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SYSTEMS IN ORGANIC DAIRY PRODUCTION

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ABSTRACT. The aim of this study was to explore stakeholder perceptions of the contribution of an Automatic Milking System (AMS) to sustainable development of organic dairy production in Denmark and the Netherlands. In addition, reasons for the current difference in AMS use on organic dairy farms between both countries were explored. To answer above mentioned aims, farmers and advisors in both countries were interviewed using a focus group approach. Questions of the interviews were based on a literature review on sustainability issues affected by introduction of AMS. Participants expressed no moral problems regarding AMS use. They, however, pointed out uncertainty about the economic gain, difficulties with grazing, adaptation problems to technology, and image problems towards consumers. The latter results from a reduction in grazing time affecting both animal welfare and product quality. The participants did not recognize eutrophication, as result of high stocking density on farmstead lots, as a problem caused by AMS. The milk quality problem related to AMS use, although acknowledged as crucial towards consumers, was not prioritized very highly, especially not by the farmers in both countries. All groups were, however, unanimous in their perception of how important image was as far as the consumers are concerned. The perception analysis revealed that Dutch participants were more concerned about the economic payoff of AMS use, and showed more reluctance towards enlargement than Danish ones. In addition, they acknowledged the small-scale naturalness of organic production. These differences in perception could possibly explain observed differences in AMS use in organic dairy production between Denmark and the Netherlands.

KEY WORDS: automatic milking system, grazing, organic dairy farming, perception, stakeholders, sustainability

1. INTRODUCTION

Organic dairy production has spread to a considerable production area in Europe (Anonymous, 2006b). Policy-makers stimulated the growth of organic production starting mid eighties, by subsidizing conversion from conventional to organic production, and through extended research programs to provide practical knowledge (Mogensen, 2005). As a result, Denmark and the Netherlands showed continuous growth and similar development of the organic production sector. The last few years, however,

Table 1. Total number of organic dairy farms in Denmark (DK) and the Netherlands (NL) from 1990 to 2005.

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
DK ^a	63	147	344	430	672	751	827	749	695	636	513	490
NL ^b	71	80	95	m.v. ^c	179	189	300	340	315	304	304	301

^aFigures from dairy industry in Denmark (<http://www.mejeri.dk>)

^bFigures from SKAL (certification body in the Netherlands), LEI (<http://www.lei.wur.nl>), and EKO monitor (<http://www.biologica.nl>)

^cm.v., missing value.

the number of organic dairy farms has not further increased (Table 1). Due to increasing herd size and milk production per cow, the total amount of organic milk has almost stabilized. In addition, the percentage of organic dairy farms relative to the total amount of dairy farms is rather constant during the years. In Denmark farm size and milk yield per cow have increased more than in the Netherlands (Table 2), resulting in a decrease in the amount of organic dairy farms. This is parallel to general structural dairy development in the two countries, where in Denmark farm quota increased with 40% over the last 4 years and in the Netherlands only with 20% (Anonymous, 2006a).

Structural development like scaling-up often goes hand in hand with technological innovation, which is used to increase productivity or save labor. For example, the use of AMS in dairy production is increasing. The current percentage of dairy farms (organic and conventional) with an AMS is 4% in the Netherlands and 8% in Denmark (C. J. A. M. de Koning, pers. commun.; M. D. Rasmussen, pers. commun.). Application of such a new technology on an organic dairy farm, however, is not self-evident, just

Table 2. Structural development of organic dairy farms in Denmark (DK) and the Netherlands (NL) from 2003 to 2005.

	DK ^a			NL ^b		
	2003	2004	2005	2003	2004	2005
Milk per farm (1000 kg)	605	725	824	325	360	400
Number of milking cows per farm	87	95	100	54	60	65
Average milk yield per cow (kg)	6954	7631	7800	6000	6300	6400

^aEstimations made using statistical data from Danish Dairy (<http://www.mejeri.dk>)

^bEstimations made using statistical data from SKAL (certification body in NL), LEI (Agricultural economical Institute; <http://www.lei.wur.nl>), and DLV (Dutch Agricultural consult).

because it functions on a conventional farm (Alrøe and Kristensen, 2004). In Denmark, more than 9% of the 490 organic dairy farmers use AMS, and this percentage is increasing (Oudshoorn and de Boer, 2005). In the Netherlands, however, AMS has been implemented only on 1.7% of the 300 organic dairy farms (SKAL,¹ KOM²). This is a divergent development in AMS use, in spite of uniform EU organic standards for both countries (see EEC regulation nr. 2092/91). The question arises if there are different perceptions between the Netherlands and Denmark in how organic dairy production can contribute to future sustainable development of the organic dairy sector, as embedded by the international federation of organic agricultural movements (Anonymous, 2005b).

An assessment of the contribution of AMS to sustainable development of organic dairy production should comprise Economic, Ecological, and Societal (EES) issues, the main aspects of sustainability. To assess the EES consequences of the introduction of AMS on organic dairy farms, stakeholders' perceptions are essential (van der Zijpp, 2001; Mollenhorst and de Boer, 2004). Stakeholders are interest groups that either influence the functioning of the production system or depend on the functioning of the production system (Johnson and Scholes, 1997). Stakeholders often judge the relevance of problems and possible solutions differently even though the hard facts (such as capacity, influence on production) generally are accepted.

The main objective of this study was to explore stakeholder's perceptions of the contribution of AMS use to sustainable development of organic dairy production in Denmark and the Netherlands. In addition, possible reasons for recent diverging development in AMS use between both countries were investigated. A literature review was used to select stakeholders and relevant EES issues for questioning, as also to evaluate the results from the interviews.

2. THEORETICAL BACKGROUND

Consequences of AMS use on conventional dairy farms have been investigated extensively (Meijering et al., 2004), whereas literature on AMS use on organic farms is absent. Hence, the available literature on AMS use on conventional dairy farms has been used to determine the relevant EES issues raised by the AMS use on organic farms. In addition, EES issues of AMS use on organic farms were related to internationally accepted organic principles, standards, and measures, including ethical aspects (Benbrook and

¹ SKAL: Certification for Organic Production in the Netherlands.

² KOM: "Kwaliteitszorg Onderhoud Melkinstallaties," Quality Maintenance Milking Machines in the Netherlands.

Kischenmann, 1997; Alrøe and Kristensen, 2000, 2004; Biao et al., 2003; Verhoog et al., 2003; Anonymous, 2005a, c; EEC regulation nr. 2091/92).

2.1. *Sustainability Issues Related to AMS use in Organic Dairy Production*

2.1.1. *Economic Issues*

From a review on sustainability issues influenced when introducing AMS (Oudshoorn and de Boer, 2005) on conventional dairy farms, it can be concluded that net farm income did not increase as expected. AMS use influences especially costs (increase), labor (decrease of demand), and milk yield (increase) (de Koning and Rodenburg, 2004). In organic agriculture, however, relationships between these factors differ, for example, organic concentrates are relatively more expensive and there is a premium price for organic milk. The time saving of between 27 and 70% (Rasmussen, 2000) by using AMS also is for the organic farmer hard to capitalize. Combining AMS and grazing might even result in additional work, such as having to fetch the cows, rather than them coming voluntarily (van Dooren et al., 2003). The demand for grazing could result also in a decrease in milking frequency, affecting the expected annual milk yield increase (Ketelaar-de Lauwere et al., 2000).

The data show that organic dairy farms in general have a better financial income than their conventional colleagues (Water, 2002; Nielsen and Vestergaard, 2003; Jørgensen and Pedersen, 2004). This could decrease the risk of large expenses when investing. However, judging from the experience of conventional AMS farms and the presumed consequences for the organic herds, no large economic gain is expected for organic farms using AMS compared to non AMS organic farms.

2.1.2. *Ecological Issues*

The environmental impact of AMS use can be assessed by estimating its effect on the use of natural resources such as water and fossil energy, and its effect on eutrophication, climate change, acidification, and biodiversity (Audsley et al., 1997; de Boer, 2003). From the literature review based on conventional farms only (Oudshoorn and de Boer, 2005), it can be concluded that water and fossil energy use is higher for farms with AMS. This is not expected to be different for the organic farms.

Eutrophication especially with nitrogen, and possibly phosphorous, due to high stocking rates caused by intensive grazing of farmstead lots, could be a problem for farms with AMS compared to farms without. This is especially true for organic farms, for which grazing is obligatory.

Global warming due to emission of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) is estimated not to be affected substantially

by AMS use, neither for organic nor for conventional dairy. The increase in CO₂ emission from the increase in fossil energy use is expected to be compensated by a higher milk yield per cow, which decreases methane production per unit milk (de Boer, 2003). This is not expected to differ for organic practices. The emission of N₂O, which is directly related to the amount of N applied on the field, is not expected to be different for organic farms with and without AMS. Similarly, the emission of ammonia (NH₃) causing acidification, from animal manure in stable, in storage facilities, during grazing and application of manure is not expected to change by AMS use. Biodiversity of landscape and pasture flora (Noe et al., 2005) are expected to be affected by AMS use as a result of a change in the pasturing system, i.e., less grazing and more mowing.

2.1.3. *Societal Issues*

On-farm societal issues affected by AMS use comprise animal health and welfare, milk quality, and the farmer's satisfaction, partially based on labor circumstances. The impact of AMS use on these issues is not always quantifiable and is subject to attitudes and reflections (ethical, pragmatic, impulsive). From the literature review (Oudshoorn and de Boer, 2005) it can be concluded that some health parameters and welfare of dairy cows is influenced negatively when grazing is reduced (Somers et al., 2003). Recent investigation showed that AMS use on organic dairy farms reduced grazing time (Hoeksma, 2005; Kramer, 2006), just as on conventional dairy farms (Mathijs, 2004). EU regulations enforce grazing, but do not specify exactly how much. AMS use affects milk quality directly through an increase in Free Fatty Acid (FFA) content, and indirectly (vitamins, carotene, and fatty acid profile) through a reduction of the intake of fresh grass resulting from a reduction in grazing time. Farmers generally are very satisfied with their gain of free time. Technical dependency of the farmer and negative influences on milk quality could influence the image and trust of the consumer (Meskens et al., 2001). Within the organic sector, where milk quality is believed to be one of the motives for buying (Torjusen et al., 2004), this is important also.

2.2. *Conclusions*

Overall, a literature review on AMS use shows that no data could be found specifically for organic dairy farms. Therefore, literature on AMS use on conventional farms was submitted to a validation of documented standards, principles, and practices in organic dairy farming and the conclusions mentioned here relate to organic farms with AMS. Concerning economy, AMS use is not expected to increase net farm income substantially, as milk

yield increase might be limited by grazing and the labor savings might be hard to capitalize. Concerning ecology, AMS use will increase water and energy use per kg of milk. Eutrophication is expected to increase as a result of a high stocking density of farmstead lots. Biodiversity is expected to decrease as a result of a change in the pasturing system. Acidification and greenhouse gas emissions are expected to be affected hardly by AMS use.

Concerning societal issues, AMS use is expected to influence animal welfare and health, and product quality, through a possible reduction in grazing time. Additionally, mechanical processes in the AMS influence product quality.

Considering the stakeholder perception investigation, economic issues (labor requirement and milk yield), the ecological impact of grazing (eutrophication and biodiversity), and the societal consequences of AMS (welfare and product quality and farmers satisfaction), imply a large influence of the primary sector.

3. METHOD

3.1. *Focus Group Interviews*

The aim of this research was to explore stakeholder perceptions in Denmark and the Netherlands of AMS use on organic dairy farms addressing sustainability issues in relation to organic principles and standards. The means adopted to achieve this aim was the focus group interview technique, where the topics discussed were based on the analyzed theoretical background. Such a technique combines quantitative factual research with qualitative participatory investigation (Halkier, 2002). The technique is appropriate for observing and tracing the divergence in development of AMS use in the Netherlands and Denmark and the expected ethical conflicts and attitudes for introducing AMS on organic farms. Focus group interview technique generates interaction between the participants in the group. It is an effective way to explore participants' perceptions and arguments. The participants themselves determine which topics they discuss in depth, showing where their interest lies. Focus group interviews produce data for groups, not individuals; how the group interprets or values the facts (Halkier, 2002). This, rather than a detailed knowledge of individual behavior and attitudes, can answer the main question of this research.

3.2. *Participants*

Evaluation of the literature showed that the main sustainability issues, affected by the use of AMS on organic dairy farms, addressed the primary

sector. In addition, the difference in AMS use between countries could emerge from the producers themselves or from the advisory system. Two stakeholder groups, therefore, were selected: farmers and advisors. Parallel sessions were organized in both countries, leading to four focus group interviews; two with organic dairy farmers, and two with advisors working in this sector. From the experiences of other group interviews with the objective of generating debate, a minimum of four people should participate in each group (Kvale, 1994). The aim of this research was to gather the range of perceptions and values. To secure a discussion based on experience and visions, some farmers working with AMS were selected. This resulted in the following group sizes: farmers in the Netherlands – five, of which two had AMS; farmers in Denmark – six, of which three had AMS; advisors in the Netherlands – eight; advisors in Denmark – six. The advisors chosen had knowledge about production of roughages, animal nutrition, and farm economics, which is due to the holistic view inherent to organic farming. In the Netherlands, most of the practicing organic advisors participated, and, therefore only one group session was arranged. Consequently, in Denmark also one session was arranged. All participants were between 30 and 60 years old. The participants in each group were personally recruited by telephone. They knew they were going to talk about the use of AMS on organic dairy farms, although information was kept to a minimum prior to the meetings.

3.3. *Procedure*

The four group interviews were held between September 2004 and March 2005. No major events that could influence the perception of the stakeholders took place during this period. It was clearly stated at the beginning of each session that the results and conclusions of the interviews would be published ensuring anonymity of the participants. The bilingual moderator explained the aim and procedure of the meeting, after which the participants introduced themselves to each other. The participants were invited to react freely to each of the moderator's questions and to each other's answers, remarks, and opinions. They were thus left free to interact and to react to everything that occurred during the session. During the focus group interview, the moderator (who was the same for all the sessions) introduced the topics. These topics were similar for the sessions in Denmark and the Netherlands, making it possible to pinpoint possible differences in perception between countries. The sessions lasted between 90 and 120 min. The interviews were audio taped and notes were made by the moderator. After the interviews, all material was transcribed and then analyzed. The condensation/indexation technique was used to analyze the sessions (Halkier,

2002). This was done by coding and categorizing all transcripts. Statements and discussion topics were systemized and grouped under coded headlines or keywords, frequency of occurrence, and time period in which they were discussed. This resulted in a schematic presentation of the topics and statements discussed, and the frequency and length of the coded topics. These schemes were then used to represent the essence of the analysis, conceptualizing the results. The results are discussed, using the literature review, based on conventional dairy farms with AMS, as reference.

3.4. *Questions*

Questions were designed to investigate whether the sustainability issues identified by literature as being influenced by AMS use on organic dairy farms, matched the stakeholders' perceptions. This resulted in a list of questions, which were preceded by so-called positioning questions (Halkier, 2002) giving information on the participants' backgrounds and practice and putting the group members at ease. The questions were mostly open, so as to let the participants take initiatives in relation to addressing topics. Later in the sessions, information from the theoretical review was brought up by the moderator for comment. In focus group interviews, general attitudes are discussed and not individual performances. Specific issues, which were identified in the theoretical background, as milk yield, direct energy consumption, therefore, were not brought forward. Sustainability issues that were not expected to be influenced substantially by AMS use on organic farms, such as acidification and global warming were not introduced by the moderator. Biodiversity was not brought up in the groups as changes in landscape or flora, between farms with AMS and without, have not been documented.

The 11 questions (Table 3), focused on three areas, each with their own agenda. The first area (questions 2, 3, 6, and 8) focused on the participants' perception of the stagnation in growth of the sector, and how they looked at the future in relation to their personal involvement with organic production. These personal motives were considered important in our study because AMS use can possibly contribute to overcoming the observed stagnation of the sector. Introduction of innovative technology could well be connected to perceptions regarding the future. Personal motives were expected to generate ethical discussions that could be projected onto using AMS. The second area (questions 4, 5, 9 partial, and 10) focused on the participants' opinions of the relationship of AMS to organic standards and principles and grazing issues. The literature review showed that grazing was a major issue concerning AMS use on organic dairy farms, as it was connected to the farm's economy, ecological factors such as eutrophication, and societal

Table 3. Questions used in the focus groups.

The participants were asked to say who they are, how much experience they have with organic farming and with AMS, and also the farmers are asked to describe their family and other social activities

The participants were asked to react to the statement that the situation and development of organic dairy farming doesn't look good: a decline in amount of organic milk delivered, some organic farmers converting back, worsening economic results and flagging demands

The participants were asked to estimate the future percentage of organic milk that will be sold in 10 years time

The participants were asked to reflect on the AMS as part of organic dairy farming
The participants were asked what they think of grazing, as part of the organic standards

The organic farmers were asked what their reasons were for farming organically

The organic farmers were asked what they think motivates consumers to buy organic produce

The organic advisors were asked what reasons they think the farmers will give for farming organically

The participants were confronted with nine sustainability issues selected from the literature survey and asked to prioritize them according to their perception of relevance and their factual knowledge

All participants were individually asked to comment on the possibility of a new rule involving pasturing on organic dairy farms making it compulsory to have the cows out for at least 6 h in the 150 days of the grazing season and have at least 0.2 ha per cow of grassland accessible (not available all the time)

The participants were confronted with a statement that there is hardly any difference between organic dairy and conventional farming

issues like animal welfare, product quality, and image. The third area (questions 4, 7, 9 partial, and 11) focused on the participants' perceptions on other sustainability aspects of concern found in the literature, such as animal health, natural resources, technical dependency, farmers satisfaction, and consumer behavior.

A confrontation with identified relevant sustainability issues (question 9) was presented rather late in the session to avoid influencing the group, and was introduced once they had discussed the possible use of AMS on organic farms in the earlier questions.

Incidentally, the participants themselves focused on other aspects than those originally planned by the moderator. On these occasions, the statements and opinions were indexed to the relevant aspects.

4. RESULTS

4.1. *Participants Viewpoints on Organic Farming*

When confronted with the statistics showing the decrease in growth of organic milk production and the decline in the number of organic dairy farms in Denmark in the period 2000–2004, nobody perceived the current stagnation as a real threat or a negative signal. Some even seemed surprised by these numbers. In general, all four groups perceived a period of stabilization and consolidation important after a period of fast growth in the 1990s. They agreed that increased concentrate prices, the accomplishment of 100% organic feeding, and lower organic premiums and subsidies are reducing the financial incentive to convert from conventional to organic dairy production. This reduced conversion together with the structural development resulting in fewer farms with increased production, results in a plateau in the number of organic farms. A better marketing effort could, according to the participants, have led to higher sales and consequently a higher percentage of organic farms.

Dutch participants generally were more optimistic about future development than Danish ones. They identified some positive ongoing developments, such as nature management, as possibilities for generating extra income and stimulating positive future expectations among the producers. They also mentioned that continuous growth of the sector should not be the only objective.

When discussing the future market share of organic dairy production in each country, no participants predicted a serious decline in organic dairy production. Dutch farmers expected a future market share of organic dairy production of on average 10% (range 5–22%), whereas Danish farmers expected a future share of on average 12% (range 7–22%). The current market share of organic dairy production is around 2.5% in the Netherlands and 10% in Denmark. Hence, Dutch farmers expected a larger growth than Danish farmers did. Advisors, however, did not want to predict exact percentages. Danish advisors stated a status quo or small growth in the market share, whereas almost all Dutch advisors expected an intermediate growth in the market share of organic dairy production.

When farmers were asked why they were farming organically, Dutch and Danish farmers mentioned the following: absence of chemicals, economic prosperity, satisfied and happy with the work of farming, responsibility for maintaining a natural environment, animal welfare, worth living in for the next generation, and professional challenge. They also mentioned the skills to manage weeds without chemicals and animal health problems without prophylactic treatments. All farmers interviewed were satisfied with current

practices, and had a positive attitude towards the future. Advisors in both countries had the same perception and stated that even where economic prosperity had been the main motive for some farmers to convert from conventional to organic production, some years of practice often showed that other motives became more important, like the joy of farming. According to the advisors, reasons to stop producing organically were not related to organic farming. Farmers (conventional as well as organic) stopped because the owners were ageing and had no successors, or because of structural developments (i.e., their farms were becoming too small).

4.2. *Participants Viewpoints on AMS use and Grazing*

The stakeholders, when asked to react freely on the use of AMS on organic dairy farms, came up with a massive response and discussion, not only about AMS as new acceptable technology or its impact on animal health, but also overwhelmingly about the grazing issue. All four groups were unanimous in not having any moral problem with this new technology. Participants also agreed that the desire to uphold organic principles and standards was no reason to reject AMS. The groups concluded that AMS use on organic farms probably will not improve the financial situation, whereas it will cause some problems with respect to the grazing that need to be solved.

In the Netherlands, advisors and farmers stated that AMS was feasible for bigger farms only, whilst Danish advisors were of the opinion that AMS was not of interest for farms of over 250 milking cows, referring to organic standards that demand grazing. Grazing problems and economic reasons were mentioned as disadvantage for the use of AMS in very big herds. Large carousel milking stalls with a capacity of 250 cows an hour were mentioned as more profitable in big herds than AMS, with capacities of 60–70 cows a day. In addition, the allocation of fields and maintenance of access roads, including labor time spent driving the cattle, were mentioned as disadvantages.

In the course of the interview, the moderator specifically asked the participants in all groups about their perception of grazing. All groups responded that grazing is closely connected to the image of organic dairy farming, expressed very succinctly by the following remarks: “it is the face of organic dairy,” “no discussion possible,” “definitely crucial,” and “essential.” Both Dutch and Danish farmers put forward additional arguments for why grazing was important to them, such as image and naturalness, but there were also differences of opinion regarding animal welfare, health, and product quality, when grazing was considered.

Danish farmers stated that grazing was sometimes labor intensive, difficult to manage correctly, and was not always animal-friendly. However, they were in no doubt that it was worthwhile, and they even encouraged the

certification bodies to “tighten” their control on pasturing management. In contrast to this, Danish advisors, who also mentioned some of these difficulties, argued for the idea of substituting grazing by time spent outdoors or indoor cubicles well covered with straw. Only the Danish participants specifically mentioned the positive effects of grazing on milk quality such as CLA (Conjugated Linoleic Acid) content, vitamin E concentration, and the presence of antioxidants.

When the participants were asked to prioritize among nine sustainability issues selected from the literature review, grazing was ranked as second most important, except by the Danish advisors (Table 4). This group felt that the pasturing problem had already been discussed intensively before the advent of AMS in organic dairy farming. In their opinion, solutions could and should be found, and this would help the organic dairy farms with and without AMS. Looking at the other issues, it is interesting to see that advisors ranked milk quality slightly higher than farmers do, both in Denmark and in the Netherlands. Milk quality was connected partly to the functioning of the AMS and partly to the pasturing on clover/grass mixtures. The issue of eutrophication was ranked completely differently by the groups. Eutrophication in connection to grazing had to be explained by the moderator and was not seen as a threat by the advisors, but it was by the

Table 4. Focus group participants priority of nine selected sustainability issues' importance when implementing AMS, scored (sc.) in consensus within the groups, by two different stakeholders, farmers and advisors in two countries, Denmark (DK) and the Netherlands (NL).

sc.	NL farmers	sc.	DK farmers	sc.	NL advisors	sc.	DK advisors
1	Economy	1	Economy	1	Economy	1	Economy
2	Grazing	2 ^a	Grazing	2	Grazing	2	Concentrates
3	Technical dependency	2	Eutrophication	3	Animal welfare	2	Milk quality
4	Sales	4	Technical dependency	4	Milk quality	4	Technical dependency
5	Milk quality	5	Sales	7	Technical dependency	5	Grazing
6	Eutrophication	6	Milk quality	7	Animal health	6	Animal health
7	Concentrates	7	Animal health	7	Eutrophication	7	Animal welfare
8	Animal welfare	8	Animal welfare	7	Concentrates	8	Sales
9	Animal health	9	Concentrates	7	Sales	9	Eutrophication

^a Where the score shows the same number, this means that no priority was given within these issues.

Danish farmers; not so much as environmental threat but as an administrative one because of mineral bookkeeping obligatory measures in the Netherlands and in Denmark. Animal welfare and health were thought unlikely by the farmers to cause problems with AMS use, but these problems were rated higher by the advisors in both countries. Farmers connected the health and welfare aspects more directly to the robotic character of AMS, stating there was absolutely no negative influence of the machines. The advisors clearly saw the lack of grazing as an indirect consequence of AMS. This would eventually cause problems with health and welfare, according to the Dutch advisors. The discussions arising whilst prioritizing the issues showed that the stakeholders recognized that many issues were connected to grazing, as seen in the literature.

To relate the discussion on grazing to the direct practice, the moderator asked for the farmers' and advisors' perceptions on a possible new rule, prescribing grazing. The current EU standards state that in general cows should graze when possible. The Dutch authorities interpret this as a minimum of 120 days and the Danish as a minimum of 150 days. The EU standards imply no grazing hours per day and no strict control. A new rule could be that dairy cows should pasture for at least 6 h a day on 150 days per year and have access to an area of 0.2 ha per cow (in the grazing season). These time and area definitions have been suggested as sustainable measures by Danish authorities, addressing both the issue of eutrophication and the cows' welfare.

All groups mentioned and concluded that there are potential problems controlling such a rule (Table 5). All groups also acknowledged that if such a rule were enforced, some organic farmers would have to stop production. All other reactions on a possible new rule revealed different perceptions, resulting in a large variation within and among groups. Consequently, no general conclusions could be drawn. It is, however, worth mentioning that Danish advisors were mostly against extra restrictions. The Danish farmers concluded differently from their advisors, declaring that farms that could not live up to these rules should be excluded from delivering organic products.

4.3. *Affect of AMS on Sustainability Issues*

When the participants were asked to react freely on AMS use on organic dairy farms, they mentioned other issues than grazing. The use of new technology was described with the following statements; "we should not be nostalgic," "no principal problems," "let new technology help us," and "new technology cannot be stopped." Referring to some critical opinions stating that automatic milking would remove animals from the farmers'

Table 5. Dutch (NL) and Danish (DK) farmers' and advisors' categorized statements mentioned by at least one member of the group, on a possible new rule suggesting a minimum 0.2 ha grazing area and 6 h of grazing per cow per day on 150 days per year.

Statements	NL	DK	NL	DK
	Farmers	Farmers	Advisors	Advisors
0.2 ha is too much	•		•	•
Should be for all countries	•		•	
Hard to regulate, control	•	•	•	•
6 h is not enough			•	
6 h is OK, 0.2 ha is too much		•	•	•
0.2 ha is necessary		•	•	
Too radical: not what the farmer accepted when they converted			•	
People deciding this don't know anything about practical farming		•	•	•
Fine	•	•	•	•
Would destroy the rotation			•	•
Would be hard on the economy	•			•
Make welfare score: grazing gives points, can be substituted by other measures		•		•
Not possible for all organic dairy farmers	•	•	•	•
You have to be clear addressing the consumers	•	•		
Makes it difficult to grow larger	•	•		
Necessary for milk quality, price		•		

caretaking, some participants mentioned that AMS could directly improve the animals' welfare by having a stable and calm herd. All participants knew that AMS could have a negative influence on milk quality, regarding both fatty acid content and hygienic standards; however, they did not see this as an insuperable obstacle. Some Dutch advisors mentioned negative factors including: cows cannot be managed from behind computers; not all farmers can handle information technology; AMS is just another technique in the efficiency race to make agricultural products cheaper, it will not help the sector; the introduction of AMS on organic farms reduces the differences between organic and conventional production. Dutch advisors and farmers focused more on the economic feasibility of AMS.

At a later stage in the interview, the stakeholders discussed and prioritized the expected effect of AMS on sustainability issues and derived aspects, selected from the literature review. All groups rated failing economic return

as the primary threat to sustainability (Table 4), and the Danish advisors also linked concentrates and milk quality to economy. In general, farmers ranked sales much higher than advisors did, indicating the threat of not being able to sell the product. Furthermore, farmers expressed concern for their premiums and contracts to the dairy industry. They argued that bad quality and image would decrease the sales of the product. None of the participants regarded the use of AMS to be a threat for animal health and some Dutch farmers criticized the moderator for even mentioning the aspect in this assignment, as it was postulated as gossip, brought into the discussion by anti-technology activists.

Throughout the interviews, the participants mentioned the consumers as an important unknown factor influencing the sustainability of organic dairy production with or without AMS. All participants agreed that consumers' own personal health, no use of chemicals, more natural methods, and animal health and welfare were the most important motives for buying organic products (see Table 6). For example the statement, "The consumer wants to see the cow outside," was expressed in all groups. Some participants claimed that consumers would not know the difference between a dry cow and a lactating cow, and the cows in the field a couple of hours a day would be enough to satisfy the consumers' desires. When more specifically asked

Table 6. What farmers (NL and DK) think (quotes) consumers want when they buy organically produced food.

Category	Key issues for the consumers
Personal health	No chemicals Better quality Healthier Egocentric buying behavior
Environment	No artificial fertilizer Respect for nature Natural
Animal welfare	Grazing Better animal welfare Cow outside
Other reasons	Relatively cheap compared to what conventional food should cost without subsidies It gives a good image Clear difference from conventional methods Because of scandals in conventional agriculture

Categorized and indexed but not rated (not in priority order).

about how the farmers and advisors thought about the lack of difference between conventional dairy farming and the present organic practice, the Dutch farmers in particular reacted by saying that there was a difference, referring to the consumers' desire for small scale, non technological farming. The Danish advisors and farmers mentioned the AMS as an example. According to them, not many consumers know what robotic milking is and how it affects the organic practice, nor the fact that many organic dairy farmers are using it. This gives the consumers the idea that there is no big difference.

5. DISCUSSION

5.1. *Perceptions: Dutch and Danish*

On average, a Dutch organic farm is smaller than a Danish farm. Dutch farmers and advisors mentioned that structural development towards bigger farms was difficult in the Netherlands. Dutch stakeholders assumed that farms with around 50–60 cows could not afford an AMS. This perception is in contradiction to economic model calculations done in France and in the USA, where farms with herds of 60 cows were regarded as ideal for the introduction of AMS (Veysset et al., 2001; Rotz et al., 2003). In Denmark, the discussion on the optimal size for farms using AMS also involved factors such as difficulties with grazing and technical dependency. Technical dependency can be a major pitfall when introducing innovative technology, as the overwhelming amount of computer data can sometimes be counter-productive (Eastwood et al., 2005). In Denmark almost 10% of AMS users have converted back to bulk milking (M. D. Rasmussen, pers. commun.), but the exact reasons have not yet been investigated. In the Netherlands, AMS was used only by six out of approximately 300 organic farms in 2005, and in Denmark by 46 out of 500 organic farms. It is reasonable to assume that the size, and recent enhanced structural development towards bigger farms in Denmark, is partly causing this. Often farmers introduce AMS when they build new housing facilities or enlarge their milk production. However, the percentage of organic farms in the Netherlands with AMS is also lower than the percentage of conventional farms with AMS in the Netherlands; 1.7% and 4%, respectively. The percentage in Denmark is on the contrary higher; 9% and 8%, respectively (C. J. A. M. de Koning, pers. commun.; M. D. Rasmussen, pers. commun.).

Reactions of Dutch advisors and farmers showed that other factors might be involved. The Dutch farmers explicitly mentioned that expanding their farm unit was not their main goal with organic farming, and in the course of the interviews a more skeptical opinion on the use of AMS was

observed, both economic and strategic. Growth expectations of the sector were discussed. Dutch participants responded more optimistically than the Danish participants did. This could be a result of the present relatively low percentage of organic sales in the Netherlands (van Ruitenbeek, 2005), and the Dutch aspiration to come up to levels of trade achieved in Denmark or other countries in the EU. Both countries, however, expressed some optimistic future view, which will be necessary if an enterprise makes large investments such as AMS. Accepting the difficulties associated with expanding in size, Dutch farmers expressed views on finding alternative enterprises for the future, like starting on-farm cheese and yoghurt dairies, or other financial possibilities such as bed and breakfast, farm campgrounds, and residence for socially deranged people offering therapy or just relaxation. Danish farmers and advisors expressed views more along the lines of economizing, labor saving, and having a good life.

All groups prioritized the failing economic performance of the farm as the main threat to sustainability when introducing AMS. This corresponds to the results found in the literature (Nielsen and Vestergaard, 2003). In the focus group sessions, where possibilities of AMS use within the organic system were discussed, the Dutch farmers and advisors emphasized the economic performance more often than the Danish participants. Even though economic performance was mentioned as crucial, this was relativized. Social factors, such as the need for family free time or flexibility, in the end determine what the enterprise decides. Here the organic farmers do not respond differently from their conventional colleagues (Meskens and Mathijs, 2002). In addition, Mathijs (2004) presents a clear difference in motivation to invest in AMS between Denmark and the Netherlands; in general the Dutch want to *save* time (economic incentive), while the Danish want more *flexible* time (well-being incentive). The number of farms using AMS is increasing (Nielsen and Vestergaard, 2003; Meijering et al., 2004), confirming that even though the net income is not improving, AMS investment is continuing. The critical view on economic gains from using AMS, in addition to the perception that units of 60–70 dairy cows are not profitable for AMS that was registered in both the Dutch advisor and farmer group, could be part of the explanation why not many organic dairy farms in the Netherlands have converted to AMS.

There seems to be no difference in primary incentives for farmers to start organic production in Denmark and the Netherlands. Their expressed ethics concerning animal welfare or use of chemicals are not in conflict with the introduction of AMS and the above-mentioned professional challenge. Furthermore, the positive reaction to the use of modern technology is in line with technological development. In addition, the acknowledgement of

small-scale naturalness, representing less mechanized agriculture perhaps, is motivating the Dutch farmers not to start harvesting their milk by robot.

5.2. *Grazing, Milk Quality, and Image*

Grazing was in the literature review (Oudshoorn and de Boer, 2005) not defined as a sustainability issue, but is associated with many issues, and as such grazing is an important aspect, as clearly mentioned in the literature (Ketelaar-de Lauwere et al., 2000; Raun and Rasmussen, 2001; van Dooren et al., 2003; Mathijs, 2004). Recent studies confirmed that organic farmers with AMS in Denmark and the Netherlands have decreased the amount of grazing (Hoeksma, 2005; Kramer, 2006), just as their conventional colleagues have done (van Dooren et al., 2003). The focus group interviews showed that grazing problems were complex. Because the economic incentives for grazing were not always obvious, the organic sector has discussed other moral or marketing-oriented arguments to motivate the farmers to maintain a high level of grazing. However, when discussing a tightening of the organic rules, specifying how long and what area the animals should be able to access, all groups, but especially the advisors, are relatively pragmatic. They understand very well that a number of farms will not be able to live up to these standards, and will have to stop their organic practice.

In all group discussions, the practical implementation of grazing rules divided the participants into two groups; one side arguing that more grazing is better for welfare and product quality; the other side suggesting that just showing that the animals are kept outside would be enough to satisfy the customers and arguing animal health and welfare not always improved by grazing the animals. Literature on this subject is not unanimous although most references state that grazing improves welfare and health (Somers et al., 2003; Munksgaard and Søndergaard, 2006). Welfare issues like more motion, better lying conditions, less aggressiveness, and better reproduction are mentioned as well as health issues like fewer claw disorder and lameness. The Danish farmers, in particular, were clear in their opinion that organic dairy farmers without facilities for sufficient grazing should stop. In the end, this would help the sector improve its image. The production of organic milk in Denmark and the Netherlands is higher than the consumption and can absorb easily those few farms stopping deliveries. On the other hand, the Danish advisors in their group argued to slack the rules, giving the possibility to compensate for fewer grazing hours by providing extra straw areas.

Danish farmers and advisors stated that the sector's image could be improved by focusing more on the product quality. Here the direct positive influence of grazing on vitamin E, fatty acids as CLA, and antioxidants was mentioned. This positive influence has been mentioned also in the literature

(Collomb et al., 2002; Elgersma et al., 2004; Nielsen, 2005). Danish participants discussed these topics because of a recently published article in a popular agricultural magazine in Denmark. All groups expected a solution for the negative influence of AMS on the FFA concentration of the milk. Farmers perceived milk quality aspects less important than the advisors, when rating them among the nine threats of AMS to sustainability. This could be due to less knowledge among the farmers on this subject.

Although connecting many sustainability issues to the grazing aspect, stakeholders did not prioritize eutrophication. Eutrophication, however, can be a problem (Søgaard et al., 2001; Kristensen et al., 2005b) and the organic dairy sector will be confronted with this (Kristensen et al., 2005a). It is not always clear to farmers and advisors that grazing management can result in excessive stocking rates, which provokes eutrophication. Eutrophication causes high nitrate levels in ground and surface water and might affect, therefore, the image of public indirectly.

All participants agreed that AMS had no direct negative influence on animal welfare and health aspects, only indirectly, by reducing grazing time. This corresponds to the conclusions found in literature (Oudshoorn and de Boer, 2005).

5.3. *The Future*

Both the literature review and the analysis of stakeholders' perceptions reveal that AMS use on organic dairy farms is not without problems. There should be no doubts about the milk quality, grazing should be possible, and the cost price and yearly maintenance should not be too high compared to the economic gains. Variation in economic results between best and worst for all AMS dairy farms has proven to be large (Nielsen and Vestergaard, 2003). The economic challenge for organic dairy farming could well be even bigger, as it needs more labor for maintaining grazing and the costs for concentrates use are higher (Ketelaar-de Lauwere et al., 2000; Kristensen et al., 2005a, b).

A lack of sufficient farmstead lots can easily cause overstocking and will demand strict management (Kristensen et al., 2007). The problem of achieving a high level of grazing when using AMS is acknowledged by the primary stakeholders of organic production. Organic farmers and advisors require research on the use of AMS and grazing, which might result in technical or operational solutions. The organic advisory system in Denmark has financed projects aiming at increasing grazing together with AMS. The challenge for the future, therefore, will be to decide how much grazing is necessary to satisfy, on the one hand, the animals' welfare, the milk quality, stocking rate, and the wishes of the consumer and, on the other hand, economic feasibility. Animal

welfare organizations are demanding obligatory pasturing of ruminants, organic and conventional (Anonymous, 2006c). One year after the focus groups discussed the tightening of the grazing rules, the Danish certification body (Danish Plant Directorate) for organic agriculture brought in a new minimum for grazing (0.2 ha and 6 h). As the participants mentioned during the interviews, the consumer demands and their view of the image of organic dairy farming is important, but was not investigated in this paper.

CONCLUSIONS

Farmers and advisors in Denmark and the Netherlands, representing relevant stakeholders of the organic dairy sector, expressed AMS use as a good development, giving the farmers more free time and possibilities to manage their farms effectively. In addition, they expressed no moral problems regarding AMS use. They, however, pointed out the uncertainty of economic gain, difficulties with grazing, adaptation problems towards new technology, and possible image problems towards consumers. Consumers' image was considered to be affected negatively by a reduction in grazing time, affecting both milk quality and animal welfare. The Dutch as well as the Danish farmers were more radical than their advisors in their suggestions for solving the grazing problem, stating that if colleagues could not live up to the grazing standard, they should stop. Within all groups, there were different perceptions on the effect of grazing on welfare, health, product quality, and economy. In particular, the Danish advisors disagreed that grazing automatically enhances animal welfare.

The participants did not recognize eutrophication, as result of grazing a large number of cows on a relatively small area, as a problem caused by AMS. The milk quality problem related to AMS use, although acknowledged as crucial towards consumers, was not prioritized very highly, especially not by farmers in both countries. All groups were, however, unanimous in their perception of how important image was as far as the consumers are concerned. The perception analysis revealed that Dutch participants were concerned more about the economic payoff of AMS, and showed more reluctance towards enlargement. In addition, they acknowledged the small-scale naturalness of organic production, and as their primary goal they did not express growth or increasing productivity. These differences in perception could possibly explain observed differences in AMS use in organic dairy production between Denmark and the Netherlands, where the Danish, parallel to their conventional colleagues, expand the size and try to replace manual labor by machines, whereas the Dutch seek other ways to support their income.

The stakeholders' perceptions were in many ways parallel to literature review based on AMS use on conventional farms. The focus group interview technique showed its ability to identify perceptions of stakeholders regarding sustainability issues of AMS use on organic dairy farms as also problems and mitigation options for implementation. In addition, the focus group interview technique identified differences in perception between the Dutch and Danish participants for the future of organic farming and future developments addressing AMS.

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