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# **Pig farmers' perceptions, attitudes, influences and management of information in the decision-making process for disease control.**

**Short title:** Exploring pig farmers' decision-making process for disease control

## **Abstract**

The objectives of this study were (1) to explore the factors involved in the decision-making process used by pig farmers for disease control and (2) to investigate pig farmers' attitudes and perceptions about different information sources relating to disease control.

In 2011 a qualitative study involving 20 face-to-face interviews with English pig farmers was conducted. The questionnaire was composed of three parts. The first part required farmers to identify two diseases they had experienced and which were difficult to recognize and/or control. They were asked to report how the disease problem was recognized, how the need for control was decided, and what affected the choice of control approach. For the latter, a structure related to the Theory of Planned Behaviour was used. Their verbal responses were classified as associated with: (1) attitude and beliefs, (2) subjective norms, or (3) perceived behavioural control (PBC). In the second part, five key sources of information for disease control and barriers to knowledge were investigated. Interviews were recorded and transcribed. A qualitative analysis of the text of the interview transcripts was carried out using templates.

Drivers for disease control were 'pig mortality', 'feeling of entering in an economically critical situation', 'animal welfare' and 'feeling of despair'. Veterinarians were perceived by several participating farmers, as the most trusted information sources on disease control. However, in particular non-sustainable situations, other producers, and especially experiences from abroad,

seemed to considerably influence the farmers' decision-making. 'Lack of knowledge', 'farm structure and management barriers' and 'economic constrains' were identified in relation to PBC. Several negative themes, such as 'lack of communication', 'not knowing where to look', and 'information bias' were associated with research from academia.

This study identified a range of factors influencing the decision-making process for disease control by pig farmers. In addition, it highlighted the lack of awareness and difficult access of producers to current scientific research outputs. The factors identified should be considered when developing communication strategies to disseminate research findings and advice for disease control.

## **1. Introduction**

In the last 20 years, the English pig industry has suffered from outbreaks of many significant, which have had a significant negative impact. For instance, Porcine circovirus type 2 associated diseases, which appeared in England in 1999, have been estimated to cost the industry approximately £88 million per year during the epidemic stage, and £52.6 million per year during the endemic stage (Alarcon et al., 2013). Pleurisy has been estimated to cost up to £2.26 per pig in England (Jäger HJ et al., 2009). Other diseases such as porcine reproductive and respiratory syndrome (PRRS) and enzootic pneumonia have become endemic and are very difficult to eliminate from farms. Furthermore, the 2000 epidemic of Classical swine fever and the 2001 epidemic of Foot and mouth substantially damaged the industry (Anonymous, 2008). All these diseases are complex in nature and very difficult to understand (many of them being also multi-factorial) and therefore to control. The effective communication of relevant disease-related knowledge is essential to facilitate farmers' decisions on disease control and, thereby to help them minimize the impact of diseases. However, some studies have shown evidence that despite the onset of major knowledge transfer programs effective communication to farmers was not achieved (Iles, 2003; Noremark et al., 2009). This suggests that farmers' perceptions, and the factors affecting their behaviour, need to be better understood if effective knowledge transfer strategies are to be implemented successfully. Indeed,

the importance of investigating and understanding, farmers' perceptions and behaviours in relation to disease control is increasingly recognized by the scientific community, with the number of publications in this area growing substantially in recent years (Wauters, 2013).

Many of the social-psychological studies carried out in the farming sector have used or adapted the Theory of Reasoned Action (TRA) or the Theory of Planned Behaviour (TPB) for the investigation of farmers' behaviours (Garforth et al., 2004; Gunn et al., 2008; Ellis-Iversen et al., 2010). The Theory of Reasoned Action was developed by Fishbein and Ajzen in 1975. It stated that an individual actual behaviour may be predicted by the strength of his intention to engage in the behaviour (Figure 1). Intention here represents an individual's behavioural orientation and reflects the person's motivation towards that behaviour. The strength of this 'behavioural intention' depends on a combination of (a) person's attitudes and (b) subjective norms. Attitudes represent the individual personal disposition towards engaging in the behaviour. It refers to the person's positive or negative beliefs about the effects of the behaviour in producing outcomes ('outcome belief') and about his or her evaluation of these outcomes ('outcome evaluation'). Subjective norms reflect the person's perceptions on whether 'significant others' want him or her to engage in the behaviour ('subjective beliefs') and on the person's motivation to comply with these external pressures ('motivation to/not to comply'). The Theory of Planned Behaviour is an extension of the TRA. In TPB, Ajzen (1991) introduced a new element referred to as 'Perceived behavioural control' (PBC). PBC accounts for the individual's belief in being able to achieve the behaviour ('control belief or self-efficacy') and also for the factors perceived to difficult or facilitate achieving the behaviour ('power of control'). Ajzen hypothesized that PBC not only affects intention, but is also directly related to actual behaviour.

These two theories, TRA and TPB, have been proven effective in predicting and explaining a wide variety behaviours (Armitage and Conner, 2001; Jackson et al., 2006). In the agricultural sector, some studies have shown that 'attitudes' were the most important predictors of behavioural intention (Thompson and Panayiotopoulos, 1999; Garforth et al., 2004; Wolff, 2012). On the other hand, Ellis-

Iversen et al. (2010) showed that lack of supportive social norms and of self-efficacy deterred farmers from their intention to control some foodborne diseases. However, other studies have investigated farmers' decision making process for disease control using other socio-psychological frameworks. Valeeva et al. (2011) used the Health Belief Model (HBM) framework to investigate Dutch pig farmers perceptions towards disease risks and risk management strategies and to explore factors underlying farmers' behaviours for the uptake of these strategies. The results of that study indicate that "perceived benefit, in terms of strategy efficacy, was the strongest direct predictor of strategy adoption". Garforth et al. (2013) created a conceptual framework based on the TPB and HBM to investigate English sheep and pig farmers decisions for disease risk management. In their study, the main factors identified were related to farmers' attitudes and perceptions towards disease risk and control measure efficacy, enterprise characteristics, previous experience and credibility of information and advice. However, the scarce literature on pig farmers decision making process for disease control, and its importance for knowledge transfer strategies, indicates the need for further studies in this area.

When considering the process by which farmers make decision about disease control, it is especially important to identify the variables which drive and motivate their behaviour. These drivers may be directly related to farmers' values. Gasson (1973) classified farmers' values in four categories: (1) instrumental (economic), (2) social (optimizing interpersonal relationship), (3) expressive (self-expression or personal fulfilment) and (4) intrinsic (lifestyle). Willock et al. (1999) identified several other motivators, including personality traits, which might also influence farmers' decision-making process. In The Netherlands, two studies carried out in the dairy industry showed that 'work/job satisfaction' was a more important motivator than economic drivers (Bergevoet et al., 2004; Valeeva et al., 2007). However, only few recent studies have investigated farmers' motivators for disease control; most of these were focussed on the dairy and beef industry (Gunn et al., 2008; Heffernan et al., 2008; Ellis-Iversen et al., 2010; Garforth et al., 2013). It is also important to note that these drivers for disease control could also be classified within the TPB framework. In this sense, drivers

derived from Gasson's intrinsic values for farming (such as 'making maximum income' or 'expanding business') could belong in different components of the TPB, such as 'motivation to/not comply' or 'outcome belief'. However, an understanding of the drivers involved in the different decision steps of disease control (such as 'deciding the need to control' and 'deciding which control measure to use') is needed to clearly understand the overall decision process.

Nowadays, the amount of information and number of information sources available to farmers and associated demands for time and resources is significant and increasing. In this context, pig farmers' perceptions and attitudes towards different information sources can significantly impact the way information is managed and decisions are made. An important part of this information is the one derived from research. In the United Kingdom, the Department of Food and Rural Affairs' (Defra) budget for evidence-based research on animal health and welfare was £63.2 million for the year 2011/12 (from a total of £198.9 million research budget) (Anonymous, 2011). In the European Union, a total of € 1,935 million were budgeted on food, agriculture and fisheries research for the period 2007-2013 (Anonymous, 2007). These amounts do not account for all the private investment on research in the farming industry. As a consequence, a substantial amount of research outputs are produced. To ensure that these research findings have a real impact in the farming industry, it is essential that the finding not only reach the producers, but also have a positive impact in their decision making.

The aims of this study were to explore the factors involved in pig farmers' decision-making in relation to the control of complex diseases and/or 'ill-defined/structured' disease situations; and to investigate pig farmer's attitudes and perception towards different disease-related sources of information.

## **2. Material & Methods**

## **2.1. Data collection**

A study involving 20 English pig farmers was conducted between June and July 2011. Eighteen farmers were selected from the Porcine Circovirus type 2 (PCV2) vaccination programme conducted by BPEX, the English pig levy payer association. Two farmers were recruited through staff at the Royal Veterinary College. Farmers were not selected at random. Purposive sampling was performed to ensure that different types of farmers (from small medium farmers with 200 sows to farmers with 3500 sows; and farmers from different regions in England) were included. Data were collected through face-to-face interviews with farmers using a combination of a semi-structured questionnaire and closed questions. Interviews with farmers were recorded and then transcribed for further analysis. A thematic analysis of the text was carried out through the use of templates, as described by King (2004) and explained in section 2.2.2. All interviews were conducted, transcribed and analyzed by the first author.

## **2.2. Qualitative research**

### **2.2.1. Interview method**

For this study an initial template composed of three parts (higher degree codes) was created (Figure 2). The first part, 'Case background', aimed at gaining a general understanding of the farmer's background, current economic situation and the perception of each farmer's role in pig health. In addition, this section was used to put farmers at ease and facilitate their responses in the rest of the questionnaire. Farmers were encouraged to respond freely throughout the interviews.

The second part aimed at understanding the factors involved in the decision-making process farmers use for disease control, with special emphasis on the management of information sources. The investigation focused on disease situations that farmers have experienced and that could be classified as 'ill-defined' or 'ill-structured' disease problems. These terms were taken from the area

of Naturalistic Decision Making (Zsombok and Klein, 1997), which investigates the decision making process in situations where little information is known and/or the complexity of the problem is difficult to understand (ill-structured), or when the nature of the problem is not well defined (ill-defined). Several pig diseases could be classified as ill-defined or ill-structure, as many are difficult to understand and no straightforward cause or solution is known or currently available to farmers. These situations also require pig farmers to make important decisions, and to do so they needed to optimize the management of information and its sources. For this, pig farmers were asked to identify two diseases that they had experienced and which were difficult to recognize and/or to control. A brief discussion was then carried out between the farmer and the researcher to agree that the diseases identified matched these criteria and therefore to continue the questionnaire using these two diseases. Otherwise, the researcher asked the farmer to identify another disease or health problem which was difficult to recognize and/or to control.

To facilitate and aid farmers' narratives of the experience, the questionnaire focussed on three important steps (second order codes); (1) recognizing a disease problem, (2) deciding the need to control, and (3) deciding how to control the disease problem. For the latter, in order to classify the factors identified in a meaningful framework, a structure related to the TPB was used (see introduction for an explanation of this theory). Factors were therefore classified as related to (1) attitude and beliefs, (2) subjective norms, or (3) perceived behavioural control (third order codes). This theory was used as a framework because it clearly separates farmers' attitudes, external influences (subjective norms) and control factors. As the aim of the study was also to understand influences by different information sources in farmers' decision process for disease control, this separation in the framework was deemed necessary.

The third part of the interview aimed at exploring farmers' perceptions and attitudes towards five key sources of information for disease control. It was also designed to identify factors related to barriers to knowledge ('general problems') using two different questions: 1) 'What were the

difficulties to get an understanding of the disease issues you have experienced?', and 2) 'What are the main issues concerning the availability of information on pig health problems?'. Factors associated with general information problems obtained throughout the interview were also classified in this part of the template. In addition, this section assessed farmers' preferences for communication media, the type of information normally sought, and explored factors involved in pro-active behaviour (e.g. active search for information).

### **2.2.2. Qualitative analysis**

In the initial interview template, a number of themes were defined *a priori*, which corresponded to the areas of investigation of this study (Figure 2). Using this template as a framework, salient farmers' opinions, perceptions, feelings, concepts and ideas were grouped as themes and classified in the template according to their relationship with the existing codes and through careful reading of the transcribed interviews. Themes could represent a group of observations derived from several farmers or be composed of just one observation from one particular producer. A hierarchical coding structure was used in order to allow various degrees of specificity in the analysis. Higher order codes represented broad, general themes, while lower level codes represented more specific themes. The template structure was modified according to the findings with new codes being added when data could not be placed in the existing codes.

Qualitative analysis was performed with NVivo 8 (QSR International Pty Ltd). In first instance the initial template was created in NVivo. Through careful reading of the text, the themes were identified and added as codes to the template (with their corresponding text) as appropriate. The template was then built and modified according to the emerging themes. NVivo was useful to revise the content within the codes in order to: (1) better understand and describe the meaning of the code and verify its placement within the template; (2) to create new lower degree codes, if needed;

(3) to create new codes in other parts of the template if some text was found not to fit within the existing code. For analysis purposes, all farmers were treated anonymously.

### **2.3. Use of closed questions**

In order to gain a better understanding of participating farmers, three sets of closed questions were introduced in the questionnaire to assess; (1) the perception of usefulness of different information sources in relation to the information provided on diseases, (2) the importance of different types of motivator for disease control, and (3) farmers' pro-activity in seeking disease information. For the first set of questions, farmers were asked to provide an estimation of the usefulness of an information source using a six-point scale (Not used, not useful, not very useful, useful, very useful or extremely useful). For the second set of questions, four types of motivators for disease control were assessed: (1) financial, (2) image and reputation of the farm, (3) sense of pride as a good manager, and (4) animal welfare. These motivators corresponded to instrumental, social, expressive and intrinsic motivators as theorised by Gasson (1973). Farmers had to estimate the importance of each motivator in a scale from 1 (not important) to 10 (extremely important). Proactivity was measure using also a five-point scale (1/week, 1/month, 1/trimester, 1/semester and 1/year). However, it is important to note here that these questions were used to describe participating farmers and as a tool to investigate farmers' perceptions. For example, farmers that replied that Defra was a useful (or not a useful) information source were asked to explain why they thought that way.

The sequence of the questions was carefully chosen in order to avoid leading responses (Table 1). No financial incentives were given to farmers to participate in this study, but personal communication of results from a study done on Post-weaning multi-systemic wasting syndrome (PMWS) in England was given.

### **3. Results**

The duration of the interviews ranged from 35 minutes to 1 hour and 25 minutes. In the part data covering 'recognition of a disease problem', limited richness was obtained, and consequently this second higher degree node and its inferior codes were removed from the template. Due to the length of the final template, only a selection of codes is described here. Farmers' characteristics are summarised in Table 2.

#### **3.1. Economic situation**

Template results for this section can be found in Figure 3. In general, farmers provided a negative and pessimistic perception of the current economic situation of the industry and of their farms. Those few farmers who felt comfortable with their current situation believed it was due to particular conditions on their farm, such as the use of a fully slatted system or the use of waste products for animal feed. Most of the farmers that provided a negative perception blamed the current economic situation on the increased feed prices, which augmented the cost of production to unsustainable levels, and also on the pig price set by the supermarkets. Disease problems were not mentioned by participants as a potential threat to the industry.

#### **3.2. Deciding the need to control**

Template results for this section can be found in Figure 4. Figure 5 shows the different diseases reported by farmers and experiences included in the analysis. It is important to note that both PMWS and porcine dermatitis and nephropathy syndrome (PDNS), were reported frequently as

disease combination, and were identified by 13 farmers as two of the diseases suffered which were difficult to recognize and/or to control.

**Motivations to control.** Results from the closed questions indicated that, for the participating pig farmers, financial reasons were the most important drivers for disease control, followed by animal welfare (Figure 6). Image and sense of pride of being a good manager were less important, but also obtained high scores. In the qualitative analysis, the most frequent drivers for disease control, as reported by farmers, were related to the observation of ill pigs, reduced production performance (including fertility issues), and/or mortality levels. The latter was mentioned by many of the participant farmers as an important trigger for disease control. For most farmers, these observations were linked to economic drivers and the feeling of entering in an economically unsustainable situation:

“Well, cost. If you had a 60, 70, 80 kg liveweight pig dead (...) So one of those costs a hundred quid, [and] the next day is going to cost 200 quid to get rid of. (...) so ...you know, financially we could not keep going much longer. You know, when it happens, pigs weren't doing very well anyway financially. And having to sack of...process dead pigs due to PDNS...it was just too....that's too expensive, you know, so we had to do something”.(Farmer 18)

Some producers reported that animal welfare was also one of the drivers for disease control, which in combination with the economic impact of the disease, lead some farmers to a feeling of despair.

This was most frequently seen with farmers describing a PMWS/PDNS disease problem experience:

“It was economic. And also it was soul destroying (...) you saw good pigs weaned...everything went alright and suddenly you have these pigs going [back], and whatever you did you couldn't actually save the pigs. And you try and try and you change things and change things....yes, sometimes you have an effect, but it is a soul destroying thing of having to shoot so many pigs. (...) When you look after the animals, and all you want to do is at the end of the day the best you can for the animals, and sort they survive and thrive...and then this came along, it's just...” (Farmer 16)

Fear of disease spread within the farm or the fact that effective control measures were available were sometimes reported as sufficient reason for farmers to decide to control a disease problem. In addition, the reputation of the farm was an important driver for farmers selling pigs to other producers. ‘Mutual social responsibilities’ were only mentioned in the case of foodborne diseases such as salmonellosis. Other drivers for disease control mentioned by producers can be explained by the impact of external influences.

**External influences.** In situations where external influences played an important role in the decision about whether there was a need to control or not, the veterinarian was identified as one the major influences by many of the farmers interviewed. Some farmers explained that veterinarians frequently used data from abattoir health scores (BPHS) and farm records, and linked these data to economic performance and cost-effectiveness of control measures to support their arguments for the need to control identified disease problems.

“The vet said that when the lung scores get over 5, it is definitively worth vaccinating. The vaccination is going to pay for itself” (Farmer 1)

In some cases, farmers were persuaded to conduct a trial (e.g. vaccination trial) to make them realize the need to control a disease problem.

The vet always suspected that we had some [pneumonia] in the background (...). Monitoring our growth rates and the vet saying that the growth rates were not particularly good (...) that they should be doing better than that. So the first one sign were....pneumonia death in winter....secondly our growth rate were reduced to what would be regarded as, for the type of farm that the vets have been around,.....and thirdly the vet persuaded us to do a trial on the pneumonia vaccine. And said ‘well, then do a trial on the vaccine, weight your pigs, see the growth rates’ (Farmer 16).

In other situations, pressure from abattoir and contractors were the main drivers for deciding to control a disease:

“Also, we get lung reports from the abattoir. It is a problem there and it is detaining a lot of pigs. They are not very happy about that.” (Farmer 10)

“The main reason was that the costumer having my weaners was having huge problems. And if I didn’t do something about it they were going to dump me. And (...)I wouldn’t be able to sell the pigs anywhere else, you know.” (Farmer 5)

Fear of diseases spread from other farms and other producers’ negative experiences also prompted farmers’ decisions to undertake preventive actions:

“Well, there was a lot of information on wasting diseases in circulation. As I said, it wasn’t something that particularly affected us.... I have heard a lot of previous stories on how bad some sites of some farms were of that problem, and so you worry that whatever is over there is going to end up here. And so you are looking for what people say is the most effective...” (Farmer 13)

Finally, deciding the need to control was driven in some cases by government pressure when related to foodborne diseases (e.g. salmonellosis):

“I mean the other thing on biosecurity...when we went from weekly farrowing to 3 week batch farrowing, about 5 years ago now. And that was driven by Salmonella ZAP testing, which we were struggling with at

the finishing end, because we were on a continuous flow.....and we had to do something about it because we had a visit from the VLA [Veterinary Laboratories Agency]. We were in class 2 regularly, which meant that we got to be seen to be doing something about it... And so we decided... we put two farrowing buildings, which gave us more farrowing capacity than we previously had" (Farmer 17).

### **3.3. Deciding how to control the disease problem**

Template results for this section can also be found in Figure 4.

#### **3.3.1. Attitudes toward measure – outcome belief**

Three codes were identified in this section: (1) belief effective, (2) uncertainty and, (3) farmers' principles.

**Belief effective.** This code relates to the belief of the farmer in the effectiveness of the control measure. Several themes composed this code and helped to explain this belief. One of them was the 'common sense of the control measure', which in most cases was derived from the explanation provided by the veterinarian. Some farmers reported that the fact that the control strategies were based on good husbandry practices or on a drastic approach inspired their belief on the effectiveness of the control measure. In some cases, other farmers' positive experiences were enough to convince the producer of the effectiveness of the control measure. However, there was also the perception that the practices of farmers in other countries were better:

"Again, I have been talking to other people. Contacting friends abroad. They do it on the continent all the time. Why they don't do it over here? I don't know. The vet has never suggested it at all. Which is common practice on the continent to do this. So hands...well it worked for them...and their figures are a lot better than our figures, so I will give it a go (...).I am pretty confident that it is going to sort it out. Fingers crossed, yes" (Farmer 6).

Farmer's previous experience or confidence and trust in the veterinarian's guidance were also identified as factors associated with farmers' belief of the effectiveness of control measures.

"He [the pharmaceutical company representative] told me that it would [work]. And the vet was certain that it would work." (Farmer 4)

**Uncertainty.** In many situations farmers were uncertain about the efficacy of the control measure. This uncertainty was in some cases due to the novelty of the disease affecting the farm, and the fact that no successful control measures had yet been described. In some situations, not being able to identify the cause of the disease problem or the fact of dealing with complex or multi-factorial disease situations also led to uncertainty (see also template: 'Power to control: lack of knowledge').

**Principles.** A few of the interviewees reported some of the principles that needed to be considered when deciding which control measure to implement for disease control purposes. One participant stated that, as a 'philosophy', antibiotics were only used when no other measures were available:

"We discussed with the feed rep [representative] about the idea of putting antibiotic in the feed as a control to it. We also discussed it with the vet on the same basis. But we have a philosophy here that antibiotic is our last call. We tend to look at prevention by either reorganizing the unit and how it is run, or by vaccination." (Farmer 16)

Other farmers reported, based on animal welfare issues and the amount of extra labour required, that they tried to avoid injections as much as possible. The belief on the cost-effectiveness of a control measure was also reported as one of the requirements essential to some of the participants.

### **3.3.2. Subjective norm**

**Subjective belief.** Veterinarians' opinion and advice were considered by many farmers in this study as the most valued.

"Mainly my vet. I have got confidence in my vet. So that's who I listen first of all" (farmer 12)

However, some producers also considered other farmers' experience to decide on how to control ill-defined or ill-structured disease problems, particularly when cost of interventions could be an issue:

"Usually word of mouth. It was usually at meetings and you talk to them and they said 'well, yeah, it made a big difference to our bank balance after two years'. That persuasion, really, rather than the vet. The vet was sort of 'well we have enough fund, do it while [making] the building that we had to do', and it was that sort of....The vet put the seed of an idea there, but it was talking to other farmers that actually convinced us what to do." (Farmer 16)

"So just because the vet say do it, we don't just jump. I mean....some of them is just...you know, sometimes its 'yeah we just do it', but another time, when there is a bit of cost involved.....You know we

enquire...I mean the batch farrowing was a bit of our own by talking to other producers and mainly sort of 'name-person' from 'breeding-company'." (Farmer 18)

Many times, other farmers' experiences were channelled through the pig press and/or BPEX, pig discussion groups and workshops. Breeding companies, feed representatives and nutritionists were also considered relevant external influences by interviewed farmers:

"...hmm....I think a lot of it was starting to come in through the general pig farming press, Pigworld, running a lot of articles on it. And the 'farm breeding-company-X', who...I wasn't at the time buying gilts from them, but I do now. They were having problems in their own farms and they were anxious to sort it out, and their production director had done a lot of work on it and followed the Madec's principles as much as possible, which move them back the route to 3-weekly batch farrowing and getting the all-in all-out production by building and this sort of things. And that was proving a great success for them, so that was the route we took at the time." (Farmer 5)

**Motivations to/not to comply.** One of the important drivers to comply with external advice, as reported by the participant farmers, was related with the 'economics' of the control measures. Most farmers in this study considered the cost and cost-effectiveness of the control measure as essential criteria; farmers may decide not to comply with the recommendation provided if they don't believe that they will obtain positive returns:

"Well, it's back to us....it's...you know, it's just a cost-benefit analysis. With EP [enzootic pneumonia] we know what the vaccine cost, we know what it does to our herd, we know that it's better to vaccinate (...) Because if you look at Circovac [PCV2 sow vaccine] or CircoFlex [PCV2 piglet vaccine] the cost of it is so high, that I can't see that the returns are going to pay for it. So we don't do it. So that is where it comes down to at the end" (Farmer 3).

As shown in previous comments, referring to other producers' positive experiences with the control measures and/or explaining and making farmers understand the logic of the measures and/or the cause of the disease, were other factors identified for compliance with external advice. The feasibility of the control measures and the amount of extra labour required were also mentioned as key factors for farmers to agree or disagree with recommendations:

"ohhh, [I] couldn't guarantee it [that the measure was going to be effective], but it wasn't a huge logistical change...you know, there was no financial suffering. We didn't have to change on how we farm a great deal....I mean, you know...you do what you can" (Farmer 20).

"...to be honest, we had to take the recommendations (...) A lot of the products we use, there is one eye on how good is this product, and the other eye on how much labour is involved using it. So anything that is single dose is preferred" (Farmer 13).

The idea of positive externalities, such as elimination of other diseases, was also reported. In some cases, farmers finding themselves in difficult situations ('situation of despair') could act against their veterinary advice and follow other farmers' recommendations:

"Once we knew there was a vaccine for APP [*actinobacillus pleuropneumoniae*]...we have always been told by our vet that the vaccine for APP was not a very successful solution. So, therefore, we knew there was a vaccine available, but we understood it wasn't very efficient and so consequently it hasn't been done. He has never recommended it and he did not recommend it this time. I mean, the situation is that we are just again back against the wall with very ill pigs, and a tremendous amount of work to try to stop them going backwards and dying. And when I heard this from my Irish friend, then I was persuaded more and the second my vet came back off holiday (...), I bought the stuff" (Farmer 8).

Nevertheless, the situation itself was at times enough motivation for farmers to follow veterinary advice, without having sufficient evidence or being uncertain of the level of effectiveness. In some circumstances, the lack of effective measures was also a motivation to agree with external recommendations:

"Madec, that's the name. That came out from France.....management procedures to try and alleviate the issues, which some of...you know, quite a few of which we...did quite a lot of changes in management wise, because there was nothing else that was working"(Farmer 17).

However, in many situations trusting the veterinarian and/or the acknowledgment of his professional competence was an important factor to comply:

"Yes, for us the vet is always the first port of call. Because they have the training, they have got the knowledge; they have also got the local knowledge of what's going on. They've got national knowledge of what is going on as well. So, that's [following vet's advice] what we are doing" (Farmer 9).

### **3.3.3. Perceived behavioural control**

**Control belief.** Four themes were classified under this code. The first one, 'conducting trial on-farm', reflects the need of some farmers to try the control measure in order to assess its efficacy and decide whether to use it or not. The second and third themes are related to farmers' feeling of control and self-efficacy when the measure was under veterinarian supervision or was implemented and monitored by a coordinated team of experts. Having a measurable outcome also contributed to farmers feeling of control of the situation (see also 'Deciding control measure: Attitude towards measure: outcome evaluation').

**Power to control.** Three major themes were identified concerning factors limiting or facilitating the decision making process. The first one is related to the economics of the farm. Some farmers reported that the difficult financial situation makes them unable to employ the labour force required to effectively implement control measures and/or did not have the resources to make major investments in the farm for that purpose:

“Now, if we get somebody in...another staff person or just another pair of hands, we can’t afford to do that, because of the economic climate. So, the economic often may compound problems onto the farm. There are things we would like to do on the farm, to minimize disease risk, but we can’t afford to do it” (Farmer 9).

“Well...the...I felt that the pneumonia vaccination wasn’t working. ...so the alternative was a partial depop / total depop, which given the financial circumstances and the effect on cash flow I have ruled out at the moment...” (Farmer 1).

The second major theme was related to the structure, management and environment of the farm. Several farmers believed that having strong bio-security measures in place facilitated the effectiveness of the control measures. On the other hand, another farmer explained that the environment of the farm, such as being an outdoor farm, could also compromise the level of bio-security achieved:

“No, it was instigated by me. You know, some might say it was a symbolic effort to try...because obviously, I will say it again, control...elimination of birds is impossible. It was to see if it could have an effect” (Farmer 20 – regarding Salmonella control in outdoor farms).

Good husbandry practices on the farm were also believed to enhance the effectiveness of the control measures. In addition, the layout of the farm buildings was seen both as a limitation or facilitator for the implementation of different control measures, and therefore influenced the decision on how to control a disease problem:

“Well, we sort of just did what we can. But at the time we had a unit that we were renting that was fully slatted. And there was not much really that you could do. The system was as it was, and it wasn’t a lot you could do to change the system” (Farmer 19).

“For us, unless we change our buildings and the way we run our herds, we have a limited number of options. So, we wash out when we can. We wash out when it is possible. And when it is not possible, then it isn’t possible” (Farmer 3).

The third theme was related to the lack of existent knowledge or understanding of the disease by the farmer, the veterinarian and/or the whole community, as perceived by the participating farmers. This was particularly relevant for novel diseases, where not enough information and/or effective control measures were available:

“Yes, you know. He [the vet] was really operating to a large degree in the dark as well. You rely on them on getting up to speed, you know, to pass the information they have” (Farmer 17).

“No [don’t look for information on PMWS control], because I don’t think you could control it. It was something uncontrollable. (...) Farmers have got it, to different degrees. So, there is nothing you can do about it” (Farmer 7).

Not being able to determine the cause or understand complex multi-factorial disease situations were also identified as limiting factors by interviewees:

“But when you have a problem like I got, we don’t know whether is PRRS, whether is a period with PRRS where they are breaking down, with cough and hearts... and they got all this pleurisy, we got some APP as well, but with APP you have instant death, and we don’t have any of those, and it’s the blind leading of line. And I have more ideas than my vets, and that’s ridiculous” (Farmer 8).

“Both are not quite obvious diseases. They are both very cyclical, they come and go. You can live quite comfortably in your herd at times, and then suddenly for whatever reason they spike and create quite a lot of problems” (Farmer 10).

### **3.4. Factors influencing the use of information sources**

Figure 7 summarises the responses obtained in the closed questions regarding pro-activity. Low pro-activity towards disease information was observed, with 12 farmers reporting that they actively looked for information only every six month or less. Passive reading of articles, mainly in the Pigworld journal, was the most common activity amongst those investigated. Template results for this section can be found in Figure 8.

#### **3.4.1. General issues with information**

Several third order themes were identified within this main theme:

**Lack of effective communication.** This theme was related to the excessive confidentiality existing within the pig industry that acted as barriers to knowledge. Many farmers believed that most producers are too 'individualist', and that they do not tend to share the disease problems at their farms. They believed that most farmers 'only tell the good things and not the bad things':

"... because pig farmers don't go onto other pig farms, you don't get an actual day to day on what exactly other people are doing. When you talk to them, they tend to tell you the good things they did, but not the bad things. So that is where we sort of, we are let down in this communication between the practical pig farmers, rather than the vet or the rep [representatives of some companies], who tend to be like Chinese whispers, almost one step away from where the information came from." (Farmer 16)

As found previously, other farmers experiences were valuable information to make informed decisions to control a disease problem. Therefore, not sharing problems and experiences was seen as a relevant issue by participating farmers. One participant defined this behaviour as a 'mindset of British farmers', indicating a cultural explanation. However, excessive confidentiality was also an issue observed with breeding companies and the research community. Although some farmers said that they understood the commercial importance of confidentiality for breeding companies, this was perceived as increasing the risk of disease spread within the pig industry. This feeling was mainly associated with the PMWS epidemic stage, where many breeding companies were blamed of disseminating the virus:

"There was a bit of fault wise with the breeding companies really, because there are some tasks where they can be a bit slow to....they don't like disclosing when there were health problems, because is such...so many issues for them, you know. (...) they play their cards a bit closely some of the times. Which I can understand to a degree, but does not necessarily....I mean when wasting disease [PMWS] came out, they probably knew it was...you know, we got problems....they certainly knew before we did. I mean, that was one of the major changes we made; we went to breeding our own farm gilts" (Farmer 17).

Overall, this lack of communication within the industry was described by one farmer as a 'feeling of isolation', which could be harmful in disease situations. In consequence, farmers' discussion groups and pig health schemes/clubs were seen as the most preferred methods of communication of disease issues by many of the producers in this study. Farmers not participating in pig health schemes/clubs felt that no real system of disease alert was in place:

"You got basic advice from your vet, like, sort of, you want the full dip. 'Scrub your boots before you get to the little pens', you get some of this basic hygiene and things that you have learnt in college and that type of things, but what we don't get is back an alert to say that there is something in the air: 'We got farm in the 'region X that are suffering from something of...'', we can sometimes pick it up from publications like Pigworld magazine or sometimes at the NPA website" (Farmer 9).

"...one of the problems is that we deal with one vet. Now the next pig farmer deals with a different pig vet. And I know vets probably talk with each other. Well, they have to. But there is no...there is no real system. So...yeah, we are going to join the BPEX scheme for this area..." (Farmer 13).

**Poor communication format.** Several farmers indicated that they had difficulty reading and understanding some of the information available. These difficulties were mainly due to the excessive scientific terminology/approach of some of the material, or due to the difficulties to access information in some of the websites.

**Lack of information.** This theme related to the information missing or not communicated to farmers. One participant expressed the view that solutions were not usually provided/proposed together with information on health status/diagnosis and this therefore limited the usefulness of the latter:

"I think that we are members of the BPHS and we have pigs regularly monitored at slaughter. And for some time now, we received stupid remarks on it to say 'you have a pleurisy problem, you need to do something about it'. And say...I got back to the vet and say 'look, this is being said, what can we do?'. If I go to MLC [Meat and Livestock Commission], all they say is 'go to your vet'. And I have done that ...when I first say this, I went on to MLC and BPEX and said 'don't just tell me that I got a pleurisy problem, tell me what I can do about it'. And the answer is 'we can't help you. Talk to your vet'." (Farmer 8)

As found in previous sections, information from other farmers or research done abroad had a significant impact on the farmers' decision-making process. Furthermore, the fact that pigs, and therefore diseases, are traded internationally and the perception that limited research is currently being performed in the UK, was mentioned by some farmers as a driver for getting 'international information'. However, a few of the producers believed that this type of information was often missing or was difficult to obtain.

**Information bias.** Concerns were raised by a few farmers on the objectivity of the information received. Conflict of interest derived from pharmaceutical companies was believed to exist:

"Apart from that in the internet, honestly...hmm...there is so much of the internet that is based on the advertising, that I am very sceptical at anything which is being supported by

drugs companies. Because they are just there to make money and that is not my interest...you know...I want to know what is best for my herd and therefore it has to be independent, and the internet doesn't come into it" (Farmer 3).

One participant explained that some of the information provided was derived from other farmers' experience with different systems, and therefore not applicable to his farm. This farmer also claimed that some erroneous advice was supported by the media or by organizations due to the eloquence of some farmers. Nonetheless, while several issues related to information on disease were identified, a few farmers indicated that they were satisfied with the information received/available and that no problem currently existed.

#### **3.4.2. Attitudes and perceptions towards information sources**

Results from the closed questions showed that farmers in this study perceived Defra, NADIS (National animal disease information services) and Farmer's Guardian as the least useful information sources on animal disease. However, as shown in Figure 9, only a few farmers reported to use or know about the NADIS programme. Only 7 farmers reported using pig websites (i.e. pig333.com, thepigsite.com or pigprogress.net) as source of information for diseases, and believed these were useful or very useful. Pigworld magazine, BPEX and BPHS were identified as the most useful disease information sources by most of the participants. Focus on the results from the qualitative analysis obtained for Defra, BPEX and research from academia was made for the purpose of this study:

**Defra.** In general, a negative perception was obtained when asked about disease information from Defra. Strong negative comments were obtained from a number of farmers, such as 'I am really anti-Defra' or 'pretty hopeless', indicating a major discontentment. For many farmers, this negative perception was due to the way the Foot and Mouth epidemic was managed in 2001:

"Well, right. I don't use it. And I have to say, with the way they dealt with us, when we had the foot-and-mouth outbreak [in 2001], they must be the most ill-informed on disease that I have ever come across.(...) They were the main cause of us having to re-stock, through their stupidity. Qualified vets, not allowing us to mock out our pigs, not allowing us to move pigs, diabolical. If I took that decision myself, I'll go to prison" (Farmer 8).

The sense of 'threat' and 'nervousness' was also reported by some producers and seemed to contribute to the negative perception towards Defra:

"When was the last time I got...had DEFRA tell me that there was a disease or any apart from me seeing it on TV? I have never seen anything that comes from Defra that might help me. Never. All we do is...you might get a threatening letter from them for something. It is nearly always a threat" (Farmer 12).

A few of the participating farmers believed Defra's information was not updated with relevant new information, was impractical, or was not useful for routine management. Many of the interviewees believed Defra was not 'pig specific' and did not have pig experts among their staff. One of the participants said that Defra was only useful for 'backyard pig keepers'. However, most of the farmers recognized that they did not consult Defra when dealing with disease issues. Defra was not seen as a priority source for information, but was only considered relevant for information regarding national disease emergencies.

In contrast, few farmers had a positive perception from Defra. Those that did so believed that Defra's information was useful during major disease outbreaks. One farmer mentioned that the 'booklets' sent by Defra were useful, because they kept him updated on disease occurrence at an international level. Two participants acknowledged the important role of Defra through funding research performed in the pig industry. However, the most positive perceptions were associated with the work done by the Veterinary Laboratories Agencies (now named Animal Health and Veterinary Laboratories Agency), primarily on their role as providers of diagnostic services for diseases to farmers and veterinarians:

"Well, is it Defra... well suppose they got to ask us... I am trying to think of what disease DEFRA has done. They might sponsor a lot of the things... I mean VLA is basically underneath their... VLA is paid by them, but I tick their box rather than the DEFRA box." (Farmer 18)

"VLA it's useful when you actually have to have a post-mortem done..." (Farmer 3)

**BPEX.** In contrast to Defra, BPEX was perceived by the majority of farmers as an extremely useful, very useful or as a useful source of information on diseases (Figure 9). BPEXs' information was seen as 'practical', 'business orientated', 'with good ideas' and provided in an 'easy reading' format.

Information from BPEX was also described as 'honest', disposed of any interest or statistical interference. The main and most frequent positive perception obtained from farmers was related to the workshops and discussion groups organized by BPEX. These were liked by interviewees because they facilitated discussion and communication between farmers, and allowed them to learn useful techniques. Furthermore, some farmers considered these BPEX meetings useful when experts are brought in to explain current disease issues.

Additional positive comments were related to the BPHS system, disease update reports and disease outbreak mapping, with special reference to the case of Swine Dysentery. BPEX was also seen as the preferred reference source of information by many participating farmers, after the veterinarian, and as the link to other information sources:

"BPEX... hmm... they are getting there. They are trying to get this website where there is a one stop shot for everything. So you can go in that website, which I do for 'electronic IML-2', you've got your salmonella reports you can access from there... hmmm... and BPHS information... hmm... so they are getting there (...) It is useful because I am going there every week to book my pigs in... so if it is somewhere you are going every week, that's the place to look at disease information" (Farmer 1).

Nonetheless, a few farmers reported some issues, or had some negative perceptions concerning information provided by BPEX. Some farmers found it difficult to trust BPEX's advice as the information was frequently provided by non-pig experts or if the farmer believed his situation was better than what it was advised:

"Not very useful (...) Why? Because the people who are giving the information don't know enough about what they are doing. Basically, in my opinion, (...) because I'm doing better than what they are telling me to do" (Farmer 7).

"They tried to push various schemes and... they... the people that end up working for them, giving the advice, are usually people that have not succeeded themselves. And I find it difficult to accept some of the comments made by this people. The main benefit from going to the meetings is to listen to other pig producers talking. Not to somebody that is standing out there, giving you their views, or his views" (Farmer 12).

The participatory methods used during some workshops were in part criticised by one participant, who felt that those were sometimes too rudimentary and preferred to have other farmers or experts discussing their own experiences or a particular topic. Negative comments were also related to short communications or 'bullet points' communications of some disease issues, where more detail is

often needed in order for the farmer to understand and trust the advice/results provided. This is in contrast with other farmers' comments which preferred simple and short communications for the dissemination of disease information.

**Research at Universities.** Although most of the farmers stated that research is 'probably good' or 'that it is good that research is being done', very few participants were actually aware of the research being conducted by universities and several negative themes were obtained. The major criticism was associated with the lack of communication of research findings. For some farmers, this lack of communication or research feedback makes them unable to provide an opinion about its usefulness and/or makes them question the relevance of the research being done:

"I rarely see any information and I just wonder how relevant is some of it that they are doing. I just wonder whether they actually are going to help. It's ok doing the research, sometimes it's what we already know, but we want to find out" (Farmer 12).

"The honest truth is, I don't know how good it is because I don't know much about it. That's part of... it's been part of my grumble for a long period of time... is... you know... we don't know which research is being done... and then when it has been done, it's not... it needs to be pushed out"(Farmer 18).

One farmer criticized the fact that most of the research is not available in open access journals and therefore was not able to access it. Another participant claimed the right of producers to have access to research findings, particularly of projects funded by BPEX. Some producers attributed the lack of their awareness of research findings to lack of time, lack of motivation, or lack of interest; or the fact that they do not know how to obtain this information:

"I never heard about it. And that is maybe my fault because I never read it, but I just don't have... just don't have the time. They are maybe doing some good stuff, I just don't know about it" (Farmer 3).

"Why don't I look for information? Well, I don't spend an awful a lot of time sitting in an office looking for information. I might decide for... in and out. Hands on with it. And then when I knock off, and have an evening indoors, I really don't feel like scrolling through pig diseases" (Farmer 4).

"eh... I don't know to that. I don't hear any results. Where do you hear the results? I don't know" (Farmer 7).

"I think also, I don't know where to look. That's another thing. And honestly, if I type university pig scour, I don't know what I will get" (Farmer 9).

The lack of research funding in the United Kingdom was also perceived by farmers as one of the reasons why they were not aware of research projects. In their opinion the English pig industry

mainly relies on research done abroad, which in some cases is not applicable to the UK pig production. One participant reported that ‘any real research’ was only done abroad:

“PCV2 in the early days of the problem, when we didn’t even know it was PCV2, it was absolutely dreadful. There just wasn’t information. Now I will say that the best thing that happened with PCV2 was the Americans getting it. Because it led to the vaccines and the rest of it” (Farmer 5).

Another problem with information on research projects was the poor communication format in which articles are normally written (See template ‘Factors influencing the use of information sources: General issues with information: poor communication format’).

Information bias was one of the worries that some farmers had regarding research done by universities. Three producers believed that the conditions of the experiments/trials performed by academics did not reflect the real pig farm conditions, and therefore the results were not applicable or useful to them:

“Again, university tend not to be what we classify as practical pig farmers (laugh). It tend to be, a little bit either, the units are under-stocked, you know, they go...they don’t see the day to day running problem. They got more labour, they got various things that makes them sort of.....It is not very useful because they don’t reflect (the real pig farms)” (Farmer 16).

Two farmers specifically criticized the low sample size of some of the trials conducted. Another two participants believed research to be funded by pharmaceutical companies. This implied a bias towards the interest of these companies. Some producers perceived the research to be outdated in nature, arriving once the farmers had already found a solution. Another farmer believed researchers lack field expertise, and that as a consequence they were reluctant to participate in some of the research projects:

“We were going to do this [PCV2 survey], because they warned us that the university will come round and doing blood test, I agree to start with... to accept that they can do the blood test. And afterwards I decided ‘hang on, that’s a bit stupid, there will be a whole bunch of people, students or people that probably would have never been on farms in their life before, have no clue at what they are looking at... we are looking at pigs that are potentially sick, and so you see things that you don’t want to see. And so, that tap of it [that triggered it], and decided not to get them and having come around” (Farmer 12).

**Veterinarians.** Veterinarians were positively perceived by the majority of the farmers in this study. However, these positive perceptions were mainly associated with veterinarians who

are specialized in pig medicine. Indeed, the fact that his or her veterinarian was a 'pig specialist' seemed to increase their confidence in them. They are seen as the person 'with the knowledge' and the training, not only in pig medicine, but also in pig production. Furthermore, several farmers considered his or her veterinarian as a 'field person', who is constantly visiting many other pig units and therefore had the knowledge of the disease situation in the country/area and the experience to prevent and control the situation.

"The vets go around different pig farms all the time. And usually what we know it's happening in one farm, is usually happening in all pig farms across the countryside. The vet will turn around and will say yes. There is a lot of that around in the moment. And this is how we are going to deal with this situation'. It is normally via the vets... the biggest [influence]". (Farmer 9)

"The good thing is that because they are working in units all the time, they see how this disease develops, actually on farm, and they can sort of tell you what to expect or what to account for, and sort of deal with things. That's really very useful." (Farmer 14)

In addition, some farmers suggested that because their veterinarian went to international conferences, was part of a team of pig specialists, and/or was able to communicate with other pig specialists, their confidence in their veterinarian's judgment and expertise was increased. Several producers perceived their veterinarian as an expert, resourceful, and with the ability to successfully assess disease problems on farms. For the latter, farmers reported the ability of the veterinarians to work with pharmaceutical companies, veterinary colleges or to the fact that they can interpret photos taken by the farmer on diseased or dead pigs. Veterinarians were also perceived as good communicators. As shown earlier (see attitudes: outcome belief), several farmers reported that veterinarians are able to explain the disease situation of their farm and the logic of the control measure to be applied. One farmer explained that he appreciated receiving 'fast reports' on the evening the veterinarian has visited his farm, because he provided him with an 'impression of urgency' and enable him to take fast actions. Other farmers valued the fact that the veterinarian was able to communicate with the staff (stockmen) working at the farm. Several producers reported the important role of the veterinarian in informing them on disease area alert and in organizing farmers' group meetings to discuss disease problems. Another important

theme, as reported by farmers, was that veterinarians are able to consider the economics of disease and of possible interventions. All these positive perceptions seem to generate an important sense of trust by farmers in the veterinarian.

"Oh, he [the veterinarian] is very good....I mean...I trusted 90% plus. Sometimes it comes down to...I mean something it will come down to cost at the end of the day, and that what he is very good at, he is very cost based..."(Farmer 18)

"I rely on my vet for information more than anyone else. He....we make good use of our quarterly visits, and talk through issues...and basic information he provides is good and make its way around. I think it gives good information, he made good advice." (Farmer 4)

However, three farmers reported that this trust relies also on the fact that veterinarians are paid for providing information and for solving disease issues on their farm.

"And then if you look at a veterinary problem, we have our vet as a professional relationship with us as a client who pays" (Farmer 13)

"It largely comes from our vet. Because that is what we pay him to do. He is a pig specialist, so I would like to think that it comes back with the right information." (Farmer 3)

Some negative perceptions were also identified regarding the veterinarians. Several farmers reported that veterinarians only provided information when asked. In this regard, four farmers complained that their veterinarians did not provide disease area alert or warnings, and that they had to ask in order to obtain this information. One farmer believed that his veterinarian wouldn't tell him which diseases were in his area because he didn't want to 'scare him'. He complained that his veterinarian was only concerned about the farm's current disease problems and not about possible risk of disease from outside. Another producer believed that veterinarians are 'always a step behind the disease', and that by the time they find a solution the disease has already evolved. One farmer complained that his veterinarian only talked with the managers of the farm and not with the stockmen. Another negative perception was related to the belief that veterinarians 'have fashions', and that therefore he (the farmer) has to be cautious in some cases when considering their advice. Finally, two farmers reported the possible conflict of interest of veterinarians due to the fact that they also sell drugs.

#### **4. Discussion**

This study has aimed at improving the understanding of the factors involved in the disease control decision-making process, information sources, and management of information by farmers.

Template analysis proved useful in capturing the high variation of experiences and perceptions amongst farmers, but also to identify common and shared themes.

It was also appropriate for this study to focus only on diseases classified as ill-structured or ill-defined. These diseases are normally characterized by having important consequences, and therefore requiring important decisions and efficient management of information. Application of scenarios based on diseases easy to recognize and/or to control would have been inappropriate to capture the full process of the decision-making and could have resulted in obvious, non-rich and non-diverse answers by participating farmers. The fact that two disease experiences, and not just one, were investigated for each pig farmer was useful to ensure a reliable exploration of factors involved in the decision-making process and to increase the level of saturation of the study.

Furthermore, the selection of farmers was not done at random, but ensured that different types of farmer were part of the study. The sample of 20 farmers was chosen in order to allow in-depth face-to-face interviews, which helped to increase the validity of the investigation over that which would have been expected with short interviews to achieve a larger sample size (Crouch and McKenzie, 2006). The agreement of the results with existent literature, especially with the study conducted by Garforth et al. (2013), also substantiates the validity of these results. The use of a systematic approach, a theoretical framework and careful sequence of questions was done to improve the reliability of the study. The selection of farmers by using the PCV2 BPEX vaccination programme database could have led to some degree of bias and might explain why PMWS and PDNS were the main diseases described by farmers. However, it is worth mentioning that over 75% of farms in England applied to this programme (White, 2012). Therefore, the level of bias that could have been

produced by using this database is considered to be low. On the other hand, it is important to note that closed questions were only used in order to describe the characteristics of farmers participating in this study. Therefore, the results from the closed questions are not generalizable to the overall English pig farmer population.

The TPB was used as a framework for the purpose of describing the decision-making process involved on the control disease problems by the farmer.. Ajzen and Fishbein (1991) developed this theory for the purpose of predicting intention to engage in particular sorts of behaviour, and it has mainly been used in quantitative studies. Nevertheless, this model presents several limitations and has been criticized by different authors. One of the major assumptions of this theory is that it assumes that peoples' behaviour corresponds to a rational and systematic decision-making process and therefore it would follow a linear decision-making process, not changing over time which might not always be the case in real situations. Some of the criticism is also associated with the relationship of the component construct with the behaviour itself. Some authors argue that in some cases attitude may not be directly related to behaviour, while other authors have argued that different components might have different weights (Sheppard et al., 1988). Armitage and Conner (2001) identified self-presentational biases (bias introduced by the individual reporting the behaviour) or the weakness of subjective norms as a predictor of behaviour as important issues surrounding TPB studies. However, it is important to note that this study did not aim to measure which factor was a better predictor of behaviour, nor to test any hypotheses. Rather it was designed to to identify and accurately understand these factors through farmers' own life experiences and perceptions. Qualitative analysis is a powerful tool to capture the variability of factors and, therefore, to understand the complexity and dynamics of farmers decision-making process. Douglas (2002) stated that *"qualitative research, and qualitative analysis, involves working out how the things that people do make sense from their perspective"*. By going into farmers' personal experiences with two complicated diseases, this study has attempted to understand the farmers' perspective. Here the the TPB provided a very useful framework for the interpretation of data. It also

helped us to clearly investigate factors related to external pressure/information sources, attitudes and control. Furthermore, several empirical studies have shown the usefulness of this theory to predict and explain behaviour and it has been widely used in the agricultural sector (Ajzen, 1991; Armitage and Conner, 2001; Garforth et al., 2004; Jackson et al., 2006; Gunn et al., 2008). In addition, the separation of the decision steps, 'deciding the need to control' and 'deciding how to control the disease', proved to be useful to investigate the drivers for disease control and the factors associated with behaviour.

Interestingly, disease problems were not mentioned during discussion of the economic environment of the industry. Although diseases are important elements in the economy for farmers, currently the issue of disease seems to have been relegated to second place. Its economic relevance to farmers is currently being overshadowed by the issues created by increasing feed costs and poor pig price problems in the industry. Nonetheless, 'economics' was one of the major themes identified consistently throughout the template. The current difficult economic environment limits and even nullifies in some circumstances farmers' profits and their capacity to undertake important investments and control measures, acting as a barrier to behaviour intention linked to disease control. As result, producers were left with a feeling of pessimism and with the need to consider the cost of disease and cost-effectiveness of control measures throughout the decision-making process. Therefore, veterinarians and other actors have to tackle and consider economic aspects, impact of disease and control measures in order to provide effective advice. As shown in the template, one of the positive characteristic of the veterinarians, as reported by participating farmers, was that they normally took into account the economic aspects when discussing different disease control strategies. On the opposite side, some farmers criticized Defra for using an incorrect approach in relation to the economics of the farm. However, economic aspects were not the only relevant factor involved in the decision process. Other factors such as understanding the cause of disease, the logic and common sense of the control measure, farmers' principles or fears, feasibility of the control measure and animal welfare, amongst others, need also to be considered when providing advice.

However, it is important to note that other drivers not identified in this study could also influence farmers' decision processes. In a study performed in The Netherlands on improvement of mastitis management on dairy farms, it was found that 'job satisfaction' and 'overall situation of the farm' had higher scores of importance than 'economic losses' (Valeeva et al., 2007). A study that analyzed the entrepreneurial behaviour of Dutch dairy farmers showed that four non-economic goals, such as 'work satisfaction', were more important than 'realizing an income as high as possible' (Bergevoet et al., 2004). Although these corresponded to goals for farming and related to the dairy sector, they highlighted the potential importance of non-economic factors in the decision-making process of farmers. It is also relevant to note that different farm types and sizes as well as a farmer's personality traits might have an influence in the relevance of drivers and goals involved in the decision-making process, and therefore should also be taken into account (Willock et al., 1999).

In general, lack of communication within the industry, and especially between farmers, was seen as one of the most important barriers to knowledge. This lack of communication provides some farmers with a feeling of isolation. These results agree with the findings of a survey conducted by BPEX in 2007 (Lukehurst, 2007). Lack of farmers' cohesion and communication was a frequent argument identified by several social studies, although most of them related to the dairy industry (Heffernan et al., 2008; Ellis-Iversen et al., 2010). Nevertheless, pig producers stated that farmers discussion groups and sharing of information between them was crucial. This seems to be the preferred method of communication, after the veterinarian, in order to tackle ill-defined and/or ill-structured diseases. Many of the disease experiences told by farmers in this study have demonstrated its importance.

Farmers' perceptions/attitudes toward information sources also highlighted several possible barriers to knowledge. In first instance, most farmers seemed reluctant to extract information from Defra. Farmers reported that they would only seek information from Defra in situations of national emergencies. This strong negative perception, in many cases associated with the FMD 2001

outbreak, was also reported in a previous study in the dairy sector (Heffernan et al., 2008). However, in this study, the perception seemed to be focussed on Defra, but not on the VLA, an agency of Defra, which was generally perceived as very useful. Yet, VLA was only seen useful in relation to disease diagnosis through post-mortem services and Salmonella surveillance. No other of its activities were mentioned by farmers. In consequence, this study identified a danger that this lack of pro-activity and mistrust towards Defra might jeopardize the communication and implementation of future disease control policies.

In a second instance, farmers reported an important lack of awareness and communication of research findings from academia and other institutions. It is possible that this information might have been communicated by the veterinarians or BPEX, but it may not to have been associated with the research bodies as such. However, although most producers considered research to be important, farmers stated that they did not seem to seek scientific knowledge on current research. Most of the participants expected their veterinarians, BPEX or the press to inform them about it. In addition, several negative attitudes toward research were also identified. As a result, the use of scientific evidence-based information may not be considered and used by farmers, which therefore may compromise the impact of the research done.

This study identified the lack of knowledge as an important factor in the decision-making process. Other studies have shown that this lack of knowledge was one of the reasons why farmers did not implement biosecurity measures, certain vaccination programmes or adopt new technologies on their farms (Jonsson and Matschoss, 1998; Garforth et al., 2004; Delabbio, 2006; Heffernan et al., 2008). This lack of knowledge in some cases could be due to attitudes towards specific information sources or to negative pro-activity. In this study, lack of time was identified as the most important factor influencing pro-activity in the acquisition of knowledge. In some instances, lack of time was due to work overload, and the perceived difficulty of affording additional labour. As shown in the template (Figure 8 point 3.5.), but not described in the text of this article, willingness to spend time

on other activities rather than looking for information or just waiting passively for the information to arrive from experts or through the press, were also identified as barriers to knowledge. Nöremark et al. (2009) identified other factors related to pro-activity, such as farm size or proximity to outbreaks. Their study showed that despite major knowledge transfer efforts, 10% of Swedish farmers were not aware that an outbreak of PRRS had occurred. This was also demonstrated in the UK, where after a major knowledge transfer plan to livestock farmers conducted between 2001 and 2002, only a limited level of awareness and access to information was achieved (Iles, 2003). This, in combination with the results obtained in this study, highlights the importance of developing effective communication methods and policies to improve farmers' access and awareness to the latest knowledge from research and other information.

BPEX, Pigworld and, especially, the veterinarians were identified as the most used and trusted sources of information. Many farmers rely exclusively on them, and sometimes just on the veterinarian, to update them on any type of information related to disease, coming from research, area alerts, and any other relevant disease information sources. Trust of producers in the press and veterinarians was also described by other researchers in the dairy industry (Gunn et al., 2008; Heffernan et al., 2008; Ellis-Iversen et al., 2010; Garforth et al., 2013). However, some farmers reported the failure of these sources in updating them on disease information. Further, in some non-sustainable disease situations where no known effective control measures are available, other producers, and especially those from abroad, seemed to influence considerably farmers in their decision-making process. The relevance of the influence of other farmers against the veterinarian's has also been shown in other studies (Jonsson and Matschoss, 1998). Nevertheless, the findings of this study highlighted the importance of the veterinarians' role and responsibilities on the pig health of the farms, but also on keeping farmers updated in relation to research and disease issues. In agreement with the conclusions drawn by Garforth et al. (2004 and 2013) and Ellis-Iversen et al. (2010), knowledge transfer should be channelled through various sources, with special emphasis in

the veterinarian and farmers' focus groups. Furthermore, it should also address and relate to other farmers' experiences in press articles and reports.

In conclusion, this study identified factors influencing the decision-making process for disease control by pig farmers and alerts to the lack of awareness by producers on current scientific research. The results of this study can be used to formulate recommendations on how to better communicate information on disease and on general research.

## **5. Acknowledgements**

The work was funded by The Bloomsbury Consortium and by a grant (BB/FO18394/1) from the BBSRC CEDFAS initiative, BPEX Ltd, Biobest Laboratories Ltd., Pfizer Animal Health Ltd. Special thanks to all the farmers who participated in this study. We are thankful to Mr. Christopher Browne for his help in the recruitment of two farms for this study. We would like also to acknowledge Professor Dirk Werling and Professor Katharina D. C. Stärk for their contribution in setting up this project and for valuable discussions.

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## Figure Captions

**Figure 1.** Theory of planned behaviour. Figure adapted from Garforth et al. (2004) and Armitage and Conner (2001)

**Figure 2.** Initial template

**Figure 3.** Final template – Part 1

**Figure 4.** Final template – Part 2

**Figure 5.** Ill-defined and/or ill-structured diseases experienced by farmers ( $n=20$ )

**Figure 6.** Level of importance of four drivers for disease control as reported by participating farmers ( $n=20$ )

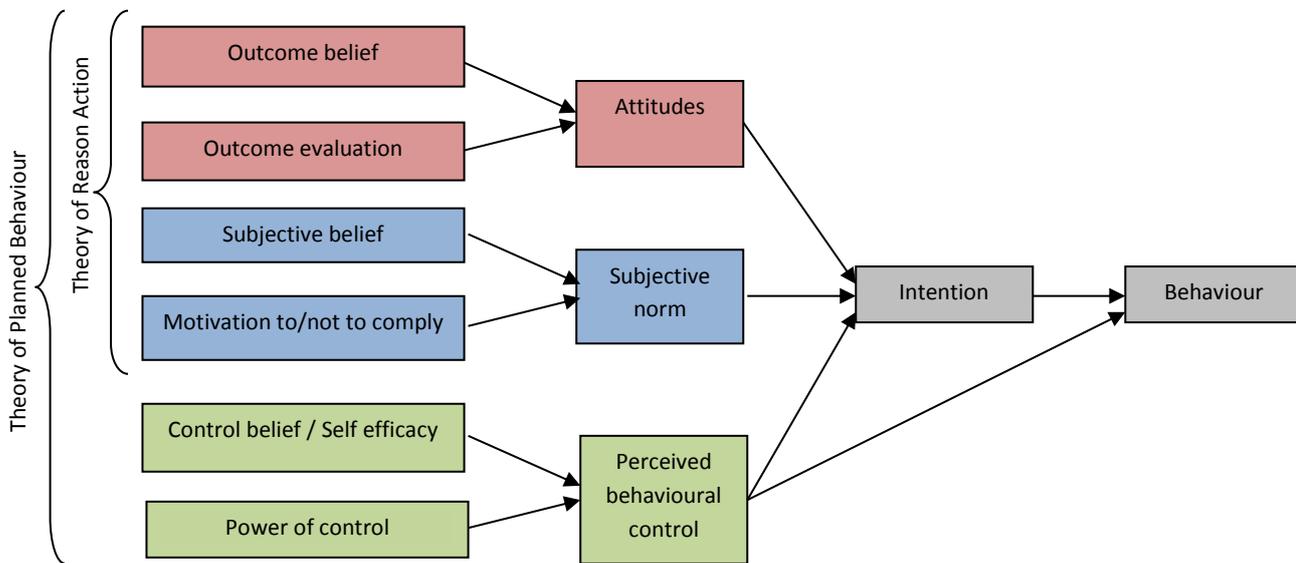
**Figure 7.** Frequency of different information-seeking activities done by farmers ( $n=20$ )

**Figure 8.** Final template – Part 3 and 4

**Figure 9.** Farmers' perceptions on the usefulness of different information sources ( $n=20$ )



**Figure 1.** Theory of planned behaviour. Figure adapted from Garforth et al. (2004) and Armitage and Conner (2001)



**Figure 2.** Initial template

<ol style="list-style-type: none"><li>1. CASE BACKGROUND HISTORY<ol style="list-style-type: none"><li>1. Type of farm</li><li>2. Reasons to become a pig farmer</li><li>3. Economic situation</li><li>4. Responsibilities towards pig health</li></ol></li><li>2. EXPERIENCE WITH COMPLICATED DISEASES (ill-defined problem)<ol style="list-style-type: none"><li>1. Recognizing a disease problem<ol style="list-style-type: none"><li>a. Reasons for suspicion</li><li>b. Confirmation of disease</li><li>c. Seek of information</li></ol></li><li>2. Deciding the need to control<ol style="list-style-type: none"><li>a. Motivations for control</li><li>b. External influences</li></ol></li><li>3. Deciding which control measure to use<ol style="list-style-type: none"><li>a. Attitude toward measure<ol style="list-style-type: none"><li>i. Outcome belief</li><li>ii. Outcome evaluation</li></ol></li><li>b. Subjective norm<ol style="list-style-type: none"><li>i. Subjective belief</li><li>ii. Motivation to comply</li></ol></li><li>c. Perceived behavioural control<ol style="list-style-type: none"><li>i. Control belief</li><li>ii. Power to control</li></ol></li></ol></li></ol></li></ol>	<ol style="list-style-type: none"><li>3. FACTORS INFLUENCING THE USE OF INFORMATION SOURCES<ol style="list-style-type: none"><li>1. General problems</li><li>2. Communication preferences</li><li>3. Attitude toward information source<ol style="list-style-type: none"><li>a. DEFRA</li><li>b. BPEX</li><li>c. Internet</li><li>d. Research / Universities</li><li>e. Veterinarian</li></ol></li><li>4. Type of information seek</li><li>5. Pro-activity<ol style="list-style-type: none"><li>a. Positive</li><li>b. Negative</li></ol></li></ol></li><li>4. PMWS study<ol style="list-style-type: none"><li>1. Farmer's reaction &amp; opinions concerning research findings</li></ol></li></ol>
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**Figure 3. Final template – Part 1**

<p><b>1. <u>CASE BACKGROUND HISTORY</u></b></p> <p><b>1. Type of farm</b></p> <ul style="list-style-type: none"><li>A. Management (Batch system, type of feed, Natural Service/Artificial Insemination)</li><li>B. Environment (indoor/outdoor, intensive/size, Floor type)</li><li>C. Business (commercial, genetic, type/age of pigs sold)</li></ul> <p><b>2. Reasons to be a pig farmer</b></p> <ul style="list-style-type: none"><li>A. Family business take over</li><li>B. Business characteristics<ul style="list-style-type: none"><li>i. Easy to start in farming</li><li>ii. Business that can be expanded</li><li>iii. Add value to an existing farming business</li><li>iv. Profitable business<ul style="list-style-type: none"><li>1. In old times</li><li>2. If doing things right</li></ul></li></ul></li><li>C. Love for animals</li><li>D. Lifestyle (pigs, outdoor work)</li><li>E. Early experience with pigs</li><li>F. Chance (opportunity arise)</li></ul> <p><b>3. Economic situation</b></p> <ul style="list-style-type: none"><li>A. Negative perception<ul style="list-style-type: none"><li>i. Feed price problem</li><li>ii. Pig price problem and uncertainty</li><li>iii. Financial pressure (investors, environmental agencies)</li><li>iv. Unfair competition from import products</li><li>v. Lack of investment capabilities</li></ul></li><li>B. Non-negative perception of individual situation, with remarks<ul style="list-style-type: none"><li>i. Making profits if:<ul style="list-style-type: none"><li>1. Hard work and through constructive thinking</li><li>2. Being efficient and having a fully slatted system</li><li>3. Control over feed (arable farm, feed based on waste products)</li></ul></li><li>ii. Having a good contract (feeling of being fortunate)</li><li>iii. Making investment based on past good years and expecting future good years</li></ul></li></ul> <p><b>4. Responsibilities towards pig health</b></p> <ul style="list-style-type: none"><li>A. Decision-maker<ul style="list-style-type: none"><li>i. Sole</li><li>ii. In partnership</li><li>iii. With vet</li></ul></li><li>B. Ensure bio-security</li><li>C. Vaccination and use of medicines</li><li>D. Disease observation, monitoring and notification</li><li>E. Working closely with the vet</li><li>F. Following health plan</li><li>G. Cleanliness and disinfection</li><li>H. Routine discussion with staff</li><li>I. Responsible for everything on the farm</li></ul>
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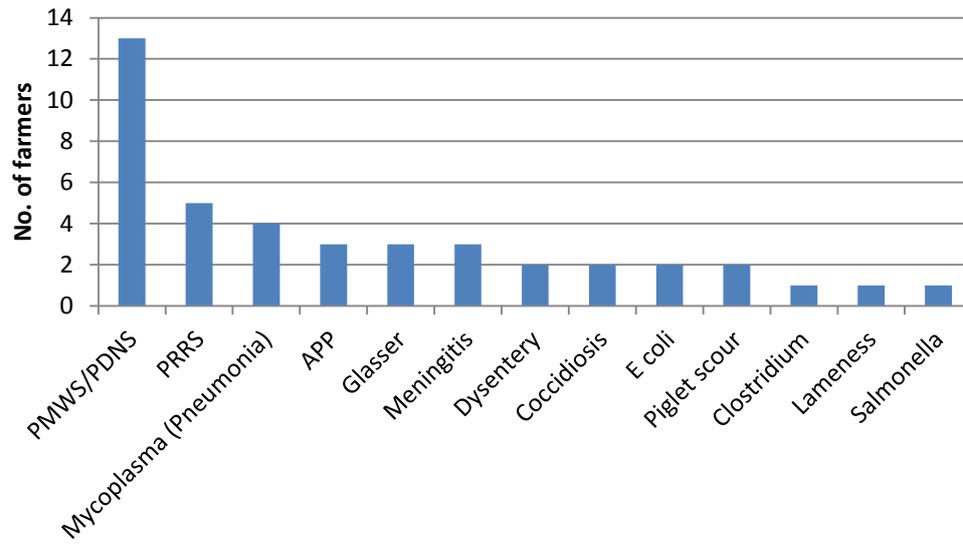
**Figure 4.** Final template – Part 2

<p><b>1. EXPERIENCE WITH COMPLICATED DISEASES (ill-define / ILL-structure problem)</b></p> <p><b>1. Deciding the need to control</b></p> <ul style="list-style-type: none"><li>A. Motivations for control<ul style="list-style-type: none"><li>I. Mortality of pigs</li><li>II. Low production performance (growth rates, feed conversion rates and fertility problems)</li><li>III. Animal welfare</li><li>IV. Economic<ul style="list-style-type: none"><li>a. Situation not sustainable</li><li>b. Economic losses</li><li>c. Fear of losing contract</li><li>d. Economically effective control measure available</li></ul></li><li>V. Existence of effective control measures</li><li>VI. Fear of getting the disease</li><li>VII. Fear of within-farm disease spread</li><li>VIII. Feeling of despair</li><li>IX. Reduce abattoir lesions scores</li><li>X. Reputation of the farm</li><li>XI. Social responsibility</li><li>XII. Frequency and persistence of disease problem</li></ul></li><li>B. External influence<ul style="list-style-type: none"><li>I. Pressure from contractor (abattoir or finishing site)</li><li>II. Vet advice</li><li>III. Other farmers (Discussion groups, Personal level)</li><li>IV. Salmonella reports (government pressure)</li><li>V. Feed representative and/or nutritionist</li><li>VI. Family/Partner</li></ul></li></ul>	<p><b>2. Deciding which control measure to use</b></p> <ul style="list-style-type: none"><li>A. Attitude toward measure<ul style="list-style-type: none"><li>I. Outcome belief<ul style="list-style-type: none"><li>a. Belief effective<ul style="list-style-type: none"><li>i. Because other farmers use it</li><li>ii. Common sense</li><li>iii. Logic of good husbandry practices</li><li>iv. Drastic measures</li><li>v. Experience on previous use</li><li>vi. Common practice abroad (“abroad is better”)</li><li>vii. Associations observed on-farm</li><li>viii. Vet confidence on the measure</li></ul></li><li>b. Uncertainty<ul style="list-style-type: none"><li>i. Lack of understanding</li><li>ii. Not identifying the cause</li><li>iii. Novel disease</li><li>iv. Complex disease</li></ul></li><li>c. Principles<ul style="list-style-type: none"><li>i. Antibiotics used as last resort</li><li>ii. Limiting injections to pigs</li><li>iii. Preventive measures</li><li>iv. Needs to be economically effective</li></ul></li></ul></li><li>II. Outcome evaluation<ul style="list-style-type: none"><li>a. Drop in mortality</li><li>b. Increase in growth rates</li><li>c. Improve fertility</li><li>d. Reduction in BPHS scores</li><li>e. Evaluation of the incidence of diseased pigs (clinical signs)</li></ul></li></ul></li></ul>
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**Figure 4 continue. Final template – Part 2**

<p>B. Subjective norm</p> <p>I. Subjective belief</p> <p>a. Veterinarians</p> <p style="padding-left: 20px;">i. Own farmer' veterinarian advice</p> <p style="padding-left: 20px;">ii. Veterinarian at producer conference</p> <p style="padding-left: 20px;">iii. Visiting veterinarian</p> <p>b. Other producers</p> <p style="padding-left: 20px;">i. at pig discussion groups</p> <p style="padding-left: 20px;">ii. at personal level</p> <p style="padding-left: 20px;">iii. Through press/magazines</p> <p>c. BPEX</p> <p>d. Feed representative and/or nutritionist</p> <p>e. Breeding company</p> <p>f. Pharmaceutical companies and Veterinary colleges (new vaccine development)</p> <p>g. Press and magazines</p> <p>II. Motivation to/not to comply</p> <p>a. Positive externalities of control measure (elimination of other diseases)</p> <p>b. Performing a trial to assess effects</p> <p>c. Common sense of the control measure</p> <p style="padding-left: 20px;">i. Overall good practice code</p> <p style="padding-left: 20px;">ii. Understanding cause of disease</p> <p>d. Trust in veterinarian</p> <p>e. Common practice abroad</p> <p>f. Cost and Economic effectiveness of control measure</p> <p>g. Labour time involved</p> <p>h. Feeling of despair</p> <p>i. There is no other option</p> <p style="padding-left: 20px;">i. Other options too expensive</p> <p style="padding-left: 20px;">ii. Other options not feasible</p>	<p style="padding-left: 20px;">iii. Failure of other measures</p> <p style="padding-left: 20px;">iv. Don't know any other control option</p> <p>j. Feasibility within the system</p> <p>k. Other farmers positive experience and similarity with other farmers disease situation</p> <p>l. Veterinarian positive experience</p> <p>m. Limiting injections to pigs</p> <p>n. Fear of other disease</p> <p>C. Perceived behavioural control</p> <p>II. Control belief</p> <p>a. Conducting trial on-farm</p> <p>b. Coordinated team of different sources (Vet colleges, Pharm. comp., Vet, ...)</p> <p>c. Veterinarian supervision</p> <p>d. Having a measureable outcome</p> <p>III. Power to control</p> <p>a. Economics</p> <p style="padding-left: 20px;">i. Lack of labour</p> <p style="padding-left: 20px;">ii. Cost of control measure</p> <p style="padding-left: 20px;">iii. Lack of cash flow (investment capacity)</p> <p>b. Farm structure and management</p> <p style="padding-left: 20px;">i. Strict bio-security facilitates control</p> <p style="padding-left: 20px;">ii. Limited bio-security on outdoor farms</p> <p style="padding-left: 20px;">iii. Operating or not at full building capacity</p> <p style="padding-left: 20px;">iv. Current status of buildings and pens</p> <p style="padding-left: 20px;">v. Good husbandry facilitates control</p> <p>c. Lack of knowledge/understanding</p> <p style="padding-left: 20px;">i. Not knowing the cause (novel disease)</p> <p style="padding-left: 20px;">ii. Complexity of disease</p> <p style="padding-left: 20px;">iii. No control measure available</p> <p style="padding-left: 20px;">iv. Disease cycle</p>
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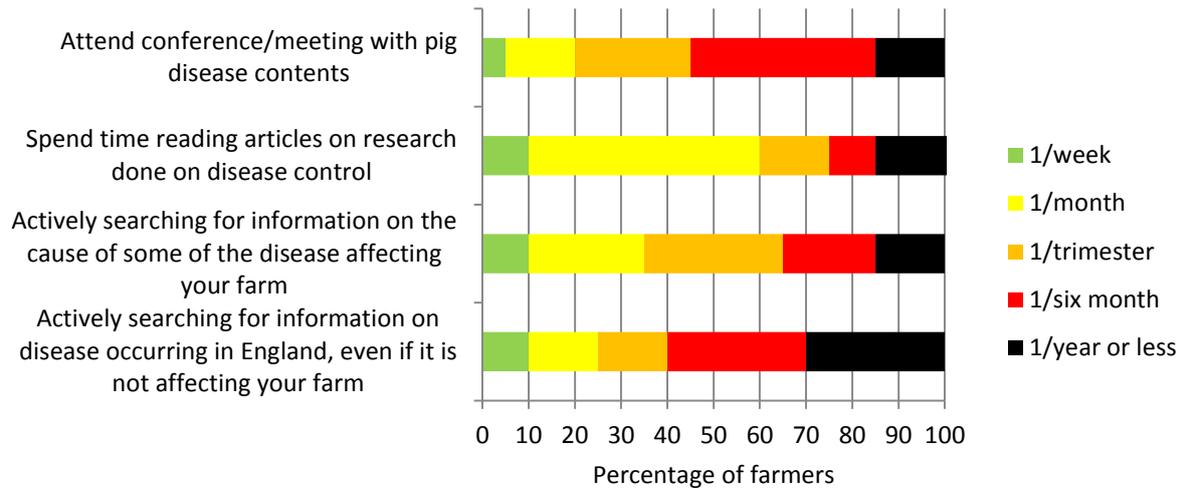
**Figure 5.** Ill-defined and/or ill-structured diseases experienced by farmers ( $n=20$ )



**Figure 6.** Level of importance of four drivers for disease control as reported by participating farmers (n=20)



**Figure 7.** Relative frequency of different information-seeking activities done by farmers (n=20)



**Figure 8.** Final template – Part 3 and 4

<p><b>3. <u>FACTORS INFLUENCING THE USE OF INFORMATION SOURCES</u></b></p> <p><b>1. General problems</b></p> <ul style="list-style-type: none"> <li>A. Lack of effective communication             <ul style="list-style-type: none"> <li>I. Breeding companies not disclosing disease problems</li> <li>II. Confidentiality of research</li> <li>III. Farmers not sharing information</li> <li>IV. Feeling of isolation</li> <li>V. No system on disease alert</li> </ul> </li> <li>B. Too much information / get lost</li> <li>C. Poor communication formats             <ul style="list-style-type: none"> <li>I. Confusion of websites</li> <li>II. Difficult to understand/read</li> </ul> </li> <li>D. Lack of information             <ul style="list-style-type: none"> <li>I. Due to the fact that some are novel disease</li> <li>II. No feedback or solutions proposed with diagnostics/reports</li> <li>III. Lack of international information</li> </ul> </li> <li>E. Information bias</li> <li>F. Lack of time (overload with work)</li> <li>G. Lack of knowledge             <ul style="list-style-type: none"> <li>I. Not knowing where to look</li> <li>II. Not having enough knowledge on disease</li> <li>III. Complex disease are difficult to understand</li> </ul> </li> <li>H. No problem</li> <li>I. Relying on very few sources</li> </ul> <p><b>2. General preferences</b></p> <ul style="list-style-type: none"> <li>A. Source preference             <ul style="list-style-type: none"> <li>I. Veterinarians as reference source</li> <li>II. Farmers discussion groups</li> <li>III. BPEX as reference source</li> </ul> </li> <li>B. Channel preference</li> </ul>	<ul style="list-style-type: none"> <li>I. Encyclopaedia on disease for farmers</li> <li>II. E-mail</li> <li>III. Post</li> <li>IV. Web forum with vets</li> <li>V. Face to face</li> <li>VI. Book preference over computer</li> </ul> <p><b>3. Attitude toward information source</b></p> <ul style="list-style-type: none"> <li>A. DEFRA             <ul style="list-style-type: none"> <li>I. Negative perception                 <ul style="list-style-type: none"> <li>a. Non new /interesting / useful / practical information</li> <li>b. FMD experience</li> <li>c. Feel threaten / nervous</li> <li>d. Only useful for national emergencies</li> <li>e. Poor format on website</li> <li>f. Difficult access of information</li> <li>g. Dislike government</li> <li>h. Not using the correct approach for farmers</li> <li>i. Not pig specific</li> <li>j. Lack of pig expertise</li> <li>k. Useful for backyard pig keepers</li> </ul> </li> <li>II. Positive perception                 <ul style="list-style-type: none"> <li>a. Funds research in UK</li> <li>b. Good format of reports</li> <li>c. Updates on disease</li> <li>d. Useful for notifiable disease</li> <li>e. VLA as a useful source</li> </ul> </li> <li>III. General use                 <ul style="list-style-type: none"> <li>a. Not used</li> <li>b. Only for notifiable disease</li> <li>c. Only to fill forms</li> <li>d. Only read their mail</li> <li>e. Internet</li> </ul> </li> </ul> </li> </ul>
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Figure 8 continue. Final template – Part 3 and 4

B. BPEX

I. Problems

- a. Do not propose solutions / interpretations / straight answers
- b. Short communications / lack of information
- c. Excess openness on economic data to outsiders
- d. Not reaching farmers standard
  - i. Farmers doing better than what they ask them to do
  - ii. Methods of workshop is low
  - iii. Lack of expertise
  - iv. Some advice is not applicable
- e. Not interesting / attractive information
- f. Need to inform about research done abroad
- g. Confusing website
- h. Workshops are not local enough
- i. Try to control/manipulate farmers

II. Advantages

- a. Disease reports / updates / mapping
- b. BPHS / Pig health schemes
- c. Facilitate farmers discussion (workshops)
- d. Good info & ideas / practical / business oriented / research programme
- e. Honest
- f. Good personal (knowledgeable)
- g. Link to other information sources
- h. Good communication format
- i. Success of PCV2 vaccination plan
- j. Good approach to farmers

III. General method

- a. Not used
- b. Attend BPEX meetings (discussion groups)
- c. Use of most of their services

C. Internet

I. Negative / problems

- a. Difficult to extract useful information (Feeling of frustration)
- b. Time consuming
- c. Poor communication format (overload of scientific papers)
- d. Lack of information on non-frequent diseases
- e. Information bias by pharmaceutical companies
- f. Accessibility issues (requires computer)

II. Positive / advantages

- a. Information on Europe situation
- b. Learning methods
- c. Detail and complete information

III. General method

- a. Only use BPEX website
- b. Not used
- c. Google
- d. Only for background information
- e. The Pig Site

D. Research / Universities

I. Positive / advantages

- a. Becoming more practical / business oriented
- b. Important for disease control

II. Negative / Problems

- a. Lack of funding
- b. Real research is done abroad
- c. Belief research should not be funded by farmers or taxpayers

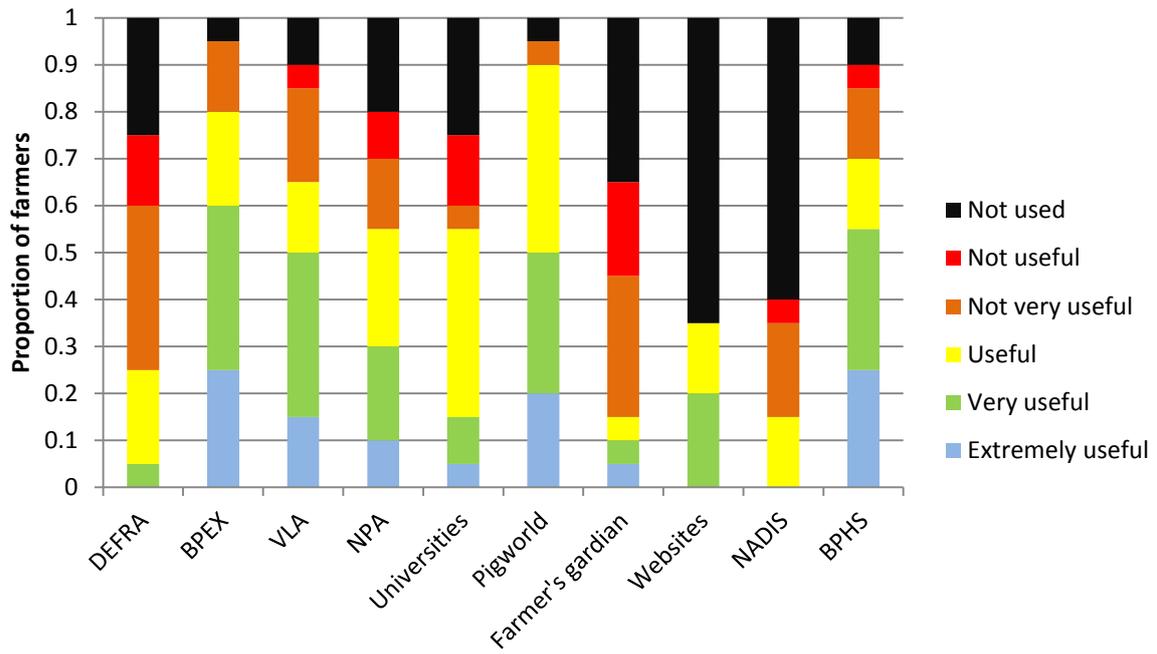
**Figure 8 continue. Final template – Part 3 and 4**

<ul style="list-style-type: none"> <li>d. Information bias             <ul style="list-style-type: none"> <li>i. Conditions in research do not match pig farm reality</li> <li>ii. Low sample size of trials</li> <li>iii. Research bias by pharmaceutical companies</li> </ul> </li> <li>e. Lack of field expertise by researchers</li> <li>f. Lack of communication</li> <li>g. Don't know where to look</li> <li>h. Historical</li> <li>i. Poor communication format</li> <li>j. Not accessible</li> <li>k. Poor quality of some research done (sample size issue)</li> <li>l. Some research is not link to their problems</li> </ul> <p>II. General methods</p> <ul style="list-style-type: none"> <li>a. Not used</li> <li>b. Informed through BPEX</li> <li>c. Only for vaccine efficacy or equipment information</li> <li>d. Through workshops</li> </ul> <p>III. Communication preferences</p> <ul style="list-style-type: none"> <li>a. BPEX should be the reference</li> <li>b. Vet should be the reference</li> </ul> <p>E. Veterinarian</p> <p>II. Positive /advantages</p> <ul style="list-style-type: none"> <li>a. Ability to assess problems</li> <li>b. Communicates with staff</li> <li>c. Close contact with other sources</li> <li>d. Quarterly visit</li> <li>e. Provide fast reports enabling fast actions</li> <li>f. Field person</li> <li>g. Goes to many other pig farms</li> </ul>	<ul style="list-style-type: none"> <li>h. Goes to international conferences</li> <li>i. Person with the knowledge / pig specialist</li> <li>j. Health plan</li> <li>k. Facilitate meeting with other producers</li> <li>l. Resourceful</li> <li>m. Accounts for economics</li> <li>n. Trust</li> <li>o. Personal / friendship</li> <li>p. Provides area disease warning and updates</li> </ul> <p>III. Problems / Negative</p> <ul style="list-style-type: none"> <li>a. Have fashions</li> <li>b. Based distant from farm</li> <li>c. Conflict of interest (with drug companies)</li> <li>d. Lack of area disease alert</li> <li>e. One step behind disease</li> <li>f. Do not discuss with stockman</li> <li>g. Provide information only when asked</li> <li>h. Do not provide a lot of information</li> </ul> <p><b>4. Type of information sought</b></p> <ul style="list-style-type: none"> <li>A. Control measures available</li> <li>B. Disease updates</li> <li>C. Fading of disease</li> <li>D. Background knowledge</li> <li>E. New technologies</li> <li>F. Similarities with own situation</li> </ul>
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**Figure 8 continue.** Final template – Part 3 and 4

<p><b>5. Pro-activity</b></p> <p>A. Positive</p> <ul style="list-style-type: none"><li>I. For disease prevention</li><li>II. Financial reasons</li><li>III. Wanted to know other farmers actions</li><li>IV. Having major problems on the farm</li></ul> <p>B. Negative</p> <ul style="list-style-type: none"><li>I. Already overload with non-useful information</li><li>II. Plenty of non-useful information out there</li><li>III. Belief there is nothing you can do about the disease</li><li>IV. Lack of on-farm problems</li><li>V. Don't know where to look</li><li>VI. Effectiveness of control measure</li><li>VII. Lack of time</li><li>VIII. Laziness</li><li>IX. Lack of interest on disease not affecting the farm</li><li>X. Satisfy with current status – waiting for expert to come</li><li>XI. Preference of field work (not office)</li><li>XII. Important information will come through the press</li><li>XIII. Want to do something else after work</li></ul>	<p><b>4. <u>PMWS STUDY</u></b></p> <p><b>1. Feeling about the results</b></p> <p>A. Positive</p> <ul style="list-style-type: none"><li>i. Avoid relying only on vaccine</li><li>ii. Enhance importance of good practice (vaccines hide poor management)</li><li>iii. Enhance importance of good bio-security</li><li>iv. Bring dialog</li><li>v. Re-enforce past actions/decisions</li><li>vi. Importance to know the causes</li><li>vii. Useful in case the vaccines lose their efficacy (Fear that the disease strikes again )</li></ul> <p>B. Negative</p> <ul style="list-style-type: none"><li>i. Not useful due to vaccine efficacy (not a priority)</li><li>ii. More interested in when to stop using the vaccine</li><li>iii. No new outcome, already known</li><li>iv. More interested in the economics</li><li>v. Worried about confounding</li></ul>
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**Figure 9.** Farmers' perceptions on the usefulness of different information sources (n=20)



**Table 1.** Order of questions applied during the interview process.

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<b>Order of questions</b>	
1	Case background (open questions)
2	Experience on disease suffered (open questions)
3	Opinion on main issues regarding disease information (open questions)
4	Measurement of usefulness of information sources (closed questions)
5	Perceptions and attitudes towards information sources (open questions)
6	Measurement of drivers for disease control (closed questions)
7	Measurement of pro-activity (closed questions)
8	Reasons for pro-activity (open questions)
10	Showing and explaining PMWS severity and risk factors research done (interviewer)
11	Farmers' perception on PMWS project results (open questions)

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**Table2.** Brief description of farmers that participated in this study (*n*=20)

<b>Variables</b>	<b>Results</b>
No. of sows	Median: 350 (min.: 200- max.: 3300)
Experience with pigs (years)	Median: 30 (min.:12 – max.:55)
Age of farmer	>50 years old: 10 farmers 40-50 years old: 8 farmers 30-40 years old: 1 farmer 20-30 years old: 1 farmer
Training/qualifications:	Higher education degree: 5 farmers Agricultural college or equivalent: 10 farmers None: 5 farmers
Gender	19 Male / 1 Female