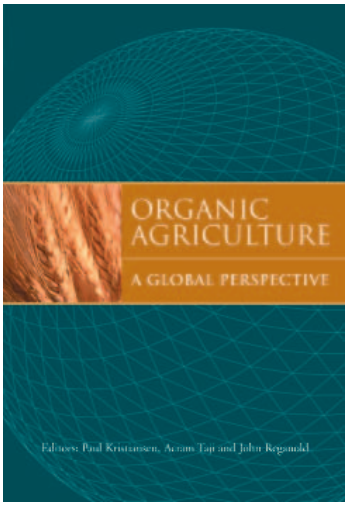

Organic Agriculture

A Global Perspective

Edited by Paul Kristiansen, Acram Taji and John Reganold

This book is available from **CSIRO** PUBLISHING through our secure online ordering facility at http://www.publish.csiro.au or from:

Customer Service
CSIRO PUBLISHING
PO Box 1139
Collingwood Victoria 3066
Australia

Telephone	+61 3 9662 7666
Local call	1300 788 000 (Australia only)
Fax	+61 3 9662 7555
Email	publishing.sales@csiro.au

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Chapter 1

Overview of organic agriculture

Paul Kristiansen*, University of New England, Australia and Charles Merfield, Lincoln University, Canterbury, New Zealand

*Dr Paul Kristiansen, School of Rural Science and Agriculture, University of New England, Armidale, New South Wales 2351, Australia. Tel: +61 2 6773 2962, Fax: +61 2 6773 3238, Email: paul.kristiansen@une.edu.au

> The most important factor that will enable organic agriculture to usefully contribute to food security is the attitude of decision-makers. Organic agriculture must be discussed with an open mind, with the advantages and disadvantages being clearly considered. (Wynen 1998)

The search for sustainability

The acquisition of food, textiles and other resources from plants and animals has been a major concern for human societies, from the earliest days as hunter-gathers, through pastoral and swidden phases, to agrarian societies, with an associated trend away from nomadic to sedentary lifestyles. Yet as agricultural production intensified and expanded, the negative effects on the underlying resource base have also increased. The history of environmental damage caused by agriculture is well documented; impacts include air pollution from greenhouse gases such as carbon dioxide, methane, nitrous oxide; land degradation as a result of clearing, cultivation of sloping land and salinity; water pollution from fertilisers, pesticides, overuse and wetland draining; and the loss of biological and ecological diversity (Norse and Tschirley 2003). In the area of conventional weed science, for example, considerable attention has been placed on herbicides but this has not achieved a long-term decline in agricultural weed populations. Instead, farmers have become dependant on herbicides as widespread resistance in a range of weed species has emerged (Gill 2002).

Although the extent of the damage may be disputed by some, the seriousness of these agricultural sustainability issues is reflected in the formal policies implemented in many countries to reduce those impacts, and in the financial benefits available for (verified) good environmental performance (OECD 2001). Policies designed to improve the environmental sustainability of agriculture include bans on increasing numbers of pesticides such as the fumigant methyl bromide, financial incentives to revegetate, penalties for water pollution and funding for research into efficiency improvement (e.g. fertiliser applications) or damage abatement technologies. The various policy tools may be applied in an *ad hoc* way or, preferably, in a strategic manner that integrates the tools and creates a supportive milieu for adoption and improvement. In regard to measuring performance, environmental management systems (EMS) for agriculture have recently become popular with some farmers, government agencies and consumers. EMS are relatively new and suffer from several limitations including credibility, complexity, financial risk, uncertain consumer demand and patchy evidence of environmental improvement (Chang and Kristiansen 2006).

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Is organic agriculture the answer to the sustainability problem?

To ensure that organic agriculture is the answer to the sustainability problem, it has to be adapted to the local farming, social, geographical and climatic factors. The European form of organic agriculture, especially its current market-driven style, is not necessarily the most appropriate system for other countries. The principles of organic agriculture are guides to tailor organic practices to each individual farming location. For example, there will always be locations where certain crops cannot be grown sustainably or economically using the current range of organic methods. As more becomes known about the environmental, social and economic performance of organic agriculture in a growing range of settings (OECD 2003), rational decisions can be made about the prospects and limitations of organic agriculture and general requirements for success can be identified.

It could be expected that settings similar to that found in Europe where organic agriculture was originally developed would be the most suitable. However, low-input systems in remote locations with marginal environments (e.g. rangeland grazing) have also been found to be well suited to organic agriculture. In New Zealand and particularly Australia, the farming conditions faced by the early proto-organic growers were very different from those encountered in Europe. In Australia the unreliable and sparse rainfall, ancient depleted soils, widely dispersed production bases and very small consumption bases present serious challenges for agriculture, both organic and conventional. Some adaptation and experimentation was going to be necessary. In parts of south-eastern Australia broadacre, organic cropping depletes phosphorus from the soil because the allowable organic fertilisers are inadequate. In contrast, further north in the rangelands of western Queensland, running beef cattle organically is straightforward and the farms appear to be no less sustainable than before conversion. Clearly, the sustainability question must be addressed in terms of particular farm types.

In many countries, organic agriculture has affected most areas of agriculture and food production, often starting in niche markets such as 'direct to customer' or on-farm processing. It has been adapted to local conditions, both social and agronomic, to produce viable sustainable farming strategies. This has resulted in a multitude of sustainable and profitable organic enterprises emerging around the world (Stokstad 2002, Thompson 2002) showing that organic agriculture can have a central role in ensuring that agriculture becomes fully sustainable.

Organic agriculture is just a small part of the agribusiness world, which itself is just a small part of the wider global socioeconomic system and its dominant cultural values. Consequently, the capacity of organic agriculture to influence, for example, international trade, labour relations and agrichemical policy is limited. An example of this lack of power is in the US National Organic Program (NOP) deliberations, in which representatives from the organic movement were secondary to government agencies (Merrigan 2003). Although the movement may internally aim for certain ideals, its development is inevitably shaped by global markets and politics. Stepping back from looking at the organic movement's success, it is apparent that despite the enormous growth since the 1990s, organic agriculture still only makes up a tiny proportion of all commercial agricultural production (Norse and Tschirley 2003).

This introductory chapter presents an overview of the history and development of the organic movement from its roots in early 1900s Europe to its current position as a high-profile, thriving niche sector in global agriculture. The chapter describes some of the key people and trends which shaped modern organic agriculture and reports on the status of organic agriculture around the world in specific countries. In order to understand the aims and practices of organic agriculture, the evolution of the core principles are also discussed. Finally, some of the challenges for organic agriculture are identified.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Definition of organic agriculture

Organics, or the 'O-word' as Mark Lipson (1997) has wryly called organic agriculture in recognition of the ambiguous nature of the word, is a problematic label that can be interpreted to mean a wide range of things. The term 'organic' was first used in relation to farming by Northbourne (1940) in the book *Look to the Land*: 'the farm itself must have a biological completeness; it must be a living entity, it must be a unit which has within itself a balanced organic life'. Clearly, Northbourne was not simply referring to organic inputs such as compost, but rather to the concept of managing a farm as an integrated, whole system (Lotter 2003).

The use of 'organic' in reference to agricultural production and food is legally constrained in many countries, and some certification agencies have more stringent compliance requirements than others. Many farmers in less developed countries may practice organic agriculture by default based on their traditional methods of production. However, it is useful to provide a general definition of organic agriculture to indicate briefly what the production systems are designed to achieve.

The international food standards, Codex Alimentarius, state:

> Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system. (FAO 1999).

The term 'organic agriculture' as used here is based on the Codex definition just given. However, the term is expanded to include the full organic and biodynamic supply chain from inputs to final manufactured goods, as well as cultural and social aspects of the movement, not just the on-farm production aspects. The phrase 'organic movement' may be no longer applicable and that the appropriate term is 'organic industry' (Cornish and Stewart 2002). However, the continued existence of a major social and political role for organic agriculture suggests that it is more than just an industry. Conservation farming (reduced tillage) also continues to be a social movement (e.g. WANTFA 2004) even after an industry has been created in the commercial arena.

Organic standards are not static, with revisions of certification standards commonly occurring every few years. Certification agencies usually have some form of certification review committee that considers new materials that become available for use, new information about existing allowed inputs, or new production and processing techniques that are introduced.

The commonly used term 'conventional agriculture' refers to the standard, dominant farming approaches promoted and researched by most government and agribusiness groups and practiced by farmers and growers throughout the world. Usually, conventional agriculture imposes no restrictions on management other than those required by law. To some extent, organic and conventional agriculture define each other. Organic agriculture could not exist as a concept until an alternative agricultural paradigm came into being allowing a distinction to be made. Indeed, the term 'organic' only became dominant from the 1960s onwards. It is acknowledged that the term 'conventional' masks the great diversity of management strategies used; for example, a conventional grain grower may use mineral fertilisers but also use green manures and avoid pesticides, or a permaculture orchardist may choose to use herbicides to control woody weeds in sloping land. The growing adoption of EMS indicates the recognition from various points along the supply chain of the need for improved monitoring of agricultural impacts (Carruthers and Tinning 2003).

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

The origins of organic agriculture

Early development

The origins of modern organic agriculture are intertwined with the birth of today's 'industrially based' agriculture. Many of the practices of organic agriculture were the only option for farmers before the advent of chemically synthesised fertilisers, biocides, medicines, mechanisation and fossil fuels that allow industrial agriculture to function. Without recourse to such technologies, farmers had no option but to work within biological and ecological systems. For example, the only source of fertiliser to replace nutrients from cropped fields was human and animal manure and leguminous plants. Failing to rotate crops caused a build up of pests, as there were no pesticides to control them. From this perspective, organic agriculture is the original and mainstream agriculture and 'conventional' industrial agriculture is the one that departs from the practices that agriculture has been following since its inception.

This split between industrial and organic agriculture dates back to the start of the 19th century when it was discovered that it was the mineral salts contained in humus and manure that plants absorbed, and not organic matter. Sir Humphrey Davy and Justus von Liebig were the key founders of this theory and published their ideas in *Elements of Agricultural Chemistry* (Davy 1813) and *Organic Chemistry in its Application to Agriculture and Physiology* (von Liebig 1840). Their argument was that inorganic mineral fertilisers could replace manures and bring agriculture into the scientific fold, with resulting increases in production and efficiency. The agricultural revolution began in the 1840s and with it came the first commercial production of inorganic fertilisers. However, like many revolutions, it was not without mistakes and significant uptake of fertilisers did not occur until the start of World War Two (Grigg 1989).

It was in the 1920s that individuals who were concerned about the direction agriculture was heading first started to speak out and to join together. Rudolph Steiner, the founder of the philosophy of 'Anthroposophy' gave his agricultural lectures in 1924. Although these lectures and other Steiner teachings were the foundation of biodynamic agriculture, which differs from organic agriculture principally as it has spiritual, mystical and astrological aspects, they were prophetic in their criticism of industrial agriculture and in plotting an alternative course. The first organic certification and labelling system, 'Demeter', was created in 1924 because of Steiner's actions (Rundgren 2002).

During this time, Robert McCarrison, a distinguished scientist, was researching the vitality of the fighting men of India and why they lacked diseases common in the west. He promoted health as a positive concept of vitality rather than a negative form viewed as an absence of disease. Good health was based on a diet of wholesome food – mostly fresh plants and grains with modest amounts of meat, grown on land to which all manures were returned (i.e. following the 'law of return'). McCarrison followed up his observations with dietary experiments on rats, feeding one group on the diet of the Indians and the other of the British poor. The rats on the Indian diet flourished, while the others suffered a range of diseases and negative sociological effects. This led McCarrison to expound the importance of a wholesome diet grown on soil fertilised with manures and other organic matter.

Sir Albert Howard was also working in India in the 1920s on an experimental agricultural research institute he established. Howard was a highly capable scientist as well, and while his training was more than sufficient to understand the new chemical ideas, his upbringing on a Shropshire farm made him highly sceptical of the approach. He was a keen observer of the local peasant farmers and said that he learnt far more from them than from his scientific training. Howard undertook a wide range of activities including a highly successful plant breeding program and observed the effects of how forage was grown on the health of farm animals. This led him to believe in the inextricable linkages between the health of the soil and

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

the health of the plants and animals fed by that soil. This lead to him adapting oriental methods of composting to Indian conditions which resulted in the 'Indore process' of composting which is now inextricably linked to his name. These experiences were distilled into his book *The Waste Products of Agriculture* (Howard 1931), which spread his message across many continents.

Beyond Europe: further evolution and new alliances

It was the work and publications of people such as Howard, McCarrison and Steiner that influenced the next wave of organic pioneers. This second wave brought the organic movement into being, with the establishment of the early associations such as the Rodale Institute in the United States of America (USA), Soil and Health in New Zealand and the Soil Association in the United Kingdom (UK). The term 'organic' was first used in relation to farming by Northbourne (1940) (see above).

In the UK, Lady Eve Balfour was setting up the 'Haughley experiment', which compared organic and non-organic production over the long term. She also wrote the highly influential *The Living Soil* (Balfour 1943), which was partly informed by the Haughley experiment. She was also the first president and founding member of the Soil Association in 1946. Pre-dating both of these organisations was the Soil and Health Association in New Zealand, founded in 1942 by Dr Guy Chapman, a practicing dentist, originally under the name of the 'Humic Compost Club'.

In Switzerland, Hans and Maria Mueller were pioneering organic farming techniques. Herr Mueller was encouraged by the biodynamic agriculture of Steiner and developed the 'organic–biological' farming method in the 1950s. Hans-Peter Rusch, a medical doctor, microbiologist and good friend of Hans provided the scientific basis for Hans's work in his book *Bodenfruchtbarkeit* [Soil Fertility] that linked soil microbiology with fertility (Rusch 1964). This movement became more formalised in the 1970s with the adoption of the trade mark Bioland, now the largest certifier in Germany (Haccius and Lünzer 2000).

In the late 1930s in rural Pennsylvania, USA, J.I. Rodale was keen to learn about and practice organic agriculture. He quickly came to realise the importance of restoring and protecting the natural health of the soil to preserve and improve human health. In 1947 he founded the Soil and Health Foundation that later become The Rodale Institute. He was also responsible for a wide range of publications on health and farming and gardening organically, with a central message and philosophy of 'healthy soil, equals healthy food, equals healthy people'.

Independent developments were occurring in Japan. In 1936, Mokichi Okada began practicing 'nature farming'. Nature farming includes spiritual and well as agronomic aspects with a view to improving humanity. It therefore has strong similarities to the biodynamic agriculture and anthroposophy of Rudolph Steiner. The Sekai Kyusei Kyo organisation was formed and continues to promote 'Kyusei nature farming' with experimental farms and offices located throughout South-East Asia. An offshoot group, the Mokichi Okada Association formed in 1980 with the aim of demonstrating the scientific validity of their farming methods (Setboonsarng and Gilman 1999). At about the same time as Okada was establishing his movement, Masanobu Fukuoka began a different approach to natural farming in Japan. With a background in microbiology and soil science, Fukuoka aimed to practice a simple form of agriculture, sometimes known as 'do nothing farming' (Setboonsarng and Gilman 1999). Like Okada, Fukuoka's farming approach also had a spiritual underpinning (Fukuoka 1978). The continuation and spread of these movements highlights the importance of seeing organic agriculture as a global phenomenon, not simply a European one.

While many of these organic pioneers' ideas are still relevant to modern organic agriculture, there were a considerable number of pioneers whose political and religious views would

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

be anathema to today's environmentally minded, socially concerned, politically left-of-centre, organic supporters. Many organic pioneers were significantly to the right of the political spectrum and strongly Christian, to the point of fundamentalism and evangelicalism. The politics, philosophy and religious motivations of these organic forerunners in the UK have been well documented by Conford (2001). The reason why the ideas of some organic pioneers are now foreign to the modern organic movement is that it underwent significant change and upheaval in the 1960s. The publication of *Silent Spring* by Rachel Carson (1962) was a key turning point for, and the start of, both the modern organic and environmental movements. This change could well be considered a revolution and, at the least, a significant evolution of the organic movement. Indeed, many of the concerns and concepts of environmentalism and modern organic agriculture would be quite alien to many of the organic pioneers, just as the politics and religion of some pioneers are alien to most involved with the modern organic movement. A case could be argued that environmentalism saved the organic movement from obscurity as it had lost the post World War Two argument over the direction of agriculture and was in significant decline through the 1950s. So while there is a continuum of thought and membership from the earliest days to the present, the modern organic movement is radically different from its original forms. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people.

Silent Spring opened the world's eyes to the damage that pesticides and other toxins were doing to the global environment. As such, *Silent Spring* brought a whole new raft of arguments against industrial farming in addition to those that the organic movement had been pushing for many decades.

The 1960s, in which *Silent Spring* was published, were also a time of significant social change and upheaval. New modes of political and philosophical thought were emerging and being hotly debated. Many of these were also highly influential within the changing organic movement. Examples of these ideas include *Limits to Growth* (Meadows *et al.* 1972) that considered the issue of the growth of the human population and the global economy and asked questions such as: what will happen if growth in the world's population continues unchecked? What will be the environmental consequences if economic growth continues at its current pace? What can be done to ensure a human economy that provides sufficiently for all and that fits within the physical limits of the Earth? Another was E.F. Schumacher's *Small is Beautiful: A Study of Economics as if People Mattered* (1974) with its many radical ideas, including the concept of sacrificing economic growth for a more fulfilling working life and making quality of life the central goal of economics. Schumacher was also a president of The Soil Association.

In the 1970s, organic agriculture re-emerged as an ecoagriculture and the strengthening of existing organic organisations and the founding of new ones occurred, many of which were focused on the process of certification of farmers and growers. Although there was growing interest in organic agriculture, it was still clearly outside of mainstream agriculture and national politics, and while members of the movement worked tirelessly, they gained little traction with authorities. The levels of self organisation, however, were increasing rapidly, from individual groups working alone to increasingly coordinated action.

The formation of a formal global network is one of the landmarks by which social and political movements can say they have come of age. For the organic movement this was the founding of the International Federation of Organic Agriculture Movements (IFOAM) in 1972, which to this day, remains the only global organic non-governmental organisation (NGO). Its creation and continuation was no easy task. Like many other organic organisations in its earlier years, it depended heavily on vast amounts of goodwill, the hard work of mostly unpaid people and its financial security was often in the balance. It has grown from a body that national governments ignored or argued against, to one that now commands the respect

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

of governments and intergovernmental organisations. IFOAM's mission is 'leading, uniting and assisting the organic movement in its *full diversity*' [emphasis added] (Woodward and Vogtmann 2004, IFOAM 2005). The main aims of the organisation are to:

- provide authoritative information about organic agriculture, promote its worldwide application and exchange knowledge;
- represent the organic movement at international policy making forums;
- make an agreed international guarantee of organic quality a reality;
- maintain the Organic Guarantee System, setting international organic standards and certification procedures and auditing member certification organisations to these standards; and
- build a common agenda for all stakeholders in the organic sector.

Explosive growth in organic agriculture occurred in the 1980s. The reasons for this are numerous and many were outside the control of the movement. The intensification of agriculture had become a national political issue, fuelled by public concerns such as the increasing destruction of valued features of the farmed landscape, the intensification of livestock production (e.g. battery hens) and food scares (e.g. bacterial contamination) which resulted in the public first discovering how industrial food production and processing systems worked, many of which they found shocking and repugnant. Organic food offered an alternative, resulting in considerable increases in organic food consumption during food scares. Increasing wealth and disposable income in some developed countries resulted in organic food becoming highly 'fashionable' among higher socioeconomic groups. This is highly ironic, as the purchasing and consumption of organic food as a symbol of social status is an anathema to the philosophy and principles of organic agriculture (Guthman 2000).

Organic agriculture goes global

Beyond the industrialised countries of western Europe and North America, a large growth in organic agriculture was occurring during the 1980s in parts of Oceania, Central and South America, Asia and Africa. Many of these regions had existing indigenous farming systems that could be readily adapted to organic agriculture, the export earnings were valuable, labour was available, and some places received support from, for example, their governments, aid agencies and NGOs. Although there are many local and regional movements around the world that are similar to (or compatible with) organic agriculture, it is the latter which has become the most well known and widely adopted complementary farming system. The other systems show how different societies develop their own approaches to low-external-input or non-chemical farming depending on their world view and the natural, intellectual and economic resources available to them. These indigenous systems themselves have enormous value in their own right (Peroni and Hanazaki 2002) and, where appropriate, should be maintained and supported. However, where the choices for farmers are changing, becoming more market orientated, for example, then a hybrid of local farming methods and organic agriculture may offer a viable alternative. Some of the incentives and constraints for farmers adopting organic agriculture in less developed countries are listed in Table 1.1.

The traditional farming systems of Central and South America have been well studied over many years (Gliessman 1985) and the principles and practices observed in these systems have been used to develop the concept and practice of 'agroecology', a scientific approach to low-input farming (Vandermeer *et al.* 1998). The emphasis on enabling biological and ecological processes, using existing resources and trading locally in the local farming system is well suited to organic agriculture. There has been a high level of adoption of organic agriculture in Central and South America in terms of certified land area and number of farms, with Argentina having

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.1 Incentives and constraints for farmers adopting organic agriculture in less developed countries (after Parrott and Marsden 2002 and Walaga 2000)

Incentives	Constraints
Disillusion with Green Revolution technologies	Lack of knowledge about organic agriculture
The inaccessibility or high cost of Green Revolution technologies	Lack of economic and political advocacy
Organic agriculture valorises indigenous knowledge	Population pressures encourage intensification
The influence of the environmental and development movements	The high cost of certification by foreign organisations
Premiums and market opportunities	Low literacy levels in rural areas make record-keeping a problem
	Lack of trade liberalisation in some countries prevents development of exports

the second highest amount of land under organic production in the world and Mexico having the greatest number of farms. With a large agricultural base, diverse environments, good labour supplies and close proximity to North America, many organic growers in Central and South America have been successful, principally in the export markets. However, socioeconomic constraints such as poverty and land tenure have shaped the process of adoption and adaptation of organic agriculture (Parrott and Marsden 2002).

Although Argentina has 3 million hectares of land under organic production (Yussefi 2004), 74% of that land is owned by 5% of the organic farmers (Lernoud and Piovano 2004). Remove those few large farms and the area of organic land would rank a more modest sixth globally, between Brazil and Uruguay. Beginning in the 1980s, the Argentinian organic movement has developed strong formal certification processes, good export links and has received valuable government support. In a show of diversity, Argentina has also eagerly adopted genetically modified crops, having the world's second largest area of such crops after the USA, with 10 million hectares grown in 2000 (Coffman 2001) and 14.2 million hectares in 2003 (Human Genome Project Information 2004). Like Argentina, Mexico exports most of its organic produce, 70% of which is coffee (Tovar and Cruz 2004). Smallholders make up about 98% of the 28,000 certified organic growers in Mexico, plus a small number of large *fincas* (estates) growing crops such as cocoa, sugar and coffee. Apart from an early biodynamic pioneer producing certified coffee in 1967, organic agriculture began to emerge in the 1980s and 1990s with the aid of some government support and easy access to US markets. However, Mexican organic producers still rely on overseas certifying agencies for exporting their goods and suffer from a lack of state support for research and development, a poorly developed domestic market, as well the dependence on foreign companies for marketing. In Cuba, the collapse of the Soviet regime in the early 1990s caused subsidies for conventional farm inputs to cease and the main markets to disappear, forcing the nation to seek sources of raw materials and alternative markets (Kilcher 2001). In response, Cuba developed several programs to promote organic agriculture including rearing biological control agents, producing bulk compost, restructuring state farms and developing training and certification frameworks. Although the country has not entirely moved away from intensive, export-oriented conventional agriculture based on plantations, Cuba produces 65% of its rice and 50% of its fresh vegetables organically.

Several recognised complementary agricultural systems have also been developed in Asia (Setboonsarng and Gilman 1999). During the Later Vedic Period (1,000 BCE–600 BCE) in India, a series of three works codified a system of agricultural principles and practices in great detail. This indigenous knowledge is still applied today in parts of India and acts as an aid for

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

farmers converting to organic agriculture (Mahale and Sorée 2002). Two very worthwhile aspects of integrated farming that were traditionally overlooked by the organic movement are aquaculture and mariculture. Yet in Asia some ecological farmers have extensive knowledge about these subjects that can be readily integrated with organic agriculture methods. Despite a long history of sustainable agricultural production in China, modernisation of farming practices during the 20th century led to the abandonment of customary methods and knowledge. This trend changed during the 1980s when China began carrying out a research and demonstration program for ecological agriculture. By 1990, they had entered the international organic market with tea certified by a foreign agency, in 1994 the Organic Food Development Center was established and the following year a set of national organic standards was published (Zong 2002). China is unusual because the introduction of organic agriculture has been a top-down process (Zong 2002), unlike the experience of most countries where organic agriculture has been a farmer/consumer-based movement, initially championed from the bottom up. The other example, Cuba, is also a socialist state.

Many parts of Africa experience severe poverty and face some of the most difficult conditions for agricultural production. Developing solutions is an ongoing problem, and it is likely that many strategies will be needed, each customised to the needs of the targeted community. Organic agriculture has been adopted in few African countries. For example, the establishment of the Kenyan Institute of Organic Farming in 1987 increased the transfer of information about organic methods and, although the government was not initially supportive, the country now has the largest number of IFOAM members of any African nation (Parrott and Marsden 2002). Countries in the west of Africa such as Senegal and Burkina Faso have also established NGOs that set local certification standards to reduce external certification costs, provide training in organic food processing, labelling, packaging and storage and establish local and distant markets for selling organic produce (Anobah 2000).

Australia has the largest (10 million hectares) and Argentina the second largest (3 million hectares) area of organic farmland in the world (Yussefi 2004). A major portion of the organic land in these countries is used for extensive, low-input grazing on relatively few individual farms. The high level of adoption of organic agriculture by graziers in these countries suggests that organic pastoral production was technically easier to implement than organic broadacre cropping. Both countries have well-developed export markets for organic grains (Halpin and Brueckner 2004, Lernoud and Piovano 2004), so differences in market size and accessibility are unlikely to be a limiting factor for organic cropping.

The modern organic movement

Scientists became increasingly interested and aware of organic agriculture in the 1980s, even those who were not supportive of alternative agricultural systems. They found the academic climate and funding sources were more amenable to its study than in previous decades, which resulted in a rash of research, much of which, unfortunately, was comparisons of organic and non-organic agriculture, rather than research designed to assist organic producers or underpin organic principles and practices (Lockeretz 2002). By the end of the decade, the level of interest in organic agriculture and the volume of information compiled about organic methods had become sufficient to enable the highly successful publication of the landmark book *Organic Farming* by Nicolas Lampkin (1990).

Trends that began in the 1970s, and accelerated through the 1980s, continued to flourish during the 1990s and into the new millennium. Demand and production continued to grow exponentially around the world, often at 20–30% per year. Formal political and legislative recognition was achieved. Normally this was started by bringing organic agriculture under legislative control. Following this were intergovernmental agreements to facilitate international

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

organic trade, mostly by creating systems by which certification standards in the exporting country were shown to be equivalent to those of the importing country, a system that parallels and duplicates IFOAM's Organic Guarantee System. Significant political traction was also being made in international/intergovernmental agencies such as the European Union (EU) and the United Nations Food and Agriculture Organization. Public concerns about food and its production systems continued with further 'food scares' such as bovine spongiform encephalopathy (BSE) in the UK and the emergence into public awareness of 'genetic engineering'that in parts of Asia, Australasia and particularly Europe became a highly charged political issue.

Science increasingly became a tool to demonstrate the benefits of organic agriculture and the problems with industrial agriculture (Pretty *et al.* 2000). This helped organic organisations make the case for much closer cooperation between themselves and other environmentally aligned organisations, for example nature conservation groups. It also showed that useful research could be carried out on organic farms. Since the 1980s, numerous organic research centres and associations have been established internationally; taken active roles in conducting new research in the agronomic, environmental and social sciences; have documented and published findings to fill the strong demand for information; and provided extension and training to farmers and advisers. Several NGOs and companies began to perform an auxiliary function to the certifying agencies by carrying out independent reviews of products intended for use in certified organic production, handling and processing. The Organic Materials Review Institute (www.omri.org) and Pesticide Action Network North America (www.panna.org) are examples of such organisations.

By the late 1990s increasing concerns were being raised about organic agriculture following in the footsteps of industrial agriculture and losing its vision (e.g. Woodward *et al.* 1996). Examples of this are the huge growth in sales though supermarkets and increasing amounts of organic produce being transported large distances to satisfy demand in affluent countries. This concern is explored further in Ikerd (see *Special topic 3*). These concerns have resulted in a refocusing on the neglected issue of social equity (e.g. ensuring that farmers are paid a fair price for their produce). One outcome of this is the linkages formed between the Fair Trade and the organic movement (Browne *et al.* 2000). There is active debate on introducing Fair Trade requirements for European organic producers that have, to date, only been used by farmers in the third world. A practical example of reforming the links that existed between organic producers and consumers in the 1960s and 1970s are the rapid increase in 'farmers markets' in the USA and UK where traditional produce markets have been resurrected by requiring stall holders to be both local and only sell goods they have produced (Vanzetti and Wynen 2002).

In 2004, 80% of organically managed land is located in only ten countries, with more than 50% in two countries, Australia and Argentina (Yussefi 2004). However, the most intensive adoption of organic agriculture has occurred in western Europe, especially in the German-speaking countries and Scandinavia, with three countries achieving at least 10% of organic agriculture and five more countries with over 5% organic agriculture (Table 1.2). The highest numbers of organic farms are reported to be in many non-European countries, although some European countries also have over 15,000 organic farms (Table 1.3).

Most consumption takes place in affluent countries. The global organic market is estimated to be worth about US$23 billion from organic food and drinks, of which North America collects about half, Europe gets nearly half also, while only 3% of revenues are shared between all other countries (Sahota 2004). Traditional staple food products such as grains, fruit, vegetables, meat and diary products are most commonly grown, although demand for cash crops such as sugar, coffee and wine is also increasing.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.2 Percentage of national agricultural land under organic management (Yussefi 2004)

Country	Percentage (%)
Liechtenstein	26.4
Austria	11.6
Switzerland	10
Italy	8
Finland	7
Denmark	6.7
Sweden	6.1
Czech Republic	5.1
United Kingdom	4.2
Germany	4.1

Many governments today have accepted the arguments that there are problems with conventional agriculture and that organic agriculture offers a viable solution to many of these. This has resulted in policies and government actions that support the development of organic agriculture along two main pathways (Dabbert *et al.* 2001):

1 for the marketplace, or
2 for public-good environmental outcomes.

There are a numerous areas where agricultural policies have the potential to influence the adoption and success of organic agriculture (Table 1.4).

A key policy role for many governments is defining organic agriculture in law and creating enforcement mechanisms, often by using existing non-governmental certification agencies. Examples of this are the NOP in the USA and EU Regulations 2092/1991 and 1804/1999 (for crop and animal production respectively). Laws such as these are often as much for the protection of consumers as for the advancement of organic agriculture. A second policy role for many governments is the provision of direct subsidies for conversion and, in some cases, ongoing production. The use of cash subsidies for using certain farming practices is a common feature of agricultural production in many countries. In Europe especially, such incentives have been

Table 1.3 Number of farms under organic management (Yussefi 2004)

Country	No. of farms
Mexico	53,577
Italy	49,489
Indonesia	45,000
Uganda	33,900
Tanzania	26,986
Peru	23,057
Brazil	19,003
Austria	18,576
Turkey	18,385
Spain	17,751

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.4 Agricultural policy mechanisms relevant to organic agriculture (after Part 3 of OECD 2003)

Providing regulatory frameworks, including review processes
Direct subsidies for conversion and on-going production or performance targets
Market facilitation (domestic and international)
Funding research, extension and educational activities
Regional development initiatives
Penalties for environmentally harmful inputs, e.g. polluting, chemical contamination
Removal of disincentives, e.g. weak labelling requirements

used for several years to encourage growers to convert to organic agriculture. Although improvements in the relative competitiveness of organic agriculture have been found and are expected to continue, it is unclear if direct payments have been the most efficient tool for improving environmental performance of farmers (OECD 2003).

More recent government policies have actively assisted and promoted organic agriculture as a means of addressing the problems of agriculture. In the UK, the Department for Environment Food and Rural Affairs (DEFRA) developed the 'action plan' to ensure stable and strategic growth for organic food production (DEFRA 2002).

Organic agriculture is now widely recognised by the public and governments as a valid alternative to conventional agriculture and is a source of ideas and approaches that conventional agriculture can adopt to make it more sustainable. However, the process of reaching this position has resulted in organic agriculture taking on some of the practices of conventional agriculture that are at odds with organic principles. A groundswell has started that is attempting to focus the organic movement on addressing these concerns; however, many of these off-farm issues, for example, food miles, may be much harder to change than what has been achieved on the farm.

The principles of organic agriculture

Development of the principles

To understand the motivations of organic farmers, the practices they use and what they want to achieve, it is important to understand the guiding principles of organic agriculture. These principles encompass the fundamental goals and caveats that are considered important for producing high quality food, fibre and other goods in an environmentally sustainable way. The principles of organic agriculture have changed with the evolution of the movement. Modern organic agriculture's alignment with the wider environmental movement has resulted in principles that have a stronger environmental focus than those from the first half of the 20th century. In addition, it is only within the last 30 years that the principles have been codified and explicitly stated. For much of organic agriculture's history, the principles were unwritten as they were inherent in the philosophy and practice of the farmers:

1 The concept of the farm as a living organism, tending towards a closed system in respect to nutrient flows but responsive and adapted to its own environment.
2 The concept of soil fertility through a 'living soil' which has the capacity to influence and transmit health through the food chain to plants, animals and [humans]; and that this can be enhanced over time.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.5 IFOAM principles of organic agriculture in 1980 (Woodward and Vogtmann 2004)

To work as much as possible within a closed system, and draw upon local resources.
To maintain the long-term fertility of soils.
To avoid all forms of pollution that may result from agricultural techniques.
To produce foodstuffs of high nutritional quality and sufficient quantity.
To reduce the use of fossil energy in agricultural practice to a minimum.
To give livestock conditions of life that conform to their physiological needs and to humanitarian principles.
To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human beings.

3 The notion that these linkages constitute a whole system within which there is a dynamic yet to be understood.
4 The belief in science and an insistence that whilst these ideas might be challenging orthodox scientific thinking, they could be explored, developed and eventually explained through appropriate scientific analysis.

It was not until the organic movement became global and its arguments started gaining recognition in the wider political and social spheres that the need to articulate organic agriculture's fundamental values to outsiders arose. IFOAM has been the key organisation defining the principles of organic agriculture. The original principles created in 1980 are presented in Table 1.5.

The principles, until now, have been published at the start of the IFOAM 'basic standards' of the organic guarantee system. They served as an introduction to the standards to clarify the aims of organic agriculture (Woodward and Vogtmann 2004). The original seven principles have frequently been amended and added to over the intervening period. The process of revision has been done at the biennial General Assembly where members tabled motions for changes, which were debated and voted on. They have also been amended as part of the revision of the standards. This process has lead to the current 'principle aims of organic agriculture for production and processing'. The current list (Table 1.6) is substantially longer than the seven principles of the 1980s and they are 'principle aims' rather than principles.

In recent years there has been an increasing feeling that the principle aims have become bloated, lack consistency and have been weakened (e.g. Woodward and Vogtmann 2004). A motion passed at the IFOAM General Assembly in 2002 resulted in the world board setting up a taskforce to rewrite the principles. The results of the taskforce's work, which includes thorough consultation, will be taken to the 2005 General Assembly for acceptance. Therefore, at this time they are a work in progress with an initial draft now published. The draft principles (Table 1.7) differ notably from the current principle aims and are closer in philosophy and structure to the original 1980 principles.

In addition to this work, others have been debating and refining organic principles. As the governments in the USA were developing rules to control the production, promotion and sale of organic goods in the 1990s, Benbrook and Kirschenmann (1997) published a brief list of principles to provide a common framework for stakeholders and decision makers to base recommendations. Around the same time, the Danish Research Centre for Organic Farming (DARCOF) initiated a national debate on the principles of organic agriculture due to perceived uncertainties in existing principles and the need for clear principles to guide research planning.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.6 Objectives that IFOAM considers 'the principle aims of organic agriculture for production and processing' in 2004 (IFOAM 2002)

To produce sufficient quantities of high quality food, fibre and other products.
To work compatibly with natural cycles and living systems through the soil, plants and animals in the entire production system.
To recognise the wider social and ecological impact of and within the organic production and processing system.
To maintain and increase long-term fertility and biological activity of soils using locally adapted cultural, biological and mechanical methods as opposed to reliance on inputs.
To maintain and encourage agricultural and natural biodiversity on the farm and surrounds through the use of sustainable production systems and the protection of plant and wildlife habitats.
To maintain and conserve genetic diversity through attention to on-farm management of genetic resources.
To promote the responsible use and conservation of water and all life therein.
To use, as far as possible, renewable resources in production and processing systems and avoid pollution and waste.
To foster local and regional production and distribution.
To create a harmonious balance between crop production and animal husbandry.
To provide living conditions that allow animals to express the basic aspects of their innate behaviour.
To utilise biodegradable, recyclable and recycled packaging materials.
To provide everyone involved in organic farming and processing with a quality of life that satisfies their basic needs, within a safe, secure and healthy working environment.
To support the establishment of an entire production, processing and distribution chain which is both socially just and ecologically responsible.
To recognise the importance of, and protect and learn from, indigenous knowledge and traditional farming systems.

This resulted in a detailed discussion document (DARCOF 2000) that has been included in the IFOAM review (IFOAM 2002).

The principle of health is holistic in its outlook and takes health as more than a state of 'not being ill' but one of holism, self regulation, regeneration and balance. It applies to the whole agricultural sphere from ecosystems as a whole to the individual parts such as soil, plants, livestock and people. This principle links organic agriculture to the issues that were of concern to the founders of the organic movement in the 1920s to 1940s, which were based on human health, and is exemplified by Lady Eve Balfour's quote 'healthy soil, healthy plants, healthy people' which has become the motto of many organic organisations such as The Soil Association (UK), Soil and Health Association (NZ) and the Rodale Institute (USA). The principle also asserts that humans are an integral part of natural systems rather than being separate from them. Being an integral part of natural systems means that humans are dependent on such systems and when they are damaged there will also eventually be negative repercussions for humanity. An illustration of this thinking is the Costanza et al. (1997) seminal paper which attempted to give ecosystem services and natural capital a monetary value where they had previously been left out of, or given zero value, in economic analysis. The paper showed that the services and natural capital, such as plants providing oxygen, were 'worth' much more than the global gross national product and highlighted humankind's dependence on these services.

The ecological principle is a broader assertion of the first principle of the 1980s that states organic farmers need to work within a closed system and draw upon local resources. This

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Table 1.7 IFOAM's draft revised principles of organic agriculture

Principle of Health Organic agriculture should sustain and enhance the health of soil, plant, animal and human as one and indivisible.
Ecological Principle Organic agriculture should be based on and work with living ecological systems and cycles, emulate them and help sustain them.
Principle of Fairness Organic agriculture should be built upon relationships that ensure fairness with regard to the common environment and life opportunities.
Principle of Care Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and the environment.

expanded vision states that organic agriculture should function in the same way as natural ecological systems. Ecological systems are viewed as being self contained, self maintaining and self sufficient; for example, most plant nutrients are continuously cycled within the ecosystem and the systems are self-regulating, in that plant and animal populations are kept within certain limits by a multitude of both positive and negative feedback mechanisms. For farms, this means they should work within a closed system for nutrients, avoid fossil fuels, and design farming systems that are self regulating, such as growing plants that increase biological control agent populations so that they control pests, rather than using interventional techniques such as pesticides derived from natural sources.

The fairness principle is concerned with the relationships between the different groups of people involved in agriculture, such as landowners, workers and consumers, and ensuring the humane treatment of animals. Organic agriculture has always had a strong social equality dimension, and while this has had less prominence during the 1980s and 1990s, there are increasing calls for greater emphasis to be given to it. This means that workers should not be exploited and should be paid a fair wage for their work that allows them to live in a dignified manner; for farmers to be paid a fair amount for their product and for consumers to get a quality product at a reasonable price. These are issues that are also at the heart of the 'fair trade' movement, and which the organic and fair trade movements are now working closely together to implement. The principle also extends beyond the present, to include future generations, wherein the activities of the current generation should not be detrimental for future generations. Concerning livestock, the principle requires producers to treat animals in a humane and ethical manner. This is a complex and controversial area as people's views on the treatment of animals has changed considerably over recent times and differs noticeably between cultures. There is, therefore, continued discussion within the organic movement on animal rights, humane treatment of animals and even the need for livestock within organic systems. Within this debate, the focus is on ensuring that livestock are healthy, that they are kept in living conditions compatible with their physiology and natural behaviour, and that minimises stress and pain. This leads to certification standards on livestock housing design, stocking densities, avoiding feeds that an animal would not naturally eat and not breeding animals so that they have inherent problems, such as insufficient leg strength in turkeys.

The principle of care is an incarnation of the 'Precautionary Principle' based on the definition made at the Wingspread Conference Centre, Wisconsin, January 1998 (Montague 1998), 'When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically'. In practice the precautionary and care principles reverse the logic of risk

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

management and cost benefit analysis where a proposed activity has to be proven to be harmful to prevent its use. The precautionary and care principles require activities that have the potential to be harmful to prove they are safe before they are permitted. The principle of care ensures that organic agriculture does not use new technologies that are likely to be harmful without a thorough understanding of them and measures to prevent potential harm. This approach is a pivotal reason for the organic movement banning the use of genetically modified organisms because it views the technology as having a high potential for producing unanticipated negative effects and that the cost of such effects will be paid for by people other than those benefiting from the technology. However, while organic standards do not currently permit the use of genetically modified organisms (GMOs), IFOAM World Board member Liz Clay (2003) has written about 'facing up to GMOs'. This indicates that evaluating new technologies according to the organic movement is problematic and will be subject to debate. In comparison, organic agriculture has eagerly adopted a range of new technologies, such as ensilaging grass and novel machinery, as their potential to cause unpredictable negative impacts is low, their use can be stopped and it is the user who is most likely to suffer if there are problems. The principle of care also extends to future generations and the environment as a whole, the considerations of which are often excluded from risk management and cost benefit analyses.

The principles in context

At its base, organic agriculture is a holistic/whole system approach to land management and agricultural production. This is demonstrated by the approach to pest control whereby it is the design and interaction of the farm as a whole that controls pests, compared to industrial agriculture where pests are viewed in isolation and are controlled with pesticides. This holism dates back to the beginning of organic agriculture in that the farm was viewed not as a collection of separate parts but a single, self-managing organism. This view of the farm as an organism is the origin of the term 'organic' and is based on similar logic as James Lovelock's (1979) theory of the planet as a single organism. For the earlier developers of organic agriculture, the common exchange of resources (labour, inputs and produce) between farms at the village or district scale would also have seemed natural. Now, inputs may be sourced from one country, applied in a second country by a farm worker from a third country, to produce food for a fourth country.

Organic agriculture also views humans as clearly being part of nature, not separate nor dominating or controlling it. It is from this perspective that the need for humans to work with, not against, ecological and other natural processes comes. Examples include ensuring closed nutrient cycles, using renewable energy and not producing pollutants. However, organic agriculture is embedded in the wider society, and it can only achieve such aims if the rest of society also achieves them. For example, it is difficult to work within closed nutrient cycles when the community that consumes organic produce has no effective means of returning the nutrients in the food back to the farm.

Although taking a holistic approach and wanting to work with natural systems, organic agriculture views current levels of scientific understanding/knowledge of such systems as incomplete. It takes the ecological view that such systems are phenomenally complex and at some levels, fundamentally unpredictable. This view of unpredictability is especially applicable when humans interfere and change natural systems; the concern is that the negative unpredicted effects are likely to be much greater than predicted benefits. This is an another application of the precautionary principle in that negative effects resulting from changes to ecological and other natural systems may take many decades, even centuries, to become apparent, at which point it is impossible to correct them.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Organic agriculture is also a highly ethical form of agricultural production, with clear concerns for animal and human welfare, such as ensuring that farmers get a fair return for their work and are not exploited by consumers. There is also a strong undercurrent of social justice, which forms a continuum back to the earliest organic proponents, and which is also equally strong in the 'green' movements across the globe. There is a view of agriculture being different and more fundamental from other 'industries' and there is a need for people to reconnect with agriculture. Such reconnection is considered an important step in addressing many of the social ills perceived by the organic movement.

These principles of organic agriculture are in contrast with industrial farming and the 'reductionist' approach that underlies it, where each crop can be grown in isolation and individual issues such as nutrition, pests and diseases are all addressed individually rather than part of a system. Industrial farming also exhibits a split between people and nature, with a confrontational attitude, as demonstrated by the militaristic trade names of many pesticides and herbicides, such as Invade, Ambush and Warrior! Farming is also viewed as just another means of production, which should not be afforded any more rights or limited by more obligations than other production sectors, and is not considered a fundamental part of a society (Reeve 1992).

Organic agriculture and the philosophy on which is it founded are fundamentally different from industrial agriculture and the philosophy that underlies it. This difference between them has been obscured since the 1990s by the rapid emergence of market-driven organic agriculture. To fully understand the organic movement it is essential to understand its worldview and underlying principles, which includes often radically different philosophies from that of mainstream society.

Challenges for organic agriculture

While organic agriculture aims to be environmentally sustainable, it has not yet reached its goals and there are issues that still need to be addressed. Many of these issues are reviewed in detail in other chapters of this book, including several key topics that were selected for particular analysis, such as the impact of tillage in organic agriculture and the industrialisation of organic production systems.

A common question asked of the organic movement relates to its yields (e.g. Trewavas 2004): can organic agriculture feed the world? Like questions about sustainability, productivity also depends on many factors including the farmer's background, the farm's resourcefulness and local and national support mechanisms. The appropriate answer may be: does conventional agriculture successfully feed the world now? High input-high yielding systems are currently failing to feed the world, not because of problems with productivity, but because of problems with food distribution and social organisation, and serious concerns such poverty, racism and gender imbalance (Woodward 1996).

Comparisons of organic and conventional farming have been a common feature of the organic literature since the 1980s. The researchers have looked at a wide range of measures including yield, economics, resource use efficiency, environmental impacts and social factors on a diverse range of farm types such as dairies, orchards and mixed cropping farms. Some important examples of comparative research have been published in prestigious journals, providing valuable credibility for claims that organic agriculture is productive *and* sustainable (Reganold *et al.* 1993, Drinkwater *et al.* 1998, Mäder *et al.* 2002). Additionally, numerous other studies have been published in academic journals of various disciplines (e.g. Murata and Goh 1997, Letourneau and Goldstein 2001). Some key findings from research that has examined yields suggest trends including (Wynen 1994, Stonehouse *et al.* 2001, Mendoza 2002):

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

- yields equivalent to or better than conventional agriculture may be achieved, although often they are not;
- yields decrease during conversion but then improve afterwards;
- organic farms have higher levels of soil biological activity and biodiversity;
- weeds can have major impact on yield in cropping systems, and specific pests and diseases can be problematic in their host crops and animals;
- some nutrients may have negative budgets for certain organic crops, depleting soil reserves of that nutrient;
- organic agriculture causes less pesticide contamination in food, people and the environment; and
- the beneficial effects of organic agriculture in food quality are unconfirmed.

Farming systems comparisons, preferably conducted over several years, supply valuable information about agricultural productivity and performance. However, they are subject to important limitations including management × site × variety interactions and externalities (e.g. energy, pollution and health) that may not be taken into account. High levels of government and commercial support have been invested over many decades in optimising plant and animal germplasm, soil fertility and pest management systems, and human capacity for conventional farming systems. This support would be expected to create substantial advantages for conventional producers.

Research methods for comparative systems trials are continually being refined, not only regarding agricultural and ecological considerations, but also social and statistical issues (van der Werf *et al.* 1997, Powell 2002). In addition to productivity, the importance of other farming systems' attributes such as resilience and stability have also been highlighted (McConnell 1992, Trenbath 1999). For example, Lotter *et al.* (2003) reported that organic maize outyielded conventional maize by significant margins in 4 out of 5 drought-affected years. A range of new frameworks are being developed for addressing externalities, environmental impacts, labour relations and so on. These frameworks include EMS (Ridley *et al.* 2003), input-output analysis (Zinck *et al.* 2004) and life cycle analysis (Brentrup *et al.* 2004).

Other, more fundamental, intrinsic differences between systems may also exist. Some farming systems attempt to do more than simply produce goods for sale. Organic farmers are required to act as stewards of the land, not just agricultural factory managers (Table 1.6). They must also observe a growing range of environmental and social restrictions, but conventional farmers are not faced with the same limitations. Wes Giblett, a biodynamic dairy farmer in Western Australia explained in a conversation recently, 'the aim is to grow topsoil', emphasising that good agricultural management as demonstrated by deepening topsoil, underpins success in sustainable farming. Wes runs the only organic dairy in Western Australia, supplying a State that is 2.5 million square kilometres – 10 times larger than Germany – with a population of almost 1.5 million. Although he has a very successful, vertically integrated dairy products business, his primary concerns about farming are topsoil, the welfare of his cows and contributing to the development of organic agriculture in his region.

Rather than limiting the analysis of organic agriculture to a comparative approach, it is more worthwhile to look for the underlying mechanisms and general principles. By identifying the strengths and weaknesses in the organic system, improvements can be made for organic farmers and relevant knowledge transferred to receptive conventional farmers. In a world of many choices, organic agriculture is a serious option for many farmers and consumers. Supporting that choice with credible science and critical evaluation is vital for improving the productivity and environmental impact of organic agriculture.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

The challenges for organic agriculture will depend in part on the location and commodities being produced, but some concerns will affect organic farmers worldwide. Agronomic constraints including weeds, animal health and soil fertility continue to concern farmers. Inadequacies in regulatory and marketing structures frustrate farmers, processors and consumers alike. With limited government support, the lack of large commercial supporters and the inability of smaller commercial operations to fund research and development, extensionists and researchers are less able to attract funding.

Maintaining a commitment to the principles of organic agriculture will also be a challenge. After almost a century of development, organic agriculture has been embraced by the mainstream and shows great promise commercially, socially and environmentally. Behind the billion-dollar markets and the million-hectare farms, there are many organic growers and consumers who are deliberately opting for cleaner and safer goods that are produced with regard for the welfare of people and animals involved in production and with minimal impact on the environment.

References

Anobah, R. 2000. Development of organic market in West Africa. In: Alföldi, T., Lockeretz, W. and Niggli, U. (eds) *IFOAM 2000 – The World Grows Organic*. Proceedings of the 13th International IFOAM Scientific Conference. Convention Centre Basel, Switzerland 28–31 August 2000. vdf Hochschulverlag an der ETH Zurich, Basel. p. 433.

Balfour, E. 1943. *The Living Soil*. Faber and Faber, London.

Benbrook, C. and Kirschenmann, F. 1997. *Proposed Principles for Evaluating the Organic 'Rule'*. Pest Management at the Crossroads, Sandpoint, Idaho. <http://www.pmac.net/ppeor2.htm>. Accessed 12/3/04.

Brentrup, F., Küsters, J., Lammel, J., Barraclough, P. and Kuhlmann, H. 2004. Environmental impact assessment of agricultural production systems using the life cycle assessment methodology. II. The application to N fertilizer use in winter wheat production systems. *European Journal of Agronomy* 20(3): 265–279.

Browne, A.W., Harris, P.J.C., Hofny-Collins, A.H., Pasiecznik, N. and Wallace, R.R. 2000. Organic production and ethical trade: definition, practice and links. *Food Policy* 25(1): 69–89.

Carruthers, G. and Tinning, G. 2003. Where, and how, do monitoring and sustainability indicators fit into environmental management systems? *Australian Journal of Experimental Agriculture* 43(3): 307–323.

Carson, R. 1962. *Silent Spring*. Houghton Mifflin Company, Boston.

Chang, H.-S. and Kristiansen, P. 2006. Selling Australia as 'clean and green'. *Australian Journal of Agricultural and Resource Economics* 50(1): 103–113.

Clay, L. 2003. Facing up to GMO and realities. *Acres Australia* 11(1): 13.

Coffman, B. 2001. *Portrait of Global GMO Usage Update*. Monsanto, Cambridge. <http://www.monsanto.co.uk/news/ukshowlib.phtml?uid=6043>. Accessed 3/10/02.

Conford, P. 2001. *The Origins of the Organic Movement*. Floris Books, Edinburgh.

Cornish, P.S. and Stewart, T.E.B. 2002. Certification – case studies with Australian market gardeners. In: Thompson, R. (ed.) *Cultivating Communities. Proceedings of the 14th IFOAM Organic World Congress*. Victoria, Canada, 21 to 28 August 2002. Canadian Organic Growers, Ottawa. p. 222.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R.G., Sutton, P. and van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253–360.

Dabbert, S., Zanoli, R. and Lampkin, N. 2001. Elements of a European action plan for organic farming. In: Ministry of Food, Agriculture and Fisheries. (ed.) *Proceedings: Organic Food and Farming – Towards Partnership and Action in Europe.* 10–11 May 2001 Copenhagen Denmark. Danish Ministry of Food, Agriculture and Fisheries, Copenhagen. pp. 199–203.

DARCOF 2000. *Principles of Organic Farming.* Danish Research Centre for Organic Farming, Foulum.

Davy, H. 1813. *Elements of Agricultural Chemistry. In a Course of Lectures for the Board of Agriculture*. W. Bulwer, London.

DEFRA 2002. *Action Plan to Develop Organic Food and Farming in England*. Department for Environment, Food and Rural Affairs, London.

Drinkwater, L.E., Wagoner, P. and Sarrantonio, M. 1998. Legume-based cropping systems have reduced carbon and nitrogen losses. *Nature* 396: 262–265.

FAO 1999. *Organic Agriculture*. Food and Agriculture Organization of the United Nations, Rome. <http://www.fao.org/unfao/bodies/COAG/COAG15/X0075E.htm>. Accessed 26/2/99.

Fukuoka, M. 1978. *One Straw Revolution*. Rodale Press, Emmaus.

Gill, G. 2002. Book review: Ecological management of agricultural weeds. *Agriculture, Ecosystems and Environment* 90(1): 106–107.

Gliessman, S.R. 1985. Economic and ecological factors in designing and managing sustainable agroecosystems. In: Edens, T.C., Fridgen, C. and Battenfield, S.L. (eds) *Sustainable Agriculture and Integrated Farming Systems*. Michigan State University Press, East Lansing. pp. 56–63.

Grigg, D. 1989. *English Agriculture: An Historical Perspective*. Blackwell, Oxford.

Guthman, J. 2000. *Agrarian Dreams: The Paradox of Organic Farming in California*. University of California Press, Berkeley.

Haccius, M. and Lünzer, I. 2000. Organic agriculture in Germany. In: Graf, S. and Willer, H. (eds) *Organic Agriculture in Europe. Results of the Internet Project* <http://www.organic–europe.net>. Stiftung Ökologie und Landbau, Bad Dürkheim. pp. 109–128.

Halpin, D. and Brueckner, M. 2004. Organic farming in Australia. In: Willer, H. and Yussefi, M. (eds) *The World of Organic Agriculture. Statistics and Emerging Trends 2004*. International Federation of Organic Agriculture Movements, Bonn. pp. 81–85.

Howard, A. 1931 *The Waste Products of Agriculture: Their Utilization as Humus*. Oxford University Press, London.

Human Genome Project Information 2004. *Genetically Modified Foods and Organisms*. Genome Programs of the US Department of Energy Office of Science, Oak Ridge. <http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml>. Accessed 15/10/04.

IFOAM 2002. *IFOAM Norms – IFOAM Basic Standards + IFOAM Accreditation Criteria 2002*. International Federation of Organic Agriculture Movements, Bonn.

IFOAM 2005. *2002–2005 IFOAM World Board Made Impressive Gains for the Organic Sector.* International Federation of Organic Agriculture Movements, Tholey–Theley, Germany. <http://www.ifoam.org/press/press/Departing_World_Board.html>. Accessed 16/12/05.

Kilcher, L. 2001. Organic agriculture in Cuba: The revolution goes green. *Journal of Agriculture in the Tropics and Subtropics* 102(2): 185–189.

Lampkin, N. 1990. *Organic Farming.* Farming Press, Ipswich.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Lernoud, A.P. and Piovano, M. 2004. Latin America: country reports. In: Willer, H. and Yussefi, M. (eds) *The World of Organic Agriculture. Statistics and Emerging Trends 2004*. International Federation of Organic Agriculture Movements, Bonn. pp. 132–137, 140–147.

Letourneau, D.K. and Goldstein, B. 2001. Pest damage and arthropod community structure in organic vs. conventional tomato production in California. *Journal of Applied Ecology* 38(3): 557–570.

Lipson, M. 1997. *Searching for the 'O–Word': An Analysis of the USDA Current Research Information System (CRIS) for Pertinence to Organic Farming*. Organic Farming Research Foundation, Santa Cruz.

Lockeretz, W. 2002. Strategies for organic research. In: Powell, J. (ed.) *Proceedings of the UK Organic Research 2002 Conference: Research in Context*. 26–28 March 2002 Aberystwyth. Organic Centre Wales, Institute of Rural Studies, University of Wales Aberystwyth, Aberystwyth. pp. 25–31.

Lotter, D.W. 2003. Organic agriculture. *Journal of Sustainable Agriculture* 21(4): 59–128.

Lotter, D.W., Seidel, R. and Liebhardt, W. 2003. The performance of organic and conventional cropping systems in an extreme climate year. *American Journal of Alternative Agriculture* 18(3): 146–154.

Lovelock, J.E. 1979. *Gaia, a New Look at Life on Earth*. Oxford University Press, Oxford.

Mäder, P., Fließbach, A., Dubois, D., Gunst, L., Fried, P. and Niggli, U. 2002. Soil fertility and biodiversity in organic farming. *Science* 296(5573): 1694–1697 (and supplementary material).

Mahale, P. and Sorée, Y. 2002. National study: India. In: UNESCAP (ed.) *Organic Agriculture and Rural Poverty Alleviation. Potential and Best Practices in Asia*. United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Bangkok. pp. 73–97.

McConnell, D.J. 1992. *The Forest-Garden Farms of Kandy, Sri Lanka*. Food and Agriculture Organization of the United Nations, Rome.

Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W.W. 1972. *Limits to Growth. A Report for the Club of Rome's Project on the Predicament of Mankind*. Universe Books, New York.

Mendoza, T.C. 2002. Comparative productivity, profitability and energy use in Organic, LEISA and Conventional rice production in the Philippines. *Livestock Research for Rural Development* 14(6). <http://www.cipav.org.co/lrrd/lrrd14/6/mend146.htm>. Accessed 15/12/05.

Merrigan, K. 2003. The role of government standards and market facilitation. In: OECD (ed.) *Organic Agriculture Sustainability, Markets and Policies*. Organisation of Economic Cooperation and Development (OECD), Paris. pp. 277–283.

Montague, P. 1998. *Rachel's Environment & Health News #586 – The Precautionary Principle*. Environmental Research Foundation, New Brunswick. <http://www.rachel.org/bulletin/pdf/Rachels_Environment_Health_News_532.pdf>. Accessed 15/11/04.

Murata, T. and Goh, K.M. 1997. Effects of cropping systems on soil organic matter in a pair of conventional and biodynamic mixed cropping farms in Canterbury, New Zealand. *Biology and Fertility of Soils* 25(4): 372–381.

Norse, D. and Tschirley, J. 2003. Agriculture and the environment: changing pressures, solutions and trade-offs. In: Bruinsma, J. (ed.) *World Agriculture: Towards 2015/2030. An FAO Perspective*. Earthscan Publications and Food and Agriculture Organization of the United Nations, London. pp. 331–356.

Northbourne, Lord. 1940. *Look to the Land*. Basis Books, London.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

OECD 2001. *Improving the Environmental Performance of Agriculture. Policy Options and Market Approaches*. Organisation of Economic Cooperation and Development (OECD), Paris.

OECD 2003. *Organic Agriculture Sustainability, Markets and Policies*. Organisation of Economic Cooperation and Development, Paris.

Parrott, N. and Marsden, T. 2002. *The Real Green Revolution. Organic and Agroecological Farming in the South*. Greenpeace Environmental Trust, London.

Peroni, N. and Hanazaki, N. 2002. Current and lost diversity of cultivated varieties, especially cassava, under swidden cultivation systems in the Brazilian Atlantic Forest. *Agriculture, Ecosystems and Environment* 92(2–3): 171–183.

Powell, J. (ed.) 2002. *Proceedings of the UK Organic Research 2002 Conference: Research in Context*. 26–28 March 2002 Aberystwyth. Organic Centre Wales, Institute of Rural Studies, University of Wales Aberystwyth, Aberystwyth.

Pretty, J.N., Brett, C., Gee, D., Hine, R.E., Mason, C.F., Morison, J.I.L., Raven, H., Rayment, M.D. and van der Bijl, G. 2000. An assessment of the total external costs of UK agriculture. *Agricultural Systems* 65(2): 113–136.

Reeve, I.J. 1992. Sustainable agriculture: problems, prospects and policies. In: Lawrence, G., Vanclay, F. and Furze, B. (eds) *Agriculture, Environment and Society: Contemporary Issues for Australia*. MacMillan, South Melbourne. pp. 208–223.

Reganold, J.P., Palmer, A.S., Lockhart, J.C. and Macgregor, A.N. 1993. Soil quality and financial performance of biodynamic and conventional farms in New Zealand. *Science* 260(5106): 344–349.

Ridley, A., Paramore, T. and Seymour, E. 2003. Towards 'clean and green' farming systems using group learning to implement Environmental Management Systems. *Australian Journal of Botany* 51(6): 637–645.

Rundgren, G. 2002. History of organic certification and regulation. In: Rundgren, G. and Lockeretz, W. (eds) *IFOAM Conference on Organic Guarantee Systems – Reader. International Harmonisation and Equivalence in Organic Agriculture. 17–19 February 2002, Nuremberg, Germany*. International Federation of Organic Agriculture Movements, Tholey-Theley, Germany. pp. 5–7.

Rusch, H.P. 1964. *Bodenfruchtbarkeit*. Karl F. Haug Verlag, Heidelberg.

Sahota, A. 2004. Overview of the global market for organic food and drink. In: Willer, H. and Yussefi, M. (eds) *The World of Organic Agriculture. Statistics and Emerging Trends 2004*. International Federation of Organic Agriculture Movements, Bonn. pp. 21–26.

Schumacher, E.F. 1974. *Small is Beautiful: A Study of Economics as if People Mattered*. Abacus, London.

Setboonsarng, S. and Gilman, J. 1999. *Alternative Agriculture in Thailand and Japan*. HORIZON Communications, Yale University, New Haven, Connecticut. <http://www.solutions–site.org/cat11_sol85.htm>. Accessed 6/9/00.

Stokstad, E. 2002. Organic farms reap many benefits. *Science* 296: 1589.

Stonehouse, D.P., Clark, E.A. and Ogini, Y.A. 2001. Organic and conventional dairy farm comparisons in Ontario, Canada. *Biological Agriculture and Horticulture* 19(2): 115–125.

Thompson, R. (ed.) 2002. *Cultivating Communities. Proceedings of the 14th IFOAM Organic World Congress*. Victoria, Canada, 21–28 August 2002. Canadian Organic Growers, Ottawa.

Tovar, L.G. and Cruz, M.A.G. 2004. Mexico. In: Willer, H. and Yussefi, M. (eds) *The World of Organic Agriculture. Statistics and Emerging Trends 2004*. International Federation of Organic Agriculture Movements, Bonn. pp. 137–140.

Organic Agriculture: A Global Perspective, Edited by Paul Kristiansen, Acram Taji and John Reganold
Published by CSIRO PUBLISHING, 2006, 484pp.

Trenbath, B.R. 1999. Multispecies cropping systems in India: predictions of their productivity, stability, resilience and ecological sustainability. *Agroforestry Systems* 45(1–3): 81–107.

Trewavas, A. 2004. A critical assessment of organic farming-and-food assertions with particular respect to the UK and the potential environmental benefits of no-till agriculture. *Crop Protection* 23(9): 757–781.

Vandermeer, J., Van Noordwijk, M., Anderson, J., Ong, C. and Perfecto, I. 1998. Global change and multi-species agroecosystems: concepts and issues. *Agriculture, Ecosystems and Environment* 67(1): 1–22.

van der Werf, E., Kariuki, J. and Onduru, D.D. 1997. Methodological issues in comparative agro-economic on-farm research assessments of organic versus conventional farming techniques. *Biological Agriculture and Horticulture* 14(1): 53–69.

Vanzetti, D. and Wynen, E. 2002. Does it make sense to buy locally produced organic products? In: Hall, D. and Moffitt, J. (eds) *Economics of Pesticides, Sustainable Food Production and Organic Food Markets*. Elsevier, Amsterdam. pp. 195–208.

von Liebig, J. 1840. *Organic Chemistry in its Application to Agriculture and Physiology*. Taylor and Walton, London.

Walaga, C. 2000. Organic agricultural trade: the state of the art in Africa. In: Lockeretz, W. and Geier, B. (eds) *Quality and Communication for the Organic Market. Proceedings of the 6th IFOAM Trade Conference*. International Federation of Organic Agriculture Movements (IFOAM), Tholey-Theley, Germany.

WANTFA 2004. *WANTFA. New Frontiers in Agriculture*. Western Australian No-Tillage Farmers Association (WANTFA), Subiaco. <http://www.wantfa.com.au/>. Accessed 8/11/04.

Woodward, L. 1996. *Can Organic Farming Feed the World?* Elm Farm Research Centre, Newbury.

Woodward, L., Fleming, D. and Vogtmann, H. 1996. Health, sustainability and the global economy: the organic dilemma. In: Kristensen, N.H. and Hogh-Jensen, H. (eds) *New Research in Organic Agriculture, Down to Earth and Further Afield: Proceedings of the 11th International Scientific IFOAM Conference*. International Federation of Organic Agriculture Movements (IFOAM), Copenhagen.

Woodward, L. and Vogtmann, H. 2004. IFOAM's organic principles. *Ecology and Farming* 36: 24–26.

Wynen, E. 1994. Economics of organic farming in Australia. In: Lampkin, N.H. and Padel, S. (eds) *The Economics of Organic Farming: An International Perspective*. CAB International, Wallingford. pp. 185–199.

Wynen, E. 1998. *Evaluating the Potential Contribution of Organic Agriculture to Sustainability Goals*. Environment and Natural Resources Service, Research, Extension and Training Division, Sustainable Development Department, Food and Agriculture Organization of the United Nations (FAO), Rome.

Yussefi, M. 2004. Development and state of organic agriculture worldwide. In: Willer, H. and Yussefi, M. (eds) *The World of Organic Agriculture. Statistics and Emerging Trends 2004*. International Federation of Organic Agriculture Movements (IFOAM), Bonn. pp. 13–20.

Zinck, J.A., Berroterán, J.L., Farshad, A., Moameni, A., Wokabi, S. and Van Ranst, E. 2004. Issues of sustainability and sustainable land management. *Journal of Sustainable Agriculture* 23(4): 87–109.

Zong, H. 2002. National study: China. In: UNESCAP (ed.) *Organic Agriculture and Rural Poverty Alleviation. Potential and Best Practices in Asia*. United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Bangkok. pp. 52–72.