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Designing Sustainable Agro-Ecological Systems
- Summary Report -

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Abstract

The design of sustainable agro-ecological systems is a great challenge for the researchers being able to a) design sustainable agro-ecological systems, b) develop methods for measuring and assessing sustainable systems, c) formulate incentives and means for changing the behaviour of farmers and determine the effects of these, and d) stimulate a sustainable development by means of farming system research (FSR), including systemic modelling. These important issues are reported in a dense form so that the consequences of moving from conventional farming to integrated farming or organic/ecological farming can be evaluated.

Background

The introduction to workshop 1 of the Second European Symposium on Rural and Farming Systems Research states: “Part of FSR has always been the design, in actual practice, of viable alternative farming systems, which could replace conventional problematic systems. At present, such work is going on in several European countries, especially with a view to developing integrated, if not more ecological farming. Such a shift in farming system raises many issues, e.g. farmer management of nutrient flows in the soil across seasons and rotations. These issues are addressed in participatory research, sometimes involving networks of experimenting farms around experimental stations or gardens.”The discussion in workshop 1 was primarily centred on the following main questions:

- Definition of sustainable agro-ecological systems
- Methods for measuring and assessing sustainable systems
- Indicators and methods of formulation
- Incentives for changing the behaviour of farmers
- Role of FSR in stimulating a sustainable development, and
- Design: systemic approaches and participatory research

In the following, most of the ideas and thoughts are presented in a condensed form. Further details are given in the individual papers.

Definition of sustainable agro-ecological systems

Agro-ecological systems are inherently dynamic and situated in a dynamic world (politics, markets etc.). Consequently, we have to talk about a sustainable development, and an appropriate definition of sustainable agro-ecological systems can be a development which results in:

a. Income generation, i.e. economic sustainability
b. Protection of the environment, i.e. ecological sustainability, and
c. Well-being of family, i.e. social sustainability

We thus see three dimensions, or main goals, of sustainability. Within each of these, several specific objectives can be formulated. The concept of sustainable development can be looked at from

- a political point of view
- an administrative point of view
- a scientific point of view, and
- a resource manager (farmer) point of view.

Sustainability also includes various spatial scales such as the following levels: farm, community, watershed and country (see Table 1, illustrating a matrix useful for discussion of the concept of sustainable development).

Table 1: Matrix useful for discussion of the concept of sustainable development (examples)

Goal\Scale	Farm	Community	Watershed	Country
Ecological issues	Nutrient flow (N,P, …)	Clean groundwater	Clean rivers & lakes	Biodiversity
Economical issues	Production & Income	Employment		Gross National Product
Social issues	Working environment	Cultural activities		Equity

Methods for measuring and assessing sustainable systems

Sustainability must be assessed at different scales, with examples given in brackets:

- Farm level (sustainable combinations of enterprises)
- Community level (clean groundwater, employment and cultural activities)
- Watershed level (clean rivers, lakes etc.)
- Country level (food supply, gross national product etc.), and
- World level (adjustment of human consumption to the potential carrying capacity of the planet)

For the development of sustainable farming systems and measuring these as well as being able to communicate about them, we need *indicators*, which can be used for among others:

- Problem identification
- Planning
- Allocation of socio-economic resources
- Legislation, and
- Assessment and other purposes

Actors, who have to communicate horizontally and vertically, are:

- 1. Farmers and family members (primary actors)
- 2. Advisers and researchers/scientists (secondary actors), and
- 3. Politicians and consumers (tertiary actors)

In addition to this, we must also consider time scale (short versus long term) and how to reconcile the conflicting objectives/interests of the various actors.

Indicators and method of formulation

Indicators should be formulated with the following features:

- Be representative of the system in focus
- Have a scientific basis
- Be quantifiable
- Be part of the cause-effect chain, and
- Offer implications for political decisions

Methods for indicator formulation should result in the above-mentioned features, which make it possible to document and communicate the research activity and results. Therefore, the method could be modelling an *indicator tree* for description of the goal of sustainability in focus by:

- Objectives
- Causing factors, and
- Indicators

Questions for further considerations are among others:

– What to value and at which spatial and temporal scales?
– How to interpret and to pool different indicators concerning e.g. ecological sustainability?
– How to pool resulting indicators for economic, ecological, and social sustainability, if needed?
– How to choose the most important indicators for analysing and describing a certain agro-ecological system for reaching consensus about the conflicting objectives of actors in Society?

Incentives for changing the behaviour of farmers

Incentives for changing farmers' behaviour in their "production" of

a) food (healthy, high quality and made with ethical production methods)
b) environmental protection

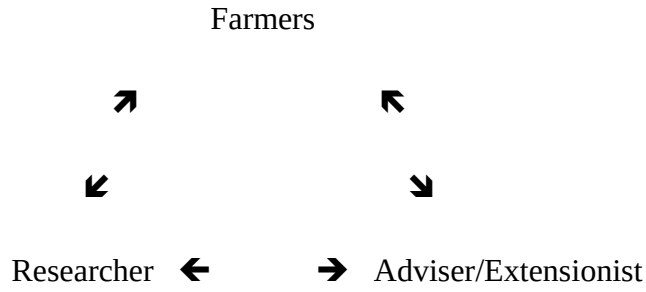
c) landscape preservation, and
d) rural development in a sustainable way

are:
- subsidies or rewards
- penalties for passing certain thresholds (ex. nitrogen)
- legislation on other topics
- consumers' demand for certain "labels" - valuable to them

The determination of the effects of the different incentives/means is very important.

Role of FSR in stimulating a sustainable development

The future role of agriculture is seen not only as a food and energy supplier, but also to some extent as being responsible for the surrounding environment and the socio-economic status of the rural environment, the reason being the changing expectations and needs of the society/consumer to the farmer. These needs in focus are not only inexpensive, healthy, and high quality products, but also ethical production methods, animal welfare, environmental protection, landscape preservation, and rural development. The farmer is asking for methods and systems of production, which *also* take into account the resource use, labour requirements, income, and farmer welfare, among others.In stimulating a sustainable development the FSR approach is very valuable as it brings in a holistic point of view as well as an interaction - and not only links and collaboration - between the following 3 actors:



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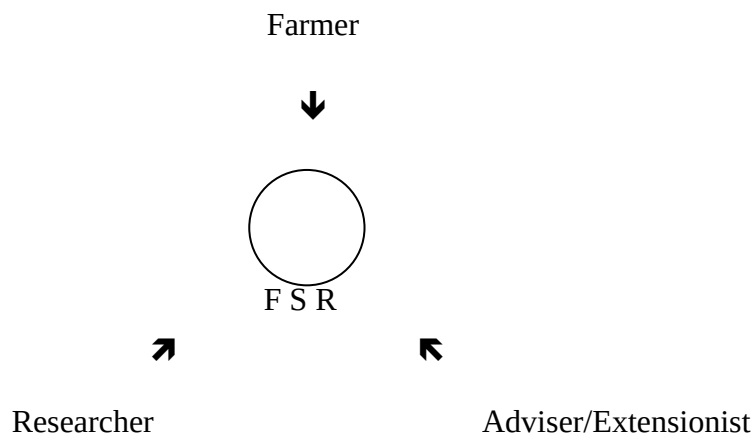

Furthermore, it is a very important objective of research to develop, by participatory approaches, sustainable systems which are reproducible, i.e. can be successfully implemented by other farmers when advised and convinced by colleagues and/or advisers. The advisers may have learnt about improved systems by “a co-learning process” in dialogue with researchers.

Designing sustainable agro-ecological systems

It is a challenge for the researcher to design farming systems which are sustainable according to the above mentioned dimensions, indicators, criteria, scales, and actors. Much work has to be done by FSR involving researchers, farmers, and advisers, and, among others, the following research tasks and activities are of great importance:

- Development of farm systems research methods (including systemic modelling, which integrates on-farm research with computer modelling) for more efficient methods to integrate experimental and non-experimental data with computer modelling.
- Holistic description of the biological, technical, and economic results of different production systems and management systems within different farms and managers over several years.
- Test and explanation of new technologies within different farms and managers over a longer period.
- Explanation of management as well as of the dynamics of the whole farming system.
- Development of management tools - also for use in the advisory service system and in educational work.
- Understanding the behaviour of the farmers and other actors.
- Multicriterial analysis involving the different issues of sustainability.
- Development of sustainable agro-ecological systems according to the objectives of actors, also by use of indicators for planning, assessment etc.