SUSTAINABLE TECHNOLOGY DEVELOPMENT APPLIED TO LIVESTOCK INDUSTRY IN THE NETHERLANDS

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Abstract

Sustainable Technology Development (STD) is an approach to formulate short-term projects to contribute to systems transitions towards sustainability. The use of future visions and back casting, both in interactivity with stakeholders, are key elements in this approach. The STD guideline has been adopted in a 4-year project in the Netherlands directed towards development of societal desirable livestock systems.
The project is carried out in three phases.
Phase 1. A long-term strategic problem description was made in interaction with stakeholders. In the vision document, including a vision of a societal desirable livestock production, two main questions about future livestock farming were raised. (1) Should animal husbandry be based on co-operation between man and animal ('eliciting') or is it allowed for man to use animals for their own needs ('controlling')? (2) Should the main function of agriculture be animal production or should it serve other functions as well? Combining these main questions resulted in 4 visions of future livestock farming.
Phase 2. Starting from the visions of a societal desirable livestock production 'back casting' was used to formulate short-term projects to start now so as to achieve the above mentioned societal desirable livestock farming systems.
Phase 3. Six short-term projects are carried out (in progress)
In this paper the STD approach is presented, results obtained summarised and discussed.

Introduction

During the second half of the 20th century, agricultural development in the Netherlands, as well as in other regions, has been oriented towards increasing economic efficiency. This led to very intensive agricultural production systems. Starting in the early eighties drawbacks with respect towards environmental and ethical issues became increasingly subject of dispute. Consequently governmental policy shifted gradually from a production orientation towards a primary orientation on land use and food safety and quality. Frictions between production to achieve profit and production systems including care for other values, including the environment, landscape, nature and animal welfare became apparent. The public opinion turned even more critical towards livestock production after outbreaks of contagious animal diseases as classical swine fever in 1997 and foot and mouth disease in 2001, and BSE.
Against this back ground the project *Future livestock production systems* was started to contribute to a transition towards a sustainable and societal desirable livestock production. An interdisciplinary team of Wageningen University and Researchcenter (Wageningen UR) and partners carried out the project.
The team chose the approach of Sustainable Technology Development as the framework for approaching the task. The first step, the long-term strategic problem orientation was completed summer 2000 by publishing a vision document (Ketelaar-De Lauwere et al.,

2000a). The second step, formulation of short-term projects was carried out in the second half of 2000. At present the short-term projects are in progress.
This paper outlines how the STD approach was adopted and gives a summary of the major results obtained. Emphasis is on the first two steps.

Sustainable Technology Development (STD)

The STD approach has been developed in the STD-program in the Netherlands in the beginning of the 1990's. STD might be considered as an approach to initiate systems transitions towards sustainability. This approach was developed in a technical environment and aimed to find technological solutions contributing to an ecological sustainable future within the context of cultural and structural factors. As basis for the ecological emphasis served the following assumptions: (1) the world population will continue to show steady growth over the next 40 years (factor 2). (2) The prosperity per inhabitant of the earth will increase (factor 5) and (3) environmental pollution per unit of prosperity has to be reduced by half for a sound environment. Consequently a factor 20 reduction of environmental pollution has to be achieved (Commoner, 1974). The approach was characterised by three elements:

- long term solutions are defined to determine the short term steps to be taken;
- technological solutions (technical means and efficiency) are viewed within the context of cultural (nature and volume of needs: sufficiency) and structural (economic and institutional organisation of production: effectively) factors;
- Solutions are agreed upon in consultation and co-operation with directly and indirectly involved parties.

In further development of the STD approach the emphasis on technological solutions shifted to co-development of technological, cultural and structural solutions. Which indeed was used in our project. The approach could be summarised in again three steps

1. *Strategic problem orientation.* In the strategic problem orientation long term visions on the future play an important role. As indication of the time horizon typically two generations, about 40 years, are used.
One type of future vision could be described as the *Probable Future* or Autonomous Future. This is the future that could develop when no actions would be taken. This future can be described on the basis of present solid trends. Examples of solid trends are growth in world population, climatic change, etc. The basis of description of the Probable Future is very much desk research including extrapolation and the use of scenario's.
To obtain a common orientation and shared learning process of the members of the project team, creativity sessions, exchange of individual views and discussions with relevant experts from outside the project team were organised.
One could say that the vision of a *Desirable Future* is the description of an economic, socially and ecological sustainable future. In contrast to the Probable Future, the emphasis in making a vision of the Desirable Future is on interactivity with stakeholders. Stakeholders to be involved were based on a stakeholder analysis. Methods used included essays on a possible future as input for discussions, small workshops with up to 10 participants and in part using a Group Support System, larger workshops (up to 60 participants) and interviews.
Confronting both descriptions of the future completes the strategic problem orientation. The discrepancies between the two are formulated as long term innovation goals and serve as motivators for action.

2. Formulation short-term projects. To formulate projects aiming to solve problems over a time horizon of 40-50 years is not feasible. It would suffer from a lack of credibility because

the long-term future can not be that well predicted, and it would not connect with to day's practices. Hereto the back casting process is foreseen within the relevant context to define what a first step could be to start a development in the desired direction. Thus short-term projects (say 2-4 years) are formulated, which start from the present situation but have found their direction of development from a long-term orientation.

3.Executing and implementing the short term project. Short-term projects may differ in their objective and approach. Development of a certain key technology as well implementing a novel vertical chain could be possible. But in all projects direct involvement of shareholders as well as other stakeholders, including non governmental organisations (NGO's), and frequent communication to the relevant environment are paramount for its success.
A detailed description of the STD approach and evaluation of previous projects is given by Weaver et al. (2000).

Results: Phase 1. Developing a long term vision[1]

As time horizon for the development of long term vision 2040 was chosen. While being a study meant for the Netherlands, N-W Europe was chosen as the relevant context to be considered and where felt necessary global trends were included. The scheme of STD was closely followed by starting with a number of desk studies meant to identify major trends in the functions animals perform in our society, the developments in the relationship between man and animals and with respect to structural changes. Together these desk studies formed the basis for the Probable Future, a description of the future based on extrapolation of present trends.

Translation of future human needs to functions of animals.

STD takes basic future needs of humans (e.g. for clothing, food, water, and mobility) as starting point. However, livestock production and other use of animals can not be regarded as a basic need. In fact animals provide humans several goods and services to meet biological, social, psychological as well as meta-physical needs. Based on the survey by Aarnink et al., (2000), it is expected that food function of animals may in part be substituted by protein-products of plant or microbial origin. The use of animals for social functions (company, recreation etc.) is expected to increase.

Animal-man relationships

Exploring the future of animal-man relationships shows at one hand concern about animal welfare and naturality of production and produce and at the other hand increasing hedonism and individualism and interest in artificial solutions ("makeability"). These are both important, but opposing trends. Concern about food safety remains a major trend in animal-man relationship. *(Dagevos, 1999; Ketelaar-De Lauwere et al., 2000b)*

Structural changes

Competition for land between agriculture and various other functions, including housing, industry, infrastructure, nature and recreation becomes dominant. The production of food as a commodity is under economic pressure due to lifting national and increasing liberalism in world trade (Langeveld et al., 2000).

[1] This description refers to the vision paper of the project (Ketelaar- De Lauwere et.al., 2000a). The full vision paper is in English translation available on the web site of the project www.vsys.nl.

Scenarios for future livestock farming

Trends have tentatively been summarised in four visions or theoretical scenario's of Probable Futures, which could co-exist (Fig. 1)

Combining trends 'concern for animal welfare' or more commonly 'responsibility' and 'naturality' results in a 'natural zoo-centric' scenario. Zoo-centric is an ethical term, meaning that animals and humans (or humans and 'other' animals) are equal (Visser and Verhoog, 1999). In a natural zoo-centric scenario animal products can indeed be used, but the production has to meet stringent conditions. Animals are kept under species specific conditions and are used not only to meet the social demand for food but are also able to live a healthy and ethically justified life.

If the trends 'responsibility' and 'makability' are combined this will lead to a 'high-tech zoo-centric' scenario. In this scenario animal welfare also fulfils a central role, but animal-friendly production is achieved in a technological manner instead of in a natural manner. Animals are adapted to their surroundings, eventually through the use of genetic modification. The demand for food and income are fulfilled in combination with a justified production.

If we combine the trends 'makability' and 'increasing materialism' which also can be referred to as 'hedonism', this will lead to a 'high-tech antropo centric' scenario. Antro pocentric is an ethical term meaning that humans are 'higher' than animals and can therefore use animals for their own benefit (Visser and Verhoog, 1999). In this scenario, animal welfare is less important. The demand for cheap, tasty and safe animal products that are easy to prepare dominates the market. This requires industrial and efficient animal production. Animals are used for food production but also for processing animal and other waste.

The last scenario combines the trends 'hedonism' and 'naturality' and could be called 'natural antropo centric'. In this scenario animals are mainly used to maintain the landscape. They contribute to an environment which fulfils the human demands for recreation and relaxation. Although the function of animals as food supplier has become less important, regional animal products are still consumed.

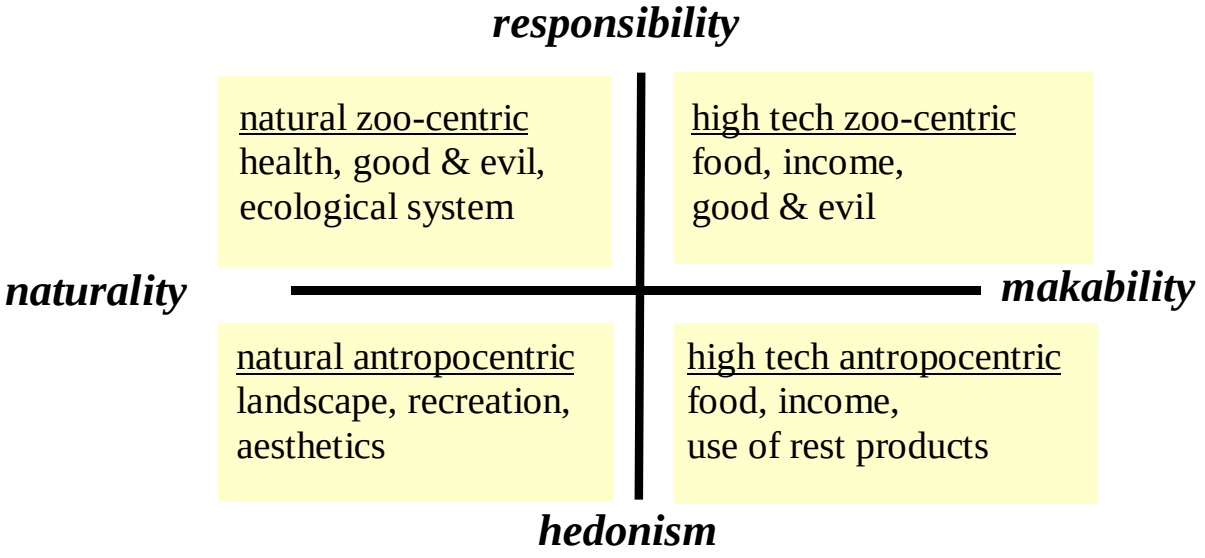

Figure 1: Four scenarios for future livestock farming systems together with their features (Ketelaar-De Lauwere et al 2000a)

Visions of desirable futures

The future scenarios presented above were determined by combining major autonomous trends in human-animal relationships, and therefore represent the future livestock farming that may come about if no actions are taken. The issue of what could be sustainable and social desirable was addressed in the next step, which was dominated by interaction with a wide variety of stakeholders. Methods included interviews with representatives of stakeholders of, small workshops (5-10 persons) with representatives of similar organisations, large workshops (50-60 persons) with a broad spectrum of stakeholders present. The above mentioned scenarios and a number of essays on possible futures written by experts (Van der Schans and Backus, 2001) were used as input for discussions in these workshops.

Of course different stakeholders have different visions on what a desirable sustainable future is. Generalised notable results were that farmers would like their (grand) sons to be farmers in more or less the same way as they farm now. NGO's in animal welfare and environmental protection express that in their view organic farming is the desirable future.

Organisations representing non-agricultural land use functions including recreation, water management and nature desire a combination of land use functions..

Overall the search for societal desirability left us with two important questions about future livestock farming. The first is whether animal husbandry should be based on co-operation between man and animal ('eliciting') or should men be allowed to use animals for their own needs ('controlling'). The second question concerns the main function of agriculture: should this be animal production or should it also serve other functions such as landscape maintenance, recreation and care for disabled persons. Combining these two questions resulted in 4 visions of societal desirable livestock farming (Figure 2).

If animal husbandry is based on 'controlling' and the main function of agriculture is animal production, future livestock farming will be like the livestock farming of today; the major challenge that we are faced with is to meet the social demands that are made in this context. Problems concerning animal welfare, environmental pollution and food safety will be solved by high tech solutions. Animals are adapted to their surroundings by natural breeding or genetic modification; the quality of animal products will be industrial in order to guarantee food safety; and the production will meet the consumer's demands. Information and communication technology will be used to a large extent.

If animal husbandry is based on 'eliciting' and the main function of agriculture is animal production, then future livestock farming will be much like the organic animal husbandry of today. To decrease the public concern about present livestock farming measures will be taken to recover the ecological balance, increase the animal's natural defence mechanisms by keeping them under more natural circumstances and adapt housing systems to the animal's specific needs. Consumers' risk perception will change and it will be commonly accepted that animal products can not be of industrial quality.

If animal husbandry is based on 'controlling' or 'eliciting' and agriculture is multifunctional, the emphasis will be on combining the various functions of livestock farming. If 'controlling' is the basis, future livestock farming will fulfil functions as landscape maintenance and recreation; food production will be mainly for the production of local products.

If 'eliciting' is the basis, other functions will arise such as education, religion and care for disabled persons; empathy towards the animal as 'fellow-creature' will be the key word in this vision.

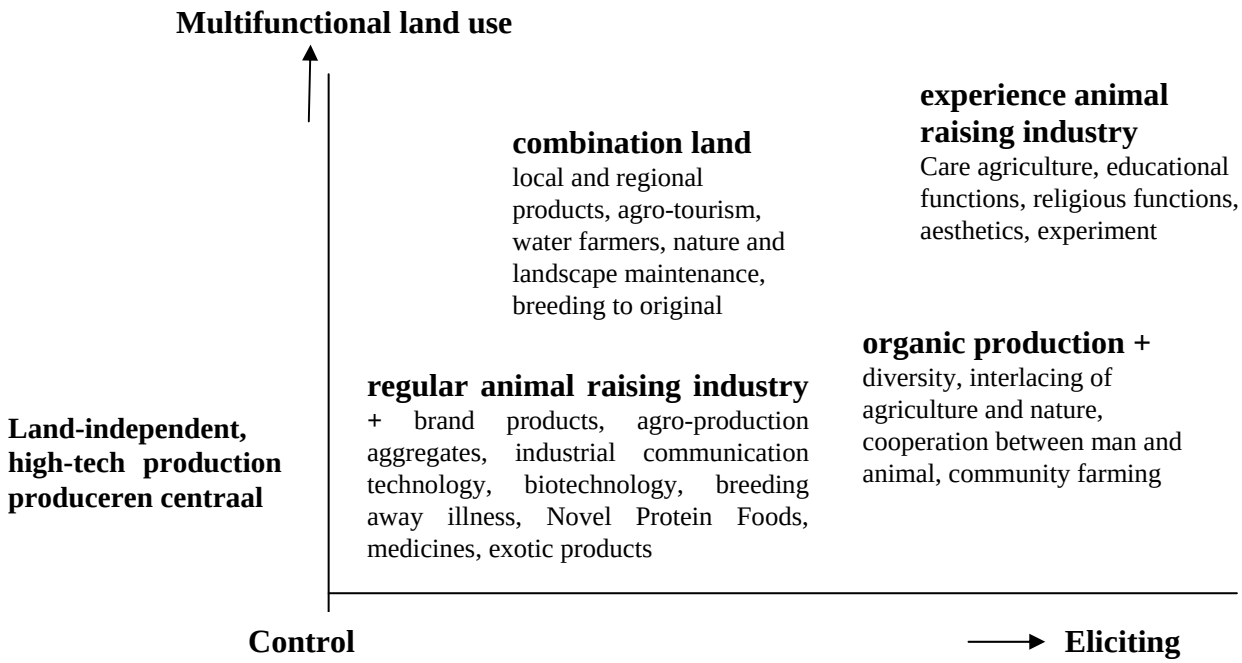

Figure 2: Four visions of societal desirable animal industry (from Ketelaar-De Lauwere et al., 2000a)

Confrontation

There is clearly a discrepancy between possible future views; the scenarios described in Figure 1, and the visions of societal desirable livestock farming systems (Figure 2). Autonomous trends will not make the desirable future happen. If we look at the visions of desirable futures in light of current, autonomous developments several obstacles and dilemmas appear. Some of these are summarised below. Systems should provide improved animal welfare. But how are the development of free-range systems with outflow, group housing systems, and restrictions regarding preventive use of medicine to combine with more strict demands for food quality and safety?

We are therefore faced with the challenge of realising a system that accommodates the animal's well being while at the same time achieving maximum control. New societal desires with respect to environmental protection will ask for new systems of animal housing. Already the houses of today do not meet the requirements set by society, while economically speaking they are not yet written-down. It seems impossible to invest in new housing for every new requirement. The farmers would get into financial difficulties. Many farmers are over fifty years old; succession is increasingly constrained by increased land prices and high societal demands to operation.. In addition long and often unhealthy working conditions and the lack of traditional successors paves the way for new organisational forms of agricultural operations. Today's Dutch livestock industry has acquired a strong export position. Increasing liberalisation of trade invites to produce more for a lower cost price. However this does not stroke with the societal demands. The answer should, therefore, not be sought in boosting of bulk production.

In the Netherlands, being densely populated and wealthy, animal production competes for space with other functions as infrastructure, dwelling, nature and recreation. How fits animal production in, with at one hand the economical urge to produce more efficient by increasing scale and at the other hand the option to focus on local forms of multifunctional land and use?

Obstacles and dilemmas have been reformulated in 6 long term innovation goals meant to serve as starting point for back casting to formulate short term projects:

1. transparency in the production chain;
2. reduction of the environmental impact by a factor 20;
3. increase animal welfare and food safety;
4. food production with added value;
5. Novel animal products and services.
6. gear livestock systems to animal keepers

Phase 2. Formulation of short term projects

Having formulated the long-term visions and long term innovation goals the next step was to formulate short-term projects contributing to a socially desirable animal husbandry.
Ideally such a project would be formulated in a given context of lower integration level by again formulating a long term vision of a desirable future followed by back casting to short term projects. Or, alternatively, translating the long-term innovation goals to long term innovation goals for the specific context and back casting to short term projects. The approach followed was exactly this. The vision report was made public in a press conference and attention drawn to it by sending it to key persons and by sending an attention e-mail to all persons that had somehow been involved in the project. Simultaneously, an appeal was send out in which parties of industry and NGO's were invited to show their interest in formulating under guidance of the research group short term projects. Projects to be selected by an independent selection committee were offered substantial research capacity of Wageningen UR to support their short-term project. In total 33 project ideas were submitted and 6 projects selected which each received support .

Phase 3. Execution of short term projects

Six short-term projects were initiated and are presently in progress. Apart from having been formulated within the framework of this project, the short-term projects have in common that they are carried out in co-operation between industry and NGO's and supported by research organisations. Project management consists typically of the leading stakeholder, leading scientist and a process manager. Part of each project is that progress is regularly communicated in a broader context (Table 1).

Table 1: Overview of short term projects in progress.

Project title	Main focus
Concepts for animal housing	Societal acceptance of pig housing using advanced technology to reduce emissions and to improve animal welfare.
Family farm for pigs	Design and partial implementation of the concept of a family farm for pigs as an integral part of a regional (organic) vertical chain.
Short chain broiler production.	Implementation of animal welfare broiler chain based on no transportation and slowly growing breeds.
Bio centric design of animal production.	Design of management, housing and genetic features of pigs and broilers from a bio-centric perspective.
Institutional strategies	Farmers institutions in search for ways to support their members with strategies to bridge the gap between farmer and consumer
Animal use in human care	Improving and dissemination of knowledge about chances and risks for patients and animals when animals are used in various therapies.

Discussion

Methodology

The STD-approach has been developed very much in a technical context focusing on developing new technologies for satisfying future basic needs of man in a sustainable way.
Earlier projects focused on production of food, on mobility, on water supply and other basic needs. A project on sustainable land use was the first major project having an agricultural focus (Weaver et al., 2000).
In our project on future livestock production systems, we deviated from the principle of addressing (a function satisfying) basic human needs. Livestock production, here interpreted as any type of use of animals by man, is more comparable to a resource connected with various technologies than with a need. The "Function analysis" of animals performed was executed to connect possible functions of animals to future needs of man. In hindsight this was a useful action because it drew attention to the non-food functions of animals and thus widened the view of participants. The original object of STD is to develop technological solutions oriented to long term future problems in meeting basic needs of the human population in a sustainable way. In the case of intensive livestock production environmental drawbacks could be a reason enough to start such a project. However, in this case even more important seems the lack of cultural/societal support. Animal welfare and confidence in safety of animal produce have in the last decades become major points of criticism in the Netherlands and other countries. This cultural focus distinguishes this project also from earlier STD projects. Not withstanding these deviations from earlier practices the STD-approach was found functional in creating a common understanding within the research team and also in communication with stakeholders.

Process

The team of 8 researchers involved in the first phase were mainly scientific specialist working in mono disciplinary groups in three different zoo-technical and one agricultural economic research institutes. They had no or little experience in trans disciplinary research. As this was foreseen, the project team received guidance of the STD as part of their learning by doing scheme and in addition a process manager was added to the group.
A main difficulty to be overcome in the first phase was the inward orientations of the of the project team members towards one's own disciplines and institutes. Interviewing stakeholders and a supporting training in interview techniques helped to shift the orientation.
In the second phase, the number of participants in executing the projects increased and again more researchers got involved with no experience in this type of research. Insight in basic principles of trans-disciplinary research was offered by a 5-day course. Further obtaining confidence of the disciplinary home research group appeared a prerequisite for the individuals for their loyalty to the project. In hindsight the guided tender functioned well to identify contexts for short-term projects. It prevented researchers to a large extent from formulating projects from their own research view. Formulating the short-term projects had to be done under time pressure because of a rigid annual cycle of planing. Largely due to this time constraint insufficient attention has been paid towards formulating long term visions for the special contexts and to the process of back casting to formulate the short-term projects. The decision of the board judging the project ideas to force several project-ideas to be fused and reformulated into one, may have been correct from the point of view of broadening support of the projects and potentially overcoming more conflicting interests. However, the project teams had great difficulty in realising this, thus reminiscences of original project ideas remained in the projects and hampered both focus and progress.

In executing the short term projects involved partners tend to stress their short term interests which could lead to deviations of the long term goals. It is considered the task of the process manager of the short term projects to signal such deviations. On the level of the overall project regular meetings are organised with the project management of all projects to evaluate progress. In addition the steering committee appointed by the commissioner periodically evaluates the project and gives stringent directions coupled to continuation of funding..

Impact

The vision document
With the short-term projects still in progress, it is too early to evaluate the impact of the project. Nevertheless some preliminary observations can be made. On the level of "national debate" on the future of animal production the vision document (Ketelaar- De Lauwere et al., 2000a) has become accepted as a report giving an overview of the dilemmas and directions of development. This can be substantiated by references made in the press and by the adoption of its contents in later documents including a vision of the Dutch Animal Welfare Organisation (Dobbe, 2001) and official advise to the minister of agriculture (Anonymous, 2001). Also within the research organisation the project receives credits, but more for contributing to developing experiences in interdisciplinary and trans disciplinary research.

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