# Impact matrix analysis and cost-benefit calculations to improve management practices regarding health status in organic dairy farming

Project Number: 311824

**- Deliverable -**

## D5.2 – Evaluation of the intention and motivation of farmers to implement health related measures

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## Executive Summary

This document provides a survey of the attitudes and intentions of 171 organic dairy farmers in four EU countries, plus a follow-up survey of 78 of the same farmers, as a means to understanding the drivers and barriers to farmers adopting optimal herd health management measures. Using an appropriate behavioural model (TPB), farmers are observed to have consistently positive attitudes towards taking additional health measures, for example believing that they will result in improved herd physical performance, will be positively viewed by peers, with a low risk of factors intervening to prevent them acting upon their intentions. The majority of farmers expressed some intention to undertake additional health measures. After being presented with a tailored package of additional health measures, the follow-up survey (after 1 year) revealed more positive attitudes to, and near universal uptake, of measures (i.e. of at least part of the package of recommendations).
Additional drivers of adoption were related to the structure of the farm business, including strongly productionist goals and the marketing of milk into specialist outlets capturing consumer interest in product quality and animal welfare more strongly. The participatory approach to veterinary and agricultural advisory engagement with farmers, and the production of tailored packages of additional health measures, was found to have performed strongly, likely contributing to very high level of uptake of the measures proposed.

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# 1. Introduction

Organic certification aims to offer an enhanced level of animal health and welfare compared with conventional production (McEachern and Willock, 2004; Edwards, 2005; Yiridoe et al., 2005; Hughner et al., 2007). This aspiration is based on the requirements of the regulations on which organic certification schemes are based, such as EU 834/2007, which promotes holistic and proactive health management, for example through the production, by the farmer and veterinarian, of an animal health plan to promote and optimise herd health. However, observational evidence suggests that organic farming does not necessarily lead to higher animal health standards than conventional production (e.g. Hovi et al., 2003; Vaarst et al., 2008; SAC, 2007). This strongly suggests that animal health status is influenced by farm-based factors that are insufficiently constrained by organic standards (Sundrum, 2001, 2006; Vaarst et al., 2006). At the heart of this problem of sub-optimal health standards, both for conventional and organic livestock production, is the failure of many farmers to fully implement recommended health improvement measures (Huijps et al., 2009, 2010; March et al., 2011). For example, Huxley et al (2003) found no clear link between the quality of health plans and animal health and welfare on UK organic dairy farms. This suggests that simply making more knowledge available will not change the current unsatisfactory situation. Improving levels of implementation will therefore require a deeper understanding of the drivers and barriers to farmers adopting optimal health management measures. A number of commentators have suggested that these barriers lie in the attitudes and perceptions of farmers themselves (Garforth, 2004). The task of this study, therefore, is to understand, by use of appropriate behavioural models, the intention and motivation of organic dairy farmers to implement measures leading to improvements in the health of their farmed animals. From portfolio of available behavioural models, the Theory of Planned Behaviour (TPB) has been selected to explain farmer behaviours and behavioural intention, in relation to animal health management. The choice of TPB is based on its capacity to capture other factors, in addition to attitudes, that have also been demonstrated to influence intentions to undertaken behaviours, such as supportive social referents (Ellis-Iversen et al. 2010). This investigation required a credible scenario on which farmers are asked to express their intentions i.e. it was not sufficient to simply ask farmers about their intentions to adopt additional herd health measures without giving any indication of their nature. The scenario therefore consisted of a programme of relevant and prospective herd health measures and detailed information on the process by which these measures are identified, i.e. the Participatory Process (reported on elsewhere in the project outputs). The Participatory Process was designed to addresses many of the weaknesses of historic Knowledge Transfer (KT) programmes identified in the literature, by encouraging active participation of the farmer in all stages of analysis of herd health status and the design of treatment programmes, as a means to encourage them to take ownership of health plans.

# 2. Objectives

Task 5.2 requires:

- The conduct of a survey, to gather data, suitable for use in behavioural models, to generate an understanding of the intentions of farmers to adopt specific disease prevention measures
- The use of behavioural model(s), and appropriate statistical techniques, to identify the factors, including salient beliefs, acting as motivations and barriers to intent to adopt additional health measures.

- Use the behavioural intentions and causal factors so identified as a normative baseline to allow for the assessment, using a second follow-up survey, of the impact on farmer attitudes and intentions of direct experience of the 'participatory intervention'. This intervention included the generation of a set of recommendations for health measures deriving from the use of the participatory approach and associated toolbox (including the impact matrix).

This report constitutes Deliverable 5.2: 'Report on farmers' motivation to implement health related measures'.

## 3. Methodology

The data on which this study was conducted was derived from a survey of the 218 organic dairy farmers in four study countries, recruited to the project in Work Package 2 (T2.2), at which point the baseline health status data, as well as the socio-demographic data used in the current exercise, were collected. For a full account of the criteria used in the selection of these farms and a reporting of their socio-economic profile, see the project report: 'D2.3 - Structural characteristics of farms'.

Data on farmer attitudes towards, and intentions to, adopt further health measures were collected as part this work package (WP5), through a follow-up postal survey of these same 218 organic dairy farms. The design of the questionnaire was broadly based around the data requirements of a social-psychology model of behaviour called Theory of Planned Behaviour (TPB). In accordance with the data requirements of the TPB model, the second survey collected information on:

- **Background attitudes** relevant to the behaviour
- **Attitudes towards** the **outcomes** of the target behaviour, i.e. the adoption of health measures
- The **influence of social referents**, i.e. the opinions of key peers, and
- The level of farmer **perceived behavioural control**, i.e. the role of factors that may constrain the farmer's ability to perform the target behaviour
- Farmer **intention** to undertake the target behaviour

A selection of socio-demographic characteristics were extracted from the baseline data collected in T2.2 on the basis of *a priori* expectation that these factors might have some influence on intention to undertake animal health measures. These socio-demographic data selected for use in the TPB analysis, were:

- Measures of animal health status
- An inventory of farm-based resources
- List of animal health measures already being undertaken (including costs), and
- Farmer profile (including business motivation).
- Farm structure (including herd size, production levels, etc)

For a detailed list of these socio-demographic variables, see Appendix A. Of the 218 organic dairy farmers surveyed in this exercise a total of 171 farmers completed the questionnaires. These farmers were distributed over the four study countries as shown in Figure 1. The highest response rates to the TPB survey were found in Germany (95%) and the lowest in France (63%). The minimum number of farmers responding in any country was 21 in Spain.

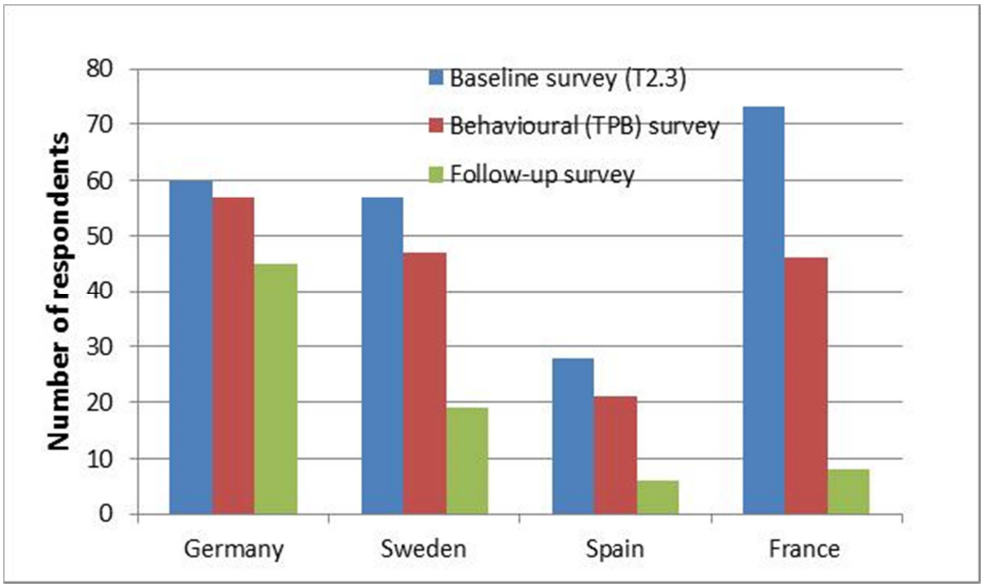


**Figure 1 – Number of farms in the current (behavioural) survey by study country.**

## 4. The behavioural model

It was not sufficient to simply ask farmers about their intentions to adopt additional herd health measures in the absence of any changes to the conditions in which they take these decisions. Therefore, the investigation required a credible scenario on which farmers could express their intentions to adopt additional herd health measures, i.e. some changes to the conditions in which they take their decisions had to be proposed. The scenario described to farmers the availability of a new decision-making process, described as a 'participatory approach' for herd health management that might lead to the achievement of a better understanding of current herd health status and the identification of a better range of options for disease prevention and cure.

The participatory approach was designed to overcome the weaknesses in traditional knowledge transfer activities by facilitating active participation of the farmer in all stages of analysis and diagnosis, together with the veterinarian, or other adviser, as a means to encourage them to take 'ownership' of the recommended health programme. To further facilitate diagnosis and planning, a toolbox of software aids was also developed to allow farmers and their advisers to better understand their current herd health status, estimate the current costs of diseases and the costs and benefits of alternative interventions. To further increase realism, the new participatory approach and the software tools developed were demonstrated to the farmers participating in the survey, together with their veterinarian, before illustrations of the type of herd health recommendations that might be produced were provided. In the context of this scenario, farmers were asked to indicate the likelihood that they would take additional herd health measures.

At the time of the behavioural survey, farmers had not undertaken the additional health measures recommended for their farm, and indeed, did not know what additional health measures would be recommended. At this point, therefore, their actual response (behaviour) to these recommendations was not known. What *was* amenable to measurement, were their expressed intentions to undertake additional health measures, based on their own perceptions of the technical requirements of these actions and their expectations of the costs and benefits associated with them. In order to model farmer behaviour, therefore, a behavioural model was required that was based on intentions to undertake behaviours, rather than direct observations of the behaviours themselves. The model

selected for this purpose was the Theory of Planned Behaviour (TPB) (Azjen and Fishbein, 1980; Azjen, 1985, 1991). TPB has a long history in social psychology research and application, having been used to explain human behaviour in a wide variety of fields of human endeavour. In recent years, TPB has been used to understand farmer behaviours, for example, by Läpple and Kelley (2013) to understand the uptake of organic farming, by Alarcon et al. (2014) to examine pig farmers' disease-control decision-making and by Jones et al. (2015) to assess dairy farmers' intentions to reduce antibiotic usage.

The origin of TPB can be traced back to much earlier theories of human behaviour such as the 'Expectancy-Value' (EV) theory (Atkinson, 1957). EV theory postulated that human behaviour is determined by an agent's expectation of the likelihood that a particular outcome will result from a behaviour, and the value that the agent places upon that outcome. Through the 1960s and 1970s, Martin Fishbein (e.g. Fishbein, 1963, 1967 and 1973) further developed the role of attitudes in theories of human behaviour, in collaboration with Isaac Ajzen (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) and had created an extended behavioural model, the Theory of Reasoned Action (TORA), which acknowledged that, in addition to attitudes, behaviours are also influenced by the agent's perception of the attitudes of others - a dimension called Subjective Norms. Through applied use in many social-psychology settings, TORA was found to be a good explanator of purely volitional behaviours, but was criticised for failing to account for the fact that not all human actions are entirely volitional. In response, Ajzen (1985; 1991) added a new dimension to TORA, Perceived Behavioural Control (PBC), to create TPB. The PBC dimension captures the agent's perception of those factors outside of their control that may facilitate or inhibit their carrying out an action.

According to TPB, the more positive an agent's attitudes to an outcome are, and the more favourable the opinions of their peers and the stronger the agent's perception that they can control their own actions, the stronger the intention to undertake a behaviour is and, therefore, the greater the likelihood they will actually undertake the behaviour (see Figure 2).

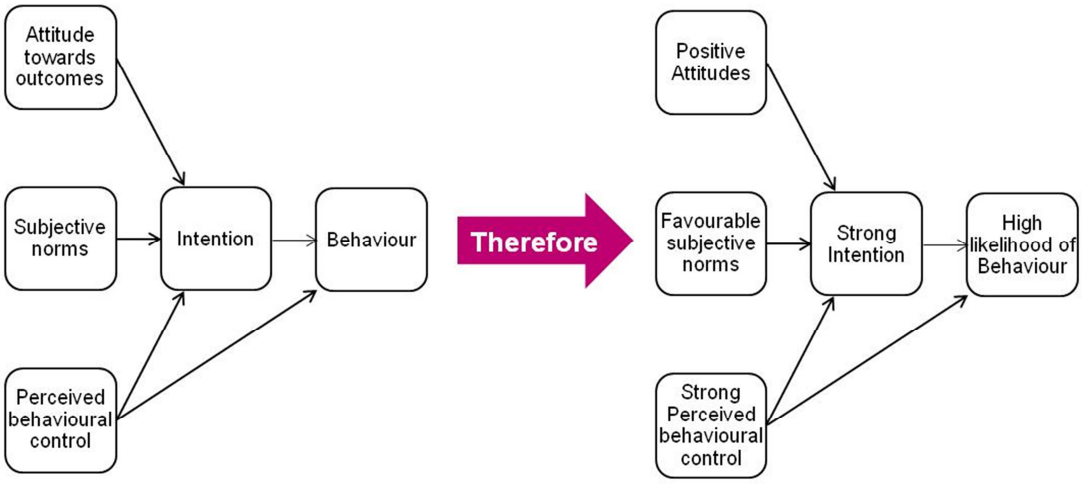


**Figure 2 – Schematic showing the components of TPB and their relationship to behavioural intent and behaviour.**

The fully specified TPB model used in this study is presented in Figure 3 with the three dimensions of TPB, i.e. Outcome Attitudes, Subjective Norms and Perceived Behavioural Control, each of which dimensions are colour coded for greater clarity.

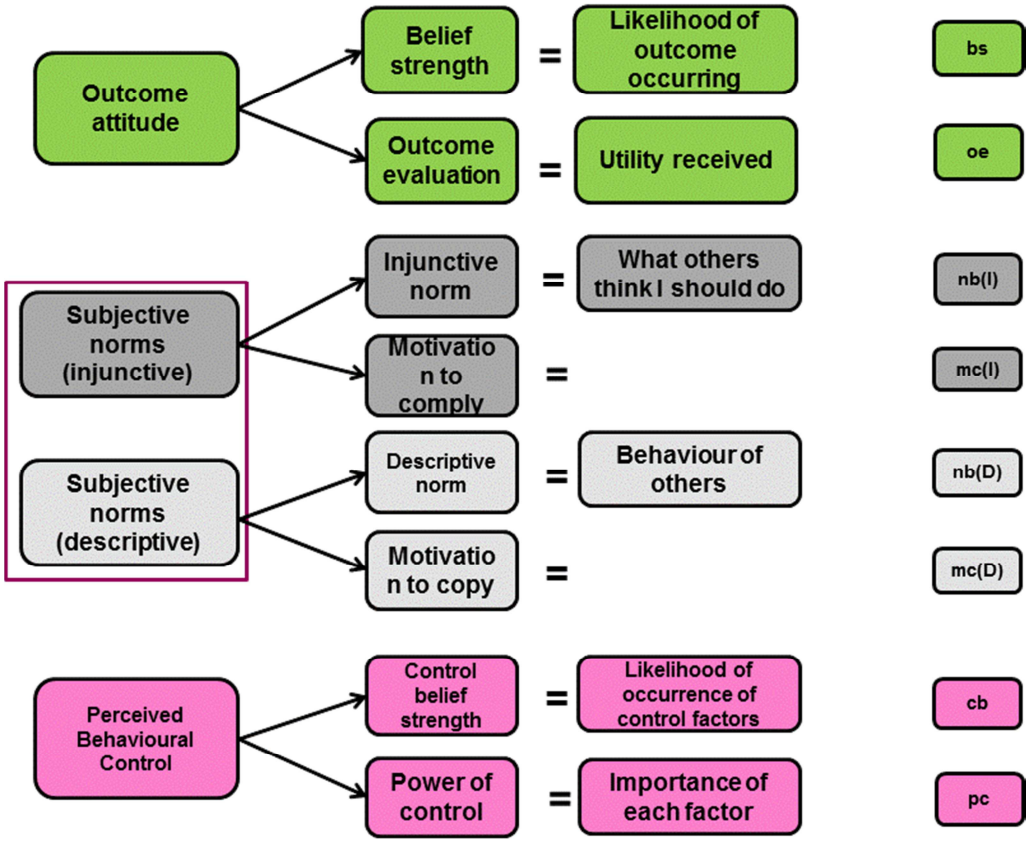


**Figure 3 – Full specification of the TPB model used in this study.**

Attitudes

Outcome Attitudes are based on the sum of the products of belief strengths (*bs*), which equates to expected probability of an outcome occurring, and outcome evaluation (*oe*), which captures the utility received from the outcome (i.e. the value that respondents place on the outcome).

$$A = \sum_{i=1}^{n} bs_i * oe_i$$ Equation 1

Where *i* = beliefs about outcome *i*.

Subjective norms

Subjective norms are perceptions of social pressure, or influence, exerted by others concerning a particular behaviour. SN is the sum of the injunctive [I] and descriptive [D] norms. Injunctive norms are respondents' perceptions about what others think the respondent should do, while the descriptive norms are respondents' perceptions about what others will themselves do. Both (SN[I]) and (SN[D]) are the sum of: the strength of the normative beliefs about the opinion/actions of others (*nb*) and motivation to comply with/copy these opinions/actions (*mc*).

$$SN[I] = \sum_{i=1}^{n} (nb[I]_i * mc[I]_i)$$ Equation 2a

$$SN[D] = \sum_{i=1}^{n} (nb[D]_i * mc[D]_i)$$ Equation 2b

Perceived behavioural control

PC captures the respondents' perception of factors that might act to facilitate or impede their performance of the behaviour. These factors can be internal, for example, reflecting levels of skills and knowledge, or external, such as level of autonomy over decision-making, or the availability of equipment or advisory services needed to undertake a task. PC is the sum of the control beliefs (*cb*) i.e. the respondents beliefs about the likelihood of occurrence of different control factors (*i*) and the power of control (*pc*) i.e. the power of each factor (*i*) to facilitate or impede the performance of the behaviour.

$$PC = \sum_{i=1}^{n} cb_i * pc_i$$ Equation 3

Ajzen (2005) assumed that what might be termed 'contextual variability', such as the personal characteristics of the respondent and, in this case, the structural and economic environment i.e. the farm business environment in which decisions are taken, are wholly mediated through the TPB constructs. However, a number of studies have demonstrated that contextual factors are sometimes only partially mediated by TPB constructs and can also operate on intent and actual behaviour over, and above, TPB constructs (see, for example, Lo et al., 2014). As it is our objective to identify all the pertinent drivers and barriers to intent, whether they are belief-based, social, economic, or physical, the unmediated effect on intent of contextual factors are also tested.

Here, data for the three determinants of intention in the TPB model (OA, SN and PC) were elicited both directly and indirectly i.e. derived from farmers' salient beliefs. The use of indirect measures allows for exploration of the reasons for people holding particular attitudes (OA), subjective norms (SN) and perceptions of behavioural control (PC) i.e. they allow for more complete examination of behavioural intent than through the sole use of directly elicited factors.

The primary objective of this analysis is to identify the differential influence of attitudes (OA), subjective norms, i.e. opinions and behaviour of peers (SN) and perceived behavioural control perceptions (PC), as well as general 'background' attitudes and socio-demographic characteristics, on behavioural intent (i.e. intent to undertake additional measures to improve herd health in the next 2 years). Additionally, this analysis explores, using these same factors, the cognitive drivers and barriers to the development of intention, together with the rationale supporting those drivers identified as influential.

# 5. Results

## 5.1. Attitudes to taking additional measures to improve animal health

### 5.1.1 Indirect outcome attitudes (belief-based measures)

Respondents were asked to indicate their perception of the likelihood that taking additional health measures would result in a range of different outcomes (see Figure 4). There is a generally positive view among farmers in all study countries concerning the likely outcomes arising from taking additional health measures, as well as considerable consistency in the likelihood ranks attached to each outcome. There is a strong sense that the health measures will add to job satisfaction and result in better herd physical performance and mild disagreement with the view that additional health measures would result in negative costs or fail to increase herd welfare.

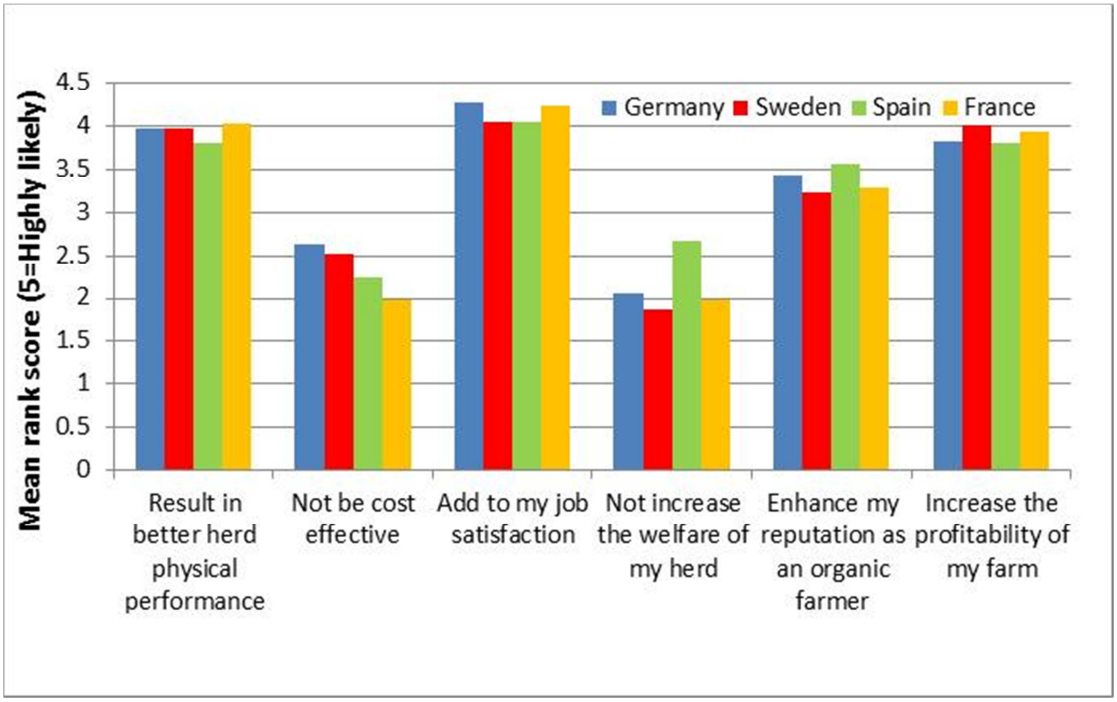


**Figure 4 – Attitudes towards taking additional health measures – expected outcomes.**

Figure 5 shows the perceptions of the whole sample of farmers on the likelihood of occurrence of a range of different outcomes that might result from taking additional health measures. These perceptions are expressed as likelihood ranks, combined with a ranking of the importance placed by the farmer sample on each of these outcomes. Note that, in the figure, the ranks of likelihood for the two negative outcomes (i.e. not cost effective and no increase in welfare) have been inverted to make their scaling consistent with the statements of positive outcomes.

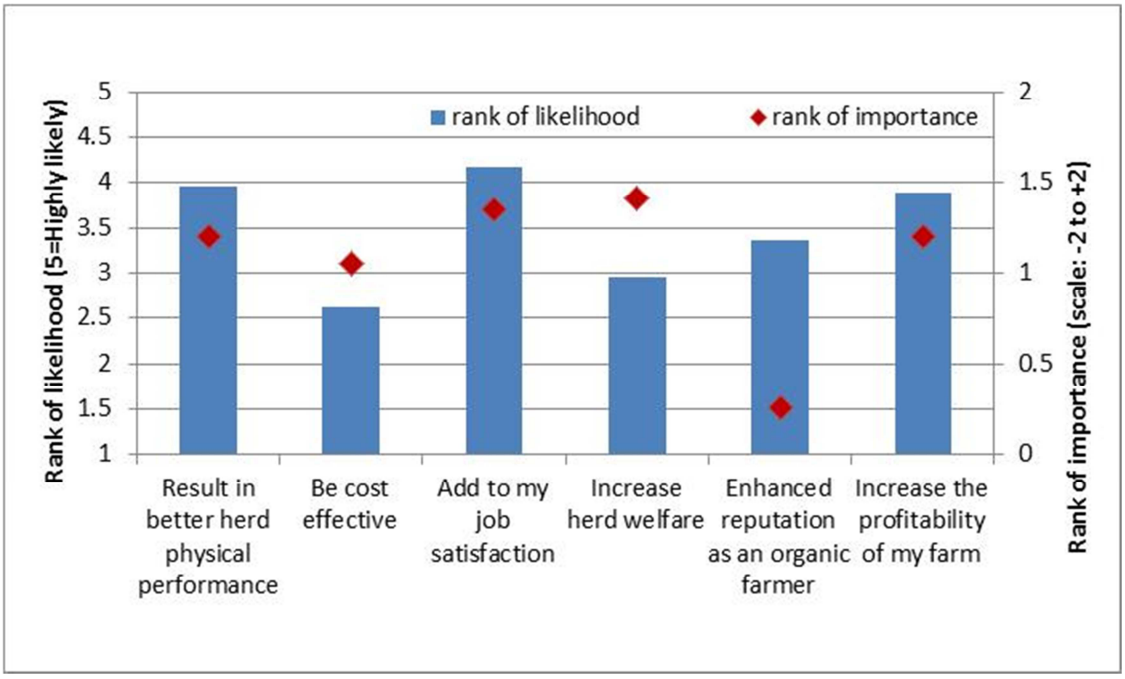


**Figure 5 – Likelihood of different outcomes resulting from taking additional health measures and a ranking of their perceived importance (whole sample).**

While the sample of farmers attached highest importance to the outcome of increasing herd welfare, this is, in their view, one of the less likely outcomes. It is worth noting that the two outcomes that were negatively phrased on the questionnaire, i.e. 'will not be cost effective' and 'will not increase herd welfare' score lowest in terms of likelihood, but score relatively high in terms of importance. In these cases, it is possible that the low likelihood scores observed after inverting their scales was caused by farmers selecting ranks reflecting uncertainty, rather than rejecting these negative outcomes.

### 5.1.2 Direct outcome attitudes

Figure 6 shows, for each study country, direct measures of attitudes towards expected outcomes, expressed in terms of a number of dimensions of utility such as, for example, degree of advantage conveyed. As Figure 6 shows, there are uniformly high rank scores for the positive attributions, signifying agreement with the propositions that taking additional health measures would be advantageous, satisfying and important etc.

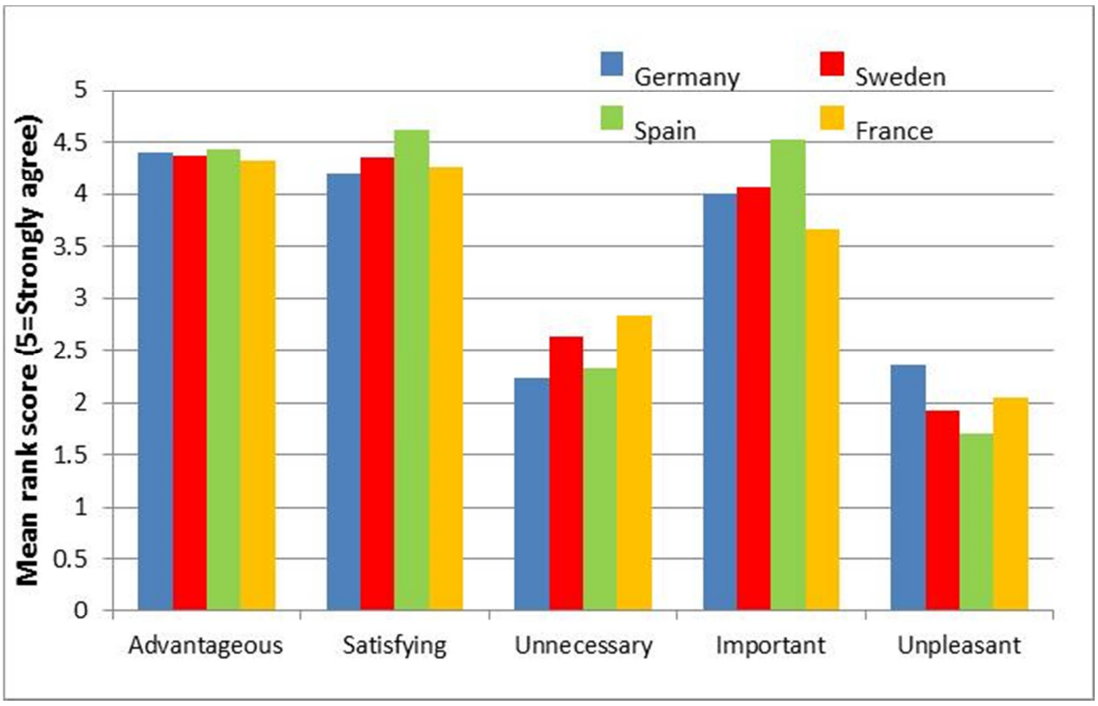


**Figure 6 – Attitudes towards taking additional herd health measures – elicited by direct measurement.**

## 5.2 Normative beliefs (subjective norms)

### 5.2.1 Injunctive norms (respondents' perception of what others would like them to do) – indirect measures

Figure 7 shows farmer perceptions of the extent to which their social referents would approve of their taking additional measures to improve herd health status. The respondents have ranked each of a number of social referents on a scale of -2 to +2, where +2=strongly approve. Farmers who selected the 'don't know' option for any question were assumed to have provided no useful information and excluded from the analysis of that question. Generally, farmers were confident that they knew what the views of most referents would be (with a range of 154-167 non-missing values provided), with the exception of scientists (only 139 non-missing values). As the figure shows, perceived approval ratings are high for almost all social referents, with no negative average ranks. The lowest scores, by some considerable margin, are for neighbouring farmers. There are some small variations between counties in terms of social referent scores, with French farmers anticipating higher levels of approval from scientists and family/friends than in other countries and German farmers out-ranking other countries in terms of their perception of levels of approval from milk buyers and organic associations.

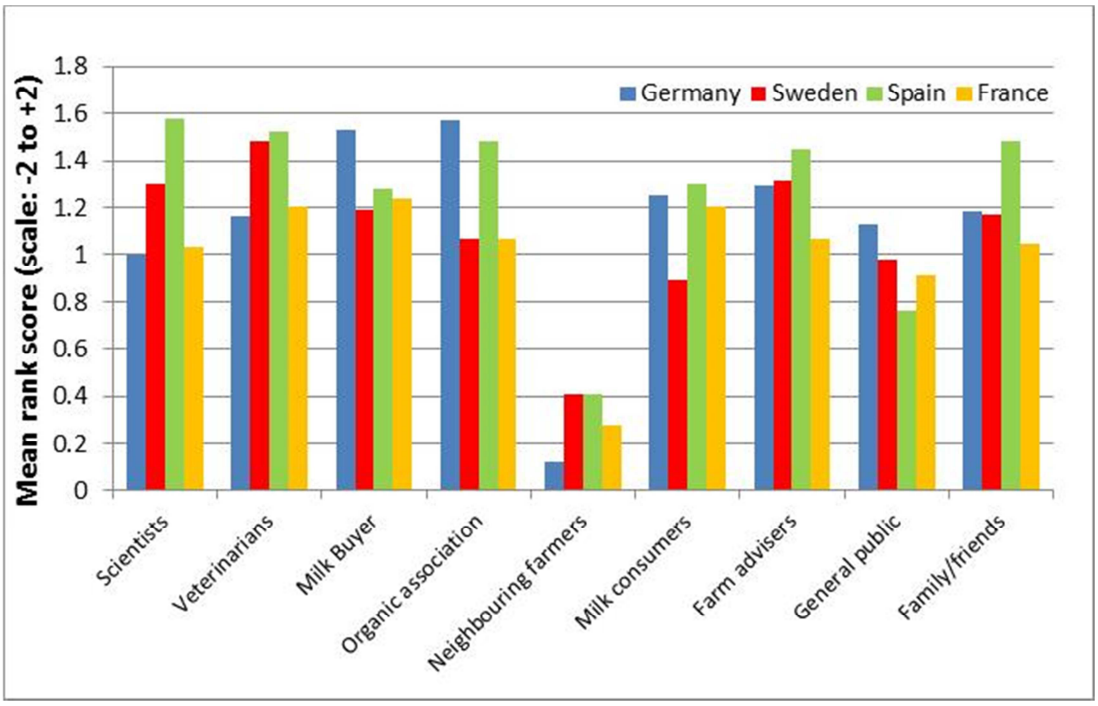


**Figure 7 – Perceived approval by others of respondent taking additional health measures – injunctive norm.**

Figure 8 shows the perceived levels of approval of different social referents expressed as ranks (where +2 = strongly approve) coupled with the respondents' rank of the importance they attach to the opinion of each of the social referents (where 5=very important). As might be expected, approval level is perceived to be lowest for neighbouring farmers, but the importance of their opinions is also low.

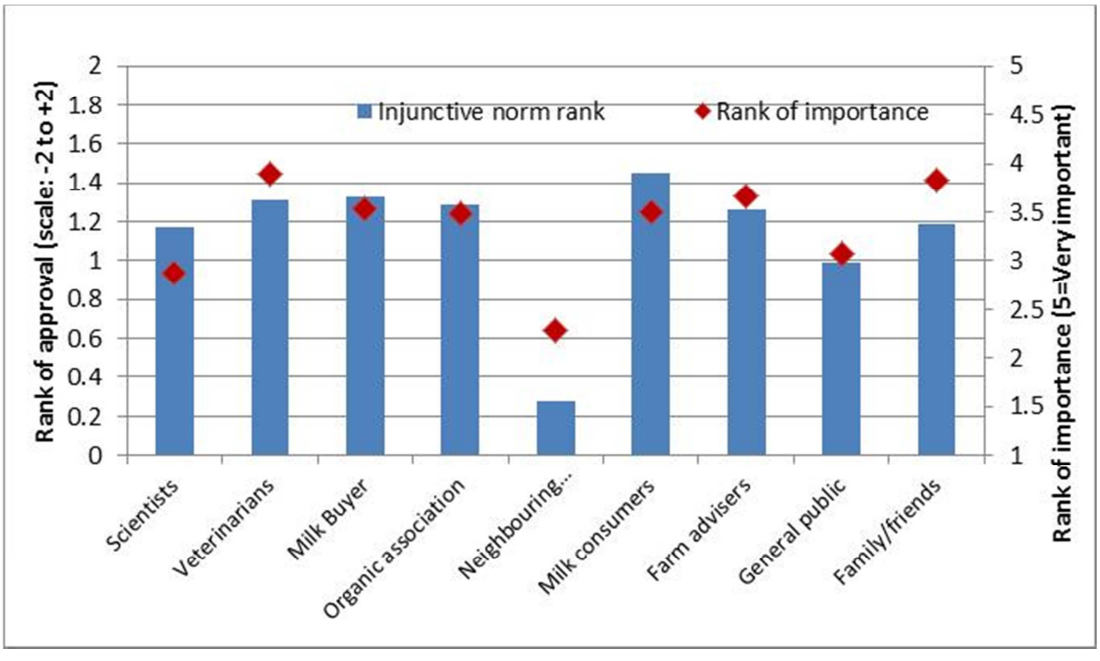


**Figure 8 – rank of approval of referent groups, plus rank of the importance of their views – injunctive norms**

### 5.2.2 Injunctive norms – direct measures

Three direct measures of respondents' injunctive norms were taken (see Figure 9). These measures involved asking respondents for their level of agreement with three statements that suggest that different groups of social referents would approve of the respondent taking additional measures to improve herd health. Respondents were asked to rank their level of agreement with each statement on a 5-point scale where 5=strongly agree. Three groups of social referents are identified, i.e. (i) 'those connected with the farm'; (ii) 'industry people with valued opinions'; and (iii) 'people who are important to me'. Farmers in Sweden rank the three groups of social referents equally and with quite low scores, while farmers in the other countries rank industry figures with valued opinions more highly than the other two groups. Interestingly, Spain has highest rank for the first two groups, but the lowest in the third. This fact, plus the observation that average rank scores for this third group are lower than the two alternative groups, perhaps suggests that this third category is not as concrete and meaningful a group as the other two categories of referents.

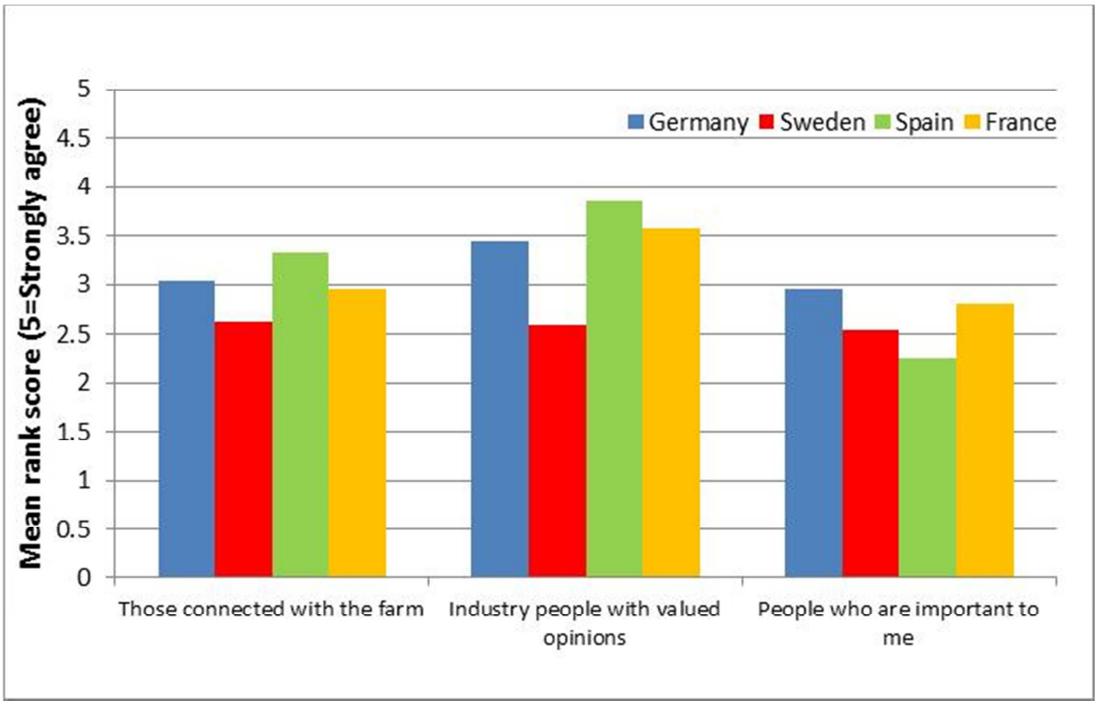


**Figure 9 – Perceived level of approval of respondent's action by referent groups – injunctive norm (direct measures)**

### 5.2.3 Descriptive norms (respondents' perception of what others are likely to do) – indirect measures

Respondents were asked for their perceptions of the likelihood that certain groups of their social referents would be undertaking their own additional measures to improve herd health in the next two years. Figure 10 shows farmer perceptions, by country, of the likelihood of this, expressed as ranks (where +2=definitely). Again, where farmers selected the 'don't know' option for any question, they were treated as providing no useful information and excluded from the analysis of that question. As the figure shows, other farmers in the project and leading organic farmers were perceived as being those most likely to be undertaking additional measures to improve herd health on their own account. There was some variation across counties, with farmers in Spain and Germany least likely to believe that other farmers, even those within the project, would be undertaking such measures.

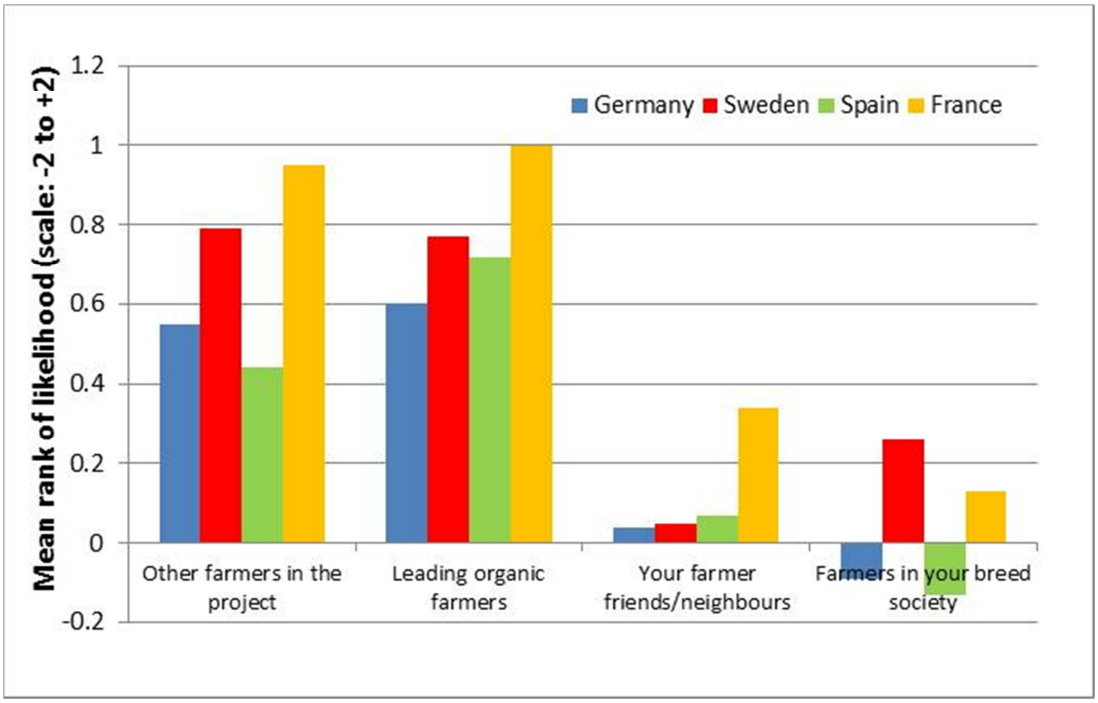


**Figure 10 – Rank of the perceived likelihood of different referent groups undertaking additional herd health measures – Descriptive norms (direct measures).**

Figure 11 shows a whole-sample ranking of likelihood of social referents undertaking additional measures to improve herd health on their own account, coupled with a rank of the importance placed by respondents on the actions of these social referents. Averaged across all countries, very much as expected, other farmers on the project and leading organic farmers are perceived as the peers most likely to be undertaking these actions on their own account and their actions are also deemed to be of most influence by farmers in the study in deciding their own actions. It is notable however, that there are no large differences in influence between the different groups of farmers in the same way as there is for expectation of them undertaking the actions themselves.

### 5.2.4 Descriptive norms – direct measures

A single direct measure of respondents' descriptive norms was taken. This measure involved asking respondents for their level of agreement with a statement that organic farmers (as a single social referent group) would be taking additional measures to improve herd health in the next two years. Respondents were asked to rank their level of agreement with this statement on a 5-point scale where 5=strongly agree.

As Figure 12 shows, farmers in Sweden provide a very slightly lower likelihood rank than do farmers in the other study countries, but otherwise there appears to be a very high level of between-country consistency that other organic farmers will themselves be undertaking additional health measures.

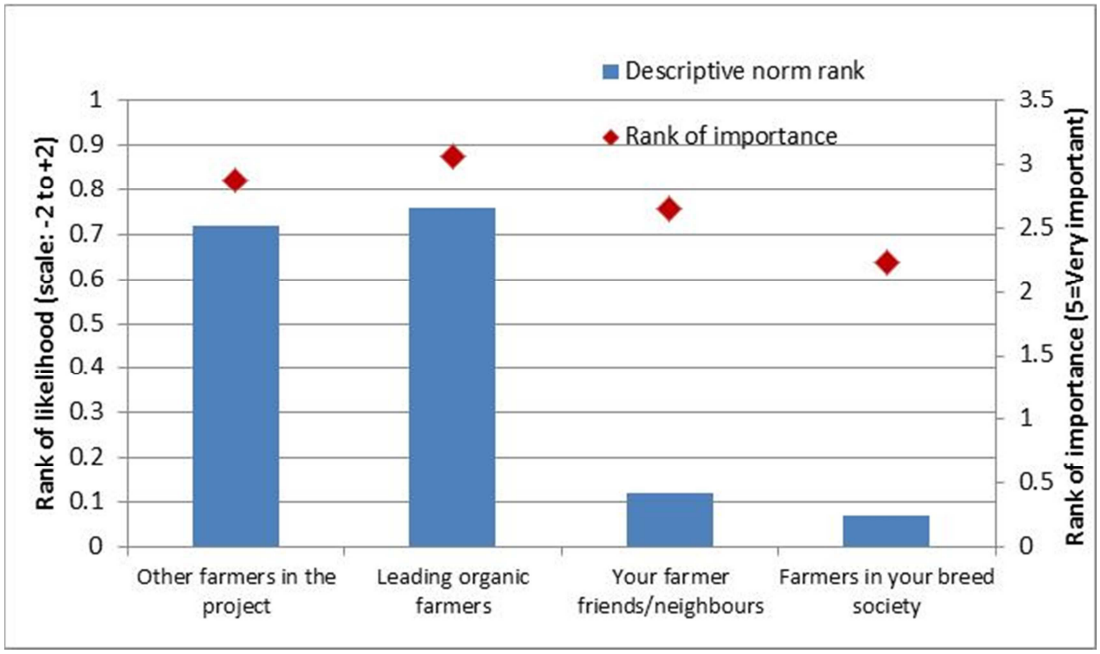


**Figure 11 – Expected likelihood of action being taken by referent groups, plus rank of the importance of the actions of these groups – descriptive norms (whole sample).**

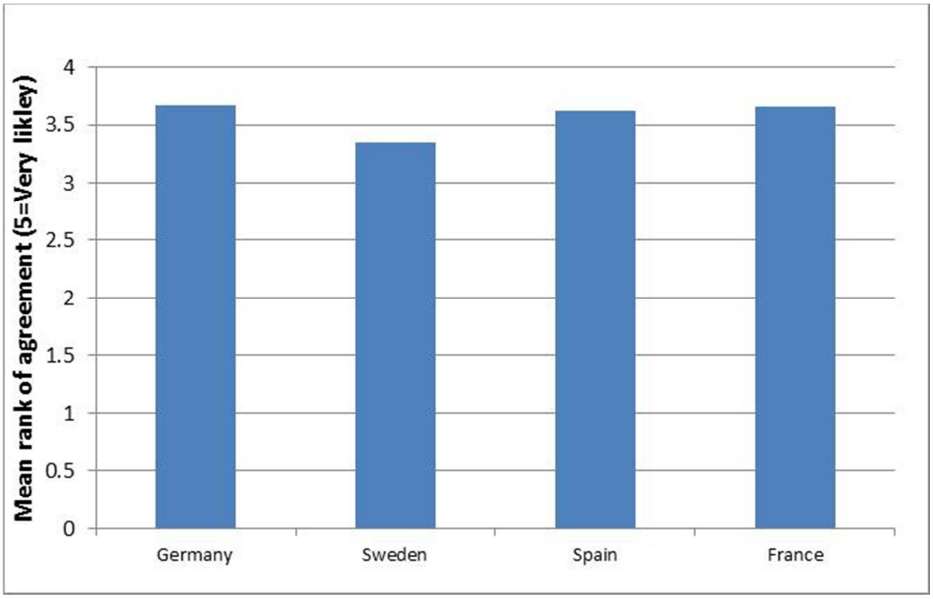


**Figure 12 – Level of agreement that other organic farmers will themselves be taking additional health measures – descriptive norms (direct measure).**

## 5.3 Perceived Behavioural Control

### 5.3.1 Indirect measures

Indirect measures capturing two different dimensions of perceived behavioural control have been used. The first measure/dimension is known as 'control belief strength' and the second is called 'power of control'. Control belief strength captures the respondents' perception of the likelihood of occurrence of a number of factors, or outcomes, which might affect their ability to undertake an action. So, for example, respondents are asked to rank the likelihood that taking additional measures will fit into their daily work routines on a 5-point scale, where 5=very likely. Here, the

extent to which the action fits into a farmer's daily work routines constitutes the factor that might impact ability to undertake the action.

Power of control is the respondents' perception of the capacity of each factor (or outcome), to impact their ability to perform the action, or achieve the desired outcome. Respondents ranked each factor on a 5-point scale depending on whether they are perceived to make the action more difficult (-2) or easier (+2).These two dimensions of PC act together to facilitate or inhibit the execution of actions by respondents. So, for example, a factor that might impact the ability of a respondents to undertake an action might be seen as more or less likely to occur, and might be seen as either strongly or weakly inhibiting to the action, or strongly or weakly facilitating of the action.

Figure 13 shows control belief strength, i.e. respondents' ranking of the likelihood of occurrence of the factors that might affect their ability to perform the action, or achieve the outcome. As the figure shows, there is a high level of expectation, especially amongst French farmers, that taking additional measures to improve herd health will fit into daily work routines and a relatively low level of expectation that such actions will be too costly, whether in terms of time or money.

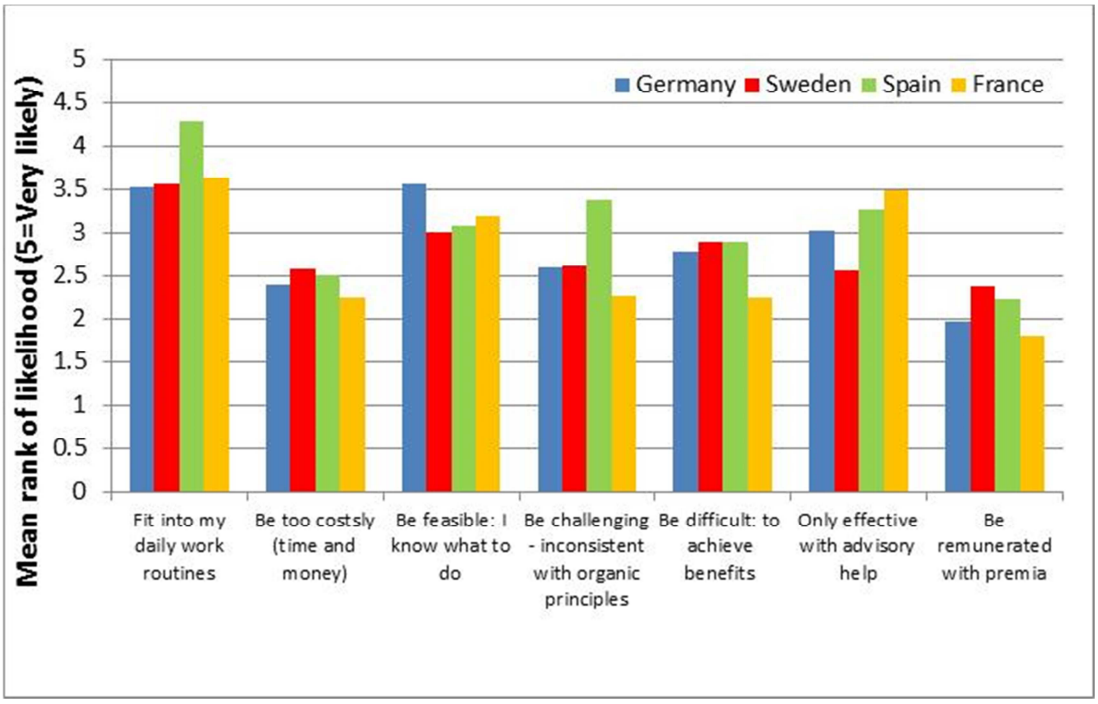


**Figure 13 – Perceived behavioural control – expected likelihood of outcomes related to the respondent's ability to complete the action.**

Figure 14 shows power of control factors (the bars), averaging over all study countries, overlaid with power of control (the red diamonds). As expected, the control factors perceived as most likely to occur were the conformity of the action with daily routines and possession of the necessary skills. In terms of the impact of these various control factors, possession of necessary skills was perceived to be the most significant, making achievement of outcomes easier, followed by availability of advisory support. The issue of the cost of the actions carries little weight.

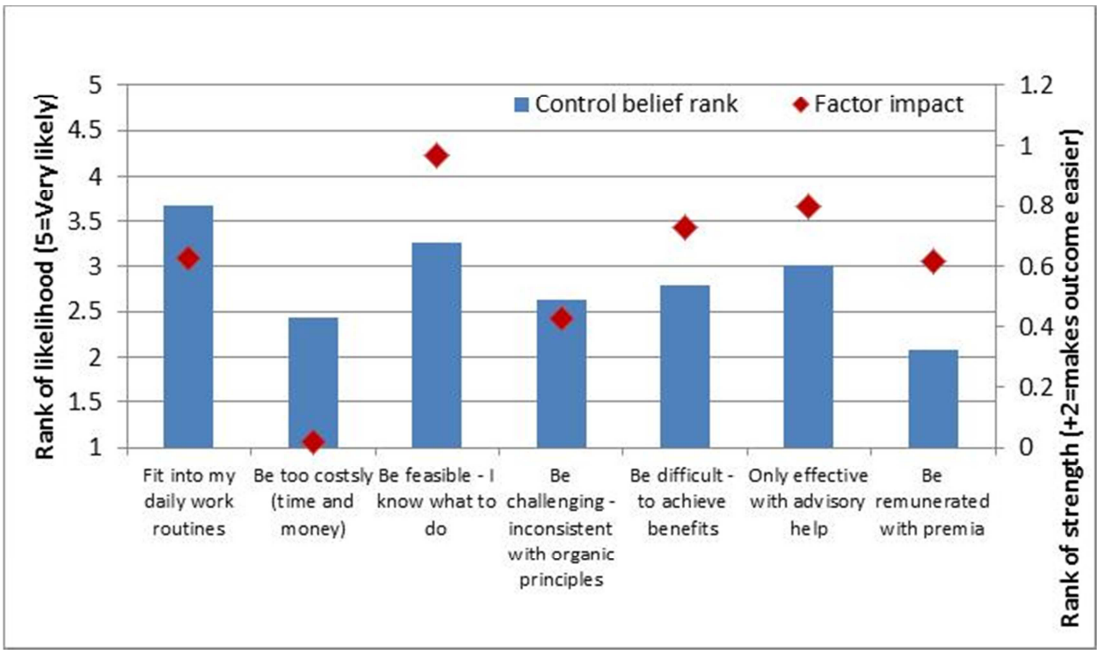


**Figure 14 – Perceived behavioural control – expected likelihood of outcomes related to the respondent's ability to complete the action, plus rank of the strength of each factor (whole sample).**

### 5.3.2 Direct measures

Four different direct measures of perceived behavioural control have been taken, reflecting different aspects of the control issue, such as the existence of the opportunity to undertake the action, management control over the decision and farmer confidence in their own ability to manage the action. Respondents were asked to give their level of agreement with four statements (all asserting a high degree of control over the process of taking the action), by means of a 5-point rank score. For example, the statement 'I have the possibility to take additional farm measures to improve the health status of my herd over the next two years' asserts that the opportunity to take the action is available. As can be seen from Figure 15, there is a fairly uniformly high level of agreement with each of these positive, high 'level of control' statements, suggesting widespread confidence amongst farmers that they have the necessary, skills, means and opportunity to undertake actions to improve herd welfare in the next 12 months. This suggests the perception amongst farmers of a high volitional content to these decisions.

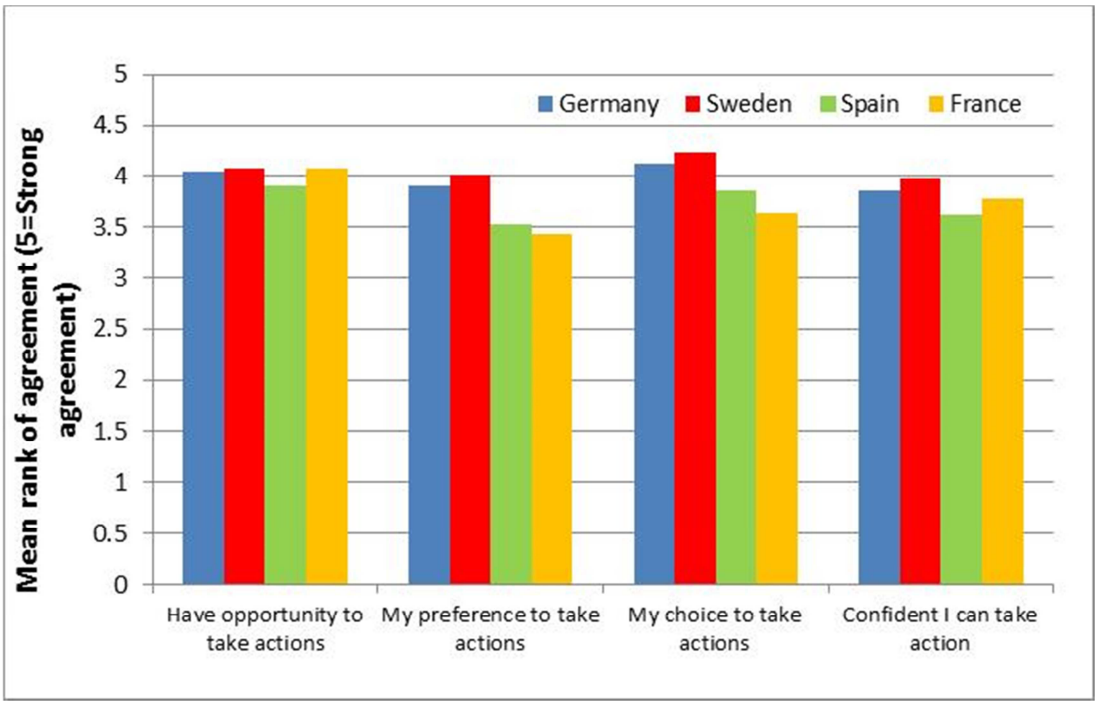


**Figure 15 – Perceived behavioural control (direct measures) – level of respondent agreement that they have the opportunity, freedom of choice and confidence to undertake the action.**

## 5.4 Intention

Three very similar measures of intention (to take additional health measures) were generated by the survey. These were derived from similarly-worded questions, varying in the degree of certainty of the intention, through use of the terms: 'plan', 'try' and 'intend'. Respondents were asked to rank the extent to which these statements of intent corresponded with their own intentions. The ranking was made using a 5-point Likert scale, where 1 equates strong disagreement with the statement and 5 is very strong agreement. As Figure 16 shows, there is some variation between countries in level of agreement with these statements, with generally higher levels of agreement across all measures in Sweden and Germany. Additionally, it is apparent that level of agreement with the 'weaker' of the three measures, i.e. the measure with least certitude, is lower, across all countries than for the measures with greater certitude.

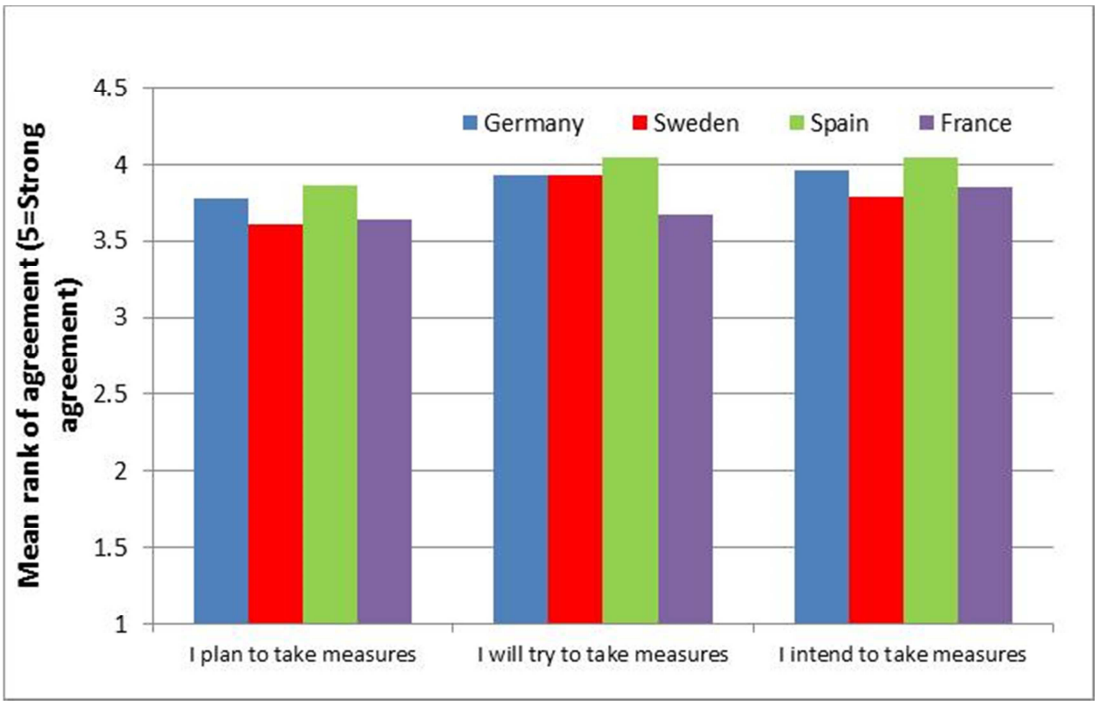


**Figure 16 – Intention to undertake measures.**

It is assumed that these three intention constructs capture some dimension of a latent (i.e. unobserved) intention construct. To test for the extent of redundancy between them, i.e. the extent to which they capture the same variance in the latent construct, a correlation analysis was undertaken (see Table 1).

**Table 1 – Spearman correlations between the three potential measures of intent**

| Spearman Correlation Coefficients<br>Prob > \|r\| under H0: Rho=0<br>Number of Observations | | | |
|---|---|---|---|
| | **I1 (Plan)** | **I2 (Try)** | **I3 (Intend)** |
| **Intention 1** | 1.00000 | | |
| I1 (Plan) | | | |
| | 168 | | |
| **Intention 2** | 0.64628 | 1.00000 | |
| I2 (Try) | <.0001 | | |
| | 167 | 167 | |
| **Intention 3** | 0.64832 | 0.75043 | 1.00000 |
| I3 (Intend) | <.0001 | <.0001 | |
| | 167 | 167 | 168 |

Strong correlations between the three measures of intent were found (i.e. these had a minimum correlation coefficient of 0.64) and all correlations were highly significant. This suggests that combining the variables together would add little, if any, new information, i.e. they are effectively replicates of one another. For the purpose of this analysis therefore, the single measure „I intend to take measures“ (**Intention 3)** has been selected for use as the dependent variable in the regression modelling and correlation analysis, as this variable showed slightly higher correlation coefficients with the other two variables than occurred between them. Figure 17 shows the level of agreement of

farmers in the sample with this statement of intent (Intention 3) to undertake additional health measures. As can be seen, only a handful of farmers indicated that this statement of positive intent did not reflect their own intentions, although about a third of the sample indicated that they were neutral with respect of the statement.

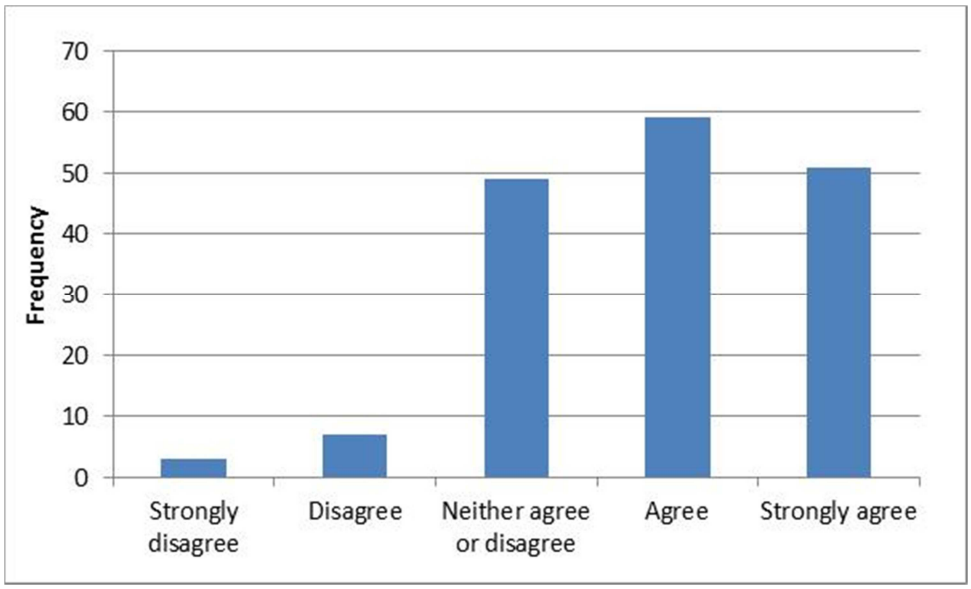


**Figure 17 – Level of agreement with the statement of intent to take additional measures (all countries).**

## 5.5 Background attitudes

Respondents were asked six additional questions intended to capture more general, underlying attitudes that might impact on intention to undertake actions to improve herd health status, i.e. attitudes potentially not mediated through the three TPB factors. These attitudinal questions (see Figure 18), reflected upon the importance of different herd/farm management objectives, such as maximising profit from the herd. Respondents were asked to state the level of importance that they attach of each of the management objectives listed, using a 5-point ranking scale, where +2=very important. In terms of their motivations and goals with respect to the management of their dairy businesses, farmers tended to place profit maximisation and enhancement of their professional reputation lower than other goals/motivations, such as achieving job satisfaction and operating cost effective businesses. It is intriguing that farmers would eschew profit maximisation, but prize cost effectiveness. This perhaps suggests that farmers have a particular view of 'success' in farming terms based on a wider foundation than simply maximising margin over costs, through increasing market returns. Having said that, profit maximisation appears to be a more important consideration in Sweden and Spain than in Germany and France.

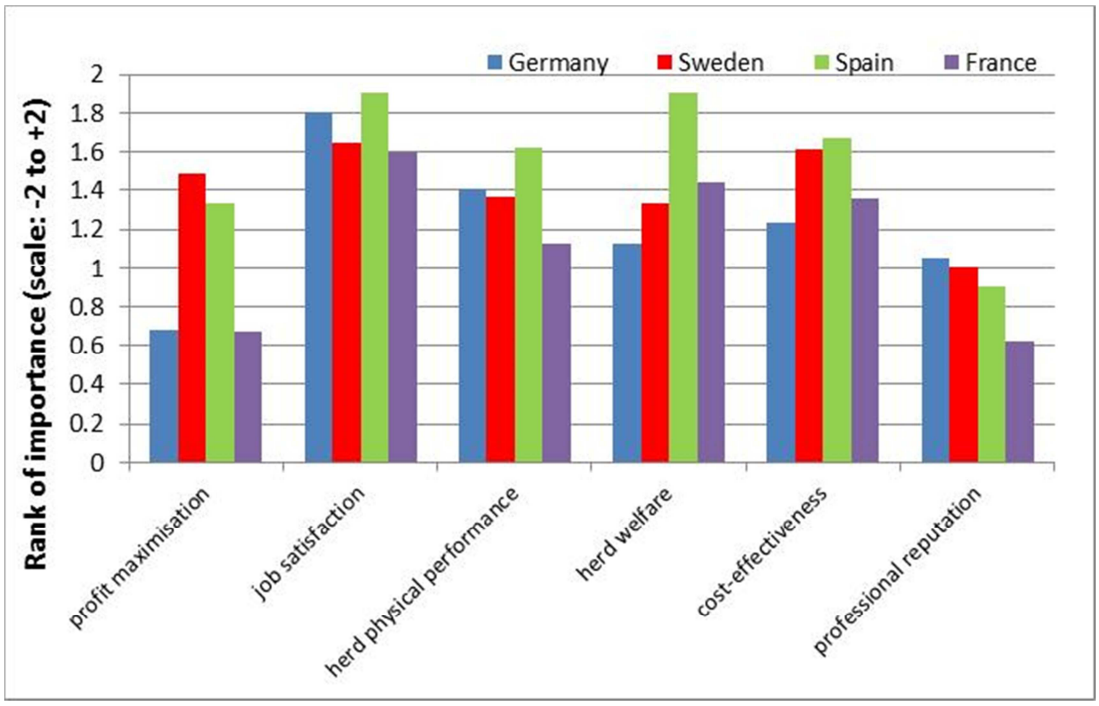


**Figure 18 – Background attitudes – farming goals**

## 5.6 Construction of the TPB variables

### 5.6.1 Outcome attitude variables

Whilst some have argued that attitudes are latent in nature, and can only be measured indirectly (see Singh, 1988), Ajzen and Fishbein (1980) hold that direct measurement is possible. However, they do concede that direct attitude measurement provides very little information about why respondents judge outcomes positively or negatively. Therefore, whilst direct measures of OA are usually preferred in statistical models of intent, indirect measures of OA allow for the specific attitudes, or constructs that drive intent to be mapped. Both direct and indirect measures of outcome attitude were therefore included here, with multiple measures in both cases. Aggregate, or composite, measures of direct and indirect OA can therefore be created, through combining individual variables within each class. These composite variables were tested to examine their role in driving behavioural intent. Because it is sometimes found that indirect measures of OA can be more highly correlated with intent than direct measures, both the direct and indirect aggregate measures were tested in this study to see which is more highly correlated with intent and therefore to be preferred in the regression modelling. The composite direct OA measure was created by addition of the five individual component measures shown in Figure 19.

Please indicate on the scale below whether taking additional measures to improve the animal health status of your farm over the next 2 years would be:

| | | | | | | |
|---|---|---|---|---|---|---|
| Disadvantageous | | | | | | Advantageous |
| Unsatisfying | | | | | | Satisfying |
| Necessary | | | | | | Unnecessary |
| Unimportant | | | | | | Important |
| Pleasant | | | | | | Unpleasant |

**Figure 19 – direct outcome attitude variables from the TPB questionnaire.**

The scales of the two negatively phrased questions were inverted to make them consistent with the three positively phrased questions. Cronbach's Alpha was calculated to test the coherence of this direct composite OA measure (see Table 3). Because of the relatively large range in possible values, the standardised Cronbach's Alpha Coefficient was used. A high Cronbach's Alpha (>0.6) indicates that the different items contributing to a measure, when summed, produce a coherent composite. Two of the components of the aggregate OA measure (i.e. items 2 and 5) would seem to be conceptually different from the other three, i.e. in capturing personal emotional impacts of taking the action, rather than expressing impacts in terms of business advantage. These two components also had relatively low correlation coefficients with the other components. However, removal of these elements did not notably increase the Cronbach's Alpha score for the composite measure and so the composite measure has been based from all five possible components.

The composite indirect OA variable is constructed as per Equation 1 above. The scales of the negatively phrased questions were inverted to be consistent with the positively phrased questions. Low internal inconsistency between the components of the composite OA variable, as measured by Cronbach's Alpha, would suggest that multiple constructs were being captured and this would necessitate breaking the composite variable into two or more internally consistent composites. However, Cronbach's Alpha in this case was 0.754. There were relatively low correlations for items 2 and 5 amongst the component questions (see Appendix 2), but removal of these components did not markedly improve the overall Cronbach's Alpha score.

**Table 2 – Mean, median and maximum permissible range for the direct and indirect composite OA measures, plus Cronbach's Alpha Coefficients**

| Measure | Number of (i) questions included in the composite measure | Sample mean | Sample median | Maximum permissible range | Cronbach's Alpha (Standardised) |
|---|---|---|---|---|---|
| Outcome Attitude (Indirect) | 6 | 25.93 | 24.0 | -60 - 60 | 0.754 |
| Outcome Attitude (Direct) | 5 | 20.13 | 20.0 | 5 - 25 | 0.748 |

While both the direct and indirect composite OA measures correlated positively and significantly with Intent (see Table 3), OA-direct (OA_D) correlated more highly and so has been used in the regression analysis that follows.

**Table 3 – Pearson correlations of composite indirect and direct outcome attitude variables with intent**

| Pearson Correlation Coefficients<br>Prob > \|r\| under H0: Rho=0<br>Number of Observations | | | |
|---|---|---|---|
| | **OA_D** | **OA_I** | **Intent** |
| **OA_D** | 1.00000 | | |
| | | | |
| | 166 | | |
| **OA_I** | 0.54116 | 1.00000 | |
| | <.0001 | | |
| | 155 | 157 | |
| **Intent** | 0.49753 | 0.39840 | 1.00000 |
| I3 (intend) | <.0001 | <.0001 | |
| | 163 | 154 | 168 |

### 5.6.2 Normative belief variables

Direct and indirect measures of normative beliefs were available, i.e. for both injunctive and descriptive norms. The two composite direct subjective norms measures i.e. SN(in)_D and SN(de)_D, were created by summation of the individual components for each measure. The two indirect aggregate measures of subjective norms, i.e. SN(in)_I and SN(de)_I were created on the basis of Equation 2. The scales of any negatively phrased questions were inverted to be consistent with the positively phrased questions. Cronbach's Alpha scores for the four composite measures were calculated to test for coherence and these statistics are presented in Table 4, although it is accepted that internal consistency on the SN composite measure is not a requirement, as there can legitimately be a divergence in perceived levels of approval over different social referents.

For SN injunctive, indirect, Alpha is very high at 0.834, with no low scoring components, so all nine components were accepted into the aggregate variable. For SN-injunctive, direct, Alpha is high at 0.822 and all components scored highly and so all three components were accepted into the aggregate variable. For SN-descriptive, indirect, Alpha is high at 0.851 with all components scoring highly and so all four components were accepted into the aggregate variable. The SN descriptive, direct variable consists of a single component.

All four SN variables were correlated against Intent 3 (see Table 5). As the Table shows, while all correlations with Intent are significant, the direct SN measures are more highly correlated than the indirect, in both the injunctive and descriptive cases. The two direct SN measures were therefore forwarded for use in the regression analysis.

**Table 4 – Mean, median and maximum permissible ranges for the direct and indirect composite SN measures, plus Cronbach's Alpha Coefficients.**

| | Measure | Number of (i) questions included in the composite measure | Sample mean | Sample median | Maximum permissible range | Cronbach's Alpha (Standardised) |
|---|---|---|---|---|---|---|
| Indirect | Subjective norms (Injunctive) | 9 | 37.7 | 34.0 | -90 - 90 | 0.834 |
| | Subjective norms (Descriptive) | 4 | 5.89 | 5.0 | -40 - 40 | 0.851 |
| Direct | Subjective norms (Injunctive) | 3 | 9.07 | 9.0 | 3 - 15 | 0.822 |
| | Subjective norms (Descriptive) | 1 | 3.57 | 4.0 | 1 - 5 | N.A. |

**Table 5 – Pearson correlations of the four subjective norms measures with intent**

| Pearson Correlation Coefficients<br>Prob > \|r\| under H0: Rho=0<br>Number of Observations | | | | | |
|---|---|---|---|---|---|
| | **SNin_I** | **SNin_D** | **SNde_I** | **SNde_D** | **Intent** |
| **SNin_I** | 1.00000 | | | | |
| | | | | | |
| | 115 | | | | |
| **SNin_D** | 0.42218 | 1.00000 | | | |
| | <.0001 | | | | |
| | 115 | 170 | | | |
| **SNde_I** | 0.35019 | 0.32729 | 1.00000 | | |
| | 0.0008 | 0.0003 | | | |
| | 89 | 120 | 120 | | |
| **SNde_D** | 0.35454 | 0.44090 | 0.40186 | 1.00000 | |
| | 0.0001 | <.0001 | <.0001 | | |
| | 114 | 169 | 119 | 170 | |
| **Intent** | 0.42938 | 0.49461 | 0.20087 | 0.43552 | 1.00000 |
| I3 (Intend) | <.0001 | <.0001 | 0.0292 | <.0001 | |
| | 113 | 167 | 118 | 167 | 168 |

### 5.6.3 Perceived behavioural control variables

Both direct and indirect measures of perceived behavioural control beliefs were available. Both classes of variables were combined into composite PC variables to test the role of PC in driving behavioural intent. The composite direct subjective norms measure was created by addition of the

four individual components for this measure, to create PC_D. The indirect composite measure of PC, i.e. PC_I, was created on the basis of Equation 3. The scales of any negatively phrased questions were inverted to be consistent with the positively phrased questions. Cronbach's Alpha scores for the four composite measures were calculated to test for coherence and these statistics are presented in Table 6.

**Table 6 – Mean, median and maximum permissible ranges for the direct and indirect composite PC measures, plus Cronbach's Alpha Coefficients**

| Measure | Number of (i) questions included in the composite measure | Sample mean | Sample median | Maximum permissible range | Cronbach's Alpha (Standardised) |
|---|---|---|---|---|---|
| Perceived control (Indirect) | 7 | 13.13 | 11.0 | -70 - 70 | 0.706 |
| Perceived control (Direct) | 4 | 15.63 | 16.0 | 4 - 20 | 0.831 |

The initial Cronbach's Alpha score for PC-indirect was quite modest, at 0.59, but removal of item 4 'Be challenging when following organic principles', increased Alpha to 0.706. Item four was therefore dropped from the construction of the composite PC-indirect variable. The Alpha score for PC-direct was high at 0.831, with all four components correlating well with the composite variable mean. All four components were therefore retained in the composite variable. A correlation of the aggregate indirect and direct PC variables (see Table 7) revealed that the indirect measure is not significantly correlated with Intent 3, but the direct measure is significantly correlated. The composite PC-direct measure is therefore carried forward for use in the regression model.

**Table 7 – Pearson correlations for direct and indirect PC measures with intent**

| Pearson Correlation Coefficients<br>Prob > \|r\| under H0: Rho=0<br>Number of Observations | | | |
|---|---|---|---|
| | **PC_I** | **PC_D** | **Intent** |
| **PC_I** | 1.00000 | | |
| | | | |
| | 153 | | |
| **PC_D** | 0.13880 | 1.00000 | |
| | 0.0881 | | |
| | 152 | 167 | |
| **Intent** | 0.05969 | 0.52342 | 1.00000 |
| I3 (Intend) | 0.4636 | <.0001 | |
| | 153 | 166 | 168 |

## 5.7. Correlation of TPB variables with intent

Table 8 shows the correlation of the direct OA, SN and PC measures with intent to introduce additional measures to improve herd health status in the next 12 months.

**Table 8 – Pearson correlations for direct OA, SN and PC measures with intent**

| Pearson Correlation Coefficients<br>Prob > \|r\| under H0: Rho=0<br>Number of Observations | | | | | |
|---|---|---|---|---|---|
| | **OA_D** | **SNin_D** | **SNde_D** | **PC_D** | **Intent** |
| **OA_D** | 1.00000 | | | | |
| | | | | | |
| | 166 | | | | |
| **SNin_D** | 0.42752 | 1.00000 | | | |
| | <.0001 | | | | |
| | 165 | | | | |
| **SNde_D** | 0.38838 | 0.44090 | 1.00000 | | |
| | <.0001 | <.0001 | | | |
| | 165 | 169 | 170 | | |
| **PC_D** | 0.36520 | 0.26250 | 0.33027 | 1.00000 | |
| | <.0001 | 0.0006 | <.0001 | | |
| | 162 | 166 | 167 | 167 | |
| **Intent** | 0.49753 | 0.49461 | 0.43552 | 0.52342 | 1.00000 |
| | <.0001 | <.0001 | <.0001 | <.0001 | |
| | 163 | 167 | 167 | 166 | 168 |

As Table 8 shows, and perhaps more clearly in Figure 20, all four TPB variables are found to be significantly and fairly equally correlated with intent. Table 8 also shows that the four TPB variables are significantly correlated with one another, suggesting that there might be significant co-linearity between them. Because collinear variables explain common variance in the dependent variable (I3), in the regression model the weaker of the two collinear variables may be non-significant and therefore could be dropped without reducing the model's explanatory power (see below).

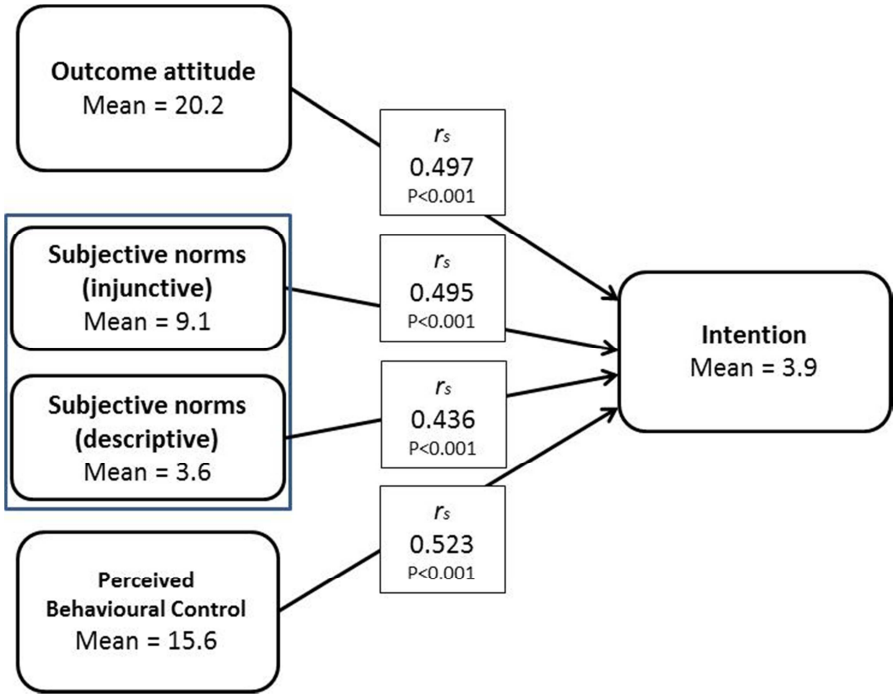


**Figure 20 – Schematic showing correlations between direct OA, SN and PC variables with intent.**

## 5.8 Predictors of intent to use additional measures to improve herd health status in the next year.

The TPB variables found to be correlated with intent were used, together with farm and farmer descriptive socio-demographic variables, plus background attitudinal variables, in a regression model to predict intention (I3 – Intend) to adopt additional measures to improve herd health status over the next 2 years. As the dependent variable in this case is non-arbitrary and categorical a non-linear, ordered probit regression was carried out, using the SAS 'QLIM[1]' procedure. The dependent variable in this case is a 5-point ordinal scale, where 1=Strongly disagree and 5=Strongly agree. However, as Figure 16 shows, responses are not evenly distributed over the response categories, resulting in estimation problems for some categories with small N values. To overcome this problem categories 1 -3 were merged, to create a 3-point ordinal variable with the first category normalised to zero (i.e. 0, 1 and 2). The ordered probit model (Zavoina and McKelvey, 1975) is based on the estimation of a latent (unobserved) utility variable $y_i^*$:

$$y_i^* = \beta_i x_i + \varepsilon_i$$

Where: I = individual farmers: -1, 2 … N
$x_i$ = a vector of explanatory variables
$\beta_i$ = a vector of parameters to be estimated
$\varepsilon_i$ = normally distributed error (or disturbance)

The observed dependent variable is assumed to be a censoring of the unobserved, underlying continuous distribution of preference, i.e. the latent variable. The vector $x_i$ includes the four TPB dimensions, plus background attitudes elicited during the survey and the vector of socio-demographic factors $(A')$ listed in Appendix Table A.1, i.e.:

$$x_i = \text{OA} + \text{SN(I)} + \text{SN(D)} + \text{PC} + \text{A'}$$

Table 9 shows the results of the ordered probit model, i.e. the final model where all remaining variables are statistically significant. The variable LACT_HOUSE_TIE is retained in the model because it is very close to being statistically significant and subsequently provides significant marginal effects (Table 10). The sign of the parameter estimate shows how the associated explanatory variable is related to intent (i.e. likelihood to adopt additional health measures). Thus positive signs, for example the three TPB variables, indicate that an increase in the units scores for these variables increases the likelihood of intended adoption. Negative signs, as found for age for example, mean that unit increases in these variables, lead to decreases in intended adoption.

To obtain estimates representing the magnitude of effects of independent variables (IVs) on the dependent variable (DV) it is necessary to calculate the marginal effects of the IVs, i.e. the partial changes in the probability of an outcome, i.e. the probability of falling into a particular DV rank, caused by a change in the value of an explanatory variable. These marginal effects are calculated as:

Prob $(\gamma = j|x)$ where: j = the different levels of the DV (0, 1 & 2).

The marginal effects are shown in Table 10.

[1] Qualitative and Limited Dependent Variable Model, SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513, USA.

**Table 9 – Results of ordered probit regression model**

| Effect | Description | Parameter estimates | Std Error | t value | Approx Pr > t |
|---|---|---|---|---|---|
| OA_D | Outcome attitude | 0.048000 | 0.018061 | 2.66 | 0.0079 |
| SNin_D | Subjective norm (injunctive) | 0.076935 | 0.016949 | 4.54 | <0.0001 |
| PC_D | Perceived control | 0.104088 | 0.015270 | 6.82 | <0.0001 |
| g3 | Background attitude (importance of improving herd physical performance) | 0.173816 | 0.070631 | 2.46 | 0.0139 |
| AGE | | -0.088583 | 0.039399 | -2.25 | 0.0246 |
| MILK_OTHER | Milk buyer (other) | 0.370265 | 0.158266 | 2.34 | 0.0193 |
| WAIT_PERIOD_DYS | Target voluntary waiting period (days) | -0.004814 | 0.001908 | -2.25 | 0.0116 |
| LACT_HOUSE_TIE | Type of housing for lactating cows (tie stall) | 0.306783 | 0.163950 | 1.87 | 0.0613 |
| HEALTH_FARMER | Ranking of importance of sources of advice on animal health (other farmers) | -0.064748 | 0.020994 | -3.08 | 0.0020 |
| HEALTH_OWN | Ranking of importance of sources of advice on animal health (own expertise) | -0.096630 | 0.030801 | -3.14 | 0.0017 |
| HEALTH_BOOK | Ranking of importance of sources of advice on animal health (books, manuals) | 0.056776 | 0.019475 | 2.91 | 0.0036 |

Log Likelihood -127.246; N=156.

**Table 10 – Marginal effects for explanatory variables on likelihood of adopting additional measures**

| Effect | Description | $P(\gamma = 0\|x)$ | $P(\gamma = 1\|x)$ | $P(\gamma = 2\|x)$ |
|---|---|---|---|---|
| OA_D | Outcome attitude | -0.041952** | 0.0071439 | 0.0348081** |
| SNin_D | Subjective norm (injunctive) | -0.0624189** | 0.0106292 | 0.0517897** |
| PC_D | Perceived control | -0.082883** | 0.014114 | 0.068769** |
| g3 | Background attitude (importance of improving herd physical performance) | -0.0901434 | 0.0153504 | 0.074793 |
| AGE | | 0.0737347* | -0.0125561 | -0.0611785* |
| MILK_OTHER | Milk buyer (other) | -0.1935538** | -0.0639238 | 0.2574776 |
| WAIT_PERIOD_DYS | Target voluntary waiting period (days) | 0.0038708* | -0.0006592 | -0.0032117* |
| LACT_HOUSE_TIE | Type of housing for lactating cows (tie stall) | -0.2107487** | -0.0895281 | 0.3002768* |
| HEALTH_FARMER | Ranking of importance of sources of advice on animal health (other farmers) | 0.0501954** | -0.0085477 | -0.0416476** |
| HEALTH_OWN | Ranking of importance of sources of advice on animal health (own expertise) | 0.0794632** | -0.0135316 | -0.0659315** |
| HEALTH_BOOK | Ranking of importance of sources of advice on animal health (books, manuals) | -0.0290415* | 0.0049454 | 0.024096 |

* significant at 5% level; ** significant at 1% level.

The sum of the marginal effects associated with each explanatory variable is equal to zero, because an increase in the likelihood (probability) in one category of the dependent variable is associated with compensating decreases in likelihood in the other categories. The marginal effect of dummy

variables (HEALTH_FARMER; HEALTH_OWN; HEALTH_BOOK; LACT_HOUSE_TIE and MILK_OTHER) reflects the effect on the dependent variable of a discrete change of the dummy variable from zero to one.

Interpreting the results from Table 10, most attention should be given to the results that are statistically significant. All three TPB explanatory variables generate statistically significant marginal coefficients. The results indicate that increasing the outcome attitude score by one unit, results in a 3.4% increase in likelihood that a respondent will score the dependent variable as 'strongly agree', and because the marginal coefficient for 'agree' is non-significant, results in a 3.4% increase in the likelihood of a 'positive' dependent variable rank score, i.e. adding 'agree' or 'strongly agree'. To put this statistical relationship more transparently, a one unit increase in the outcome attitude score increase the likelihood of intention to adopt additional measures by 3.4%.

A one unit increase in subjective norms increases the likelihood of intention to adopt by 5.2% and a one unit increase in perceived behavioural control increases the likelihood of intention to adopt by 6.9% (in both cases the marginal coefficient for 'agree' is N.S. All three TPB constructs are therefore seen to have broadly similar, albeit modest, effect on intent and therefore equal measures of improvements in these constructs would likely yield similar increases in intention.

There are negative marginal effects for farmer age, suggesting that for each year of increase in age, there is a 7.4% decrease in the likelihood of intention to adopt. In short, the older the farmer, the lower their likely intention to undertake the behaviour. Negative marginal effects coefficients were also found for target voluntary waiting period and farmer reliance on their own and neighbouring farmer knowledge of animal health issues, i.e. farmers more reliant on their own, or neighbours knowledge, rather than professional sources, have lower intent ranks.

The most significant drivers of increased intent appear to be the use of specialist milk buyers and the use of the tie stall for herd housing. In the regression model these are both binary variables and the marginal effects suggest that the use of tie stalls, and specialist milk buyers increase the likelihood of a intent to adopt by 25% and 30% respectively. Some caution needs to be attached to the tie stalls result as not all countries operate this management system, for example, is not permitted in organic systems in Germany, and it may therefore capture country effects to some extent. However, these two results suggests that these two contextual factors do exert some influence on intent beyond that mediated by the TPB constructs.

In terms of background attitudes, while a higher ranking of the business objective of improving herd performance was associated with higher intent ranks the marginal effects were N.S.

## 5.9. Cognitive barriers to, and drivers of, intent

Barriers and drivers of intent were identified by correlating intent with individual outcome attitude, subjective norms and perceived behavioural control questions. To reduce the size of the correlation matrix, correlations were run for each of the TPB factors separately. A significant positive correlation between a TPB question and intention indicates a cognitive driver, while a significant negative correlation indicates a cognitive barrier. In Table 11 significant correlates, i.e. with a probability of error less than $p<0.05$ and an 'rs' value greater than 0.3 or less than -0.3 are highlighted in bold.

**Table 11 – Spearman correlation of TPB variables with intent**

| **Spearman Correlation Coefficients Prob > \|r\| under H0: Rho=0** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| OA variables | Intent with OA variables | | SN(in) variables | Intent with SN(in) variables | | SN(de) variables | Intent with SN(de) variables | | PC variables | Intent with PC variables |
| OA_I_1 | **0.3782** | | SNin_I_1 | 0.25797 | | SNde_I_1 | 0.18145 | | PC_I_1 | 0.09525 |
| | <0.0001 | | | 0.0025 | | | 0.0284 | | | 0.2251 |
| OA_I_2 | 0.09144 | | SNin_I_2 | **0.35797** | | SNde_I_2 | 0.18681 | | PC_I_2 | -0.04116 |
| | 0.2487 | | | <0.0001 | | | 0.0216 | | | 0.6041 |
| OA_I_3 | **0.31352** | | SNin_I_3 | 0.23280 | | SNde_I_3 | 0.10698 | | PC_I_3 | 0.27167 |
| | <0.0001 | | | 0.0031 | | | 0.2100 | | | 0.0005 |
| OA_I_4 | **0.31635** | | SNin_I_4 | 0.22107 | | SNde_I_4 | 0.12503 | | PC_I_4 | 0.08002 |
| | <0.0001 | | | 0.0050 | | | 0.1548 | | | 0.3114 |
| OA_I_5 | 0.26113 | | SNin_I_5 | 0.13677 | | | | | PC_I_5 | 0.02453 |
| | 0.0009 | | | 0.1071 | | | | | | 0.7581 |
| OA_I_6 | **0.37020** | | SNin_I_6 | 0.24349 | | | | | PC_I_6 | 0.07890 |
| | <0.0001 | | | 0.0019 | | | | | | 0.3183 |
| | | | SNin_I_7 | **0.32461** | | | | | PC_I_7 | -0.00963 |
| | | | | <0.0001 | | | | | | 0.9035 |
| | | | SNin_I_8 | 0.17484 | | | | | | |
| | | | | 0.0324 | | | | | | |
| | | | SNin_I_9 | **0.36323** | | | | | | |
| | | | | <0.0001 | | | | | | |

As Table 11 shows, four of the six individual OA variables have significant positive correlations with intent. However, none of these correlations reaches 0.4 or above, confirming the regression model finding that OA is a relatively weak driver of intent. The largest correlation coefficient is for item (1), i.e. expectation of better herd physical performance. There are significant positive correlations between item (6) and four of the other items (not shown in Table 11), suggesting a complex of positive expectations for the outcomes of additional health measures based around improved physical and financial performance.

Most of the Injunctive subjective norms variables are significantly correlated with intent, but only weakly so, i.e. Rho<0.4. The strongest correlation is item 9, i.e. the attitudes of family members and friends. These weak correlations confirm the results of the regression modelling, which showed that the composite Injunctive subjective norms variable was a relatively weak predictor of intent. There are a number of strong and significant correlations between the elements of Injunctive subjective norms (not shown), notably item 4, the organic association, which was correlated with a wider community, including milk consumers, farm advisers and the general public. This perhaps suggests that organic dairy farmers perceive an alignment between the views of their organic association and wider public concerns.

There is a high degree of correlation between the elements of the Descriptive subjective norms (not shown in Table 11), but there is rather low correlation with intent. Indeed, only one of the elements show significant correlations and in these case the Rho value is small. This confirms the results of the regression modelling, where the composite Descriptive norms variable was non-significant. Only

one of the PC elements is significantly correlated with intent, but this has a small Rho value. There are a number of small to moderate significant correlations between the PC elements (not shown), suggesting less coherence in the PC composite variable than the other TPB composites.

# 6. The follow-up survey

## 6.1 Aims

Based on the positive farmer expectations of the outcomes of taking additional health measures recorded in the Behavioural (TPB) survey outlined above it would not be unreasonable to suppose that when presented with a tailored package of measures for their farms, the great majority of farmers will follow through and implement some or all of these measures. This supposition is also supported by the confidence of study farmers that they are equipped to undertake these actions, together with the high rates of intent to implement such measures. On the basis of these conclusions, a number of 'predictive' hypotheses can therefore be made.

1. The great majority of farmers will follow through and implement some or all of the tailored package of measures recommended for their farms;
2. There is no strong reason to suppose that the intervention will significantly increasethe incidence of negative attitudes towards taking additional health measures;
3. Rates of follow-through will be higher for: younger farmers; those who make greater use of vets and professional advisory services and information sources; specialist milk marketing chains; and tie stalls;
4. Farmers will be most likely to take up additional actions where these are compatible with their everyday management activities
5. Farmers with strong business goals based on maximising herd physical performance will have higher rates of follow-through
6. Intention to implement additional herd health measures will prove to be a very good predictor of actual behaviour in this regard.

If the conclusions drawn from the TPB analysis above are correct, these 'predictive' hypotheses will be confirmed by observational data on the actual behaviour of these farmers. The follow-up survey is therefore designed to test these hypotheses using data on the actual behaviour of farmers following the participatory intervention, while seeking possible explanations for any divergences from expectation. To achieve this aim the follow-up survey questionnaire contains replicates of most of the attitudinal questions contained in the pre-intervention behavioural (TPB) survey, so that the impact of the intervention (including the participatory approach) on attitudes can be gauged. Additionally the survey collects information on the extent of follow-through to implement recommendations for additional herd health measures arising from the intervention, to allow for analysis of sub-group variation in follow-through and comparison with the expressed intentions recorded in the pre-implementation survey.

## 6.2 The sample

The majority of farmers who had participated in the pre-intervention behavioural (TPB) survey were approached to participate in the follow-up survey. The survey was undertaken by means of a telephone interview. Of the 171 farmers who participated in the pre-intervention survey, 78 responded to the follow-up survey, as shown in the final column of Figure 1. As Figure 1 shows,

retention of farmers in the survey process is most successful in Germany, where 45 farmers respond to the follow-up survey.

## 6.3 Results

### 6.3.1 Change in outcome beliefs

In the pre-intervention survey respondents were asked a number of attitudinal questions to indirectly measure: (a) beliefs that they hold about the nature of the outcomes that would result from taking additional herd health measures; and (b) the importance that they attach to each of these expected outcomes. These questions contribute to the Outcome Attitude dimension of the TPB behavioural framework). Table 12 lists these attitudinal questions and shows the difference between the pre- and post-intervention rank scores for each. In this case, pre-intervention scores were subtracted from post-intervention scores and therefore positively signed values mean that the post-intervention rank score is larger than the pre-intervention score. Where the question reflected a positive outcome this would mean that the post-intervention attitudes were more positive than they were before the intervention. Where negative outcomes are being expressed by a question, a positive difference score would mean a more negative post-intervention attitude. Table 12 also shows statistical tests for the significance of the differences observed. In the case of Table 12 (and all of the tables which follow) because these metrics were based on ordinal scales, and because assumptions of the normality of the underlying distribution cannot be met, a non-parametric test of the significance of differences has been used. As the pre- and post-intervention variables were repeated measures (i.e. two time-separated measures from the same individuals) the Wilcoxon Matched Pairs Signed Ranks test has been used. The more powerful non-parametric Walsh test was not used in this case because this requires that the distribution of ranks be symmetrical, i.e. the mean and median values would be the same and this assumption cannot be made. The Wilcoxon test estimates whether the mean of the difference score is significantly different from zero – in effect, whether the pre- and post-intervention ranks are statistically different.

**Table 12 – Differences between pre- and post-intervention outcome attitude measures.**

| Outcome attitude measure:<br><br>'Taking additional health measures would': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Result in better herd performance | +0.263889 | Zero | 185 | 0.0454 * |
| Not be cost effective | -0.26087 | Zero | 144 | 0.1047 |
| Add to my job satisfaction | -0.06944 | Zero | -47.5 | 0.5375 |
| Not increase the welfare of my herd | +0.089552 | Zero | 31.5 | 0.6041 |
| Enhance my reputation as an organic farmer | +0.191176 | Zero | 90.0 | 0.2180 |
| Increase the profitability of my farm | +0.257143 | Zero | 129 | 0.1010 |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

In only one case are the pre- and post-intervention rankings for outcome attitude questions significantly different, this being Item 1: 'Taking additional health measures would result in better herd performance'. In this case the pre-intervention rank is higher than post-intervention, suggesting that as a result of the intervention, i.e. being made aware of the nature of the health measure recommendations and possibly also observing the effect that implementing the recommendations has on herd performance, respondents have more positive attitudes about the beneficial effects that taking additional herd health measures might have on herd physical performance. In all other cases,

while the direction of change might be of interest, the different scores cannot be assumed to be significantly different from zero.

**Table 13 – Differences between pre- and post-intervention ranks of outcome importance**

| Outcome attitude measure:<br><br>'Taking additional health measures would': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Better herd performance | +0.13699 | Zero | 60 | 0.2769 |
| Cost effectiveness | +0.35616 | Zero | 150.5 | 0.0050 ** |
| Job satisfaction | +0.38356 | Zero | 221 | 0.0008 ** |
| The welfare of my herd | +0.27397 | Zero | 176.5 | 0.0035 ** |
| Reputation as an organic farmer | +0.67123 | Zero | 354.5 | <.0001 ** |
| Profitability of my farm | +0.40278 | Zero | 222 | 0.0016 ** |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

Table 13 shows that respondents have significantly increased the importance ranking that they ascribe to five of the six potential outcomes of implementing additional herd health measures. The only potential outcome not to see a significant increase in perceived importance is 'Better herd performance'. This is, in fact, the one outcome that respondents decided was more likely than previously believed to result from undertaking more health measures after the intervention. The fact that respondents increase their importance rankings across such a wide range of outcomes might be taken to suggest that the intervention has had a broad impact on farmer aspiration, or standards setting. Farmers would as result of their experience of the intervention (and the participatory approach) appear to be more 'focussed' on a range of goals and consequently have 'set the bar' higher in a number of areas of business and management performance. The alternative explanation is that these results are artefacts resulting, not from systematic experimental effects, but rather from random error. However, random error would be stochastic in nature and would not bias difference scores, but would rather increase variance about the mean (of zero), making significant differences between pre- and post-intervention scores less likely.

### 6.3.2 Change in social norms

Table 14 shows, very broadly, that experience of the intervention, with its participatory approach and herd health recommendations, has had very little effect on farmers' perception of the level of approval of different peer groups of their undertaking further measures to improve herd health. This result is somewhat unexpected, given the fact that the intervention has increased farmers' expectations that taking additional measures will have a beneficial impact on herd health. One exception to this, however, is a post-intervention increase in the expectation of the approval levels of milk consumers. This increase in expected approval perhaps derives from a belief that consumer perception will be impacted favourably if farmers are seen to be 'doing more' and achieving improvements in herd health and welfare. However, while this expectation is predicated on the existence of a market-based mechanism by which consumers might be informed of the additional measures that farmers are taking – a mechanism which, at present time, does not exist – farmers would probably not have been mindful of this fact.

**Table 14 – Differences between pre- and post-intervention ranks of approval of action by peers (Injunctive norm) (whole sample)**

| Injunctive norm measure:<br><br>'Do you think the following would approve of you taking additional measures?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Scientists / researchers | -0.07273 | Zero | -9 | 0.7944 |
| Veterinarians | -0.02899 | Zero | -7.5 | 0.9133 |
| Your milk buyer | 0.028986 | Zero | 28 | 0.5660 |
| Your organic association | 0.073529 | Zero | 40.5 | 0.3598 |
| Neighbouring farmers | 0.178571 | Zero | 52 | 0.1452 |
| Milk consumers | 0.375000 | Zero | 154 | 0.0006 ** |
| Farm advisers | 0.090909 | Zero | 43.5 | 0.3275 |
| The general public | 0.095238 | Zero | 59 | 0.3123 |
| Family members and/or friends | 0.130435 | Zero | 68.5 | 0.2803 |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

Based on the negligible impact that the intervention has had on farmer perceptions of peer group approval levels, it might be expected that the intervention would also have little or no effect on the level of farmer compulsion to comply with the views of peer groups. Table 15 affirms this expectation with no significant differences observed between pre- and post-intervention ranks for any peer group.

**Table 15 – Differences between pre- and post-intervention ranks of importance of opinion of peers (Injunctive norm) (whole sample)**

| Injunctive norm measure:<br><br>'How important are the opinions of the following people?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Scientists / researchers | 0.0 | Zero | 0.5 | 0.9960 |
| Veterinarians | -0.09589 | Zero | -61 | 0.4437 |
| Your milk buyer | 0.041667 | Zero | 20 | 0.8198 |
| Your organic association | 0.083333 | Zero | 51 | 0.4997 |
| Neighbouring farmers | 0.211268 | Zero | 151 | 0.1428 |
| Milk consumers | -0.10959 | Zero | -54 | 0.5985 |
| Farm advisers | 0.027778 | Zero | 29.5 | 0.6839 |
| The general public | -0.10145 | Zero | -27.5 | 0.7701 |
| Family members and/or friends | -0.21127 | Zero | -112 | 0.1596 |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

Table 16 shows the impact of the intervention on farmers' beliefs about the likelihood of other groups of farmers adopting additional herd health measures. As can be seen, the intervention has had no impact on farmers' perception of the likelihood that other farmers in the project, or organic farmers in general, would adopt additional measures. This is perhaps because farmers in this study perceive that these groups are already fully committed to undertaking any additional measures necessary to improve herd health and welfare. Interestingly, there are significant changes in the perceptions of the likelihood of other groups undertaking additional measures, i.e. friends and neighbours and farmers in the breed society. One possible explanation for the expected decrease in likelihood might be that having seen, first hand, the type, number and nature of the additional measures being recommended, farmers in this study expect that this will in some way act as an

obstacle to these groups undertaking the measures, perhaps because of the cognitive or resource burden involved with implementation, or because the measures are particularly attenuated to organic production methods.

**Table 16 – Differences between pre- and post-intervention ranks of expectation of peers taking additional measures (Descriptive norm) (whole sample)**

| Injunctive norm measure:<br><br>'How likely is it that the following groups will be taking additional measures?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Other farmers in the project | -0.25581 | Zero | -42.5 | 0.1832 |
| Leading organic farmers | 0.159091 | Zero | 30 | 0.3772 |
| Your farmer friends / neighbours | -0.46512 | Zero | -136 | 0.0184 * |
| Farmers in your breed society | -0.6105 | Zero | -130.5 | 0.0096 ** |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

Experience of the intervention has relatively little effect on the ranking of the importance of the actions of peers on the decision-making of study farmers. The one exception to this is a near significant fall in the rank attributed to the actions of other farmers involved in the project. This might suggest a partial weakening of the role of subjective norms in light of increased personal knowledge of the recommended herd health measures, i.e. growing self-sufficiency resulting from the acquisition of knowledge.

**Table 17 – Differences between pre- and post-intervention ranks of importance of peers taking additional measures (Descriptive norm) (whole sample)**

| Injunctive norm measure:<br><br>'How important is it that the following groups will be taking additional measures?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Other farmers in the project | -0.31579 | Zero | -104 | 0.0549 |
| Leading organic farmers | 0.321429 | Zero | 67 | 0.1032 |
| Your farmer friends / neighbours | -0.10714 | Zero | -40.5 | 0.5405 |
| Farmers in your breed society | -0.37037 | Zero | -108.5 | 0.0945 |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

### 6.3.3 Change in perceived behavioural control

In terms of the perceived behavioural control dimension of the TPB framework, there were changes to the rankings of the likelihood of occurrence of just two of the factors perceived to influence farmers' ability to undertake the behaviour. Post intervention, the changes to rankings are also positive, i.e. having had experience of the recommendations resulting from the intervention, farmers are even more confident that these positive outcomes (i.e. 'Fit into daily work routines' and 'Be feasible as I know exactly what should be done') will result. Additionally, farmers even more strongly disagree that the actions would only be feasible with advisory support. Taken together these changes in perceptions or attitudes suggest growing confidence amongst farmers in their own capability to implement all measures that might be recommended.

**Table 18 – Differences between pre- and post-intervention ranks of likelihood of occurrence of factors affecting farmers' ability to undertake action (PC) (whole sample)**

| Injunctive norm measure:<br><br>'How likely is it that taking additional measures would?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Fit into my daily work routine | -0.25000 | Zero | -167.5 | 0.1007 |
| Be too costly as my time and money are needed for other matters | 0.0 | Zero | -7.5 | 0.9211 |
| Be feasible as I know exactly what should be improved | 0.342857 | Zero | 216 | 0.0083 ** |
| Be challenging when following organic principles | 0.042254 | Zero | 45 | 0.5828 |
| Be difficult to achieve results and benefits in the short term | -0.18310 | Zero | -95.5 | 0.3330 |
| Only be effective with advisory backup | -0.43662 | Zero | -307 | 0.0038 ** |
| Be remunerated with premiums | -0.05634 | Zero | -38.5 | 0.6299 |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

In the pre-intervention TPB survey farmers were also asked to indicate the extent to which the control factors listed in Table 18 above enhanced or inhibited their ability to implement additional health measures. Table 19 shows the extent to which these ranks have changed in light of the intervention, i.e. experience of additional recommended health measures. In this case, positively signed differences mean that the factor makes implementation easier, while negatively signed difference scores indicate the perception that factors make implementation more challenging.

**Table 19 – Differences between pre- and post-intervention ranks of positive or negative impact of each of the factors perceived to affect farmers' ability to undertake action (PC) (whole sample)**

| Injunctive norm measure:<br><br>'Do the following factors make it easier or more difficult to take additional measures?': | Difference in mean ranks | Median of difference in ranks | Signed rank (S) | Pr>(S) |
|---|---|---|---|---|
| Fit into my daily work routine | -0.34483 | Zero | 90.5 | 0.1678 |
| Be too costly as my time and money are needed for other matters | -0.44643 | Zero | -153.5 | 0.0471 * |
| Be feasible as I know exactly what should be improved | -0.24074 | Zero | -65.5 | 0.1487 |
| Be challenging when following organic principles | -0.36364 | Zero | -127 | 0.0222 * |
| Be difficult to achieve results and benefits in the short term | -0.81481 | -1 | -254.5 | <.0001 ** |
| Only be effective with advisory backup | -0.80000 | -1 | -262.5 | <.0001 * |
| Be remunerated with premiums | -0.43396 | Zero | -135.5 | 0.0261 * |

Note to table: * signifies significance at the 5% level; ** significance at the 1% level or better.

Table 19 shows some anomalous results. As expected, there is no change in the ranking of the extent to which 'Fit into my daily work routines' and 'Be feasible as I know exactly what should be improved' are perceived to facilitate or inhibit adoption of additional health measures. Farmers remain generally sure that these outcomes will arise and that they are positive factors. However, in the case of other factors there are significant negative changes in perception, suggesting that having become familiar with the recommended measures farmers now believe that that the constraint set is more binding. For example, there is an increased perception that the cost and time

required to implement measures will be constraining. However, as there is no relative weighting of these factors, it is difficult to know whether this increased perception of the strength of some constraints is sufficient to significantly constrain behaviour. Indeed, the extremely high rate of uptake of recommended additional health measures by study farmers (see below) suggests that these changes to perceived constraint strengths have negligible influence. It is also worth noting that in the case of some of these constraints, farmers' post intervention perception is that they are less likely to occur (see Table 18).

### 6.3.4 Intention as a predictor of actual behaviour

The follow-up survey records the extent to which farmers implemented the additional herd health measures that were recommended to them as part of the intervention (with participatory approach). Farmers were first reminded of the measures that were recommended and then asked to indicate whether they had implemented each measure. In follow-up questioning, they then indicated why they had implemented the recommended measure, or why they had not. If they had not implemented the recommended measure they were also asked if they had implemented any alternative measures. As an indicator of the extent to which measures had been taken up the percentage of recommended measures adopted was calculated, as a means of normalising for the number of recommendations made. This measure of actual uptake was then correlated against the expressed intentions of farmers provided prior to the intervention. As the measure of actual behaviour is measured at the interval scale and the intention variable, which is based on a 5-point ordinal scale, is assumed to represent an underlying normal distribution, the parametric Pearson correlation was deployed. Against expectation, the correlation between these two measures is fairly low (Rho=0.19856, p=0.0702) and the correlation coefficient is not significant, although it is close to significance. The explanation for this low level of correlation is that rate of uptake of recommended health measures is extremely high, with all but a few farmers taking up at least some of the additional measures recommended. This means that farmers who expressed low levels of intention to adopt measures (i.e. who stated they had no intention of adoption), actually adopted measures at much higher rates than would have been expected, and at rates that are not significantly different from those that expressed a relatively high level of intent (i.e. who stated they might or definitely would adopt). The average rate of uptake, expressed as a percentage, of recommended measures of these two groups is 66.6% and 46.9% respectively (t=-1.77, p=0.0809). For the same reason, the effects of socio-economic characteristics on intention are also not reflected in actual behaviour (results not shown).

# 7. Discussion and conclusions

The general picture that emerges from the analysis of these two surveys is that organic dairy farmers across the study countries share a generally positive view of the value of taking additional health measures to improve the health of their herds. The expected outcomes of such actions are widely believed to be positive, i.e. resulting in improved herd physical performance, greater cost effectiveness, leading to greater job satisfaction. There is a notably high degree of consistency of views between farmers across the study countries. This, combined with a general lack of interest in the views of neighbouring farmers, plus more significant appreciation of the views of organic associations and expert advisers, suggests that organic dairy farmers identify to a greater extent with other organic dairy farmers, even in other countries, than they do with conventional farmers in their own neighbourhood.

Prior to the intervention there was a very high level of confidence among study farmers that they had the means and ability to take additional measures to improve herd health, i.e. they considered these actions to be largely volitional, with a low risk of factors intervening to prevent them acting upon their intentions. This observation is somewhat surprising given the fact that at the time of survey, none of the farmers in the study had seen any of the recommendations that would be made for further actions to improve herd health on their farms. One explanation for this is that study farmers perceived themselves to be so familiar with herd health management issues that they could anticipate the type of actions that would be recommended for their farm. This supposition is supported by the perceptions of study farmers that these future management actions would be consistent with their everyday management routines and would not be prohibitively expensive. This trend may possibly be influenced by self-selection bias in the drawing of the sample involved in the study, i.e. the study may have attracted those organic dairy farmers with greater interest in, and experience of, herd health management. There is unfortunately no means to test for this.

While the assumption underpinning the TPB approach that background and salient attitudes are mediated through the TPB variables is supported by the modelling, some salient attitudes and other economic and structural factors do not appear to be fully mediated through the TPB factors and so have a direct impact on intent. In terms of salient attitudes, the business goal of the farmer appears to be important, so that intent is increased where farmers have the goal of maximisation of herd physical performance. Additionally, the statistical modelling suggests that some economic and physical parameters are at least as important as attitudes and beliefs in determining intent, especially the particular milk market outlet and herd housing system being used. The former seems to be important where milk is sold to specialist chains, where there may be particular attention paid to the health and welfare of supplier's herds, or where these chains strongly identify with organic methods of production. The housing system may have an effect where particular housing or herd management systems facilitate more interventionist herd health management, such as, for example, providing greater opportunity for direct observation of animals. However, as previously indicated, this ‚tie-stall' housing system is not used on some study countries, and so the variable may capture some country effects. For this reason this result should be treated with some caution.

As explained above the participatory intervention took place against a backdrop of already very positive farmer attitudes towards the benefits that might arise from adopting additional health measures and considerable confidence amongst study farmers that they had both the skills and resources to undertake these measures. The follow-up study confirms that farmer experience of the participatory approach and recommended measures does not impair these positive attitudes. In general attitudes towards the outcomes of undertaking these measures remains unchanged, indeed

farmers appear to become more confident that these measures would lead to further improvements in herd health and welfare. This speaks well of the merits of the measures that were suggested, which seem very credible to farmers and may have already (i.e. by the time of the follow-up survey) yielded proven benefits in practice.

One very intriguing observation relating to outcome attitudes is that experience of the intervention has seemingly increased the importance that farmers place on many of the outcomes believed to result from adopting additional health measures. This is very suggestive of the power of the participatory approach as a motivational tool, i.e. raising farmer awareness of particular outcomes and increasing their levels of concern towards each.

While levels of perceived peer group approval remain unchanged, the intervention has increased the perception that consumers would approve of farmers undertaking additional herd health measures. This finding again speaks volumes for the credibility and efficacy of the recommended measures, as this suggests that farmers increasingly believe that these additional measures credibly meet consumer demands for higher standards of animal health and welfare.

A number of attitudinal changes speak of the success of the participatory approach in identifying bespoke measures that are well suited to the needs and constraints of study farms. The first is the increased confidence shown by farmers in the follow-up survey that they already have the necessary skills and resources to undertake these measures, even without advisory support. A further line of evidence comes from the increased belief of study farmers that their neighbouring farmers would be less likely to take up these measures in light of their own experience of them. This perception perhaps has less to do with the perceived efficacy and credibility of these measures and more to do with the closer integration of these non-generic measures with organic farming principles and the specific requirements of their farms, i.e. perhaps rendering them less suitable for conventional systems and farms with different constraint sets.

The hypothesis that the great majority of study farmers would follow-through and take up at least some of the additional measures recommended to them was also upheld. However, the very success of the participatory approach has in some sense mediated against the hypothesis that expressed intent would be a good predictor of actual behaviour. In fact intention has proven to be a poor predictor of actual behaviour. However, this should not be interpreted as a general failure of the TPB behavioural model, because when uptake of a particular behaviour (in this case adopting additional health measures) becomes ubiquitous, behavioural models are rendered superfluous as none of the population characteristics, including attitudes, normally used in such models retain any discriminatory power.

The near universal uptake of recommended measures, or at least some of them, even by farmers showing low levels of intention to adopt prior to the intervention, strongly suggests that the measures identified during the on-farm intervention are perceived by farmers to be credible, relevant and tailored to the needs and constraints of farms. It might be concluded from this that the new participatory approach has done its job admirably.

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# Appendix A – socio-demographic variables derived from the 1st farm visit

The following socio-demographic variables (Table A.1) were selected from data collected as part of the baseline survey undertaken at the 1st farm visit. This selection of variables were believed, a priori to have potential to influence farmer intention to undertake disease management behaviours. All these variables were tested to identify their level of influence in the behavioural modelling.

Table A.1

| Variable name | Description of variable | Format |
|---|---|---|
| Age | Farmer age | Ordinal scale (6 categories) |
| Gender | | Nominal (binary) |
| Decis_maker | Is respondent the main decision-maker on the farm? | Nominal (binary) |
| Yrs_organic | Number of years involved with dairy production | Interval scale |
| OFA | Member of an organic association? | Nominal (binary) |
| AA | Total agricultural area | Interval scale |
| Inc_agr_pct | Proportion of family income derived from agricultural activities | Interval scale |
| Inc_dairy_pct | Proportion of income derived from dairying | Interval scale |
| Milk_cow_sold_mean | Average volume of milk sold per cow in last year | Interval scale |
| MP_agr | Manpower devoted to agricultural activities | Interval scale |
| MP_dairy | Manpower devoted to dairy activities | Interval scale |
| Milk_cons; _priv; _coop; _retail; _other | Milk buyers (5 variables for 5 categories of buyer represented by variable suffix) | Nominal (binary) |
| Yrs_school | Years in full-time education | Interval |
| Edu_none; _voc; _high | Level of agricultural education (3 levels represented by variable suffix) | Nominal |
| Edu_recent | Uptake of agricultural education/training in last 12 months | Nominal (binary) |
| group | Active involvement in a farmers group | Nominal (binary) |
| Breed1 | Predominant breed of dairy herd = 1 ‘holstein_b/w’ | Nominal (binary) |
| Breed2 | Predominant breed of dairy herd = 2 ‘holstein_red’ | Nominal (binary) |
| Breed3 | Predominant breed of dairy herd = 3 ‘swiss brown’ | Nominal (binary) |
| Breed4 | Predominant breed = 4 ‘Fleckvieh/Simmental’ | Nominal (binary) |
| Breed5 | Predominant breed of dairy herd = 5 ‘Jersey’ | Nominal (binary) |
| Breed6 | Predominant breed of dairy herd = 6 ‘swedish red’ | Nominal (binary) |
| Breed7 | Predominant breed of dairy herd = 7 ‘Montbélliarde’ | Nominal (binary) |
| Breed8 | Predominant breed of dairy herd = 8 ‘Mormande’ | Nominal (binary) |
| Breed9 | Predominant breed of dairy herd = 9 ‘other’ | Nominal (binary) |
| Wait_days | Target voluntary waiting period (days) | Interval |
| First_calv_mth | Target age for first calving | Interval |
| m_sys1 | Type of milking system = 1 ‘side-by-side’ | Nominal (binary) |
| m_sys2 | Type of milking system = 2 ‘tandem’ | Nominal (binary) |
| m_sys3 | Type of milking system = 3 ‘herringbone’ | Nominal (binary) |
| m_sys4 | Type of milking system = 4 ‘rotary parlour’ | Nominal (binary) |
| m_sys5 | Type of milking system = 5 ‘other’ | Nominal (binary) |
| Lact_house_loose; _tie; _out | Type of housing for lactating cows (3 variables for 3 types of system represented by variable suffix) | Nominal (binary) |
| Adj_rough; _conc; _not | Type of adjustment of ration according to individual performance (3 variables for 3 types represented by variable suffix) | Nominal (binary) |
| Conc_100kg | Amount of concentrate fed on average | Interval |

| | | |
|---|---|---|
| Past_days | Time that cows spend at pasture | Interval |
| Health_iss | Presence of significant herd health issues in the past year | Nominal (binary) |
| Sanitation | Participation in herd health sanitation programme | Nominal (binary) |
| Prevention | Participation in herd health prevention programme | Nominal (binary) |
| Health_vet; _farmer; _family; _colleag; _assoc; _web; _own; _book | Ranking of importance of sources of information and advice on animal health in general (1=most important; 8=least) (8 variables for 8 categories represented by variable suffix) | Ordinal scale (8 categories) |
| healthplan | Use of written herd health plan including defined health measures | Nominal (binary) |
| Def_aims | Strives for concrete, defined aims for animal health | Nominal (binary) |
| antibiot | Makes use of antibiotics | Nominal (binary) |
| homeop | Makes use of homeopathic remedies | Nominal (binary) |
| phyto | Makes use of phytotherapy | Nominal (binary) |
| Alt_treat | Makes use of alternative treatments | Nominal (binary) |
| Data_analys | Health data are analysed | Nominal (binary) |
| DL | Dummy variable for indicating respondents from Germany | Nominal (binary) |
| FR | Dummy variable for indicating respondents from France | Nominal (binary) |
| SP | Dummy variable for indicating respondents from Spain | Nominal (binary) |
| SW | Dummy variable for indicating respondents from Sweden | Nominal (binary) |