Human-animal relationship: stockmanship and housing in organic livestock systems

Proceedings of the Third NAHWOA Workshop

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Introduction

Network for Animal Health and Welfare in Organic Agriculture (NAHWOA) is a Concerted Action Project funded by the European Commission. The main aim of the project is to provide a joint platform for research organisations and institutions involved in organic livestock production, to enable sharing of information and ideas along with development of new research priorities, and to analyse the conventional research methodologies and their suitability to organic livestock research. It is hoped that the project will create a forum for an on-going discussion on animal health and welfare and their interrelationship within the framework of organic livestock production, in order to contribute to the development of organic regulations. The Network has 17 member organisations from 13 European countries.

The four thematic workshops planned for the years 2000–2001 are an important part of the project. The second one of these – and the 3rd NAHWOA Workshop – was held at the Ecole National d'Ingénieurs des Travaux Agricoles (ENITA) in Clermont-Ferrand, France, on 21-24 October, 2000. Some 60 delegates, from 13 European countries and from the USA participated in the proceedings, working groups and field visits. Facilities at ENITA provided a relaxed and practical backdrop for the Proceedings, and the beautiful autumn landscapes made the fiels visits greatly enjoyable.

The theme of the 3rd NAHWOA Workshop was *"Human-animal relationship: stockmanship and housing in organic livestock systems"*. The stockperson's ability to understand livestock and to respond to the needs of the domesticated animals is probably the most important building block of animal health and welfare in any livestock production system. It is clear, from the papers presented in the Workshop, that great demands are put on the herdsperson's, shepherd's or flockmaster's ability to adopt new techniques and approaches to husbandry, when a livestock unit converts from intensive, conventional management to organic production system. The importance of stockmanship was notably emphasised also by all presentations discussing housing.

These Proceedings include two reports of the discussions from the Workshop and a few papers presented on ongoing research among the NAHWOA partners. It is hoped that the publication of such papers will encourage and inspire research collaboration in the future. In these Proceedings, are also included abstracts from posters presented both in the ClermontFerrand Workshop and in the previous Workshop in Cordoba.

To highlight the importance of the farm and field visits that take place during the workshops, we have also included a report on the visit to a goat dairy farm near Clermont-Ferrand. For those who visited the farm, this report will bring back memories of a lovely autumn day and excellent goat cheese. For those who were not present, the report will hopefully convey something of the nature of this particular organic farm, where an obvious and happy balance between humans and animals had been successfully established.

Reading, January 2001

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For further information on the NAHWOA project, please contact the Co-ordinator or visit our Website at http://www.veeru.reading.ac.uk/organic.

Acknowledgements

The Network for Animal Health and Welfare in Organic Agriculture would like to than thank Michel Bouilhol and all the members of staff of Ecole National d'Ingénieurs des Travaux Agricoles (ENITA) in Clermont Ferrand for making the Workshop a success.

We are also grateful to the goat farmers Jean-Pierre and Anne-Marie Lantenois, who welcomed us for a very interesting excursion of their organic goat farm and cheese dairy. A definite highlight of the visit was the sampling of their homemade goat cheeses.

We also want to thank Xavier Boisvin and Jean-Marie Chupin of INRA de Theix for their presentation of INRA activities in the Region. Also an interesting visit to INRA farm was made possible by Marc Benoit and Hervé Tournadre, who explained their breeding system for organic sheep.

We were extremely lucky with the weather that showed the countryside around Clermont Ferrand in wonderful autumn colours, contributing to the success of the Workshop.

Many thanks also go to all the speakers and the delegates who made the event such a lively exchange of opinions, scientific data and reflections on the significance of stockmanship in any livestock system.

Part A:

Human-animal relationship: stockmanship and housing

The farmer and the animal: a double mirror

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Introduction

Presenting the farmer and the animal as a double mirror indicates that both the animal's perception of the human and the stockman's perception of the animal determine the quality of the stockman-animal relationship. The purpose of this paper is to emphasise that not only the stockmen are looking to the animals but also the farm animals are watching their caretakers. Thus, the animal behaviour reflects, as a mirror, the human behaviour, and in certain circumstances, the human behaviour reflects the animal behaviour.

Organic husbandry is regulated by European legislation since 1998 (Document 399R1804). In this EU-document, the only sentence clearly referring to the human-farm animal relationship in organic livestock production is: "Systematic operations which lead to stress, harm, disease or of the suffering of animals during the production, handling transport and slaughtering stages should be reduced to the minimum". This text appears to us inadequate to define the consequences of human-animal relationships on animal welfare. To our knowledge, no specific study exists on the importance of the human-animal interactions in organic farming. However, we will try to extrapolate the consequences for organic farming from the results obtained in conventional husbandry.

How do ethologists analyse the human-farm animal interactions?

Farmers, economists, psychologists, sociologists or ethologists are all interested in the human-animal research area. In contrast to the other categories, ethologists, who study animal behaviour, consider more the human-animal relationship through the eyes of the animals than through the eyes of the human. Therefore, as the authors of this paper have more an ethological background, the studies presented on the human-animal relationship will focus more on animal behaviour. As most of the studies performed in the authors' research group concern cattle and sheep reared in non-organic farming systems, the examples presented concern more these species.

Most domesticated animals are gregarious. For example in ruminants, after birth, the young animal develops a social network, first with its dam and later with other members of the species and will then live in large groups of adults (Veissier *et al.*, 1998). However, in farm animal husbandry, another partner, the human, interacts regularly with the young animal from early age. How do these animals perceive the human?

From the animal's behavioural responses to humans, the animal's perception of human can be inferred and classified in four main categories (Estep and Hetts, 1992):

1) The human perceived as a danger if animals are flying away or attacking him when handled;
2) The human as an indifferent object when animals do not react to his presence as for a non-living object;
3) The human perceived as a food or water provider, inducing animal's approach to full-filled that hunger or thirst motivation;
4) The human perceived as a social partner when his presence induces approach, grooming and his leaving leads to distress separation, particularly in social isolation.

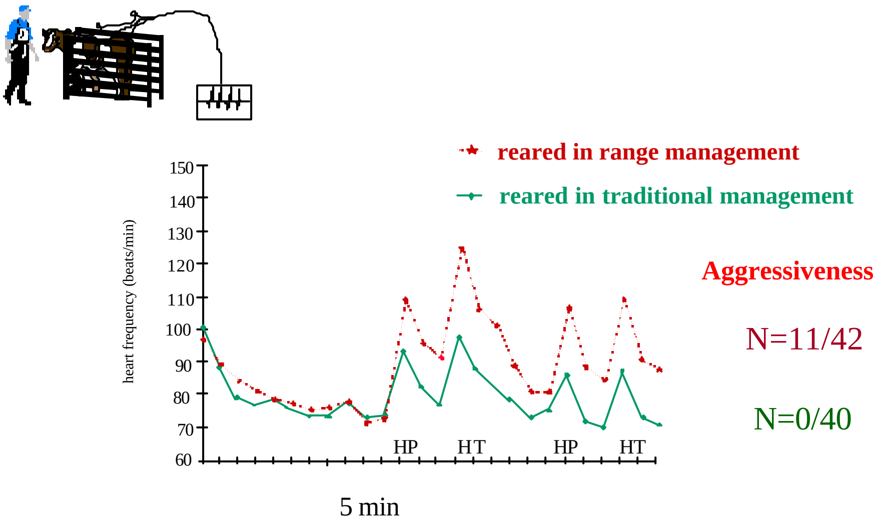
The animal perception of the human as a danger (fear of human) or as a social partner will be illustrated here for their particular importance on animal welfare and production.

Humans perceived as a danger: reduced human-animal interactions increase animal's fear of human

As a first example of how animals can be the mirrors of human behaviour, it has been shown that an increased animal fear of humans is induced by reduced human-animal interactions, particularly in early age. For example, considering the French beef cattle husbandry, for the last 30 years, two general observations can be done. Firstly, the number of animals per worker is increasing, from 13 cows per farmer in 1970 to 70 today. Secondly, the husbandry system has changed. Traditionally, cows were tied with twice a day suckling, and a considerable amount of contact existed between the stockman and the calves. Today, more free-stall or free-range conditions are implemented for animals that are reared in groups. In such systems, the interactions between humans and animals could be seriously reduced, especially in early age. Do we observe therefore an increased stress for the animals in the presence of the humans? Do we encounter more frequent handling problems?

We do not have data from commercial farms but we have some from experimental studies (Boivin *et al.*, 1994, 1998). In these studies, calves were reared in the traditional system or reared outdoors during the first 3 months of age and with a minimum of human contact necessary for husbandry. They were reared in the same conditions afterwards. At 20 months of age, their reactions were observed in a cage. Figure 1 presents the heart rates of the animals when left alone for 5 minutes and when a human approached and touched the animal. Also the number of aggressive animals during handling was noted. The heart rate was significantly higher when the human approached and touched the outdoor-reared calves than the ones reared in the traditional system. In addition, none of the animals raised in the traditional system showed aggressive acts towards the human, while one third of the animals reared outdoors did. Clearly, outdoor-reared calves, mainly characterised by a reduced number of positive contacts with humans early in life, were much more and durably fearful of human than the traditional housed ones.

Figure 1: Comparison between heifers reared traditionally or in range management during the first three months of age. Heart rate measurement in a cage test at 20 months of age (Boivin et al, 1998)

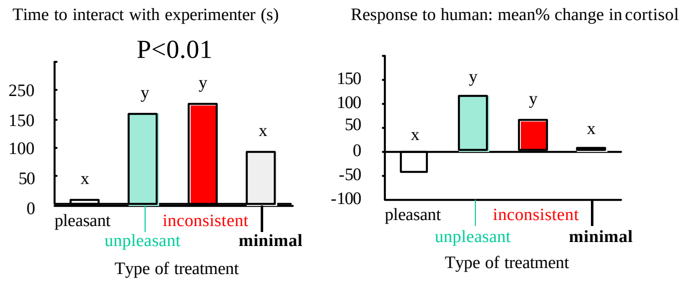


(HP: human presence ; HT: human touch)

Human perceived as a danger: negative human-animal interactions increase animal's fear of human

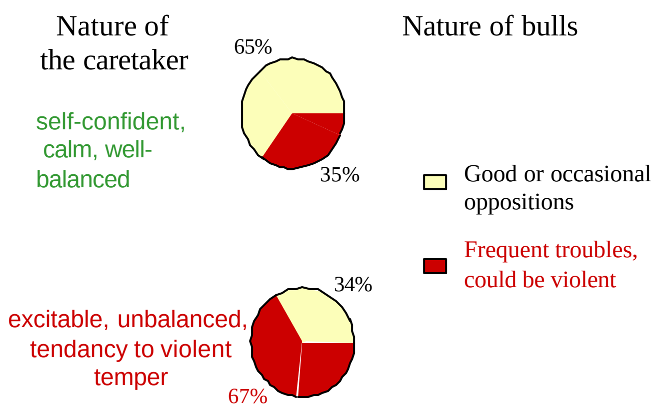
Animal's fear of human is not only due to reduced human-animal interactions. Negative human-animal interactions induce also animal's fear of humans. A good example, from Hemsworth *et al.* (1987), is taken from the industrial pig production in Australia, and has been confirmed later on commercial farms by the same authors. In their experiment, pigs were either not handled, gently handled (petting), negatively handled (hit, electric shock), or handled inconsistently with a mixture of positive (5/6 times) and negative handling (1/6 times). The contact was applied from 7 to 14 weeks of age, 3 minutes per session, 3 sessions per week. When tested on their reaction to an experimenter in a test arena, negative and inconsistent handled pigs did not differ significantly in their reactions to the human (Figure 2). However, the latency to approach the experimenter and the cortisol increase during the test were much higher for these two groups than for the other two groups (Figure 2). These results indicate that animals handled negatively, even rarely and despite many other positive interactions, could become highly fearful of human.

Figure 2: Behavioural and cortisol responses of pigs in relation to the quality of the human-animal relationship (Hemsworth et al., 1987)



In the same way, Renger (1975) made a comparison between the behavioural reactivity of bulls and the nature of the stockman (Figure 3). In 65% of the observed cases, the bulls reacted calmly to the stockman when he was described as self-confident, calm and well balanced. In contrast, 67% of the bulls reacted violently if the stockman was described as excitable, unbalanced with a tendency to a violent temperament.

Figure 3: Behaviour of bulls according to the psychological profile of the caretaker (from Renger, 1975).

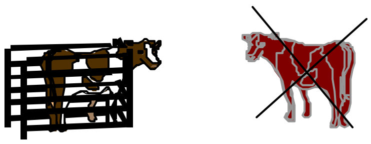


Human perceived as a social partner?

A last example of the animal's behaviour as a mirror of the human behaviour, is that positive human-animal interactions can improve the animal welfare. As an experimental example of this last category, when cattle are put in a cage with peers, increases in cortisol level, heart rate and agitation are recorded when the peers are removed and the tested animal stays alone (Boissy and Le Neindre, 1997, Figure 4). In the same way, when an artificially reared lamb is left alone in a new pen with a familiar stockman, increases in the number of bleats and in agitation are recorded when the stockman leaves the tested animals alone (Boivin *et al.*, 2000, Figure 4).

Figure 4: Perception of the partner, measure of the separation distress in heifers and artificially reared lambs.

peers



	with peers	alone
cortisol (ng/ml)	**11**	**38**
Heart rate	**71**	**92**
agitation[1]	**21**	**27**

(Boissy and Le Neindre, 1997)

stockperson

	with stockperson	alone
bleats [2]	**7**	**24**
agitation[3]	**5**	**14**

(Boivin et al., 2000)

1: elec. signals/ mn
2: / mn
3: squares crossed / mn

What determines human behaviour and with which consequences for the animals?

Among the several factors determining the stockman behaviour, the attitude of the stockman towards the animals and their consequences on animal behaviour, animal welfare and production has been recently studied.

Following their numerous studies on pigs, Hemsworth and Coleman (1998) proposed the following model for the stockperson's impact on farm animals (Figure 5). They demonstrated that negative stockperson's attitudes towards animals can lead to negative interactions with animals. Those negative interactions with animals can lead to an increased animal fear of humans, accompanied with chronic stress. This fear of humans and chronic stress will affect the animal's welfare and its productivity.

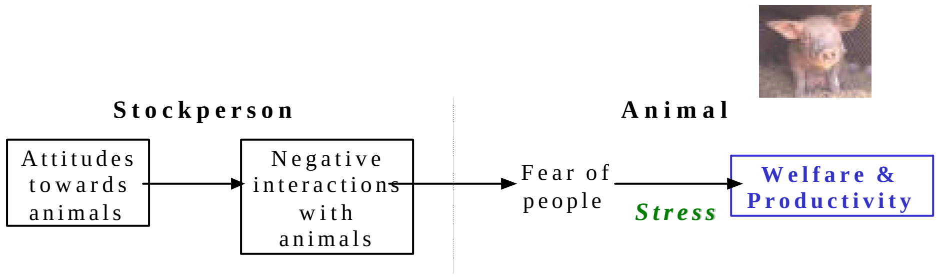
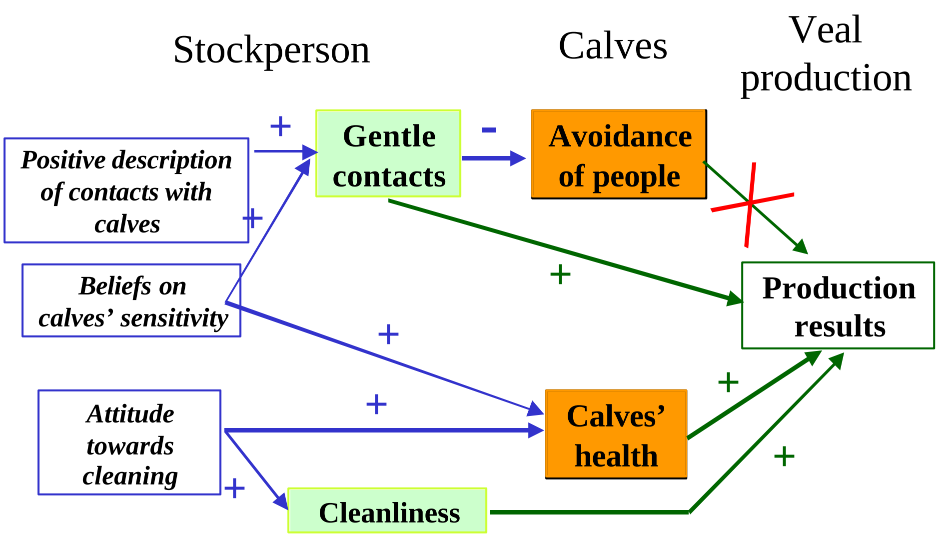


Figure 5: Model of relationship between the stockperson characteristic and animal welfare and productivity (from Hemsworth and Coleman, 1998).

Another survey has been recently performed on 50 industrial veal farms with the same husbandry conditions (Lensink, 2000, in press). Two questionnaires were constructed to measure the attitude of the stockman towards the calves and the level of cleaning and surveillance. Furthermore, the stockman behaviour towards the animals, the animals' reactions towards the stockman and the health status of the veal calves were recorded. The attitude of the stockman towards the animals was measured by the description of the contacts with the calves and the beliefs on the calves' sensitivity. A positive attitude of the stockman was positively linked to gentle contacts with the veal calves (Figure 6). These gentle contacts were positively linked with a decreased avoidance of people and with an increase in production results. However, no statistical link was found between the avoidance of people and the production results. In addition, the attitude towards the calves was linked to the calves' health and the attitude towards cleaning was linked to cleanliness (Figure 6). The health status of the calves was positively linked with the production results.

This presentation shows many results indicating that the animal's behaviour is the mirror of the stockman's behaviour. Could the stockman's attitude also be, in certain circumstances, a mirror of the animal's behaviour? Some data are available on farm animals. In some cases, the animal's stress could be transmitted to humans. This engages a vicious cycle: the more the animal is stressed, the more the human will be stressed. Then, as it has been described previously with the experiment of Renger (1975), such human stress will again increase the animal's stress and so on. Farmers should therefore not be scared or show their fear when handling animals.

Figure 6: Model of relationship between the stockperson characteristic and animal welfare and productivity (from Lensink, 2000)



Fields of research and conclusions

Three main directions of research need to be further explored in this area, and should help our consideration of this factor in organic farming.

1) First of all, which biological mechanisms are key-factors for the establishment of the human-animal relationship that could be described as social? Each time decisions are made in animal husbandry (e.g. such as mechanisation, young and dams reared together in free-stable or outdoors rather than tethering the cows etc.), this question should be asked. What are the consequences of proposed changes for the human-animal relationship? For example, the aim in organic farming to rear the animals more extensively: as shown by Boivin et al. (1994, 1998), rearing animals outdoors could induce increased fear reactions of these animals towards humans, compared to more traditional rearing systems. Care should therefore be taken to assure that a good human-animal relationship exists in order to overcome handling problems and aggressiveness. Providing positive contacts early in life and regular presence might be necessary to avoid these problems.

2) Some results demonstrate the existence of a genetic basis for the animal response to humans and the possibility to select animals on these criteria. In organic farming, the use of local, often rare breeds, might interfere with possible handling problems. It can be imagined that the local breeds are well adapted to the sometimes-harsh conditions in certain areas. However, these animals have not always been selected

on their reactions to humans. Therefore, care should be taken with the choice of the animals and its possible effect on the human-animal relationship.

3) Last but not least, the human attitude towards the animals is a key factor in this topic with a permanent question for the stockman: How do the animals that I have to handle or observe perceive my behaviour and me? How important is my presence close to them? For example, different studies have demonstrated the importance of the stockperson's attitude towards the animals and their contacts with them on the animal's welfare and production. A good human-animal relationship is a key factor in the determination of the animal's fear of humans. However, a good and close human-animal relationship makes it also possible for the stockperson to determine earlier deviations in the animal's behaviour, which might express the first disease symptoms. A good relationship with the animal can therefore be related with a better health status of the animals, which coincides with the aim in organic farming to minimise the use of antibiotics.

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Qualitative welfare assessment: reading the behavioural expressions of pigs

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Introduction

It is widely recognized and supported by much research, that good stockmanship is crucial to animal welfare (Hemsworth and Coleman, 1998; Lensink *et al*., 2000; Seabrook and Wilkinson, 2000). Typically, stockmanship reflects a *lived* perspective on animals. Farmers and stockpersons live and work with animals as fellow creatures, communicate with them, and wish to keep them in good health and welfare (Seabrook and Wilkinson, 2000). In such a lived, common sense perspective, we look at animals in an integrated qualitative way, and see them as expressive individual beings (Hearne, 1995; Wemelsfelder, 1997a; Sanders, 1999). Science teaches us to observe and describe behaviour as a sequence of distinct physical movements; in daily life interactions, however, we first and foremost see integrated beings that act in a certain way.

Consider, for example, the pig portrayed in Figure 1. This pig is housed in isolation from other pigs, it lacks bedding for comfort and substrate for interaction, and it has swollen and possibly infected leg-joints. A behavioural scientist may describe the behaviour of this pig as ‘sit’, which would obviously be correct. The pig sat in this position for hours on end, which was likely due to chronic physical and thermal discomfort (Webster, 1994). However, the description ‘sitting’ does not exhaust the information presented by Figure 1. What can be observed is not just ‘sitting’: we see a pig that sits *in a certain way*, with a certain expression. This pig could have sat in different ways. Any one behaviour can be performed in several different dynamic styles: animals may walk from A to B confidently, playfully, hesitantly or fearfully.

And so we do not just see sequences of 'behaviour' (sniff, bite, pull), we see a dynamic 'behaver', who moves in a certain style and with a certain expression (Wemelsfelder, 1997a,b).

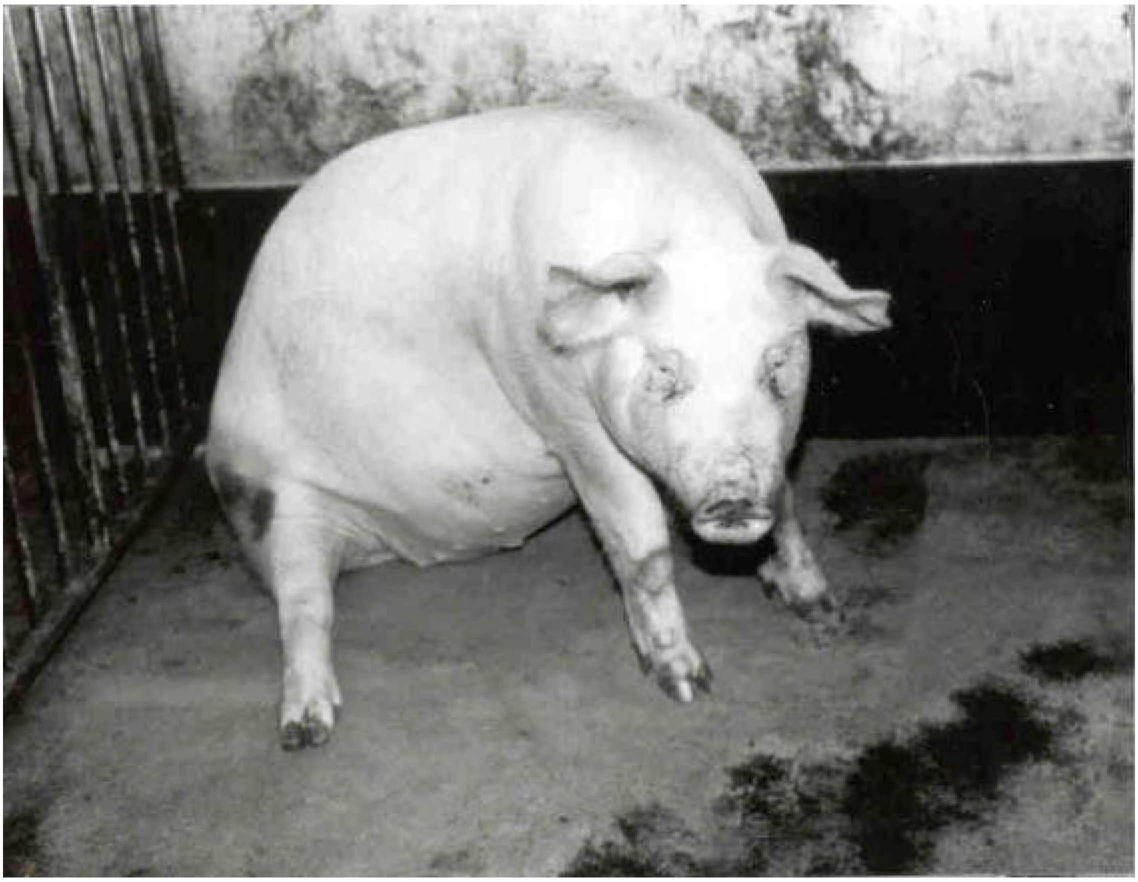

Figure 1 Pig, isolated from other pigs, in poor environment.

Thus, in qualitative assessment, we sum up the perceived details of an animal's dynamic style of interaction, into naturally expressive terms such as 'calm', 'anxious', 'timid' or 'confident'. Farmers, stockpersons and veterinarians routinely use the information provided by such terms to assess their animals' health/welfare state. While handling or feeding animals they notice whether these animals are relaxed and friendly, tense and aggressive, or timid and evasive, and take action when something does not seem right. Despite this great practical usefulness, however, scientists are not sure what to make of expressive terminologies. There is increasing recognition that such terms may be useful in describing an animal's predisposition for a certain type of personality or temperament (Clarke and Boinski, 1995; Gosling, 1998; Lanier *et al*., 2000; Ruis *et al*., 2000). However, scientists still have considerable difficulty in accepting that when someone spontaneously describes an animal as content, anxious or distressed, this could be a valid description of the animal's *present* state of welfare or suffering. They are wary that such descriptions may be anecdotal, anthropomorphic, imprecise and generally unreliable interpretations of behaviour, which cannot be part of a scientific approach (Kennedy, 1992).

However, the reliability of spontaneous descriptions of animal behavioural expressions can and should be investigated. If as suggested here, an animal's dynamic style of interaction contains observable expressive information, then it should be possible to make reliable and repeatable assessments of that information. Testing this hypothesis, however, requires the use of an experimental methodology, which facilitates the integrative nature of qualitative assessment. The aim of my research work in recent years has been firstly to develop such a methodology, and secondly to test the inter- and intra-observer reliability of spontaneous descriptions of pig behavioural expression Wemelsfelder *et al.*, 1998, 2000a). In the remainder of this paper, I will provide a brief overview of this work and its results. In conclusion, I will discuss some implications of these results for our view of stockmanship and its role in on-farm welfare assessment.

Outline of a methodology for qualitative behaviour assessment

To test the reliability of describing behaviour as an expressive process, we wished to bias observers as little as possible in their judgement of an animal's expression. Rather than give observers a list of pre-fixed terms, we instructed them to create their own descriptive terminologies through an experimental procedure called 'Free-Choice-Profiling' (FCP). This method has been developed and tested extensively in the food sciences (Oreskovich *et al.*, 1991), but had not been used in animal science previous to our work. Free-choice conditions, more so than fixed rating scales, are highly conducive to integrative behaviour assessment, because the observers themselves have to summarize all perceived details of behaviour into terms, which in their view best describe the animals' behavioural expression.

The experimental animals in our recent experimental work were 10 Large White x Landrace female growing pigs of approximately 15 weeks old, housed together in a straw-bedded pen of 4 x 4 metres. These pigs were trained to be separated from their pen mates in a test pen, which was identical and directly adjacent to the home pen. At the moment of testing, pigs were brought singly into the test pen and given the opportunity to interact with a human person for 7 minutes. Around the test pen, 9 observers (academic students, who had no previous experience in the observation of pigs) were seated behind wooden screens. These observers were asked to observe each pig for 4 minutes, and then in the remaining 3 minutes to write down those terms, which, in their view, best described the pig's behavioural expressions. In a second phase, they were instructed to use these self-created terms to quantitatively score the behavioural expressions of the pigs, giving each pig a score on each of their terms. One week after the live sessions had come to an end, observers repeated their assessment from two video-recordings of the live session. One tape showed the pigs in the same order of appearance as the live session, while the other tape showed the pigs (from the same live session) in different order. These tapes were shown to observers on two consecutive days. Thus in total 3 sets of 9 individual observer data-matrices, all describing the same 10 pigs, were obtained.

These data were analyzed with Generalized Procrustes Analysis, a multivariate statistical technique associated with FCP (Arnold and Williams, 1985; Oreskovich *et al*., 1991). This technique transforms individual observer matrices of pig scores into multi-dimensional configurations, and determines the similarity between these configurations through a process of complex geometric transformation. Thus, it finds a 'best-fit' of all observer-scoring patterns, generally referred to as the 'consensus profile'. The significance of this consensus profile is calculated against a randomized profile, obtained through re-running GPA with randomized observer data sets (Wakeling *et al*., 1992).

It should be emphasized that calculation of the consensus profile takes place entirely independently of semantic information provided by observer terminologies. GPA should be thought of as a pattern-detection mechanism, which assumes that even if measurement variables (terms) are not fixed, the distances between samples (pigs) are comparable because the samples are the same. Semantic interpretation of the consensus profile takes place *after* its calculation, by correlating it to the original individual observer data matrices. Thus GPA analysis produces 9 individual semantic word charts (1 for each observer), describing the consensus profile in each individual observer's terms. Close comparison of these charts is an important part of investigating observer agreement; in principle a consensus profile, though significant, could show poor convergence in its semantic charts and make little sense.

Finally, GPA attributes individual pigs with a score on the main dimensions of the consensus profile. These dimensions can be interpreted with the help of the semantic charts, and the expressive characteristics of individual pigs can thus be identified and compared. In this experiment each individual pig was attributed with 3 scores, 1 live- and 2 video-scores. The correlation between these scores can be used to determine the repeatability of observer assessments. The higher this correlation, the higher the intra-observer reliability of qualitative behaviour assessment.

In summary, GPA analysis typically produces 3 sets of results: (i) 'observer plots', indicating the level of observer agreement for the consensus profile; (ii) semantic 'word charts', reflecting observer interpretations of the consensus profile, and (iii) 'animal plots', which give the position of individual pigs on the main dimensions of the consensus profile. For a detailed presentation and discussion of FCP/GPA procedures and their results, the reader is referred to Wemelsfelder *et al*. (2000a,b). The present paper offers space only for a brief summary of results.

The reliability and repeatability of qualitative behaviour assessments

The results of our study indicate that qualitative assessments of pig behaviour show high levels of reliability and repeatability. Firstly, the consensus profiles of both the live- and video-sessions were highly significant in comparison to randomized profiles ($p<0.001$). Thus, even though observers all used different terminologies, they showed significant agreement in the way they used their terminologies to score the behavioural expressions of the pigs.

Secondly, individual observer word charts showed strong semantic convergence in their characterization of pig behavioural expressions, again in both live and video sessions. Observers distinguished two main dimensions of behavioural expression, which together explained approximately 80% of the variation between pigs. The individual terminologies of observers were mostly highly correlated to these dimensions, describing meaningful, semantically coherent transitions of expression (e.g. confident-bold-boisterous-excitable-restless-anxious-timid-calm-relaxed-friendly-confident).
Observer word charts could have been a chaotic mixture of terms; that they were not indicates that observers could use their spontaneously chosen terms systematically, as coherent frameworks of pig behavioural expression.

Finally, pig scores on the main dimensions of live and video consensus profiles showed highly significant positive correlations (Pearson Correlation, r-values ranging from 0.88-0.99, all $p<0.001$), indicating excellent repeatability. This suggests that the description of behavioural expression is not, as is often assumed, a matter of vague, imprecise guesswork. Observers used their terminologies to locate individual pigs in their expressive charts in a way, which could be repeated with great accuracy. Potentially these pig scores can be used to investigate the effect of different housing conditions and management procedures on pig behavioural expression. It may be hypothesized, for example, that pigs housed in restrictive and barren conditions will obtain significantly lower scores on the timidity-confidence axis than pigs housed under more enriched conditions. We found some evidence of such an effect (Wemelsfelder *et al.*, 2000a), but further work is required to confirm this result.

Comparison of assessments across different interest groups

The observers used in the experiment were academic students, a relatively neutral group. The question is whether observers with different professional backgrounds and views would also agree in their assessment of the pigs. We therefore repeated Free-Choice procedures as outlined above with 3 different observer groups, consisting of 12 pig farmers/stockpeople, 10 large animal veterinarians and 10 animal protectionists. The results of this experiment fully confirm the results reported above. The consensus profiles of the 3 observer groups were highly significant ($p<0.001$), both when analyzed separately, and in a merged analysis as one large group. Observer word charts did not diverge significantly from those discussed above, while repeated pig scores again showed highly significant positive correlations ($p<0.001$). Thus these results suggest that assessments of animal behavioural expressions are not unduly influenced by personal attitudes, but show a common basis across the various interest groups.

Together the results reported here demonstrate that spontaneous qualitative assessments of pig behavioural expression show high inter- and intra-observer reliability. This indicates that these assessments are based on commonly perceived and systematically applied criteria; the question is on which aspects of behavioural organization these criteria may be based. As suggested in the introduction, I propose that expressive criteria reflect an integrative, ‘whole-animal’ level of organization, on which we perceive not merely a string of separate behaviours, but their focal point of origin, the ‘behaver’ (see Wemelsfelder (1997b, 2000b) for more detailed discussion). From this point of view categories of behavioural expression should not be seen as causal states of any (physical or mental) kind. They do not describe feelings, genetic predispositions, cognitions, or any factor in isolation, but all of these factors as inclusive aspects of one integrated state. To see if there is any substance to this view, we should study in detail the relationship between qualitative expressive scores and quantitative behavioural and physiological measurements, to see if qualitative measures may indeed guide the interpretation of other data. Informally, scientists frequently use 'whole animal' perceptions to guide the interpretation of behavioural and physiological results. The question is whether a formal investigation can support the validity of such an approach.

Conclusion and implications for stockmanship

The qualitative assessment of pig behavioural expression as discussed in this paper took place under controlled experimental conditions. However, given its spontaneous and integrative nature, the proposed Free-Choice methodology seems naturally suitable for on-farm use (Wemelsfelder and Lawrence, 2000). The present results support that reading animal behavioural expressions is an important skill that farmers and stockpersons have. It is the farmer/stockperson who interacts with the animals the most, and who will be in the best position to integrate the expressive details he/she has observed. Such observation could quite easily fit in with any kind of on-farm work routine, and could increase scrutiny by the farmer of any animal health/welfare problems that may occur. Assessment of animal behavioural expression could also become an integral part of training courses in stockmanship. This may lead to an increased acknowledgment of this traditional stockmanship skill, and to an increased participation of farmers/stockpersons in on-farm welfare assessment schemes.

In conclusion, the next step is to develop Free-Choice-Profiling procedures for on-farm use, and to test the inter- and intra-observer reliability of the proposed procedures. It will then be possible to cross-validate on-farm assessments of animal behavioural expression with conventional on-farm indicators of welfare, to create a more comprehensive animal welfare-monitoring tool.

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The effect of the operational environment and operating protocols on the attitudes and behaviour of employed stockpersons

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1. The requirements from the stockperson

The process of working on livestock systems can be isolated into three components;

MANAGEMENT ENVIRONMENT - e.g. breeding and feeding policy
OPERATIVE STOCKPERSONSHIP - e.g. technical ability with stock
EMPATHETIC STOCKPERSONSHIP - e.g. the qualitative manner of interaction with stock

The goal is an effective management environment in which technically skilled people operate in a way that involves good empathetic interaction with animals. Seabrook (1972) presented results for probably the first rigorous study into the role of the dairy stockperson on the yield of dairy cows. Since then, the results of other studies have been published. These have been effectively summarised by Hemsworth and Coleman (1998). The earlier text by English, Burgess, Segundo and Dunne (1992) covers aspects such as the importance of job satisfaction in affecting the attitudes of staff to animals. The health and welfare of farm animals are crucially dependent upon the action of the stockpersons who handle, observe and monitor the animals in their charge daily. In all aspects of work with animals, the role of the human as an interactor is decisive. Table 1 summarises the desired behaviours for good interaction with animals. The crucial point is that good interaction leads to increased observation of stock and earlier recognition of disease symptoms.

Table 1 The behaviours to adopt for good interaction

HIGHER PERFORMANCE BY GOOD INTERACTION	**LOWER PERFORMANCE BY POOR INTERACTION**
Confident personality	Under confident personality
Consistent behaviour	Non-consistent behaviour
Emotionally stable	Less emotionally stable
Independent personality	Dependent personality
Not affected by system	Affected by system
Pleasant physical contact	Aversive physical contact
Operant conditioning - rewarding wanted behaviour	Punishing unwanted behaviour
Using voice in kind tone	Using voice in aggressive tone
When a crisis happens staying calm and stable, using calm tones	When crisis occurs NOT staying calm, becoming stressed
When a crisis occurs rationally working out what to do with a lot of touching	Acting irrationally often hitting out
Low aggression	High aggression

A set of research results has confirmed that the manner of interaction can affect performance, (Seabrook, 1994a). The desired action was POSITIVE ACTIVE INTERACTION involving much use of the voice in a calm manner, patting, stroking and touching of the animal, particularly the head area and around the ears. Compared to NEGATIVE ACTIVE INTERACTION involving more impatient manner of voice and slapping of the animal, (Seabrook and Mount, 1992).

Livestock production requires that the stockperson, (synonymous with stockwoman, stockman and animal caretaker), enters and imposes upon the perceived physical, social and cognitive environment of the animal. However, in most modern systems each individual stockperson will have responsibility for only a small part of the production cycle, and functions in an environment where individual recognition of animals is minimised, where the number of animals dealt with is large, where the opportunity for contact with individual animals is limited and where impersonality is the order of the day.
Some of the differences in behaviour and interaction processes of the stockpersons can be related to personality attributes, Seabrook (1991) and Seabrook (1995). A summary of the work is shown in Table 2, with an indication of the mean position. This profile is for a group of stockpersons seen to exert high empathetic interaction, as defined by much Positive Active Interaction and pleasant handling, vocal contact and regular interaction at

close quarters. In general terms, these results are also confirmed by Hemsworth and Coleman (1998).

Table 2 Personality attributes of Positive interacting stockpersons

Reserved			*					Outgoing
Less emotionally stable						*		Emotionally stable
Confident	*							Lacking confidence
Humble		*						Assertive
Serious					*			Happy go lucky
Expedient						*		Conscientious
Shy		*						Venturesome
Tough minded			*					Tender minded
Trusting						*		Suspicious
Practical		*						Imaginative
Unpretentious						*		Shrewd
Traditional		*						Experimenting
Group dependent							*	Self sufficient
Independent		*						Concerned with image
Relaxed		*						Tense
Less intelligent				*				Intelligent

The research work emphasises the importance of the stockpersons attempting to create a stable, consistent and caring environment, scratching and stroking their animals regularly. In addition, if the stockperson rewards behaviour of the animal that is considered desirable, for example, by contact or hand feeding them a little food, the animal will learn to adopt that behaviour (operant conditioning). At all times, aggression towards animals should be avoided, even gentle slapping and hitting animals makes them more difficult to deal with and more restless. There are a number of processes, for example, castration and vaccination that involve negative stimuli. The incorporation of positive stimuli, for example, food or a novel environment to examine, may be useful in speeding habituation of the stockperson and reducing, or, avoiding the deterioration in the human-animal relationship. However, there are considerable differences between individual animals and so the stockperson should be able to interpret the individual reactions of their animals, in order to judge the correct behaviour to adopt. This sensitivity can to some extent be learned. The stockperson should adopt the stimuli used by the animals in social communication, for example, social grooming. The social bond so established may be important in reducing fear and in creating a stable social hierarchy where the stockperson is dominant role player.

2. The tasks that stockpersons like and dislike

In a major series of standardised interviews with 240 dairy stockpersons, (Seabrook and Wilkinson 2000), milking was considered both the most important and the most enjoyed task. This association has many benefits because a task that is enjoyed is also likely to be undertaken diligently and competently, Table 3. The main task, which was disliked was overwhelmingly that of cleaning the parlour and yards. This has important consequences in relation to herd health. The stockpersons clearly valued their interaction with animals, "a special event involving animals" was frequently mentioned as the component of a "good" day. In parallel, "a bad event involving animals" was almost unanimously the factor associated with a "bad" day, Table 4.

Table 3 Dairystockperson's views of tasks

Best / most liked	Milking Calving Feeding "Just being with animals" AI
Why ?	Just like/enjoy it" "Can see results" "I am in touch with my animals" "I am alone" "I'm good at it" "It is not routine"
Worst / most disliked task	Cleaning Feet trimming Record keeping Culling cows Calving Feeding
Why ?	Just dislike it, it's dirty" "It is tedious" "It is dangerous" [1] "It means paperwork" "It's so repetitious" "Don't see results" "It is hard work"

Table 4 What happens on “good” and “bad” days

Good days	"Nothing went wrong" "A special event involving animals" "Good weather" "No disruptions" "I felt in control" "A special event involving the system"
Bad days	A bad event involving animals" "Too many disruptions" "Bad weather" "All went wrong" "A bad event involving management"

The study provides a useful insight into stockpersons' perceptions of the routine tasks. Those people dealing with stockpersons have now information to utilise. The key issues for those concerned with managing herd health are:

- The overwhelming dislike of cleaning, so crucial for disease control and general herd health, suggests a real need for investment in better cleaning equipment and services. This is confirmed in this survey of stockpersons when five out of the seven of the most frequently mentioned important areas for innovation and/or research were given as "automatic/robotic scrapers", "greater/better use of plastics/new easier to clean materials in the parlour", "better conduit/piping in parlours", "research into easier to clean parlours"
- If possible work tasks need to be so organised in order to allocate sufficient time to and sufficient support to help the stockperson with the cleaning tasks effectively. So often this highly disliked task is fitted in after milking without adequate support and before other more enjoyed tasks. Help with the "worst" tasks is always more valuable than help with "enjoyed" tasks. The veterinary profession can help stockpersons by encouraging management to provide this help and support.
- Encouragement should be given for investment in the right areas. This investment would be better made in lightening tedious tasks, e.g. cleaning, rather than in streamlining the tasks the stockpersons enjoy, e.g. milking.
- Verbal encouragement to staff when cleaning is well done, would greatly enhance the quality of the work. There appeared a tendency by some managers/employers to be ready to criticise when a task was not done well but to be less ready to praise if it was done well. There is clearly an important role here for the veterinary profession to give praise when it is due and so encourage diligent fulfilment of disliked tasks.
- Stockpersons generally disliked foot trimming, better equipment would help as indeed would the use of specialist feet trimming contractors.

Herd health and welfare will suffer with inadequate cleaning of the parlour and buildings. Herd welfare and productivity will be at risk from poor care of the feet of the cow. Yet both of these crucial tasks are highly disliked by dairy stockpersons. A concerted effort should be made by all involved in dairy production to recognise this issue and design and operate systems that ease the burden of these tasks on stockpersons.

3. The difficulties in achieving desired behaviours

There are a number of crucial factors that adversely affect the behaviour of stockpersons and so inhibiting the desired interaction.

Habituation

This is the process in which an action towards animals become accepted by frequent action or custom. It is exemplified by the following statements made by stockpersons;

"I was told to do it this way, this is how we do it I do not know if it hurts the animal, but everyone else throws the piglets into the trolley so I do as well."

and

"Everyday is the same old routine, feed, move pigs, feed, move pigs. When they won't go where you want them too it so easy to lash out with the foot, they are so stubborn."

Habituation occurs in response to the work load and pressures created in the system and the fact that for many stockpersons coming into intensive livestock units the only role model is the existing staff. Thus in this environment new staff may become accepting of the poor treatment of animals, because they know no other or do not question it. This may arise through the gentle intimidation of existing staff, who may not want to adopt a changed method when their short cut enables them to achieve the task quicker. A similar process leads to perception adaption.

Perception adaption

Even if the individual comes into the unit with a perceived view of animals and a basic positive drive he/she may find this challenged.

"These sow crates and other parts of the system treat pigs like machines, so I suppose I now see them as mere machines, machines passing through the system."

The person thus treats animals like machines, the pressure and environmental influences overriding his/her basic care needs. In order for this to occur suppression must occur.

Suppression

In order to cope with the situation stockpersons may suppress their feelings. This is a well recognised coping mechanism to deal with unacceptable or uncertain situations, *"I would rather just not think about it"*, is a coping response. This is exemplified by the following statement;

"If you thought too much about the system and the conditions you just would not do it. You have to turn your thoughts off, you just can't think too much about the pigs in the crowded pens. As long as you feed them that is o.k."

Feelings of a basic desire to care may thus be suppressed, and replaced by a rationalisation process, *"they must be reasonably happy else they would not eat"*. This process of suppression can be reinforced by the Terminal concept.

Terminal concept
There is conflicting pressure on the stockperson who has to balance the pressure arising from caring for, relating to and interacting with an animal knowing that they will be killed and be eaten. The coping mechanism is one of not wishing to relate to the animal.

"No point in relating to them, they are going to die, best to detach yourself from them."

The stockperson may wish to reinforce their psychological distance from the animal by deliberately not relating and interacting with it. This will lead to poor observation and reduced welfare for the animal.

Selective attention
This occurs because of signal overload, attention is only given to certain events and abnormal behaviours of animals are ignored. This is generally a factor influenced by constraints on time available.

"I am so busy I really did not see that sick pig, there just isn't time!"

or

"I meant to go back and look later but other things needed to be done."

In fact the stockperson may look in the pen and genuinely not see a problem, and miss other signals, for example, auditory signals.

4. Aggression as an example of aversive behaviour
Seabrook (1994) published the results of a research study into aggression on pig units. The basis conclusion that the level of aggression was affected by the actions of role models. High aggression managers tend to have high aggression staff. One set of measurement showed that 73% of those stockpersons with low aggression scores spent more than 15 minutes per day talking with their animals, while none of the stockpersons with high aggression scores spent more than 15 minutes per day talking to their animals. The conclusion is that there are behavioural changes and factors that create negative influences for the welfare of animals, and that some stockpersons become more aggressive, particularly if the level of management is less effective.

In a more recent study (unpublished), involving in-depth discussions with 25 stockpersons both individually and in focus groups. They had all been on their units for at least 10 years. i.e. they were fully experienced. They were milking alone in a herringbone parlour or else where stockpersons on large pig units. In view of the high sensitivity of the aspects being discussed full confidentiality was assured in an attempt to achieve honest, open answers. The first stage of the research was to ask the stockpersons to think about occasions when they had acted aversively towards their animals. This was in an attempt to define what these highly experienced, well-trained and competent staff thought aversive behaviour was about. Table 5 sets out the descriptors given.

Table 5 Aggressive behaviour descriptors

DESCRIPTOR
"Provoked action and striking the animal with hand or stick"
"Using excessive force to move animal, including kicking"
"Loosing temper and pushing side when cow kicked off cluster in milking parlour"
"Loosing temper and pushing animals with gate or some other object"
"I admit to unprovoked action"

The staff were then asked to think of occasions when they had acted aversively and to try and explain what was happening. The results are shown in Table 6.

Table 6 Reasons behind aversive actions

REASON
"Time pressures, just so much to do, can't afford to hang about"
"Sheer frustration as animals can be so stubborn"
"Frustration with equipment, so take it out on cows"
"Cows kicking off clusters for no reason just gets to you"
"I have a short fuse"
"Family and home problems spill over into work"
"Same old routine, just didn't think"
"I was working outside my normal work boundary / area"
"My work role is complex, can't always juggle all tasks"
"Just got side tracked, just forgot what I was doing"

These are important results and further studies and analysis continues. The important implications for those involved in managing stockpersons are:

- The study highlights the pressures that exist on many dairy units, with the conflicting pressures on the stockperson, to achieve high work output in limited time while creating good animal welfare.
- The study raises the issue of the intense workload on many stockpersons and its potentially adverse affects for animal welfare.
- The manager must take time to watch the actions and point out failures when good behaviour is not being undertaken.
- The manager must take time to reward correct non-aggressive behaviour.
- The manager must make an effort to help with routine tasks.

5. Stockpersons on organic systems

A detailed study of the conclusions of the work discussed above might suggest that organic systems are designed to meet many of the problems identified. This may in part be true. However, they may pose other problems. This is an important issue for study. In a preliminary investigation at the University of Nottingham, twelve stockpersons working on organic (or converting to organic) livestock units were brought together in a focus group. The attitudes in the group range from *"I really believe in what I am now doing",* through *"I am interested, I'll try and make it work"*, to *"its a b........ silly idea, but I reckon there is money in it for me and the boss*." However most, if not all, recognised and commented on the specific problems they had as stockpersons. These are summarised in Table 7.

Table 7 Some comments made on "problems" in organic systems

COMMENTS MADE
The work
Work is physically harder
Tasks take longer
Straw is dustier than slats
My actions
I have to be more diligent and take more care
I have to pay more attention and be more observant
There are more problems to worry about
Solutions to problems are more complex
My animals
Animals are less constrained, I have less control, I can become more aggressive to them

Conclusions

The welfare of farm animals is crucially dependent upon the actions of the stockpersons who day in day out handle, observe and monitor the animals in their charge. The animals' well-being and performance depend as much of the stockperson as the building and the space allocation. Aversive action can arise through ignorance, but usually staff know what to do to handle animals correctly. They know what to do for good welfare but sometimes they do not act correctly and in their words *".. let ourselves and our animals down"*.

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Daily practice and dialogue - aspects of stockmanship and inter-human relations between farmers and their partners

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Introduction

Several epidemiological studies describe risk factors for different disease outcomes, and very often, a small remark is included in the conclusion pointing at the fact that 'individual herd characteristics' or 'management factors' may explain a large part of the variation in the study. In on-farm studies, the close contact to a number of different herds and farmers makes this statement obvious and striking: the difference between farmers with regard to strategies, daily practices and attitudes is substantial, also within the same types of farming systems.

When trying to include management factors in the spectrum of risk factors in an epidemiological model, a critical question eventually arises: were the management routines really present before the disease outbreak? Which one came first – the 'risk factor' or 'the outcome', and in which direction will the causal relationship work? Through a continuous contact to farmers, it can be illustrated that 'management factors' change over time – they are not static. The farmer reacts on what he or she observes - which seems logical! In practice, this means that one must be very strict when describing management related risk factors for e.g. mastitis, since the routines most likely have been changed several times in order to control or handle the situation. A management factor can be the outcome of a disease outbreak, because the farmer tries to change things and control the situation!

The more one goes into this fascinating landscape of human action and reaction, the more one gets caught. First the complexity and the chaos are dominating 'the search for the answer'. After travelling in chaos, the effort and the motivation to describe the local senses of logic take over. The aim of the studies is to find patterns that can be articulated, communicated, understood and form basis for an inter-subjective understanding of stockmanship. The aim of this presentation is to illustrate different aspects of stockmanship and inter-human relations related to a herd. The impact and importance of these for the daily practice and the outcome will be discussed, based on practical experience and interviews.

Material and methods

Presentation of research projects

- Synthesis of knowledge on animal health, welfare, and medication in organic herds when converting to organic farming. This project was carried through from 1998-1999 and was based on qualitative interviews of veterinarians and agricultural advisors and group focus interviews of newly converted organic farmers. The results of these interviews were presented and discussed by an expert panel from relevant research and practice areas. The results of the whole project are presented in a final report (in Danish; Kristensen & Thamsborg, 2000). Data and conclusions from this project are used in the part of this presentation concerning conversion to organic farming and co-work between the farmer and partners of the farm.
- Development of organic milk and egg production: A research project was carried through during the period from 1994-1998, primarily focusing on – beside egg production - mastitis, homeopathic treatment and characterisation of daily management routines in organic dairy production. 15 organic farms were followed closely, and farmers were interviewed about their daily routines. Milking routines were recorded through participation in milking, and procedures with regard to calving and milking of 1st lactation cows were investigated during farm visits and questionnaires on single cow level during a period of two housing seasons. Data from this project contribute in this presentation in the part concerning milking and daily routines, and with regard to the change from tied to loose housing.
- Project 'Development of Health Advisory Service in Organic Dairy Herds' is an on-going project (until summer 2001), which includes 20 dairy herds with agreements with their veterinarian and agricultural cattle advisor about health plans and health service in the herds, and 20 'control herds' (herds with no health advisory service). Data and preliminary conclusions from this project are currently being described, as well as models of co-work between farmers and the partners of the farm are being used in dialogue with farmers, veterinarians, and agricultural cattle advisors.

Qualitative interviews and participation-observation

Qualitative interviews have been carried out as described by Kvale (1996) and Strauss & Corbin (1990 & 1997). Thematic questions have been discussed in semi-structured interviews, which were taped and later transcribed in full length. Analysis has been carried through by means of grounded theory analysis as well as through case studies where qualitative aspects were combined with direct observations and recording, and analysis of central data. Milking and other daily routines have been described through observation in the herd, and disease treatment patterns have been regularly described through data analysis and in interviews with farmers and veterinarians.

Results and discussion

The conversion process

The experience of converting from conventional to organic farming was described both from veterinarians', agricultural scientists', and farmers' points of views through interviews in relation to the project 'Synthesis of knowledge' in 1998-1999. A number of changes in the dairy herds, the disease pattern and the farm structure were described and discussed (Vaarst, 2000a & b). Severe disease problems were described among small calves, which had to stay outdoors during the summer. Many of these problems could be related to lack of familiarity with such systems (both farmers and advisors). The farmers' focus during conversion was mainly on the fields and crops, and the cow herd – despite changes in housing system (in some cases) and changes in the feed ration – was often regarded as relatively uncomplicated.

The legislation with regard to use of pesticides and chemical fertilisers was regarded as 'logical' while the rules about disease treatments and other factors in the herd were regarded as illogical, e.g. the prolonged withdrawal time. In many cases of conversion, very little communication between farmers and persons related to the herd (veterinarians, agricultural cattle advisors) was experienced. The combination of a farmer, who was a bit uncertain about new routines, and veterinarians, who did not sympathise or seem to find any particular challenge in organic animal husbandry, seemed to cause a relatively low degree of focus on the conversion of the herd. Some farmers had unrealistically high expectations on the decrease of disease incidence after conversion. In spite of the fears expressed by most of the interviewed veterinarians in regard to avoidance of treatments when needed, organic farmers did have their animals treated when relevant and necessary. These experiences opened a discussion on how to understand animal welfare in the framework of organic.

Furthermore, the terms 'technical conversion' and 'mental conversion' were clearly illustrated through the many examples given by interviewed persons. Technical conversion is considered as the process of changing things in accordance with the rules. Mental conversion describes the change in the farmer's (or veterinarian's) mind so that 'being organic' is a part of the identity of the 'converted person', and he/she can explain the idea of organic farming from inside. In Figure 1, this is illustrated in a simple diagram, demonstrating the process of the conversion as experienced by interviewed persons.

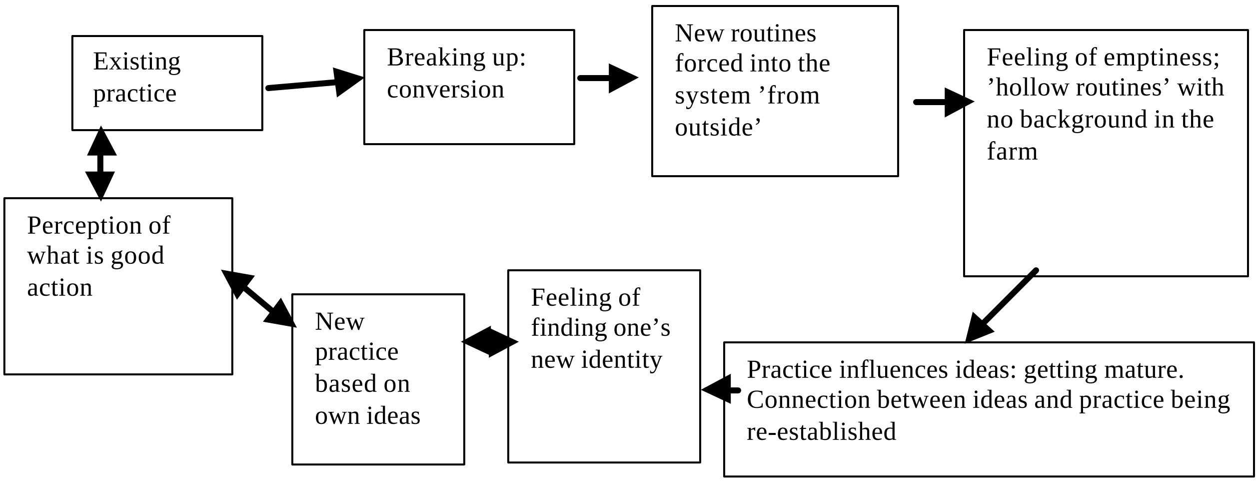

Figure 1. A simple diagram, illustrating the interaction between new practice and development of new ideas, while identifying oneself and one's farm with the idea of organic farming. This model may explain the conversion in cases, where the 'technical conversion' is started before the 'mental conversion'. Modified from Vaarst (2000; Chapter 3 in Kristensen & Thamsborg, 2000).

Daily routines: the example of milking

In a dairy herd, milking is repeated twice per day all year round. It is a direct confrontation between cow and stockperson. Much inter-action takes place in relation to milking, including observation of the cow on a more general level (claws, way of moving etc.). The behaviour of the cows in a whole herd context is also expressed relatively clear in this situation (e.g. dominating cows and their ways of entering a milking parlour). There is a huge variation between herds, which is illustrated in Table 1.

In another example (Table 2), milking in two herds is presented in more detail. Herd 6 is a loose-housed herd with milking parlour. In this herd, hardly any 'extra routines' were carried out. Herd 1 is tied housing system with relatively few cows (30). In this herd, more than 40% of the cows were subject to some 'extra routines'. This illustrates the situation of the milking. In a traditional Danish milking parlour, the rhythm of the milking has to be relatively uninterrupted. All cows enter at the same time and leave at the same time. The farmer cannot decide any specific order of the cows. One 'difficult cow' can delay everything and disturb the rhythm of the whole milking. If in need of extra care, the cow has to be marked in a way which makes it easy to identify – but it will still delay the milking of maybe 11 other cows, if the farmer concentrates on this single cow a couple of minutes extra. In a tied housing system, more flexibility is possible, because the milking machines are carried to the cows, and the farmer can go back to one specific cow, which may need some extra milking out by hand or other types of care. The advantages and disadvantages of two widely different systems may be illustrated through these cases: the flexibility in the tied housing system, where the farmer is 'allowed' to return to each cow and do something extra, and the firm rhythm, where cows continuously enter and leave the milking parlour. The milking of the two herds takes approximately the same time!

Table 1. Reactions of cows in 10 organic herds, described through direct observation of 2-5 milkings per herd, illustrating the huge variation between herds (from Vaarst, 1997).

Herd	No. cows observed / no. milking	Defecation during milking, %	Kicking, %	Kicking off the milking machine %	Kicking restraint used, %	Farmers' palpation of udder, % cows	Milking by hand after machine, %
Tied housing system							
1	(114 / 5)	6	4	1	0	29	10
2	(110 / 3)	1	7	0	0	10	0
Loose housing system with milking parlour							
3	(547 / 5)	1	7	2	2	20	4
2	(95 / 2)	2	29	0	1	2	1
4	(765 / 4)	0	4	1	7	1	0.5
5	(270 / 5)	0	6	3	1.5	33	3
6	(369 / 5)	0	3	0	3.5	0	1.5
7	(223 / 4)	7	4	3	3.5	77	1
8	(367 / 5)	0.5	3	0.5	0.5	2	3

Table 2. Examples from two different housing systems with regard to their milking of cows.

	Herd 1	Herd 6
Housing system (no. cows milked)	Tied housing (approx. 30)	Loose housing (approx. 73)
Using kicking restraint	0	3%
Kicking off	4%	0
1 gland not milked ('dried off gland')	11%	1,5%
Palpating the udder after milking	39%	0
Milking by hand after machine milking	4%	0

One aspect of the conversion process in the herd: from tied housing to loose housing system with specific focus on milking

In a large number of herds, conversion to organic farming has included change of housing system. The change may lead to udder health problems, and this is very often described as being due to technical difficulties (e.g. new milking equipment, new floor) and the cows getting used to the new routines. The difficulties of humans getting used to new routines should not be over-looked. Through interviews, it became clear that the change takes place on a deeper level. In the following, the experience of change is outlined in some of the points observed and described among the farmers who changed housing and milking system:

- The farmers described that they continued to remember the cows on 'where they used to be placed' in the housing system. New cows coming into the herd were

consequently not given ‘an identity’, since they had never had a place in the old system.
- In the tied housing system, it was possible to observe the manure and the eating pattern of each cow. In the loose housing system, the farmer should learn to look whether the cows actively came to eat.
- Tied housing systems give the possibility to handle single cows very easily, just by walking up to it. In loose housing systems, you had to find the cow and catch her first.

In general, the change was considered great, and the farmers described it as very basic for their whole perception of animals and their own role in relation to the animals. Farmers, who normally focused on single animal level, watched ‘whole animals’, and took care of single animals, had to get used to working with flocks of animals, where the single animal was less in focus and less under control. The farmer had to focus on the whole group and the interactions between individuals, and he was confronted with the question about e.g. culling cows, which were ‘difficult’ in a milking parlour. The whole policy of the herd had – in other words – to be revisited.

Aspects of health advisory service: co-work between the farmer and his ’partners’
The co-workers (advisors, vets, consultants) of the farm have significant influence on the actions and daily practice in the herd. During conversion to organic farming, it is the duty of the co-workers to make an effort to understand the process of conversion, and to support the farmer in finding and expressing the goals for the herd and the farm. In a current research project in 20 organic dairy herds, the process of communication and dialogue is described through farm-meetings, interviews, group-focus-interviews, and meetings between farmers and their advisors. The experience from the first 1.5 years of the study indicates the following:
- It is absolutely necessary in a co-work process that the farmer has clear goals for the herd, and that he expresses these goals as a part of the co-work process. It is the responsibility of the organic farmer to identify, which kind of advice he needs and wants, especially when dealing with advisors who are unfamiliar with the idea of organic farming.
- The co-worker (veterinarian or agricultural cattle advisor) must guide the development in the herd and advice the farmer towards the expressed goals set for the farm and in accordance with the logic and the strategy of the farmer. It is acceptable to ask critical questions about organic farming and to the practice of the farmer, but not to the basic ideas: the advisors should help the farmer to fulfil his or her strategy in a way, which meets the demands of animal welfare etc. This demands a lot of creativity and context-dependent advice, which is a challenge to all involved.
- The veterinarian’s contact with a farm is very often based on acute disease treatment and practical work (e.g. fertility control, dehorning etc.). The pattern of this role should be broken, and this can only happen in a very active dialogue where the farmer is conscious about the goals for his herd. Roles should be defined and accepted.
- Dialogue is basically a meeting between two different rationalities. All people – also farmers and veterinarians – practice on a rational basis, even though they may not

share the ideas of what is ‘rational’. This demands sincere interest for other humans – and time and work. A dialogue should basically be viewed as a dance (if one falls, both fail) rather than a war (one-of-us-can-win-and-one-of-us-can-loose-attitude).

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Strategies to improve animal welfare through "good" stockmanship

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Introduction

Animal welfare in intensive farming systems is often poor. Most often, housing and management conditions do not meet the minimal standards, which are known as the "Five Freedoms" (first formulated by the Brambell Committee in 1965, reformulated in 1993 by the Farm Animal Welfare Council (FAWC). These minimal standards were accepted as guideline for European conduct. However, according to Broman and Legge (2000), European policy in practice, is guided by financial, rather than ethical considerations.

In contrast to intensive systems, ethical considerations are the frame of reference for organic stock farming. However, also in organic stock farming, there is an increasing tendency to strive for increased production efficiency at the expense of ethical considerations in general, and animal welfare more in particular. Thus, it was recently accepted by SKAL (certifying organization for organic products) to beak-trim laying hens in organic farming systems in the future in an act that will inevitable decrease animal welfare standards.

Public concern about animal welfare is growing. However, this concern is accompanied by a proportional confusion about questions like "what is actually meant by the concept of animal welfare", "how can animal welfare be measured and quantified" and, finally, "how can optimal levels of animal welfare be realized in daily farming practice". To preserve and improve animal welfare standards in organic stock farming, it is therefore

important to communicate better, what we want to preserve, and, how we want to preserve it.
This paper will first present a study on differences in perception of animal welfare among a population of Dutch pig farmers. Subsequently, we propose and summarize some major principles that could guide the farmer's behaviour to improve animal welfare on his/her farm. These principles are derived from available scientific evidence from the field of applied ethology and have been summarized by De Jonge (2000).

Perception of animal welfare

As part of a larger study on "perceptions of animal welfare in the Netherlands", we interviewed 24 pig farmers in the Netherlands in order to investigate their norms and values on animal welfare, and how these were related to farm management, behaviour and attitudes towards their animals. The farms included both organic and conventional farms, and the size of the farms varied from 1 to 100 sows and 9 to 600 fattening pigs for the organic farms and from 110-400 sows with 500-4500 fattening pigs for the conventional farms.

From these interviews, it became clear that both organic and conventional Dutch pig farmers thought that animal welfare on their own farm was reasonably "good", although both types of farmers also thought that the level of animal welfare could be improved. However, conventional farmers predominantly related the concept of animal welfare to 1) the level of production efficiency on their farm and 2) the question whether or not housing conditions fulfilled the officially prescribed regulations. On the other hand, the interviewed organic farmers 1) related the concept of animal welfare primarily to the animal's ability to perform "natural" behaviour, 2) estimated the level of welfare on their farm primarily on the basis of their own observations of their animals and 3) thought that the prescribed regulations for organic stock farming could only function as a general frame of reference for further optimization of animal welfare through adaptation of housing conditions and farm management procedures on their farm. Finally, both organic and conventional farmers agreed that a compromise should be found between the sometimes-conflicting interests of animals and farmers. In summary, the results showed that organic and conventional farmers have similar *values*, but different *norms* about animal welfare.

In general, people that professionally deal with the concept of animal welfare tend to operationalize the concept in terms that are manageable. Organic farmers operationalize animal welfare mainly in terms of the animal's possibilities to perform "natural behaviour". Conventional farmers in contrast, are more inclined to search for a simple measuring scale. It should be stressed, however, that *"animal welfare involves the subjective feelings of animals"* (Dawkins, 1990), implying that animal welfare will be determined both by the present and past experiences of the animal and both by its physical and psychological condition. The possibilities to perform "natural behaviour" can, from this perspective, function as the best reference point available and an "animal welfare scale" may be useful when composed of many different parameters and taking life history into account. More or less sophisticated animal welfare scales (e.g. Animal Welfare Index or Tiergerechtheitsindex) most often fail to address all different aspects.

Breed

Good animal welfare on the farm starts with the choice of a breed with low incidence of genetically determined welfare problems. On farm selection for those characteristics that optimally fit the local farm production conditions (family breeding), may be realized by some, but not by all organic farmers. The breeding goals of conventional farming systems, which have been exclusively directed towards increased production efficiency, have most often resulted in animals that will not be able to profit from welfare friendly housing conditions and management procedures. The type of breed, therefore, may severely frustrate the farmer's efforts to improve animal welfare. Some welfare problems are well documented (for instance the growth rate of broilers, high milk yields in cows associated with increased incidence of production diseases). Others however, have been less well documented: the majority of pig breeds, for instance, have been consistently selected for the production of lean meat. As a consequence, sows tend to lack adequate fat reserves to feed the piglets for longer than 4 weeks. The extended weaning periods that organic farms strive for, therefore, tend to deteriorate the sow's condition, to decrease her welfare and to lower her production capacity (De Jonge, 2000; Rauw *et al.*, 1998).

Early ontogeny

Production animals are often gregarious species. In such species, social skills are typically learned during the early ontogenetic period: playing among peers and the mother, infant interactions appear of crucial importance to learn adult social skills. But also other learning processes during this early ontogenetic period may profoundly influence the behaviour of the animal in adulthood. Examples are learning processes related to the search and acquisition for food, learning to flight in response to threatening but not in response to "safe" stimuli and learning to understand and cope with a complex and challenging environment. For instance, only a very limited number of laying hens may use an outdoor pasture if they are not reared in an environment in which they learned to explore a pasture during early development. Similarly, feather pecking was decreased in laying hens kept in groups and on appropriate straw bedding, but particularly so in hens that were reared on straw bedding after hatching. Contact with handlers during this period diminishes fear and facilitated friendly human-animal relationships in cattle, hens and pigs.

Mother-infant interactions with more than conventional possibilities of the sow to regulate the nature, intensity and frequency of interactions with her piglets, help to keep the sow's physical condition good: thus Weary (2000) could show that sows on low quality diets tend to decrease the number of sucklings thereby stimulating the piglets urge to feed concentrates at a somewhat younger age. As a result, sows could be reinseminated earlier and piglets showed less diarrhoea after weaning.

Apart from beneficial effects of appropriate ontogenetic conditions, there is growing evidence that physical or psychological stressors during the early ontogenetic period, and even during the prenatal period, may decrease the animal's potential to cope with future stressors in adulthood. Thus, capacities of farmers to optimize animal welfare of the animals on their farms will be limited *a priori* if their piglets, calves, hens and broilers are (sometimes necessarily) derived from conventional breeding companies.

In my own research, I studied the effects of rearing conditions on later social skills, stress-susceptibility and reproductive capacities in pigs. Half of the piglets were reared and born to tethered sows in a conventional farrowing crate. The other half was born to sows kept on an outdoor pasture and farrowing in $4m^2$ straw-embedded get-away farrowing crates with 0.5 ha outdoor pasture. After 4 weeks, all piglets were weaned and kept under exactly the same conditions during the rest of their life. The results showed that piglets reared under barren conditions, showed more aggression. As a result, submissive animals that were originally reared under barren conditions, showed higher levels of cortisol, lower growth rates and belated puberty. Finally, when all the animals were subjected to severe stressors, the piglets reared under barren conditions, showed more stereotypies and an accelerated decrease in the expression of oestrous behaviour.

The available evidence actually suggests that the quality of the rearing conditions may determine the extent to which farmers are able to improve animal welfare in their adult stock (De Jonge, 2000; Rauw *et al.*, 1998; Weary, 2000; De Jonge *et al.*, 1996; Braastedt, 1998).

The physical and social environment

Favourable housing conditions for production animals, are often defined in terms of available space and whether social contacts between animals are possible. However, dimensions, bedding, compartimentalization and human animal interactions within this environment appear to be of even higher importance. In addition, since most domestic animals are typically gregarious species, creating an environment that enables the development of qualitative, good social relationships between animals, deserves even more attention from the stockperson.

A review of literature on stress, it appears that negative implications of stressors are strongly ameliorated when the animal is able either to predict or to control the arrival of a stressor ("perceived control of the environment"). This knowledge emerged in the seventies when Weiss could show in an experiment with rats that the effect of electric shocks on a variety of stress parameters diminished when the arrival of the shock was signalled by a light, and even more so, if the rat was also able to prevent the arrival of most shocks by active manipulation of a wheel. Thus, stressors may lead to stress symptoms in animals that have the *feeling* that they can neither predict nor control their environment, while similar stressors may lead to fewer symptoms when the animal *perceives control* about the environment. For instance, in terms of social relationships, it is to be expected that "perceived control" of each other's behaviour is strongly diminished in large flocks or herds. Several examples of how such principles may be integrated in management-procedures have been given (Wiepkema and Koolhaas, 1993; De Jonge, 2000).

Similarly, the impact of positive rewards in the physical and social environment of animals may be increased by integration and application of principles from learning theories in animals. Thus, according to the effects of "intermittent rewards" as opposed to "continuous rewards" on the animal's motivation to work for such a reward, it should be expected that continuous application of “rewarding stimuli” (for instance access to a pasture, giving the animal’s favourite food, access to a mud-pole for pigs) may have less impact in terms of the animal’s well-being than situations in which such “rewarding stimuli” are given intermittently. Conversely, the impact of aversive stimuli may be decreased by effectively associating such aversive events to “positive” rewards (Spruijt, in press; De Jonge, 2000).

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Improvement of human-animal relationship needs a reliable measurement tool for animal welfare

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Introduction

Human-animal relationship plays a central role in the development of animal-friendly housing systems. It is important to know how well or badly our farm animals fare, if animal welfare on farms is to be improved. Some farmers have a good intuition for the needs of their animals, but usually a basis or a guide is required to keep animals under conditions that meet their requirements with respect to animal welfare. Agricultural advisory agencies also need an assessment tool to help farmers to get a better understanding for the needs of their animals. The target of all efforts must finally be the continuous improvement of animal welfare in animal husbandry.

In Austria, animal welfare is assessed by an index system, the "TGI[1] 35 L" Animal Needs Index (Bartussek, 1997 a, 1997 b, 1998, 1999).

It is not only used as a guide for the farmer to detect faults in the housing system and as an advisory tool but also for certification of animal products. The "TGI 35 L" Animal Needs Index is widely used in Austria with animal welfare currently being assessed on about 20,000 farms by about 150 trained assessors. It is widely accepted by the authorities, farmers and consumers. Since 1995 the "TGI 35 L" is mainly used in controlling animal welfare in housing systems in organic farming and on a private law basis for "welfare-friendly" animal products. Prices farmers get for their products as

[1] TGI = Tiergerechtheitsindex

well as subsidies depend on the result of the welfare assessment. The "TGI 35 L" is also included in animal welfare legislation of Salzburg and Tyrol.

The "TGI 35 L" Animal Needs Index was firstly introduced in 1985. It has been under continuous development over the past years. The TGI index system includes the following aspects that are considered essential for animal well being (Bartussek, 1997 b):

- movement possibilities;
- possibility of social contacts with other animals;
- floor design;
- climatic conditions in the housing; and
- intensity of care by the farmer.

It is recognised that animals can compensate negative influences in one aspect by positive ones in another as long as their adaptability to their environment is not exceeded. The form to be filled in for the assessment is divided into five sections corresponding to the list above. Each section is scored. The better the housing system and management by the farmer the higher the TGI score. The TGI system takes into account the phenomenon of compensation by adding the scores that are achieved in the five sections to give a total score. However, minimum standards have to be achieved in each section. If not, the TGI is only scored provisionally. The housing conditions have to be improved within a fixed period of time, and then the TGI is scored again.

As mentioned above, the assessment of animal welfare by the "TGI 35 L" has major consequences for farmers. So it is important to investigate the quality of this assessment tool.

In the last years, the Institute of Agricultural, Environmental and Energy Engineering (ILUET) examined the sensitivity of the "TGI 35 L", and also first results could be obtained concerning the precision of assessment of animal welfare, e.g. the repeatability between persons. In an ongoing research project, ILUET will continue to validate the assessment quality of the "TGI 35 L 1995/96" Animal Needs Index in housing systems for cattle, calves, fattening pigs and laying hens on a broad data basis. The investigations will focus on the repeatability of the assessment between persons and within persons, the development of further parameters for the assessment section "Looking after the animals" and on the correlation between the TGI score and animal health and behaviour parameters.

Sensitivity

In the last years, the Institute of Agricultural, Environmental and Energy Engineering (ILUET) examined the sensitivity of the "TGI 35 L" and derived measures, which could further improve the assessment quality (Schatz, 1996). It was shown that the "TGI 35 L" is able to detect faults in housing systems. Hence it should lead to eliminating such faults in Austrian animal husbandry.

Precision of assessment

The precision of assessing animal welfare with the “TGI 35 L” has been subject to research projects, as well (Amon *et al.*, 1998; Kummernecker, 1999; Ofner, 1999). Precision is the closeness of repeated measurements of the same quantity to each other (Sokal & Rohlf, 1995). The research projects aimed at investigating the precision of the total TGI score as well as the precision achieved in each section of an assessment.

ILUET aimed to investigate whether animal welfare could be assessed sufficiently precisely by the “TGI 35 L”, the magnitude of errors, and what measures would further help to improve precision of the assessment.

This paper describes the results from this work.

Materials and methods

Precision of animal welfare assessments by the “TGI 35 L” Animal Needs Index was investigated on 13 dairy farms in Austria. 74 persons who are employed by controlling agencies to carry out the assessment were included in the investigation. The TGI score for each dairy farm was assessed by two to nine different persons who worked at the same time, but independently. Thus it was possible to calculate the repeatability of the assessment between persons. “Repeatability between persons” here signifies the ability of different persons to carry out the assessment on the same farm and to assign similar TGI scores to the farm.

Repeatability between persons

Repeatability ($\hat{w}$) is a measure of the precision of observations or measurements (Sachs, 1992). It describes the relative similarity of repeated measurements on one object compared with results obtained from measuring different objects (Essl, 1987) and is thus a means for quantifying the quality of observations or measurements. Repeatability is calculated according to the following formula:

$$\hat{w} = \frac{s^2(b)}{s^2(b) + s^2(e)}$$

where:

$\hat{w}$	=	repeatability
$s^2(b)$	=	variance of the farm
$s^2(e)$	=	error variance

The principle of assessing repeatability is already widely used, e.g. in animal breeding (Essl, 1987; Pirchner, 1979) or in describing meat quality. ILUET wanted to apply the principle of assessing repeatability to the assessment of animal welfare, as well.

Repeatability can vary between 0 % and 100 % for non to fully repeatable. The higher the repeatability of the TGI score, the more precise the animal welfare assessment. If the repeatability is low, the TGI score has to be assessed several times on the same farm in order to get a reliable result. If the repeatability is high, animal welfare can reliably be assessed by one single observation on each farm, because in that case results would differ very little if the assessment was repeated several times. Thus repeatability markedly influences the amount of time and money that is needed to obtain reliable assessments.

Repeatability, however, is also influenced by the differences between farms. This means that if the precision of assessment is to be estimated correctly, the farms included in the investigations have to be representative of Austrian conditions.

The variances that can be traced to the farm or to the assessment are estimated by an analysis of variance using the following model (Essl, 1987):

$$Y_{ij} = m + b_i + e_{ij}$$

where:

Y_{ij} = assessment of animal welfare j = 1,2... 4-9, on farm i = 1,2...13;

m = mean of the sample;

b_i = deviation from m that can be traced to the farm;

e_{ij} = randomdeviation from $m + b_i$ (error of assessment).

Error standard deviation

Differences in the TGI scores can either be caused by differences between farms or by differences in the assessment of the same farm by different assessors. The latter is called "error standard deviation" and is an important factor in the precision of assessment. s(ε) is the estimated standard deviation of the TGI scores on a given farm and is an absolute measure of the differences in the TGI scores that can be exclusively traced to the assessment. It is therefore a very suitable measure of the precision of the assessment.

$$s(\varepsilon) = \sqrt{s^2(e)}$$

where:

s(e) = error standard deviation

s²(e) = error variance

Results and discussion

Table 1 gives the repeatability between persons of the TGI score that was estimated in the investigations. The repeatability was 96 %. This means that the TGI score can be assessed sufficiently precisely by having only one assessment on each farm. The results also allow one to calculate how often the TGI would have to be assessed if a given repeatability was to be achieved. For example if different people assessed the TGI score twice on the same farm, the repeatability would rise to 98 %. This is calculated according to the following formula (Essl, 1987):

$$w_k = \frac{k \cdot w}{1 + (k-1)w}$$

where:

w	=	repeatability, if the TGI score is assessed once
w_k	=	repeatability, if the TGI score is assessed k times

The error standard deviation is also a measure of the precision of the assessment. With a confidence interval of 95 %, 95 % of all TGI scores lie in the area of “true TGI ± 2 s(ε)”, i.e. if 100 assessors assessed the TGI score on one farm, only 5 assessments would show a larger deviation from the true TGI score than ± 2.34 points.

Table 1. Repeatability between persons and error standard deviation of the TGI score.

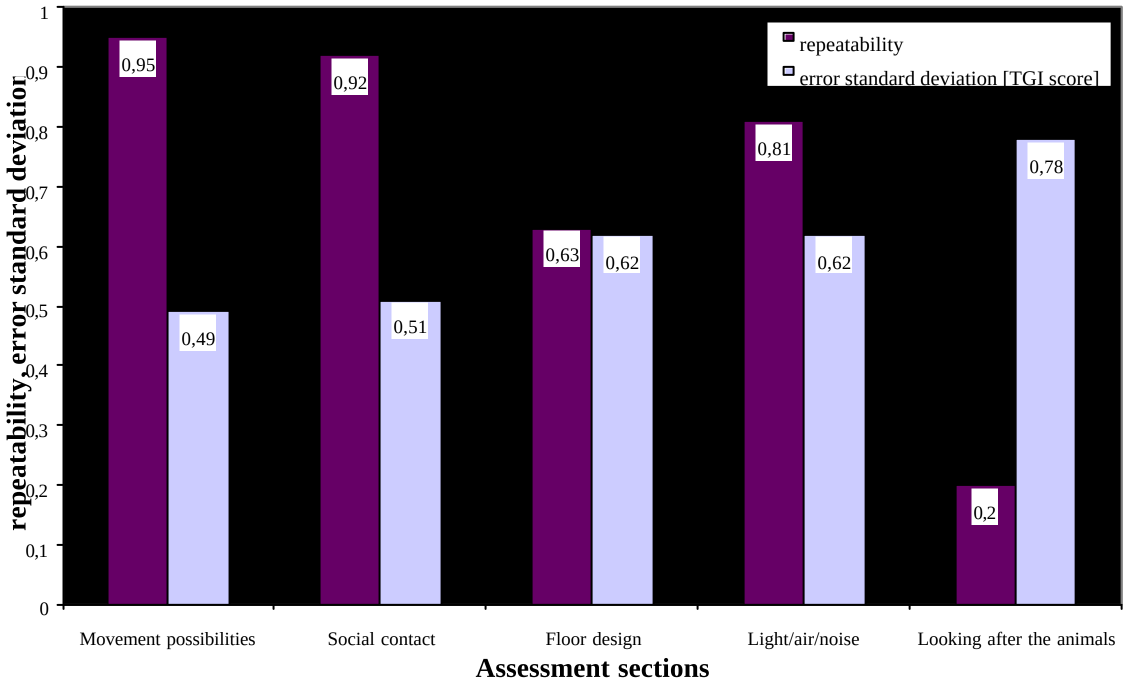
Assessment section	Repeatability between persons	Error standard deviation s(ε) [1] [TGI score]	Deviation from the ”true TGI” 2 s(ε) [2] [TGI score]
Movement possibilities	0.95	0.49	± 0.98
Social contact	0.92	0.51	± 1.02
Floor design	0.63	0.62	± 1.24
Light/air/noise	0.81	0.62	± 1.24
Looking after the animals	0.20	0.78	± 1.56
Total TGI score	0.96	1.17	± 2.34

[1] with a confidence interval of 68 % (for normal distribution)
[2] with a confidence interval of 95 %

The precision of assessment is different in the different sections (Table 1, Figure 1). ”Movement possibilities” and ”social contact” showed high repeatability and can therefore be assessed with high precision. ”Floor design” and ”light/air/noise” showed medium repeatability. ”Looking after the animals” had a low repeatability.

The differences in repeatability in the different sections can be traced to the criteria that have to be assessed. If they can be measured objectively — e.g. m^2 per animal or days of pasture — repeatability is high. If the criteria also have a subjective component — e.g. cleanliness of the animals — repeatability is lower. However, animal welfare is a complex phenomenon that cannot be fully described only by objectively measurable criteria. Qualitative and subjective criteria are very important for a comprehensive assessment of animal welfare and should, therefore, not be excluded from the TGI system. While qualitative, subjective criteria show a lower precision of assessment, the overall precision is still at a sufficiently high level.

Figure 1. Repeatability between persons and error standard deviation of the TGI score.



There are two possibilities for further improving the precision of assessment:
(1) making repeated assessments of the TGI score on each farm
(2) reduction of the error standard deviation

In Austria, it has been decided to choose the second alternative. The error standard deviation can still be further reduced by the following measures:

- further improving the descriptions of the criteria that have to be assessed on the basis of experience gained
- intensive theoretical and practical training of the assessors
- exchanging assessors between the Austrian regions
- regular exchange of experience between the assessors
- improved co-operation and exchange of experience between the Austrian controlling agencies

Current research on precision of assessment

In the next two years, ILUET will continue to investigate the precision of assessment of animal welfare by the "TGI 35 L 1995/96" Animal Needs Index in housing systems for cattle, calves, fattening pigs and laying hens. The investigations will focus on the repeatability of the assessment between persons and within persons.

Repeatability between persons

The first aim of the project is to investigate the repeatability of the assessment between persons on a broad data basis. The TGI assessments will be carried out by trained assessors who are employed by controlling agencies. They will assess animal welfare in 110 houses for dairy cows, calves, fattening pigs and laying hens. On each farm, several persons will assess the TGI score at the same time, but independently from each other.

Repeatability within persons

A second aim is to investigate the repeatability of the assessment within persons. Again trained assessors who are employed by controlling agencies to carry out the assessment will be included in the investigation. The same farm will be assessed by the same assessor several times in course of the year. The similarity of these assessments will be analysed. These investigations will comprise housing systems for dairy cows, calves, fattening pigs and laying hens.

Development of additional parameters for the assessment section "Looking after the animals"

A third aim of the above mentioned research project is the development of additional parameters for the assessment section "Looking after the animals". "Looking after the animals" is the fifth assessment section of the TGI assessment system and should describe the quality or intensity of the stockman's care for the animals, i.e. it describes human-animal relationship.

The problem of "measuring" the quality of human care has not yet been resolved satisfactory. There are indicators of human-animal relationship that can be easily assessed by a person visiting a farm for about half an hour. But these indicators do not fully depict the quality of the human-animal relationship (Bartussek, 1999). In addition the repeatability of the assessment section "Looking after the animals" is comparatively low. Thus, it is necessary to find and test additional parameters to improve the assessment of human-animal relationship on farms.

The research project has started recently. From extensive literature studies a questionnaire was compiled, which will be filled in by users of the TGI assessment system and by a number of experts in the area of animal welfare. The results will be the basis for the development of additional parameters for the assessment section "Looking after the animals". The parameters will then be tested with respect to the precision of assessment.

Correlation between the TGI score and animal health and behavioural parameters

The ongoing research project will further validate the assessment quality of the "TGI 35 L" by investigating additional aspects. The aim is to see if there is a correlation between animal welfare assessed by the "TGI 35 L" animal needs index and animal health and behavioral parameters. A housing system is suitable with respect to animal welfare if the animals living in it remain healthy and feel well (Bartussek, 1988). If the "TGI 35 L" Animal Needs Index is a suitable measure for animal welfare, a high TGI score must correspond to a low level of health problems and behavioral disturbances. From the results it can be derived if the criteria assessed by the "TGI 35 L" ensure a high level of health and normal behaviour. In a first step it is necessary to find parameters of animal health and behaviour that can be mainly traced to the housing system. Again from extensive literature studies two questionnaires were compiled which will be filled in by a number of experts in the area of animal welfare.

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The behaviour of farm animals and its significance for housing design

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Introduction

With regard to livestock, one of the principle aims of organic production and processing is "to give all livestock conditions of life with due consideration for the basic aspects of their innate behaviour" (IFOAM Basic Standards). This basic standard has strong implications for the design of housing systems for organic livestock. One major point that should be met by housing conditions in order to fulfil this aim has already been emphasised by Vonne Lund at the 2nd NAHWOA workshop (Lund, 2000). By asking whether there can be a specific "organic" definition of animal welfare. She discussed concepts from which criteria for a suitable definition of animal welfare in organic systems can be developed. The "respect for nature"-concept includes that the animals' integrity and dignity must be respected, and Lund argued that this "could require the opportunity for the animal to exhibit species-specific behaviour in an environment as close as possible to the species' `natural` environment – in other words, similar to the environment that animal would have chosen if wild, or at least offering key features of that environment." In this paper, I will discuss that this claim can be derived from and justified by the behavioural evolution of farm animals. Subsequently, I will give some examples illustrating that the knowledge of the behaviour of farm animals is significant for housing design and management practices.

Ultimate functions and proximate mechanisms of behaviour

Just as the anatomy of our farm animals also their behaviour has evolved as an adaptation to their respective natural environment. For example, in cattle the rumen has evolved as an adaptation, which enables the animals to digest coarse grass. Equally, the behavioural patterns shown in the context of feeding have evolved as an adaptation, which enables cattle to ingest grass. Both the anatomy and the behaviour are highly adaptive since they enable the animal to survive and to reproduce successfully in their natural environment. That is, each behaviour, which is shown by animals, has its specific biological function and reflects the characteristics of the environment in which the behavioural patterns have evolved.

When we talk about the function of a behaviour we ask how the behaviour contributes to the survival of the animal or its success at reproducing itself, i.e. we ask for the ultimate function of a behaviour. For example, when we ask why cattle uses the tongue to grasp the blades, the answer is that this is the most effective way for this species to get grass into the mouth. Throughout the evolution of cattle, subjects have been positively selected which showed this behavioural pattern.

However, it is obvious that an animal does not ask for the ultimate function of its behaviour and that an animal's behaviour is not driven by its ultimate function. Instead, the behaviour of an animal is controlled by certain proximate mechanisms. The perception of external and internal stimuli result in a motivation to perform a particular behaviour (Fig.1). For example, after resting at night the behavioural activity will be triggered by sunrise and by a feeling of hunger. Subsequently this motivation will cause the cow to search for specific cues in her environment, for instance, for places with long, green leaves at pasture. She will stop searching after she has perceived such a place. She will now be motivated to graze and will stop grazing when she perceives that her rumen is filled and/or the temperature becomes too warm due to sunshine. Thus, the behaviour is controlled by a sensory feedback from the result of the behaviour to the motivation to perform this behaviour (Fig.1).

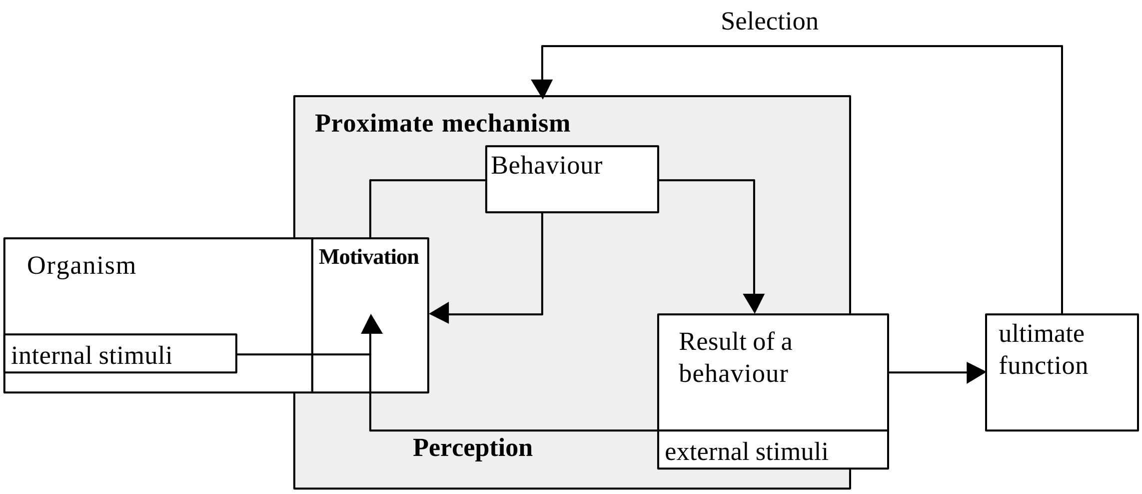

Figure 1: Feedback loops between the motivation to perform, the performance, and the result of a behaviour (proximate mechanisms), and between the ultimate functions of behaviour and the proximate mechanisms (see text for details).

However, it has also been shown, that the performance of the behaviour itself can feed back to its motivation, for instance, in the nest building behaviour of sows. Arey *et al.* (1991) offered sows a pre-formed nest one day before farrowing. If the motivation to build a nest would be fed back negatively by the nest, i.e. the result of nest building behaviour, the amount of nest building behaviour should be reduced in presence of a nest. However, even in the presence of a pre-formed nest the sows still performed nest building behaviour and, actually, increased the activity of behaviours, which are more typical for latter stages of nest building. In another study on nest building behaviour of sows Jensen (1993) found that nest building behaviour can be divided into two parts: A first part of preparation of the nest site which is largely triggered off internal factors, and a second and later part of gathering and arranging nest material which is largely dependent on external stimuli.

In sum, the proximate mechanisms, which lead to the performance of a particular behaviour at a particular moment are feed back by the perception of the result of the behaviour or by the performance of the behaviour itself (Fig.1).

Proximate mechanisms and ultimate functions of behaviour are often disconnected in farm animal housings

In nature, the proximate mechanisms, which control the behaviour, are inextricably connected with their ultimate functions and, consequently, have a strong genetic background. Throughout the process of evolution, such individuals have been positively selected, whose proximate mechanisms serve a particular function best. This holds irrespective from the flexibility of behaviour and from the selectivity of the perception of environmental cues. Both reflect the particular requirements of the environment in which the respective species evolved. For example, the possibility to modify behavioural patterns by learning is adaptive in a changing environment, and fixed behavioural patterns are adaptive whenever an animal has to react without any experience (e.g. searching for the teats, flight from a predator).

Under husbandry conditions, the connection between proximate mechanisms and ultimate functions is often disrupted. The design of animal housing at conventional farms is most often exclusively directed to the ultimate functions. In order to optimise production the growth, maintenance, and reproduction of animals are ensured as much as possible by technical solutions, such as sophisticated feeding systems and artificial insemination. The proximate mechanisms, which have evolved to achieve these functions, are ignored and farm animals are hampered and often not allowed to perform a variety of behaviours, which they would show in the wild. It should be noted that throughout the process of domestication, none of the natural behaviours have disappeared. The behavioural repertoire of domesticated farm animals is fully comparable to that of their wild ancestors (for review see: Reinhardt, 1980, Stolba & Wood-Gush, 1989, Wechsler *et al.*, 1991).

The neglect of the proximate mechanisms of behaviour can result in behavioural problems of farm animals. The animals (a) are motivated to perform a particular behaviour but cannot succeed as they are restricted in their behavioural activity or (b) housing conditions do not offer the appropriate environment, which would be necessary to perform the behaviour. That is, the negative feedback, which controls the motivation of behaviour, is missing. Consequently, the animals will proceed in the attempt to perform these behaviours despite the fact that their artificial environment does not enable the performance and/or their behaviour does not serve any function in the artificial environment. The proximate mechanisms, which are highly adaptive in a natural environment, may become maladaptive in an artificial environment.

Two examples may illustrate the problems that arise if the proximate mechanisms of behaviour are ignored in housing conditions.

Restriction of behaviour may result in damages: Tail tip lesions in cattle
In nature or at pasture, the lying behaviour of cattle is characterised by particular features. Before lying down they carefully inspect different possible lying places and they choose areas with soft surfaces to lie down. During lying down, they ease their centre of gravity forwards along a longitudinal axis, which requires a forward space demand of about 80 cm. This behavioural sequence minimises the stress on the limbs. They will keep a distance of about 1-3 m to their next neighbour to avoid social tension with other cattle. During resting, the tail serves different important functions. It is used to repel insects and serves for thermal regulation. Thus, the tail is often moved or otherwise most often lies on the floor away from the animal's body.

In conventional housing systems, such as for fattening cattle, these behaviours often are restricted. Housing is optimised with respect to production efficiency and process engineering. Space allotment per subject is low. As a consequence, the animals are significantly restricted in choosing their lying place and they are not able to keep the normal individual distance between each other. Most often, fattening cattle is housed on slatted floor, which is hard, inflexible and rough. On such floor, the lying behaviour can be seriously altered. Reduced frequencies of lying periods and high percentages (up to 50%) of abnormal patterns of standing up and lying down can be observed (Drolia *et al.*, 1990, Mayer *et al.*, 2000). All these factors contribute to the incidence of severe pathological alterations of the tail tip such as lesions, inflammations, or necrosis (Schrader *et al.*, in press). In slatted floor pens, we found a significant higher incidence of tail tip lesions compared to deep bedding pens (Fig.2).

With an increasing weight of subjects, the frequency of lesions increased in slatted floor pens but not in deep bedding pens (Fig.3). In addition, in slatted floor pens the incidence of tail tip lesions increased with a decreasing space allotment which we did not found in deep bedding pens (Fig.4 a & b). One major risk of tail damage is trampling by pen mates. It is rather plausible that this risk increases with decreasing space allotment. The consequences of trampling are higher on a hard and inflexible floor such as in slatted floor pens and on such floors the severity of the damages increases with increasing weight of animals. In addition, the high number of abnormal patterns of standing up and lying down on slatted floors may lead to self-injuries of the tail because the tail may come to lie between the hock and the floor (Drolia *et al.*, 1990).

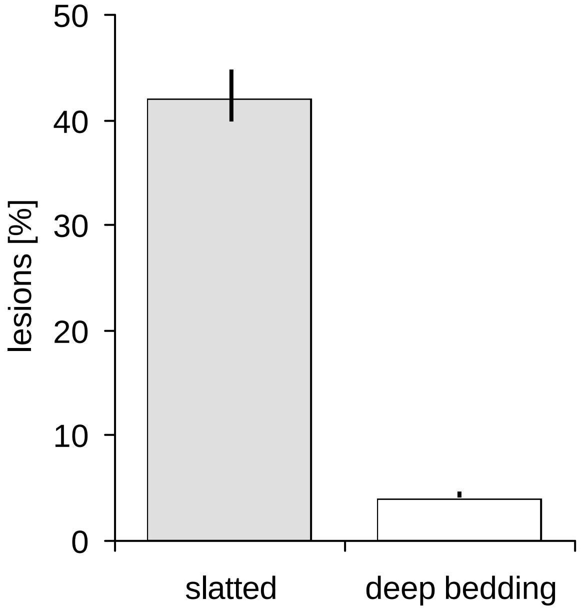

Figure 2: Frequencies (mean ± SEM) of tail tip lesions in slatted floor pens and in deep bedding pens.

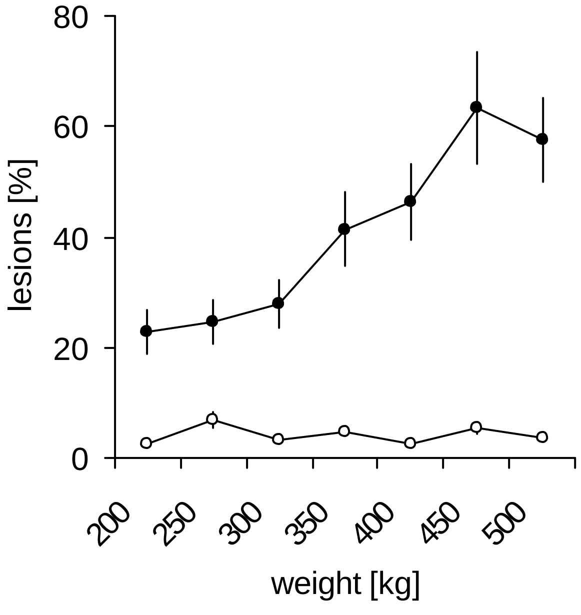

Figure 3: Frequencies (mean ± SEM) of tail tip lesions at different classes of weight of subjects in slatted floor pens (filled dots) and in deep bedding pens (open dots).

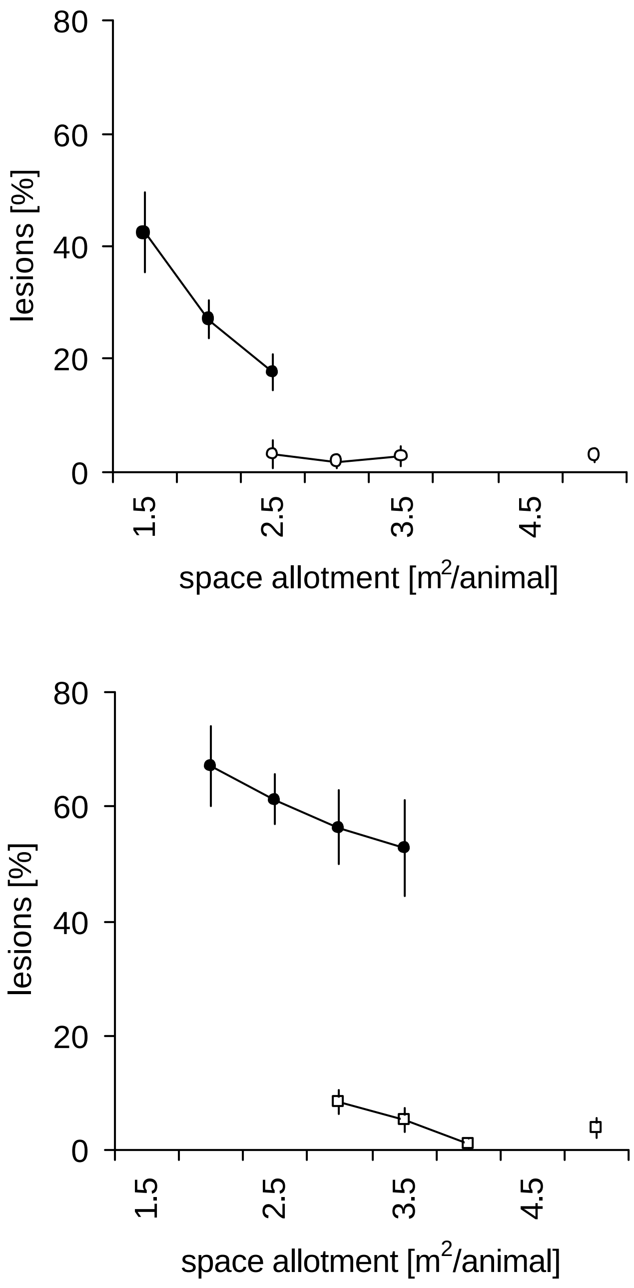

Figure 4: Frequency (mean ± SEM) of tail tip lesions at a weight of (a) 200-300 kg and (b) 400-500 kg of fattening bulls at different classes of space allotment in slatted floor pens (filled dots) and deep bedding pens (open dots).

In this example, the performance of a particular behaviour, such as the use of the tail, is still possible. However, the artificial environment does not appropriately allow the performance of this behaviour. A behavioural mechanism, which would prevent that the animals' tails are trampled by conspecifics has not evolved because in their natural environment it has not been necessary. Thus, in artificial environment the use of the tail, in part, may become maladaptive.

Because lesions of the tail tip can impair the production efficiency farmers often reduce the incidence of tail tip lesions by prophylactic tail tip docking (Schrader *et al.*, in press). This intervention results in an enhanced sensitivity of the amputation stump to pain. As a consequence the animals alter their behaviour as they try to protect their docked tail by keeping it close to the body, which reduces the risk to be trampled (Winterling and Graf, 1995). This is an example for an adaptation of farm animals to an inappropriate housing system. Instead, housing conditions should allow the animals to perform their lying behaviour in an appropriate manner. The lying behaviour of cattle is adapted to their natural environment, i.e. to lie on a soft and non-slip surface as on pasture. These qualities of surface must be appropriately replaced in the artificial environment, for instance, by deep bedding, in order to avoid the discussed damages. In addition, the animals' demand for sufficient space during lying down, lying, and standing up has to be considered.

Restriction of behaviour may result in behavioural disorders: Intersucking in heifers

In nature, a calf sucks the udder of its mother about 8 to 10 times per day in the first month of life and each sucking lasts about 5 to 10 minutes. The frequency of sucking decreases to 1 to 2 times when a calf is about 8 to 10 month old and is weaned by its mother. A calf starts grazing at an age of about 10 to 15 weeks. Thus, weaning is a gradual process that goes along with the calf's increasing ability to graze and to ruminate. During sucking a typical behavioural sequence is shown. The calf approaches its mother, takes a parallel reverse position combined with a characteristic body posture, and butts the udder before it starts sucking. The motivation in particular for sucking results from the feeling of hunger and is triggered by external stimuli such as daylight and presence of the cow. However, the proximate mechanisms of sucking are not yet fully understood. It seems that a sucking bout is at first maintained by the positive feedback of the taste of milk (de Passillé *et al.*, 1992), and then regulated by the negative feedback of sucking behaviour itself and the intake of nutrients (de Passillé and Rushen, 1997). The ultimate function of sucking is obviously the intake of energy and nutrients, which are necessary for maintenance and growth.

Under husbandry conditions the function of sucking behaviour is replaced by artificial feeding systems. At many farms calves are only fed twice per day with milk offered in a bucket and they have to drink the milk instead of sucking it. The milk most often is ingested within a few minutes. Calves are weaned abruptly at an age of 2 to 4 months as soon as they have a sufficient intake of solid foods.

Although artificial feeding can fulfil the nutritional needs of calves it is not able to meet the animal’s need for sucking behaviour. Sucking behaviour is highly motivated and is still performed: Instead of sucking the teats of their mother they suck other calves or even parts of their pen. An increase of the frequency of feeding (e.g. by automatic milk dispenser) or a prolongation of sucking durations (e.g. by artificial teats) can reduce sucking but not prevent it. In other words, even if the artificial replacement of the function of sucking behaviour fulfils the nutritional needs of calves these artificial conditions do not match the proximate mechanisms, which control sucking behaviour. This mismatch can lead to behavioural disorders.

A behavioural disorder related to sucking behaviour in heifers and dairy cows is intersucking. The intersucking animal is sucking the udder of others. This can lead to udder damages, mastitis, milk loss, and finally, culling of breeding animals. In an epidemiological study Keil *et al.* (2000) identified several factors, which are likely to increase the risk of intersucking in heifers. Most of these factors were related to the housing and the feeding management of calves during weaning. The risk for intersucking in heifers was increased on farms where calves were raised in a non-stimulating environment (no access to barnyard or pasture, pens in enclosed buildings) and where heifers were fed with a ration that did not fulfil their energetic and behavioural needs (availability of food, sufficient feeding duration). In a consecutive study, Keil and Langhans (in press) tested (a) whether intersucking is acquired already during the calf-rearing period and (b) whether there is an impact of feeding management on intersucking during weaning. More than 90% of the calves showed intersucking before weaning and these calves were likely to continue after weaning. From a total of 27 calves, which showed high intersucking activity before weaning 16 calves still showed this behaviour 9 weeks after weaning. In contrast, none of the 11 calves with low sucking activity before weaning did so nine weeks after weaning. One week after weaning, the frequency of sucking increased with decreasing feeding duration of calves. In addition, the frequency of intersucking increased with decreasing adequacy of their energy supply (Fig. 5), and the highest intersucking activity was recorded on farms with restricted availability of food.

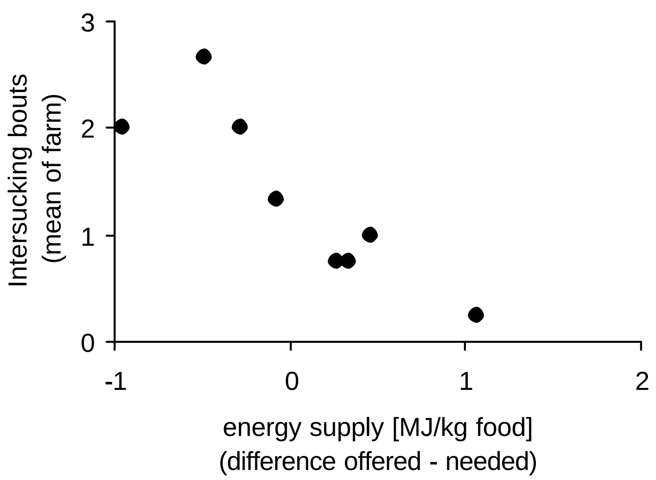

Figure 5: Relation between mean inter-sucking activity per farm one week after weaning and the adequacy of the energy supply in the rations on farms with ad libitum-feeding. (Keil and Langhans, in press).

Abrupt weaning in combination with nutritional deficits, insufficient feeding durations and availability of food can lead to an establishment of intersucking in adult animals.

This example shows that the "basic aspects of (the calves') innate behaviour" cannot be considered sufficiently by artificial feeding systems and lead to the behavioural disorder of intersucking. Suckling systems that fulfil the behavioural need of calves in dairy herds could be achieved by allowing the calves to suck either at foster cows or at their own cows which are machine-milked in parallel (Krohn, 1999).

Conclusions

These examples illustrate that the knowledge of the natural behaviour of farm animals is significant for housing design and management practices. Behaviour has evolved as an adaptation to the animals' natural environment and enables them to survive and to reproduce. If the functions of behaviour are replaced in an artificial environment, the motivation to perform a particular behaviour may remains high, irrespective from whether the behaviour fulfils any function in the artificial environment or not. Welfare problems arise when the proximate mechanisms, which are highly adaptive in the natural environment become maladaptive in the artificial environment. This can occur if the animals' behavioural activity is restricted, the artificial environment does not appropriately allow the performance of behaviour, or no environmental substrates are offered which are necessary to perform the behaviour. In particular, in organic animal husbandry, the housing conditions and management practices should not ask for the conditions, which are merely sufficient to prevent behavioural disorders or damages. Instead, the requirements of housing in organic livestock should be derived from the behaviour, which the farm animals perform in natural environments. Also, in their artificial environment farm animals should be allowed to perform all aspects of their species-specific behaviour.

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Understanding the cow - the central role of human-animal relationship in keeping horned dairy cows in loose housing

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Introduction - horned or dehorned - why is it a subject of interest in organic livestock discussion

Reasons and effects of dehorning

In loose housing systems dairy cows usually are dehorned. One reason is the general opinion that horned dairy cows are a danger to herd members, causing injuries and stress for subdominant animals. The second argument, often heard, is the risk of accidents for the farmer. However, dehorning is a painful treatment both for calves and adult cattle (Graf et al. 1996; Taschke 1995; Taschke/Fölsch 1997). It is an artificial and symptomatic ”adaptation” of the animals to the housing by amputation instead of adapting housing and management conditions to the needs of the animals. Horns are typical for the species cattle (*Bos taurus* and *Bos indicus*). Horns do have functions in social behaviour and dehorning shows effects on social behaviour and rank order (Graf 1974; Kimstedt 1974; Oester 1977). While in horned herd’s age and size of horns are main influencing factors (Schein/Fohrman 1955; Sambraus/Osterkorn 1974; Jansen 1982), without horns weight is highly associated to rank (Wagnon et al. 1966; Dickson et al. 1967). Further, dehorned cow herds appear to have higher levels of agonistic behaviour than horned ones (Graf 1974; Menke et al. 1999). Thus, in horned herds, older animals remain better able to keep their rank and to contribute to a stable herd structure.

Organic agriculture and dehorning

In guidelines and regulations for organic agriculture, mutilations are not allowed or at least may not be carried out systematically. However, exceptions for dehorning are possible both in IFOAM standards and the EC Council regulation No. 1804/1999 (Schmid 2000). In some organisations, e.g. Demeter Germany, Freiland-Verband Austria, dehorning is banned in general. This is in line with the consumers' expectation of preventing unnecessary pain for the animals, of keeping the animals "naturally", according to their species specific nature, according to the animals needs and on a high welfare level. Furthermore, horns have specific functions in the biodynamic principles (Steiner 1924).

However, as mentioned above, some people argue that welfare is at risk in horned herds. This paper therefore focuses on the questions: What is the situation in loose housed horned dairy herds with respect to social behaviour and injuries of the cows? What are guidelines to keep horned dairy cattle in loose housing systems? What is the specific importance of human-animal relationship within this welfare question?

Horned cows in loose housing – the situation

The social structure in herds of cattle can be described by dominance relationships, a rank order and social bonds. In pasture, cattle keep an individual distance between 0.5 and 10m (Porzig/Sambraus 1978). Once dominance relationships are established, butting and injuries are rare - the animals can avoid or withdraw easily. In housing, butting frequency increases (Wierenga, 1984) because of reduced space and limited resources, e.g. lying places, feeding places. Subdominant animals usually avoid dominants. In the stable, they might not be able to do so, and injuries may result in horned herds.

In practice, the experiences with horned dairy cows in loose housing vary widely in-between farms. Some herds hardly show any problems, whereas in other herds the problems can be considerable. Normally, the farmers have no idea what the relation is with their daily management and their own attitude. This was the cause for starting investigations in this subject to find out, how this system functions in practice, and what are the reasons for problems. These studies were carried out by the Swiss Federal Institute of Technology Zurich, on Swiss and German farms (ETH) and the Louis Bolk Institute (LBI), The Netherlands, on Dutch farms.

The investigation of the LBI corresponds with the expectations on effects of reduced space on injuries. The amount of injuries caused by horns in the investigated herds was higher in the housing period compared to summer pasture (fig.1; Baars/Brands 2000). Because of the connection of rank and age, a significant relation between amount of injuries and age was found.

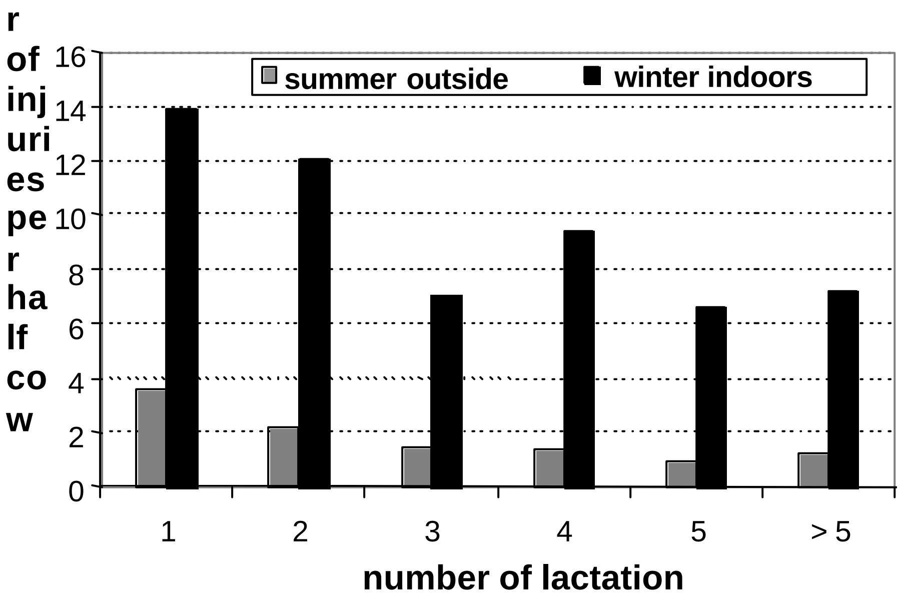

Figure 1. Relationship between age and number of injuries per half cow (right); eight farms in indoor and outdoor period.

The results of the ETH survey in 1991 confirmed the experiences of the practice (Menke et al. 1999). The 35 investigated herds differed largely in agonistic social behaviour, defined as "chasing and pushing away", and injuries. The range of injuries caused by horns was from 2 until 63 per cow. However, more than 90% of the injuries were superficial hair grazes. In more than 70% of the herds the frequency of injuries was lower than 15 per cow. According to the close relationship of injuries with agonistic social behaviour, the social climate of these herds was balanced (Figure 2). Yet, the results also show, that some farms had considerable problems in keeping horned dairy cows in loose housing.

The herd size of the investigated herds varied from 9 until 92 cows per herd. The social behaviour in the larger herds was significant different to smaller herds. In large herds agonistic behaviour was more common and social licking less as compared with small herds. Arave et al. (1984) ascribed such difference to two main aspects. First, mutual recognition is difficult in large herds and this reduces the effectiveness of an existing rank order. Also the space per cow is often so low that the rate of meeting of individual cows is high. Therefore rank positions have to be tested frequently. Second, in large herds, the frequent integration of new cows, partly resulting from the short service life of dairy cows (Frey/Berchtold 1983), also counteracts an existing rank order and reduces the development of lasting social bonds. This effect can be interpreted as a reduced stability of a herd resulting from a decreased controllability per cow of its own social environment. Such a loss of controllability implies welfare problems if it exists for longer periods of time (Wiepkema/Koolhaas 1993). However, the largest herd (92 horned cows, herd 35) showed a well-balanced social behaviour and the frequency of injuries was low. This indicates, that herd size is not the most important factor of this system, but other factors within herd management and human-animal relationship were affecting strongly the overall results.

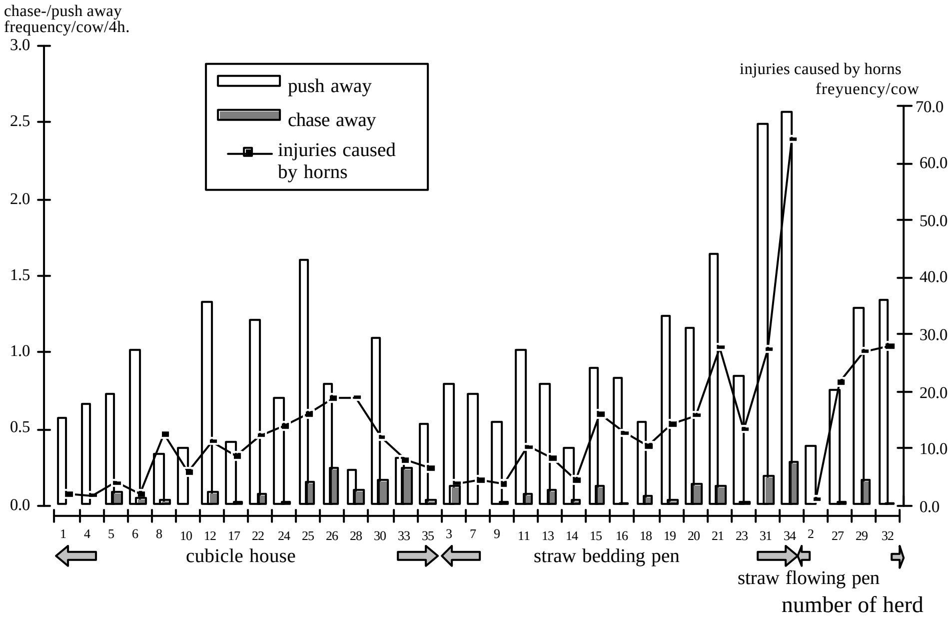

Figure 2: Comparison of dairy herds for chase away and push away behaviour, and for injuries caused by horns.

Housing and management factors influencing success or failure

The success of the system depends on the ability to achieve a low level of agonistic behaviour and injuries. Both studies at the ETH and the LBI on horned dairy cows could identify several farming conditions affecting social behaviour and injuries. These factors can be divided in factors of housing, management and human animal relationship. As the example above shows, within a specific farm situations negative factors can be compensated by other points of attention. Below, the most important housing and management factors are described before coming to the role of human-animal relationship.

Housing

Housing conditions that meet the needs of the animals have to take into account the social behaviour of the cows. That is, housing should offer the subdominant animals the opportunity to avoid or withdraw from dominant ones. Housing design, where the subdominants are hindered to do so, could result in stressful situations even for dehorned animals and can cause severe injuries in horned herds.

Consequently, dead ends are one of the most significant housing faults for horned dairy cows. Especially low ranking cows are not able to avoid others if they stay near such places.

A place with lot of competition is the feeding rack. In feeding racks with a bar and locking device above the neck, horned cows have not enough time for liberate out of the opened feeding rack. Is the locking device integrated in the looking bow under the neck of the cow, the time of leaving the opened feeding rack is much lower (Ackermann/Hinder 1992; Figure 3).

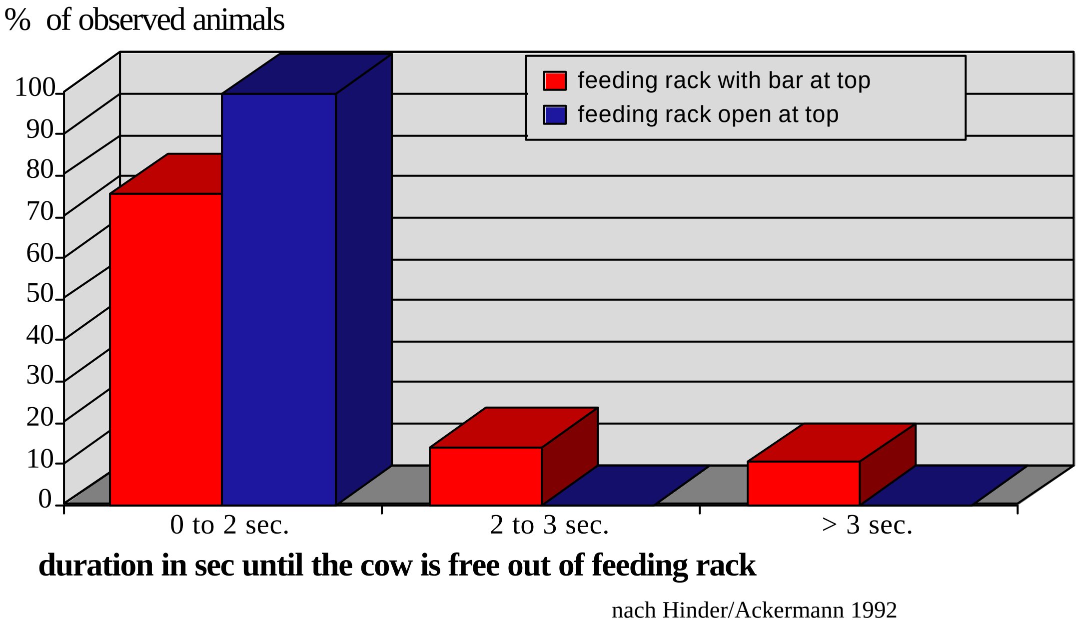

Figure 3. Time to leave a feeding rack with or without a bar at top; observation on two farms.

Another factor affecting the butting frequency and number of injuries of the animals is the presence of an unlocked concentrate feeder. High-ranking animals are waiting until the concentrates falls and then the low ranking animals are roughly chased away. Systems with an automatic door behind the animals can prevent this problem.

The total space is an important factor affecting injuries. In the investigation of the ETH, space per cow shows a distinct relationship with both the occurrence of agonistic behaviour and of skin injuries. The LBI survey found a significant correlation between available area and butting frequency in straw yards, too. This confirms former investigations, in which a reduced space per cow resulted in a higher frequency of agonistic behaviour (Lippitz et al. 1973; Czako 1978; Metz/Wierenga 1984; Andreae et al. 1985; Zeeb 1987). Obviously adequate space per cow is a prerequisite to reduce the occurrence of injuries to a low and acceptable level. But it is also interesting that in the herd with the least space per cow (5 m^2) the frequency of chase and push away was in the middle third. In the ETH survey, several farms have enlarged the indoor area with an extra concrete walking area outside. Positive effects are measured if the animal have access to this area (Menke et al. 2000). Besides the mere effect of enhancing space per cow, outside yards structure the living environment of the animals. In a stress situation inside the stable especially low ranking cows use the yard. Competition and the frequency of interactions between cows is low there. In addition, yards make it possible to defuse dead ends in a stable.

Besides the total space per cow, the width of alleys is important. Especially the walking area directly after the feeding rack should be wide enough for turning and passing of animals. The same accounts for alleys between lying boxes.

The comparison of the loose housing systems (cubicle houses, straw bedding pens and in straw flowing pens) in the investigation of the ETH showed, that in all three housing types herds were seen with a low level of injuries and agonistic behaviour (Figure 2). An advantage of a definite housing system could not be found. However, cubicles offer the cows protection against attacks of other cows and can minimise the agonistic interaction in this stable area. This is especially important for lower ranking cows or new animals in the herd. But sometimes there are cows in the herd, which attack other cows when they are in the cubicle. This can be a serious problem and those "specialists" should be removed from the herd. To improve the situation in cubicles, lying boxes with flexible neck rail and space in front of the cubicles wide enough (80cm) to built an alley for cows could be used. In such cubicles, the cows could flee an attack from behind by leaving the box to the front. Further, combined with optimised size and floor surface (soft, non-skid), such cubicles offer good lying conditions. This brings about that cows lie down quickly, which can further contribute to reduced agonistic behaviour. The advantage of a free lying area is the possibility to avoid without obstacles, which could reduce injuries. Compared with the ETH results, the LBI found a higher frequency of blood udders and vagina injuries in cubicle housing compared to straw yards, although the level of skin injuries was the same. The differences were explained by the presence of fixed walking paths in cubicle housings. Animals could attack each other easily from the backside. Several cubicle housings were built for dehorned cattle, often of a much smaller size. A negative situations exists if animals do not fit any more in the boxes. The cubicle floors are occupied with backsides of cows.

Management

Problems of faults in housing design, e.g. dead ends, defect feeding racks or low space per cow, get worse, when social climate is characterised by a high level of agonistic interaction, caused by for instance competitive situations or by a period of social instability, like integration of new animals. Moreover, even in well-designed housing, problems can occur when competition is high by mistakes in management. On the other hand, poor housing situations could be compensated, if the stockperson is able to create a socially balanced herd. Accordingly, management was found to have distinctly higher effects on agonistic behaviour or injuries than housing factors in the ETH survey.

One of the most important factors of herd management is the readiness, intention and ability of the farmer to recognise and solve occurring problems immediately, i.e. problem solving management. On the German/ Swiss farms, where problem solving was on a high level, the frequency of agonistic behaviour and skin injuries was low. The implication is that farmers who identify and prevent situations that facilitate competition among cows, reduce by their way of acting negative symptoms in their herds. For example, on several farms we noticed that faulty feeding racks were repaired after a long delay - sometimes more than two years. Since at feeding places a highly competitive situation for the animal does exist, cows may receive serious injuries at faulty feeding racks, as was pointed out years ago by Woodbury (1941).

Feeding management has to minimise competition. The most important factor is to feed enough fodder per time, offering at least one feeding place per animal. Food should be offered ad libitum in a constant quality. This way, low ranking and anxious animals could eat at times of the day, when most of the animals lie down. If there is not enough fodder available butting problems occur in the area of the feeding gate and the floor area directly behind the gate (Fig. 4). If food of a special quality is restricted, animals should be fixed in the feeding rack long enough to enable low ranking animals to feed.

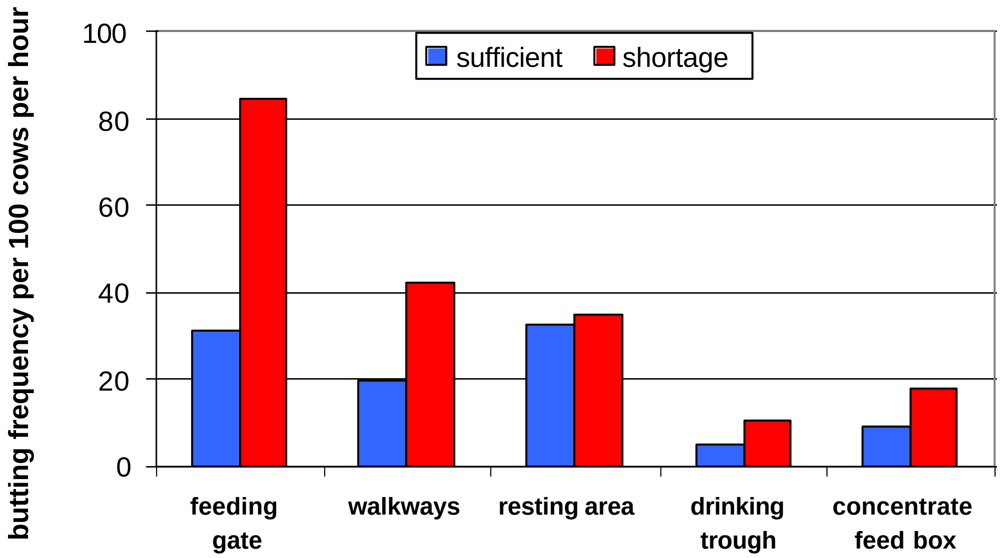

Figure 4. Butting frequency with sufficient or shortage of feed; average of 4 farms.

The stability of the herd is an important factor to manage horned dairy cows. Management measures reducing it, also affect frequency of social behaviour. Herd structure can be disturbed if animals are bought from outside the farm. The LBI study found a significant effect of being ”strange through buying” or ”being familiar through own rearing” on the number of injuries (Tab. 1). Bought animals showed an increased amount of injuries, although their age was higher, which should have led to a lower number of injuries.

Table 1. Effect of ”being bought” on the amount of injuries per half a cow.

	Age	Injuries
Own rearing	2.9	6.9
Being bought	4.0	10.4

Further, the separation time of dry or calving cows from the herd may have relevant influence on the stability of the entire herd by interfering with bonding mechanisms between cows. In the ETH survey, in herds, where cows were removed for periods of two or more weeks the frequency of social licking was relatively low. In general, the best result with regard to the herd structure can be reached if the time of separation is short, at best less than two weeks.

Another point of discussion is, whether calves should stay with their mother after birth. If so, how long should these animals stay in the herd? Several cases in the LBI survey showed a positive effect of the presence of calves in the herd onto the social behaviour. This could be due to a calming effect on the mother cows.

Oestrus cows are characterised by their restless behaviour; they perform horning and mounting directed at other herd members not avoiding higher-ranking cows. Therefore, agonistic behaviour is lower, when oestrus cows are temporarily removed from the herd.

The tips of the horns sometimes could be very sharp, thus could result in sharp wounds. e.g. of the vulva. Rounding the sharp tips diminishes the negative consequences of a butt.

In summary, adequate management may significantly reduce agonistic behaviour and, by this, also the number of injuries in herds of horned cows.

Human-animal relationship - the central factor

Above, several housing and management factors influencing the frequency of agonistic social interactions and injuries were described. Besides management factors, human-animal relationship variables - described in terms of the intensity and quality of contact and the personnel management (see Waiblinger/Menke 1999) - showed correlations with the animal welfare parameters, social behaviour and injuries in the ETH survey. By means of regression analysis. these factors were identified as predicting variables (Menke 1996). Compared to management factors, the predicting value of these variables was not very high. On the other hand, human-animal relationship was regarded as the central overall factor. Below, we will explain the mechanisms.

In sociology, relationship is defined as ”degree of connectivity or distance between individuals resulting from social processes” (Anonym. 1987) or as ”term of mutual influences and behaviours between persons” (Anonym. 1981). The nature and quality of interactions determines the nature and quality of relationship, which in turn can be assessed from the observable interactions. According to Estep/Hetts (1992) human-animal-relationships are built up from human-animal interactions.

This concept of human-animal relationship refers to the direct contact of humans and animals, to the visible part. In stockman-animal relationship, it is important to consider the mechanisms lying behind the visible relationship. The degree of the stockperson's connectivity with the animals will not only influence the direct interactions (and to some degree result from it), but also his view of the animals' needs, his decisions concerning the animals, speed of interfering after problems and thus affecting the overall herd management. This is a crucial point when discussing the role of human-animal relationship.

Influences on cows' behaviour and welfare

We have to consider two ways of effects of human-animal relationship on behaviour and injuries of the cows: (1) a direct effect of human-animal interactions and (2) an indirect effect via a better understanding of the cows and therefore a better-suited management.

(1) Some authors report about stabilising or destabilising effects of the stockperson onto the social behaviour of cows (Seabrook 1988; Wiepkema/Schouten 1990; Le Neindre et al. 1992). If the stockperson is able to create a calm atmosphere, where stress is low and the environment highly predictable for the animals, this might reduce aggression. In contrast, higher levels of insecurity and stress will occur within an environment with low predictability and controllability, which might lead to higher levels of aggression. While experiments on influences of handling on social behaviour are lacking, it is evident from theories on aggression, that negative experiences with humans may enhance agonistic interactions. Frustration, pain and received aggression, respectively, can lead to aggression (Scott 1958; Fox 1968; Neumann/Steinbeck 1971; Reinhardt 1980). In a small experiment with one herd, agonistic interactions increased in a herd of 80 cows after only 10 of them had been milked in a rough manner (Menke 1986). Because transmission of ”danger information” in general, and of social suspicion particularly, exists in animals, it may not be necessary that each animal has contacted the stockperson regularly or intensively to develop suspicion. Rough handling, i.e. negative experience, of single animals may be signalled through the whole stable, making most cows suspicious or afraid of humans and upsetting the whole herd (Wiepkema/Schouten 1990, Boissy et al. 1998).

(2) Problem solving management as well as management of the social behaviour were the most important variables to reduce agonistic social behaviour and injuries. Both factors were highly positively correlated with the intensity/quality of contact as well as with the frequency of the milkers' friendly interaction with the cows in the ETH survey (Table 2, Waiblinger 1996). Stockpeople cultivating an intense and friendly contact to their cows paid attention to and were able to apply an optimal herd management. This

can be attributed to a better understanding and knowledge of both the individual animals and the herd structure in case of a more intense and more frequent contact. A close contact and a low number of milkers, enhances the ability to recognise individual cows' problems. Seabrook (1986) reported that in case of a positive relationship the human is able to recognise changes in behaviour early and to react immediately.

Table 2. Spearman rank correlations of management to human-animal relationship. *=p≤0,05; **=p≤0,01¸***=p≤0,001

	Friendly interaction during milking	Intensity/quality of contact
Problem solving	0.441**	0.628***
Management social behaviour	0.537*	0.562**

A survey of Zeeb/Heinzler (1990) on 12 dehorned herds in cubicles also demonstrated a strong correlation between the qualification of the stockperson and the frequency of agonistic social behaviour (rs = -.86). The qualification was scored from 0 to 2 in 15 single aspects, including both handling of the animals as well as management.

Human-animal relationship and risk of accidents

Besides effects on social behaviour, a good human-animal relationship is especially important to minimise the risks of accidents with the cows. This concerns not only accidents caused by horns, but also accidents in general. If fear of humans is low or trust in humans is high, respectively, animals are better to handle, show less defence reactions, are less jumpy and in sum less dangerous (Hemsworth et al. 1994; Grandin 1987; Boivin et al. 1992; Waiblinger et al. 1999). This is achieved by positive interactions between humans and animals. In the survey of ETH, reactions of cows towards humans as well as the intensity and quality of human-animal interactions were recorded on the 35 farms. In general, distinct differences existed both in the reactions towards humans as well as in the human-animal interactions between the 35 farms. E.g. the median of avoidance distance per herd ranged from 0 to 1.5m, and the percentage of cows, which could be touched ranged from 2 to 67% of the tested animals. The animal's reactions were highly correlated to the intensity and quality of interactions. A close, intense contact of the stockperson and a higher level of friendly interactions with the cows during milking, indicative of a positive relationship to his/her animals, led to animals which could be approached closely or even touched, i.e. animals confident in humans, with a low level of fear. Such animals are less scared from human action. Scaring of the animals and wrong behaviour of the human are the most important reasons for accidents (Mack 1979). Both are reduced in a good relationship - both human and animal know each other and trust each other.

In the farms of the ETH investigation, none of the farmers or employees working in the herds were ever hurt seriously by one of the horned cows in loose housing. Some of the herds involved existed for more than 20 years already without such problems. So far, we have been informed about injuries caused by horns, they all occurred in former tying stalls or with bulls.

Attitude, personality and the human-animal relationship

Within psychology, personality and attitude are the main aspects to explain behaviour of humans (Schiefele 1990; Rotter/Hochreich 1979). The personality of the stockperson as well as his/her attitude to the animals are important factors influencing his/her behaviour towards the cows, both the direct contact as well as management (Seabrook 1972; Waiblinger et al. 1995, Waiblinger 1996; Hemsworth/Coleman 1998). But, as attitude develops or can change over time with experience, the interactions with the animals and thus the relationship act back on attitude.

The attitude about keeping horned cows is important. If a farmer accepts a cow as a cow with horns as part of her integrity, he will adapt his management in such a way that this will please his animals. A survey on 10 farms converting from tying stable to loose housing underlined the importance of the farmers ability to recognise problems within the herd and willingness to change it (Menke/Waiblinger 1999): In one of the ten farms injuries occurred immediately after moving to the new shed. During the observation it was obvious, that only one cow made problems - she was very aggressive. Despite our advice to remove this cow from the herd, at least for some days, he decided to dehorn all of his cows after 8 weeks - without trying to separate or partly dehorn the aggressive animal. One of the Dutch farmers pointed out, that he had completely changed his approach of the animals after he led the horns grow. Instead of a hurried contact he had to slow down his movements and wait a bit more.

Conclusion

Keeping horned dairy cows in loose housing is possible without unacceptable risks for cows and humans. However, a good human-animal relationship and an underlying attitude of the stockperson, comprehending the cow in her integrity and with her needs, is crucial for the success. He or she will be able to solve problems specifically only if there is a proper understanding of the individual cows and the herd as a whole. This understanding is based on a close contact to the cows and a good human-animal relationship. As a result, the stockperson will be able to create a calm atmosphere, where the environment is highly predictable, competition and stress is low and the risk for accident as well as injuries are minimised (Figure 5).

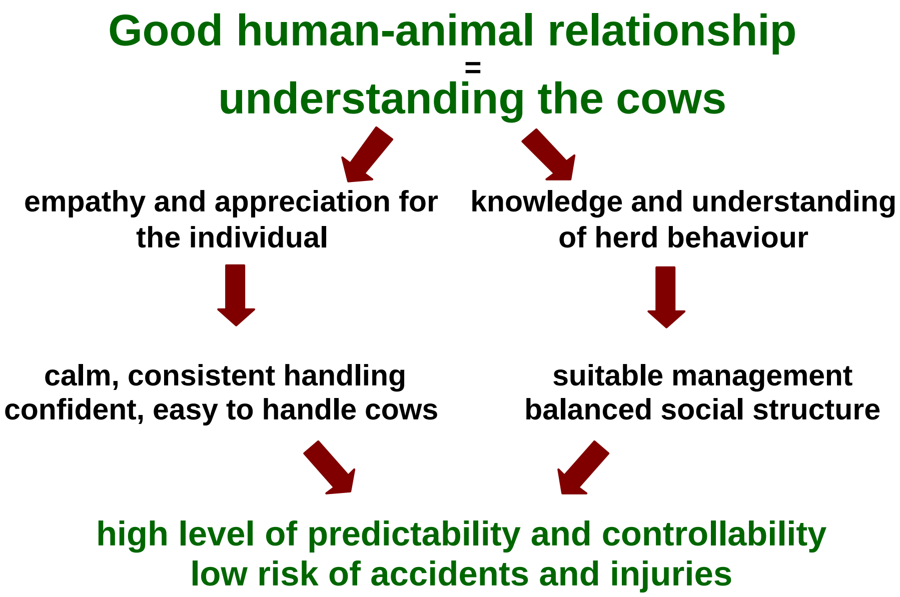

Figure 5. Scheme of cow human-animal relationship acts onto a successful system.

Today, attitudes towards horned cows in some countries or regions are very negative. There is a long tradition of dehorning. However, attitudes can change by new knowledge and experience.

In the preamble of the EC Council regulation No. 1804/1999 on organic livestock production, it is stated in paragraph 19 that ”housing ....should satisfy the needs of the animals concerned as regards ventilation, space and comfort and sufficient area should accordingly be provided to permit ample freedom of movement for each animal and to develop the animal’s natural social behaviour”. Together with a concept of animal welfare in organic agriculture, where the animals’ integrity and dignity is respected, as suggested by Lund (2000), we conclude that dehorning is not in line with the ethical values of organic agriculture.

Research and practice showed that there are ways to keep horned dairy cows in loose housing. Besides stockmanship several factors within housing and management were described, affecting the social behaviour and amount of skin injuries. To change the farmers’ way of thinking and attitudes, however, is a process that requires patience. This process will be accelerated with every successful farm working with horned cows.

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The role of management and housing in the prevention of feather pecking in laying hens

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Introduction

Feather pecking is one of the main welfare problems in modern poultry keeping. Laying hens can start feather pecking because of several factors, such as feed deficiencies, absence of litter, poor litter quality, boredom, etc.. It is suggested that the common factor, which links these diverse factors, might be stress. Feather pecking is regarded as redirected pecking behaviour. The two most common hypotheses are that feather pecking is either linked to foraging (Blokhuis & Arkes, 1984) or dust bathing (Vestergaard *et al.*, 1993) behaviour. Since the factors eliciting this behaviour are so numerous it can be regarded as a complex problem.

What does feather pecking look like? There are two types of feather pecking: gentle and severe feather pecking. Gentle feather pecking does not cause damage and is performed by most birds in a group. Severe feather pecking is the behaviour that is responsible for the damage and is performed by only a small percentage (9% according to Keeling, 1994) of the birds in a group. The birds that perform the severe feather pecking behaviour in general are the most active birds, even when housed in cages individually. In a group, they move from one victim to another and try to pull out feathers. Often the feathers are eaten. Feather pecking is not an aggressive behaviour, because the victims do not react to feather pecking in the same way as to aggressive behaviour. Another difference is that aggressive pecks are directed to the head and neck region, while feather pecks are directed to the back, rump and belly (Keeling, 2000).

Whilst feather pecking and cannibalism often are mentioned together, there is no automatic connection between the two behavioural disturbances. Keeling (1994) reported that in flocks with feather pecking there was not always cannibalism present. If it does occur in flocks with feather pecking, the cannibalistic behaviour is performed by other birds than the few percentage of feather pecking birds. In organically managed flocks in the Netherlands (Bestman & Reuvekamp, unpublished results) it appears that feather pecking occurs during the whole laying period. However, cannibalism is more related to the incidence of diseases or other negative events. This makes the occurrence of cannibalism much more unpredictable than the occurrence of feather pecking. This article only concerns feather pecking.

In conventional poultry keeping, the damage caused by feather pecking is reduced by beak trimming. This is a painful measure, which does not fit in an ethical treatment of animals. It does not take away the causes for feather pecking, it only reduces the damage. It is prohibited by the E.U.-regulations for organic poultry keeping. Although the standards for the husbandry of organic layers seem welfare friendly (low stocking density, access to litter and access to outdoor run) this is no guarantee for the absence of this behaviour. In the Netherlands, 50% of the organic flocks have severe feather pecking, 25% moderate feather pecking and another 25% have no or very little feather pecking.

Most scientific studies on feather pecking focus on single factors, and experiments are done with small groups of, at most, several tens of birds, sometimes even with hens housed individually. Pecking towards a bunch of feathers in front of their cage is regarded as feather pecking in these experiments. If small groups of hens are kept according to the E.U.-standards for organic poultry keeping, feather pecking is seldom seen. Another difficulty with modern scientific studies concerning feather pecking is how to 'translate' the results to the daily practise of modern farming.

Materials and methods

In the period of August 1999 till June 2000 for this study, data were collected about housing and management of 36 organic flocks on 25 Dutch farms in relation to feather pecking. All flocks consisted of at least 100 birds; most of them had more than 1000 birds. The measure of feather pecking in these flocks was estimated by judging the plumage damage on 10 different body parts of 40 randomly chosen birds at an age of at least 50 weeks (Van Hierden, 1996).

Factors that were looked at concerned the farmer (experience, working according to the E.U.- or the biodynamic regulations), the hens (breed and strain, rearing season, age at arrival at the laying farm, group size, stocking density), stable layout (type and location of several functional units) and daily management in order to stimulate natural behaviour (scattering of grains, use of outdoor run). Since this study was observational, only correlation between factors with regard to feather pecking could be described. No causal relations are identified, although they sometimes seemed very obvious. for statistical tests, correlation, Fischers's exact test and regression analysis were used. The meaning of correlation coefficient in this text is as follows: correlation coefficient 0.0-

0.4: no correlation, 0.4-0.6: weak correlation, 0.6-0.8: moderate correlation and 0.8-1.0: strong correlation.

Results and discussion

Human factors

Experience of the farmer in years was established. With gaining experience (see Table 1, n=33, correlation -0.550**) less damage caused by feather pecking was seen. Especially the flocks of farmers working according to the more strict biodynamic rules performed less feather pecking (see Table 2, n=35, sign. 0.027). Probably not the differences between the E.U.-regulations and the biodynamic regulations are responsible for this effect, but the fact that biodynamic farmers belong to the first generation of organic farmers and thus they have the most experience. Perhaps also especially highly motivated farmers chose the biodynamic standards, and they are probably the farmers who are also motivated most in paying the extra attention, which is needed in order to prevent the birds from feather pecking. In general, they scatter more grain daily, they make an effort to make their outdoor run attractive with for example maize, fruit trees, low willow (*Salix* spp.) or other trees and bushes, and the result is that, in general, a bigger percentage of their birds use the outdoor run.

Table 1. Statistical relations between several housing and management factors and plumage damage caused by feather pecking in laying hens.

Factor		N	Pearson	Spearman's rho	Fischer's exact test
Human factors	Farmers experience in years	33	-	-0.550**	-
	E.U. or biodynamic rules	35	-	-	See table 2
Animals	Strain	33	-	-	n.s.
	Rearing season	32	-	-	n.s.
	Age at arrival on laying farm	34	0.439**	-	-
	Flock size	35	-	0.646**	-
	Stocking density	19	0.603**	-	-
Stable layout	Feed system	35	-	-	See table 3
	Location of feed	34	-	-	See table 4
	Location of water	34	-	-	See table 5
	Type of nest box	35	-	-	See table 6
	Location of nest box	35	-	-	See table 7
Stimulation of natural behaviour	Grain scattered	26	-	-0.487*	-
	Daily access to outdoor run?	27	-	-	See table 8
	Time of access to outdoor run	32	-	-	See tables 9-12
	Percentage of birds that uses outdoor run	22	- 0.800**	-	-
	Percentage of outdoor run covered by vegetation	30	- 0.635**	-	-

Meaning of the correlation coefficient: 0.0-0.4: no correlation, 0.4-0.6: weak correlation, 0.6-0.8: moderate correlation, 0.8-1.0: strong correlation. Meaning of the significance symbols: *: correlation is significant at the 0.05 level (2-tailed) and **: correlation is significant at the 0.01 level (2-tailed).

Table 2: Fischer's exact test (2-sided) for E.U.- or biodynamic rules

	E.U.	Biodynamic	Total
Severe feather pecking	16	2	18
No severe feather pecking	9	8	17
Total	25	10	35

Significance 0.027

Animals

There is no relation found between the breed or strain of birds. This could be expected because all strains used were the modern commercial hybrids, which are bred for high production. Although the breeding companies might pretend the opposite, the strains do not differ much from each other. A total of 35% of the flocks were Bovans nera, 22% were Bovans goldline and 18% were Isabrown/Warren.

Of every strain, at most 5 to 10 flocks were investigated. Unfortunately, it was not possible to collect enough data on the rearing period of all these flocks, but from most of them the season, in which the rearing took place was known. There was no relation between this season and feather pecking. Most of the flocks, 60%, arrived at the age of 17 weeks at the laying farm, just before the onset of laying. Another 25% arrived at the age of 6 weeks, when the so-called 'warm rearing' is finished. In general, more feather pecking is seen when hens arrive at an older age (see Table 1, n=34, correlation 0.439**), especially in the larger flocks (which consist of 1000 hens or more). It is hard to interpret this result, as it might be caused by both the transportation stress and by the adaptation to the new environment.

The flock size seems to be associated with the risk of feather pecking (see Table 1, n=35, correlation 0.646**). Flocks of over 2000 birds had problems with severe feather pecking. However, these large flocks were only found at recently converted farms: experience of the farmer might be of influence. Hirt (2000) found that larger flocks had more problems in the use of the outdoor area. The same phenomenon is confirmed in this study. Also, less grain is scattered in the larger flocks. There is also a correlation between stocking density and feather pecking (see Table 1, n=19, correlation 0.603**).

Stable layout

Location and the type of some of the equipment used were considered. The type of feeding system does seem to be a risk factor. Less feather pecking is found , if reservoir feeders are used instead of the chain system (see Table 3, n=35, sign. 0.007). The location of the feeding system in the stable also seems to be important. If this is located in the litter area (and not on the elevated grid floor), less feather pecking is found (see Table 4, n=34, sign. 0.080).

Table 3. Fischer's exact test (2-sided) for feed system

	Feeders	Chain	Other	Total
Severe feather pecking	5	13		18
No severe feather pecking	11	4	2	17
Total	16	17	2	35

Significance 0.007

Table 4. Fischer's exact test (2-sided) for location of feed system

	Elevated grid floor	Litter area	Other	Total
Severe feather pecking	10	7		17
No severe feather pecking	4	12	1	17
Total	14	19	1	34

Significance 0.080

The main water system used was bell drinkers. Therefore, no analysis was made on the type of drinking system. The location of the drinking system did show a difference, whereas less feather pecking was found, if this was located in the litter area (and not on the elevated grid floor (see Table 5, n=34, sign. 0.000).

Table 5: Fischer's exact test (2-sided) for location of water system

	Elevated grid floor	Litter area	Total
Severe feather pecking	16	1	17
No severe feather pecking	6	11	17
Total	22	12	34

Significance 0.000

The type of nest boxes was also related to feather pecking. Fewer problems occurred, when individual boxes were used instead of communal nests, made for 6 birds (see Table 6, n=35, sign. 0.000), if the nest boxes were located above the litter area instead of on the elevated grid floor (see Table 7, n=35, sign. 0.003). In the relations between the location of a system and feather pecking, always less feather pecking occurred, if the system was located in the litter area instead of on the elevated grid floor. An explanation might be that the less systems are located on the elevated grid floor, the more clearly pronounced are the activity area (= litter area) and the resting area (= elevated grid floor) in the stable. In stables without feed and nest-boxes on the elevated grid floor, this floor was used by resting and preening birds, which were not disturbed by active animals. This might positively affect the behaviour.

An explanation for the positive effect of reservoir feeders on feather pecking might have nothing to do with the feeding system, but more with the fact that reservoir feeders were found in smaller flocks and chains only in the larger flocks. A possible explanation for the positive effect of individual nests might be that in communal nests feather pecking takes place, if more animals are present, whereas in individual nests this cannot occur. More detailed observations are necessary to confirm this hypothesis. Also, communal nests were seen in larger flocks at recently converted farms .

Table 6. Fischer's exact test (2-sided) type of nest boxes

	Communal	Individual	Total
Severe feather pecking	10	8	18
No severe feather pecking		17	17
Total	10	25	35

Significance 0.000

Table 7. Fischer's exact test (2-sided) for location of nest boxes

	Elevated grid floor	Litter area	Total
Severe feather pecking	10	8	18
No severe feather pecking	1	16	17
Total	11	24	35

Significance 0.003

Stimulation of natural behaviour

Although both human and animal factors are involved here, these factors will be mentioned separately. Wild chickens spend a big part of their daily exercise on looking for feed. Domesticated chickens in modern husbandry systems with chain - and reservoir feeders have such a well-balanced diet at disposal, that within a short time they reach their daily needs. A lot of time is left over which has to be filled with other behaviour. This means that because of the modern conveniences the birds are not stimulated to perform their natural behaviour. The former Dutch organic standards used to prescribe that grains should be scattered daily in the hen house in order to stimulate natural foraging behaviour. At first, the standard was 20 grams per hen per day, now it became 5 grams per hen per day. Although more was expected, only a weak correlation was found between the amount of grains scattered daily and the measure of feather pecking (see Table 1, n=26, correlation -0.487*).

In a British study (Green *et al.*, 2000), a strong relation was found between the litter quality at the end of the laying period and the occurrence of feather pecking. Dry and loose litter provides the animals with opportunities for scratching, which is very well stimulated if something edible can be found as well. In this study, no data were available on litter quality. However, much more stronger relations were found for the access to the outdoor run, with less feather pecking if the birds could use it daily (see Table 8, n=27, sign. 0.000), the earlier in the day they were allowed to use it (see Tables 9 - 12) and especially the percentage of birds that did use the outdoor run (see Table 1, n=22, correlation -0.800**). Moreover, this last factor was the only risk factor that fits in a regression model (see Table 13). Such a strong relation was also found by Green *et al.* (2000). They suggest that if a lot of birds are outside, the birds are not only busy with the environment instead of with conspecifics, but also the perceived stocking density is much lower.

To prevent feather pecking the attractiveness of the outdoor area is also important, which is expressed by the area covered by vegetation. The higher the percentage of the outdoor surface covered by high (higher than 1 meter) vegetation is, the less feather pecking was seen (see Table 1, n=30, correlation -0.635**). The remains of a bush-bird that our modern hybrids still carry with them, makes them afraid of open spaces. An open grass-clover field is the least suitable outdoor area that can be offered to such animals. Planting with maize, fruit trees, willows and with a fence or an embankment around it, fits more in the nature of these animals. Experiences in early life can have their influence as well: if the birds arrived at the laying farm at a younger age than 17 weeks, then a higher percentage of the flock used the outdoor run.

Table 8. Fischer's exact test (2-sided) for daily access to outdoor run

	Daily no	Daily yes	Total
Severe feather pecking	8	3	11
No severe feather pecking		16	16
Total	8	19	27

Significance 0.000

Table 9. Fischer's exact test (2-sided) for time of access to outdoor run

	Before 10 a.m.	10 - 12 a.m.	After 12	Total
Severe feather pecking	4	9	3	16
No severe feather pecking	12	1	3	16
Total	16	10	6	32

Significance 0.003

Table 10. Fischer's exact test (2-sided) for time of access to outdoor run

	Before 10 a.m.	10 - 12 a.m.	Total
Severe feather pecking	4	9	13
No severe feather pecking	12	1	13
Total	16	10	26

Significance 0.004

Table 11. Fischer's exact test (2-sided) for time of access to outdoor run

	10-12 a.m.	After 12	Total
Severe feather pecking	9	3	12
No severe feather pecking	1	3	4
Total	10	6	16

Significance 0.118

Table 12. Fischer's exact test (2-sided) for time of access to outdoor run

	Before 10 a.m.	After 12	Total
Severe feather pecking	4	3	7
No severe feather pecking	12	3	15
Total	16	6	22

Significance 0.334

Table 13. Logistic regression model of association between the percentage of birds that use the outdoor run and feather pecking.

	Std error	Sign.	Confidence interval	
Constant	0.516	0.000	5.041	7.195
% of birds outside	0.008	0.000	-0.062	-0.030

Regression equation: Plumage condition = 6.118 x -0.04587 % of birds that use the outdoor run.

Overall, results show that feather pecking is a result of a complex problem. Within such an epidemiological study only correlations can be mentioned to several factors. Some of these factors, however, are linked to each other and therefore it is impossible to point out one single factor. The connection of factors shows that inexperienced farmers do not understand the basic needs of beaked hen keeping. Their actions are still based on debeaked chickens. Farmers who had a good feeling for the basic needs of the chicken in relation to her origin as a bird of prey living in small flocks in a forested area, have adapted their management, were keeping animals in smaller flocks, looked after the outdoor area and paid attention to the first part of life of laying hens. This understanding of the animal's need is an expression of man-animal relationship and can be interpreted as an overall factor affecting all other farmer's choices. A similar result was found in studies about management of horned dairy cattle (Waiblinger, 1996 and Waiblinger *et al*., 2000).

Beak trimming or not: what is the difference?

In 75% of the organic layer flocks in this Dutch study, feather pecking occurs from moderate to severe extent. The British study mentioned (Green *et al*., 2000) was done at 198 farm (172 of them had an outdoor area), who all kept beak trimmed birds. 55% of them reported feather pecking in their latest culled flocks. If we assume that both moderate and severe feather pecking is combined in this study, and that the other differences between free range and organic poultry are of minor importance, then the incidence of severe feather pecking is 20% lower in beak trimmed flocks than in non-beak trimmed flocks. Of course, this is a risky estimate, but it is clear that even in flocks of beak trimmed birds feather pecking occurs and it is important to adapt the management and housing in order to prevent feather pecking. Beak trimming thus cannot be regarded as a serious solution for feather pecking. At most, it reduces the damage and the step to killing, but it does not take away the causes for this abnormal behaviour.

Conclusions

It seems to be hard to keep organic poultry in conditions where feather pecking does not occur, but it is not impossible. In this study, some risk factors were identified, and they were all factors that were affected by the farmer's management. However, to avoid the risk in the daily practise, farmers should pay more attention to their animals than only acting according to the E.U.-regulations for organic animal husbandry. It depends on the motivation and devotion of the farmer if he (or she) succeeds in keeping feather pecking in his (or her) flock under control. If the farmer understands the basic behaviour of poultry, his overall attitude and management will be adapted to the needs of the animal, which is the main step in reducing feather pecking.

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Scientific principles and practical examples of species-specific husbandry

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Introduction

In modern times, the initial criterion of the truth of science has increasingly been replaced by the criterion of utility, leading to 'Isolation ethics" (Teutsch, 1979) in the sense of self-interest. Today, a reversal in ethical development can take place if the revelational or convictional ethics, which were formerly justified, are now augmented to cognitive ethics.

Epistemology, a science of understanding

The assumed subjectivity of thinking (Kant, 1877) contradicts the experience of an engineer who - by thinking and understanding and acting - can effectively influence the inorganic sphere of the world. To overcome this contradiction, a science of understanding is required to show how man can understand the world. This epistemology was successfully established and implemented by Steiner (1921). In trying to observe one's own cognition processes, one can easily apply and modify Furrer's (1980) arguments-. "it is not enough for us to think, act and perceive. Experiments can only be carried out if nature itself is thinkable, treatable and perceivable. Yet we can only find out by Experiment whether nature has these qualities."

However, nature's essential quality is not its questionability but its mental conceivability and its functionality. One could even say that any science is the science of behaviour i.e. ethology, since all thinkable expectations of behaviour (hypotheses) are observed in the experiment as nature's actual behaviour.

The cognition process can be followed by anyone who observes his or her own efforts to understand. This can be illustrated as shown in Figure 1.

The perceivable and questionable world phenomena, - which needs explanations - draws on human concepts created through thinking. Experiments show whether or not the expectations concerning behaviour are confirmed by world behaviour. If this is the case, the world of phenomena is no longer questionable, its functionality and its laws will be recognised and understood. In other words, the world becomes real; we can realise the world. By linking conception and perception, our concepts -which always have a generic character- become individualised, i.e. a generic concept becomes an individual representation (Witzenmann, 1983). The generic concept of an injury, for example, becomes individualised to a laceration on the femur (see Figure 1).

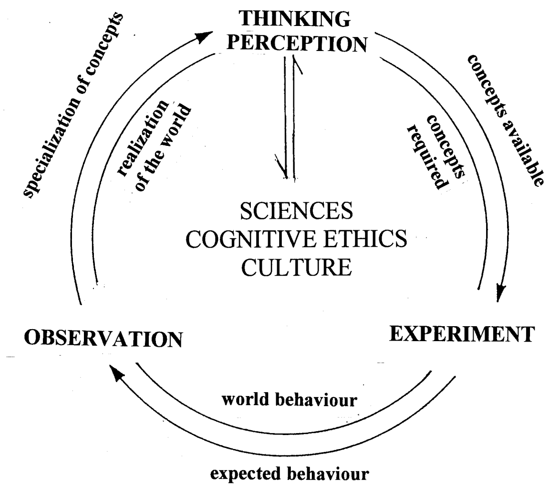

Figure 1: Diagram of the process and evolution of sciences, cognitive ethics and culture.

By carrying out this cognition process in all the different spheres of conception - corresponding to the different spheres of being (inorganic, physiological, psychological and spiritual) - mankind recognizes the world and thus creates the different sciences (physics, biology, psychology and the humanities). Cognitive ethics derives from the links between scientific understanding of the world and of human nature. Implementing these ethics by acting according to reason and understanding leads to cultural progress in the form of a metamorphosis of natural evolution.

Ethology of farm animals

By applying this cognition process to animal behaviour, it becomes apparent that animal behaviour cannot be understood without the concept of autonomous activity, because this behaviour is not simply the causal effect of the environment, but an expression of the animal actively coming to terms with its surroundings (Sommer *et al.,* 1976). The animal applies its species-typical behaviour in order to satisfy its needs and to avoid suffering. This has given rise to the "prerequisites to meet the animal's needs and to avoid suffering" theory (Rist *et al.*, 1989). The satisfaction of needs and the avoidance of suffering leads to self-organisation and self-preservation of the animal physis, corresponding to the "theory of the prerequisites to meet needs and to avoid injuries" by Tschanz (1987). Housing systems that do not comply with the behaviour patterns of a species can impair or even prevent species-typical behaviour. Figure 2 will show how inadequate housing systems lead to injuries in the anatomical sphere; cause diseases, illness and pain in the physiological sphere; and, in the animal's psychological sphere, bring about suffering and anxiety, resulting in stress and the reduction of well-being.

SPECIES-TYPICAL BEHAVIOUR WELLBEING		
in the anatomical sphere ↓ disharmony ↓ injuries	in the physiological sphere ↓ disharmony ↓ diseases	in the psychological sphere ↓ disharmony ↓ suffering
STRESS REDUCTION OF WELLBEING		

Figure 2: The impairment or prevention of species-typical behaviour in the anatomical, physiological or psychological sphere can lead to injuries, illness and suffering

In positive terms we have:

- Absence of injuries as the successful interaction between animal and environment in the inorganic sphere

- Hea1th as the successful interaction between animal and environment in the physiological sphere

-We1lbeing as the successful interaction between animal and environment in the psychological sphere

By recognising and understanding the qualitative inter-relations between animal and environment, it is possible to deduce quantitative and measurable parameters for the assessment of housing systems and housing equipment. They can be classified and differentiated into pathological, physiological and behavioural parameters.

Pathological parameters:

-Injuries, contusions and abrasions due to inadequate housing
-Losses

Figure 3 shows the locations of injuries which -according to Kämmer *et al.* (1975) result from cubicles in loose-housing systems for dairy cows unsuitable for the motion sequences of getting up and lying down.

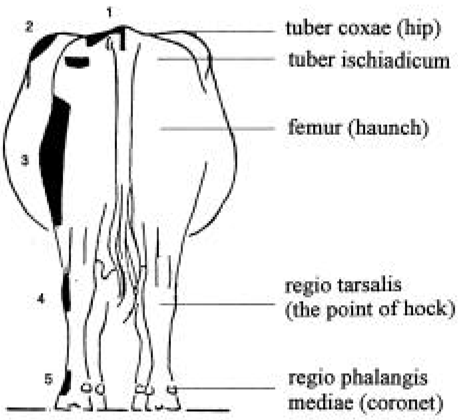

Fig. 3: Location of contusions, abrasions and lacerations on the animal body in loose-housing systems for dairy cows with cubicles unsuitable to their behavioural needs. Contusions at 1, 2, 6; Abrasions at 1, 2, 4, 5; Lacerations at 3

Physiological parameters:

- Changes in respiratory and pulse rate
- Changes in blood pressure
- Changes in blood parameters (haemoglobin, hormone and enzyme levels)
- Deviations in the digestion process
- Deviations in the reproduction process

By simultaneously analysing the state of agitation and hormone levels in young bulls, Unshelm *et al.* (1978) were able to prove that different levels of psychological agitation clearly influence the hormone levels. As shown in Table 1, there is a difference in adrenaline blood-levels of up to 10.4 ng/ml between resting bulls and those moving evasively after antagonistic clashes.

These and similar surveys disprove the commonly held materialistic view that anatomy determines physiology which, in turn, determines the psyche. In reality, it is the other way round: psychological processes are expressed in physiological processes and thus, in the course of time, the physiological structures (e.g. the immune-system) are also influenced. Hence psychological well-being is the determining factor for an animal's health or illness.

Table 1: Different levels of adrenaline in the blood samples of young bulls in various states of excitement or agitation (after Unshelm et al., 1978)

Activities	Number of observations	Adrenaline in ng/ml
lying and ruminating	54	-2.17
lying	60	-2.30
standing, ruminating and feeding	25	-1.44
sniffing, social grooming, looking around, turning towards others	21	-1.52
rubbing, pushing, playful head-pushing	16	+6.07**
attentive waiting, walking around, head forward	9	-1.65
evasive movement, restlessness	10	+8.10**
defence reaction	2	-2.08
**highly significant		

<u>Behavioural parameters</u>:

- Deviations in sequence, duration and frequency of species-typical behaviour (e.g. lying time, feeding time, etc.)
- Antagonistic reactions (e.g. chasing away members of the herd from the feeding area in loose-housing systems for dairy cows).
- Loss of essential behaviour patterns (e.g. impaired motion due to cage or crate systems).
- Behavioural disorders (e.g. tongue-swinging of calves).

The most comprehensive and the most telling parameters are the behaviour parameters, since they show disequilibria between animal and environment, in many cases long before this becomes manifest in the physiological or anatomic sphere.

Repeated 24-hour observation of animal behaviour in different housing systems using the electronic device for registration of duration and frequency (Etho-Piano, see Figure 4) has become a standard method for comparing and assessing different housing systems and the development of new housing equipment.

Figure 4: Electronic device to register time and frequency of animal- behaviour in quantitative terms

Quintessence for animal husbandry

Now that the limitations of species-typical behaviour patterns of farm animals have been brought to light through farm-animal ethology over the past 2 decades, it is evident that animals must be given an environment in which they can live true to their type. For example, it has been shown that continuous housing cannot be justified for any animal species. Cattle as well as pigs and poultry need adequate space to run about in. lf meadows and grazing areas can be made available -the ideal species-typical situation - this should also be provided for pigs and poultry along the lines already established for cattle.

Autonomous beings and causality

From the above it follows that for *autonomous* beings - including human beings - outer circumstances are not the causes for autonomous activity, but that under more or less favourable conditions, an autonomous being produces autonomous activities. It also follows that physical causality always presupposes that if the factors under consideration manifest no autonomous activity, that they are passive and non-living things (Rist, 1985).

In his introductions to Goethe's scientific writings on the distinction between the phenomena of inorganic and organic nature, Rudolf Steiner commented as follows: “An example of the former kind, for instance, is the collision between two elastic balls. We have *comprehended* this phenomenon when we are able to state the velocity and direction of the second ball on the basis of the mass, direction and velocity of the first and the mass of the second; when we see that, under the given conditions, that phenomenon must occur as a matter of *necessity*. But this means only that what is presented to our senses must appear as a necessary result of what we have to postulate in the idea. If such is the case, we have to say that concept and phenomenon coincide. There is nothing in the concept, which is not also in the phenomenon, and nothing in the phenomenon which is not also in the concept.”

Living beings such as plants and animals are different in that in the constant metabolism, change of shape and behaviour, the autonomous activity of the animal or plant *species* comes to expression. It is characteristic that throughout the life history organisms of the species remained the same, whereas the material composition constantly changed. Because of this, the modern geneticist is forced to speak of a genetic 'program'. He must have some sort of constant in the change of appearances and cannot find it in the matter. Rudolf Steiner (1884 - 1887) expressed it thus: "For instance, it cannot be said of the plant that size, form, position, etc. of the roots determine the sense perceptible characteristics of the leaves or the flowers. A body in which such would be the case would not be an organism but a machine. It must be admitted, rather, that sensible characteristics in a living entity do not appear as effects of other sense perceptible conditions, as is the case in inorganic nature. All sensible qualities appear here rather as a result of something, which is not perceptible to the senses. We must go beyond the sense world. What is perceived does not any longer suffice; if we are to explain the phenomena we must conceptually grasp the unity."

Goethe described this higher ideal unity, whence all animal and plant species come, as the 'type' or as Rudolf Steiner (1886) put it: 'The type is the true primal organism; either primal plant or primal animal according as it specialises ideally. It cannot be any single sensibly real living entity."

This ideal differentiation of the primal organism is based on two formative tendencies (see Figure 5): plants are organisms which both functionally and morphologically - from seed, through seedling and green leaf to flower - open out more and more to the environment, indeed, lose themselves in it as pollen. In fertilisation, this abandonment to the *environment* reverses and, in fruit and seed formation, leads back once again to the closed form of *autonomy.* This counteracting form-tendency prevails in the animal organism. Animals increasingly close themselves off from the outer world with their skin (fur, feathers, shell etc.), thus emphasising their autonomy (Rist, 1993). This gives only the main tendencies, the ultimate form depending on two aspects:

1. How the environment or autonomy of a particular plant or animal species metamorphoses, specialises: "The type, the revelation, of the principle in the organism, its idea, the animality in the animal, which out of the life that unfolds from it, has the power and ability to develop a multiplicity of outer forms (species, genera) out of its inner potential." (Steiner, R. 1884 - 1897)

2. How the outer conditions are formed, amongst which the individualisation of the type take place.

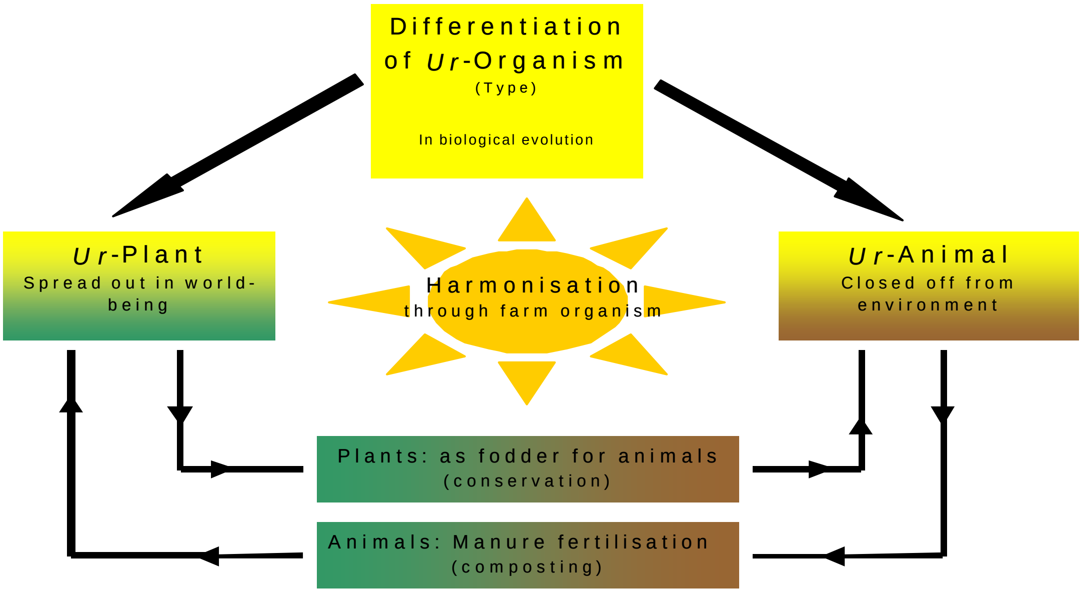

Figure 5. Differentiation of Ur-organism in Ur-plant and Ur-animal and its relation to farm-organism in biodynamic agriculture.

It is not that outer circumstances shape the organism, but that these can provide more or less favourable conditions. What appear physically are only particular metamorphoses, individualisation of particular species that develop from the type. The species as such are not sense-perceptible, only their representatives in the form of individual organisms, which under particular conditions are not exactly the same, but because they belong to the same species are similar. "...since it [the organism] is here subject, not only to its own formative principles, but also to the conditioning influences of the external world - since it is not such as it ought to be according to the nature of the self-determining entelechy principle, but also such as it is through the influence of something else upon which it depends - it therefore appears as if never in full accord with itself, as if never heeding only its own nature. Here human reason now enters and forms in *idea* an organism not corresponding to the influences of the external world, but heeding only that principle." (Steiner, R. 1884-1897)

This shows that the species are soul-spiritual beings, which, stemming from the spiritual cosmos, enter into earthly events. That a plant or animal species is not an abstract concept, not even a subjective scheme for putting things in order, but soul-spiritual potential can be clarified with the following example: we know that soul-spiritual conditions affect our bodily functions, such as blushing, trembling with excitement or raised adrenaline levels with stronger stimuli. This is demonstrated experimentally in bullocks, which have differing blood adrenaline level according to the level of psychological stimulus (Unshelm *et al.* 1978). The hormone production is the result of the stimulus and not the reverse. Hormones provide the conditions for our soul-spiritual state to affect our bodies. Hence we call them messenger substances. Interestingly, certain hormones can affect the genes and exert a regulatory influence in genetic processes (Wehner and Gehring, 1990). Thus information flows not only from DNA to protein, but also from immaterial, soul-spiritual potentiality of the species to the hormone and then to the DNA. Because of this we can answer the question raised above as to what life is in the following manner: *Life is the autonomous interaction of the respective plant or animal species or the human individuality with the prevailing environmental conditions.*

An alternative perspective on genes

A way of looking at genes that accords with the spirit does not comprise the inadequate view that genetic substance builds up the organism in a physical causative way. Rather, it is the genetic substance that is the *condition*, under which the omnipotence of the *species* individualises itself to a specific phenomenal form, similar to its predecessors whence came the genetic substance (Rist, 2000). The genetic substance is the condition for getting a Friesian calf from the mating of a Friesian cow with a Friesian bull. That an organism of the cattle kind arises at all is not attributable to the genetic substance but to the soul-spiritual 'information' of the species of cattle.

Unbiased observation of gene *technology* or genetic *engineering* suggests that these designations are inappropriate because, for one thing, many experiments do not 'succeed', i.e. do not deliver confirmation of the materialistic theory (Goodwin, 1984; Holliday, 1988; Heusser, 1989; Reiber, 1995; Strohman, 1997), or when they do 'succeed', malformations result or unexpected results are produced. It is less a matter of a mature 'technology', than an interesting field of scientific research. To this one might add that many experiments, which have not succeeded according to the current theory, have not been reported (Fox, 1991). If mechanical technology had a similarly uncertain outcome, hardly anyone would set foot in an aeroplane or even a train.

The most extensive proliferation of gene manipulation has been with bacteria. Wirz (1995) explains this as being the result of the fact that bacteria can be easily cultured in millions and the few good examples easily isolated and multiplied. It is also worth noting that bacteria have a natural tendency to exchange genes. Furthermore, bacteria allow the introduction of genes from higher organisms, but even then the outcome is not at all certain as shown for example by the *Escherichia coli* bacterium which received a foreign gene for the oxidation of naphthalene to salicylate, but unexpectedly produced the dye indigo (Ensley *et al.*, 1983). In addition, we need to consider that in prokaryotes (organisms with no cell nucleus), which include the bacteria, it is always the whole gene that is expressed, whereas with eukaryotes (organisms with a proper cell nucleus), which include almost all plants and all animals, only a part of the gene is expressed. Here, even at the molecular level, lies a functional difference between the simpler and the more developed species.

It can happen that some DNA sequences code for more than one protein or that genes overlap. Through varying the splicing, different proteins can be obtained from the same nucleotide sequence (Lewin, 1991). The more highly developed species are less able to fit themselves to different environmental conditions than universal organisms, which can appear under various conditions and, therefore, from an experimenter's point of view, are more easily manipulated.

In the transition from bacteria to higher organisms, it is clear that genetic engineering experiments are most successful with plants that are more closely related to one another (Potrykus, 1991). Even here, the boundaries are once again closely set, as for example with the 'tomato' which was a protoplast crossing between the two nightshade species, tomato and potato. Although it grew, it resulted in neither an edible tomato nor an edible potato. Both species could still influence the genetic material but it led to corresponding disturbances in their species-specific formative tendencies, especially their assimilation into the corresponding fruit or root regions. In addition, it should be noted that in plants, genes foreign to the species are soon no longer expressed, i.e. brought to appearance, but through a molecular reaction (methylation) are inactivated (Meyer, 1996). In this so-called gene silencing, the transgene concerned poses an unfavourable condition for the plant *species* and can be silenced by it.

Stable expression of such transgenes is difficult to attain, especially when the environmental conditions vary a lot. Thus, in an open-air experiment, petunias containing a so-called colour gene from maize initially showed the desired colour. But when a period of hot weather arrived - i.e. a change in the environmental conditions - they lost the coloration once again, showing that the gene had been inactivated (Linn, 1990). So-called pleiotropic effects appeared, meaning that other features than pigmentation were affected. The transgenic petunias had more leaves and shoots per plant and were more resistant to pathogenic fungi. They showed greater vitality and lower fertility than the unmanipulated petunias (Meyer, 1995). During the hot weather, the vitality of the transgenic petunias was suppressed. This illustrates clearly how the petunia *species* can more or less effectively influence its hereditary material depending on the environmental conditions.

Gene manipulation comes up against the greatest difficulties with mammals. In the so called 'knockout experiments' on mice in which genes are switched off by a molecular technique, out of approximately a million treated cells only one with the desired effect could be found (Capecchi, 1994). In the 'production' of transgenic animals, one can hardly fail to notice the enormous 'embryo consumption'. In a large experiment on pigs lasting three years, only 8% of the manipulated egg cells gave rise to births. Of these 8%, only 7% had, in fact, taken up the transgene. This corresponds to a success rate of only 0.6% (Pursel *et al.*, 1989). In the animals that actually took up the foreign gene, its effect, in most cases, showed as deformations or functional disturbances. For instance, the pigs grew faster. But in the long run, this was detrimental to health as the pigs showed a strong tendency to gastric ulcers, arthritis, cardiomegaly, dermatitis and kidney diseases. Through this intervention, the conditions for the porcine species became so unfavourable that it could only imperfectly form its organism. The 'growth hormone' gene became - in the language of genetics - an arthritis gene.

In the aforementioned knockout experiments, people hope to gain information on the function of the deleted gene in the organism. To the amazement of the experts, a large number of these deletions were without visible consequences for the organism or quite other characteristics were affected from the ones predicted from theory (Tautz, 1992;

Brookfield, 1992). When the species is capable of forming a complete organism without a gene presupposed to be essential, it can only mean that genes are not the cause of the organism's existence, but only provide more or less favourable conditions and, in some cases, can be completely absent.

Consequences for breeding

From these examples, it is clear that the species, in its soul-spiritual potentiality from the non-spatial and non-temporal, exerts its influence at all times and throughout the organism. It can manage this better the more favourable are the available conditions (Rist, 1997; Rist, 1998).

Three categories of conditions can be distinguished: firstly, the *terrestrial* conditions, which include the external environmental influences (e.g. warmth, light, moisture, soil composition with plants, husbandry and nutrition with animals); secondly, the *cosmic* conditions, which include the relation of the sun, moon and planets to one another and to the fixed stars (Steiner, 1924), as frequently shown experimentally by Spiess (1990), Zürcher (1992) and Thun (1993); and thirdly, the *genetic* conditions. The latter stem from the ancestors and set more or less favourable *inner* prerequisites for the organism for it to develop in accord with its species. Breeders do their best to bring together the most favourable *outer* conditions with the most favourable hereditary material (inner conditions). Through getting all the conditions optimal, it becomes possible for the species - over several generations (Steiner, 1924) - to form its genetic material optimally. In conventional breeding, it is always ensured that along with selection the optimal conditions for life for the desired goal of the breeding are made available - albeit with the justification that what is stored genetically can also manifest itself. It is therefore questionable whether the characteristics achieved arise through chance mutation and/or the *conditions* for life (for which 'chance' is not a scientific explanation, but rather shows that one does not know the reasons, conditions or inner activity at work which give rise to the appearances in question).

One can even accept that through the intervention of gene manipulation of the hereditary material this too could be improved. But it is worthwhile first considering that by optimising the environmental conditions the species is not forced to do anything in particular, but is left to respond according to its own potential. As the species has self-referentially developed its whole organism - including its hereditary material - under *terrestrial* and *cosmic* conditions appropriate for the species, over a series of generations, the hereditary material becomes increasingly characteristic for the species. In this way, through optimising the environmental conditions, the *genetic* conditions become increasingly optimal, i.e. increasingly species specific, because the species itself knows best the optimal genetic make up needed for doing justice to the intentions characteristic of the species.

From knowledge to an ethics for the living world

Thus conditions for embodiment can be divided into three categories: terrestrial, cosmic and genetic. It follows from this that the genetic conditions are also dependent upon the terrestrial and cosmic conditions, because the genetic material is formed and stabilised only in the organism that contains it in its series of generations. As an alternative to genetic engineering's relatively clumsy intervention in the hereditary material, researchers who think biologically have at their disposal the optimisation of the terrestrial and cosmic conditions. This means that, for certain activities (e.g. sowing, fertilisation), particular cosmic constellations must be selected.

Mankind's task lies not in forcing the species to our own de*genera*te intentions, but in *optimising the conditions* in which the species can develop free from unfavourable circumstances. This is the goal of plant and animal husbandry that is true to the species, as is striven for and practised in biodynamic farming. That with this the *nutritional quality* of the respective plants or animals improves, has already been demonstrated by experiment (Balzer-Graf, 1995).

The foregoing yields an ethical insight that the task of the people who understand plants and animals is to create the optimal conditions for their embodiment. Optimal product quality, e.g. in milk, vegetables, corn, medicinal herbs arises in this way as a reciprocal exchange from the plants and animals to the caring human beings. Agriculture then becomes the art of creating the optimal living conditions for plant, animal and human being.

Science and ethics

The fact that individual human behaviour is largely determined by the individual's own philosophy of life is all too often neglected in ethics. This is illustrated in Figure 6.

If the constituent principles of life are coincidence and necessity (Monod, 1971), the individual can only fatalistically submit to these coincidences and necessities. If, however, the struggle for existence (Darwin, 1884) is the adopted principle of life, it is evident that the individual will try to win control in order to ensure survival through individual or group egoism. If ecology is the guiding principle of life, then the individual's efforts will go into conserving and protecting the environment. However, if the world we live in is not only seen as a material world but also as a world, which respects and reflects the intrinsic nature of every species, then it is only reasonable to behave accordingly.

PHILOSOPHY OF LIFE	HUMAN BEHAVIOUR
chance and necessity	fatalistic obedience
struggle for existence	individual or group egoism
ecology	conservation and protection of the environment
intrinsic nature of species	according to intrinsic nature of species

Figure 6: Philosophy of life and the resulting human behaviour.

Basic Research and cognitive ethics

The duties science has with regard to human behaviour go very much further than generally practised. Thus basic research really means searching for the relation between mankind and the world and finding out which of the previously mentioned or other constituent principles really correspond to our world. These two questions cannot be answered without a suitable science, i.e. without epistemology. Consequently, such basic research would lead to cognitive ethics, to acting on the basis of loving understanding and true cultural progress.

This vision should not be rejected out of hand. We have already made noteworthy progress, despite the obstacles and setbacks we have encountered. Species-typical housing-systems, feeding- and breeding-methods are consequences of an understanding of the animals as autonomous partners with their species-typical needs and wants. Therefore the alternative approaches presented in this paper have the function of prevention and thus have a great impact on animal health because they prevent the development of diseases at any levels of the animal (and plant) organism.

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Discussion report

Stockmanship: Constraints, evaluation and suggestions for improvement -

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Three separate working groups discussed the following in regard to stockmanship and human animal relationship: 1) implications for organic standards and certification/inspection, 2) constraints to improvements in stockmanship and husbandry skills, 3) research needs and 4) suggestions for practical advisory work in relation to stockmanship.

1) Stockmanship: Implications for the standards and certification/inspection procedures

Accepting that the new EU livestock regulation has just been implemented, the group assumed that major changes to the standards are not very likely in the near future.

The following points and suggestions were made during the discussion:

1) Are the inspectors trained to observe good stockmanship and animal welfare or is the inspection procedure mainly based on assessment of the records e.g. area

per animal, number of treatments etc.? Is there a need to train inspectors in the assessment of stockmanship?

2) It was concluded that there is a need to elaborate and collate more detail on species-specific housing conditions and husbandry guidelines from existing knowledge, keeping in mind that general welfare standards already include some detail and that over-regulation might occur. It was pointed out that the experience from other farm assurance schemes should be studied and considered where appropriate.
3) It was argued that there is a lack of welfare related goals in organic standards. It would be important to include clear indicators of good welfare (e.g. low level of feather pecking) in the certification requirements in order to put more emphasis on improved/changed husbandry requirements during conversion.
4) It was suggested that the inclusion of a requirement for health management plans in the standards would be helpful in monitoring husbandry standards and stockmanship as these plans would increase the transparency of the results of husbandry/stockmanship (disease levels, incidence of injuries etc.) on the farm.
5) The possibility of compulsory training for organic farmers in stockmanship and husbandry was discussed? In Finland, the converting farmers have to undergo a certain amount of compulsory training during the conversion period. The papers in these proceedings suggest that the stockperson's understanding and knowledge of the animals' needs is paramount to good stockmanship (see Waiblinger *et al.* and Bestman). On the other hand, it is suggested that farmer/stockmanship characteristics are also important to good stockmanship (see Seabrooke) and that humans have fairly good ability to interpret animal behaviour without training (see Wemlesfelder).

2) Stockmanship: The major constraints to improving stockmanship and husbandry skills.

The following were identified as major constraints to improving stockmanship and husbandry skill among farmers in general and among organic farmers in particular:

1. Lack of benchmarking

   There is a difficulty in assessing and comparing the standards of stockmanship on a specific farm in the absence of parameters that clearly measure good stockmanship. Stockmanship is also a sensitive area in regard to assessment as the jury is still out on whether good stockpersons are born or made. It should, however, be possible to set minimum levels in order to ensure good animal welfare.
2. Lack of hard data on the tangible benefits of good stockmanship

   Is it possible to calculate these? Herd health plans in cattle and pig systems have been shown to produce clear financial benefits, but even good stockpeople have injured or diseased animals?
3. The difficulty of transferring prescription into knowledge

   This is particularly difficult in case of stockmanship as a change is required on rather personal level: you can bring a horse to water… Compulsory training, if carried out in a participatory/partnership level, may be helpful.
4. Availability and uptake of existing information

There is a need to guarantee that existing and new information, even when produced within conventional management systems is transferred to organic farmers. Organic farmers often have more channels for technology transfer than conventional farmers, as there is a need for support and collaboration in conversion and marketing of organic produce. Organic farmers may also be more open to change as conversion in itself forces a lot of change.

5. Lack of continuity in family farming
   Poor profitability of farming prevents takeover by young farmers. Many new farmers enter the "profession" via organic farming. Both phenomena prevent technology transfer between generations: learning through experience is lost.
6. Coping with change during conversion and potential lack of real change
   Conversion period can be demanding, particularly for paid stockpeople who have not taken the "conversion decision" personally (see Seabrooke). There may also be significant demands on new skills and procedures but no real change in the herd, flock or infrastructure level to allow for these changes.
7. Infrastuctural constraints
   Poor housing, lack of support of equipment, poor and old milking machine may be a source of major frustration that prevents the use of existing skills and know-how. This may apply to both paid staff and owner-farmers. Unrealistic expectations under poor circumstances may lead to complacency or frustration and, ultimately, to poor stockmanship. Lack of influence by paid staff on decision making in regard to infrastructure leads to lack of interest. Farmers need advice/training on how to be a good employer.
8. Lack of dissemination of "know-how"
   Stockmanship is not something that is easily discussed between farmers and stockpeople (i.e. it is easier to talk about the new tractor or the new seed variety than about one self). The "grumpy herdsman" factor (see Seabrooke) may contribute to this (i.e. the best herdsmen are introverted and "like animals better than humans", i.e. do not communicate there know-how to other stockpeople).

3) Stockmanship: Research needs

The following areas of research needs were identified:

1) Is a good stockman made or born? This question has implications for the training in stockmanship.
2) What is a definition of good stockmanship? Which and whose values are represented in definitions? Is there any variation between farming systems in regard to good stockmanship?
3) How can the learning of stockmanship be best studied? Do we need social science methodology, and which of the methodologies are most appropriate?
4) The impact of changing housing and husbandry systems on stockmanship, e.g. the welfare implications of automated or free range systems with less human-animal interaction.
5) Do we need to change the animal, e.g. the role of breeding in animal behaviour and adaptability to housing/husbandry systems?
6) What are the quantifiable benefits of good stockmanship to the farmers, e.g. financial benefits, reduced disease incidence etc.

4) Stockmanship: suggestions for practical advisory work in relation to stockmanship

The following suggestions were made:

1) Working with a participatory approach, on the basis of knowledge networks and farmer-to-farmer interactions, was recognised as better than the traditional approach of expert consultation. It was also pointed out that the individuality of the stockpeople involved must be considered. The constraints in regard to infrastructural constraints must be recognised in each farm in order to avoid undue expectations on what "good" stockmanship can do.
2) Training and information for farmers, stockpeople, vets and other "co-workers" on stockmanship. Higher profile for stockmanship when farm level risk factors, constraints and strengths are analysed.
3) Showing the benefits of good stockmanship more clearly, in very practical terms. The benefits should be expressed in terms of objectives that matter to the farmer (e.g. good stockmanship improves fertility parameters/milk yields, paid stockpeople are motivated by good salary etc.).
4) It is important to raise awareness about the fact that observation of the animals and recording of the observations is an important task. Time spent on observation/recording is valuable work – both when carried out by the owner-farmer or by paid staff.
5) Attention paid on the development of practical templates and novel methods to record data on farms may pay off in increased motivation. Analysis of recorded data and its presentation in ways that help practical work (e.g. action lists, graphs about trends in production levels or disease incidence) also increase motivation (i.e. "somebody in interested in what I am doing and what the results of my actions are"). The use of recorded and analysed data as a decision making tool can also empower paid staff if used in a creative way ("my data helped them/forced them to change the feeding system" etc.).

Discussion report

Human animal relationship and housing: How to translate research into better standards and practice?

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Introduction

This paper will summarise the output generated from small group discussions on housing and human-animal relationship, with a central theme of “how to translate research into better standards and practice”.

The discussions focussed on the following basic questions:

- What is the role, and what are the limitations, of organic livestock standards?
- What is the role, and what are the limitations, of the researcher?

The role and limitations of organic health and welfare standards?

1. Organic livestock standards have a basic requirement of *improving animal welfare,* partly through the *promotion of good stockmanship*. However, they tend to be goal-orientated and rather inflexible. Whilst standards may aim to achieve "minimum" standards of welfare, they are not really devised to achieve a continuous improvement in the welfare of livestock. Some form of continuous improvement is required. Although standards have to be such that the promotion of good stockmanship will result in good welfare, ethological knowledge cannot be easily translated into practice, and is even more difficult to reflect in a set of rigid standards.
2. So, what is the difference between standards and practice? Can the difference be reflected in the difference in approach between "the actors" and "the believers." For the "actors" involved in organic farming, where the motivation may be more commercial than philosophical, the standards present a bottom line of achievement. This has resulted in increasing pressure being put on the standards. The achievement of a target has become more important than the continuous development of a system and the level of welfare.
3. Applying organic standards does not guarantee good animal welfare. In some situations, despite the underlying aim of organic standards, there are demonstrable welfare problems on organic farms.
4. Standards are often based on very little or inappropriate research. Furthermore, in certain circumstances, standards may be set without understanding why and how these may result in improved welfare e.g. having animals outside for welfare reasons does not result in good welfare if they are not properly taken care of, and appropriate systems of surveillance are not in place.
5. Whereas the relative rigidity of the standards are accepted, a code of practice, that allows a more flexible approach to livestock management is more appropriate to achieving the underlying aims of an organic approach. To facilitate this, perhaps standards should not only be quantitative, but should also be sufficiently flexible to deliver a system that the animal easily fits into.
6. Although standards aim to achieve a desired level of stockmanship, they should also be motivational. This raises the question as to whether producers should be instructed to comply with standards or be facilitated and motivated through a process of participation involving advisors, certifiers and researchers. Or perhaps this is the role of organic codes of practice designed to assist producers to not only achieve standards, but to also implement systems of management that aim for continuous improvement.
7. In order for standards to be reflected in good practice, the approach to the implementation of standards should be a two way process, where researchers/advisors work closely with producers i.e. participatory methods of research and development.

What is the role, and what are the limitations, of the researcher?

1. A provider of information? There are three groups working with producers to ensure achievement of good animal welfare on organic farms: the inspectors, advisors and researchers. Whilst it is the inspectors role to enforce standards and the advisors role to advise on the implementation of the standards, perhaps the researcher has a double role in providing information that i) enables employment of standards, and ii) provides advice to the advisors. Is there more to research than this?

2. Should the researcher be attempting to demonstrate the application of the standards, or how this is reflected in practice (e.g. not only to demonstrate that an outdoor area for exercise is available to poultry, or advise on the supply of an outdoor area, but also to demonstrate whether this achieves the objective of satisfying birds needs)?

3. This raises the question as to whether the real role of the researchers should be to conduct research on problems associated with current standards, or on the development of future standards (e.g. should we be doing research on birds that don't feather-peck or should we focus the research on the problem of feather-pecking?).

4. So, perhaps the role of the researcher lies in developing systems and methods that go beyond the mere application of standards, and attempting to ensure that the intended animal welfare benefits are actually achieved.

5. One demonstrable output that would enable the link between standards and practice would be the development of codes of practice for organic producers. Codes of practice may be more detailed than standards, and offer the opportunity for flexibility not possible in goal-orientated rules. The UK MAFF currently produces codes of practice for all livestock producers, which although voluntary, are motivated by animal welfare and disease control legislation. The development of health plans for organic producers are a dynamic and continuous form of code of practice aimed at ensuring good animal health and welfare. Should codes of practice become a legal requirement for organic producers?

6. The role of the organic researcher is often perceived as a "lobbyist". This role raises questions regarding the validity and objectivity of research outputs.

7. Animal welfare research should start from the perspective of the natural behaviour of animals and practical application on farms. However, it is frequently the case that the research is dominated by a cost-benefit approach to the development of suitable systems for improving welfare.

8. Research and development should ensure that the standards that are currently in place are sustainable e.g. poultry systems in the Nordic countries – there has been no or little research on the suitability of the standards for this region.

9. Beyond the mere achievement of standards, continuous development of systems, and ultimately enhanced animal welfare, can only be realistically applicable through collaborative efforts between researchers, producers and those that advise producers.

This takes the role of the researcher beyond that of a conventional scientist to a dual role of facilitator and collaborator.

Recommendations

1. Research is required into the development and application of “codes of practice” for organic livestock producers;

2. A greater degree of communication and participation between producer, researcher and advisor is required;

3. Organic standards should be sufficiently flexible to allow continuous improvement of animal welfare and not just the achievement of a goal(s);

4. Standards should be driven and informed by research that reflects the practice and experience of organic farmers.

Part B:

Reports on on-going research and new research concepts

Controlling internal parasites without the use of pharmaceutical anthelmintics

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Introduction

Organic systems seek to reduce reliance on external inputs (Lampkin, 1999), and develop sustainable methods of production, which balance output with high standards of animal welfare. Internal parasites, specifically nematodes, are a significant potential threat to the health and productivity of ruminant organic livestock (Svensson *et al.*, 2000). Clean grazing systems have been developed for conventional producers (MAFF, 1992), but uptake has been poor (Davies *et al.*, 1996) mainly due to a perception of more complex and less flexible management. Furthermore, conventional clean grazing systems generally rely on the strategic use of anthelmintic to prolong the clean status of the pasture. Organic farms tend to have lower stocking rates, and a better balance of enterprises (1). It has been demonstrated that, under optimum conditions of stocking rate and rotational grazing, it is possible to eliminate anthelmintic from hill and upland (Waterhouse *et al.*, 1992), and lowland (McNeidhe,1998) organic systems. However, these optimum conditions rarely apply in most commercial situations, and significant use of anthelmintic has been recorded on UK organic farms (Roderick and Hovi, 1999).

Effective alternatives to the use of pharmaceutical anthelmintics are a serious technical and ethical constraint for the organic livestock sector (UKROFS, 1998). There is a clear need to develop additional strategies, within the ethos of organic farming, which can support and increase the flexibility of basic clean grazing systems (Niezen *et al.*, 1996). Genetic differences in resistance to parasites are known to exist (Stear *et al.*, 1995), however underdeveloped selection tools, and variable correlations between parasite resistance and economically important traits, remain an impediment to rapid genetic progress. Biological control (Hay *et al.*, 1997) could potentially have a role to play in organic farming. However, before application could be considered under UK field conditions, a number of key issues (e.g. long-term efficacy, appropriate delivery systems, and potential long-term environmental effects) need to be resolved. Current evidence for the efficacy of herbal and homeopathic approaches is unconvincing (Day, 1995).

Research in New Zealand (Niezen *et al.*, 1998) has shown that specific crops, notably tanniferous plants such as *Lotus spp,* can reduce the effect of internal parasites on the grazing animal. Results of early field studies in the UK (Marley *et al.*, 1998), confirm the potential of novel crops for parasite control, but also highlight the importance of good establishment under UK conditions. Energy, protein and mineral nutrition can affect the host response to parasitic infection (Holmes, 1993). In particular, protein supplementation has been shown not only to improve resilience (Donaldson *et al.*, 1998), but also to enhance the expression of immunity to gastrointestinal nematodes (Coop and Kyriazakis, 1999). Improved understanding of host/parasite/nutrition interrelationships could provide a basis for the manipulation of diet in the control of internal parasites. The objective of this three-year (2000-2003) project is to combine existing and new knowledge of parasite, host and management interactions, with organic principles and practice. Focusing on ruminants, the approach has been to combine on-farm epidemiological studies, with replicated experiments, to develop and demonstrate applied systems of control directly applicable to organic farms.

Components of the study

On farm epidemiology

Five commercial organic farms have been selected for in-depth epidemiological study, using standard techniques -including faecal egg counts, herbage larval counts and tracer animals, supported by management (grazing and veterinary records) and meteorological data. Farms have been selected to reflect a range of production systems (e.g. specialist hill sheep, intensive dairying, mixed arable/livestock). The aim was to select farms with a more mature organic system i.e. already operating at a low level of anthelmintic for that system. This will enable a picture to be built up of the overall level of parasite challenge, critical points in the system, and the degree of control achieved with current management practices.

Replicated experiments

A programme of replicated experiments is being set up to compare the effects of novel cropping (*Lotus corniculatus*, ryegrass/white clover, *Lotus*/white clover, white clover) on the pattern of PGE in grazing ewes and lambs, and in young weaned stock (lambs and calves). These grazing experiments are further supported by small plot studies of pasture parasite ecology (larval development, survival and migration). Further experiments are being conducted on the direct effect of tannins, the effect of level of nutrition on the periparturient rise in faecal egg output, and on nutritional effects on overwintering infection in young dairy cattle.

Developing control systems on-farm
The collaborating research team is working closely with participating farmers and their vets, to improve parasite control on farm. It is intended to extend the results of replicated experiments into commercial practice, as and when appropriate. Combining laboratory tests, with grazing records and farm experience provides the opportunity to probe critical thresholds in the host/parasite relationship, and improve the interpretation and practical application of laboratory results.

Wider technology transfer
Using the focus farms as a platform, a programme of demonstration and technology transfer is planned to support publication in scientific journals and the popular press. It is expected that the results will be relevant to conventional producers looking to reduce costs and anthelmintic use, as well as to organic farmers.

Results to date

Epidemiological studies and experiments began in Spring 2000. As yet, few experimental results are available, but preliminary findings indicate a much wider range of internal parasites than normally found within conventional systems. In some instances, levels of faecal egg output have reached very high levels, without apparent detrimental effect on animal performance. A range of farm specific issues have arisen – nematodirus in young lambs, lungworm in cattle, and possibly a trace element/PGE interaction, which reflect the systems studied. Feedback from participating farmers has been very positive, particularly highlighting the desire for a better decision support framework to guide management, and more accurately define the circumstances where anthelmintic intervention is required. A further issue has been the ethical basis for pursuing conventional epidemiological approaches (e.g. serial slaughter) within studies of organic systems.

It is intended that the results of this project will advance understanding of parasite control on organic farms, provide better management guidelines, improve productivity, animal welfare and consumer expectations of organic livestock production.

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Utilisation of homeopathy in dairy cattle - first results of an Italian trial.

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Introduction

In EU Regulation No 1804/99 (supplementing EU Regulation No 2092/91), point 5 (Disease prevention and veterinary treatment) paragraph 5.4, it is stated that the use of veterinary medicinal products in organic farming shall comply with the phytotherapeutic, homeopathic products in preference to chemically synthesised allopathic medicinal products or antibiotics. The Mountain Community of Mugello and Alto Mugello (northern part of the Florence Province) in Italy, utilising LEADER II EU funds, commissioned a trial on the utilisation of Unconventional Medicines (UM) in dairy farms. Mugello is a suitable region for organic production. The main organic products of the region are milk, meat, apples, peaches and chestnuts (Martini et al., 2000).

Materials and methods

In the "Marchi brothers’" herd, close to Firenzuola (Alto Mugello, 400 m above sea level), 50 dairy cows (Italian Brown) were divided in two groups. A group of 25 cows were treated with UM, and 25 with conventional medicine (Control). Each of the two groups reflected the composition of the herd, with an equal number of young (> 6 months < 2 years), middle (> 2 years and < 4 years) and older (> 4 years) cows (see Table 1.).

Table 1. The grouping of animals for experimental purposes on Marchi brothers’ farm.

UM		**Control**	
Categories	Number	Categories	Number
> 6 months < 2 years	9	> 6 months < 2 years	9
> 2 years and < 4 years	8	> 2 and < 4 years	8
> 4 years	8	> 4 years	8

In this trial, classical unicistic homeopathy was used (Kent and Ullman, 1979). We also used a homeopathic eugenics program, designed for this farm, to obtain healthier calves (see Table 2.).

Table 2. Treatment of dams to obtain healthier calves.

Remedy and potency	**Month of pregnancy**
Sulphur 200 CH	3
Calcarea Phosphorica 200 CH	5
Arsenicum Album 200 CH	7
Sepia 200 CH	9

To prevent neonatal pathologies, all calves received at the birth a dose of TK 200 CH.

The animals were visited every 15 days and the necessary remedies prescribed. All the important events were registered daily by the farmer. Individual milk productions were recorded monthly, at the same time that the milk analyses were carried out.

Data from milk production and analysis of the first 17 months (May 1999/ September 2000) were analysed by the three-ways ANOVA system. With Calving (C), Months (M) and Treatments (T): UM or Control, including the interactions among months and treatments.

Results and discussion

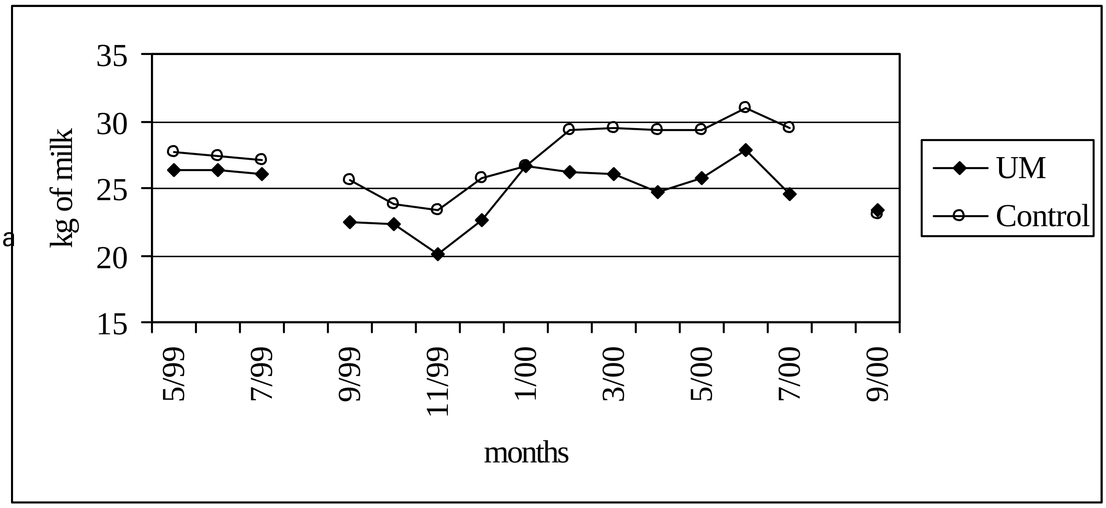
The data of milk production and analysis are detailed in the Table 3. The quantity and quality of milk was very good for the Italian Brown breed for this Apennines' area. The Somatic Cell Count (SCC) level was sufficiently low to permit the farm to participate in the "High Quality" EU programme. Calving (C) and month of measurement (M) influenced the milk production and fat and protein content. Treatment (T) affected only the milk production. The milk production trends of the two treatment groups are reported in the Figure 1. The data for August are not recorded.

Table 3. Results of the analysis of variance on milk production in the experimental herd.

DF = 354	Mean	C	M	T	MxT
Milk kg	25,98	***	***	***	Ns
Fat %	4,08	*	***	Ns	**Ns**
Protein %	3,63	**	***	Ns	Ns
SCC x1000 cells/ml	218,36	Ns	Ns	Ns	Ns

C = Calving; **M** = Months; **T** = Treatments.
P≤ 0,05; ** P≤ 0,01; *** P≤ 0,001

Figure 1. Treatments x Months: kg of milk



The UM group started with lower production levels compared to the Control group, and only twice (in January and in September 2000) reached the same levels. A possible explanation is that the two groups, chosen on the basis of the age of animals, are not well balanced regarding the milk production, as the higher yielding cows were put in the Control group.

In November 1999, the milk production was negatively influenced by a change of the ration, and in summer 2000 due to poor silage.

The number of the syndromes cured by each remedy in the UM group is reported in Table 4. Remedies at the potency of 200 CH were used, because our previous experience has indicated that the cows are more sensible to the high homeopathic potencies.

The number and type of the remedies utilised for each syndrome is reported in Table 5.

These last two tables are interesting because they allow us to choose a restricted number of remedies that we could utilise in preventive mass treatments.

Table 4. Number and type of the syndromes cured by each remedy in the UM group.

Remedy	**Syndromes**
Aconitum napellus 200CH	1 mastitis (= mast)
Apis mellifica 200 CH	1 infertility (= infer) , 1 mast
Arnica montana 200 CH	1 results of uterine twisting
Arsenicum album 200 CH	2 placenta retention (= ret sec), 1 mas, 1 toxaemia
Bacillinum 200 CH	2 mycosis
Belladonna 200 CH	2 mast
Bryonia 200 Ch	6 mastitis, 2 high SCC, 1 placenta retention
Calcarea carbonica 200 CH	4 low lactation, 1 infer, 1 mast, 1 ret sec, 1 uter fibroma
Caulophyllum 200 CH	1 milk retention
Conium maculatum 200 CH	2 udder nodosities, 1 mast
Hepar sulphur 5 CH	1 abscess, 1 conjunctivitis, 1 udder nodosities
Kali muriaticum 200 CH	1 mastitis
Lachesis 200 CH	1 infertility
Lycopodium 200 CH	1 placenta retention
Mercurius solubilis 200 CH	1 podoflemmatitis, 1 udder ulcer
Natrum muriaticum 200 CH	1 diarrhoea, 1 low starting lactation, 2 mycosis
Nux vomica 200 CH	4 mastitis, 1 toxaemia
Phosphorus 200 CH	4 infertility, 1 toxaemia
Phytolacca 200 CH	2 mastitis
Podophyllum 200 CH	1 infertility
Pulsatilla 200 CH	2 infertility, 2 mastitis, 1 placenta retention
Pyrogenium 200 CH	1 mastitis, 1 placenta retention
Sabina 200 CH	1 infertility
Sepia 200 CH	7 placenta retention, 2 infertility, 1 mastitis
Silicea 200 CH	4 mast, 2 high SCC, 1 udder nodosities, 1 uter fibroma
Sulphur 200 CH	2 mycosis, 2 warts
Thuja 200 CH	1 warts

Table 5. Number and type of the remedies utilised for each syndrome in the UM group.

Syndromes	**Remedies**
Abscess	1 Hepar sulphur 5 CH
Conjunctivitis	1 Hepar sulphur 5 CH
Diarrhoea	1 Natrum muriaticum 200 CH
High SCC	2 Bryonia 200 CH, 2 Silicea 200 CH
Infertility	5 Phosphorus 200 CH, 2 Pusatilla 200 CH, 2 Sepia 200 CH, 1 Apis Mellifica 200 CH, 1 Calcarea carbonica 200 CH, 1 Lachesis 200 CH, 1 Podophyllum 200 CH, 1 Sabina 200 CH,
Low starting lactation	4 Calcarea carbonica 200 CH, 1 Natrum muriaticum
Mastitis	6 Bryonia 200 CH, 4 Nux vomica 200 CH, 3 Silicea 200 CH, 2 Belladonna 200 CH, 2 Phytolacca 200 CH, 2 Pulsatilla 200 CH, 1 Aconitum napellus 200 CH, 1 Apis mellifica 200 CH, 1 Arsenicum album 200 CH, 1 Calcarea carbonica 200 CH, 1 Conium maculatum 200 CH, 1 Kali muriaticum 200 CH, 1 Pyrogenium 200 CH, 1 Sepia 200 CH,
Milk retention	1 Caulophyllum 200CH
Mycosis	2 Bacillinum 200 CH, 2 Natrum muriaticum 200 CH, 2 Sulphur 200 CH
Placenta retention	7 Sepia 200 CH, 2 Arsenicum album 200 CH, 1 Bryonia 200 CH, 1 Calcarea carbonica 200 CH, 1 Lycopodium 200 CH, 1 Pulsatilla 200 CH, 1 Pyrogenium 200 CH
Podoflemmatitis	1 Mercurius solubilis 200 CH
Results of uterine twisting	1 Arnica montana 200 CH
Udder nodosities	2 Conium maculatum 200 CH, 1 Hepar sulphur 5 CH, 1 Silicea 200 CH
Udder ulcer	1 Mercurius solubilis 200 CH
Uterine fibroma	1 Calcarea carbonica 200 CH, 1 Silicea
Warts	1 Sulphur 200 CH, 1 Thuja 200 CH

Conclusions

The trials have only started and will continue until May 2002. It is too early to interpret these preliminary data conclusively, but the utilisation of UM permitted the same production as the conventional medicine. At the end of this research, it will be possible to evaluate the influence of the homeopathic eugenic program in the animals born during this period. It will also be possible to evaluate the influence of the UM with regard to the health and the fertility of the cows.

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Strategies of organic milk production

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Introduction

The framework for organic dairy farming is set by the general principles and by the standards and legislation, in Europe in particular the new regulation on organic livestock production (EC Reg. 1804/99). With an increasing number of dairy producers converting it appears as if different strategies producing organic milk are emerging. Converting farmers aim to maintain their existing milk production levels and fulfil their quota, whereas organic milk production was historically been characterised by reduced production levels, low external inputs and mixed enterprise structure. Converting producers attempt to achieve their aims by making full use of the organic standards allowances regarding the purchases of feeds. The production standards allow a certain proportion of the diet to be supplied by concentrate (up to 40% for cattle), and up 10% of the dry matter of the diet can be obtained from specified conventional components.

Different strategies of organic milk production are, therefore, likely to develop between the two broad objectives of:

(a) maximising productivity within the constraints of organic standards; and
(b) maximising resource use efficiency and sustainability.

Research has mainly focused on a comparison between organic and conventional dairy production systems, but different questions now are debated, such as:

- How diverse ought an organic dairy farm to be?
- Is the use of home-grown concentrates preferable over purchased concentrates?
- Is there a maximum yield level for organic dairy cows?

It appears, therefore, necessary to investigate the variation among organic producers and what implications this may have for their financial performance and the resource use. It is also important to recognise the role that farmers play in this, for example what influence the farmers' goals may have in their choice of different strategies of organic milk production.

Background

The key principle of organic farming, to rely mainly on the management of internal farm resources rather than external inputs, applies also to organic livestock and dairy production. According to the new European Regulation 1804/99 on organic livestock production the principles can be summarised as follows:

- Organic stock farming is a land related activity. In order to avoid environmental pollution, in particular of natural resources such as the soil and water, organic production of livestock must in principle provide for a close relationship between such production and the land.
- Livestock should have access to free range exercise area and/or grazing apart from some specified exemptions.
- Biological diversity should be encouraged and preference should be given to breeds adaptable to local conditions. Genetically modified organisms and products derived thereof are not compatible with organic production.
- Organic livestock should be fed on organically produced grass, fodder and other feed stuffs, apart from some specified derogations (for ruminants 10% of DM of specified components may from conventional origin).
- Animal health management should be mainly based on prevention (appropriate breeds, a balanced high-quality diet and a favourable environment in terms of stocking density and husbandry practices). The preventive use of chemically synthesised medication is not permitted, but sick and injured animals must be treated immediately (although this may affect their status with regards to organic certification).
- Housing should satisfy the needs of the animals concerned regarding ventilation, light, space and comfort and sufficient area should be provided to permit ample freedom of movement to develop the animal's natural social behaviour.

The general principles of organic animal husbandry as developed by IFOAM emphasises more strongly than the EU Regulation that livestock management should be governed by the physiological and ethological needs of animals, but detailed livestock production standards in the area of housing for all animal species have not yet been developed (Schmid, 1999).

Studies of organic milk production reveal some variation among organic milk producers, particularly if studies from different countries are compared. In general terms the land use organic farms appears to be more diverse than on conventional farms (e.g. Offermann and Nieberg, 2000), but few studies investigate in particular the land use on organic dairy farms. A Danish survey of organic and conventional dairy producers in Denmark found more temporary grassland on organic farms, less cash crops, but also less fodder beet and whole crop silage (Halberg and Kristensen, 1997; Kristensen and Kristensen, 1998). A British survey found comparable land use on organic and conventional dairy farms, apart from reductions in the proportion of root crops and a greater use of set-aside in a sample of five organic dairy farms. On five farms in conversion, a greater proportion of cereals compared to the conventional comparison was found (Fowler *et al*., 2000). In Austria, where the majority of organic dairy farms are located in the mountainous Western provinces, a survey of four case study farms included one all grass farm with no arable area and three farms with considerably more permanent pasture than arable area (Zollitsch *et al*., 1999). Overall, there does not seem to be a clear pattern regarding land use on organic farms with dairy herds, which ranges from mixed rotational to a more specialist, grass-based farms.

Variation has also been reported regarding the stocking rate per forage hectare (GLU/ha) on organic dairy farms. Offermann and Nieberg (2000) reviewed a wide range of studies on economic performance of organic farming and found stocking rates (total livestock per hectare Utilisable Agricultural Area (UAA)) to be consistently lower on organic farms (between 70 and 88% of conventional systems) with absolute values ranging from 0.8 to 2.0 LU/farm hectare. Recent surveys from Denmark and Germany reported even lower levels (0.8 LU/ha to 1.1 LU/ha (Kristensen and Kristensen, 1998) and 1.2 LU/ha (Schuhmacher, 2000), whereas values reported from the UK were slightly higher (1.3 to 1.45 LU/ha in Fowler *et al*., 2000 ; 1.6 to 2.0 LU/ha in Lampkin, 1993). Offermann and Nieberg (2000) attributed the lower values of organic compared with conventional systems to restrictions imposed by the organic production standards, the aim to feed stock mainly from farm produced feeds and higher prices for organic cereals. But stocking rates on organic farms also appear to be lower than those observed in clover-based milk production systems in Scotland (1.9 LU/ha, Leach *et al*., 1999).

Although studies may differ in their sampling and investigation methods the results show a substantial variation in the annual milk yield per cow that organic farming systems have achieved, with levels ranging from 4000 to over 7000 litres. In a recent review of comparative economic studies from various European countries milk yields per cow were found to be in the range of 80% (France, Norway) to 105% of conventional levels (Belgium, Czech Republic, Italy) (Offermann and Nieberg, 2000). Absolute yield levels in organic farming also varied between and within countries. At the lower end were studies from Germany, Italy, Norway, Switzerland and the UK with yield levels of 3990 t0 5500 kg per cow, whereas reported yields from the Netherlands, Denmark, Finland were 6000 to 7200 kg per cow (Offermann and Nieberg, 2000; Fowler, 2000). Two high yielding farms with milk yields of 8300 and 9400 kg per cow have been studied in Austria (Zollitsch e*t al*., 1999).

Lower yields per cow on organic farms compared to conventional can be the result of a combination of different factors, including low concentrate feeding and/or low forage supply (in quantity and/or quality, lack of continuity). This is confirmed by milk yield reductions during conversion being more marked in intensively managed systems with high yielding breeds (such as Holstein Frisian) and high levels of concentrates, whereas similar, or increasing yields, have been observed on farms with lower milk yields and less intensive breeds (Freyer, 1994; Huus, 1992; Lampkin, 1993; Schulze Pals, 1994; Hagger and Padel, 1996). In combination with reduced stocking rates this would lead to lower milk production per forage hectare.

There is no clear evidence supporting differences in forage quality between organic and conventional farms, but several studies report reductions in the use of concentrates and a more mixed diet on organic farms compared to conventional farms. A survey of 268 organic herds in Germany found low use of concentrates (average of 600 kg per cow) (Krutzinna and Boehncke, 1996) compared to common practice in the German dairy industry. Other authors have reported reductions in concentrate use during conversion in the range of 15% to 40% (Lampkin, 1993; Schulze Pals, 1994) or higher proportions of energy in the organic cows' diet supplied from forage (43% of energy intake compared with 31% on the conventional farms; Kristensen and Kristensen, 1998). The reductions in concentrate compared to conventional management tie in well with the observed reductions in milk production, particularly during conversion and lower stocking rates on organic farms. Most studies report a range between farms, which would indicate the presence of different milk production strategies on the organic farms.

There is some evidence that diets for organic cows are more diverse than conventional ones, with a higher proportion of hay and root crops (swedes and fodder beet) and a reduction in silage (Ebbesvik and Loes, 1994; Krutzinna *et al.*, 1995). However, the reported lower proportion of root crops on Danish and British organic dairy farms compared with conventional systems does appear to confirm this. Apart from concerns for the cows' health and welfare, ethical and political reasons might influence the organic farmers' decision to feed dairy cows a low concentrates diet (Phillips and Sorensen, 1993). Studies generally do not report the proportion of concentrate that is grown on the farm itself.

Overall the literature review seems to confirm a substantial variation in milk production strategies between different countries in Europe in terms of land use, milk production levels and the diet, particularly concentrate use.

Case study farms and methods

This paper is based on a study of eight commercial dairy holdings in England and Wales from the beginning of their conversion period (between 1989-1992) to the financial year of 1997-98. Of all farms some biophysical data were collected in a large multi-disciplinary research project over two main data collection periods (1993-1995 and 1996-1998). Farm account data over the whole conversion period including the last conventional year and several years of organic management were evaluated from all farms, although on four farms the data for the 1995 financial year were not evaluated. The farms were compared with each other, with their own situation prior to conversion and with some average data from conventional farms.

All farmers or farm managers (including two farms that did not continue in the study) were interviewed at the end of their conversion period in 1995. The interviews lasted approximately 1.5 hours and covered their motives for conversion, experience with the conversion process, information sources used and more general farming and personal objectives.

Results and discussion

The case study farms varied in the proportion of forage crops and in intensity (stocking rate, milk yield and concentrate input) not only prior to conversion but also and under organic management, which confirms the existence of different strategies of organic milk production, although no dairy farms of very high intensity were studied.

Land use and farm type

Based on the proportion of forage area the farms fell into two broad farm-types, mixed farms and specialist farms, with four farms in each category (see Table 1). The mixed farms used between 58% and 71% of their land in forage production, whereas the specialist farms grew forage crops on more than 95% of their land. The farms also fell into two size categories, a group of small farms between 48 and 85 ha and a group of larger farms between 235 and 435 ha. All but one small farm (Farm 7) had on average more than 95% forage area, whereas all but one large farm (Farm 11) had a mixed enterprise structure and grew forage crops on less than 90% of their area. There was a tendency on several farms to increase the forage production area in the first few years after the conversion, which was particularly marked on the large mixed farms and took place alongside increases in farm size. One specialist farm stopped growing cereals during the conversion, whereas on others the diversity in land use increased.

Forage and milk production

Two on-farm indicators of forage production were used and the trends compared with each other. Stocking rate (LU per forage hectare) could be calculate on the basis of account information and is well known to most British dairy farmers. However, the stocking rates do not consider the varying levels and energy demands of animal production, and, what appears more important in the context of this study, the energy supplied by off farm feed sources, such as purchased concentrates. It is therefore not a very accurate indicator of the on farm forage production and changes in it during conversion. Therefore Utilisable Metabolisable Energy per hectare (UME) was calculated as a residual difference between the energy requirements of milk produced minus energy supplied by off-farm sources, using estimates for the energy content of milk and various feeds as no accurate data were available.

On average the stocking rate (LU per forage hectare) for all eight farms fell more or less continuously by 15% from 1.8 LU/ha in last year prior to conversion 0 to 1.5 LU/ha in the 1997/98 financial year. Stocking rate levels ranged from 1.6 LU/ha to 2 LU/ha prior to conversion and 0.9 LU/ha to 2.0 LU/ha under organic management in 1997/98. It appeared as if farms stocked high prior to conversion aimed to re-establish a higher stocking rate under organic management, but only one farm achieved pre-conversion stocking rate levels in the final year. On the farms with arable enterprises the stocking rate development was also influenced by the need for fertility building in the crop rotation. Average stocking rate levels in the range of 1.5 to 1.7 LU per ha were substantially lower than those reported for conventional farms (Franks, 1999; Harper and Jones, 1998; MAFF, 1999), but higher than typical stocking rate levels of organic dairy producers reported from Germany and Denmark (1.1 to 1.2 LU/ha) (Kristensen and Kristensen, 1998; Schuhmacher, 2000).

Utilisable Metabolisable Energy (UME) showed lower reductions than stocking rate in the same period from prior to conversion to the final year of data collection (8% reduction compared with 15%). Average UME value development under organic management corresponded with annual rainfall data, but on individual farms it appeared as if the conversion had influenced on-farm forage production substantially.

The average milk yield per cow of all farms remained relatively stable over the conversion period (1990-1993), with similar levels prior to conversion and at the end of the study period of approximately 5300 litres per cow, ranging under organic management from 4900 to 5500 litres per cow. Farms with higher than average milk production prior to conversion showed greater reductions in the first study period, but increased their milk yield under organic management achieving pre-conversion levels in the final year of data collection. On most farms with lower than average milk yield no marked reductions and on some farms continuous increases were observed. Yield trends on the case study farms were different from the national trend for conventional dairy farms, where a continuous increase in milk yield per cow occurred in the same period (Franks, 1999).

The average yield level of the case study farms in 1997/98 was 10% lower than the national average for conventional dairy farms in the UK (MAFF, 1999) and considerably lower than yield levels monitored as part of a dairy costing scheme (Harper and Jones, 1998). They were similar to those reported for organic farms from Germany, but lower than studies reported from the Netherlands (Offermann and Nieberg, 2000) and lower than yields reported from Denmark and two case study farms from Austria (Kristensen and Kristensen, 1998; Offermann and Nieberg, 2000; Zollitsch *et al*., 1999). [2]

There did not appear to be a direct link between yields and farm enterprise structure, although yield levels on two specialist farms were above average, but on the other hand the lowest milk yield of all case study farms was also found one a specialist farm. Average levels for the group of specialist farms showed substantial fluctuations, and it appeared as if as forage supply might have had a major influence on the milk yield development.

The farmers increased the milk production from forage, by reducing the average feeding of concentrates by approximately 20% per cow or 25% per litre during the conversion, but the variation between the farms was substantial. Under organic management concentrate levels varied from 0.10 kg per litre to approx. 0.28 kg per litre or from less than 500 to 1450 kg per cow. There was a tendency for lower concentrate use per cow on the mixed farms, but the difference to the group of specialist farms was not significant. Farms varied in the proportion of home-grown concentrate from 0 to 75% which resulted in variations in milk production from the farm's own resources (MFR) from 44 to 98%.

[2] The comparison gives only an indication of yield levels as there are differences in measurement (kg versus litres) and the calculation of annual milk yield levels between different countries.

Table 1 Average values for physical indicators of organic milk production on eight cases study farms (4 year organic average 1993/94, 1995 to1998)

		Mixed farms				*Specialist farms*				*Av.*
	Farm No.	1	5	7	9	2	3	11	12	8 farms
Size in UAA	ha	431	511	65	368	48	83	271	56	228
Forage area as percent of UAA	%	58	53	71	67	95	98	85	93	77
Cow number	No.	132	124	46	280	46	101	257	59	131
Stocking rate	LU/ha	1.5	1.0	1.6	1.7	1.3	1.8	1.7	1.6	1.5
UME	GJ/ha	56	39	77	66	60	73	62	57	61.5
Milk yield	l/cow	5160	5222	5536	5509	5289	5401	5227	4963	5269
Concentrate use	kg/cow	1445	1186	477	1310	751	1184	1164	1227	1093
Concentrate use	kg/litre	0.28	0.23	0.09	0.24	0.14	0.22	0.22	0.25	0.21
Home grown concentrate for dairy	%	15	31	76	14	27	2	0	15	22
Milk from forage (MFF)	litres/cow	2218	2806	4565	2841	3759	2990	2856	2464	2600
Milk from farm resources (MFR)	%	52	71	92	56	78	54	44	54	62
Milk from forage per ha	litres/ha	3402	2740	7249	4688	4965	5362	4746	3843	4654
Dairy output	£/cow	1471	1405	1539	1311	1542	1629	1457	1560	1489
Total variable costs	£/cow	430	447	288	483	242	525	304	435	394
Dairy gross margin per cow	£/cow	1040	958	1252	828	1300	1104	1152	1076	1095
Dairy gross margin p. forage ha	£/ha	1568	886	1968	1373	1718	1980	1893	1785	1646
Net Farm Income (NFI)	£/ha	10	147	461	-90	674	329	658	469	306

This reduced the reliance on external resources in line with general principles of organic farming and would have direct health benefits for the cow (Boehncke, 1996), but none of the farmers stated that this was a particular objective with the conversion. On the case study farms, the concentrate use under organic management did not appear to be related to milk production per cow. It appears as if some farmers may have fed additional concentrates to compensate for low forage yields or quality, but on the basis of the available data it is not possible to confirm the cause. Reductions in concentrate use during conversion or low use of concentrate on organic farms had also been found in Denmark and Germany (Kristensen and Kristensen, 1998; Krutzinna, 1996).

Similarly, and also contributing to the aim of greater diversity in the land use, the use of home-grown concentrates increased on the case study farms, despite the fact that one farm stopped growing cereals during the conversion process. The proportion of the home-grown cereals in the diet varied between 0 and 75% with an average of 20%, which is still relatively low, but higher than on conventional farms, where on average less than 10% of concentrates were home-grown (Franks, 1999). Most of the case study farms made use of the allowances in the standards to purchase concentrates.

Milk production from forage per cow and per ha increased on average by 40%. The group of mixed farms showed greater increases per ha, whereas increases per cow were greater in the group of specialist farms, values under organic management ranging from 2200 to 4500 litres per cow. The trends for milk production per hectare corresponded with UME production and annual rainfall data.

The average Net Farm Income (NFI) per ha for all farms increased in most years after 1992/93, compared with pre-conversion levels. Under organic management the farms also varied considerably in their dairy cow gross margins and income levels per hectare (see Table 1), and the farm type appeared to have had some influence on overall income development with the specialist farms outperforming the more mixed farms in most cases. Among the three farms with the highest dairy gross margin per cow and highest NFI (per farm) were two specialist farms (2 and 11) and the mixed Farm, whereas the lowest NFI (per ha and per farm) and lowest dairy enterprise gross margin was observed on the three large, mixed farms (Farms 1, 5 and 9).

A highly significant (P = 0.01) correlation could be established between NFI levels per hectare and each of the following: The dairy cow gross margins per cow (in £ per cow), the farm size (UAA in hectare), the proportion of forage area (% of UAA) that also indicates the degree of specialisation, and the milk production from forage (MFF in litres per cow) (see Table 3). The correlation between NFI per ha and milk from the farms own resources (MFR in % of milk production per cow) was of lower significance (P = 0.1), whereas between NFI and UME production (GJ per ha), the rent equivalent (RE), the stocking rate (LU/ forage ha) and fixed costs no significant correlation could be found.

Table 2 Relationship between NFI (£/ha) and other factors (31 observations, 1993/94 and 1995/96 to 1997/98)

	DGM	*Size*	*Forage area (%)*	*MFF*	*MFR*	*UME*	*RE*	*LU/ha*	*Fixed costs*
R^2	0.55	0.2408	0.2057	0.1953	0.0642	0.0477	0.0109	0.0003	0.0064
t value	5.954	3.033	2.740	2.653	1.411	1.205	0.565	0.093	0.432
Significance	***	***	***	***	*				

Farmers' objectives in relation to farm performance

The farmers’ motivations, objectives and experience of the conversion process studied through intensive interviews were contrasted with some physical and financial indicators. At the end of the semi-structured interviews all farmers were given a list of objective statements that they had to score with a value representing how important this objective was to them, which are shown in Table 2. The table includes two farms for which financial data were not continuously available.

Mixed farms
On two estates with a relative high public profile (Farms 1 and 5), the owners' decision to go organic went hand in hand with the aim to develop the previously cropping oriented farms into more diverse organic systems with a mix of arable and livestock enterprises. This was reflected in the farm managers' objectives (with whom the interviews were carried out). Both managers considered it equally important to improve crop and livestock production. However, both farms had below average milk yields, used relatively high amounts of concentrates per litre and were in the category of farms with the lowest dairy gross margins. And, despite the clear economic orientation of the managers, both farms had a comparably low income for the first five years of study, which can be attributed to the diversification process of the farms. It appears therefore as if the overall aim for greater diversity of the farming systems had, in both cases, been achieved at the expense of the financial performance of the dairy enterprise.

Table 3 Scores for objective statements of the case study farmers

	Mixed				*Specialist*						*Av.*	*No.*
Farm Number	1	5	7	9	2	3	4	10	11	12		>4
1 improve the crop production	4	4	4	4	4	5	5	5	2	3.5	**4.1**	**8**
2 more time for the family	5	1	2	3.5	4	5	5	5	5	4	**4.0**	**7**
3 improve the livestock production	4	4	2	5	3	5	4	5	2	3.5	**3.8**	**5**
4 increase our income	5	4	2	5	3	4.5	4	3.5	3	3	**3.7**	**5**
5 improve of the marketing	4	4	2	4	1.5	5	1	5	4	5	**3.6**	**5**
6 have less work	4	1.5	5	2	3	3	4	4	4	2	**3.3**	**4**
7 less financial worries	3	1	2	5	1	4	4.5	5	0	3	**2.9**	**4**
8 diversify the farming business	1	3	1	0	0	5	5	5	4	1	**2.5**	**4**
9 improve the housing conditions	3	3	2	2	1	5	2	5	1	1	**2.5**	**2**
10 process on the farm	4	4	0	0	0	0	0	3	4	3.5	**1.9**	**3**
Average score	3.17	2.88	2.42	3.29	1.88	3.71	3.21	4.63	3.33	3.46	2.94	

On a small family farm with mixed enterprise structure (Farm 7) the owner had also had a preference for a more mixed farm structure, facilitated by a favourable location for cropping, but this was already in place before the conversion started. Apart from the dairy the farm had a sheep enterprise and grew cereals and potatoes. The owners considered the further development of the crop production an important objective. However, in contrast to the larger estates, he had adopted a financially more successful strategy of milk production by using low amounts of concentrates and achieving high milk production from forage, which resulted in low variable costs for the dairy herd. The farm was among the three farms with the highest dairy cow enterprise gross margins and highest NFI per hectare.

The fourth mixed farm (Farm 9) had the largest dairy herd in the study and dairying was clearly the most important source of income, despite a mixed enterprise structure with a range of cash and forage crops including fodder beet. The farmer gave a high score to the improvement of the livestock production, which corresponded with above average physical production data (high milk production per cow). Due to the relatively high concentrate use (0.24 kg/litre) the milk production from forage and from farm resources was comparably low. The farm had high variable costs and additional costs for quota transactions led to the lowest dairy gross margin per cow. Overall it appeared as if the level of production was more important to the farmer then sustainability of resource use or immediate economic returns.

Specialist farms

Of the specialist dairy farms, Farm 3 converted with the burden of a relatively high debt so the owners felt a need to maintain a relatively high income. This was reflected in an attitude of dedication towards production on the part of both spouses, who considered improvements of the crop and livestock production as very important. Under organic management the farm had the highest stocking rate and second highest milk yield per cow and was among those with the highest dairy enterprise gross margin per forage hectare, but not per cow. However, the farm suffered problems with forage production due to slugs and had to use concentrates (1.2 t per cow) to maintain milk production, as the intensive stocking rate had not allowed the building up of forage reserves. The aim for greater diversification of the farm was realised in the final year when the farm re-introduced home-grown cereals into the rotation, but this resulted in even higher stocking rates per forage hectare. Despite the relatively high levels of production the farm achieved only average levels of income per hectare.

The specialist family Farm 2 used a relatively extensive and low cost way to run the farm, which corresponded well with the lack of ambition on the part of the farmer with regard to production. Milk production levels were close to the average for all farms, but stocking rate and concentrate use were lower; some concentrates were grown on the farm. On average over four years of organic management, the farm had the lowest variable costs, and was among the three farms with the highest dairy gross margin per cow and per litre. Although economic reasons were not mentioned for the conversion and did not appear to be an important concern to the farmer, the organic management was profitable and the farm was among those with the highest Net Farm Income per hectare.

Similarly, the dairy farmer of the only large specialist dairy farm (Farm 11) appeared moderate in his aims to improve the production. The family partnership also included a vegetable enterprise, but this was not included in the study. The dairy farmer did not consider further improvement of crops or livestock production to be very important, but wanted to spend more time with his family, and again this was reflected in the physical performance, such average level of milk production per cow and low stocking rates. However, because of relatively low variable costs in the milk production the farm was among the three with the highest gross margin per cow and per hectare in the four years of organic management, despite the apparently relaxed attitude of the farmer.

The last case study farm was a small, owner-occupied family farm (Farm 12). Although the farm was classed as a specialist dairy farm on the basis of the proportion of forage area, this did not really capture the orientation of the farm as a substantial amount of additional income was derived from on-farm processing, a farm shop and a tourist enterprise. This corresponded well with objective statement that was most important to the farmer, the improvement of the marketing. The farmer also wanted more time for the family, which is likely to be related to the additional workload from the diversification. Similar to the large Farms 1 and 5 the diversity of the farming systems appeared to have had a negative impact on the dairy herds performance. Under organic management, the farmer had lowest milk yield of all farms, despite the second highest use of concentrate per litre. Financially, the farm made up for it through an above average milk price and high income from quota leasing, so that the dairy cow gross margin per cow was similar to the average for all eight farms.

Organic milk production strategies or farming styles

The case studies provide evidence that organic farmers differ in their strategies of organic milk production. Land use on the farms varied from mixed to more specialist enterprise structure. The majority of farms diversified during the conversion, but one farm reduced the cereal area in the rotation.

On the basis of a combination of social, physical and financial data some variables could be identified among the case study farms that could form the basis for a classification of organic dairy farmers according to different farming or management styles (see Table 4). However, because of the small sample size some styles are only represented by one farm, so the results provide a qualitative rather than a quantitative picture of their distribution among organic dairy producers.

The variables correspond well with those found in other studies of organic farmers (Noe, 1999; Peters, 1997), but did not include all styles and value orientations that were found among conventional producers farmers, such as "flexibility" (Fairweather and Keating, 1990), "cow breeding" and "greed" (van der Ploeg, 1994a; van der Ploeg, 1994b). The results confirm the findings of a growing number of studies that farmer decisions making is complex and influenced by a range of socio-economic and psychological variables (various authors quoted by Willock, 1999) contradicting the neo-classical assumption that farmers' behaviour is driven by profit maximisation alone.
Although the conversion process led to initial yield reductions particularly on the higher yielding farms, increasing yield trends in the second data collection period indicate that improvements in the milk yield per cow remain an important objective also for organic

dairy producers. This raises the question, what strategies organic producers can use to improve yield levels per cow and whether there is a maximum yield level of organic production. With regard to the first question, Zollitsch (1999) concluded that as long as high milk production was obtained on the basis of a high energy intake from forage this would not contradict the principles of organic production. In attempting to answer the second question, Haiger (2000) suggested that an acceptable yield level for organic farms would be up to 8000 kg annual yield per cow.

Table 4 Goal related variables influencing the farmer decision-making and farm development

- Diversity
- Production with the four sub-orientations
    - *Craftsmanship*
    - *Intensity*
    - *Size*
    - *Cost saving*
- Income
- Lifestyle
- Marketing

On three farms (1, 5 and 12), the aim to increase diversity clearly had negative impact on the physical and financial performance of the dairy herd (average milk yields and high use of concentrate). It appears that only on one small farm (7) a diverse enterprise structure did coincide with good financial performance of the dairy herd. Two farms (3 and 9) were clearly oriented towards high levels of production, in one case this coincided with a strong orientation towards a large herd. However, in both cases high variable and fixed costs resulted in average or below average income levels per hectare. This was in marked contrast to two specialist farms (2 and 9) where lifestyle was clearly more important and low cost extensive organic dairy systems with low use of concentrates had been developed, in one case with a large proportion of the cereals grown on the farm.

Conclusions

On the case study farms and through a comparative review of studies, different strategies of organic milk production could be identified, but most studies have focused on the comparison of organic and conventional milk production systems.

Organic dairy farms vary in their land use patterns from on the one hand a mixed enterprise structure with a proportion of land used for cash crops to a relatively high proportion of grassland and/or permanent pasture. Stocking rate levels also vary considerably. The tendency for specialisation appeared greater on the smaller farms, whereas the larger farms had or aimed with their conversion for a more diverse enterprise structure.

Among the case study farms different orientations towards the goal-related variables of husbandry (with the sub-orientations of craftsmanship, intensity, size and costs saving) and towards income, lifestyle, farm diversity and marketing could be identified which had implications for the management approach and financial performance of the farm.

The case study farms showed that the conversion period may disrupt milk yield development, particularly on higher yielding farms, but increases in production occurred on several farms under organic management and would, if they continue, lead to higher levels of organic milk production than have been observed in the past.

The general aim of organic farming to reduce the reliance on external inputs is realised on many dairy farms by reducing the feeding of concentrates and producing more milk from forage. However, farms vary clearly in concentrate feeding per cow and per litre, which on same farms and in some years appears to be used to compensate for lack of forage and/or poor forage quality. Farmers also vary in their aim to replace purchased concentrates through home-grown cereals and pulses.

Apart from farm size, which clearly influences the income levels per hectare, farm type and milk production from forage appear to have a considerable influence. With regards to milk from forage the principle to reduced the reliance on external inputs appear to have some financial benefit, whereas, as far as income is concerned, it is of lower importance whether or not the concentrate is grown on the farm. On three case study farms increases in diversity appeared to coincide with reduced financial performance in the dairy enterprise and relatively low milk production from forage.

Overall, it can be concluded that the restrictions on the use of conventional concentrates and the need to purchase organic forages laid in the organic standards leave the dairy producers with fewer possibilities to compensate for reductions in forage quantity or poor forage quality. On the other hand high income on organic dairy farms seem to coincide with high milk production from forage, although data from a much larger number of organic dairy farms would be needed to confirm this. It appears therefore as if organic dairy producers would be well advised to develop a management system, which allows them to keep forage reserves, for example by not aiming for very high stocking rates.

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Part C:

Posters

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Assessment of animal welfare on organic farms

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Consumers expect organic farming to assure good animal welfare (e.g. Brandscheid 1998). This renders both the definition of good welfare and its on-farm assessment necessary.

Animal welfare means different things to different scientists: welfare is defined in terms of (1) biological fitness; (2) the animal's feelings; (3) the feelings as well as the animal's bodily state.

In agreement with the last definition, we regard animal-related parameters such as health or behaviour as direct indicators of animal welfare. However, on-farm welfare assessment for practical use has specific requirements: (1) measures must be reliable and valid, (2) easy to use by trained people, (3) limited time needed for the assessment to render repeated measures on many farms possible, (4) able to reveal causes of impaired welfare and thus potential improvements of the husbandry and management system. Animal-related parameters hardly fulfil requirements (2) and (3) and do not much contribute to aspect (4).

Therefore, most research on welfare assessment has focused on environmental factors influencing animal welfare, especially on design criteria. Yet, they can only serve as indirect welfare parameters as far as lawful relationships to animal-related welfare indicators are known, and a high and reliable predictive value for the welfare state of the individual animal is proven. We suggest that an appropriate operational assessment tool will comprise a mixture of husbandry and animal-related criteria. However, basic knowledge on interactions between different husbandry influences and the relative importance of housing and human factors is still very limited and urgently needs to be ascertained. For the final welfare assessment we propose that integrating different aspects of welfare, such as health or behaviour, into a single overall assessment means an undesirable loss of information and is unnecessary.

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Organic pig farms in the Netherlands

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Introduction

The rapid increase in organic pig farming in Europe results in a need for information, especially on systems according to the new European organic regulations (Table 1). Major changes are the larger required pen surface and the need for weaners and lactating sows for outside area.

Table 1. European housing regulations for organic pigs.

Category	Indoor	Outdoor
Sows	2.5 m²	1.9 m²
Lactating sows	7.5 m²	2.5 m²
Piglets (<30kg)	0.6 m²	0.4 m²
Finishers (<110kg)	1.3 m²	1.0 m²

Research is planned on specific organic research farms, such as in Raalte (NL), but at this stage information can be derived from variation on commercial organic pig farms. Ten pig farms were visited during the summer of 1999 and the winter of 1999/2000. A wide variety of data was collected.

Farm description

Organic pig farms have some land (2 to 80 ha) in contrast with traditional pig farms. The majority (80%) has as well breeding as finishing on the same farm where the traditional farm is more specialised. The average number of sows is 50 ranging from 20 to 100. The average number of finishing pigs is 255, ranging from 130 to 505. The animals are mainly housed in converted traditional buildings with less space than in Table 1.

Technical performance

The performance of the farms was calculated on the basis of 1999. The results are presented in Table 2.

Table 2. Technical performance of breeding and finishing on 10 Dutch organic pig farms.

	Average	Range
Litter index (litters/sow/y)	1.97	1.79 - 2.16
Weaned piglets (piglets/sow/y)	18.3	16.8 - 20.8
Preweaning mortality (% live born)	16.5	14.9 - 21.1
Daily gain 25-110kg (n=2) (g/d)	749	725 - 772

Health and well being

The general health status on the farms was satisfactory. However two aspects need extra attention in future research: lung problems caused by poor climate control and parasitic infection levels caused by pasture for the sows combined with absence of preventive measures.

Abnormal behaviours like oral stereotypies, tail biting and vulva biting were rare on the visited farms.

Labour

The farmer with 100 sows and 505 finishing pigs spent 9 h per day on the farm. The others spent less time on their smaller pig branch and more time on other activities on their mixed farm. With the current knowledge the estimation is that organic family pig farm can be around 60% of the size of a traditional pig farm. The organic pig farmers qualify their working conditions as positive except for the dust levels.

Economics

The high cost price of organic pig meat is caused by a higher feed price, housing costs, lower performance and more labour. The benefits come from the higher (fixed) meat price of 2.05 Euro/kg. This price will hardly cover the costs.

Conclusions

The present generation of organic pig farmers run their farm according to the old organic regulations. Most of them found solutions for their own specific problems. A new generation of starting farms under new EU-regulations will face other questions. They have to learn from practical experience of the first generation and from research results. Research is focussing on farrowing accommodation, health control, environment, climate control, housing and labour.

Organic productions with “other” animals

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Introduction

In the Council Regulation (CE) No 1804/99 EU (supplementing Regulation (EEC) No 2092/91) only few species of domestic animals are included: bovine (including bubalus and bison species), porcine, ovine, caprine, equidae, poultry and bee. Many others species of animals may be of interest for organic production in different EU countries.

Fish

In Northern Europe (and North America) organic fish are normally bred (salmon, trout), but in southern countries only few fish farmers are actually interested in this productions. On the other hand, the consumers are interested in fish quality. An agro-alimentary commercial Italian group (COOP) will sell fish fed with vegetable food and fishmeal in 2000.

E.g.: a USA standard for organic fish production (1)

I. Feed:

Permitted:

a) Only organic grains can be used for the grain portion of the ration for vegetarians.
b) Minerals derived from naturally occurring mined products.
c) The only acceptable fishmeal is that which is 100% from wild marine fish.
d) Kelp meal from the ocean.

Restricted:

a) Synthetic minerals that can’t be obtained as a mined mineral

Prohibited:

a) Artificial colours, binders and additives.
b) Synthetic astaxanthin
c) Antibiotics in feed.

Fish should be fed at least 4 times daily or more so that feed is consumed by the fish rather than polluting the filter. Amounts of feed should be carefully adjusted to what the fish need at each stage of growth.

II. Environment:

Required:

a) Water used in fresh water farms must meet EPA water quality standards. Water should be tested for heavy metals periodically.
b) A recirculating system should replace 10% of the volume each day with new water to help maintain the water quality for the fish.
c) Water must be kept as clean as possible. It should be monitored daily from ammonia, nitrates, oxygen levels, pH and temperature. It should also be monitored regularly for solids and salinity.
d) Oxygen should never fall below 60% saturation.
e) In a recirculating system pH should be maintained between 6.8 and 8. This minimises fish stress and permits nitrifying bacteria to effectively remove nitrogen wastes in the biological filter, pH should be maintained as stable as possible. Calcium carbonate is the preferred product for maintaining pH but sodium carbonate may be used in an emergency where the calcium carbonate can’t work fast enough.
f) Fish should have access to shade over 50-100% of the area at all times.

g) A complete water exchange should be done after each production cycle to reduce build-up of nitrate and dissolved organic material. Water must not under any circumstances be used more than three times within the farm. When water is reused, pipes and holding facilities should be scrutinised for waste build-up.
h) Wastes removed from filters and fresh fish tanks should be handled in an environmentally responsible way, preferably returning these resources to the land in a nutrient recycling system. Solids shall be removed from water before it leaves the farm.

III. Veterinary treatments:
Permitted:
a) Hydrogen peroxide for parasite control.
b) Salt-water fish should be treated whit a fresh water flush once a month to prevent parasite build-up where practical. Likewise fresh water fish should be treated with a salt-water flush to prevent parasite build-up.
c) Fish should be carefully checked for parasites and diseases before introduction into the system.
d) Handling of fish must be kept to a minimum when fish are moved. Fish should never be out of water than 30 seconds.

Prohibited:
a) Triploiding by any means.
b) Hormonal treatments.
c) Chemical or antibiotic treatments for parasites or diseases. If need as an emergency measure for disease outbreaks, the fish treated must be sold as non-organic.

IV. Harvest:
Permitted:
a) Fish must be killed by a method that minimises pain or suffering. Concussion for salmon and trout, electrocution for trout followed by immediate evisceration is permitted. Ice may be used with Tilapia slaughter followed as rapidly as possible with evisceration.
b) Processing operations must comply with all relevant statutory regulations and local authority hygiene regulations.
c) Fish processing, storage, and transport must comply with the standards for processing, packing and distribution.

Other requirements for organic certification:
a) Distinct, defined boundaries including separate and labeled or numbered tanks or ponds.
b) Appropriate physical facilities and management practices to prevent mixing of organic and non-organic fish.
c) An audit trail to include:
   - date and sources of feed and feed supplements
   - record of all regulated substances administered
   - water and efficient test results

Rabbit

In the Mediterranean countries, many farmers produce organic rabbits with standards that are often unclear and imprecise (due to the lack of research regarding this matter), whereas in Northern EU countries these animals are normally considered pets. The biggest problem is to define, which breeding system would meet rabbit welfare and sufficient meat production requirements to satisfy the organic market demand. In Italy the first studies was carried out by Finzi. Finzi proposed a rationalisation of the ancient “garenna “ system, in which a colony of rabbits live in a pen. The main structures of this system are: some nests, one straw-stack, and one restricted area with drinking troughs and mangers, where it’s possible to capture the animals. The “garenna” system is suitable for small-scale production only. Finzi also proposed a system for breeding females in underground cells (50 x 50 x 50 cm), where there is a nest, connected to an external cage with a pipe (60 cm). For fattening rabbits in pasturage areas, Finzi utilised mobile cages (1,30 x 0,82 x 0,36 cm). The cages are moved every two days. This system can limit the problem of coccidiosis in rabbits.

In 1995 the Council of Tuscany Region defined the standard to produce organic rabbits.

Act of Tuscany Region 12 of April 1995, n. 54 **2. Free range areas and livestock housing** **2.3 The minimum surface areas must be the following:**
Rabbits: Outdoors area for fattening 2 m^2/head. Outdoors area for breeding 2 m^2/head, nest included, as in "garenna" system.
If this is impossible, the females can be kept in cages of which minimum dimensions must be 0,50 m^2/head, nest included. The exposition, even partial, to sunlight and open air must be guaranteed.

Organic breeders asked for a derogation, thinking that it was impossible to fat a sufficient number of organic rabbits outdoor. This derogation was approved.

Derogation to Act of Tuscany Region n. 54 (3)			
	Dimensions	Description	Prohibitions
Breeding cages: females + litter until 1 month of age	0,50 m^2/head		
Fattening cages	0,125 m^2/head	Multiples cages for 7 – 8 subjects	
Environment: for breeding and fattening		"pleine aire" or "semi-plein aire" systems; cages disposed only at one level	Closed rooms with insufficient ventilation or air-conditioning rooms
Wastes		Daily removal	Insufficient removal

Ostrich

In Italy the largest certifying organic body (AIAB) established a specific regulation for ostrich production, which is beginning to interest producers as a method of organic meat production.

Standard to breed organic ostrich (source AIAB)
Maximum number of animals per ha
The maximum number of animals must respect the limit of 170 kg N/ha/year (but the standard doesn't define how many animals are the equivalent to 170 kg N/ha/year).
Free range areas and livestock housing
a) Pens dimensions: minimum width 15 m and minimum length 60 m. The ground must be dry and rich of stone, with grass and a sand area.
b) A shade area must be present in the pen.
c) Young ostriches must be bred indoor at the ground, but with the possibility of going out. The bedding material must be vegetal.
d) Every two years the pens must be moved in a ground where, for at least two years, animals of the same species hadn't lived.
e) To prevent animal's traumas we must prefer resistant and elastic cords to the metallic nets.
f) The pen can be divided in different areas during the egg deposition time, but it must be unified during the remaining time to allow a common living among the animals.

Feed

a) The ostrich is herbivorous therefore at least 75% of the dry matter in daily rations is to consist of roughage, fresh or dried fodder or silage, and not more than 25% of concentrates.

b) It's recommended fresh minced alfalfa, and in winter dehydrated alfalfa.

c) The increase of barley percentage can be permitted in January when the hours of light increase, until a maximum of 10% for 2 months.

d) The increase of maize percentage is permitted during the fattening period, until a maximum of 20%.

The inspection body can permit the utilisation of synthetic amino acids (lysine and methionine) only exceptionally in the first phases of their life.

Egg incubation and hatching

a) At the hatching the utilisation of steramine is permitted if essential oils result insufficient.

b) It's prohibited to incubate at the same time farm eggs and eggs of foreign origin. If the incubation is done for another farmer the inspection body must be capable of checking it.

c) Optimal hygienic and environmental condition (temperature, humidity, ventilation) in the incubation rooms must be respected.

d) The maximum hatching duration must be 36 – 48 hours. The ground of the hatching baskets mustn't be slippery.

Veterinary treatments

a) The vaccines are not admitted if not compulsory by law.

b) The allopathic treatments are admitted in case of surgical intervention and, except these cases, for a maximum of two courses within the animal life. The withdrawal period after the treatment must be twice that laid down by law.

c) The advice of a vet expert in NCM is requested.

Pigeon

In many parts of some EC countries (e.g. in the regions of central Italy) the pigeon meat is very appreciated, and some organic breeders would certify their animals as organic. In Italy AIAB is already studying a regulation for this animal.

Proposal of a standard to breed organic pigeons (source AIAB)

Few couples of pigeons can be bred free with few problems.

A big quantity of animals (same hundreds) must be bred in aviaries, where it's possible to control:

- hygiene;
- feeding;
- genetic selection.

The animals bred in aviaries can live in good conditions if their physiological and ethological demands are respected.

The young pigeons are weaned by their parents, and they are slaughtered when they are 30 days old.

The aviaries must be sufficiently ventilated, without humidity.

It's better if the sunlight doesn't arrive directly into the nests.

The bedding of the nest must be made in expanded clay to prevent parasites and moulds.

Animals must have an easy access to water and food.

Animals must be fed "ad libitum".
The animals must be fed on organic feeding stuffs.
The aviary must be equipped with boxes for mineral integrators, vegetal coal, calcium carbonate, sea salt, yeast, and other natural products.
Animal care and prevention must be carried out with NCM.

Game

Organic certification of game causes a different set of problems for organic sector. Many game breeders would like to certify their "production", but the concept of hunt is seen to be against the organic philosophy. The ungulate breeding (red deer, fallow deer, wild board), often extensive, would be more suitable for organically certified game keeping. Pheasant, partridge, grey partridge and hare breeding, often intensive, would need suitable organic regulations to be formulated.

Others

In the future, animals such as frogs, snails, etc. may be certified as organic.

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Improving welfare in organic dairy cattle

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The poster introduces the project 'Improving welfare in organic dairy cattle' due to start November 2000. The overall aim of the project is to investigate animal health and welfare in organic dairy production with focus on coccidiosis among calves. It comprises of the three following work packages:

Work package one: Welfare in organic dairy herds

The aim of this work package is to form a theoretical framework for assessing animal welfare under organic production conditions. It hopes to discuss, through the opinions of an expert panel drawing on people within the NAHWOA network, whether welfare in organic herds should be defined differently from welfare in conventional herds and if it should then to define such a definition. The project is designed to try to identify relevant welfare problems in organic production through synthesis of knowledge project and expert panel discussions. Furthermore it is hoped that a set of practical guidelines will be developed in the workgroups and that these then can be utilised for practical evaluation and assessment of different types of systems. Finally it is hoped that a manual for welfare assessment as a dialog tool between the organic farmer and his partners will be developed.

The time scale for this work package is as follows: Start 1st. Nov 2000 End 1st. Jan 2003.

The conclusion of this work package will hopefully be a publication – 'Aspects of animal welfare under organic production conditions'.

Work package two: Bovine coccidiosis

This work package investigates incidence and spread of coccidiosis amongst calves, primarily aged one to three months, in organic dairy herds through experimental investigation. It will try to identify the causal factors of bovine coccidiosis and will concentrate on the risk of the disease from the effect of nutrition, housing and management. The aim of the work package is the development of methods for non-medical prevention and control of coccidiosis.

The timescale for the project is from 1st. September 2001 and end 1st. March 2004. A publication on the prevention of coccidiosis and a review of causal factors of coccidiosis amongst calves in organic dairy herds will also be published.

Work package three: Veterinary homeopathy

The aim of this work package is the development of a model for clinical trials in veterinary homeopathic treatments. The work package hopes to update present knowledge and produce an overview of the possibilities for the treatment of precaution diseases with 'so-called' alternative treatment methods with focus on homeopathy.

In order to discuss an appropriate model for the trials, the first step will be the establishment of a team of international experts in veterinary homeopathy and a team of practicing Danish veterinarians who carry out treatments in clinical trials. The second step will be the development of a system of journals for anamnesis and clinical findings in a case of disease. The third step will then be the development of an appropriate follow-up matching the demand for documentation of the development of a disease course.

Time scale: The work package is set to start 1st May 2001 and end 1st. Jan 2003. It hopes to conclude with a publication of the results of the study.

Effect of organic fodder on prevention of milk fever

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Introduction

Earlier studies of organic farms in Norway have documented that cows in organic herds have less milk fever compared with the overall average incidence of milk fever in Norway (Strøm and Olesen, 1997). Milk fever occurs most frequently in high-yielding cows. In organic husbandry the production level is often lower than in conventional husbandry (Strøm and Olesen, 1998). This could be one reason for the lower incidence of less milk fever in organic herds. On the other hand, there is an increasing risk of milk fever connected with increasing age and the higher average age of cows in organic herds than in conventional herd (Strøm and Olesen, 1998), might contribute to a higher incidence of milk fever in organic herds.

Numerous publications have demonstrated that feeding cows in the dry period with diets high in cat ions, especially Na^+ and K^+, tends to induce milk fever. Feeding cows with diets relatively high in anions, primarily Cl^- and SO_4^{2-} can prevent milk fever (Horst *et al.,* 1971). In organic farming, no inorganic fertilisers are used. This may result in lower content of potassium in the plants, and with that, a lower content of potassium in the fodder. Also, there is often more diversity of plants (clover, herbs, and "weeds") in an organic meadow than in a conventional meadow. Plants vary in their uptake of each element. One can therefore expect a different ratio of cat ions to anions in organic fodder than in fodder produced conventionally. This project will analyse whether the fodder produced on organic farms can be connected to the reduced level of milk fever. The project is a part of a larger programme called "Animal health in Organic Agriculture" at the Norwegian Centre for Ecological Agriculture (NORSØK). The project runs from July 1998 to March 2003.

Method

An important parameter used to measure the relation between cat ions and anions is the dietary cation-anion balance (DCAB). The DCAB can be calculated by taking the sum of the Eq/kg feed of dietary Na^+ and K^+ minus the Eq/kg feed of Cl^-. A method for determining whether an animal is responding to a negative or low value of DCAB in the diet is to monitor the pH of its urine.

Data will be collected on sixteen farms: eight organic farms and eight conventional farms matched by climate, geography, and farm management. From each farm seven cows will be selected. Fodder given to the cows in the dry period will be analysed for Na^+, K^+ and Cl^-, and the botanical composition and development stage of the roughage will be determined. DCAB will be calculated and compared to the pH of the cows' urine. The cows' urinary pH will be measured during the dry period, using pH-papers. The fodder will also be analysed for other minerals (Ca, Mg, P, Mn, Fe, Cu, Zn and Mo) to get a broader picture of the ration. The cows' body condition score in the dry period will also be measured. Data were analysed with the general linear models procedure of SAS according to the model for a nested design.

Results

The first preliminary results show no difference in pH of the cow's urine. The urinary pH was about 8.5, indicating that the DCAB in the diet was positive and did not have any preventive effect on milk fever. A negative DCAB would give a urinary pH under 7.3. There is no significant difference in the cows body condition score. Half of the organic farms had a significant higher DCAB value than the conventional farms (fig. 1). Two of the farms had lower DCAB values than the conventional farms, so the results are not clear. Looking at the separate minerals (fig. 2) the most clear results are higher Ca content in organic grass silage, and lower Cl content in organic than in conventional grass silage. There are no significant differences in Na, Zn and Cu contents in the grass.

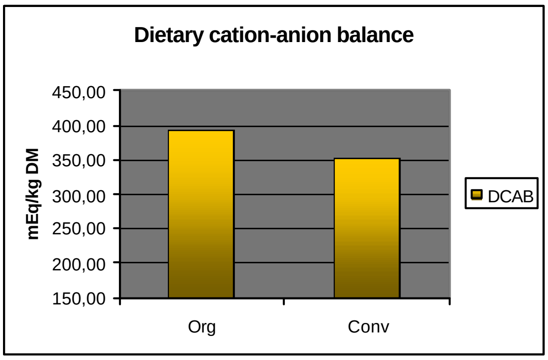

Fig.1 Dietary cation-anion balance in grass silage

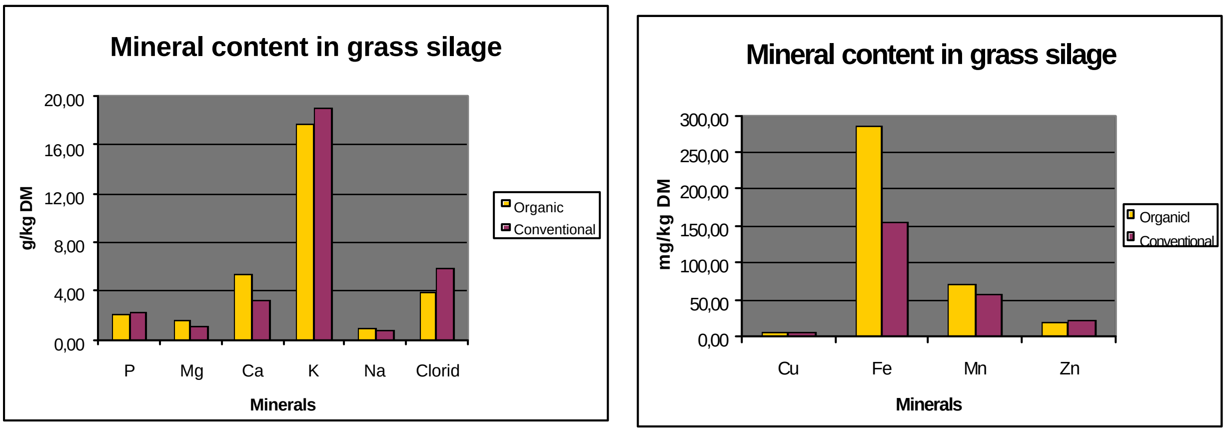

Fig. 2 Mineral content in grass silage

Conclusions

It is too early to draw conclusions sins the results are based on only one registration period.

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Part D

Farm visit

An organic goat farm in Auvergne

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History

Mr and Mrs Lantenois entered into farming in 1978 without farming background. Mr Lantenois has a BSc degree in Agriculture and Mrs Lantenois has a BSc degree in biology.

Their first farm with 36 dairy goats (1978-1986) was in an upland area (1000 m above see level) and very isolated. In 1986, they decided to establish themselves in a new region in Auvergne and started of with 7.5 hectares of organic vegetables and herbs. In 1988, they bought 45 kid goats. The milk was sold to a dairy, every two days without an organic price premium: 3 FF/l (about 0,45 Euro/l). In 1990, they began cheese processing of about 20% of the milk production. Since 1997, they have slowly built up the stock numbers to 120 dairy goats, with the milk is sold to an organic dairy that pays a 20% price premium. Some 25% of the milk is still processed to cheese on the farm.

Current farm profile

Labour: two people in total for both farm and cheese making (farmer and his wife)

Usable farm area: 35 ha in total

- Permanent grassland: 12 ha
- Temporary leys: 15 ha
- Cereals and cereal peas: 8 ha

Animal production:

- 120 goats
- 20 replacement goats
- About 80.000 l of milk/year
    - 60 000 l for a dairy (0.55 Euros/l)/20 000 l of milk processed into cheeses on farm (1.21 Euros/l)

- 10 mares
- 10 free range pigs (fattening 120 kg LW)

Mean yields for arable crops:

- Spring barley: 3,5 – 4,0 t/ha
- Cereals/peas: 4, t/ha

Current objectives of the farmers

The following objectives are identified by the farmer partnership as important for the future development of the farm:

- to produce with organic certification;
- to process cheese only 3 mornings a week;
- to be self sufficient in hay, if possible in concentrates, and in protein by cropping legume fodder and cereal peas;
- to have a sufficient farm income for the family (3 children);
- to work with other farmers and have shared farm equipment; and
- to have free time for other activities.

Cropping plan and rotation plans for the farm

The cropping plan and the rotations used on the farm are based on the following principles:

- Mares graze 10 ha of permanent grassland.
- Leys are a mixture of 10 meadow species including legumes (alfalfa, clover…) and rye grass.
- Cereals and cereals peas are grown to produce protein.
- Sandy soils are located on the top of the hills and clay soils in the lowest parts
- The paddock size is smaller than 1ha on average, with many trees around.
- Rotation takes place on ploughed field where meadow, spring barley, cereals and cereals/peas follow each other.
- The first cereal grows with Nitrogen given by the mineralising of the organic matter of the meadow.
- All the manure is composted.
- In winter, there are no barren soils.

Livestock management:

Reproduction

Natural mating period is in August/September, and kidding takes place in January/February. Births are grouped in one period, which makes the management easier for mating, kidding, and feeding supervision. In order to have no break in cheese production, the farm keeps 15 milking goats during winter.

The average duration of lactation is about 300 days and most goats are dried off on 15th November.

As hormonal manipulation is necessary for AI to be successful in goats, this practice has been abandoned on the farm. Natural mating is practiced with males bought at one month of age from farms that carry out milk recording to allow selection according to sire's and dam's performances in milk production and milk protein content. The sire farms are chosen so that they have a similar management system as the Lantenois' farm.

Feeding

Winter diet:

During the dry period: hay ad-lib about 2 kg of D.M/goat (20% refused given to horses). Females are allocated from 300g to 600g with concentrate 3 weeks before kidding.

Milking diet:

Goats are fed three times a day:

- 2 meals of 2nd cut of hay
- 1 meal with 1st cut of hay, concentrate is given twice a day during the milking time from 700 g/day at kidding to 1kg/day at the end of the 1st month.
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Concentrate is made of cereals and peas produced on the farm and organic cake. Part of the cereals is bought.

Pasture:

Turnout takes place at the beginning of March. Animals are fed by rationed grazing on leys. The refusal of ungrazed grass is very high and the animals come back a 2nd time on pastures only after grass cutting. The concentrate given after the turnout is about 800g/day.

Health

Replacement goats

At birth, kids suck their mothers for 1 day. They drink mothers' milk for 1 month. Before weaning they are fed with milk powder, concentrate and hay. Poor kids are given glucose at birth to fortify them. No particular problems are noted on these young animals.

Coccididiosis is treated at weaning (2.5 months old) with conventional drugs.

Male kids are sold when they are 3 weeks old.

Parasite control

Moniezia

During the first grazing season, when young goats are turned out at 6 months old, they acquire immunity against parasites, and at the 2nd grazing season they are stronger to resist parasites and the yield of the first lactation is better.

Moniezia in young goats is controlled by conventional drugs once a year.

Gastrointestinal and lungworms

These controlled with twice a year (mating and drying off) strategic treatment with chemical drugs.

A mixture made of herbs is given to the goats each month, from the turn out to housing, in order to suppress parasites implantation in the intestine (efficiency is unknown, but the farmers are satisfied with it).

Liver fluke

Liver fluke is present on farm but does not affect goats as pasture areas are alternated with cutting and, because wet grasslands are grazed by horses. As a precaution, goats are not given hay from wetlands.

Grazing and parasite control

A new grazing area is opened each day (rationed grazing). Goats do not graze again before cutting grass or harvesting hay. This practice keeps the pastures cleaner from worms (not free) and enables harvesting for hay.

Mastitis

Goats are very susceptible to mastitis, and its control requires particular care. The somatic cell numbers in goat's milk is generally higher than in cow's milk. Hot udder (at milking) with a normal body temperature is treated with homeopathy. When udder is hot and the goat has fever, they are treated with antibiotics or culled. In the last year, two goats have been culled due to mastitis.

The milking machine is tested once a year with a dynamic testing protocol. Goats are bedded with clean straw twice a day during housing period.

Other disease control measures

Feeding round bale haylage to goats has been stopped as this was seen as a disease risk. Minerals and trace elements are given all the year through.

Cheese processing

In 1990, the dairy enterprise planned to decided to build on the farm a dairy plant for cheese processing that met the EU health and safety and hygiene standards.

Some 100-200 litres of milk is processed three times a week. On one of the processing days, cheeses are made by lactic fermentation and sold as fresh cheeses (less than a week) called "crottins". Approximately one litre of milk is required for 150g of cheese.

On the second processing day, milk is mixed with rennet for processing two other cheeses: “brique” (a semi-fresh, 2-week-cheese) and “Tome” (a pressed cheese, kept for two months or more in a cellar. These cheeses require some six litres of milk for 500g of cheese.

Quality control of the cheese is carried out by self-sampling and submitting the samples to an independent laboratory four times annually. Analysis is carried out on Salmonella spp., Listeria, E. coli and Staphylococcus spp. The farm has not experienced any problems with bacterial quality of cheese.

Marketing of cheese

Almost 70% of the cheese production is sold to six local shops (40 km around the farm). The rest is sold on an organic farm market once a month.

Pig production

The farm has two groups of five fattening pigs for 6 months each year. The pigs are reared in a free-range system outdoors and fattened with the whey from cheese processing and cereals from the farm. They are sold at a premium price of 2.56 Euros/ kg carcass weight).

Financial key information

(whole farm, Euros)

Gross income	60 900	
Subsidies	10 000	(upland area - no subsidies for organic production)
Fixed costs	24 400	
Operating costs	20 000	
Farm income	26 500	