Impact matrix analysis and cost-benefit calculations to improve management **pr**actices regarding health status in **o**rganic dairy farming

Project Number: 311824

- Deliverable -

D2.2 – Variable list

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Executive Summary

This document provides the variable list for the Impact matrix

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

SEVENTH FRAMEWORK PROGRAMME

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1 Background

The innovative approach of the IMPRO project is to apply a systemic approach to animal health planning on the farm level. The systemic approach proceeds from the basic idea that many real phenomena and processes cannot be explained adequately by searching only for classical mono-causal relationships. There is a growing understanding within the scientific community that it is necessary to develop more comprehensive concepts in agricultural science which simultaneously consider a larger number of causal relationships. The isolated view under ceteris paribus assumptions is beginning to be replaced by the holistic or systemic approach (DFG, 2005). However, an on-going and accelerated fragmentation of veterinary and agricultural science is observed into a large number of sub-disciplines with an increasing risk of misinterpretation in diagnosis (Zinsstag et al., 2011). The key feature of the systemic approach is, however, that it captures the dynamics and interactions between the various elements of the system (Sundrum, 2007).

Improving animal health status at herd level relies on the identification of the most effective and efficient control measures considering the complexity of farm specific conditions. An appropriate diagnostic procedure on the 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 status. In this context, the Impact Matrix is a tool for characterising the health management profile of dairy farms. Vester & Hesler (1980) integrated the impact matrix in a sensitivity model, a software-based planning- and management tool for complex situations. While a systems' approach is widely spread in domains of operational research and management science, the application in agriculture is limited to terms of more general relevance like farming systems' research and natural resource management (Mingers & White, 2010).

Beyond the identification of relevant criteria in the evaluated context, the concept leads through a holistic illustration of the system to a better understanding. It refers to bio-cybernetic knowledge and focuses on the interconnection of structuring parameters. On the one hand, the participatory modelling with an impact matrix provides several tools to focus on relevant data and to identify key variables. On the other hand, it contains a mediation capacity. These features indicate the innovative approach to deal with a complex situation (like a farm specific animal health status) and to strengthen a participative management: relevant stakeholders (farmer, veterinarian, advisor and researcher) participate in the assessment and decision process. The method provides a structure to support the dialogue process and to organise and evaluate complex ideas and information generated by participants using elementary mathematics.

Identifying a collection of relevant variables affecting animal health is the first step in making use of the Impact Matrix. Further steps are the application of the Impact Matrix on 200 organic dairy farms, the evaluation of systemic roles of variables due to their interdependencies and the identification of effective measures to improve animal health in a specific farm situation.

2 Process

Five workshops gathering a total of 80 experts in animal health on organic dairy farms (farmers, advisors, veterinarians, researchers, and members of dairy associations and the dairy industry) were held in France, Germany, Spain and Sweden to obtain variables through a systemic analysis of the organic dairy farm system. Areas relevant to animal health at the farm level were identified by applying participatory methods. Aggregation and structuring led to the nomination of system-

relevant variables whose exact meaning was defined and further explained by a list of indicators. The results of the national expert workshops were four national variable lists (see Deliverable 2.1).

Comparing the 4 national lists, a great congruence was found between the lists. Taking definitions and indicators into account, the total of 81 national variables was aggregated to a list of 20 variables to be used in all European countries involved in the IMPRO project.

The list of variables represents the perspective from a meta-level facilitating a view on the whole farm system. The level of aggregation covers the variation of structural differences between various organic dairy farming systems and the involved countries (figure 1). Five workshops gathering a total of 80 experts in animal health on organic dairy farms (farmers, advisors, veterinarians, researchers, and members of dairy associations and the dairy industry) were held in France, Germany, Spain and Sweden to obtain variables through a systemic analysis of the organic dairy farm system. Areas relevant to animal health at the farm level were identified by applying participatory methods. Aggregation and structuring led to the nomination of system-relevant variables whose exact meaning was defined and further explained by a list of indicators. The results of the national expert workshops were 4 national variable lists (see Deliverable 2.1). These lists were further discussed within the IMPRO-team; first at a meeting with a small group of scientist representing all participating partners and secondly with the whole team by e-mail and a video conference. The aim was to obtain in a consensual way a list of variables that cover the most relevant factors on the farm level with a relevant impact on the animal health status.

Comparing the 4 national lists, a great congruence was found between the lists. Taking definitions and indicators into account, the total of 81 national variables was aggregated to a list of 20 variables to be used in all European countries involved in the IMPRO project (Table 1).

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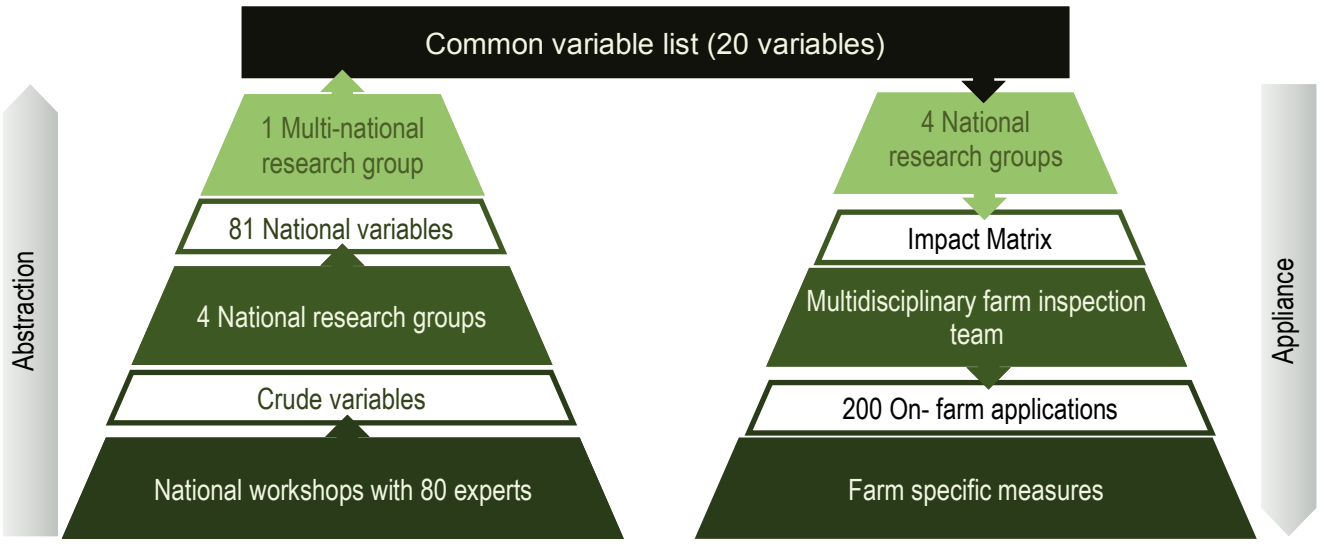

Figure 1: Bridging variation

The variables list was screened to a set of criteria provided by Vester (2007). Vester found 18 criteria, describing spheres of life, physical and dynamic categories and system relations to be relevant for each viable system. Screening a set of variables to this criteria is essential to avoid a one-sided view on a system. Each criterion has to be represented in the system, even though not all criteria

are represented equally. The representation of criteria gives a first picture of the system in question. In the criteria matrix each variable can cover several criteria. The more criteria a variable covers the higher is the level of aggregation.

Following this procedure the set of variables was found to cover all criteria and therefore meets the demand to characterise the system in question. Figure 2 shows the representation of the essential criteria by the variable list. The system represented by the variable set is to a large degree controllable from inside the system. Information and communication play a prominent role, followed by temporal dynamics, represented by variables that change over time. The less represented criteria are participants, represented by variables about the inhabitants of a system, the space utilization and rules and laws.

The variables cover from 3 to 9 criteria on an average of 6.5, according to the high level of aggregation that is required to cover the complexity of the animal health related farm system (table 3, Annex).

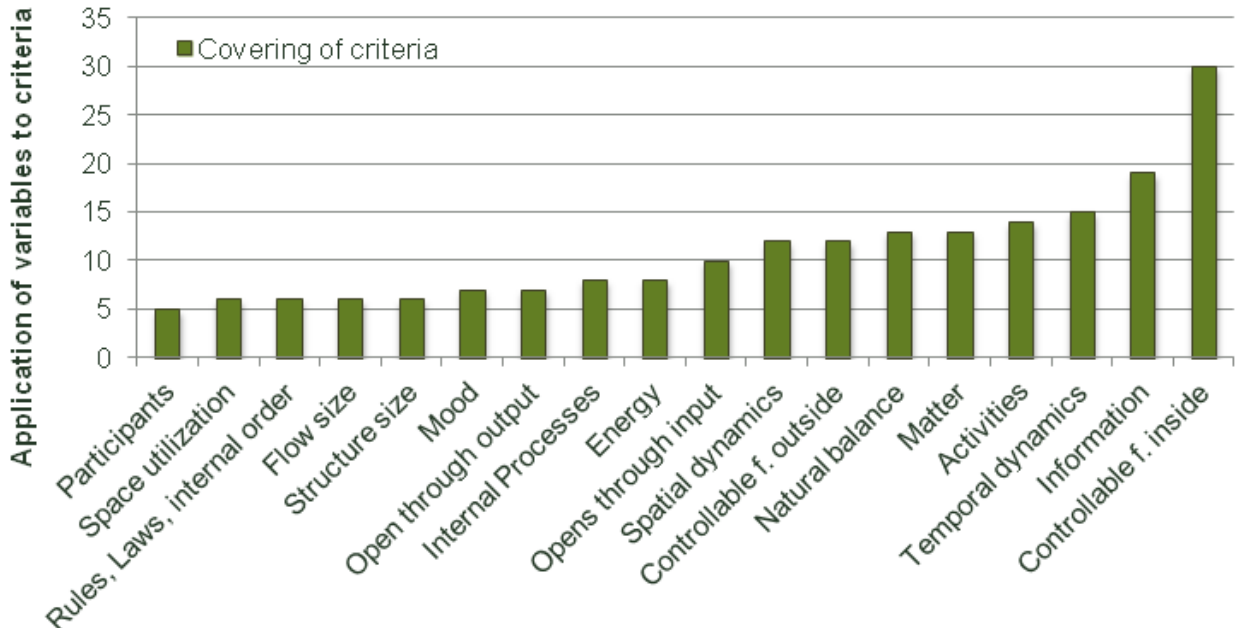

Figure 2: Representation of essential criteria in organic dairy farming

3 Variables related to animal health in organic dairy farming

The list of 20 variables as the result of the decision-making process is presented below.

Table 1: Variables related to animal health in organic dairy farming

No	Variable	Definition	Indicators	Examples for measures
1	**Appropriateness of cow environment in relation to animal welfare**	Level / degree of correspondence between the cow environment (buildings, pastures etc.) and the needs of individual animals, and the cows' capability to cope with their environment	Percentage of integument alterations, animal density, cleanliness of hind leg and udder	Extending, building, optimization of interior and management

2	**Availability of high-quality advice**	Farmers' access to high-quality advice from dedicated advisors or colleagues.	Number of different advisors, communication skills of the advisor, specific knowledge on dairy cows and open-mindedness	More frequent use, change in advisors, intensification of cooperation
3	**Quality of young stock management**	Appropriate management to insure optimal conditions (regarding nutrition, housing, hygiene, welfare) for the development of the young stock to start their first lactation healthy and in time.	Age and weight at first calving, calf mortality, monitoring efforts concerning the risk of parasites, pasture management, use anti-parasitical methods	Feed whole milk, changes in colostrum management, changes in hygiene measures, vaccinations, form groups, improve weight monitoring
4	**Quality of dry cow management**	Appropriate management to insure optimal conditions (regarding, nutrition, housing, hygiene, welfare) for dry cows to be able to start healthy the next lactation	Disease recovery rates during the dry period	Improve dry cow management and feeding
5	**Level of legal and private regulations**	Criteria demanded by legal or private regulations or retailers. If legal and private regulations and market claims are stricter or more relaxed, what would be the consequence for the farm?	Requirement profile of legal framework conditions and private standards, premium payments by the industry, market requirements	Can hardly be influenced except maybe by the choice of the farmers' association / dairy etc.
6	**Financial resources**	Economical results, financial resources of the farm to modify and improve suboptimal conditions	Balance between income and expenses, milk price including premium prices or penalties, prices for stock / meat, financing and investment possibilities (e.g. bank), liquidity, costs	Reduction of costs, increase the added value
7	**Adequacy of the diet for lactating cows during grazing**	Degree of meeting the nutrient requirement of individual animals in their actual life stage, including water supply during grazing	quality of the pasture, litres of milk per ha-pasture, livestock density	Improved pasture management: rotation, cultivation, fertilization, cutting, resting
8	**Availability of quality feed**	Availability of home-grown and bought-in feedstuffs of high quality necessary to fulfil the nutritional requirements of animals	Amount of land in relation to herd size, characteristics of the land, number and quality of crops, amount of purchased feed	Cooperation with neighbouring farms, feed purchase, crop rotation
9	**Level of correspondence between farm conditions and breed / genetic potential**	Level of the cows' correspondence between the cows and the farm conditions (nutrient availability, housing conditions, management intensity); the aim is reaching an equilibrium between system and productive potential	Production level per cow, BCS, availability of feed components	Improve the feed ration by changing crop rotation or purchasing feed, improve management, reduce the genetic potential and thus demand of the herd
10	**Amount of labour capacity**	Ratio between available labour time and work to do	Number of employees, herd size, farm area, degree of organisation etc.	Recruitment of staff, distribution of work and tasks, outsourcing, management
11	**Adequacy of the diet for lactating cows during indoor feeding**	Degree of meeting the nutrient requirement of individual animals in their actual life stage, including water supply during stable feeding	Access to feed and water, availability of minerals, grazing time, technical know-how to compose an optimized diet, feed storage conditions, feeding management (including grazing, feed presentation), DM-intake	Ration adjustment, more frequent pushing up of feed, pasture management, feed analyses, feed purchase

12	**Expertise and skills of the farmer**	Availability and implementation of knowledge	Stockmanship qualities, technical skills, problem-solving skills, rigor in work, willingness to gain information, process sequence structuring	training, recruitment of skilled persons, outsourcing
13	**Quality of herd health monitoring**	Quality of perception and documentation of herd health and production; health monitoring at individual cow and herd level.	Animal observation time, technical know-how, quality and use of health surveillance protocols, rigor of the process, diagnostic expense, level of documentation	Training, use of reasoned health surveillance protocols
14	**Degree of implementation of preventive measures**	To what extent is information processed, analysed and implemented; to which degree are measures appropriate to the farm situation; are effects traced back to initial measures	Use of data to implement measures, verification, feedback, time spent on this, use of management software	Increasing diagnostic expenses, more documentation, analysis of results, change of actions, use of management tools
15	**Level of hygiene**	To what extent are hygiene standards met / hygienic measures taken with respect to housing and milking	Management of animal waste, cleaning & disinfection, cleanliness of the cows, milking protocol, presence of a calving pen and sick bay	Creation of sanitation areas, detection of pathogens, change of bedding material, change in milking equipment
16	**Level of production diseases**	Health status of the herd related to endemic diseases	Incidence of disease, mortality, lameness prevalence, somatic cell count, health related culling (number, age, percentage being primiparous, number of animals bought)	Improvement of diagnostics, prevention and treatment
17	**Milk performance level**	Level of production and the relation between quota and production level can be taken into account	M kg, protein, fat, per day / lactation, persistence, quality, Lifetime milk yield per day, genetic performance potential	Improvement of animal health, change of feeding, optimize breeding strategy
18	**Quality of reproduction management**	To what extent are special demands of (newly calved) heifers, calves, dry cows and purchased animals recognized and considered; important for Spain: seasonal calving	Quality of reproductive performance: non-return rate after first artificial insemination, interval calving to first artificial insemination, calving interval	Establish performance groups, video surveillance, improved heat detection, quarantine of new animals
19	**Risk of introducing infectious diseases**	Risk level of introducing infectious diseases through hazardous contacts; material or animal based, through internal and external contacts.	Number of bought animals, number of neighbouring pastures, preventive measures taken, known presence of infectious diseases on the farm	Hygiene measures, parasite control, quarantine, culling, control of dogs / cats / veterinary visits / rodents / starlings
20	**Appropriateness of treatment**	Degree of meeting the need of an individual (sick) animal by using remedies and palliative measures	Early disease detection and treatment, usage of priori effective treatment protocols, nursing quality, vaccinations adapted to herd health status	Training of staff, detection of pathogens, improving animal observation, vaccinations

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5 Appendix

Table 3: Criteria Matrix

	Criteria →	SPHERES OF LIFE							PHYS. CATEG.			DYNAMIC CATEGORY				SYSTEM RELATIONS				Number of criteria covered by variable
	2 = FULLY applicable 1 = PARTIALLY applicable	Participants	Activities	Space	Mood	Natural balance	Internal processes	Rules, Laws, Internal order	Matter	Energy	Information	Flow size	Structure size	Temporal dynamics	Spatial dynamics	Opens through input	Opens through output	Controllable f. inside	Controllable f. outside	
1	Appropriateness of cow environment in relation to animal welfare			1					1		1		2		2			2	1	**7**
2	Availability of high-quality advice	1			2		1		1		2	2			2	2			2	**9**
3	Quality of young stock management		2				1			1	1							1		**5**
4	Quality of dry cow management		2				1			1	1							1		**5**
5	Level of legal and private regulations			1				2			2		1		1	2		1	2	**8**
6	Financial resources									2				2			2	1	1	**5**
7	Adequacy of the diet for lactating cows during grazing			1		2			2		2			2	1			2		**7**
8	Availability of quality feed					2			2					2	2	1		1	1	**7**
9	Level of correspondence betw. farm conditions and breed / genetic potential			1					1		1		2		2			2		**6**
10	Amount of labour capacity	2			1					2				2		1		1	1	**7**
11	dequacy of the diet for lactating cows during indoor feeding			1		2			2		2			1				2		**6**
12	Expertise and skills of the farmer	2			2		1			2				1		1		1		**7**
13	Quality of herd health monitoring		2		1		2	2			2	2						2	1	**8**
14	Degree of implementation of preventive measures		2		1		1	2			1	2						2		**7**
15	Level of hygiene					2												2	1	**3**
16	Level of production diseases					2					1			1			2	2		**5**
17	Milk performance level		2						2					1			2	2		**5**
18	Quality of reproduction management		2	1			1		2		1		1	2			1	2		**9**
19	Risk of introducing infectious diseases					1					1			1	2	1		2	1	**7**
20	Appropriateness of treatment		2			2					1					2		1	1	**6**
	Covering of criteria:	**5**	**14**	**6**	**7**	**13**	**8**	**6**	**13**	**8**	**19**	**6**	**6**	**15**	**12**	**10**	**7**	**30**	**12**	