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

Project Number: 311824

- Deliverable -

D3.1 – Results of proactive approach

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Executive Summary

The proactive approach described in deliverable D3.2 was applied in 40 farms during 15 months. This document provides the results in terms of the compliance to the monitoring and prevention protocols, the opinion of farmers and advisors who participated, and the impact observed on herd health status based on a comparison to control herds and previous status of the same herds. Twenty one farms of 40 performed the number of visits planned in the Herd Health Production Management (HHPM) program. The monitoring tool and the prevention protocols were generally used as expected, and recommendations made when alerts triggered. The users were in general satisfied with the tool, found it useful but not easy to use. The reporting was too long for the advisors.
Finally, no effect was found of the HHPM program on the herd health from the data analysis but the farmers and advisors considered it helped them to improve the herd health.

Dissemination Level		
PU	Public	**PU**

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1 Introduction

Good health is one of the main principles of organic farming and it is considered as more than the absence of illness, and includes also preserving physical, mental, social and ecological welfare (IFOAM, 2005). However, despite the objective of enhanced health it is not necessarily a guarantee for higher animal health situations in organic dairy farms compared to conventional farms (Hovi et al., 2003; Sundrum, 2001). It can thus be considered that there is room for improvement of herd health in certain organic dairy farms.

According to the European production regulation No 889/2008, animal health should be promoted through the prevention of disease. In addition to the means imposed by the organic production regulation, Vaarst et al. (2011) identified conditions of animal health and welfare planning processes in organic dairy farming that could potentially increase its success; e.g. farm specific planning, farmer ownership of the planning process, acknowledgement of success stories and respectful communication between the farmer and his advisor (Vaarst et al., 2011). However, the results of planning activities have not always been satisfactory in the improvement of health and welfare. Effectivity of the plans depends, amongst others, on the participants' compliance to the program and/or their acceptability and resulting implementation of recommended measures. Furthermore, successful planning processes requires mutual trust between actors (Tremetsberger and Winckler, 2015).

Proposing recommended measures acceptable for farmers requires effective communication between farmer and advisor in animal health. Farmers' decision-making process to implement practices is complex and influenced by at least: farming' objectives and constraints, previous experiences, understanding and perception of animal disease risk and the expected affectivity of corrective practices (Garforth, 2011). This can be a challenge for veterinarians as they have not always been found to be well aware of organic dairy farmers' goals and priorities (Vaarst et al., 2006) or knowledgeable of the specific challenges of organic farming (M Vaarst et al., 2011).

The use of Herd Health Production and Management (HHPM) programs seems promising to reach the goal of herd health improvement through disease prevention and animal health promotion strategies, adapted to each farmer. HHPM programs aim to support farmers in their decision-making in reaching their farming goals, taking into account the farmers' sociological style. Thus, HHPM programs put farmers at the center of the decision-making process and are tailored to farmers' style (Brand et al., 1996).

As described in deliverable 3.2 a HHPM-like program was developed, using a participatory approach. The designed tool brings together the necessary elements, as listed above, of a potential effective tool to improve herd health in organic dairy farms. The tool has features that promote farmer ownership of the process, it stimulates dialogue between farmer and advisor, and it is adaptable to farm specific situations and farmers' objectives. Thus, in theory, these features promote compliance to the tool and the implementation of recommended measures, and ultimately promote herd health.

However, the implementation of the tool in the advisory services of the participating farms can be regarded as a complex intervention. Complex interventions were characterized by Craig et al. (2008) as interventions that enclose several interacting elements. Characteristics of complex interventions are e.g. the fact that a degree of flexibility or tailoring of the intervention is allowed, a number and variable outcomes are possible, different groups or organisational levels are targeted

by the intervention and the number and the difficulty of the behaviours needed by those that convey or receive the intervention (Craig et al., 2008). Characteristics of a complex intervention can be identified in the context of the present study; i.e. flexibility in the use of the tool is allowed (e.g. choice of indicators for herd health monitoring, there are no predefined recommended measures), both the farmer and his advisor are targeted, the outcomes can be numerous based on the heterogeneity of the farms and advisors and the farmers' decision-making processes are complex.

Complex interventions are often difficult to evaluate and the outcomes of evaluation studies can be difficult to interpret, reproduced or replicated in a specific context. Therefore, it is important to evaluate the complete process of an intervention and not only its outcomes; to assess the level and quality of implementation, to identify causal mechanisms and contextual factors that can explain variation in results (Moore et al., 2015). Hawe et al. (2004) suggest allowing adaptation of the form of the intervention to the specific context. Rather than evaluating the form, one should aim for the evaluation of the steps that, in theory, would facilitate change. Moreover, allowing the tailoring of the form could improve the effectiveness of complex interventions, which in general are disappointingly low (Hawe et al., 2004). Furthermore, a dialogue between designers and end-users that have tested a prototype creates a learning environment in which can be discussed what the response is of the tool to 'real-life' working situations. Debriefing with users can provide understanding whether the tool allows to do what it was conceived for, to identify areas in which further research might be needed and to show discrepancies between the way the designers and users theorize action (Cerf et al., 2012).

2 Objectives

The objectives of deliverable 3.1 are related to task 3 and 4 of WP3, namely:

1. Dow (xii) "*Assessing the benefits of a pro-active strategy in comparison to a re-active strategy*"
2. Dow (xiii) "*Testing the manageability of the pro-active protocol under commercial conditions, identifying potential constraints to account for in organic farming systems*"
3. Dow(xiv) "*Testing the effectiveness of this technique to improve the animal health status*"

In other words, the complete process of the pro-active protocol will be assessed.

3 Material and methods

3.1 On-farm implementation of the Herd Health Production Management (HHPM) program

3.1.1 Selection of farmers and advisors implementing the HHPM

In France and in Sweden, 20 farms were selected by convenient sample from the farms that participated in WP2. We assumed that the success of the implementation would depend on the motivation of the farmer to improve or secure the herd health status. Considering that the relationship between the farmer and the advisor (herd management advisor, dairy production advisor or veterinarian) can be an important success factor, each farmer was invited to choose the advisor. Only one herd management advisor declined thinking that the veterinarian should be more relevant for health monitoring. On the other hand, one advisor could accept to accompany two or three farmers and this was the case for 1 veterinarian in France and 5 in Sweden. Finally 40 farmers accepted to participate; this corresponds to 6 herd management advisors, 2 dairy production advisors and 27 veterinarians (Table 2).

Table 1: Farmers and advisors participating in the WP3

	Farms	Veterinarians	Herd management advisors	Dairy production advisors
FRANCE	20	13	4	2
SWEDEN	20	14	2	0

3.1.2 On farm implementation of protocols as pro-active tools by the advisors and farmers

General framework of the HHPM program

The HHPM program proposed to the 40 farmers and their advisors, explained in the deliverable 3.2, lasted around 15 months. Farmers and their advisors were provided with the flexible monitoring and preventive protocols that aim to monitor all common health problems and enhance prevention by good farming practices in all farm areas. As explained in the deliverable 3.2, these protocols are not static in their usage but adaptable to the specific herd health situation. If health problems are identified by the monitoring protocol in a certain area, a reasoned intervention will be triggered using the preventive protocols (figure 1). Not all components of the preventive protocol will always be activated. For example, udder health problems in the lactating herd caused by environmental pathogens demands a different corrective action compared to mastitis with contagious pathogens. Farmers and their advisors should be able to select the appropriate corrective action to improve the health situation with the help of the prevention protocol.

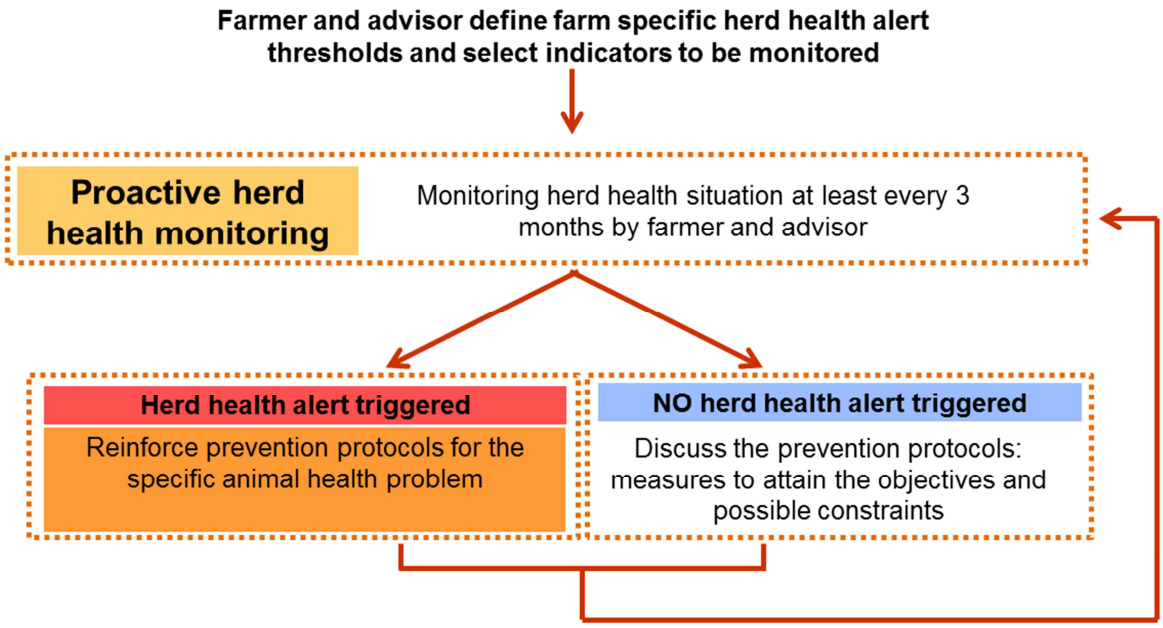

Figure 1: General framework of the Herd Health Management Program

Practical on-farm implementation

The protocols were introduced and explained during the first farm visit (visit 0) by a member of the French and Swedish research team, respectively, to the farmer and his/her advisor. The objectives of visit 0 were:

- Presentation of the principles of the protocol by the researcher;
- Discussion of the current health status of the herd in order to identify the herd health priorities of the farmer,
- Choice of the indicators for the first level monitoring and their alert thresholds. At the end of the visit, the farmer was supposed to have his/her set of indicators he/she chose to monitor herd health. Those indicators could change during the course of the study, if needed.
- Definition of the contract between the participants: defining the responsibilities of each participant. The advisor agreed to send reports to the research team soon after each visit in order to be remunerated.
- Planning the visits in a calendar:
  At least 4 visit per year for 1st level monitoring activities and discussion of specific parts of the preventive protocols (for example health of calves before the indoor season). Farmers and advisors were free to choose and adapt the dates of the planned visit, based on their needs.

The 4 physical visits of the farmer with his advisor were planned in the 12 months following the first visit. The objectives of the visits were (figure 2):

- Performing the first level monitoring on all the health domains (except if the farmer chose not to monitor one health domain considering there was no need);

- If a health problem was identified (by crossing of herd health alert threshold) a detailed diagnosis was done by the advisor and corrective actions to tackle the health problem were selected with the farmer.
- If no health problem appeared, the farmer and the advisor could take the opportunity to discuss how the farmer implements preventive measures on his/her farm. The different chapters of the preventive protocols can help selecting additional measures he/she wanted to take to improve his/her preventive strategy.

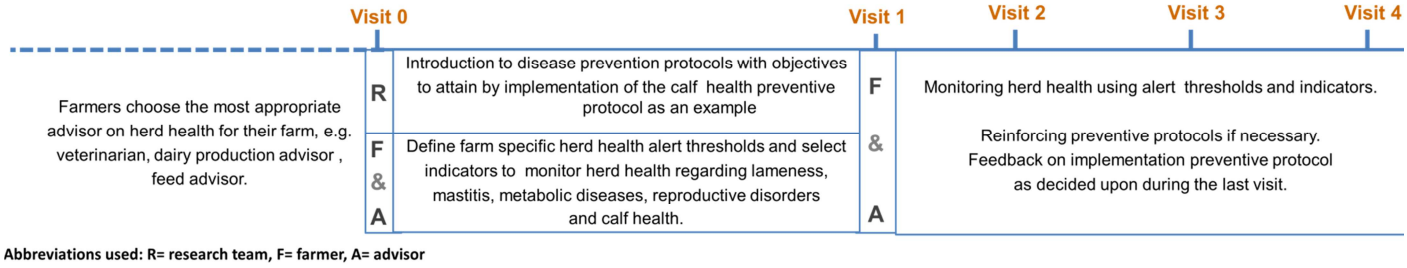

Figure 2: Practical on-farm implementation

3.2 Evaluation of the Herd Health Production Management program

3.2.1 Evaluation of the compliance to the Herd Health Management Production program

The researchers were not present during the visits following the first one (visit 0) in order not to intervene in the relation between farmer and his/her advisor. Thus, to follow the progress, the advisor sent to the research team a report after each visit consisting in a template to fill in (annex 1).

- The compliance to the whole HHPM program was evaluated through:
- The number of visits performed, from 1 to 4;
- The monitoring of all selected indicators per health disorder agreed to be monitored (annex 1);
- The use of the preventive protocols with a herd alert (annex 1);
- The proposal of recommendations to improve a deteriorated situation (annex 2);
- The discussion of the recommendations made during the previous visits (annex 2).
- The implementation of recommended measures if known in the farm visit reports.

Due to the low sample size, Fischer-test was used to identify whether significant differences existed in the results between French and Swedish compliance in the reports.

3.2.2 Evaluation of the users opinion on the HHPM program

The opinion of the participants as first users of the monitoring and preventive tool was collected at the end of the study. Each participant was asked what he thought of the HHPM program, compared to what he/she already knew about this kind of management program. A questionnaire was designed and sent to every participant to get their opinion about:

- The monitoring protocol and its value;
- The preventive protocols and its value;
- The way of using and the ease of use;

- The possible change in the work relationship between farmer and advisor;
- The perspective of future use.

Every farmer and advisor has been called to be informed of the end of the HHPM program, and was asked to fill in the questionnaire in the web survey or in a paper format. A software (Netigate®) was used to create and send the questionnaire by email. Only one farmer asked for a paper questionnaire. In order to make the data processing easier, no open question was asked but respondents were free to add comments in the end of the questionnaire (annex 3). In general, fifteen to twenty minutes were needed to answer the 41 questions. All French farmers answered the questionnaire and only one Swedish farmer did not. Less advisors answered (17/20 in France; 10/20 in Sweden).

Answers to questions where a Likert-scale was used were transformed into agree or disagree answers for the analysis. The scores 1 to 3 were converted into disagree and scores of 4 to 6 were converted into agree. Due to the low sample size, Fischer-test was used to identify whether significant differences existed in the results between groups; (i) French farmers were compared to Swedish farmers, (ii) French advisors were compared to Swedish advisors and (iii) the results of all the farmers were compared to the responses of all the advisors. A significant difference (p-value < 0.05) is indicated with ** in the tables.

3.2.3 Evaluation of the HHPM program impact on the herd health

Evaluation protocol

In France, 60 farms of the total of organic dairy farms participating in the IMPRO project were involved in the evaluation of the HHPM program. From the 60 farms, 40 farmers have performed the impact matrix (IM) with their farm advisor and veterinarian; the 20 other ones were considered as the control group. Of the 40 “Impact Matrix farmers”, 20 agreed to go further in the project and to implement the HHPM program (figure 3). Corresponding number of farms for Sweden was 20 (control farms), 37 (IM farms) and 20 farms in HHPM program.
All farms participated in the milk recording schemes the year of data recording.
The French farms were certified organic dairy farms located in the same geographic areas, with comparable feeding practices, herd size and milk production level. They all received at least one visit of a researcher in order to collect general information and make one locomotion score. In Sweden, the 20 control farms were not visited.

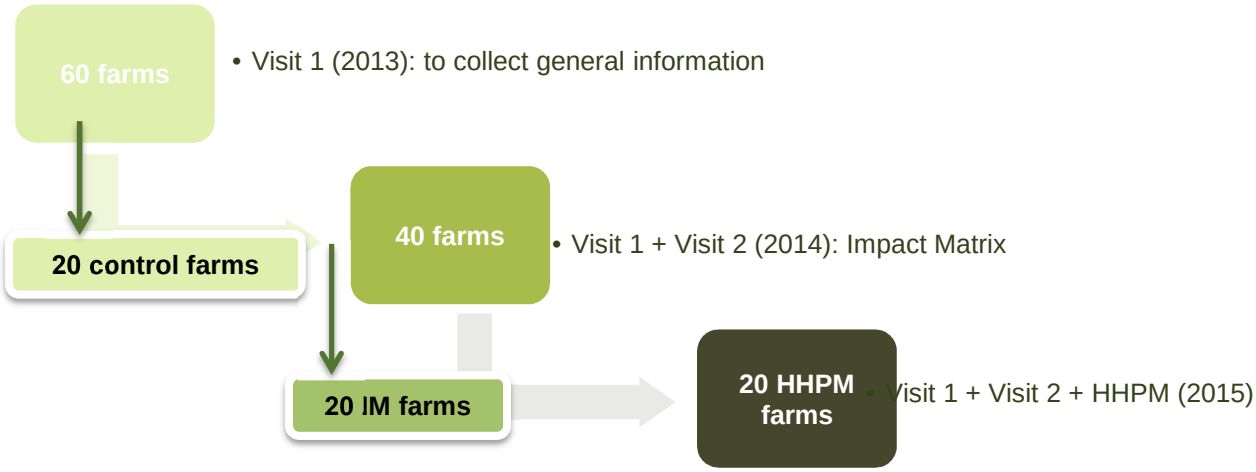

Figure 3: The construction of the three groups to be compared in the evaluation of the HHPM program in France

The effectiveness of the HHPM program in terms of improvement in animal health was assessed by a double comparison: the 40 HHPM farms have been compared to the 40 control farms and also to the 57 Impact Matrix group for France and Sweden all together. In addition, putative differences between France and Sweden have been assessed.

Data source

Data from the national recording systems was retrieved for France and Sweden: the official milk recording schemes, the artificial insemination data bases and the animal identification and registration databases. The national recording systems are not harmonized and record keeping is vastly different, as is the amount of information that is recorded. The different data bases were for France separate entities, while in Sweden, all the information is maintained in a common cattle database for herds that participate in the official milk recording scheme. For the purpose of this report, only data that was available both in France and Sweden was used. In France there is the issue of the lack of data to be used as an indicator for lameness. As a consequence, this health disorder was excluded from the evaluation.

Herd health indicators

The same indicators as in deliverable D 2.5 “Results of on-farm assessment” were used to describe the herds’ health.

Production is used as an overall variable of the herds:

1. Kg milk – defined as the milk yield produced by the cows in the herd in one day during the time period of interest.

Indicators that depict udder disorders are:

2. Prevalence of high somatic cell counts (SCC) – defined as the proportion of all test-days, during the time period of interest, with an SCC-value above 200 000 cells/mL, respectively.
3. Incidence of increased SCC – defined as the proportion of cows moving from below 200 000 cells/mL to above between consecutive test-days during the time period of interest.

No direct information on reproductive disorders was available in both countries, only the calving interval and the median calving to first artificial insemination interval that are directly or indirectly associated to such disorders could be calculated:

4. Median calving interval – defined as the herd median of all days between the latest and the previous calving date, for all calving’s occurring during the time-period of interest.
5. Median calving to first artificial insemination interval – defined as the herd median of all days between the latest calving and the first artificial insemination following, for all calving’s occurring during the time-period of interest.

Indicators that depict metabolic disorders were:

6. Prevalence of fat/protein ratios indicating increased risk for ketosis – defined as the proportion of all test-days between 30 and 100 days after calving (“days in milk”, DIM), during the time period of interest, with a fat/protein ratio above 1.4.

7. Prevalence of fat/protein ratios indicating increased risk for “sub-acute ruminal acidosis” (SARA) – defined as the proportion of all test-days, during the time period of interest, with a fat/protein ratio below 1.0.

Finally, mortality ratios were also calculated:

8. On-farm mortality of cows – defined as the number of cows, i.e. after first calving, that die or are euthanized on farm divided by the sum of their days at risk of dying. Animals that were sold were censored at the day of leaving the herd. Only cows that died during the time-period of interest were included in the calculations and days at risk were also based only on the time-period of interest.
9. Calf mortality – defined as the number of calves that die between first day and 30 days of life divided by the sum of their days at risk of dying. Animals that were sold were censored at the day of leaving the herd. Only calves that died during the time-period of interest were included in the calculations and days at risk were also based only on the time-period of interest.

Periods to compare

The indicators described above have been calculated for three distinct periods (figure 4). The Period 1 from the 1st of January, 2012 to the median dates of performing the Impact Matrix analysis (we took the real date for the farms that performed the IM) is a reference where no intervention has been made. Period 2 corresponds to the time interval between the implementation of the impact matrix and visit 0. For this period we could expect some effect of the Impact Matrix. Period 3 covers the implementation of the HHPM program from visit 1 (the median for the farms out of the program) to the 15th of March, 2016. We aim to measure if there is an improvement of the herd health starting from the first visit without the researcher of the monitoring and prevention program.

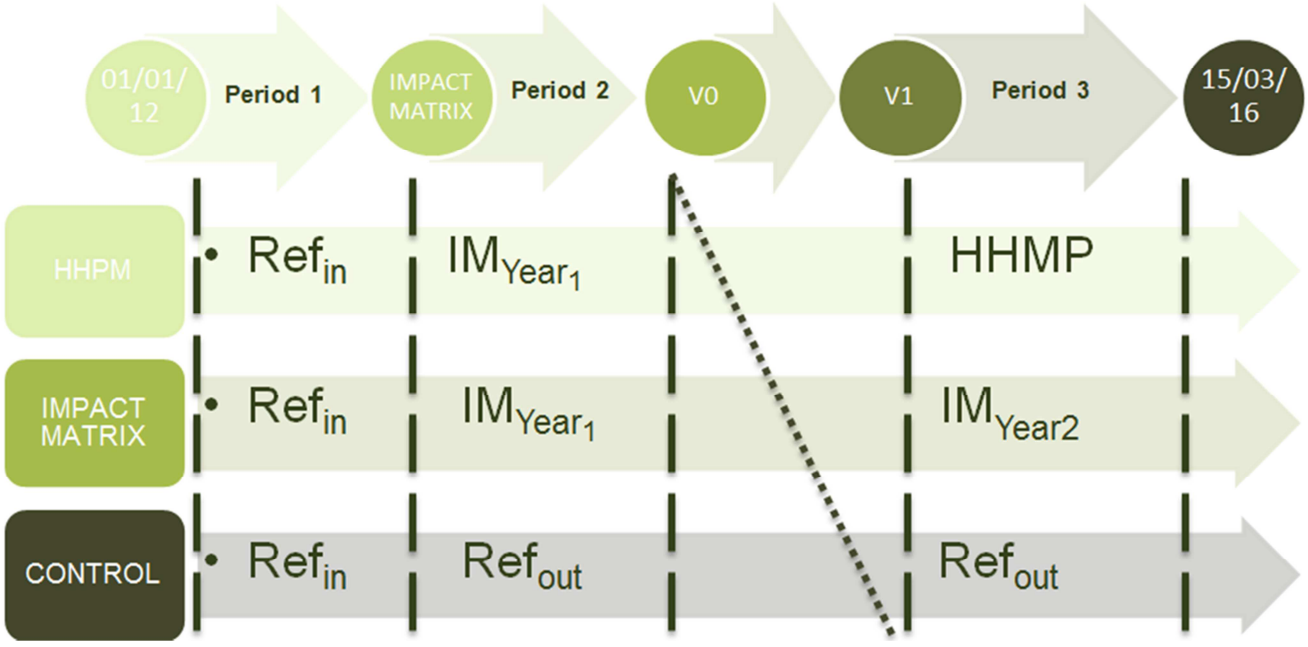

Figure 4: Definition of the periods and the group of farms used for the comparison of the health indicators
(Ref_{in} = inside reference; Ref_{out} = outside reference)

The statistical analysis

The evolution of the herd health indicators from Period 1 to Period 2, and to Period 3, within the three farm groups was analysed with a general linear model for those with a normal distribution. For the others, a transformation with the log normal was necessary.

We analysed the situation in France apart from the situation in Sweden and we compared the two.

4 Results

4.1 The compliance to the HHPM program

Number of visits implemented in the HHPM farms

Visit 0 was implemented in all HHPM farms (gathering the farmer, the advisor chosen by the farmer and the researcher). Yet, three farms in France and two in Sweden did not go further than visit 0. Four vets declared they had no time to dedicate to the other visits and one farmer got sick.

The pairs of farmer/advisor who performed the other visits without the presence of the researcher did not all comply with the four visits proposed in the HHPM program. The table below displays the number of visits performed per farm.

Table 2: Number of farms respect to the number of visits gathering the farmer and his/her advisor
(* Unknowns were due to a problem of getting the reports back)

	Number of implemented visits					
	1	**2**	**3**	**4**	**5**	**Unknown***
Number of farms	1	5	6	20	1	3
French farms	1	2	2	12	1	0
Swedish farms	0	3	4	8	0	3

A Fisher's exact test revealed that there was no significant difference for the number of farmers who completed the full number of visits proposed in France (13/21) respect to in Sweden(8/20) (p-value = 0.3005).

Twenty one farms completed at least the four visits on the 40 farms involved (one French farmer made one more with his vet). Some reasons given not to go further than one, two or three visits were relative to the lack of time: farmer and advisor did not find time to meet again (4) or the satisfaction of the farmer for his herd health situation (4).

For more details from the visits, the analysis of the reports allowed us to evaluate the compliance to the HHPM program. The graphs to follow illustrate this compliance. The axe Y is always the number of farms who implemented what is mentioned in the title and the axe X.

The use of the monitoring tool

At each visit, the farmer and the advisor were supposed to check all the indicators selected according to the frequency of monitoring decided during visit 0. Some health domains did not have

to be controlled every time the farmer and advisor met, according to the frequency of monitoring agreed. However, they would have to be checked at least once in the HHPM program.

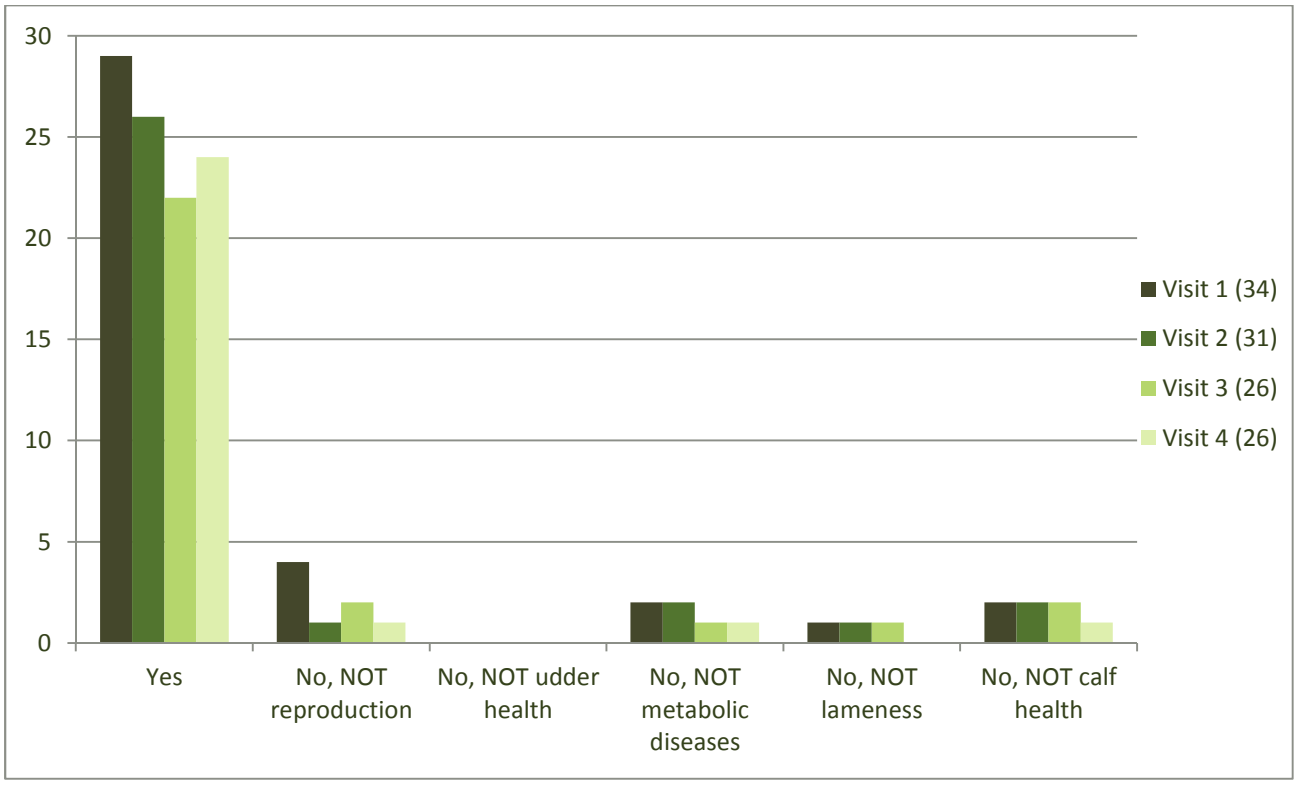

Figure 5: Implementation of the first level monitoring for each health domain
(The question was "Was first level monitoring implemented for all 5 health domains?")

Figure 5 represents the number of health domains controlled during the visits 1 to 4. We can notice that the udder health was systematically looked at while other health domains were not. They are three reasons to that: the main is because, according to the chosen frequency of monitoring, they did not have to control a health domain (13/24). Or they did not have data for (7/24). Or else, the farmer considered there was no need for monitoring this time (4/24). For reproduction, if the visit was not in a period of breeding and there were no results to deal with, the indicators were ignored. As the presence of calves in the nursery depends on the calving season, the calf health was equally unregularly evaluated. For the metabolic disorders the farmer could consider that there was no need or that the data was insufficient, as for lameness, lack of data was the reason most expressed.

The alerts triggered and the ones resulting in the use of a preventive protocol

The farmer and the advisor had to report every alert that was triggered during the 15 months of the study. Consequently we are able to say which health domains were more critical for the HHPM farms (figure 6). Whatever the visit, udder health is the domain which counts most alerts, followed by calf health and reproduction. Metabolic diseases and lameness are less highlighted but as we saw before they also are less controlled because of the farmer' willingness or the lack of data.

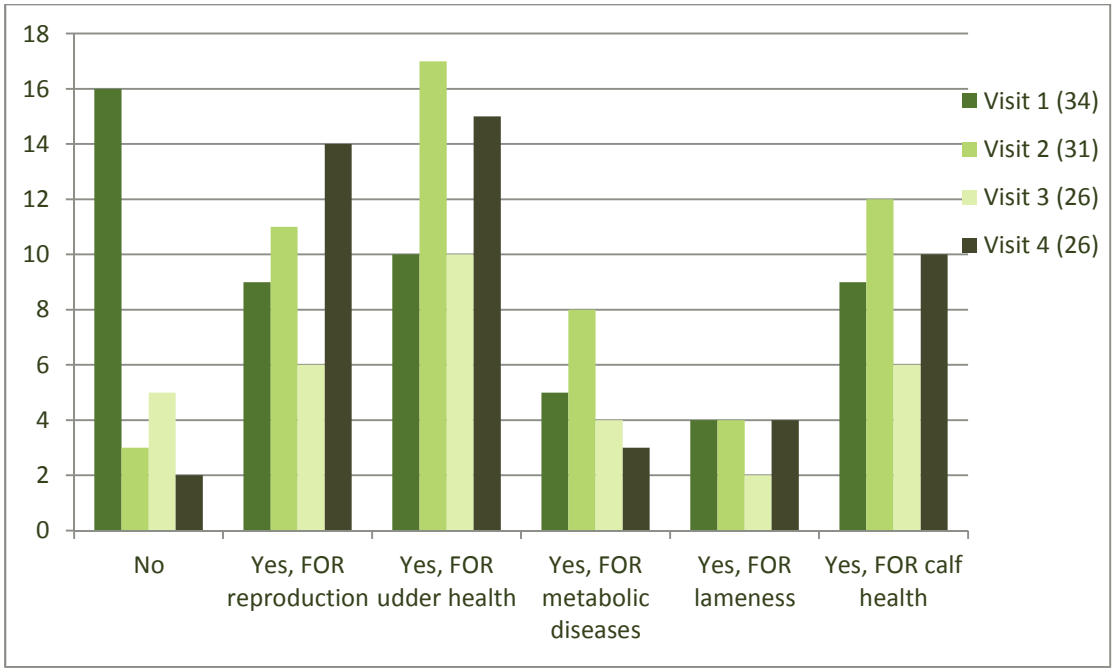

Figure 6: Health domains in alert

As thought by the scientists, an alert in a health domain should lead to a preventive protocol to orientate towards the right risk factors and help to identify relevant corrective actions. However, when looking at the farm visit reports, it is not systematically (figure 7).

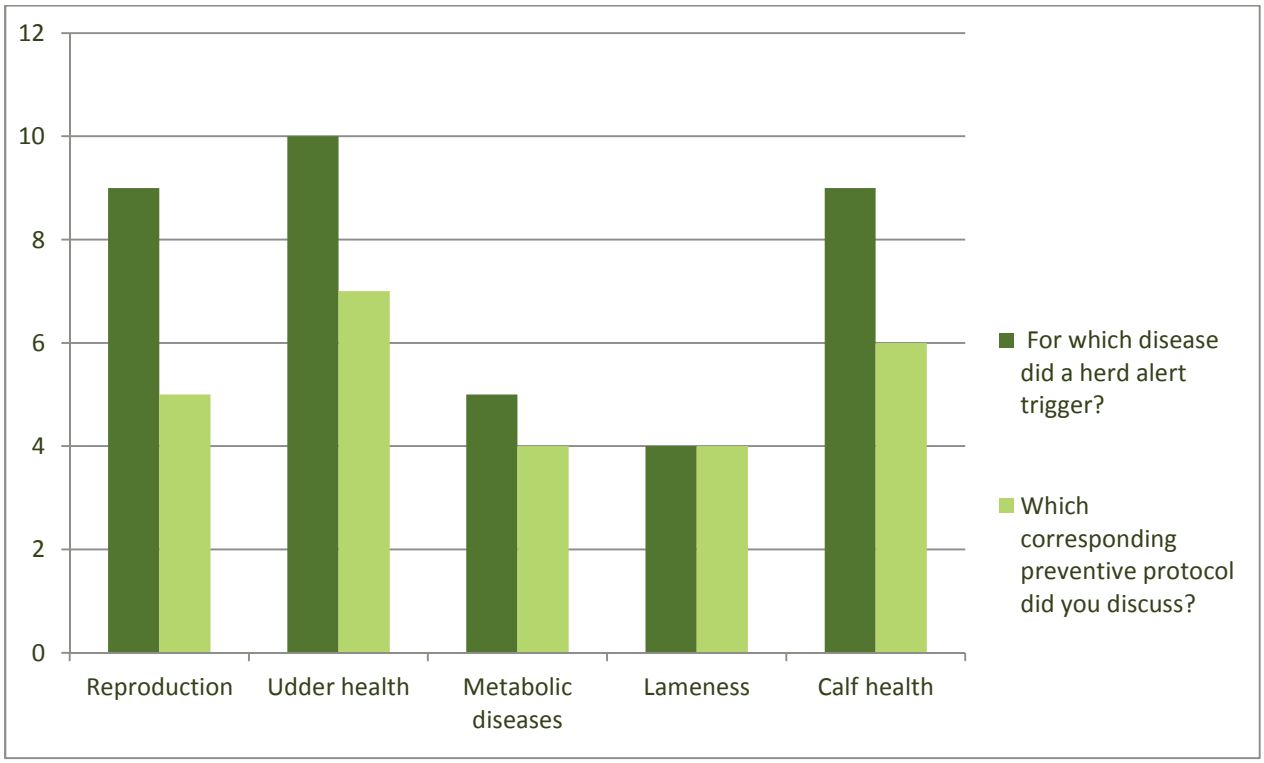

Figure 7: Discrepancy between herd health alerts and preventive protocols used

Figure 7 illustrates that a herd health alert does not always lead to the use of a preventive protocol, except for lameness. We can assume for the other category or health domains that the advisor, , did without the protocol having the risk factors in mind. One report said that they did not succeed in the

identification of the right protocol for udder health which is different according to the infectious model. One last reason was that the farmer was satisfied with his situation even with an alert and saw no need to consult some protocols.

Another use of the protocols was expected by the scientist: some prevention protocols were referred to without any alert triggered. Except the first visit, around 50 % of the farms consulted the protocols without alert for the visit 2, 3, 4. This was particularly true for lameness and metabolic disorders (fig 8). The general motive was to check up on farm the recommended preventive actions in terms of the different intervals in reproduction, the different dietary transitions, the milking hygiene… It is also a good opportunity to discuss the farmers' practices.

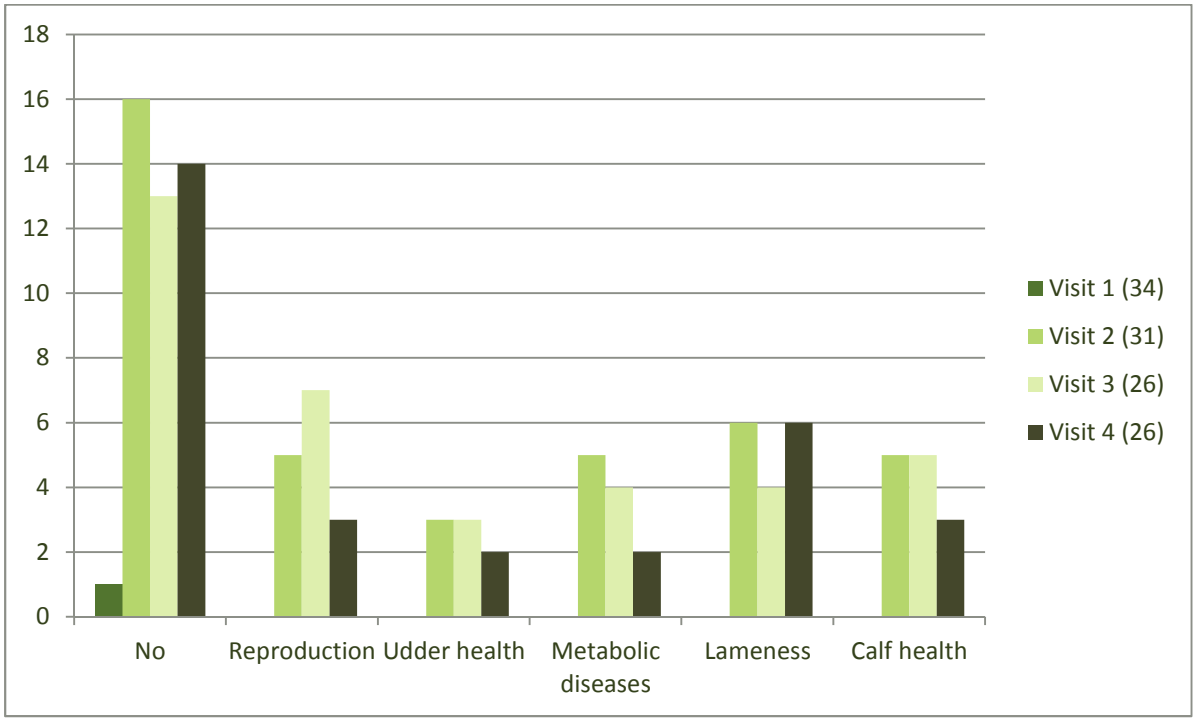

Figure 8: Preventive protocols used without any herd health alert

To the question: does an alert lead to a prevention protocol, a Fisher's exact test showed that there was no significant difference between France and Sweden (p-value = 1). In Sweden, on average over the 4 visits, 81 % of the alerts led to implementation of a protocol, while in France, 85 % on average.

The recommendations

As shown by the figure 9, most of the visits were concluded by some recommendations. With a thorough lecture of the reports, recommendations were given after health domains in alert.

The figure 9 shows also if the implementation of the recommendations was discussed from one visit to another. The visit 0 was not concluded with recommendations; that is why the visit 1 has no discussed recommendations of the previous visit. More than half of the pairs of farmer/advisor discussed the actions implemented in the farm since the last visit. Different cases are described. The taken actions were effective and the problem was solved. On the contrary, some recommendations were maintained from one visit to another because they need more time to be

effective or because the farmer did not implement them yet. And finally, some of them were abandoned.

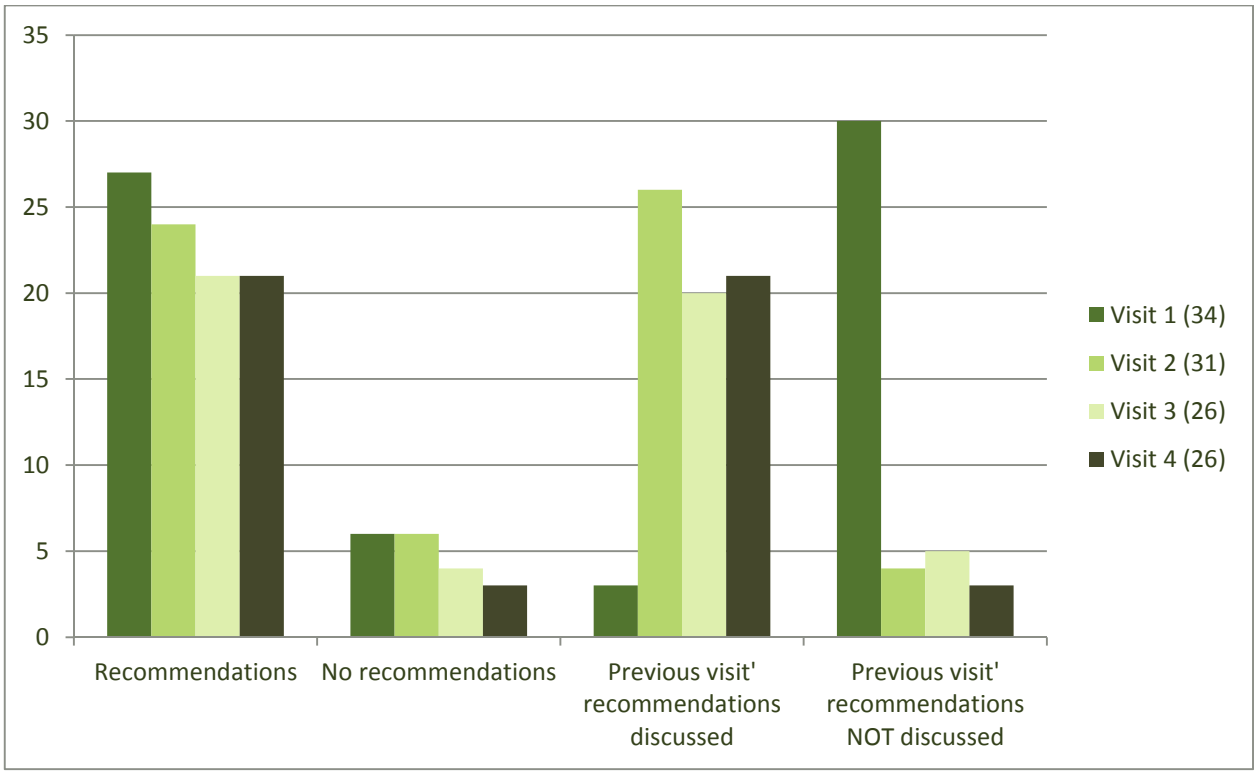

Figure 9: Recommendations made and discussed during the visits

To the question: “does an alert lead to a recommendation”, an exact fisher test showed again no significant difference between France and Sweden (p-value = 0.4819). On average over the 4 visits, 100 % of the alerts led to recommendations in Sweden while 85 % in France.

Moreover, when identifying the recommendations made, they were more relative to udder health, reproduction and calf health while very few concerned lameness and metabolic disorders.

Some of the recommendations were observed several times: much attention was payed to milking and lactating and dry cows housing hygiene, to culling and to detection of the mastitis (table 4). Reproduction disorders are mainly linked to the diet and negative energy balance, minerals or trace elements. Recommendations about calf health mainly concerned the colostrum (quality, quantity and a precocious intake) and hygiene of the nursery.

When no recommendations have been made while some alerts triggered, several reasons were found in the reports:

- The farmer thought he/she already did all he/she could to prevent this problem;
- The recommendation was not adaptable enough to his/her daily work to be implemented
    - Example: not getting up at night for a calving; not realizing the fore milking because it increases the duration of milking
- The problem seemed to be cyclic; it happened at some period and always disappeared by itself so that the farmer had no willingness to do something about it.

- The farmer was not convinced that improving some health domain would be beneficial to him/her
    - Example: the male calves were less monitored as they were not kept and sold at a very low price

Sometimes measures were abandoned because they took too much time to the farmer for the benefit they brought.

Table 3: Examples of recommendations in France per health domain

Reproduction	Udder Health	Metabolic Disorders	Claw Health	Calf Health
Heat recording	Milking machine	Improve actual balance of the diet (energy/protein/minerals)	Perform preventive hoof trimming	Improve calf housing
Monitor the heats at midday	Milking hygiene level		Prevent sub acidosis: careful with feeding order	Disinfect the navel
Reduce retained placenta	Disinfection of the milking brand			Control and improve colostrum quality *Example:* supplementation in trace elements of dry cows
Improve the energy ratio of the diet	Limit density in dry cow housing			Clean out the nursery every 2-3 weeks
Improve heat detection: 15-20 minutes in the morning, midday and evening	Perform California Mastitis Test every new infected cow			Improve colostrum intake
Improve dry cows feeding	Cull cows with high SCC			Give less cereals and more protein
Measure heifers chest size before AI	Keep the cows on feet 45-60 minutes after milking			Clean individual boxes, buckets and nipples
Optimize AI time after heat detection	Implement pre/post-dipping			
Ensure the intake of magnesium chloride	Use well washed dishcloths between 2 milking			
	Improve housing ventilation			
	Use sleeves for the milking man			
	Dry the litter			

4.2 The HHPM impact on the herd health

The results have been compiled below and are presented indicator per indicator. Each time, the two graph (figure 10 to 18) show the distribution of the French herds (in the left) and the Swedish herds (in the right) for every health indicators (milk mean included). P1, P2, P3 are respectively the period 1, the period 2 and the period 3. And groups 1, 2, 3 are respectively the control group, the Impact Matrix farms and the HHPM program farms. The results of the statistical analysis are given with the model used (linear, transformation with the log). One star * means the result is not significant while two stars ** means it is.

No effect of the HHPM program has been demonstrated with the data we had. The statistical analysis showed no significant difference in the health status between the group 1, 2 and 3, in France or in Sweden after the implementation of the Impact Matrix on the one hand, and after the implementation of the HHPM program on the other hand.
However, the herd health differences between the different countries of the project described in the deliverable 2.5 “Results of on-farm assessments” are true here too between Sweden and France. The average daily milk production is significantly higher in Sweden than in France (figure 10). The prevalence and the incidence of somatic cell count > 200 mil cells/ml are lower in Sweden than in France (figure 11 & 12). No significant difference has been found between the two countries for reproductive and metabolic disorders’ indicators (figure 15 & 16). And finally, the calf mortality is significantly higher in France than in Sweden when it is the contrary for cow mortality, lower in France, but not significantly.

The average daily milk production

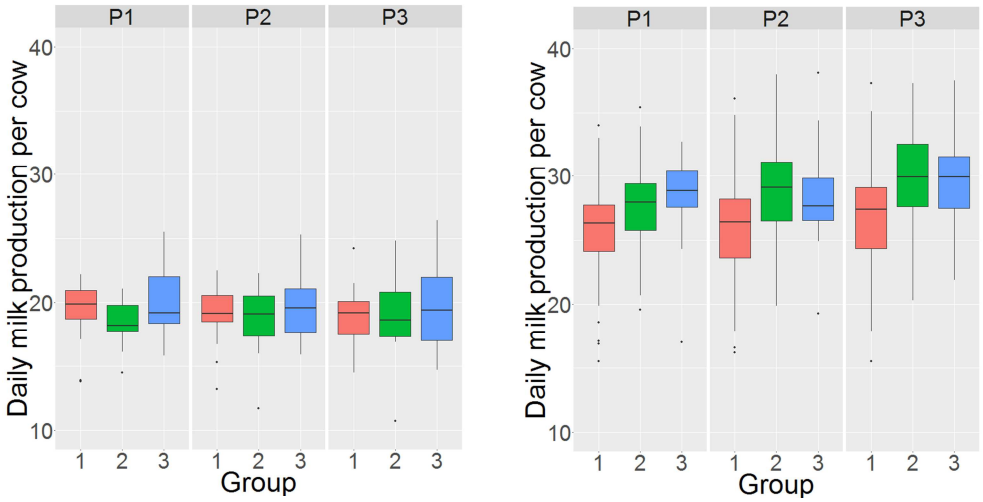

Figure 10: Kilogram of milk per cow and day in average - (left) France (right) Sweden

Results of the statistical analysis:

*lm(milkMean ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	17.12	0.55	30.91	**
countrySE	8.97	0.40	22.43	**
factor(num_gr)2	1.48	0.70	2.10	**
factor(num_gr)3	2.37	0.80	2.96	**
factor(num_gr)2:PeriodP2	0.47	1.01	0.47	*
factor(num_gr)3:PeriodP2	-0.29	1.14	-0.25	*
factor(num_gr)2:PeriodP3	0.62	1.02	0.62	*
factor(num_gr)3:PeriodP3	-0.11	1.14	-0.10	*

The prevalence of SCC > 200000 cells/ml

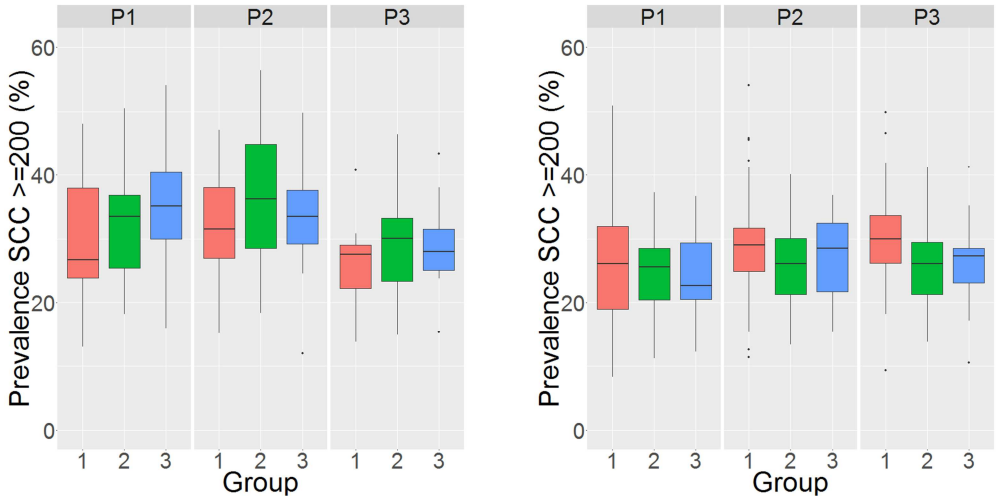

Figure 11: Prevalence of SCC > 200000 cells/ml - (left) France (right) Sweden

Results of the statistical analysis:

*lm(sccPrev ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	31.67	1.40	22.69	**
countrySE	-5.00	0.97	-5.18	**
factor(num_gr)2	-1.07	1.80	-0.59	*
factor(num_gr)3	0.89	2.06	0.43	*
factor(num_gr)2:PeriodP2	0.37	2.55	0.15	*
factor(num_gr)3:PeriodP2	-1.74	2.90	-0.60	*
factor(num_gr)2:PeriodP3	-0.91	2.61	-0.35	*
factor(num_gr)3:PeriodP3	-3.16	2.91	-1.08	*

The incidence of SCC > 200000 cells/ml

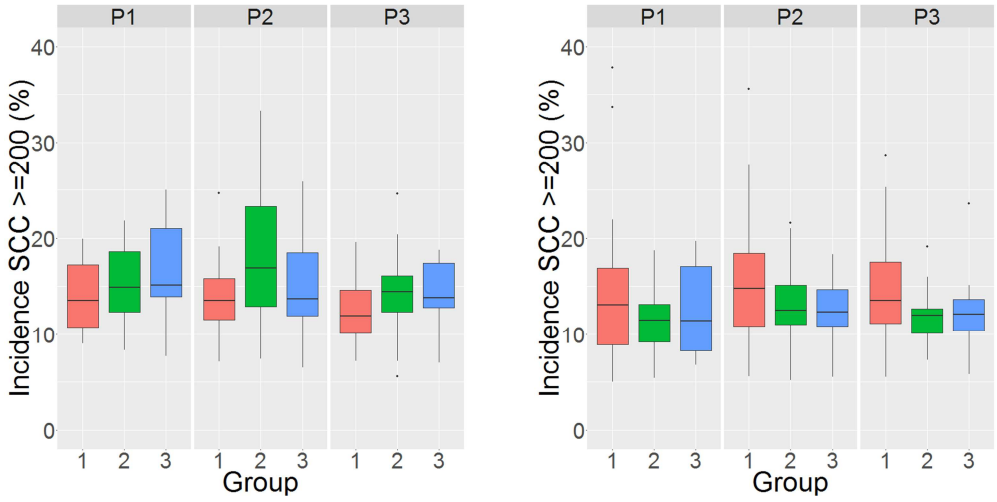

Figure 12: Incidence of SCC > 200000 cells/ml - (left) France (right) Sweden

Results of the statistical analysis:
*lm(sccRais ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	15.63	0.88	17.74	**
countrySE	-2.15	0.60	-3.56	**
factor(num_gr)2	-1.33	1.13	-1.18	*
factor(num_gr)3	0.08	1.29	0.07	*
factor(num_gr)2:PeriodP2	1.13	1.59	0.71	*
factor(num_gr)3:PeriodP2	-1.59	1.81	-0.88	*
factor(num_gr)2:PeriodP3	-0.89	1.64	-0.54	*
factor(num_gr)3:PeriodP3	-2.16	1.82	-1.19	*

Average calving interval

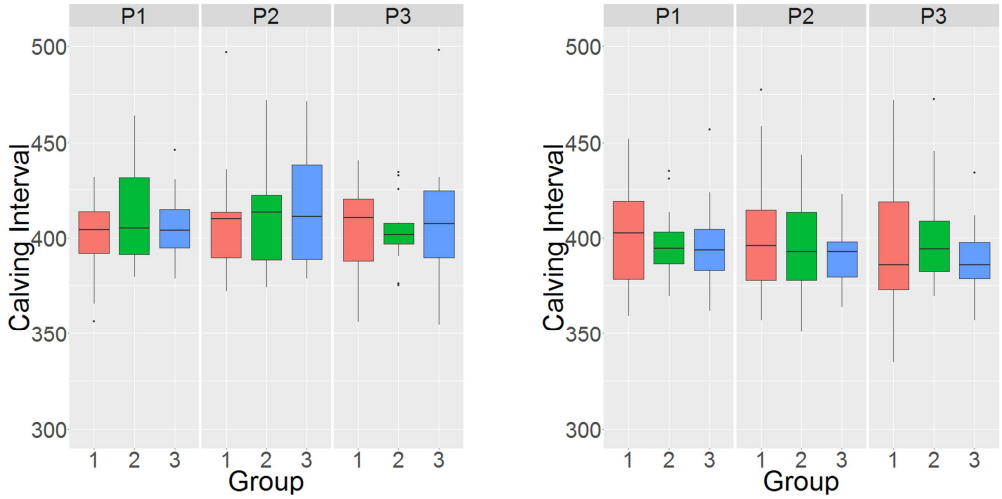

Figure 13: Average calving interval - (left) France (right) Sweden

Results of the statistical analysis:
*lm(log(calvIntGeoMean) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	6.04	0.02	400.38	**
countrySE	-0.02	0.01	-2.25	**
factor(num_gr)2	-0.03	0.02	-1.42	*
factor(num_gr)3	-0.03	0.02	-1.57	*
factor(num_gr)2:PeriodP2	0.00	0.03	0.04	*
factor(num_gr)3:PeriodP2	0.01	0.03	0.19	*
factor(num_gr)2:PeriodP3	0.02	0.03	0.55	*
factor(num_gr)3:PeriodP3	0.01	0.03	0.19	*

Average interval between calving and first artificial insemination

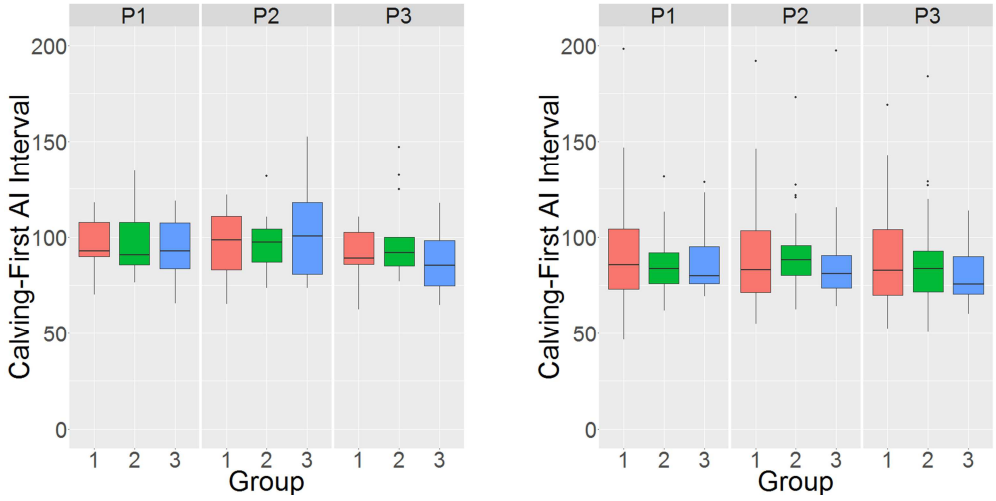

Figure 14: Calving to first artificial insemination median interval - (left) France (right) Sweden

Results of the statistical analysis:
*lm(log(IVIA1) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	4.60	0.04	109.10	**
countrySE	-0.10	0.03	-3.12	**
factor(num_gr)2	-0.05	0.05	-1.00	*
factor(num_gr)3	0.01	0.06	0.13	*
factor(num_gr)2:PeriodP2	0.04	0.08	0.54	*
factor(num_gr)3:PeriodP2	-0.03	0.09	-0.38	*
factor(num_gr)2:PeriodP3	0.07	0.08	0.89	*
factor(num_gr)3:PeriodP3	-0.08	0.09	-0.89	*

Prevalence of increased risk of ketosis

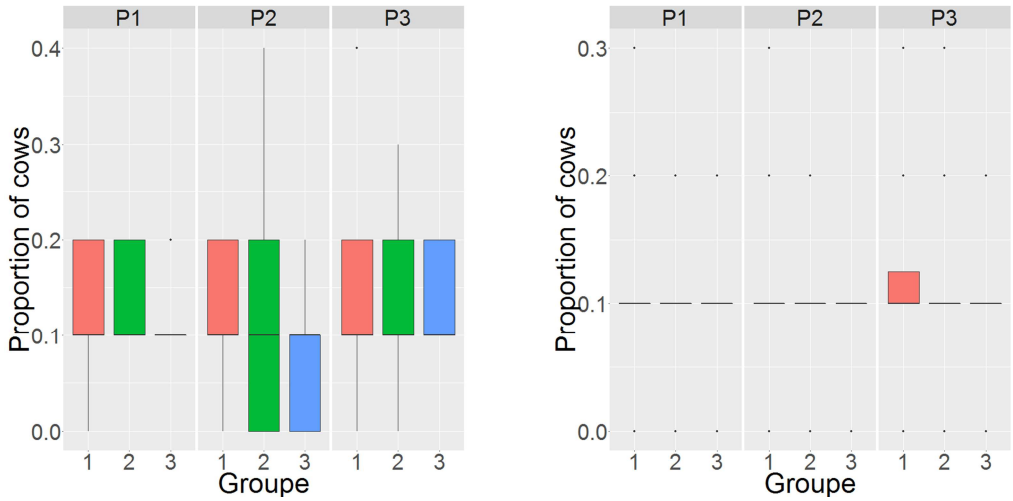

Figure 15: Proportion of cows with Fat Protein ratio > 1.4 - (left) France (right) Sweden

Results of the statistical analysis:
*lm(log(fpr_ket + 1) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	0.11	0.01	12.46	**
countrySE	-0.01	0.01	-1.21	*
factor(num_gr)2	0.00	0.01	-0.32	*
factor(num_gr)3	0.00	0.01	-0.30	*
factor(num_gr)2:PeriodP2	-0.01	0.02	-0.57	*
factor(num_gr)3:PeriodP2	-0.02	0.02	-1.12	*
factor(num_gr)2:PeriodP3	0.00	0.02	0.14	*
factor(num_gr)3:PeriodP3	0.00	0.02	0.01	*

Prevalence of increased risk of SARA

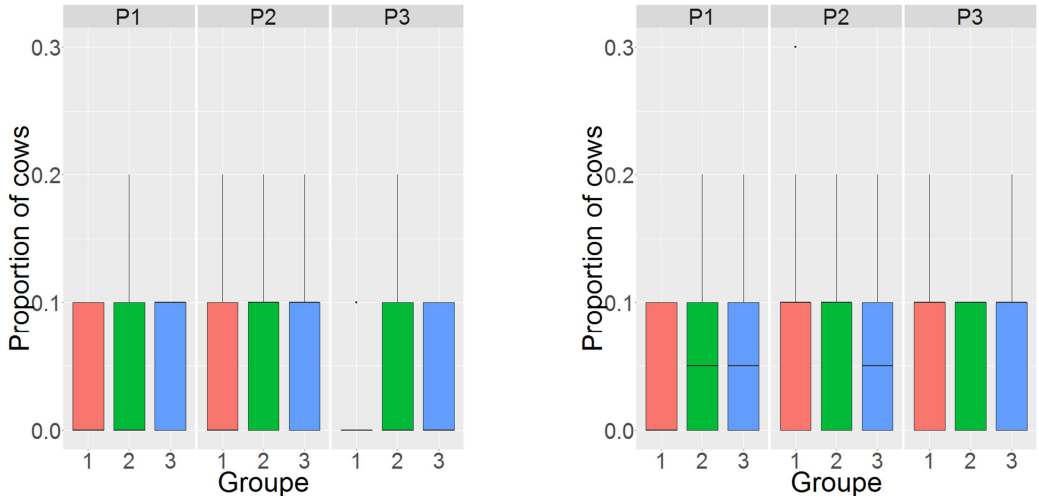

Figure 16: Proportion of cows with Fat Protein ratio < 1.0 - (left) France (right) Sweden

Results of the statistical analysis:
*lm(log(fpr_sara + 1) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	0.04	0.01	5.09	**
countrySE	0.01	0.01	0.92	*
factor(num_gr)2	0.01	0.01	0.57	*
factor(num_gr)3	0.01	0.01	1.03	*
factor(num_gr)2:PeriodP2	-0.01	0.01	-0.82	*
factor(num_gr)3:PeriodP2	-0.02	0.02	-0.96	*
factor(num_gr)2:PeriodP3	-0.01	0.01	-0.45	*
factor(num_gr)3:PeriodP3	-0.01	0.02	-0.61	*

On-farm mortality of cows

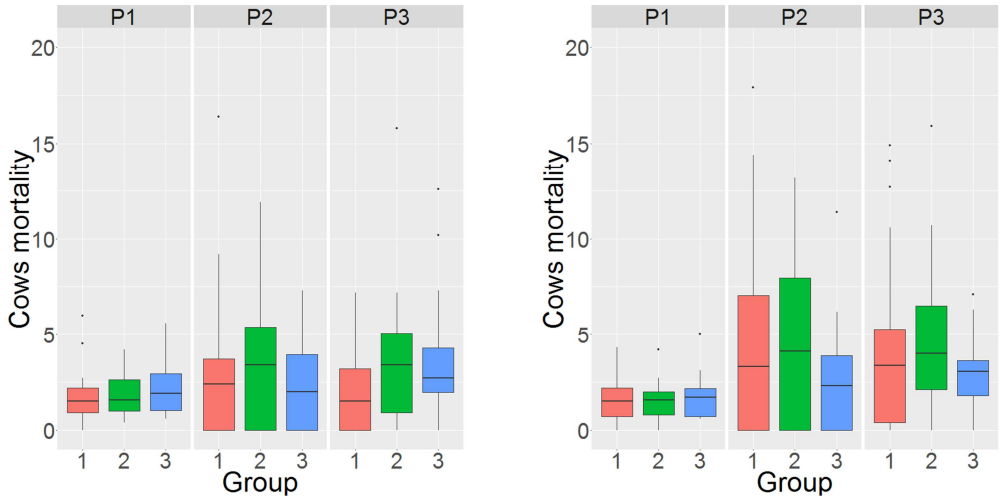

Figure 17: Mortality of cows - (left) France (right) Sweden

Results of the statistical analysis:

*lm(log(mort_cow_years + 1) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	0.78	0.10	7.96	**
countrySE	0.10	0.07	1.41	*
factor(num_gr)2	0.06	0.13	0.43	*
factor(num_gr)3	0.16	0.15	1.11	*
factor(num_gr)2:PeriodP2	0.05	0.18	0.27	*
factor(num_gr)3:PeriodP2	-0.38	0.21	-1.85	*
factor(num_gr)2:PeriodP3	0.16	0.18	0.89	*
factor(num_gr)3:PeriodP3	-0.07	0.21	-0.33	*

Calf mortality

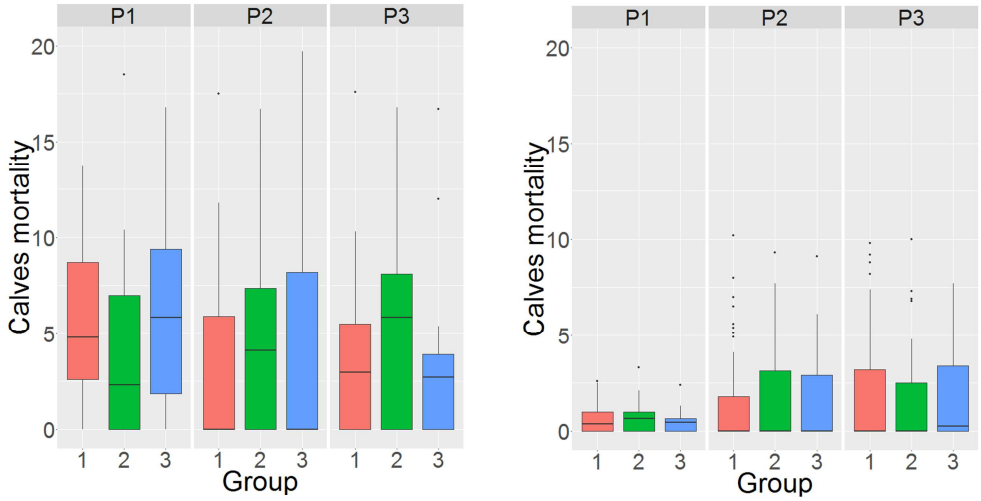

Figure 18: Mortality of calves - (left) France (right) Sweden

IM**Figure 19: Mortality of calves - (left) France (right) Sweden**

Results of the statistical analysis:
*lm(log(mort_all_calves + 1) ~ country + factor(num_gr) * Period)*

	Estimate	Std. Error	t value	
(Intercept)	1.24	0.12	10.44	**
countrySE	-0.75	0.08	-8.78	**
factor(num_gr)2	0.02	0.15	0.13	*
factor(num_gr)3	0.10	0.17	0.58	*
factor(num_gr)2:PeriodP2	0.14	0.22	0.66	*
factor(num_gr)3:PeriodP2	-0.06	0.24	-0.26	*
factor(num_gr)2:PeriodP3	0.03	0.22	0.12	*
factor(num_gr)3:PeriodP3	-0.25	0.25	-1.01	*

4.3 The time investment of the participants in the HHPM program and its cost

4.3.1 The advisors' point of view

The time spent by advisors preparing, performing and summarizing the farm visits could vary a lot between participants (table 5). The preparation of the visits in France was on average shorter than in Sweden.

Table 4: Average time spent by the advisors to perform the farm visits

	France *(min; max)* (n=16)	**Sweden *(min; max)* (n=7)**
Average number of hours needed to prepare a visit	0.3 *(0;1)*	1 *(0.3;2)*
Average number of hours needed to perform a visit	2 *(1;3.5)*	1.8 *(1;4)*
Average number of hours spent to write the summary of the visit	1 *(0.1;3)*	1 *(0.5;1.5)*

In France, advisors were paid 1000 euros per farm (without taxes) to perform the complete HHPM program during one year, thus performing 4 visits. In Sweden it was 10 000 kr (Swedish krona) or 1080 euros with the conversion rate. Advisors were asked whether this amount corresponds to what they would ask of farmers for this kind of services (table 6). Only a small proportion of the advisors would ask a higher amount of money for similar advisory services.

Table 5: Advisors' reaction to the following questions

	France (%) (n=17)	**Sweden (%) (n=8)**
I would ask more	17,6	12,5
I would ask less	47,1	25,0
I would ask an equivalent amount	35,3	62,5

4.3.2 The farmers' point of view

Farmers who answered to be possibly willing to pay their advisor for this kind of services were asked which amount they would accept to pay per year. In France this varied from 150 to 1500 euros per year. Certain farmers expressed to be willing to pay the hourly wage of a veterinarian or to look for a format based on a fix amount per year per cow. Swedish farmers proposed varying amounts ranging from 1000 to 5000 Swedish kroners per year.

4.4 The opinion of the farmers and advisors on the HHMP

4.4.1 General appreciation of the tool

Both farmers and advisors were asked whether they were of the opinion that the implementation of the tool during the study had a positive impact on the health of the herd (table 7). Farmers were more positive than advisors on the health impact of the HHPM program that has been tested, however this difference was not significant. Not all the farmers were willing to pay advisors for these kinds of services and a significant difference was observed between the farmers in the two countries (p-value 0.042). Participants in the different countries did not reply with a significant difference to the other questions presented in table 7.

Table 6: Participants' perception on the effect of the tool on herd health and possible future use
(* = not significant; ** = significant)

	Farmers			Advisors		
	FR (n=17) %	**SE** (n=10) %		**FR** (n=17) %	**SE** (n=8) %	
The implementation of the advisory service as proposed has contributed to improve the health of the herd	64,7	90	*	58,8	62,5	*
I am ready to pay the advisor for this kind of service	47,1	90	**	-	-	
I will keep using the tool						
yes, both the monitoring and the prevention tool	58,8	80	*	64,7	62,5	*
yes, but only the monitoring tool	5,9	0	*	5,9	0	*
yes, but only the prevention tool	5,9	0	*	5,9	25	*
I would recommend the monitoring and/or prevention tools to colleagues?	65	100	*	71	88	*

Although not all French participants expected an improvement of the herd health situation of the participating herds, the percentage of participants answering to keep using (certain elements of) the tool is higher than the percentage of participants estimating a positive effect on herd health. In Sweden this was the case for the advisors but not for the farmers. When comparing farmers to advisors no significant differences were found.

4.4.2 The monitoring tool

4.4.2.1 Intended objectives of the tool

Participants were asked whether the intended objectives of the monitoring tool, thought by the scientists, were fulfilled by the tool (table 8). The aim was to assess whether the tool allows doing what it was intended for. The main difference that can be found between the two countries is regarding the statement that the implementation of the tool was a way to have regular contact between farmer and advisor. This seemed to be more important in France than in Sweden, although

this was not significantly different either (p-value 0.081). Nor were any significant differences observed between farmers and advisors across countries.

Table 7: Participants' agreement to the fulfilment of intended uses of the monitoring tool
(* = not significant; ** = significant – p-value < 0.05)

	Farmers			Advisors		
Agreement with the following statements: ***The herd health monitoring was useful because***	**FR** (n=17) %	**SE** (n=13) %		**FR** (n=17) %	**SE** (n=8) %	
- **it allows for the early identification of herd health problems**	82	69	*	88,2	75,0	*
- **it allows to secure herd health**	77	46	*	76,5	75,0	*
- **it is a way to have regular contact with my advisor/ the farmer**	77	46	*	94,1	62,5	*
- **it gave me a better idea of how I can use data for herd health monitoring/it gave me more access to herd health data of the farm**	71	62	*	59	63	*

Allowing each farmer to choose the indicators considered appropriate for herd health monitoring in his/her farm was done with the intention to improve the shared understanding by farmer and advisor on several aspects; the herd health situation of the farm, farmers' focus areas regarding herd health, the way the farmer monitors herd health. Participants' experiences related to these objectives are presented in table 9. Differences between the two countries can be observed, but within country differences also exists between farmers and advisors. Farmers were in general more positive about the effect of the tool on the shared understanding between farmer and advisor, but these differences were not significant. The only significant difference was observed between French and Swedish advisors concerning the effect the chosen indicators had on improving their knowledge of farmers' way to monitor health and farmers' focus areas.

Table 8: Participants' agreement to the fulfilment of intended objectives by the monitoring tool to improve shared understanding between farmer and advisor on the herd health
(* = not significant; ** = significant)

	Farmers			Advisors		
Agreement with the following statements: ***Choosing indicators adapted to the farm:***	**FR** %	**SE** %		**FR** %	**SE** %	
- **changed my perception of the herd health situation of the herd**	53 (n=17)	23 (n=13)	*	-	-	
- **improved the advisor' understanding of the way the farmer monitors herd health**	82 (n=17)	50 (n=12)	*	82 (n=17)	25 (n=8)	**
- **improved the advisor knowledge on the herd health situation of the farm**	82 (n=17)	67 (n=12)	*	94 (n=17)	63 (n=8)	*
- **improved the advisors/my knowledge on your focus areas regarding herd health**	82 (n=17)	67 (n=12)	*	94 (n=17)	25 (n=8)	**
- **led to a list of indicators that was appropriate for herd health monitoring on the farm**	77 (n=17)	75 (n=12)	*	77 (n=17)	75 (n=8)	*

Another aim of the scientists was to allow adaptability of the tool, for example by adapting indicators to changing animal health situations during the course of the study. In most cases, the chosen indicators were indeed adapted (figure 19).

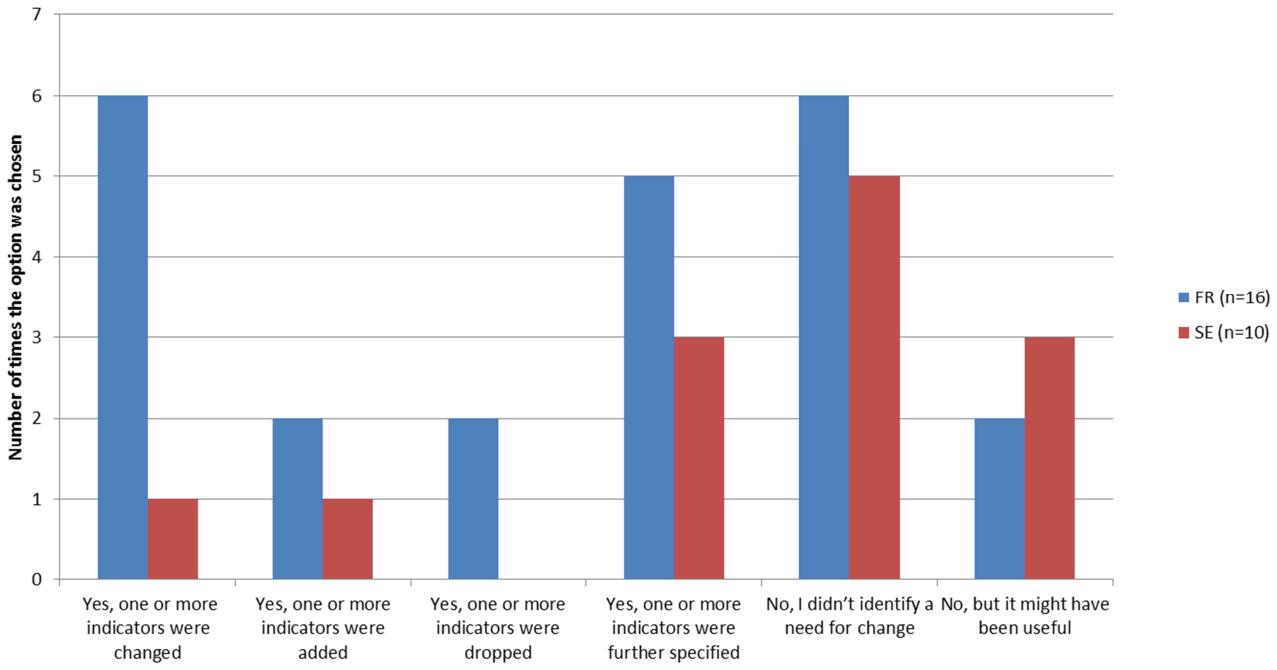

Figure 20: Farmers' use of possibility to adapt indicators during the course of the study (multiple answers)

4.4.2.2 Possible constraints in the use

Possible difficulties in the use of the tool were anticipated due to its adaptable nature and/or regarding the participants' varying experience with herd health monitoring and planning activities in general. Table 10 shows participants' opinions on the possible constraints in the use of the tool, without indicating whether or not it is a motive to stop using it. No significant differences were found comparing the participants in both countries nor when comparing farmers with advisors.

Table 9: Participants' experiences regarding possible difficulties in the use of the monitoring tool
(* = not significant; ** = significant)

•	Farmers			Advisors		
Percentage of participants agreeing with the following statements:	**FR %**	**SE %**		**FR %**	**SE %**	
Choosing indicators adapted to the farm was difficult in its use because I lacked references to interpret with the indicators whether the herd health situation was satisfying/ or not	47 (n=17)	50 (n=12)	*	41 (n=17)	0 (n=8)	*
I did not have enough data to be able to check all health indicators	6 (n=17)	31 (n=13)	*	18 (n=17)	29 (n=7)	*
The monitoring is difficult to keep doing over time	56 (n=16)	36 (n=11)	*	59 (n=17)	38 (n=8)	*

4.4.3 Prevention tool

4.4.3.1 Intended objectives

Like the monitoring part, the prevention part of the tool was designed to serve different purposes; the identification of risk factors of disease, showing the link between practices and health outcome, identifying corrective measures to improve or secure health and to stimulate discussion between farmer and advisors on management practices. Table 11 presents participants' agreement to whether or not these functions are fulfilled by the tool.

Table 10: Participants' agreement to the fulfilment of intended uses of the prevention tool
(* = not significant; ** = significant)

	Farmers			Advisors		
Agreement with the following statements:	**FR** %	**SE** %		**FR** %	**SE** %	
In general, when a herd health problem was identified, the prevention protocol helped to identify relevant risk factors present on the farm	82 (n=17)	91 (n=11)	*	59 (n=17)	88 (n=8)	*
Using the prevention protocol allowed to show the link between management practices and animal health outcome	82 (n=17)	80 (n=10)	*	82 (n=17)	88 (n=8)	*
In general, it was possible to identify correctives actions on the farm corresponding to risk factors identified with the advisor/farmer	88 (n=17)	91 (n=11)	*	82 (n=17)	88 (n=8)	*
The use of the prevention protocol stimulated discussion farm management practices	(n=17)	(n=10)	*	(n=17)	(n=8)	*
- ***yes, we* discussed *more than we usually did***	70	40		47	75	
- ***yes, but in the past we already discussed farm management practices***	18	60		35	25	
no	12	0		18	0	

In general, according to the participants, the prevention tool meets the functions it was intended to accomplish. No significant differences in perception were found between countries or groups of participants.

4.4.3.2 Effectivity of the tool in producing advice adapted to the farm and farmer specific situation

The characteristics of the prevention tool, such as showing the link between practices and health outcomes and stimulating discussion about farmers' practices, aimed at promoting the advisors' recommendations to be adapted to the farm and the farmer. A positive answer to the question 'Were identified corrective actions always implemented?' was given by 35% and 27% of the farmers in France and Sweden, respectively. This difference was not significant.

Reasons stated by farmers for not implementing the recommendations are presented in figure 20. Although these results do not show the percentage of the recommendations that have been implemented, the results suggest that the effectivity of the prevention tool in promoting adapted advice is not sufficient.

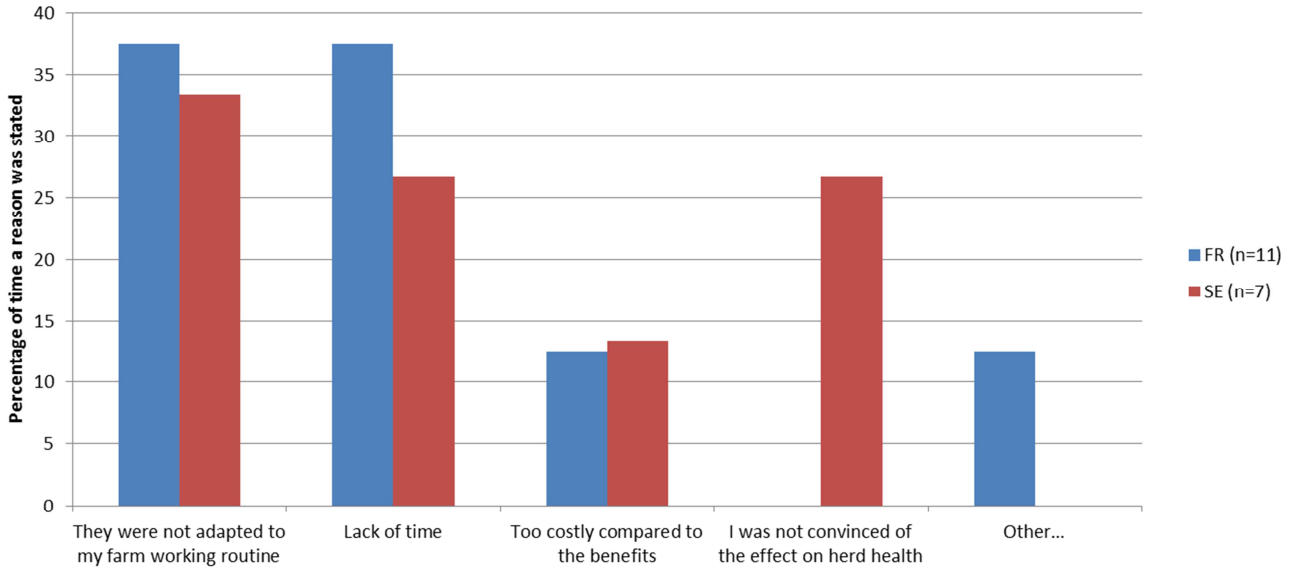

Figure 21: Reasons stated by farmers for not implementing the recommendations

(multiple answers)

4.4.4 Regular farm visits

Literature shows that veterinarians in organic dairy farms often have solely a curative role in cases of animal health emergencies (Brand et al., 1996). Imposing 4 visits in a year, for reasons other than emergencies, might have an effect on the collaboration between the farmer and his/her advisor in animal health. Indeed, the visits were considered by the participants as an opportunity to discuss; the animal health situation of the farm, questions of the farmer on animal health and animal health management practices (table 12). Farmers and advisors agreed on this in both countries, as no significant difference could be found between these groups.

Table 11: Participants' agreement regarding the effect of regular farm visits imposed by the study
(* = not significant; ** = significant)

	Farmers			Advisors		
Agreement with the following statements: ***Having regular visits (for reasons other than emergencies) during the year was***	**FR (n=17) %**	**SE (n=10) %**		**FR (n=17) %**	**SE (n=8) %**	
- **an opportunity to take more time to discuss the animal health situation on the farm**	100	80	*	100	87,5	*
- **an opportunity to have more time to discuss the questions the farmers have on animal health to the advisor/ veterinarian**	100	80	*	94,1	87,5	*
- **an opportunity to discuss animal health management practices**	100	80	*	100	87,5	*

Furthermore, French and Swedish advisors acknowledged that during the farm visits of the study they discussed topics which they would not have discussed in the setting of their normal collaboration, according to respectively 70.6% and 75% of the advisors respectively (figure 21).

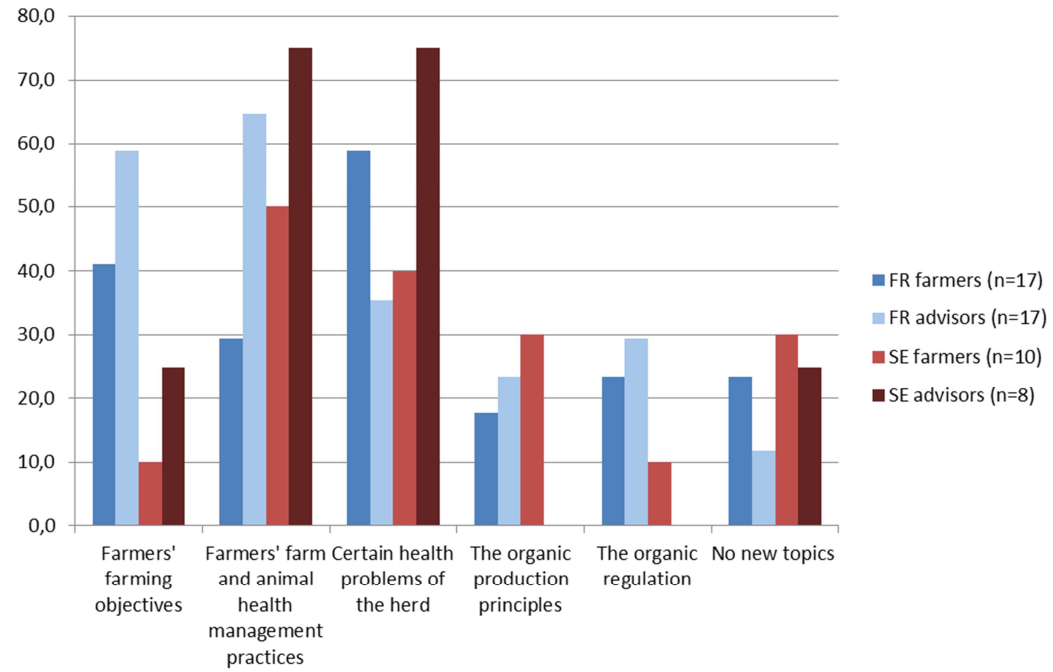

Figure 22: Participants' expectations of areas in which advisors learned new information

Advisors' opinion on animal health in organic dairy farms or on the organic production principles did not change during the course of the study, they all had a positive opinion and that remained so (data not shown).

In addition, in 88.2% and 75% of the cases in France and Sweden, respectively, advisors agreed with the fact that the collaboration was an opportunity to make farmers more aware of the knowledge and services they can offer them. Furthermore, 41.2% of the French advisors thought to have more knowledge after the study of what the farmers expect from them, compared to 37.5% in Sweden (table 13).

Table 12: Proportion of farmers with changed knowledge of services/information advisors can provide them due to the collaboration during the intervention study
(* = not significant; ** = significant)

	FR (n=17) %	SE (n=10)%	
Yes	41,2	50,0	*
No, I already knew	29,4	40,0	
No, I don't know more about it	29,4	10,0	

4.4.5 Overall characterization of the tool by the participants

Participants were asked to tick the boxes that correspond to how they would characterise the tool. Most often the labels 'thought provoking', 'helpful in communicating' and 'instructive were used by French participants (Figure 22). Thirteen French advisors classified it as time consuming in contrast to only two Swedish advisors. Swedish participants used most often 'helpful in communicating', 'motivating' and 'instructive'.

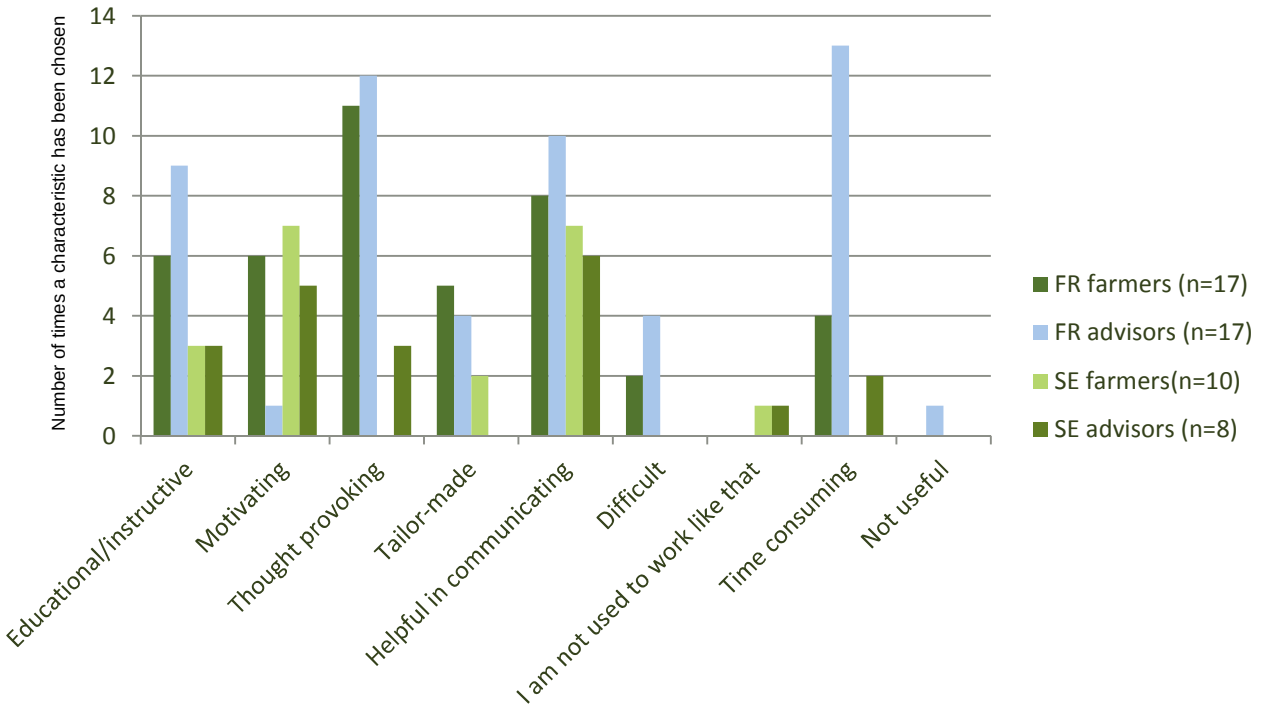

Figure 23: Illustration of how participants characterise the tool

4.4.6 Areas for improvement of the tool in general

4.4.6.1 Training advisors

Advisors were asked whether they would have liked to have more training in the use of the tool. In France 35.3% of the advisors wished to have had more training, compared to 75% in Sweden, but this difference was not significant. However it might have had a higher impact than calculated since in Sweden several advisors followed more than one farm during the IMPRO project.

4.4.6.2 Number of visits per year

The number of farm visits proposed (4 per year) was considered as appropriate by most participants (table 14).

Table 13: Proportion of participants agreeing with the frequency of farm visits proposed in the study
(* = not significant; ** = significant)

	Farmers			Advisors		
Right number of visits:	**FR (n=17) %**	**SE (n=10) %**		**FR (n=17) %**	**SE (n=17) %**	
yes	94,1	80,0	*	88,2	75	*
no, too few	5,9	10,0		0	0	
no, too many	0,0	10,0		11,8	25	

4.4.6.3 Missing elements in the tool

For future development of this tool or others, it was considered of interest to understand, whether the participants identified functionalities that would have been useful but that could not be assured by using this tool or areas of interest that were lacking.

Table 14: Participants' opinion on the completeness of the tools in terms of information
(* = not significant; ** = significant)

	Farmers			Advisors		
Percentage of participants agreeing with the following statements:	FR %	SE %		FR %	SE %	
It would have been useful to monitor other health domains than the ones proposed (reproduction, udder health, lameness, metabolic diseases and calf health)?	24 (n=17)	9 (n=8)	*	24 (n=17)	25 (n=8)	*
I missed information in the prevention tool	35 (n=17)	18 (n=11)	*	47 (n=17)	38 (n=7)	*

French farmers proposed as additional areas (table 15) for monitoring feeding (3), tick-borne diseases (1). The Swedish farmers did not specify which new area(s) should be added. French advisors proposed to monitor feeding (1) and parasitic diseases (3). Swedish advisors proposed in addition mortality and culling reasons (1) and calving problems (1).

Six French farmers considered that information was missing in the prevention tool (table 15). In detail it concerned; missing risk factors (3), missing objectives to attain (2), and missing health topics (1). In Sweden one farmer was of the opinion that objectives to attain were missing and another farmer considered that a health topic was missing. These participants did not further specify exactly what they were missing.

4.4.6.4 Format prevention protocol

A major anticipated constraint or possible discouragement in the use of the tool was its format. The format in which the tool was tested was a paper format (87 pages for the prevention protocols plus a few pages for the monitoring and reporting supports). The prevention tool was structured per health area, which was further subdivided in areas of interest (feeding, housing, and etcetera). Participants were asked whether they would prefer the tool in a different format (table 16). They were presented with three options (multiple answers were possible); digital format, a different structuration of themes or other. In the category 'other' two French farmers asked for simplification and one for a lower amount of pages. French advisors asked as well for simplification of the tool, e.g. by reducing the number of pages.

Table 15: Participants' preferences for improvement of the tool' format

•	Farmers		Advisors	
Options proposed	**FR (n=13)**	**SE (n=9)**	**FR (n=13)**	**SE (n=9)**
Digital format	6	6	13	4
A different structuration of themes	4	3	4	1
Other	4	0	3	1

5 Discussion

5.1 Testing a tool under field conditions to improve its relevance to practice

A dialogue between designers (in this context, the research team) and users during the development phase of tools can support the construction of tools that are relevant to real-life conditions (Cerf et al., 2012). Therefore, testing the HHPM program under conditions as close as possible to the field was considered inevitable, and receiving feedback from participants that interacted with the tool, crucial to further improve the tool for future use. Moreover, testing the tool and reporting on the context of its implementation should make the report more useful for future users and decision-makers, e.g. by understanding which resources or actors are needed (Waters et al., 2011).

The HHPM-program seemed to be appreciated by most users of the tool, based upon the perceived effectiveness of the intervention on herd health, according to a majority of the respondents of the questionnaire improvement of herd health and their willingness to continue the use of (certain elements) of the tool. In general, we could hardly see a difference in the appreciation of the tool between French and Swedish users, or between advisors/veterinarians and farmers.

5.1.1 Technical functions tool

The concept for the HHPM program, recommended by the research team, seems to be applicable under field conditions.
All the farmers have constructed their farm specific monitoring tool for the monitoring of at least four health domains simultaneously (Duval et al., 2016). In general, the five health domains were monitored as frequently as planned, and the chosen indicators calculated for each health domain. When an alert triggered the approach allowed the identification, the consultation of the relevant prevention protocol and the recommendation of corrective actions. However, the numbers of visits were not fulfilled on all farms.

Both farmers and advisors agreed the tool complied with certain 'technical' functions it was expected to fulfil, such as allowing the early identification of herd health problems, securing herd health and the identification of relevant risk factors and corrective actions. Farmers also agreed to the statement that the tool gave them a better idea of how they can use data for in herd health monitoring.

The users of the tool were not always satisfied with its user-friendliness. Certain users found it not so easy in its use and the format not adapted to a use on farm. The important number of documents

could have made it difficult to manipulate and to find the needed information. A digital format could be a solution to optimize its use, as proposed by numerous users.

5.1.1.1 The monitoring tool: strong points, improvements possible

The farmer was able to design his own monitoring tool so it would remain close to his priorities and adapted to his routine. He chose the health domains he wanted to monitor, the indicators to do it and their thresholds, and the frequency of monitoring. We observed from the reports that many alerts were triggered and that a visit with no alert was rare. Thus, we can consider that the farmers have set realistic targets and have not opted for easily reachable targets. Another observation that points in that direction is that the targets set did not discourage participants to keep monitoring herd health. Only in a few cases, despite the alert, the farmer remained satisfied with his situation or considered that he already did all that he can to prevent health disorders.

Some health domains showed certain limitations in order to be able to monitor them, e.g. regarding locomotion disorders. The lack of precise data made the monitoring difficult. Moreover, a lack of reference values for monitoring indicators was identified by certain users as a difficulty. Adaptability of the indicators to farm specific situations can be beneficial to advisory situations. As shown by Duval et al. (2016) it stimulates e.g. the dialogue between farmer and advisor on herd health, farmer' objectives and constraints in some cases, thus rendering, in theory, the monitoring activities and proposed advice pertinent to the farm specific situation. However, it requires that the advisors are able to adapt themselves to the use of farm specific indicators. We can argue that advisors need a certain level of expertise to be able to do so, as expertise will allow choosing actions that are efficient and effective. Expertise is a dynamic process of continuous learning; requiring integrating different kind of knowledge and experiences in a specific domain, reorganizing information and problem-solving efforts that are not routine. Not everybody is an expert and expertise is not equal to a lot of experience (Herling, 2000).

3.1.1.2 The preventive protocols: strong points, improvements possible

The farmers appreciated the fact that the prevention protocols were different from the good practice guides produced in general. No detailed recommendations were listed, but the prevention protocols described objectives to attain to prevent health problems. This promoted the discussion between farmer and advisor on the preventive practices already installed, possible corrective actions the farmer could implement to attain the objective and to show the link between practices and health outcome. The transfer of knowledge occurred thus in both directions from farmer to advisor and the other way around.

Two different uses of the prevention protocols were observed that we can qualify as reactive and preventive use. The first corresponds to the consultation of a prevention protocol when an alert triggered. A health problem was detected and farmer and advisor had to find a way to solve it and to avoid it to happen again. The reaction was thus a bit too late, it is not preventive. The other use of the protocols was preventive, before any health problem appeared in the herd. The farmer and the advisor discussed together the current preventive strategies in the farm and refered to the protocols to see if they can be reinforced. It secures the herd health more than a reactive strategy even if it does not prevent every disease or disorders to happen.
The prevention protocols seem thus to not to be a set of static documents but the different elements were actively used, depending on the needs identified. Vaarst et al. (2011) recommended that animal health planning activities need to become a dynamic process; this requires a dialogue between farmers and advisors as to make the connection between the plan and the advice given.

Some advisors find the protocols too detailed so that it took too much time reading all. Some advisors were interested in the idea of having a “check-list” when facing a health problem in order to review all the possible risk factors that might be at the origin of the problem. The recommendation was thus to shorten the protocols and to simplify. Another possibility would be a digital format which allows the advisor to target one or more risk factors and ”zoom in” to see the detail if needed. Furthermore, propositions were made to add prevention protocols for certain health domains, e.g. for parasitological diseases which is a problem farmers are facing in organic dairy farming.

5.2 The effect of the intervention on the herd health

No significant effect of the HHPM program on the herd health was found, either in France or in Sweden. However, it does not necessarily mean that the tool was useless but we could not show its effectiveness on herd health. Some limits of the research strategy chosen have to be taken into account:

First, the sample size was very small so the statistical power limited; 20 French and 20 Swedish farms participated and not all completed the HHPM program to the end. Three farmers decided not to monitor all health domains. The frequency of monitoring per indicator could vary from 1 or 2 to 4 times over the 4 visits planned.

Secondly, the diversity of alerts made the sample stratified as there were five health domains (even if we saw that udder health and reproduction performances had the highest number of alerts). The reporting allowed us to follow what recommendation was proposed in a farm but not the implementation itself, and how and how long it was implemented by the farmer. The control strategies were thus out of our control and could not be accounted for in an analysis of potential effects.

Thirdly, the initial herd health situations differed and were not all poor. If the only objective of the study was to measure the effectiveness of the intervention on herd health, then a different type of study design would have been more appropriate. For that purpose it would have been more appropriate to test the tool in e.g. herds with severe udder health and reproduction problems, with farmers highly motivated to improve the health situation. Ivemeyer et al. (2009) for example reported also more improvements in animal health in herds with a poorer health level at the start of the study (Ivemeyer et al., 2009).

Finally, the testing period may have been too short to see an effect of the program. Indeed, depending on the recommendations, they may have needed more time to have a real effect. In other intervention studies similar difficulties were identified (Bell et al., 2009; Ivemeyer et al., 2012). Moreover, it was not possible to check whether the recommended measures were appropriate for the identified problem. Concerning the length of the testing period, we can also imagine that the farmer and the advisor need time to establish a relationship of trust and that the effectiveness of their cooperation could depend on that.

5.3 Evaluation of steps that can facilitate change in herd health management

For the evaluation of complex interventions effectiveness, such as the implementation of an adaptable HHPM program to the different farm specific conditions, requiring the interaction between different actors, a different type of research strategy is recommended (Hawe et al., 2004). Interventions might not be successful for numerous reasons that need to be understood; such as a lack of implementation or failure of one of the components of the intervention (Waters et al., 2011).

We can thus consider it would be more pertinent to study the different factors that in theory could facilitate a change in farmers' herd health management, namely; a change in farmers' perception of the herd health situation, changed knowledge about the effect of practices in herd health outcome, improved dialogue between farmer and advisor (leading e.g. on a shared understanding of farmers' objectives, constraints, perceived efficiency of practices).The first two functions have been found to be fulfilled to a certain extent, as discussed in the first paragraph of this discussion.

The HHPM program stimulated the dialogue between farmers and advisors. A striking example is that the majority of the participants perceived that it improved advisors knowledge of the health situation on the farms.
The quality of the dialogue between farmer and advisor is considered as a key to success of animal health planning activities (Vaarst et al., 2011). For example, when veterinarians did not take into account farmers' goals into consideration this could lead in certain cases to the dismissal of veterinarians' knowledge by organic dairy farmers for their animal health promotion strategies (Vaarst et al., 2007). Furthermore, certain advisors expressed to have learned about the organic principles and regulation during the intervention study. The lack of veterinarians' knowledge on the organic regulation was identified, in an earlier study, as a weakness (Vaarst et al., 2007).

Regular and frequent visits within a year could have been a step forward in itself to stimulate an advisory role for advisors in herd health management on organic dairy farms.
French veterinarians have been found to be rarely invited to organic dairy farms and find it difficult to make their role in organic dairy farmers animal health management evolve from a therapeutic role towards an advisory role (Duval et al., 2016). This might be true for other countries. Also, in Denmark, veterinarians were not much involved by organic dairy farmers in their animal health promotion strategies (Vaarst et al., 2006). Despite the fact that in the Danish context of organic farming the veterinarian is, in most cases, the only person allowed to treat animals (Vaarst and Bennedsgaard, 2001).

5.4 Evaluation of the interactions between farmer and advisor

It is not possible to evaluate in detail the advisory action since the research strategy chosen did not include the presence of researchers during the farm visits, with the aim to test the tool as close as possible to 'real-life' situations. However, the consequence was that an important amount of reporting by the advisors to the research team was necessary to be able to evaluate the tool in the end. Certain advisors found this reporting too detailed, and too time consuming. In the advisors' evaluation, there may have been confusion between the real time needed for the implementation of the program and the extra time due to the reporting required by the researcher. People reporting that the tool was time consuming may have thought about the amount of time they dedicated to the reports. In real life conditions, they probably might not have spent so much time on reporting. Even though, written record keeping of farm visits is part of HHPM programs in general (Cannas da Silva et al., 2006), not all participating advisors might have been used to it in their daily work.

Even with a detailed reporting, there are elements of the visit we could not catch. Using reporting by advisors did not allow us to evaluate how the farmer and the advisor interacted with each other, with their own personality. There must have been as many way of working together as farms involved in the study and only the presence of a researcher during the visits could have captured this. In theory, the analysis of data using theoretical knowledge will lead to information that is context specific and for the purpose of decision-making (Wolf et al., 2001). Klerkx et al. (2010) hypothesize that information will only be of significance to the receiver if it is built upon his/her existing

knowledge. Hence, this underlines the importance of the dialogue between farmer and advisor to exchange information with the aim to build new knowledge (co-constructing the advice) rather than only exchanging information (the advisor gives to the farmer the solution to the problem, like a recipe) (Klerkx and Jansen, 2010).
The results of this study show that both farmers and advisors perceived that they have acquired knowledge that was new to them. However, the research strategy chosen does not allow to measure if and how the knowledge and experience of farmers and advisors were combined to e.g. identify corrective measures to improve health. Insufficient integration of farmers' knowledge might be a possible explanation for the fact that not all recommended measures were implemented. It has been shown that long-term collaborations between farmers and their advisors can be created when both are knowledgeable and have a proactive approach, but at the same time they are ready to learn from one another and integrate each other's knowledge (Ingram, 2008).

Conclusion

The monitoring tool and the prevention protocols used in this study provide guidelines for farmers and the advisors willing to implement a HHPM-type of program. It can be used as a proactive/reactive or as a disease prevention tool. The evaluation of such a complex intervention is complicated and requires an adapted research strategy to be able to value the effect of the different elements of the intervention. Although no significant effect of the intervention on herd health was demonstrated, the HHPM-tool activated multiple factors that could facilitate change in farmers' animal health management. Due to the feedback from the users it was possible to identify difficulties encountered in its use and as well as possible ways to improve of the tool.

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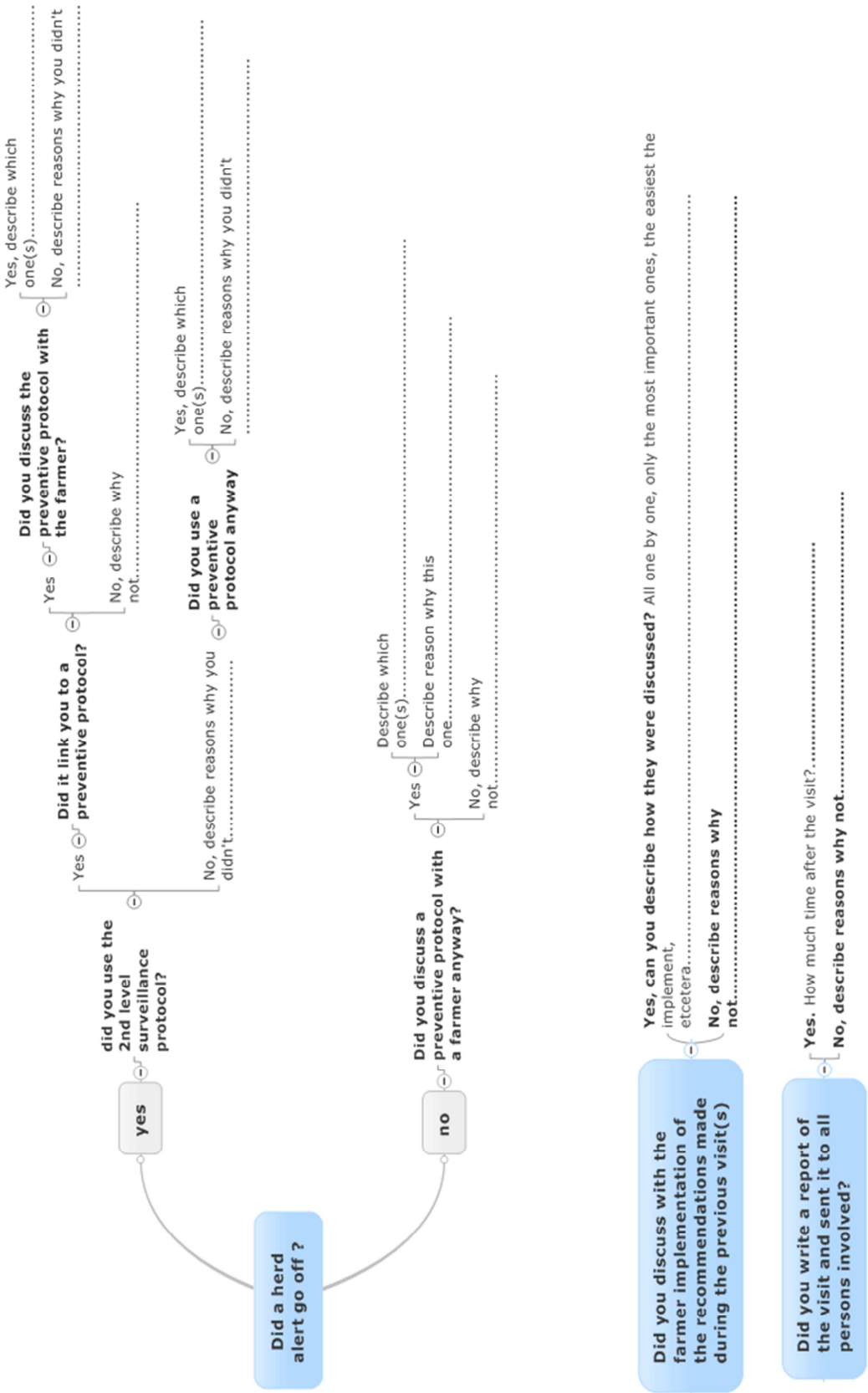
Annexes

Annex 1: Template to fill in for each health domain (udder, claw, calf health and metabolic, reproductive disorders) at each visit



Annex 2: Frame work for written farm visit summary

Official farm number: ……..

Name(s) persons involved in the farm visit:

…….

Name author summary: ……

Date of the visit: …… /……. / ……..

1- Levels herd health indicators

Health domain	**Indicators used**	**Health level identified per indicator**	**Alert level crossed** Yes/No	**Improvement or degradation of the situation compared to the last visit**
Reproduction				
Mastitis				
Metabolic diseases				
Lameness				
Health calves				

2 - Diagnosis of the health problem (if one identified) and associated risk factors

It will be necessary to resume certain elements of the diagnostic procedure to explain how the origin of the health problem was identified.

The advisor explains in this part the risk factors identified and hierarchies them in order of importance:

Risk factors identified:

3 - Objective(s) farmer with regard to the identified herd health problem

4 - Summarize practices proposed/identified and explain how these can help to attain improvement of the herd health problem

5 - Expected implementation of proposed practices

Practices	**Expected month of implementation**					
	M+1 (January)	M+2 (February)	M+3 (March)	M+4 (April)	M+5 (May)	In 6 months, precise
Example : *Start disinfection of the teat ends after milking*		X				
Practice n°1						
Practice n°2						
Practice n°3						
Practice n°4						

Remarks on the calendar, include also feedback on the implementation of recommended practices identified during previous visits (delayed implementation of practices, abandonment of practices, etc.)

Date of the next visit:

Annex 3: Questionnaire of evaluation of the HHPM

Farmers version

A1. Monitoring tool

The monitoring tool is the set of indicators linked to a certain alert threshold that were chosen during the very first farm visit about one year ago.

1. To what degree to you agree with the following statements? **Herd health monitoring** like this was useful (range 1-6, from I fully disagree to I fully agree)
    1. Because it allows for the early identification of herd health problems
    2. Because it allows to secure herd health
    3. Because it gave me a better idea of how I can use data for in herd health monitoring
    4. Because it changed my perception of the herd health situation of my herd
    5. Because it is a way to have regular contact with my advisor
    6. It was not useful at all.

B. Would it have been useful to monitor other health domains than the ones initially proposed (reproduction, udder health, lameness, metabolic diseases and calf health)?
    1. Yes
    2. No
    3. If yes, which one(s)?

4. Did you have enough data to be able to check all health indicators?
    1. Yes
    2. No

5. To what degree do you agree with the following statements? According to you **choosing indicators adapted** to your farm, as was done at the very first farm visit, ... (range 1-6, from I fully disagree to I fully agree)
    1. Improved your advisor understanding of the way you monitor herd health
    2. Improved your advisor knowledge on the herd health situation of your farm
    3. Improved your advisors knowledge on your focus areas regarding herd health
    4. Led to a list of indicators that was appropriate for herd health monitoring on your farm
    5. Was difficult in its use because I lacked references to interpret with the indicators whether the herd health situation was satisfying/ or not satisfying
    6. Other remarks….

6. Did you adapt indicators during the time you used the monitoring tool?
    1. Yes, indicators were changed
    2. Yes, indicators were added

3. Yes, indicators were dropped
4. Yes, indicator(s) were specified
5. No, but it might have been useful
6. No, I didn't identify a need for change

7. To what degree do you agree with the following statements? **The simultaneous monitoring** of multiple health problems is… (range 1-6, from I fully disagree to I fully agree)
    1. Is more pertinent than disease per disease to ensure effective herd health monitoring
    2. Difficult to keep doing it over time
    3. Part of my daily work as a farmer

A2. Prevention tool

The preventive tool is the set of documents in which for each health domain (reproduction, udder health, lameness, calf health and metabolic diseases) risk factors where listed with the corresponding objectives to attain to prevent disease.

1. Did you use the prevention protocol without an alert going off?
    1. No, I never used it without an herd health alert
    2. Yes, please fill in for what purpose(s) you have used it……
2. In general, when a herd health problem was identified did the prevention protocol help to identify relevant risk factors present on your farm using the prevention tool?
    1. Yes
    2. No
    3. If no, can you describe why?
3. In general was it possible to identify correctives actions on your farm corresponding to risk factors identified with the advisor?
    1. Yes
    2. No
    3. If no, can you describe why?
4. Were identified corrective actions always implemented?
    1. Yes
    2. No
5. When identified corrective actions were not implemented what was/ were the reason(s)?
    - ☐ They were not adapted to my farm routine
    - ☐ Lack of time
    - ☐ Too costly compared to the benefits
    - ☐ I was not convinced of the effect on herd health

- Other…

6. Do you think the objectives / goals listed in the preventive protocol gave you more possibilities to discuss and propose corrective actions adapted to your situation, compared to being provided with a list of standard recommendations telling you how to do that?
    1. Yes
    2. No
    3. Maybe
7. Did using the prevention protocol stimulate discussion between you and your advisor on your farm management practices?
    1. Yes, we discussed more than we usually did
    2. Yes, but in the past we already discussed farm management practices
    3. No
8. Did the discussion using the prevention protocol allow you to see the link between management practices and animal health outcome?
    1. Yes
    2. No
    3.
9. Did you miss information in the prevention protocols?
    - Yes, on a certain health topic
    - Yes, risk factors were missing
    - Yes, objectives to attain were missing
    - No
10. Did you find the prevention tool easy to use?
    - (Slide from 1-5, not easy at all - very easy)
11. What would you like to see improved in the format of the prevention protocols?
    - Digital format
    - Different structuration of the themes
    - Other, please fill in….
    -

- **A3. Regular visits**
-

1. Was the frequency of farm visits proposed the right one (4 visits in 12 months)?
    1. Yes
    2. No, too few
    3. No, too many

2. To what degree do you agree with the following statements? **Having regular visits** (for reasons other than emergencies) during the year was…(Range 1-6, from I fully disagree to I fully agree)
    1. An opportunity to take more time to discuss the animal health situation on your farm
    2. An opportunity to discuss your animal health management practices
    3. An opportunity to have more time to discuss the questions I have on animal health to the advisor/ veterinarian

A4. Overall

1. How would you characterize this flexible approach where indicators can be adapted to the farm and that you don't have a list of standard corrective measures but objectives to attain to prevent disease?
    - Educational/instructive
    - Motivating
    - Thought provoking
    - Tailor-made
    - Helpful in communicating
    - Difficult
    - I am not used to work like that
    - Time consuming
    - Not useful
2. Is the service what you have been testing in IMPRO for the last 12 months what you expect of a herd health monitoring and disease prevention program?
   (Range 1-5, Not at all close to what I had expected – It was very close to what I expected)

•

3. Will you keep using the monitoring protocol? Or in the case that you have returned the documents, would you have liked to keep using the monitoring protocols if you were provided with the tools again?
    1. Yes
    2. No
4. Will you keep using the prevention protocols? Or in the case that you have returned the documents, would you have like to keep using the prevention protocols if you were provided with the tools again?
    1. Yes
    2. No
5. Would you recommend the monitoring and/ or prevention protocols to other farmers?
    1. Yes, both the monitoring and/ or prevention parts
    2. Yes, only the monitoring part
    3. Yes, only the prevention part

4. No

-

B. Working relationship between you and your advisor

1. Who took the lead during the visits?
    1. You
    2. The advisor/ veterinarian
    3. Shared
2. Do you now have more knowledge of what kind of services/information your advisor can provide you (expertise in specific domains, services offered by the vet…)?
    1. Yes
    2. No
3. Did your opinion about the advisor' role in your animal health promotion strategy change because of your work with him/her during this study?
    1. Yes, he/she will have a more important role in the future
    2. Yes, he/she will have a less important role in the future
    3. No, he/she already had an important role
    4. No, he/she did not have important role and that will remain the same
4. Did you discuss topics with your advisor during the IMPRO study that you had not discussed in depth together before? (checkbox answer)
    - ☐ Yes, your farming objectives
    - ☐ Yes, your farm and animal health management practices
    - ☐ Yes, the organic production principles
    - ☐ Yes, the organic regulation
    - ☐ Yes, recurrent health problems of the herd
    - ☐ No

D. Herd health improvements

1. Do you think that the implementation of the advisory service as were proposed in this study has contributed to improvement of the health of your herd?
    1. Yes
    2. No

E. Costs using the tool

1. Would you be ready to pay for this kind of service?
    1. Yes

2. No

2. If you were ready to pay for this kind of service, which amount per year would you be willing to pay an advisor/veterinarian per year?

If you have any further comments, please feel free to write them down below.

Advisors version

A1. Monitoring tool

The monitoring tool is the set of indicators linked to a certain alert threshold that were chosen during the very first farm visit one year ago.

1. To what degree do you agree with the following statements? **Herd health monitoring** like this was useful…(range 1-6, from I fully disagree to I fully agree)
    1. Because it allows for the early identification of herd health problems
    2. Because it allows to secure herd health
    3. Because it gave me more access than before to the herd health data of the farm
    4. Because it is a way to have regular contact with the farmer
2. Do you think it would have been useful to monitor other health domains than the ones initially proposed (reproduction, udder health, lameness, metabolic diseases and calf health)?
    1. Yes
    2. No
    3. If yes, which one(s)?
3. Did you have enough data to be able to check all health indicators?
    1. Yes
    2. No, not on all farms
    3. No, never
4. To what degree do you agree with the following statements? **Choosing indicators adapted** to the farm' situation… (range 1-6, from I fully disagree to I fully agree)
    1. Improved my understanding of the way the farmer monitors herd health
    2. Improved my knowledge of herd health problems of the farm
    3. Improved my knowledge on the focus areas of the farmer regarding herd health
    4. Led to a list of indicators that was appropriate for herd health monitoring on the farm
    5. Was difficult in its use because I lacked references to interpret with the indicators whether the herd health situation was satisfying/ or not satisfying

5. Did you ever adapt indicators during the course of your use of the monitoring tool?
    1. Yes, indicator(s) were changed
    2. Yes, indicator(s) were added
    3. Yes, indicator(s) were dropped
    4. Yes, indicator(s) were specified
    5. No, but it might have been useful
    6. No, I didn't identify a need for change
6. To what degree do you agree with the following statements? **The simultaneous monitoring** of multiple health problems is… (range 1-6, from I fully disagree to I fully agree)
    1. Is more pertinent than disease per disease to ensure effective herd health monitoring
    2. Difficult to keep doing it over time
    3. Part of my daily work as an advisor/veterinarian

- **A2. Prevention tool**

The preventive tool is the set of documents in which for each health domain (reproduction, udder health, lameness, calf health and metabolic diseases) risk factors where listed with the corresponding objectives to attain to prevent disease.

1. Have you used the prevention protocol without an alert going off, if so for which purpose was it used?
    1. No, I never used it without an herd health alert
    2. Yes, please fill in for what purpose(s) you have used it……
2. In general, when a herd health problem was identified did the prevention protocol help to identify relevant risk factors present on the farm(s) using the prevention tool?
    1. Yes
    2. No,
    3. If no, can you describe why?
3. In general, was it possible to find correctives actions corresponding to risk factors identified with the farmer(s)?
    1. Yes
    2. No
    3. If no, can you describe why?
4. Were identified corrective actions always implemented by the farmer(s)?
    1. Yes

2. No

5. According to you, when identified corrective actions were not implemented what was/were the reason(s)?
   - ☐ Not considered by the farmer to be well adapted to the farm
   - ☐ Lack of time farmer
   - ☐ Too costly compared to the benefits
   - ☐ The farmer was not convinced of the effect on herd health
   - ☐ Other, please describe…
6. Did you appreciate the fact that the prevention tool contained only objectives to attain without imposing the management practice(s) to do so?
   1. Yes
   2. No
7. Did using the prevention protocol stimulate discussion between you and the farmer(s) on his/her/their farm practices?
   1. Yes, we discussed more than we usually did
   2. Yes, but in the past we already discussed farm management practices
   3. No
8. Did the discussion using the prevention protocol have an educational function in explaining the link between management practices and health outcome to the farmer?
   1. Yes
   2. No
9. Did you miss information in the prevention protocols? If so, what would you have liked to have added? (checkbox answer)
   - ☐ Yes, information on a certain health domain
   - ☐ Yes, risk factors were missing
   - ☐ Yes, objectives to attain were missing
   - ☐ No
10. According to you, how easy was it to use the prevention tool?
    - (Slide from 1-5, not easy at all - very easy)
11. What would you like to see improved in their format?
    - ☐ Digital format
    - ☐ Different structuration of the themes
    - ☐ Other, please fill in….

- **A3. Regular visits**

-

1. Was the frequency of farm visits proposed the right one (4 visits in 12 months)?
    1. Yes
    2. No, too few
    3. No, too many
2. To what degree do you agree with the following statements? Having **regular visits** (for reasons other than emergencies) during the year was…(range 1-6, from I fully disagree to I fully agree)
    1. An opportunity to have more time to discuss the animal health situation on the farm(s)
    2. An opportunity to discuss farmer(s)' animal health management practices
    3. An opportunity for the farmer(s) to discuss with me questions he/she had on animal health
    4. An opportunity to make the farmer(s) more aware of the knowledge and services I can offer him/her

A4. Overall

1. How would you characterize this flexible approach where indicators can be adapted to the farm and that you don't have a list of standard corrective measures but objectives to attain to prevent disease? (checkbox answer)
    - ☐ Educational/instructive
    - ☐ Motivating
    - ☐ Thought provoking
    - ☐ Tailor-made
    - ☐ Helpful in communicating
    - ☐ Difficult
    - ☐ I am not used to work like that
    - ☐ Too time consuming
    - ☐ Not useful
2. Would you have liked to have had more training in the use of the monitoring and/or prevention protocols at the start of the study?
    1. Yes
    2. No
3. Will you keep using the monitoring protocol on this farm and/or on other farms?
    1. Yes, on the farm(s) in the IMPRO project
    2. Yes, on the farm(s) in the IMPRO project and other farms
    3. No, not the farm(s) in the IMPRO project but I might use it on other farms

4. No, I will not use it at all

4. Will you keep using the prevention protocols on this farm and/or on other farms?
    1. Yes, on the farm(s) in the IMPRO project
    2. Yes, on the farm(s) in the IMPRO project and other farms
    3. No, not on the farm(s) in the IMPRO project but I might use it on other farms
    4. No, I will not use it at all
5. Would you recommend the monitoring and/ or prevention protocols to other advisors/vets?
    1. Yes, both the monitoring and/ or prevention protocols
    2. Yes, only the monitoring part
    3. Yes, only the prevention part
    4. No

B. Working relationship with the farmer

1. Who took the lead during the visits?
    1. You
    2. The farmer(s)
    3. Shared
2. During the visit, did you discuss topics that you in the way you usually met would not have been discussed with the farmer(s)?
    1. Yes
    2. No
3. Do you now have more knowledge of what the farmer(s) expect from you?
    1. Yes
    2. No
4. Did your opinion about organic farming change because of your work with the farmer during this study?
    1. I had a positive opinion of organic farming and that stayed positive
    2. I had a positive opinion of organic farming and that has deteriorated
    3. I had a negative opinion of organic farming and that stayed negative
    4. I had a negative opinion of organic farming and that changed in a positive opinion
5. Did your opinion about animal health situations on organic dairy farms change because of your work with the farmer(s) during this study?
    1. I had a positive opinion of animal health situations on organic dairy farms and that stayed positive

2. I had a positive opinion of animal health situations on organic dairy farms and that has deteriorated
3. I had a negative opinion of animal health situations on organic dairy farms and that stayed negative
4. I had a negative opinion of animal health situations on organic dairy farms and that changed in a positive opinion

6. In which areas have you learned new information during the study intervention (checkbox answer):

- ☐ farmer(s)' farming objectives
- ☐ farmer(s)' animal health and farming practices
- ☐ certain health problems of the herd(s)
- ☐ the organic production principles
- ☐ the organic regulation
- ☐ I didn't learn any new information

C. Herd health improvements

1. Do you think that the implementation of the advisory service as were proposed in this study has or could contribute to improvement of the health of participating herd(s)?
    1. Yes
    2. No

D. Costs using the tool

1. Could you give an indication of the hours you spent on average to prepare a visit?
2. Could you give an indication of the hours you spent on average to perform a visit on a farm?
3. Could you give an indication of the hours you spent on average to write the summary of the visit?
4. For a complete follow-up of the farm(s) (4 visits in 12 months) we offered to pay you 1000 euros per farm (without taxes). Compared to that would you ask from farmers for this service…
    1. More
    2. Less
    3. Equivalent amount

If you have any further comments, please feel free to write them down below.