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

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D5.1 – Analysing farmers' perception towards animal health problems

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Executive Summary

This document provides a description and analysis of the adaptive conjoint analysis performed on 210 farms enrolled in IMPRO to estimate the relative importance of animal health management in relation to other farm management activities when extra labour time would become available in their routine. This study indicates that farmers differ considerably in their preference for animal health management in relation to other areas of farm management. At the same time, results show a large variation among the preferences of the individual farmers, which will influence their adoption of animal health related advice. It is concluded that providing farm specific advice by accounting for farmers' preferences will create a higher adoption potential.

Dissemination Level		
PU	Public	PU
PP	Restricted to other program participants (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including Commission Services)	

SEVENTH FRAMEWORK PROGRAMME

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1 Introduction

Compared to conventional dairy farms it is clear that organic dairy farmers fail to outcompete conventional systems regarding the level of animal health (Sundrum, 2001). Better animal health, however, is one of the main motivators for consumers to buy organic products (McEachern and Willock, 2004). There thus seems to be a need for organic dairy farmers to increase the level of animal health to maintain consumer willingness to pay for organic products. However, to a dairy farmer animal health problems (e.g. lameness, mastitis) reflect only one source of risks dairy farmers need to manage. Considering the limited availability of resources on a farm, farmers allocate resources to the management areas which are considered to be of the highest importance.

Management areas that could potentially conflict with animal health management could relate to general activities (e.g. improve hygiene, better feed), pasture (e.g. intensify grassland management, weed control) or young stock (e.g. improve monitoring, dispense of colostrum). Until now, little knowledge is available on the preferences of farmers for different management areas. Motivating farmers to implement animal health related management measures has traditionally been done by performing a cost-benefit analysis. However, the impact of these analyses is questionable because it does not include the personal preference. Farmers may have a preference for different management areas which might influence their decision on the adoption of animal health related measures.

A method to quantify the preference of farmers towards different management areas is called Adaptive Conjoint Analysis (ACA). This method can be used to determine which features of a defined product are preferred. At the same time ACA leaves room to the participant to evaluate his/her own preferences (e.g. being either economically, quality or time driven or a combination of these). Understanding the preference of a farmer for a certain management area over another helps to create a farm-specific advice in which, besides a cost-benefit analyses, the personal preference can be taken into account when constructing an advice.

The objective of this study was to study the preference and variation in preference of farmers for animal health management in relation to other areas of farm management when extra labour time would become available.

2 Materials and Methods

In our study ACA is used to value the preference of farmers for different farm management areas when extra time becomes available. In total, 210 European organic dairy farmers participated in our study. The ACA survey carried out in this research consisted of four sections and aimed to determine the management area that the farmers prefer most. In the first section, the farmers were asked per individual management measure about their preference to implement that specific management measure when extra labour time would become available in their routine. The second section elicitated the differences in preferences between two management measures. Farmers were asked which of the two management measures had their preference. The third section in this questionnaire dealt with the conjoint task in which farmers had to assess their preference with respect to 2 different combinations of management measures. In the fourth section a consistency check was done by showing the farmers various packages of management measures. The farmers were subsequently asked to give the individual packages a value (0 – 100) best representing his/her preference. After the survey, final estimations were made using hierarchical Bayesian updating. A final statistical analysis was performed to test if farmers preferred the animal health management over other areas of farm management. The theoretical background of the ACA method is based on Churchill Jr and Iacobucci (2009), Orme (2006), Sawtooth Software (2006) and Sawtooth Software (2007).

2.1 Data collection

A total of 73 French, 52 German, 28 Spanish and 57 Swedish organic dairy farmers completed the ACA. The French farms were located in the administrative areas: Morbihan, Loire Atlantique and Lorraine. The German farms were located in the regions: Schleswig-Holstein, Mecklenburg-Vorpommern, Lower Saxony, Hesse, Northern Bavaria, Lower Bavaria and Baden-Württemberg. The Spanish farms were located in the Autonomus Communities: Galicia, Asturias, Cantabria, Basque country, Catalonia and Madrid. The Swedish farms were located in the regions: Gävleborgs, Värmlands län, Uppsala, Västmanlands län, Stockholms, Västra götalands, Östergötlands län and Västra götalands län. The ACA was performed as part of the first farm visits of the IMPRO project during the period March 2012 until August 2012. The farm visits were based on a strict protocol and were carried out by one (Spain and Sweden) or two researchers (France and Germany) per country. The farm visits lasted between 3 and 5 hours of which the ACA lasted approximately ½ hour. The conjoint analysis was performed with the use of Sawtooth software for adaptive conjoint analysis (2007) via a laptop. The ACA was setup in English. A first version of the ACA was first tested on one Dutch farmer. The final version of the ACA was then translated to the official language of the corresponding countries and tested for bugs and errors on multiple pilot farms in each country before the official farm visits. The structural farm characteristics of the official farms can be found in D2.3 “Structural characteristics of farms”.

2.2 Definition of attributes and levels

The conjoint model is a multi-attribute model, which assumes that individuals purchase products (e.g., apple) based on their characteristics, or attributes (e.g., flavor) and that each attribute may have two or more levels (e.g., sweet, tart, bitter). Then the individual’s utility for a multi-attributed product concept, U, can be expressed in a simple way as a sum of utilities for its attributes, $u(a_j)$, that is:

$$U = u(a_1) + u(a_2) + \ldots + u(a_n)$$

Where U = utility for a product concept, and $u(a_j)$ = utility for level of the level of an attribute a_j (j = 1 to n). Conjoint analysis relies on the ability of respondents to evaluate a product concept by combining the separate amounts of utility provided by each attribute of the concept.

In this study the product is described as farm management with five farm management areas as attributes. The farm management areas were defined in such a way they were independent of each other. The following management areas were defined: udder health management, barn management, claw health management, calf management and pasture management. Udder health management and claw health management were selected to represent animal health management, the remaining management areas were selected as potential competing management areas if extra labour time would become available. As an indicator for every farm management area three related management measures (levels) were described. An overview of the management areas and management measures can be found in Table 1. Management areas and management measures were based on literature reviews (Table 3), authors' expertise and farmer's knowledge (Leenaars, 2013). Selected management measures were not likely to be already included in the management routine and could be implemented by the farmers themselves. Management measures were defined as clear as possible leaving little room for subjective interpretation by the farmer. The farmers were asked to judge their preference for measures when extra labour time would become available. If farmers were already implementing any of the measures they were asked to evaluate the management measure on their farm in a situation where it has not been implemented yet. Even though management measures were defined as strict as possible the ACA leaves room for own evaluation on which management measures are preferred by the farmer. E.g. one farmer could weigh the costs of implementing a management measure as most important whereas another farmer values possible efficiency of the measures highest.

Table 1 ACA overview of management areas and respective levels

Management areas	Management measures
Barn Management	1. Ensure sufficient feed is accessible for all lactating dairy cows for at least 12 hours per day 2. Clean all drink water troughs daily 3. Clean and disinfect calving pen after each calving
Calf management	1. Supply colostrum to the calf within four hours after birth 2. Thoroughly disinfect calf pens when calves leave the pen 3. Measure chest girth of all calves (age groups 0-1 yr) bimonthly to monitor development and growth
Claw management	1. Trim hoofs of lame cows immediately after detection 2. Check treated lame cows 1 week after treatment again 3. Place footbath once every two weeks
Pasture management	1. Mechanically remove most weeds from all grassland twice per year 2. Measure grass growth once per week during growth season 3. Move dairy cows to different paddock in order to apply rotational grazing
Udder management	1. Use of milker's gloves during milking 2. Post treatment of teats of all cows after milking (dipping or spraying) 3. Milk cows with a high somatic cell count or clinical mastitis last

Table 2 Overview of literature/ expert knowledge used for constructed management areas/ measures

Management area	Author (Year of publication)
Barn	DeVries et al. (2005) Wemmenhove et al. (2009) Morgan (2004)
Calves	Lorenz et al. (2011a) Lorenz et al. (2011b) Lorenz et al. (2011c) Mee (2008) Kehoe et al. (2007) Zanker et al. (2000)
Claw	Manske et al. (2002) Wemmenhove et al. (2009)
Pasture	Kahmen and Poschlod (2008) Ball et al. (2007)
Udder	Huijps et al. (2010)

2.3 The Adaptive Conjoint Analysis

2.3.1 Preference for management measures

In the first section of the ACA, for every management measure, the farmer was asked about his preference for implementing the extra available labour by this measure on his farm. The question was posed as a rating task on a seven point scale ranging from ‘not preferable’ to ‘extremely preferable’. For each combination of management area (5 attributes) and related management measures (3 levels per attribute) preferences were elicit, resulting in a total of 15 preferences. Figure 1 presents the question as it was posed to elicit the preference for the measures within the attribute “Barn management”. The preferences were converted to quantitative values. In the example in Figure 1 the most left button (not preferable) got a value of -3 and the button most right (extremely preferable) the value +3. For each attribute, the average was calculated to centre its values at 0. The values for each attribute were scaled to have a range of unity.

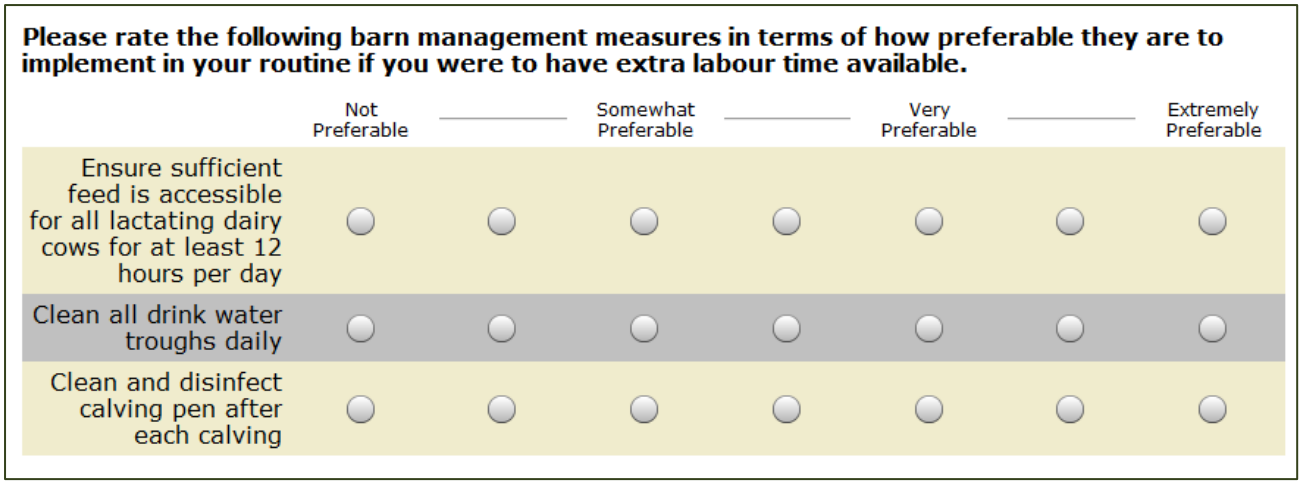

Figure 1 Example of the section one question for the attribute "Barn management"

2.3.2 Management area importance

After the elicitation of the management levels, farmers were asked to state their preference for a level within a management area assuming that all other farm aspects remain the same. The most and least preferred management level (based on prior estimations determined in the first section) of each management area were displayed to the farmers and they were asked to indicate whether they had a preference for one of the two mentioned management measures. In the example of figure 2 the most left option indicates that the farmer has no preference for either of the two management levels, the most right option indicates that the farmer has a very strong preference for one of the two management levels. In total this section consisted of five questions, one for each management area.

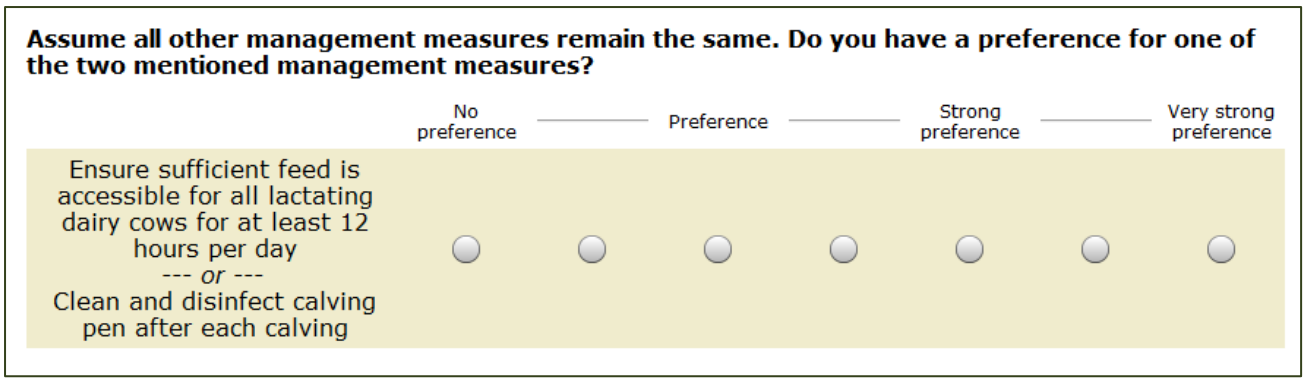

Figure 2 An example of section two question where two levels of one attribute are being compared, in this case dealing with management measures of the management area "Barn management"

The elicit values were initial estimates of utilities, with the following characteristics:

- within each attribute the values have a mean of zero,
- for each attribute the range of utility values for the levels within that attribute is proportional to stated importance, and attribute importance's differ by at most a factor 4, the maximum number of scale points that can be specified for preference questions.

The sections one and two result in part-worth utilities which are the sum of the utilities for the different measures of each management area. These part-worth utilities are used by the ACA software to select the first paired comparison trade-off question for the third section.

2.3.3 Paired-comparison trade-off questions

The third section in this questionnaire dealt with the conjoint task by making paired comparison questions. ACA first focuses on the management areas that the farmer already stated as most important. It uses the information from the two earlier sections to construct two management alternatives (described by various combinations of management levels) that are nearly balanced in preference. In total 12 paired questions were asked as suggested by the method by setting the number of pairs equal to $3(K - k - 1) - K$ where

K = the total number of management measures (15).

k = the total number of management areas (5).

In the example in figure 3 a section three question is presented and farmers were asked which combination of management measures they would prefer to implement in their routine. Farmers could indicate their preference on a nine point scale, if farmers had no particular preference for either of the combinations they could indicate they were indifferent. After having become familiar with the methodology farmers were asked to assess a combination of three management levels on each side to gain as much information as possible.

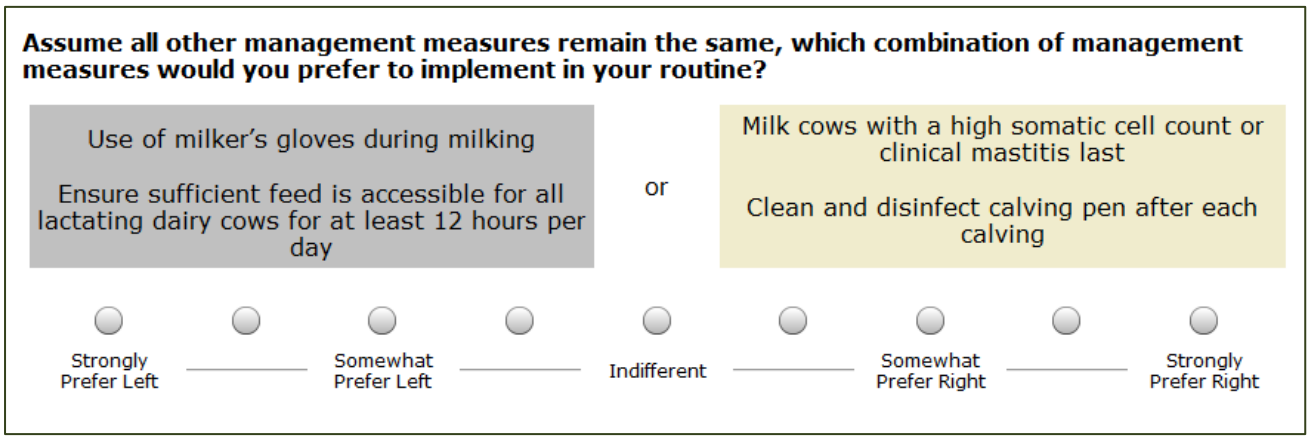

Figure 3 Example of a section three question where different levels of attributes are combined.

The farmers' answer at each step is used to select the next paired comparison question by updating the estimates of the farmers' part worth utilities after each paired comparison response. This allows ACA to evaluate many attributes without asking the respondents to deal with too much information in the questionnaire.

To update the part-worth utilities, an independent variable matrix is constructed with as many columns as levels taken forward to the "pairs questions" (X). If a management measure is displayed within the left concept, it is coded as -1; levels displayed within the right-hand concepts are coded as +1. All other values in the independent variable matrix are set to 0. A column vector (y) is created for the dependent variable as follows: the farmers' answers are zero-centred, where the most extreme value for the left concept is given as -4, and the most extreme value on the right +4. Interior ratings are fit proportionally within that range. Each "pairs question" contributes a row to both the independent variable matrix (X) and dependent column vector (y). Additionally an $n \times n$ identity matrix is appended to the independent variable matrix, where n is the total number of management measures taken forward to the "pairs questions". Additional n values of 0 are also appended to the dependent variable matrix. The resulting independent variable matrix and dependent variable col-

umn vector each have *t* + *n* rows, where *t* is the number of pairs questions and *n* is the number of management measures taken forward to the “pairs questions”. Ordinary least squares estimates of the *n* attribute management measures are computed by regressing the dependent variable column vector on the matrix of independent variables.

Algorithms for updating respondent’s utilities are given below:

Let *X’* be a matrix of predictor variables for a new observation.

Let *y* be a vector of predictor values for a new observation, appended as a row to *X*

Let *z’* be a row vector of predictor values for a new observation, appended as a row to *X*.

Let *r* be a response for the new observation.

Considering only the first *n* observations, we have the regression equation:

$$Xbn \sim y$$

where

$$bn = (X'X)^{-1}(X'y) \tag{1}$$

is the vector of coefficients that would be obtained by least square estimation based on the first *n* observations. Now consider adding one observation. The expanded layout is

$$\begin{bmatrix} X \\ z' \end{bmatrix} b_{n+1} \sim \begin{bmatrix} Y \\ r \end{bmatrix} \tag{2}$$

where $b_{n+1} \sim (X'X + z'z)\text{-}1(X'y + zr)$ is the least squares estimate based on *n*+1 observations. Suppose we already have b_n, *X, y, z* and *r* and we want to obtain b_{n+1}. First consider an identity. Let

$$v = (X'X) - 1z \tag{3}$$

then it can be shown that

$$(X'X + zz')^{-1} = (X'X)^{-1} - \frac{vv'}{1 + v'z} \tag{4}$$

substituting into Eq. (2), we get

$$b_{n+1} = b_n + v\frac{\rho - \varsigma'\beta_v}{\Delta + v'\varsigma} \tag{5}$$

Eq. (5) gives a formula for updating the utilities of each management measure following each response, the inverse as in equation (4) also has to be updated. This is a significant savings when compared to the cost of re-estimating “from scratch” after each response, and the final results are identical.

2.3.4 Calibrating concepts

In the fourth section a consistency check was done by showing the farmers a package of 3 management measures. ACA attempts to measure each farmer's degree of involvement by asking "preferences of applying" questions for several concepts that differ widely in attractiveness. The data obtained from those concepts is useful to analyse correlations between utilities and likelihood responses. An example of such a question is presented in Figure 4. In total three packages were presented to the farmer to be scored, with varying utilities. Each farmer is first shown what would be the least attractive possible concept, followed by the most attractive possible concept, as determined from his or her own answers. Those two concepts establish a frame of reference. The remaining concept is of intermediate attractiveness.

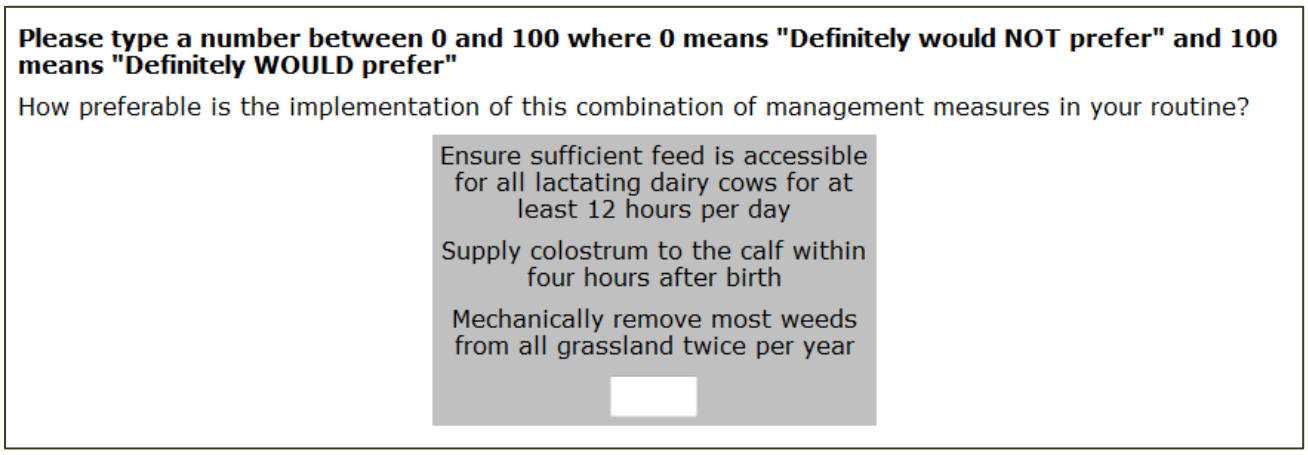

Figure 4 An example of a section four question where a package of levels of different attributes is presented

2.4 Final estimation of preference scores

The estimates of the final utility values were calculated following an iterative process, the Hierarchical Bayes (HB) estimation as recommended by the ACA software. The HB estimation consists of two levels. At the first level it is assumed individual part-worths have a multivariate normal distribution,

$$\beta_i \sim Normal(\alpha, D)$$

In which β_i is a vector of part-worths for the i-th individual, α is a vector of means of the distribution of individuals' part-worths and D is a matrix of variances and covariances of the distribution of part-worths across individuals.

At a second level it is assumed, given an individual's part-worths, the probabilities of responding in a particular way are governed by a multinormal distribution. These are described by the following model

$$y_{ih} = x_{ih}' \beta_i + e_{ih}$$

In which y_{ih} is the answer to question i by respondent h, x_{ih}' is a row vector of values describing the i-th question for respondent h and e_{ih} is an independent identically distributed error term, distributed normally with mean of zero and variance σ^2. The estimated parameters are the vectors of β_i of part-worths for each individual, the vector α of means of the distribution of part-worths, the matrix D of the variances and covariances of that distribution and the scalar σ.

Parameters are estimated by an iterative process. The process starts off with estimates of the parameters that are close to the final values. The initial estimates of β's are the part worth values obtained from the paired-comparison trade off questions of the ACA interview. The initial value of α is the average of the initial β's. The initial estimate of D consists of variances and covariances of the initial betas. The initial value of σ is set to 1.0.

Each consecutive iteration consists of four steps.

(1) Given the present values of α, D and σ new estimates of the β's are generated following the 'Metropolis Hastings Algorithm'.
(2) By the use of the present estimates of β's and D a new estimate of α is generated. Assuming α is normally distributed with mean equal to the average of the β's and covariance matrix equal to D divided by the number of respondents. A new estimate of α is drawn from that distribution.
(3) By using the present estimates of the β's and α, a new estimate of D is drawn from the inverse Wishart distribution.
(4) By the use of the present estimates of α, D and β's, a new estimate of σ is drawn from the inverse Wishart distribution.

This process is continued for a large number of iterations, typically 10,000 or more. The process stops when improvement of the fit of the model is no longer possible. The above method describes the HB estimation process, a more in depth insight in this process can be found in the technical paper of Sawtooth Software (2006).

2.5 Statistical analysis of preference score

The sum of the estimated preference scores of the 5 attributes per respondent equals 100%. Thus the preference for the management areas had to be tested with a method which takes into account the fact that the values are correlated. Accordingly, generalized estimated equations (GEE) with farmer as repeated subject, preference as dependent variable and management area and country as independent variable were used to assess whether, on average, some attributes were perceived to be more important than others and if there were country specific differences. To determine this, the following equation was used:

$$Preference = \beta_0 + \beta_1 \text{ x } management\ area + \beta_2 \text{ x } country \quad (1)$$

Where the outcome is the preference score of the farmers, β_0 is the estimated intercept and the regression coefficients were estimated for management area (β_1) and country (β_2). Data was analysed using SAS/STAT® (PROC GENMOD) version 9.3 software.

3 Results and discussion

Results for the consistency of farmers indicated that farmers had a rather good correlation between the utilities and likelihood responses of section four questions. For all farmers the individual utilities were calculated and summarized per country in the relative preference for the management areas. Differences between farmers were large with quite a few extremes present, as is shown in Figure 5.

The results of the generalized estimated equation (GEE) are presented in Table 3, combined with the mean importance scores for each management area. Management area and country were included as dependent class variables. For management area, barn management was set as

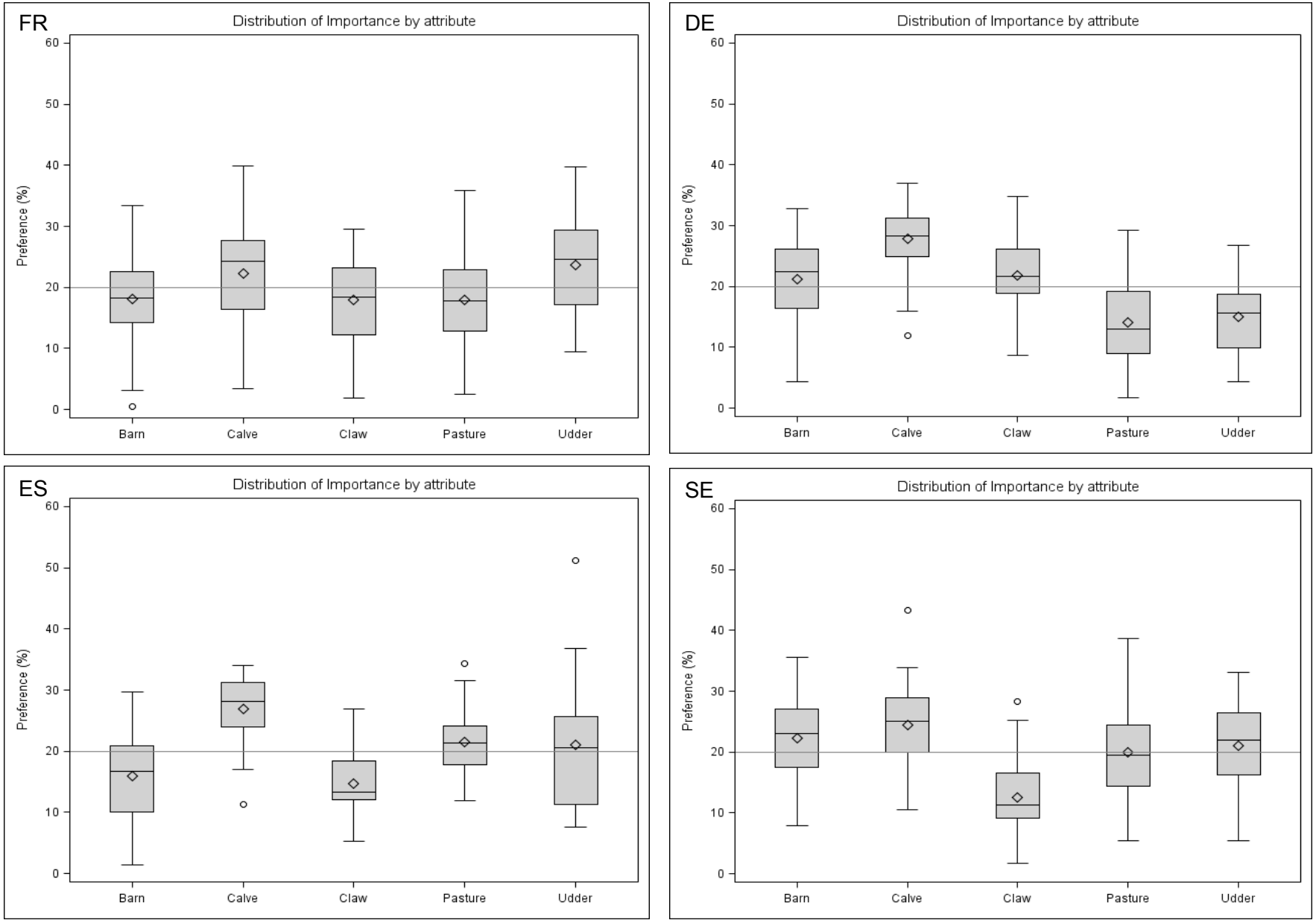

Figure 5 Box-and-whisker plot of the preference (%) of the attributes with a reference line at 20%, representing equal importance. The dots represent the means, the boxes represent the lower and upper quartiles and the medians, the serifs of the whiskers represent the minimum and maximum values within 1.5 times the interquartile range of the quartiles, and squares represent observations outside 1.5 times the interquartile range of the quartile. FR: France, DE: Germany, SE: Sweden and ES: Spain.

reference class, which was due to our hypothesis that there is a preference of farmers for animal health management in relation to other areas of farm management. The choice for barn management with respect to the other farm management areas (pasture, calves) was made because mean preference of barn management was closest to a relative preference of 20% (equal importance). For the variable country Sweden was selected as reference class, as Sweden was found to represent most closely the mean overall preference scores in each management area (Figure 5).

In our study we opted claw management and udder management as variables to represent animal health management. Within animal health management farmers do have a preference for certain areas, represented by a mean importance score of 17.0% for claw management and 20.4% for udder management. Given this information it is suggested that in general farmers would be inclined to implement udder management measures before implementing claw health management measures. However animal health management areas have to compete with other management areas and out of these calve management scored highest. This could indicate that in general farmers included in this study were most likely to implement management measures concerning their calves before taking action in any of the other management areas.

If a famer would be indifferent about implementing any of the management areas the mean importance would all be equal to 20%. However based on the statistical analysis it is found that farmers differ significantly in their preference in what management area to exploit when extra labour time would become available. Based on the mean preference of all participating farmers for every management area it can be concluded that there exists a preference for which management area to exploit when extra labour time becomes available. This finding is further supported by Figure 5 which represents the box-and-whisker plots of the four participating countries.

Table 3 Statistical results Generalized Estimated Equations, with farmer as repeated subject, importance as dependent variable and management area and country as independent variables. REF: reference within class variable, n=210.

Variable	Relative importance	Standard deviation	P value
Management area			
Barn	19.7	7.2	REF
Calve	24.9	7.3	<0.0001
Claw	17.0	7.0	0.0003
Pasture	18.0	7.1	0.0345
Udder	20.4	8.1	0.3935
Country			
France			<0.0001
Germany			<0.0001
Spain			0.1051
Sweden			REF

The statistical analysis includes the variable country to explain potential differences in mean preference score. Within the country variable it is shown that mean preference score of French and German farmers differs significantly (*P* value <0.0001) from the mean preference scores of Swedish farmers. Mean preference score of Spanish farmers does not significantly differ from Swedish farmers however a trend (*P* value 0.1051) can be reported. These outcomes show that preferences for different management areas differ between countries, which might be due to the country specific challenges organic dairy farmers face (e.g. climate, availability of land, endemic diseases).

All farmers with the exception of the French farmers prefer calve management as the most preferred area of action when extra labour time becomes available. French farmers prefer udder health man-

agement as the most preferred area of action. The second preferred management area differs per country. French farmers prefer calve management as the second most preferred management area. For German, Spanish and Swedish farmers the second most preferred management area is respectively claw management, pasture management and barn management. It is interesting to see that French farmers show a preference for the first and second preferred management area and that they are indifferent for any of the remaining three management areas. The mean preference scores of French farmers for barn, claw and pasture management all equal 18%.

Claw health management is the least preferred management measure for Spanish and Swedish farmers. This management area however scores as second most important for German farmers. Probably claw health is more of a problem in German organic herds than for the other countries, which is further supported by the lameness scoring results of the first farm visits (Appendix Table 6), which show that only 21% of the German farms are without clinical signs of lameness compared to 49%, 73% and 75% of respectively the French, Spanish and Swedish farms.

Based on the statistical test we could find some common preferred areas of interest amongst farmers and between countries. At the same time Figure 5 shows a large variation in importance scores between farmers. Lower and upper quartiles of the median are relatively large as do the minimum and maximum values. This would suggest that the preference for animal health management does not only differ between countries but also within countries. This information shows the need to construct a farm specific advice.

Advising a farmer to implement a management measure associated with animal health, while he considers this management area of very low importance, may not be a very effective way of giving the advice. It would be helpful to take the preference of the management area into account when giving the advice. When the farmer has a preference for other management areas than the one technically most important, one can first try to show the importance of that management area. If the farmer is not receptive for that information it can be better to advice implementation of the next best management measure. Maybe the compliance with the next best management measure will be better than to the best management measure.

The fact that farmers are not as straightforward in their decision making does not mean that the current economic models cannot be used as an economic base for advice. However, the results described in this paper do make clear that next to straightforward economic considerations, more aspects can influence the final decision making of a farmer. One of those aspects, the preference of management areas, is discussed in our study.

Traditional economic calculation will remain important to create a starting point for recommendations which will ultimately be re-interpreted to follow the preferences and objectives of the dairy farmer. Understanding the dairy farmer and being able to provide farm specific advice, will improve the value of the advice.

4 Conclusion

This study proves farmers differ in their preference for animal health management in relation to other areas of farm management. At the same time, results show a large variation among the preferences of the individual farmers, which will influence their adoption of animal health related advice. Providing farm specific advice by accounting for farmers' preferences will create a higher adoption potential.

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Appendix

Table 4 ACA/HB importance estimates and rank of management areas and zero-centred utilities of management levels for the countries France and Germany.

Country	Management areas and measures		Relative importance	Rank	Zero-centred utilities	
					Mean	Standard deviation
France (n=73)	Barn		18	3		
		Feed			38.4708325	27.8341823
		Water			-39.8224486	23.7958757
		Disinfect			1.3516160	26.2723429
	Calves		22	2		
		Colostrum			53.9520024	28.1447457
		Pens			-4.6169704	23.2455898
		Girth			-49.3350320	29.4961356
	Claw		18	3		
		Trim			40.8496374	24.6317417
		Check			-1.5120994	24.0846998
		Footbath			-39.3375379	21.7310617
	Pasture		18	3		
		Weed			-20.9280959	35.0225243
		Grass			-15.7267039	31.5445779
		Rotate			36.6547998	26.7993887
	Udder		24	1		
		Gloves			48.3152533	32.0167358
		Treat			32.4540984	40.8468083
		Milk			15.8611549	45.5676103
Germany (n=52)	Barn		21	3		
		Feed			55.8594868	20.7068943
		Water			-16.8089655	22.1678679
		Disinfect			-39.0505214	25.6823830
	Calves		28	1		
		Colostrum			58.7533199	25.2151358
		Pens			13.0127392	30.6221335
		Girth			-71.7660591	20.0125817
	Claw		22	2		
		Trim			50.7161046	17.2931006
		Check			3.0040919	20.8762493
		Footbath			-53.7201965	20.5813498
	Pasture		14	5		
		Weed			15.9050247	29.9399254
		Grass			-22.2019546	26.6183157
		Rotate			6.2969298	29.2710981
	Udder		15	4		
		Gloves			-3.2061225	34.9307519
		Treat			-2.6258060	27.4476496
		Milk			5.8319285	39.6133582

Table 5 ACA/HB importance estimates and rank of management areas and zero-centred utilities of management levels for the countries Spain and Sweden.

Country	Management areas and measures	Relative importance	Rank	Zero-centred utilities	
				Mean	Standard deviation
Spain (n=28)	Barn	16	4		
	Feed			34.7554183	34.3784841
	Water			-26.7057482	27.0715428
	Disinfect			-8.0496701	21.6040554
	Calves	27	1		
	Colostrum			63.8608212	14.0761655
	Pens			6.8844752	11.9391347
	Girth			-70.7452965	16.0247103
	Claw	15	5		
	Trim			30.3715650	21.5847021
	Check			-3.9461262	24.1848229
	Footbath			-26.4254389	25.0839756
	Pasture	22	2		
	Weed			3.2397061	27.1112131
	Grass			-51.6718584	16.6637202
	Rotate			48.4321524	23.1366603
	Udder	21	3		
	Gloves			-30.2479539	33.4402602
	Treat			-15.3751509	33.5114014
	Milk			45.6231048	45.0104868
Sweden (n=57)	Barn	23	2		
	Feed			52.5892792	27.4595686
	Water			-28.5276364	36.9197709
	Disinfect			-24.0616428	31.7631709
	Calves	25	1		
	Colostrum			59.7799732	25.4345718
	Pens			-7.9898177	25.5305958
	Girth			-51.7901555	27.7328408
	Claw	11	5		
	Trim			19.2825275	23.1840556
	Check			-0.2372196	23.9640395
	Footbath			-19.0453079	26.5741963
	Pasture	20	4		
	Weed			-8.6270678	29.3317204
	Grass			-37.6883695	23.5228985
	Rotate			46.3154373	30.1949078
	Udder	22	3		
	Gloves			37.6183861	33.3236210
	Treat			17.0838999	42.5778931
	Milk			20.5344861	40.6648768

Table 6 Distribution of herd prevalence of cows without lameness, results derived from D2.3. Number of farms is 200 of which 55 (FR), 60 (DE), 28(ES) and 57(SE).

Country	Minimum	25th percentile	50th Percentile (median)	75th percentile	Maximum
France	49	70	77	83	100
Germany	21	64	80	87	100
Spain	73	83.5	89	94	100
Sweden	75	91.5	98	98	100