Exploring New Ways

Systemic Research Transitions for Agricultural Sustainability

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Abstract

The potential of facilitating transitions for sustainable development in Swedish agriculture through systemic participatory learning and action research was examined. The work was based on research and learning from two cases of vegetable growers collaborating with researchers, advisors and a research facilitator. A range of possibilities arose from the different approaches adopted in the cases, which were aimed at improving sustainability in vegetable production. The possibility of using systems ecology to improve the outcome of participatory learning and action research was examined. The results emphasise the importance of using approaches that are aligned with the nature of the situations and problems in order to improve systemic situations and problems, and what this alignment implies. It is concluded that sustainable development is about organizing ourselves in accordance with the functions of the ecological system that already is there, and the social values we already know give rise to thriving social systems. For research to contribute to sustainable development, new ways of carrying out research are needed whereby research approaches based on basic principles applicable to the systemic development issues, opportunities and situations under examination are used.

Keywords: participatory learning and action research, deltagardriven forskning, systemic learning, systemic research, sustainable development, Sweden, agriculture, horticulture, systems ecology, non-dualism

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Contents

List of Publications

This thesis is based on the work contained in the following papers, which are referred to in the text by their Roman numerals:

I Eksvärd, K. (2009). Is conventional agricultural research fit for the purpose to support ecological agriculture? A study from Sweden. Submitted.

II Eksvärd, K. and Björklund, J. (2009). Is PLAR a sufficient approach for supporting increased sustainability transitions in organic agriculture? A case study from Sweden. Submitted

III Eksvärd, K. (2009). Facilitating systemic research and learning and the transition to agricultural sustainability. Submitted

IV Eksvärd, K. and Rydberg, T. (2009). Integrating participatory learning and action research and systems ecology – potential for sustainable transitions in agriculture (manuscript).

The contribution of Karin Eksvärd to the papers included in this thesis was as follows:

I Karin was responsible for the case study material and the writing of the article.

II Karin together with Johanna Björklund was responsible for the case study material and Karin for 90 % of the writing of the paper.

III Karin was responsible for the case study material and the writing of the paper.

IV Karin was responsible for the case study material and made an equal contribution to Torbjörn Rydberg in writing the paper.

Abbreviations and Glossary

Anthropocentric world view	Intrinsic value is given only to humans
Asymmetrical	Used here to describe uneven distribution of power
Axiology	The study of the nature, types and criteria of values and value judgement
Complexity	Something consisting of interconnected or interwoven parts in intricate arrangement.
Connectivity	The quality or condition of being connected or connective
CUL	Centre for Sustainable Development
Data	Values or pieces of information presented as having objective reality
Disciplinarity	Research by researchers within one discipline
Eco –centric worldview	Intrinsic value is given to all of nature, nature parts and processes (including humans)
Ecological agriculture	Agriculture practice striving towards improved accordance with the ecosystem principles
Emergy	Total solar equivalent available energy of one form that has been used directly and indirectly in the work of making a product or service.
Epistemology	The branch of philosophy that studies the nature of knowledge, its presuppositions and foundations, and its extent and validity
Holistic	Concerned with the whole rather than analysis of its parts, Emphasising the importance of the whole and the interdependence of its parts
Holon	A system or phenomenon that is whole in itself as well as a part of a larger system. Every system, from subatomic particles to the universe, can be considered a holon.
Information	A collection of facts or data.
Knowledge	Personally integrated 'information' and experience ready to be acted upon.

KRAV	Swedish certification system for organic agriculture
LAG	Unit of Rural Development
Maximum empower principle	The claim that self-organisation is driven to allow the maximum rate of useful emergy transformation
Maximum power principle	The claim that self-organisation is driven to allow the maximum rate of useful energy transformation
Method	A means or manner of procedure, especially a regular and systemic way of accomplishing something.
Methodology	A body of practices, procedures and rules, used by those who work in a discipline or engage in an inquiry
Organic agriculture	Agriculture practiced according to EU-statues for organic agriculture
Ontology	The study of the nature of being, existing or reality in general, as well as the basic categories of being and their relations.
Outcomes	Changes that occur within the community that can be attributed to the research process and outputs
Outputs	Concrete and tangible products of research
PLAR	Participatory Learning and Action Research
SE	Systems Ecology
Self-organisation	Organisation that develops in a system not managed by man
SLU	Swedish University of Agricultural Sciences
SOL	Department of Rural and Urban Development
Symmetrical	Used here to describe even distribution of power
Systemic	System studies focusing on connectivity and systems as open systems in a context
Transdisciplinarity	Symmetrical collaboration between different actors on research
Transitions	Passage from one form, state, style or place to another.

Preamble

Standing on the edge of the ditch where pasture and forest turn into mature wheat field, where culture and nature are one, I experience how everything, everything, is connected. I am about 10 years old and know then that I want to work with agriculture. A year later, an impression from my father's place of work is that of massive pieces of rusting, decaying Western forest machinery at a stand-still, while beside them people are felling gigantic trees with tiny axes made from soft metals, and, at the Indian girls' school, I am just the same as everyone, yet so different. The need to 'fit in' to the context, understand the situation, is almost carved into me.

In 2002, I accepted half-time employment at the Centre for Sustainable Agriculture (CUL) at the Swedish University of Agricultural Sciences (SLU) to facilitate the development of 'participatory research' in Swedish organic research and extension community and assist create an academic base for this at the University. The decision was preceded by reflection, on the possibility of creating an activity where I would be the 'expert'. I made a solemn promise to myself to share with others as much as I could of what I learned and to aim to work myself out of a job in the three years that the post was intended to last. I eventually left CUL in the summer of 2008. This thesis forms part of the task of 'creating an academic base' originally set in 2002, but the scope extends beyond the original understanding of this goal. The intention during the writing was to convey experiences that may be of use to others, and to present these in such a way that readers can make up their own mind on whether they should use the 'lessons' using the guidance provided on the why and how.

It has been inspiring, fun, challenging and at times tough to understand the differences and similarities between 'traditional research' and the 'partici-

pant-driven research' we set out to establish. There has been so much to learn about the philosophy, methodology and application of science and about the way we as academics put these into practice. The sometimes frustrating division into parts, the boundaries of mine and yours, this and that, the competition, hierarchies and strict views of what is research also facilitated my own learning about these aspects. This inner learning was greatly supported by a network of people, all striving to shrug off the remnants of a dualistic world view and all having come to the realisation that beneath their unpleasant exterior, 'tough' experiences can contain a real gift that ultimately makes life simpler and much more enjoyable when properly understood.

The thesis is but one of many outcomes of interactions between many people, all contributing in different ways to its content, reflecting life as a continuing learning process. I am happy to have shared different parts of this process with: Ola, Kristina, Audun, Gabriella, Karin, Örjan, Carina, Lennart, Lars, Eva-Lena, Torbjörn, Klas, Claes, Thomas, Sten, Oloph, Elisabeth, Kristina, Trygve, Ebba, Bengt, Olof, Karl-Gunnar, Ulf, Agnes, Adim, Bengt, Dan, Britt-Inger, Anders, Hans, Lars, Göran, Karin, Mats, Lisbeth, Sven-Erik, Lena, Erik, Ingela, Ola, Annica, Birgitta, Göran, Henry, Leonard, Ylva, Lars, Gunnela, Liv, Fredrik, Birgitta, Håkan, Mia, Birgitta, Berit, Sune, Lars, Jenny, Johan, Christina, Ulrika, Karin, Johanna, Maria, Ann-Marie, Märet, Anita, Åsa, Ann-Charlotte, Robert, Johanna, Ottilia, Maria, Louise, Jan, Britta, Robin, Klas, Sri, Kristina, Bengt, David, Annchristine, Jan, Janice, Bengt-Erik, Niels and Agneta. Without their contribution, guidance, inspiration or support, this thesis would not exist or have become what it is. I also want to share the special joy of having met and interacted with some of these people at different 'just in time' occasions that greatly facilitated my decisions on the progress of this work. Their personal support of me as a person working on this thesis warms my heart. I have greatly enjoyed my time at CUL and appreciate the opportunity to locate this PhD thesis at the Rural Development division (LAG). The friendship at the department and among the PhD students has been of great importance to me.

A very special and warm thought to all the people who for decades have struggled to develop the subject of Agroecology at SLU and who have created the space that made it possible for me also to contribute to this work through this thesis. I consider this to be a PhD thesis in Agroecology.

1 Introduction

This thesis is about the need for systemic transitions. We tend to call such transitions 'change for sustainable development'. Such a phrase leaves unexamined both the 'process of change' and how it occurs, and what might be 'sustainable' in a particular context. Specifically, the thesis is about the potential contribution of organising a different way of researching in order to bring about transitions within agriculture, by facilitating the co-development of new kinds of connectivity between people, their (farm) resources, and the wider political and economic world. It thus seeks to make a contribution to theory, methodology and practice.

The domain in which these research issues are explored is the organic agricultural sector in Sweden; the research material offers case studies as well as exemplary, evidence-based instances that are used to probe theoretical and conceptual issues.

The PhD studies reported in this thesis were carried out at the Rural Development and Agroecology division (LAG) of the Department of Rural and Urban Development (SOL) at SLU. The participatory learning and action research experiences that form the backbone of the thesis emerged through work at CUL, SLU, which has played a major role in introducing Participatory Learning and Action Research (PLAR) within the organic and ecological agriculture movement in Sweden. It is a joy to see all the steps taken by those engaged that, in different forms, have brought about increased interaction between research and agricultural practice. More information on this can be found in Eksvärd and Gibbon (2004), Gibbon and Eksvärd (2006) and Eksvärd et al. (2009), or for readers of Swedish on the CUL website *http://www.cul.slu.se*.

The thesis is built on four papers. Paper I discusses the capability of conventional research results to facilitate desired transitions toward sustainable development of organic agriculture and the possibility of using PLAR as an add-on to such a project; Papers II and III explore the possibilities of PLAR as a framework to facilitate such transitions; and Paper IV explores systems ecology as a systems research tradition that may enrich and complement PLAR. Most of the data and information drawn upon in this thesis are from research processes carried out by two PLAR groups:

- The green manure group (2002-2005).
- The organic greenhouse tomato production group (1999-2004), supplemented by follow-up informal interviews (to end December 2007).

Inspiration and experience were also gained through the overall work at CUL, as well as through commissions as an independent consultant on sustainable development and as a member of a network acting on the role of personal responsibility and leadership to enhance quality of life for individuals, families and society as a whole.

2 Context

2.1 Centre for Sustainable Agriculture - CUL

In 1998, a participatory research programme with organic farmers in Sweden was initiated at SLU. In Swedish the term 'Deltagardriven forskning' was decided on for such research. In direct translation this means 'participant-driven research' implying the objective of supporting transdisciplinary collegial collaboration.

In deciding to support and lead the institutionalisation of PLAR the strategy was to: (i) introduce the PLAR-approach to agriculture in Sweden; (ii) facilitate groups of farmers, researchers and advisors working with PLAR; and (iii) facilitate a dialogue within and outside the university on the contribution of participation to research for change.

I was involved in the development and implementation of this strategy from the first 'kick off' seminar held by David Gibbon in 1998 until the summer of 2008. I specifically contributed to planning the institutionalisation process, facilitating multi-stakeholder groups to undertake research, producing reports and developing material explaining and describing PLAR in Swedish, giving courses for advisors and researchers to act as facilitators, supporting other facilitators, hosting network meetings for active PLAR participants and participating in conferences.

A number of groups of organic farmers wishing to develop research capability around their common interests contributed to the programme, including groups working on cereals, greenhouse tomatoes, dairying, poultry production, green manure systems (Figure 1), vegetables, ley seeds, weeds, and also

groups exploring the relevance of research undertaken at research farms and on climate change. The initiative to set up these groups was mainly taken by advisors or researchers.

Figure 1. Memories from the tomato group, the dairy group, the poultry group, the green manure research project and the cereal group.
(Photos by: E. Ögren, J. Björklund, K. Eksvärd and unknown.)

2.2 Cases in the thesis

The thesis is based on two contrasting experiences of working with PLAR as an approach to research. The first case centres on a group active between 2002 and the beginning of 2005. The participants were farmers from six farms, two researchers, an advisor and myself as research process facilitator. This case formed part of a larger research project, as one of several work packages on green manure as a multifunctional tool in organic agriculture. The six participating farms were situated far from each other as shown in Figure 2, and most meetings were held in a conference room in Stockholm.

Figure 2. Location of farms in the group (lighter dots) and the project research farms.

Contact with the other work packages was accomplished through study tours to farms in the summer, project seminars and steering committee meetings. The group work ended with a facilitated evaluation of the group process on the research output and outcomes, and the contacts with the overall project and other work packages. This case is presented in Paper I.

The second case study, which centres on PLAR with organic greenhouse tomato growers, was initiated in 1999 and is still continuing. When the group was initiated it included seven tomato growers, two advisors, one researcher and myself as research facilitator. Although the distance between farms was as much 300 km (Figure 3), meetings were frequently held on the farms, with additional meetings in conference rooms when suitable. At the start, times were financially difficult for all the participating growers due to severe

problems with corky root disease (*Phyrenochaeta lycopersici)* and the dumping of surplus Dutch tomato on the Swedish market, driving down prices. A sub-component of the overall PLAR process addressed the specific question of what the group considered 'organic' to be. This question was identified through a research initiation process that assisted the farmers to identify and develop research questions on topics of most interest to themselves. This case is presented and analysed in Papers II and III and provided the data for Paper IV. At the time, the tomato production units of the participants constituted almost 40 % of the total production area in their counties. The group has contributed substantially to the development of organic tomato production through its reports and sharing of experiences with others through participating as lecturers in courses, but also at conferences. For the Swedish reader more information can be found on the group website, *http://www.ekotomat.se*.

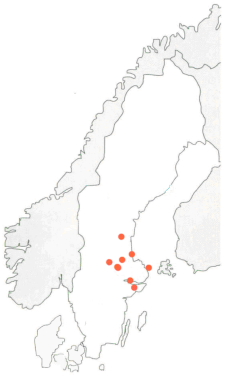

Figure 3. Location of the eight farms participating in the tomato group in 2003.

2.3 Defining sustainable development

There are innumerable definitions of sustainable development. The most well-known definition is probably that of the Bruntland Commission (United Nations, 1987): *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. This anthropocentric interpretation focuses on the needs of people, as does an official Swedish definition of the meaning of sustainable development in agriculture, which states that sustainable development is needed so as:

> … to provide for Man's basic needs, as well functioning ecosystems are needed for food to eat and air to breathe. If the ecosystems are damaged, conditions necessary for the services and commodities that nature provides and that are the basis for economic and social development are reduced. It is therefore necessary to manage the natural resources and other resources in a way that good economic and social development is reached, today and for coming generations, without undermining the resources. (SCB et al., 2007).

These definitions hold to a central view of mankind's intrinsic value, which the environment needs to be managed well enough to serve, but they do not give intrinsic value to the whole interconnected system that includes mankind (Stenmark, 2000).

This thesis shares the opinion that the anthropocentric focus in basic thoughts and structural conditions of Western industrial society is the root cause of the unsustainable development we have today. It thus starts out from a normative perception of the need for deep and radical change processes in our views on equity, life and nature. The *meaning* of sustainable development that is used in this thesis is as follows: the *learning processes* of man to live life in a way systemically supportive to humans, the human activity systems and the natural systems, and the carrying through of the transitions needed for a continued sustainability process. The human *intention* of working for a viable and healthy world, based on a communicative rationality (see 5.7), is seen as an important part of sustainable development. In more formal terms, the thesis takes an eco-centric (Kronlid, 2005) and systemic world view, in which the whole life support system has intrinsic value (Stenmark, 2000), and where sustainability is regarded to be dependent on human activities (De Groot, 1992). This gives a clear focus to the decisions of humans.

2.4 Governance

There is an increased awareness of the importance of decision-making and the processes by which decisions are implemented for the outcomes of sustainable agricultural development. One part of this awareness recognises, for instance, the importance of social responsibility. The International Organization for Standardization (ISO) has launched an International Standard providing guidelines for social responsibility, ISO 2600, (ISO, 2009). The final version of the guidance standard (to be published in 2010) adopts a concept of social responsibility that includes issues of environment, human rights,

labour practices, consumer issues, organisational governance, fair operating practices, community involvement and societal development, all relevant in agriculture.

A 'human rights' lens on the challenge of developing new forms of governance of the relationship between sustainable agriculture, food, natural resources and human welfare is given by de Schutter (2008). One of his strong, evidence-based conclusions is that investment in agricultural development will 'largely miss its target' if it fails to factor in all the place specific and larger contextual variables that contribute to sustainable forms of agricultural production. While we in Sweden do not face imminent food shortages in the near term, the search for resilience in production poses profound challenges to the governance of agricultural research that encompass moral and not just technical values.

Major international assistance agencies and financial institutions are increasingly basing their aid on the condition that any reforms undertaken must contribute to 'good governance' in agriculture. 'Good governance' implies at a minimum that decision-making at any level or scale of interaction be essentially free from abuse, individual greed and corruption.

According to the United Nations (UNESCAP, 2009), good governance has eight major characteristics;

> It is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of society.

Good governance at all levels is the outcome of human decision-making.

2.5 Swedish policy and sustainable agriculture

In Sweden, agricultural policy has a large impact on what and how much is produced. There are comparably high demands for transition towards 'sustainability' across many sectors, including environment, food quality and animal health. The pattern of subsidies is changing, from securing food supply to also securing the delivery by farmers of services such as managing

rural nature and culture, environmental assets such as the biodiversity of the agricultural landscape, production of renewable energy, the potential of recycling nutrients and other ecosystem services.

A dominant element in environmental policy in relation to agriculture concerns the reduction in the quantities of plant nutrients that are causing eutrophication problems in the Baltic Sea. Other pressing issues recognised in policy include problems with the use of pesticides and their leakage into ground water, re-forestation, the loss of farmland due to the declining numbers of active farms, and high consumption of fossil fuels. Social problems include farmers' increasingly negative feelings, that they are exposed to official decisions that have a large impact on their situation but that they cannot influence. Many farmers feel frustrated and powerless due to the sometimes contradictory messages in different instances (Nordström Källström, 2004). Administrative work on the farm has increased immensely and there are other social problems such as lack of friends, colleagues and social support. Stress is increasing and no other industry has a comparable amount of heavy lifting and awkward working postures – issues of increasing concern as the agricultural work force ages, (SCB, 2004). The number of farms is decreasing rapidly – by about 20 % per decade since 1980, while the average acreage has increased, from 25 to 41 ha in 2004. Nevertheless, according to an investigation carried out in 2006, 96 % of farmers like being farmers (LRF *et al.*, 2006) and they value their work more highly and free time less highly than the average Swede (LRF, 2005).

The Swedish government and the agricultural sector itself have developed a series of formal goals and targets to stimulate the transition towards environmentally, economically and socially sustainable farm systems. According to the head of sustainable development at the Federation of Swedish Farmers (J. Eksvärd, pers. comm. 2008), the greatest obstacle encountered in working toward sustainable agriculture is the lack of understanding of the whole picture. He argues that a situation in which researchers give their conclusions, and politicians make their decisions, with too little contact with the agricultural and farming industry is unsatisfactory. He gives the example of a decision concerning the handling of nutrient leaching to water. In some areas the reduction goals suggested could not be met even if agriculture were to cease completely; *When researchers do not agree and authorities make decisions that work for them, but not in practice, what are farmers to do on farm level*?

Farming in Sweden is developing in two different directions: small-scale and large-scale. Large-scale development is continuing towards specialisation and capital-intensive food production companies. Small-scale development is moving toward diversification, for instance in association with tourism, small-scale local food production, energy production and landscape management. This is encouraged by the national support programme for rural development. Part-time farming is also increasing (SCB et al., 2007).

2.5.1 Organic production

Organic production is defined by the Swedish government partly as *a crop and animal production where a high degree of self-support is striven for* (Regeringens skrivelse, 2006). For both plant nutrients and fodder, local and renewable resources are mainly used. The conditions for organic production are the same for all EU member states and are regulated by EU statutes (EG 834/2007). Most organic farmers in Sweden use the organisation KRAV as their certification system and use the KRAV label for their produce. KRAV also covers food processing, supermarkets and restaurants. The Swedish national environmental objectives include goals on the percentage of organic production at national level as a means of fulfilling national environmental objectives such as a non-toxic environment, a varied agricultural landscape, good quality groundwater and a rich diversity of plant and animal life. A political decision has been taken to increase the acreage of certified organic agricultural production from 6 % in 2006 to 20 % of the total production area by 2010 (Environmental Objectives Portal, 2008). The consumption of organically certified food within the public sec-tor (state institutions covering healthcare, law, education, defence etc.) should reach 25 % of the total expenditure for food consumed (Regeringens skrivelse, 2006). Within the horticulture sector, organically-grown vegetable production accounted for 9.4 % of total horticultural field production in 2005 (Statistics Sweden, 2008). It is seen as challenging for production to reach the levels set in the above goals. Competition from imported vegetables is severe, keeping domestic prices to growers low and there is a need for increased profitability and cropping reliability to secure expansion in the area (Nilsson, 2007). Problems such as weeds, long working hours, lack of capital for investments and disordered management are considerable, while there are also problems of pathogen control and nutrient management (Rölin and Larsson, 2001; Hanson, 2006).

2.6 The need for new forms of knowledge creation

In Sweden, farmer participation in research has normally been limited to a contractual or consultative mode or by contributing resources such as land and labour. The introduction of a form of participatory action research, in which farmers are regarded as research partners, is one aspect of meeting Swedish agriculture's need for new knowledge and competence to deal with problems of sustainable farming and farm livelihoods in a rapidly changing market and biophysical environment. The effort to find new ways of collaborative learning and knowledge creation on the basis of closer contact between farmers, advisors, researchers and other actors is increasing steadily. During 2003, the Programme for Ecological and Organic Agricultural Research, which provides the main guide for government and private funding bodies, was rewritten. The programme emphasised the contribution of participatory research as a major approach complementary to conventional ways of researching. Another example of increasing dialogue between researchers and practitioners is the creation of special funding programmes such as LOFT (Farmers and Researchers Together) hosted in partnership by several research funding organisations.

3 Problem addressed: the need for transition

The seriousness, complexity and urgency of social and environmental problems we are facing locally and globally show the need for transitions that focus on improvement of the existing situation without compromising long-term sustainable development. Current policies and conventional approaches too often lead to *sub-optimal solutions, generating even more persistent and complex problems in the long term* (Loorbach and Rotmans, 2006). Research needs to include interactions across time and space, whether for instance embedded in national institutional frameworks, global economic and financial driving forces, or in the relationships of individual daily life. In this respect, a key element of sustainability is about individual responsible choices.

There is an urgent need to find new forms of human activity that fit human needs and aspirations into the overall natural and social systems. This means finding new bases for interaction and exchange, and ways to learn that sustain the relationship between people and their context. The question is how we should do this, what we should decide on and based on what grounds. Society expects to get some of the answers to the above questions from agricultural research. Will research deliver what is needed?

3.1 Research for sustainable agricultural transitions

Conventional research has been based on dualistic thinking since Descartes in the 1700s (Hamilton, 2002). Where do these basic assumptions of separation between 'mind' and 'matter', between 'people' and 'nature' actually take us? Are they aligned with what we actually need to know and want to

have? Al Gore (2007) expresses the challenge, using a Mark Twain quote, when talking about the problems of sustainable development:

> What gets us into trouble is not what we don't know,
> it's what we know for sure that just ain't so).

That is, what we take for granted might not offer the best basis for creating what we want.

Another famous quote frequently used, and said to be Albert Einstein's, is that we cannot solve our problems with the same kind of thinking that created them. PLAR is essentially about framing research in a process that allows research activity (however performed, and whether at the research station or in the field) and a different way of thinking to emerge, that questions pre-analytic assumptions and implicit values.

Röling (2003) suggests that the task involves:

- Rebuilding theory to allow identification of the causes of the undesirable outcome as the basis for a response or action to change it to a more desirable one.
- Adapting intentionality to render palatable those outcomes that are perceived as unchangeable.
- Adapting perception to be better able to assess the context (new indicators and standards, monitoring procedures, agreed information systems).
- Developing new ways of acting and technologies to deal with the causes of the undesirable outcomes.
- Mutually re-aligning the changed elements to build coherence.

Can approaches such as PLAR add to research relevance for the transitions needed? This thesis aims to contribute answers to this question by tracking empirical experiences that capture objective data, process insights and growers' own perceptions of the transitions they wish to make and achieve through PLAR.

4 Main research questions

When starting to work with PLAR I was relieved to have found a way to undertake research by working *with* growers, advisors and researchers as part of a joint team involved in co-creation of knowledge. I could see that the facilitation of such a process posed intriguing questions that could be researched but I kept a critical mind (and I must admit, at times a sceptical mind) as to the 'agricultural research' value implied in the acronym PLAR. Using PLAR as 'tool' for enabling transitions toward sustainable agricultural development in organic farming gave rise to questions about the framework, methodology and practice of PLAR as a means to effect practical change 'on the farm'.

The initial Research Questions (RQs) were defined as follows*: (i) Could PLAR complement conventional research and if so, how exactly?;* and *(ii) does PLAR as an approach to research for sustainable development of organic agriculture in Sweden need to be developed or adjusted to fit the Swedish context?* These two empirical questions were addressed by means of case study field work and are reported and analysed in Papers I & II.

Based on my experience of working with the institutionalisation of PLAR in the organic research and extension community in Sweden (beyond the cases reported in this thesis), the most common question raised in different forms by trained academics has been 'How can you say that this is research?'. The questions from PLAR facilitators more often relate to how to support the development of stable, secure collaboration. At the same time, I was considering why I at the time, would call some research work in a PLAR context more 'systemic' than other research and what would make a trial 'systemic'. So a third question came to be posed: (iii) *Is it possible to work for sustainable agriculture in groups that address research needs in a 'participatory and*

systemic way'? This question calls for a more interpretive stance, based on analysis of the case study findings and data. It is addressed mainly in Papers III and IV.

Redefining the RQs through action researching; By immersing myself in the experiences reported in this thesis and others, in a systematic process of re-searching and learning about the issues of 'real research' while working with PLAR groups, the question of being 'truly participatory and systemic' continued to develop. So the fourth question for this research became: (iv) *What makes groups ask questions about, and want to research, their own agricultural sustainability, and what is needed to fulfil such ambitions?*

Toward the end of the main empirical work, a final, retrospective question began to emerge, addressing the strategic question (v) *What can we learn from Papers I-IV when using PLAR as a means for sustainable development, starting out from systemic ontology?* In addition to the lessons summarised in the Conclusions of the Papers I-IV, an answer to this question is offered in this thesis essay.

5 Conceptual Framework

This section reviews the key concepts that informed this study and it offers a discussion on how the research has contributed to further development of these concepts when applied in practice.

5.1 From disciplines to transdisciplinarity

Expressed in its simplest way, all research is formed by assumptions about how the world is constructed (ontology), how knowledge is gained (epistemology) and the values and value judgments that are held to be relevant to it (axiology). Depending on different standpoints in these areas, different philosophies of science are formed, associated with distinctive methodologies for research. A researcher consciously or through learned habit makes decisions on the 'research tools' appropriate within his or her community of practice (Guba and Lincoln, 1994; Röling, 2003). The framework and applied methodology consciously chosen in this thesis is that of Participatory Learning and Action Research (PLAR) (Pretty et al., 1995; Defoer, 2002; Gonsalves et al., 2005; Chambers, 2008).

Today's widely held convention is that scientific research in agriculture provides methods for testing hypotheses by objective measurement and experiments (nested in a positivist realist epistemology and ontology, i.e. that phenomena can be objectively known in a given reality), and by statistical enquiry (that seeks to establish correlation and probability). The convention does not deal adequately with phenomena involving inter-subjective relations, societal interactions, or anything that is reflexive, i.e. where people's perceptions, meanings and values change the nature of what is observed or acted upon. Many social phenomena, as well as e.g. financial markets, fall into this class. For these phenomena, the convention is that research seeks to

establish understanding of perception, meaning and reasons by use of rigorous methods able to reveal the inter-subjective nature of the relationship between people and the world around them (Pearson and Ison, 1997), i.e. a social constructivist framework (where reality is considered to be personally constructed and ontology, or understanding of reality, is seen as being built through the design of processes and spaces for knowing - epistemology).

The challenge for research that seeks to support the transition of farming as a management practice toward more sustainable forms of agriculture, as is the aim of the work reported in this thesis, is that 'farming' has both what is considered 'objectively measurable' and 'constructivist' elements. Such studies thus demand a mix of methods that explicitly combine contrasting methodological frameworks based in disciplines appropriate to objective measurement, experimentation and statistical analysis, as well as those disciplines centred e.g. on adult learning and the generation of understanding through interactions in a specific context. PLAR offers just such an encompassing framework, by allowing the design of an explicit process through which:

- The purpose of the research can be inter-subjectively constructed.
- Contrasting elements drawn from different conventions of inquiry (as appropriate to different disciplines) may be combined.
- 'Data' becomes 'information' that has meaning for all the participants through processes of shared learning.
- 'Information' becomes 'knowledge' that is effective for action as it combines with the life experiences of practitioners.

Each farm is a managed enterprise with a purpose – that may change over time – defined by the operator in relation to internal values, personal and family circumstances, histories and life goals, and to a dynamic context (Lyon, 1996). Each develops in some ways as a unique production system that involves complex and partly unknowable or poorly understood interactions. Conventional reductionistic scientific studies, called by Gibbons et al. (1994) 'Mode 1 research', capture only part of 'what is going on' on a farm and cannot alone solve the problems that farmers experience in practice (Röling and Wagemakers, 1998).

Mode 2 research, according to Gibbons et al. (1994), aims at producing knowledge that is intended for a given purpose within a practical setting. Typically, heterogeneous disciplines, skills and experiences are needed and

practitioners seek to combine these through constructing transdisciplinary understanding.

Steyaert and Jiggins (2007) suggest that transdisciplinary Mode 2 studies are a response to:

> the idea that a natural resource management problem brings diverse interests to deal together with the interrelationships of a set of very heterogeneous elements which range from political rules and institutions, to stakeholder practices and perceptions, and biophysical flows.

To sum up the discussion so far, according to Scholz et al. (2000) transdisciplinarity can be considered as a type of scientific activity that:

- Supplements the traditional disciplinary and interdisciplinary scientific activities by incorporating processes, methodologies, knowledge and goals of stakeholder from science, industry and politics.
- Deals with relevant, complex societal problems and thus has the potential to contribute to sustainable development.
- Organises processes of mutual learning between science and society so that also persons from non-academia participate in transdisciplinary processes.

Papers I, II and III in this thesis together illustrate a transition from Mode 1 to Mode 2 research. Through Papers II and III to Paper IV, the systemic aspects (as described in paragraphs 5.8.2 and 5.8.3) increase and efforts are made to develop Mode 2 research to support transitions for agricultural sustainable development.

5.2 Dimensions of PLAR

PLAR can be described as a transdisciplinary, systemic learning and research approach for enabling transitions that yield situational improvements. Transdisciplinary approaches such as PLAR are now common in developing and developed country research systems. They have matured and evolved over the past 50 years (Collinson, 2000). The common core, when applied within agricultural development, is that farmers and resource users have an equal voice to formal researchers in the process of understanding the nature of the 'problem' and in developing ways of either solving the problem or in developing ways of improving the situation to create more sustainable systems (Röling and Wagemakers, 1998).

Denvall and Salonen (2000) describe six dimensions of transdisciplinary collaboration. Somewhat modified, they work well to describe the importance of participation in research within PLAR:

- People are both unique and sovereign. They have the ability to think, create and take responsibility for their lives and their contexts.
- Human development is largely enacted through action. Through experimenting and developing social innovations, we create our contemporary time. Humans and societies are in constant change and need both creativity and courage to try new solutions.
- People are social creatures that fulfil themselves in collaboration with others. When we decide to take responsibility for a collective task and collaborate, the most unexpected things can happen. Insights and energy are created in confrontations and encounters with other people.
- The dynamics in teamwork between critique and vision play a central part in human development. A one-sided critical approach can be destructive or distorting of change, and visions not rooted in people's everyday life can become high-sounding but empty phrases.
- When a matter of change, large or small, concerns people, the possibilities for carrying out the changes and reaching sustainable transitions increase when the people concerned are part of the decision making process.
- Within varying degrees of freedom there are always possibilities for choosing different futures.

The above bullet points served as the basis for the facilitation carried out in the case studies in this thesis.

5.3 PLAR and learning

The metaphor of 'transfer' as in 'transfer of technology', or in 'knowledge transfer' is widely used in everyday language, as well as in much scientific writing dealing with agricultural development. It is based, quite simply, on a mistaken understanding of cognitive science: knowledge is created in an ephemeral process of learning by a cognitive agent in interaction with its environment (Maturana and Varela, 1992). However, information and data about that process and what results form it can be communicated and transferred, as in formal scientific publications. Farmers always and everywhere also share information and sometimes also data, in social networks and when

e.g. organised in study clubs, but also in more systematic ways (Leeuwis and Pyburn, 2002).

The development and use of new knowledge in a site-specific agricultural production system is a complex process (Bateson, 1972). It involves situational biophysical interactions, social relations and the values and perceptions of the farmer and farming family. It includes the farmer's view on what there is to know, when and how the farmer decides to make changes on the basis of new knowledge and the farmer's motivations to learn (Lyon, 1996). PLAR, as in other systems research approaches, seeks to structure the development and sharing of data and information process among scientists, advisors, farmers and the farm environment in ways that allow richer – or different – kinds of knowledge to be co-created (Lyon, 1996).

Adults join learning situations voluntarily and with the intention to learn something of importance to their context and their needs. They come with their own legitimate and important experiences (Smith, 1983; Rogers, 1989). This does not fit well with the teaching situation of strict lecturing, where the lecturer is assumed to be the knowledgeable person intended to transfer knowledge to passive listeners with little or no feedback (Ison, 1990), as in the transfer of technology and knowledge model described earlier. These learning situations need to be active and involve the participants (Pretty et al., 1995). For these situations the definition of learning used by Kabourakis (2000) as *the dynamic processes for generating, acquiring, using, improving and exchanging knowledge and information* describes another arena of possibilities for learning. The importance of learning by doing has been stressed during the development of PLAR, learning actively through starting off in one's own experience questioning what it is, what it means, what can be done with or about it and how this can be done (Kolb, 1984) (Figure 4 in paragraph 5.3.2), creating open processes for learning and sharing to gain in relevance and finding solutions for improved long term sustainability.

This change in views of learning has been closely associated with that of empowerment. The understanding that the poor and uneducated (which implies every sound human being) have the capacity to research the own situation stems from the work of Freire (1968). Chambers (1997) describes the empowerment that comes about in projects and processes, explaining how sequences and planned processes of methods and sharing, as well as the behaviour of the participants, have an impact. Believing that people can do something and not falling into assumed patterns of hierarchy brings about a

situation facilitating people to do new things. Chambers (1997) points out the importance of facilitating people's *ability to learn*, not how to do something, and that the most important part of learning is to keep an open mind. This also is a prerequisite for a well functioning group dynamic.

5.3.1 Learning loops

Wang and Ahmed (2003) claim that changes in behaviour and lifestyle, as needed for sustainable development, also require the unlearning of existing beliefs and methods that might otherwise hinder the new learning needed. Learning loops are a concept used to understand learning (Argyris and Schön, 1996). There are three types of learning, all necessary, illustrated by the questions *Are we doing things right?, Are we doing the right things?* and *How do we decide what is right?* (Mason, 2005). The connected 'loops' with their different degrees of learning and degrees of change are described by Groot and Maarleveld (2000) as:

- Single loop learning occurs when the intervention brings about changes in people's existing practices without significantly changing their vision, objectives, norms and values. Changes in behaviour are at the level of 'more of the same, but better'.
- In double loop learning, changes take place not only in existing practices, but also in underlying insights and principles. This type of learning strives to achieve collective knowledge and understanding by learning about assumptions and goals behind routines.
- Triple loop learning occurs when essential underlying principles are questioned to an extent that includes (re)designing the norms and protocols that govern single and double loop learning. Thus it entails learning about single and double loop learning.

5.3.2 Experiential learning

Experiential learning implies learning from experience. The most recognised theory for this is that presented in the form of a learning cycle (Kolb, 1984), see Figure 4. Full learning is considered to take place first when a cycle has been completed. The cycle includes a concrete experience that a person reflects on and is able to conceptualise into words and coherent understanding that can be tried in a new situation. This gives a new concrete experience that can give cause to further learning. The basic assumptions are that learning is a process (not an outcome) and that it derives from experience, requires an individual to resolve dialectically opposed demands, is holistic

and integrative, requires interplay between a person and their environment and results in knowledge creation (Kolb, 1984).

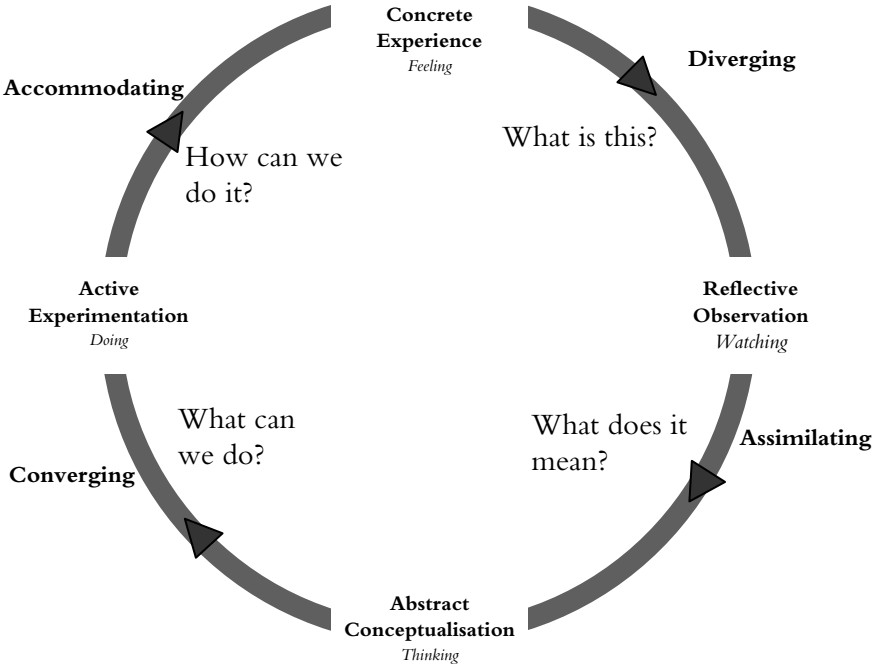

Figure 4. The Kolb learning cycle (adapted from Kolb, 1984).

This basis for learning for conceptualising new knowledge and being able to implement it into action is important to participatory and action learning and was the foundation for the design of the learning processes in the two case studies presented in this thesis.

5.3.3 Systemic learning

Systemic learning has its focus on connectivity when structuring the learning process, understanding levels of interests and sub-projects within a situation of improvement (Figure 5 in paragraph 5.8.1). Participants learn about processes and factors relating to their perceptions of the system of interest in which their activities are embedded and this learning constitutes part of the interrelationship to other processes and factors in their environment, at other system levels. The challenge of 'defining the boundaries' of the core system

of interest, and the system levels with which it might interact, thus becomes a key part of the learning process.

Miller (2002) claims that systemic learning requires a 'regulative principle' (normative rules), but that it is *not the intentions of individual agents but the logic of discourse systemic learning essentially depends on*. This view of systemic learning is not used in this thesis, where preference is given to the theory on social learning presented by King and Jiggins (2002). This includes a systemic inquirer (for example the group in Papers II and III) with an intention. This theory contains a:

- *Basic metaphor.* An adapting and self-renewing people-environment system (qualities: structural coupling through mutual perturbation, intention, appreciation).
- *Diagnostic system.* Perception, action and emotion tending toward mutual consistency; a people-environment analysis (and synthesis); renewal and regeneration; the capacity for effective action.
- *Ideal model.* Intention of creating space, capacity-building, celebration, cognitive awareness, consciousness of unconsciousness, collective cognition and critical systems thinking.
- *Intervention strategy.* To act with intention (e.g. facilitating dialogue, visualisation, languaging, becoming).
- *Change agent role*: A systemic inquirer in collective action; a facilitator of single, double and triple loop learning across system boundaries.

Thus the ideal model for systemic learning by a person or group includes space for symmetrical collaboration when acting with the intention to diagnose something together.

Systemic learning as described in this thesis can only develop when there is an understanding of the unpredictability of cause and emerging effects in the adapting and self-renewing system and when group participants want to learn and are willing to share their knowledge and experience with others.

5.4 Transitions

Stenmark (2000) quotes Max Weber's saying about traditional research:

> Science is a map that can tell us how to get to many places,
> but not where to go.

However, if we decide that a viable earth as we know it, including humans and our social systems, is wanted, transitions in deciding 'where to go' are needed. This means that an explicit axiological standpoint is necessary and that we need research for facilitating the process of 'getting there'.

Kemp and Rotmans (2001) also describe how transitions result from interplay between unlike processes and how, without a preconceived goal of an equitable and sustainable future, they do not lead to a more sustainable society but the opposite. They describe this as:

> …sustainable development is intrinsically a normative, ambiguous and subjective notion, a practical implementation of sustainable development has to incorporate the inherent conflict between the values, ambitions and goals of a multitude of stakeholders.

Transitions involve innovations in society that create shifts from one state to a new situation and such shifts may be influenced in their direction and speed by 'scientific research interventions'. Typically, transitions pre-develop, the potential to transform is built up, before they take off, spread and stabilise (Rotmans et al., 2001).

Kemp and Rotmans (2004) describe two types of transition:

- Evolutionary transitions, in which the outcome is not planned in a significant way.
- Goal-orientated teleological transitions, in which (diffuse) goals or visions of the end state guide public actors and orientate the strategic decisions of private actors.

This thesis demonstrates the possibility of goal-orientated transitions for sustainable development at the niche (micro) level – individual actors and groups. It also discusses the possibilities for this kind of work to affect dominant practices embedded as rules and shared assumptions on 'regime' (meso)

level, and on the political culture, material infrastructure, social values and world views ruling the socio-technical landscape (macro or landscape level).

5.5 Action research

Although its origins differ somewhat, the development into practices where greater power symmetry is sought have brought action research and participatory research very close together. PLAR is a combination of both. Reason and Bradbury (2006) define action research as:

> … a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes... It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities.

This could be a definition of PLAR too, as long as the learning and action research process is a joint responsibility of all participants.

5.6 PLAR and questions of power asymmetry

It has long been realised in participatory research practice and theory that researchers and facilitators typically intervene (or enter into) social situations characterised by power asymmetries. The ways in which the experience of participation is then structured can either accept, seek to moderate or transform the gradient of power. Table 1 describes how different approaches to power relations can impact on participation (Pretty, 1995).

Table 1. *A typology of participation.*

Typology	Characteristics of each type
Manipulative participation	Participation is simply pretence, with 'people's' representatives on official boards but who are unelected and have no power.
Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
Participation by consultation	People participate by being consulted or by answering questions. External agents define problems and information-gathering processes, and so control analysis. Such a consultative process does not concede any share in decision-making, and

	professionals are under no obligation to take on board people's views.
Participation for material incentives	People participate by contributing resources, for example labour, in return for food, cash or other material incentives. Farmers may provide the fields and labour, but are not involved in either experimentation or the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.
Functional Participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision-making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be co-opted to serve external goals.
Interactive Participation	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.
Self-mobilisation	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for the resources and technical advice they need, but retain control over how resources are used. Self-mobilisation can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilisation may or may not challenge existing distributions of wealth and power.

Source: Pretty (1995).

This classification correlates with Arnstein's ladder of citizen participation (Arnstein, 1969) and puts the focus on power issues e.g. between 'research teams' and 'practitioners'. These power issues can be illustrated through questions such as (Okali et al., 1994; Pretty et al., 1995; Chambers, 1997; Hassanein, 1999):

- According to whose interest is the process planned?
- Whose knowledge counts? Formal or informal knowledge? Scientific or tacit knowledge?
- Are the researchers insiders or outsiders?

- Who asks the questions?
- According to what knowledge is analysis made and conclusions drawn?
- Who owns the outputs and outcomes?
- Will it be possible to have a continued collaboration process among the 'practitioners' if the research team and facilitator are no longer available?

There is a clear division in this classification between 'Functional' (as in the case study in Paper I) and 'Interactive' (as in the case study in Papers II and III) participation according to issues of power. For instance, interactive participation seeks consensus decisions, while in functional participation basic decisions are made by one or a few of the participating actors. However, an 'interactive participatory' research setting and process alone is not sufficient to moderate, let alone transform, power relations. This takes deliberate action.

5.7 Facilitation

In interactive or self-mobilised participation the role of facilitation is to facilitate the actors' work, i.e. they decide on their goals and how to get there. This includes contributing to rigour, structure and monitoring to make possible collective reflection on the accuracy of the developing process, returning to set goals and aims for their renegotiation when needed, returning to reflection on the sub-questions in the actual context and dealing with issues of representation and authority.

Understanding power and power relations is crucial when understanding the reasons behind different forms of facilitation. Awareness of personal underlying motives or intentions behind facilitation is crucial to being able to truly facilitate the work of the *group* and to avoid, consciously or unconsciously, steering the process according to *personal* interest. This is especially important when there is a designated facilitator as there is always the risk of taking on the role of 'leader' rather than 'facilitator', something often expected by the participants in the beginning. Groot and Maarleved (2000) present a framework to distinguish approaches to facilitation and their consequences:

- *Instrumental rationality* values actions in terms of their ability to achieve preset goals by manipulating others (things, people) as objects. One does something because it is way of achieving one's goals.

- *Strategic rationality* shares with instrumental rationality a goal- orientated approach to action. However, people are seen as strategic actors rather then objects, which need to be outwitted to achieve one's predetermined goals through others. i.e., one seeks to influence the decisions and actions of others to maximise one's own interest.
- *Communicative rationality* gives rise to interaction in which the goals and plans of action of different actors are negotiated and coordinated through '*use of language (or coordinated non-verbal expressions) orientated to reaching shared understanding'* (Habermas, 1984 in Groot and Maarleved, 2000). In other words, action is taken through agreement and shared understanding. One does something because of commitment and interdependency *with* others.

The goal of the facilitation in this thesis was that of communicative rationality. The aim was also to carry out research as an insider, an actor involved in the process, using a reflective style to facilitate ongoing and sustainable learning and with an integrative mediation style, when needed, seeking win-win solutions (Groot and Maarleved, 2000). This facilitation style also seeks empowerment, which is an expression signalling an aspiration for the actors to learn to trust in their own creativity and capability and to take over facilitation of their own work. Different facilitation styles are compared in Table 2. The reflective facilitator values the process of people improving their own capacity for problem-solving, adaptation, negotiation and conflict resolution, while the instrumental problem-solver focuses on helping people solve a problem situation. When mediating in negotiations, the distributive mediator sides with one party at the expense of the other, while the integrative mediator looks for win-win solutions.

Table 2. *Facilitation styles compared*

	Reflective Facilitator	Instrumental Problem-solver	Distributive Mediator	Integrative Mediator
System thinking and practice involved	Yes	No	No	Yes, likely to be
Rationale	Communicative	Strategic	Strategic	Communicative
Position of Facilitator	Facilitator is one of the actors in the process	Facilitator is outsider assisting participants in solving problem situation	Facilitator is outsider manipulating participants as strategic subjects	Facilitator is one of the participants in the process
Learning loops[1] involved	Single, double and triple loop learning	Single loop learning	Single loop learning	Single, double and triple loop learning

Source: Groot and Maarleveld (2000).

Facilitation is also about making choices among options for the quality of the process as being clear, open and discussed, evaluated and decided on.

Reason (2006) writes that:

> Quality in action research will rest internally on our ability to see the choices we are making and understand their consequences, and externally on whether we articulate our standpoint and the choices we have made transparently to a wider public.

The choices that decide the quality of the work need to be scrutinised by the participants, the co-researchers and the wider community, so that they are clear to the actors, transparent when reporting and made in the best interest to develop the community (Reason, 2006).

5.8 Agroecology and systems

Within agroecology and farming systems research, the use of systems thinking has contributed to the understanding of the complexity and connectivity on a farm, within livelihoods and in communities. Through describing a

[1] See paragraph 5.3.1

farm as a system, the connectivity between the natural and social systems is made distinct.

In defining agroecology, Altieri (1987) emphasised the field as an ecosystem that includes environmental and social aspects. In 1987 Conway described how agroecology as a research practice views farms as systems that need to be:

- Productive enough to produce enough *valued product per unit resource input* needed.
- Stable, keeping a *constancy of productivity in the face of small disturbing forces arising from the normal fluctuations and cycles in the surrounding environment.*
- Sustainable, to *maintain productivity when subject to a major disturbing force.*
- Equitable, *evenness of distribution of the productivity of the agroecosystem among the human beneficiaries.*

Norgaard (1987) also emphasised the connection between agro-ecological systems and the cultural systems they contain:

> And so human culture molds biological systems
> while biological systems mold culture.

The understanding that new ways of performing research that include connectivity and complexity are needed to improve agricultural and rural sustainability was an important input to the PLAR research applied in Papers I-IV.

Today, according to Wezel and Soldat (2009), there are three approaches to agroecology; the plot/field scale, the agroecosystem/farm scale and the definition here used of agroecology as *the integrative study of the ecology of the entire food systems, encompassing ecological, economic and social dimensions, or more simply the ecology of food systems* (Francis et al., 2003). World-wide, agro-ecology is seen as a movement, science and practice (Wezel et al., 2009) and is claimed by Ikerd (2009) to be based on three basic principles; agriculture is a purposeful activity, all life is inter-connected and continuation of life on Earth is inherently something good. This fits well with in this thesis.

5.8.1 Systemic thinking

Systems are often defined as comprising components connected to constitute a whole, or a whole containing several parts connected to each other. This

description is insufficient, and applies mainly to things such as cars, electric mixers or technical production systems that can be viewed as closed systems. Natural systems, to the largest extent known as the universe, are perceived as being made up of all the component parts *and* the ongoing processes within the system. In systems thinking, all parts and processes have an impact on and are affected by other parts and processes within a system and are therefore described as 'connected'. The complexity of open systems alludes to the difficulty in foretelling the connections and their effects across dynamic interconnections across time and space. Human activity systems are systems created by people for a given purpose, with boundaries defined with reference to that purpose (Checkland, 1991). A farm is a clear example of the interactions between the natural system and the human activity systems: the issue always in dispute is where to draw the boundaries of interconnections that are considered meaningful with respect to the given purpose. Insofar as researchers and farmers may define purpose, boundaries and meaning differently, systems researching has to be associated with a methodology such as PLAR that enables participants to understand and negotiate these differences.

Systems can be described as being part of hierarchies where parts make up entities / levels / aggregations that in turn make up new entities / levels / aggregations, as exemplified in Figure 5. Change or transformation in one part is perceived as causing transformation in the others. Levels are used as a way to describe the area studied and levels of interest to the stated purpose. These hierarchies have nothing to do with measurement of importance, but are a way of describing the construction of a system and how changes on different levels in the hierarchies also have varying influence on other parts, and to make this dynamism graspable to the observer.

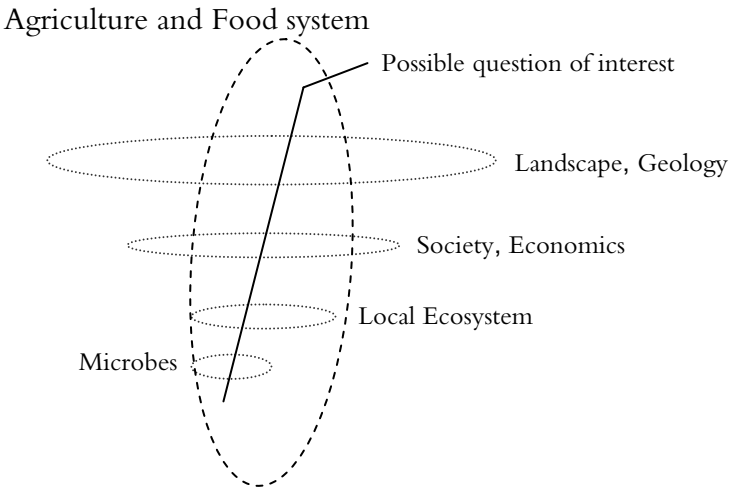

Figure 5. Example of system hierarchies or levels within a system of interest.

Systems thinking is the use of the notion of systems as an epistemological tool, a sense-making way of thinking about reality. In *systemic* thinking special attention is paid to the interconnections within the system (Ison, 2008). As PLAR uses transdisciplinarity, i.e. collaborating across professions and scientific disciplines, systemic thinking and learning processes are foundations for PLAR research. As research is done in collaboration on the situation that is experienced in common among the participants in the collaborative research activity, science works as an insider. Science can in such situations be described as a purposeful agent to cause change (Midgley, 2003). When the world view is that of the world being a connected whole or system, research activity is included in the systems studied. Systemic science can thus be defined as a science that influences its own subject area (Alrøe and Kristensen, 2002) and the subject area influences the science. This takes other ways of (still) keeping science rigorous and relevant. In this thesis, when systems are applied to a problem or situation as a way of structuring the *thinking*, as a method, to be able to deal with it, the term 'systems thinking' is used. When research is based on a world view of the world as *being* a whole containing parts and processes connected through their impacts on each other, the term 'systemic research' is used.

Defining boundaries is seen by some as the most important aspect of systems thinking (Midgley, 2003). When using systems thinking, boundaries are drawn by the practitioner to define a study area and make it 'manageable', relevant to the purpose and its comprehension easier. In this way it is also possible to discuss differences in the perspectives of those defined by a systems thinker as being connected to the context. This can be exemplified by Figure 2 in Paper I, where a system has been drawn by researchers, which does not include the researchers themselves, while farmers are positioned to the side of the picture. Midgley (2000) discusses the art of drawing boundaries around the 'subject', the agent (person, group or organisation), as it is the subject's experiences and knowledge that sets the boundaries of what is studied. He further discusses the need to expand the boundaries so as to explore contexts and hierarchies, and what happens when agents with different boundary conceptions meet. These boundaries are 'open', i.e. they interrelate with the context and the purpose of study. If the perceived boundaries are set tightly, two agents meeting will have the experience of 'the other', an encounter with people with different perspectives. The larger the area that boundaries are defined as containing, the more interests the 'system' is seen as including. An example of this can be seen in Figure 1 in Paper III where the growers, in defining their area of interest, have placed themselves in the picture.

5.8.2 Systems ecology - an approach based on systemic ontology

> … Nature consists of animals, plants, micro-organisms, earth processes, and human societies working together. These parts are joined by invisible pathways over which pass chemical materials that cycle around and around, being used and reused, and through which flow potential energies that cannot be reused.

Odum (2007) starts his book by claiming how the world *is,* i.e. its ontology. It is not fragmental; it is connected through a complexity of interactions impossible to study through positivism. However, as it *is a reality*, the use of constructionism is also ruled out. Systems ecology has a systemic ontology. It starts out from the assumption based on evidence that life is systemic and from there has developed a way to study the systemicity of the world. Knowledge about this systemic world is gained through studying the patterns, processes and principles that shape and are shaped by the systemicity (T. Rydberg, pers. comm. 2009).

Systems are studied as open, i.e. when we choose to define areas as sub-systems they have to be treated as having open fluxes of energy, information and material with their environmental context, while they also self-organise and build their own structures. They constantly evolve and add to surrounding systems (Doherty and Rydberg, 2002). They can be described as having levels, being complex and nested, i.e. components are affected by each other through the ongoing process between them and are process-orientated. They maintain and renew themselves and components adapt to changes that also affect the whole system. The systems are formed depending on their context. The ongoing processes in that context make them multifunctional with emerging properties.

The experiences underlying this thesis from its beginning in 1998 and the learning described in Papers I-III moved my perception from using systems methods, adopting systems thinking as a way of thinking about the world, to an appreciation of the systemicity of life.

6 Overall design of the research

6.1 Design overview

Papers I-IV of this thesis present experience of research in two PLAR groups. The main field research activities ran from 1999-2005, but were supplemented in the second case by informal follow-up interviews to the end of 2007. In both cases I had the dual role of facilitator and researcher. Thus I shared with the other actors the responsibility for the process and the outputs and outcomes they generated. My own interpretation of my dual role was as a 'researching facilitator', with special responsibility for the design and execution of the PLAR process and for the analysis and interpretation of the particular results reported here.

In a formal sense, the inter-subjective 'objects of analysis' comprise the following:

- the research and facilitation experience, as seen by myself but also by other actors.
- the case study groups.
- the PLAR process in the two cases.
- the research trials (on farms, generated through the PLAR process, but also on research stations, with which a group interacted).
- interconnections among the experiences of different groups through facilitating network meetings.
- a focus group on experimental trials in a participatory setting.
- interviews with other PLAR facilitators.
- interplay at courses and personal support to individual facilitators (a part-time role during the period 2003- 2008).

6.2 Structure of the thesis

The thesis is introduced by an opening chapter that sets the scene, then introduces the research questions, design and process, summarizes the main findings of the research, and discusses key contributions that the study make to practice, methodology and theory. The four Papers in which the research is presented then follow. The logic of the thread that organizes their contribution is as follows:

- Paper I presents and analyses the first case study, which examines whether a conventionally organised research process is able to adequately or sufficiently deal with sustainability transition issues in organic agriculture, and whether a PLAR sub-component in a conventionally organised research activity is able to 'drive' the sub-component content and the emergent understanding of the research team.
- Paper II presents and analyses the experience of the second case study, where the PLAR framework allowed a fundamental new question to emerge. This drove an important grower-determined research activity that confronted the values and meaning of their organic tomato enterprises in relation to the wider market and policy developments, and their family and community life.
- Paper III then analyses how the 'art of facilitation' might have allowed and empowered (in the second case), issues of the 'sustainability' of agriculture in organic enterprise development to surface and be addressed.
- Paper IV explores the complementarity of PLAR and Systems ecology. It uses the data generated within the PLAR process in the second case study to develop a theoretical analysis of the sustainability of organic tomato growing, and explores how Systems ecology could assist growers to achieve a deeper understanding of the options confronting them.

6.3 Methodology

The methodology of this thesis is based on consciously trying to contribute to the introduction of research practices that might promote practical transitions towards the sustainable development of Swedish agriculture. The research is thus empirically driven, using theory to explain happenings and to adjust and develop methodology.

Science can be seen in part as an intervention, a *purposeful action by an agent to create change* (Midgely, 2003), where observation is part of intervention. PLAR offers a set of theoretically coherent principles and guidelines for practice for designing a systematic process of learning-driven change (Okali 1994; Mikkelsen, 1995; Pretty et al., 1995). In this way the research provides descriptive knowledge within a normative setting that also reveals errors and the need for correction of previous knowledge (Robinson, 2001).

This thesis does not seek to question PLAR in itself; its methodological interest lies in the application of PLAR in terms of its potential to shift transitions toward sustainable agriculture. The research activity on which this thesis is based thus takes PLAR processes as the methodological framework in which the activity of the facilitator of these processes, the cases as action researching and learning processes, and the sufficiency of the methodology itself also are placed under scrutiny.

In order to observe the contribution of PLAR and the facilitation process, the following specific techniques and method disciplines were used:

Primary data were recorded through participant observation, written notes taken at group work meetings, study seminars, group evaluations, in the facilitator's research diary, and records taken during farm and study visits. Data from the research trials and experiments were also used (referred to in Paper I). Data-gathering tools included in the processes were semi-structured interviews (SSIs) with a group as a whole, in-depth interviews and more informal follow-up discussions. Measurements of resource use within the farm enterprise were also made in the second case study (Paper II). The data that fed and informed this process were analysed by means of statistical analysis and estimation of ecological footprints (presented in Björklund et al., 2005) based on *emergy* analysis (Odum, 1996). Secondary information was drawn from project documentation and reports, as well as other literature.

Another data stream was compiled in the iterative cycles of reflection, planning and further co-learning activities. In addition, numerous process methods (further explained in the articles) for supporting shared learning, reflection and mutual understanding were used, such as diagramming, visual representations and reviews and evaluations of the processes (Reason, 1994; Mikkelsen, 1995). The process information captured by these methods and observational data were processed manually and written up as case study reports (Eksvärd et al., 2001; Björklund et al., 2005; Eksvärd, 2007).

In Paper IV, the analytic design uses system ecology and diagramming for the purpose of assessing the goal conflicts described in Papers II and III, and for analysing the complementarities of Systems ecology and PLAR and the possible strengths of the combination in analysing transitions in systems and larger scale surroundings.

7 Main findings

The main findings from Papers I-IV are here briefly stated.

7.1 Is conventional agricultural research fit for the purpose to support ecological agriculture? A study from Sweden

The research questions addressed in Paper I were: *Is conventional agriculture research fit for the purpose of supporting ecological agriculture?* and *Is a PLAR 'add-on' sufficient to overcome any shortfalls in the conventional approach*? Paper I presents a case study of efforts to support growers by means of technical research to effect further transitions toward sustainable agriculture. It discusses the outputs and outcomes of a case in which a PLAR group was added to a conventional research project seeking to find options for using green manure as a multifunctional tool in vegetable production. It is based on collaboration among farmers from six farms, two researchers working on nutrients, plants and composting, an advisor working within organic vegetable production and myself as researching facilitator. Paper I describes the outputs and outcomes that arose from adding a PLAR group as a work package to the research project. The aim was to use the group to evaluate the research outputs from the other (technical) work packages, in farmers' practice. The scope of the material analysed included the process of deciding which trials the farmers eventually chose to undertake on their farms and the evaluation of the PLAR group work. The work discusses the collaboration within the group and between the group and the research project, and analyses the 'space for adaptability' that the project variously restricted or supported. The main findings are that it is difficult to combine a research approach based on collaborative experiential learning, transdisciplinarity and systemicity with a conventional research activity. Moreover, the expectation that a simple add-on (of the participatory research activity) would in itself

improve the relevance of the outputs and outcomes of conventional research proved over-optimistic. Though many interesting 'knowledge encounters' and discussions took place among the participants, the only partly acknowledged differences in the research approaches did not allow the expected results to emerge. The conclusion was that unless researchers organise their activity so that co-generation of knowledge is allowed to drive the research process, the goal of increased relevance of scientific research outputs for organic farming will remain elusive. An add-on work package is not an effective way to organise the connectivity between science and transitions toward sustainable agriculture.

7.2 Is PLAR a sufficient approach for supporting increased sustainability transitions in organic agriculture? A case study from Sweden.

Paper II deals with an ongoing PLAR activity conducted by a group of organic tomato producers and two advisors in organic vegetable production. A sub-project within the overall PLAR process on what they believed organic should be provides the focus of the paper. The story concentrates on the years 1999 to 2004, when I acted as a researching facilitator of the group. A researcher interested in sustainable resource use also took part. The material was complemented by follow-up contacts until the end of December 2007.

The paper examines the following question: Is Participatory Learning and Action Research (PLAR) a sufficient approach for the purpose of supporting the development of ecological agriculture? The sub-component that comprises the case material presents and analyses the co-researching process generated by the question: *What should the concept of 'organic' include in order to qualify as a guarantee of transitions toward sustainable agriculture?* The first finding was that the latter question itself emerged as a direct result of opening up scientific research to a PLAR process. Its roots were first formulated at the initial meeting (17.02.99) of the group, and subsequently refined and deepened, becoming formulated as: *What can I, and we together, do to create a more sustainable production and lifestyle?* The term 'organic' from then on was used by the group as a synonym for *sustainable practice,* in awareness that sustainability is a process that evolves.

Other findings may be categorised in terms of two transitions: (i) A transition from factor trials to researching dynamic systems; and (ii) transitions in the domain of knowledge creation.

(i) From factor trials to researching dynamic systems; The group came to define its work in terms of the following aim:

> To be able to make choices that are in line with our values and world views, to clarify our standpoints and to have good grounds for choices of change. To improve the possibilities to do a job that is as 'organic' as possible and be more able to answer questions from the world around and discuss with the Swedish organic production organisation and the European Union. And, for our own satisfaction. (06.11.02)

Two 'process' activities, conducted iteratively throughout, are shown to have enabled and empowered group members to develop and pursue this goal in relation to technical research on-farm: group measurement and analysis of data on their own natural resource use in their enterprises; and analysis and contextualisation of organic tomato growing in the light of family and community values and wider market and policy developments.

(ii) Transitions in the domain of knowledge creation; an emergent finding (a 'surprise' not predicted by the research design) was that definitions of what constitutes knowledge valid for development of enterprise practice began to widen and deepen. This came about because 'issues of knowledge', including who has power over processes of 'knowledge production,' became items of explicit discussion. In the course of such reflections, members of the group became aware of widening 'disconnects' between what the growers termed 'grey zones' of practice. They felt that the demands made by policy frameworks and standard setting did not conform to their own (deepening) perceptions of what transitions toward sustainable agriculture might entail.

The article reveals the boldness involved in asking the question *We claim to be organic, but do we really think we are?*

It led in this case of a PLAR approach to research management to new ways of acting in order to influence the situation in which they produced, by bringing into consideration values, facts and experiences. The new solutions to technical enterprise that were developed were based on investigation of interdependent components of an enterprise system in its biophysical and social environment. The group learned to let the solutions emerge as the

learning unfolded. These processes have been identified as being important to sustainable adaptation in complex situations (Kahane, 2004).

As the focus of the work widened to encompass the whole system, a new awareness grew in the group of the tight coupling between organic farming and conventional systems. The realisation that national food policies had an effect on for instance the time the farmers spent with their families, or whether they would accept fertilisers based on non-organic animal production, led to new systemic understanding. The farmers understood that to find solutions to these challenges they had to pay attention to the interconnections between different areas of their production and between the enterprise and other system levels.

The case also showed that goal conflicts, among group members but also between goals defined at different system levels, appeared unavoidable. Paper II conclude that PLAR does not remove such conflicts but does assist participants understand better the reasons for these differences among social, environmental, enterprise profitability and production goals. PLAR can support the participants to search for synergies among goals at different system levels.

Paper II also showed that in this case, PLAR was useful but not sufficient for supporting the development of a more sustainable agro-ecological system. It created a context in which participants could learn from diversity and it helped develop a more sustainable basis for production at niche level. In this case it did not seek to change the regime or the landscape in which organic tomato growing takes place. However, as growers' confidence increased through their common process, they began to see how they could communicate what they learned in order to dialogue on the regime and landscape level for change. The contribution of PLAR to multilevel systemic transitions remains unclear, although a number of experiences have been reported that sketch the potential (Blackmore *et al.*, 2007). However, the kind of collaborative environments developed in this case study supported the participants to ask questions that challenge 'business as usual' in a more carbon-constrained and climate changing world.

7.3 Facilitating systemic research and learning and the transition to agricultural sustainability

Paper III deals with facilitation of the learning process within the case study described in Paper II, centred on the experience of researching the question 'what do we consider organic to be?'. This paper shows that the transitions described were made possible because of how the systemic learning process was facilitated. The design of the learning process was based on structuring shared analysis of three sets of drivers of the production process: a) the grower/s themselves; b) social system drivers such as marketing, sales outlets, political decisions, services and labour issues; and c) natural system drivers such as the quality and availability of manure, biological pest controls, water, soil, energy, sunlight and technology. The learning process was also shaped by working with the growers to develop and explore definitions of the aim of their group, individual decisions on whether and how to participate and the members' building power and confidence to decide if and how to proceed and conduct the learning process.

The 'facilitation practice' acted as the object of analysis. It was shown to have been based on a systemic world view, on the design of focus areas that interconnected all members' interests, and on the way that the different sub-projects all gave rise to questions concerning what products and production methods actually could be considered organic?

Paper III also showed that learning on this 'triple loop' level is needed for transitions toward sustainable agriculture. The transition takes a commitment to personal 'unlearning and relearning' that cannot be forced or pushed, but that can emerge in systemic and symmetrical processes. The conclusion was that the important element was not 'is there a designated facilitator of the process?', but that a systemic process of co-creation of knowledge and shared learning was facilitated by the group members. This conclusion suggests that further development of the professional skills of university-based science students and researchers is merited, as well as capacity-building support to farmer organisations and groups so that they can internalise this competence in their own practice.

7.4 Integrating Participatory Learning and Action Research and Systems Ecology – a Potential for Sustainable Agriculture Transitions

Paper IV discusses the possibility of using a combination of PLAR and SE, arguing that using SE within a PLAR process would increase agency and awareness and deepen the possible learning in a way that would enhance transitions to sustainable solutions. Paper IV uses the process of the case study described in Paper II and the unresolved goal conflicts that arose while researching the sustainability of the growers' production and the basis of their choices. The reasons are discussed concerning the need to maximise useful energy transformation, instead of maximising economic profit expressed in monetary measures (leaving significant life-sustaining processes outside the 'evaluation window'), when seeking to tighten the reliance on the natural support system. The paper brings to surface the need for human actions to fit into the systemicity of life, based on a more informed understanding of systemic ontology. This is also shown to be the common ground of the approaches used, offering positive possibilities for integration.

The SE diagramming is explained as a new 'language' used to show the character of systems made up of interactions between properties that add different qualities, functions, processes, flows of material, energy and information. The understanding of the character is an important 'output' from a SE study, giving information on how to improve the 'fit-in-ness' of human activity. This would have fitted well with the growers' increasing understanding of the interconnectedness within their farm systems and with context described through the questions addressed in Paper III on the systemicity of products, services and actions.

According to SE, decision-making for sustainable development in agriculture needs to be aligned to fit the different hierarchies within the system so that actions taken are 'of use to' and supportive of all parts included. This has been simplified into a 'mini-model' for decision-making by Doherty and Rydberg (2002), which presents a need for decisions to be aligned with what supports the natural support system, the social system and the self. This fits well with the findings on systemic learning reported in Papers II and III. The possibility of SE showing the factors regulating or hindering 'bottom up' development spreading to higher system levels holds the capacity to align development through 'bottom up' local solutions and 'top down' regulators such as policies.

8 Discussion: Moving from thinking systems to systemic research …

The common thread in all four papers included in the thesis is the goal to facilitate decision-making for sustainable development of agriculture.

During the process of working to introduce PLAR to the Swedish organic agriculture community, the question of developing or adjusting PLAR for the Swedish context turned into a question of adjusting the accuracy of research when researching possibilities for transitions for agricultural sustainability. The questioning from researchers using conventional research approaches, and the confusion experienced while working with a conventional research project containing a sub-PLAR project (Paper I), clarified the need to really understand the research being done from the perspective of different system levels and the need for approaches and questions to fit the needs of transformational changes in how agriculture is performed. This challenge requires the philosophy of science, methodology and practice espoused by researchers to be better aligned.

8.1 … or from dualities to non-dualism

This thesis is also about the need to rediscover how human activity can fit into the system of life. It has been said that we act as if we believe that we have to invent the functioning system for earth. But in reality we, as a species, have so far created increasingly severe problems for *the already functioning* biosphere, which we are part of, and that is constantly inventing itself.

Almost all the research that has been used to come to terms with the problems is based on acting as if mankind were separated from the world and nature. PLAR and similar approaches seek to re-establish the relationship but

to some extent PLAR still maintains the separation – an idea inherent in the very notion of 'establishing' or 'connecting'. Yet our environmental problems have surely taught us that mankind is an inseparable part of the world and nature.

von Foerster (1992) describes this contrast by posing a decisive pair of questions:

> 1. Am I apart from the universe? That is, whenever I look I am looking as through a peephole upon an unfolding universe.

And

> 2. Am I part of the universe? That is, whenever I act, I am changing myself and the universe as well.

The re-positioning called for here has a moral dimension. We – as reflexive actors whose intentions shape the world we observe – need to realise that we are responsible for our choices and the effects they create (von Foerster, 1992). We have to start to acknowledge what we ourselves contribute to; that our actions are a part of all the actions that create the situation on earth and that we are the ones who choose the action. According to Josephson (2002), good decision-making is based on two core principles:

> We all have the power to decide what we do and what we say.

And

> We are morally responsible for the consequences of our choices.

Full understanding of von Forester's second question involves accepting that something that is empowering on the global level also has to be empowering on the local and individual level, or it will not be empowering for the whole, and vice versa. This correlates with the 'mini-model' on decision-making offered in Paper IV. It brings out the need for people to align their choices more coherently to benefit a range of system levels.

Ivakhiv (2002) describes the debate between different philosophies of science (positive realists and social constructivists) on environmental issues that distinguish between 'nature' and 'culture'. In his thorough discussion of the difficulties in leaving such separations, he notes that many attempts had been made to leave this duality. Nonetheless, claims on humanity's distinctive,

higher position over nature in the hierarchy have a clear tendency to creep back into descriptions of the relationship even when the intention is to move beyond duality, and to re-establish inseparable, reciprocal connectivity or to construct a holistic and systemic understanding. In this study, Paper I can be seen as a research intervention that maintained duality; Papers II and III as a search for a means to enact research as a choreographed dance; and Paper IV as an exploration of the potential for developing PLAR as a means of enacting holistic and systemic research by allying it explicitly to systems ecology. Ivakhiv (2002) writes that we might thus need to create:

> … a space in which reconceptualization might be able to proceed on neutral and non-dualistic terms.

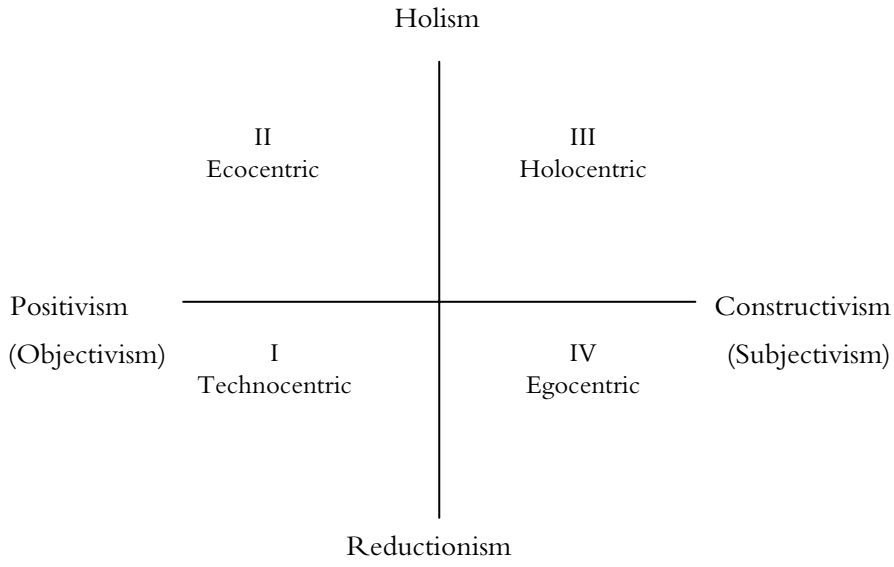

Figure 6. The Miller / Bawden quadrants (Röling, 2002)

Figure 6, often used when describing PLAR and similar approaches to describe the methodology used, should also remind us that it is the observer who has divided the world into holons and fragments. In reality, this division does not exist. Molander (2000) noted a similar categorical division with respect to whatever we choose to call object and subject. He writes: *In strict terms, the fundamental assumption that such a category exists (objectivity or*

subjectivity) can be neither proved nor verified (Molander, 2000, p. 42). In the words of Naess (1976), there is not an either/or, but only a both/and. Only a person seeing him- or herself as a subject separated from nature can study the world as an object. Such separation allows the pursuit of individual 'wants' (or perspectives) that impose on 'the environment' (distancing the individual from the other and the context) costs that in the end have become detrimental even to that individual's own survival. When truly seeing oneself as part of a system, such selfish agendas are not possible. As Molander (2000) states:

> In the dualistic picture we are forever locked in our own subjectivity. Whatever we do to reach out in the world, it involves only a perpetual struggle against ourselves. Take off the straitjacket! Look at human beings as part of the world, of nature! (p. 43).

von Forster (1992), having posed his two questions, observes that how the questions are answered creates two fundamentally different worlds:

> Either to see myself as a citizen of an independent universe, whose regularities, rules and customs I may eventually discover, or to see myself as the participant of a conspiracy, whose customs, rules and regulations we are now inventing.

In other words, what the individual does that is hardly noticeable feeds back in ways we cannot foretell on all participants in the system of inter-relations of which all individuals form part. von Foerster's own suggestion of the way forward is to encourage the development of learning on how to learn how to make moral judgments, and how to integrate that process into other ways of learning.

How does this translate into the study presented in this thesis? When looking for solutions on individual farms through systemic learning and research in a group setting (as described in Paper II), the question of what is right or wrong, true or false is no longer the key scientific issue; what is at stake is whether new practices and understanding can be aligned to support and fit into a systemic world.

In Paper IV, the alignment with life support systems, the individual and his or her farm enterprise, and the communities in which the individual operates is taken as an explicit theoretical and moral (or 'fitting in') challenge

(Shreck et al., 2006). As analysed in Paper II, the very act of seeking such an alignment takes moral courage, an opportunity that is enabled (though not guaranteed) by favouring PLAR as a legitimate research practice.

8.2 Implications for PLAR

Let us start this section with the question of whether PLAR can be considered rigorous research, aligned to the nature of the problem addressed. I argue – and have demonstrated in the papers in this thesis – that rigorous research can indeed be conducted under the PLAR heading when there is a suitable research methodology, based on a clear ontology, epistemology and axiology, a structured way of identifying questions, a well-defined and documented learning process, validated or verified outputs and outcomes and where transferable or generalizable new knowledge has been shared with a wider audience. Furthermore, insofar as this research was carried out with multiple actors who acknowledged the transformations in their thinking and practices induced by that learning, then participatory learning and action research can be said to have taken place. If all actors have an equal possibility of influencing the work and taking responsibility for the process, then this can be said to be research that is 'driven by the participants', as in the second case described in Paper II and III.

However, as researchers working with agriculture and participation, we can quickly run into the challenge of how we can describe the basis for systemic research that works for the whole system, when our intellectual cognitive framework does not allow us to grasp 'the system' in its entirety or understand it. Flood (1999) argues that it is of profound importance to realise that we *manage within the unmanageable, organise within the unorganisable and know of the unknowable*. When a researcher decides to see himself as part of the system, the possibility of cutting out fragments to study diminishes. There is a need to handle what can be experienced while standing in the messiness of a complexly connected world. This 'messiness' can be realized as the simple richness of life, described as qualities in Paper IV.

What does this imply for PLAR in theory, methodology and practice? The lessons learned from Papers I-IV are discussed below.

8.2.1 Theory

Non-dualism sees duality as an illusionary phenomenon and everything as a holon, a part of the same holistic and systemic world. This idea is partly used

within PLAR insofar as collaborative work and self-led realisation within the collective enterprise are positioned within a context experienced in common (Okali et al., 1994; Johnson et al., 2004). This is illustrated in Papers II and III, and is taken as a basic assumption within systems ecology theory in Paper IV.

In systems ecology, knowledge is gained through studying patterns, principles and processes in the systems observed. Similar observations are made by a facilitator of systemic learning processes (the action going on in its context), with the principles coming from the goals (the participants' stated purpose) of the work, and the patterns of individual and group behaviour (based on personal intentions) and societal structures. The differences experienced revealed in this thesis as in the contrast between Paper I and Papers II & III, in the symmetrical development of the learning and research process, indeed call for a distinctive axiological standpoint. All people and their knowledge and experience have intrinsic value that cannot be extrinsically compared as being of different value. We, each with our possible contributions, simply fit differently into a given process and in relation to the purpose of the situation studied, i.e. as relevant or not at a certain moment or for an intention. The knowledge that emerges from the engagement is valid when it is shown to be aligned at all three system levels (life support system, social system and the self, could also be niche, regime and the landscape) and as long as no one has anything further to add or contradict at that point.

8.2.2 Methodology

The methodology of PLAR processes is well developed when understood and taken seriously by participants. Securing at the outset an agreement on the methodology, from its basis in a distinctive philosophy of science to practice and clarity where differences of view arise, has been shown to be important. In order to effect transitions by asking questions of importance for sustainable development that were previously not considered, a systemic and transdisciplinary process of experimentation and shared learning, as evidenced in Papers II and III, has been shown to be necessary.

The habit of using closed boundaries, in everyday life as well as science, focuses attention and makes possible investigation of the fragments of biophysical and social life. However, it has proven well nigh impossible to at the same time include more global understanding or to re-connect the knowledge of the fragments to larger frameworks of understanding and practice. The agricultural technologies that have emerged from habitual

practice have been shown in recent global assessments – e.g. the Climate Change Report (IPCC, 2007) and McIntyre et al. (2008) – to have led the quest for food security along non-sustainable pathways. At the same time, a focus purely on a global level risks leaving out the needs of the local and individual and the understanding of context. The sharper the boundaries set in research, the greater the risk of the results not being in alignment with the needs of the whole. A systemic theory takes a transdisciplinary methodology in order to build understanding across levels of interaction.

Allee (1997) describes the concepts that are needed in a world that is transforming all the time and shows organisation to be something that keeps emerging. The only way to learn, as a part of the 'something transforming', is to see things in terms of the whole and to understand that motivation to change comes from within, to sustain the structural coupling between an organism and its environment (Maturana and Varela, 1992), and is not something externally imposed. These are exactly the concepts that informed and guided the research analysed in Papers II and III.

However, such work raises its own systemic problems. Group work may itself give rise to processes that are unhelpful from the point of view of systemic research – such as the well-known problems of premature closure on 'solutions' and peer pressure as a way to compete for truth, value and the primacy of one's own agenda, with pressure to conform to majority views and so on. Where the boundaries for the planned research have been set before the actual starting meeting of the group, the area of the research is closed and it is difficult to get a self-developing learning cycle going, a challenge analysed in Paper I. The open boundaries and aggregated iteration among levels used in Papers II-III kept the learning and research connected to the fluxes of the wider environment.

8.2.3 Practice and practising

For a well-functioning practice that strives to use systemic research, participants need to practise taking personal responsibility for the overall process. Papers II and III analyse how this might be brought about. Key points that emerge are:

- Making personal independent decisions; to take part, agreeing on the methodology being sound and accurate, agreeing on issues and aims, to stand behind agreements or group decisions, insisting on clarity.

- Listening as interaction; to understand, to be able to contribute accurately, to be able to give feedback.
- Sharing as interaction; sharing influence, attention and space, knowledge, ideas, feelings and personal experiences.

Daugherty (2006) describes how stress, anxiety and 'negative' emotions reduce our cognitive ability, maintain and worsen emotional stress and are destructive to our bodies, brains and relationships. By correlating this to the understanding of connectivity in living systems, we may discover clues about human decision-making and actions based on decisions as reactions to the context. We need to ask of ourselves the discipline of self-reflexivity in order for systemic research and learning to take place (Bawden, 2005). We need to reflect on how we, as participants, contribute to the context by our decisions and actions, and on the implications that these hold for the design of 'research as learning' at individual, local and larger scales of interaction.

This also means leaving behind the dualistic base of power asymmetries and engaging in reflection on equality and what support for transdisciplinarity and communicative rationality and action implies for power dynamics. Engagement in co-researching requires effort to develop each participant's sense of 'fit-in-ness' and sense of belonging. This is well connected to the questions of 'empowerment' and the role of facilitation in fostering this, and to the realisation of the importance of one's own contribution to accomplish well-informed learning and solutions through collaboration. In Papers II and III, the participants aspired to contribute to the interdependent sustainability of agriculture as well as of the work in itself. They did so by contributing their independent experiences as inputs to the group work and applied the outputs and outcomes through independent solutions on their own farms. Creating this space for a mutually informative interaction between the individual and the collectivity in turn contributes to systemically dependent sustainable development.

Creating and contributing to trust-based companionship, based on respect for the intrinsic value of others (leaving aside extrinsic comparisons), asks of the facilitator – and eventually of all participants – a capability for self-reflection and willingness to change. Self-reflection has been described as a 'stepping out' of the system, of observing, 'from outside' the phenomenon observed (Alrøe and Kristensen, 2002). However, if we accept that it is not possible to literally 'step out', and add that we, through our choices, contribute to what the whole system is becoming, self-reflection is still possible.

The skill comes about through the mental exercise of detaching oneself from unconsidered preferences and self-interested agendas (i.e. 'wants'). Thus one may begin to ponder the interactions between oneself, the options for possible choices in a context, and the effects of the subsequent actions and behaviour on the context. This, in brief, is the difference between joining a collaborative effort in order to ensure that one's own interests are fulfilled, and joining in order to contribute to learning how to achieve a common goal. This difference in *intention* was crucial to the achievements reported in Papers I and II. When participants recognise that they gain more personally when their intention is to contribute to the common work and goal, rather than in striving for a unique preference and withholding their inputs to the process, then transformative research can truly be said to be practised.

8.3 Outputs and outcomes

Sustainable development has been said to be an emergent property of human decisions. But, sustainable development is something we can do, not wait to be given through the decisions of others. The foundations are already there, in living life within life's possibilities, not exceeding them and not limiting them. *Un-sustainability* is an emergent property from choices based on the illusion of the possibility of excluding ourselves from the system of which we are a part, and the habit of extrinsic valuations that set in motion competition and exclusion. This implies that to handle the complexity of life in a sustainable way, we need individual 'good governance' – and it is the contention of this thesis that this can be learned and supported through scientific research practices, with groups and individuals.

In this way, research could contribute to decision-making for sustainable development transitions and to the work of defining sustainable development aligned with a systemic world view that could guide such transitions.

9 Conclusions

- Sustainable development is not about inventing a functioning ecological system, as there already is an existing system much more intricate then we can ever understand. It is not about finding the social values that will give thriving social systems, as we already know them (including love, sharing, equality, care). It is about organising ourselves in accordance with what is already there and making decisions based on these qualities. We need confidence in the capacity for social and ecological systemic re-generation and evolution.

- For research to contribute to sustainable development, new ways going beyond Mode 2 research are needed, combining research basics with research approaches applicable to the current systemic development questions, problems, opportunities and situations we need to handle. This, simply put, is a call to align research to means appropriate for what is studied.

- To contribute to sustainable development, actors involved in PLAR processes need to re-negotiate and reflect on their views and intentions as they co-construct the world, their ways of learning and the effects of driving forces of change in relation to contrasting world views and values.

- Through learning and researching by combining PLAR and Systems ecology, systemic societal transitions could be better facilitated.

In retrospect, this thesis has actually been about the need for growth into our human capacity.

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