Reconciling scientific approaches for organic farming research

Part I:
Reflection on research methods in organic grassland and animal production at the Louis Bolk Institute, The Netherlands

Part II:
Effects of manure types and white clover *(Trifolium repens)* cultivars on the productivity of grass-clover mixtures grown on a humid sandy soil

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Reconciling scientific approaches for organic farming research

Part I:
Reflection on research methods in organic grassland and animal production at the Louis Bolk Institute, The Netherlands

Ton Baars

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Abstract Part 1

This dissertation focuses on the research question: what is peculiar to agricultural research when its purpose is to support the conscious development of organic agriculture? What approaches, designs and methods are used for such research? Since the 1990s the Louis Bolk Institute has become one of the important actors in the field of organic research and development. The author analysed the methodological aspects of seven case studies, each following the same format: background of the project, methods used, a reflection on the methods and, to a limited extent, agronomic results. Each of these sheds light on an aspect of the Louis Bolk Institute's approach to research. Organic farming is experienced as a new paradigm and its research methods need to do justice to it. Three criteria were formulated for this purpose: the self regulation of farming systems, the involvement of farmers and the respect for the integrity of life. Two conceptual frameworks are used to analyse the research methods: (1) a four-quadrant matrix. Epistemological, ontological and methodological changes in the way of thinking are relevant in discussions about holism versus reductionism and positivism versus constructivism. The second framework is (2) a triangle which can show the relationship between the underlying values, the involvement of the actors and the nature of the scientific process. The scientific position which is defended in this dissertation can ultimately best be described as a *'radical holistic research strategy'.*

Research approaches applied in the case studies are: interdisciplinary research, experiential science and mutual learning, farmer-to-farmer learning, exploring tacit knowledge, bio-ethical evaluation, Goethean science and systemic development. In the four quadrant matrix two new additional research methods are positioned: (1) Goethean science is included as a holistic counterpart to multidisciplinary system ecology; (2) experiential science is included for comparison with mono-disciplinary experimental research. The constructivist character of both Goethean science and experiential science particularly distinguishes these methods from mainstream science. The meta-reflection on the research showed some important new elements of research. There was a systemic orientation in terms of a cohesive set of management measures and actions. This systemic orientation also encompasses holism in terms of Goethean science. In addition there is the experiential science based on intuitive action and pattern recognition. The reflection on the methods made it clear that their acceptance was influenced by the underlying scientific philosophy. The entire research strategy is thus based on two different interpretations of knowledge. Experiential science focuses on the actions of the farmer and is based on the epistemology of action. In addition there is an epistemology of knowledge, where it relates to interdisciplinary research and Goethean science. There are barriers to the acceptance of these scientific methods in the current lack of suitable statistical evaluation methods, and also in the absence of accepted methods for explicitly exploring reality as constructed by people.

Key words: organic agriculture, anthroposophy, methodology, research strategy, experiential science, multidisciplinary research, Goethean science

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Preface and acknowledgements

This thesis is a result of teamwork. Several colleagues inside and outside the Institute have been part of the projects in this thesis. Several others gave me feedback about preliminary concepts. Inside the Institute, I am very grateful for comments by Joke Bloksma, who developed a very similar way of participatory research and extension in the field of organic fruit growing. A specific colleague with whom I started the research on grassland and animal production at the Institute is Albert de Vries. Albert was my teacher in Goethean science. Since he left the Institute in 1988, he has remained an important actor in the development of the concept of experiential learning. Albert's professional strength of his advisory company called 'Investigate your own work' is that he is applying the approach of experiential learning to all fields of society.

In my 15 years at the Sub-Department for Fodder and Animal Research, I have been working together in projects with a number of colleagues; people who directly or indirectly contributed to this thesis:
Albert de Vries, biology, research methodology (1979-1987)
Gerda Peters, laboratory assistance (1982-1986)
Marian van Dongen, grassland agronomy and Goethean science (1988-1996; 2001 onwards)
Edo Offerhaus, veterinary science (1992-1993)
Thomas Smeding, statistics and grassland agronomy (1993-1994)
Hans Vereijken, landscape development and Goethean science (1993-1995)
Frens Schuring, animal nutrition (1993)
Liesbeth Brands, technical assistance in all fields of research (1993-1997; 2001 onwards)
Erik Prins, grassland agronomy (1994-1998)
Monique Hospers, arable cropping and statistics (since 1996)
Geert-Jan van der Burgt, soil science and farming systems (since 1996)
Nick van Eekeren, grassland and fodder crops, nutrients and farming systems (since 1997)
Jolanda Bleumink, grassland agronomy and farming systems (1997-2000)
Klarita Varenkamp, animal welfare and old organic pastures (1997-1998)
Wytze Nauta, animal breeding and farming systems (since 1998)
Monique Bestman, animal welfare (pigs and poultry) (since 1999)
Marlies Beukenkamp, animal welfare (poultry) (1999)
Liesbeth Ellinger, homeopathic veterinary science (since 1999)
Henk Verhoog, ethics and biotechnology (since 1999)
Jan-Paul Wagenaar, grassland agronomy, animal welfare and farming systems (since 1999)

Jan de Wit, grassland agronomy and farming systems (since 2001)
Udo Prins, arable cropping and farming systems (since 2001)
Ellen Heeres, soil science (since 2001)
Goaitske Iepema, animal science (since 2002)
In addition to these direct colleagues, I am thankful for the inspirational atmosphere at our Institute. A special word of thanks is for Eugene Thijssen. Eugene, with whom I wrote many research proposals, has been our fund raiser since 1995.

This work could only be done with the organic farmers [1]. The farmers I loved most were those who had their own personal vision of a qualitative future organic system, which was not only an idea, but transformed their practical life and daily action. A very inspirational farmer for me is Dirk Endendijk, breeder of Dutch Friesian cows. A very loyal partner in grassland science is Leon Veltman, bio-dynamic farmer at the 'Warmonderhofstede' college farm. Although I have been co-operating with a lot of other farmers in all kind of projects, I will specially thank them by means of their farmer's association 'De Natuurweide'. In 1986 this group of farmers voluntarily decided to spend a percentage of their income on research. Due to this 'warm' money, it was possible to explore new fields of interest in organic dairy farming. I mention only some of the farmers who were on the board of the association or were delegated to control the money for research, now or in the past, and who were advocates of the support of our Institute: Jos Pelgröm, Gerard Grolleman, Jan Spaans, Wietze de Boer, Piet van IJzendoorn, Arjen Boer, Simon Galama, Piet Boons, Riet Biemans, Henk Brandsma, Anne Koekkoek, Cees Over and Roelof Smeenge.

Scientists who inspired my own work from outside the Institute were, among others Jochen Bockemühl, Dick van Romunde, Jan Grommers, Aart Malestein, Frederik Bakels and Gerrit van Putten. Jochen Bockemühl was my teacher in life sciences, although he was at a distance. I met him in the early 1980s at a scientific conference for biologists on the theme of 'genetic adaptation'. Together we were members of an international group of scientists in bio-dynamic farming, who met once a year and discussed the differences in research approaches within bio-dynamic farming. As the previous director of the scientific department of the Goetheanum in Dornach (CH), he was my source of inspiration for a new view of plants and animals, growing processes and scientific approaches based on empathic relationship. His magnificent books *In partnership with Nature* and *Awakening to Landscape* and his articles in the Journal *Elemente der Naturwissenschaft* were a great inspiration to me and allowed me to discover the intentions of holistic life sciences. It is interesting that the three translated titles of the first book, for me

[1] Farmers in this dissertation are meant both as males and females.

together express the different views on life sciences. The original German title *Lebenszusammenhänge* (translated by me as 'connections in life') expresses for me the feeling of wholeness. The Dutch title *Levensprocessen in de natuur* (translated by me as 'life-processes in nature') focuses much more on interest in the developing process as the core of life, instead of the measurable, dead values, whereas the English title *In partnership with Nature* focuses on the need for another attitude; for people to widen their understanding of nature and life.

Special thanks go to two promoters and the co-promoter. After his return from Australia, Professor Leen 't Mannetje (grassland science) was the stimulating force for white clover research at the Wageningen University. We met in 1987 during a field trip by his scientific staff to the Warmonderhof college farm, where he persuaded me to write a dissertation about our work on white clover. It took more than 10 years for me to answer this question positively and now, after his retirement, I am one of his last 'PhD-students' working on grassland science. I am very thankful for his open mind about organic farming and it is a pity that Wageningen University discontinued the professorship in grassland science, since organic farming has more to profit from a grassland department than from all kinds of attention to biotechnology.
I met the co-promoter Dr. Anjo Elgersma in her function of scientist at the Grassland Department of the Wageningen University. Together we have attended several scientific conferences in Europe and we are both members of the FAO-lowland pasture white clover group. In The Netherlands, we are members of a scientist group on forage legumes, Anjo as the president and myself, at the start of the group, as the secretary. Anjo has critically reviewed the two grassland research topics in this thesis with me. I am very thankful for her clear comments about the rules for writing a scientific journal paper.
The encounter with Professor Niels Röling was in a project called 'The farmer as an experiential scientist' (1995-1998). He was asked to be on the board of that project, because of his long experience in participatory research techniques developed in tropical areas. At the end of this project, I suggested to Niels that I would write a doctoral thesis about the participatory approach combined with my experience as a grassland scientist. I am very thankful for his stimulating thoughts on the core of the agricultural crisis. Although we came from different sides of agricultural society, his and my feelings about agricultural problems, challenges, solutions and threats were very similar.

Professor Ariena van Bruggen has carefully reviewed an earlier version of this thesis and made many suggestions for improvement that I have gratefully used in writing the final text.

I am very thankful to five people who helped me write this document in English. As native English speakers Gill Cole and David Wright, both connected with the New Zealand Bio-dynamic Association, have spent days to improve the written text. Rosemary Martin (Aberdeen) was responsible for several direct translations from Dutch to English. My promotors who have both worked and lived in English speaking environments for many years have devoted considerable time and effort in the final editing of the text. I have experienced that it is not easy to write your thesis directly in a foreign language. Many thanks for all the work you have done.

Last, but not least, I want to thank my family; at first my father Wim and his wife Gery. I am especially grateful for my father's open mind, which allowed me to experience as much as possible in my life as a young adult student in biology. That was the basis for me to get to where I am now. I met my wife, Gerda, in 1981 at the Institute when I did a phenomenological study of milk quality. Our love was formed above the smell of rotting or sour milk. We were the first 'Bolk-marriage' in 1985. We had the same spiritual feelings about life, based on anthroposophical insights into the world. Having such a partner is a very strong basis for doing all kinds of pioneering work. Although she has her own job as a graphic designer, Gerda never was angry when I spent a lot time during the weekends working on this book. Our two children, Brechtje and Jelle, did not experience me much as their father during this last two years. But I have promised to slow down after the completion of this thesis and to be with them in their next years of puberty.

Final motto

A motto from Rudolf Steiner, which have moved me since the first time I heard it and which very much covers the intention behind this doctoral thesis, is as follows:

Seek the really practical material life,
But seek it in a way that will not make you insensitive to the Spirit working in it.
Seek the Spirit,
But do not seek it as supersensible ecstasy through supersensible egoism,
But seek it, because you want to work with it selflessly in practical life and in the material world.
Use the old adage:
'The Spirit is never without matter, matter never without spirit' in this way, that you say:
We want to achieve everything material in the light of the Spirit,
And we would seek the light of the Spirit,
That warmth may be created for our practical activity.

Financial support
This thesis is based on 15 years of experiments and experience. In the thesis, all kind of projects are reported. All projects had different types of financing, because our Institute is still only project-based. Financial support in these past years came from:

- 'De Natuurweide', organic dairy farmers' association
- The Dutch bio-dynamic society
- Private persons giving donations to the Institute
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- Laser, Office of Ministry of Agriculture for demonstration projects
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Ton Baars
October 2002


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BALANCING ORGANIC MILK UREA IN SUMMER

1. Introduction

The present chapter introduces all elements of the doctoral thesis that lies before you. The reflection on my experiences as a researcher, trainer and teacher in organic farming that accompanied its writing made me aware of the transformation of my thinking since I became involved in organic farming. This change is reflected in the discussion, later in the thesis, of objectivism versus positivism and holism versus reductionism in the philosophy of science. To grasp this change, it is relevant to understand what motivates organic farmers and how they think, the background and intentions of organic farming, and to define organic farming as a holistic principle for guiding action. Organic farming is not a static method of farming based on certain recipes. Not only do legal standards and regulations change but also the market and the players in it are constantly changing. Since organic farming has become part of official EU policy, the interest in organic farming is growing. This has led to a rapid change in market development, trading policy and to a more anonymous market. As its volume increases, also the pressure on organic farming increases to become incorporated into markets and institutions that serve conventional farming. At the same time, public research agencies, that have so far served conventional farming, are now entering the field of organic farming. Together these developments imply that both organic farming and the agricultural research organisations that seek to serve it have entered a period of dynamic change. It is appropriate at such a moment to ask which research structure and what kind of research methods best fit the character of organic farming.

This dissertation tries to address these questions. It is based on the author's 20 years of experience as a grassland researcher in a private research institute, the Louis Bolk Institute. The Institute is based on anthroposophical [2] principles. These principles are quite different from those underlying conventional science. To make these principles explicit, I thought it helpful for the reader to briefly describe the transformation I experienced since my graduation as an ecologist. Firstly I shall deal with this personal transformation, followed by a definition of organic farming. There are many different and related practices. I will also describe the pressures on organic farming in the Netherlands in this period of change. These provide an important context and reason for undertaking the research presented in this part of the dissertation (the other part reports on experiments with manure and white clover in grassland). To complete the initial part of the study, I will also give some background on current research in organic agriculture.

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[2] **Anthroposophy is the spiritual worldview based in the insights of Rudolf Steiner (1865 – 1925). See also Chapter 1.1.1.**

1.1. Personal reflections on organic farming research

My 20 years of working with organic farming, were not only as a scientist, but also as an involved partner in research and development (R&D). My personal attitudes and choices were as important as the technical outcomes of studies. Therefore, this thesis will not only reflect on research outcomes in terms of technical findings, but also be a discussion on the role as a partner in transformation processes. In a self-reflective circle of learning, I am an involved *'actor'* in terms of being part of research systems in which subjective choices are made. At the same time I am expected to be an objective '*observer*' of the on-going interactions as a result of this involvement (Figure 1.1) (Alrøe and Kristensen, 2002).

The relationship to the observed object, therefore, has two faces: involved partnership and objective onlookership (Van der Wal, 1997). As I change face, the reality of the observed world also changes due to the change in my position. This realisation leads to the discussion on the difference between a constructed [3] worldview ('a world') versus a positivistic worldview in science ('the world') (Pretty, 1995; Pearson and Ison, 1997; Bawden *et al.*, 2000) later on in the thesis.

I will, at first, describe in general terms my own shift in perspective as I became involved as an 'actor' in the organic farming research projects described in this thesis. These biographical elements hopefully help the reader understand the choices made in this thesis and its

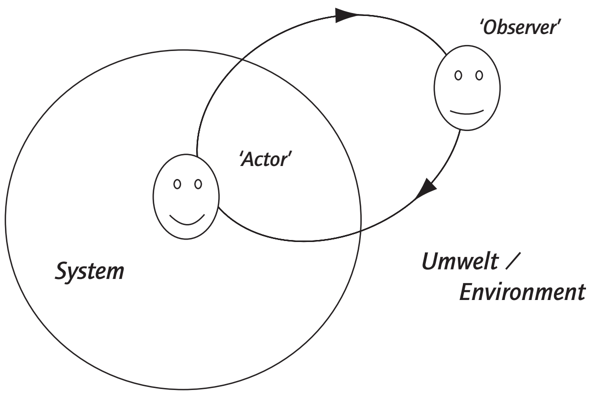

Figure 1.1. The self-reflective circle of learning in systemic research, moving from an inside actor viewpoint, or stance, to an outside observer viewpoint, and back (taken from Alrøe and Kristensen, 2002).

[3] According to Pearson and Ison (1997), a 'construct' is the particular viewpoint or perspective of 'reality' unique to an individual and specific to time and place. A constructivistic perspective is one in which the observer is part of the system rather than independent of, or external to, it.

exploration of the additional research methodologies that are required to support organic agriculture.

1.1.1. Paradigm change

My experiences are based on basic and applied research, demonstration and extension projects in the field of grassland and animal production at one of the pioneering research institutes in organic farming in Europe, the Louis Bolk Institute in The Netherlands. As a research organisation in a new area of farming, the Louis Bolk Institute has accompanied, investigated and answered all kinds of questions raised by organic farmers and traders (Chapter 1.1.4). The Institute has made the choice to carry out its research on farms together with the farm managers who feel responsible for personally realising new approaches in farming. In our exploration of unknown areas of organic farming, we work mainly with farmers who are ahead of the group. Choices for co-operation are based on 'relevance of discovery' and not on the representativeness of the pioneers for the entire population of organic farmers. We work with pioneers who choose their own style of farming, and who have a strong inner drive to explore new, often high risk areas and to develop and fine-tune their management. In the research projects reported in this dissertation, I have respected this co-search process together with farmers as much as possible. Therefore, my relationship with the farmers involved was co-operative and egalitarian rather than a teacher – pupil relationship. Farmers have another kind of knowledge and make other types of observations, which could be described as broad, coherent, connected and holistic [4]. During my experiences, it became clear to me, that farmer and researcher each have a different role in the process of learning and innovation. This allows a co-operation that can be the basis for interactive learning, which we later called experiential [5] science (Baars and De Vries, 1999; Baars, 2001-c; Baars and Wagenaar, 2002; see Chapter 5.2 and 5.3).

Although my responsibility was in the field of grassland and animal production, the interdisciplinary character of Louis Bolk Institute was an important support for a holistic approach to organic farming and nutrition. The anthroposophical background of the Institute made me aware how one's personal attitude and philosophy affect one's choices, action,

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[4] Holism is the perspective that makes the existence of 'wholes' a fundamental feature of the world. It regards natural objects, both animate and inanimate, as wholes and not merely as assemblages of elements or parts. Organisms as biological wholes are not isolated units and they do not exist apart from their surroundings (Smuts, 1929 in Woodward, 2002).

[5] Experiential learning is based on reflection of experiences during action and can be seen as part of an epistemology of action. In that sense it can be distinguished from experimental learning based on experimental design that is part of an epistemology of knowledge. Of course, experiments also lead to (contrived) experience. Experiential learning, as I use it in this dissertation, refers to the learning that occurs in a complex field situation and that focuses on developing 'systems that work' instead of on establishing causal relationships. Experimental science can provide important inputs into experiential learning.

observations, learning processes and judgements. Exposure to the spirituality and worldviews or cosmovisions that underpin agricultural and health practices in many non-western countries made me aware of cultural diversity and affected my own convictions (Haverkort and Hiemstra, 1999). Anthroposophy introduced me to new concepts that were necessary to create scope for solutions of problems organic farmers mentioned. The strong side of anthroposophy for me is that it is a comprehensive and inclusive philosophy that gives one an additional perspective on all areas of life and living. Personally I was highly affected by new insights into evolution, the relation of spirit and matter, and the role of man in nature as more than a mere coincidence in evolution (Mees, 1984; Verhulst, 1994; 1999). Anthroposophy is practised in architecture (Alberts, 1990), medicine, science (Bockemühl, 1985; Seamon and Zajonc, 1998), education, religion, agriculture (Steiner, 1924; Klett, 1985; 1992; Beekman and De Jonge, 1999), the arts, economics and social life (Brüll, 1984).

I received my research training as an ecologist in grassland biology and landscape ecology at Utrecht University [6]. The tensions between objectivity versus subjectivity and reductionism versus holism were personally brought home to me during a two-year training course in bio-dynamic [7] farming in 1979-1980. This course was additional to my training as a scientist/ecologist. During these two years, I was most affected by the training in the philosophy of science and by the biology curriculum. This new biology was taught as phenomenology [8] and not discussed in terms of physics and chemistry, based on mechanistic and reductionistic explanations. I became aware of holistic levels of integration of life and of the entelechie (see below) of life. In the area of holistic life sciences, researchers were exploring new methods to directly visualise these life forces. These methods included picto-morphological methods, such as the use of crystallisation and chroma pictures (Anderson *et al*., 1998; Ballivet *et al*., 1999), and later delayed luminescence (Van Wijk and Van Aken, 1992; Bloksma *et al.*, 2001; Köhler *et al.*, 2002). During the two-year course, I learned to observe plants and animals in terms of life processes, meaningfulness and as an expression of a vital force (Bockemühl, 1980; 1985; Schad, 1977;

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[6] Dr. Jacques de Smidt was an important inspirator of my ecological thinking. He was a pioneer in the analysis of the relationship between ecology and farming (De Smidt, 1973), which inspired me to think in terms of processes and development (Baars, 1990 b). Due to his specialisation in heather ecology he was interested in mineral cycling of agro-ecological systems (De Smidt, 1978), which I have used later for my own research in farm mineral balancing (Baars, 1991; 2002 c).
[7] Bio-dynamic farming is a practical translation of anthroposophic principles into agricultural practices. Bio-dynamic farming is one of the 'blood groups' in organic farming.
[8] Phenomenology can be understood in two ways (1) The first interpretation stresses on the holistic observations: direct observation of the life cycle of the observed by using all senses and without use of instruments and (2) Mentioned as Goethean phenomenology or Goethean science, which in connection with the first point reflects the understanding and interpretation of phenomena as an holistic entity.


... action based on animal integrity: in an attractive chicken run there are plenty of places for a hen to hide ...

1985). All these aspects could directly be observed or taken from the living creature as a whole. Due to this new worldview, I explored new terms such as coherence, interaction and development over time, but also intrinsic value [9] and the living creature as a being. This transformation of my thinking affected the rest of my scientific life. It can be summarised by saying that I became aware and accepted the premises of Goethean science [10], and the implicit relationship between spirit and matter and the need to integrate the philosophy of science and ethical questions.

The transformation that resulted from participating in the course described above was confirmed by insights gained into the process of conversion that farmers experience when they embrace organic farming. It became clear that farmers experienced this conversion as a complex inner change that can justly be called a paradigm shift (see also: Briones *et al.*, 1996; Wijnen, 1997; Østergaard, 1998). During conversion, the farmer not only experiences an adaptation of concepts, mentalities and actions, but also a change in his social environment. These changes often require a process of between four to seven years to structure a new and integrated way of anticipating and acting that arises out of the new holistic thinking. Comprehensive management at the right time and the right place turns out to be an important quality of this new skill. A good example is a study of the behaviour of beaked chickens (Bestman, 2000; 2002). Although the study looked at chickens, it became clear that farmers could not manage large numbers of chickens whose beaks had not been blunted without an inner transformation. Farmers who had not experienced this transformation kept asking for symptomatic and technical, instead of systemic solutions, and could not follow the organic principles of animal welfare and integrity [11]. Such farmers only reacted on the symptoms of cannibalism and feather pecking without

[9] Intrinsic value is the value of the object or organism of itself and is used in contrast to instrumental value, which is the value an object or organism has for people's purposes.
[10] Goethean science is the study and comparison of morphological and biological phenomena in order to establish the characteristics of their relationships, what they have in common and in what ways they are different (Van der Bie, 2001).
[11] integrity is the inalienable intrinsic value of the being, based on its needs. Integrity can be seen as uprightness, as the state of being, whole, entire or undiminished.

... norm versus reality: sufficient surface area in the run complies with the standard, but unfortunately it is not used ...

considering their own role as a manager of man-animal relationship and without considering the specific needs of chickens, their housing and rearing.
Although I have experienced the power of a positivistic research strategy (see the case described in Chapter 5.1), I have come to accept that there is also a subjective aspect of a research project that has its impact before and after the measurements are made. As Pretty (1995) put it, *'the problem with the positivistic paradigm* [12] *is that its absolutist position appears to exclude other possibilities'.* One's perception of truth very much depends on one's point of view and on the context in which one is working and these elements are not paid attention to in the positivistic paradigm.

1.1.2. Philosophical reflections

The scientific methods in which I was trained during my university education were based on a philosophical choice. For four centuries, Western science has been based on philosophies of Descartes and Kant whose approach to biology reflects the ideas of Bacon and Newton and a mechanistic and mathematical interpretation of nature. The Cartesian paradigm commonly is called positivism or rationalism. In Pretty's words (1995): '*this posits an objective external reality driven by immutable laws. Science seeks to discover the true nature of this reality, the ultimate aim being to discover, predict and control natural phenomena. Knowledge about the world is summarised in the form of universal, or time-free and context-free generalisations or laws. The consequence is that investigation with a high degree of control over the system being studied has become equated with good science. And such science is equated with 'true' knowledge'.*

The discussion on positivism and objectivism is closely related to the discussion on holism and reductionism. In his dissertation on philosophy about holism and reductionism in biology and

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[12] **Paradigm is the set of principles, assumptions or the framework underlying theories and models, comprising epistemology, methodology and ontology.**

ecology, Looijen (1998) distinguished between epistemological [13], ontological [14] and methodological [15] aspects. Distinguishing these three aspects is helpful for positioning worldviews in science and for becoming aware of the self-imposed limits of science due to agreements within the scientific community.
Looijen (1998) said that *'in the epistemological discussion, reductionism in its extreme reduces biology as a whole to chemistry, and chemistry to physics as the unity in science. Laws in nature can be reduced to fundamental theories of physics. Holists deny this possibility to reduce biological wholes to physico-chemistry. They defend the autonomy of biology with respect to chemistry and physics'.* The claims of both reductionists and holists appear to be based partly on ontological and partly on methodological arguments. However, Looijen (1998) considered the ontological differences less relevant. *'In relation to ontological aspects most biologists, reductionists and holists alike, are in the first place 'materialists'. That is, they assume that nature is entirely and exclusively made up of 'material' substances and forces, where 'material' is meant in the sense of modern physics. Both holists and reductionists are 'causal determinists'. Disagreement in biology appears with respect to the role of functional explanations (holism) versus causal explanations (reductionism). Another disagreement is the way in which the principle works.* However, Looijen (1998) also mentioned a minority of scientists who claimed that animate nature was different from inanimate nature: *'Most scientists developed a resistance to any idea of a non-material force, entelechie or 'soul', which would distinguish animate from inanimate nature'* [16]*.* Ontological reductionism finally becomes atomism that assumes that biological structures are composed of, and have developed from, physico-chemical structures, and that therefore the former must be causally determined by the latter. Both holists and reductionists agree on the principles of evolution. Holists, however, point to the emergent aspects of the evolutionary process: new structures and forms having new, 'emergent' properties. Emergent properties are generally considered to be 'irreducible' and can be applied to all levels of organisation. Organicism is the view that living organisms are complex, hierarchically structured wholes, whose parts are functionally integrated in and co-ordinated by the whole. The causal influences from the whole are thought of as integrated and co-ordinating actions on its

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[13] Epistemology: the branch of philosophy that deals with the varieties, grounds, and validity of knowledge (Oxford Interactive Encyclopaedia); the way the knowledge is embodied in theories, and to logical relations between theories (Looijen, 1998).
[14] Ontology: The science or study of pure being; that part of metaphysics which relates to the nature or essence of being or existence (Oxford Interactive Encyclopaedia); the relation to the entities, things or substances that are assumed to constitute nature (Looijen, 1998).
[15] Methodology: the way of acquiring knowledge related to the principles, rules and strategies used in acquiring it (Looijen, 1998). Looijen distinguishes between methodology as method of research (scientific method) and methodology as strategy of research.
[16] A description of how plant growth is accompanied by immanent forces is found in: Van Romunde (1998).

component parts. The whole itself is part of an environment present or a larger whole. In methodological respect, reductionism is a very common effort both in science and in everyday life to reduce complexity. *'Reductionists are mechanicists, when they try to understand phenomena at the level of the whole to study causal mechanisms at lower levels of its constituent parts. Holists say that in order to understand the whole, one must not (only) study its component parts, but (also) the whole itself as well as the larger whole of which it is itself a part. Reductionism is directed downwards and associated with analysis, holism is directed upwards and associated with synthesis.'* Looijen (1998) described how scientists chose different research strategies. Holism and reductionism can become intertwined, depending on the way positions are decomposed into their epistemological, ontological and methodological dimensions.

Following Looijen's (1998) arguments, I will, in this thesis, take a specific position with respect to agricultural science. I assume holism with respect to all three elements of the scientific paradigm: ontology, methodology and epistemology. All levels of organisation in life are interesting and the explanations of research findings and the correlation between observations should be considered from a holistic point of view, because of the emergent properties at higher levels of integration. Life is too complex to ultimately be reduced to physico-chemistry. In the methodologies applied reductionistic measurements have to be an integrated part of a holistic approach.

1.2. Organic farming: its character

In the present Chapter, I will try to define organic farming and its different blood groups. Chapter 3 will present additional information on the history and development of organic farming.

In the Netherlands, organic farming is the umbrella term for both ecological and bio-dynamic agriculture. In the EU, organic agriculture is the legally protected term for a specific method of production. Organic farming must be seen as a second-generation development. It is not the same as the traditional farming systems that have evolved over often thousands of years before the advent of chemical industry, mechanisation and global marketing. Organic farming is a reaction to the modern developments in mainstream farming, especially in industrial countries. Hence organic farming emerged as a kind of protest movement around the 1920s. In recent history, several basic innovations have been introduced into farming, such as chemical fertilisers, large-scale mechanisation, the co-operative movement and, after the 1950s, chemical protection against pests and diseases (Bieleman, 1992). These innovations completely changed the nature of agriculture because of the possibilities they offered to standardise all kinds of agro-ecological farming situations.

The invention of organic farming was not the only reaction to industrial agriculture. For example, as a reaction to the use of pesticides that accumulate in the food chain, for ever associated with Rachel Carson's 'Silent Spring' (1963), ecological approaches to pest management were introduced as a first step in integrated production (Gruys, 1970; Van der Fliert, 1993). This gradual 'ecologisation' of conventional farming led to so-called 'integrated production' as a 'modern way of conventional farming' that is based on the economic integration of ecological and technological knowledge (Van der Weijden *et al.*, 1984). As all agriculture, integrated production does not constitute a fixed set of techniques. Newly developed methods and techniques are used to find a balance between conflicting goals in agriculture, economics, environment, health, nature and landscape. Examples of integrated farming are the production systems for dairy and mixed farming respectively that have been developed on the experimental farms De Marke and Minderhoudhoeve (Aarts, 2000; Lantinga and Van Laar, 1997). As a matter of principle, integrated farming does not reject technical or artificial solutions.

Although many aspects of integrated farming are also applicable to organic farming, the latter adheres to the complete rejection or prohibition of a number of practices. For instance, artificial fertilisers, chemical pesticides, embryo transfer and genetic modification are not allowed in organic farming (Schmidt and Haccius, 1998). Therefore, at the farm level, there will sometimes be a gradual, but more often a fundamental difference between integrated and organic farming. Although both methods use ecological principles, organic farming involves a complete change of thinking and acting. The focus in organic farming is principally oriented to preventive management, adapted and resistant breeds and races and long-term investments.

In comparison to many developing countries, agriculture in industrial countries does not retain many elements of traditional farming. Organic farming can definitely not be seen as the continuation of traditional farming, based on the conservative refusal of farmers to modernise. Of course, many traditional practices can be very relevant to organic farming because traditional farming represents thousands of years of experimentation and learning in the absence of chemical solutions by people who had to live by the results. Organic farming is 'modern' in that it can be strongly supported by modern science, although its principles voluntarily restrict the implementation of certain methods and materials. Knowledge about the functioning of ecosystems, pest ecology, soil-plant-animal-relationships are very relevant for organic farming. In addition, standards in organic farming will be expanded, refined and renewed on the basis of the emergence of ethical principles from public debates on food safety, food security, the sustainability of food production, and other issues, that regularly arise in industrial society as it tries to cope with the threats to essential ecological services.

Due to their ethical convictions, organic farmers voluntarily restrict their management options (Lampkin, 1990; Gerber *et al.*, 1996), and the extent of the intensification and specialisation of their farming. Organic farmers deal with complex issues (different integration levels), multi-factorial problems (depending on the context), sub-optimal solutions (depending on their self-chosen objectives), site-related adaptations and with issues that are beyond the immediate control of the farmer. Many site-adapted options appear to exist for solving problems that seemed unambiguous at first, depending on the farm situation and social context (Baars and De Vries, 1999; Van der Burgt and De Vries, 1998). It can even mean, that agricultural or economic problems are solved by sociological approaches instead of by finding technical agronomic answers [17]. A shift to organic farming makes increased demands on farm management, farmer involvement and farming skills.

1.2.1. Definition, principles and standards of organic farming

The Nordic Platform (= umbrella of the Nordic organic associations) states the following definition of organic farming (Alrøe *et al*., 2001). This definition is formulated in terms of idealistic principles, and reflects the international IFOAM (International Federation of Organic Agricultural Movements) standards (2002): *'Organic farming is conceived as a self-sufficient and sustainable agro-ecosystem in equilibrium. The system is based as far as possible on local, renewable resources. Organic agriculture is based on a holistic view that encompasses the ecological, environmental, economic and social aspects of agricultural production, both in a local and global perspective. Thus, organic agriculture perceives nature as an entity which has value in its own right; human beings have a moral responsibility to steer the course of agriculture such that the cultivated landscape makes a positive contribution to the countryside.'*

Woodward (2002) mentioned three schools of thought, the bio-dynamic or anthroposophical school of Steiner, the Organic-Biological School of Muller and Rusch and the Organic School of Howard and Balfour. World-wide, the practice and philosophy of modern organic farming are based on at least 50 pioneers, people who were dealing with special aspects of agriculture, health, food quality, nature and socio-economics (Lünzer, 2000; Vogt, 2000). The first pioneers in organic farming (1920s-1940s) were largely motivated by idealistic goals, based on holistic principles, spiritual and intrinsic values and concern about food quality (Pfeiffer, 1970; Vogt,

[17] For example, the incredible increase of land prices in the last decade strongly has restricted the application of the principles of closed mineral cycles. On purely financial grounds, it is not economically sustainable to grow concentrates on such expensive land so that farmers buy cheaper concentrates produced elsewhere. Current land prices frustrate the development of organic farming in all sectors.

2000). In the 1960s and 1970s, the ecological concerns and fears about environmental problems, nature degradation and future energy supply, led to an increasing interest in organic farming and to the first impulse for the growth of the sector (Gerber *et al*., 1996). In the 1990s, organic farming approached adulthood, when governments supported price premiums for organic produce and conventional retailers became interested. These developments led to a new and exponential growth of the organic market [18] (Gerber *et al.*, 1996).

Although there are some highly significant differences between the three schools of thought (Woodward, 2002), from the work of these pioneers in organic farming, a set of objectives can be described that cover the main aspects of organic farming in general. Lund and Röcklingsberg (2001) confirmed that the values adhered to in organic farming today were established by people in the early organic movement. These authors derived the following core values of organic farming from the IFOAM standards (IFOAM, 2002): (1) Aim for a holistic approach; (2) Aim for sustainability; and (3) Respect for nature. These general values have been implemented in objectives and have found their expression in restrictive standards defined in terms of allowed levels and prohibitions (IFOAM, 2002, EU-regulations 2092/91 and SKAL-regulations, 2002). The objectives of organic farming were summarised by Gerber *et al*. (1996), Niggli (2000), Woodward (2002) and reflect the international IFOAM-standards (2002). Organic farming:

- minimises the use of non renewable resources, including fossil energy; and uses strictly naturally derived compounds, resources and physical methods for direct interventions and control (with only few and listed exceptions);
- maintains and improves soil fertility through a 'living soil [19]', which is the starting point for a healthy system;
- respects and enhances production processes as far as possible in closed cycles [20] to be responsive and adaptive to its own environment; avoids environmental pollution as much as possible, and develops a land and landscape-related farming system;
- establishes links between soil, plant and animals to constitute a whole system with a dynamic

[18] At the time of writing both the UK and Denmark experienced a surplus in the market for organic milk. This strongly affected price premiums. Given the international nature of the market, this in turn affected the rate of conversion to organic agriculture in the Netherlands (personal communication P.Boons, president of the Natuurweide association of dairy producers).

[19] Eve Balfour created widespread awareness of these issues through her book 'The living soil' (Balfour, 1946). Together with Albert Howard she was one of the philosophers behind the organic movement in Anglo-Saxon countries (Lampkin, 1990). Their approach to soil fertility was based on the improvement of soil structure by means of plant composts. The notion of a living soil leads to the practice of 'feeding the soil' instead of mineral fertilisers that can be directly taken up by plants.

[20] Closed cycles refer to the flows of minerals through soil, plant, animal and manure within a mixed farming system. The term 'closed' is not entirely accurate. Cycles are open for N fixation by legumes and release of nutrients by export of products from the farm, erosion and weathering of the soil. In organic farming some well described rock minerals are allowed as external farm inputs.

that is yet to be understood;
- develops a diverse landscape based on cultural diversity, and local agro-ecosystems;
- stimulates and enhances self-regulatory processes through system, habitat, and species diversity and through locally adapted breeds and cultivars;
- improves animal husbandry based on the natural behaviour and the needs of the domesticated animal (derived from the concept of 'animal integrity');
- produces healthy food with a high qualitative value. The discussion of what constitutes a high qualitative value is accompanied by a search for more abstract concepts and principles (for instance 'vital quality') and new methodologies (Meier-Ploeger and Vogtman, 1988; Bloksma *et al.*, 2001);
- considers the wider social, ethical and ecological impacts of farming (linked, for example, to the ideal of a fair-trade economy (Roozen and Van der Hoff, 2002; Klein, 2000)).

Such objectives can be given different accents in different EU countries and by the different organic movements (Schmid, 1999). The harmonisation of EU standards (EU 2092/91; Schmidt and Haccius, 1998) led to a list of minimum restrictions for the organic farming practice. In The Netherlands these standards are controlled by SKAL, the organisation that seeks to maintain organic standards. Due to the need for harmonisation within the EU, regional differences between systems are hardly allowed.

As can be gleaned from the discussion in the above section, wide consensus exists with respect to what constitutes organic farming. Bio-dynamic farming which seeks to implement anthroposophic principles in farming practice distinguishes itself from other blood groups by its emphasis on life forces which are believed to play a key role in agriculture, i.e., agriculture is not just a matter of physical, chemical and even biological (in the sense of genetic and evolutionary) processes. This emphasis on life forces adds relatively minor additional considerations with respect to the objectives and especially the practices followed in organic farming. The key differences are:
- the emphasis on the farm- and site-specific nature of farming. The farm is seen as a living entity on its own;
- the use of methods to identify and manage life forces (e.g., the use of certain compounds in compost making);
- the emphasis on the intrinsic nature of beings and their integrity, and the effort to understand these through e.g. Goetheanistic approaches.

These relatively small differences are additional to the bulk of the standards that define organic agriculture in general. Throughout this dissertation I will use the term organic farming to refer to the broad set of widely shared standards, and not specifically to those used in bio-dynamic farming. When I come to analyse my own research projects to tease out the specific nature of the research approaches and methods that can support organic farming (Chapter 5), I shall try to make clear where and how anthroposophic principles affected my practice.

1.3. Organic farming: threats, obstacles and uncertainties

Verhoog *et al.* (2002 a and b) contended that although organic farming is diverse, there is a tendency in society and politics to push organic farming towards uniformity. The main focus is on general public concerns about environmental pollution, food safety and the natural origin of food additives (see Chapter 3.4). Consumers have a strong belief that organic food is healthier, less polluted and more natural, than conventionally produced foods. This motivates the rapid industrialisation and commercialisation of organic food production (the 'Organic-Industrial Complex'), especially in the USA (Pollan, 2001). Pollan claimed that the way of thinking behind the industrialisation process is very conventional. The aim is to produce uniform organic products that have to be substantially processed to be able to transport them over long distances. The organic produce can be processed, except for the fact that natural additives are used instead of artificial flavours and substitutes. This leads traders and processors to alter the standards to allow all kinds of 'natural additives'. To the consumer, organic farming is presented as a small, but healthy change. Organic produce is very similar to conventional produce, except for the fact that the (many) ingredients should not be artificial. Retaining organic farming as a truly alternative approach to integrated and environmentally friendly production requires political support based on the improvement of farming system ecology and life integrity. These notions would also have to be incorporated in research to support the development of organic farming (Chapter 3.4).

Organic farming is now at a very critical point in its development. The Dutch Government is stimulating organic farming to grow to a level of 10% of total agricultural area in 2010 (LNV, 2000), a large increase compared to the 1.5% in the year 2001. This stimulation takes the form of a new market infrastructure, support for advice and training, subsidies for covering the first two years of conversion, and support for R&D. This rapid expansion and the presumably large numbers of converting farmers raise questions with respect to the nature of the conversion that the converters experience and the nature of the organic principles that they will follow. There is the not imaginary threat that organic farming will be reduced to an improved system of integrated farming that is among others caused by:

- insufficient holistic regulation to support organic principles. This leads to contradictions between the reality of the farm economy and the identity of organic farming. Adequate economic alternatives are absent and economic incentives are too oriented on the short term;
- the innovations in organic farming promoted by the new generation of traders and processors is based on too low standards and does not reflect its holistic principles;
- regulations and state legislation covering conventional farming are oriented on symptoms and therefore come into conflict with holistic solutions;
- the nature of scientific support and advice given is not based on an inner conversion of the scientific community.

I expand on some of these issues because they are important for understanding the new context within which research in support of organic agriculture is expected to work.

Scaling up of its share of the consumer market is a necessary next step in the development of the organic sector. The question can be raised how the innovative elements and holistic views of organic farming can be retained by the new generation of farmers, scientists, traders, politicians and extensionists. The inner conversion to organic ideas is a time consuming process. For instance, the effort to create a new type of agricultural professional for Australian agriculture in the so-called Hawkesbury experiment took almost 20 years. (Bawden *et al.*, 2000). *'Clearly a praxis that is truly systemic, has to embrace learning competencies that accommodate the ethical along the technical, the aesthetic along the practical, the spiritual along with the rational'.* Exactly these aspects are also part of the conversion to organic agriculture.

In our economy, the distance between consumers and producers has become larger and the anonymity of products has increased. Players in the organic market are rapidly changing from involved pioneers to companies with multinational activities (Chapter 3.2). The same price squeeze that threatens the survival of conventional farms is felt in organic agriculture. Each year brings new pressures to reduce costs, to increase efficiency and to scale up farm size. To maintain farm income, the farm structure also in organic farming has changed from farms with closed mineral cycles to more specialised, simple structured farms with a high production per animal and per land area, still within, but challenging the constraints of EU 2092/91[21] (Baars and Van Ham, 1996). The economic room for making the conversion to organic farming or for maintaining a certain standard quality of farming system is becoming smaller (Chapter 3.3).

[21] Schlüter (2001) showed the differences between the bio-dynamic principles and the EU-standards. For instance in the EU-standards there are no restriction on inputs of organic fodder; 10% of the fodder purchase can be conventional; and cattle can be fed with 40-50% of concentrates.

An adequate regulation that reflects the identity of organic systems in a growing market is very important (Vogt, 2001). In several areas, regulatory development still does not support the principles of organic farming. In the past, at first restrictive guidelines were established for manure use and plant production. Later on, regulations were developed for animal production (EU regulation 2092/91). At present, a discussion has been started about standards for animal welfare (Alrøe *et al.*, 2001; Lund and Röcklingsberg, 2001; Spranger and Walkenhorst, 2001), about the origin and type of breeds (Nauta *et al*., 2002) and about seed production techniques (Lammerts van Bueren *et al*., 1999; Lammerts van Bueren, 2002 in prep.). But it is not only the lack of suitable guidelines for specialised issues, such as animal health and welfare that is frustrating the intentions of organic farming (Keppler, 2001). Adequate standards are necessary also with respect to more holistic issues such as the nature of mixed farming systems (Schlüter, 2001), bio-diversity and landscape (Bosshard, 2001), socio-economic conditions (e.g., labour quality, fair trade and ownership and price of land) and 'values of scarce commodities' (e.g. wildlife, fresh air, clean water). Since market prices are determined by supply and demand, issues such as produce quality, regional production or closed mineral cycling are not accounted for in the prices of organic produce.

Taking organic farming as an integrated solution to agricultural problems would not only imply a change in technology, but also a change in the socio-economic network in which agriculture is embedded. From the point of view of organic farming, the new mid-term review of the EU's Common Agricultural Policy (CAP) only provides an opportunity to give political support for another view of the market that will cut the link between production and direct payments. In addition to supporting farm incomes, CAP will also reward farmers for food quality, animal welfare, the preservation of the environment, landscapes, cultural heritage, and the enhancement of social balance and equity[22].

1.4. Changes in R&D of agriculture

Sustainable agriculture is knowledge-intensive. Organic farming has expanded the horizons of agricultural practice. It is questionable, therefore, whether the methods, techniques, social approaches and organisation that have been used in agricultural research and extension to intensify conventional agriculture are suitable to support organic farming (Röling and Jiggins, 1998). It is clear that organic farming calls not only for new knowledge and techniques, but also for new attitudes, socio-economic behaviour and mentality in farm practice and in science and advice. With regard to systemic development, Bawden *et al.* (2000) described the reform of the

[22] **EU press release July 10, 2002: Towards sustainable farming - Commission presents EU farm policy mid-term review.**

agricultural curriculum at the University of Western Sydney. The evolution of methods of research and extension has been described for the developing countries (Chambers, 1992) and also for integrated farming (Vereijken, 1992; Somers and Röling, 1993; Proost and Röling, 2000). Table 1.1 summarises the development of research and extension.

Table 1.1 Research and extension: some dominant beliefs and approaches 1950-2000 (after Chambers, 1992)

	Explanation of non-adoption	**Prescription**	**Key activities**	**Focus of socio-economic research**	**Methods**	**Label**
1950s 1960s	Farmers' ignorance	Extension education	Teaching, transfer of technology	Diffusion of innovations, determinants of adoption	Questionnaire surveys	Diffusion research
1970s 1980s	Farm-level constraints	Removal of constraints	Input supply, adapted approaches	Constraints; farming systems	Questionnaire surveys, on-farm research	Farming system research
1990s	Inappropriate technology	Farmer participation	Facilitation of participatory processes	Participatory approaches and methods	Discussion observation, diagramming by and with farmers	Farmers participatory research, Participatory Technology Development, farmer-first, PRA[23] , etc.
>2000	Inappropriate policies, failure of market forces and technological fixes	Multi-stakeholder learning	Facilitation of discovery and learning	Multi-stakeholder situations, Interactive learning	RAAKS [24], stakeholder meetings, platforms	Social Learning

Röling (2000) mentioned three driving forces behind the development of industrial agriculture and the role of science in it: (1) Science is the source of agricultural innovations. These innovations address component technologies and have been developed on the basis of positivistic and reductionist practices aiming at gaining control over nature. (2) The 'Agricultural Treadmill' (Cochrane, 1958; Röling *et al.*, 1998), which creates a constant price squeeze. Each technical innovation gives its early adopters an economic advantage and creates pressure on

[23] PRA = Participatory Rural Appraisal (Röling and Wagemakers, 1998)
[24] RAAKS = Rapid Appraisal of Agricultural Knowledge Systems (Engel, 1997)

others to follow suit to stay in the income race. (3) A continuum of organisations is required which covers the whole field from basic research to application, which delivers science-based technology to 'ultimate users'. Kline and Rosenberg (1986) called this approach the 'linear model'. Of course, the practice of research and extension often differed from this model, but policy, public investment, and development assistance were based on it (Hubert *et al.,* 2000).


... farmer participation in the Farmer Field School approach ...

It is fair to say that the explicit resistance against this model started in developing countries. It soon became clear that Western technologies and farm management approaches could not be used as blueprints in the sometimes very complex farming systems in those countries. Therefore, other ways of developing technology and of learning to improve farm situations had to be invented. A typical example is the Farmer Field School which was developed for Integrated Pest Management (IPM) in rice in Asia, after it became evident that so-called Green Revolution rice production technologies and especially pesticide use induced pest problems that threatened food security in countries such as Indonesia. The Farmer Field School approach is now used for a wide variety of farm situations, crops and problems. An unexpected side effect of the Field Schools, based on farmer experimentation, discovery learning, discussion in farmer groups, etc., is that farmers gain pride, no longer consider themselves as helpless peasants and begin to develop their own organisations to solve their own problems (Röling and Van de Fliert, 1998). This human factor has been an important starting point for sustainable bottom-up development (Hagmann *et al.*, 1995).

Another example of the adaptation of the linear model in developing countries as the 'discovery' indigenous knowledge. One of the first times this happened was when Norman (1980) and his colleagues in Northern Nigeria started to ask themselves why farmers adjacent to the experiment station refused to adopt mono-cropping. A study of multiple cropping as practised by local farmers revealed that the local practice provided better protection against the risks emanating from unpredictable rainfall, provide better pest control, used the scarce production factor of labour at peak times more efficiently, gave a higher yield per hectare and brought more profit

both per person-day and hectare. Such discoveries led to the development of approaches that involved farmers in technology development (e.g., Pretty, 1995; Waters-Bayer and Bayer, 2000). Also in the 1970s, it became clear that the extent to which project impact proved sustainable was directly related to the extent to which the beneficiaries participated in and felt committed to the project.
Several guides for participatory approaches and for participatory technology development have now been published (see for instance: Mutsaers *et al.*, 1997; Selener, 1998; Van Veldhuizen *et al.*, 1997). Sumberg and Okali (1997) remarked in their overview of the literature dealing with indigenous agricultural experimentation and innovation: '...*both farmers' experiments and much formal experimentation aim to develop practical solutions to immediate problems or to seek gains within the context of proven production methods and systems. Both are largely experiential and iterative, combining experience, observation (both methodological and opportunistic), intuition, persistence, skill and luck....'*

Facilitating sustainable farming systems means active creation of local knowledge through discovery learning and inter-subject social learning (Röling and Brouwers, 1999). The focus changes from techniques to the management of ecosystems and insight into processes. In a focus on learning, it is not so much the end result and the exact answer that matter, but the process of the search for your own solutions and development (Bawden *et al.*, 2000). The process of co-learning combines academics, teachers, facilitators and farmers within a team. Østergaard (1997) mentioned two basic expansions of the traditional role of the agricultural researcher as the producer of knowledge. *'There will be a need for methods and structures which enable farmers to become co-researchers and learners. Secondly there is a need for developing 'flexible tools' – methodologies adaptable to the individual situations on farms with regard to human, climatic and economic conditions. The farm can become a place of mutual learning where concrete problems and challenges in concrete situations form the common task for the learning among farmer, advisor and researcher.'*

Approaches using such principles are rapidly becoming mainstream, also in industrial countries (e.g., the Landcare movement in Australia). In the Netherlands typical examples are the introduction of integrated farming (Somers and Röling, 1993; Proost and Röling, 2000) and the VEL-VANLA project (Verhoeven and Van der Ploeg, 2001). In terms of the philosophy of science, the development described means that R&D is incorporating a greater attention to systems (i.e., moving from reductionism towards holism) and accepting that 'realities' other than the scientific reality matter (i.e., changing from positivism towards constructivism) (LEARN group, 2000). In The Netherlands on-farm research with farmers has only emerged in an approach that seeks to prototype farming systems (Vereijken, 1992; 1995; 1997; Wijnands, 2000). There also is a much greater interest in interdisciplinary research approaches to farming systems (Aarts, 2000).

Organic farming with its emphasis on farm- and site-specific development, on holism and on interaction with pioneering farmers and problem owners has, from the start, experimented with approaches that reflect a recognition of the farming system and that are what one would now call 'participatory' (see Lockeretz, 1991).

1.4.1. R&D discussion in organic agriculture

The current mainstreaming of organic farming is now supported by governmental policy. Where research in support of organic farming was once only carried out by private research institutes and initiatives, now, all over Europe, research in organic farming is being taken up by existing public institutions and universities, and supported by national governments (Niggli, 2002). The research approaches and methods that are used in the new situation have remained implicit. The point of departure of this thesis is, therefore, to explore whether organic farming, by its very nature, requires different R&D approaches and methods.

I am not the only one concerned with this issue. At the IFOAM meeting in Canada, Köpke *et al.* (2002) launched an International Society of Organic Farming Research out of concern that the principles of organic concept might be diluted if many disciplinary research activities are undertaken that have not been properly grounded on these principles. However, older networks also dealt with these issues. A European network of bio-dynamic researchers, who annually met in the period 1980-1990 (among others Bockemühl *et al*., 1992), discussed principles and differences of research methodologies and strategies between conventional and organic farming research. Recently a group of researchers in organic farming initiated a discussion on the need for new or additional methods of research and extension in organic farming (Krell and Zanoli, 1999; Zanoli, 1998). Key words with regard to methodologies used in R&D in organic farming identified in this group are (Krell and Zanoli, 1999): on-farm research, participatory research, tailor-made decision support, case studies, pilot farms, prototyping, decision-support tools, farming systems, whole-farm studies, demonstration farms. All these terms show an interest in additional research methodologies and ask for strategies that integrate basic and applied research and extension.

One can suggest several reasons why on-farm research is still not generally applied in organic farming. Lockeretz and Stopes (1999) discussed the problems of on-farm research on organic farms. Reasons why such research seems very dissimilar to conventional agricultural research from a methodological point of view are: '*realistic (complex and integrative) management of the experimental area conflicts with traditional criteria for good experimental design, because many more variables come into play. In traditional research, only a few variables are considered relevant and all others are carefully controlled at their ideal values. Otherwise, analysis of the data becomes difficult and it may become difficult to pin down the phenomenon of interest. On-farm research is difficult to analyse because it allows more complexity, but is more complex because it is more realistic'.* Earlier I have remarked that such farm research is probably more appropriate for developing 'systems that work' than for establishing causal relationships.

Evaluations of research programs in organic farming (Lund, 1998) or abstracts and papers presented at scientific conferences in organic farming (Lockeretz, 2000), showed that over 90% of organic farming research hardly differs from conventional research. The majority of projects discuss only one component of a farming system and only a few outcome variables are included. There was little evidence of interdisciplinary approaches or of participation by farmers. The main difference is the *topic* of study, not *how* it was studied (Lockeretz, 2000). Although Lockeretz did not explain the reasons for his findings, he suggested a moratorium on the use of the words 'holistic' and 'system-approach' in discussions about research methodologies in organic farming. I believe that such a moratorium would be a mistake. In the first place, organic farming research, as practised, especially now that so many conventional researchers are entering the field of organic farming research, might not be the best guide for what such research could or should be, given the intrinsic character of organic farming. I shall, of course, discuss this issue in greater detail during the rest of this thesis. In the second place, Lockeretz' findings can give a biased picture for a number of reasons:

- In order to have their papers accepted by mainstream peer-reviewed journals researchers choose to communicate their findings in terms of accepted research methods. Journals ask for a traditional evaluation of findings, based on statistics and quantification of measurement. Integrated studies of systems are classified as 'case studies ', the lowest category of studies in terms of scientific rigour and predictive power (Vandenbroucke, 1999);
- Researchers in organic farming are likely to communicate their more holistic and participatory work in other journals, mentioned as grey literature (Dororszenko, 2000) and farmer-oriented magazines (e.g., 'Ekoland' (NL) and 'Ecology and Farming' (IFOAM)). Even then, results based on participatory approaches often are only reported in terms of their 'hard science' results and neglect the 'soft' dimensions, such as the critical learning involved, and the roles of attitudes, ethics and reflection. Holistic methods in biological research, such as picto-morphological methods and Goethean science are considered non-scientific by mainstream science. Results from such studies tend to be published in 'alternative' journals (e.g., 'Elemente der

Naturwissenschaft' (CH)).
- Holistic systems that seek to integrate the contributions of different disciplines are hard to investigate, time consuming and depend, naturally, on the input of researchers working in different disciplines (see for instance Aarts, 2000 and Chapter 7). Little money is available to carry out such projects.

1.5. Purposes of this dissertation
Conventional research strategies are also incorporating system approaches and interactive agricultural science and research institutes that used to support only conventional industrial agriculture are now also moving into organic farming. But organic farming has its own set of values. Its holistic character means that the embrace of, or transition to, organic farming implies a shift of paradigm. The organic research community explicitly asks for and experiments with, new research methods and approaches, although the outcomes do not find an outlet in established scientific journals. It is time to make these issues explicit and to systematically explore the nature of methods and approaches that are required for the development of organic agriculture. Together these elements form the point of departure of this thesis.

Based on the experience of the Louis Bolk Institute, one of the pioneering institutes in R&D in organic farming in Europe, I will investigate the research strategies, approaches and methods that support and operationalise the values and principles of organic farming as they have been established by its pioneers in their protest against the advent of industrial agriculture. As a private research organisation, the Louis Bolk Institute was in a position to develop its own R&D strategy based on additional methods of value explanation and investigation, Goethean life science, and experiential research approaches. Out of its experiences the following elements are important to support the intentions of organic farming:
- Acceptance of the self-regulation of the farming system as a complex agro-ecosystem based on site-related farming solutions, while maintaining diversity and respecting the integrity of life and its manifestations.
- Acceptance of the independence and autonomy of farmers' judgements so that they can trust their own observation, intuition, experience and insight and are supported in their learning. In that sense, the farmer is considered to be an expert (this is also one of the principles of IPM Farmer Field Schools).

The purpose of this thesis is to explore whether, and to what extent, organic farming is fundamentally different in character from integrated production or conventional farming and how R&D does and can support this character of organic farming. This exploration is based on an analysis of research projects carried out at the Louis Bolk Institute. This analysis will hopefully identify the fundamentals, if any, that exist with regard to R&D in organic farming. If successful, as a final step, the exploration will suggest a coherent approach to the design, strategy, approach and methods of R&D that supports organic farming.

In my analysis of research practices in organic farming, anthroposophy will emerge as an important background. It provides the spiritual basis of this dissertation as well as the holistic philosophy of nature and life that underpins the research approach used in the case studies that I have analysed. The question is whether this anthroposophical point of departure nullifies any claims I might make with respect to the generalisability of my findings across all 'blood groups' in organic farming. As I will explain in Chapter 3, when more information is available, I believe it is fair to say that the central spiritual tenets of bio-dynamic farming, especially where the holistic philosophy is concerned, are widely shared among the different blood groups in organic farming. It is true that many organic farmers reject some of the fixed prescriptions that are used in bio-dynamics [25] to mobilise cosmic forces for farm practice. But the blood groups in organic farming share its holistic approach [26] and try to translate it into daily farm practice (Cf. Chapter 1.2). Later in this dissertation, I will I discuss in more detail the implications of adhering to anthroposophy for the generalisability of the outcomes of the thesis to research for organic farming in general.

1.6. Structure of the dissertation

This dissertation has two parts. Part I reflects on learning processes, research methodologies, and approaches in science in the field of organic farming as explained above. Seven research projects carried out by the Department of Grassland and Animal Production of the Louis Bolk Institute are used as case studies to highlight lessons in this respect. Part II is a scientific report on a large multidisciplinary research project on the use of manure and the choice of varieties in grass-clover swards. Part II reflects on the scientific *results*, whereas Part I, is a reflection on *methodology.* Below, I only provide the outline of Part I.

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[25] These are specific actions designed to 'vitalise the earth', and to affect the growth of plants and animals as much as possible by using forces that emanate from cosmic constellations. Examples are ash-peppers to reduce pest, weeds and diseases, herbal and animal preparations to vitalise compost and soil, and a cosmic calendar for sowing and cultivating crops (Boeringa, 1977; Klett, 1985; Schilthuis, 1999; De Jonge and Beekman, 1999).

[26] I am aware that other philosophies are underpinned by similar principles. For instance, Alrøe and Kristensen (2002) discussed the ethics of organic farming in general terms, whereas Alrøe *et al.* (2001) and Lund and Röcklinsberg (2001) discussed the principles of animal welfare. The authors developed very similar concepts of animal integrity to those used in bio-dynamics (Verhoog, 2000). Similar holistic interpretations are found in Boehncke (1991) who discussed the principles of ecological animal husbandry. More recently the German organic research community discussed the guiding models (German: Leitbilder), which inspire organic farmers (Reents, 2001).

Chapter 1 presents the introduction to the dissertation Chapter 2 outlines the conceptual framework and methodology used to analyse the different case study projects that form the empirical base of the dissertation. Chapter 3 provides necessary context by describing the organic dairy sector in The Netherlands over the last 15 years. Also by way of context, Chapter 4 summarises some of the history of R&D at the Louis Bolk Institute. Chapters 5 and 6 contain the descriptions of six case studies and the research methods used. Smaller case projects focusing on specific main aspects of the research approaches used are presented in Chapter 5, whereas Chapter 6 presents an integrated research strategy of a large interdisciplinary project. The analysis of each project outlines the background of the question, the methods used, reflects on the method used in terms of a framework established in Chapter 2, and summarises the research findings. Chapter 7 provides an overall analysis of and reflection on the methodologies presented in the previous Chapters. Where the case studies presentations could not avoid presenting a fragmented picture, Chapter 7 seeks to establish that the consistent elements of R&D can be seen as a coherent research strategy. The final Chapter 8 draws together the main conclusions about R&D in organic farming, and identifies the implications for improvement and future research.

2. Conceptual framework and methodology

This Chapter will outline the framework for analysing the different research methods used in organic grassland and animal production by the Agricultural Department of the Louis Bolk Institute. It is a reflection on the nature of science and on methods used according to the Institute's research philosophy as it was outlined in Chapter 1.1.2. A complication for this reflection is my personal involvement as an actor in all research projects (see Figure 1.1). There are three levels of involvement and therefore three levels of reflection are needed. I was an involved actor in a R&D project (*process actor*). But I was also an observer of the outcomes of each case study project (*observer*). Thirdly, I am an analyst of methodologies used in the projects (*meta-observer*).

My analysis of the research process in this dissertation was greatly supported by three sets of experience. In the first place, the double position of the researcher in experiential science as both a researcher-observer and as an actor in a process of mutual learning (Baars and De Vries, 1999). In this project, an external process counsellor, De Vries, supervised the researchers involved with regard to the research approach and the interactive learning process with farmers. BOX 7.1 (Chapter 7) will further elaborate on the position of 'process-actor'.
In the second place, I have been a member of two international networks of researchers in bio-dynamic farming and organic farming for several years (Krell and Zanoli, 1999). These networks have been set up to discuss research strategies and methods. That is, the focus of these networks was on research methods and not on the outcomes of research. One of the networks also pays explicit attention to the philosophy of science.
In the third place, research methods and ethics relating to organic farming are regularly discussed within the Institute itself. A circle of colleagues meets for 1½ hours every week to assess the results of research projects, and discuss the methods used and the underlying research philosophy.

Two complementing frameworks will be used for the analysis of the observer's role in the different case studies and for the meta-analysis of the methods applied in the projects. The frameworks were adapted so as to allow a holistic approach, position the research methods applied and reflect on the steps undertaken in each project. The two frameworks are a four quadrant framework, representing some basic choices of the philosophy of science (Chapter 2.1) and a triangle of research methods applied in agricultural R&D (Chapter 2.2). The adaptation of the frameworks is based on the earlier discussion on holism-reductionism. One could say that the use of the adapted frameworks allowed me to follow what Looijen (1998) calls a '*radical holistic research strategy*' (see 1.1.1).

2.1. The four-quadrant framework

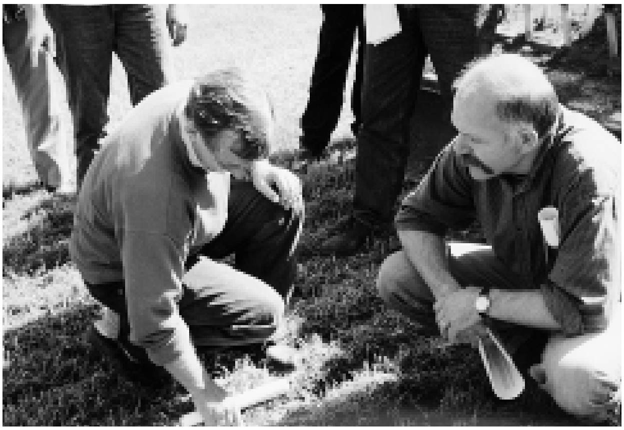
The first framework is a four-quadrant matrix, developed by Miller (1985) and adapted by Bawden (1997) and Röling (2000) (Figure 2.1). The matrix reflects two polarities derived from the philosophy of science:

- The objectivist, positivistic approach to knowledge, versus the subjectivistic, constructivistic one. This contrast reflects different epistemologies in the way we try to understand the world;
- The holistic versus the reductionistic approach to observation, thinking and explanation. This distinction reflects two discussions. In the first place, the discussion about mono-, multi- and interdisciplinary approaches in which holism stands for recognition of higher levels of organisation in nature and of emergent properties (Looijen, 1998). Holism in this sense refers to the move from purely reductionistic science to the embrace by scientists of hard systems thinking and to the recognition of emergence and complexity. In Figure 2.1 this move is represented by the move from quadrant 1 to quadrant 2. In the second place, holism is used to reflect the acceptance of 'soft' systems, i.e., acceptance of the distinction between hard goal seeking systems with given goals, and soft systems with contested human goals (Checkland, 1999). The third quadrant in Figure 2.1 represents the recognition that most hard systems are sub-systems of soft systems (Pearson and Ison, 1997). Often the distinction between holism and reductionism in science is discussed without paying explicit attention to constructivism.

	Constructivism (subjectivism)	**Positivism (objectivism)**
Holism	3. HOLO-CENTRIC	2. ECO-CENTRIC
Reductionism	4. EGO-CENTRIC	1. TECHNO-CENTRIC

Figure 2.1. Matrix to distinguish between different scientific paradigms (after Miller, 1985; Bawden, 1997 and Röling, 2000).

These basic distinctions in the philosophy of science have also been used to describe the evolution of R&D strategies (LEARN Group, 2000). Figure 2.2, illustrates this evolution as the move from mono-disciplinary research (quadrant 1), via the (multi-disciplinary) attention to (farming) systems (quadrant 2), to (trans-disciplinary) research projects based on interactive and critical learning (quadrant 3). This development represents an integration of hard agro-ecological approaches and soft system thinking which sees agro-ecological outcomes as emergent from human interaction (Jiggins and Röling, 1998). The ecologist Holling (1995) referred to this integration as 'adaptive management', i.e., the need to take into account the ecological imperatives through learning. According to Kersten (1995), the researcher is not external to the system but part of it. The system is socially constructed and therefore involved responsibility replaces outsider objectivity. In soft systems thinking, human reasons become causes, and 'institutions' matter more than experimental proof (Röling, 1998). A good example is the way in which Pearson and Ison (1997) discussed the evolution of grassland agronomy strategies: *'No longer can a grassland agronomist be concerned with only technical issues that have preoccupied grassland agronomy for most of the last 50 years. The complex, messy problems that the next generation of agronomists will attempt to address will require skills and understanding that are not found within conventional agronomy texts' 'Thinking of grassland systems is necessary as social constructs and system concepts are used to think about, describe, and inform action in the design of future grasslands.'*



... the complex messy problem of oversowing of white clover solved in a social context ...

2.1.1. Expansion of the four quadrant matrix

A regular and recurrent point of discussion in organic farming research concerns the definition and contents of holistic research methods (Lund, 1998, Niggli, 1998, Alrøe *et al.*, 1998; Lockeretz, 2000). In Chapter 1.1.2, the discussion of holism versus reductionism in biology and ecology was introduced and attention was paid to epistemological, ontological and methodological aspects (Looijen, 1998). In view of that discussion, the four-quadrant matrix can be elaborated as follows.

- A reductionistic research approach looks for explanations at lower levels of complexity. Explanations are thought of in terms of causal relationships, and the lowest level of life is thought to be DNA. The communication of scientific findings is based on measurable quantities. Holling (1995) called this approach a science of parts. In this thesis I will also use the word reductionism to refer to a limitation of attention and a narrowing of focus of an observer without the use of the reductionistic explanation.

- A holistic research approach looks for understanding at higher levels of integration, focusing on the context of the object of research, on the relationships between the elements making up the whole, and on the emergent properties of each level. According to Holling (1995) this approach is a science of the integration of parts. In anthroposophist thinking, holism is search for unity, entity and/or integrity, and the highest level of unity is the level of spirit. That is, systems are not just assemblies of a chemico-physical nature. Unity is thought of as a spiritual and leading principle that can be recognised at all levels of integration.
- An objective, positivistic approach tries to eliminate the viewpoint of the observer (Pretty, 1995) by means of methods that prevent bias and by using instruments that eliminate subjective interpretations. Unbiased values have to be discussed as measured, counted or weighed relationships. A statistical analysis is used to discriminate between observations (Looijen, 1998).
- In a subjectivist, constructivistic perspective multiple realities exist that are socially constructed. As part of a community, people collectively bring forth *a world,* which is realised through involvement and personal commitment. The constructed world is value-bound, instead of value-free and has emergent properties due to human action (Pretty, 1995). The choices of themes in research and the interpretation of its findings depend on personal attitudes, experiences, beliefs, personal worldviews, religion, etc. Röling (1997; 2000) spoke of 'the soft side of land use' and called for research on the way in which people construct their land use. From my own anthroposophic perspective, the reality of hard natural science also is a constructed world. Science is a human method of knowing and subjectivity is part of the observation method itself, and cannot be divorced from the personal skills, belief and experience of the observer. This is particularly the case in Goethean science, which can be interpreted from the point of view of natural science as a 'double constructivistic scientific approach [27]'. Only direct observations are made without interposing instruments between the perceiver and the phenomena and all senses are used for observation [28]. The human being is the measuring instrument itself. Goethean science is also holistic, because it focuses on different system levels. However, in order to prevent a chaos of arbitrariness, people can be trained to use their personal skills in an objective way and the personal findings have to be

[27] In science the bias of the scientist is reduced in two ways: instruments objectify the observation and measurement objectifies the observed. Therefore Goethean science has two elements of construction, namely the observer himself, his/her skills, involvement and attitudes, and the observed, whose characteristics cannot be reduced to only measurable values.
[28] Goethe was deeply convinced of the primacy and immediacy of sensory phenomena. For him, sensory qualities were substantial irreducibles that are explicable only in terms of themselves (Hensel, 1998). This conviction is, of course, disputable from the point of view of objectivity.

reflected upon.
- Experiential science too has the same constructivistic element. However, the reflection now focuses on personal action based on skills. As in experimental science, experiential science is reductionistic because it always reflects on a part of the world.

Using the above elaboration of the dimensions used in the four quadrant matrix, I have relabelled the four quadrants below in a manner that provides a framework for analysing concrete case studies of research in organic agriculture. I have already made clear what specific anthroposophic elements are being introduced.
- *Eco-science-holism (2nd quadrant)*: research is expanded from component, reductionistic science (1st quadrant) towards multi- and interdisciplinary system science, based on the ecosystem approach of Odum (quoted by Lund, 1998), who looked at relations within the ecosystem based on energy flows. In agriculture, the agro-ecosystem was formulated as a new level of analysis and as context of detailed research questions. Instead of the farm's components, the total farming system became the focus of attention, even if the same scientific methods often are used as in compartmentalised science (Aarts, 2000). Farm models can be used as blueprints based on complex constructions based on the integration or synthesis of reductionistic research findings. An expansion of a hard farming system approach to incorporate the needs of society is often accomplished by focusing on agricultural marketing chains.

The additional elements that play a role in the third quadrant are (1) human values, beliefs and behaviour, including learning and education processes, and (2) ethics. I include a third dimension for this quadrant, the *constructive elements within science itself*. Therefore, three elaborations are made for the 3rd quadrant:
- *Socio-holism:* focus on farming styles and human attitudes, i.e. the connection between beta end gamma sciences with an emphasis on learning processes (Jiggins and Röling, 2000). This includes the economic studies of farming systems. Röling and Brouwers (1999) discussed the human side of indigenous knowledge in plant breeding. In their view, indigenous knowledge is not only a physical relic of the past in terms of old tools and machinery or old cultivars within a seed bank, but also a living and adaptive resource of human skill and local knowledge needed to manage ever-changing local situations.
- *Value-holism:* focus on ethical values. The relationship to life styles or business styles is part of this aspect. One's personal ethical values affect one's view on life. Verhoog (2000) distinguished five bio-ethical theories: anthropo-centric, patho-centric, zoo-centric, bio-centric and eco-centric. A bio-ethical theory is normative in that it defines what is to be considered

morally relevant and what is not. For example animal breeding strategies should include awareness of these different bio-ethical theories. One should realise, for instance, that the concept of animal integrity cannot be found within anthropo-centric and zoo-centric approaches, the most prevalent bio-ethical theories at present (Visser and Verhoog, 1999). Therefore, a discussion of values is only relevant if one is prepared to become involved in other points of view.

- *Goethean science as life science holism:* as a phenomenological approach, this orientation is holistic because all elements of a life cycle are a part of research. Its context is inclusive. At the same time, the approach is constructivistic because the method is based on direct observation that depends on human skills, etc. The observer directly experiences the phenomenon being studied without the use of instruments. Therefore the skills of observation have to be trained to reach a level of inter-subjectivity and to prevent subjective statements (see Chapter 5.5).

The interpretation of science in the 4th quadrant is called 'experiential science', the epistemology

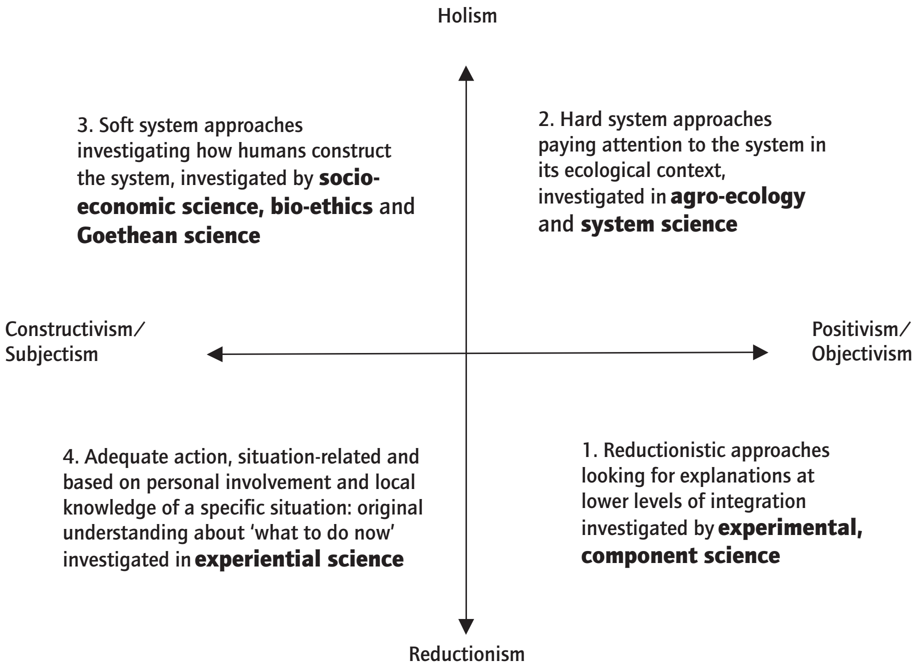


Figure 2.2. Adaptation of the Four-Quadrant matrix to provide a framework for the analysis of case studies of research projects in organic agriculture. The adaptation makes clear where anthroposophic principles come into play in the analysis.

of action research. A key element of experiential science is '*adequate action*' in terms of relevance, effectiveness, timing and vision. Such an action is always related to a part of the world, which gives the quadrant a reductionistic element. At the same time, adequate, situation-based solutions are found only after personal involvement, which provides a constructivistic element. Maturana and Varela (in Kersten, 1995) said, that *'to know is to be able to operate adequately in a situation'*. In their emerging view of professionalisation of agricultural R&D workers, Bawden *et al.* (2000) used a similar term to describe adequate action: '*responsible action*'; '*the idea of responsibility of action is very firmly linked to notions of ethics and of moral dimensions in decision making'.* In all, I suggest a new epistemology of action in terms of experiential science:

... experiential science: concrete issues facing individual farmers ...

- *Experiential science based on adequate, situation-based action (4th quadrant):* the final goal is to look for adequate answers ('systems that work') and site-adapted solutions. Its final methodology as elaborated in this thesis, includes intuitive learning of farmers, mutual learning of on-farm experiments and a reflection on farmers' action. Together these are the elements of experiential science (Baars and De Vries, 1999).

2.2. The triangle of research methods

The second framework is a tool to describe the relative position of various methods in strategic and applied agricultural sciences (Alrøe *et al.,* 1998). The three corners of the triangle are used to discriminate scientific methods:
- *Laws of nature*: knowledge about the world explained as causal relationships of materialistic findings;
- *Images*: models to construct the knowledge of a complex world;
- *Actions*: action to test and apply knowledge and models of the world.

The two frameworks do have a relationship. The polarity of holism – reductionism in terms of more or less integration of research disciplines in relation to the emergent properties can also be recognised in the triangle in Figure 2.3. In the upper half of the triangle, research methods are more holistic, which in this case means being more systemic, covering a higher integration of farm segments and using more interdisciplinary approaches to research. At the bottom end of the triangle, basic research approaches are emphasised, focusing on details mainly through mono-disciplinary research and small-scale and detailed experiments. The distinction between constructivism and objectivism is not present within this triangle because all research methods mentioned in Figure 2.3 are assumed in the original to emanate from a positivistic approach.

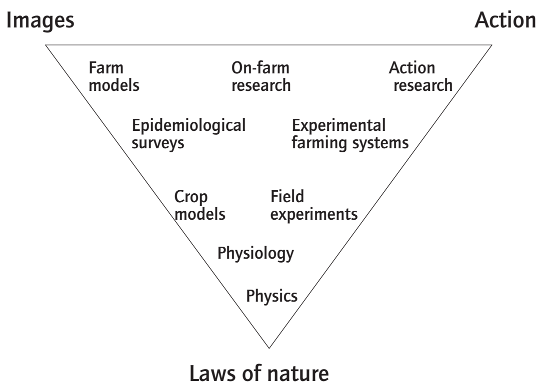


Figure 2.3. A triangular view of research methods (based on Alrøe et al., 1998)

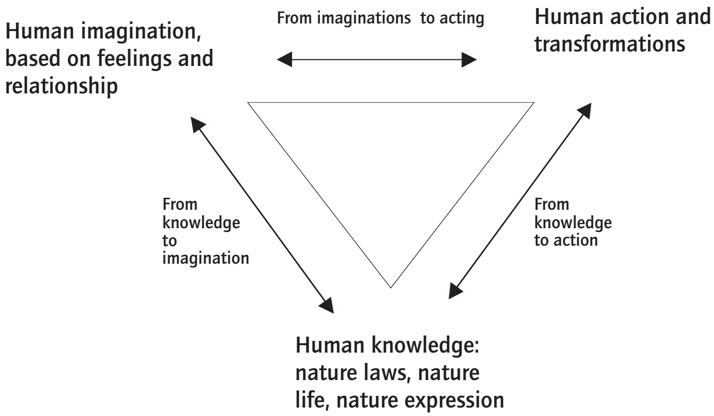


Figure 2.4. The triangle adapted to allow its use as a framework for analysing case studies of research projects in organic agriculture (adapted from Alrøe et al., 1998)

2.2.1. The adaptation of the triangle for purposes of the present research

As mentioned above, the triangle sorts conventional science approaches in agriculture. Before I can use it as a framework for the analysis of the case studies, the triangle needs to be adapted. I made adaptation on the basis of the work by Maturana and Varela (1992) on the elements of the cognitive system, and on the basis of Steiner's (1904) work on the domains of the human soul, thinking, feeling and willing. These three elements of cognition are connected in such a way that subject oriented feelings or emotions finally decide about the type of our action and perception (see 1.1). Table 2.1 suggests that the elements of cognition, the domains of the soul, and three areas of human interest suggested by the triangle can be considered as basic dimensions underlying the approaches used in the holistic research methods applied by the Louis Bolk Institute.

These parallels allow the adaptation of the triangle so that it can be used as a framework to analyse the activities undertaken in the different case study projects, as shown in Figure 2.4. Projects can start in any corner of the triangle. Some start in actions with farmers (upper right hand corner of the triangle), they can start from an exploration of ethics (upper left hand corner) or they can start because of a lack of knowledge about natural processes (lower corner). During the project, connections with one or both other corners of the triangle are established. The triangle can be used to make a first classification reflecting the main focus of each project.

Table 2.1. Parallels between the elements of cognition, the domains of the soul, the dimensions of human interest and their relationship to scientific approaches used by the Louis Bolk Institute

Elements of the cognitive system (Maturana and Varela, 1992)	Domains of the soul (Steiner, 1904)	Area of human interest (Alrøe's 1998 triangle, Figure 2.4)	Louis Bolk Institute's approaches in holistic research
Perception	Thinking	Knowing and understanding	Goethean life science, picto-morphological methods and inter-/multi-disciplinary science
Emotion	Feeling	Judging, images, values	Bio-ethics, visioning and communication of concepts
Action	Willing	Acting and transformation	Participatory research and experiential learning with pioneering farmers

2.3. Case studies to develop new concepts

The evaluation is based on an analysis of seven case-studies (Chapters 5 and 6) chosen by myself to illustrate the full range of specific methods, findings and statements used in the past 20 years by the Louis Bolk Institute's grassland and animal systems research. No attempt has been made to select representative case studies or to select all projects. According to Vandenbroucke (1999) case studies are important because a case-report can tell us what is 'unknown' or 'unrecognised'. It can present a general truth that can be stated in abstract scientific terms even though it was based on a single observation. According to conventional science criteria, case study reports and case series are regarded as the least rigorous approaches. Yet they have a considerable potential to stimulate new learning and formulate new ideas. Case studies are highly sensitive to novelties that are identified in a qualitative way (Vandenbroucke, 1999). Yin (1993) defined the case study method as a form of empirical inquiry that investigates a contemporary phenomenon within its real-life context, addresses a situation in which the boundaries between phenomenon and context are not clearly evident, and uses multiple sources of evidence. Case studies can be exploratory, descriptive or explanatory. In this dissertation, case studies are used to explore, identify, describe, analyse and illustrate the range of research methods used in organic agricultural research.
Each of the chosen case studies analyses a specific research method, describes the research findings (briefly in most cases) and reflects on the results. Since the purpose of this dissertation is to position, analyse and reflect on scientific strategies that support the characteristics of organic farming, the focus is mainly on the research process in terms of steps undertaken and less on the research findings and technical outcomes. The seven case studies each had a focus in one of the corners of the triangle presented in Figure 2.4. In selecting the cases in relation to action research we relied on the questions and challenges of pioneering farmers or traders.

In almost all cases, the actions of farmers in their own daily practice were an important source of new questions. Dialogue groups (Kersten, 2000) were used to discover new areas of interest and to maintain contact with farming practice, the key to our awareness of farmers' needs [29]. Due to our on-farm trials and demonstration projects, we were conversant with farming practice on different soil types, and with different farming styles and farm intensity levels. New questions and new areas for development were obtained directly from practice. Thus at each of the three

[29] An important dialogue group that reflects on research topics is the 'Natuurweide' Farmers' Association. It carries out research financially supported by the Louis Bolk Institute. At least once a year, members of the Institute meet with a delegation of farmers to discuss research outcomes, problem areas and new research topics.

corners of the triangle, whether it reflects farmers' actions, ethics or knowledge, farming practice was the entry point for raising issues.

In conclusion

The case studies in Chapters 5 and 6 will be analysed according to the two adapted frameworks. One of the key characteristics of organic farming is the rejection of the use of artificial fertilisers and chemicals. Compounds have to be replaced by agro-ecological measures to support *the self-regulation of systems*, to allow *site-related solutions*, to maintain *a diversity of farming systems* and to respect *the integrity of life*. The statements in italics represent 'the spectacles' for examining research methods at the meta-level (Chapter 7).

3. Organic farming in The Netherlands

In this chapter, the history and development of the two mainstream organic farming associations will be presented to provide some context for the research presented in this dissertation [30]. In order to understand the approach and background of research for organic farming, it is relevant to provide some historical background on organic farming and to show how differences emerge in modern organic agriculture.
I will start the chapter by describing the two main labels used in organic farming in the Netherlands. I then explain the structure of the organic dairy farming in the year 2000 with the use of economic statistics. All organic dairy farmers have to deal with the same market characteristics. Also organic farming is based on principles and standards that are reflected in the worldwide IFOAM standards and in national legislation. However, it is clear that organic farming even in one country does not reflect only one style of farming and the milk market is changing rapidly. In the last part of the Chapter, I will present an additional set of concepts with which it is possible to classify organic farming according to the ways farmers interpret nature and natural processes in farming.

3.1. EKO and Demeter as the two mainstreams in organic farming

The two mainstreams in organic farming in the Netherlands are called ecological (EKO-label) and bio-dynamic (Demeter-label) farming. In terms of the EU regulation 2092/91, the overall term for organic farming in The Netherlands is 'biologisch' and the overall label is EKO. As in other European countries, labels such as Demeter are additional to the mainstream label.

3.1.1. EKO

The ecological movement started as an initiative that had nothing to do with bio-dynamic farming, even though bio-dynamic farming in the Netherlands had been going on for many years at the time. The ecological movement was born in the city of Amsterdam in the early 1970s. It was based on the revolt of the student movement against established politics. An important issue was the ownership of property. For example, the so-called 'Provo-movement' developed various plans for the shared and free use of bicycles in the city. Around 1970, the report of the

[30] Important sources for Chapters 3.1 and 3.2 were: 'Ekoland', the farmers' journal for organic farming; 'Vruchtbare Aarde', the journal of the bio-dynamic society until 1990; 'Verenigingsnieuws', the journal of the bio-dynamic society since 1990; Schilthuis, (1999); Boeringa (1977), and personal communication with Rob Boeringa (formerly of the NRLO (Nationale Raad voor Landbouwkundig Onderzoek)).

Club of Rome raised widespread awareness about the natural limits to the exploitation of non-renewable resources. In the same period, various environmental organisations were established, partly related to environment (e.g., Stichting Natuur en Milieu, Milieudefensie), and partly based on agriculture (e.g., De Kleine Aarde). Members of the movement who were interest in agriculture started their own small market gardens. The first 'organic shops' to sell their produce appeared in the major cities.
Nowadays, the 'Green' political parties reflect the intentions of the erstwhile ecological movement. These intentions were based on personal responsibility and environmental concern. The main issues of the ecological movement were:

- work should be friendly to people as well as to the environment;
- enterprises should be small-scale;
- trading should be regionally based with short transport lines;
- agricultural prices should not be based on an anonymous market;
- the earth should not be exploited, recycling should be stimulated;
- over-consumption of food should be discouraged; and
- the third world should not be exploited.

The ecological movement was the first organisation to develop official guidelines and standards for farm practice (March 1982). The Dutch Society for Ecological Farmers (NVEL) was founded in 1982.

People within the ecological movement were not primarily attracted to the anthroposophic and spiritual character of bio-dynamic farming. Their interest was much more based on the overall concern for the environment and pollution. Ecological farming started in 1978 as a separate body of practice. Its development was based on private consulting ('Ekologisch Landbouw Consulentschap'), a control body ('Stichting Alternatief Warenonderzoek') and an information service for consumers ('Alternatieve Konsumentenbond'). Initiatives for an ecological school similar to the bio-dynamic school at Warmonderhof began in 1982. However, the Ecological Movement did not succeed in establishing private education of this nature. Later, courses in organic agriculture were integrated into several 'conventional' tertiary level schools of agriculture.

3.1.2. Demeter

The first bio-dynamic farm in the Netherlands started in 1926 (Heinze *et al.*, 1986). In 1937, the 'Foundation for Bio-dynamic Farming' was established. Information about bio-dynamics was published in a journal called 'Vruchtbare Aarde', later 'Dynamisch Perspectief'. In 1964, a private advisor was employed, although only 20 bio-dynamic farms existed at the time. Bio-dynamic farming in those years was and still is connected with the anthroposophic movement. Anthroposophy, as a spiritual way of life, is active in different parts of society. In the Netherlands, education for bio-dynamic farming was already established in 1947 at the 'Warmonderhof' (Meijer *et al.*, 1980). In addition, Waldorf school pupils stayed on bio-dynamic farms for one or two weeks during the course of their education.

... the first bio-dynamic farm started in 1926: Ter Linde at Walcheren ...

Consumer circles based on ideals with respect to the design of the economy where consumers and producers were directly connected, were already active in the cities in the 1960s. A consumer group, the so-called 'Landelijk Consumenten Contact', entered into agreements with farmers about the amount, quality and price of bio-dynamic produce. The first regular supply of bio-dynamic vegetables by subscription was in that period. In the 1990s, the idea of subscriptions was replaced by Consumer Supported Agriculture (CSA) (Lamb, 1994; Getz and Morse, 1995; Fieldhouse, 1996; Lind, 1999;). In the Netherlands, this CSA was established through the 'Pergola Association'. Bio-dynamic traders followed the CSA vision about the relation between consumer and producer. A large consumer circle in the region of The Hague and Leyden was transformed into the first trading centre for bio-dynamic produce, Proserpina, established in 1966. The basis for trade was a co-operative union of the farmers. The Dutch variety of the CSA was the weekly vegetable, fruit or even meat subscription. This initiative started on private organic farms, which distributed their own vegetables to consumers in their direct surroundings. The content of the bag depended on the season. That initiative was commercialised in 1994 by 'Odin', a trader of organic produce. Ecological traders also followed this initiative. Each week consumers received their bag of organic produce and the trader informed them about the different farms the produce came from. In this way the distance between consumer and producer was diminished and consumers could buy a more personal organic product. By 1999, there were 30,000 subscriptions per week for fruit and vegetables. Nickerson (1997) called the CSA 'a risk-reducing strategy' for organic farmers.

Since 1978, the foundation ‘BD Grondbeheer’ is active with the goal of buying and managing land for bio-dynamic purposes. The people involved were motivated by the idea that land should not be part of trading. Land was no merchandise, a view that is comparable to the vision of Native Americans in the 19th century who were astonished that white people could own the land. Even today, the staff of the oldest bio-dynamic farm in the Netherlands is not the owner of the farm. The workers only bring their personal skill and labour to manage the farm. Land, buildings, animals and machinery are owned by a foundation. This complete separation of ownership and labour is much more popular in the German bio-dynamic movement.

A specific form of multifunctional agriculture within bio-dynamic farming is the care for mentally or socially disabled people. Within so called Camphill communities, farms, family life, housekeeping and specific workshops are integrated.

3.2. Changes in the organic milk market

In The Netherlands, the market for processed organic dairy products has developed since 1976 (Island of Terschelling) and 1980 (Limmen) based on private initiatives. In the development of this market, several different economic approaches can be recognised. At first, the market was

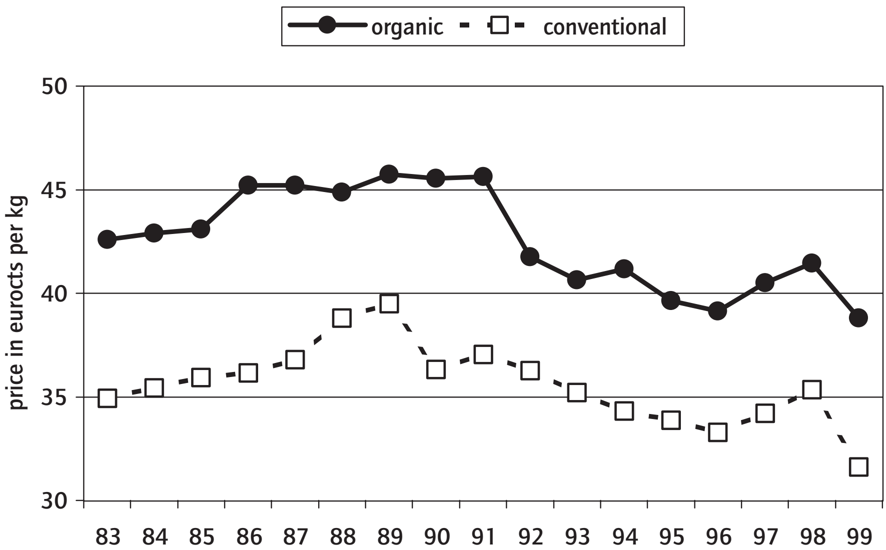


Figure 3.1. Annual average price of organic and conventional milk (Dairy factory ‘De Vereeniging’; Hoogland, 1995)

protected and was controlled by only one of the processors. In 1990, the first sale of organic milk through a supermarket chain failed because conventional processors did not advertise the added intrinsic value of organic milk. In the 1990s, the growth of the sector attracted new processors who tried to decrease the consumer price. The first competition between processors of organic milk led to a price decline for the farmers (Figure 3.1). To prevent prices from decreasing to the lowest level possible, the organic dairy farmers united in a farmers' union called 'Natuurweide'. The decision in 1996 by the supermarket leader Albert Heijn to develop a new organic market was an important support for the growth of the sector. Parallel to this, conventional processors took over the most important pioneering private organic milk processors in the middle of the 1990s.

In 2001, nine factories processed almost 81 million kg of organic milk (personal communication P.Boons, President of 'Natuurweide'). This large number of processors was a reaction to the earlier take-over of the two main organic milk processors by a conventional processor (Campina-Melkunie). As a result of this take-over, several new and often small-scale initiatives to process organic milk emerged. One of the main reasons for farmers to look for new private processors and traders was the loss of control over milk market politics. Since 1996, the majority of organic dairy milk suppliers joined forces in a union of organic milk suppliers. The main reason for the co-operation was that farmers wanted to prevent competition among themselves. Together they tried to control the flood of converting farmers. Lessons from the past had shown that within the small market any surplus of milk supply immediately affected the price. The policy of the union is to achieve a fixed premium price for all organic farmers without being affected by the competition between the different factories. Since 1999, the united organic dairy farmers even meet internationally. The change of ownership of processors, from private companies to multinational processors, led to an international union of organic dairy farmers. Organic dairy farmers are now informed about surpluses and shortages in several European countries to have a better position for negotiation with the processors. Recently similar changes in processing and trading were realised in the organic butchery sector. The private company 'De Groene Weg' had a central slaughterhouse for organic meat and franchised organic butcher shops all over the country. At the end of 2000, the slaughterhouse was sold to Dumeco. The take-over was accepted because the 'Groene Weg' was not able to make the step to supply supermarkets. Its level of organisation, financing, control and automation could not handle the increase in demand.

[31] In: Zuivelzicht, 22 March 2000.

According to the Dutch Central Bureau of Statistics (CBS), in 1999, sales of organic dairy produce reached € 20 million, 7,7 million higher than the previous year and about 1.1 % of total dairy consumption [31]. In total, € 227 million of organic produce was sold in 1999, 75% in health food shops, farmers' markets and by produce subscriptions, the other 25% by supermarket chains, mainly Albert Heijn (Motivaction, 2000). However, since 2002, the sales by supermarket chains are higher than in the other markets (Press release Platform Biologica, 2002).
Key players in the organic milk and meat markets have changed in the last five years. This means that processing and trading of organic produce is now in a phase of conversion, from health food shops and private pioneering processors to supermarkets and multinational traders and processors (such as Wessanen, Campina and Dumeco). The development in the organic milk market fits very well in Dutch Government policy on organic farming that emphasises an increase in the area of organic farming. The aim of the government is that 10% of land area should be under organic farming in 2010 (LNV, 2000).

Table 3.1. Characteristics of specialised dairy farms in 1998/99: figures for 'organic' are an average of nine farms in the project BIOVEEM (see chapter 7) (Zaalmink, 2000)

	Organic	**Conventional**
Hectares: No	42	34
Cows: No per ha	1.3	1.6
Milk: kg per cow	6,200	7,300
Milk: kg per ha	8,300	12,000
Income in € per 100 kg milk:		
Milk	38.66	34.35
Beef	4.27	3.90
Other	4.99	1.59
Total	47.92	39.84
Costs in € per 100 kg milk:		
Fodder	6.76	5.90
Labour	19.88	15.66
Machinery and hired labour	8.89	7.71
Land and buildings:	10.66	7.12
Other	9.62	11.53
Total: € per 100 kg	55.81	47.92
Net farm result: € per 100 kg [32]	-7.90	-8.08
Family income: € per 100 kg [33]	11.98	7.56

[32] Net farm result is based on a fixed rate per hour of labour.
[33] Family income = Net farm result plus labour income.

3.3. Structure and economy of the Dutch organic dairy farms

WUR-LEI recently evaluated the economics of organic farming (Zaalmink, 2000). Table 3.1. shows that organic dairy farms on average are about 8.0 ha larger than conventional farms; that the number of cows is roughly the same, but that the total milk production is 80,000 kg lower. The average milk production per ha is 8,300 kg, which is far below the conventional specialised dairy farms (12,000 kg per ha), but it has increased by 70% compared to 1980. The production per cow (6,200 kg) is about 1,100 kg below the conventional cow productivity. Compared with 1980 figures, the production per cow on organic farms has increased by 45%. The most extensive of the organic dairy farms produced 5,000 kg ha^{-1}. Such farms are self-supporting for all fodder. The most intensive farms produced 11,000 kg ha^{-1}. The amount of concentrates per cow varied between 1,100 and 1,600 kg per cow. The most extensive farms used 160 kg per cow.

The average milk price per 100 kg in 1998/99 was only € 4.31 above the conventional price. Organic dairy farms had a higher total income per 100 kg of milk (€ 8.08) compared to conventional farmers, mainly because of subsidies (included in other incomes: € 3.49). The total costs per 100 kg were higher for the organic farmers(€ 7.90). The main source of these extra costs were labour (€ 4.22), plus higher costs for land and buildings (€ 3,54). Costs for land and buildings are relatively higher when farms are more extensive. Zaalmink concluded, that the overall net farm income was the same for conventional and organic specialised dairy farms. However, the differences in farm structure between the two types of farms were large.

The price of milk paid to bio-dynamic suppliers [34] has declined since 1991 (Figure 3.1). After 1991, the price differential with conventional milk decreased as well. Milk prices for ecological farms were even lower (€ 1.36). The loss of income from milk has been partly compensated by subsidies paid for conversion as well as income for nature conservation activities. The government subsidy was for a five-year period only, and payments by nature conservation bodies depend very much on regional factors. For instance, the Friesian subsidy for delaying the 1st spring cut of silage (to improve the survival of nests and young meadow birds) is only operating in small parts of the Province. A maximum of 10 ha per farm can be part of this nature conservation scheme.

Parallel to the price development and related to their year of conversion, the production intensity of organic dairy farms is increasing. From a study of breeding strategies in organic dairy farming

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[34] **Data were derived from the processor 'Zuiver Zuivel' in Limmen, North-Holland, which is the largest processor of organic milk.**

Table 3.2. Organic dairy farm characteristics in 2000, related to the year of conversion of the farm (N = 149) (Nauta and Elbers, 2000) [35].

Year of conversion	<1987	87-90	91-96	97-98	99-00	Mean
No of cows	37	50	51	51	49	**49**
Farm size (ha)	39	46	43	39	35	**39**
Milk quotum: kg x 100,000	2.14	3.31	3.42	3.34	3.41	**3.26**
Milk yield per cow: kg	6,746	6,790	7,034	7,148	7,885	**7,242**
Milk quotum: kg/ha	6,359	7,421	8,614	8,928	9,747	**8,683**
% EKO-farm	31	56	88	100	97	**86**

(Nauta and Elbers, 2000), we can see a clear trend towards increasing intensification of more recently converted dairy farms (Table 3.2). On average there is no increase in cow numbers since 1987, the overall farm-area has decreased and the milk yield per cow increased. Therefore the increase in farm intensity showed up most clearly in terms of milk per ha. Since 1991 the growth of the organic dairy sector as a whole is mainly based on the growth of the numbers of ecological, and not those of bio-dynamic dairy farmers. This was caused by the demand for EKO-milk, the support for EKO-advertising, the more restrictive rules for bio-dynamic production and the lack of appreciation of additional values in bio-dynamics.

The overall intensification and specialisation of dairy production was considered a progressive evolution within the organic dairy sector, leading to comparable organic and conventional farming systems depending on large inputs of concentrates and purchased fodder and straw (Baars and Prins, 1996). The background of intensification in organic dairy farming lies in the price squeeze to lower production costs. Based on the area outside the home farm required to produce imported manure and fodder, organic dairy farms with a milk production of 10-11,000 kg per ha or more used an '*external farm area*' (Baars and Van Ham, 1996) of more than 35% of the home farm area. There is a structural dependency on external fodder, concentrates and even manure, leading to a constant import of minerals. At the same time, more intensive farming guarantees a higher farm income. According to EU standards, organic dairy farming is no longer bound to the land actually farmed. A recent study of the use and origin of manure, straw and

[35] Differences in yield per cow between Table 3.1 and 3.2 were caused by the sample. In Table 3.1 9 farms with a longer conversion history were included.

fodder in the west and centre of the Netherlands (Hendriks and Oomen, 2000) showed that organic arable, vegetable and fruit producers rely for 70-100% of their manure on conventional sources. Most dairy producers are using all their own manure on their own fields and even then 50% of the dairy farmers still import conventional manure. Eighty percent of the straw used for bedding is conventionally produced. Nowadays most of the dairy herds are housed in cubicles, which hardly need any straw. The need for straw only increases when animals are kept in different housing systems. The study also showed that 30-40% of concentrates is still based on conventional ingredients. Figures for the landless organic poultry and pig sector showed that concentrates for egg and meat production are mainly produced outside the Netherlands. This development leads to problems of traceability of produce (see for instance the organic food scandal in Germany May 2002) and there is no longer a connection between land, manure and the level of production.

One of the threats the development of organic farming mentioned in Chapter 1.3 was the lack of 'holistically-oriented regulations'. The regulation on manure is an example of this. Produce is certified as organic if farmers did not use fertilisers and chemical plant protection. This type of regulation only takes into account the natural origin of the materials used in production but does not reflect on the farm as a coherent agro-ecosystem. Such an open regulation allowed organic farms to become strongly dependent on conventional manure inputs. Since 2001, however, according to SKAL regulations, at least 20% of the animal manure applied in the fields must be of organic origin. This small change in regulation (from 0 to 20% organic manure) has an impact on the use of legumes in arable and grassland farms, on crop rotation and on the efficiency of manure use. Instead of manure-N inputs in limited crop rotations, systems will increasingly have to depend on N-fixation by legumes, which will widen the crop rotations. Both in organic grassland and in arable crop rotations, manure will be replaced by greater use of legumes (see Part 2 of this thesis; Baars, 2001-a). A full rejection of conventional manure inputs has been developed in the new concept of '*partner farms*' or '*mixed farming at a distance*' (Chapter 5.3; Baars, 1998; Nauta *et al.*, 1999). Such collaboration between specialised systems will allow closed mineral cycling and should lead to a 100% organic origin of manure, fodder and food. In future, all organic crops should be grown on manure of 100% organic origin. This will not only affect the production level per hectare, but also will increase the cost price of milk, meat, arable produce and vegetables.

Another, although negative, example of the importance of adequate regulation with regard to the identity of organic farming, is the discussion on the amount of concentrates fed to ruminants. From the organic point of view, which is based on a vision of the integrity of the animal, ruminants by nature consume fibrous material that cannot be eaten by most monogastrics. In the wild they hardly eat any seeds. In the holistic concept of a mixed and closed farming systems, cows are kept to produce manure to maintain and improve soil fertility. However, after the acceptance of the new EU standards for organic animal production in August 2001 (EU 2092/91), the amount of concentrate per dairy cow has increased to such a level that, after conversion, dairy farmers in The Netherlands hardly needed to reduce their concentrate level and organic dairy cows are not really fed according the nature of ruminants.

Supported by the (too open) EU standards, the price of organic milk has now dropped to a level that is too low for a true land-related production, but is still higher than the world price for milk and does not give room to organic farmers to follow high animal welfare standards. Farm costs have increased in organic systems. For instance, land prices in The Netherlands have tripled in the last 15 years. To speculate about a more realistic milk price, we indexed the producers' price of 1989 (€ 46.30 per 100 kg milk) with a fixed inflation of 2.5% per year. After 10 years the indexed price would have been € 59.27. However, the main group of EKO-farmers only received € 37.89 per 100 kg milk, which is 36% lower. From this calculation it becomes clear, that political choices, economical forces and the choices of the consumer force organic dairy farms to increase production per cow and per ha and to look for the lowest possible standards. This gap between market and realistic or fair trade price partly explains the ongoing need for intensification of organic farming and the scaling up of farm size. Instead of the domination of market principles in defining the future possibilities of organic farming, standards should much more reflect the ideals of organic farming. As a consequence, farmers might receive a direct payment for their extra efforts with respect to the production of welfare, environment, land related production and food safety. Such direct payments would be supported by green taxes and by a direct relationship between farmers and consumers. However, as long as milk is only treated as a bulk component, organic farmers will be fixed in the treadmill of intensification and the scaling up of size.

3.4. Farming styles in organic farming

Van der Ploeg (1991; 1994) introduced a classification of modern farming styles. Farmers were grouped on a personal scale, reflecting their aims in terms of interest, attitude and strong sides of farming skills. Styles were defined as a set of strategic and practical considerations of how they farm (Van der Ploeg, 1999). Farmers were classified in groups such as 'cow farmers, economical farmers, optimal farmers, double-purpose farmers or machine farmers'. Unfortunately Van der Ploeg did not provide a class for organic farmers. Therefore, additional typification is needed for the organic sector.

Verhoog *et al*. (2002 a, b) interviewed organic farmers and traders about their understanding of the concepts of nature and naturalness, three main approaches to action could be distinguished. It became clear that these approaches could also be recognised as steps in the inner conversion process of some farmers from conventional to organic agriculture. In relation to each other the three approaches are not meant as morally higher or lower. Only when farmers or traders claim 'naturalness' the authors suggest including all three approaches. However, farmers can chose for a certain style, because of market pressure or personal philosophy towards organic farming. More relevant is that farmers do not act consistently in all areas of their farm, because a particular farmer can be more involved in a certain aspect of his farming, comparable with the styles of Van der Ploeg.

Three main approaches within organic farming were:

- **the no-chemicals approach**. The holistic approach taken in organic farming leads to a rejection of component technologies dealing with symptoms without taking the whole into consideration. This is one reason for rejecting chemicals. The distinction between living (organic) nature and dead (inorganic) nature is associated with the distinction between healthy and unhealthy (related to death). The no-chemicals approach is a negative expression in the sense that organic agriculture is said to distinguish itself from conventional farming because *no chemical pesticides, no synthetic fertiliser, no GMO's, etc*. are permitted. Farmers have to replace (bio)chemical-synthetic substances by more natural substances. Instead of chemical sprays against diseases, farmers use 'natural' sprays or biological controls, synthetic fertiliser has to be replaced by organic manure, and instead of herbicides mechanical weed control is used. Even the use of homeopathic remedies in animal husbandry can be seen from this point of view. Homeopathic medicine is believed to be more natural because it is derived from natural substances and not from chemical substances synthesised in the laboratory. This approach is linked to a rather limited view of human and environmental health. Using natural pesticides and herbicides (etc.) is believed to be healthier not only for the environment, but also for humans.
- **the agro-ecology approach**. The farmer learns from nature and *reflects on process in nature*. In practice this means that the ecological farmer wants to model his agricultural practice on nature as an agro-ecosystem. Farmers might experience that during their conversion period they cannot ignore the ecological context of emerging problems. They notice that under organic circumstances it is not sufficient to only stop using chemical pesticides and artificial fertilisers. A new attitude and another way of acting is needed, based on prevention through knowledge of ecological processes. Diseases are seen as symptoms of an unbalanced system expressed in the lack of balance between plant or animal and farm


... the agro-ecology approach: self-regulation of systems ...

environment. Rather than fighting pests and diseases with chemicals, the emphasis shifts to control of the environment. A more diverse environment is necessary in which wild plants in hedges, borders or ditches are grown to maintain natural enemies within the farm system. Plant strength can also be increased through the right choice of manure, or by sound crop rotation. All this means that farmers start to think in a more ecological way, looking for the broader context of a problem and realising that the farm should be transformed into a complex, sustainable and balanced agro-ecosystem. Terms such as closed system, mineral cycle, self-regulation and bio-diversity are important keywords to characterise naturalness in this approach of organic agriculture. One needs to work together *with* nature instead of fighting against it. Solutions are based on rational, experiential and experimental ecological knowledge.

- **the integrity approach**. The recognition of integrity reflects an attitude of respect that inspires the farmer to find the right course of action at the right moment in the specific farm context. This respect for integrity first emerged in animal husbandry. The animal's needs (Rist, 1987; Bartussek, 1991) have to be understood by farmers in the context of the farming system. Cattle should be fed as ruminants instead of monogastrics (Bakels and Postler, 1986; Haiger, 1989).


... the integrity approach: horned dairy cattle grazing outside as real ruminants ...

> They should be kept as horned animals in a well-balanced herd. De-horning can only be avoided if the farmers are prepared to develop a new way of herd management, housing and feeding based on the cow's needs (Baars en Brands, 2000; Waiblinger *et al.*, 2000). Also the cows' right for outdoor grazing is derived from respect for the cow's 'nature'. Outdoor grazing can not be replaced by an outdoor run only. This approach manifests itself among others as respect for the integrity of life, for the agro-ecosystem, and for human needs (including social and economic integrity). The term 'natural' here refers to taking into account the *characteristic nature* of plants, animals, man and ecosystem because nature has an intrinsic value. Respect for the integrity of the farm ecological system, the living soil, the plant and animal species used is the result of an inner process of involvement with the way of being of natural entities. Farmers begin to experience that their focus on problems and solutions is connected with their personal attitude and their personal relationship with either the soil or the cultivated plants or animals. They experience that organic farming is more than a complex ecological mechanism and more than the sum of the parts. This feeling is also present in relation to the plants or animals they take care of. They develop a respect for the wholeness, harmony or identity of a living entity based on a personal involvement with the life of plants or animals.

Given that organic farming is likely to distinguish itself from conventional farming in terms of combining the three approaches described above, i.e., in terms of its 'naturalness' as defined by these three approaches, the question raised in this dissertation becomes more pertinent. Which research methods are the most adequate within these three meanings of naturalness? This question assumes that the different approaches are integrated and lead to one shared set of criteria for organic farming.

If such an integration of interpretations were impossible, a next step would be to distinguish the three styles of organic farming and introduce regulatory differences. In Germany, the AGÖL umbrella organisation has recently split up into three different regulation schemes. Farmers can be controlled at the level of the EU standards that represent the most open and simple form of regulation in that it mainly limits the system in terms of chemical use. On the other hand, both the Demeter and Bioland associations have chosen for higher ethical standards compared to the AGÖL standards, mainly in terms of animal welfare and the overall farming system. The rest of the organic organisations kept an intermediate position, in comparison to Demeter and Bioland, accepting the less restrictive AGÖL standards. A similar change has occurred in Switzerland where three levels of organic farming are certified nowadays.

In conclusion

This chapter described the evolution of the organic dairy sector in The Netherlands. Market forces rapidly push organic farming in the direction of the anonymity of the supermarket. Its increasingly conventional partners in trading and processing leads organic farming to fall into the same trap as conventional farming, exposing them to the price squeeze of the global market and pressures to reduce costs, and scale up farm size. The review of the history of organic farming shows that, after 1980, the size of EKO farm area became about 10 times bigger than the Demeter label. Since the Demeter label is the most restrictive label in terms of limitations and the most difficult in terms of philosophy, it is obvious that converters oriented mainly on the EKO label. This has important implications for the criteria used to establish the nature of appropriate research in support of organic farming. Organic farming in future might split up into three styles. Based on research findings of the Louis Bolk Institute on how organic farmers interpret naturalness, each ‘blood group’ would be supported by different sets of regulations and intentions.

Another solution would be to accept naturalness as one of the basic values for organic farming as a whole. In that case, all three basic meanings of the world ‘natural’ as expressed in the three approaches I have described above should be included in the principles of all types of organic farming. That would mean that the different methods of research that I have distinguished before should all be developed and applied in organic agriculture research. In this dissertation I have chosen to look at organic farming as a practice that adheres to, and integrates, the three approaches to naturalness. That choice means I will look at the ‘most difficult’ and least developed case. It allows me to describe the widest range of research practices in organic farming. This will hopefully help other organic researchers to be aware of the implications of the choices they make when designing their research projects.

4. Changes in research and development

The case studies presented in Chapters 5 and 6 are based on research projects selected from all the projects carried out by the Louis Bolk Institute in the past few years. Since the Institute is a private research institution that does not form part of the official public agricultural research infrastructure in the Netherlands, I believe it is useful to briefly describe the work of the Institute's Agronomic Department. The chapter will conclude with a brief overview of organic agriculture research carried out by other organisations in the Netherlands, mainly to demonstrate that the Institute is by no means the only player in this field. In fact, since the 1970s, a state-supported R&D programme for organic agriculture has been developed.

4.1. Agricultural Research at the Louis Bolk Institute 1980-2000

The Institute was founded in 1976 after the University of Amsterdam had prohibited continuation of a homeopathic *in vitro* experiment on cell tissues (Amons and Van Mansvelt, 1972; Van Mansvelt and Amons, 1975). This prohibition led to the initiative to establish an institution where researchers could not be stopped from pursuing research topics that were not in accordance with accepted science. The Institute was named after Louis Bolk (1866-1930) who was professor in human anatomy at the University of Amsterdam. He presented himself as a scientist with a broad and encompassing view which is best expressed in the following statement *'How much broader would our view of life be if we could study it looking through reducing glasses. This would widen our range of vision, thus allowing the coherence of phenomena to become visible to the naked eye'*. The Louis Bolk Institute tries explicitly to take into account this coherence in its research. When conventional research methods are considered not to suffice, new ones are developed or adopted, such as phenomenology, picto-morphological investigations and methods that use enhanced consciousness and intuition (Anonymous, 1999).

In the Agricultural Department of the Institute all fields of agronomy are represented. In the year 2001, a total of 25 researchers were working in five sub-departments: soil and manure, horticulture and glass houses, plant breeding, fruit growing, grassland and animal production. The income of the Institute is mainly based on contract research. The number of projects and their share of the total work of the Institute increased rapidly in the 1990s.

The research topics and methodologies of the Grassland and Animal Department cover four types of activity:

- '*farmer supporting research*' was initially based on farmers' questions, later transformed into

participatory research and eventually into experiential science (Baars and De Vries, 1999);
- *'basic research'* focused initially on questions about research methodology and later on understanding basic agricultural processes. The activity is science-driven, although it could be initiated by farmers' questions. Within this framework more attention has been paid to phenomenology of life processes and new researchers could freely explore intuition and imagination in developing scientific knowledge;
- *'concepts of organic farming '* were developed, explained and renewed and later mathematical modelling was also undertaken;
- *'sharing our own research findings'* directly with farmers by means of farmer discussion groups, demonstration projects and by means of articles and leaflets targeted directly at farmers.

4.1.1. Farmer supporting research

The Institute made the fundamental choice to engage in R&D together with organic farmers. The 1985 annual report of the Institute (Anonymous, 1985) presented a policy for organic agricultural research: *'A core idea of bio-dynamic farming is the perspective on the individuality of the farm (Steiner, 1924). This means that every farm has its own identity, depending on the farm's position, soil quality, natural, social and economic environment and the farm's managers. The specific farm identity can be developed more intensively when the import of inputs such as manure, fodder and seeds is reduced. Research will be undertaken to strengthen organic farms in such a way that farms become less dependent on conventional inputs.'* Of course, organic farmers undertook many small trials themselves. They were very keen to develop new insights to improve their farming situation. Such 'research' activities took place without any formal connection between farmers and researchers. Recently, Swagemakers (2002) defined the results of such small trials as novelties (see also Nielsen, 2001): '*a change in the farming system and / or the relation between the farm and its environment, which is developed by the farmer himself, although not yet recognised or valued by others. Novelties are meant to reach a new, desired farming situation....Farmers improve their situation in a certain direction and bring it to perfection by means of one or a set of novelties.'* From our own experience we knew that, depending on their interest, farmers tried to develop their system by trial and error. However, in the choice of our on-farm research projects we focused on the farmers' actions and activities and not on their oral description of their problems. Their activities better express the personal involvement of the farmers with the problem or new challenge. It is important that the farmers were really the owners of a question.

This research approach was initially called farmer-supporting research. Researchers would assist the farmer in his development activities. The farm manager was the owner of the problem. It was the task of the researcher to assist him with literature review, layout of experiments, specific

... farmer supporting research: experimenting on commercial farms ...

analytical measurements (if necessary), and the publication of results. The selection of research topics was discussed in an annual meeting with a delegation of four organic dairy farmers plus a farm adviser. The delegates were responsible for the choice of research topics and decided how to divide up the available money. This approach led to a large number of small on-farm projects. Questions were farm-specific and therefore very diverse. Questions covered all areas of organic dairy farming. The criterium for deciding to work on a farmer's question was whether the specific question was innovative for the farmer (personal innovation) and whether the question opened new horizons for the improvement of organic systems (sector innovation). The farmer had a large responsibility in looking after the on-farm trials. This responsibility consisted of technical assistance to care for the plots and the treatments, and an interpretation of the effects. In most cases, trials were set up without replication. In specific questions, a specialised scientist, such as a nutritionist or a housing specialist, assisted in the research process. BOX 4.1 provides some examples of research undertaken in the field of grassland and animal production.

In addition to these farmer-directed research questions, there were topics that were hard to investigate in farm practice, because of time, risk or cost. In that case the researcher had another role as dialogue facilitator in group meetings of farmers. Examples are the introduction of dairy cows from a specific breeding program based on life-time production; prevention strategies for mastitis from an organic point of view; discussion groups about the role of the farmer's biography in relation to choices and farm results.

An important conclusion was that these farmer-directed experimental studies could be seen as pilot projects for exploring new problem areas. They could be transformed into more detailed and larger experimental trials, if necessary and supported by basic scientific studies. Another possibility was to deepen the participatory work on individual farms in projects of a longer duration and with a longer co-operation between the farmer and a group of scientists of different disciplines. In that case commercial farms were treated as experimental farms.

BOX 4.1. Examples of research topics in grassland and animal production research

- Comparison of dairy breeds in terms of their suitability for a mixed farm;
- The feasibility of replacing composite concentrates by individual ingredients;
- Optimal timing of manure application on grassland;
- The effects of bio-dynamic preparations 500 and 501 on the yield and quality of natural grasslands;
- The effects of extra potassium on yields of permanent pastures;
- The control of docks (*Rumex obtusifolius*) by bio-dynamic ash preparations;
- Alternative strategies to reduce phosphate shortages and increase the availability in crop rotations;
- The quality of the intake of roughage from nature reserves;
- The extent of leaching of nutrients from compost stored in the field;
- The feasibility of over-sowing with clover;
- Comparison of the quality of calves from different breeding programs;
- Comparison of red clover varieties on their suitability for ley farming;
- The effectiveness of using homeopathic nosodes to improve dairy cow disease resistance;
- Fly ecology and control of flies in barns;
- The effectiveness of grass-white clover mixtures in leys or in permanent pastures;
- Minimum P and K levels required for effective grass-clover mixtures;
- Methods to control bird damage in germinated maize and cereals.

4.1.2. Basic science

The focus in basic research at the Louis Bolk Institute was on 'life science'. At the Institute, the term has the meaning of a science concerned with life processes in general. Three types of life science research can be distinguished and two of these are discussed in this thesis, Goethean science (see BOX 4.2 [36]; Seamon and Zajonc, 1998) and multidisciplinary system research. The third one, the so-called picto-morphological method of crystallisation, that is thought to reveal complex life processes, and used in research of produce quality, is left out of the discussion. Picto-morphological methods are practised especially at the Department of Human Health and Nutrition of the Institute.

[36] Miller (1994) describes Goethe's scientific studies on plants, light and animals.

BOX 4.2. Johan Wolfgang von Goethe (1749 – 1832).
Goethe made observations on plants as well as on animals, but he is also famous for his theory of colour. His most popular book is 'The metamorphosis of the plant' (Von Goethe, 1978). Goethe was looking for the unity in the world of plants, a holistic point of view. He was interested in the 'archetypal plant', an idealistic or spiritual phenomenon or proto-plant from which all plant types can be developed. This plant is not physically present, but is present as an idea in the cosmos. Such a view can be compared with a 'model', although Goethe's imagination of this proto-plant was not fixed, but very lively. Within anthroposophy, the work of Goethe has been developed into phenomenology, called Goethean science. As a holistic method of research, Goethean science looks for the 'expression of an organism' or in other words the 'inner language of an organism'. In discussing Goethe's scientific work, Brady (1998) calls this 'the idea in nature'.

The initiatives in Goethean science were mainly undertaken by scientists interested in a better understanding of complex research issues. As a qualitative and descriptive research method, Goethean Science tries to understand and reveal the quality of life. In addition to traditional quality criteria, such as nutrient content, taste and absence of negative values (mainly of end products), attention was also paid to the growth and development of plants and the expression of life in growth patterns. Based on this attention to process and development, the physiognomy of the object of study (the 'Gestalt') is used to answer questions about its inner quality. The approach is used for topics such as improvement of the landscape quality on farms, grassland quality in relation to the use of bio-dynamic preparations, produce quality in relation to specific plant shapes, soil fertility and landscape, and the quality of organic products.
In the multidisciplinary research approach we emphasised measurable, quantitative and technical results of organic farming, based on reductionistic science.

4.1.3. Development of concepts

The development of concepts relating to organic farming was based on three approaches. In the first two indigenous knowledge was used, at first from more spiritual sources and secondly from experiences of farmers who had worked out complete farming systems, or parts of farming systems. The third approach to concept development was very similar to conventional mathematical modelling used as the final step in a reductionistic approach.
In bio-dynamic farming, concept development is based on the spiritual insights of the anthroposophist Steiner (1856-1925). His insights were used for concept building of mixed

farming, landscape building, composting of manure, closed nutritional farm cycles, etc. Steiner's tacit knowledge were transformed into terminology that could inspire organic farmers in their farm development. Important issues were 'the individuality of the farm' and 'the farm as an organism' (Steiner, 1924). Examples of the use of these insights as concepts for farmers are:

- Using the wholeness and the growing process of the forest ecosystem as a metaphor for organic farming systems (Baars, 1990-b);
- the concept of naturalness as a basic principle of organic farming (Verhoog *et al.*, 2002 a; b);
- the concept of partner farms as an alternative to mixed systems (Baars, 1998; Nauta *et al.*, 1999, see also Chapter 5.3);
- the concept of family breeding as a breeding method reflecting the interaction of genome and environment (Baars, 1990-a; Endendijk *et al.*, 2001, see also Chapter 5.4).

... the forest ecosystem as a metaphor ...

4.1.4. Consulting and dissemination

The dissemination of research findings is a follow-up to research. In communication with organic farmers we have used different tools to share information. Although knowledge was also disseminated to the extension service (DLV), we have chosen to stay in direct contact with the organic farmer community for purposes of sharing our own research findings. Tools for sharing research findings were: training courses for farmers and advisors; one or two page pamphlets and newspaper articles; translations of available foreign knowledge; farmers' guides; loose leaf intermediate reports, final scientific reports, posters and scientific conferences; national and international scientific discussion groups; books.

4.1.5. Mission statement of the Agronomic Department of the Louis Bolk Institute

After more than 20 years of R&D experience, the mission statement of the Agronomic Department was adapted in 1999 to express the objectives of our scientific approach as follows:

The research will build bridges between
- *science and pioneering farmers*
- *science and ethics of organic agriculture*
- *science and ecology..........*

..to serve the quality of life and life processes.

The development of the budget of the Louis Bolk Institute is presented in Figure 4.1

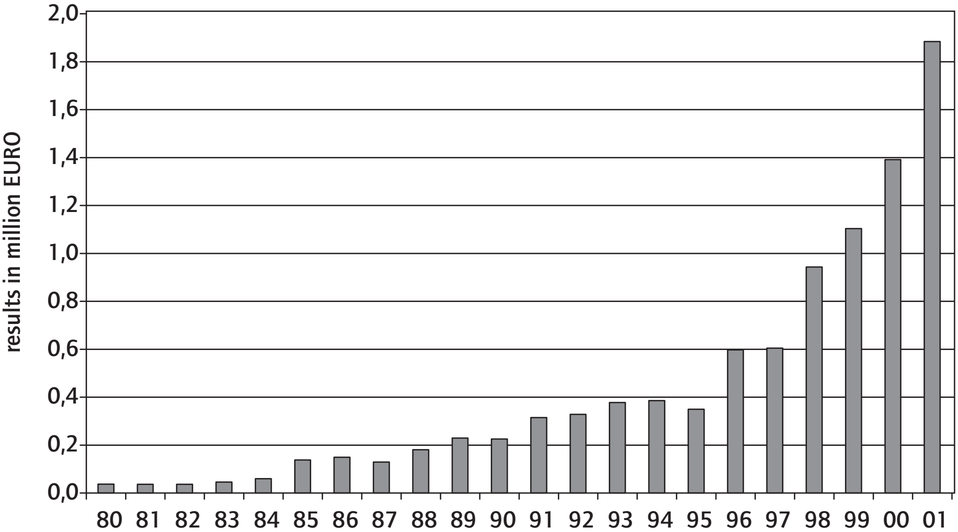

Figure 4.1. Annual financial turnover of the Agricultural Department of the Louis Bolk Institute in million Euro

4.2. Research in organic farming by public institutions

In he Netherlands, the growth of the organic sector in the last 25 years has led to a gradual change of policy and support. In 1976, the Commission on Research into Biological Methods of Agriculture (COBL) published a description of existing types of alternative agriculture (Boeringa, 1977). The commission's report advised to give high priority to research into new forms of agriculture with specific targets such as the relationship of agriculture and nature and alternative forms of agriculture. Thirteen themes were distinguished in alternative agriculture that needed research attention. The report suggested that specific attention be paid to the quality of organic produce. As a result of the report, two private advisors of the Bio-dynamic Association were employed in the governmental advisory service (1979). Furthermore, a farming system experiment started in 1978 to compare the outcomes of conventional, integrated and bio-dynamic farming in terms of yields, N-emissions, etc. (OBS at Nagele, Flevoland), and a study was launched to compare quality of produce (carrots, wheat and milk) of organic and conventional origin (1981/82). The comparison not only took into account the origin of the produce, but also the different research methodologies employed (Baars, 1982). In 1981, a special chair for alternative agriculture was established at Wageningen University using external funds.

In those early years, official research in organic farming was mainly based on the personal interest of individuals. The Institute for Agricultural Economy (WUR-LEI) started in 1972 with a case study of an organic dairy farm (Cleveringa, 1978). Cleveringa was already involved in the bio-dynamic movement. Later years the Government gave WUR-LEI the task of regularly collecting information on economic results of a group of organic farms as part of WUR- LEI's official task of collecting farm economic data. Another research initiative came from the erstwhile Institute for Agro-biological Research (CABO). Its interest in nutrient losses and nutrient cycling in farming systems and the role of red and white clover in grasslands led to two research projects on the contribution of legumes to grassland systems (Van der Meer and Baan Hofman, 1989). Ennik *et al.* (1982) also measured the productivity of old pastures in Friesland that did not receive mineral fertilisers. These projects were undertaken mainly because of the interest in forage legumes in low input systems. Due to high fertiliser nitrogen levels, legumes had almost disappeared from conventional farming systems.
In October 1992, a full professorship in organic farming commenced at Wageningen University. The title of the professorship was changed in 1999 from *alternative agriculture* to *organic farming systems*. A weak point was the poor contact among researchers of several disciplines within the university and between researchers and farmers. It was decided that more attention should be paid to complete systems and less attention to partial solutions.

New government policy on research into organic farming led to an increase in the conversion of official research farms in the late 1990s. WUR-PRI and WUR-PPO converted several locations for arable and vegetable production. In May 1997, the official research farm of Wageningen University, the AP-Minderhoudhoeve (Swifterbant), started a research project on different farming systems, one based on ecological farming and another on 'best agronomic methods '. The aim was to reduce harmful emissions while meeting the profitability needs of a farm [37].

[37] The Minderhoudshoeve will be closed in 2003. A new organic testing and learning facility will be created in Wageningen.

In 1997, applied research farms also converted to organic fruit growing, organic bulb-flower production and production of organic nursery trees. The Ministry of Agriculture invested in the stimulation of the exchange of knowledge and information between researchers of the Louis Bolk Institute, which was regarded as a pioneer institute, and scientists of the different research stations for applied research. In dairy production, the conversion of a research farm to an organic experimental facility was made in 1998 (at Heino), for pigs in 1999 (at Raalte) and for poultry in 2001 (at Lelystad). In August 1998, a program was formulated for multifunctional agriculture (WUR-PRI). Keywords in this program were 'sustainable agriculture' and 'ecologisation of agriculture'. In addition to attention to labour, income and production, organic agriculture was expected to also pay attention to environment, animal health and welfare.

The amalgamation of Wageningen University and the public agricultural research institutes (DLO) and Applied Research Institutes led to the formation of Wageningen University and Research Centre (Wageningen-UR, WUR). In has established a central, organisation-wide co-ordination centre for organic agriculture called the Innovation Centre for Organic Farming (IBL). It advises in the formulation of the research agenda for organic farming, together with the Platform Biologica [38] and the Louis Bolk Institute. In February 2000, a research agenda was presented (Kloen and Daniels, 2000). The information was based on an inventory of ongoing research in 1999 and demands for research formulated by the organic sector. Twelve themes were defined and a plan was made to increase the yearly budget for organic farming from 4% in 2000 to 10% in the next years [39].

In conclusion

The share of public R&D in organic farming is increasing rapidly in The Netherlands. The research agenda is based on the needs of the organic sector. The early start of the Louis Bolk Institute in R&D for organic farming has allowed it to formulate a clear mission statement with regard to research methodology. In co-operative projects with other organisations increasingly engaged in R&D for organic agriculture, shared experience can be used to develop an approach research that reflects the principles of organic farming. In this dissertation, an attempt is made to identify such an approach.

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[38] This is an umbrella organisation of organic farming, connecting farmers and traders. Since 2000 there are two joint staff positions between Wageningen-UR and the Platform Biologica dealing with R&D in organic farming.
[39] The budget for organic farming research at Wageningen UR was € 8.5 Million in 2002, 7.7% of their total agricultural research budget (personal communication J.Meijs, director IBL).