A deductive approach to animal health planning in organic dairy farming: Method description

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Abstract: Organic farming is often directly associated with an enhanced level of animal health and welfare. However, in spite of ongoing efforts in the fields of animal science, the animal health status in organic dairy farming does not in all respect meet consumers' expectations. Reasons are manifold and differ considerably between farms as do the multi-factorial production diseases. Success of animal health planning highly depends on a sound diagnostic procedure at farm level and farmers' intrinsic motivation to improve the animal health status. Both aspects are essential preconditions for the identification and implementation of the most appropriate farm-specific management measures.

The aim of this paper is to introduce a participatory and farm-centric methodological approach, facilitating the comprehension of farm specific processes and encouraging farmers to increase animal health status. The system 'organic dairy farm' is described and vital key variables that play a role in the way the system behaves are determined in intensive workshops involving relevant stakeholders. On the basis of farm protocols, milk recordings, and animal based measurements the animal health status is determined for each farm and discussed in a 'round table' situation involving the different perspectives of the farmer himself, the local veterinarian and an agricultural advisor. By making use of the impact matrix as an innovative diagnostic tool to deal with the complexity of the farm system, the interconnectedness of 13 system variables is assessed at farm level. The method is used to gain a comprehensive insight from different perspectives and achieve agreement about the systemic functional role of relevant factors involved in the development of multi-factorial production diseases. Based on the on-farm assessment and the impact matrix analysis the discussion results in the formulation of farm-individual goals and the identification of measures that are expected to most likely improve animal health in the farm specific situation taking into account the availability of resources. The participatory process facilitates knowledge exchange and collective learning.

For animal health planning to be effective, farm-specific interconnections have to be taken into account instead of focussing on general recommendations. The impact matrix analysis promises to be an effective method to reduce the complexity of the farm system and to identify measures which can be expected to have a relevant impact on the animal health status. Thus, reducing health problems deriving from complex interactions is expected to benefit from the integration of different perspectives.

Keywords: cow, systemic, impact matrix analysis, advisory, participatory, complexity

Introduction

Consumers are becoming increasingly sensitive about health and welfare problems in commercial livestock production systems. They expect their food to be produced with greater respect for the needs of farm animals. Organic farming is often directly associated with an enhanced level of animal health and welfare (McEachern & Willock, 2004). However, despite their benefits for animal welfare and environmental friendly production organic standards do not automatically lead to a high status of animal health that exceeds the level in conventional production (Sundrum, 2001; Vaarst et al., 2006). Studies indicate that a considerable number of organic farms cannot fulfil, in all respects, the high demands (Sundrum, 2012).

Rationale for deficits may be due to the fact that time requirements for animal husbandry are in competition with other agricultural fields and often fail to be of first priority. Taking preventive steps concerning animal health and welfare to a certain degree competes with the objectives of high productivity and low production costs. Furthermore, animal health management is often facing uncertainty about the outcome of health relevant measures, complicating the decision processes. Identification of the most effective measures in the farm specific situation is therefore a crucial challenge and must take into account best available knowledge on animal health planning and the farmer's role in this process as well as the farm specific conditions, structures, and processes that lead to multi-factorial production diseases.

Herd health planning

Animal health plans in organic farming basically strive to promote and optimise the health of individual animals, minimise the mortality rate, prevent the spread of illnesses, reduce the risk of injury over time, increase the animals' resistance to diseases, support early disease detection and last but not least prevention (Lovatt, 2004; Dobbs, 2005). Whilst health planning is widespread at least in some European countries, the impacts are not satisfying due to a lack of implementation (Huxley et al., 2003; Bell et al., 2009). According to Green et al. (2007) the success of intervention plans depends on both the correct identification of risk factors and the correct implementation of changes. There is a big difference between the on-farm presence of an animal health and welfare plan versus animal health and welfare planning. The first is viewed by many farmers solely as a 'document', whereas the latter is a process involving the farmer in making a plan for improvements in the herd and implementation of this plan (Vaarst et al., 2008). More systematic protocols and a deeper analysis of farm constraints are expected to improve their effectiveness.

Farmers' role in animal health planning

Farmers are not a homogenous group, neither those who have recently converted to organic agriculture nor those who have been organic farmers for decades (Flaten et al., 2006). The way farmers perceive livestock farming varies widely in terms of emotional attachment to the animals, their ethical view of the profession, the perception of the animals' needs, and the definition of animal health and welfare (Dockès & Kling-Eveillard, 2007; Kristensen & Enevoldsen, 2008). In general, producers anchor their idea of a good life for animals largely in their own daily practices and link welfare to the technical conditions necessary to ensure profitability and good welfare; a discourse that is also influenced by the official standards (Skarstad et al., 2007). Thus the focus is on the process of production neglecting the quality of the outcome, such as animal health status and consequently product quality. Results of previous projects indicate that the creation of new diagnostic and advisory tools and the organisation of training courses for farmers and advisors are required (Atkinson & Neale, 2008). As the farmers are in the centre of any animal health plan, they should take ownership and responsibility for the health plan, and should actively participate in the analysis of the situation and articulate their interests and planned actions (Atkinson & Neale, 2008).

Challenges by multi-factorial diseases

Multi-factorial diseases emerge from interactions and synergetic effects between different risk factors and processes which in themselves would not necessarily cause clinical signs of a disease. Their occurrence indicates an overstrained demand of farm animals to cope with the environment. Husbandry systems and conditions found in practice are so manifold and diverse that it is often difficult to identify the most influential in any actual combination of factors. Indeed, there is reason to assume that multi-factorial diseases can only be addressed appropriately by deducing the causes of specific diseases for the individual farm by taking into account the whole farm context. Correspondingly, farm specific conditions with respect to both, resources and barriers have to be taken into account. Many farmers are captured in their own perspective and left alone without monetary incentives to improve the situation. Advice is needed providing valid information on the effectiveness and efficiency of target-oriented measures in the farm specific situation. Thus, there is a need to bridge the gap between general knowledge and the farm-specific demands with respect to a clear diagnosis.

System approach to deal with health problems

To improve animal health on the farm level requires not only physiological and pathological background knowledge but also an understanding of farm structures and processes. To assess the impact, variability, and interactions of the most relevant factors involved in the development of diseases, an interdisciplinary systemic research is a necessity. An appropriate diagnostic procedure at farm level considering animal health as an emergent property of the farm system is an essential precondition to identify those measures that are most likely to improve animal health (Sundrum, 2012).

The aim of this paper is to introduce a participatory and farm-centric methodological approach that is capable of facilitating the comprehension of farm specific processes and encouraging farmers to increase animal health status. It is based on a method developed by Vester & Hesler (1980) who used an 'impact matrix' in a structural approach to gain insight into complex systems by evaluating the interconnections between system variables and integrated it into a software-based planning and management tool. The methodology has successfully been used to actively involve stakeholders (Cole et al., 2007) and to enhance an adaptive management approach for the selection and evaluation of sustainability indicators (Schianetz & Kavanagh, 2008). The impact matrix was also successfully adopted to assess farm systems related to animal health in organic pig farms (Hoischen-Taubner & Sundrum, 2012).

Method description

The deductive approach to animal health planning that is subject in this document can be broken down into four interacting operations: (1) description of the system, (2) pattern recognition, (3) interpretation and assessment, and (4) strategy. They are described in the following chapters.

Description of the system

Describing the system is an upstream process that was performed once for all farms. In the first instance the system borders were specified, so as to frame the system 'organic dairy farm'. Next, the subordinate partial goals of the approach were defined, the superordinate goal of every system being 'enhancing its viability' according to Vester (2007). In our approach the main goal was defined as 'improved animal health status'. These determinations stipulate who should be involved in the subsequent process, namely those affected by and affecting future decisions concerning the system: farmer, agricultural advisor, and veterinarian.

The purpose of describing the system is to identify vital key factors that play a role for the system's behaviour. Those factors are changeable in a qualitative or quantitative way, and therefore called ‘variables’. These variables are ascertained in a brainstorming session with all relevant stakeholders involved. For describing the system ‘organic dairy farm’ in a European context, five regional workshops were organised in France (2), Germany (1), Spain (1), and Sweden (1). The workshops were organised within a multidisciplinary framework and attended by a total of 80 experts in animal health on organic dairy farms, comprising farmers, advisors, veterinarians, researchers as well as members of dairy associations and the dairy industry. Factors in relation to animal health at farm level were initially collected in a moderated process, subsequently structured by the participants and finally reduced to a set of essential components. Special attention was paid to eliciting variables that are specific to farm management in the context of organic production, and implications in terms of options or constraints. Four national variable lists were created containing altogether 81 variables. Based on these a multinational team of researchers established a pan-European set of 20 variables that is applicable to a wider range of farms (Duval et al., 2013). Variables were screened to essential bio-cybernetic criteria, provided by the Sensitivity Model of Vester (2007). Following two pan-European pilot visits on organic dairy farms in Germany and The Netherlands the number of variables was further reduced to a final set of 13 variables (Table), comprising all relevant influencing factors in relation to animal health on the farm level on an operational aggregation level.

Table 1: List of system-relevant variables describing the organic dairy farming system

	Variable	***Definition***
1	Milk performance	Level of milk production (considering quality and quantity).
2	Production diseases	Health status of the herd related to production diseases including udder diseases, lameness, and reproductive and metabolic disorders.
3	Financial resources	Economical results, financial resources of the farm to modify and improve suboptimal conditions.
4	Labour capacity	Ratio between available labour time and work to do.
5	Feeding	Degree of meeting the feeding requirement of individual animals in their actual life stage (energy nutrients, structure, water etc.); influenced by feeding management and the availability of feed.
6	Keeping conditions	Attributes of the cow environment (housing and pastures) that have a potential effect on animal health and welfare.
7	Reproduction management	Ensuring fertility in heifers and dairy cows meets the objectives of the farmer.
8	Dry cow management	Ensuring optimal conditions (regarding, nutrition, housing, hygiene, welfare) for dry cows to be able to start healthy into the next lactation.
9	Calf and heifer management	Ensuring optimal conditions (regarding nutrition, housing, hygiene, welfare) for the development of calves and heifers.
10	Herd health monitoring	Quality of the perception and documentation of herd health and production at individual cow and at herd level.
11	Hygiene	To what extent are hygiene standards met/hygienic measures taken with respect to housing, milking, and the risk of transmitting infectious diseases through internal or external contact.
12	Treatment	Degree of meeting the need of an individual (sick) animal by using remedies and palliative measures; needs-related = appropriate (made-to-measure therapy) and in time (early/timely treatment).
13	Knowledge and skills on the farm	Knowledge and skills that can be accessed for the benefit of the farm. This includes knowledge and skills of the farmer and of external persons, which can be involved if necessary.

Pattern recognition

During the second operation, corresponding to 'pattern recognition', each individual farm system is assessed in a participatory approach. For this purpose farmer, agricultural advisor, local veterinarian and researcher meet on the farm, whereby the latter takes up the role of the moderator. Each visit starts with a short farm walk focussing on dairy herd, feed, and buildings. This activity eases up the forming phase of the group (Tuckman, 1965) and fosters the familiarisation process with the other participants as well as with the current farm situation. After the farm walk, a written report based on farm protocols, milk recordings, and animal based measurements containing general farm characteristics and information on the recent animal health status of the dairy herd is presented by the researcher and discussed with the participants.

Next, the impact matrix is applied, which is based on a first model described by Vester (1976) and integrated into a software tool, which is an adaptation of the Sensitivity Model (Vester, 2007). The impact matrix is filled by quantifying the relationships between each two variables in a pair-wise comparison. Thereby the underlying question for each pair is: "If variable A changes, will variable B change on this farm? If so, how strongly will variable B react?" Only changes as a result of direct influence are taken into account, irrespective of the direction of the anticipated shift. The strength of influence is scored with 0 (no obvious influence), 1 (weak change), 2 (proportional change), or 3 (strong change). The scoring of factors in the impact matrix is done by farmer, veterinarian, and advisor in a moderated discussion. Each of the participants is equipped with a paper matrix for entering their individual scores. The given scores are immediately discussed and a consensual score is inserted into the software tool by the researcher. Once all interrelationships are scored for one farm this results in a consensual impact matrix as depicted in figure 1.

Figure 1: Impact matrix of one exemplary farm.

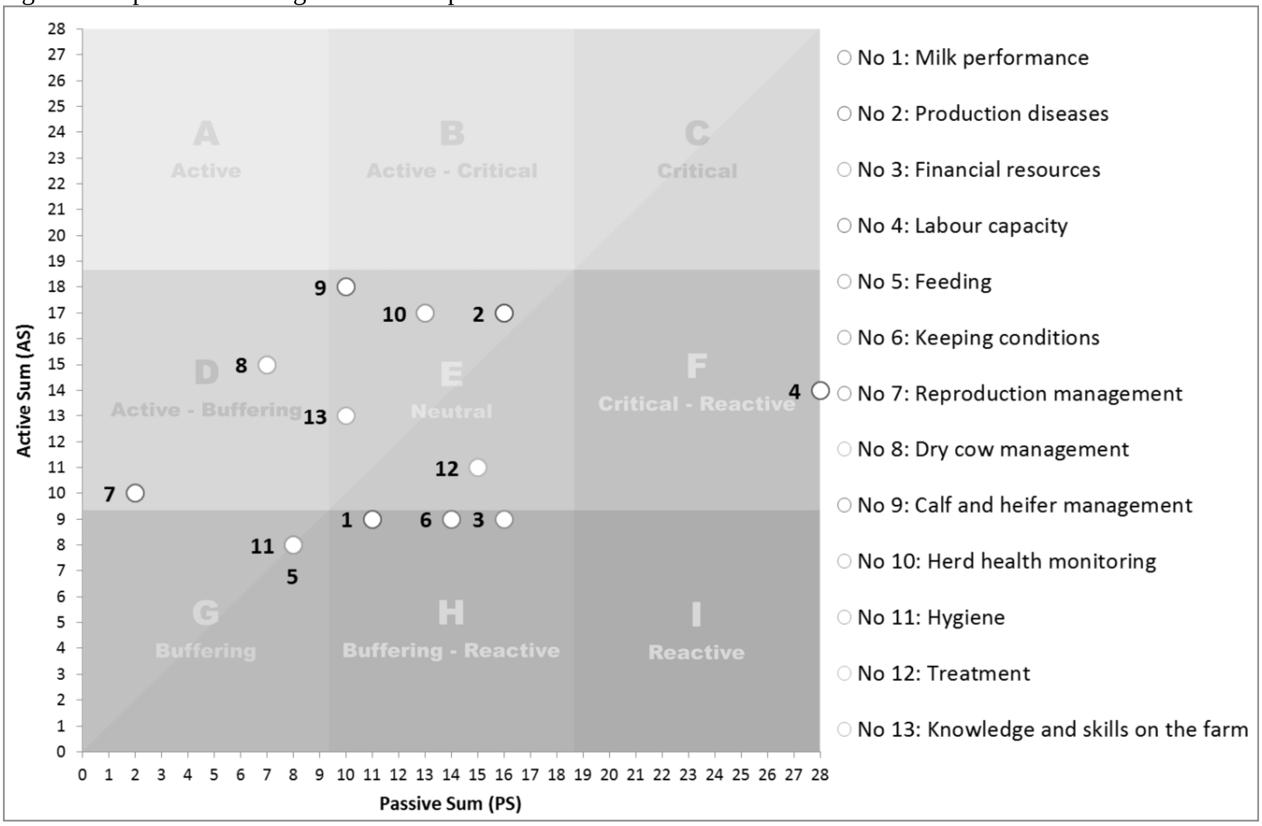
How strongly would ➡ react, if ⬇ would change?	1 Milk	2 ProD	3 Finan	4 Lab	5 Feed	6 Keep	7 Repr	8 Dry	9 CaHei	10 Monit	11 Hyg	12 Treat	13 KnSki	∑ (AS)
1 Milk performance		3	1	3	2	0	0	0	0	0	0	0	0	9
2 Production diseases	2		3	3	0	1	0	1	1	1	1	2	2	17
3 Financial resources	0	0		2	0	3	0	0	2	0	0	2	0	9
4 Labour capacity	1	1	1		0	3	0	1	1	1	2	1	2	14
5 Feeding	2	1	3	2		0	0	0	0	0	0	0	0	8
6 Keeping conditions	1	1	1	2	0		0	0	1	1	1	1	0	9
7 Reproduction management	1	0	1	2	1	0		0	0	2	0	2	1	10
8 Dry cow management	1	2	1	2	1	2	0		0	2	1	2	1	15
9 Calf and heifer management	1	2	2	2	2	2	0	0		3	1	2	1	18
10 Herd health monitoring	1	2	1	3	1	1	1	2	2		1	1	1	17
11 Hygiene	0	1	0	2	0	1	0	1	1	1		0	1	8
12 Treatment	1	2	1	2	0	0	0	1	1	2	0		1	11
13 Knowledge and skills on the farm	0	1	1	3	1	1	1	1	1	0	1	2		13
∑ (PS)	11	16	16	28	8	14	2	7	10	13	8	15	10	

Interpretation and assessment

Using the impact matrix it is possible to assess the interconnected effects of the elements of the system and hence the role they play from the standpoint of dominance (active), susceptibility to influence (reactive), and the part they play in events (from buffering to critical). The role of each variable in the system is presented in a two-dimensional diagram (figure 2) in which the current position of a variable between the four key roles (active, reactive, buffering and critical) can be seen at a glance and properties can be assigned to it accordingly. As all variables are positioned on the axes of coordination 'active-reactive' and 'critical-buffering', this representation offers a comprehensive if somewhat approximate overview of the different distributions of roles in the system (Vester, 2007). The diagram is displayed with a grid of nine sectors developed by Schianetz & Kavanagh (2008) which simplifies the allocation of systemic roles. The process of allocating roles to variables provides improved information on the variable itself as well as on the system as a whole. The distribution of variables gives an immediate impression of the character of the system, which may turn out to be generally critical or particularly inert (Vester, 2007). The roles of individual variables can be interpreted to emphasise their individual behaviour within the system. In different systems, the same variable may occupy quite different positions.

The diagram is presented by the researcher and discussed with farmer, veterinarian, and advisor. One aim of the participative process is to assess whether the signals provided by the graph prove justified and usable.

Figure 2: Impact matrix diagram for one specific farm.



Strategy

Having been confronted with the animal health status and having performed the impact matrix analysis, the farmer is given the opportunity to express his view on the current animal health situation. Advisor and veterinarian are free to comment on the farmer's statement. When forming a strategy the leading question to each of the participants, starting with the farmer, is: "Where do you see room for improvement?" Thereby the conversation is steered towards possible objectives with respect to animal health. For each of the four production disease complexes 'metabolism', 'reproduction', 'claws and limbs', and 'udder' the participants can choose between the following options: (a) to be improved, (b) to be stabilised, and (c) no action necessary. Once areas with the need for stabilisation or improvement are identified, all participants are encouraged to make suggestions for potential management measures that contribute to the achievement of these goals, keeping in mind the systemic roles of related variables. This way, either the systemic role of the variable related to a suggested measure is examined and discussed with the participants or the effect of a recommended measure is estimated according to its interaction within the system (e.g. which variables may be affected). Proposed and discussed measures are documented. Those measures which the farmer agrees to implement in the near future are merged into an action plan.

Expected benefits

Farm management on organic dairy farms is facing high demands. Farmers have to cope with disparately high requirements (e.g. housing and management) while at the same time they do not have access to those resources that are available to their conventional colleagues (Sundrum, 2012). Moreover, every organic dairy farm has its very individual structures and processes, which need to be understood. Characterising the health management profile for each specific dairy farm is an essential precondition for successful animal health planning.

The participatory modelling using the impact matrix, which was refined within the framework of the European project IMPRO (www.impro-dairy.eu) and is currently being tested on 200 organic dairy farms, has a mediation capacity. During the scoring of impacts on the visited farms, the variable definitions generate discussions. According to Vester (2007) one side effect of clarifying those definitions is that in this way the project group finds its way to a common language and gains a more precise idea of what the others are trying to express by the terms they employ. During the participatory process the farmer's view on his animals and on his farm is expressed aloud and is complemented by the views of veterinarian, advisor, and researcher. The systemic assessment allows the identification of risk factors and makes visible not only options but also focusses on farm constraints. The method provides a structure to stimulate the dialogue between farmers, veterinarians, advisors, and scientists, and to organise and evaluate complex ideas and information generated by the participants. The participatory process thus bridges the gap between general knowledge and the farm-specific demands, and facilitates knowledge exchange and collective learning.

The complexity of the farm system is captured and reduced within a deductive approach that leads through a better understanding of the individual farm situation and prevents the fixation on singular causes and effects. Otherwise hidden interrelationships are made visible by means of the graph chart provided by the software and factors are identified that are influential under the specific farm conditions. Since the position of a variable is always a product of the overall interconnectedness of the network, such a statement comes not from the person studying the system but from the system itself (Vester, 2007). Compiling and interpreting the relationships among the system variables enables the participants to characterise the farm system with respect to the target value to improve animal health. The deductive approach to animal health planning works as a decision support tool pointing out the most effective measures that fit the appointed target and gives at least hints as to what the outcome may be. The on-farm 'round table discussion' involving experts from different disciplines ensures the validity of the exchanged information.

Conclusions

For animal health planning to be effective, farm-specific interconnections have to be taken into account instead of focussing on general recommendations. The impact matrix analysis promises to be an effective method to reduce the complexity of the farm system and to identify measures that can be expected to have a relevant impact on the animal health status. Thus, reducing health problems deriving from complex interactions is expected to benefit from the integration of different perspectives.

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