PLAYING GAMES FOR THE FUTURE: A METHOD FOR CONSTRUCTION AND EVALUATION OF SCENARIOS FOR SUSTAINABLE ANIMAL PRODUCTION

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SUMMARY

Sustainability within agriculture is a complex issue. In this study we have worked with a forecasting scenario technique. A methodology for working with scenarios for future agricultural production systems was developed. The scenarios can then be evaluated both quantitatively, e.g. economy and life cycle analysis (LCA), and qualitatively, e.g. animal health and welfare. The method has been used on pig production, beef production, dairy production and the production of food potatoes.

Keywords: sustainable agriculture; animal health, animal welfare, scenario method

INTRODUCTION

The Swedish research program FOOD 21 are working with sustainable food production in many aspects; plant nutrient management, animal welfare and production, consumer research, farmer interaction, systems analysis modelling and food quality (FOOD 21, 2004). In order to communicate the massive amount of results from the program a synthesis work was initiated.

Sustainability is doubtless a complex subject with many aspects. In agriculture, sustainability contains a large portion of ecological issues, if the environment is damaged you can not sustain your production since it relays on natural systems (Tilman et al., 2002). The social as well as economic aspects of sustainability are also important since agriculture is important in rural areas. An often used term when discussing sustainability is the "triple bottom line", referring to the three main aspects of sustainability; ecological, economical and social. This means that true sustainable requires that all these three aspects are taken into account. For sustainable agriculture there is not a triple bottom line, but a "quadruple bottom line", since there is also an agriculture-specific aspect of animal husbandry; animals are used for producing food, which brings in ethical considerations on how we treat our animals. In agriculture there are several conflicting goals between the four sustainability aspects. Examples of conflicts are: economic efficiency is increased by using less space for the animals which involves reduced animal welfare. Another example is that in order to promote a natural behaviour for animals deep litter bedding should be used which probably increases the emissions of ammonia. Moreover, agriculture is a complex business, it consists of biological production in an environment that is neither easy measurable

nor controllably (as compared to industrial production). Rigby and Caceres (2001) propose that agriculture can be sustainable on three levels; field, farm and society level, considering that sustainability means managed in a way that enables the system to continue its activities into the future. Following that definition, agriculture can be sustainable on field level even if the farm is not sustainable, and it is also possible that a farm can be sustainable in a non-sustainable society. Hence they conclude that it is very important to state the level of sustainability, when discussing agricultural sustainability.

There are articles presenting actual production systems and their sustainability. Sundrum (2001) presented a review of several sustainability aspects (even though he did not mention the word sustainability) in organic livestock production, as environmental protection and product quality but focused on animal welfare. In contrast to Sundrum (2001), who discussed sustainability aspect on farm level, de Wit and co-workers (1995) article approached a societal level of farm sustainability. This means that they also wanted aspects as food shortages and equity of food supply to be included in the criteria for sustainability. One feasible way of elaborating sustainability issues generally, but also within agriculture, is to use scenario methodology. Scenarios originally were used for military purposes and when the method entered the civil society it was in economy and management, an example from management literature is Schoemaker (1995). The objective of this study was to develop a method to design scenarios for future agricultural systems that can be used for different productions, as pig, milk and arable farming.

MATERIAL AND METHODS

We chose a back casting scenario approach since the purpose was to develop a method for constructing scenarios that are more sustainable than today's system, not to present different outcomes of varying policies or technologies. We were also working with a definition of sustainability as an ability to fulfil certain criteria, as described by Hansen and Jones (1996), and sustainability on farm level, according to Rigby & Caceres (2001). The core principles in the method are transparency and structure. This means that when the method has been used for constructing scenarios, all assumptions are explicit, all choices made are clear and conflicting goals are identified. A reader should be able to use the process scheme and follow the scenario construction all the way from the values used for stating the goals through the process, understanding all choices made and be able to judge how relevant the choices are. The structure in the method is important to help the people involved to think of the production system unbiased of how the system looks today.

A very important background for the development of the method is the assumption that the most efficient way of incorporating experts from different fields of agricultural research as well as authorities and business is to present concrete descriptions of scenarios on meetings. This will initiate discussions about the relevance of the choices made in designing the scenarios and possibilities to develop the scenarios based on these "expert meetings". Hence the process described below is of an iterative nature.

1. Define and describe the value base that will guide the work.
2. Define systems boundaries and describe the system.
3. Define all relevant sustainability parameters (called "focus parameters"). This is a list of parameters relevant for the studied system. In our work we mainly used the list of

"sustainability goals" defined by FOOD 21 (FOOD 21, 2004), but it is obvious that other definitions of sustainability can be used.

4. Describe all sub systems that make up the entire system.
5. Formulate "focus scenarios". A focus scenario is a scenario where the system is optimised for just one focus parameter. To formulate a scenario is to describe how all functions are solved principally and technically, e.g. describing how the animal feed is composed and delivered to the animal or what tillage methods are used. These focus scenarios are rather extreme, taking only one aspect into consideration for every sub system. The principal solution for a sub system is described, e.g. "the manure must be removed quickly from the house". This "principal concept" is then transferred to an "implementation concept" which is a technical description how the principal concept can be achieved. It is not necessary that there are technical solutions ready on the market but technical concepts that could be developed based on today's knowledge. At this stage is it not absolutely important to find the best solution, the scenarios developed here will be refined later in the process.
6. Identifying conflicting goals. Conflicting goals are solutions for a sub system that are chosen to optimise one focus parameter that will obstruct the optimisation of another goal.
7. Describe goal visions. A goal vision is a description of what sustainability aspects that are most important, as decreasing emissions, save scarce resources or working environment and animal welfare.
8. Describe goal vision scenarios. One new scenario, goal vision scenario, per goal vision is described. A goal vision scenario is a description of how the system should look if the focus parameters belonging to that goal vision are optimised.

   In earlier steps (point 5) two levels of solutions, concepts, are described, principal and implementation concepts. These two levels can be regarded as two time horizons. Principal concepts are not definite in time but can work as guides to where we should strive. The implementation concept on the other hand, is solutions that are possible to implement in a rather short time frame. Hence, by combining the principal concept we get a scenario that are more far away and by combining the implementation concept we get a scenario that are feasible in the short term. Conclusively two goal vision scenarios for each goal vision is designed, one principal and one implementation. On the latter it is possible to make rather detailed quantification regarding both economical and environmental impact, but for the former the accuracy of quantifications is lower.

   When goal vision scenarios for the first system are ready, the same procedure is applied on the next system that is part of the total production system under study. With the goal vision scenarios for the system needed ready, next part of the process begins which is to combine the goal vision scenarios.
9. Design goal vision scenarios for the total system.
10. Meeting with experts.
11. Modification of the scenarios.
12. Evaluation of the goal vision scenarios. Life Cycle Assessment combined with farm modelling was used for quantifying the environmental effects. For an economic analysis it is necessary to make assumption about agricultural policies and prices of input resources. The qualitative evaluation was based on literature review and panel discussions with groups of experts/stakeholders.

RESULTS AND DISCUSSION

The method described in this article is developed within a Swedish research project, but the approach is not limited to Swedish or even European agriculture. The stepwise method where single sustainability issues are dealt with one at a time is general for agriculture. The definition of "Goal visions" can be very different from the one relevant for Swedish agriculture but still the method works and produce the same transparency. The structured working process, describing focus scenarios for the system where just one sustainability parameter is optimised, facilitates free thinking since it allows the working group to disregard all other aspects which leaves room for new ideas. The feasibility of these new ideas will later in the process be tested and perhaps form part of a new solution in a scenario. The focus scenarios are also valuable since they facilitate "traceability" in the process; it is possible for the receiver of the results to identify the whole process from the entire scenario back to every single choice on every sub-system and function.

The main aim with developing the method described was to find a method of developing scenarios in a more transparent and structured way. Since the scenarios are both rather concrete and logically constructed, they can be very valuable when the issue of sustainable agriculture is discussed. Such scenarios, and quantified results from them, can work as platforms for discussions between different stakeholders since they provide a mutual and concrete picture of different perspectives of sustainability. The explicit descriptions of goal conflicts that is a result of the method is very useful to realise where the conflicts between different interest lies. Our method deals with two time frames, principal long term scenarios and implementation short term scenarios, but it builds on the same goal visions, i.e. sustainability goals. At the same time as concrete and detailed descriptions are needed, the method also must entail discussions on a rather high systems level; otherwise the scenarios will not fulfil the aim of presenting examples of more sustainable systems. By using the method, a wide range of systems levels, from definitions of sustainability to descriptions of housing for animals, are considered in a logical way. In Figure 1 schematic picture of the different systems level for the steps in the method is presented.

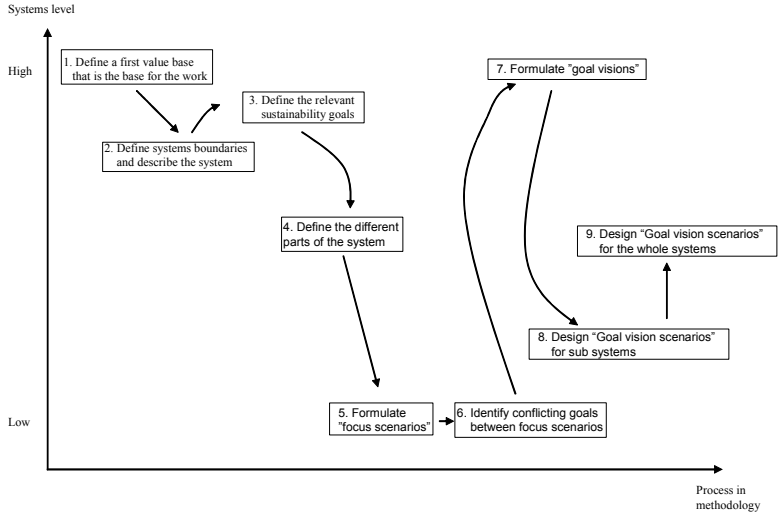

Figure 1. Schematic presentation of the different systems level considered in the steps in the methodology

The feasibility of using the method for other production systems, as industrial production, is not analysed, as it is not within the scope of this study. One very specific asset of agriculture is the strong interdependency between many parts in the system, as soil, plant, animals, technology and humans. These interrelationships makes it very difficult to analyse parts of the system alone since choices made for one part often heavily affects other parts. Another difference compared to industrial production is the large range of products delivered from the system, and where the production of each one often is connected to several others, e.g. crops in a crop rotation or animals fed with crops from the fields. There are certain limitations of the method. One limitation is that the method is used on farm level; e.g. how is milk production best performed. The matter of the sustainability of the food system as a whole is not addressed. This aspect includes what products should be produced and in what amounts. The question of where different products are best produced is also omitted. Other aspects not covered are "margin effects", i.e. what will happen if the need for arable land increases or decreases. A second disadvantage is that even if the aim is to synthesise scientific knowledge into more comprehensible pictures of more sustainable systems, there is a risk that important information can be neglected. There is no absolute methodological mechanism that guarantees the completeness of the scenarios.

The method has been tested on Swedish pig production (Stern et al., 2005), dairy production (Gunnarsson et al., 2005) and beef production (Kumm et al., 2005) and the experiences from that work are promising; the process facilitated free thinking and it was possible to manage very different system level. The latter means that both a very concrete discussion about the systems can be achieved in the same study as a more hypothetical discussion about conflicts between sustainability goals in a long time perspective. But since the actual goal of agricultural production is to deliver raw material to either the food industry or directly to consumers via retail, an analysis of the whole chain up to consumption would be an important step. A final important conclusion is that the scenario work should be performed by a team composed of persons experienced within the field of study and some type of systems analysis. It is matter of finding generalists rather than specialists, when putting together the group (Lund et al. 2006).

CONCLUSIONS

The method presented herein offers a structured way of synthesising large amount of research knowledge into something comprehensible and practically understandable that can be used as a platform for further discussions about sustainable agriculture. The resulting scenarios can be subject to external assessment of all steps in the process. The method has been used on pig production, beef production, dairy production and the production of food potatoes. It offers a structured way of synthesising large amount of research into something comprehensible and practically understandable that can be used as a platform for further discussions about sustainable agriculture.

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