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Organic farmers' experiments in Austria

Learning processes and resilience building in farmers' own experimentation activities



Doctoral thesis

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Abstract

Historically, farmers' experiments have been the means through which locally adapted farming systems worldwide developed. Farmers' experimentation is the process by which local people informally conduct trials or tests with their own methods. Farmers' experiments can be defined as the activity of trying or introducing something totally or partially new at the farm, including evaluation of the success or failure of this introduction. The process of experimentation is closely linked to the process of learning. Experimentation is one of the fundamental strategies involved in farmers' attempts to learn about and control their environment.

The resilience concept is used in this thesis to study the interrelation of change and learning processes with farmers' experiments. Resilience is the capacity of a system to cope with change, and to turn crisis into opportunity. To explore whether farmers' experiments can contribute to building resilience on farms and in the region, four principles that build social-ecological resilience are taken up as a point of departure.

This thesis investigates topics, motives, methods and outcomes of farmers' experiments, and the factors influencing organic farmers when they experiment. It discusses how different kinds of farmers' experiments can be characterised, and how singular experiments are related to each other. Furthermore it is examined, if and how experimentation can be a strategy to cope with ongoing change and build resilience on farms. The role of practical experimentation as a learning strategy of farmers is investigated to assess the potential of farmers' experiments to adapt and shape farming activities according to individual needs and external change processes. Data collection and analysis combined qualitative and quantitative approaches. Personal interviews were conducted with 73 organic farmers (semi-structured interviews with 47 farmers and structured questionnaire interviews with 26 farmers). Qualitative content analysis was based on deductive and inductive coding. Quantitative data was analysed using univariate and bivariate statistical methods and tests.

Organic farmers in Austria were found to experiment in a broad range of topics, depending on the properties and type of the farm and the regional conditions. Farmers were most often motivated to start an experiment when they confronted a concrete problem or felt the need to change and adapt their farm to specific circumstances. But also personal motives such as curiosity or interest in a specific topic were central motivations for farmers deciding to experiment. Farmers used a diverse range of methodological approaches in their experiments, ranging from accurate experiments or particularly creative procedures, to pragmatic, intuitive, or implicit approaches. Farmers' experiments were influenced by different factors, such as the regional and social context, type of farm production, information sources used, exposition to other contexts, and personal attitude of the farmer. Farmers' experiments can be tools to build farm resilience. In the cases investigated in this thesis, farmers experimented in ways that can be argued to enhance social-ecological resilience on the farm and in the region.

Farmers need the ability to experiment in order to find their own creative solutions for their specific conditions and emerging problems. Therefore it is advisable to support farmers in their experimentation activities and give farmers room for creativity within the regulatory frameworks and conditions for farming. Another possibility would be to engage farmers more actively in the advisory system and make active use of the outcomes of farmers' experiments for the development of local agricultural systems.

Keywords: farmers' experiments, organic agriculture, learning processes, social-ecological resilience, Austria

Kurzfassung

Historisch betrachtet wurden landwirtschaftliche Systeme weltweit durch bäuerliche Experimente entwickelt. Bäuerliche Experimente bezeichnen Prozesse, bei denen Bäuerinnen und Bauern informelle Versuche mit ihren eigenen Methoden durchführen. Bäuerliche Experimente können definiert werden als Tätigkeiten, in denen etwas komplett oder teilweise Neues auf einem landwirtschaftlichen Betrieb ausprobiert wird, und bei denen der Erfolg oder Misserfolg dieser Neuerung evaluiert wird. Der Prozess des Experimentierens ist eng verknüpft mit Prozessen des Lernens. Experimentieren ist eine der grundlegenden Strategien von Bäuerinnen und Bauern, um über ihre Umwelt zu lernen und diese zu kontrollieren.

Das Konzept der Resilienz wird in dieser Arbeit verwendet, um die Beziehung von Veränderungs- und Lernprozessen mit bäuerlichen Experimenten zu untersuchen. Resilienz bezeichnet die Fähigkeit komplexer sozial-ökologischer Systeme, mit Veränderung umzugehen, und Krisen in Möglichkeiten zur Entwicklung umzuwandeln. Vier Prinzipien zum Aufbau von Resilienz werden als Ausgangspunkt herangezogen, um den Beitrag von bäuerlichen Experimenten zum Aufbau von Resilienz am landwirtschaftlichen Betrieb und in der Region zu untersuchen.

In dieser Arbeit werden Themenbereiche, Motive, Methoden und Ergebnisse bäuerlicher Experimente erforscht, sowie Faktoren, die Experimente beeinflussen. Außerdem werden verschiedene Typen von Experimenten charakterisiert, und die Beziehung zwischen einzelnen Experimenten diskutiert. Darüber hinaus wird untersucht, ob und in welcher Weise bäuerliche Experimente Strategien sein können, um mit Veränderungen umzugehen und Resilienz am Betrieb aufzubauen. Die Bedeutung von Experimenten für Lernprozesse von Bäuerinnen und Bauern wird erforscht, um das Potenzial bäuerlicher Experimente für Anpassungs- und Gestaltungsprozesse am Betrieb entsprechend den individuellen Bedürfnissen und externen Veränderungen einzuschätzen. Die Sammlung und Analyse von Daten kombinierte qualitative und quantitative Zugänge. Es wurden Interviews mit 73 Biobäuerinnen und Biobauern durchgeführt (semi-strukturierte Leitfadeninterviews mit 47 Personen, und strukturierte Fragebogeninterviews mit 26 Personen). Die qualitative Analyse basierte auf einer Kombination von deduktivem und induktivem Kodieren. Quantitative Daten wurden mittels uni- und bivariater statistischer Methoden und Tests analysiert.

Die befragten Biobäuerinnen und Biobauern führten Experimente in verschiedensten Themenbereichen durch, abhängig von der Beschaffenheit des Betriebes und den regionalen Gegebenheiten. Meist waren die Experimente motiviert durch konkrete Probleme oder sich ändernde Rahmenbedingungen, die eine Anpassung erforderlich machten. Aber auch personliche Motive wie Neugier und Interesse an einem bestimmten Thema waren wichtige Auslöser für Experimente. Die methodische Vorgehensweise der Befragten umfasste eine Bandbreite, die von genauen, exakten Methoden, oder besonders kreativen Zugängen, hin zu pragmatischen, intuitiven oder impliziten Vorgehensweisen reichte. Bäuerliche Experimente wurden von verschiedenen Faktoren beeinflusst, wie regionalem und sozialem Kontext, Betriebstyp, verwendeten Informationsquellen und persönlicher Einstellung. Bäuerliche Experimente können zum Aufbau von Resilienz beitragen. Die in dieser Arbeit untersuchten Experimente wurden auf eine Weise durchgeführt, die den Aufbau von Resilienz am Betrieb und in der Region fördern können.

Bäuerinnen und Bauern benötigen die Fähigkeit zum eigenständigen Experimentieren, um kreative Lösungen für ihre spezifischen Gegebenheiten und für auftretende Probleme zu finden. Daher ist es empfehlenswert, Bäuerinnen und Bauern beim Experimentieren zu unterstützen und ihnen Freiraum für Kreativität innerhalb der rechtlichen Rahmenbedingungen und Verordnungen zu schaffen. Eine weitere Möglichkeit besteht darin, Bäuerinnen und Bauern aktiver in die landwirtschaftliche Beratung einzubinden und mehr Gebrauch von Ergebnissen aus bäuerlichen Experimenten für die Weiterentwicklung lokaler landwirtschaftlicher Systeme zu machen.

Schlüsselworte: Bäuerliche Experimente, biologische Landwirtschaft, Lernprozesse, Resilienz, Österreich

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Structure of the thesis

This doctoral thesis is written as a monograph, and is complemented by two scientific publications about the dissertation subject. The two papers attached are concerned with the following topics:

Paper I (literature review paper)

Leitgeb, F.; Sanz, E.; Kummer, S.; Ninio, R.; Vogl, C. R. (2008): La discusión académica sobre experimentos de agricultores (farmers' experiments) – una síntesis // Academic discussion about farmers' experiments – a synthesis (Spanish and English). Pastos y Forrajes, 31(1), pp. 3-24.

Friedrich Leitgeb wrote this paper with inputs from all co-authors. The article was published in the Cuban journal 'Pastos y forrajes' in Spanish and English. The journal is not SCI-listed, but is a peer-reviewed scientific journal. The paper summarises scientific literature on the topic of farmers' experiments based on an extensive literature review. This article contains a literature review performed in the beginning of the research project and presents the theoretical base from which the research project and this thesis departed.

Paper II (conference paper)

Kummer, S.; Leitgeb, F.; Vogl, C. R. (2008): Changes as triggers and as results of farmers' experiments: Examples of organic farmers in Austria. In: Dedieu, B. Zasser-Bedoya, S. (Eds.), Empowerment of the Rural Actors: A Renewal of Farming Systems Perspectives, INRA SAD 2008, 8th European IFSA Symposium, 6.-10.7.2008, Clermont-Ferrand, pp. 413-422.

I wrote this paper with inputs from the co-authors for the 8th European IFSA-Symposium. The paper was peer-reviewed, presented as full paper at the conference and published in the conference proceedings. The paper is concerned with the question of how change processes and farmers' experiments are interrelated.

1. Introduction and overview

Experimentation was and is a vital part of farming activities all over the world. The development of locally adapted farming systems worldwide can be ascribed to the continuous experimentation activities of farmers (Hoffmann et al., 2007). Farmers' experiments enable farmers to adapt their farms to ever changing circumstances (Bentley, 2006), build the base for countless agricultural innovations, and are a means to generate local knowledge (Sumberg and Okali, 1997). According to the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), local knowledge plays a crucial role for the further development of agricultural systems. *'Traditional and local knowledge constitutes a n extensive realm of accum ulated practical knowledge and kno wledge-generating capacity that is needed if sustai nability and development goals are to be reached'* (IAASTD, 2009, p. 11).

Agriculture provides vital services for mankind by producing food and energy (Millenium Ecosystem Assessment, 2005). In the production of these goods, farmers are challenged by changing conditions. In order to maintain and improve farming activities, farmers need the ability to adapt to and learn from these changing conditions. Research and advisory work may provide farmers with information and techniques to cope with changing circumstances, but these off-farm resources have to be integrated and adapted to the local conditions of the farm and the specific needs of the farmer or the farming family. Farmers integrate off-farm information and techniques into their farming system by experimenting with them. Experimentation allows farmers to assess the value of innovations they choose to test while improving their ability to make informed decisions through critical thinking and analysis (Sturdy et al., 2008). However, farmers not only adapt off-farm information and techniques, but also experiment by themselves, out of necessity, interest or curiosity (Rhoades and Bebbington, 1991; Sumberg and Okali, 1997; Saad, 2002).

Literature about farmers' experiments draws diverse conclusions about experimentation activities of farmers, but a considerable number of sources state that all farmers have some experimentation capacity (Sumberg and Okali, 1997; Stolzenbach, 1997; Rhoades and Bebbington, 1995; Bentley, 2006). However, there are notable differences between their intensity and propensity to conduct experiments. Based on the consideration that sustainable land use is more knowledge-intensive than conventional land use (Röling and Brouwers, 1999), and thus organic farmers in general have more need to experiment within the complex natural systems with which they work, it is particularly relevant to investigate the experimentation activities of organic farmers in a systematic way.

Scientific research about farmers' experiments until now mainly focused on case studies set in development contexts in countries of the south, especially in Asia, Africa and Latin America (cf. Reij and Waters-Bayer, 2001a; Chambers et al., 1998; van Veldhuizen et al., 1997; Haverkort et al., 1991), and little has been written about the European context (Kandel et al., 2008; Kummer and Vogl, 2009). In the literature available, few research activities investigate farmers' experiments in a systematic way, by studying the entire process of experimentation and the methodology that farmers apply when they try something on their farms. Furthermore, research about this topic is new and relatively scarce in the European context.

This thesis investigates whether organic farmers in Austria experiment, why and how they experiment, the results they obtain by experimenting, and the factors influencing organic farmers – positively and negatively – when they experiment. It also discusses how different kinds of farmers' experiments can be characterised, and how singular experiments are related to each other. After describing and discussing elements, characteristics and interrelations of farmers' experiments, the question of how experimentation can be a strategy to cope with ongoing change and build up resilience on farms is examined. Furthermore, the

role of practical experimentation as a learning strategy of farmers is investigated to assess the potential of farmers' experiments to adapt and shape farming activities according to individual needs and external change processes.

2. Objectives and research questions

This thesis contributes to the research about farmers' experiments by adding empirical evidence on organic farmers' experiments in Austria. The research aims at demonstrating the potential of organic farmers to conduct their own research, create innovations, find solutions for current problems, and learn to sustain their farms in the face of change.

The thesis is structured in line with the following research objectives:

- To understand the situation of organic farmers' experiments in Austria
    - by identifying topics, motives, methods and outcomes of farmers' experiments;
    - by exploring the factors that influence farmers' experiments.
- To present the significance of organic farmers' experiments in the context of learning processes and resilience building strategies of farmers
    - by exploring the learning processes involved in farmers' experiments;
    - by identifying the contribution of farmers' experiments to building farm resilience.

The following research questions were examined in the study:

- What are the topics, motives, methods and outcomes of farmers' experiments in Austria?
- What factors influence farmers in their experimentation processes?
- How can different types of farmers' experiments be characterised?
- What role do experiments play in the context of change and learning processes of farmers?
- How do farmers' experiments contribute to building farm resilience?

3. Background and conceptual framework

As organic farming is the broader context in which this doctoral thesis is embedded, it starts with an overview of organic farming. The concept of farmers' experiments and farmers' innovations is then described by summarising literature on the topic. A more extensive literature review is summarised in research paper I that is attached to this thesis. To conceptualise organic farmers' experiments, a theoretical model of farmers' experiments is presented. In understanding the process of experimentation as a learning process, experiential and transformative learning theories are presented. Finally, the resilience framework is introduced as a theoretical concept to investigate the potential of farmers' experiments to cope with and learn from changing conditions.

3.1. Organic agriculture

Organic agriculture is an alternative agricultural production system that initially emerged as a radical alternative to mainstream agriculture (Michelsen, 2001). Organic agriculture aims at creating a sustainable production system. The term 'organic' refers to the concept of a farm as an organism (Padel, 2001). In this sense, reliance is placed on self-regulating ecological and biological processes and renewable resources, and the reliance on external inputs is reduced as far as possible (Lampkin, 1994).

A definition of organic agriculture was developed by the International Association of Organic Agriculture Movements (IFOAM) over a process of three years. It states that 'organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved' (IFOAM, 2008).

Organic agriculture developed in Central Europe in the 1920s, initiated by farmers, researchers and philosophers (Gerber et al., 1996). During the early pioneer phase, the relatively small bio-dynamic farming movement was mainly characterised by the anthroposophic world view (Padel, 2001). Starting in the 1950s, organic agriculture developed, stimulated by the beginning industrialisation of agriculture and its negative effects. These negative effects concerned not only some farmers and agricultural researchers, but also considered consumers. Organic agriculture therefore developed as a grassroots movement, mainly driven by the farmers themselves (Padel, 2001). The first production standards for organic agriculture were also established by the farmers involved, who organised themselves into organic farmers' associations (Vogl et al., 2005).

There are two reasons why it is particularly interesting to explore farmers' experiments in the context of organic agriculture. First, sustainable land use practices are more knowledge-intensive (Röling and Brouwers, 1999). While conventional farmers can use external inputs such as synthetic pesticides and synthetic fertilisers to handle adverse dynamics in their agro-ecosystem, organic farmers need to develop knowledge about the agro-ecosystem to a larger extent to be able to manage their farms successfully without these inputs. Second, organic agriculture was developed by farmers' grassroots organisations, where farmers themselves were responsible for advances and innovations. Official research only played a minor role in the development of organic agriculture (Padel, 2001), and organic farming developed by practical experiments and trials of farmers and practical researchers. The lack of advice and formal research in the pioneer phase of organic agriculture resulted in the assumption that organic farmers have developed a culture of experimentation. Organic farmers in the pioneer phase can be referred to as active experimentors and practical researchers (Gerber et al., 1996). However it was not only the pioneers of organic agriculture who experimented; many organic farmers in Austria are presumably still actively trying and experimenting to answer questions and solve the problems that emerge continuously.

3.2. Farmers' experiments and innovations

Historically, farmers' experimentation and innovation have been the means through which technological advances have been made (Critchley, 2000; Chambers et al., 1998). Testing new methods and technologies is an integral and common element in the daily life of farmers (Haverkort, 1991; Scheuermeier, 1997; Sumberg and Okali, 1997; Bentley, 2006; Richards and Suazo, 2006). Farmers adopt, adapt and formulate new ideas, try them out in different settings, evaluate the results, and make decisions on their value for improving the farm. All of these experiments, no matter what methods they employ, can be referred to as farmers' experiments (van Veldhuizen et al., 1997). Farmers' experimentation is the process by which local people informally conduct trials or tests that can result in new knowledge and innovative management systems suitable for agro-ecological, socio-cultural and economic conditions (Rajasekaran, 1999).

An experiment in general is defined as *'a course of action tentatively adopted without being sure of the outcome'* (ODO, 2010). Farmers' experiments can be defined as the activity of trying or introducing something totally or partially new at the farm, including evaluation of the success or failure of this introduction (Quiroz, 1999), or as the comparison of something known with something unknown (Stolzenbach, 1999). Sumberg and Okali (1997) consider two conditions necessary for an activity to be labelled an experiment: the creation or initial observation of conditions, and the observation or monitoring of subsequent results.

In general, farmers themselves do not use the term 'experiment' to refer to their practical on-farm trials, but relate this term more to a scientific and formal procedure. The term farmers use to refer to activities in the sense as defined above is 'trying' or 'testing'. In various empirical studies on the topic, the term 'trying' instead of 'experimenting' has been seen as being more appropriate (Sumberg and Okali, 1997), while in other cases local terms are used to address the subject in the field (Stolzenbach, 1999).

Various authors draw diverse conclusions about the significance of farmers' experiments, although most of the authors agree that all farmers have experimental capacity (Rhoades and Bebbington, 1991; Bentley, 2006; Critchley and Mutunga, 2003; Quiroz, 1999; Chambers, 1999). However, this does not mean that all farmers are innovative and are able to cope with changing conditions (Quiroz, 1999). Some farmers may not be interested in experimenting. In addition, policies, regulations and subsidy systems may inhibit or support farmers' experiments. Experimenting farmers are not a homogeneous group. They have been found to be both resource-rich and resource-poor (Amanor, 1993 in Saad, 2002), both men and women, both outsiders and well-integrated, and both well-educated and less educated (Reij and Waters-Bayer, 2001b). However, some similarities can be found among experimenting farmers. For example, many farmer experimenters have travelled and experienced other areas (Critchley and Mutunga, 2003) and many are devoted to full-time farming and are flexible enough to be able to experiment (Reij and Waters-Bayer, 2001b).

Each farm is unique, and so the motives that drive each farmer's decision to experiment vary (Sturdy et al., 2008). Farmers conduct experiments to test their ideas in their own way (Rajasekaran, 1999). Experimentation can be induced by intuition or by an explicit desire to learn (Stolzenbach, 1999). Farmers can be driven by economic motives as well as a concern for production; saving labour or capital, or both (Bentley, 2006; Critchley, 2000). Other motives for experimentation range from survival, response to disaster, social responsibility, peer pressure, problem solving and curiosity (Rhoades and Bebbington, 1991; Millar, 1994; van Veldhuizen et al., 1997; Gupta, 2000). Influences from different scales, such as environmental or economic changes, can motivate farmers to try new things and change management practices as a result (Bentley, 2006). Farmers' experiments concern both 'hard' innovations such as production technologies as well as 'soft' innovations such as new ways of communication or marketing strategies (Waters-Bayer, 2005) or farmer networks (Kroma, 2006).

Experiments can be carried out at the level of the farm, field, individual animal or herd. Gardens or the margins of fields provide small-scale, low-risk learning environments for

experimentation through trial comparisons (Quiroz, 1999). Problem-solving skills that are developed during such experiments can be extended to other aspects of rural life and agriculture (Saad, 2002; Sturdy et al., 2008). An experiment can be the outcome of an earlier experiment, or experiments can be carried out simultaneously. Furthermore, each individual experiment does not have to be very useful or novel. It is their aggregate effect over the long run that gives them value (Bentley, 2006). While new ideas and changes spark creativity and induce experiments, the capacity to experiment and learn also depends on 'old' knowledge and experiences. The source of farmers' experiments is a combination of old knowledge and experiences, and new information (Bentley, 2006).

The potential of farmers' experiments to contribute to agricultural development has not been taken into consideration for a long time. Only a small group of anthropologists and agricultural historians have shown an interest in the topic of farmers' experiments in the past (Sumberg and Okali, 1997). Early research on traditional farming communities tended to over-emphasise the conservative and conformist attitude of traditional farmers. This was due to the fact that reports by anthropologists stressed the shared, normative and cultural aspects and drew the picture of 'typical farmers', while at the same time overlooking what 'different farmers' do (Johnson, 1972). With the relatively recent interest in rural development including the concepts of participation, empowerment and sustainability, the topic of farmers' experiments and local knowledge began to attract more attention within research, especially in the context of development studies (Okali et al., 1994; Sumberg and Okali, 1997).

To conceptualise farmers' experiments, a theoretical model of the experimentation process (Figure 1) was set up at the beginning of the research on farmers' experiments (Ninio and Vogl, 2006). The model defines the boundaries of the research area. When a certain problem or topic arises, a farmer can decide to adopt an available method or solution to deal with the situation, without entering an experimentation process. If the farmer decides to start an experiment on the situation, he or she can adapt a common solution that is already known to him or her (Pretty, 1991), or can decide to try a new idea. The experimentation process can be defined as a research process that involves a specific methodological approach, including research set-up, monitoring of the process and evaluation of the results. Different factors, such as environmental, economic or social conditions, influence the experimentation process (Sumberg and Okali, 1997), and have an effect on the set-up, duration, methods and results of the experiment. Interrelations also exist with regard to the communication system in which the farmer is involved. Farmers can use different information sources and types of knowledge that can come from a multitude of sources such as other farmers, media, science or advisory services (Stolzenbach, 1999; Bentley, 2006; Sturdy et al., 2008). In this way, farmers combine different knowledge systems and thus use knowledge from their own farm in combination with knowledge developed by research institutions or knowledge from other sources. A bi-directional flow of information from producers to researchers allows farmers to use the best possible information for their farms (Hendrickson et al., 2008). Formal and informal research is complementary and may create synergies (Hoffmann et al., 2007; Berkes, 1993). The results of an experimentation process can be classified into adaptations of a method or solution, local innovations, i.e. innovations that are not new in general but to the specific area or context, inventions and failures, i.e. experiments that do not lead to satisfactory results.

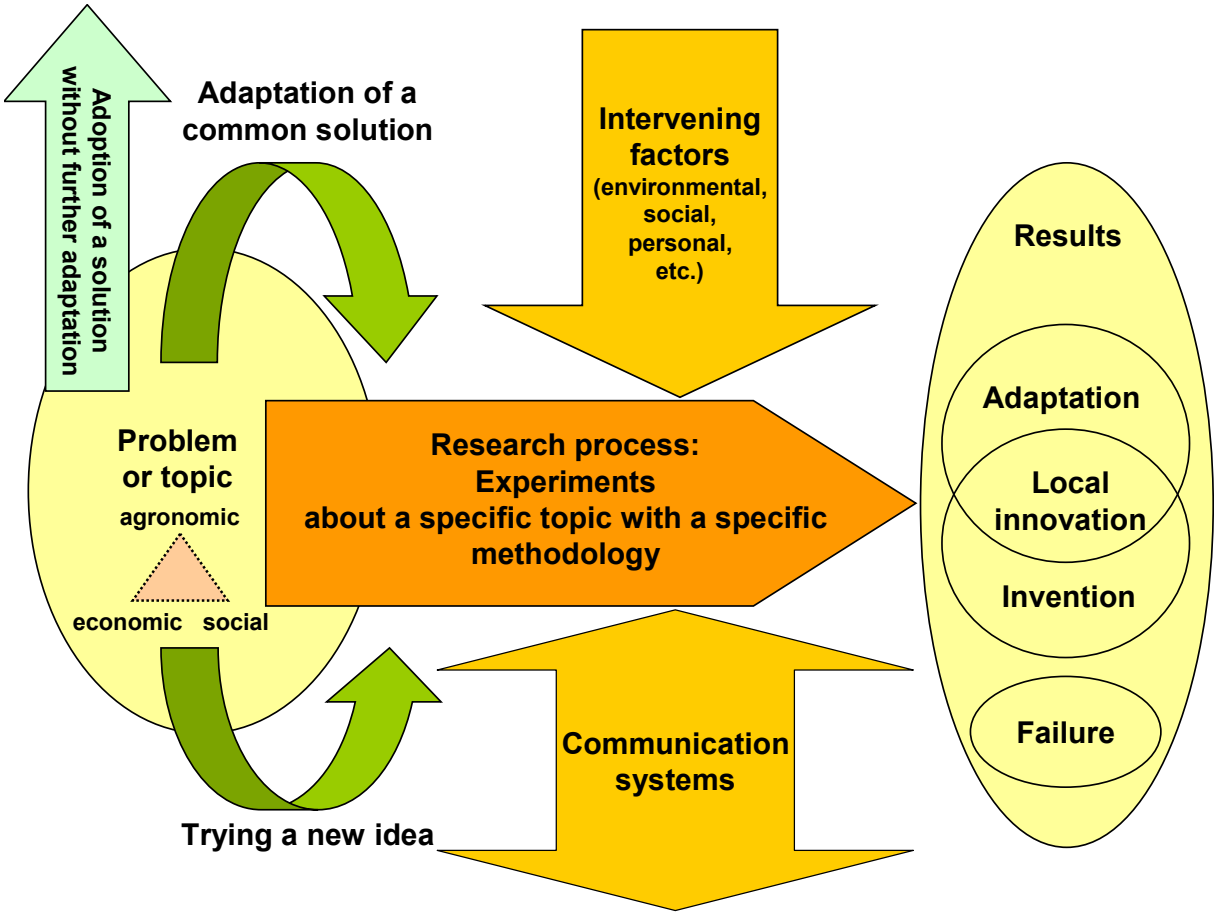

Figure 1: Theoretical model of th e research process in farmers' e xperimentation activities (Ninio and Vogl, 2006, modified)

A word closely linked to the topic of experimentation is 'innovation'. An innovation is an idea, practice or object that is perceived as new by an individual or another adoption unit. It is of little importance whether the idea is objectively new, measured in the passage of time since the first use or discovery (Rogers, 1995). An innovation can be a new material or tool (e.g. new product, new tillage tool) or a new way of doing something (e.g. improved crop rotation). The novelty does not have to be new to the world, but new to the contexts where it is used (Reij and Waters-Bayer, 2001b). In this sense, a farmer who uses a new land preparation method, crop rotation, crop variety, etc. for the first time is an innovator (Saad, 2002).

Experiments and innovations of farmers are different but complementary processes (Hocdé, 1997). Experimentation contributes to the creation of new knowledge, a precondition for the development of an innovation (Rogers, 1995). Experimentation can be seen as a process by which an innovation is generated, tested and/or evaluated (Saad, 2002; Pretty, 1991; Sumberg and Okali, 1997).

3.3. Learning theories

The process of experimentation is closely linked to processes of learning. Experimentation is one of the fundamental strategies involved in farmers' attempts to learn about, and control, their environment (Rhoades and Bebbington, 1991).

3.3.1. Experiential learning

A learning theory that seems to be particularly relevant in the context of experimentation is experiential learning. The theory of experiential learning can be regarded from a constructivist perspective (Fenwick, 2001 in Seaman, 2008). Experiential learning is based on the work of different theorists and combines e.g. the educational philosophy of John Dewey (1859-1952), the social psychology of Kurt Lewin (1890-1947), and the developmental psychology of Jean Piaget (1896-1980). The best known model of experiential learning and probably the most influential one was defined by David Kolb (1984), who states that *'learning is the process whereby knowledge is cr eated through the transformation of experience'*. The theory presents a cyclical model of learning, consisting of four phases in the learning process – from experience to reflection to conceptualisation to application, with the cycle being continuously repeated. Learning is conceived as a process, and not in terms of outcomes. The process of learning is grounded in experience. In this sense, all learning is re-learning, i.e. new learning experiences confront, modify and merge with existing learning experiences. Knowledge is therefore seen as a transformation process that is continuously created and recreated (Kolb, 1984).

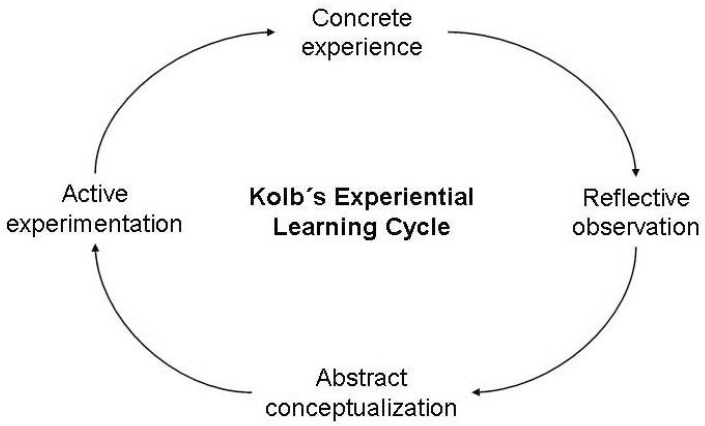

Figure 2: Experiential learning cycle according to David Kolb (Kolb, 1984, modified)

A number of authors criticised Kolb's experiential learning cycle. The main criticism was that the model is reductionistic and incomplete, and over-emphasises the role of the individual, while disregarding social power issues and social relations. Seaman (2008) reviews the existing criticisms of the concept of the experiential learning cycle and concludes that stepwise models inadequately explain holistic learning processes that are central to learning from experience. Complex cultural, social and physical processes during experience and learning are reduced to a rational, predominantly cognitive, individual phenomenon. The cyclical model has to be seen in its historical context, taking into account that it developed in the 1960s and 1970s embedded in changing educational and social trends. As a conclusion on criticisms on the learning cycle, the pattern of 'experience-reflect-learn' of the cyclical model is rejected as being an ideology rather than a theory of experiential learning (Seaman, 2008). Apart from these considerable criticisms, the core concept of experiential learning, i.e. the importance of concrete experience, observation and reflection for the learning process of

adults, is taken up by various authors who discuss and develop experiential learning theories (Mezirow, 2000a; Percy, 2005; Ison et al., 2000; Bawden, 2005).

Various authors propose that learning occurs at different levels or orders. Bateson described logical categories of learning (Bateson, 1972), suggesting that learning denotes change, and that among the different levels of learning, each level provides the context for the next in a nested manner. Applying Bateson's idea of levels of learning to the context of organisational learning, Argyris and Schön (1996) distinguished single-, double- and triple-loop learning. Single-loop learning occurs when goals, values and strategies are taken for granted and the emphasis is on the routine learning of 'how to do things'. In contrast to this, double-loop learning occurs when not only the goals, values and strategies, but also the governing variables that underlie those strategies are critically examined (Argyris & Schön, 1978 in Arévalo et al., 2010). Then the question becomes one of not simply 'doing things right' but 'doing the right things'. In triple-loop learning, the learner steps back and reflects on the underlying assumptions and goals and on the reflections themselves (Arévalo et al., 2010). Triple-loop learning can be described as the action of 'learning about the context of learning', and is difficult to achieve (Bateson, 1972).

There are parallels between these levels of learning and first- and second-order experiences that are described as key features of experiential learning. First-order experiences are past, lived experiences that are tacit or implicit, and can be characterised as incomplete, inadequate or distorted. For experiential learning to occur, these experiences have to be connected to second-order experiences that challenge first-order experiences and lead to reconsideration and modification of existing knowledge and experience (Percy, 2005).

Reflection is integral to experiential learning and can be described as a developmental process. The higher the level of critical reflection, the more likely it is that transformation, autonomy and empowerment occur. Another key factor within experiential learning is dialogue and interaction between people (Percy, 2005).

3.3.2. Transformative learning

These assumptions lead us to a more recent experiential learning theory, and that is transformative learning. This theoretical framework focuses on the question, how the ways in which adults see things can become more differentiated, inclusive and integrated, and thus transformed (Percy, 2005). Transformative learning is understood as the process of using a prior interpretation to construct a new or revised interpretation of the meaning of an individual's experience (Mezirow, 2000a).

Three major elements of transformative learning theory are described (Mezirow, 2000a): *frames of reference, learning domains*, and *types of ref lection*. Frames of reference or 'meaning perspectives' include different but interacting perspectives: the epistemic perspective, i.e. what we know and how we know it; the socio-linguistic perspective, relating to social norms and the culture in which we are embedded; the psychological perspective, referring to how we see ourselves; and philosophical and aesthetic perspectives. The three learning domains are identified as: instrumental knowledge – learning to control or manipulate the environment or other people, communicative learning – learn what others mean when they communicate with us, and emancipatory learning – involving critical self-reflection that can possibly lead to transformations of our meaning schemes or perspectives. The transformation process of emancipatory learning pertains to both instrumental and communicative learning. Three types of reflection are distinguished: content, concerning what we know; process, concerning how we know it; and premise, concerning why we need to know it (Mezirow, 2000a; Percy, 2005).

However, transformative learning has also been criticised (Taylor, 2000). The three major criticisms concern the high emphasis on the individual at the expense of power and social action issues, the fact that the situatedness of learning, i.e. the social context of learning, is

not acknowledged adequately, and the over-emphasis on rationality. When applying transformative learning theory, these weaknesses have to be taken into account.

Overall, transformative learning theory provides a framework to investigate how people reflect on and analyse their lives through learning (Percy, 2005). In the context of farmers' experiments, transformative learning offers a framework to discuss how adults – in this case farmers – can transform their ways of thinking and acting through practical experimentation by building competence, and acquiring knowledge and skills.

3.4. Resilience framework

A resilient system has the capacity to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Carpenter et al., 2001; Gunderson and Holling, 2002; Walker et al., 2004). Thus, resilience is the capacity of a system to cope with change, and to turn crisis into opportunity (Folke, 2010). Social-ecological resilience, i.e. resilience of the linked social-ecological systems, is reflected in the buffering capacity, the degree of self-organisation and the adaptive capacity of a system (Carpenter et al., 2001).

Resilience thinking offers a framework for understanding the dynamics of complex systems (Bennet et al., 2005). Farming systems can be characterised as being complex adaptive systems (Darnhofer et al., 2010a). Farmers have always lived in changing environments in terms of social, ecological, economic and political conditions, where surprise and disturbances are inevitable. Each major environmental or social change alters the human-environment relationship, and a new balance develops (Gunderson and Holling, 2002; Berkes and Turner, 2006). The ability of individuals to adapt to changing circumstances and to change their behaviour is important for building social-ecological resilience (Fazey et al., 2007).

Resilience has proven difficult to measure and operationalise (Bennet et al., 2005; Cumming et al., 2005). An attempt to operationalise social-ecological resilience was made by Folke et al. (2003). Based on a number of case studies the authors suggest four principles that build resilience in social-ecological systems.

The first principle, *learning to live with change and uncertainty*, focuses on the need to learn from crises and to acknowledge the existence of uncertainty and surprise in development. Management actions on the farm may include spreading risks by e.g. diversification.

The second, *nurturing diversity for reorganisation and renewal*, emphasises the need to use ecological and social memory, or diversity, when coping with change. Ecological memory consists of the diversity of species within and between functional groups (Nyström and Folke, 2001). Basically, farmers who use and enhance biodiversity in their experiments nurture ecological memory. Social memory builds on the diversity of individuals, institutions, organisations and other actors with different and overlapping roles within and between groups of people that are crucial for the management for resilience. In order to build resilience, social memory needs to be in tune with ecosystem dynamics and encompass ecological knowledge.

The third, *combining different types of knowledge for learning*, acknowledges that both scientific and practical, local knowledge are important in order to develop the ecological knowledge needed to build resilience. Thus, the knowledge of different actors and groups is relevant. Furthermore, Folke et al. (2003) emphasise the knowledge of ecosystem processes and functions as most pertinent.

Finally, Folke et al. (2003) suggest *creating opportunity for self-organisation toward social-ecological sustainability* as the fourth principle to build resilience. This can be done by taking the dynamic interplay between diversity and change into account, as well as cross-scale issues such as the impacts of external social and economic drivers (e.g. market fluctuations

or policy changes). Thus, ecosystems and their governance need to be on matching scales in order to build social-ecological resilience.

The concept of resilience has also been criticised. Hornborg (2009) places the concept of resilience in line with other concepts about sustainable development that are *'dominated by assumptions of consensus and a trivialization of obstacles to implementation of the requisite policies. In order to remain within acceptable discursive territory, politicians and researchers alike are expected to (…) continue to offer pathways to sustainability that do not seem too uncomfortable or provocative. This explains why the rallying-cry of the early 21st century is not 'revolution' (as in the early 20th century), but 'resilience'.'* (Hornborg, 2009, p. 252). According to Hornborg, resilience thinking is largely founded on the epistemological traditions emphasizing the *'harmonious functioning of natural systems through adaptation, wise management, and appropriate technologies'*. In the light of the current trends of global environmental change, he describes the idea that modern society will be able to learn how to manage natural resources sustainably by e.g. studying the small-scale, traditional ecological practices as being *'naïve and paradoxical'*, although he admits that *'there is definitely something to learn from local and contextualized ecological practice'* (Hornborg, 2009, p. 252).

The critical points and assumptions that Hornborg raises are comprehensible. Researchers that use the resilience framework have to pay attention to the fact that consensus is difficult to achieve in the complex interrelations of social-ecological systems. In contrast to Hornborg who assumes that *'social systems (…) are generally propelled by individuals and groups struggling to maximize their power and affluence'* (Hornborg, 2009, p. 254) – a concept that can also be criticised and questioned – the concept of resilience may be a conceptual framework that assumes a certain level of altruism of the involved actors. Resilience thinking alone will not be sufficient to understand and solve all the problems humanity is currently facing, but may offer suggestions for a development into a more sustainable direction.

In this thesis, the resilience concept is used as a framework to study the interrelationship of change and learning processes with farmers' experiments. It deepens the understanding of how farmers' experiments may contribute to knowledge development of farmers and enhance the adaptive capacity of farms. To explore whether farmers' experiments can contribute to building social-ecological resilience on farms and in the region, the four principles that build social-ecological resilience (Folke et al., 2003) are taken up as a point of departure in section 5.2.2, and are dicussed in section 6.2.2.

4. Methods

This doctoral thesis is based on the research project 'Organic farmers' experiments – Learning local knowledge', that was conducted between January 2007 and June 2009. The research project was funded by the Austrian Science Foundation FWF and employed three doctoral students. The research proposal was written by Racheli Ninio and Christian Vogl, the latter being the project leader. When I started my research within the project in January 2007, the general outline of the research was already specified in the proposal. In the initial phase until June 2007, the project team, consisting of the three doctoral students and the project leader, jointly developed the methodological approach of the project, especially that of the first research phase. The methodology was discussed and written down in a methods manual.

Data were mainly collected in personal interviews with organic farmers at their farms. I conducted all the interviews used in this thesis personally, most of them alone. In several interviews I was accompanied by Rebecka Milestad, a fellow researcher. On those occasions we shared different tasks during the interview, so one person asked the questions and guided the interview, while the other person observed the situation, took notes and pictures, and provided additional questions if appropriate. After the interview, we discussed our observations and gave feedback to each other. This procedure enriched my research and helped me to improve my interviewing skills. Especially in the initial phase of the research process, I exchanged the experiences with my doctoral colleagues. Supervision of the research process by the project leader and supervisor of the dissertation took place in regular personal meetings, written feedback and project reports over the entire research process.

4.1. Research site

Austria is a Central European country with 8.4 million inhabitants and a size of about 83,800 km². Geographically, the country is dominated by the Alps; 60% of the surface is mountainous. In the East of the country flat to hilly lowlands characterise the landscape. There are approximately 187.000 farms in Austria, and the average farm size is 19 ha (BMLFUW, 2010).

Austria has a long history of organic agriculture. The organic movement started in 1927 with two biodynamic pioneer farms. In 1962 the first organic farmers' cooperative was established. The first common crop production standards were defined in 1980 by the farmer associations (Vogl and Darnhofer, 2004). In the 1980s, when the negative impact of intensive conventional agricultural methods became apparent, the interest in organic farming reached a broader public (Darnhofer et al., 2010b). In 1994 supermarkets started selling organic produce, and two years later the marketing agency Ökoland was established to strengthen the farmers' bargaining position when dealing with large retail chains (Vogl and Darnhofer, 2004).

With the availability of the first government support schemes for farms in conversion in the early 1990s, the number of certified organic farms increased rapidly. Starting in 1994 direct payments were made available for organic farms through the introduction of the Agri-Environment Programme in preparation of the EU accession of Austria in 1995. The growth in the number of organic farms reached its peak in 1998 with 20,316 farms (Vogl and Darnhofer, 2004). Since then the number of organic farms has first declined slightly and then reached a plateau (Figure 3). In contrast, the surface of agricultural land that is cultivated according to organic production standards is increasing, but the growth has slowed down since 2006. Currently, 14% of the farms and 16% of the utilised agricultural area in Austria are cultivated according to organic standards, and so Austria ranks first amongst the European countries in relative terms (BMLFUW, 2009).

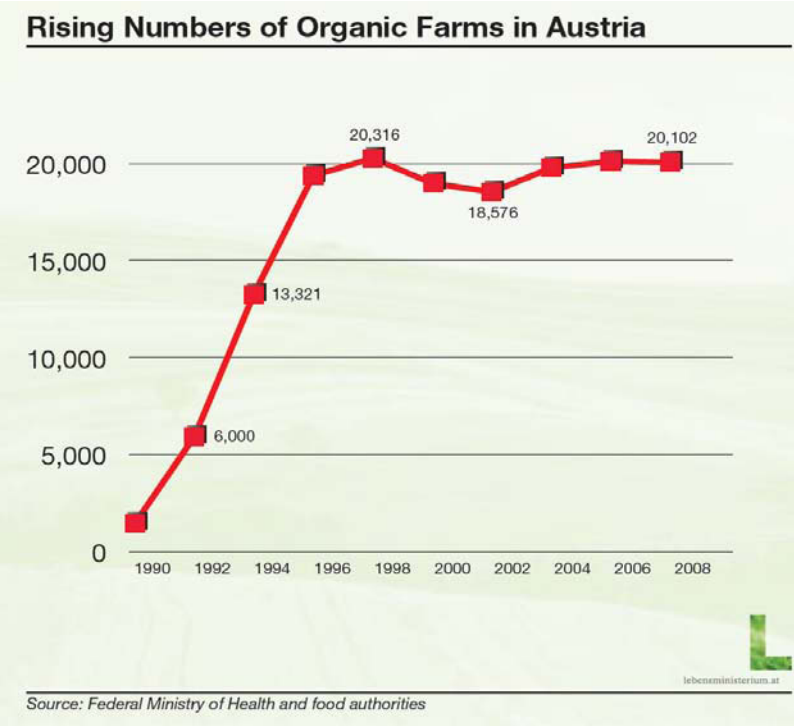

Figure 3: Number of organic farms in Austria between 1990 and 2008 (BMLFUW, 2009).

For this thesis, interviews with organic farmers were carried out all over Austria as indicated in the map (Figure 4). Black dots indicate the farms where semi-structured interviews were carried out. Green circles indicate the two study regions where structured questionnaire interviews were carried out (random sample of 10% of organic farmers in each region). A detailed description of the methods used in this thesis is given in continuation.

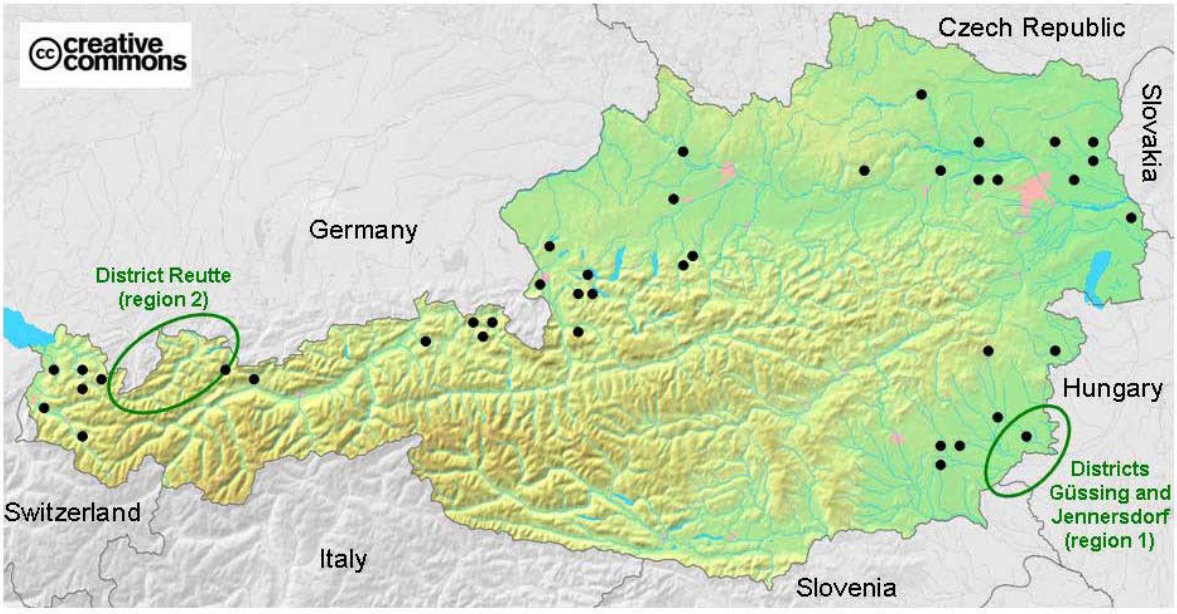

Figure 4: Localisation of interv iewees (black dots) and study regions fo r structured questionnaire interviews (green circles) (Source: Wikimedia commons, creative commons, modified)

4.2. Triangulation of methods and data collection

In 2007 and 2008, field research was carried out in two field research phases. In the first research phase, semi-structured interviews with organic farmers and representatives of the organic agriculture movement were conducted, while in the second phase data were collected in structured questionnaire interviews (Bernard, 2006).

A combination of qualitative and quantitative approaches was chosen in order to gain a broad understanding of the research topic and to obtain qualitative data rich in detail, with strong potential to reveal complexity (Miles and Huberman, 1994), and quantitative data allowing for statistical analysis.

The process of combining different perspectives and approaches when investigating a subject is called triangulation (Flick, 2007). The aim of this process is to combine triangulation sources that have different biases and strengths, so they can complement each other (Miles and Huberman, 1994). In qualitative research, the discussion of validity of research findings is an ongoing debate. Triangulation in this context is discussed as a strategy that allows for justification of qualitative research findings. This does not mean that results obtained with qualitative methods need to be 'controlled' with quantitative methods, but refers to an approach that systemically expands and completes insights of qualitative research. Triangulation is therefore less a strategy to validate qualitative methods and results than an alternative validation approach by adding complementary viewpoints (Flick, 2007). The reverse assumption also applies; qualitative and quantitative approaches can complement each other, and ideally lead to more reliable research findings.

In this thesis, triangulation refers to both data and methods triangulation (Denzin and Lincoln, 2000). Qualitative data were collected in semi-structured and informal interviews, as well as during participant observation and farm walks. Quantitative data were obtained using structured questionnaires. The sampling methods also differed: selective sampling was applied for the semi-structured interviews, and random sampling in two contrasting regions of Austria for the structured questionnaire interview phase. In the analysis of data, qualitative content analysis and quantitative statistical analysis were used.

Collection of data included personal interviews with organic farmers and representatives of the organic agriculture movement, participant and non-participant observation in courses and workshops of organic farmers, as well as working at farms, writing up field notes, and analysing magazines about organic agriculture (Table 1).

Table 1: Overview of the different phases of field research in the course of the study

Phase of field research	Aim	Method	Time period
Review of technical journal of Austrian organic farmers' association	Investigate how and to what extent organic farmers' experiments are taken up in the Austrian technical journal on organic agriculture	Content analysis of articles, analysis of quantitative share of articles on experimentation within all articles in 2005 and 2006	February-March 2007
Preparation of semi-structured interview guide, test interviews	Elaborate and test interview questions according to wording, sequence and relevance	3 semi-structured test interviews with farmers	February-July 2007
First phase of semi-structured interviews	Collect qualitative data from a purposive sample with maximum variation of organic farmers all over Austria	Semi-structured interviews with 45 organic farmers and 8 representatives of the Austrian organic agriculture movement	July-November 2007
Second phase of semi-structured interviews	Conduct follow-up interviews to deepen understanding of the research subject and complete the data	Follow-up interviews with 9 organic farmers and additional semi-structured interviews with 2 farmers	November-December 2007, May-September 2008
Preparation of structured questionnaire, test interviews	Elaborate and test questionnaire based on preliminary analysis of semi-structured interviews	Discussion with expert on questionnaires about structure of questionnaire, test interview with 2 farmers	March-August 2008
Phase of structured questionnaire interviews	Collect quantitative data from a random sample of organic farmers in two contrasting regions of Austria	26 structured questionnaire interviews with organic farmers (13 in each region)	August-September 2008
Explore the context of organic farmers' experiments in the Austrian organic movement	Collect additional information about experimentation and innovation in the Austrian organic movement, conduct spontaneous interviews with farmers and representatives of the organic sector	Participant observation at 17 workshops and meetings within the Austrian OF movement, various informal interviews	February 2007-January 2010
Involvement of interviewees in the research process	Give interviewees and members of the Austrian organic movement the possibility to get involved in and discuss the research process	Audio files and photos of interviews sent to interviewees of semi-structured interviews	July 2007-August 2008
		2 articles in technical journals	August 2007, October 2009
		Presentation about preliminary results at national organic farmers' conference	January 2010
		Short report on research progress sent to interviewees	February 2010

4.3. Qualitative approach – Semi-structured interviews

In the first field research phase, personal semi-structured interviews were conducted to gain a broad and comprehensive picture of the research subject. Semi-structured interviews enable conversation along a logical structure of questions, and allow for open answers and flexible adaptations of the interview process according to the specific interview situation.

4.3.1. Sample design and selection criteria

For the semi-structured interviews, a purposive sample with maximum variation was used (Bernard, 2006; Miles and Huberman, 1994). As a first step in sampling, potential interviewees were listed, based on prior analysis of the Austrian organic farmers' magazine 'Bio Austria', on recommendations of representatives of the organic farmers' movement (e.g. organic advisors), on contacts that were established in meetings of organic farmers, and on recommendations of organic farmers. Potential interviewees were mainly well known for experimentation activities or for innovations they introduced or developed on their farms. To contrast these 'experimentors' with 'average organic farmers', additional farmers who were not known for specific experimentation activities were included on the list. These farmers were either chosen by snowball sampling (cf. Miles and Huberman, 1994), asking organic farmers and advisors in the interviews for farmers not especially involved in experimenting, or by randomly selecting organic farmers from a complete list of Austrian organic farmers.

The list of potential interviewees was complemented during the entire period of the first field research with new contact information, with the aim of obtaining maximum variation in the sample. The final list contained contact addresses and general information on 63 organic farms and 47 of these were contacted for an interview. In six cases, the interview could not be carried out because of time constraints. Only in one case did the contacted person refuse to participate in the research study. A final total of 44 interviews were carried out on 40 organic farms with a total of 47 persons (Table 2). In three cases the interview was carried out with the farming couple together.

Table 2: Sample design and selection criteria for the semi-structured interviews

Selection criteria	Definition	f	%	total f	total %
Environment	Farm in mountainous region	19	43.2%	44	100.0%
	Farm in flat region	25	56.8%		
Main emphasis of production	Arable land	9	20.4%	44	100.0%
	Livestock	16	36.4%		
	Special cultures (e.g. horti- and viticulture)	8	18.2%		
	Processing and direct marketing	11	25.0%		
Experience in organic farming	Experienced (organic farmer since > 15 years)	27	61.4%	44	100.0%
	Between 5 and 15 years of experience	13	29.5%		
	Novice (organic farmer since < 5 years)	4	9.1%		
'Innovativeness' of the farm	Farm branches or farming philosophy are unusual for the region	26	59.1%	44	100.0%
	Farm is normal/typical for the region	13	29.5%		
	Farm is neither very unusual nor very typical for the region	5	11.4%		
Sex	Male	35	76.6%	47	100.0%
	Female	11	23.4%		

Sample size: 44 interviews, 47 interviewees (3 interviews were conducted with farming couples)

To illustrate the relation between farmers' experiments and farm resilience (see sections 5.2.2 and 6.2.2), five examples of organic farmers were selected out of the qualitative data set (n=47). These five farmers or farmer couples were selected because they explicitly conducted experiments and considered trying and experimenting important activities within farm management. Furthermore, these farmers are well known as pioneers or innovators in their region due to their new or exceptional farming practices, and are recognized for their knowledge of these practices. An additional selection criterion was that the farms were all located in a similar environment; in this case in Eastern Austria. This area is characterized by flat to hilly lowlands and temperate climate, as well as high external input agriculture and few organic farms compared to other areas in Austria. The selected cases are not representative for all organic farmers in Austria, but for a subgroup of active experimenters. The sections on resilience in this thesis are based on the collaboration with Rebecka Milestad.

4.3.2. Qualitative data collection methods

In the first field research phase, a pre-tested semi-structured interview guide (Bernard, 2006; Flick, 2007) was applied. The semi-structured interviews were combined with a structured questionnaire to collect socio-demographic data about the farmer and the farm. All interviews were conducted face-to-face at the farms of the interviewees.

An interview guide consists of a written list of questions and topics that need to be covered in a certain order (Bernard, 2006). The guide was elaborated within the project team in an intensive workshop. Interview questions were discussed regarding phrasing (Bernard, 2006; Atteslander, 2008) and checked for their relevance and positioning in the interview guide (cf. Flick, 2007). Experiences of the first test interviews were discussed and reflected upon within the project team, and the interview guide was adapted accordingly.

Potential interviewees were contacted by telephone and asked about their willingness to participate. Interviews were carried out in face-to-face settings at the farm of the interviewee. To start the interview I presented myself and the topic of the research briefly, and I handed over an information letter to the interviewee. The information letter provided the following information:

- General information about the topic of the research.
- Confidentiality statement.
- Petition for informed consent to record the interview and take pictures on the farm.
- Contact details of the interviewer (name, office address, role in the research project, i.e. doctoral student).

General information about the research topic included the following statement:

'Organic agriculture was mainly developed through organic farmers themselves. Organic farmers worldwide adapt organic agriculture to constantly changing conditions and by doing so further develop organic production. Thus, organic farmers are the experts in organic agriculture, and therefore we want to learn from your knowledge in personal interviews.'

The information letter did not contain terms such as 'experiment', 'trial' or 'innovation' in order to leave the interview open for the emic perception and definition of the research subject by the interviewees. The terms 'experiment' and 'innovation' were introduced only at the end of each semi-structured interview, and interviewees were asked to define these terms in their own words. These emic definitions are presented in section 5.1.8.

To get a general overview of the farm, interviewees were asked to briefly describe their farm, concerning the type of farm, farming activities, and size of the farm. They were also asked why they work as farmers, and why they chose to be organic farmers. After these introductory questions, a timeline was drawn together with the interviewee, indicating events and changes ordered chronologically on this line, mentioning events and dates (Bernard, 2006). The timeline started with the moment the interviewee began to work as a farmer until

the present moment, and contained notable events and changes in the history of the farm and the farmer. The central question guiding the elaboration of the timeline was 'What has changed since you started farming? What have you tried (out) in the course of time?' The compilation of the timeline helped to get into the subject and reveal experimental activities at the farm. In this initial phase of the interviews, emphasis was placed on not mentioning the term 'experiment', or other related terms (trial, innovation, etc.) but on allowing emic expressions of this term by giving the respondents the possibility to talk extensively about 'changes' that happened on their farms. These changes were examined in detail later in the interview process to elicit their experimental characteristics.

In the continuing interview, one of these topics was returned to in order to examine the details of the specific experiment. The topic was either chosen by the interviewer, because it emerged as a central experimentation activity of the respective farmer, or, if more activities emerged as promising topics to go further into detail, the interviewee was asked which of the topics he or she would choose to be interviewed about in more detail.

After choosing the topic of a specific experiment, the semi-structured interview developed along the prepared interview guideline, containing the following key questions about the experimentation process:

- What was the reason for starting this experiment?
- Where did the idea for the experiment come from?
- How was the experiment conducted?
- What results were obtained through the experiment?
- What information flows were involved in the experimentation process (information sources, dissemination of information and experiences obtained through the experiment)?

Depending on the time available, one or more experimentation activities was examined in detail during this part of the interview. In the last part of the interview, socio-demographic data about the farm and the farmer were collected with the help of a structured questionnaire. A farm walk complemented and finished most interviews, unless there was no time for this. Farm walks allowed deepening of the information received during the interviews, as farmers showed me ongoing trials or results of experimentation. Notes were taken during these walks, or the conversation was recorded if it was particularly rich in new information.

To complement the data set, additional semi-structured interviews were conducted with eight representatives of the organic agriculture movement to allow for better understanding of the institutional background of organic agriculture and farmers' experiments in Austria.

In 2007 and 2008, follow-up interviews took place with nine farmers to clarify details of their previous answers. Participant observation was carried out on four farms. Participation in 17 meetings and workshops of organic farmers or of the organic agriculture movement was carried out to better understand the institutional context of dissemination of information, advisory services and the role of farmers' experiments in the organic farmers' communication network. In the course of these meetings, informal interviews were carried out whenever possible. Research notes were written down to document observations, preliminary findings and explanations, and open questions for further investigation.

4.4. Quantitative approach – Structured questionnaire interviews

A second data collection phase was carried out with a structured questionnaire to obtain quantitative data that allows for statistical analysis and reliable comparisons (Bernard, 2006). The questionnaire confronted all interviewees with the same set and sequence of questions.

The questionnaire was based on the semi-structured interview guide of the first field research phase. The composition of the interview questions was similar to the semi-structured interviews, but instead of open ended questions interviewees were confronted with the same

set of predefined answer possibilities. Predefined answer categories resulted from preliminary analysis of the qualitative interviews. Answer possibilities included one- to multiple-choice answers, as well as ratings along Likert scales (Bernard, 2006). Interviewees had the possibility to add additional answer categories to the predefined choices. Some open-ended questions were also included in the questionnaire when interviewees were asked for explanations.

4.4.1. Sample design

Interviews with a random sample (Raithel, 2008; Bernard, 2006) of 26 organic farmers in two contrasting regions of Austria were conducted in August and September 2008. Random sampling was performed by using a table of random numbers from Bernard (2006, pp. 697-699). The first region was located in the south-east part of Austria, a flat to hilly area dominated by crop production. In the districts Güssing (GS) and Jennersdorf (JE) in South Burgenland, a random sample of 10% of organic farmers (N=135; n=13) was interviewed in personal interviews with a structured questionnaire. As a second contrasting region, the district Reutte (RE) in Northern Tyrol in the west of Austria was chosen. This alpine region is characterised by grassland farming and animal husbandry (milking cows and suckler cows for meat production). A random sample of 13 organic farmers was used (N=146; n=13). In this case the percentage was slightly smaller than in the first region (9%) to obtain the same number of interviews in both areas. Data on organic farms in Austria were provided by the Federal Ministry of Agriculture, Forestry, Environment and Water Management in an encrypted Access database on signature of a data protection statement.

The two regions differ significantly in terms of natural conditions and therefore agricultural activities (Table 3). Region 1 is situated in the lowlands of southeast Austria, and is characterised by a temperate climate with medium to low precipitation. Cropping is the prevailing agricultural activity, but animal husbandry of a variety of animals, and the cultivation of wine, fruits and vegetables is also common. Farm size varies notably, with a tendency for larger farms, even in organic agriculture. Region 2 is characterised by an alpine climate, with low temperatures and high precipitation rates. Agriculture is clearly dominated by grassland farming, pasture, and milk and beef production. Farm size is small in comparison with the average farm size in Austria. Besides the natural conditions, the social conditions in which agricultural activities are embedded differ from each other between the regions. Agriculture in region 2 has a traditional background, and is generally only carried out by persons that inherited the farm from the previous generation. In region 1, low land prices enable agricultural outsiders to start farming.

Table 3: Characteristics of the two contrasting regions

Characteristics	Region 1 (GS/JE)	Region 2 (RE)
Area	738 km²	1.237 km²
Natural conditions	Temperate lowlands	Alpine region
Altitude above sea level	200-400 m	830-1530 m
Average annual temperature	8.7-9.0 °C	6.5-7 °C
Annual precipitation	700-750 mm	1300-2000 mm
Number of farms	1533	855
Number of organic farms	135	146
Proportion of organic farms	8.8%	17.1%
Main agricultural activities	Cropping, fruit, wine and vegetable production	Grassland farming, milk and beef production
Average farm size	18 ha	7 ha
Average farm size sample	41.1 ha	17.3 ha

(Data source: Chamber of Agriculture in Güssing and Reutte, data from 2008)

4.4.2. Quantitative data collection methods

Randomly selected farmers were contacted by telephone in the same order as they appeared on the sample list. If a farmer refused to be interviewed, or if a person could not be reached after several attempts, the next person in the list was contacted until the sample size of 13 farmers was obtained. Interviews were conducted personally at the farm of the respective interviewee and started with a short presentation of the interviewer and the research topic, by handing over an information letter as in the semi-structured interviews. In contrast to the semi-structured interviews, interviewees were confronted with the term 'experimentation' in the beginning of the interview by stating a definition of the term that was based on findings of the semi-structured interviews. The following definition was used:

'If we use the terms trial, test or experiment here, we refer to how YOU assess and test, if and how something works or is suitable for you and your farm. We do not refer to a scientific procedure, but to practical trials conducted on organic farms. What you try or test can be your own idea or something you saw or heard about, a change that you implement, etc.'

After defining the research topic, farmers were asked directly if they conducted experiments on their farm by the question 'Do you try different things on your farm, or did you try things in the past (according to the given definition)?' If the farmer answered in the affirmative, he or she was asked to freely list topics of experiments he or she already experimented on. After the free-listing exercise, farmers were asked to select one of the experimentation topics listed to talk in more detail about this specific experiment. The experiment was then described by the farmer. Later, farmers were confronted with closed questions about reasons, methods, information sources and results of the selected experiment. To conclude the interview part about a specific experiment, farmers were asked whether they thought the selected experiment was a typical example of how they conducted experiments, or whether there had been significant differences to other experiments. With this question I wanted to check the extent to which specific behaviour can be abstracted to the general behaviour of the interviewee. The interview was then completed by collecting socio-demographic data about the farm and the farmer. During the whole period of quantitative data collection, data were stored and structured, and research notes were elaborated to reflect about the research process and to document information obtained in addition to the quantitative data.

4.5. Data processing and analysis

In total, 73 organic farmers in Austria were interviewed about experiments they had carried out on their farm. Semi-structured interviews were conducted with 47 farmers, and structured questionnaire interviews were conducted with 26 farmers.

All semi-structured interviews were recorded with a digital voice recorder after asking the interviewee for permission, and later transcribed with the transcription software 'Express Scribe'. Transcription was conducted by me, with the help of technical staff. Transcripts that I did not transcribe personally were controlled and checked for possible errors. Quantitative data from the semi-structured and structured questionnaire interviews were inserted into an Access database (Microsoft Office Access 2003).

'Data analysis is a syst ematic and essentially t axonomic process of sorting and classifying the data that have been collected' (Green et al., 2007). The main task during data analysis is to apply the theoretical framework of the study to the data set and to classify the findings which emerged from the data. The data have to be sorted into different conceptual categories, which serve as a basis to provide an explanation for the findings (Daly et al., 2007).

In this study, qualitative data analysis was conducted by coding the transcripts with the help of the qualitative data analysis software Atlas.ti. Codes are used to retrieve and organise chunks of text, so the researcher can easily find, extract and cluster the segments relating to a particular research question, hypothesis, construct or theme. Clustering and the display of condensed text pieces then set the stage for drawing conclusions (Miles and Huberman,

1994). Coding can be defined as *'categorizing data extracts according to how they relate to emerging or existing analytic themes'* (Li and Seale, 2007).

The coding structure and the analytical steps followed the research questions and hypothesis stated in the project proposal. A combination of deductive and inductive coding was applied (Miles and Huberman, 1994). Codes should be part of a governing structure, i.e. relate to one another in coherent, study-relevant ways. An operative coding scheme is a conceptual web, including larger meanings and their constitutive characteristics (Miles and Huberman, 1994). The governing structure in the coding process was a code book that was set up in the research team. The code book was configured as a mind map (Figure 5), starting at the first level with central research questions and concepts, and branching out into various levels of detail. Notes on the terms used and their definitions were added into the code book.

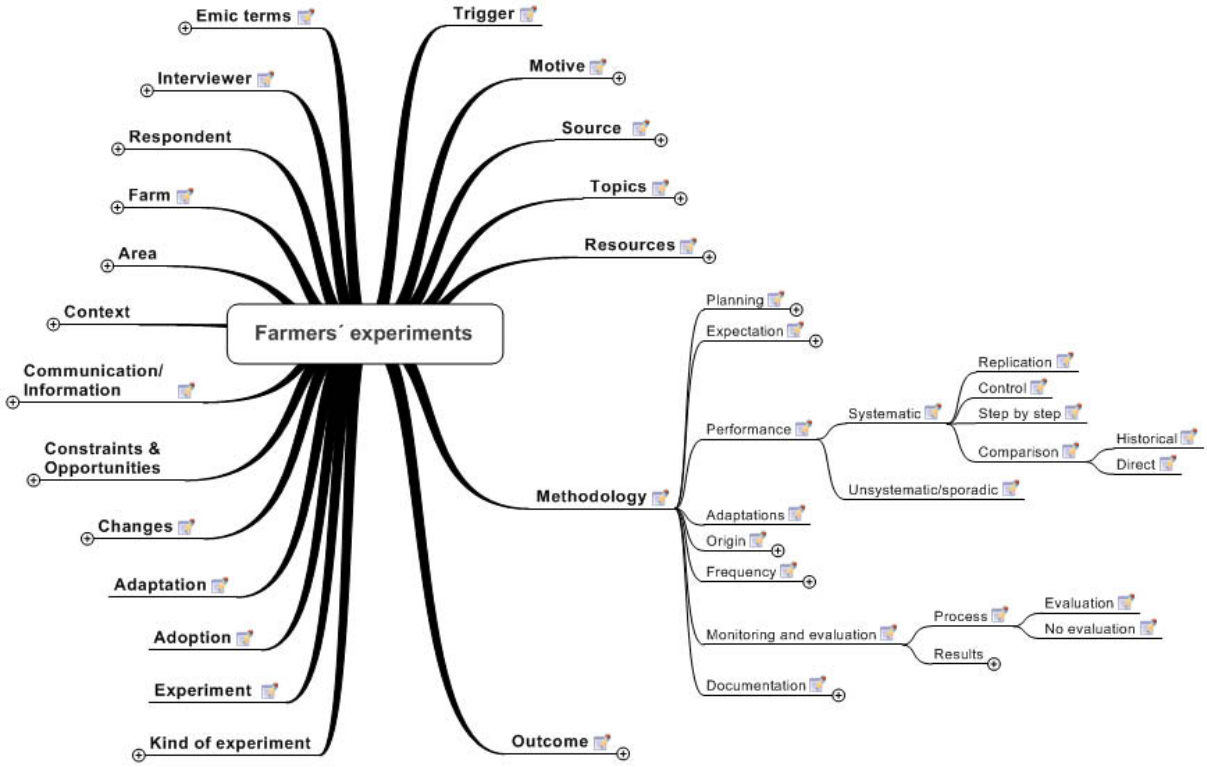

Figure 5: Basic and exemplified detailed structure of the code book

Analysis of quantitative data was performed through univariate and bivariate statistics with the help of the software SPSS. Univariate statistics allow for a descriptive and inferential analysis, whereas bivariate analysis describes relations between pairs of variables and tests the significance of those relations (Bernard, 2006). Chi square tests and Spearman correlations were used to test the significance of bivariate relations on a significance level of $p<0.05$, and in one case on $p<0.1$ level. For data display, 5-point Likert scales were reduced to 3-point scales to facilitate visual comprehension.

Statistical analysis was mainly employed for data from the structured questionnaire interviews. Some descriptive statistical analysis was also conducted for qualitative data of the semi-structured interviews, i.e. for Figure 6 (topics of farmers' experiments), and for Table 26 (descriptive personal and farm data of the interviewees).

Data from semi-structured interviews are presented as case studies in research paper II and in section 5.1 and 5.2. To illustrate the relation between farmers' experiments and farm resilience (see sections 5.2.2 and 6.2.2), a case study of five organic farmers or farmer

couples was selected out of the data from semi-structured interviews (n=47). The research findings of this case study on resilience were summarised in a manuscript that will be submitted to a scientific journal after completion of this thesis. Findings of quantitative analysis are presented in section 5.1, and have not previously been presented in research papers.

4.6. Critical reflection on the methods applied

The reason for the selection of the deliberate sample design in the first field research phase was to get a broad picture of organic farmers' experiments, in order to assess the variations in the research subject and possible influencing factors in the experimentation process. I chose to interview persons who are especially knowledgeable in the subject, and complemented the sample with persons supposedly lacking special knowledge. In the interviews, however, it turned out that in some cases farmers recommended to me as being innovative added only little new or additional information to my research. On the other hand, some farmers who were sampled as 'average farmers' emerged as keen observers with rich experience in experimenting. In retrospect, it would have been advisable to add more 'average farmers' to the sample and not concentrate so much on well-known and successful farmers. By applying a random sample in the second field research phase, this imbalance was corrected.

The low proportion of women in the sample (23% in the semi-structured, 27% in the structured questionnaire interviews) is also a factor that can be criticised. By basing the selective sampling mainly on recommendations and magazine articles of the Austrian organic farmers' association, the list of potential interviewees contained a significantly higher proportion of men. Besides the sampling source, the approach in contacting potential interviewees also did not result in a gender-balanced sample. I actively tried to involve more women by asking them explicitly for an interview. Some women stated that they did not feel knowledgeable or that they were not sufficiently involved in farming activities. In the context of research about farmers' innovations, other researchers have faced similar situations. A study about the promotion of farmers' innovations that was carried out in Africa found that only 20% of the participants in the programme were women. *'It is not surprising that more men than women have been identified as innovators (…). There is a natural tendency for men to present themselves as innovators even when the woman of the household is equally (or mainly) involved'* (Critchley et al., 1999, p. 43). It would have been possible to involve more women, e.g. by applying snowball sampling and asking interviewees to specifically name women for further interviews, or by more explicitly asking women farmers for an interview. In the case of this thesis, however, I could not conduct a reliable analysis of gender aspects of the topic, as the sample was not balanced.

As the sample size in the structured questionnaire interviews was small (n=26), and only two regions in Austria were sampled, the results of statistical analysis can not be generalised for the overall situation of farmers' experiments in Austria. Still the results of the statistical analysis are valid, because interviewees were selected based on non-purposive random sampling, and around 10% of the total population of organic farmers in the respective region were interviewed (see section 4.4). To increase the significance of statistical analysis, a larger sample size would be needed. The questionnaire interviews can be seen as exploratory research for a more extensive survey that could not be realised within this doctoral project.

The combination of qualitative and quantitative methods for data collection and analysis was a decided objective of both the project team and me as a researcher and doctoral student, so a feasible solution had to be found to fit the working conditions and the limited time frame. The decision to carry out the second field research phase in a pilot study mode allowed me to approach the research subject from a different angle. By conducting the quantitative questionnaire survey in personal interviews it was possible to acquire additional qualitative information and feedback regarding the applicability of a structured questionnaire for a

complex topic such as farmers' experiments. With these insights, an optimised questionnaire can be drawn up that allows for self-administered response and can be applied to a large sample.

When comparing the methods of semi-structured and structured questionnaire interviews, it became evident that a complex topic such as farmers' experiments and learning processes can only partly be investigated by providing pre-defined answer categories, as used in the structured questionnaire interviews. It is necessary to let farmers explain in more detail about the process of experimentation by integrating open-ended questions into the interview. On the other hand, extensive qualitative interviews with a high quantity of questions concerning a multitude of subjects and factors associated with the research topic, such as the semi-structured interviews, frequently lead to long and exhausting interview situations, where it is difficult to keep the level of concentration. By combining the two methods it was possible to obtain a picture of the research subject that is both rich in detail and focused on central research questions. The combination therefore provided a suitable approach for the investigation of the research topic.

Another topic for critical reflection is the fact that I carried out my research 'at home' (in my home country, partly in my home region) and as an 'insider': I was raised as daughter of farmers, and therefore many things seemed normal and familiar to me, e.g. fixing broken things or slightly changing tools, etc., or using things or technologies in a different way. In this sense I am kind of an insider, which probably made me blind to certain small-scale experiments. The next critical observation was that doing the research 'at home', especially in the region I come from and as a person with a university degree in agriculture, i.e. somebody expected to be a kind of agricultural expert, complicated matters sometimes. For example, interviewees sometimes looked astonished because of a question about something that I was 'supposed to know'. Therefore it was important to make it clear to the interviewees that I wanted to know what they thought about a certain practice, how they actually did things, and so to learn from them without anticipating 'what (s)he means by that'.

There were also advantages with being an insider: I already had knowledge about the reality of Austrian farmers and I had close relations with organic farmers, with whom I could discuss my research on a meta-level and ask them what they thought about the research, my hypotheses and my findings.

To face the challenges related to this situation, I orientated my research approach on what Bernard (2006) writes about objectivity: *'We can become aware of our own experiences, our opinions, our values. We can hold our field observations up to a cold light and ask whether we've seen what we wanted to see, or what is really out there. The goal is (…) for us to achieve objective – that is, accurate – knowledge by transcending our biases.'* (Bernard, 2006, p. 370).

5. Results

This chapter is structured into two parts that correspond to the overall objectives of the thesis: First, results about the general situation of organic farmers' experiments in Austria are presented based on the analysis of semi-structured and structured questionnaire interviews. The results of quantitative data analysis are displayed in tables and complemented by quotes from the semi-structured interviews. Second, results regarding the significance of farmers' experiments as learning strategies to deal with change and build farm resilience are presented by drawing on selected case studies of the semi-structured interviews. Furthermore, research results of paper II are summarised.

5.1. Situation of farmers' experiments in Austria

In the following, the situation of farmers' experiments is presented regarding frequency, motives, sources of information, methods and results of experiments, as well as factors that influence farmers' experiments. Furthermore, a characterisation of different experimentation types is developed, and interrelations between individual experiments are demonstrated.

5.1.1. Occurrence and frequency of farmers' experiments

All 73 farmers interviewed reported at least one activity in the course of their occupation as 'trying something' on their farms. In total, 385 individual experiments were mentioned by the 73 interviewees and 92 experiments were discussed in detail in the interviews (66 experiments in semi-structured and 26 experiments in structured questionnaire interviews). These numbers do not display the total quantity of experiments carried out on the farms of the farmers interviewed, but only refer to experiments that had been mentioned freely in the interviews. The numbers therefore do not allow for quantification of experiments on farms, but give information about the empirical base of the following results.

In the structured questionnaire interviews (n=26), farmers were asked to freely list experiments they had carried out. Between one and 10 topics of experiments were mentioned by the farmers, with an arithmetic mean of 5.4 topics. Asked for the frequency of experimentation, 50% of the farmers stated that they tried things 'rarely' (defined as 'not regularly and not every year'), 30.8% stated that they tried things 'sometimes' (defined as 'at least once every season or year'), and 19.2% stated that they 'very often' tried things on their farm (defined as 'frequently during the whole season or year') (Table 4).

Table 4: Frequency of experimenting among randomly sampled farmers (n=26)

On your farm you try things:	**f**	**%**
Very often	5	19.2%
Sometimes	8	30.8%
Rarely	13	50.0%

5.1.2. Topics of farmers' experiments

This research was not limited to experiments in a certain area of agricultural activities. Farmers were asked for all kinds of experiments they conducted on their farm in order to assess the topics represented in experimental activities by organic farmers. The 92 individual experiments that were discussed in detail in semi-structured and structured questionnaire interviews (n=73) were clustered into 15 overall topics (Figure 6).

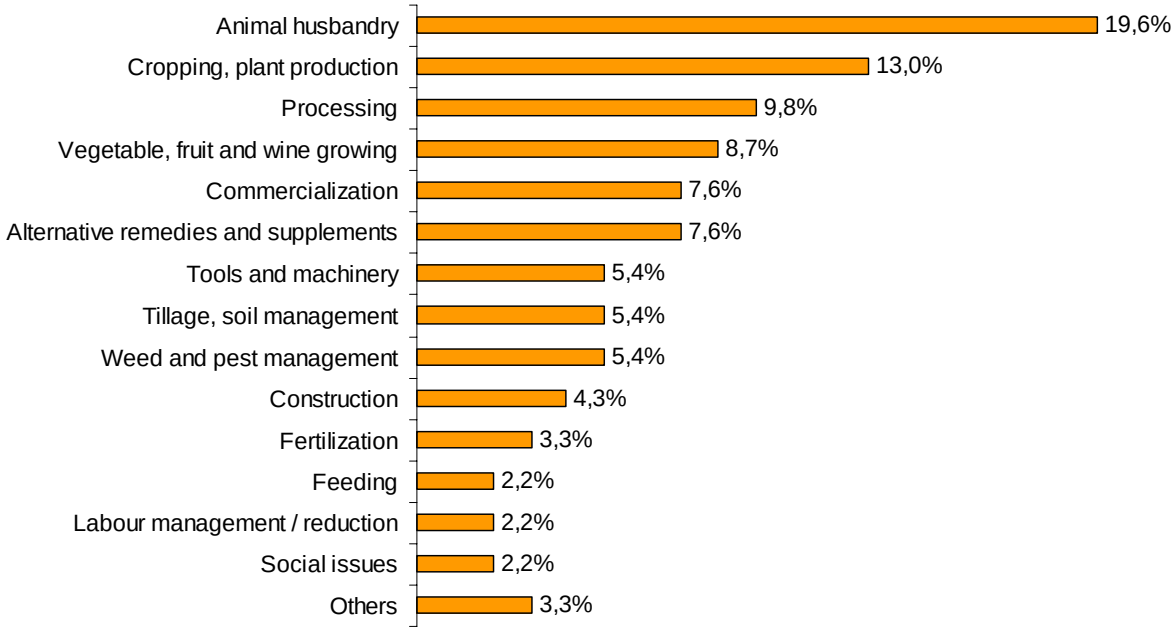

Figure 6: Frequency of topic s for farmers' experiments according to thematic clusters (92 experiments discussed in detail in semi-stru ctured and str uctured questionnaire interviews, n=73).

Of the experiments discussed, 35.8% were conducted in the context of plant production, cropping and tillage, and included:

- Testing of new varieties and crops, including old and rare varieties;
- Breeding activities, especially in the context of fruit and vegetable production;
- Testing of different alternatives within plant production, e.g. intercropping and undersowing;
- Optimising the crop rotation;
- Testing different tillage tools and systems, including new systems such as ploughless tillage, reduced tillage and direct sowing;
- Trying different methods of weed control, e.g. different tools and machines for tillage, methods and time schedules for mechanical weed control, or introducing new crops into the crop rotation to suppress weeds;
- Testing different ways of fertilisation, e.g. commercial organic fertilisers, farm manure, compost or mulching.

Experiments in the area of animal husbandry (21.8% of the experiments) included:

- Introduction of new breeds and species on the farm;
- Testing of different feedstuffs and optimisation of feed composition;
- Testing of different ways to handle animals, e.g. rearing animals and young animals (assistance before, during and after birth, handling and feeding of suckling animals);
- Trying new forms of housing and pasturing, e.g. conversion from tethered systems to loose housing systems in dairy farming, implementation of free-range systems;
- Converting to alternative husbandry systems, e.g. from dairy farming to suckler cow systems.

Experiments regarding processing and commercialisation (17.4% of the experiments) included:

- Development of recipes, testing of new ingredients, development of new products, establishment of product ranges, e.g. broad range of different breads and pastries for direct selling, and improvements in processing to reduce or ease labour;

- Development of alternative marketing systems, e.g. implementation of direct selling (farm shops, catering systems, self-harvest systems), cooperations with other farmers in direct marketing, establishment of farmers' markets.

A range of further experimentation activities (25.0% of the experiments) were found in the interviews and included:

- Experiments in a technical context, such as developing or modifying and adapting tools and machinery on the farm;
- Testing of different alternative remedies, preparations and supplements to improve plant or animal health, or to improve compost, manure and soil quality, e.g. testing of effective microorganisms, homeopathy, biodynamic preparations, and other alternative remedies, or testing the lunar influence and farming according to the moon's cycle;
- Experiments in a social context, such as implementing social activities on the farm, e.g. caring for children and teenagers, social work with socially, physically or mentally handicapped people; establishing excursions, courses and holidays on the farm; developing and offering educational activities on the farm (e.g. 'farm schools' or 'forest schools' for pupils).

5.1.3. Motives for farmers' experiments

Farmers were asked to rate different motives according to their importance for a specific experiment (Table 5). 'Problem solving' was considered an important motive by all interviewees in the structured questionnaire interviews (n=26); 85% of the interviewees considered 'personal reasons' an important motive for the respective experiment, and 77% rated 'necessity' as an important motive.

Table 5: Importance of motives for farmers' experiments according to frequency (f) and percentage (%), (n=26). Motives were pre-coded answer categories using terms from previous semi-structured interviews.

	Important		Neutral		Not important	
Motive	**f**	**%**	**f**	**%**	**f**	**%**
Problem solving	26	100.0%	0	0.0%	0	0.0%
Personal reasons	22	84.6%	2	7.7%	2	7.7%
Necessity	20	76.9%	0	0.0%	6	23.1%
Challenge	16	61.5%	4	15.4%	6	23.1%
Promoted by others	14	53.8%	2	7.7%	10	38.5%
Making work easier	13	50.0%	1	3.8%	12	46.2%
Improving quality	13	50.0%	1	3.8%	12	46.2%
Environmental reasons	12	46.2%	3	11.5%	11	42.3%
Saving money	11	42.3%	1	3.8%	14	53.8%
Increasing production	11	42.3%	2	7.7%	13	50.0%
Increasing income	10	38.5%	3	11.5%	13	50.0%
Saving time	10	38.5%	3	11.5%	13	50.0%
Increasing safety	9	34.6%	1	3.8%	16	61.5%
Self-sufficiency	7	26.9%	0	0.0%	19	73.1%
Market demands	5	19.2%	3	11.5%	18	69.2%
Coincidence	5	19.2%	1	3.8%	20	76.9%
Diversification of production	4	15.4%	1	3.8%	21	80.8%

The motives for starting an experiment that were mentioned most often in the semi-structured interviews (n=47) were problem solving and necessity, personal reasons, increasing income and market demands.

Problems with weeds and pests, diseases of animals or plants, but also external pressure such as regulations constituted motives for farmers' experiments.

> *"I tried a lot of things in tillage. The thistles showed me that I am not on the right path. I ploughed deeper, and then more shallow, then very deep. The thistles just laughed at me. They got more and more, at least not less. So I searched for alternatives, and if you search, then different possibilities emerge. Then I got in contact with people that practise tillage without plough, and I liked that very much. So I immediately sold the plough and worked according to their insights. (…) Humus contents increased, and behold – the thistles diminished." (IP.09)*

Personal reasons included interest in the topic or curiosity about how something could work or not, and also the opinion that implementing a specific practice on the farm would be meaningful and desirable for the respective person. A female farmer who started to implement self-harvest allotments on her farm and to offer excursions for adults and school children expressed her motives as follows:

> *"To create a link between producers and consumers was important for us from the start. I experienced that many adults do not have any idea [about farming]. (…) For me, this is not only about healthy food and a bit of countryside, but about starting a thinking process, and about appreciation." (IP.03)*

Increasing income and economic considerations also constituted a frequent motive for the interviewees, as in the case of this farmer:

> *"It was an economic motive; I saw that [starting to produce organic strawberries] as the only possibility. Somebody approached me and said that I could earn a lot. The situation in farming in our region is like that, when you sell the hay, you get pocket-money, so forget about that. And cereals do not yield enough here. With the strawberries I hoped that I could earn more." (IP.16)*

5.1.4. Sources of ideas and information sources of farmers' experiments

Of the farmers in the structured questionnaire interviews (n=26), 69% considered their own idea an important source of idea. Other farmers (54%) and literature (42%) were also important sources of ideas for farmers' experiments. Scientists were rated the least important source of idea, with 92% of the interviewees considering scientists as not important sources of ideas for their experiments (Table 6).

Table 6: Importance of different sources of ideas for farmers' experiments according to frequency (f) and percentage (%), (n=26). Sources of ideas were pre-coded answer categories using terms from previous semi-structured interviews.

	Important		Neutral		Not important	
Source of idea	**f**	**%**	**f**	**%**	**f**	**%**
Own idea	18	69.2%	0	0.0%	8	30.8%
Farmers	14	53.8%	1	3.8%	11	42.3%
Literature	11	42.3%	1	3.8%	14	53.8%
Friends, acquaintances	9	34.6%	2	7.7%	15	57.7%
Advisors	9	34.6%	2	7.7%	15	57.7%
Other knowledgeable persons	8	32.0%	0	0.0%	17	68.0%
Family members	7	26.9%	1	3.8%	18	69.2%
Courses	6	23.1%	2	7.7%	18	69.2%
Excursions	5	19.2%	2	7.7%	19	73.1%
Customers	3	11.5%	1	3.8%	22	84.6%
Internet	3	11.5%	1	3.8%	22	84.6%
Fairs	3	11.5%	2	7.7%	21	80.8%
Scientists	2	7.7%	0	0.0%	24	92.3%

A farmer explained the process through which he comes to ideas for experiments like this:

> *"It happens by thinking for a long time about something, without forcing it. And by looking at other areas, what they do there to confront similar problems. Or it simply comes to your mind while you are jogging and you think about something and follow your spontaneous ideas. And then you puzzle as long as you reach to a solution where you think this is feasible." (IP.07)*

Other farmers were frequently mentioned as a source of idea and inspiration to start an experiment. When the farmer was unsure about how an unknown crop would work for his farm, he observed a farmer colleague during a period of time until he decided to try it also:

> *"He approached me and said that I should also start. But first I didn't want to take the risk, because I thought strawberries would not grow in our climate. Then I observed his farm for two years. When I saw that it worked well, I decided to start myself." (IP.16)*

Literature such as books, technical journals and newspapers also motivated farmers to start an experiment:

> *"I took the idea from literature not one-to-one, but it motivated me to try by myself. For example mulching, it is not common in our region, and I adapted it to our conditions. Reading opens your eyes for something you probably already know, something that is logical to you, and then you try it." (IP.11)*

In the structured questionnaire interviews (n=26), farmers were asked about where they got information from to carry out experiments. Literature was rated as the most important information source to carry out experiments, with 61.5% of the interviewees citing it as their most important source. Other farmers were rated an important information source by 54% of the interviewees, and advisors were considered an important sources of information by 46% of the farmers interviewed. Scientists and fairs were rated as less or not important sources of information by 88.5% of the interviewees (Table 7).

Table 7: Importance of information sources for farmers' experiments according to frequency (f) and percentage (%), (n=26). Information sources were pre-coded answer categories using terms from previous semi-structured interviews.

	Important		Neutral		Not important	
Information source	**f**	**%**	**f**	**%**	**f**	**%**
Literature	16	61.5%	1	3.8%	9	34.6%
Farmers	14	53.8%	1	3.8%	11	42.3%
Advisors	12	46.2%	0	0.0%	14	53.8%
Friends, acquaintances	10	38.5%	2	7.7%	14	53.8%
Other knowledgeable persons	7	26.9%	1	3.8%	18	69.2%
Courses	7	26.9%	2	7.7%	17	65.4%
Internet	6	23.1%	0	0.0%	20	76.9%
Family members	5	19.2%	1	3.8%	20	76.9%
Excursions	5	19.2%	0	0.0%	21	80.8%
Scientists	3	11.5%	0	0.0%	23	88.5%
Fairs	3	11.5%	0	0.0%	23	88.5%

Comparison of Table 6 and Table 7 shows that literature was rated an important source of idea by 42% of farmers, but an important source of information by 61.5%. Advisors were rated an important source of ideas by 35%, but an important information source by 46% of the farmers. The internet, which was one of the least important sources of ideas (11.5%), was considered an important information source by 23% of the farmers interviewed.

5.1.5. Methods used in farmers' experiments

To assess the methods that farmers used in their practical experiments, farmers were asked about planning, set-up, monitoring, documentation and evaluation of their experiments.

Most of the interviewees (73%) with the structured questionnaire interviews (n=26) had an explicit mental or written plan, and 27% of the farmers reported that they did not have an explicit plan before starting an experiment (Table 8). Some basic considerations or expectations about the process or outcome of the experiment were involved in 80% of the reported interviews (Table 9).

Table 8: Frequency of different kinds of planning strategies for farmers' experiments (n=26)

Planning	**f**	**%**
Explicit plan	19	73.1%
Written plan	5	19.2%
Mental plan	14	53.9%
No explicit plan	7	26.9%

Table 9: Frequency of different kinds of expectations when starting an experiment (n=26)

Expectations	**f**	**%**
Explicit expectations	15	57.7%
Rough expectations	6	23.1%
No expectations	5	19.2%

In the semi-structured interviews (n=47), farmers stressed the importance of basic considerations or a kind of mental plan before starting an experiment. Some farmers added that such a plan had to be flexible enough to allow for adjustments and for taking up opportunities that emerged.

"Planning for me works like this: I visit other farms, I look at how they do that, I read technical literature, I try on small scale, and then I adapt it from year to year." (IP.29)

"My plans are not too fixed and not too much focused on a long term, because I have to be flexible to react to market or weather conditions. There are farmers that have very strict plans, e.g. for their crop rotations, and they already planned everything until 2015. I cannot cope with that, it would constrict me too much. If there emerged a new crop or new technologies, how could I implement that if everything were planned already?" (IP.46)

Some experiments were conducted without explicit planning. In these cases, farmers often reported that they acted based on their experiences, feeling, and intuition:

"I just did it acting on my senses. I simply added it [effective microorganisms] to everything I thought it would be right or necessary." (IP.15)

The majority of the farmers (69%) in the structured questionnaire interviews (n=26) stated that they set up their experiments first on a small scale and enlarged them if the outcome of the experiment was satisfactory. By doing so, farmers were able to first try a new method or practice with little risk.

Small-scale set-up of experiments was also the prevailing strategy reported in the semi-structured interviews (n=47), as in the case of an organic wine grower or a female farmer that started to bake bread and sell it on farm:

"I try everything first at small scale, for example by trying an organic remedy in two or three of my vineyards, but only on one third of the area. Then I evaluate the effect and compare it [with the non-treated area]. The first trials date back seven or eight years, and since some years I apply [sodium bicarbonate] on the entire area." (IP.31)

"Then I thought if I could stand to bake bread on a regular basis, or if I would be bored baking bread every week. So I tried it here in the kitchen oven, and I liked it. Then we reactivated an age-old baking oven that had not been in use for 25 years. This was my oven until 2000, and I baked bread for the surrounding farm shops. (…) Now we have a farm bakery with three part-time employees." (IP.08)

Of the interviewees in the structured questionnaire interviews, 31% (n=26) started the experiment on a large scale, either because they were convinced the new method would work satisfactorily, or because it was difficult or impossible to run a small-scale test. The impracticability of a small-scale test was often cited in the case of experiments that involved technical constructions such as buildings or machinery that were implemented at once for the entire production unit. Setting up a test version in these cases would have been more costly than the construction of the entire production unit.

All interviewees in the structured questionnaire interviews (n=26) used regular observation, or at least observation of the outcomes of the process to monitor their experiments, with 88.5% of the farmers reporting monitoring activities daily, weekly or several times during the season and 11.5% observing the experiment only at the end (Table 10).

Table 10: Monitoring frequency of farmers' experiments (n=26)

Monitoring frequency	f	%
Daily	9	34.6%
Weekly	3	11.5%
Several times during season	11	42.3%
At the end	3	11.5%
No monitoring	0	0.0%

All farmers in the structured questionnaire interviews (n=26) reported that they observed the experimental process, 88.5% of the farmers conducted comparisons, and 15% of the

interviewees employed some kind of measurements, e.g. yield quantity, counting (e.g. of plants affected by a certain disease), or economic measurements (e.g. price calculations for different processed products for marketing) (Table 11).

Table 11: Frequency of different kinds of monitoring of far mers' experiments (n=26, multiple answers possible)

Monitoring	f	%
Observation	26	100.0%
Comparisons	23	88.5%
Measurements	4	15.4%
No monitoring	0	0.0%

To evaluate the success or failure of an experiment, 23 farmers in the structured questionnaire interviews (n=26) stated that they compared their experiments with former experiments (historical comparison), with other units or practices on their own farm, with units or experiences of other farmers, with information from advisors or other experts in the subject, and with results described in literature (Table 12).

Table 12: Frequency of different kinds of co mparison as a monitoring strategy for farmers' experiments (n=23, multiple answers possible)

Comparisons	f	%
With own experiences	22	84.6%
With other farmers	19	73.1%
With other unit on the farm	7	26.9%
With results from literature	7	26.9%
With information from advisors	5	19.2%

In the semi-structured interviews (n=47), farmers also reported different kinds of comparisons. A farmer who has been experimenting for some years with ploughless tillage reported about historical comparison as follows:

> *"The observations I made is that the thistles definitely declined. And if there was still thistle in the field, then it was not as strong as in the past. Because in the past the thistles often grew higher than the grain and topped it." (IP.09)*

The method of formal direct ('side-by-side') comparison of two or more alternatives was reported by few farmers. In the following, a farmer reported how he compared different crops side-by-side in a trial garden to select the most appropriate crop for organic production:

> *"When we converted to organic agriculture, we played with many crops, with amaranth, and with crambe [Crambe abyssinica], with lupin, and also with hemp, all kind of unusual things that nobody really knows any more. We set up little trial plots, just a few square metres each in a trial garden, sorted out the best of these and continued with that. (…) We did that for two years during the conversion period. He mp was a ctually the most comfortable crop, beca use it doesn't need any fertiliser, no maintenance, nothing, and therefore it fits ideally." (IP.05)*

Some farmers commented that side-by-side comparison would be a lot of effort and would require additional documentation of the observations:

> *"I am not the kind of pe rson to set up trials with different varieties, for example growing three varieties of carrots and evaluating how they grow, how they develop, and how much they yield. That is too much effort a nd probably too scientific, I don' t know. Then I would also have to document, because I couldn't remember all that." (IP.03)*

A farmer reported about practical obstacles he confronted when he set up trial plots:

> *"Two years ago we set up 64 small parcels of land with different crops, just in front of the house, all sorts of things, also teff, millets, lentils, different amaranth varieties. I made a plan, and we divided everything with sticks and put numbers. But then the next day there was a heavy shower, and the parcels eroded, so the more sensitive crops didn't grow well." (IP.24)*

Different challenges relating to the practical work and conditions of farmers were also reported by a grassland farmer:

> *"I do not really have the possibilities to evaluate my experiments. Well, I see that the grassland composition develops in a positive direction. I often divided my pastures to compare manured areas with areas that were not manured. But then I do not have the time to evaluate that. You cannot always see the difference easily, but you can imagine it works. But this is not objective. (…) Sometimes I mark the area with sticks, but then the sticks fall over. Or with composting: Sometimes I do not even have the time to compost the manure, and I leave it on a heap, and then simply take it and spread it on the pastures. Time is often lacking to do the things properly, so they would be successful." (IP.43)*

Less formal direct comparison was frequently used e.g. by comparing a newly introduced cattle breed with individuals of the cattle breed already present on the farm and comparing behaviour and performance of the two breeds.

A farmer that cultivated strawberries experimented with different varieties on a regular basis. He compared the performance of every variety regarding health, yield and taste with one reference variety:

> *"Because one variety, Elsanta, is the variety everything refers to; in general, not only on our farm. And when I see that a variety is as good as Elsanta, or better, then it is fine." (IP.16)*

Of the farmers in the structured questionnaire interviews, 65% (n=26) stated that they carried out some kind of written documentation. Written documentation involved individual notes (38.5%), but obligatory records that farmers had to provide to comply with requirements of the regulation and subsidy system were also seen as documentation of farmers' experiments. 11.5% of the farmers took photographs of their experiments. Almost half of the farmers interviewed did not document their experiments (Table 13).

Table 13: Frequency of different kinds of documentation of farmers' experiments (n=26, multiple answers possible)

Documentation	f	%
Taking notes	10	38.5%
Obligatory records	7	26.9%
Taking photographs	3	11.5%
No documentation	11	42.3%

Farmers in the semi-structured interviews (n=47) reported different documentation strategies. A farmer explained the importance of documentation as follows:

> *"I mainly take pictures. And then I can look at the pictures later on. You wouldn't believe how fast you forget how all this developed. If you look at a picture after one year you see things that you are not aware of any more. The longer you go back in your memory, the less you remember, and after four or five years you know hardly anything! (…) Digital pictures carry the date automatically, and then I sort them according to the field. Every field has a name. And then I also sort the pictures according to the year. Like this, I am*

able to find things fast. The most interesting pictures I put in a separat e folder and use them for talks and lectures." (IP.46)

A farmer producing different home-made beef products explained his documentation procedure as follows:

"We always write recipes. They are written very detailed: So much percent beef, so much bacon, if the bacon is diced or chopped, and then the s pices, which spices we add. Everything exactly in grams, so everything is weighed exactly, so that the taste is always the same." (IP.12)

Obligatory records, e.g. for the organic inspection system, were also used as documentation of experiments and were sometimes complemented with additional observations:

"I don't know, probably we are a bit lazy when it co mes to writing. The only t hing I document quite in detail is the crop rotation, where I document what t he plants o n the different plots look like. Anyway I have to docu ment the yield of eve ry variety fo r the organic inspection. And so I document all this, becau se it is nice to look at , and it is interesting." (IP.05)

Some farmers stated that documentation was time-consuming for them:

"I am not a bureaucrat who writes everything down very detailed. P robably this is a disadvantage, but it does not make sense, at least for me, if I docum ent even more and have even more work." (IP.36)

A female farmer providing an organic catering service stated that it would have advantages for her if she documented her recipe experiments:

"Unfortunately I do not docum ent my recipes, and I a m angry about m yself because of that. Because from time to time something special happens to you, and then you want to repeat that, but you didn't write it up!" (IP.01)

Some farmers stated that they did not write documentation, but had a kind of mental documentation, as in the case of a farmer who cultivates herbs:

"We write up our knowledge up here, in the head, and can also pass it on like this." (IP.17)

A farming couple that worked in sheep milk production explained their thoughts about documentation as follows:

"We do not write up so much. If so mething does not work, you notice it anyway. And if it does not work it is better you forget it [laughs]. I mean: Until now we didn 't find the optimum solution, we are still trying. When we find the optimum solution, then we will write it up [laugh s]. Anyway, we have the effects e very day in front of us when we milk the sheep. We do not have to write tha t up. If you work with so mething every day, the n you know exactly what is good and what is not." (IP.32)

5.1.6. Outcomes of farmers' experiments

Of the 92 experiments discussed in detail in the semi-structured and structured questionnaire interviews (n=73), 75% constituted a minor modification or rediscovery of something already known in the region, 15% of the experiments constituted a major modification of an already known practice or method, and 10% of the experiments represented a novelty, i.e. a very unusual and uncommon practice in the social or regional context of the farmer.

All but one farmer in the structured questionnaire interviews (n=26) confirmed that they obtained more knowledge as a result of the experimentation process, one farmer was neutral about that statement, and no farmer denied the statement. Increased satisfaction was also seen as an outcome by the majority (84%) of the farmers interviewed. The statements about outcomes that were referred to as 'not applicable' by the interviewees most often were reduction of labour (44%), gaining reputation (44%) and increasing income (40%) (Table 14).

Regarding labour reduction, these farmers stated that the outcome of the specific experiment (e.g. new product, new or additional marketing channel) resulted in even more work, or that the overall outcome (e.g. new working method) did not increase the income directly, or may even have caused additional costs. One farmer did not answer this part of the questionnaire.

Comparing these results against the motives for experiments (Table 5), it becomes evident that making work easier was only a motive for 50% of the interviewees. The same observation is valid for increasing income, which was only an important motive for 38.5% of the interviewees.

Table 14: Frequency of different kinds of outcomes of farmers' experiments (n=25). Outcomes were pre-coded answer categories using terms from previous semi-structured interviews.

	Applicable		Neutral		Not applicable	
Outcome	**f**	**%**	**f**	**%**	**f**	**%**
Obtained more knowledge	24	96.0%	1	4.0%	0	0.0%
Increased satisfaction	21	84.0%	2	8.0%	2	8.0%
Created something new	19	76.0%	2	8.0%	4	16.0%
Adapted something to farm conditions	17	68.0%	4	16.0%	4	16.0%
Eased or reduced labour	12	48.0%	2	8.0%	11	44.0%
Increased production	12	48.0%	4	16.0%	9	36.0%
Gained reputation	11	44.0%	3	12.0%	11	44.0%
Increased income	10	40.0%	5	20.0%	10	40.0%

Outcomes of farmers' experiments were either materialistic, such as new materials (e.g. adapted seed drill, compost-turning machine, worm-composting plant), new products (e.g. pumpkin jam, ham made from boar meat, hemp oil, vegan pastries) or farm branches (establishment of free-range pig keeping, farm bakery or farm shop, self-harvest allotments), or immaterialistic, such as new working methods and technologies (manure treatment with effective microorganisms, pasturing according to lunar cycles, vegetable growing without irrigation, ploughless tillage and direct drilling) and new knowledge (knowledge about how to treat suckling sows in a group of pigs, how different plants in the vineyard support or inhibit the growth of the vines, how to compose intercropping mixtures for optimised fertilising effects).

5.1.7. Factors influencing farmers' experiments

Structured questionnaire interviews (n=26) were conducted in two contrasting regions of Austria (see section 4.4). A relationship between the frequency of conducting experiments and the region in which the farm is situated was found (Spearman correlation: r=0.403; p=0.041) (Table 15). 30.8% of the farmers interviewed in region 1 stated that they very often try things on their farm, but only 7.7% of the farmers in region 2.

Table 15: Frequency of experimentation in the two study regions (n=26; % within regions)

	Region					
	Region 1 (GS/JE)		Region 2 (RE)		Total	
Frequency	**f**	**%**	**f**	**%**	**f**	**%**
Very often	4	30.8%	1	7.7%	5	19.2%
Sometimes	5	38.4%	3	23.1%	8	30.8%
Rarely	4	30.8%	9	69.2%	13	50.0%

Spearman correlation, r=0.403; p=0.041 (correlation is significant at p<0.05)*

Farmers in the two regions reacted differently to the interview subject and the terms 'experimenting' and 'trying something'. Farmers in region 1 generally reacted positively to the topic and the terms and stated that trying new things was a crucial activity within farming. In contrast, farmers in region 2 showed a more negative reaction to the term, and many farmers stressed that they 'do everything like every farmer does it and how it has always been done'.

Significant correlations between the region in which a farm is situated and the agreement to statements relating to attitude about experimenting were found: Farmers in region 1 agreed significantly more often with positive attitudes about experimenting. In contrast, farmers in region 2 agreed significantly more with statements showing a negative attitude to change and experimenting (Table 16).

Table 16: Correlation between farm region and farmers' attitudes to e xperimenting (n=26; % within region for each statement)

Statement about farmers' attitude to experimenting		Region 1 (GS/JE)		Region 2 (RE)		Spearman correlation	
		f	**%**	**f**	**%**	**r**	**p**
I frequently try new things.	Agree	12	**92.3%**	4	30.8%	0.668**	0.000
	Neutral	1	7.7%	1	7.7%		
	Don't agree	0	0.0%	8	61.5%		
I like to do things differently than others do.	Agree	10	**76.9%**	4	30.8%	0.509**	0.008
	Neutral	1	7.7%	0	0.0%		
	Don't agree	2	15.4%	9	69.2%		
I only try or change things if it is necessary.	Agree	6	46.2%	10	**76.9%**	0.414*	0.036
	Neutral	1	7.6%	3	23.1%		
	Don't agree	6	46.2%	0	0.0%		
I like it when things are stable.	Agree	6	46.2%	11	**84.6%**	0.456*	0.019
	Neutral	2	15.4%	2	15.4%		
	Don't agree	5	38.4%	0	0.0%		

** Correlation is significant at p<0.05*
*** Correlation is significant at p<0.01*

When the farmers were asked to freely list topics of experiments they conducted during recent years on the farm, farmers in region 1 on average listed 5.8 topics, and farmers in region 2 listed 5.1 topics. The farmer who listed least topics of experiments (1) was situated in region 2, and the farmer who listed most topics of experiments (10) was situated in region 1.

While the topics most often mentioned in region 1 were cropping and plant production, as well as tillage and soil management, in region 2 farmers mainly mentioned experiments in the topics animal husbandry and alternative remedies (referring mainly to homeopathic treatments of farm animals) (Table 17). These differences can be related to the natural conditions and agricultural production emphases of the two regions.

Table 17: Frequency of topics for experiments in the two study regions (n=26)

	Region		
	Region 1 GS/JE	Region 2 RE	Total
Topics of experiments	**f**	**f**	**f**
Cropping, plant production	23	0	23
Tillage, soil management	13	2	15
Fertilisation	2	1	3
Weed and pest management	7	2	9
Vegetable, fruit and wine growing	3	0	3
Tools and machinery	0	3	3
Animal husbandry	6	27	33
Processing	9	5	14
Commercialisation	5	3	8
Labour management / reduction	0	3	3
Alternative remedies and supplements	3	12	15
Construction	3	6	9
Others	1	2	3
Total	**75**	**66**	**141**

Farmers in the two regions reported different methodological procedures related to experimentation. Significant correlations were found between the region in which the farm is situated and the frequency of comparison and repetition of experiments: All farmers in region 1 used some kind of comparison (with former experiments, with other areas or units on their farm, with other farmers, with literature) to evaluate their experiments. In region 2, 61.5% of the farmers compared their experiments. (Chi-square test: p=0.013). Region and experiment repetition were significantly related: All farmers in region 1 repeated their experiments, whereas only 38.5% of the farmers in region 2 repeated experiments (Chi-square test: p=0.001).

A correlation was found between age of interviewee and frequency of experimentation (Spearman correlation: r=0.336; p=0.093) (Table 18). The mean age of farmers who stated that they often tried things on their farm was 40.6 years, whereas the mean age of farmers who said that they rarely tried things was 48.7 years.

Table 18: Frequency of experimentation compared with mean age of farmers (arithmetic mean; n=26)

Frequency of experimentation	Mean age (years)
Very often	40.6
Sometimes	43.1
Rarely	48.7
Total sample	45.4

Spearman correlation: r=0.336; p=0.093 (correlation is significant at p<0.1)

The frequency of experimentation was related to the place where the farmers grew up. Farmers who did not grow up on a farm were more likely to do experiments very often than farmers who grew up on a farm (Spearman correlation: r=-0.412; p=0.037) (Table 19). Descriptively, 60% of the farmers who reported that they experimented very often had not been raised on a farm. In contrast, 92% of the farmers who stated that they rarely experimented grew up on a farm.

Table 19: Correlation between frequency of experimentation and place of growing up (arithmetic mean; n=26; % within frequency of experimenting categories)

	Grew up on farm			
	Yes		No	
Frequency of experimentation	**f**	**%**	**f**	**%**
Very often	2	40.0%	3	60.0%
Sometimes	7	87.5%	1	12.5%
Rarely	12	92.3%	1	7.7%

Spearman correlation: r= -0.412; p=0.037 (correlation is significant at p<0.05)*

The importance of information sources was rated differently by farmers with high or low experimentation frequency: Farmers who reported a high frequency of experimenting rated books a more important information source than farmers with low experimentation frequency. In contrast, farmers who reported a low frequency of experimentation rated other farmers, courses, and the chamber of agriculture as more important than did farmers with high experimentation frequency (Table 20).

Table 20: Correlation between frequency of experimentation and importance of different information sources (n=26; % within frequency of experimenting categories for each information source)

Information source		Frequency of experimentation						Spearman correlation	
		Very often		Sometimes		Rarely			
		f	%	f	%	f	%	r	p
Other farmers	Important	3	60.0%	8	100.0%	13	**100.0%**	0.441*	0,024
	Neutral	1	20.0%	0	0.0%	0	0.0%		
	Not important	1	20.0%	0	0.0%	0	0.0%		
Chamber of agriculture	Important	2	40.0%	7	87.5%	13	**100.0%**	0.545**	0.004
	Neutral	1	20.0%	0	0.0%	0	0.0%		
	Not important	2	40.0%	1	12.5%	0	0.0%		
Books	Important	4	**80.0%**	5	62.5%	4	30.8%	0.407*	0.039
	Neutral	0	0.0%	1	12.5%	1	7.7%		
	Not important	1	20.0%	2	25.0%	8	61.5%		
Courses	Important	2	40.0%	5	62.5%	11	**84.6%**	0.438*	0.025
	Neutral	0	0.0%	2	25.0%	2	15.4%		
	Not important	3	60.0%	1	12.5%	0	0.0%		

** Correlation is significant at p<0.05*
*** Correlation is significant at p<0.01*

Other correlations between the frequency of experimentation and influencing factors related to farming activities, travel habits of the individual and personal characteristics of the interviewees:

Dairy farming was significantly correlated to a low frequency of experimentation. All dairy farmers interviewed (n=7) reported that they rarely tried things on their farm (Spearman correlation: r=0.574; p=0.002).

Travelling outside Europe was significantly related to the frequency of experimentation. Farmers who stated that they often tried things on their farm showed a higher travel activity as farmers who reported a lower frequency of experimentation (Spearman correlation: r=0.599; p=0.001).

Farmers who reported a high frequency of experimentation agreed with the statement that they 'liked to try new things' (Spearman correlation: r=0.652; p=0.000). In contrast, farmers who reported a low experimentation frequency agreed with the statement that they 'liked it when things are stable' (Spearman correlation: r=0.594; p=0.001).

Factors that were not found to have an influence on the propensity to experiment were size of farm, level of education and years of farming experience.

Summarising results about influencing factors for farmers' experiments it was found that:

- Farmers in region 1 reported higher experimentation activity, free-listed more topics of experimentation, and showed a more positive attitude to experimenting than farmers in region 2.
- Farmers who reported a low frequency of experimentation were more often dairy farmers, were raised on a farm, relied more strongly on other farmers, courses and the chamber of agriculture as information sources, and reported less travel outside Europe in comparison with farmers who reported a higher frequency of experimentation.
- Farmers who reported a high frequency of experimentation were generally younger, relied more strongly on books as information sources, reported more travel outside

Europe and showed a more positive attitude to experimenting than farmers who reported a lower frequency of experimentation.

5.1.8. Emic definitions of farmers

'Experiment' is a term that is commonly used within science, and is even explicitly linked with scientific activities. As the term 'experiment' is loaded with the notion of a scientific procedure (cf. Sumberg and Okali, 1997, p. 58), it was not used in the semi-structured interviews. The term I used to refer to experimentation activities was 'to try, to try something, to try something new'. Less frequently I used the term 'trial', as this term was also associated with a more formal course of action by the farmers interviewed.

In the semi-structured interviews (n=47), I asked the interviewees at the end of the interview to express their emic definitions of central terms of the research subject, by asking them 'What is for you an experiment / an innovation?'

5.1.8.1. Emic definitions of experiment

The central characteristic of the emic definitions of the interviewees for the term 'experiment' is that experimenting means 'trying something'.

> *"Experimenting means to come up with something new, and then to implement and try it." (IP.42)*

Emic definitions that were phrased by the farmers implied a denotation referring to learning processes involved in experiments, and the development of new knowledge. Interviewees stated that in an experiment they tried something to see how and if it works, to gain new insight and knowledge, or to test general assumptions about the feasibility of a certain method or practice.

> *"For me, experimenting means trying something where others say it does not work. I only believe the things I have seen myself. I want to know it, because I do not believe everything just like that." (IP.16)*

Some definitions referred to the uncertainty involved with experimenting, and the possibility of failing. Interviewees stressed the importance of knowledge acquired by experimenting, even in cases where the experiment had not been successful.

> *"An experiment is something where I want to take big steps forward. An experiment does not result so much in higher yields, but in accumulation of knowledge, and the results may include quite enormously important knowledge. My first experiments were set up on too large scale, and that was everything but profitable. But you learn out of that." (IP.46)*

Some emic definitions included statements about the methodological procedure involved in experimenting, e.g. the process of monitoring or documentation involved in experiments.

> *"An experiment is something semi-scientific, a trial that is arranged a bit more professional, and that is also documented, for example by taking pictures." (IP.30)*

> *"When I experiment, I put my ideas into practice. And then I observe that and draw my conclusions." (IP.29)*

Some emic definitions also revealed personal beliefs of the respondents regarding the creative and innovative act involved in experimenting. They stated that through experimenting it was possible to effect change and improvements, and to progress in respect of both agricultural and personal aspects.

> *"When you try to do something new, you try to move things that are 'rooted', you try to change the world in a way. If there would not have been people that tried to make a change, we would still be living in caves." (IP.44)*

5.1.8.2. Emic definitions of innovation

When farmers were asked for their emic definition of the term 'innovation', they typically referred to things and developments that were 'new' and 'exceptional'. Innovation was frequently linked to strategies and activities that were in contrast to traditional and 'mainstream" behaviour.

> *"Innovation is when I do something differently than everybody does. That I try for myself to progress." (IP.05)*

Innovation was also linked to a more planned and intended development.

> *"Innovation is a new idea, a reformation in a way, referring to something novel; something that has not evolved incidentially or has developed by itself, but something that has been planned and conceptualised intentionally." (IP.03)*

Emic definitions of innovation frequently referred to 'doing something successful', and were also linked to denotations of progress. Definitions also included statements about personality aspects linked to innovation, and stated that being innovative means 'standing out', being determined, future-orientated or having a certain spirit of exploration. Innovation was regularly linked to economic and 'materialistic' considerations, e.g. by aiming at creating a profitable product or marketing strategy.

Innovation was also linked to denotations of results diffusion, such as communicating and showing the results to others.

> *"Innovation also involves trying to approach and set fire to others, like farmer colleagues, and disseminating the idea, so that others can also benefit." (IP.44)*

When defining 'innovation', farmers considered that the reference point was the individual. As the interviewees understood the term, an innovation did not have to be something completely new, as would be the case for an invention.

> *"Innovation is something new. That is a subjective concern: For me, an innovation can be something that is 'old hat' for somebody else. It means choosing new paths. First and foremost an innovation has to be an improvement." (IP.13)*

The term innovation was also criticised and seen as being a buzzword. A number of farmers stated negative denotations related to the term, and criticised the excessive use of the term by politicians and agricultural representatives. In the context of critical reflections on the term 'innovation', a farmer stressed the importance of acknowledging existing and traditional knowledge.

> *"Being innovative means being open for new things, but not forgetting about the old things. Something new does not have to be better. People in the old days were not stupid either." (IP.42)*

Farmers also saw a connection between an experiment and an innovation. Interviewees saw an innovation as the continuation of a successful and promising experiment that was integrated into the working process on the farm.

Analysing the emic definitions farmers gave for the terms 'experiment' and 'innovation', it becomes evident that the term innovation was more related to extroverted activities than was the case for experimenting. Definitions of experimenting referred to a more personal, intimate process, where 'I want to try something and see how it works'. In contrast, innovation was frequently related to 'doing something successful' that diffuses and crosses the farm boundaries.

5.1.9. Types of farmers' experiments

Experiments of organic farmers in Austria were found to have diverse characteristics regarding motives, topics, methodological performance and information sources. In the following, some examples of farmers' experiments are presented to demonstrate the range of these activities. These typology is based on the analysis of semi-structured and structured questionnaire interviews (n=73).

5.1.9.1. Accurate, objective experiments

The following characteristics were found to be typical for this type of experiment, which can be compared to scientific experimentation procedures:

- Technical journals were used as information source. The experiment aimed at reconstructing and testing scientific results.
- The experiment had been planned beforehand, and the set-up was on a small scale (trial plots or units, small-scale test version).
- Only one single treatment/variable/method was tested in each experiment (control of variables).
- Evaluation of results contained quantitative strategies (measurements, counting, weighing, etc.).
- The experiment was documented.
- The farmer collaborated with research institutions, conducted on-farm research, made use of laboratory analysis, and had personal contacts with researchers.

Farmers who conducted experiments of this type argued that experiments had to be conducted in an accurate way, aimed at being as objective as possible to gain reliable results.

> *"When I try so mething, I have to evaluate th at as accur ate as possible. Otherwise the results are not significant." (IP.31)*

A number of farmers commented that this kind of 'scientific' procedure did not make sense or was not applicable for them. The reasons they mentioned were the complexity of natural conditions (e.g. weather, precipitation, soil conditions, etc.), and also personal and farm-related conditions (e.g. availability of time and labour resources).

> *"In practice, it does not work like in a scientific experiment. You have t o take the whole system in consideration. For example, just dividing one plot into several subplots and then testing different tillage tools, following the sa me procedure does not work. You ha ve to adjust the whole system to every single method and vice versa." (IP.24)*

> *"Testing different varieties in d irect comparison, evaluating how every variety perfor ms in comparison to the other and docum enting everything, I am n ot that type. That is too tim e-consuming and in a way too 'scientific'." (IP.03)*

5.1.9.2. Inventive, ingenious experiments

Experiments of this type were characterised by a high level of creativity and inventiveness. The following characteristics were typical for this type:

- Inspiration played a crucial role and often occurred suddenly and/or without inducing it intentionally, e.g. while jogging, driving, 'doing nothing'.
- The source of idea or inspiration frequently originated from non-agricultural areas.
- Information sources were diverse and numerous, and included a range of non-agricultural sources.
- The diversity of complex factors and variables from different areas were interrelated in the experiment.

- A specific topic of experimentation was investigated over a longer time period, and the initial idea was further developed.
- The methodological procedure was either explicit (e.g. including regular photographic documentation) or implicit (e.g. making use of 'gut feeling' and intuition), and often a mixture of the two.
- A strong personal identification with the topic of experimentation was found. The subject that was experimented on was considered of high importance, and so outcomes and insights of experiments were actively disseminated and communicated.

A farmer explained how he reached such moments of inventive inspiration:

"It has a lot to do with intuition and faith. I often ask myself, 'How can I improve?' and then I leave it to the so-called coincidence, and the answer appears. For example when I drive the tractor, and I turn off the mobile phone, and I try to empathise with nature, then something appears. These are very creative periods of time." (IP.46)

5.1.9.3. Business experiments, entrepreneurial experiments

Business experiments had a clear focus on economic matters, and included the following characteristics:

- Profitability was the most important motive.
- Experiments aimed at resulting in a concrete innovation (e.g. product).
- Gaining reputation was a desirable outcome or side-effect of the experiment.
- The search for a profitable farm branch or production system existed during a longer time period, but the idea for a concrete experiment often emerged spontaneously.
- An already existing example or a role model was regularly taken as a guideline, but was adapted to the specific needs and preferences.

A farmer that experimented with the production of home-made ice cream from goat's milk explained his initial considerations and motives as follows:

"We started to produce ice cream from goat milk. We visited a farmer that produced ice cream on the farm, and when we tasted it we said, 'With this home-made ice cream we will be rich!' We ordered the machine before Christmas to be able to profit from the Christmas business. (…)So we have created an income pillar for our farm. This goat milk ice cream is a 'must-have'-product, because the tourists ask in the hotels what they can offer for dessert, if they or their children have allergies on cow milk, or if they have neurodermatitis. So the hotels have to have it." (IP.18)

5.1.9.4. Experiment as a matter of personal importance

Experiments of this type were conducted with high personal involvement. The following characteristics were found to be typical:

- The topic of experimentation was seen as a matter of high personal importance, and was perceived as meaningful and satisfying.
- The farmer was convinced that applying this method is an important and 'right' thing to do.
- Beliefs and attitudes were linked to the topic of experimentation.
- The accuracy of the methodological performance was seen as less important than the matter itself.
- If the outcomes of an experiment were not completely satisfactory, the topic was not rejected but further experiments were conducted. Disadvantages of the tested topic/matter were accepted as transition stage on the way to an improved situation.
- The topic was investigated over a longer period of time, conducting regular experiments and further developing the implementation on the farm.

A farmer experimenting on ploughless tillage explained the strong personal identification with this method as follows:

"Probably I wish so strongly that tillage without plough is the better option, also regarding yield, that I do not want to divide plots and compare tillage with plough and without plough side-by-side during several years. That would be the best; cultivating the same crops, comparing the yield and then you would have the results. You know what I think about that? Probably I do not want to make this comparison and then possibly be disappointed. That is really an insight for me right now [laughs]." (IP.24)

5.1.9.5. Problem solving experiment

For this type of experiments, problem solving was the main focus.

- The aim of the experiment was to solve a concrete problem or to achieve an improvement.
- The topic of experimentation was of minor personal importance and identification. The approach and performance was pragmatic.
- Different possibilities were tried to find the most appropriate solution.
- When the solution for the problem was found, no further experiments were conducted.

A farmer who kept geese at his farm let the geese be slaughtered and plucked by a regional organisation, but the farmer was not satisfied with the quality of plucking, because the skin of the slaughtered geese was frequently disrupted by the plucking machine. So experiments with hand-plucking were started at the farm until they achieved satisfactory results.

"We have always been slaughtering the chickens on our own, and we had three ducks each year. Therefore we knew approximately [how it worked], with the steamer and that. The grandmother still knew about that, she was still quite fit at that time. And now we already do it [hand-plucking] for 10 years and it works very well." (IP.05)

5.1.9.6. Transformative experiment

This type of experiment showed similarities with problem solving experiments, but there were characteristics that went beyond problem solving:

- Solving a concrete problem was also the initial point of the experiment, but the personal identification with the topic was stronger.
- The process of experimentation on the specific topic continued over a longer time period.
- During the process, the identification with and enthusiasm about the topic increased.
- The solution of the problem was not the final point, but experiments continued to further improve the system/method.
- The experimental process had a transformative character, i.e. it led to major changes and in some cases a reorganisation of the farm.

A farmer who took over the dairy farm from his parents-in-law recognised that the soil and grassland quality was low, which had negative effects on milk production. Confronted with this problematic situation, he started experiments to improve the soil quality and grassland composition:

"I used a lot of straw in the stables and tried to produce farm manure that I composted outside. I applied rock meal and effective microorganisms to the manure. And I manured the pastures during the vegetation period. (…) I also started to experiment with different grass seed mixtures that I partly mix myself, and with different methods of sowing the seed mixtures on the pastures." (IP.43)

The goal of the entire experimentation process was to transform and improve the production system. Although the farmer did not effect changes that were easily visible for outsiders – he

still ran a dairy farm – he effected major changes on his farm regarding type and quantity of litter used in the house, processing and treatment of the manure, and treatment of the pastures, i.e. manuring, improvements of grassland composition by sowing more suitable grass varieties for pasture, and grazing management. As an effect of these experimental activities over several years, grassland composition and productivity improved, and milk production increased. At the time of the interview, the farmer was still involved in active experimentation to further improve the situation.

5.1.9.7. Coincidence experiment

Experiments of this type included the following characteristics:

- The idea for the experiment emerged by coincidence.
- The experimental procedure was frequently of an implicit nature, i.e. the farmer was not aware of conducting an experiment.
- When the observations of the outcomes or effects of the experiment proved to be interesting for the farmer, the outcomes were further used on the farm. Otherwise the results were rejected and not further used.

During participant observation on a farm, I observed such a coincidence experiment: A farmer suddenly had the idea of putting sheep wool into a plastic greenhouse to see if it were possible to extract lanolin from the wool in the heat of the greenhouse. She explained coincidence experiments like this:

> *"These are flashes of thought that suddenly appear and that I simply try, because they do not cost anything, and they do not imply a lot of effort. I like to try things or search for solutions when I have the feeling that I could solve it. It is more or less like a sudoku [laughs]." (IP.03)*

These types of experiments can differ regarding motives, methodological approach, information sources used, personal identification with the topic, and duration of the experimental activities on a specific topic (Table 21).

Table 21: Types of experiments and their main characteristics

Type of experiment	Motive	Methodological approach	Information sources	Personal identification	Duration
Accurate, objective experiment	Personal (knowledge development)	+++	+++	++(+)	+(++)
Inventive, ingenious experiment	Personal	+(++)	+++	+++	++(+)
Entrepreneurial experiment	Economic	+(+)	+(+)	++	+(+)
Experiment as a matter of personal importance	Personal	+/-	+	+++	+++
Problem solving experiment	Problem solving	+/-	+	+/-	+/-
Transformative experiment	Personal, problem solving	+/-	++(+)	++(+)	+++
Coincidence experiment	Not specified	-	+/-	-	+/-

+++ very elaborate / intensively used / very strong / very long
++ elaborate / much used / strong / long
+ less elaborate / less used / less strong / less duration
+/- less or not elaborate / less or not used / less or not strong / less or short duration
- not elaborate / not used / not strong / short duration

5.1.10. Farmers' vs. scientists' experiments

In the same way as differences between experiments of farmers were found, there was also evidence of differences between experiments of farmers and experiments of scientists. Farmers explained that following strict experimental procedures as applied in scientific experiments would not make sense for their needs. As farmers have to handle complex systems where a multitude of variables and factors have an influence, they integrate these factors into their practical experiments too and do not strictly isolate or control variables, as would be the procedure in scientific experiments. A farmer explained the validity of this practical experimentation approach as follows:

> *"I think it is not a problem at all that a multitude of factors interact [in an experiment]. One should easily try various things at the same time. In the end it does not matter which of the factors had been crucial, and one thing alone is often not sufficient either. Generally it is the diversity that makes it work." (IP.43)*

Farmers also saw limitations of scientific research and argued why it did not always lead to more valid or accurate results. In other words, farmer also cited limitations of scientific experiments in comparison with farmers' experiments. A farmer working in crop production and experimenting with different ways of reduced tillage explained the limitations of a scientific experiment he observed on a research farm in the region as follows:

> *"You cannot simply take a field that has been managed homogenously and divide it and compare plough and grubber, like scientists like to do it. You have to adjust the whole system to the tillage tools and vice versa. In the grubber variant you have to grub two*

times, whereas in the plough variant ploughing one time is enough. (…) But they wanted to investigate the tillage system and leave everything else identical. Of course they had problems with weeds in the grubber variant. You can forget that, these results are not useful for the practice!" (IP.24)

The farmers interviewed were aware of the strengths, but also of the limitations, of their practical experiments. In the same way, farmers knew about the strengths and limitations of scientific research. A number of farmers reported that they made active use of the outputs of scientific experiments. A farmer experimenting in worm composting explained:

"I do not set up my experiments in a scientific way, the time for doing so is often lacking. I try to take up what is already there in scientific studies and choose what I can implement for my farm. I leave the 'real' research to science. I like to participate in research, but it is too time-consuming with regard to documentation and analysis." (IP.07)

5.1.11. Interrelation of farmers' experiments – 'Nested experiments'

Experimentation at the studied farms frequently took place on different scales. An experimentation process about a certain field of interest of a respondent was often a complex, long-term process that involved smaller subordinate experiments that were connected to each other. When the farmers interviewed started to try a new method, tool or resource, decided to establish a new production branch or develop a new product, a series of further questions, problems, details and challenges emerged as a consequence, and led to the initiation of further experiments that were related to the initial overarching topic of experimentation.

As an example, after deciding to establish free-range pig keeping on a farm of a respondent (IP.37), various smaller experiments about composition of optimal fodder rations, handling of rearing sows, fencing of the pigs, handling of animals in medical treatments, manufacturing of specialities such as pastries and ham, marketing of the products, and others emerged as a consequence (Figure 7). These smaller experiments were carried out either successively, or also in parallel and interwoven with each other, and all contributed to the overall experimentation process, in this case to the successful establishment of free-range pig keeping as a new farm branch.

Literature about farmers' experiments mainly concentrates on singular experiments, and few sources refer to different scales of larger experimentation processes and smaller experiments involved in these processes. The phenomenon of 'nestedness' of experiments therefore provides a novel viewpoint on farmers' experiments, by emphasising a systemic context and the interrelations of farmers' experimental activities.

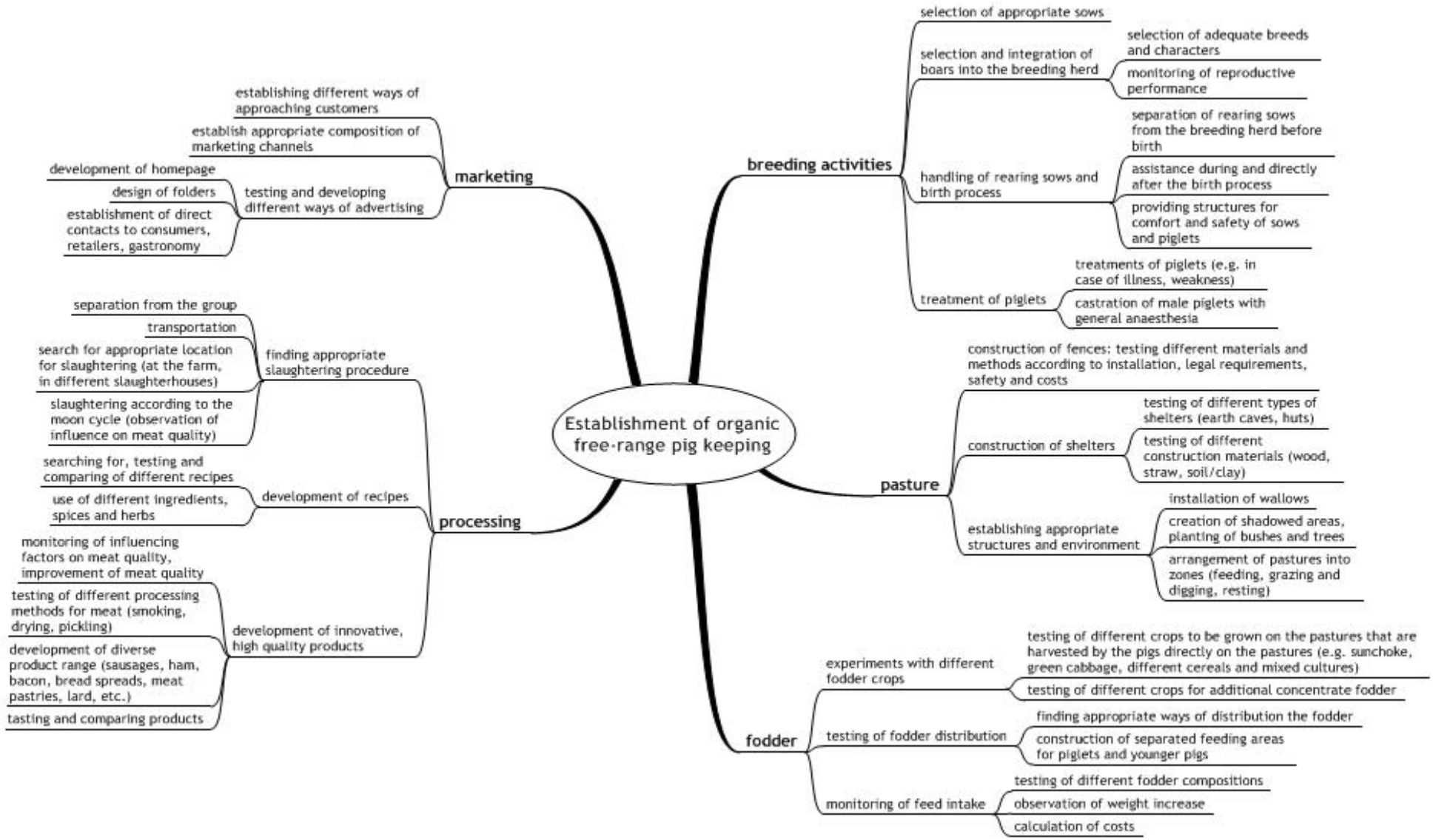

Figure 7: Nestedness of experiments, example of the establishment of organic free-range pig keeping (IP.37)

5.2. Farmers' experiments as learning strategy to face change and build farm resilience

After investigating the situation of organic farmers' experiments in Austria, the second objective of this dissertation was to present the significance of organic farmers' experiments in the context of learning processes and resilience building strategies of farmers.

5.2.1. Summary of research paper II: Interrelation of change processes and farmers' experiments

Paper II is concerned with the question of how change processes and farmers' experiments are interrelated. As farmers are frequently confronted with changing ecological, economic and social conditions, adaptations are necessary in order to maintain and further develop farming systems (Bentley, 2006; Mak, 2001). Farmers' experiments are tools for farmers to develop their farms according to site-specific conditions, emerging constraints and their personal needs (Chambers et al., 1998; Rhoades and Bebbington, 1995; Sumberg and Okali, 1997). Farmers' experiments can be seen as central features to create and maintain the adaptive capacity of a farm.

Change is an act or process through which something becomes different (ODO, 2010). Two types of change are differentiated in paper II according to the point of origin: External change is defined as change originating outside the farm level and refers to political, economic, social, technological and ecological environment. Internal change originates at the farm level and concerns the farm, the family or the individual person.

In the interrelation of change and experiments (Figure 8), change can act as a motive for farmers' experiments. To start an experimentation process, certain conditions are necessary, e.g. the availability of external resources such as information or material, and internal preconditions such as knowledge or motivation to experiment. Given these preconditions, the farmer may start an experiment that can be seen as a research process involving testing, trying, adapting and developing methods, technologies and materials. This experimentation process involves learning processes, as the farmer reflects, evaluates and compares experiences and new insights that emerge. The results of the process again involve changes at farm business level and personal level. Change is therefore not only a possible motive for farmers' experiments, but also a result of the experimentation process.

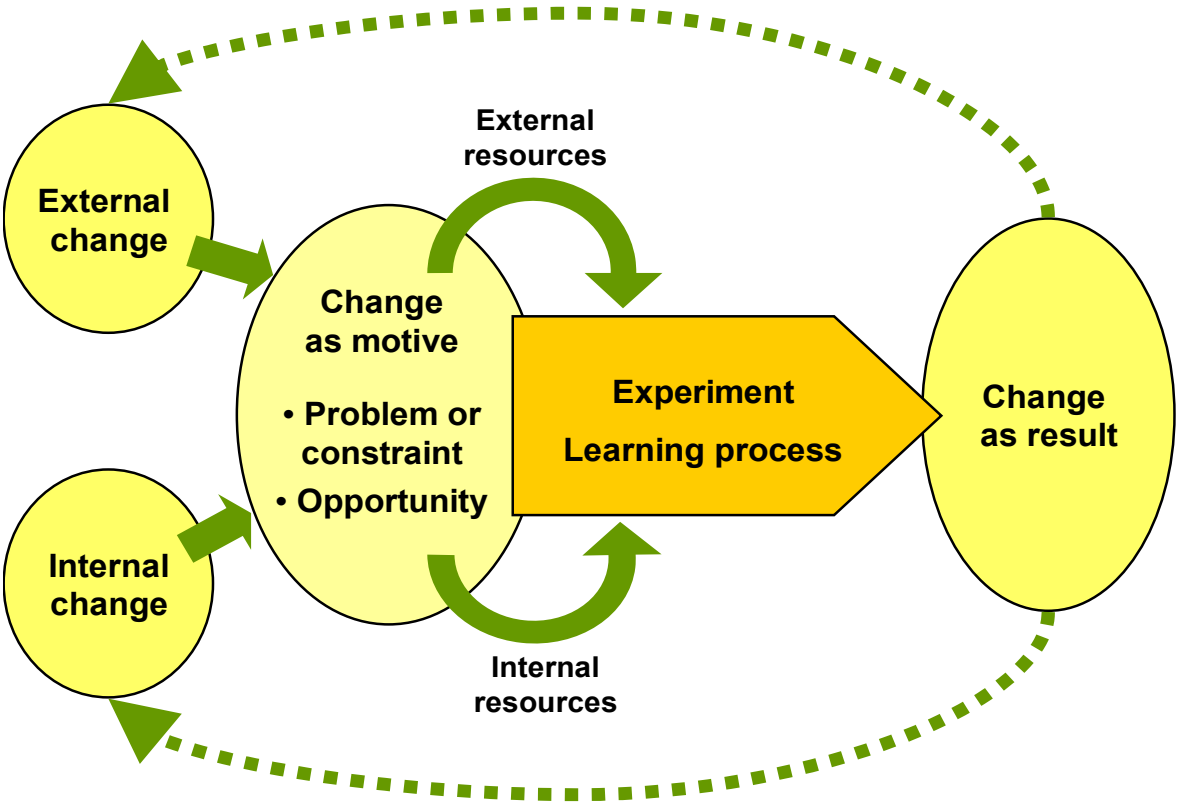

Figure 8: Simplified model of the interrelationships between change and experiments (own figure)

Nine selected cases of Austrian organic farmers are presented in paper II to illustrate the presumed interrelationships. These cases were selected out of the data set of semi-structured interviews. The interviews started with the creation of a timeline that displayed major changes and events that occurred on the farm since the farmer had started farming. Asking the farmers about changes that occurred on the farm was based on the hypothesis that changes are related to experimentation processes of farmers.

External change was found to trigger experiments in relation to changes in agricultural policies and standards, product prices, environmental conditions, market demands and opportunities, and technological progress. Examples of internal change acting as a trigger of experiments was found to concern personal changes such as observations and reflections, changes at the level of the family or at farm level. Farmers described these changes as initial points of the experimentation process, and also stressed the importance of influencing conditions, e.g. information from outside the farm or the personal motivation to find a solution for the present problem.

Learning processes were involved in all reported experiments, in the form of increase or modification of existing knowledge. The examples presented lead to the conclusion that changes are not isolated occurrences, leading to a single reaction, but are interrelated and interwoven with each other (Darnhofer, 2006). Personal characteristics of the farmer are likely to be the most significant factor in the interrelation of change and experimentation, as it is the farmer that decides if and how to face change, how to turn changing conditions into opportunities for development, and how to generate beneficial changes through experimenting.

5.2.2. Building farm resilience through organic farmers' experimentation

In continuation the question how farmers' experiments can be related to social-ecological resilience is investigated. The results are structured along the four principles that build social-ecological resilience suggested by Folke et al. (2003).

To investigate the relation between farmers' experiments and resilience, five farms out of the qualitative data set (n=47) were selected (see section 4.3.1). These five farmers or farmer couples were selected because they explicitly conducted experiments and considered trying and experimenting important activities within farm management. Furthermore, these farmers are well known as pioneers or innovators in their region due to their new or exceptional farming practices, and are recognized for their knowledge of these practices. An additional selection criterion was that the farms were all located in a similar environment. The selected cases are not representative for all organic farmers in Austria, but for a subgroup of active experimenters. The following sections 5.2.2.1, 5.2.2.2, 5.2.2.3 and 5.2.2.4 present results of these five selected farms.

5.2.2.1. Learning to live with change and uncertainty

Changes that affect farmers can emerge from events on the farm (internal change), or can be influences from outside the farm (external change) (see section 5.2.1 and paper II). In the cases described (Table 22), changes that motivated farmers' experiments included crop production failures (IP.46), crop diseases (IP.03/IP.04 and IP.31) and high losses of piglets (IP.37).

Experiments can act as tools to help farmers to deal with emerging crises. It is also possible that a crisis can be used as an opportunity for development. For example, farmer IP.46 (Table 22) experimented with no-plough tillage, direct sowing and intercropping as a response to decreased soil fertility and crop failures. The farmer used the crisis to develop a fully new cropping system, which was better adapted to the climatic conditions and soil structure of the farm.

Spreading risks is an important strategy when living with uncertainty. Some farmers experiment with organic production methods before they decide to convert, so they are able to assess the new farming practice. This was the case for farmer IP.30 (Table 22). The farmer experimented with organic crop and vegetable production before officially converting his farming system to organic production.

Another example of risk-spreading strategies is small scale experimentation. Starting an experiment on small scale allows the farmer to collect experiences of the new crop or management technique in a safe manner. For example, farmer IP.31 (Table 22) tried remedies for powdery mildew *(Oidium tuckeri)* on grapes in parts of his vineyards and only scaled up after careful evaluation. Farmer IP.37 started to experiment with free range pig keeping with three sows and one boar before successively expanding to more than 200 rearing and fattening pigs.

Table 22: Learning to live with change and uncertainty through farmers' ex periments (examples)

Experiments in this context help farmers to deal with and learn from crisis, or even turn crisis and change into opportunity for developm ent. Experiments are set up in a way that enables farmers to spread risks and build insurance on the farm.

Farmer	Examples for resilience building strategies through farmers' experiments
IP.03/ IP.04	Attack of heavy powdery mildew (*Oidium tuckeri*; fungus affecting vine) infections in their vines brought the farmer couple to experiment with grafting sensitive vines with mildew tolerant varieties. The farmers grew new vegetable species and varieties first in their homegarden and expanded the cultivation to their self-harvest allotments (see Vogl et al., 2004 for detailed explanations about the 'self-harvest' concept) when they had concluded that the crop was appropriate for the regional conditions.
IP.30	Before officially converting to organic farming the farmer already experimented with organic cropping techniques to proof the feasibility of this production method in an area of intensive conventional agriculture. When he officially converted to organic farming, the risk of failure was therefore relatively low. The farmer experimented each year with new crops or varieties on small plots to get to know them. By observing the crop or varieties and by evaluating the market demand for the specific crop he was able to decide if it fitted into his production system.
IP.31	Fungal infections are common problems every vine grower has to deal with. In this case, the farmer conducted continuous experiments in his vineyards, especially about early detection of risk for fungal infections and about remedies to control these infections. He used a vineyard in one disadvantaged location with wet microclimate as indicator for powdery mildew (*Oidium tuckeri*) infection risk. The vineyard served as an early warning system for fungal infections and as indicator for the effectiveness of remedies against these infections. To reduce the risk when experimenting, the farmer set up his experiments at small scale. When experimenting with different remedies to control mildew he applied the remedy only in one third of two or three of his vineyards. After accurate quantitative evaluation (direct comparison) of the effectiveness, he scaled up the method that proofed to be successful. Experimentation with applications of sodium bicarbonate to control mildew proofed the efficiency of this organic remedy that does not generate any resistance of the pathogen.
IP.37	When high losses of piglets occurred in the farmer's free-range pig herds, the farmer initiated experiments with handling of the rearing sows. He divided the breeding herd into smaller subgroups and separated the sows from the herd before parturition to reduce stress and rivalry. Direct observation and historical comparison proofed the efficiency of the new method. When the farmer started organic free-range pig keeping, he first experimented on a small plot with three sows and one boar to have the possibility to observe and learn with little risk.
IP.46	Decreasing soil fertility and diminishing yields lead the farmer to experiment with no-plough tillage, direct sowing and intercropping. Continuous, interwoven experiments with these crop production methods led to enhanced drought tolerance, reduced erosion, as well as enhanced soil fertility by improving soil structure and biological activity of the soil. To secure the harvest even in dry years, he experimented with intercropping of two to four crops in one plot.

5.2.2.2. Nurturing diversity for reorganisation and renewal

The second principle of building resilience refers both to ecological diversity (biodiversity) and social diversity. A common type of experiments carried out by farmers is the testing of new crops and varieties, so farmers use biodiversity in order to find suitable crops for their farms. The five selected farmers experimented with biodiversity in some way (Table 23). For example, farmers IP.30, IP.37 and IP.46 experimented with different mixed cultures, both to find the best proportion between the types of crops for intercropping, and to find the right species and varieties for their local conditions. Farmer IP.31 experimented with wild plants that he thought might stimulate growth of vines. Farmers IP.03/IP.04 and IP.30 experimented with crops to find varieties and species suitable for their farming conditions. Farmer IP.46 mimicked natural grasslands when trying to find the appropriate proportion between grasses and legumes for his fields. Farmer IP.37 used native and rare pig breeds when developing the free-range pig keeping.

Diversity is important in the social context as well. Farmers that experiment and develop new management practices and new knowledge enhance social memory in the organic farming movement as well as in the region where the farm is situated through stimulating discussion, change and learning. The five selected farmers were well known for their innovative practices and the knowledge and experience they have built up through experimenting (Table 23). Farmers IP.03/IP.04, IP.30, IP.31 and IP.46 were pioneers of organic farming. They exchanged and passed on their knowledge to colleagues, held farmer meetings, invited students onto their farms, etc. Thus, the outcomes from experiments were passed on and exchanged with people from outside the farms.

Table 23: Nurturing diversity through farmers' experiments (examples)

Experiments in this context foster ecological diversity by using or enhancing biodiversity when experimenting. When experiences from experimentation are shared within the farming community or communicated to other members of society (customers, advisors, scientists), it stimulates social diversity.

Farmer	Examples for resilience building strategies through farmers' experiments
IP.03/ IP.04	The farmers conducted experiments with a multitude of different vegetable species and varieties – many of them rare or old – to find appropriate crops for cultivation without irrigation in the dry area their farm is located. The farmers experimented with different vine varieties that are tolerant against fungal infections that caused considerable problems after the conversion to organic farming. The farmer couple had a highly diversified organic farm in an area of intensive cropping. The farmers actively networked with other farmers and interested consumers. They supported an organic farmer in building up self-harvest allotments by sharing their knowledge obtained in continuous experiments about this vegetable growing system.
IP.30	The farmer continuously experimented with a variety of different crops and intercropping with different mixtures of crops. He conducted comparative experiments with different crop varieties to find the most appropriate ones for his conditions and needs. The farmer was a pioneer in organic vegetable growing in his region, where intensive monocropping is usual practice, and acted as an advisor for other farmers.

IP.31	The farmer observed that different plants that grow in the vineyard could either support or inhibit the growth of the vines. After this observation he started to experiment with different wild plants that he collected and sowed in his vineyards to observe their positive and negative effects on the vines. The farmer won a national environmental award for this practical research project. The farmer acted as pioneer for organic wine growing in the region. By giving a positive example and spreading his knowledge that he mainly built up through experimenting he motivated neighbouring farmers to convert to organic farming.
IP.37	The farmer used rare, robust pig breeds as base for his experiments on free-range pig keeping. In plant production, the farmer experimented with mixed cultures and alternative crops, e.g. sunchoke *(Helianthus tuberosus)* as fodder base for the pigs. In the region the farm is located, organic farming as such is still unusual. The farmer's extensive free-range pig husbandry is even more exceptional and attracted many interested farmers, scientists and consumers. The farmer and his wife also participated in building up an alternative school in the region that can be seen as a social experiment in this traditional rural area. The education is tightly linked with the organic farm (regular excursions to the farm, implementation of practical garden experiments together with the pupils).
IP.46	Through experiments on intercropping of up to four different crops, the farmer developed his arable farming system from common mono-cropping to diversified plant populations. He continuously experimented on optimized plant combinations for his mixed cultures. In the composition of the mixed cultures, he used natural plant communities as a model (e.g. proportion of grass and legumes). The farmer actively enhanced the social diversity of the regional farming community by spreading his experiences with alternative cropping systems. He acted as a practical advisor for interested farmers and organized field walks on his plots. In a regional farmer group that was organized by him, he stimulated other farmers to adopt and experiment with these farming methods.

5.2.2.3. Combining different types of knowledge for learning

Using and developing new knowledge is closely linked with farmers' experiments. Farmers can combine different knowledge systems and thus use knowledge from their own farm in combination with knowledge developed by research institutions or knowledge from other sources. Farmers IP.30, IP.31 and IP.46 cooperated with research institutions to conduct experiments and exchange experiences (Table 24). Farmer IP.31 actively used scientific literature to inspire new experiments and to compare with his own results. All five farmers used knowledge from outside the farm, e.g. from farmer colleagues, to inspire new experiments.

The pioneer organic farmers in the selected cases (IP.03/IP.04, IP.30, IP.31, IP.46) have experimented with organic production techniques and inspired other farmers to convert to more ecologically sustainable farming. The experiments these farmers carry out contribute to the advancement of organic production methods appropriate for the conditions in Eastern Austria.

Farmers that communicate, discuss and exchange results from experiments expand their knowledge about experimentation into networks and institutions. The partners in this process can be other farmers, farmer organisations or groups, researchers, advisors, consumers or any other actors. In the cases selected (Table 24) all farmers had networks of colleagues, consumers and/or advisors and/or scientists for the exchange of knowledge coming out of

experiments. The knowledge of these five farmers was both passed on in the farmers' networks and into research and education institutions.

Table 24: Combining different types of knowledge for learning through farmers' experiments (examples)

Experiments in this context make use of different sources of information to learn and build up agro-ecological knowledge. Sharing experiences about experimentation within the farming system builds resilience.

Farmer	Examples for resilience building strategies through farmers' experiments
IP.03/ IP.04	Experiments within vegetable production were based on the farmers' own experiences obtained in their social work in Latin America (where they implemented homegardens together with indigenous people), as well as on expert knowledge from formal courses and literature. Knowledge to conduct experiments within wine growing came from own experimentation over the years, from experiences of farmer colleagues, and from organic advisors. The farmers intensively communicated own experiences from experimentation with other (organic) farmers, friends, volunteer workers, university students and interested consumers.
IP.30	The farmer started to experiment with anise *(Pimpinella anisum)* production by combining own extensive experiences about specialized crops with information from literature and other organic farmers. He built agro-ecological knowledge on a multitude of different crops and cultivars through continuous experimentation. On-farm research was carried out on the farm by conducting crop breeding experiments in collaboration with research institutions. Furthermore, the farmer passed on and exchanged knowledge about experiments on organic cultivation of different crops in regular meetings with local farmers, and in courses for organic farmers.
IP.31	The farmer used information provided by scientific research in technical journals as incentive to start experiments about organic mildew control in vine. In doing so, he critically assessed the practical implementation of scientific knowledge by contrasting it with his own results. He also conducted experiments about mildew tolerant vine varieties together with a research institution. The farmer exchanged experiences about organic disease control with national and international wine growers.
IP.37	Experiences of an organic farmer colleague motivated the farmer to start experimenting with free-range pig keeping. To find an appropriate fodder base for the pigs, he used insights of his own experiments, as well as advice of farmer colleagues and advisors. The farmer accepted farm visits and gave public presentations about his innovative breeding methods, addressing farmers as well as other interested persons (e.g. consumers, cooks). He participated in a university research project about animal health in organic pig production.
IP.46	To experiment on no-plough tillage, direct sowing and intercropping, the farmer made active use of own experience from experimentation (long term observations and photo documentation) and external knowledge of other farmers, scientists and experts. Outcomes of experiments were passed on to organic farmers and other actors on a regular basis. The farmer acted as practical advisor for interested farmers and organized field walks on his plots.

5.2.2.4. Creating opportunity for self-organisation

There are a variety of external influences to which farmers have to adjust, for example changing policies and subsidies, market fluctuations, powerful market actors and erratic weather events. Experiments may aim at reducing dependence on external influences from higher scales. Farmers IP.37 and IP.46 experimented in order to gain more independence from external inputs (Table 25). Farmer IP.46 saved fuel and material when using direct sowing and farmer IP.37 aimed for increased self-sufficiency in fodder for the pigs. Other farmers tried to become less susceptible to fluctuating markets when experimenting with direct marketing (IP.03/IP.04) and niche crops (IP.30).

Table 25: Creating opportunity for self-organization through farmers' experiments (examples)

Experiments aim at making the farm less dependent on external influences, and/or take opportunity of dynamics and diversity to find creative solutions.

Farmer	Examples for resilience building strategies through farmers' experiments
IP.03/ IP.04	The farmers experimented with different types of direct marketing (farmers' markets, direct selling on farm, self-harvest vegetable allotments) in order to build up a loyal consumer stock and to be more independent from market fluctuations.
IP.30	The farmer continuously experimented with alternative and niche crops. In case of declining market prices the farmer shifted to more profitable crops that he already knew from previous experiments or got to know by experimenting with the new crops. He shifted to crops where there are less market competitors to get a better position on the market.
IP.31	The farmer built up comprehensive knowledge through intensive experimentation in wine production (vine growing and wine processing), using a multitude of information sources in combination with his own experiences. By doing so, he established a stable wine production system and a broad consumer stock for his high quality wines.
IP.37	The farmer experimented with sunchoke *(Helianthus tuberosus)* as fodder base for his extensive free-range pig fattening system. Becoming more independent from fodder purchase in times of rising costs for cereal was a prior goal for the farmer. Sunchoke as fodder base instead of maize or soybean also allowed the farmer to distance his products clearly from genetically modified fodder inputs.
IP.46	Experiments about direct sowing aimed at saving time, energy, fuel and material and allowed the farmer to reduce dependence on external inputs. The farmer generally kept his farming system open for opportunities to conduct spontaneous small-scale experiments, e.g. by leaving a corner of a plot unplanted or by documenting his observations and conclusions about incidences and 'mistakes' on his farm.

6. Discussion

The first part of this chapter discusses the situation of farmers' experiments in Austria. Therefore, results of semi-structured (n=47) and structured questionnaire interviews (n=26) are discussed. The second part concentrates on the significance of farmers' experiments for learning processes and farm resilience. This specific aspect of farmers' experiments is discussed based on selected case studies out of the qualitative data set.

6.1. Situation of farmers' experiments in Austria

All 73 farmers interviewed reported activities that can be labelled experiments. These activities involved trying something on the farm, and the observation of the process and/or the outcomes of the experiment. Many authors agree that all farmers have experimenting capacity (Johnson, 1972; Rhoades and Bebbington, 1995; van Veldhuizen et al., 1997; Sumberg and Okali, 1997; Quiroz, 1999; Stolzenbach, 1999; Bentley, 2006).

Fifty percent of randomly sampled farmers stated that they rarely experimented, which was defined as not regularly and not every year, and 19% stated that they very often tried things on their farm. Literature in the context of participatory research mainly focuses on cases of active experimenters within the farming community (cf. Reij and Waters-Bayer, 2001a; Haverkort et al., 1991), 'research-minded farmers' (Biggs, 1990) and 'farmer innovators' (Critchley, 2000), and thus little is known about less active experimenters, or the relative proportions of active and less active experimenters.

Farmers who considered themselves active experimenters tended to follow a certain topic of investigation during several years and aimed at further improving the methods and outcomes of their experiments. In contrast, farmers who rarely experimented mainly reported short-term experiments that were mostly not further improved or continued over a longer period of time. Different attitudes towards experimenting were expressed: Active experimenters considered experimenting an important activity within farming, whereas less active experimenters showed less personal interest in experimenting, but tended to stress the necessity to try or change things when confronted with a problem.

6.1.1. Topics and motives of farmers' experiments

Farmers in Austria were found to experiment in a broad range of topics. Most of the experiments (36%) were reported in the context of plant production (including vegetable, fruit and wine growing), cropping and tillage, 22% of the experiments concerned animal husbandry, 17% concerned processing and commercialisation, and 25% of the experiments related to other areas such as technical experiments, experiments with alternative remedies, in the context of labour management, or experiments within a social context (e.g. care farming or courses on farm).

The literature mainly concentrates on experiments in the area of crop production and related activities such as fertilisation or tillage (cf. van Veldhuizen et al., 1997; Sumberg and Okali, 1997). Sumberg and Okali (1997) catalogued 155 examples of farmers' experiments in three African countries and found that only 5% of the experiments were about non-agronomic topics such as labour management and marketing.

The broad variety of topics in comparison to research findings of studies carried out in a development context may be due to the fact that farming in industrialised countries is partly moving from the production of agricultural raw products to more multifunctional farm activities (Hubert et al., 2000; Björklund and Milestad, 2006) and rural development activities (Darnhofer, 2006). Another factor that influences agricultural activities is decreasing prices due to liberalisation of markets (Hubert et al., 2000). Decreasing agricultural income motivates farmers to experiment with alternative marketing strategies such as direct

marketing, or with the production of alternative goods and services such as composting of organic residues for the community, or social services such as education or leisure time activities (parties, catering, holidays) on farm. Decreasing income in agriculture and changed social conditions, such as off-farm work of farmers or the attempt to separate farm work from family life, also causes farmers to search for time saving measures (Cournut and Dedieu, 2006). As animal husbandry is especially labour-intensive, farmers working in this area reported labour-saving experiments such as the conversion from dairy farming to suckler cow systems, or experiments in the context of extensive animal husbandry, such as pasturing systems.

Problem solving and necessity were considered important motives for farmers to start an experiment. Some farmers commented that while no problem occurred, they saw no reason to experiment. Personal reasons such as curiosity, interest in a specific topic, the will to learn about or prove a specific question were also important motives for farmers to start experimenting.

Motives for farmers' experiments described in literature include problem-solving (Hocdé, 1997), curiosity, adaptation of existing technologies (Rhoades and Bebbington, 1995), peer-pressure (Millar, 1994), and economic and environmental change (Bentley, 2006). Personal motives range from concern for the future of later generations and the community (Zigta and Waters-Bayer, 2001), or interest in looking for a challenge and trying something different, to being able to convince others (Scheuermeier, 1997).

6.1.2. Methodological approach of farmers' experiments

About three-quarters of the farmers interviewed had an explicit mental or written plan before starting the experiment, and 80% of the farmers had expectations about the outcomes of the experiment. These results are in line with comparable studies that report a share of 65 to 95% of proactive, planned experiments (Sumberg and Okali, 1997).

In addition, 69% of the experiments were first set up on small scale, so the farmers could experiment with little risk and scale up the method if the experiment produced satisfactory results. Most authors agree that farmers' experiments often start on small scale, for example in home gardens (Sturdy et al., 2008) or along the borders of fields, to reduce the risk linked to experimenting with unknown practices (Saad, 2002). Starting on small scale allows farmers to collect experiences of the new crop or management technique in a safe manner. The strategy of risk-spreading by small-scale experimentation is also important in the context of resilience building (Folke et al., 2003; Sturdy et al., 2008).

In the cases where experiments were implemented at once on large scale, farmers were either highly convinced that the experiment would be successful, or a small-scale experiment was not possible, e.g. in the case of construction for the entire production unit. In these cases, the farmers generally based their experiments on reliable reference experiences of other farmers, advisors or literature. With regard to resilience, this strategy means taking a risk, and may therefore weaken farm resilience. On the other hand, farmers tried to minimise the risk by combining different types of knowledge to estimate the risk they were taking.

All farmers interviewed reported that they observed the process and/or outcomes of their experiments, and 89% of the farmers conducted observations either daily, weekly, or several times during the season. The frequent observation of the crops during the entire season is highlighted as a strength of farmers' experiments in the literature (Stolzenbach, 1999).

In all, 89% of the farmers employed some kind of comparison to evaluate their experiments. Most comparisons (85%) were conducted with the farmer's own experience, a strategy that is called 'historical comparison' or 'historical control'. 'Historical control' is based on the accumulated understanding of past farming performances and major influencing factors such as rainfall (Sumberg and Okali, 1997). Comparisons were also conducted with plots, units or experiences of other farmers. Comparisons with other units on the farm, with literature or

with information from advisors were also common. In their study in Africa, Sumberg and Okali (1997) found that 39% of the experiments included a direct, side-by-side comparison, but did not assess the frequency of historical or other types of comparisons. They concluded that the majority of experiments were likely to incorporate comparisons (Sumberg and Okali, 1997, p. 99).

Extensive debates have been going on about the comparison of scientific and practical farmers' experiments (cf. Sumberg and Okali, 1997; Chambers et al., 1998; Saad, 2002; Bentley, 2006). An experiment in the context of science has to fulfil a number of criteria, e.g. control of the variables, testing of only one variable at the same time, measurements, documentation and evaluation of the process and the results. Scientists regard an experiment as an inquiry during which all parameters are controlled except the variables under study. Farmers' experiments differ from scientific experiments in the sense that they are conducted in everyday circumstances. Farmers' experiments are an integral part of their farming activity (Röling and Brouwers, 1999).

Since the nature of farming is adaptive performance, farmers' experimentation is not strictly systematic in general. Farmers have to deal with complex contexts in their farming practice. Flexibility and adaptive performance, which are essential qualities for farmers, do not easily go together with systematisation. Spontaneous variation during experimentation is considered a valid source of information itself, and it can be the essence of success for an experiment (Stolzenbach, 1999).

When comparing farmers' experiments with criteria of scientific experimentation, the former have been described as not being systematic (Stolzenbach, 1999). In an article by Gupta (1998) based on interviews with 61 agricultural scientists in India, some scientists saw farmers' practices as potentially being useful and innovative, but overall they had sceptical and critical attitudes towards farmers' practices, regarding them sub-optimal or unscientific (Gupta, 1998).

Other authors do not stress the differences between farmers' and formal experiments as much and claim that farmers' experiments share many characteristics with formal agronomic experimentation: Both aim at developing practical solutions to existing problems, and both are largely empirical and iterative, combining experience, observation, intuition, persistence, skill and luck (Sumberg and Okali, 1997).

Characteristics in common for farmers' and formal research were also found in this study. The majority of farmers had an explicit mental or written plan before starting their experiment and conducted regular monitoring of the process, while all farmers evaluated the process or results of their experiments, and more than half of the farmers documented their experiments. These results are similar to those of Sumberg and Okali, who found *'that the vast majority of farmers' experiments are proactive and that approximately half share key elements with standard agronomic trials'* (Sumberg and Okali, 1997, p. 108).

Nevertheless, farmers also noted differences between farmers' and formal experiments, and explained that following the strict experimental procedures applied in scientific experiments would not make sense for their practical experiments. Farmers have to handle complex systems where a multitude of variables and factors have an influence, so they integrate these factors into their practical experiments and do not strictly isolate or control variables, as would be the procedure in scientific experiments. Farmers also saw limitations of scientific research and argued why those did not always lead to more valid or accurate results. In other words, farmers also saw limitations with scientific experiments in comparison with farmers' experiments.

Farmers' experiments have a number of strengths in comparison with formal agricultural research: Farmers have more opportunities for decentralised experimentation than researchers, and combine inputs in a variety of ways. Farmers have comparative advantages in evaluating and testing new technology, as they consider the complexity of their farming system when evaluating their innovations. Farmers also have an advantage in disseminating knowledge about agricultural innovation. They may share it through their social networks.

Such personal communication is more readily trusted than information provided by outsiders (Hoffmann et al., 2007).

The farmers interviewed were aware of the strengths, but also the limitations, of their practical experiments. In the same sense, farmers knew about the strengths and limitations of scientific research. A number of farmers reported that they made active use of the outputs of scientific experiments. The combination of formal scientific and practical, local knowledge is also a key principle for building resilience (Folke et al., 2003). The combination of different knowledge systems is important since no knowledge system alone is sufficient for maintaining sustainable resource use (Alcorn et al., 2003). Formal and informal research is complementary and may create synergies (Hoffmann et al., 2007).

6.1.3. Outcomes of farmers' experiments

Outcomes of farmers' experiments can be categorised into novelties, minor modifications, or major modifications of existing practices (Sumberg and Okali, 1997). According to this classification, 75% of the 92 experiments discussed here constituted minor modifications to existing practices, while 25% constituted major modifications or novelties in the regional context. These results underline the importance of farmers' experiments for adjusting farming practices to the needs of farmers and specific circumstances. A smaller proportion of farmers regularly use experiments to develop novel ideas or techniques.

All but one of the farmers interviewed confirmed that they obtained more knowledge as a result of the experimentation process, one farmer was neutral about that statement, and no farmer denied the statement. This result underlines the importance of experimentation processes for learning processes and knowledge development (Hocdé, 1997; Sumberg and Okali, 1997).

6.1.4. Factors that influence farmers' experiments

Different factors influenced farmers' experiments. The location of the farm had an influence on the propensity to experiment. Significantly more farmers in region 1 claimed that they very often experimented. This may partially be explained by the environmental conditions in the region, which allow for the production of a variety of agricultural products due to the temperate climate. In contrast, region 2 is located in the alpine area, which mainly allows for grassland farming and animal husbandry. Farmers in region 2 reported that they had fewer possibilities to change things on their farm, as there was 'only grass' growing in the region. Climatic limitations and often steep slope of their farmland were named as factors that limited and challenged farmers in region 2. The influence of the life cycle of crops is mentioned in the literature. Perennial crops or systems, such as pasture and grassland systems, offer relatively fewer occasions to experiment than do annual cropping systems. At the same time, long-cycle systems pose additional challenges in terms of interpretation of cause and effect (Sumberg and Okali, 1997).

It was not only natural conditions that influenced the experimental activity in the two regions. Farmers in region 2 also showed a more negative attitude towards changing, trying and experimenting and often stated that they did 'everything as it has always been done and as everybody else here does it'. In contrast, farmers in region 1 gave more positive comments about experimenting. It is evident that the social environment in the respective region had an influence on the propensity to experiment, or at least on the attitude towards experimentation and innovation.

These regional differences are also described in the literature. Sumberg and Okali (1997) found considerable differences between research sites in Africa when they asked about people who frequently tried things on their farms. In some regions farmers stated that 'no one here is doing anything different' (ibid, p. 127). Cohen (1993 in Sumberg and Okali, 1997) suggests that members of one community might present their knowledge to outsiders as

homogeneous, as a form of community solidarity. By doing so, they define their community and separate it conceptually from the rest of the world (Cohen, 1993 in Sumberg and Okali, 1997). Social pressure can have a negative influence on people with ideas that differ from those of the agricultural society. Some experimenting farmers can be criticised by others and considered disrespectful of the traditional culture (Reij and Waters-Bayer, 2001b).

Traditional agricultural values generally seemed to have a higher influence in region 2 than in region 1. In region 2, it is difficult for an outsider to buy farmland and start farming, as federal regulations are more restrictive than in region 1 (regulated in Tiroler Grundverkehrsgesetz, 1996). Therefore it is the norm that farms are inherited from one generation to the next. All farmers interviewed in region 2 inherited the farm from their parents or the parents-in-law. In contrast, 23% of the farmers interviewed in region 1 had not grown up in the region, and had not inherited the farm but bought it. Nevertheless, farmers in region 2 also reported innovative practices on their farms in the course of the interviews. It seemed more the attitude of the community and the social understanding that experimenting and changing things was not desirable. As the propensity to experiment was surveyed through self-assessment by the farmers, it is not possible to determine and compare the absolute numbers of experiments conducted in the two regions.

Further factors that influence farmers' experiments mentioned in literature are age, sex, education level, farming occupation (full-time or part-time), socio-economic status, political, social or ecological constraints, off-farm experiences, contact to research and advisory services, and personal characteristics of the farmers (cf. Sumberg and Okali, 1997; Saad, 2002; Critchley and Mutunga, 2003). Sumberg and Okali (1997) concluded that there were no strong relationships between the socio-economic characteristics they assessed and either the propensity to experiment or the characteristics of the experiments. However, some similarities can be found among experimenting farmers described in the literature. For example, many farmer experimenters have travelled and experienced other areas (Critchley and Mutunga, 2003) and many are devoted to full-time farming and are flexible enough to be able to experiment (Reij and Waters-Bayer, 2001b).

In the structured questionnaire interviews, farmers who reported frequent experimentation were found to be slightly younger that the average, were more often agricultural outsiders, i.e. had not grown up on a farm, and reported higher travelling frequencies to distant places than farmers who reported low experimentation activities. Size of farmland, level of education and years of farming experience showed no significant influence on the reported frequency of experimentation.

6.1.5. Social context of farmers' experiments

Farmers' experiments are embedded in a social context (Sumberg and Okali, 1997; Wu and Pretty, 2004). Although this thesis focuses mainly on the individual experimentation and learning process, the importance and influence of social relations was addressed by most of the interviewees. For example, organic farmers who converted many years ago, in the pioneer phase of organic agriculture, reported how difficult their standing within the general farming community had sometimes been. Some of them had been confronted with lack of understanding and acceptance by other farmers (Padel, 2001). In this period, the support within organic farmers' associations and groups had been very important to reassure the farmers in their decision and to discuss problems they faced due to conversion.

These pioneer farmers also reported about the importance of own experimentation and the sharing of experiences within organic farmer groups, as there had been little or no practical experiences, and no information coming from agricultural research or advisory systems. Experiences were spread within these networks, and supported the development of the local organic agriculture system. In regions where farmers were able to establish organic agriculture in a successful way, they motivated neighbouring farmers to also convert to organic agriculture. Based on the practical, local experiments these pioneer farmers had

carried out, it was easier and less risky to convert to organic agriculture. In this sense, the pioneer farmers supported the development of local farming systems towards a more sustainable and ecological direction. This development was to a large extent based on their practical experiments that convinced other farmers in the region to convert.

These pioneer groups of organic farmers have partially lost their importance during recent years. This may be due to the fact that organic agriculture is now well established in Austria (Vogl and Darnhofer, 2004), and information is easily available to farmers. It may also be due to the fact that organic agriculture as such is changing (Darnhofer et al., 2010b), and the social diversity within the organic movement has increased as farmers are driven by a variety of motivations to engage in organic agriculture. These motivations can differ significantly, and so organic farmers nowadays do not easily form a homogeneous group as was the case in the pioneer phase of organic agriculture. Organic farmers use a variety of information sources for their farming activities. However, the social context still has an important influence on experimenting, and farmers reported that they were motivated or inspired by other farmers to start experimenting on a specific topic.

6.2. Farmers' experiments as learning strategy to face change and build farm resilience

6.2.1. Learning processes involved in farmers' experiments

Using and developing new knowledge is intrinsically linked with farmers' experiments. When farmers adopt, adapt and formulate new ideas, try them out in different settings, evaluate the results and make decisions of their value for improving the farm, they are involved in knowledge development (van Veldhuizen et al., 1997; Rajasekaran, 1999). Local knowledge is a living resource that is constantly reinvented, and farmer expertise is an indispensable element in sustainable agriculture, i.e. sustainable agriculture requires farmers to be experts in managing complex systems (Pretty, 1998; Röling and Brouwers, 1999). Experimenting as a continuous innovative element of farming is a way to learn in practice (Stolzenbach, 1999), and one of the fundamental strategies involved in farmers' attempts to learn about and control their environment (Rhoades and Bebbington, 1991).

Most farmers' experiments result in the creation of new knowledge and thus imply learning processes. The learning outcomes from experimentation can range from small observations and minor insights to considerable transformations of existing knowledge, beliefs or practices. Minor learning experiences add to the existing knowledge and experience of farmers, but do not necessarily have to change the existing knowledge base of the person.

Some of the experiments farmers reported in the interviews involved learning processes that showed characteristics of transformative learning. According to transformative learning theory, important features in adult learning are contextual understanding, critical reflection on assumptions, and validating meaning by assessing reasons (Mezirow, 2000b). In transformative learning a disorientating dilemma provokes self-examination, which, in turn, leads to critical assessment of internal assumptions. At this stage the learner may feel alienated and, in questioning assumptions, may relate to other people's experiences. The person attempts to understand problems and opportunities and searches for new options and things to try. The next stage involves the learner in exploring options for new behaviours and building competence. A plan of action is developed and the learner acquires knowledge and skills for implementing the plan. This stage may involve active experimentation, where the learner makes efforts to try out the new roles and obtain feedback. The last stage involves reintegration into society from a new meaning scheme and/or perspective (Cranton, 1994 in Percy, 2005).

Some of the farmers interviewed reported learning experiences that included characteristics of transformative learning. For example, one farmer (IP.46) realised that his cropping and tillage techniques over the years led to diminishing soil quality, and he experienced considerable yield losses. Confronting this 'disorientating dilemma', he decided to actively search for sustainable alternatives to improve his organic cropping system. He got in contact with an expert on ploughless tillage and decided to implement a similar tillage technique on his own farm. Over the years he experimented with different ploughless tillage techniques and direct drilling, and also helped improve a special tillage tool created for these alternative techniques. In the beginning, he experienced rejection and lack of understanding within the farming community, but over the years he gained the reputation of being one of the most knowledgeable farmers in the area of ploughless tillage. He now advises farmers and farmer groups in and outside his region, and organises courses and field trips to pass on his experiences.

This is one example that shows how experimentation can be linked to transformative learning. However, the majority of the experiments reported did not include transformative learning. Much of what adults learn is not transformative, nor does it need to be. However, the uncertain, disorientating conditions in which farming communities find themselves suggest that, in order to learn, change and develop, transformative learning may sometimes

be called for. Transformative learning enables people to reflect on and analyse their lives. New meaning schemes or perspectives empower people and allow them to recognise new options (Percy, 2005).

6.2.2. Farmers' experiments as tools to build farm resilience

To test whether farmers' experiments can be tools to build farm resilience, a case study was carried out on five farmers or farming couples (see section 4.3.1). The experiments reported by these selected farmers were related to the four principles for building social-ecological resilience defined by Folke et al. (2003) (see section 5.2.2). The insights from this case study are discussed below.

Learning to live with change and uncertainty

Experiments in this context help farmers to deal with change and learn from crisis (Quiroz, 1999), or even turn crisis and change into opportunities for development. Experiments are set up in a way that enables farmers to spread risks (Saad, 2002) and build insurance on the farm.

Farmers live in dynamic environments, which they have to master to build social-ecological resilience. To build up farm resilience, there have to be knowledge, practices and social mechanisms that recognise that dynamic factors such as disturbance, change and crisis are part of development (Folke et al., 2003). These dynamic factors and changes can emerge from events on the farm, or can be influences from outside the farm (Kummer et al., 2008). The necessity to deal with change and uncertainty can be a reason why farmers experiment (Hoffmann et al., 2007). For example, changes in farmers' economic reality or a need to save on labour or capital, or both, can induce farmers to experiment (Bentley, 2006; Critchley, 2000). Influences from outside the farm can motivate farmers to try new things, and change management practices as a result (Bentley, 2006).

Experiments can act as tools to help farmers deal with emerging crises (Quiroz, 1999). Confronted with crises, farmers often need to draw on their previous experiences. Results and insights from earlier experiments provide useful knowledge and practical solutions that farmers can use in the event of an emerging crisis. Furthermore, experiments may help farmers to shape their farming system so that a crisis does not have harmful impacts. It is also possible that a crisis or disturbance can be used as an opportunity for development (Darnhofer et al., 2010a). Turning crisis into opportunity is characteristic of resilient systems (Folke et al., 2003). For example, farmers that confront a crisis can use the situation as an opportunity to develop their farming system further in a direction that is better adapted to regional conditions and their specific farm.

Spreading risks is important when living with uncertainty. Examples of risk-spreading and insurance-building strategies can be found e.g. in the context of the conversion to organic farming. Many farmers experiment with organic production methods before they decide to convert. Experiments and the knowledge they generate help farmers to decide whether organic farming is suitable for them and their farms, thus reducing the risk of making the wrong decision (Padel, 2001).

Management measures that are first tried on a small scale are also examples of risk-spreading strategies (Sturdy et al., 2008). For example, farmers experiment with a new crop or management technique in a small field or in the homegarden before the crop or management technique is used in larger fields (Saad, 2002). Starting on the small scale allows farmers to collect experiences of the new crop or management technique in a safe manner.

Nurturing diversity

The second principle comprises the ability of systems to nurture diversity for reorganisation and renewal. Experiments performed in this context foster ecological diversity by using or enhancing biodiversity, e.g. by testing crops and varieties of crops for particular farm conditions (Bentley, 2006).

Diversity is important in the social realm as well. Farmers can develop a collective memory of experiences with resources and agro-ecosystem management. This memory provides a context for social responses to change; it increases the likelihood of flexible responses, and seems to be particularly important in times of crisis, reorganisation and renewal (Folke et al., 2003). Increasing the diversity of actors has the potential for bringing new thinking and expanding the role of information, education and dialogue (Berkes, 2007). Folke et al. (2003) describe social memory as consisting of the diversity of individuals, groups, institutions and organisations with different but overlapping roles. Experimenting farmers can be e.g. innovators, entrepreneurs, networkers and/or knowledge carriers. Farmers that experiment and develop new management practices and new knowledge enhance social memory in the organic farming movement as well as in the region where the farm is situated through stimulating discussion, change and learning (Kroma, 2006).

In order to build social-ecological resilience, the knowledge developed in experiments requires social networks and institutional frameworks to be sustained effectively. When experiences from experimentation are shared within the farming community or communicated to other members of society, e.g. customers, advisors and scientists, they may stimulate and enrich social diversity (Kroma, 2006). The experimenting farmers presented in section 5.2.2 enhanced social diversity by exchanging and passing on the knowledge and experiences they have built up through experimenting to farmer colleagues and to other people from outside the farms.

Combining different types of knowledge

In their experiments, farmers use different types of knowledge that can come from a multitude of sources, such as other farmers, the media, science or advisory services (Bentley, 2006). Driven by intuition or an explicit desire to learn, farmers can gain the information and ideas needed to start an experiment from the formal research sector and/or advisory services (Sturdy et al., 2008; Stolzenbach, 1999). In this way, farmers can combine different knowledge systems and thus use knowledge from their own farm in combination with knowledge developed by research institutions or other sources. A bi-directional flow of information from producers to researchers allows farmers to use the best possible information suited to their farms (Hendrickson et al., 2008). This is important since no knowledge system alone is sufficient for maintaining sustainable resource use (Alcorn et al., 2003). Formal and informal research are complementary and may create synergies (Hoffmann et al., 2007).

Experiments performed in this context made use of different sources of information to learn and build up agro-ecological knowledge. The selected farmers were found to combine their own practical observations and experiences with those of farmer colleagues, with information from advisors and experts in specific agricultural topics, with information from the media and science, and also with non-agricultural impressions and information. The farmers also shared their experiences from experimentation within the farming system, e.g. by advising other farmers, and by doing so contributed to building resilience, not only on their individual farm but also within the wider farming system.

Creating opportunity for self-organisation

Systems that do not allow change will generate surprise and crisis. Systems that allow too much change and novelty will suffer loss of memory. Folke et al. (2003) suggest that the interplay between change and the capacity to respond and shape change is a key function in self-organisation, and that self-organisation is vital in building social-ecological resilience.

Self-organisation in this context could be finding windows of opportunities or the ability to keep control of the farm in turbulent times. Self-organisation can emerge when farmers experiment to make their farm less dependent on external influences (such as market fluctuations, policy changes, environmental changes) and/or when farmers use dynamics and diversity to find creative solutions (Folke et al., 2003; Milestad and Darnhofer, 2003).

Farmers' performance is embedded in a particular agro-ecological and socio-cultural context that exists beyond the farm gate and which is usually beyond the farmer's control (Quiroz, 1999). Thus, there are a variety of external influences to which farmers have to adjust. External influences include cross-scale dynamics and external drivers that impact on the farm, such as changing policies and subsidies, market fluctuations, powerful market actors and erratic weather events (Hanson et al., 2008). Experiments may aim at reducing dependence on external influences from higher scales (Quiroz, 1999; Bentley, 2006).

The selected farmers were found to experiment in order to gain more independence from external inputs and increase the farm's self-sufficiency. Other farmers tried to become less susceptible to fluctuating markets when experimenting with alternative marketing concepts and niche production. In this context, farmers explained the importance of being flexible and open to react to changing conditions and emerging opportunities.

6.3. Possibilities to support farmers' experiments

Through experimenting, farmers develop knowledge and skills, and implement changes on the farm that help build farm resilience. This potential has long been overlooked by the conventional research and advisory system (Chambers et al., 1998; Röling and Wagemakers, 1998; Chikozho, 2005) and is still not acknowledged and considered to an adequate extent. Furthermore, institutions such as regulations, subsidies and support payments influence the possibility of farmers to conduct experiments.

How can farmers' experiments be supported? The need to 'strengthen' farmers' experiments is sometimes interpreted in the literature as the need to formalise them by including e.g. replications, standardisations and quantifications (cf. FiBL Deutschland, 2004), but these changes are likely to increase the cost and the risk of experimentation (Sumberg and Okali, 1997). Some authors even suspect that introducing scientific methods may sidetrack farmers into pseudo-scientific trials that do not take advantage of their own knowledge, especially when formal research is seen as more valid and relevant (Saad, 2002). In fact, it is not necessary to teach farmers scientific methods, as they have their own valid methods for carrying out and evaluating experiments (Bentley, 2006).

While supporting local innovation, scientists should not try to 'scientificate' farmers' experimentation or insist on the use of rigorous agronomic research methods. Formal researchers could better broaden their epistemological base by understanding the importance of phenomenology and tacit knowledge and learning from farmers' strategies in dealing with complexity (Hoffmann et al., 2007). To optimise collaboration between farmers and scientists in the field of technological innovation, these two groups could play complementary roles in setting research priorities. There is thus a need for decentralised community-based technology testing that makes use of farmers' experimentation and dissemination capacity. Formal research should be more open to farmers' informal experimentation and pay more attention to the spread of farmers' knowledge and experimental findings (Hoffmann et al., 2007).

'Formalisation' of experimentation processes is not the most adequate way to support farmers' experiments and their search for their own creative solutions. Farmers can best be supported by providing supportive conditions, e.g. access to different sources of information, or possibilities for exchange of experiences and information between farmers, and between farmers, advisors and researchers. Formal and practical research may have different approaches, but both are equally relevant for the further development of sustainable farming systems. Exchange between these two areas of research could be beneficial for both areas.

Farmers could use formal research results as an inspiration and source of information in their experiments. In this thesis, some farmers were found to do exactly this. In the same vein, outcomes of farmers' experiments can be spread to other farmers, incorporated into advisory programmes, and act as an incentive for researchers.

In order for farmers' experiments to be effective tools for building social-ecological resilience, the social memory held by individual experimenting farmers needs to be connected to, and supported by, individuals or groups outside the farm. Farmers' experiments can be a driving force for agricultural development when integrated into the agricultural innovation system (Leitgeb and Vogl, 2010). There is potential to make more active use of farmers' experiments and innovations by raising awareness of the topic within the farming community, the respective political and institutional landscape, and the agricultural research and advisory services.

To take advantage of the potential of farmers to build resilient farming systems, it is important to develop policy tools that do not inhibit (Chikozho, 2005), but rather support, farmers in their experimentation activities (Johnson, 1972; Quiroz, 1999). National regulations, subsidies and support payments could be used to give farmers room for creativity within the regulatory frameworks and conditions for farming. It is important to develop policy tools that support farmers in their experimenting role. For example, subsidy systems could be adapted to give farmers a range of possibilities to fulfil a policy measure rather than only one option. Another possibility would be to engage farmers more actively in the advisory system and make active use of the outcomes of farmers' experiments for the development of local agricultural systems.

7. Conclusions

Organic farmers in Austria were found to experiment in a broad range of topics, depending on the properties and type of the farm and the regional conditions. Farmers were most often motivated to start an experiment when they confronted a concrete problem or felt the need to change and adapt their farm to specific circumstances. Personal motives such as curiosity or interest in a specific topic were central preconditions for farmers deciding whether to conduct an experiment.

Farmers used a diverse range of methodological approaches in their experiments. Some farmers conducted accurate experiments that were comparable to scientific trials, others engaged in particularly creative procedures, other farmers chose pragmatic or intuitive approaches, and other experiments were conducted implicitly, without the farmer being aware of experimenting. The choice of methodological procedure depended on various factors. Personal preferences of the farmer played a crucial role in this context, with some farmers preferring to rely on objective, quantitative criteria when experimenting, and others preferring to trust their intuition or their ability to interpret complex interrelations based on their experience.

Farmers' experiments were influenced by surrounding conditions, for example the social context of the farmer. Farmers in regions with a more traditional background were less interested in experimenting and reported fewer experimentation activities. Farmers who used a variety of different information sources and did not exclusively rely on the most common agricultural information sources reported a more positive attitude towards experimenting. In that sense, farmers' experiments could be fostered by providing access to relevant and useful information sources, and by motivating farmers to use diverse information sources. Fostering and supporting the exchange of information and experiences between farmers could also motivate farmers to experiment.

Based on the results of this thesis, I see no need to formalise farmers' experiments, for example by teaching farmers how to set up experiments in a more formal way. Farmers have their own valid methods and approaches to conduct and evaluate their experiments. Furthermore, a number of farmers explained why they preferred their own experimentation approach and did not want to conduct experiments in a more formalised and standardised way, as that would mean more effort and would not be compatible with their work and life conditions. This does not mean that farmers are generally not interested in formal experimentation approaches. Some farmers were found to apply accurate, quantitative methods in their experiments and could be supported by providing them with information about formal experimentation set-up. What is important to consider is the fact that farmers engage in very diverse types of experiments, and one type or procedure is probably not better or more valid than another. What matters is the fact that farmers have the ability to experiment in order to find their own creative solutions for their specific conditions. Therefore it is advisable to create supporting conditions for farmers to experiment in the way they find appropriate.

Farmers' experiments can be tools to build farm resilience. The five farmers or farming couples that were investigated in this thesis experimented in ways that can be argued to enhance social-ecological resilience on the farm and in the region. In other cases experiments may weaken resilience, for example if the experiment is established on too large a scale, if it exposes the farm to high risk (e.g. in financial, ecological or social terms), or if the experiment makes the farm more dependent on external influences. When supporting or advising farmers, it is therefore important to raise their awareness of these risks. Furthermore, principles to build social-ecological resilience can be used and communicated as guidelines for sustainable farm management.

To conclude, it is crucial to take account of the experiments that take place at farm level. Farmers need to be able to find their own creative and locally adapted solutions to changing

conditions and emerging problems. Therefore it is advisable to give farmers room for creativity within the regulatory frameworks and conditions for farming, e.g. by developing policy tools that support farmers in their experimenting role. Farmers' experiments can also be supported by exchanging information and experiences between farmers, by providing easy access to relevant information for farmers, and by communicating methods and outcomes of farmers' experiments within the farming system and to the public.

8. Literature

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Paper I

Academic discussion about farmers' experiments – a synthesis

Leitgeb, F.; Sanz, E.; Kummer, S.; Ninio, R.; Vogl, C. R. (2008): La discusión académica sobre experimentos de agricultores (farmers' experiments) – una síntesis // Academic discussion about farmers' experiments – a synthesis (Spanish and English). Pastos y Forrajes, 31(1), pp. 3-24.

Friedrich Leitgeb wrote this paper with inputs from all co-authors. The article was published in the Cuban journal 'Pastos y forrajes' in Spanish and English. The journal is not SCI-listed, but is a peer-reviewed scientific journal. The paper summarises scientific literature on the topic of farmers' experiments based on an extensive literature review. This article contains a literature review performed in the beginning of the research project and presents the theoretical base from which the research project and this thesis departed.

La Discusión académica sobre los experimentos de los agricultores – una síntesis

Academic discussion about farmers' experiments – a synthesis

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Resumen

Este artículo representa una síntesis de varios trabajos científicos que tratan los temas de la experimentación e innovación de los agricultores, y se realizó por medio de una búsqueda en bases de datos, libros y revistas científicas. Basado en esa información se pudo constatar que, durante la evolución agraria, la experimentación y la innovación de los agricultores han formado parte integral del desarrollo de los sistemas agrarios mundiales. La capacidad de ellos para responder y adaptarse a los cambios externos e internos forma la base para la evolución agraria. El agricultor es una parte del sistema en el cual está experimentando, y tiene un interés directo de mejorar la situación en cuanto a sus necesidades. La motivación para iniciar la experimentación proviene de la necesidad o del deseo percibido de solucionar problemas determinados, o simplemente de la curiosidad de probar algo. Los agricultores experimentan e innovan con sus propios métodos, que normalmente son distintos a los de los científicos. Los experimentos varían desde muy fáciles hasta muy complejos, suelen ser llevados a cabo con recursos locales y disponibles, y pueden clasificarse en: técnicos, económicos, sociales e institucionales.

Palabras clave: Saber local, experimentación campesina, innovación

Abstract

This paper reviews scientific literature dealing with farmers' experimentation and innovation. For this a search was conducted in databases, books and journals. Based on this information it can be stated that during the evolution of agricultural systems, farmers' experimentation and innovation have been an integrated part of the development of the worlds'agricultural systems. The capacity of farmers to respond and adapt to external and internal changes is the basis for agricultural evolution. The farmer is part of the system in which he/she is conducting experiments and has direct interest in improving the current situation. The motivation to start farmers' experiments arises from the perceived necessity or wish to find solutions for certain problems or just from the farmer's curiosity to try something. Farmers experiment and innovate with their own methods, which usually differ from scientific ones. The level of complexity ranges between very easy and very complex.The experiments are mainly conducted on the basis of locally available physical and biological resources. They can be classified into technical, economical, social and institutional ones.

Key words: Local knowledge, farmers' experiments, innovation

Introducción

La revista *Pastos y Forrajes* es un medio profesional y académico de alto nivel para la presentación de resultados científicos, en la mayoría de los casos a base de experimentos. Para los científicos, la experimentación está estrechamente vinculada con los diseños clásicos, réplicas, tratamientos controlados, un monitoreo estructurado y análisis multivariado, muchas veces incluyendo modelos matemáticos para la comparación de variables y su influencia en los indicadores.

Pero la experimentación no es solo una herramienta académica; es también una actividad cotidiana de los actores no académicos, incluso de los agricultores, en su esfuerzo por adaptar técnicas y procesos agrícolas a nuevas realidades. Últimamente estos experimentos han recibido atención en varios países del mundo. Antropólogos, sociólogos y agrónomos han manifestado su importancia para el desarrollo rural, la seguridad alimentaria, la salud y el ingreso económico. A diferencia de otros países, Cuba tiene una política de apoyo a la experimentación de los agricultores y a los procesos participativos de innovación en el campo; además sus resultados reciben un alto reconocimiento público.

Dichos experimentos forman parte de la agricultura desde que el suelo fue cultivado y los animales fueron domesticados, es decir desde hace miles de años son la base para el desarrollo de la agricultura y de la cultura humana. Probar nuevos métodos y tecnologías, así como experimentar e innovar, han sido elementos integrales y comunes en la vida diaria del agricultor (Haverkort, 1991; Scheuermeier , 1997; Sumberg y Okali, 1997; Bentley , 2006; Richards y Suazo, 2006). El desarrollo de la agricultura está asociado con cambios frecuentes en los niveles socioeconómico, sociocultural, político y agroecológico. La evolución agraria tiene su base en responder a estos cambios mediante los experimentos que realizan los agricultores en su sistema agrario (Mak, 2001). El proceso de experimentar es necesario para adaptar la forma de producir en diferentes con-

Introduction

The *Pastos y Forrajes* journal is a high level professional and academic means for the presentation of scientific results, in most of the cases based on experiments. For scientists experimentation is closely related to classical designs, replications, controlled treatments, structured monitoring and multivariate analysis, often including mathematical models for the comparison of variables and their influence on the indicators.

But experimentation is not only an academic tool; it is also an everyday activity of non-academic actors, even of farmers, in their effort to adapt agricultural techniques and processes to new realities. Lately these experiments have received attention in several countries. Anthropologists, sociologists and agronomists have shown their importance for rural development, food security, health and economic income. Unlike other countries, Cuba has a policy of support to experimentation by producers and to participatory processes of innovation in the countryside; besides, their results receive high public acknowledgement.

Such experiments are part of agriculture since the soil was first cultivated and animals were first domesticated, i.e., since thousands of years ago they are the base for the development of agriculture and human culture. Testing new methods and technologies, as well as experimenting and innovating, have been integral and common elements in the daily life of the farmer (Haverkort, 1991; Scheuermeier , 1997; Sumberg and Okali, 1997; Bentley, 2006; Richards and Suazo, 2006). The development of agriculture is associated to frequent changes in the socioeconomic, socio-cultural, political and agroecological levels. The agricultural evolution is based on responding to thesechanges by means of the experiments carried out by farmers in their agricultural system (Mak, 2001). The experimenting process is necessary to adapt the production form under different conditions, which vary according to the agricultural and social system. They experiment based on their

diciones, que varían según el sistema agrario y social. Ellos experimentan sobre la base de sus conocimientos y experiencias con el fin de mejorar su sistema agrario (Rajasekaran, 1999).

Por la importancia de estos experimentos para el desarrollo de la agricultura, es necesario entender la experimentación de una forma más detallada. El objetivo de este artículo es estructurar la discusión científica actual sobre el tema y presentar los resultados, como una contribución a los esfuerzos para combinar la experimentación de los agricultores con la experimentación científica, con el fin de desarrollar la agricultura para el bien del pueblo.

El artículo se basa en una búsqueda estructurada y documentada científicamente sobre palabras clave, combinando *farm, farmer* (campesino) con *experiment* (experimento), *innovation* (innovación) y *adaptation* (adaptación). Durante el año 2006 se realizó una revisión bibliográfica de la literatura escrita publicada y la electrónica, como catálogos electrónicos de bibliotecas, revistas (por ejemplo: Science Direct, Kluwer) y bases de datos (por ejemplo: Agris). Después del análisis de todos los datos se creó una base propia, clasificando la información relacionada con la experimentación; los diversos temas fueron separados y resumidos en cada capítulo.

La búsqueda de la literatura se hizo como paso inicial en el proyecto "Or ganic farmers' experiments", apoyado por la Fundación Austríaca para la Ciencia (FWF). Este proyecto incluye también investigación de campo entre junio de 2007 y agosto de 2008, en Cuba, bajo contratos de la Universität für Bodenkultur de Viena (University for Natural Resources and Applied Life Sciences, Vienna), con dos instituciones científicas cubanas: el Instituto Nacional de Ciencias Agrícolas y la Estación Experimental de Pastos y Forrajes "Indio Hatuey" (de la Universidad de Matanzas "Camilo Cienfuegos").

Desarrollo

1. Definición de términos

La palabra más común de los agricultores cuando hablan sobre el tema de este artículo es

knowledge and experiences with the objective of improving their agricultural system (Rajasekaran, 1999).

Due to the importance of these experiments for the development of agriculture, it is necessary to understand experimentation in a more detailed way. The objective of this work is to structure the current scientific discussion on the topic and present the results, as a contribution to the efforts to combine farmers' experimentation with scientific experimentation, aiming at developing agriculture for the welfare of the people.

The paper is based on a structured and scientifically documented search on key words, combining farm, farmer, with experiment, innovation and adaptation. During 2006 a bibliographic review was carried out of the published written and electronic literature, such as electronic catalogs of libraries, journals (e.g. Science Direct, Kluwer) and databases (e.g. Agris). After analyzing all the data a proper base was created, classifying the information related to experimentation; the diverse topics were separated and summarized in each chapter.

The search in literature was made as initial step in the project "Or ganic farmers' experiments", supported by the Austrian Foundation for Science (FWF). This project also includes field research between June, 2007 and August, 2008, in Cuba, under contracts of the Universität für Bodenkultur ofViena (University for Natural Resources and Applied Life Sciences, Vienna), with two Cuban scientific institutions: the National Institute ofAgricultural Sciences and the Experimental S tation of Pastures and Forages "Indio Hatuey" (of the University of Matanzas "Camilo Cienfuegos").

Development

1. Definition of terms

The most common word of farmers when speaking about the topic is «testing». The first definition one finds of this term is: 'to make exam and experiment of the qualities of someone or something' (RAE, 2001). Farmers define

'probar'. La primera definición que se encuentra de este término es: 'hacer examen y experimento de las cualidades de alguien o algo' (RAE, 2001). Los agricultores definen 'probar' en una forma amplia, muchas veces sinónimo de 'experimentar', por ejemplo como la actividad de introducir algo total o parcialmente nuevo a su explotación y evaluar el éxito o fracaso de esta introducción (Quiroz, 1999).

'Experimentar' significa hacer operaciones destinadas a descubrir, comprobar o demostrar determinados fenómenos o principios científicos (RAE, 2001). Cuando los agricultores utilizan esta palabra, muchas veces significa: 'observar profundamente los resultados de un cambio inducido por ellos en su finca y comprobar estos resultados con lo que otros opinan o dicen'. También significa: 'comparar algo ya conocido con algo no conocido'(Stolzenbach, 1999).

Una palabra vinculada estrechamente con el tema de la experimentación es la 'innovación'. Una innovación es una idea, una práctica o un objeto que es percibido como nuevo por un individuo u otra unidad de adopción. Es de poca importancia si la idea es objetivamente nueva, medida en el transcurso del tiempo desde el primer uso o descubrimiento. Se entiende como 'invención' una idea o una tecnología realmente nueva, es decir, descubierta o creada por primera vez (Rogers, 1995).

Los experimentos y las innovaciones de los agricultores son procesos distintos pero complementarios. Los experimentos contribuyen a la creación de nuevos conocimientos, condición previa para el desarrollo de una innovación (Rogers, 1995) o invención. Experimentar es un proceso dinámico en un período determinado antes del desarrollo de una innovación o invención. El experimento y la innovación son partes del proceso de la experimentación de cada agricultor (Rogers, 1995; Hocdé, 1997). Si los resultados de un determinado experimento no son satisfactorios, no se desarrolla una innovación o una invención. En cualquier caso los agricultores aumentan su experiencia y el saber local a través de la experimentación (Bentley , 2006; Richards y Suazo, 2006).

'testing' widely, often as synonym of 'experimenting', for example, as the activity of introducing something totally or partially new to exploitation and evaluate the success or failure of this introduction (Quiroz, 1999).

'Experimenting' means making operations destined to discover, test or prove certain phenomena or scientific principles (RAE, 2001). When farmers use this word, it often means: 'to observe deeply the results of a change induced by them in their farm and test these results with the opinion or statements of others'. It also means: 'comparing something already known to something unknown' (Stolzenbach, 1999).

A word closely linked to the topic of experimentation is 'innovation'. An innovation is an idea, a practice or an object that is perceived as new by an individual or another adoption unit. It is of little importance whether the idea is objectively new, measured in the passage of time since the first use or discovery . 'Invention' is understood as a really new idea or technology , i.e., discovered or created for the first time (Rogers, 1995).

The experiments and innovations of farmers are different but complementary processes. Experiments contribute to the creation of new knowledge, previous condition for the development of an innovation (Rogers, 1995) or invention. Experimenting is a dynamic process in a certain period before the development of an innovation or invention. Experiment and innovation are part of every farmer's experimentation (Rogers, 1995; Hocdé, 1997). If the results of a certain experiment are not satisfactory, an innovation or an invention is not developed. In any case farmers increase their experience and local knowledge through experimentation (Bentley, 2006; Richards and Suazo, 2006).

2. Justification of farmers' experiments

Rural zones are characterized by their diversity of conditions, for which the needs of the people who live in rural areas are dif ferent according to the site and, consequently, it is not possible that one innovation is applicable for all

2. Justificación de los experimentos de los agricultores

Las zonas rurales están caracterizadas por su diversidad de condiciones, por lo que las necesidades de las personas del medio rural son diferentes según el lugar y, en consecuencia, no es posible que una sola innovación sea aplicable por todos los agricultores (Reece y Sumberg, 2003); cada individuo tiene que adaptar la innovación a sus condiciones (Niemeijer, 1999; Sumberg, Okali y Reece, 2003) a través de un proceso de experimentación. La capacidad de ellos para experimentar e innovar es una parte importante del desarrollo de los sistemas agrarios; tienen que ajustar su forma de trabajar y su sistema agrario a los cambios de su entorno (Bentley, 2006; Richards y Suazo, 2006).

Los agricultores experimentan e innovan continuamente para mantener y mejorar la producción agraria, pero la comunidad científica pocas veces muestra atención a la metodología y a los resultados de esos experimentos (Haverkort, 1991; Bentley y Baker, 2005). Sin embargo, ellos experimentan, con el apoyo científico o sin este. Hasta hoy no existen métodos suficientes para documentar ni para divulgar dichos experimentos (Bentley, 2006). Las actividades de los centros de investigación y las empresas multinacionales, frecuentemente minimizan la importancia de la experimentación de los agricultores y, en muchos casos, se subestima la capacidad de estos para experimentar e innovar. La investigación científica no siempre está basada en la realidad de la vida del agricultor, ni tiene en cuenta sus conceptos ideológicos, aunque los valores personales pueden influir en la aceptación y la adopción de las innovaciones. En muchos casos los científicos y extensionistas utilizan el modelo jerárquico para transferir innovaciones, sin tener en cuenta adecuadamente los conceptos locales, ni las condiciones económicas, socioculturales, ambientales y técnicas de los agricultores (Bunch, 1991). Con este modelo de transferencia, conocido como *top-down*, surgieron problemas, porque las innovaciones no fueron orientadas a

farmers (Reece and Sumberg, 2003); each individual has to adapt the innovation to his/her conditions (Niemeijer, 1999; Sumberg, Okali and Reece, 2003) through an experimentation process. Their capacity to experiment and innovate is an important part of the development of agricultural systems; they must adjust their working way and their agricultural system to the changes of the surroundings (Bentley, 2006; Richards and Suazo, 2006).

Farmers continuously experiment and innovate to maintain and improve agricultural production, but the scientific community seldom pays attention to the methodology and results of those experiments (Haverkort, 1991; Bentley and Baker, 2005). Nevertheless, they experiment, with or without scientific support. Until now there are not enough methods for documenting or divulging such experiments (Bentley, 2006). The activities of research centers and multinational enterprises, frequently minimize the importance of farmers' experimentation and, in many cases, their capacity to experiment and innovate is underestimated. Scientific research is not always based on the reality of the farmer's life, nor takes into consideration his/her ideological concepts, although personal values can influence the acceptance and adoption of innovations. Frequently scientists and extension workers use the hierarchical model to transfer innovations, without considering adequately local concepts or the economic, socio-cultural, environmental and technical conditions of farmers (Bunch, 1991). With this transference model, known as *top-down*, problems emerged, because the innovations were not oriented to the needs of the people of rural areas. An example is the gender issue in agriculture, because the role of women did not always have adequate attention by scientific research. A consequence was that innovations were neither appropriate nor applicable by women (Haverkort, 1991).

In many countries small farmers represent a little favored social class, while most of the scientists usually belong to the highest social classes. This fact causes a difference between both social groups (Hagmann, Chuma and

las necesidades de las personas del medio rural. Un ejemplo es la cuestión de género en la agricultura, ya que el papel de la mujer no siempre tuvo la atención adecuada por parte de la investigación científica. Una consecuencia fue que las innovaciones no resultaran apropiadas ni aplicables por las mujeres (Haverkort, 1991).

En muchos países los pequeños agricultores representan una clase social poco favorecida, mientras que la mayoría de los científicos suelen moverse en clases sociales más altas. Este hecho causa una diferencia entre los dos grupos sociales (Hagmann, Chuma y Murwira, 1997), que la ciencia intenta eliminar, pero sin tener un conocimiento detallado de las condiciones locales de los pequeños agricultores. Las soluciones de los científicos requieren altos gastos y recursos externos, para ahorrar tiempo y trabajo; pero en la mayoría de los casos los agricultores intentan ahorrar dinero en vez de gastarlo (Haverkort, 1991; Bentley, 2006).

Los agricultores tienen un saber local específico acerca de las condiciones ambientales y de los problemas locales, así como experiencias que un investigador no puede tener (Sumberg y Okali, 1997). Entender el proceso de la experimentación de los agricultores es la base para una cooperación beneficiosa y una creación participativa de nuevos conocimientos. La ciencia formal tiene que aceptar la capacidad innovadora del agricultor para cooperar y desarrollar tecnologías más apropiadas (Bentley y Baker, 2005).

3. Factores que influyen en los experimentos de los agricultores

Entre los factores que influyen en la disposición para experimentar con nuevos métodos o tecnologías, se encuentran los externos y los internos. Los externos están vinculados de manera indirecta con el agricultor e incluyen cambios que tienen su origen a nivel político, institucional, social, cultural o económico. Otros factores externos pueden ser el entorno biofísico y las condiciones agroecológicas (Mak, 2001; Padel, 2005).

Murwira, 1997), that science tries to eliminate, but without detailed knowledge of the local conditions of small producers. Scientists' solutions require high expenses and external inputs, to save time and money; but in most cases farmers try to save money instead of spending it (Haverkort, 1991; Bentley, 2006).

Farmers have specific local knowledge about the environmental conditions and local problems, as well as experience that a researcher can not have (Sumberg and Okali, 1997). Understanding the farmers' experimentation process is the base for a beneficial cooperation and participatory creation of new knowledge. Formal science has to accept the innovating capacity of the farmer to cooperate and develop more appropriate technologies (Bentley and Baker, 2005).

3. Factors that influence the farmers' experiments

Among the factors that influence the willingness to experiment with new methods or technologies, are the external and internal ones. The external factors are linked indirectly to the farmer and include changes originated at political, institutional, social, cultural or economic level. Other external factors could be the biophysical environment and agroecological conditions (Mak, 2001; Padel, 2005).

The internal factors are directly related to the farmer; they are: age, sex, social network, work organization, production process or farmer 's budget; other factors can be: size of useful agricultural surface or type of agricultural production (Mak, 2001; Padel, 2005).

3.1 Agroecological factors

Topography, such as slopes or other land characteristics, influence the willingness for experimenting. Slopes can favor experiments to stop erosion (GebreMichael, 2001). Climatic changes, such as severe drought, can force the farmer to test new irrigation methods (Niemeijer, 1999; Sumberg *et al*., 2003).

If the quantity of variables is high, such as the varieties of plants cultivated, animals or even

Los factores internos están relacionados directamente con el agricultor; estos son: la edad, el sexo, la red social, la organización del trabajo, el proceso de producción o el presupuesto del agricultor; otros pueden ser: el tamaño de la superficie agraria útil o el tipo de producción agraria (Mak, 2001; Padel, 2005).

3.1 Factores agroecológicos

La topografía, como las pendientes u otras características de la tierra, influyen en la disposición para experimentar. Las pendientes pueden favorecer experimentos para detener la erosión (GebreMichael, 2001). Los cambios climáticos, como una sequía extrema, pueden forzar al agricultor a probar nuevos métodos de regadío (Niemeijer, 1999; Sumberg et al., 2003).

Si es alta la cantidad de variables, como las variedades de plantas cultivadas, los animales o incluso la maquinaria agrícola en una explotación, las posibilidades de experimentar aumentan. En situaciones agroecológicas diversificadas existen más posibilidades de experimentar para un agricultor (Sumberg y Okali, 1997).

3.2 Factores socioeconómicos

Existe una relación significativa entre las redes de comunicación y la capacidad de innovar Una red social bien desarrollada favorece el intercambio de ideas y tecnologías. Las conexiones y relaciones sociales que tiene un agricultor significan más oportunidades para obtener información, tecnología, capital y asesoramiento (Wu y Pretty, 2004). Una red social de agricultores experimentadores facilita la investigación informal y tiene un impacto en la calidad y la cantidad de los experimentos (Hagmann et al., 1997).

La presión social puede tener una influencia negativa en las personas con ideas extraordinarias y distintas a las de la sociedad agraria. Algunos agricultores experimentadores pueden ser criticados por otros agricultores y considerados como no respetuosos de la cultura tradicional (Reij y Waters-Bayer, 2001).

Las decisiones institucionales o políticas pueden causar cambios a nivel socioeconómico, así

agricultural machinery under exploitation the possibilities for experimenting increase. In diversified agroecological situations there are more possibilities for a producer to experiment (Sumberg and Okali, 1997).

3.2 Socioeconomic factors

There is a significant relationship between communication networks and innovation capacity. A well-developed social network favors the exchange of ideas and technologies. The social connections and relationships of a farmer mean more opportunities for obtaining information, technology, capital and advisory (Wu and Pretty, 2004). A social network of experimenting farmers facilitates informal research and has an impact on the quality and quantity of experiments (Hagmann *et al*., 1997).

Social pressure can have a negative influence on the people with extraordinary ideas different from those of the agricultural society . Some experimenting farmers can be criticized by others and considered disrespectful of the traditional culture (Reij and Waters-Bayer, 2001).

Institutional or political decisions can cause changes at the socioeconomic level, as well as mean opportunities or threats for farmers; those that cause precarious situations induce the need to experiment (Mak, 2001; Padel, 2005). In the case of the changes that affect production negatively, the farmers perceive inexperimentation their only possibility to sustain their family and adapt their working ways to them (Tonda, Hien and Zango, 2001).

The economic situation of the experimenting farmer has a different impact according to the country and it can also affect positively or negatively (Sumberg and Okali, 1997; Miiro, Critchley, Wal and Lwakuba, 2001; Reij and Waters-Bayer, 2001; Wu and Pretty, 2004). If farmers perceive a bad financial situation they can feel encouraged to improve it. Likewise, an insufficient economic situation can prevent the farmer from experimenting, due to the high risk of losing money (Sumberg and Okali, 1997; Quiroz, 1999).

como significar oportunidades o amenazas para los agricultores; los que provocan situaciones precarias causan una necesidad de experimentar (Mak, 2001; Padel, 2005). En el caso de los cambios que afectan la producción de una manera negativa, los agricultores perciben en la experimentación su única posibilidad para sostener su familia y adaptar su forma de trabajar a estos (Taonda, Hien y Zango, 2001).

La situación económica del agricultor experimentador tiene un impacto diferente según el país y también puede afectar de una manera positiva o negativa (Sumberg y Okali, 1997; Miiro, Critchley, Wal y Lwakuba, 2001; Reij yWaters-Bayer, 2001; Wu y Pretty, 2004). Si los agricultores perciben una mala situación financiera, pueden sentirse animados para intentar mejorarla. De la misma manera, una situación económica insuficiente puede impedir que el agricultor experimente, debido al riesgo elevado de perder dinero (Sumber g y Okali, 1997; Quiroz, 1999).

Los agricultores que trabajan a tiempo par - cial y tienen ingresos aparte de los de la agricultura, se enfrentan a condiciones distintas. Los ingresos adicionales pueden afectar la disposición para que ellos experimenten positivamente, al tener más dinero para las inversiones agrícolas (Sumberg y Okali, 1997; Nasr , Chahbani y Reij, 2001). Por otro lado, trabajar a tiempo parcial en la agricultura implica dedicar menos tiempo al campo. Es probable que los agricultores a tiempo parcial sientan menos necesidad para invertir en el futuro de la producción agraria. En la literatura sobre el tema se destacan los ejemplos de los agricultores que se dedican únicamente a la agricultura (Critchley, 2000; GebreMichael, 2001).

3.3 Factores sociodemográficos

Los experimentos son realizados por agricultores de todos los grupos sociodemográficos, independientemente de la edad, el género, el nivel de educación, el estado civil o la situación laboral (Hocdé, 1997; Sumberg y Okali, 1997; Critchley, 2000). Aunque algunos agricultores están involucrados de forma más activa en los

The farmers that work part-time and have other incomes beside agriculture face different conditions. Additional incomes can af fect positively their willingness to experiment, as they have more money for agricultural investment (Sumberg and Okali, 1997; Nasr , Chahbani and Reij, 2001). On the other hand, working part-time in agriculture implies dedicating less time to the field. Probably part-time farmers feel less need to invest in the future of agricultural production. In the literature about the topic the examples of farmers who are dedicated only to agriculture stand out (Critchley, 2000; GebreMichael, 2001).

3.3 Socio-demographic factors

The experiments are carried out by farmers from all the socio-demographic groups, independently from age, gender , educational level, marital status or work situation (Hocdé, 1997; Sumberg and Okali, 1997; Critchley , 2000). Although some farmers are more actively involved in the experimentation processes and develop new methods and technologies or modify significantly the innovations introduced externally, it is dif ficult to identify the socio-demographic factor responsible for this attitude (Zigta and Waters-Bayer, 2001; Sumberg *et al*., 2003).

The experimenting farmers that develop innovations or inventions have some socio-demographic characteristics different from those that only adopt innovations created by others; the former have a higher educational level than the latter (Miiro *et al*., 2001). In addition, they generally maintain more cosmopolite relationships, travel frequently out of their towns and have other experimenting and innovating farmers in their social network. Nevertheless, there can be members within the local social network that do not accept the experimenting and innovating character (Rogers, 1995).

The farmers with large agricultural surfaces are usually less motivated to experiment than those with small plots (Hagmann *et al*., 1997; GebreMichael, 2001). According to other sources, there is no correlation between the

procesos de experimentación y desarrollan nuevos métodos y tecnologías o modifican significativamente las innovaciones introducidas externamente, es difícil identificar el factor sociodemográfico responsable de esta actitud (Zigta y Waters-Bayer, 2001; Sumberg et al., 2003).

Los agricultores experimentadores que desarrollan innovaciones o invenciones tienen algunas características sociodemográficas distintas de las de aquellos que solo adoptan innovaciones creadas por otros; los primeros suelen tener un nivel de educación mayor que los segundos (Miiro et al., 2001). Además, generalmente mantienen más relaciones cosmopolitas, viajan con frecuencia fuera de sus pueblos y tienen en su red social a otros experimentadores e innovadores. No obstante, dentro de la red social local pueden existir miembros que no acepten el carácter experimentador e innovador (Rogers, 1995).

Los agricultores con superficies agrícolas grandes suelen estar menos motivados para experimentar que aquellos con pequeñas parcelas (Hagmann et al., 1997; GebreMichael, 2001). Según otras fuentes, no hay correlación entre la disposición para experimentar y el tamaño de la explotación (Nielsen, 2001); incluso se afirma que los agricultores experimentadores poseen superficies agrarias grandes (Miiro et al., 2001).

Algunos autores plantean que los agricultores experimentadores tienen entre 30 y 50 años (Nasr et al., 2001), pero según otras fuentes pueden ser de más edad (Miiro et al., 2001; GebreMichael, 2001). Los agricultores mayores poseen más experiencia, lo que les da ventajas para experimentar (Miiro et al., 2001). Los agricultores jóvenes, que recientemente empezaron a trabajar en la agricultura, todavía se encuentran en un proceso de aprendizaje, lo cual les conduce a la necesidad de experimentar (Reij y Waters-Bayer, 2001).

Los dos géneros llevan a cabo experimentos, aunque existe una tendencia que sostiene que los hombres están más involucrados en el tema de la experimentación e innovación (Sumberg y Okali, 1997; Miiro et al., 2001).Tres

willingness to experiment and the size of the population (Nielsen, 2001); it is even stated that experimenting farmers have lar ge agricultural surfaces (Miiro *et al*., 2001).

Some authors state that experimenting farmers are between 30 and 50 years old (Nasr *et al*., 2001), but according to other sources they can be older (Miiro *et al*., 2001; GebreMichael, 2001). Older farmers are more experienced, which gives them advantages to experiment (Miiro *et al*., 2001). Young farmers, who recently started to work in agriculture, are still in a learning process, which leads them to the need of experimenting (Reij andWaters-Bayer, 2001).

Both genders carry out experiments, although there is a trend that sustains that men are more involved in the experimentation and innovation topic (Sumberg and Okali, 1997; Miiro *et al*., 2001). Three fourths of the experiments are performed by men. The question is whether it makes any sense to distinguish between men and women, because the decisions about important changes in the farm management, as well as the introduction of new technologies or methods require the agreement and support of the family Some innovations carry such a risk that they require, at least, consultation with the family or even their active participation (Reij andWaters-Bayer, 2001).

There is a separation of tasks in a farmer family. Men work in the field, which explains that most of the experiments are carried out by them (Hocdé, 1997; Reij and Waters-Bayer, 2001; GebreMichael, 2001). Women have wide knowledge in topics such as seed storage, food elaboration, medicinal plants or marketing (Gupta, 1996); more experimenting women are found in such topics (Hocdé, 1997; Reij and Waters-Bayer, 2001).

3.4 Personal factors

The personal character of the farmer is important in the experimentation process. If he thinks he knows everything about his/her exploitation and that agricultural production can not be improved in any way , he will not experiment with alternatives; i.e., the farmer has

cuartas partes de los experimentos son realizados por hombres. La pregunta es si tiene sentido distinguir entre hombres y mujeres, porque las decisiones sobre cambios importantes en la gestión de la finca, así como la introducción de nuevas tecnologías o métodos, requieren el acuerdo y el apoyo de la familia.Algunas de las innovaciones conllevan un riesgo tal que requieren, al menos, la consulta de la familia o incluso su participación activa (Reij y Waters-Bayer, 2001).

Suele existir una separación de tareas en una familia campesina. Los hombres trabajan en el campo, lo que explica que la mayor parte de los experimentos sean realizados por ellos (Hocdé, 1997; Reij y Waters-Bayer, 2001; GebreMichael, 2001). Las mujeres tienen un amplio conocimiento en temas como el almacenamiento de semillas, el huerto familiar , la elaboración de alimentos, las plantas medicinales o el *marketing* (Gupta, 1996); En dichos temas se encuentran más mujeres experimentadoras (Hocdé, 1997; Reij y Waters-Bayer, 2001).

3.4 Factores personales

El carácter personal del agricultor tiene importancia en el proceso de la experimentación. Si este opina que sabe todo de su explotación y que no se puede mejorar de ninguna manera la producción agraria, no experimentará con alternativas; es decir, el agricultor tiene prejuicios que le impiden experimentar (Sumberg y Okali, 1997). Los agricultores experimentadores que desarrollan innovaciones o invenciones con éxito suelen tener una personalidad fuerte (Reij y Waters-Bayer, 2001); son capaces de observar cambios y de analizar e interpretar los resultados (Zigta y Waters-Bayer, 2001); también tienen que ser capaces de manejar un alto grado de incertidumbres (Rogers, 1995). La creatividad, la perseverancia y la convicción de que el propósito va a tener éxito, son cualidades que favorecen la experimentación con métodos y tecnologías alternativas (Zigta y Waters-Bayer, 2001). Además los innovadores suelen ser curiosos, orgullosos y dispuestos a arriesgar (Critchley , 2000).

prejudices that prevent him from experimenting (Sumberg and Okali, 1997).

The experimenting farmers who successfully develop innovations or inventions usually have a strong personality (Reij and Waters-Bayer, 2001); they are capable of observing changes and analyzing and interpreting the results (Zigta and Waters-Bayer, 2001); they should also be capable of managing a high degree of uncertainties (Rogers, 1995). Creativity , perseverance and conviction that the purpose will be successful, are qualities that favor the experimentation with alternative methods and technologies (Zigta and Waters-Bayer, 2001). In addition, innovators are usually curious, proud and willing to take risks (Critchley, 2000).

4. Sources of farmers' experiments

The experience acquired by a farmer throughout his/her life widens his/her local knowledge and is a good base for experimenting with new ideas or technologies (Zigta and Waters-Bayer, 2001). Successful experiments emerge by the combination of new ideas with local knowledge; the former can be introduced by extension workers, research centers or other farmers, but they can also be the experimenting farmer's own ideas (Bunch, 1991; Bentley , 2006).

Sumberg and Okali (1997) identified three important sources for farmers' experiments: in the first place, the farmer attempts something he/she observed or was recommended by others; in second place are the farmer's own ideas; and in the third place he/she experiments with technologies or methods that were actively promoted by institutions.

5. Motives of the experimenting farmers

Experimenting farmers can be motivated by economic considerations, for example, market demand. Through the experiments they try to increase incomes (Bentley, 2006) or avoid economic losses (Quiroz, 1999; Critchley, 2000). The reduction of the use of synthetic pesticides, and consequently of their cost, can lead to experiments with methods of biological control

4. Fuentes de los experimentos de los agricultores

La experiencia que gana un agricultor durante su vida amplía su saber local y forma una buena base para experimentar con nuevas ideas o tecnologías (Zigta y Waters-Bayer, 2001). Los experimentos exitosos surgen por la combinación de nuevas ideas con el saber local; estas pueden ser introducidas por los extensionistas, los centros de investigación o por otros agricultores, pero también pueden ser ideas propias del agricultor experimentador (Bunch, 1991; Bentley , 2006).

Sumberg y Okali (1997) identificaron tres fuentes importantes para los experimentos de los agricultores: en primer lugar el agricultor intenta algo que observó o que fue recomendado por otros; en segundo lugar se encuentran las ideas propias del agricultor; y en tercer lugar experimenta con tecnologías o métodos que fueron promocionados activamente por instituciones.

5. Motivos de los agricultores experimentadores

Los agricultores experimentadores pueden estar motivados por consideraciones económicas, por ejemplo la demanda del mercado. A través de los experimentos ellos intentan aumentar los ingresos (Bentley, 2006) o evitar pérdidas económicas (Quiroz, 1999; Critchley, 2000). La reducción del uso de pesticidas sintéticos, y en consecuencia del costo de estos, puede desencadenar experimentos con métodos de control biológico de las plagas. Disminuir el costo y el tiempo de trabajo anima a los agricultores a experimentar con nuevas tecnologías o métodos (Bentley, 2006). La necesidad de un determinado cultivo para el autoconsumo puede promover experimentos con nuevas plantas; de esta manera no hace falta comprarlo en el mercado (Quiroz, 1999).

Además de los estímulos económicos, se pueden identificar los estímulos personales para la experimentación de los agricultores. La preocupación por el desarrollo de la explotación, por las generaciones posteriores y por la comunidad, es otra motivación para experimentar (Zigta y Waters-Bayer, 2001). Hay agricultores expe-

of pests. To decrease the cost and work time encourages farmers to experiment with new technologies or methods (Bentley , 2006). The need of a certain crop for self-consumption can promote experiments with new plants; so that there is no need to buy it in the market (Quiroz, 1999).

In addition to economic stimuli, personal stimuli can be identified for farmers' experimentation. The concern for the development of the exploitation, by later generations and the community , is another motivation for experimenting (Zigta andWaters-Bayer, 2001). There are experimenting farmers who look for a challenge and try something different, to be able to convince their neighbors afterwards (Scheuermeier, 1997). Through experimentation they discover a fundamental function of agriculture: to protect, create and improve land (Hocdé, 1997).

6. Characteristics of farmers' experiments

Farmers' experiments have general characteristics in common, although it is important to acknowledge that they depend on several factors and are different in each region (Quiroz, 1999).

During the process of agricultural production farmers go through several stages, in which they must make decisions and undertake actions to reach their objectives, as well as reflect about the results in order to improve them (Sumber g and Okali, 1997; S tolzenbach, 1999). In each stage of production in which the farmer must make decisions, a possibility for experimenting can appear. The exploitation management is a series of experimentations by means of which agricultural production should improve; it means that experimentation is an integral and continuous element of agriculture (Stolzenbach, 1999).

The experiments that require thorough changes in the or ganization of the agricultural system or the social relationships of the farmer decrease the willingness to experiment, which can be due to the complexity of the purpose or the risk that accompanies the experiment (Sumberg and Okali, 1997; Padel, 2001).

rimentadores que buscan un reto e intentan algo diferente, para luego poder convencer a sus vecinos (Scheuermeier, 1997). A través de la experimentación descubren una función fundamental de la agricultura: proteger, crear, y mejorar la tierra (Hocdé, 1997).

6. Características de los experimentos de los agricultores

Los experimentos de los agricultores tienen características generales en común, aunque es importante reconocer que estas dependen de varios factores y son distintas en cada región (Quiroz, 1999).

Durante el proceso de la producción agraria los agricultores pasan por varias etapas, en las cuales tienen que tomar decisiones y emprender acciones para alcanzar sus objetivos, así como reflexionar sobre los resultados para mejorarlos (Sumberg y Okali, 1997; Stolzenbach, 1999). En cada etapa de la producción en la que el agricultor tiene que tomar decisiones, puede aparecer una posibilidad de experimentar . La gestión de una explotación es una serie de experimentaciones mediante las cuales la producción agraria debe ir mejorando; eso significa que la experimentación es un elemento integral y continuo de la agricultura (S tolzenbach, 1999).

Los experimentos que requieren cambios profundos en la organización del sistema agrario o en las relaciones sociales del agricultor, disminuyen la disposición de experimentar , lo que puede deberse a la complejidad del propósito o al riesgo que acompaña el experimento (Sumberg y Okali, 1997; Padel, 2001).

Dichos experimentos suelen estar basados en prueba-error (Bajwa, Gill y Malhotra, 1997; Rajasekaran, 1999; Bentley, 2006); ello significa que los agricultores deciden, según el procedimiento, cómo continuar el experimento y pueden modificar los métodos. Si el resultado cumple las necesidades de los agricultores y mejora sus condiciones de trabajo o de vida, puede ser interesante también para otros (Bajwa et al., 1997). Los experimentos se realizan con los recursos físicos y biológicos disponibles, como por

Such experiments are usually based on trial-error (Bajwa, Gill and Malhotra, 1997; Rajasekaran, 1999; Bentley, 2006); it means that farmers decide, according to the procedure, how to continue the experiment and can modify the methods. If the result fulfils the farmers' needs and improves their work or living conditions, it can be interesting for others too (Bajwa et al., 1997). The experiments are carried out with the available physical and biological resources, such as, for example, local seeds, manure, land or labor (Rajasekaran, 1999).

Farmers' experiments vary from very easy to very complex (Hocdé, 1997), but for decreasing the risk of experimentation the farmer usually applies new methods to small plots and maintains the experiment simple (Connell, 1991). There are few examples in which farmers' experiments cause radical and complex changes in the production system (Sumber g and Okali, 1997).

The farmer begins with an experiment to start a change in his/her agricultural system, but he/she generally does not have a concrete concept of the result; according to what is obtained he/she decides whether this type of experiment continues (Stolzenbach, 1997). Innovations, born from successful experiments, can cause changes in the work methods or the agricultural system. If they are complex, but successful at the same time, they can be quickly disseminated (Niemeijer, 1999).

6.1 Planning of farmers' experiments

Sumberg and Okali (1997) classify experiments as proactive and reactive. Most experiments are usually proactive, i.e., the farmer uses a certain statement before experimenting. Being proactive the farmers can experiment actively to solve the problems, trying several choices. Reactive experimentation is based on chance; it means that the farmer experiments without having a hypothesis or a statement.

Farmers do not usually analyze in detail their agricultural situation to formulate the justification, hypothesis and methods of their

ejemplo semillas locales, abonos, tierra o trabajo (Rajasekaran, 1999).

Los experimentos de los agricultores varían desde muy fáciles hasta muy complejos (Hocdé, 1997), pero para disminuir el riesgo de la experimentación el agricultor suele aplicar los nuevos métodos a parcelas pequeñas y mantener el experimento simple (Connell, 1991). Hay pocos ejemplos en que los experimentos de los agricultores causan cambios radicales y complejos en el sistema de producción (Sumber g y Okali, 1997).

El agricultor comienza con un experimento para iniciar un cambio en su sistema agrario, pero generalmente no tiene un concepto concreto del resultado; según lo que obtenga, decide si continúa con este tipo de experimento (Stolzenbach, 1997). Las innovaciones, nacidas de experimentos exitosos, pueden causar cambios en los métodos de trabajo o en el sistema agrario. Si son complejas, pero a su vez exitosas, pueden difundirse rápidamente (Niemeijer, 1999).

6.1 Planificación de los experimentos de los agricultores

Sumberg y Okali (1997) clasifican los experimentos como: proactivos y reactivos. La mayoría de los experimentos suelen ser proactivos, es decir que el agricultor utiliza un determinado planteamiento antes de experimentar . Al ser proactivos, los agricultores pueden experimentar activamente para solucionar los problemas, probando varias opciones. La experimentación reactiva tiene su base en la casualidad; significa que el agricultor experimenta sin tener una hipótesis o un planteamiento.

Los agricultores no suelen analizar en detalle su situación agraria para luego formular la justificación, la hipótesis y los métodos de sus experimentos; este proceso se desarrolla intuitivamente. Ellos simplemente pueden tener la curiosidad de intentar algo nuevo, o han identificado algún problema y buscan una solución; también puede ser que conocieron de una información nueva en la que ven una oportunidad única para mejorar su situación (Scheuermeier, 1997).

experiments afterwards; this process is developed intuitively. They can just have the curiosity to attempt something new , or have identified a problem and look for a solution; it can be also that they heard new information in which they see a unique opportunity to improve their situation (Scheuermeier, 1997).

6.2 Classification of farmers' experiments

The experiments can be classified according to their origin, cause or the topic selected by farmers to experiment. They can be also distinguished by the process followed in experimentation and the final result to which they arrive.

There is a combination of the above-mentioned types: double experimentation. It refers to cases in which farmers experiment with more than one variable at the same time; for example, manure varieties with dif ferent planting distances (Quiroz, 1999).

6.2.1 Classification according to the source of experiments

The sources of the experiments can be: the interest for solving the problems, curiosity or testing of expectations.

Farmers look actively for solutions for new or old problems of their agricultural system, motivated by the need or the wish to solve them, because they feel compelled to improve their current situation (Rhoades and Bebbington, 1991; Hocdé, 1997; Sumberg and Okali, 1997; Quiroz, 1999; Zigta and Waters-Bayer, 2001). Frequently, to acknowledge a problem or a need is the first step for the development of an innovation (Rogers, 1995).

As all human beings, farmers are curious and want to know if their ideas work. This type of "experiment due to curiosity" is carried out, for example, when a farmer obtains seeds from his/her neighbor and tries to sow them in his/her exploitation system (Stolzenbach, 1997; Quiroz, 1999; Zigta and Waters-Bayer, 2001).

The farmer can have an expectation of the results before beginning to experiment; the intention is to test a hypothesis, which he/she

6.2 Clasificación de los experimentos de los agricultores

Los experimentos pueden clasificarse por su origen, por la causa o por el tema que eligen los agricultores para experimentar. También se pueden distinguir por el proceso que se sigue en la experimentación y por el resultado final al que se llega.

Existe una combinación de los tipos ya mencionados: la experimentación doble. Se refiere a los casos en los cuales los agricultores experimentan con más de una variable al mismo tiempo; por ejemplo, variedades de abono con distintas distancias de plantación (Quiroz, 1999).

6.2.1 Clasificación según la fuente de los experimentos

Las fuentes de los experimentos pueden ser: el interés por solucionar los problemas, la curiosidad o la comprobación de expectativas.

Los agricultores buscan activamente soluciones para nuevos o antiguos problemas de su explotación agraria, motivados por la necesidad o el deseo de solucionarlos, ya que se sienten llamados a mejorar su situación actual (Rhoades y Bebbington, 1991; Hocdé, 1997; Sumber g y Okali, 1997; Quiroz, 1999; Zigta y Waters-Bayer, 2001). En muchas ocasiones el reconocer un problema o una necesidad es el primer paso para el desarrollo de una innovación (Rogers, 1995).

Como todos los humanos, los agricultores tienen curiosidad y quieren saber si funcionan sus ideas. Ese tipo de "experimento por curiosidad" se lleva a cabo, por ejemplo, cuando un agricultor obtiene semillas de su vecino e intenta plantarlas en su explotación (S tolzenbach, 1997; Quiroz, 1999; Zigta y Waters-Bayer, 2001).

El agricultor puede tener una expectativa del resultado antes de empezar a experimentar; la intención es comprobar una hipótesis, la cual formuló cognitivamente. Él no tiene que ser consciente que está comprobando una hipótesis, sino que lo hace intuitivamente (Stolzenbach, 1997; Zigta y Waters-Bayer, 2001; Bentley, 2006).

formulated cognitively. He/she does not have to be conscious of being testing a hypothesis, but he/she does it intuitively (S tolzenbach, 1997; Zigta and Waters-Bayer, 2001; Bentley, 2006).

6.2.2 Classification according to the topics of the experiments

There are topics that seem common and interesting for experimenting farmers. The experiments can be classified into: technical, economic, social and institutional, although 75% of those described in literature are technical (table 1). Within this category the experiments with new crops or varieties, soil preparation and fertility, sowing methods and crop density are the most common topics (Sumber g and Okali, 1997; Nielsen, 2001). Complex experiments, such as the social or institutional ones, require high management and or ganization capacities, for which they are scarce (Sumberg and Okali, 1997).

6.2.3 Classification accor ding to the experimentation process

According to several authors, adaptation experiments and the ones originated from other experiments can be distinguished.

Adaptation experiments often occur after the introduction of an innovation. In this sense, the experimentation process arises from adopting and adapting innovations. The modification or reinvention is important for farmers (Sumber g and Okali, 1997) because almost all of them experiment with adopted technologies (Cramb, 2005). Adapting innovations means that farmers apply new elements and factors to their agricultural system; adaptation is a complex process of experimental learning (Mak, 2001; GebreMichael, 2001). Adaptation experiments can be found in two forms (Rhoades and Bebbington, 1991): a) farmers that apply and modify an innovation in a known environment; b) farmers that apply a known technology in a new environment. Adaptation is defined as the degree in which an innovation is changed by its user during the adoption and introduction process (Rogers, 1995).

6.2.2 Clasificación según los temas de los experimentos

Hay temas que parecen comunes e interesantes para los agricultores experimentadores. Los experimentos se pueden clasificar en: técnicos, económicos, sociales e institucionales, aunque el 75% de los descritos en la literatura son técnicos (tabla 1). Dentro de esta categoría los experimentos con nuevos cultivos o variedades, la preparación y la fertilidad del suelo, los métodos de siembra y la densidad del cultivo son los temas más comunes (Sumberg y Okali, 1997; Nielsen, 2001). Los experimentos complejos, como los sociales o institucionales, requieren altas capacidades de gestión y organización, por lo que son escasos (Sumberg y Okali, 1997).

6.2.3 Clasificación según el proceso de experimentación

Según varios autores, se pueden distinguir los experimentos de adaptación y los que provienen de otros experimentos.

Los experimentos de adaptación muchas veces ocurren después de la introducción de una innovación. En este sentido, el proceso de la

On the other hand, farmers' experiments do not have to appear isolated, but can cause a series of experiments or innovations closely and logically connected to each other, called in literature 'experiments that arise from other experiments'. The introduction of a new technology or an alternative method can inspire the farmer to experiment more and thus adjust the agricultural system to the changes caused by such method (Thawa, 2001). When the conditions of an agricultural system change, as consequence of an experiment or an innovation, the farmers must adjust to the new situation, and thus an experiment or innovation can trigger other experiments. For example, an innovation that increases agricultural production requires faster harvest methods and a better distribution system (Reij and Waters-Bayer, 2005).

6.2.4 Classification according to the final result of the experiment

From farmers' experiments 'hard innovations' can emerge, which are physical and visible results, e.g. new tools, different substances for pest control, soil fertility, crop rotation, sowing technology, animal rearing,

Tabla 1. Temas de los experimentos de los agricultores.
Table 1. Topics of the farmers' experiments.

Experimentos técnicos	
Nuevos cultivos o variedades	Conservación del suelo
Métodos de siembra	Conservación del agua
Período de siembra	Sistemas de riego
Policultivos	Poda
Rotación de cultivos	Gestión de residuos orgánicos
Métodos de cosecha	Alimentación animal
Métodos de labranza	Salud animal
Fertilidad del suelo	Nuevos animales
Abonado	Almacenamiento
Abono verde	Elaboración de productos
Control de plagas	Herramientas
Control de malas hierbas	Transporte
Agroforestería	
Experimentos económicos, sociales e institucionales	
Cooperativismo	*Marketing*
Gerencia de la explotación	Gestión del trabajo
Intercambio de información	

Fuente: Sumberg y Okali (1997); Niemeijer (1999); Nielsen (2001); Wu y Pretty (2004); Reij y Waters-Bayer (2005).

experimentación surge de adoptar y adaptar las innovaciones. La modificación o reinvención resulta importante para los agricultores (Sumberg y Okali, 1997), pues casi todos experimentan con tecnologías adoptadas (Cramb, 2005). Adaptar innovaciones significa que los agricultores apliquen nuevos elementos y factores a su sistema agrario; la adaptación es un proceso complejo de aprendizaje experimental (Mak, 2001; GebreMichael, 2001). Los experimentos de adaptación pueden encontrarse en dos formas (Rhoades y Bebbington, 1991): a) agricultores que aplican y modifican una innovación en un ambiente conocido; b) agricultores que aplican una tecnología conocida en un ambiente nuevo. La adaptación se define como el grado en el cual una innovación es cambiada por su usuario durante el proceso de adopción e implantación (Rogers, 1995).

Por otra parte, los experimentos de los agricultores no tienen que aparecer aislados, sino pueden causar una serie de experimentos o innovaciones conectadas estrecha y lógicamente, llamadas en la literatura 'experimentos provenientes de otros experimentos'. La introducción de una nueva tecnología o un método alternativo puede inspirar al agricultor a experimentar más y así ajustar el sistema agrario a los cambios causados por dicho método (Tchawa, 2001). Cuando las condiciones en un sistema agrario cambian, como consecuencia de un experimento o una innovación, los agricultores tienen que ajustarse a la nueva situación, y así un experimento o una innovación puede desencadenar otros experimentos. Por ejemplo, una innovación que aumente la producción agraria requiere métodos de recolección más rápidos y un mejor sistema de distribución (Reij y Waters-Bayer, 2005).

6.2.4 Clasificación según el resultado final del experimento

De los experimentos de los agricultores pueden surgir 'innovaciones duras', que son resultados físicos y visibles, por ejemplo: nuevas herramientas, distintas sustancias para el control de plagas, fertilidad del suelo, rotación de cultivos, irrigation, drainage, etc. (Rogers, 1995;Waters-Bayer, 2005).

In addition, 'soft innovations' can emerge, which mean that the result of the experiment is a method for improving an intangible situation. They can be: knowledge, ability, procedures and/or principles that are useful as informative base for the development of tools or technologies. Soft innovations appear when farmers experiment with new marketing or communication methods (Rogers, 1995; Waters-Bayer, 2005). They can also be qualitative methods for pest counting in agricultural plots, important for effective and sustainable control (Bentley, 2006).

7. Evaluation of the experiments

Evaluation, as well as reflection about the results by experimenting farmers, is supported in a wide context of agricultural production.The agricultural system is the base for the family livelihood, which makes farmers perceive it as a highly valuable system, although it does not mean that they attempt to fulfill their expectations. Besides, the environmental surroundings prevents total manipulations and the farmers would not have advantage if they changed variables for improving the results (Sumption, 2004); they are usually self-critical, and the fact that they work in the agricultural system allows them to observe continuously the experimentation process (Stolzenbach, 1999; Sumption, 2004).

In many cases the experiments are qualitative, i.e. without sample groups or numbers (Bentley 2006), although other sources indicate that up to 40 % of the experimenting farmers use control groups or direct comparison to test their ideas. Some trust their local knowledge as the "historical control", i.e. farmers that have a deep knowledge, arisen from experience and also know which factors have influence (Sumberg and Okali, 1997).

8. Differences between farmers' experiments and scientific experiments

Farmers experiment and innovate with their own methods, which are normally different from

vos, tecnología de siembra, cría de animales, riego, drenaje, etc. (Rogers, 1995;Waters-Bayer, 2005).

También pueden surgir 'innovaciones suaves', las cuales significan que el resultado del experimento es un método para mejorar una situación no tangible. Estas pueden ser: el conocimiento, la habilidad, los procedimientos y/o los principios que sirven como base informativa para el desarrollo de herramientas o tecnologías. Se habla de 'innovaciones suaves' cuando los agricultores experimentan con nuevos métodos de *marketing* o de comunicación (Rogers, 1995; Waters-Bayer, 2005). También pueden ser métodos cualitativos para el conteo de plagas en parcelas agrícolas, importante para un control efectivo y sostenible (Bentley, 2006).

7. Evaluación de los experimentos

La evaluación, así como la reflexión acerca de los resultados por parte de los agricultores experimentadores, están cimentadas en un contexto amplio de la producción agraria. El sistema agrario es la base para el sustento familiar, lo cual hace que los agricultores lo perciban como un sistema de gran valor, aunque eso no significa que intenten cumplir sus expectativas. Además, el entorno medioambiental impide manipulaciones totales y los agricultores no tendrían ventaja si cambiaran variables para mejorar los resultados (Sumption, 2004); ellos suelen ser autocríticos, y el hecho de que trabajen en el sistema agrario les permite observar el proceso de la experimentación continuamente (Stolzenbach, 1999; Sumption, 2004).

Para la evaluación de los resultados no hace falta medidas exactas si las diferencias son claramente visibles, como puede ser la cantidad de la cosecha. Además, no todos los agricultores saben calcular y este hecho dificulta la evaluación cuantitativa (Sumption, 2004).

En muchos casos los experimentos suelen ser cualitativos, es decir sin grupos de muestra o números (Bentley, 2006), aunque otras fuentes indican que hasta el 40% de los agricultores experimentadores utilizan grupos de control o comparación directa para comprobar sus ideas. Al-

the scientific ones, and do it under different conditions from researchers (Sumberg *et al*., 2003). The farmer is part of the system in which he/she is experimenting and has a direct interest in improving the situation regarding his/her needs. Although farmers sometimes change variables during the experimentation process, they assure they can determine the limiting factor. Scientists usually reduce reality to few variables and, of course, they are more thorough.The methods used by scientists must be understandable, which allows them to explain their results to a group of experts. According to Stolzenbach (1999), the model of scientific experimentation is too strict for farmers.

9. Farmers' experiments, innovation and ecological agriculture

Until the last decade of the past century, the first ecological farmers in Europe did not have the support of science or consultancy or agricultural extension programs. They had to develop ecological agriculture individually, through experiments and continuous innovations. Institutional research has denied for many years the efforts of ecological farmers (Padel, 2001).

Farmers preferred to experiment with ecological methods before making the conversion, to test little by little the feasibility of ecological agriculture and reduce the risk.The experiments in small plots, as for example family gardens, before the conversion to ecological agriculture, reduce the technical and economic risk. Such experiments can include: the reduction of fertilizers, use of alternative treatments for animals, introduction of legumes, new crops under ecological production or conversion of only a few plots (Padel, 2001; König, 2003).

Based on the results of the experiments, farmers made decisions for changing their way of working. Most of them have some experiences with ecological methods before the conversion to ecological agriculture. But not only before this process does experimentation have an important role, but also during the first years (Padel, 2005). The conversion requires deep and

gunos confían en su conocimiento local como el "control histórico", es decir, agricultores que tienen un conocimiento profundo, surgido de la experiencia y saben además qué factores influyen (Sumberg y Okali, 1997).

8. Diferencias entre los experimentos de los agricultores y los experimentos científicos

Los agricultores experimentan e innovan con sus propios métodos, que normalmente son distintos a los de los científicos, y lo hacen en condiciones diferentes a las de los investigadores (Sumberg et al., 2003). El agricultor es parte del sistema en el cual está experimentando y tiene un interés directo en mejorar la situación en cuanto a sus necesidades. Aunque los agricultores a veces cambian variables durante el proceso de experimentación, aseguran que pueden determinar el factor limitante. Los científicos suelen reducir la realidad a pocas variables y , por supuesto, son más minuciosos. Los métodos que utilizan los científicos tienen que ser comprensibles, lo que les permite explicar sus resultados a un grupo de expertos. Según Stolzenbach (1999), el modelo de la experimentación científica es demasiado rígido para los agricultores.

9. Experimentos de los agricultores, la innovación y la agricultura ecológica

Hasta la última década del siglo pasado, los primeros agricultores ecológicos en Europa no recibían apoyo de la ciencia ni de programas de asesoría o extensión agrícola. Ellos tenían que desarrollar la agricultura ecológica individualmente, a través de experimentos e innovaciones continuas. La investigación institucional ha negado durante muchos años los esfuerzos de los agricultores ecológicos (Padel, 2001).

Los agricultores preferían experimentar con métodos ecológicos antes de realizar la conversión, para probar poco a poco la factibilidad de la agricultura ecológica y reducir el riesgo. Los experimentos en parcelas pequeñas, como por ejemplo los huertos familiares, antes de la conversión a la agricultura ecológica, reducen el riesgo técnico y económico. Dichos experimen-

complex changes in the agricultural system, which are usually accompanied by an intense learning process to obtain experiences in ecological production (Sumption, 2004).

Conclusions

Farmers' experiments increase self-consciousness, strengthen their identity and confidence in their capacities (Hagmann *et al*., 1997), because they perceive they are capable of experimenting and developing useful technologies or methods. Experimentation is a basic process for the development of agriculture, through which farmers have the opportunity to increase their experience and widen their local knowledge (Sumberg and Okali, 1997).

The integration of such experiments in the agenda of scientific research would improve the cooperation between scientists and farmers, and the results would be more adequate for the agricultural community (Sumberg and Okali, 1997).

Experimenting farmers can be conscious or not of their research and learning activities (Hocdé, 1997); every time they begin using an unknown crop or method, they enter a new learning process (Sumption, 2004). Through the experiments farmers understand better the agricultural system, understand why they try to change certain variables and at the same time reflect on experimentation and its results (Hocdé, 1997; Stolzenbach, 1999).

Experiments are actively used as a learning tool for the farmers to acquire knowledge of their surroundings and production system; through this learning method they increase their consciousness and pride.

In addition, experimentation can lead to social acknowledgement with a generalization of its use in the community. Farmers develop a new willingness to experiment and the quantity of experiments increases (Hagmann and Chumab, 2002). Through the experiments they obtain a deep understanding of their surroundings, which is continuously changing (Niemeijer, 1999).

A farmer's innovation, born from a successful experiment, can activate the willingness to

tos pueden incluir: la reducción de los fertilizantes, el uso de tratamientos alternativos para los animales, la introducción de leguminosas, los nuevos cultivos en producción ecológica en pequeñas parcelas o la conversión de algunas parcelas solamente (Padel, 2001; König, 2003).

Basado en los resultados de los experimentos, los agricultores toman decisiones para cambiar su forma de trabajar. La mayor parte de ellos tienen algunas experiencias con métodos ecológicos antes de la conversión a la agricultura ecológica. Pero no solo antes de este proceso la experimentación tiene un papel importante, sino también durante los primeros años (Padel, 2005). La conversión requiere cambios profundos y complejos en el sistema agrario, los cuales suelen estar acompañados por un intenso proceso de aprendizaje para obtener experiencias en la producción ecológica (Sumption, 2004).

Conclusiones

Los experimentos de los agricultores aumentan la autoconciencia, fortalecen su identidad y la confianza en sus capacidades (Hagmann et al., 1997), ya que ellos perciben que son capaces de experimentar y desarrollar tecnologías o métodos útiles. La experimentación es un proceso básico para el desarrollo de la agricultura, a través del cual los agricultores tienen la oportunidad de aumentar su experiencia y ampliar su conocimiento local (Sumberg y Okali, 1997).

La integración de dichos experimentos en las agendas de la investigación científica mejoraría la cooperación entre los científicos y los agricultores, y los resultados serían más adecuados para la comunidad agraria (Sumberg y Okali, 1997).

El agricultor experimentador puede ser consciente o no de sus acciones investigativas y de aprendizaje (Hocdé, 1997); cada vez que comienza con un cultivo o método desconocido, entra a un nuevo proceso de aprendizaje (Sumption, 2004). A través del experimento el agricultor comprende mejor el sistema agrario, entiende porqué intenta cambiar determinadas variables y al mismo tiempo reflexiona sobre la experimentación y sus resultados (Hocdé, 1997; Stolzenbach, 1999).

experiment within the community. In addition, there are innovations that require the help of other farmers and thus a social network of experimenting farmers is enhanced (T chawa, 2001).

For all these reasons, farmers' experimentation is an important and indispensable practice for successful rural development, and also for the dissemination of the results of scientific agronomic studies. In general, each farmer incorporates new recommendations that emerge from scientific research, through experiments in his/her farm. For such reason scientific experimentation does not end after achieving and publishing the results.

Experimentation in agronomy is a continuous process carried out in experimental plots and farms by scientists, and it is also performed in farms by the farmers themselves. From the farmers' experiments often emerge new ideas, which are incorporated to scientific research.

--End of the English version--

Los experimentos se utilizan activamente como herramienta de aprendizaje para que el agricultor adquiera conocimientos de su entorno y de su sistema de producción; a través de este método de aprendizaje, aumenta su conciencia y su orgullo.

Además, la experimentación puede llegar a un reconocimiento social con una generalización de su uso en la comunidad. Los agricultores desarrollan una nueva disposición a experimentar y la cantidad de experimentos aumenta (Hagmann y Chumab, 2002). A través de los experimentos ellos consiguen una profunda comprensión de su entorno, que está en continuo cambio (Niemeijer, 1999).

La innovación de un agricultor, nacida de un experimento exitoso, puede activar la disposición de experimentar dentro de la comunidad. Además, hay innovaciones que requieren la ayuda de otros agricultores y así se fortalece una red social de experimentadores (Tchawa, 2001).

Por todas estas razones, la experimentación de los agricultores es una práctica importante e indispensable para un desarrollo rural exitoso,

y también para la divulgación de los resultados de estudios agronómicos científicos. En general, cada campesino incorpora nuevas recomendaciones que parten de la investigación científica, a través de experimentos en su finca. Por ello, la experimentación científica no termina después de lograr los resultados y publicarlos.

La experimentación en la agronomía es un proceso continuo que se lleva a cabo en parcelas experimentales y en fincas por los científicos, y también se realiza en fincas por los propios agricultores. De los experimentos de los agricultores muchas veces surgen nuevas ideas, que son incorporadas a la investigación científica.

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Paper II

Changes as triggers and as results of farmers' experiments: Examples of organic farmers in Austria

Kummer, S.; Leitgeb, F.; Vogl, C. R. (2008): Changes as triggers and as results of farmers' experiments: Examples of organic farmers in Austria. In: Dedieu, B. Zasser-Bedoya, S. (Eds.), Empowerment of the Rural Actors: A Renewal of Farming Systems Perspectives, INRA SAD 2008, 8th European IFSA Symposium, 6.-10.7.2008, Clermont-Ferrand, pp. 413-422.

I wrote this paper with inputs from the co-authors for the 8th European IFSA-Symposium. The paper was peer-reviewed, presented as full paper at the conference and published in the conference proceedings. The paper is concerned with the question of how change processes and farmers' experiments are interrelated.

Changes as triggers and as results of farmers´ experiments: examples of organic farmers in Austria

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Abstract: *Experimentation is an essential tool for farmers to develop their farming systems according to emerging changes, site-specific conditions and their personal needs. The present study examines the interrelation of changes and experiments. Which role do changes play as triggers of experiments? Which changes result from farmers´ experimentation? To answer these questions, nine selected cases of Austrian organic farmers are presented and examined. The case studies reveal different types of external and internal changes as possible triggers for experiments. The cases demonstrate that a combination of different factors is involved in the initiation of an experimentation process. These nine case studies were also utilised to demonstrate the importance of changes at farm level, or personal level, as results of farmers´ experimentation. Changes and modification of working methods, products and farm systems, as well as increase or modification of existing knowledge as result of experimentation highlights the importance of experiments within the learning processes. The study demonstrates that changes are no isolated occurrences, leading to a single reaction, but that change processes evolve successively or interwoven with each other.*
The presented cases are examples for possible interrelations of changes and experimentation processes of farmers. As analysis is currently going on, the results presented in this paper are first insights into this complex interrelation and require further investigation to achieve in-depth comprehension of the topic.

Keywords*: farmers´ experiments, external and internal changes, organic farming, Austria.*

Introduction

Ever-changing ecological, economic and social conditions have always characterized the reality farmers faced in their practical work. History of farming shows how farmers have continuously developed and adapted their farming systems to cope with constraints and to create opportunities out of change. Farmers are therefore actively engaged in experimentation as part of their farming routine and have an intimate knowledge of their local environment, conditions, problems, priorities and criteria for evaluation (Chambers et al., 1989, Rhoades and Bebbington, 1995, Sumberg and Okali, 1997).

Significant changes in agriculture are currently going on, resulting in challenging conditions for the farmers. In many countries farmers face a tense economic situation and criticism by the society due to modern agriculture´s impact on environment and climate. Organic farming constitutes an alternative for a growing number of farmers all over the world (Vogl et al., 2005) that has experienced an increase in public acceptance and a growth “out of the niche” (Best, 2007).

Organic farming is especially site-specific, demanding detailed knowledge about the local conditions and good observation skills to being able to react to changes and constraints in an appropriate way. Conversion to organic farming in many cases implies a substantial change in the learning processes of farmers, which are different from the processes of adoption of “ready-made” innovations in conventional farm management. Farmers practicing organic agriculture must learn to apply general ecological principles to the time- and context-specific situation and to their own locality (Röling and Wagemakers, 2000).

An experiment can be described as *"the action of trying anything, or putting it to proof; a test, trial; an expedient or remedy to be tried; a tentative procedure"* (OED 1992). Experimentation is an essential tool for farmers to develop their farming systems according to site-specific conditions, emerging constraints and their personal needs. Through experimenting, farmers learn, gain experience, and innovate.

Changes in the context of this study refer to external or internal farm related factors that for specific reasons have become different. These changed factors may constitute constraints or opportunities for the farmer, depending significantely on the personality of the respective person. What is a constraint for one farmer can be seen as an opportunity by another farmer. Furthermore, farmers create opportunities by actively effecting change.

It is feasible to assume that experiments are key elements to maintain and secure the adaptive character of a farm in the face of continuously changing conditions. In a case study about family farms in the southeast of Austria, Jiggins et al. (2000) conclude that organic farmers in the studied region have proven to be a large, growing and creative force. Through experimenting, they create niches for their products, build up new market relations (e.g. box schemes, direct producer-consumer trading, community-supported farming, etc.) and create networks of suppliers, support organisations and information. Nine case studies of Austrian organic farmers are presented in this study, in order to examine the interrelation of changes and experiments. The study raises the following questions: Which role do changes play as triggers of experiments, and which changes result from farmers´ experimentation?

Interrelation of change and experiments

Maintaining the adaptive capacity of a farm implies the ability to cope with changes in both external and internal conditions (Milestad and Darnhofer, 2003). Experiments are central features to create and maintain the adaptive character of a farm. The circular model (Figure 1) illustrates that the interrelation of changes and experiments is not a linear event, but rather a complex, continuous process with changes emerging and influencing the process at different stages, or resulting out of the process itself. The model is based on Mak (2001), who illustrated farmer testing and recombination of new elements within their rice-based farming system. Mak concludes that continual experimentation helps farmers to match their farming systems to constantly changing circumstances.

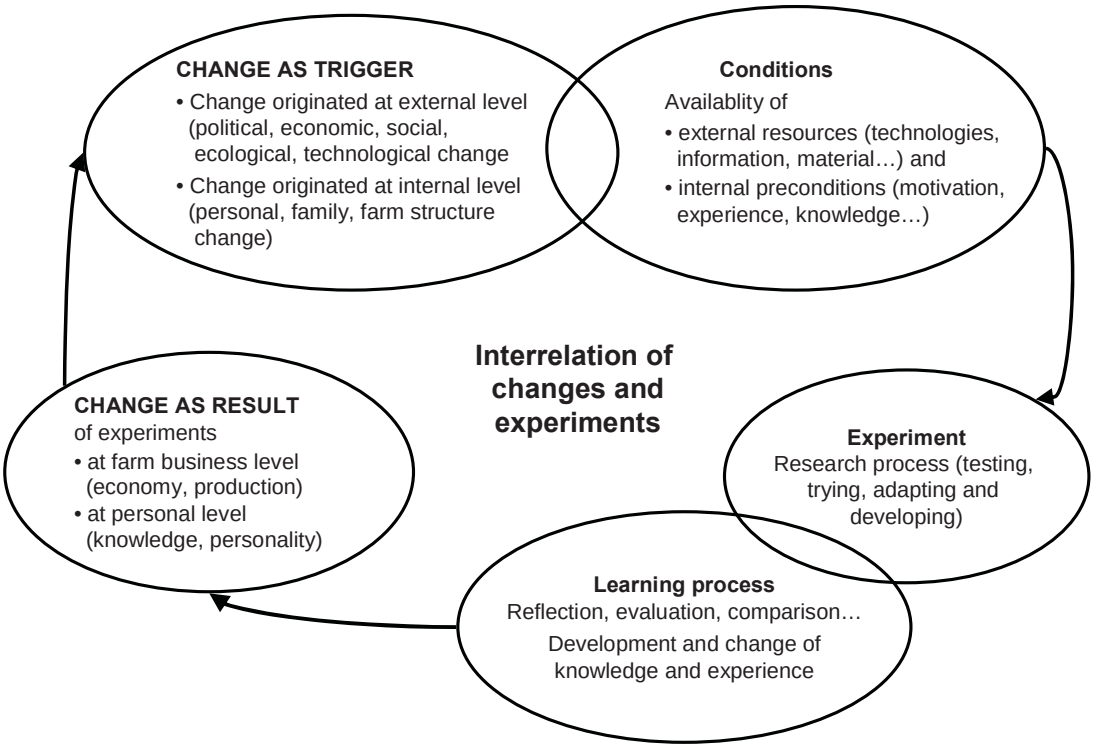

Figure 1. The interrelation of changes and experiments

Research methods and data evaluation

The present study is part of a comprehensive research project about organic farmers´ experimentations and learning processes carried out during the years 2007 and 2008. Semi-structured interviews with organic farmers and other actors within the organic farming movement (such as advisors or representatives of organic farmers´ institutions) were conducted. Farm walks and photographic documentation were carried out during the visits on organic farms to complement the perception obtained during the interviews. Emphasis was given to motives, triggers, methods and outcomes of experiments that organic farmers conduct. To reveal the continued processes of change throughout the history of the farm, a timeline was used at the beginning of each interview, asking the interview partner for major changes and events that occurred on his or her farm since the farmer has started working at the present farm. Asking the farmers for changes on the farm was based on the hypothesis that changes may be related to experimentation processes of the farmers.

The interviews were recorded after prior informed consent. Data analysis started with the transcription of the digitally recorded interviews. Coding of the transcripts using the software package ATLAS.ti was carried out. ATLAS.ti is a software that enables the analysis of qualitative data, offering tools to manage, extract, compare, explore, and reassemble pieces from large amounts of data in systematic ways. The present study describes and discusses preliminary results obtained through the analysis of nine case studies of organic farmers.

Case study of organic farmers in Austria

Intermediate results obtained from semi-structured interviews show different roles that change might play in relation to experiments. The cases represent examples for possible interrelations of changes and experimentation processes of farmers. As analysis is currently going on, the results presented in this paper are first insights into this complex interrelation and need further investigation to achieve in-depth comprehension of the topic.

Changes as triggers of experiments

Two different types of changes to farming systems are distinguished (Figure 2): First, external change can be defined as change originated outside the farm level. External change occurs in the political, economic, social, technologic, and ecologic environment. Second, change originated within the farm level (farm, family and farmer) is referred to as internal change. Internal changes may concern labour organisation, work cycle, organisation of production, income activities and budgeting (Mak, 2001).

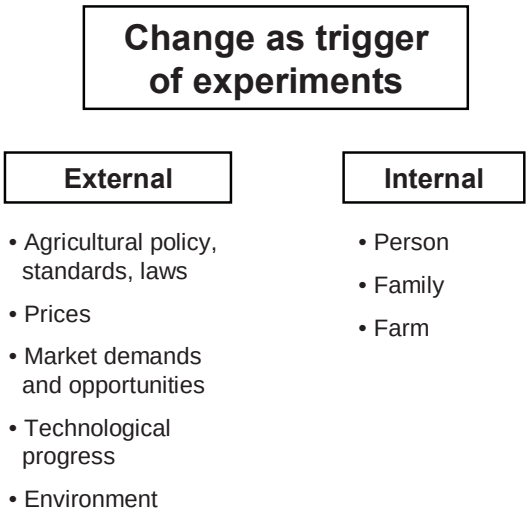

Figure 2. Different types of change as trigger of experiments

External change

Five different changes originating outside the farm level are presented as examples for external change involved in the initiation of farmers´ experiments (Table 1): changes in agricultural policies and standards refer to modifications of or addition to established regulations. Changing prices can be increases or decreases in price levels for agricultural products. Changes in market demands mainly regard to new market opportunities taken up by the farmers. Technological progress refers to new developments in technology (e.g. machinery, information technology). Ecological change refers to changes in the natural environment (e.g. occurrence of pests and diseases, changes in physical conditions, like precipitation, temperature or wind force). These external changes frequently interact; e.g. change in agricultural policies is likely to have significant effects on prices of certain agricultural products.

Table 1. External change as trigger of experiments.

Case	External change in	Example
1	Agricultural policies / standards	Implementation of milk quota system triggers manufacturing of milk products
2	Prices	Increased number of competitors triggers cultivation of alternative crop
3	Environment	Increase in erosion and wild pig population triggers cultivation of clover grass in stead of maize
4	Market demands and opportunities	Cultivation of green asparagus to provide supermarket chain
5	Technological progress	Access to information through the internet triggers initiation of worm-composting

In the following, one case is used to illustrate each change factor. The interviews were conducted in German. The following sections of the interviews were translated to English by the author.

Case 1 – Change in agricultural policy

The implementation of the milk quota system in 1984 was triggering the processing of milk products at the farm. The farmer, a 52 year old woman, remembers the change vividly:

"I really got angry about that [the milk quota regulation], and I thought, 'I am not going to give our milk away as a gift.' And so I started to produce curd cheese. (…) The quality was lousy at that time, from today's point of view. But the people bought it. It was really great that the customers supported these steps of development."

In the following years the woman continuously broadened the range of milk products manufactured on the farm through experimenting with the most appropriate recipes.

In this case the change in policies has acted as trigger. The woman faced this change actively and decided to create a market opportunity out of this problematic situation. In addition, the demand for homemade curd cheese has been expressed by some neighbours, so customer demand was also an influencing factor for the decision of the woman to experiment with the elaboration of this particular milk product.

Case 2 – Changing prices

In this case the 47 years old farmer has been cultivating anise seed already for some years, conducting continuous experimentation to find the most appropriate variety for his soils, as well as the best harvesting method to achieve an appealing light-green colour of the seeds. After some years the increased number of competitors caused a price decline for anise, so the farmer decided to stop cultivating anise seed and instead started the cultivation of vegetables for deep-freezing. He has become well known for his knowledge about vegetable growing. In the following the farmer briefly describes one of his experiments:

"It's like that; many cultures just happen because firms or traders call me and ask me if I couldn't grow that for them. Once I did something for Switzerland: Dried pole beans. Things that I even didn't know that they existed. (…) It [the drying of the beans] was considerably more difficult than I would have thought."

The case of this farmer gives an example of falling prices as a trigger to start experiments with alternative crops. The strategy of shifting to alternative crops as soon as the number of competitors rises and the prices decline is characterized by the farmer as typical farming strategy of him. He regularly applied this shifting strategy on his farm. The farmer mentioned curiosity and a certain "spirit of research" as factors that considerably influence his propensity to conduct experiments. As he puts it:

"I don't rest on things that I already know how to do."

Case 3 – Environmental change

After having converted to organic farming in 1994 (at the age of 40), the dairy farmer had to change from the cultivation of maize for cow feed to clover grass, mainly because of the following reasons:

"First, the hillside situation and the inclination, we couldn't do mechanical weeding, when we hoed we had the erosion. The next thing was the wild pigs. The wild pigs escalated more and more."

Experiments with different mixtures of clover grass for making silage started at that time and are still going on. The farmer changed from commercial mixtures to self-made mixtures, because commercial seed breeding has developed increasingly precocious clover grass for intensive production, i.e. the grass maturates early in the year and therefore gets hard and woody, which is not suitable for his practice of late mowing. He currently uses red clover seed harvested at his farm, and mixes it with different types of commercial pasture seed mixtures.

In the present case, an important factor that caused his shift to clover grass was the increased erosion, which is a result of the farmer's modified land management in the form of mechanical weeding. The initiation of mechanical weeding in turn resulted out of his conversion to organic farming, a change that originated at the farm level. The external environmental change is represented by the increasing wild pig population that has considerably damaged his maize fields. This environmental change constitutes an additional factor for the farmer to decide shifting from maize to clover grass.

Case 4 – Changed market demands

In 1994 the farmer stopped milk production. At that time he was 30 years old and was searching for an appropriate production alternative in vegetable growing. To explore the market opportunities for different vegetables, he decided to approach the buying agent of a big international supermarket chain. In a personal conversation, the representative of the supermarket commented that he would be interested in green asparagus to supply the company:

"In whole Austria he couldn't get green asparagus, because some 10 or 12 years ago green asparagus had the image of being inferior white asparagus. (…) And already at that time he [the buying agent] said, 'That is coming' and he could need that. And so I started the experiment."

In the first years after having started to grow green asparagus the farmer faced several constraints. The planting density a plant breeder had recommended turned out to be too high, causing a lot of manual work, as machines were not able to pass in the densely grown rows. Pests were also a considerable problem. Continuous experimentations, observations and modifications over the years lead to satisfying solutions.

The fundamental condition for the start of asparagus cultivation was the farmer's decision to explore the market opportunities. The changed market demand gave the impulse to start experimenting with asparagus production. As mentioned above, an important internal change had already happened before: the decision to quit dairy farming to become more independent from daily farm work. The cultivation of vegetables resulted in more independence for the farm family, due to seasonal work peaks followed by periods of spare time.

Case 5 – Changed technology

In the year 1998, when the farmer was 28 years old, he found information about worm composting in the internet and was fascinated by the idea:

"At that time I have been one of the first ones that had access to the internet; I think it was via Germany. (…) I was fascinated that it was possible to send an E-mail in real time to a professor in America, somebody who is the leading scientist worldwide [for this topic] (…). The know-how [about worm composting] was very concentrated there, discussion fora and all sorts of things already existed and you were able to learn a lot, and then all the literature you could order online. (…) Then I started to play around and try by myself."

Over the next years the farmer built up his own small-scale worm-composting plant and is currently planning to patent the compost harvesting mechanism that has been developed by him.

The farmer used the opportunity offered by technological advance in the form of the internet. In this case the internet was not indispensable to initiate those experiments, but facilitated the access to information and know-how.

Internal change

Internal changes are defined as changes originating at the farm level (concerning the farmer, the family and the farm). At the level of the person, changes are due to internal reflections caused by observations, new information or experiences. At the family level, changes concern the structure of the family and/or individual changes in the life of family members affecting the family (e.g. beginning or termination of partnerships, birth of children, occupational changes). At the farm level changes are related to different properties and elements of the farm (e.g. farm production, buildings, acreage, equipment). Data evaluation revealed examples for internal changes at different levels (Table 2).

Table 2. Internal change as trigger of experiments.

Case	Level / Kind of internal change	Example
6	Level of person	Observations triggered documentation of supporting and inhibiting effects of different plants in the vineyard
7	Level of family	Retired father cultivates vegetables, excess produce triggers experiments with tinned vegetables
8	Level of farm	End of dairy production leaves pastures without use, start of free-range geese keeping
9	Not influenced internal change	Accident on the farm and long convalescence triggered experiments with organic vegetable growing

Case 6 – Change at the level of the person

In 1988, at the age of 36, the farmer and wine grower won the environmental citizen prize of the province for his study on supporting and inhibiting effects of plants growing in vineyards. The study started with an interesting observation:

"We were planting a new vineyard and my father still had a say at that time and said, 'We plant a sack of potatoes for subsistence.' (…) In the rows between the vines there was enough space, and so we always laid one potato between two vines. (…) The potatoes were growing beautifully, but the vines not at all. (…) There was a three year-long depression of growth because of the potatoes. Meanwhile we know that all solanaceous plants, like the potato, are antagonists of the vine. (…) That prompted me to observe, which plants go with the vine. (…) At that time I surveyed virtually all the plants growing here, which ones are supporting and which ones are inhibiting the growth of the vine."

In this case, the observation of the potatoes in the vineyard caused an intensive process of internal reflections, triggering the farmer to survey plants in vineyards and their effects on vines.

Case 7 – Change at the level of the family

The interviewed woman is not descended from a farm family. When she married a farmer she herself became a full-time farmer. When her father retired, she was about 30 years old. Her father, an enthusiastic hobby gardener, started to cultivate vegetables on a plot at his daughter's farm, because he had enough time in his retirement:

"He wanted a plot, and then he worked the plot on his own. Over the years it became bigger and bigger (…). Then there were too many zucchini, there were too many tomatoes, and so I started to search for ideas, 'How can I make use of this, what can I do?' And I was like a sponge, I am still like this, when a customer or somebody else says, 'There is a fantastic recipe!' then I try that. When I think this could work well, I do it."

The vegetable harvest was overwhelming and she had to find ways to deal with it. So she started to experiment with different recipes to preserve the vegetables. The recipes she used to produce tinned vegetables are her own creations as well as ideas from other people (e.g. friends, neighbours, customers of her farm shop), often modified and improved by her. She also conducted experiments regarding the production process of the tinned vegetables, basically to save labour.

Case 8 – Change at the farm level

In this example, the 23 years old farmer remembers how his father has stopped dairy farming:

"We had 25 milking cows and we threw them out, now we only have our six suckler cows. But we had a crazy acreage of pasture at that time. Then we said, it is really a pity, because selling the hay doesn't pay. And so we started with the geese."

This case illustrates how a causal chain of different external and internal changes triggered the experiment of free-range geese keeping: First, the end of dairy farming, a decision made by the farmer's father; and second, the lack of use of the pastures. Due to the low price for hay the farmer had to think about alternatives to make use of the pastures. Another important external factor appeared at the same time: A regional organisation arranged a meeting about free-range geese keeping. The change at the farm level, in the form of the unused pastures combined with the information input offered by the meeting triggered the initiation of the experiment of geese keeping. In the beginning the geese were slaughtered and plucked by a regional organisation. But the farmer was not satisfied with the quality of plucking, because the skin of the slaughtered geese was frequently disrupted. So they started experimenting with hand-plucking at the farm:

"We have always been slaughtering the chickens on our own, and we had three ducks each year. Therefore we knew approximately, with the steamer and that. The grandmother still knew about that, she was still quite fit at that time. And all these experiences we brought together. And now we already do it [hand-plucking] for 10 years and it works very well."

Case 9 – Not influenced change

In this case the farmer talked about a change at the personal level that he had no influence on: a working accident the farmer had at the farm in 1987 at the age of 41. At that time he was still a conventional vegetable grower, based on intensive greenhouse production:

"After the accident I didn't really recover, and then I consulted an alternative practitioner. (…) During the conversation he said it would be advisable to convert to organic farming, because that would also improve my health. And in 1987 I already had met some organic farmers. Then I took a course and in 1989 we experimented with organic production in the greenhouse, without having converted officially. (…) We actually were quite successful, and then we officially converted to organic farming [in 1990]."

In this interview the farmer mentioned the accident as one of the most important changes that has happened in his life, causing a chain of further changes that in consequence resulted in the initiation of experiments with organic vegetable growing. An important impulse to consider converting to organic farming was the advice of the alternative practitioner. This caused a more intensive contact with organic farmers and interest in different courses about alternative farming systems. His own experiments with organic vegetable production were finally the most significant motivation to officially convert to organic farming.

Changes as results of experiments

Changes as results of experiments can be divided into changes at the level of the farm business and at the level of the person (Figure 1). At farm business level, experiments may result in changes concerning the production level (e.g. dimension and organisation of the production, changed production methods), and/or the level of economy of the farm business, regarding sales, marketing or economic autonomy of the farm. At the level of the person, experiments may cause changes regarding knowledge, like increase of knowledge and experience or modified knowledge, affirmation or falsification of a hypothesis, and/or changes regarding personality, like satisfaction and contentment with the private or work situation, as well as reputation, e.g. within the (farming) community.

Changes that farmers effected through their experiments are illustrated by means of the same nine case studies already presented in the previous chapter. It can be assumed that in most of the cases changes concern several aspects of the farm business level as well as the personal level. In the following, not all the changes that actually resulted out of the experimentation process are described, but only the main change for each of the nine cases is specified (Table 3).

Table 3. Different types of changes as results of experiments.

Case	Main change regards	Example
1	Farm business level (economy)	Manufacturing a variety of milk products caused an expansion of direct marketing
2	Personal level (personality)	Considerable practical knowledge in crop production caused good reputation as skilled cultivator for demanding crops
3	Personal level (knowledge)	Trials with grassland mixtures generated in-depth knowledge about their qualities within crop rotation and suitability as cow feed
4	Farm business level (production)	Cultivation of asparagus enables periods of spare time
5	Farm business level (economy)	Continued improvement in processing of worm-compost created a high-quality product that promises good sales
6	Personal level (personality)	Farmers´ survey on plants in vineyards resulted in in-depth knowledge about inhibiting and triggering plants for vines
7	Farm business level (production)	Manufacturing tinned vegetables broadens the product range of the farm shop
8	Farm business level (production)	Shift from dairy cows to geese keeping caused reorganisation of animal husbandry
9	Personal level (personality)	Conversion to organic farming resulted in personal contentment and increased enthusiasm for farm work

Discussion and conclusion

The study demonstrates how organic farmers deal with change in a creative way, by taking change as trigger for experiments. Furthermore it is shown, which changes result from farmers´ experimentation, highlighting how farmers effect changes through experimenting.

What changes trigger farmers´ experiments? The case study presents examples for two categories of changes: external changes, originating outside the farm level, and internal changes, originating within the farm level. Emerging changes can act as constraints or as opportunities for farmers. It depends on the personality of the farmer if a change is experienced as constraint or as opportunity, and on the ability of the farmer to create opportunities out of ever-changing circumstances.

In a case study of New Zealand coping strategies of family farms that have been facing radical economic reforms are demonstrated. The reforms implemented by the government exposed the farmers to the unpredictable developments of the global market. At the farm level, adjustment strategies included modifications in farm scale and type, reductions in farm and/or household expenditure, reorganisation of labour (such as off-farm work and utilisation of contracted labour) and alterations of physical and economic farm practices. Problematic effects resulting from these changes are the lack of time because of off-farm work, the reduced attachment to the farm and the stress resulting from on- and off-farm work burden, as well as the oppressive economic situation of the farm (Johnsen, 2004).

The situation described in the case study of New Zealand is comparable with experiences of farmers in the alpine areas of Austria that are confronted with low prices for milk and the limited production alternatives because of geographic and climatic conditions. Most of the organic farmers interviewed in alpine regions reported lack of time due to off-farm work and a tense economic situation. These factors were even mentioned as inhibitors of experiments and on-farm trials. A farmer put this situation into words:

"You need so much time for breadwinning. We have to work off-farm , we are 'moonshine-farmers': During the day we work for the company and at night we come home and toil on the farm. And then we often don't have the time to sit down and think: (…) Why is it like this? How could it work in a different way? What else could I try? "

A contrasting case study from France demonstrates that lack of time is not only a possible inhibitor of experimentation, but may as well be a powerful trigger to start experimenting with labour-saving solutions. In the case study dairy farmers in Central France conduct experiments with different types of simplified dairy herd management, adapting even radical innovations on milking practices (Cournut and Dedieu, 2006).

Change acting as an opportunity, like emerging market opportunities, triggered interesting experiments by the interviewed farmers. According to Bentley (2006), peasant farmers in Latin America experiment to adapt to changes in their economic environment. Bentley presents case examples referring to experiments with commercial vegetable growing triggered by expanded market opportunities. In the case of changes acting as opportunities, the personality of the farmer again plays an important role. The farmer decides if the opportunity is detected and taken up to benefit the farm enterprise.

In the majority of the cases a combination of different changes, as well as factors that are no changes (e.g. availability of resources, personal motivation to experiment) is triggering the experimentation process. Because of the complex interaction of different factors influencing the initiation of an experiment, it is probable that not all triggering factors, like changed information sources, changed interests and/or changed personal contacts, have been explicitly discussed in the interviews.

Considering the role of changes as results of experiments it is feasible to draw the conclusion that every experiment results in a bigger or smaller change in knowledge, in the form of increase or modification of existing knowledge. It is by experimenting that farmers learn about their social, economic and ecological environments. Environments are always changing, frequently due to the very process of experimentation (Rhoades and Bebbington, 1995).

Finally, the study demonstrates that changes are no isolated occurrences, leading to a single reaction, but that changes cause continuous change processes, evolving successively or interwoven with each other. Each variation of a given practice is not an abrupt or discrete event, but is enacted through a series of ongoing adaptations and alterations that draw on previous variations and mediate future ones (Darnhofer, 2006).

Farmers´ experiments are strategies to deal with ongoing change. Furthermore experiments are tools to design and develop farming systems according to the farmers´ needs. The personal characteristics of a farmer are likely to be the most significant factors in the interrelation of changes and experiments, because it is the farmer who decides how to face changes, how to turn changing circumstances into opportunities, and how to generate beneficial changes through experimenting. The importance of personal factors in the interrelation of changes and experiments will be central for further analysis.

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Appendices

Tables: Descriptive data of interviewees

Table 1: Descriptive personal and farm data of interviewees (semi-structured interviews; n=47)

Code	Region	Sex	Operation type	Age (years)	Farm size (ha)	Farmer since (years)	Organic since (years)
IP.01	flat to hilly lowlands	female	regular	49	43	16	16
IP.02	flat to hilly lowlands	male	regular	59	43	16	16
IP.03	flat to hilly lowlands	female	regular	47	15	20	18
IP.04	flat to hilly lowlands	male	regular	51	15	20	18
IP.05	foothills of the Alps	male	regular	23	51	5	5
IP.06	flat to hilly lowlands	male	regular	51	70	10	10
IP.07	flat to hilly lowlands	male	regular	37	111.5	14	1
IP.08	foothills of the Alps	female	regular	40	55	21	13
IP.09	foothills of the Alps	male	regular	45	55	27	13
IP.10	foothills of the Alps	male	regular	53	8	37	17
IP.11	foothills of the Alps	female	regular	43	8	21	17
IP.12	alpine	male	regular	61	30	33	10
IP.13	foothills of the Alps	female	regular	52	15	33	20
IP.14	foothills of the Alps	male	regular	54	35	34	34
IP.15	foothills of the Alps	male	sideline	34	24.5	19	19
IP.16	alpine	male	sideline	58	8	27	25
IP.17	alpine	male	regular	56	5.3	20	15
IP.18	alpine	male	sideline	53	13	27	22
IP.19	foothills of the Alps	male	regular	39	20	14	14
IP.20	foothills of the Alps	male	regular	61	12	35	17
IP.21	foothills of the Alps	male	regular	57	41.5	29	28
IP.22	foothills of the Alps	female	regular	52	41.5	29	28
IP.23	foothills of the Alps	male	sideline	58	17	27	12
IP.24	foothills of the Alps	male	regular	34	59	12	8
IP.25	foothills of the Alps	female	regular	50	9.55	26	17
IP.26	foothills of the Alps	female	regular	34	24	6	1
IP.27	flat to hilly lowlands	male	regular	54	16.5	30	20
IP.28	flat to hilly lowlands	male	regular	52	23	23	18
IP.29	flat to hilly lowlands	male	regular	43	37	14	6
IP.30	flat to hilly lowlands	male	regular	47	61.66	21	18
IP.31	flat to hilly lowlands	male	regular	55	70	34	25
IP.32	flat to hilly lowlands	female	regular	45	31	25	18
IP.33	flat to hilly lowlands	male	regular	50	31	30	18
IP.34	flat to hilly lowlands	male	regular	41	130	10	10
IP.35	foothills of the Alps	male	sideline	46	15	21	18
IP.36	foothills of the Alps	male	regular	53	87	31	16
IP.37	flat to hilly lowlands	male	regular	34	50.5	16	5
IP.38	alpine	male	sideline	44	17	21	14
IP.39	alpine	female	regular	51	14	34	16
IP.40	alpine	male	regular	49	70	21	16
IP.41	foothills of the Alps	male	sideline	63	12	38	27
IP.42	foothills of the Alps	male	sideline	56	13	25	15
IP.43	foothills of the Alps	male	sideline	46	17	27	27
IP.44	flat to hilly lowlands	male	regular	55	47	29	12
IP.45	flat to hilly lowlands	female	regular	52	47	29	12
IP.46	flat to hilly lowlands	male	regular	44	80.7	20	13
IP.47	foothills of the Alps	male	sideline	60	9.5	23	1
			Arithmetic mean	**48.7**	**36.4**	**23.4**	**15.7**

Table 2: Descriptive personal an d farm data of interv iewees (structured questionnaire interviews; n=26)

Code	Region	Sex	Operation type	Age (years)	Farm size (ha)	Farmer since (years)	Organic since (years)
GS-01	flat to hilly lowlands	female	sideline	50	33.0	31	5
GS-02	flat to hilly lowlands	female	sideline	43	13.5	27	14
GS-03	flat to hilly lowlands	female	sideline	31	2.0	7	7
GS-04	flat to hilly lowlands	male	sideline	48	15.0	25	6
GS-05	flat to hilly lowlands	female	sideline	46	54.0	25	25
GS-06	flat to hilly lowlands	male	sideline	57	13.0	32	5
GS-07	flat to hilly lowlands	female	regular	42	22.0	23	7
GS-08	flat to hilly lowlands	male	sideline	37	11.4	2	2
GS-09	flat to hilly lowlands	male	sideline	35	13.2	14	10
GS-10	flat to hilly lowlands	male	sideline	55	13.5	25	6
GS-11	flat to hilly lowlands	male	sideline	42	11.0	8	5
GS-12	flat to hilly lowlands	male	regular	61	103.0	28	17
GS-13	flat to hilly lowlands	male	regular	53	230.0	32	6
RE-01	apline	male	sideline	40	4.0	19	13
RE-02	apline	male	sideline	60	5.0	19	13
RE-03	apline	female	sideline	38	10.0	15	2
RE-04	apline	male	sideline	37	29.5	15	13
RE-05	apline	male	sideline	49	16.0	14	11
RE-06	apline	male	regular	25	35.0	8	8
RE-07	apline	male	sideline	70	9.5	28	13
RE-08	apline	male	regular	42	40.0	25	3
RE-09	apline	female	sideline	38	23.0	10	10
RE-10	apline	male	sideline	37	15.0	18	13
RE-11	apline	male	sideline	46	18.1	25	13
RE-12	apline	male	sideline	47	8.0	24	18
RE-13	apline	male	sideline	52	12.0	32	18
			Arithmetic mean	**45.4**	**29.2**	**20.4**	**10.1**

Semi-structured interview guideline

(including introductory letter for interviewee)

Universität für Bodenkultur Wien
University of Natural Resources and Applied Life Sciences, Vienna

Department für Nachhaltige Agrarsysteme

Institut für Ökologischen Landbau

Arbeitsgruppe für Wissenssysteme und Innovationen

Gregor-Mendel Straße 33, 1180 Wien

Brief für den Gesprächspartner
Lokales Wissen von Biobauern

Mein Name ist Susanne Kummer und ich arbeite am Institut für Ökologischen Landbau an der BOKU Wien. Im Rahmen unseres aktuellen Forschungsprojektes führen wir Interviews mit Biobauern in Österreich, Kuba und Israel durch. Über dieses Forschungsprojekt werden meine Kollegen und ich unsere Doktorarbeiten schreiben.

Die Biologische Landwirtschaft wurde hauptsächlich von Biobauern selbst entwickelt, lange bevor offizielle Forschungsinstitutionen sich mit dieser alternativen Form der Landwirtschaft beschäftigt haben. Biobauern auf der ganzen Welt passen die Biologische Landwirtschaft ständig an sich ändernde Rahmenbedingungen an und entwickeln auf diese Art und Weise die Biolandwirtschaft immer weiter. Biobauern sind also die Experten für den Biolandbau, und aus diesem Grund möchten wir in unserem Forschungsprojekt im direkten Gespräch von Ihnen lernen.

Wir garantieren Ihnen, dass die Informationen, die wir in diesem Projekt sammeln, in anonymer Weise und nur zu Forschungszwecken verwendet werden. Ihre Informationen werden nicht an Dritte weitergegeben.

Ich bitte Sie um Ihre Zustimmung, unser Gespräch aufzunehmen. Das erlaubt mir, mich ganz auf das Gespräch zu konzentrieren, und ermöglicht mir, das Gesagte hinterher zu transkribieren und auszuwerten. Falls ich Teile unseres Gesprächs nicht in meiner Forschungsarbeit verwenden soll, sagen Sie mir bitte Bescheid, während oder nach dem Interview. Ich gebe Ihnen gerne eine Kopie der Tonaufzeichnung und der Fotos, wenn Sie das möchten.

Bitte kontaktieren Sie mich jederzeit, falls Sie noch etwas zu diesem Gespräch hinzufügen möchten oder falls Sie Fragen haben.

Ich danke Ihnen, dass Sie sich Zeit für dieses Gespräch genommen haben!

Sie sprachen mit: Susanne Kummer

Tel. Büro: 01/47654-3782

E-mail: susanne.kummer@boku.ac.at

Datum, Unterschrift: _____

In case of exhaustive interest of respondent about project, please explain that we are willing to give all explanations, but after the interview***, because the information will influence the answers and we would like to avoid that.***

Lokales Wissen von Biobauern

Interview

Namenscode:_____

Beginn:_____ Ende:_____

Daten

Persönliche Daten

Vorname: _____Nachname:_____

Addresse:_____

Tel.:_____

E-mail:_____

Webpage:_____

Geburtsjahr:_____

Aufgewachsen in: _____

1 Einleitende Fragen

- Kurzbeschreibung Betrieb (Betriebsform, Betriebszweige, Größe)
- Warum sind Sie Bauer?
- Warum sind Sie Biobauer?

2 Zeitlinie – Signifikante Ereignisse am Betrieb

Ich möchte gern mit Ihnen eine Zeitlinie zeichnen, beginnend mit dem Zeitpunkt, als Sie als Bauer auf diesem Betrieb zu wirtschaften begonnen haben, bis heute. Ich möchte Sie bitten, auf dieser Linie die Ihrer Meinung nach wichtigsten Ereignisse auf Ihrem Betrieb einzuzeichnen (wo sich etwas verändert hat, wo Sie **etwas ausprobiert** haben).

(-) Vergangenheit (0) Signifikante Ereignisse/Veränderungen am Betrieb Heute Zukunft →

(-) Was vorher passiert ist (bevor Person Bauer geworden ist / auf anderem Betrieb).

Underneath the line: professional; Above the line: rest (personal, etc.)

2.1 Veränderungen

- Was hat sich auf dem Betrieb verändert, seit Sie angefangen haben?
- Wann haben Sie etwas verändert/ausprobiert? Was?
- Welche Probleme gab es? Wie haben Sie diese gelöst?
- Welche Pläne haben Sie für die Zukunft?

3 Der Experimentationsprozess/Lernprozess

Thema:_____

3.1 Motiv/Grund

- **WANN** haben Sie das probiert/damit angefangen?
- **WARUM** haben Sie das probiert/gemacht?

3.2 Ideenquelle

- Wie / **WOHER** haben Sie die Idee dazu bekommen?
- Haben Sie aktiv nach Ideen und Information dazu **gesucht**, bevor Sie das ausprobiert haben?
- Haben Sie die ursprüngliche Idee **geändert**? Warum? Wie?

3.3 Prozess

- **WIE haben Sie begonnen**, diese Idee umzusetzen?
- Was haben Sie dann gemacht?
- **Wie lang** machen/benutzen Sie das schon bzw. haben Sie das benutzt?
- Wie haben Sie gearbeitet, **bevor** Sie das probiert/entwickelt haben?

3.4 Methode

- **WIE haben Sie das gemacht?**

- Sind Sie nach bestimmten **Schritten**/Methoden vorgegangen?
- Machen Sie dazu Berechnungen? **Messen** Sie das?
- Haben Sie das „**im Kleinen**“ probiert?
- Haben Sie das isoliert von anderen Rahmenbedingungen probiert?
- Haben Sie diesen Versuch **wiederholt**/es nochmal probiert? Wie oft?
- Als Sie das nochmal gemacht haben, haben Sie es da anders gemacht? Wie?
- **Wo** auf dem Betrieb probieren Sie Dinge aus?
- Würden Sie das heute anders machen? Warum?

3.5 Planung

- Sind Sie nach einem **Plan** vorgegangen?
- Wie haben Sie das geplant?
- Wie haben Sie den Prozess/die Entwicklung **beobachtet/kontrolliert**?
- Was haben Sie **erwartet**, als Sie damit begonnen haben?
- Hat es sich so entwickelt, wie Sie das erwartet haben?
- Machen Sie sich **Notizen**? (Foto)

3.6 Resourcen

- Welche Resourcen haben Sie für diesen Versuch/ diese Entwicklung benutzt?
    - Kapital
    - Arbeitskräfte
    - Materialien, Werkzeug
- Haben Sie irgendwelche Resourcen nicht gehabt, die Sie gebraucht hätten?

3.7 Ergebnisse

- Was waren/sind die Ergebnisse dieses Prozesses/Versuches?[1]
- Wie **beurteilen** Sie diese Ergebnisse?
- **Vergleichen** Sie Ihre Ergebnisse (mit Kollegen, mit Information aus Büchern/ Zeitschriften, mit anderen)?
- Was glauben Sie haben Sie daraus **gelernt**?

3.8 Weitergabe/Kommunikation

- Haben Sie mit anderen Personen über diesen Versuch/die Ergebnisse **gesprochen**? Mit wem?
- Kennen Sie andere Bauern, die das benutzen/machen? Wer?
- Haben sich andere Bauern/Personen dafür interessiert?
- Geben Sie ihr Wissen über das … an andere Bauern/Personen weiter? Wie? An wen?
- Falls nicht, warum nicht?

WISSEN: Wie und woher glauben Sie haben Sie Ihr Wissen entwickelt?
Woher haben Sie am meisten gelernt für Ihre Tätigkeit als Biobauer?

[1] *New method; new machine; new system; new working group; new market? As well as higher production capability; higher profits; fewer expenses for labour and so on… Try to define the results: rediscovery of something known; minor modification to existing production method; adaptation of technologies; invention; other…learning, changing to add to code book under outcomes*

4 Soziodemografische Daten

4.1 Familienstand

Verheiratet/Lebensgemeinschaft □
Alleinstehend □
Geschieden □
Verwitwet □
Kinder: □ ja □ nein
Wenn ja:
Wie viele:_____ Davon zuhause lebend:_____
Alter der Kinder:_____

4.2 Schulausbildung

- Schulform
  - Pflichtschule (9 Jahre)
  - Lehre_____
  - Meisterprüfung_____
  - Fachschule_____
  - Höhere Schule (Matura)_____
  - Akademie_____
  - Fachhochschule_____
  - Universität_____
- Gesamtzahl Ausbildungsjahre:_____
- Zusätzliche Ausbildung (Kurse…) _____
  _____
  Landwirtschaftliche Ausbildung? □ ja □ nein

4.3 Beruflicher Hintergrund

- Wie lang sind Sie schon in der Landwirtschaft tätig?
- Was haben Sie davor gemacht?_____
- Sind Sie hauptberuflich Biobauer? □ ja □ nein
- Falls nicht, welchen Beruf haben Sie sonst noch? _____
- Sind Sie auf einem Bauernhof aufgewachsen? □ ja □ nein
- Haben Sie als Kind in der Landwirtschaft mitgearbeitet? □ ja □ nein

4.4 Umstellung

- Waren Sie vorher ein konventioneller Landwirt? □ ja □ nein
- Wie lang?____Jahre, Umstellung im Jahr_____

4.5 Arbeitskräfte

- Wie viele Personen arbeiten am Betrieb (inklusive Betriebsleiter)?
- Konstant: Familie und Verwandte:_____ Angestellte:_____
- Saisonal: Familie und Verwandte:_____ Angestellte:_____
- Praktikanten:_____

4.6 Betrieb

- Wie groß ist der Betrieb?_____ha
  - Ackerland_____ha
  - Grünland_____ha
  - Wald_____ha
  - Sonderkulturen_____ha
  - Andere_____ha_____
- Tierhaltung
  - Tierart: _____ Anzahl: _____
  - Tierart: _____ Anzahl: _____
  - Tierart: _____ Anzahl: _____
- Geräteausstattung (wichtigste Geräte und Maschinen):

_____
_____
_____

- Was produzieren Sie?

_____
_____

- Wie vermarkten Sie Ihre Produkte?

_____
_____

- Welcher Betriebszweig ist am wichtigsten für das landwirtschaftliche Einkommen des Betriebes? _____

4.7 Region

4.7.1 Betriebsdaten

- Seehöhe_____m
- Betriebsflächen überwiegend
  - flach
  - flach mit manchen geneigten Flächen
  - hügelig
  - steile Flächen
- Wie würden Sie kurz die Qualität Ihrer Böden beschreiben?

_____

4.7.2 Geografische Daten

- Durchschnittstemperatur:_____°C
- Niederschlag:_____mm
- Natürliche Katastrophen:_____

4.7.3 Erschwernisse

- Welche Einschränkungen und Hindernisse gibt es auf Ihrem Betrieb?

_____

- In dieser Region?_____

4.7.4 Infrastruktur

- Energieversorgung_____
- Wasserversorgung_____
- Internet □ ja □ nein
- Zufahrtsstraße, Beschaffenheit_____

Erreichbar-keit (in min.)	Transport-mittel	□ Auto	□ Öffentl. Transport	□ Zu Fuß	□ Fahrrad
Hauptstraße					
Nächster Bauernhof					
Nächster Biobauer					
Nächster Nachbar					
Nächster Kollege, der in gleichem Zweig tätig ist					
Nächstes Dorfzentrum					
Nächste Stadt_____					
Nächster Verkaufspunkt _____					
Lw. Berater					
Nächste Werkstatt					

- Wie sehen Sie sich selbst integriert in:
  - Fachdiskussionen über Biolandbau
    gut integriert 1 2 3 4 nicht beteiligt
  - die Nachbarschaft
    gut integriert 1 2 3 4 kein Kontakt

4.8 Vertrautheit mit der Umgebung/Umwelt

- Seit wann leben Sie hier?_____/ Sind Sie hier in der LW tätig?_____
- Hatten Sie davor anderswo einen Hof? Wenn ja, wo?_____Wie lang?___J.

4.9 Finanzielle Situation

- Wie wichtig schätzen Sie das Einkommen aus der LW für das gesamte Familieneinkommen ein?
  - Sehr wichtig
  - Wichtig
  - Nicht so wichtig
  - Garnicht wichtig

- Wie wichtig sind Förderungen für das gesamte Einkommen aus der LW?
  - Sehr wichtig
  - Wichtig
  - Nicht so wichtig
  - Garnicht wichtig

- Bitte beurteilen Sie die finanzielle Situation Ihrer Familie:
  - Nicht genug zum Leben
  - Genug zum Leben
  - Genug zum Leben mit Geldmitteln für
    - Investitionen
    - Sparen
    - Luxus

4.10 Informationssysteme und Kommunikationsnetzwerke

- In welchem Bioverband sind Sie Mitglied?
- Sind Sie Mitglied in einem sonstigen lw. Verein?

  _____
- Mit wem tauschen Sie sich über lw. Themen aus?

  _____
- Zu welchen Themen?

  _____
- Treffen Sie sich regelmäßig?_____
- Wenn Sie Informationen zu lw. Themen/Fragen brauchen, woher holen Sie sich diese? Bitte listen Sie Ihre Informationsquellen auf:

Quelle	Wichtigkeit	Reihung

- Bitte nach Wichtigkeit benoten: 1-4 (1 sehr wichtig; 2 wichtig; 3 weniger wichtig; 4 garnicht wichtig); Gründe für diese Noten?
- Reihung: 1. Platz, 2. Platz,…)

4.10.1 Reisen

- Besuchen Sie andere Orte innerhalb Österreichs? Aus welchem Grund?

  _____
- Haben Sie andere Länder besucht? Gründe?

  _____
- Reisen Sie regelmäßig?
  - Mehrmals im Jahr
  - Einmal im Jahr
  - Seltener
- Haben Sie in anderen Ländern längere Zeit gelebt/gearbeitet? Wo? Wie lang?

4.10.2 Büro

- Wo machen Sie Ihre Schreibarbeiten? Haben Sie ein Büro? (Foto)

- Möchten Sie noch etwas hinzufügen?_____
  _____

5 Definitionen

Was bedeutet für Sie:

- Experiment?_____
  _____
- Innovation?_____
  _____
- Erfindung?_____
  _____

6 Feedback

Wie war das Interview für Sie?
Welche Änderungsvorschläge haben Sie für den Fragebogen?
Möchten Sie eine Kopie des Tonbandes oder der Fotos?

7 Questions for us after the interview

Directly after the interview

- Where was the interview done?
- Who was present?
- General impression of the farm / Specific observations about the farm
- General impression of the interview: openness/comfortableness of interviewee interviewer; specific observations about the interview
- Main subjective impression about the farmer
- Short summary
- Circumstances influencing the interview

After transcribing/first analysis of the interview

- Which phrases did the farmer use to define the learning process?
- Did the farmer talk about experimentation alone?
- Did the farmer talk about methodology?
- New hypotheses?
- Did you make any very good/bad questions?

Structured questionnaire

(including introductory letter for interviewee)

Universität für Bodenkultur Wien
University of Natural Resources and Applied Life Sciences, Vienna

Department für Nachhaltige Agrarsysteme

Institut für Ökologischen Landbau

Arbeitsgruppe für Wissenssysteme und Innovationen

Gregor-Mendel Straße 33, 1180 Wien

Brief für den Gesprächspartner
Fragebogen über Versuche und Experimente von Biobauern

In diesem Fragebogen geht es darum, wie Biobauern auf ihren Betrieben Dinge ausprobieren, etwas versuchen oder „experimentieren“. Wie wir durch unsere bisherigen Befragungen herausgefunden haben, probieren Bauern verschiedenste Dinge auf ihren Betrieben aus, manche mehr und öfters, manche weniger. Wir sind daran interessiert, was Biobauern auf ihren Betrieben ausprobieren und wie sie das machen.

Mit ausprobieren, versuchen und „experimentieren“ meinen wir die Arbeit und Tätigkeiten der Bauern auf ihrem Betrieb, ihre Versuche, die sie durchführen. Wir meinen damit nicht die Tätigkeit von Wissenschaftern. Daher verwenden wir hier den Begriff „Experiment“ auch unter Anführungszeichen, weil die meisten Personen diesen Begriff eher mit einer wissenschaftlichen Tätigkeit verbinden.

Vertraulichkeitserklärung

Die Daten, die im Zuge des Projektes gesammelt werden, werden streng vertraulich behandelt und nicht an Dritte weitergegeben. In Berichten und Publikationen werden die Daten nur in anonymer Weise beschrieben (z.B.: „30% der Befragten geben an, dass …“).

Kontakt

Wenn Sie Fragen zum Projekt haben, kontaktieren Sie mich bitte:

DI Susanne Kummer
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Gregor Mendel Straße 33
1180 Wien
Tel Büro: 01/47654-3782
E-Mail: susanne.kummer@boku.ac.at

Herzlichen Dank, dass Sie sich für dieses Gespräch Zeit genommen haben!

Ich werde Sie über die Ergebnisse des Projektes nach Ende der Projektlaufzeit (Sommer/Herbst 2009) gerne per Mail verständigen.

Datum, Unterschrift: _____

Nr:_____ Datum:_____

Fragebogen über Versuche und Experimente von Biobauern

Definition
Wenn wir die Begriffe ausprobieren, versuchen oder experimentieren verwenden, meinen wir damit, wie SIE überprüfen und testen, ob und wie etwas funktioniert, und ob dies für Sie und Ihren Betrieb passend ist. Gemeint ist also nicht ein wissenschaftlicher Versuch, sondern wie Versuche in der Praxis von Biobauern auf ihren Betrieben durchgeführt werden.
Was Sie versuchen oder ausprobieren, kann eine eigene Idee sein, oder etwas, das Sie gesehen oder von dem Sie gehört haben, eine Veränderung, die Sie auf Ihrem Betrieb durchführen, und vieles mehr.

1 Probieren Sie auf Ihrem Betrieb verschiedene Dinge aus, oder haben Sie das früher gemacht?

(Unterstützend: Definition wiederholen oder Kategorien aufzählen.)

Im Folgenden zähle ich Ihnen verschiedene Arbeitsbereiche auf, in denen Sie möglicherweise etwas ausprobiert haben:

- Ackerbau
- Bodenbearbeitung
- Düngung
- Unkraut- oder Schädlingskontrolle
- Geräte und Maschinen
- Tierhaltung
- Verarbeitung
- Vermarktung
- Weitere (z.B.: Arbeitseinteilung, Homöopathie, EM, Präperate, Arbeiten nach Mondphasen)

1.1 ❑ Ja, ich probiere Dinge auf meinem Betrieb aus/ich habe Dinge ausprobiert.
1.2 ❑ Nein, ich habe auf meinem Betrieb keine Dinge ausprobiert (entsprechend der gegebenen Definition).

Falls NEIN, gehen Sie bitte zu Frage 30 (Seite 9).

2 Wenn Sie etwas ausprobieren/ausprobiert haben, sagen Sie mir bitte, was Sie probiert haben. Welche Themen fallen Ihnen ein, wo Sie etwas ausprobiert haben? (Bitte nur die Themen anführen):

(Interviewer: Themen in der gegebenen Reihenfolge aufschreiben.)

2.1 Thema 1:_____
2.2 Thema 2:_____
2.3 Thema 3:_____
2.4 Thema 4:_____
2.5 Thema 5:_____
2.6 Thema 6:_____
2.7 Thema 7:_____
2.8 Thema 8:_____
2.9 Thema 9:_____
2.10 Thema 10:_____

3 Auf Ihrem Betrieb probieren Sie Dinge

3.1 ❑ Sehr oft (regelmäßig während der gesamten Saison)
3.2 ❑ Manchmal (jede Saison/jedes Jahr)
3.3 ❑ Selten (nicht regelmäßig, nicht jedes Jahr)

4 In den folgenden Listen sind weitere mögliche Themen aufgezählt, in denen Biobauern etwas ausprobieren könnten. Bitte geben Sie für jedes Thema an, wie oft Sie in diesem Bereich etwas ausprobiert haben:

Ackerbau

		Mehrmals	Einmal	Nie
4.1	Einführung einer **neuen Pflanzenart** am Betrieb			
4.2	Probieren **verschiedener Sorten** von Pflanzen			
4.3	Züchten eigener Sorten am Betrieb			
4.4	Probieren unterschiedlicher Fruchtfolgen			
4.5	Probieren verschiedener Saat-/Pflanzabstände			
4.6	Probieren verschiedener Saat-/Pflanztermine			
4.7	Probieren von Mischsaaten			
4.8	Probieren von Untersaaten			
4.9	Sonstiges:			

Bodenbearbeitung

		Mehrmals	Einmal	Nie
4.10	Probieren verschiedener Bodenbearbeitungstechniken			
4.11	Probieren von reduzierter BB, pfluglose BB			
4.12	Probieren von Mulchen			
4.13	Probieren verschiedener Bewässerungssysteme			
4.14	Probieren verschiedener Abdeckungen (Vlies, Folie)			
4.15	Sonstiges:			

Düngung

		Mehrmals	Einmal	Nie
4.16	Probieren verschiedener biologischer/organischer Dünger			
4.17	Probieren verschiedener Gründüngerarten			
4.18	Herstellung von Kompost oder Wurmkompost			
4.19	Variationen in der Ausbringung von Düngemitteln (Technik, Zeitpunkt)			
4.20	Probieren verschiedener Arten der Düngeaufbereitung (z.B. Belüften von Gülle)			
4.21	Sonstiges:			

Unkraut- und Schädlingskontrolle

		Mehrmals	Einmal	Nie
4.22	Probieren verschiedener Methoden/Mittel zur Schädlingskontrolle			
4.23	Probieren verschiedener Methoden der Unkrautkontrolle			
4.24	Probieren verschiedener Wirkstoffe/Bio-Spritzmittel gegen Unkraut			
4.25	Sonstiges:			

Geräte und Maschinen

		Mehrmals	Einmal	Nie
4.26	Probieren von neuen Geräten/Maschinen (von jemand anderem entwickelt)			
4.27	Abwandlung/Nachbau von Geräten oder Entwicklung von eigenen Geräten/Maschinen			
4.28	Probieren von alternativer Energie- oder Treibstoffversorgung			
4.29	Sonstiges:			

Nr:_____ Datum:_____

Tierhaltung

	Mehrmals	Einmal	Nie
4.30 Probieren von verschiedenen Futtermitteln/Rationen			
4.31 Einführung neuer Tierarten/neuer Rassen am Betrieb			
4.32 Eigene Züchtungstätigkeit am Betrieb			
4.33 Probieren verschiedener Wirkstoffe bei Krankheiten			
4.34 Sonstiges:			

Verarbeitung

	Mehrmals	Einmal	Nie
4.35 Herstellung neuer Produkte			
4.36 Probieren neuer Arten der Verarbeitung (z.B. um Arbeit zu erkleichtern oder zu reduzieren)			
4.37 Probieren verschiedener Lagerungsmethoden			
4.38 Sonstiges:			

Vermarktung

	Mehrmals	Einmal	Nie
4.39 Probieren verschiedener Vermarktungswege			
4.40 Probieren verschiedener Direktvermarktungs-Strategien (z.B. Kisterlsysteme, Internetverkauf, Marktstand)			
4.41 Kooperation mit anderen Personen zu Vermarktungszwecken			
4.42 Sonstiges:			

Weitere Bereiche

	Mehrmals	Einmal	Nie
4.43 Probieren verschiedener Arten der Arbeitseinteilung (Verringern oder Erleichtern der Arbeit)			
4.44 Systematische Beobachtung von Umweltbedingungen (Regenfall, Wetter, Temperatur,…)			
4.45 Testen des Mondeinflusses (auf Pflanzen, Tiere)			
4.46 Anwendung von Präperaten (z.B. biodynamische Präperate, EM)			
4.47 Anwendung von energetisiertem Wasser (z.B. Grander, Pyramidenwasser)			
4.48 Ausprobieren/Testen von Homöopathie			
4.49 Sonstiges:			
4.50 Sonstiges:			

Nr:_____ Datum:_____

5 Bitte wählen Sie nun einen dieser Bereiche, wo Sie innerhalb der letzten 5 Jahre etwas ausprobiert haben oder Versuche gemacht haben. Das kann ein Bereich sein, der Sie besonders interessiert (hat), der Sie besonders beschäftigt (hat), der sehr wichtig oder „typisch" für Sie ist (war), oder den Sie besonders gern mögen (mochten).

5.1 Bitte beschreiben Sie kurz, was Sie probiert haben:

Bitte beantworten Sie die folgenden Fragen bezogen auf den gewählten Bereich.

6 Wie wichtig waren die folgenden Gründe für Sie, um diesen Versuch zu BEGINNEN?

	Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig/ trifft nicht zu
6.1 Einkommen erhöhen					
6.2 Zeit sparen					
6.3 Geld sparen					
6.4 Arbeit leichter machen					
6.5 Notwendigkeit					
6.6 Problem lösen					
6.7 Marktnachfrage					
6.8 Persönliche Gründe (Interesse, Neugier,…)					
6.9 Herausforderung					
6.10 Produktion/Ertrag erhöhen					
6.11 Qualität verbessern					
6.12 Selbstversorgung					
6.13 Umweltschutz, Nachhaltigkeit					
6.14 Vorbildwirkung anderer					
6.15 Zufall					
6.16 Mehrere Standbeine schaffen					
6.17 Sicherheit erhöhen					
6.18 Sonstige _____					
6.19 Sonstige _____					
6.20 Sonstige _____					

7 In der folgenden Frage geht es darum, woher Sie die Idee zu diesem Versuch hatten. Wie wichtig waren die folgenden Personen oder Ereignisse als IDEENQUELLE für diesen Versuch?

		Sehr wichtig	Wichtig	Neutral	Weniger wichtig	Nicht wichtig
7.1	Andere Bauern					
7.2	Familienmitglieder					
7.3	Freunde, Bekannte					
7.4	Kunden					
7.5	Berater					
7.6	Wissenschafter					
7.7	Andere erfahrene Person; bitte anführen: _____					
7.8	Literatur (Bücher, Zeitschriften,…)					
7.9	Internet					
7.10	Kurse					
7.11	Exkursionen					
7.12	(Lw.) Messen					
7.13	Ich selbst (Eigene Idee)					
7.14	Sonstige; bitte anführen: _____					

8 Bevor Sie mit diesem Versuch begonnen haben: Haben Sie nach Informationen zu diesem Bereich gesucht?

8.1 □ Ja, habe ich.
8.2 □ Nein, ich habe nicht nach Informationen gesucht oder gefragt, bevor ich begonnen habe.

9 Wie wichtig waren die folgenden Informationsquellen, um diesen Versuch durchzuführen?

		Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig
9.1	Bauern					
9.2	Familienmitglieder					
9.3	Freunde/Bekannte					
9.4	Berater					
9.5	Wissenschafter					
9.6	Andere erfahrene Person; bitte anführen: _____					
9.7	Literatur (Bücher, Zeitschriften,…)					
9.8	Internet					
9.9	Kurse					
9.10	Exkursionen					
9.11	(Lw.) Messen					
9.12	Sonstige, bitte anführen): _____					

10 Wie haben Sie mit diesem Versuch begonnen?

10.1 □ Ich habe einen schriftlichen Plan/ein gezeichnetes Modell gemacht
10.2 □ Ich habe darüber nachgedacht, wie ich das machen werde, und habe mir einen Plan im Kopf gemacht
10.3 □ Ich habe spontan und ohne Planung begonnen

11 Haben Sie mit diesem Versuch zuerst im kleinen Rahmen begonnen? *(Bitte nur eine Antwort wählen)*:

11.1 □ Ich habe im kleinen Rahmen begonnen (kleinen Flächen, wenige Pflanzen/Tiere) und habe dann vergrößert, als die Ergebnisse zufriedenstellend waren und/oder ich genug Erfahrungen hatte
11.2 □ Ich habe gleich im großen Rahmen begonnen (große Flächen, gesamter Bestand)

12 Wie haben Sie die Entwicklung des Versuches/den Prozess verfolgt? *(Sie können mehrere Antworten wählen):*

12.1 □ Ich habe Beobachtungen gemacht/beobachtet (visuell)
12.2 □ Ich habe Messungen durchgeführt (abwiegen, "bonitieren", abzählen, abmessen…)
12.3 □ Ich habe Vergleiche gemacht/es mit etwas anderem verglichen
12.4 □ Ich habe den Prozess nicht verfolgt oder beobachtet

13 Falls Sie Vergleiche gemacht haben: Womit haben Sie verglichen? *(Sie können mehrere Antworten wählen)*:

13.1 □ Mit meinen Erfahrungen aus früheren Jahren bzw. mit früheren Versuchen von mir
13.2 □ Mit einer anderen Fläche meines Betriebes
13.3 □ Mit einem anderen Bauern (mit seinen Flächen, Produkten, Tieren,…)
13.4 □ Mit Ergebnissen, die in Büchern oder Artikeln beschrieben werden
13.5 □ Mit Informationen von Beratern oder anderen Experten
13.6 □ Sonstige Vergleiche: _____

14 Falls Sie die Entwicklung des Versuches verfolgt/beobachtet haben, wie oft haben Sie das gemacht? *(Bitte nur eine Antwort wählen)*:

14.1 □ Täglich
14.2 □ Wöchentlich
14.3 □ Mehrmals pro Saison, aber seltener als wöchentlich
14.4 □ Nur am Ende des Versuches
14.5 □ Ich habe den Versuch nicht beobachtet

15 Haben Sie den Versuch dokumentiert? *(Sie können mehrere Antworten wählen):*

15.1 □ Ja, ich habe mir Notizen gemacht
15.2 □ Ja, ich habe Fotos gemacht
15.3 □ Ja, ich habe eine Probe/ein Muster genommen
15.4 □ Ja, ich habe ein Video darüber gemacht
15.5 □ Ja, ich hatte verpflichtende Aufzeichnungen (z.B. für ÖPUL oder Biokontrolle) zu führen
15.6 □ Sonstiges (bitte anführen):_____
15.7 □ Nein, ich habe den Versuch nicht dokumentiert

16 Haben Sie Erwartungen über die Ergebnisse des Versuches gehabt? *(Bitte nur eine Antwort wählen)*:

16.1 □ Ich hatte konkrete Erwartungen über die Ergebnisse
16.2 □ Ich hatte eine grobe Vorstellung, was herauskommen könnte oder sollte
16.3 □ Ich hatte keine Erwartungen (bitte bei Frage 18 weitermachen)

Nr:_____ Datum:_____

17 Wie wichtig waren die folgenden Erwartungen für Sie?

	Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig
17.1 Höheres Einkommen					
17.2 Höherer Ertrag/Produktion					
17.3 Arbeitserleichterung/-verringerung					
17.4 Höhere Qualität					
17.5 Mehrere Standbeine					
17.6 Wissenserweiterung					
17.7 Bekanntheit, Anerkennung von anderen					
17.8 Sonstiges _____					

18 Haben Sie diesen Versuch wiederholt? *(Bitte nur eine Antwort wählen)*:

18.1 □ Ja, ich habe ihn wiederholt
18.2 □ Nein *(Bitte bei Frage 20 weitermachen)*

19 Wenn Sie den Versuch wiederholt haben, haben Sie… *(Bitte nur eine Antwort wählen)*:

19.1 □ Es gleich gemacht wie beim ersten Mal
19.2 □ Es etwas anders gemacht als beim ersten Mal (Wie? _____)
19.3 □ Es komplett anders gemacht (Wie? _____)

20 Wenn Sie nun an die Ergebnisse dieses Versuches denken: Wie sehr treffen die folgenden Aussagen auf den Versuch zu?

	Trifft voll zu	Trifft eher zu	Neutral	Trifft eher nicht zu	Trifft nicht zu
20.1 Ich habe mehr Wissen über diesen Bereich gewonnen					
20.2 Ich habe mein Einkommen erhöht					
20.3 Ich habe Arbeit erleichtert/reduziert					
20.4 Ich habe meine Produktion erhöht					
20.5 Ich habe etwas Neues geschaffen (neues Produkt, Arbeitsmethode, Maschine, Gerät, Vermarktungsweg)					
20.6 Ich habe eine bekannte Methode/Maschine/etc. an meinen Betrieb/meine Region angepasst					
20.7 Ich bin dadurch bekannt dafür, mich in dem Bereich auszukennen					
20.8 Ich bin nun zufriedener mit meiner Betriebs-/Arbeitssituation					
20.9 Sonstige (bitte anführen): _____					

21 Waren die Ergebnisse zufriedenstellend für Sie? *(Bitte nur eine Antwort wählen)*:

21.1 □ Ja, vollkommen zufriedenstellend *(Bitte bei Frage 23 weitermachen)*
21.2 □ Teilweise zufriedenstellend
21.3 □ Nein, nicht zufriedenstellend

22 Falls die Ergebnisse nicht oder nur teilweise zufriedenstellend waren, wie sehr treffen die folgenden Aussagen zu?

	Trifft voll zu	Trifft eher zu	Neutral	Trifft eher nicht zu	Trifft nicht zu
22.1 Ich sah, dass das zuviel Arbeit ist					
22.2 Ich sah, dass es zu teuer ist					
22.3 Ich sah, dass es zu kompliziert ist, um es in der Praxis anzuwenden					
22.4 Ich sah, dass es nicht so gut funktioniert, wie erhofft					
22.5 Sonstiges (bitte anführen): _____					

23 Kennen Sie andere Personen, die die Ergebnisse oder Erfahrungen Ihres Versuches verwenden?

23.1 □ Ja
23.2 □ Nein, ich kenne niemanden *(Bitte bei Frage 25 weitermachen)*

24 Welche Personen nutzen die Ergebnisse oder Erfahrungen Ihres Versuches? *(Sie können mehrere Antworten wählen):*

24.1 □ Andere Bauern
24.2 □ Familienmitglieder
24.3 □ Freunde
24.4 □ Kunden
24.5 □ Berater
24.6 □ Experten
24.7 □ Wissenschafter
24.8 □ Sonstige _____

25 Wie wichtig waren die folgenden Hilfsmittel/Ressourcen, um diesen Versuch durchzuführen?

	Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig/ trifft nicht zu
25.1 Unbezahlte (eigene) Arbeitskraft					
25.2 Bezahlte Fremdarbeitskraft					
25.3 Eigene Materialien/Resourcen					
25.4 Zugekaufte Materialien					
25.5 Eigenes Geld					
25.6 Fremdkapital (Kredit, Förderungen)					
25.7 Eigene lw. Flächen					
25.8 Zugepachtete Flächen					
25.9 Eigenes Wissen und Erfahrung					
25.10 Informationen von außen					
25.11 Sonstiges: _____					

26 Haben Sie für den Versuch mit anderen Personen zusammengearbeitet?

26.1 □ Ja, ich habe mit anderen zusammengearbeitet
26.2 □ Nein, ich habe den Versuch allein gemacht *(Bitte bei Frage 28 weitermachen)*

27 Falls Sie mit jemandem zusammengearbeitet haben, wie wichtig war die Unterstützung der folgenden Personen?

	Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig
27.1 Familienmitglieder					
27.2 Nachbarn					
27.3 Freunde					
27.4 Andere Bauern					
27.5 Berater					
27.6 Wissenschafter					
27.7 Andere _____					

28 Wenn Sie nun nochmal an diesen Versuch denken: Sind Sie bei anderen Versuchen auch so vorgegangen? Oder haben Sie es bei anderen Versuchen anders gemacht?

28.1 ☐ Was ich soeben beschrieben habe, trifft auch auf andere Versuche von mir zu *(bitte bei Frage 31 weitermachen)*

28.2 ☐ Es gibt Unterschiede zu anderen Versuchen

29 Falls es Unterschiede gibt, bitte beschreiben Sie, was anders war:

30 Falls Sie selten oder nie etwas auf Ihrem Betrieb ausprobieren/Versuche machen, wie wichtig sind die folgenden Gründe?

	Stimme voll zu	Stimme eher zu	Neutral	Stimme wenig zu	Stimme nicht zu
30.1 Ich kann keine Fehler oder Verluste riskieren.					
30.2 Ich habe gute Erfahrungen damit gemacht, Standard-Empfehlungen oder Lösungen zu übernehmen, die mir empfohlen werden.					
30.3 Es ist nicht die Aufgabe eines Bauern, etwas auszuprobieren/Versuche zu machen. Das wird von anderen durchgeführt.					
30.4 Ich muss nichts probieren, da alles gut läuft, so wie es jetzt ist.					

Nr:_____ Datum:_____

In den folgenden Fragen geht es um Informationen über Sie und Ihren Betrieb:

31 Zur Person

31.1	Geschlecht	□ Frau □ Mann
31.2	Geburtsjahr	
31.3	Aufgewachsen in	

32 Familienstand

32.1 verheiratet/Lebensgemeinschaft	32.2 Ledig/Single	32.3 verwitwet	32.4 geschieden
□	□	□	□

Kinder

33	**Kinder**	33.1 Anzahl ____
34	**Kinder die im Haushalt leben**	34.1 Anzahl ____

Landwirtschaftliche Flächen

35	**Gesamtfläche mit Wald (inkl. Pachtflächen)**	35.1 _____ha
36	**Ackerland**	36.1 _____ha
37	**Grünland**	37.1 _____ha
38	**Wald**	38.1 _____ha
39	**Sonstige (bitte anführen)_____**	39.1 _____ha
40	**Sonstige (bitte anführen)_____**	40.1 _____ha

Tierhaltung

41	**Rinder**	41.1 _____ Stück
42	**Schweine**	42.1 _____ Stück
43	**Schafe**	43.1 _____ Stück
44	**Ziegen**	44.1 _____ Stück
45	**Hühner**	45.1 _____ Stück
46	**Bienen**	46.1 _____ Völker
47	**Sonstige Nutztiere: _____**	47.1 _____ Stück
48	**Sonstige Nutztiere: _____**	48.1 _____ Stück

49 Betriebszweige und Tätigkeiten am Betrieb:

(1. Spalte: Produktion für Markt; 2. Spalte: Selbstversorgung)

□	□	49.1 Ackerbau
□	□	49.2 Waldwirtschaft
□	□	49.3 Milchwirtschaft
□	□	49.4 Fleischerzeugung
□	□	49.5 Legehennen
□	□	49.6 Tierzucht
□	□	49.7 Imkerei
□	□	49.8 Obstbau
□	□	49.9 Gemüsebau
□	□	49.10 Weinbau, Weinwirtschaft
□	□	49.11 Verarbeitung

Sonstige Tätigkeiten am Betrieb

☐	49.12	Direktvermarktung
☐	49.13	Lw. Lohnarbeit (z.B. auf Maschinenringbasis)
☐	49.14	Urlaub am Bauernhof
☐	49.15	Catering, Buschenschank/Heurigen oder ähnliches
☐	49.16	Schule am Bauernhof
☐	49.17	Betreutes Wohnen (für Menschen mit besonderen Bedürfnissen, alte Menschen,…)
☐	49.18	Alternative Energiegewinnung (Biogas, Photovoltaik,…)
☐	49.19	Kurse und Seminare am Bauernhof
☐	49.20	Sonstige (bitte benennen): _____

50 Wie sehr treffen die folgenden Erschwernisse auf Ihren Betrieb zu?

	Trifft sehr zu	Trifft zu	Neutral	Trifft wenig zu	Trifft nicht zu
50.1 Steile Flächen/Hänge					
50.2 Niedrige/Schlechte Bodenqualität					
50.3 Platzprobleme (z.B. Nachbarn direkt angrenzend, keine Flächen zu kaufen)					
50.4 Zu wenig Niederschlag/Regen					
50.5 Zu viel Niederschlag/Regen					
50.6 Ungleichmäßige Verteilung der Regenfälle					
50.7 Natürliche Katastrophen (Sturm, Dürre, Hagel, Erdrutsch, Lawinen,…)					
50.8 Große Distanz zur nächsten Stadt					
50.9 Zu wenig außerbetriebliche Arbeitsmöglichkeiten für mich					
50.10 Wenig Geld vorhanden					
50.11 Schlechte Vermarktungsmöglichkeiten					
50.12 Wenig Kontakt zu anderen (Bio-) Bauern und/oder in der Nachbarschaft					
50.13 Wenig soziale Kontakte generell					
50.14 Aufwändige Bürokratie					
50.15 Sonstiges:					

51 Erwerbsform

51.1 ☐ Vollerwerb
51.2 ☐ Nebenerwerb
51.3 ☐ Hobbybetrieb

52 Sind Sie auf einem landwirtschaftlichen Betrieb aufgewachsen?

52.1 ☐ ja
52.2 ☐ nein

53 Haben Sie als Kind am Betrieb mitgearbeitet?

53.1 ☐ ja
53.2 ☐ nein

54 In welchem Jahr haben Sie begonnen als Bauer zu arbeiten?

54.1 Im Jahr _____

55 In welchem Jahr haben Sie auf Bio umgestellt?

55.1 Im Jahr _____

56 Bitte geben Sie Ihren höchsten Ausbildungsabschluss an:

56.1 □ Pflichtschulabschluss
56.2 □ Lehrabschlussprüfung
56.3 □ Fachschulabschluss
56.4 □ Meisterprüfung
56.5 □ Matura
56.6 □ Akademie (Diplom)
56.7 □ Universitätsabschluss

57 Haben Sie eine landwirtschaftliche Ausbildung gemacht?

57.1 □ Ja
57.2 □ Nein

58 Falls Sie sonstige Weiterbildungen oder Kurse abgeschlossen haben, geben Sie bitte an, welche das sind:

58.1 _____
58.2 _____
58.3 _____

Die folgenden Fragen beziehen sich darauf, wie und mit wem Sie Erfahrungen und Informationen austauschen:

59 Bitte kreuzen Sie an, ob diese Aussagen auf Sie zutreffen:

59.1 □ Ich bin Mitglied in vielen Verbänden und Gruppen
59.2 □ Ich organisiere selbst Treffen von (Bio-) Bauern oder anderen interessierten Personen

60 In welchen Verbänden und Vereinen sind Sie Mitglied?

Bioverband
60.1 □ Bio Austria
60.2 □ Demeter
60.3 □ Erde&Saat
60.4 □ Freiland Verband
60.5 □ Sonstiger: _____

Offizielle lw. Verbände/Vereine
60.6 □ Bauernbund
60.7 □ Maschinenring
60.8 □ Sonstiger: _____

Sonstige Vereinigungen mit Bezug zur LW
60.9 □ Arche Noah
60.10 □ „A faire Milch“
60.11 □ Via Campesina
60.12 □ Sonstiger: _____

Vereine ohne Bezug zur Landwirtschaft
60.13 □ Feuerwehr
60.14 □ Schützen
60.15 □ Musikkapelle
60.16 □ Jäger
60.17 □ Kulturpflege
60.18 □ Tourismusverband
60.19 □ Sonstige: _____

Nr:_____ Datum:_____

61 Wie oft nehmen Sie an regelmäßigen Treffen von Bauern und/oder Biobauern teil?

61.1 □ Mehrmals im Monat
61.2 □ Mehrmals im Jahr
61.3 □ Einmal pro Jahr
61.4 □ Seltener als einmal pro Jahr
61.5 □ Garnicht

62 Bitte schätzen Sie ein, wie sehr diese Aussagen auf Sie zutreffen (Bitte in jeder Zeile zutreffendes ankreuzen):

	Trifft sehr zu	Trifft zu	Neutral	Trifft wenig zu	Trifft nicht zu
62.1 Ich tausche regelmäßig Erfahrungen mit anderen Bauern aus.					
62.2 Die meisten meiner Freunde und Bekannten sind selbst Bauern.					
62.3 Viele meiner Freunde und Bekannten sind keine Bauern.					
62.4 In unserer Nachbarschaft gibt es guten Kontakt.					
62.5 Für die Bereiche, die mich interessieren, kenne ich keine kompetenten Personen, die ich kontaktieren könnte.					

63* Wie wichtig sind die folgenden Informationsquellen für Sie? *(Bitte in jeder Zeile Zutreffendes ankreuzen):

	Sehr wichtig	Wichtig	Neutral	Wenig wichtig	Nicht wichtig
63.1 andere Bauern/Biobauern					
63.2 Bioverband					
63.3 Landwirtschaftskammer					
63.4 Internet					
63.5 Fachbücher					
63.6 Österreichische Fachzeitschriften					
63.7 Internationale Fachzeitschriften					
63.8 Kurse zu lw. Themen					
63.9 Messen					
63.10 TV und Radio					
63.11 Zeitung					
63.12 Andere: _____					

64 Die folgende Frage bezieht sich darauf, wohin Sie Reisen unternehmen:

(Mehrmals: Nicht jährlich, aber schon mehrmals im Leben)

	Jährlich	Mehrmals	Einmal	Nie
64.1 Österreich				
64.2 Europa				
64.3 Außerhalb Europas				

Nr:_____ Datum:_____

65 Aus welchen Gründen unternehmen Sie Reisen? *(Bitte in jeder Zeile Zutreffendes ankreuzen):*

	Trifft sehr zu	Trifft zu	Neutral	Trifft wenig zu	Trifft nicht zu
65.1 Ich reise ausschließlich um Urlaub zu machen und mich zu entspannen					
65.2 Ich reise auch, um zu sehen, wie Landwirtschaft im jeweiligen Land betrieben wird					
65.3 Ich nehme an landwirtschaftlichen Exkursionen teil					
65.4 Ich nehme an Messen, Ausstellungen und Tagungen teil					
65.5 Sonstiges:					

66* Mit den folgenden Aussagen bitten wir Sie, sich selbst einzuschätzen. *(Bitte in jeder Zeile Zutreffendes ankreuzen):

	Trifft sehr zu	Trifft eher zu	Neutral	Trifft wenig zu	Trifft nicht zu
Ich probiere ständig etwas Neues aus					
Ich mache Dinge gern anders, als die Mehrzahl der Leute / der Bauern					
Ich verändere nur dann etwas auf meinem Betrieb oder probiere etwas Neues aus, wenn es notwendig ist					
Ich gebe meine Ideen oder Erfahrungen an andere weiter					
Veränderung, Herausforderungen und Risiko machen mein Leben interessant					
Neugierde ist eine meiner wichtigsten Charakterzüge					
Ich bin ein genauer Beobachter					
Ich habe meine Dinge gut sturkturiert und ordentlich					
Ich mache meine Arbeit in kleinen Schritten, um Risiken und Stress zu vermeiden/verringern					
Ich mag es, wenn die Dinge stabil und gleichbleibend laufen					

67 WennSie noch etwas hinzufügen möchten, können Sie das gerne tun:

68 Sind Sie daran interessiert, die Ergebnisse der Befragungen zu erhalten?

68.1 □ Ja □ per Post □ per Mail (bitte Mailadresse auf Adressblatt angeben)
68.2 □ Nein

Nr:_____ Datum:_____

69 Personendaten

69.1 Name	
69.2 Adresse	
69.3 Telefonnummer	
69.4 Email	
69.5 Homepage	
69.6	

Dieses Blatt wird vom restlichen Fragebogen getrennt aufbewahrt, um die Anonymität der befragten Person sicherzustellen!

Curriculum vitae

Personal data

Name	Susanne Kummer, Dipl.Ing. (equivalent to MSc)
Date, Place of birth	09.06.1978, Graz
Nationality	Austrian
University	University of Natural Resources and Life Sciences (BOKU), Vienna
Education	
01/2007-02/2011	Doctorate student at University of Natural Resources and Life Sciences (BOKU), Division of Organic Farming.
10/2003-10/2004	Academy for agricultural education and consultancy, Vienna, Graduate degree in agricultural education and consultancy.
10/1997-08/2004	Master degree (Agriculture) at the University of Natural Resources and Life Sciences. Specialization in organic farming, nature protection within agriculture and communication processes. Master thesis about landscape conservation carried out by farmers in traditional vineyard slopes in Wachau, Lower Austria.
10/2001-07/2002	Erasmus student, Universidad Politécnica de Valencia, Spain.
10/1996-06/1997	University of Veterinary Medicine, Vienna.
06/1996	Graduation (A-levels) from grammar school (humanistic branch).
Professional experience	
since 07/2010	Assistant professor at the Division of Organic Farming, Department of Sustainable Agricultural Systems, BOKU.
09/2008-06/2010	Research assistant and lecturer at the Division of Organic Farming, Department of Sustainable Agricultural Systems, BOKU.
01/2007-08/2008	Research assistant and doctoral candidate at the Division of Organic Farming, Department of Sustainable Agricultural Systems.
09/2005-09/2006	Volunteer educator and streetworker for socially disadvantaged children and teenagers, “Proyecto Don Bosco”, Ambato, Ecuador.
01/2005-07/2005	Research assistent at the Center for Environmental Studies and Nature Conservation, BOKU. Project title: “MOBI-E: Development of a Concept for the Monitoring of Biodiversity in Austria”.

09/2004-01/2005	Research assistant in project “OEKU-Online: A transdisciplinary content-pool about economy, culture and environment”.
02/2000-12/2004	Part-time employee of “*Frisch&Frei* Home-delivery-service” of organic food. Activities: Customer service, accountancy, delivery.
09/2002-10/2004	Research assistant in project “Sustainable nature protection strategies in a traditional cultural landscape“, Center for Environmental Studies and Nature Conservation, BOKU. Realization of master thesis within the project.
2003-2005 (during summer)	Maintainance of Nature protection area in Lower Austria through pasturing, scientific supervision and care of grazing animals.
Scientific community services	
10/2009-07/2010	Member of organizing committee of 9th European IFSA Symposium (International Farming Systems Association), 4-7th July 2010, Vienna.
07/2010	Workshop organization: Knowledge systems, innovations and social learning in organic farming, 9th European IFSA Symposium.
since 2010	Delegate of BOKU University in ENOAT network (European Network of Organic Agriculture Teachers).
since 2008	Delegate of BOKU University at Terra Madre.

Publications

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