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Use and non-use values as motivational construct dimensions for farm animal welfare– impacts on the economic outcome for the farm

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Abstract

This study explored how farmers' motivation in terms of use values and/or non-use values to work with farm animal welfare are associated with the economic outcome for the farm. Use values in farm animal welfare refer to economic value derived from productivity and profitability considerations. Non-use values in farm animal welfare refer to economic value derived from good animal welfare, irrespective of the use the farmer derives from the animal, currently or in the future. The analysis was based on detailed information about the income statements of a sample of Swedish dairy farmers, obtained from the Swedish Farm Economic Survey, complemented with survey information about their perceived use and non-use values in farm animal welfare. The

findings suggest that farm economic outcome is significantly associated with motivation in terms of use values, but not so much with motivation in terms of non-use values. This is interesting from a policy point of view, because it indicates that farmers with different approaches to farm animal welfare may experience different economic outcomes for their farms. Findings can, for instance, be used to strengthen farmers' engagement in various private quality assurance standards, which generally focus on values of non-use type, by pointing to that realization of such values will not impair the economic outcome of the farms. Moreover, findings also suggest that farmers' economic incentives for engagement in such standards may need to be further strengthened in order to become more attractive, as findings point to that a focus on non-use values generally is not associated with more favourable economic outcomes.

Keywords: Dairy farms; Economic outcome; Farm animal welfare; Non-use values; Use-values

Implications:

We investigate how differences in dairy farmers' motivations to animal welfare are associated with the economic outcome of the farm. We found that motivational factors based on productivity and profitability concerns were statistically significantly positively associated with economic outcome, and that motivational factors based more on aspects such as ethics, animal rights and legitimacy of the production were not significantly associated with the economic outcome. Findings are interesting for policy as they suggest that farmers' economic incentives for engagement in various private

quality assurance standards, which generally focus on ethics, animal rights and legitimacy, may need to be strengthened.

Introduction

Since the inclusion of Farm Animal Welfare (FAW) requirements within European livestock production in the 1980s, the concept of animal welfare has evolved from an "almost exclusive consideration of the animal towards a multidimensional concept, which at present has strong, obvious socio-economic implications" (Averós *et al*. 2013, p. 787). Studies performed over the past 15 years indicate that FAW is considered a major concern in society (e.g. Verbeke and Viaene, 2000; Dockès and Kling-Eveillard, 2006; Borgen and Skarstad, 2007; Kling-Eveillard *et al*., 2007; Mayfield *et al,.* 2007; Kielland *et al.,* 2010; Lagerkvist and Hess, 2011; Franz *et al.,* 2012; de Jonge and van Trijp, 2013. Within the European Union, FAW standards are regulated by minimum requirement regulations specified by the European Commission, in laws specific to individual member states and in private product certification schemes.

A number of studies have examined farmers' view of FAW (e.g. Te Velde *et al.,* 2002; Dockès and Kling-Eveillard, 2006; Bock and van Huik, 2007; Kauppinen *et al.,* 2010). In a synthesis of these studies, Hansson and Lagerkvist (2014, p. 54) concluded that farmers view FAW as being related to the following aspects: "animal health, physiological needs of the animals, natural behavior of the animals, living environment of the animals, humane and ethical treatment of the animals, and the farmer's own wellbeing and knowledge". Previous studies have also described the decision framework

67 including values and goals within which farmers' make decisions related to FAW (e.g.
68 Lagerkvist *et al*., 2011; Gocsik *et al*., 2014). In this respect, Hansson and Lagerkvist
69 (2016) found that among the 10 most important motivational factors for working with
70 FAW, only two could be classified as referring to profitability and productivity. Instead,
71 the most salient motivational factors were related to farmers feeling personal happiness
72 from knowing that their animals are well-kept; to preventing disease, pain and injury
73 among the animals and treating them quickly if needed; and to the business being
74 profitable enough so that conditions for the animals could be further improved. Values of
75 existence type in FAW have also been found to (negatively) affect farmers' acceptance
76 of hypothetical FAW program (Schreiner and Hess, 2017).

77 It is reasonable to expect that decision making motivated by different ideas of FAW
78 leads to different types of measures being taken on the farm and consequently that
79 these are associated with the economic outcome for the farm in different ways. This
80 means that there should be a relationship between the nature of FAW aspects realised
81 by farmers and the economic outcome for their farms. This relationship is currently not
82 well understood, but insights regarding it would help clarify whether farmers motivated
83 by different types of FAW dimensions can achieve similar economic results or whether
84 certain FAW dimensions can only be achieved at the expense of the economic outcome
85 for the farm.

86 Previous literature has addressed the relationship between FAW and farm economic
87 results in various ways. In an empirical study of farmers' attitudes to FAW, Bock and
88 Van Huik (2007, p. 936) concluded that "the most important barrier to participating in
89 specific animal welfare schemes was farmers' distrust in the economic advantages of

doing so". They also found that farmers distrusted consumers' willingness to pay for animal-friendly production. In a study of stockkeeper personality traits and attitudes, Hanna *et al.* (2009) observed a low correlation between farmers' attitudes to FAW and dairy cow productivity. However, other empirical studies have revealed that positive attitudes to FAW can influence how animals are handled, housed and managed on the farm, all of which can impact on farm productivity and ultimately performance. For instance, Waiblinger *et al.* (2002) and Kauppinen *et al.* (2012) found that positive attitudes to FAW can lead to early recognition of welfare problems on the farm and hence immediate actions, which can influence farm productivity, while negative attitudes to FAW may limit farm productivity (Breuer *et al.*, 2000; Hemsworth *et al.*, 2002). According to Lagerkvist *et al.* (2011), improved FAW can result in healthier animals and improved productivity, thereby indirectly affecting the costs of production, for example by reducing the costs of veterinary treatments, discarded milk and meat, etc.

This study differs from previous research on the relationship between FAW and the farm economic results in one fundamental aspect, namely that when examining aspects which are potentially associated with farm economic outcome it considers how farmers' motivation in relation to a set of use- and non-use values in FAW are associated with the economic outcome for the farm. This is done using the characterisation of use- and non-use FAW values developed by McInerney (2004) and Lagerkvist *et al.* (2011) to examine how FAW values held by the dairy herd manager are related to the contribution margin from each farm's dairy production. This study makes three novel contributions. First, to our knowledge, no previous study has tested whether and how use and non-use values are associated with the farm economic outcome. In the definition of *use* values

(McInerney, 2004) this effect is assumed, as use values relate to values derived from the use of livestock in the production processes. *Non-use* values, however, may relate to the economic outcome, but no previous study has examined whether farmers' consideration of such values is actually associated with the farm economic performance. Second, non-use values are typically the focus in private quality assurance standards regarding FAW. Therefore, from a practical point of view, the present analysis is useful for developing farmers' engagement in FAW. Third, the analysis is useful for policy making and for farmers who would benefit from understanding possible trade-offs between farmers' motivation to FAW-related actions and the economic outcome at the farm.

Material and methods

Conceptual framework

In order to conceptually describe farmers' motivations to work with FAW, we build on the framework of use and non-use values introduced by McInerney (2004) and detailed by Lagerkvist et al. (2011) and which recognizes that farmers may obtain economic value in terms of these two types from working with their livestock. In particular, use values in FAW arise from farmers' direct use of their livestock in the production process, for instance in order to: maximise their productivity (e.g. production of milk); increase farm profitability; assure farm survival; adjust their production to market prices; have a better workplace; have healthier animals; and/or create time for other activities (Hansson and Lagerkvist, 2016). Thus, use values arise from concerns about farm productivity and profitability and in order to achieve other business goals that are not related to the well-

being of the animals for its own sake. The motivation for providing FAW is similar to that of maintaining any other production factor on the farm. Non-use values in FAW refer to any other economic value the farmer finds in FAW and explain why farmers provide FAW beyond the level attributable to concerns related to achieving use values. In particular, Lagerkvist *et al*. (2011, p. 486) explains that "the concept of non-use value FAW values refers to the value that the producer derives from economic goods related to the well-being of the livestock, independent of any use, present or future, that the producer might make of the animals". They also state that non-use FAW values are "generally differentiated from use values, which the producers derive from direct use of the livestock through the production process" (ibid. p. 486). Lagerkvist *et al.* (2011) and Hansson and Lagerkvist (2016) extended the notation of non-use values in FAW by categorising them into five distinct theoretical types: existence, pure, bequest and option values, and value derived from paternalistic altruism. Accordingly, non-use FAW values may arise from: 1) farmers' feeling of satisfaction about their animals' wellbeing, their desire to provide animals with fresh water, a proper diet and comfortable resting areas and their desire to prevent injuries and pain among animals etc. (existence value); 2) farmers' interest in FAW, even though it is too costly to take 'better' care of their animals (pure non-use value); 3) farmers' desire to preserve farm animals (and their products) for the use of future generations (bequest value); 4) providing consumers with the opportunity to choose products from farms with good FAW practices (option value); and 5) farmers feeling proud that their animals' good welfare is recognised by industry, retailers and consumers (paternalistic altruism) (Lagerkvist *et al.,* 2011; Hansson and Lagerkvist, 2016).

158 Thus farmers' decision-making with respect to FAW can be considered to be driven by
159 economic values of use and/or non-use types, or a combination of these. From a human
160 behaviour perspective, we further suggest that farmers' provision of FAW can be
161 determined from farmers' perceptions and preferences regarding use and non-use
162 values in FAW (Lagerkvist *et al.,* 2011; Hansson and Lagerkvist, 2014). Human
163 behaviours and decisions are determined from goals (Atkinson and Birch, 1970;
164 Gollwitzer and Bargh, 1996). Goals are instrumental to motivation, with the degree of
165 motivation derived from each specific goal depending on the subjective utility derived
166 from that goal (Kopetz *et al.*, 2012). Because farmers' FAW-related actions can be
167 expected to be driven by the perceived economic value in FAW and because motivation
168 drives action, economic value in FAW can be considered a motivational construct
169 (Hansson and Lagerkvist, 2016), with the various use and non-use values representing
170 different dimensions of this motivational construct. The use and non-use values are
171 viewed as desirable outcomes which motivate farmers' actions. Each dimension of the
172 motivational construct is associated with measurable motivational attributes, as detailed
173 above. Furthermore, because the economic outcome of any business is determined by
174 the strategic and operational decisions taken by the business manager, farmers'
175 preferences for use and non-use values, via their effect on action, can be expected to be
176 associated with the economic outcome for the farm.

177 *Data*

178 For this study, Swedish Farm Economic Survey (FES) data for 2009-2011 were
179 obtained from the Swedish Board of Agriculture. FES collects full income statements
180 (revenues and costs), balance sheets (assets and liabilities) and some additional

information, e.g. number of hours worked on the farm, and the sample is stratified to cover farms from different size groups and geographical locations. FES is maintained by Statistics Sweden on behalf of the Swedish Board of Agriculture, with the primary purpose of meeting Sweden's obligations within the European Farm Accounting Data Network (FADN). In particular, the study sample consisted of dairy farmers who operated the dairy farms in the FES listings that received at least 50% of their total farm revenue between 2009 and 2011 from milk production, and could thereby be considered specialists in dairy production. These farms would thus be relatively dependent on their dairy production and dairy cow welfare would be a significant issue for the participating farmers.

A structured questionnaire was designed for this study and used to collect data on FAW motivational construct dimensions from dairy farmers as key informants. These data were matched with the FES data in order to evaluate the associations between those FAW motivational construct dimensions and the economic outcome for farms. Due to the confidentiality agreement and to ensure respondent anonymity, data collection was conducted by the Swedish Board of Agriculture on behalf of the research group, which only obtained anonymous data. Data collection took place between March and May 2014. Among a total of 357 dairy farmers identified in the FES, after two reminders a total of 126 responses were obtained, 106 of which were usable (response rate ~30%). However, after removing irrelevant cases from the original population (e.g. farms that no longer produced milk or had such a small dairy herd that they were obviously about to exit dairy production), the effective response rate was approximately 32% (i.e. 106/336).

Descriptive statistics for the responding farms (Table 1) revealed that 38% of the respondents had an agricultural degree or diploma, 84% had conventional dairy production and 58% housed their dairy cows in tie stalls. The average herd size was 70.73 cows.

*** Table 1 about here ***

Measures

Use and non-use FAW values. The scale used for measuring farmers' FAW motivational construct dimensions was adopted from Hansson and Lagerkvist (2016). This scale consists of a set of 27 individual motivational attributes in FAW and is expected to cover the whole motivational construct, including its use and non-use parts. A list of all specific motivational attributes and specification about how they relate to the motivational construct dimensions is provided in the Supplementary material (Table S1). To mitigate the effect of order bias, we prepared 10 versions of the questionnaire in which the order of the statements regarding use and non-use FAW values differed randomly. The questionnaires were then distributed randomly among the respondents.

We asked respondents to indicate the degree to which they perceived the specific motivational attributes as an important driving force to improve FAW in their dairy production. In particular, we used the constant-sum approach, and asked the farmers to divide the set of 100 points between the motivational attributes by giving the most points to the most important attribute and the least points to the least important attribute. At the same time, we asked the respondents to indicate with an *x* the (possible) unimportant

motivational attributes. While possibly being cognitively demanding, this procedure has clear advantages above other rating methods such as the Likert scale, by preventing respondents from claiming that everything is very important. However, as some farmers erroneously distributed slightly less or slightly more than 100 points, we standardised the points given to each individual motivational attribute so that each motivational attribute for each respondent received a proportion of all points distributed by each respondent. This figure was multiplied by 100 to obtain a percentage value.

Following this, each motivational attribute was assigned to a motivational construct dimension, based on the theoretical understanding about the six dimensions of the economic value construct in FAW (i.e. use values, pure non-use values, existence value, bequest value, option value and paternalistic altruism (Lagerkvist *et al.,* 2011), please see Supplementary material (Table S1) for details about what attributes were mapped onto what motivational construct dimension. Summed scales were calculated for each of these motivational construct dimensions. Each such summed scale was normalised by dividing the sum by the number of items used to capture that particular motivational construct dimension. Motivational attributes indicated as unimportant received a zero. In this way, measures of the motivational construct dimensions were obtained. Using the decision criterion developed by Jarvis *et al.,* (2003), a formative relationship between the motivational construct dimensions and their attributes was considered.

Economic outcome. Using detailed farm level accounting data, we calculated the contribution margin from each farm's dairy production for the years 2009, 2010 and 2011. This was defined as revenue from milk and revenue associated with the calf and

culling of dairy cows minus costs associated with buying pregnant heifers, feed, litter, veterinary services, artificial insemination and insurance. In order to take differences in contribution margin due to size of the dairy enterprise into consideration and to avoid inadvertently measuring farm size instead of economic outcome, the contribution margin was divided by the sum of the revenue from milk and the revenue associated with the calf and culling of dairy cows. This was taken as a measure of the contribution margin ratio (e.g. Anthony *et al.,* 2014) of dairy production on each farm. The average contribution margin ratio (ACMR) for the three years was calculated and taken as an indicator of economic performance of the dairy enterprise on the farm. For the entire sample, the average ACMR was 0.63 (std: 0.12; range: 0.34-0.92). The distribution of the ACMR was approximately normal according to the skewness/kurtosis tests for normality (p=0.879; indicating that the null hypothesis of normal distribution cannot be rejected).

Statistical procedures to relate motivational construct dimensions to economic outcome

A linear regression model was used to test how the motivational construct dimensions affected ACMR. Due to apparent problems with multicollinearity in the linear regression model, this approach was complemented with a step-wise regression method, where the impacts of the use values and the non-use values could be sequentially evaluated separately. Using this approach, we were able to evaluate whether the model fit was significantly improved by step-wise addition of information about: i) the use value motivational construct and ii) the non-use values motivational constructs. All statistical procedures were implemented using the STATA 15 Software (StataCorp., 2017).

Results

Descriptive statistics on the motivational construct dimension

Descriptive statistics on the summed scales accounting for each motivational construct dimension are presented in Table 2, where the median values can be interpreted as the median value of points (out of 100 points) given to each of the individual motivational attributes in each motivational construct dimension. Descriptive statistics were calculated based only on those farmers who rated the motivational construct dimension in question as important, and also based on all farmers where a notation of unimportance was substituted with a zero. As indicated in Table 2, the existence non-use value category appeared the most important construct dimension. Interestingly, the use value appeared among the less important motivational construct dimensions. A Wilcoxon signed-rank test (not shown; based on all farmers) suggested that the importance assigned to the use value dimension was significantly lower than the importance assigned to the pure non-use value dimension and the existence value dimension, significantly higher than the importance assigned to the option value category, but not significantly different from the importance assigned to the bequest value category or paternalistic altruism value dimension. This suggests that the pure non-use values and the existence values are the most important motivational constructs dimensions in work with respect to FAW performed by the farmers in the sample.

*** Table 2 about here ***

Correlations between the motivational construct dimensions and the farm economic outcome

Table 3 shows Spearman correlation coefficients among the different motivational construct dimensions and between the motivational construct dimensions and the ACMR. All five types of non-use value dimensions were negatively (and most significantly so) correlated with the use values, suggesting that farmers view those motivational construct dimensions as being in conflict. Furthermore, among motivational construct dimensions of the non-use type there appeared to be some values that were in conflict with each other; paternalistic altruism was significantly negatively correlated with existence values and bequest values. However, option values were positively correlated with both bequest values and paternalistic altruism, suggesting that those values are perceived as being related to each other. None of the motivational construct dimensions was found to be significantly correlated with the indicator of economic performance, suggesting that at this stage these are unrelated to the ACMR.

*** Table 3 about here ***

Regression analyses

In order to test the associations between the motivational construct dimensions and the ACMR of the dairy enterprise on the study farms, the summed and normalised scales accounting for each motivational construct dimension were regressed on the ACMR. Indicators accounting for production orientation in terms of conventional or organic production and for type of housing system were used as control variables in the regression analysis, as those variables are also likely to significantly affect the economic performance.

316 Model 1 in Table 4 shows regression results for the initial model estimated. Because the
317 motivational construct dimensions were highly and significantly correlated on several
318 occasions (see Table 3), multicollinearity was a problem in interpretation of the
319 regression coefficients, as confirmed by the VIF values (see Table 4, Model 1). In order
320 to account for this, the independent variable with the highest VIF value (the variable
321 accounting for use values) was removed from the model and it was re-run. The results
322 are presented as Model 2 in Table 4. A new estimation of the VIF values suggested no
323 problems related to multicollinearity. In order to evaluate the impact of the use value
324 motivational construct dimensions, the model was re-estimated, this time including this
325 variable and the control variables only (Model 3 in Table 4).

326 Taken together, the results reported in Table 4 indicate that the use value motivational
327 dimension was significantly and positively associated with the ACMR of the dairy
328 enterprise on the study farms. Among the non-use value motivational construct
329 dimensions, only the variable accounting for bequest values was significantly associated
330 with the ACMR, and only in Model 1. As expected, the results suggested that the non-
331 use motivational constructs were largely unrelated to the economic performance of the
332 dairy enterprise on the farms.

333 *** Table 4 about here ***

334 Because of the apparent multicollinearity in Model 1, a step-wise regression method was
335 also applied to evaluate the potentially significant associations between the use value
336 motivational construct dimensions and the ACMR, and also between the non-use value
337 motivational construct dimensions and the ACMR, while keeping the control variables

338 constant. The results are presented in Table 5. In Model 4, the most general model
339 (Model 4.1) consisting of the intercept and the two control variables (conventional
340 farming and tie stalls) and variables accounting for the use value and non-use value
341 motivational construct dimensions was first estimated. Following this, Model 4.2, where
342 the variables accounting for the non-use value motivational construct dimensions had
343 been removed, was estimated. In a third step, Model 4.3 was estimated, where also the
344 variable accounting for the use value construct dimension had been removed,

345 The Wald test (p=0.18) supported that model fit would not be significantly reduced by
346 not including the non-use value motivational construct dimension (Model 4.2 compared
347 to Model 4.1), thus suggesting that no model improvement could be achieved from
348 including variables accounting for non-use value motivational construct dimensions in
349 the regression model. However, the same test (p=0.09) rejected the hypothesis that
350 model fit would not be significantly reduced by not including the variable accounting for
351 the use value construct dimension (Model 4.3 compared to Model 4.2), thus suggesting
352 that the use value motivational construct dimension is associated with the ACMR.

353 In order to evaluate whether the order in which the use and non-use value motivational
354 construct dimensions were removed from the model had any effect on the conclusions,
355 the procedure outlined above was repeated. However, this time the variable accounting
356 for the use value motivational construct dimension was removed from the model before
357 the variables accounting for the non-use value motivational dimensions were removed.
358 Thus, in Model 5.1, the base model from Model 4.1 was estimated in a first step.
359 Following that, Model 5.2 was estimated, where the variable accounting for the use
360 value motivational construct dimension had been removed. In the next step Model 5.3,

where also the variables accounting for the non-use value motivational construct dimensions had been remove, was estimated.

The Wald test (p=0.06) supported that model fit would be significantly reduced by not including the use value motivational construct dimension (Model 5.2 compared to Model 5.2), thus suggesting that model improvement could be achieved by including the variable accounting for the use value motivational construct dimension in the regression model. However, the Wald test (p=0.62) supported that model fit would not be significantly reduced by not including the non-use value motivational construct dimensions (Model 5.3 compared to Model 5.2), suggesting that inclusion of the non-use value motivational construct dimensions did not improve the explanation of the economic performance of the dairy enterprise on the farms.

As confirmation, Models 4 and 5 both suggested that significant model improvement could be achieved by including the variable accounting for the use value motivational construct dimension in the regression model, and that this was independent of the order in which this variable was included in the model. However, both models also suggested that no significant model improvement could be achieved from including the non-use value motivational construct dimensions in the regression model. Thus the non-use value motivational construct dimensions appeared to be unrelated to the ACMR of the dairy enterprise on the study farms.

In order to evaluate the sensitivity of the results due to including both organic and conventional farms in the regression analyses, Models 4 and 5 were re-run with only conventional farms included (the number of organic farms were too few to meaningfully

include alone in the regression analyses; the dummy variable “Conventional” was excluded in the analyses). Findings (not shown) lend support for identical conclusions except for the change in model fit when estimating Model 5.2, which was not statistically significant.

*** Table 5 about here ***

Discussion

Based on information from a sample of Swedish dairy farmers, this study explored how FAW motivational factors in terms of use and/or non-use values were associated with the economic outcome for farms. The link between farmers’ motivation to work with FAW and the economic performance of their dairy enterprise was thereby evaluated. Use values in FAW refer to economic value derived from the use of animals in the production processes. Non-use values refer to economic values in FAW that are obtained from good animal welfare, irrespective of the use the farmer may derive from the animal, at present or in the future.

Taken together, our findings suggest that the motivational construct dimension of use-value type is significantly and positively related to the economic performance of the dairy enterprise on farms, measured in terms of ACMR, and that the motivational construct dimensions of non-use value type are relatively unrelated to this measure of economic performance. A notable exception to this pattern for motivational construct dimensions of non-use value type is the bequest value type, which according to Model 1 appears positively related to the ACMR. Overall, our findings confirm the definition of use values provided by McInerney (2004) as being related to values derived from the use of

livestock in the production processes. Our findings thus indicate that farmers who are motivated by use values in FAW succeed in running their dairy operations in a more profitable way.

The statistically non-significant findings related to the non-use motivational construct dimensions suggest that the actions taken on the farm based on those motivational construct dimensions are of a type that has a neutral association in total with the economic outcome. Thus, non-use values appear not to be associated with the economic outcome for the farm, at least not in the short-term. It is important to point out that our findings indicate that motivation by non-use values is unrelated to the economic outcome, which means that focusing on such values does not appear to reduce the economic performance of dairy enterprises. This is interesting because if farmers who are more motivated by the non-use values in FAW also run farms with higher levels of FAW, our findings may indicate that higher levels of FAW are unrelated to economic performance. Reasons for this may be that the increased costs that higher levels of FAW may imply are offset by other economic benefits in terms of reduced production costs and/or increased revenue. However, we did not attempt to link the dimensions of economic value in FAW to the actual levels of FAW on the farms, and this relationship needs to be confirmed in future studies. It should also be noted that motivation by non-use values may have visible effects on the farm economic outcome only in the long run, for instance by possibly contributing to healthier animals and/or increased the legitimacy of dairy production in society, but such effects were not captured in this study given the short time span covered by the data (2009-2011).

427 The findings presented here are of value for policy formulation. In discussions about
428 FAW and related standards implemented on farms, a good starting point would be the
429 farmer, their decision making and the motivational factors underlying this decision
430 making. Despite the important role of actors such as consumers, veterinarians and
431 members of various pressure groups in the debate about FAW, it is farmers who make
432 the actual decisions with regard to FAW (Kauppinen *et al.,* 2012; Franz *et al.,* 2012). It is
433 also farmers who may directly benefit or suffer economically from FAW measures
434 undertaken on farms. Various FAW-related schemes and measures are often promoted
435 to farmers as a way to improve farm performance, but it is not certain that those
436 schemes and activities actually lead to enhanced profitability (Bock and Van Huik,
437 2007). The results presented here suggest how different dimensions in the economic
438 value construct in FAW, which directs FAW-related action, may be associated with the
439 economic outcome for the dairy enterprise on farms. In this respect, from a policy point
440 of view it is interesting to note that different motivations to FAW actually affected the
441 economic outcome, i.e. farmers with different approaches to FAW achieved different
442 economic outcomes for their farms.

443 Furthermore, for the development of private quality assurance standards, our findings
444 suggest that farmers' economic incentives for participating in such activities may need to
445 be strengthened in order to make them more attractive and incentivising, because, at
446 current, a focus on non-use values generally not appear associated with more
447 favourable economic outcomes.

448 Limitations of this study should be acknowledged. Firstly, due to time lags in preparation
449 of FES, the information obtained from the questionnaires had to be supplemented with

information about an economic situation at an earlier point in time, i.e. the economic outcome had to be explained using questionnaire-based data collected at a later stage in time. However, we consider this a minor issue because it can be considered highly unlikely that the farmers changed their motivational profile over only a few years. Thus it is likely that the farmers participating in this study were motivated by the same type of economic value in FAW at the time their economic results were measured as they were at the time of the questionnaire. Secondly, the possibility to generalise the findings to livestock farmers other than dairy farmers must be considered limited. Bock *et al.* (2007) concluded that the human-animal relationship depends on the type of species kept by the farmer and the purpose of keeping them. It is plausible to assume that the human-animal relationship also affects farmers' views on FAW for that particular species and thus their motivation to work with FAW. Thus, in future research the type of study conducted here needs to be repeated for farms with other types of livestock operations if we are to fully understand how the FAW motivational construct dimensions are associated with economic performance.

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Table 1: Descriptive statistics on the study sample of Swedish dairy farms. Std = standard deviation

Agricultural education (share)	38%
Conventional production (share)	84%
Tie stalls only (share)	58%
Size of dairy herd[a] (average; std)	70.73; 85.63

[a]Compared with the full population of Swedish dairy farmers, where the average herd size in 2014 was 78 cows (Statistics Sweden 2015). This difference was not statistically significant.

580 Table 2: Descriptive statistics on the motivational categories. The figures are normalised with
581 respect to the number of motivational attributes in each motivational dimension

	Based on the farmers that recognised motivational attributes as important				Based on all farmers. A notation of unimportance is substituted with a zero		
Motivational construct dimension	Median	Min	Max	Share of farms recognising as important	Median	Min	Max
Use values	3.43	0.63	10	95%	3.41	0	10
Pure non-use values	4.00	0.68	33.33	90%	3.81	0	33.33
Existence values	4.12	0.6	8.33	97%	4.04	0	8.33
Bequest value	4.02	0.49	11.24	77%	3.00	0	11.24
Option value	4.04	0.93	12.50	65%	3.00	0	12.50
Paternalistic altruism	3.66	0.65	30.67	84%	3.33	0	30.67

582

583

584 Table 3: Correlation coefficients (Spearman) among the motivational construct dimensions and
585 between the motivational construct dimensions and the three-year average contribution margin
586 ratio (ACMR) in dairy production

	Use values	Pure non-use values	Existence values	Bequest values	Option values	Paternalistic altruism
Use values	1.00					
Pure non-use values	-0.13	1.00				
Existence values	-0.28**	-0.14	1.00			
Bequest values	-0.41***	-0.06	-0.17	1.00		
Option values	-0.34***	-0.00	-0.15	0.37***	1.00	
Paternalistic altruism	-0.30***	-0.11	-0.42***	-0.22*	0.31***	1.00
ACMR	0.13	-0.09	0.02	0.12	0.10	-0.07

587 ***p<0.01; **p<0.05; *p<0.10.

588

589 Table 4: Regression results for Models 1 to 3, associations between motivational construct
590 dimensions and the three-year average contribution margin ratio (ACMR) in dairy production

	Model 1	VIF value	Model 2	VIF value	Model 3	VIF value
Intercept	0.32		0.77		0.65***	
Tie stalls (1 if only tie stalls; 0 if loose housing or a combination of loose housing and tie stalls)	0.04	1.07	0.04	1.06	0.04*	1.05
Conventional (1 if conventional production; 0 if organic or if under conversion to organic production)	-0.12***	1.13	-0.11***	1.08	-0.11***	1.05
Use values	0.05*	10.17	---	---	0.01*	1.02
Pure non-use values	0.01		-0.00	1.24	---	---
Existence values	0.03	8.67	-0.01	1.41	---	---
Bequest values	0.02**	3.10	0.00	1.19	---	---
Option values	0.00	1.66	-0.00	1.23	---	---
Paternalistic values	0.01	6.91	-0.01	1.42	---	---
Fit statistics	F-value: 6.84 (p=0.00) R^2 = 0.20		F-value: 1.95 (p=0.07) R^2 = 0.16		F-value: 7.82 (p=0.00) R^2 = 0.15	

591 Note: Statistical inference in Models 1 and 3 is based on robust standard error, as the Breusch-
592 Pangan/Cook-Weisberg test significantly indicated presence of heteroscedasticity in those
593 models (p= 0.05 and 0.09, respectively).

594

595 Table 5: Step-wise regression results, associations between motivational construct dimensions
596 and the three-year average contribution margin ratio (ACMR) in dairy production

	Model R^2	Change in R^2	P-value for change in model fit (Wald test)
Model 4			
Model 4.1[a] Conventional and tie stalls; non-use values; use values	0.20	-	-
Model 4.2[a] Conventional and tie stalls; use values	0.15	0.05	0.18
Model 4.3 Conventional and tie stalls	0.12	0.03	0.09*
Model 5			
Model 5.1[a] Conventional and tie stalls; non-use values; use values	0.20	-	-
Model 5.2 Conventional and tie stalls; non-use values	0.16	0.04	0.06*
Model 5.3 Conventional and tie stalls	0.12	0.04	0.62

597 * Significant at p<0.10.

[a]Statistical inference based on robust standard error, as the Breusch-Pangan/Cook-Weisberg test significantly indicated presence of heteroscedasticity in those models.

The Ramsey RESET test (Ramsey, 1969), for omitted variables for the general models (4.1 and 5.1) yielded a p-value of 0.445, thus supporting the null hypothesis of no omitted variables in terms of non-linear combinations of the explanatory variables. The test was implemented by the ovtest function in the STATA software (StataCorp., 2017).

Use and non-use values as motivational construct dimensions for farm animal welfare– impacts on the economic outcome for the farm

Hansson, H., Lagerkvist, CJ and Azar, G.

Supplementary material

Table S1: Motivational attributes for farm animal welfare in dairy production (from Hansson H and Lagerkvist CJ 2016)

Attribute	Type of FAW value
1. To make sure that my dairy cows are kept in such a way that they can produce as much as possible	Use
2. To make sure that the production of my dairy cows is at such a level that my business is as profitable as possible	Use
3. To make sure that my dairy cows are kept in such a way that I can continue my business	Use
4. To make sure that my dairy cows are healthy, so that I have time available to do other things	Use
5. To make sure that my dairy cows are kept in such a way that my work environment is good	Use
6. To make sure that my dairy cows are kept in such a way that my milk production is adjusted to current producer prices for milk	Use
7. To make sure that my dairy production is run in such a way that the current animal welfare law is satisfied, but not more.	Use
8. To make sure that my dairy cows are kept in such a way that I can earn my living from my business	Use

9. My interest is in good handling of animals, even though it is currently too expensive to keep the animals in as good a way as I would like	Pure non-use
10. For the business to make enough profit for me to further improve the way my dairy cows are kept	Pure non-use
11. To feel happy knowing that my dairy cows are well-kept	Existence
12. To avoid feeling uncomfortable knowing that my dairy cows are not well-kept	Existence
13. Dairy cows have a right to be treated well	Existence
14. To make sure that my dairy production is ethical	Existence
15. To feel that I keep my dairy production in the right way	Existence
16. To make sure that my dairy cows have free access to water and that they have a balanced feed regime	Existence
17. To make sure that my dairy cows have good housing that offers shelter and comfortable places for resting	Existence
18. To make sure that disease, pain and injury among my dairy cows are prevented and that diagnosis and treatment are quickly established if needed	Existence
19. To make sure that my dairy cows are able to practise their natural behaviours, for instance by offering enough space and the company of other dairy cows	Existence
20. To prevent my dairy cows feeling fear or in other ways suffering mentally	Existence
21. To make sure my dairy cows feel well even when this requires unprofitable actions	Pure non-use
22. To contribute to future generations also being able to experience dairy cows outdoors in their natural environment	Bequest
23. To contribute to dairy cows in Sweden being so well kept that Swedish dairy production can continue	Bequest

24. To contribute to giving consumers the choice to purchase food products that have been produced under good animal husbandry, if they would like to do that	Option
25. To make sure that consumers will continue to demand my production in the long run	Paternalistic altruism
26. To feel proud that the way I keep my animals is acknowledged by the industry, market or consumers	Paternalistic altruism
27. To contribute to consumers being offered high-quality food products	Paternalistic altruism

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