SUSTAINABILITY OF FUTURE SWEDISH DAIRY FARMING; SCENARIOS FOR ANIMAL HEALTH, ENVIRONMENT AND ECONOMY

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SUMMARY

The overall aim of this study was to describe future scenarios for dairy farm production in Sweden, and to analyse sustainability of theses scenarios, using a method previously developed. Two goal visions for dairy farming were developed; Specialised Dairy Farming (SDF) with high production intensity and Mixed Dairy Farming (MDF) with increased crop rotations and large share of pasture. When quantification was performed the scenarios were evaluated concerning economics, environmental effects and animal welfare, including health. No scenario was superior in all aspects and the goal for developing sustainable dairy farm production must be guided by analysis of values.

Keywords: sustainable agriculture, animal health, animal welfare, dairy

INTRODUCTION

The development of the dairy farming is important for environmental aspects, as well as social and economic development of the countryside in Sweden. When aiming at a sustainable dairy production it is crucial to include these issues, but animal health and welfare should also be considered.

The dairy sector is one of the most important sectors in Swedish agriculture today. The development of dairy farm production is important for environmental aspects, as well as social and economic development of the countryside. It is important to aim for a sustainable development including these issues, but also the ethical aspects of animal husbandry; we must manage our animals in an acceptable way, which means that animal health and welfare should be considered.

The overall aim of this study was to describe future scenarios for dairy farm production, and analyse the scenarios from a sustainability point of view. The specific aims were to identify conflicts between different sustainability goals for dairy farm production; to formulate future scenarios based on defined FOOD 21 sustainability goals and analyse conflicts between goals, and to evaluate the scenarios from economic, environmental and animal welfare perspectives.

MATERIAL AND METHODS

When scenarios were designed, it was crucial that the results reflect the basic values behind the scenarios, and that the assumptions made were clear and handled in a transparent way. In the scenario design process, several choices have to be made and the rationale for these choices must be explicit. The method used was a stepwise process where all steps were presented (Sonesson et al., 2003). The starting point was to define the parameters used to design the future scenarios. The Food 21 sustainability goals relevant for the milk farming system were mainly related to natural resources, external environmental, animal welfare and economics. A principal description of the milk production system is given in Fig 1.

Two goal visions for milk farming were developed. Each goal vision was completed with grouping of the focus parameters in respect to their relative importance for the goal vision. These groups of parameters will constitute the starting point for designing the goal vision scenarios. The two goal visions developed were;

a. Efficient production and small environmental impact per product ("High intensity")

This goal vision was focused on efficiency, both economic and environmental. The environmental performance and resource efficiency optimised was the product oriented impact. This means that in this scenario we strived for high production per unit resource put in and per unit emission let out. The feed production was mainly based on local supply of forage feed and some grain completed with import of high quality protein feed. The production was also concentrated on milk; it was a highly specialised enterprise, which makes it possible for the staff to become specialists on dairy cows.

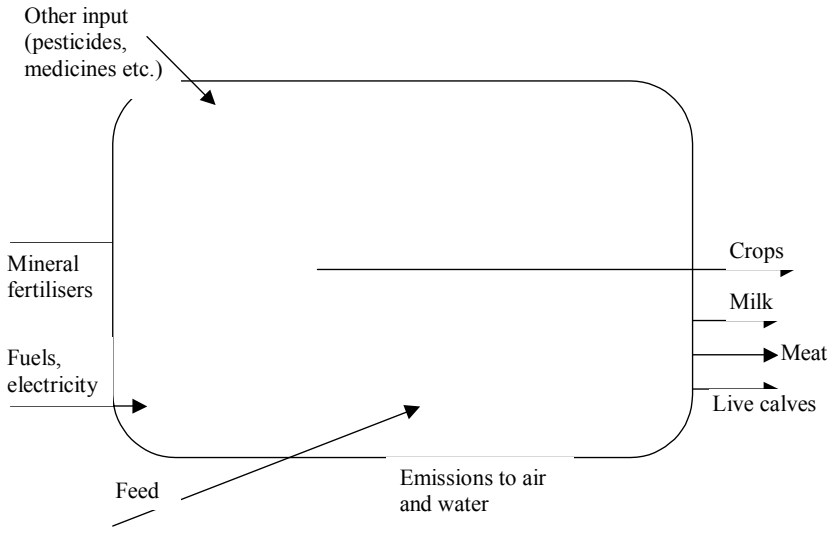

Figure 1. Principal description of the milk production system

b. Focus on animal welfare, working environment and local environmental impact ("Low intensity")

This goal vision was focused on environmental efficiency, mainly on area level, but the production level was also taken into account. This means that the environmental impact per unit of land was minimised, but the impact per unit produced was also considered. The systems build on integration of milk and meat production based on local feed production, both forage and protein feed. The milk production was managed in a way that fits well into sustainable meat production. A second aspect of the integration was that in this goal vision was that the farm can grow more cash crops in order to optimise the crop rotation; the machinery and knowledge about crop production was a natural part of the enterprise.

Two goal vision scenarios were created from the goal vision. The goal vision "Efficient production and small environmental impact per product" resulted in a scenario we call "Specialised Dairy Farming", since the design of the scenario based on focus scenarios, resulted in a specialised system with high intensity. The goal vision "Focus on animal welfare, working environment and local environmental impact" resulted in a scenario we call "Mixed Dairy Farming". The focus scenarios most important for this goal vision resulted in a system where good crop rotations and large share of pasture were important.

Based on the qualitative descriptions and the design of buildings, the farming systems were quantified. The quantification was done through expertise judgement based on available statistics on agricultural production combined with general knowledge synthesising research and extension services (Statistics Sweden, 2004; Agriwise, 2005; Swedish Dairy Association, 2005). When quantification was performed the scenarios were evaluated concerning economics, environmental effects and animal welfare, including health. An environmental assessment of the two scenarios was performed, using Life Cycle Assessment. The analysis included investigation of eutrophication, global warming potential, acidification and toxicity (measured as amount of active substance of pesticides used). The use of resources for the system was quantified as energy use, land use and usage of phosphorus.

RESULTS AND DISCUSSION

Cost of production was in scenario "Specialised Dairy Farming" 3.02 SEK/kg milk, in scenario "Mixed Dairy Farming" 4.34 SEK/kg milk, and in the present production 2.87 SEK/kg milk. The economic analysis shows that neither of the two scenarios was economically viable in the present economic context. This was due to high building costs for both scenarios and also higher labour and feed costs for scenario "Mixed Dairy Farming". The high cost for labour in scenario "Mixed Dairy Farming" was a result of high ambitions for animal welfare and reflects the cost of a high level of animal welfare in dairy production. If the economic result had been used to refine the building design the costs would have decreased. The high cost for feed in "Mixed Dairy Farming" was somewhat complicated; the on-farm production of feed was more costly than purchased feed used in "Specialised Dairy Farming". This was not logical since the components in the feed was largely the same, so perhaps the price of purchased feed actually does not reflect the production costs, i.e. the feed producers are not paid enough to cover their actual costs. A second explanation for the high feed costs per kg milk in scenario "Mixed Dairy Farming" was the relatively low milk production per cow.

The emissions of eutrophying emissions are especially important for agricultural production since agriculture contribute to approximately 50% of all eutrophying emissions in Sweden. The

contribution to eutrophication per litre milk was lowest for scenario "Specialised Dairy Farming". At the same time, scenario "Mixed Dairy Farming" contributes less to eutrophication per land area used. This can be equally important since eutrophication largely is a local or regional environmental effect. Both these aspects are important and the emissions per litre milk should be an important aspect when discussing total environmental impact from dairy production. The emission per area land is important when livestock production is discussed on a regional level, in areas where the intensity is high or the receiving watershed is sensitive. The environmental assessment showed that the co-production of meat and live calves has important effect for the overall environmental impact; hence the choice of analysis method was crucial. This affects the results, mainly for the "Mixed Dairy Farming" since it produces more meat and calves. We have assumed that the alternative beef production was an extensive suckler cow production, which means that the meat and calves are saving relatively large emissions of ammonia and land use. If a more intense beef production system would have been chosen, these effects would have been lower, but energy use and emissions causing global warming potential would increase for the alternative beef production. However, the results showed the importance of including the co-products in systems analyses of this kind. (For complete report on the life cycle analysis see Sonesson, 2005)

In the scenario construction, factors that are considered to improve animal welfare were implemented in both scenarios, as the legal requirements on the animal housing in Sweden have to be met. We used areas of concern found in previous research as a guideline to investigate the potential welfare differences between the scenarios we constructed. We found that a theoretical evaluation partly would be possible, considering the scientific knowledge about how housing and management is affecting health and welfare (e.g. Bendixen et al., 1988; Bergsten, 2003; Enevoldsen & Gröhn, 1996. Hultgren, 2001, Murray et al., 1996; 1990; Singh et al. 1994).

Cows in "Specialised Dairy Farming" were found to have a higher risk of lameness as they both have and increased risk of getting heel-horn erosion and laminitis, compared to cows in the "Mixed Dairy Farming" scenario. In the "Specialised Dairy Farming" scenario, the cows were having a higher milk yield, which have been found to be associated with an increased risk of mastitis, ketosis and abomasal displacement. Furthermore, the extended access to grazing on pasture in the "Mixed Dairy Farming" scenario decreases the risk of getting mastitis, and they also have lower risk of dystochia.

Comparing the two scenarios, "Mixed Dairy Farming" probably has more positive impacts on the long term environment than "Specialised Dairy Farming". The reason was that "Mixed Dairy Farming" involves a more varied crop rotation, which is beneficial for many biological aspects. Scenario "Mixed Dairy Farming" also uses more pasture, which can improve the biodiversity. However, the pasture was intense and hence less valuable from a biodiversity point of view. (For details see Gunnarsson et al., 2005)

The objectives of the study were met, and the process of designing the scenarios gave valuable insights and contacts within the dairy sector. The concrete way of describing the future scenarios worked well in discussions both with researchers from different fields as well as practitioners. The systematic approach; starting with defining the sustainability goals in an operational manner made a clear and logical analysis of goal conflicts possible. The transparent choice when goal conflicts appear also contributed to higher acceptance of the scenarios.

The assessments of the scenarios are complex; there are many aspects to consider simultaneously. The fact that the evaluation of scenarios was done both quantitatively and qualitatively involves difficulties with balancing the conclusions; the quantitative results often are given more weight than the qualitative ones. The results show that no scenario was superior in all

aspects. The implication of this is that the goal for developing sustainable dairy farm production must be guided by values, i.e. choices of what sustainability goals that is more important. This is an important finding in our perspective; no system is the sole solution and choices have to be made, and studies of this kind is important to see what the choices are and what the consequences of the choices are. The choice of scenarios in this study was to some extent extreme, in reality a combination of the solutions in the two scenarios were likely to be most efficient in the quest for a sustainable development. The mainly positive environmental results for scenario "Mixed Dairy Farming" must be considered as rather strong, since the assumed milk yield is rather low. However, the low milk yield results in high production costs per kg of milk.

The results from the study can function as a discussion platform, where the debate about sustainability in dairy farming can be directed towards the conflicting goals instead of towards what measures to prefer. The methodology has been applied to pig production (Stern et al., 2005), and beef production (Kumm et al., 2005).

CONCLUSION

No scenario was superior in all aspects and the goal for developing sustainable dairy farm production must be guided by analysis of values. The economic analysis shows that neither of the two scenarios was economically viable in the present economic context. The contribution to eutrophication per litre milk was lowest for scenario "Specialised Dairy Farming", but the "Mixed Dairy Farming" contributes less to eutrophication per land area used. Cows in "Specialised Dairy Farming" were found to have a higher risk of lameness as they both have and increased risk of getting heel-horn erosion and laminitis, compared to cows in the "Mixed Dairy Farming" scenario. No system is the sole solution and choices has to be made, and studies of this kind make it possible to survey which choices that can be made and what the consequences are.

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