9
Researching Farmers Possibilities and Motivation for Including Environmental Aspects in their Management

Niels Halberg

Introduction

The more than ten year old focus on the negative impact from intensive farming on the environment in Denmark challenges the agricultural sector as a whole and the individual farms in particular. Public pressure to strengthen the regulation of the farmers' use of inputs threatens to raise costs and bind the individual farmer by detailed rules for crop rotation, fertiliser strategy etc. At the same time, there is evidence that this type of general regulation is not sufficient to reduce the environmental impact compared with overall goals (for instance, the goal of reducing nitrate leaching and pesticide use by 50% before 1997 has failed). This has lead to increased pressure to use economic regulation (nitrogen taxes etc.) which the farmers' unions have been able to avoid so far (except for a very small pesticide tax). Also, authorities increasingly try to protect groundwater in zones of special interest as drinking water reservoirs by severely limiting agricultural production or even by expropriating farmland for reforestation projects. Moreover, new issues concerning for instance, landscape aesthetics and biodiversity are even more complicated to regulate using only nation-wide legislation and economic incentives. For these reasons, both farmers and authorities have interests in finding ways to stimulate the inclusion of environmental aspects in the local development of agricultural systems in different parts of the country.

Based on this background, this paper will

- present results from the co-operation over a four year period (1993-97) with 20 private conventional and organic livestock farms concerning the development of an ethical accounting system. The approach will be described and the farmers' reactions discussed. Examples of indicators used and the variation of indicator values between the farms and years will be presented.
- present a new project using the decision aid in co-operation with 30 neighbouring farmers in a small region with potential conflicts concerning drinking water quality. The ideas behind this project will be presented to facilitate a discussion of the possibilities for creating bottom-up solutions to important environmental goals in society.

The Ethical Accounting for a Livestock Farm: A New Decision Aid for Farm Families

As a response to the increasing demand from society for agriculture to minimise the negative impacts on environment and landscape values, the Danish farmers unions have defined the goals for so-called good agricultural practice in the next century (Good farming practice in

the year 2000, Anonymous 1996). These goals include aspects such as reducing loss of nutrients and pesticides to the surroundings, reducing energy use, minimising the need for pesticides by implementing resistant varieties and good crop rotations, and contributing to a high biodiversity and a good landscape and creating good working conditions etc. It is, however, not easy for the individual farm family to know to what extent they want to pursue the different goals, to know how close their farm is to these goals, and to appraise the development of the farm's results.

Therefore, there is a need for a decision aid to help the farm family reflect on these goals in light of the current practices on their farm and the possibilities for improvement.Based on this, The Danish Institute of Agricultural Sciences has developed an „ethical accounting system" for livestock farms in a multidisciplinary project comprising agronomists, animal scientists, veterinarians, social scientists, professional philosophers and a group of farmers (Jensen & Sørensen, 1997). The overall idea was that it would be beneficial for the farm family and for the farm as an enterprise to reflect on the farm's impact on relevant interests of different stakeholders (Pruzan & Thyssen, 1990). From a system's point of view this argument can be described as the farm manager's need to reflect on his current management in light of changes in the perception of farming in the outside world (Kristensen & Halberg, 1997). The stakeholders were defined broadly as present and future generations of people, the farm animals and the farm family (Jensen & Sørensen, 1997). The ethical accounting consists of several components with the overall aim to facilitate a learning process for the farm family:

- Group dialogues between farmers with the aim of helping each family to clarify their own values in light of the ethical conflicts in agriculture and letting the family formulate farm specific personal goals to be included in the account .
- A yearly account for each farm including indicators of resource use, environmental impact, product quality and animal welfare besides the traditional technical-economic results.
- A multi-objective strategic planning process with the aim of finding farm specific limits and possibilities for alleviating the conflicting goals.

This paper will focus on the last two elements. The indicators for animal welfare are described by Sandøe et al. (1997) and will not be discussed here. Product quality was only described by preliminary indicators like milk and meat classification, use of medicine and salmonella status. The indicators of resource use and potential environmental impact will be described in the following as an example of the process.

Indicators of Resource Use and Environmental Impact

The selection of environmental and resource use indicators for the ethical accounting was based on an analysis of the effects of Danish livestock farms on relevant interests of present and future generations (Halberg, 1997). These effects might be classified into

- the use of non renewable resources (fossil energy, phosphorus),
- impact on the farm's natural basis for production (the soil),
- impact on the surrounding environment, i.e. the conditions under (groundwater), over (atmosphere) and around (marine environment, wildlife) the farm, respectively.

Since the indicators are to be used by farmers, they have been chosen in order to fulfil certain requirements. They should thus

- describe and operationalise relevant aspects of farm resource use or environmental impact,
- make sense to farmers and preferably also to non-farmers,
- be calculated, measured or registered by farmers together with local advisors at a reasonable cost,
- be sensitive to changed management practice (i.e. farmers should be able to influence the indicator levels),
- (preferably) be suitable for use in multiple objective decision making.

As many Danish livestock farmers already use continuous monitoring of production results as a basis for their management, some indicators are based on calculations of the flows of energy and nutrients. Even though this approach requires rather large data handling compared with other methods (like qualitative indicators) it has been chosen because of the expected benefit of being able to predict the consequences of alternative plans on a given farm with simulation models.

Table 1 gives a list of selected indicators and examples of results from the accounts of 15 mixed dairy farms in the second year of the project (May 1995 - April 1996). For the greater part of the indicators there was a variation between farms that could be explained to a large extent by differences in management. The use of fossil energy calculated after Refsgaard et al. (1997) varied due to the level of fertiliser and concentrates used and was especially high on farms where cows were kept indoors all year round instead of being grazed (for instance No. 13).

The surplus of phosphorus, a limited resource, varied between 0 and 28 kg per ha reflecting apart from stocking rates also the feeding and fertilising strategies of the farmers. With 2/3 of the land used for agriculture, the wild flora and fauna in Denmark is very dependent on the farming practices on the agricultural land as well as on the extent and quality of the small uncultivated biotopes between the fields (McLaughlin & Mineau, 1995; Prip et al., 1995). The percentage of weeds left in grain crops after heading is important not only for the population of weed species but also for the amount and biodiversity of insects and birds (Reddersen, 1997). The percentage of small biotopes (uncultivated area) is interesting because biotopes contribute to biodiversity and to landscape aesthetics. Again, there was again a large variation between farms, a variation that could stimulate each family to reflect on the means and ends of their cultivation practice and intensity.

The variation between farms was most often larger than the variation between years on a single farm. Also, most of the differences between years on each farm could be explained by changed management practice. As an example, figure 1 shows the farm gate nitrogen surplus per ha (Halberg et al., 1995) over three years on all 20 farms. Farm No. 11, thus, had significantly higher N-surplus in the year 1995-96 than farms Nos 13 and 14, even though they all had comparable stocking rates (1.1, 1.3 and 1.3 Livestock units per ha respectively). This was caused by a combination of a crop rotation dominated by grass/clover and a mixture of barley and peas for whole crop silage (high biological N-fixation) and a resulting high-protein diet for the cows. The other two farms used fodderbeets and a more balanced feed

ration. In 1996-97 the N-surplus on farm No. 11 was reduced, primarily due to a reduced input of fertiliser and lower N-fixation in the barley/peas mixture caused by a failed establishment of peas (only 7% ground cover in June 1996 compared with 52% in 1995).

Table 1. Selected indicators and examples from the ethical accounts 1995-96

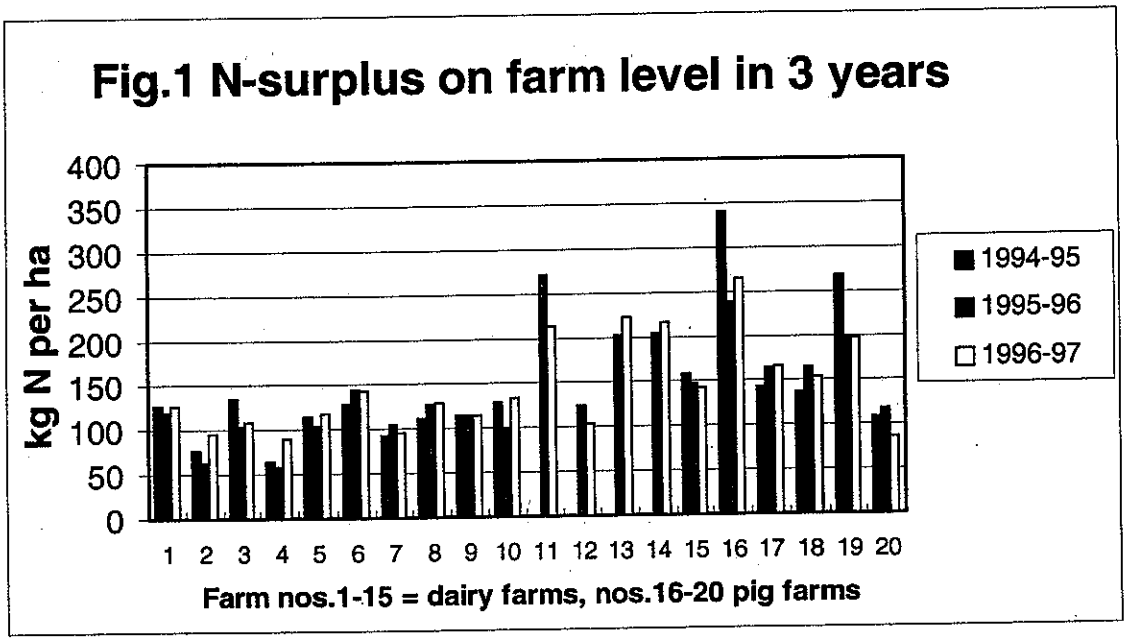
			15 dairy farms*		
Farm No.	8	13	Average	min	max
Hectares	155	107	92	50	155
Cows	141	91**	75	38	141
MJ per kg milk	2,3	3,5	3,0	2,1	3,9
N-surplus, kg per ha	103	204	132	58	272
P-surplus, kg per ha	5	19	11	0	28
Pesticides, Avr. No. std. treatments	0	0,8	0,5	0,0	3,0
Pesticides, % untreated area	100	48	78	24,0	100,0
% weeds in small grain	18	1	4	0,0	17,5
% small biotopes	4	5	4	0,0	9,5
% cows with: - leg disorders	12	30		0	33
- physical injuries to the hogs	17	8		2	40

* 10 organic and 5 conventional farms ** plus 1874 pigs/year

On the five pig-farms also the surplus of Cu and Zn was calculated due to the risk of concentration of those heavy metals with possible detrimental effects on different organisms in and on the soil (Bååth, 1989; Huysman et al. 1994). The surplus of Cu varied between 0.2 and 1.2 kg per ha on the farms due to different amounts of Cu used in the feed as a growth promoter.

When registration and calculation of indicators are made as part of the existing advisory services (fodder planning, milk control schemes etc.) and farm bookkeeping/accounting systems, the extra time consumed for the estimation of the figures of resource use and environmental impact was estimated to 6-7 hours per year. The single most time consuming task was the registration of the small biotopes and the clover contents in the grass fields. By including values for the nutrient content of inputs and products in the computer based bookkeeping systems the calculation of nutrient balances could be made relatively efficient.

The indicators of animal welfare were more time consuming and more research is needed to make a selection of a few central indicators possible.



The Farmers' Reactions to the Indicators

An independent evaluation of the farmers' reaction to the elements of the ethical accounting (Michelsen, 1995; Michelsen & Al Seadi, 1996) has shown that the indicators of resource use and environmental impact generally made sense to the farmers and that the calculation methods were understood. Several farmers also found that the aggregation of otherwise scattered information into a coherent evaluation ("whole-farm-oriented") was a positive quality of the ethical accounts. Moreover, the hypothesis that farmers would benefit from facing the farm's consequences for other parties and from reflecting on their possibilities for changing their practice was confirmed during the interviews.

Experiences from the presentation of the accounts to the farm families indicate different ways to use the ethical accounts. While some families (for example farm Nos 8 and 13 in table 1) reflected on the results and on how to improve in one or several aspects, a few farmers (for instance the organic farms Nos 4 and 5) felt no need to change their management (but they were happy with the documentation which they got via the account). Thus, not all farmers intended to use the ethical accounting to reconsider their ideals and goals in the light of present results, for they find that they are already doing what they can. Some organic farmers, for instance, find that they are ahead compared with conventional farms. Others have involved themselves in a search for solutions to cut down energy use or fodder import.

A general result was that many farmers were willing to include aspects of resource use and environmental impact in the management of their production if they could see the point in it (i.e. believe in the effect) and if they knew of feasible possibilities for a changed practice. This points to two aspects that will be described in the following: The need to combine the

yearly accounting and budgeting with a long term perspective and the problems of interpretation of the individual farms' results.

Strategic Planning Using the Ethical Accounting

Via the group dialogues and the first two accounts, the families began to clarify their own values and objectives in relation to the dimensions of animal welfare and environmental impact etc. However, for two reasons there was a need to include a more formalised strategic planning process in the concept of ethical accounting:

- The changes needed to accommodate some of the problems pointed out in the accounts would only be possible in the long run, for instance because of the investments needed.
- Because of the many new aspects of farming that were operationalised on the farms the families needed information regarding their possible alternatives to be able to decide if they should change practices and, in the affirmative, how.

Thus, to facilitate the family's reflection on how to weigh their different goals, they were invited to participate in an interative multi objective planning procedure based on ideas from Multi Criteria Decision Making (MCDM) (see Romero & Rehmann, 1989). However, since the farmers could not be expected to have clear goals and preferences concerning the extra dimensions of animal welfare and environmental impact, a procedure was set up allowing the participating families to clarify and change their goals and preferences when confronted with the predicted consequences of alternative plans (Bogetoft & Pruzan, 1991). The procedure was as follows:

- Each of the 14 interested families formulated ideas for a change of their current practices either in the form of goals they wanted to pursue or in the form of alternative production plans following the distinctions between a so-called „Prior Articulation of Preferences" method or a „Prior Articulation of Alternatives" method (Bogetoft & Pruzan, 1991).
- The consequences of each alternative plan for the different dimensions were described by the researchers (mimicking the situation of an advisor) using predicted values for the indicators used in the ethical accounting. For example, the production and nutrient surplus resulting from alternative crop rotation and feeding plans on the dairy farms were predicted using the model SAMSPIL (Hansen & Kristensen, 1996). Energy use was predicted with a model using the principles explained in Refsgaard et al. (1997). Some consequences, especially regarding animal welfare, could only be predicted in terms of the direction of change (i.e. plan Y results in fewer cows with leg disorders compared with plan X).
- The alternative plans and their predicted consequences were then discussed with the family who were asked to give priority to some of the plans or to give weight to or to set goals for some of the indicators. With this type of information on the family's preferences the researchers reformulated alternative plans before returning to the family for a second and third time (this time most often per telephone). In each round some plans were given up and the direction in which to search for interesting solutions became clearer. The farm family decided when to stop the search. Thus, no mathematical modelling of the farmers' preferences was attempted and the search for optimal solutions used the farmers indications as to the direction in which the plans should be changed and the relative importance of the different criteria.

The process started with a workshop for all farmers, in which the most frequent problems were discussed and suggestions for their solution were presented by the researchers. This way drastic changes could be evaluated on typical farms (selected among the participants) in order to allow each family to eliminate some of the solutions in an easy way.

As an example of the planning process, farm No. 13 that had many cows with leg disorders (table 1) decided to investigate the possibilities for alleviating this welfare problem. The aching hoofs were caused by an old slatted floor and the degree of the problem was not atypical among dairy herds in this type of cowhouse. Different solutions were considered among which were the establishment of deep litter straw bedding and letting the cows graze in the summer. Both changes were expected to reduce the number of cows with leg disorders, though a combination of the two would be most effective according to the veterinarian. The consequences for the economy, energy use, nitrogen surplus and pesticide use of the two suggestions alone and in combination were predicted.

With the plans for the new stable, the N-surplus would increase (up to 25 kg N per ha) due to the lower utilisation of nitrogen from composted manure compared with slurry and the energy use would increase due to the import and handling of large amounts of straw. Thus, there was a conflict between animal welfare and environmental consideration that had been described only because of the co-operation between different experts (advisors). However, from the discussion with the family it appeared that their working conditions played a major role in their judgement as did the possibilities of securing the cows a homogenous diet throughout the season. For several reasons the deep litter straw bedding system was thus rejected. The farmer decided to start letting the cows graze again but requested plans in which the grazing area and period were reduced compared with the first suggestion. This was developed and sent to the family who, stopped the process thereafter.

Of the 20 farmers co-operating in the project, 14 families decided to participate in the strategic planning process, the rest finding themselves in no position to consider the long term development of their farm. An average of 5-6 farm specific plans were presented to each family beginning with the family's choice of aspects on which to focus. On all of the 11 dairy farms changes of the stables were considered to improve animal welfare. Moreover, most families requested suggestions for the reduction of energy use or other types of negative environmental impact, including the possibilities for a conversion to organic farming.

The process proved promising and gave fruitful insight into the potential for including very different goals in the long term management of dairy farms in a rational and conscious way. It should thus be seen as a supplement to other concepts of strategic planning (Jensen et al., 1993). However though not new, the interactive MCDM methods are still under development and not free of problems. The most important difficulties using the PAP and PAA methods detected here were:

- reducing the included dimensions to an acceptable number of indicators corresponding to the family's criteria,
- getting the farmers to assign precise weights or trade-offs to their different criteria in terms of the size of the indicator values,

- combining quantitative and qualitative information in the search for the best solutions (for some indicators it was not possible to predict more than the direction of change in the alternative plans, like "reduced percentage of cows with leg disorders"),
- the lack of one coherent model, capable of predicting all or most of the indicators values, and thus facilitating a computerised search for optimal solutions.

However, most of these problems are connected to the characteristics of real world decision situations that might not be easily changed. Thus, the most important outcome of the planning process might be the increased knowledge achieved by the participants from the learning process, and not the actual plan chosen in the end. This is especially so because of the rapidly changing conditions that the farmers are facing, making it necessary continuously to adjust most plans. A final conclusion on the feasibility of the process awaits an independent evaluation concerning the farmers' view of their outcome.

Problems with the Interpretation of Results on the Individual Farm

The indicators were chosen to describe the (potential) impact of the farm on the different interests of stakeholders defined from a philosophical (i.e. consequentialistic) point of view (Jensen & Sørensen, 1997). Thus, the normative assumptions behind each indicator were debated with the farmers in groups and during personal visits to the farm, but the ethical accounting does not claim any objectively correct balance of the conflicting interests, and statements concerning the correct level of indicator values are not offered. This leaves, however, the farmer with the difficult task of interpreting the account figures and the question with what to compare his results. What would, for instance, be a reasonable level of nitrogen loss from my farm and what significance will it have for the interests/environment, if I reduce my N-loss by 25 kg N per ha?

There are several possibilities for comparing and evaluating the individual farm results:

- comparison with formulated target values and goals,
- comparison with other farms (average, the best 10% or critical cases),
- comparison with own results from previous years.

Since many of the indicators are new, a large amount of data set up to compare oneself with does not exist yet, but the farmers found it stimulating to use the variation within the 20 farms included in this project. During the presentation of the second and third account, reference was often made to the previous year. When there were changes, a discussion of possible reasons gave fruitful insight to both farmers and researchers. Due to the demands of the farmers, an interpretation in prose of their results (indicator levels) was given in the third version of the accounts. As an example, the account for farm No. 9 included this comment: *The P-surplus is reduced by 40 % primarily because of reduced input of minerals to the cows. P-surplus and P-efficiency are now at a medium level.* In the future, as data from more farms become available, econometric analyses of resource use efficiency (Reinhard & Thijssen, 1996; Lund & Ørum, 1996) might give useful target values.

There are several ways of interpretation and several possible reference targets relating to different types of indicators. Using only qualitative indicators for instance *„the manure is supplied to the crops according to a fertilising plan for the farm"* the reference would be guidelines for good agricultural practice. This might give some farmers a preliminary

appraisal. Later, though, the farmer would have difficulties in evaluating changes from year to year. In the ethical accounting quantitative indicators of the results of the farming practice were chosen when possible. For a discussion of different types of indicators used for environmental appraisal of farms and their possible interpretation see Halberg (1997).

From Farm Level to Micro Region Farm Level to Micro Region/ Water Catchment

Experiences with the ethical accounting suggests a potential for stimulating farmers to include environmental consideration in their management. However, many aspects of a farm's environmental impact can only be evaluated in relation to locally defined goals for landscape and environment and in relation to the conditions on the neighbouring farms. Likewise, important environmental and landscape values can only be furthered if several farmers in a small region change production methods in the same direction.

The evaluation of the possibilities for development of a small region must, therefore, be based on the understanding of the farmer's motivation for a participation in a co-ordinated implementation of some of the goals for good agricultural practice. This was also shown in an evaluation of the attempts of establishing green corridors in two Danish counties (Just et al., 1996). Personal contact and public plans adjusted to local farmers' interests thus proves to be better than a simple introduction of general economic incentives to introduce environmentally friendly production methods (Wiborg, 1997). Röling (1994) suggests the creation of local platforms for dialogue and experiences from different European projects suggests that the creation of a common understanding of problems and possible solutions among stakeholders in an area is a prerequisite for fruitful development (Deffontaines et al., 1993; Hubert et al., 1993; Ploeg & Long, 1994).

To research this potential for profiting from local resources, when defining environmental problems of agriculture, and finding possible solutions, a project has been started in a small area with 30 neighbouring farms. The area is situated in a region with important interests in drinking water and a traditional landscape undergoing changes. The work will use experiences from the ethical accounting including the group dialogues and the combination of natural and social science.

The main research topics are

- to develop farming systems that are economically viable and environmentally friendly in terms of locally defined goals,
- to study different types of farmers' motivation for including local goals for landscape and environment in their management
- to find ways to create a platform for dialogues between different stakeholders in the area, i.e. intensive farmers, part time farmers, local authorities etc.
- to research the importance of farmers' networking for the implementation of environmentally sound agricultural systems.

It is our hope that this project will give two types of results:

- Development and demonstration of environmentally improved farming systems on private farms,

- Knowledge on the possible potential in a bottom-up process for the "effective management of a change in the rural environment".

References

Anonymous 1996: Godt landmandskab år 2000. De danske Landboforeninger, Dansk Familielandbrug. Landbrugets Rådgivningscenter, Skejby.46 pp.

Bogetoft, P. & P. Pruzan, 1991: Planning With Multiple Crireria - Investigation, Communication, Choice. North-Holland, Amsterdam. 368 pp.

Bååth, E. (1989): Effects of heavy metals on soil microbial processes and populations (a review). Water, Air and Soil Pollution (47) 335-379.

Deffontaines, J.P., M. Benoit, J. Brossier, E. Ghia, F. Gras & M. Roux (eds), 1993: Agriculture et Qualité des Eaux. Diagnostic et propositions pour un périmetre de protection. INRA, URSAD Versailles-Dijon-Mirecourt. 334 pp.

Halberg, N., Kristensen, E. Steen & Kristensen, I. Sillebak 1995. Nitrogen turnover on organic and conventional mixed farms. J. Agric. Env. Ethics. 8. 30-51.

Halberg, N. (1997): Farm level evaluation of resource use and environmental impact. In: Isaart, J. & J.J. Llerena (eds): Proceedings of the 3th ENOF Workshop, "Resource Use in Organic Farming", Ancona.

Hansen, J.P. & I. Sillebak Kristensen (1996): Needs, development and experiences with an interactive tool for planning of manure allocation and feed supply on organic dairy farms. Paper presented at the Camase/PE workshop „Rotation models for ecological farming", Wageningen.

Hubert, B.; E. Rigolot; T. Turlan, & N. Couix (1993): Forest Fire Prevention in the Mediterranean Region - New approaches to agriculture-environment relations. In: Systems studies in agriculture and rural development. Ed: Brossier, J.; L. de Bonneval & E. Landais. INRA, Paris. pp 63-86.

Huysman, F., W. Verstraete & P.C. Bruce (1994): Effect of manuring practices and increased copper concentrations on soil microbial populations. Soil biol. Biochem. (26) 103-110.

Jensen, C.; J. Mogensen; G. Sigaard & J. O. Thøgersen (1993): Action Research in Strategic Whole Farm Planning. Paper for the 11th European Seminar on Extension Education, Århus, Denmark 29th August to 3rd of September 1993. 20 pp.

Jensen, K.K. & Sørensen, J.J. 1997. The idea of an ethical account for livestock farms (submitted).

Just, F; E. Noe og L.A. Rasmussen (1996): Korridorer i landskabet - En evaluering af Miljøministeriets Eksempelprojekt nr. 7. South Jutland University Center.

Kristensen, E.Steen & N. Halberg (1997): A systems approach for assessing sustainability in livestock farms. In: Sørensen, J. Tind et al. (Eds): Proceedings of the 4th International Livestock Farming Systems Symposium, More than food production. Foulum, 1996.

Lund, M. & Ørum, P.B. 1996. Effektivitetsanalyser for landbrugsbedriften - beskrivelse af sammenligningstal (Efficiency analyses for farms). SJFI-rapport nr. 88. Pp 99.

McLaughlin, A. & Mineau, P. 1995. The impact of agricultural practices on biodiversity. Agriculture, Ecosystems And Environment (55). 210-212.

Michelsen, J. 1995. 1. evaluering af etisk regnskab for husdyrbrug (1st evaluation of the ethical accounting for a livestock farm). Working paper, South Jutland University Center. Pp 20.

Michelsen, J. & Seadi, T.A. 1996. 2. evaluering af etisk regnskab for husdyrbrug (2nd evaluation of the ethical accounting for a livestock farm). Working paper, South Jutland University Center. Pp 25.

Prip, C., Wing, P. & Jørgensen, H. 1995. Biologisk mangfoldighed i Danmark - status og strategi. Miljø- og Energiministeriet, Skov- og Naturstyrelsen. Pp 200.

Reddersen, J. 1997. The arthropod fauna of organic versus conventional cereal fields in Denmark. Biological Agriculture and Horticulture. In press

Refsgaard, K., N. Halberg & E. S. Kristensen 1998: Energy utilization in crop and dairy production in organic and conventional livestock prduction systems. Agricultural Systems. Accepted.

Reinhard, S. & Thijsen, G. 1996. Econometric measurement of technical and environmental efficiency of Dutch dairy farms. Paper presented at „Georgia Productivity Workshop, Athens, Georgia. Nov. 1996.

Romero, C. & T. Rehman (1989): Multiple Criteria Analysis for Agricultural Decisions. Elsevier. 256 pp.

Röling, N., 1994: Platforms for Decision-making about Ecosystems. In: The Future of land: Mobilising and Integrating Knowledge for Land Use Options. Eds.: L.O. Fresco, L. Stroosnijder, J. Bourma & H. van Keulen. John Wiley & Sons Ltd. p. 385-393.

Ploeg, J.D. van & A. Long (eds), 1994: Born from Within - Practice and Perspectives of Endogenous Rural development. Van Gorcum, Assen, The Netherlands. 298 pp.

Pruzan, P. & O. Thyssen (1990): Conflict and consensus: Ethics as a shared value horizon for strategic planning. Human Systems and Management (9) 135-151.

Sandøe, P., L. Munksgaard, N.P. Bådsgård & K. Hjelholdt (1997): How to manage the management factor, -assessing animal welfare at the farm level. In: Sørensen, J. Tind et al. (Eds): Proceedings of the 4th International Livestock Farming Systems Symposium, More than food production. Foulum, 1996.

Wiborg, I.A. (1997): The lack of success of the accompanying measures in Denmark. Proceedings from NJF-seminar on Alternative Use of Agricultural land, Foulum. 57-65.