAI, in order to match actors' interest for epidemiological information on poultry diseases in general. Semi-structured interviews were performed to list the benefits of early information about the sanitary situation of poultry flocks in the region. The participants had to think of how they could use such information and what could be the expected gains or avoided losses from the anticipated actions. Then, contingent valuation was applied. It consisted in offering a virtual contract from a company providing information to the participant at a certain cost. Two factors were considered: the price the participant was willing to pay to receive information in an appropriate timing (i.e. to allow enough time for implementation of prevention and control measures) and the price the participant was willing to accept as a compensation to deliver information himself within an appropriate timing.

6.4.2.2. DISCRETE CHOICE EXPERIMENT TO VALUE THE NON-MONETARY COSTS AND BENEFITS

Second, a modified protocol of discrete choice experiment was applied to value the non-monetary costs and benefits linked to the HPAI suspicion reporting process [39]. The participant had to list and explain the different options he/she was willing to consider when confronted to a hypothetical scenario of disease suspicion (50% mortality in less than 2 days) in his/her chicken flock, and the relative consequences (financial and non-financial) upon reporting or not reporting the disease suspicion to the authorities. Then the farmer was asked to estimate a relative likelihood to the three possible actions: (i) reporting the HPAI suspicion to authorities, (ii) not reporting the HPAI suspicion to authorities, and (iii) discuss with other people in the community about the need to report or not (Fig. 6.4). The objective of the third option was to give a possibility for the participant to opt out, as well as a possibility for the respondent to give a more detailed explanation of the social interactions conditioning the decision-making process. The likelihood of each option was quantified using proportional piling [16]: a set of 100 counters was divided and ascribed to each above-mentioned option by participants, in quantity proportional to the relative likelihood of choosing this option. Different scenarios were then tested by varying the levels of indemnities provided by the government upon report. The motives for the stated likelihoods were assessed at each step and considered as incentives or disincentives of the decision-making. The participant was then asked to assign likelihoods to each action in situations where the incentives and disincentives considered were not applicable (e.g. assign likelihood of each action when considering that authorities provide or do not provide help in disease management following a disease suspicion report). The presence/absence of these incentives and disincentives were considered as the qualitative attributes to be valued through the different choice scenarios (Fig. 6.4).

All statistical analyses were made using R.2.15 [23]. Results from contingent valuations were analysed through descriptive statistics. Results from the adapted discrete choice experiment were analysed considering the stated likelihoods of action as probabilities of choice. Being collected following distinct interview processes according to each individual case, data were analysed individually. To allow for the statistical estimation of utility coefficients of the different scenario attributes with standard statistical package, each individual probability gathered through proportional piling was simulated as resulting from a mock sample (n = 100 for the

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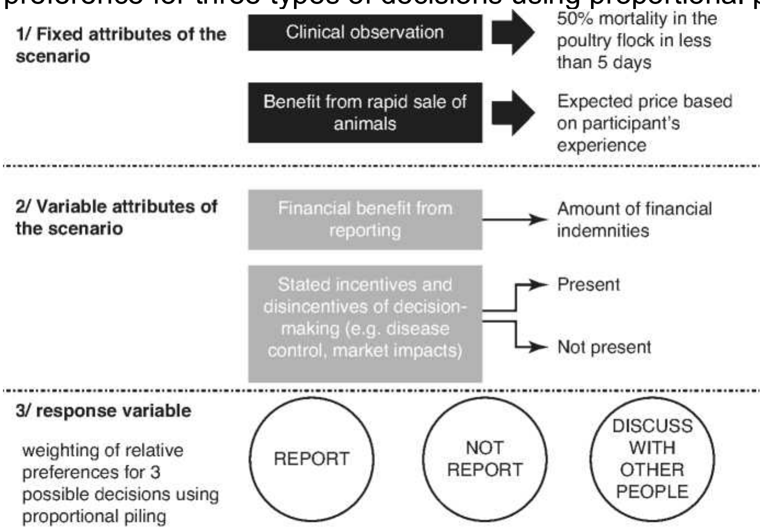
each scenario). A multinomial logistic regression model was applied to derive the monetary values of attributes [39] from data collected for each individual, using the 'mlogit' package [40]:

$$P = \frac{e^{b_r X_r}}{\sum_j e^{b_j X_j}}$$

with *X* being the vector of the attributes of the scenario (non-monetary and monetary incentives and disincentives), *b* being a vector of utility coefficients of the scenario attributes to be estimated, *r* being the report option, and *j* the choice set.

Figure 6.4 Structure of the adapted discrete choice experiment tool. Scenarios are composed of fixed attributes and variable attributes. Responses of participants were a scoring of relative preference for three types of decisions using proportional piling. [18, 19]



6.4.3. RESULTS

The contingent valuation tool and the adapted discrete choice experiment were tested, with 21 and 17 poultry producers, respectively, of Hải Dương province (North Vietnam), of which 4 were female and the rest male. They were all smallscale farmers producing between 100 and 1000 broiler chickens per cycle.

The anticipated costs of poultry farmers for reporting HPAI suspicions were the fear of being responsible for the losses incurred by other producers and feed sellers, due to the drop of poultry prices in case of notification, and the transaction costs (administrative procedures and delays before receiving financial indemnities, as compared with the immediate payoff obtained by selling the affected flock). From the 17 interviews performed in HD with broiler chicken producers, 11 results were interpretable. Failures to obtain interpretable results arose from inability or unwillingness of participants to envisage hypothetic scenarios. For five farmers the effect on prices and resulting losses for other farms did not affect their decision (null cost). For five other farmers this cost had an impact that could be quantified at a median value of 442 USD (range: 108–2979 USD) (exchange rate: 1 USD = 21,000 Vietnam Dong). One farmer considered the impact of notifications on the income of other farmers was priceless (absolutely intolerable). Five farmers did not mention the transaction costs of reporting. For six other farmers these transaction costs could be estimated as a median value of 694 USD (range: 236–1081 USD). Seven farmers did not mention the benefit of help in disease management.

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For four other farmers this benefit could be estimated as a median value of 292 USD (range: 248–829 USD).

A quantified value of acceptable price for getting disease outbreak information (willingness to pay) could be obtained from 13 out of the 21 interviews performed in HD with broiler chicken producers. The median value was 0.04 USD (range: 0.005–0.05 USD) per chicken per cycle, which corresponds to about 1% of the chicken sale price.

6.4.4. DISCUSSION

Stated preferences method is based on the elicitation of specific choices of participants under hypothetic scenarios with specific attributes. It is usually applied to assign a value to goods or attributes of goods which do not have a market [39]. In animal health, stated preferences were used, for example, to evaluate the willingness of farmers to pay for the extension of local veterinary services [41] or for vaccination programmes against livestock diseases, based on their attributes [11, 42]. Classically, stated preferences require data collection using standardised questionnaire-based approaches. Survey interviewees are required to make discrete choices in response to several sets of scenario attributes and model coefficients are estimated on the overall sample of participants (see Sect. 6.5).

The data collection protocol presented here was adapted to allow flexibility in conducting interviews with survey participants and defining scenario attributes. This flexibility was essential, given the complex and sensitive nature of the topic. It enabled to ascertain that participants had a good understanding of the proposed scenarios, the different choices they were faced with and their potential consequences, and to explore thoroughly the different incentives and disincentives conditioning their decision process. The method was well adapted to identify scenarios and relevant attributes that matched participants' specific perceptions. Proportional piling was used in conjoint analysis as a way to capture relative probabilities of decisions in response to change in scenarios attributes. These attributes were progressively adapted by the interviewer all along the exercise until capturing changes in probability that were precisely linked with the factor of interest.

A substantial proportion of the pilot interviews failed to produce relevant data. Indeed, the applicability of the tool proved to depend on the knowledge and experience of participants with the topic of the evaluation (poultry diseases and suspicion reporting) and their ability or willingness to consider hypothetic scenarios that could significantly diverge from their personal experience.

6.4.5. IMPLICATION IN TERMS OF DISEASE MANAGEMENT POLICY

The willingness of farmers to contribute financially and informationally to the suggested 'service of health information' highlights their interest in a well-functioning surveillance system and a direct illustration of the public value that such systems are creating. However, the fact that farmers did not consider this service to be synonymous of the actual surveillance system points to a lack of return of information to these users, hence pointing to the foregone creation of value. A flowing back of information to end-users is thus needed to realise the full social potential of surveillance. This case study illustrates how stated preference methods may be used at the individual level as a tool for in-depth qualitative investigation of actors'

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decisionmaking and attitude towards implemented or envisioned policies. The present results point particularly to the importance of disease management interventions and market impacts on the decision to report or not to report cases, which also appeared as resulting from social interactions, beyond the sole individual weighing of costs and benefits.

6.5. Case Study 4: The Willingness to Forego Compensation: Application of the Discrete Choice Experiment to Evaluate Swine Disease Surveillance in Vietnam

6.5.1. INTRODUCTION

Farmers' decision to report cases, and therefore the effectiveness of passive surveillance, crucially depends on the institutional framing of animal disease surveillance and control. Indeed, farmers' anticipation of consequences shapes their final decision to report [43, 44], which implies that passive surveillance cannot be considered separately from the planned control actions. Applying to swine diseases in two provinces of the Red River Delta, in the North of Vietnam, this case study applied discrete choice experiment (DCE) to evaluate passive surveillance as an institutional object, characterised by policy options as perceived by field actors. More details on the study can be found in Pham et al. [14].

6.5.2. MATERIALS AND METHODS

6.5.2.1. DISCRETE CHOICE EXPERIMENT APPLIED TO PASSIVE SURVEILLANCE

As mentioned in the previous case study, discrete choice experiment (DCE) is part of the so-called stated preference method. It aims at estimating the value of goods or their characteristics (also called attributes) based on the analysis of choices made by individuals facing virtual alternatives between different kinds of the good to be evaluated. Such virtual choices are needed in cases in which real transactions on markets cannot be observed to obtain these estimations. Similar approaches were adopted by other authors to identify and evaluate farmers' reporting decisions [45] and animal disease control measures [42, 46].

By analysing the trade-off that the interviewees make between the policy options and compensation throughout their virtual choices, the DCE protocol allows for an estimation of the willingness of farmers to accept or to forego compensation facing different policy arrangements. This willingness may also be directly understood as a willingness to report, as the survey includes the possible choice of not reporting. Finally, this willingness to report may also be expressed as probabilities of reporting decisions, hence as an evaluation of the foreseen effect of different policy options on passive surveillance.

6.5.2.2. DEFINITION OF POLICY OPTIONS TO BE TESTED

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A DCE protocol needs to elaborate different profiles of the good to evaluate, to be proposed as alternatives. These profiles represent different combinations of characteristics, here policy options, relevant to the actors' decision-making. Those were identified through a participatory survey consisting of 18 focus groups with farmers and key informant interviews. The policy options included were as follows: (1) uncertainty of being compensated in case of animal disease reporting; (2) delivery time of compensation payment; (3) pig culling in case of disease reporting; (4) burden of administrative procedures for disease notification and getting compensation payment; (5) movement control in case of disease notification; and (6) compensation levels in case of animal culling. Each option was then assigned different modalities (attributes' levels) on the basis of the survey results and from a literature review on veterinary regulations in Vietnam [47, 48], as detailed in Table 6.1. Compensation level was expressed as a percentage of the market price for the live body weight (LBW) of a fattening pig, considering a fixed market price of Vietnam Dong (VND) 48,000 per kg LBW. Compensation levels were set at 50%, 70%, and 80% of market price.

6.5.2.3. STUDY LOCATION AND PARTICIPANTS

The DCE survey was conducted in eight communes of four districts of two provinces, based on pig density, extent of pig production, diversity of pig farming systems, and occurrence of notified swine infectious diseases (PRRS, FMD, and CSF). Stratified random sampling was carried out based on production types (mixed vs. fattening farm) and production systems (small vs. large farm, based on a threshold of 20 sows and/or 200 fattening pigs). Target sample size was 120 pig farms in each province (30 large farms and 90 smallholders). According to the WHO guideline on discrete choice experiments in public health research, a minimum sample size of 30 is required for each sub-group of the main sample to perform econometric analysis [49]. Each farmer was asked to make 12 virtual choices. Each choice consisted of two unlabelled disease-reporting alternatives and one opt-out alternative (nonreporting alternative).

From March to July 2015, face-to-face interviews in Vietnamese were conducted, resulting in 196 completed questionnaires in total (out of 240 pig holders contacted for interview). Mixed pig farms represented 81% of sample (keeping sows, growers, and fattening pigs), while 19% kept fattening pigs only. Small pig farms with 6 sows and 100 fattening pigs on average were dominant in both provinces (79% and 88%, respectively).

Table 6.1 Policy options used in the discrete choice experiment to estimate farmers' willingness to report swine disease in two provinces of Northern Vietnam

Attribute	Levels
Probability of being compensated	Uncertain
	Certain
Compensation level (Vietnam Dong per kilogram live body weight)	24,000
	33,600
	38,400
Animal culling policy	Dead/unrecovered pigs

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	All pigs at farm
Administrative procedures of disease reporting and compensation payment	Simple
	Complicated
Movement control in outbreak area	No movement ban
	Movement ban
Delivery time of compensation payment	3 months
	6 months
	1 years

6.5.3. RESULTS

From the selected policy options, all showed a statistically significant influence ($p < 0.01$) on farmers' decision-making, except the administrative procedures burden. No significant difference was observed between provinces. As expected, higher compensations increased the likelihood of reporting, allowing for the calculation of the so-called 'willingness to accept compensation' for negatively perceived policy options or 'willingness to forego compensation' for positively perceived policy options. The strongest influence on decision-making was obtained for the certainty of receiving compensation and for culling policy, the preferred option being to restrict it to not-recovering pigs only. Movement restriction and delayed compensation payment also reduced the probability of farmers' disease reporting but showed a lesser weight in decision-making. Regarding the desired policy changes, the highest willingness to forego compensation is obtained for restricting the culling policy to non-recovering pigs only and for shortening the compensation delivery time from 1 year to 3 months, amounting to 71% and 25% of the market price, respectively (Fig. 6.5).

With regard to the policy options that were considered, the current situation in Vietnam is defined as follows: uncertainty of being compensated, movement restriction, total culling in affected farms, complicated administrative procedures, compensation level equal to 70% of market price, and compensation delay of six months. Based on scenarios simulation, under this policy setting, the probability of case reporting was estimated at only 4% (95% CI: 0.9–14.3%). A change in the culling policy to restrict it to unrecovered pigs in affected farms brings this reporting probability up to 26% (95% CI: 6.2–65.4%). If farmers were certain of being compensated, probability of disease reporting would rise up to 52% in case of total culling in affected farms (95% CI: 16.8–85.3%) and up to 91% (95% CI: 59.7–98.5%) in case of targeted culling. Making administrative procedures less cumbersome, allowing free movements of uninfected pigs in the area, and increasing the compensation payment to 80% of market value do not significantly increase the proportion of farmers willing to report. In accordance with the calculated willingness to forego compensation, under the favourable options of a targeted culling policy and certainty of compensation, the scenario testing a lower compensation level (50% market value) could deliver an estimated probability of reporting as high as 84% (95% CI: 47.9–96.8%).

Figure 6.5 Probability of swine disease reporting by farmers under different scenarios of control policy. (From Pham et al. [14])

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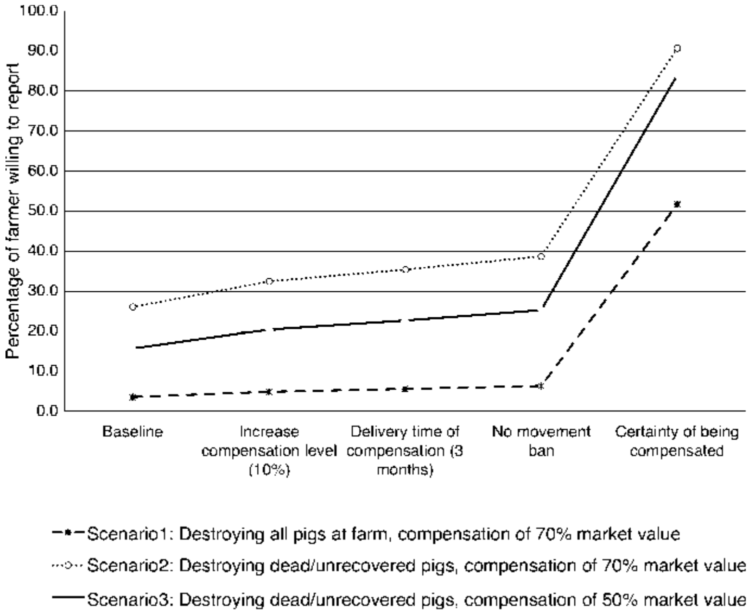

6.5.4. THE BURDEN OF DISTRUST, THE UNBEARABLE COST OF MASSIVE CULLING OUTWEIGHS COMPENSATION LEVELS

The willingness to forego compensation highlights the true barriers opposed to disease notification from the perspective of Vietnamese pig holders' decision-making. Indeed, compensation is classically considered critical in disease control policies as an incentive to case reporting and compliance with culling actions [50]. Hence, policies often focus on this rate, with recommendations, for healthy and diseased animals, ranging from 75 to 90% of the reference price [50]. Yet, this case study brings a quantitative illustration of the secondary importance of compensation level in farmers' decision-making. Two policy elements are pointed as more relevant to this decision: *the certainty of compensation payment and the culling strategy*. As the present method mobilises stated preference, it is primarily handling perceptions of a policy by stakeholders rather than policy itself. Therefore, it is useful to translate these results into their perceptual equivalent, meaning that policy efforts have to increase the confidence in compensation payment and the acceptability of stamping out strategies. Clearly, in the present situation, the effort made to ensure a compensation level as high as 70% of the market price is totally overweighed by a lack in these two components coming up to massive underreporting behaviour. On the contrary, lower compensation rates may allow for an effective passive surveillance provided that confidence and acceptability are fostered. Similarly to compensation level, movement restriction and delivery time of compensation are minor although significant decision factors.

The lack of acceptability of stamping out strategies may be understood from qualitative in-depth interviews having accompanied the present DCE protocol. First, the destruction of clinically healthy pigs is perceived as a waste of resources and food, which is deemed unacceptable. Second, compensation rates based on fattened pig prices is considered as not relevant to compensate the culling of clinically healthy breeding stock that present a higher value as a built capital. Third, notifiable swine diseases such as PRRS and FMD are endemic in Vietnam, which leads farmers to perceive these diseases as a usual burden that does not

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call for stamping out strategies, then perceived as 'over-reaction'. According to Vietnamese disease control policy ([47, 48], culling upon disease confirmation applies for all pigs in the farm in case of a new outbreak or if the outbreak occurs in a limited area (few households in the village/commune). Targeted culling of non-recovering pigs already applies for wider outbreaks or in recurrently affected zones. Thus, the Vietnamese policy is not totally at odds with farmers' wishes but the wider acceptability of restricted culling invites to apply this strategy in a maximum of relevant cases. A true stamping out should be decided under very strict conditions, with both a profound work to promote its acceptability *ex ante* and a follow-up of farmers upon implementation.

The lack of confidence in compensation payment is the other main barrier for disease reporting identified through this case study. This relates to a more profound distrust in veterinary authorities and control measures, which is, indeed, known as an important barrier to disease reporting [43, 44, 51]. The timeliness and reliability

of compensation delivery are critical elements in building this missing trust [50]. Finally, we could understand from open interviews that the flexibility of procedure, as mentioned here above, makes things unclear for farmers. These results suggest the importance of clarifying culling rules with adequate communication strategy.

6.5.5. IMPLICATION IN TERMS OF DISEASE MANAGEMENT POLICY

Delay in detecting and culling infected animals has been found as key factors of diseases spread, undermining the efficacy of control programmes [52, 53]. Conversely, the efficacy of control programmes, the acceptability, and the clarity of their procedures appear as feedback drivers of surveillance efficacy. This case study illustrates how discrete choice experiment can be mobilised to investigate the barriers to a timely disease reporting by farmers. Combined with qualitative interviews to grasp profound motives and justifications of farmers' choices, it proved useful to inform the needs for policy framing of communicable disease management. The present case particularly highlights the need for renewed communication strategies around animal disease control policy, to clarify the latter and build trust with farmers. Stamping out proved a critical factor in their decision-making. Therefore, there is a need to mobilise this measure with scrutiny in accordance with the epidemiological situation of the region, and to communicate duly about its need, legitimacy, and modalities in order to increase its acceptability.

6.6. General Discussion

This chapter has focused on practical applications used to describe and estimate wider surveillance values as well as factors that influence them.

Some aspects of the value of surveillance are quantifiable using market values, in particular the monetary losses avoided in animal populations (e.g. reduction in yield, loss of animals) and human populations (e.g. losses due to absence from work). In addition, some of the wider externality effects, such as the losses caused by a reduction of tourism due to disease outbreaks, can be measured in monetary terms. The comparison of the loss avoidance

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achieved through disease surveillance and control with the resource costs accrued for these activities allows determining the economic efficiency of surveillance, as described in Chap. 5 and illustrated in various studies (see, e.g., examples mentioned in this chapter or the RISKSUR outputs: http://www.fp7-risksur.eu/progress/publications- presentations).

While several studies focused on the value of surveillance for animal diseases, recent work has elaborated the theoretical foundations to extend the existing concepts to One Health or integrated health surveillance [7]. Benefit streams in the human health sector resulting from information generation in the animal health sector are expected to be generated from disease reduction in human populations that can be attributed to earlier or better knowledge produced by animal health surveillance—conceptually similar to considerations in the animal health sector. However, Babo Martins [7] found that there is a considerable time lag from the generation of information in animal health to interventions in the public health sector. In other words, the information is more often used to assess trends and trigger research, all of which can be used at a later point in time to inform the design of interventions. Consequently, the quantification of benefit streams in a One Health surveillance setting requires a long-term time frame to be able to estimate their economic value. This leads to situations where intangible benefits to surveillance are identified, such as intellectual property, experience, knowledge, which in the future may be used to realise a tangible value as explained in Case Study 2. In other contexts, the measurement of intellectual capital, knowledge, or research information is a question of interest to research institutions, governments, or funding bodies.

Importantly, the concept of value is not static, but varies with time, geographic setting, culture, etc. Thus, the value of surveillance is strongly determined by the context, as illustrated in Case Study 1 where qualitative studies on avian influenza surveillance identified clear differences in the perception of the usefulness of surveillance information in Vietnam and Thailand. Large-scale poultry farmers were mainly interested in financial income resulting from poultry flocks and used the surveillance information received to make decisions to sell their poultry (a risky practice in terms of disease spread) and maximise their income. This example clearly shows that the intended use (and consequently potential benefits) of surveillance information as conceptualised by public authorities (protection of animal and human populations by enabling interventions) may differ from private stakeholder interests and use. Consequently, any study aiming to estimate the value of a surveillance policy should take care to define clearly the viewpoints of the analysis and to reflect on different stakeholder perceptions and how these could be integrated in the study. This was highlighted by the results from Thailand, where the social, cultural, and political importance of cockfighting determined the value of poultry and was consequently the major driver of producers' perception of surveillance and disease reporting behaviour.

To understand the full value of surveillance, the assessment of non-monetary benefits should be an integral part of the analysis. Stated preference elicitation methods, such as conjoint analysis, have been presented in this chapter to explore their usefulness in generating new insights into surveillance values. They are based on the elicitation of specific choices of participants under hypothetic scenarios with specified attributes. They are commonly used to assign a value to goods or attributes of goods which do not have a market [39]. Case Studies 3 and 4 are examples of applications of these methods in an animal health context. From a methodological perspective, they showed the importance of having flexibility in interviewing

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people and defining scenario attributes to make sure that people were able to understand in detail the choices and consequences to gain robust insights into their decision process. In combination with qualitative interviews, profound motives and justifications of farmers' choices may be understood. In Case Study 4, information was gained on the two policy elements relevant for farmers' disease reporting behaviour, namely, the certainty of compensation payment and the culling strategy. This knowledge is useful for policymakers to be able to generate surveillance systems that are functional, accepted, and effective. In this case, contextual factors and local value systems influenced important signals in the surveillance pathway and therefore directly affected the value of surveillance that could be realised.

In conclusion, the case studies presented are examples of approaches that do not only help to identify perceived values of surveillance that may not be immediately obvious to the analyst, but they also allow describing, conceptualising, and quantifying non-monetary surveillance benefits. Finally, they are also helpful to characterise contextual factors, which directly affect functional and performance attributes of surveillance and in consequence its economic value. Together with the theory outlined in Chap. 5 and techniques to assess economic efficiency, they allow conducting robust and effective economic evaluation of animal health surveillance.

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