APPENDIX A: FULL LITERATURE REVIEW

List of Acronyms

AQIS	Australian Quarantine and Inspection Service
ATTRA	Appropriate Technology Transfer for Rural Areas
BMPs	Best Management Practices
CBOs	Community-Based Organisations
CCOF	California Certified Organic Farmers
DAEA	Department of Agriculture and Environmental Affairs
DED	Department of Economic Development
EMS	Environmental Management System
EPOPA	Export Promotion of Organic Products from Africa
FAO	Food and Agriculture Organisation
FiBL	Research Institute of Organic Agriculture (English Translation)
GDP	Gross Domestic Product
GM	Genetically Modified
GMO	Genetically Modified Organism
GOAN	Ghana Organic Agriculture Network
GTZ	Gesellschaft fur Technische Zusammenarbeit
GWP	Global Warming Potential
IBS	IFOAM Basic Standards
IFAD	International Fund for Agricultural Development
IFM	Integrated Farm Management
IFOAM	International Federation of Organic Agriculture Movements
IMO	Institut fur Marktokilogi
IOAS	International Organic Accreditation Service
IOFGA	Organic Farmers and Growers
ISO	International Standards Organisation
ITC	International Trade Centre
ITF	International Task Force
KOAN	Kenya Organic Agriculture Network
KZNDED	KwaZulu-Natal Department of Economic Development
LAMP	Use Management Programme
LEAF	Linking Environment and Farmers
MEF	Middle East Food
NFA	Natural Food Associates
NGOs	Gon-Governmental Organisations
NOGAMU	National Organic Agricultural Movement of Uganda
NOP	National Organic Program
NOPE	Natural and Organic Products Exhibition
NOSB	National Organic Standards Board
NRDC	National Resources Defense Council
OACC	Organic Agriculture Centre of Canada
OF&G	Organic Farmers and Growers Ltd
OFDC	Organic Food Development Centre
OFF	Organic Food Federation
OFPA	Organic Foods Production Act of 1990
OFRC	Organic Food Research and Consulting Centre

OGS	Organic Guarantee System
OPAC	Organic Product Advisory Council
OPPAZ	Organic Producers & Processors Association of Zambia
OSA	Organics South Africa (previously OAASA - Organic Agriculture Association of South Africa)
QAI	Quality Assurance International
RCOs	Registered Certification Officers
SACU	Southern African Customs Union
SADC	Southern African Development Community
SEPA	State Environmental Protection Administration
SIDA	Swedish International Development Agency
SIPPO	Swiss Import Promotion Programme
SÖL	Stiftung Ökologie & Landbau
SOPA	Scottish Organic Producers Association
TOAM	Tanzania Organic Agriculture Movement
UK	United Kingdom
UKROFS	United Kingdom Register of Organic Food Standards
UNCTAD	UN Conference on Trade and Development
UNDP	United Nations Development Programme
UNEO-GEF	United Nations Environmental Programme – Global Environment Facility
USAID	US Agency for International Development
USDA	United States Department of Agriculture
ZOPPA	Zimbabwe Organic Producers' and Processors' Association

1 HISTORY AND DEVELOPMENT OF THE ORGANICS INDUSTRY

1.1 Introduction

During the last decade, the organic agriculture industry has experienced rapid development worldwide. Today, over 31 million hectares are currently managed organically, and certified as such, in approximately 120 countries (Yuseffi, 2006) and involves at least 623 174 farms (Willer & Yussefi, M, 2006). At present, Australia accounts for greatest area under organic management (12.1 million hectares) followed by China (3.5 million hectares) and Argentina (2.8 million hectares). The distribution of area under organic management for each continent as at 2004 is indicated in the figure below. While Oceania (Australia, New Zealand and other Pacifica countries) has the largest share, some 41.8%, it should be borne in mind that no distinction is made between areas under extensive livestock and those for more intensive forms production, and therefore can be misleading. Africa has the smallest area certified organic - 1.3%, indicating that there are opportunities for expansion of certified organic agriculture in Africa. In addition to this, there are many farmers who farm using organic principles who are not formally certified and it is probable that the area farmed by organic principles is larger than this.

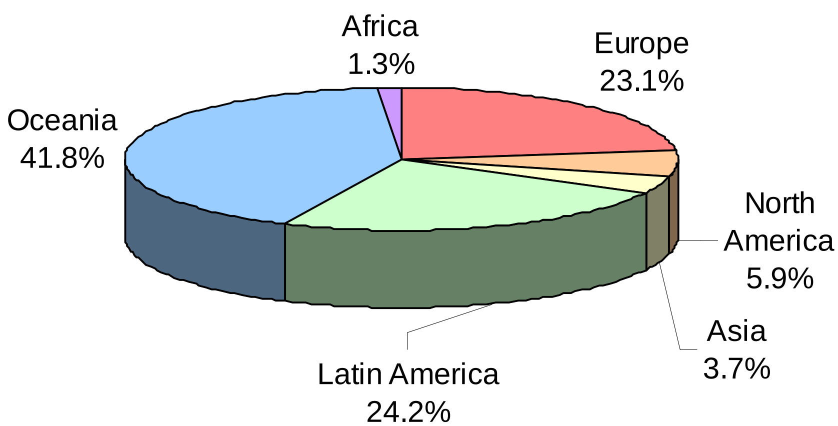


Figure 1 Total area under organic management – share by continent (adapted from Yussefi & Willer, 2004)

1.2 History of Organic Agriculture by Continent

It could be argued that all farming prior the green revolution was “organic”, which it was in as much that no artificial chemicals were applied to the land. The definition and principles of organic farming, detailed in Section 2 will show that organic farming is more than just avoiding the use of synthetic inputs. The history in this section aims to investigate the development of the organics industry to its current state.

1.2.1 Europe

Organic farming in Europe has developed through a combination of pioneer farmers and scientists and the formation of organic organizations and associations. In the beginning, several scientists including Sir Albert Howard, Lady Eve Balfour, Rudolf Steiner, Hans Mueller and Hans Rustch formulated ideas and undertook various research activities. Much of this work overlapped in various European countries and consequently the transition between various concepts and ideas is unclear.

The organic farming concept was pioneered by Sir Albert Howard, a British colonial officer who was born and educated in England. In the early 1900's Howard conducted a variety of notable experiments at agricultural research centres in India. He observed the reaction of properly grown varieties of plants subjected to insect and other pests and found that the primary factor of soil management was the maintenance of soil fertility. He believed that crops grown on land treated with a consistent supply of fresh humus prepared with vegetable and animal wastes resisted common pests and that this resistance was passed on to livestock who fed on these plants. His conceptualisation of soil fertility emphasized the connectivity of the health of crops, livestock and mankind. His thinking on soil fertility and the need to recycle waste materials onto farmland was reinforced by F.H. King's book, Farmers of Forty Centuries. Howard developed a method of composting which was widely adopted. He also felt it better to adapt species through breeding to the local conditions of the area rather than to supplement a western strain with chemicals to encourage growth. In 1940 he published a landmark book, *An Agricultural Testament*, in which he argued that relying on fertilizers was unwise as it could not maintain farmland indefinitely. The system of agriculture advocated by Howard was coined 'organic' by Walter Northbourne and was used in reference to a system 'having a complex but necessary interrelationship of parts, similar to that in living things' (Heckman, 2006). Lady Eve Balfour, one of the first women to study agriculture at a UK University and graduating from Reading University, began farming in Suffolk in 1919. In 1939, with her neighbor and friend, Alice Debenham, she launched the Haughley experiment, the first long term scientific experiment comparing organic and chemical based farming. In 1943, she published 'The Living Soil', a book which combined her research and initial results on the Haughley experiment and three years later she co-founded and became the first president of the Soil Association, an international association promoting sustainable agriculture. (Balfour, 1977; Wikipedia - The Free Encyclopedia Website)

In 1924 Rudolf Steiner, an Austrian philosopher and founder of anthroposophy[1], presented eight courses on the spiritual foundation of farming later known as Biodynamic agriculture. Biodynamic agriculture recognises the basic principles at work in nature and takes these principles into account to bring about balance and healing. Although biodynamic agriculture differs from organic agriculture in that it is spiritual, mystical and astrological, it was prophetic in its criticism of industrial agriculture. In his courses, Steiner considered the farm as a living organism and posed that the ideal self contained farm should include just the

[1] A movement based on the concept that there is a spiritual world accessible to pure thought through a path of self-development.

right number of animals to provide manure for fertility and that these animals should in turn be fed by the farm. As a result of Steiner's actions, the first organic certification and labelling system, 'Demeter" was developed. (The Biodynamic Farming and Gardening Association website; Kristiansen *et al*, 2006)

At a similar time in Switzerland, Hans Mueller and his wife Maria, committed themselves to the maintenance of family farming. Mueller was influenced by biodynamic agriculture in the 1930's and in the 1950's he collaborated with Hans Peter Rusch and developed the organic-biological farming method. Distinctive characteristics of this method are the importance attributed to soil humus, the use of composting and minimum soil tillage to optimise us of natural resources and prevent altering soil microflora. (Willer and Yussefi, 2006(a); Fersino & Petruzzella, Undated).

In the 1960s and 70s there was a proliferation of organisations and associations promoting organic agriculture and in 1972 a number of organisations joined to found the International Federation of Organic Agriculture Movements (IFOAM) (Fersino & Petruzzella, Unkown).

Table 1Timeline of events contributing to the development of the Organic Industry in Europe (adapted from Yussefi & Willer, 2004)

1900s	Sir Albert Howard carried out agricultural experiments in India
1924	Rudolf Steiner's ran course on bio-dynamic farming
1939	Lady Eve Balfour conducts the Haughley experiment – the first long-term scientific comparison on organic and chemical-based farming
1930s/40s	Formation of the first bio-dynamic associations in Europe ('Demeter') Dr Hans Mueller active in Switzerland (Organic- biological farming otherwise reffered to as 'Bioland' or 'BioSuisse) Sir Albert Howard publishes land mark book – An Agricultural Testament
1943	Lady Eve Balfour published 'The Living Soil'
1946	Lady Eve Balfour founded the Soil Association in the UK
1972	International Federation of Organic Agriculture Movements (IFOAM) founded
1973	Research Institute of Organic Agriculture FiBL founded in Switzerland
1975	Foundation Ecology & Agriculture SOEL founded in Germany
1980s	The majority of other organic organisations and associations founded
1990	First BioFach Fair takes place in Ger many, now the biggest fair for organic products worldwide
1991	IFOAM European Union Regional Group founded EU regulation 2078/92 published in official Journal or the European Union which established area based support for organic farming in most EU countries
1992	IFOAM Accreditation Program established
1995	First action plan for organic farming launched in Denmark
1999	Global *Codex Alimentarius* standards on organic agriculture published
2000	Agenda 200 implemented which established support measures for organic farming including continuation of area-based payments
2001	January – BSE crisis in Europe which resulted in an attitude shift toward organic farming

	May – Initial consideration of European Action Plan for organic farming
2003	European consultation on the action plan for organic farming Various research projects related to organic farming accepted under the first call of the sixth framework program

1.2.2 United States

Henry Wallace served as the US Secretary for Agriculture from 1933 to 1940 and was at the helm of the USDA commitment to health, conservation and soil restoration. Although his focus was largely soil conservation rather than the development of the organics industry, his efforts did contribute indirectly. The Soil Conservation Association was established under him in 1935 with the primary aim 'to conserve fertility, prevent soil erosion and promote good land use'. Wallace favoured natural resource planning on a national scale with decisions based on long-term social values and conservation. Many of his conservation concerns have been entrenched in Federal government policy ensuring lasting value to soil (Kupfer, 2001).

William Albrecht, Head of Soils for the University of Missouri also focused on soil and promoted the idea that improving the soil by fertilisation and increasing the organic matter improved the nutritive value of forage. He conducted extensive experiments with growing plants and animals to substantiate his idea that declining soil fertility was responsible for poor crops and pathogenic conditions in animals (Kupfer, 2001)

During the 1930's, the 'Country Life Movement' began and city dwellers chose to move to the country in search of a simpler life. The most influential leader of the movement was Louis Bromfield, a agricultural scholar of Cornell University. After spending a decade in France, Bromfield returned to Ohio and in 1938 began to put into place the principles of grass-based, sustainable farming at "Malabar Farm." Bromfield captured this work in a series of five books and also showed neighbouring farmers how traditional agricultural practices, crop rotations and livestock manures could build healthy productive farms (Wikipedia - The Free Encyclopedia Website).

Around the same time, a self-labelled experimental farmer, Edward Faulkner, presented a critique of current farming practices and proposed solutions rooted in ecologically based husbandry that emphasised the importance of societal permanence. In 1943 he published his ideas in a book, *Plowman's Folly* and proposed the concept of 'trash farming' in which large amounts of organic material were incorporated into the soil (Kupfer, 2001).

Technological advances during the Second World War accelerated advances in all aspects of agriculture including mechanisation, fertilisation and pesticides. In 1944, a large-scale campaign was launched in Mexico which encouraged the development of hybrid plants, chemical control and mechanisation in agriculture world-wide. These experiments resulted in significant crop yield increases and became known as the "Green Revolution". This high input farming system become widely adopted world wide, particularly in developed countries.

During the time of the green revolution, a loose network of farmers including Jerome Rodale, shunned chemical agriculture and began farming organically (Wikipedia - The Free

Encyclopedia Website). Rodale was one of the first advocates of sustainable agriculture and organic farming in the US. In 1941, Rodale came upon the works of Sir Albert Howard which directed his personal and business interests for the remainder of his life. He purchased a 60 acre farm to test Howard's ideas and in 1942 he published *Organic Farming and Gardening*, with Howard as an associate editor, which promoted organic approaches to agriculture (Department of Environmental Protection website). At the same time (1940), Austrian biochemist Ehrenfried Pfeiffer and protégé of Rudolf Steiner, fled the Nazi regime and settled in Pennsylvania where he established the Kimberton Farm School, a biodynamic model farm.

In 1962, Rachel Carson published 'Silent Spring' which documented some of the negative consequences associated with chemical use in agriculture. The book had a profound impact and gave rise to environmental consciousness and a renewed focus on organic agriculture. By the end of the same year more than 40 bills in different state legislatures had been introduced governing the regulation of pesticide use.

For a number of decades there was little communication between the organic community and traditional agricultural scientists. In the 1980s organic agriculture began to receive renewed attention when the United States Department of Agriculture (USDA) published their Report and Recommendations on Organic Farming. The National Resources Defense Council (NRDC) also released their report on the carcinogenic growth regulator Alar, which was used on apples. These reports and the awareness raised as a result, culminated in the Federal Organic Foods Production Act in 1990. This Act established the framework to create National Organic Standards. The Act also enabled the formation of the National Organic Standards Board (NOSB) to advise the Secretary of Agriculture in setting the standards for the UDSA National Organic Program (NOP). The USDA's initial standards were presented in 1997 but were severely rejected. It was only some five years later, 2002 that the official labelling as USDA Certified Organic in 2002 was implemented (Heckman, 2006).

Table 2 Timeline of events contributing to the development of the Organic Industry in Europe (adapted from OM Organics website).

1920's to 1940's	Writers in the U.S. and Great Britain published influential works introducing the basic idea of organics – that the health of plants, soil, livestock and people are interrelated – and advocating a fundamental approach to farming based on understanding and working with natural systems rather than trying to control them.
1940's	Synthetic pesticides and herbicides were introduced to American agriculture in the 1940s, and like many new inventions of the era, were embraced and used wholeheartedly.
1940's to 1950's	A loose network of farmers, including J.I. Rodale, Ehrnefried Pfeiffer of Kemberton Farm School, and Paul Keene of Walnut Acres Farms, shunned chemical agriculture by farming organically and writing about their experiences.
1953	Natural Food Associates (NFA) was formed in Atlanta, Texas, to help connect scattered

	organic growers with fledgling markets for organically grown foods.
1962	Rachel Carlson's Silent Spring was published, documenting some of the negative consequences associated with chemical use in agriculture. Its publication gave rise to environmental consciousness and a renewed focus on organic agriculture.
1970's	The growth of the organics industry prompted activists across the U.S. to form regional groups and create organic standards to certify farmers and their crops. A group of farmers formed California Certified Organic Farmers (CCOF), becoming the first organisation to certify organic farms in North America. Their standards eventually became the model for the Organic Food Protection Act of 1990.
1973	Some attribute the United States' ban of the pesticide DDT as the start of the modern environmental movement. The organics industry grew substantially due to expanding consumer opposition to chemical pesticides coupled with a desire for food that was produced without harming the environment.
1989	The National Resources Defense Council (NRDC) released their report on the carcinogenic growth regulator Alar, which was used on apples. This was one of the earlier studies illustrating the health risks of genetic engineering.
1990's	The organic industry had estimated sales of more than one billion dollars, and Congress passed the Organic Foods Production Act of 1990 (OFPA), which established the framework to create National Organic Standards. OFPA mandated the formation of the National Organic Standards Board (NOSB) to advise the Secretary of Agriculture in setting the standards for the UDSA National Organic Program (NOP). NOSB based its recommendations on industry consensus.
1997	The USDA's initial proposal for organic standards was presented for approval despite some provisions not recommended by the National Organic Standards Board (NOSB), and was severely rejected. This marked the first time in history an industry fought for stricter standards for themselves.
2000	Organic industry members and consumers sent over 275,000 responses to the USDA on their proposed National Organic Standards, requesting stricter standards for organic farmers.
2001	USDA passed the National Organic Program (NOP) after reinstating prohibitions on irradiation, sewage sludge and genetically-engineered seeds.
2002	October 21, Official implementation date of the USDA's National Organic Program (NOP) certification for organic labelling.
2004	April: the USDA passed new rules that allow USDA-certified organic farms to use fertilisers and pesticides that contain "unknown" ingredients, and USDA-certified organic dairy cows that have been administered antibiotics or fed non-organic fishmeal – made with synthetic preservatives and potentially contaminated by mercury and PCBs (a known carcinogen). USDA also announced they will no longer regulate non-

	agricultural products labelled as "organic". Any seafood, body care products, pet foods, fertiliser, and clothing, no matter how they are produced, could be labelled "organic". May: After a flood of petition signatures, calls, and letters, the USDA retracted their directives from the previous month. June: USDA reinstated one of the three directives from April, which allows seafood, body care products, pet foods, fertiliser, and clothing to be labelled "organic", regardless of how they are produced.

1.2.3 Australia

Although the organics industry had been in existence for some time, it was only in the middle of the 20th century that enthusiasts brought organic techniques from Europe to Australia (Austrailian Government Department of Agriculture Fisheries and Forestry, 2004). Throughout the 70's organic products were only available in health food stores and food cooperatives but by the 1980's consumers began to express a desire to purchase food with minimal chemical residue. Increased demand resulted in increased supply and researches in Australia began looking at the long term viability of organic farming. Much of this research focused on finding ways in which producers could match the supply of the rapid growth in the organic industry. Surveys of farm viability and the nature of producers were conducted across Australia. At the same time organic groups in the country began actively lobbying which assisted in state and federal government becoming aware of the industry and the potential for increased production. In 1988, the Primary and Allied Industries Council produced a report titled '*Implications of increasing world demand for organically grown food*'. The report examined the global supply for organic food and examined how sustainable agriculture in Australia could be developed to meet both the domestic and export demand. By the 1990's organic products occupied prime shelf space in the large supermarkets and organic farms were clustered near Australia's big cities (Kondinin Group, 2000).

1.2.4 Other Continents

Other so-called developing countries such as Asia, Africa and Latin America do not appear to have a history of organic agriculture as such. It appears from the literature that organic agricultural practices developed around development projects and initiatives that transferred organic technologies. It is regularly acknowledged that many farmers in these parts were *de facto* organic farmers because they did not use chemical inputs. Further, it does not appear that traditional knowledge systems for crop management have been captured or documented as far as organic agricultural interests are concerned. With these initiatives, however, many developing countries have successfully accessed lucrative western markets with organic produce.

1.2.4.1 Asia

The organic industry in Asia has evolved at varying rates and is currently at different stages of development. Japan has a mature, well-organised industry, followed by Korea which is still maturing. China is also viewed as on its way to maturity while India and Thailand are seen as emerging. The Philippines, Sri Lanka and Malaysia are still at an infant stage with the movement led largely by civil society and the private sector which draw some support from government (Briones, Undated).

Although the organic industry in most of these countries is relatively new, many of the farming practices within the culture have evolved from ancient farming traditions. However, these have been practically extinct over vast areas under conventional farming for several decades (Briones, Undated).

In Japan, Masanobu Fukuoka, a microbiologist working in soil science and plant pathology pioneered the development of an agricultural technique known as Fukuoka farming. His doubt in modern agriculture led him to quit his job and in the 1940s he began to focus his attention on the development of the no-till organic method for growing grain (Wikipedia – The Free Encyclopedia Website).

Organic agriculture and associated industries began in earnest in China in 1990 when Zhejiang Provincial Tea Import & Export Corporation developed an organic green tea for export to Europe. This was followed four years later by the founding of the Organic Food Development Centre (OFDC) of the State Environmental Protection Administration (SEPA). OFDC was tasked with national certification and labelling of organic products, the provision of training and advice to farmers and applied research and promotion of organic products in China. Currently, 17 OFDC branches have been approved in various provinces and municipalities within the country (Biao & Xiaorong, 2003).

In 1999, in response to ISO Guideline 65, which requires certification and inspection services to be entirely independent from support services such as consulting and extension, OFDC separated into two branches. The OFDC continues to provide certification and inspection services, while a new organisation, the Nanjing Global Organic Food Research and Consulting Centre (OFRC) was established to provide technology, research, consulting and information services. OFRC is China's first formal and registered centre for organic consulting and extension work. Since then, much organic farming research has been undertaken, and consultation institutions have established as the need arose. This has all contributed significantly to organic farming development in China (Biao & Xiaorong, 2003).

1.2.4.2 Africa

The history of organic agriculture in Africa dates back to 1898 when the first organic garden was established at Peramiho in southern Tanzania. Since that time, the garden has been fertilised only with compost, wood ash, stable and latterly green manure thereby maintaining the soil fertility.

The development of sustainable, organic and ecological agriculture in Africa has mainly been in response to problems associated with production decline and increasing input prices. Most of these initiatives were based on practices and principles, which are today embedded in organic agriculture.

In Cameroon, organic agriculture has been driven through an organisation called EXPORT AGRO, which started in 1990. EXPORT AGRO was pioneered by Jean-Martin Tetang and has organised and secured production through a dense channel of small-scale producers.

The objective of this initiative is to value the local small-scale production and to ensure a regular revenue to very small producers. A collection channel of the controlled and certified production has been established in the main provinces of Cameroon.

In Kenya, formal organic agriculture began in the early 1980s with the establishment of organic training institutions. At the same time, some horticultural companies started growing organic vegetables for export. Initial efforts to develop organic agriculture were through rural development non-governmental organisations (NGOs), faith-based organisations, individuals and community-based organisations (CBOs). These organisation aimed to assist rural farmers to address declining agricultural productivity, land degradation, poverty, food insecurity and low incomes. Low incomes meant that farmers were not able to purchase conventional inputs at a high cost. Organic systems of agriculture presented low cost opportunity to improve farm productivity. As a consequence, organic farming was associated with poverty and this “poor man” perception of organic agriculture continues and is considered to be reason for the low level of commercialisation of organics at the smallholder level (Taylor, Undated).

In Uganda, the development of organic agriculture was driven by the export market. in 1994 commercial companies began engaging in organic agriculture, seeking the export market. There was also a general movement in the agricultural sector to develop sustainable agriculture as a means of improving livelihoods. Many NGOs, CBOs and, importantly, the government promoted an approach to agriculture which would allow for the safeguarding of food security, provide income, maintain soil fertility and control pests. This provided a solid foundation for the development of organic agriculture. The emphasis on nature of organic agriculture also appealed to the Ugandan people, which may have enhanced the uptake of this farming system (Taylor, Undated).

In South Africa, organic farming has grown from small informal groups producing organic products to a rapidly growing and formalised industry. While there is no formal detail on the history of the organics industry in South Africa, the formalisation of the industry can be considered to have begun with the establishment of the Organic Agriculture Association of South Africa (OAASA) in 1994 (Jackson, *pers comm.*). According to Mead (Undated), organic sales remained relatively low until 2003, after which rapid growth was experienced in both local an export markets. There are a number of different estimates of the value and extent of the industry in South Africa (Mead, Undated; Van Zyl, 2000; Parrott and Elzakker, 2003), which range from 200 to 250 farmers cultivating between 45 000 and 515 000 ha of land. Due the lack of formal legislation or record keeping for organic agriculture in South Africa, the actual value and extent of organic agriculture has yet to be determined accurately. Nevertheless, South Africa has a robust and growing domestic market for organic products and exports are increasing.

2 WHAT IS ORGANIC FARMING?

Organic farming (also known as ecological or biological farming) is commonly recognised as a farming system that excludes the use of synthetic fertilisers and pesticides. This is a rather simplistic view of organic agriculture as it differs from other farming systems around the management of the entire system. Organic farming is a clearly defined production system that takes an holistic approach to production, considering the entire farm or production system as an ecological unit.

Central to the organic farming system, in terms of physical production, is the management of the soil. Soil is managed in such a way as to optimise soil health through the management of the inorganic and organic soil processes to enhance biological processes that improve plant health. This is primarily based on the exploitation of natural biological cycles in the soil (e.g. nitrogen fixation and nutrient cycling in the soil). Crop combinations and rotations are also managed in such a way as to improve plants' competitive ability and create a favourable environment for the presence of natural predators of crop pests. In livestock, animals are managed to enhance natural resistance to pests and diseases though good nutrition and management practices such as interrupting host / pathogen relationships. These kinds of practices reduce the necessity for external inputs to manage disease and fertility (FAO, 1998; Scottish Agricultural College, 2005).

Organic farming is not only about managing the soil – plant – environmental interaction in an holistic manner – it also has food quality, human health, animal welfare and socio – economic aims. As a result of these principles and philosophies, organic food has a strong brand image in the eyes of the health, environment and socially conscious consumer. Organic agriculture is therefore, is not only driven by farmers' philosophical approaches to agriculture, but is also drawn by consumer demand (Scottish Agricultural College, 2005). This strong brand image combined with generally limited supply means that organic produce can command higher prices for retailers and farmers than conventionally produced food.

The International Federation of Organic Agriculture Movements (IFOAM), the umbrella body for organic agriculture worldwide, defines organic as the farming system described in its basic standards. IFOAM outlines the principle aims of organic agriculture as follows:

- to produce food of high nutritional quality in sufficient quantity;
- to interact in a constructive and life enhancing way with all natural systems and cycles;
- to encourage and enhance biological cycles within the farming system, involving micro organisms, soil flora and fauna, plants and animals;
- to maintain and increase long-term fertility of soils;
- to promote the healthy use and proper care of water, water resources and all life therein;
- to help in the conservation of soil and water;
- to use, as far as is possible, renewable resources in locally organised agricultural systems;
- to work, as far as possible, within a closed system with regard to organic matter and nutrient elements;
- to work, as far as possible, with materials and substances which can be reused or recycled, either on the farm or elsewhere;

- to give all livestock conditions of life which allow them to perform the basic aspects of their innate behaviour;
- to minimise all forms of pollution that may result from agricultural practices;
- to maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats;
- to allow everyone involved in organic production and processing a quality of life conforming to the UN Human Rights Charter, to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment;
- to consider the wider social and ecological impact of the farming system;
- to produce non-food products from renewable resources, which are fully biodegradable;
- to encourage organic agriculture associations to function along democratic lines and the principle of division of powers;
- to progress towards an entire organic production chain, which is both socially just and ecologically responsible.
- IFOAM states that "Genetic engineering focuses on the genetic makeup without taking into account the complete organism or system in which the organism functions. It is thus a contradiction to the above mentioned principle aims of organic agriculture."

2.1 Definitions

It is helpful to look at some of the definitions of organic farming by major certifying bodies and organisations. From these definitions it becomes clear that while definitions may differ, the underlying principles of the definitions are common:

2.1.1 International Federation of Organic Agriculture Movements (IFOAM)

"Organic agriculture includes all agricultural systems that promote the environmentally, socially and economically sound production of food and fibres. These systems take local soil fertility as a key to successful production. By respecting the natural capacity of plants, animals and the landscape, it aims to optimise quality in all aspects of agriculture and the environment. Organic agriculture dramatically reduces external inputs by refraining from the use of chemo-synthetic fertilisers, pesticides, and pharmaceuticals. Instead it allows the powerful laws of nature to increase both agricultural yields and disease resistance."

2.1.2 Codex Alimentarius

"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."

2.1.3 United States Department of Agriculture (USDA)

"A production system which avoids or largely excludes the use of synthetically compounded fertilisers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic agriculture systems rely upon crop rotations, crop residues, animal manure, legumes, green manure, off-farm organic wastes, mechanical cultivation, mineral bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests'. The USDA definition includes the following observation: "The concept of the soil as a living system which must be "fed" in a way that does not restrict the activities of beneficial organisms necessary for recycling nutrients and producing humus is central to this definition."

2.1.4 National Organics Standards Board (NOSB)

"Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony.

'Organic' is a labelling term that denotes products produced under the authority of the Organic Foods Production Act. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole.

Organic agriculture practices cannot ensure that products are completely free of residues; however, methods are used to minimise pollution from air, soil and water.

Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agricultural products. The primary goal of organic agriculture is to optimise the health and productivity of interdependent communities of soil life, plants, animals and people."

2.1.5 Wikipedia

Wikipedia (2007), the popular free encyclopaedia defines organic farming as follows:

"Organic food is produced according to legally regulated standards. For crops, it means they were grown without the use of conventional pesticides, artificial fertilisers or sewage sludge, and that they were processed without ionising radiation or food additives. For animals, it means they were reared without the routine use of antibiotics and without the use of growth hormones. Also, at all levels, organic food is produced without the use of genetically modified organisms."

An internet search of definitions of organic agriculture yielded numerous definitions. Based on the above definitions and this search, the following key words/ concepts have been identified which describe what organic agriculture *is* (see Table 3 below).

2.1.6 South Africa

An extensive literature search did not reveal a South African definition for organic farming.

2.2 Principles of Organic Agriculture

According to IFOAM (2005), the principles of organic agriculture are based on four fundamental principles:

The principle of health

- Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. The health of individuals and communities cannot be separated from the environment.
- The role of organic agriculture is to sustain and enhance the health of ecosystems and organisms. Organic agriculture aims to produce high quality, nutritious food that contributes to preventive health care and well-being. It should avoid the use of fertilisers, pesticides, animal drugs and food additives that may have adverse health effects.

The principle of ecology

- Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. It is rooted within living ecological systems and production is to be based on ecological processes and recycling.
- Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature and organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources.
- Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

The principle of fairness

- Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities
- Fairness is characterised by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.
- This principle emphasises that organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties, should provide everyone involved with a good quality of life, contribute to food sovereignty and reduction of poverty. Animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behaviour and well-being.
- Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

The 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.
- Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardising health and well-being. Consequently, new technologies need to be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken.
- This principle of care views precaution and responsibility as key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

There is no universally recognised definition or description of organic farming. Many organic organisations have proposed definitions, but no single definition has been adopted by organisations as an accepted definition/description (FAO, 1998).

Table 3 Key words and concepts obtained from definitions and principles of organic agriculture

Ecological Production	Biological Cycles
Restore Ecological Harmony	Integrated Management
Health	Productivity
Crop Rotation	Green Manures
Compost	No Synthetics
No GMs	Harmony
No Harmful Chemicals	Certification
Record Keeping	Renewable Resources
Recycling	Environment
Labelling	Pollution Minimisation

Integrity	Interdependent Communities
Sustainable	Respect
Holistic	With Nature (not against)
Fairness	Benefit Sharing

2.3 Other Farming Systems

The concept of sustainable agriculture, within the broader context of sustainability has become a common term. Sustainability is embodied by the Brundtland Commission definition: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

Gold (1991) observes that questions of sustainability in agriculture have arisen from concerns around the following areas:

- Ecological
    - Declining soil productivity
    - Pollution – agriculture is the largest non-point source of water pollutants
    - Water scarcity and overuse of surface and groundwater resources
    - Other environmental problems, such as pesticide resistance, loss of habitats, loss of crop and livestock genetic diversity
    - Agricultures role in climate change – due to loss of native vegetation, release of carbon from soils
- Economic and Social Concerns
    - Sustainable and equitable food supply
    - Widening disparity in farmers' incomes
    - "Corporatisation" of agriculture – agribusiness is becoming concentrated in fewer and fewer hands, and the loss of the small family farm and subsequent disintegration of rural communities
- Human Health Concerns
    - Traces of pesticides, antibiotics and hormones in produce
    - Health of farmworkers applying pesticides
- Philosophical
    - The agrarian roots of many communities are being lost
    - The implication of sustainability to conventional farmers is a criticism that they have been "doing it wrong" all this time

There are a range of sustainable agricultural practices and technologies that are now available to the farmer. Organic farming is a part of this, but combines a range of sustainable agricultural practices and technologies together. Three farming systems are described below to provide a comparison with organic farming and thereafter a range of names and descriptions for sustainable agriculture are provided, of which organic is one. For full descriptions, please refer the Gold (1999) document at www.nal.usda.gov/afsic/AFSIC_pubs/srb9902.htm

2.3.1 Conventional Farming

Conventional farming can be described as an industrialised agricultural system characterised by mechanisation, monocultures and the use of synthetic inputs such as chemical fertilisers and pesticides. It is also known as extractive farming and industrialised agriculture. Industrialised agriculture developed mainly as a consequence of technological developments during and immediately after world war two. One of the major breakthroughs that allowed the massive growth of agriculture was the "*Haber-Bosch process*". This technique, developed in the 1920s, was perfected by the 1940s and allowed atmospheric nitrogen to be converted to ammonia and subsequently into nitrates, probably the most important and difficult to obtain macro nutrient required for plant growth.

Although this system of farming has been in existence for a relatively short period of time, its mass uptake around the world has resulted in this farming system being known as "conventional".

2.3.2 No-Till Farming

No-till farming is a system of crop production that does not use conventional tillage operations such as ploughing, disking and ripping. It is also known as conservation farming or zero tillage and was also called chemical farming, although this name has been little used due to the negative connotations associated with chemical use on farms (Wikipedia – The Free Encyclopaedia Website). It is becoming increasingly popular due to a number of economic and environmental benefits.

Conventional tillage operations are widely used for weed control, application of fertilisers and pesticides, to shape the soil (create beds) and ensure a good tilth for seedling germination and growth. Such operations can have unfavourable environmental effects such as:

- Soil compaction
- Increased runoff
- Erosion
- Loss of soil structure
- Organic matter loss
- Loss of soil biodiversity
- Loss of nutrients through erosion and leaching

(Wikipedia - The Free Encyclopedia Website, 2007b; Kuepper, 2001)

The practice of minimal disturbance of the soil and leaving crop residues on the soil surface minimises the environmental damage associated with tillage and provide a number of benefits, including (Wikipedia - The Free Encyclopedia Website, 2007b; Kuepper, 2001; Peet, 1995; United States Department of Energy, Undated):

- Carbon sequestration - tilled soils lose organic carbon through oxidation processes from the exposure of soil to the atmosphere. Zero till allows crop residues to decompose *in situ* and soil organic carbon is increased in the soil
- Reduced carbon emissions from machinery that would have been used in tillage operations
- Soil quality and function is improved due to improved soil structure as a result of increased organic matter in the soil, including
    - Improved infiltration and water holding capacity, reduced soil evaporation from the soil surface
    - Improved soil biodiversity and micro-organism activity
    - moderation of soil temperature
- Economic benefits:
    - Fiscal incentives, such as grants and awards for practicing conservation tillage (particularly in the USA and the EU).
    - Farmers can earn carbon credits, which they can trade
    - Reduced fuel, machinery and fertiliser costs associated with minimum tillage.

No-till is usually associated with the use of herbicides, as one of the purposes of land preparation is to remove weeds. Many farmers use herbicide regimes that can result in soil fatigue and toxicity from high loads of herbicides. Integrated systems are practices that use a combination of mechanical control, hand weeding and herbicides.

One of the criticisms of organic farming is its reliance on tillage to control weeds, insects and diseases. It has been proposed that combining no till farming with organic farming could significantly enhance the sustainability of both farming systems (Wikipedia - The Free Encyclopedia Website 2007b; Keupper, 2001; Trewavas, 2004). A study published in *Science* (Robertson *et al*, 2000) of the global warming potential (GWP) of a range of agricultural production systems showed conventional tillage to contribute significantly to global warming. Organic farming systems, while performing better than conventional, had a much higher GWP than no till systems.

Keupper (2001) researched the possibility of increased application of no-till systems in organic agriculture and found that there were a number of herbicide free no-till operations that have shown potential in organic production systems. He found that there are a number of mechanical options available for organic farmers and also alluded to the development of organic herbicides which have potential application in organic farming. There are therefore opportunities for marrying these two farming systems to enhance the overall contribution of both systems to improved environmental management.

2.3.3 Integrated Farm Management

Integrated Farm Management (IFM) is a system of farming promoted by the organisation Linking Environment and Farmers (LEAF) (www.leafuk.org). IFM aims to combine the best traditional farming methods with modern technology, which can allow farmers to manage their farms in an "informed, professional and caring way".

IFM is based on traditional cropping systems such as crop rotation, but also makes use of pesticides and fertilisers only when absolutely necessary to ensure crop and animal health. IFM maintains high standards of food production with minimum environmental impact.

IFM is defined as "A whole farm policy providing the basis for efficient and profitable production which is economically viable and environmentally responsible. IFM integrates beneficial natural processes into modern farming practices using advanced technology. It aims to minimise environmental risks while conserving, enhancing and recreating that which is of environmental importance."

2.3.4 Other Terms

Additional terms that are linked to agricultural sustainability include:

- Agroecology – a generally more environmentally and socially sensitive approach to agriculture.
- Agroforestry – a system of combing the use of tree species and row crops in combination.
- Alternative agriculture – an array of practices that are considered different from prevailing / conventional agricultural activities
- Best management practices (BMPs) – established practices for the optimal management of a given system, based on required outcomes, but generally related to overall sustainability.
- Agrobiodiversity – includes the wide variety of species used by farmers as well as how biological diversity is exploited to produce and manage crops.
- Biodynamic farming - a more spiritual approach to agriculture requiring specific practices and preparations to work within these spiritual parameters. Biodynamic foods are certified through the Demeter Association.
- Biointensive farming or mini gardening – a production system that enables one person to grow all their and or family's needs on a small area without relying on non renewable resources.
- Biological farming / Ecological farming – in Europe, this refers to specifically to organic farming, while in other countries, it can refer to adopting specific practices that enhance the sustainability of farming.
- Biotechnology – the techniques of breeding and cultivation of plants to enhance a given trait or set of traits. This term has now been coopted by GM interests and is invariably

associated with genetically engineered organisms. There are factions who believe that Biotechnology will enhance the sustainability of agriculture, although this is a fiercely debated subject, and is included for this reason.

- Carrying Capacity – theoretical equilibrium population size at which reseource production and consumption will stabilise i.e. the maximum size that can be supported indefinitely into the future.
- Holistic management – a decision making process allowing people to make decisions that satisfy immediate needs without jeopardising future well being. A process which identifies deeply held values and uses this to create a vision and a long term picture towards which they will progress and assist in making decisions that are environmentally, socially and economically sustainable.
- Integrated Farming systems – viewing farms as an integrated whole to make more efficient use of natural, economic and social resources.
- Integrated Pest management – an ecologically based approach to pest control that uses a multidisciplinary knowledge of crop and pest relationships to keep pest populations within acceptable limits. IPM does, however, make use of pesticides.
- Low input agriculture – a system that seeks to optimise management and use of on farm inputs to reduce the need for external inputs to lower costs, avoid pollution and pesticide residues while maintaining and enhancing short and long term farm profitability.
- Natural Farming – based on the philosophy of Japanese farmer Masanobu Fukuoka and is a farming system with no tillage, fertilisers, pesticides weeding pruning and even very little labour.
- Permaculture – or permanent agriculture – the emphasis is on design to produce an efficient, low maintenance integration of plants, animals people and structures applied at the scale of a home garden.
- Precision Farming – a management strategy employing detailed, site specific information for precise management of farm inputs to optimise (reduce) input use. This system has come under criticism in terms of sustainability due to high capital outlays and high technology requirements.
- Regenerative Agriculture – a term coined by Robert Rodale and refers to the regeneration of the renewable resources on the farm as well as regeneration related to economic sectors and social concerns.

The principles and standards for organic agriculture draw on many elements of the above descriptions and philosophies for sustainable agriculture.

2.4 Organic Production Practices and Norms

Although organic agriculture can be separated into two broad categories, namely livestock and crops, organic farming focuses on the interrelatedness of these two elements. Consequently, organic systems are usually mixed operations involving a number of enterprises combined in a holistic manner (McCoy & Parlevliet, 2001). The production practices and norms outlined below are not intended to be comprehensive. Individual combinations of products and the management practices associated with them vary tremendously, further compounded by different environmental conditions. This section aims to provide insight into the types of systems and management that needs to be in place for organic production.

2.4.1 Livestock

2.4.1.1 Soil Fertility and Stocking Rates

Organic livestock farming is based on the principle of a close link between the animals and the soil This link requires animals to have free access to outside areas for exercise and implies that their feed should be organic and preferably produced on the farm (Le Guillou & Scharpé, 2000). The influence of livestock on soil fertility and the influence of soil fertility on livestock nutrition are important management considerations within organic farming systems. Livestock impacts on soil fertility through physical effects such as trampling and the removal and return of nutrients through dung and urine (Watson *et al*, 2002). Soil fertility determines pasture productivity and quality and therefore the carrying capacity of an area (McCoy & Parlevliet, 2001). Organic livestock production is extensive and involves modest stocking rates, irrespective of the type of stock. On organic dairy farms, variations in stocking rates per forage hectare (GLU/ha) ranged from 0.8 to 2.0 Livestock Units (LU)/farm hectare with Denmark and Germany reporting even lower levels (Padel, 2000).

2.4.1.2 Pasture and Grazing Management

Pasture on organic farms should produce high quality forage by using and developing soil fertility, and relying on legumes for nitrogen fixation thereby minimising the need for mineral and nutrient fertilisers (McCoy & Parlevliet, 2001). Increasing soil fertility, in conjunction with sound grazing management, can assist desirable pasture species to outcompete weeds and improve the quality and nutritional value of pastures (McCoy & Parlevliet, 2001). Livestock production is highest when animals have access to green leaves all year round. This requires careful species selection and the following factors should be considered:

- Intended lifetime and purpose of the specific pasture;
- Climate and adaptability to soil and environmental factors;
- Compatibility between species;
- Growth cycles;
- Seasonal herbage quality;
- Palatability; and
- Cost of the seed.

Rotational grazing systems are generally preferred as they can be designed to optimise pasture utilisation, maintain pasture composition and control parasites. Short duration, high intensity grazing followed by a long rest period, is often used to help prevent preferential selection. Stock movements are also limited to reduce stress (McCoy & Parlevliet, 2001).

2.4.1.3 Animal health and welfare

Regular and routine use of medication is not permitted in organic livestock systems. Veterinary problems are believed to result from mineral or nutrient deficiencies caused by soil imbalances. The underlying problem therefore should to be identified and rectified. Prevention of disease rather the treatment is the preferred approach (McCoy & Parlevliet, 2001).

The health and welfare of livestock is dependent upon the action of stockpersons who handle, observe and monitor the animals (Seabrook, 2001). Close observation of individual animals is important in early identification and treatment of disease. Furthermore, good record keeping may assist in assessing the origins of the problem (McCoy & Parlevliet, 2001).

The welfare of animals in organic systems is crucial and must be guided by an attitude of care, responsibility and respect. Thought must be given to natural behaviour patterns and living conditions should fulfil the natural requirements of the animal and include free movement, food, water, shelter and shade (McCoy & Parlevliet, 2001).

2.4.2 Crops

2.4.2.1 Soil Fertility

The foundation of organic agriculture lies in the health of soil (VanTine & Verlinden, 2003). Soil fertility management maintains and improves soil condition and minimises erosion. Strategies used to achieve this include crop rotation, the use of green manures and cover crops, the application of plant and animal matter and the application of allowable soil amendments. Nutrient levels in soil should be regularly tested to determine the amount of nutrients required for optimum growth of a particular crop as well as the necessary amount of manure, compost and allowable fertiliser that should be applied (Anon, 2003).

2.4.2.2 Plant and animal materials

Plant and animal materials which have not been treated with prohibited substances may be applied to soil as composted or uncomposted material (Anon, 2003). Animal manures are the most common amendments applied to soil particularly in mixed livestock farms. Uncomposted animal manure is generally only applied under specific conditions (Anon, 2003):

- On fields with crops not to be consumed by humans
- If it is integrated into the soil a minimum of 90 days before harvest, provided that the edible portion of the crop does not contact the soil, or
- If it is integrated into the soil a minimum of 120 days before harvest for a product that does come into contact with the soil.

Livestock manures are important not only because they provide organic matter and nutrients but also improve soil physical properties, thereby assisting water infiltration and preventing erosion (Klonsky & Tourte, 1998).

Organic manures are traditionally applied to root crops and silage although it may be beneficial to apply them to cash crops. Research suggests that manure management within the rotation has significant effects on both yield and product quality (Watson *et al*, 2002). The quantity of nutrients within manures varies depending on the type of animal, feed composition, quality and quantity of bedding material, length of storage and storage conditions.

2.4.2.3 Fertilisers and Soil Amendments

A number of mineral nutrient sources, approved by certifying bodies, may also be used in organic agriculture. These include rock phosphate, rock potassium, magnesium rock and gypsum (Watson *et al*, 2002). Trace elements may also be applied, as well as lime to maintain soil pH. Using allowable fertilisers can be costly as they tend to be low in nutrients and need to be applied in large quantities (Anon, 2003).

Table 4: Soil amendments and their uses (adapted from Organic Production Systems)

Mineral nutrient source	Use
Lime	To increase pH; supply calcium.
Dolomite	To increase pH; supply calcium plus magnesium.
Gypsum	To improve structure (especially salt affected); supply calcium plus sulphur.
Rock phosphate (various forms), guano	To supply phosphorous.
Sulphate of potash	To supply potassium and sulphur.
Crushed mineral bearing rock	To supply potassium plus other minerals; and increase 'paramagnetism'.
Calcified seaweed / Volcanic Rock Ash	To supply trace elements.
Various formulated fertilisers	Approved for use in organic systems.
Trace elements including natural chelating agents.	Promote plant health, growth and vigour.

2.4.2.4 Pest Management

Pests are primarily managed through the use of biological and cultural control methods (Fouche *et al*, 2000). These include diverse crop rotations, enhancement of soil quality by incorporation of specific cover crops and/or the addition of soil amendments and the use of resistant crop varieties to prevent or reduce pest outbreaks (Wyss *et al*, 2005).

Organic agriculture prohibits the use of genetically modified organisms and requires that seed and planting stock is organically produced. If no commercial organic seed or planting stock is available, untreated non-organic seed and planting stock may be used, subject to the conditions of certification. Seed and cultivars with good resistance to disease and pests in a specific area should be selected (Anon, 2003). Mixed species cropping, including row intercropping and strip cropping, are also viable tool to control pests and diseases (Rämert *et al*, 2002).

2.4.2.5 Weed Control

Weed control and management is probably one of the greatest challenges to organic farmers in terms of physical production (Klonsky & Tourte, 1998). Combinations of both cultural and direct control strategies are generally employed to control weeds.

Cultural methods include crop rotation, one of the basic building blocks of organic farming. Weed population density can be substantially reduced using crop rotation. The aim is to produce an unstable environment in which no single weed species is allowed to dominate or adapt. Merthfield (2000) indicates that the success of this method depends largely on alternating between crops which have different:

- Cultivation and planting dates
- Rooting habits
- Volume and type of top growth
- Lengths of production
- Cultivation requirements
- Harvesting requirements
- Weeding requirements

Generally rotation cycles extend over several years with an annual change of crop in a given field. The length of rotation, selection and sequence crops depends on a range of environmental factors, such as climate and geographic location (Garden Organic Website).

Other cultural control strategies include the use of manures and cover crops as well as the strategic use of fallowing. Fallowing is a technique in which a field is shallow cultivated (3-6 cm) every time the weeds produce above-ground growth. Fallows are very effective in controlling shallower and vertical rooting weeds, but the constant tillage has negative impacts on soil structure and organic content (Merfield, 2000).

Cultural controls provide the basis for weed management in organic systems but are often supplemented with direct action. These include mechanical and manual weed control, thermal and biological weed control and mulching.

Mechanical weed control can involve weeding the entire crop or specific inter-or intra-row weeding (Garden Organic Website). Types of mechanical weeders range from basic hand tools such as hoes, harrows, mowers and brush cutters to tractor driven or self-propelled machines. There are two broad classes of equipment for annual crops, broadacre and interrow machines. Broadacre machines have a weeding action which kills the weeds but does not affect the crop. Interrow machines only kill weeds between crop plant rows (Merfield, 2000).

Biological weed control uses living organisms to destroy weeds or inhibit their growth, thereby limiting their ability to compete with crops. Biocontrol can be separated into the use of *biocontrol* agents such as insects and *inundative* controls which involves the mass production and release of natural enemies, usually disease agents (Organic Agriculture Centre of Canada (OACC) website). Conservation control is also used, which manipulates the habitat around the weed with the objective of encouraging those organisms which attack the weed (Garden Organic Website).

Manual weed control is still widely used in organic systems. Hand weeding is most effective on annual weeds and some perennial weeds. This method is costly however a certain amount of hand weeding is usually necessary (Frost, 2003).

Thermal weed control involves the use of heat to control weeds. Direct flame and infra-red, are the most common methods of thermal weed control. Flaming prior to emergence is normally used in slow germinating row crops such as onion, leek, carrot and maize (Melander, 2000). Weeds are most susceptible to flame heat when they are young with broadleafs more susceptible to flaming than grasses (Sullivan, 2001). One of the advantages of flaming is that it does not disturb the soil or leave chemical residues (Melander, 2000).

Mulching excludes light from reaching the soil surface thereby preventing weeds from germinating. This technique is widely used in perennial crops such as strawberries and is often combined with mowing in permanent crops (Frost, 2003).

BIOTECHNOLOGY, WASTE MANAGEMENT AND ORGANIC FARMING

INTRODUCTION

The United Nations Convention on Biological Diversity defines biotechnology as:

"…any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use."

Biotechnology may be regarded as the use of micro-organisms, like bacteria or yeasts, or biological substances like enzymes, to perform specific industrial or manufacturing processes. Applications include the production of certain drugs, synthetic hormones and bulk foodstuffs as well as the bioconversion of organic waste. Biotechnology involves manipulating organic and inorganic materials to work as part of a single unit, and bridge the gap between living and non-living components and their ability to function together.

Biotechnology has applications in four major industrial areas, including health care, crop production and agriculture, non food uses of crops (e.g. biodegradable plastics, vegetable oil, biofuels), and environmental uses. For example, one application of biotechnology is the directed use of organisms for the manufacture of organic products (examples include beer and milk products). Another example is using naturally present bacteria by the mining industry in bioleaching. Biotechnology is also used to recycle, treat waste, clean sites contaminated by industrial activities (bioremediation), and produce biological weapons.

Biotechnology and waste management are closely interlinked and this section will focus on how these two concepts function together. The different components of agricultural biotechnology will be discussed, leading on to the role of waste management within this, focusing on both the sources of waste and the use that organic production can make of this.

Agriculture and biotechnology

Biotechnology in agricultural plays an integral role in:

- The control of pests and diseases
- The release and transformation of essential nutrients so that they can be utilised by plants, and
- The transformation of waste products such as animal manure and silage into usable inputs in agricultural production.

Historical Evolution of Biotechnology in Agriculture

Early civilisation understood the importance of using natural processes to break down waste products into inert forms. From very early nomadic tribes to pre-urban civilisations it was common knowledge that given enough time organic waste products would be absorbed and eventually integrated into the soil. It was not until the advent of modern microbiology and chemistry that this process was fully understood and attributed to bacteria.

Early agricultural processes and methods have been refined over the decades. Through early biotechnology, farmers were able to naturally select the best suited and highest-yield crops to produce enough food to support a growing population. Other uses of biotechnology were required as crops and fields became increasingly large and difficult to maintain. Specific organisms and organism byproducts were used to fertilize, restore nitrogen, and control pests.

Modern scientific developments have, however, begun to artificially manipulate the natural biotechnology process, with modern genetic engineering transferring genes into the DNA of some plant cells and regenerating a whole plant from the transformed tissue. This branch of biotechnology is hotly contested and as such clouds out the other natural biotechnology processes and benefits available today.

There are five main components of agricultural biotechnology; genetically modified organisms, micro-organisms, pest management, hybrid species and natural predators. Each of these components will be discussed and their connection to biotechnology clarified.

Genetically Modified Organisms (GMOs) and Organic Production

It is unfortunate that when one speaks of biotechnology in agriculture this is seen to be synonymous with genetically modified organisms. While this section does not seek to explore the GMO debate, it acknowledges its place in biotechnology, thus it is best that the issue of GMO's be addressed at the onset and excluded from further discussion.

Genetic engineering is a process which attempts to artificially transfer a desired characteristic from one living thing to another. This is achieved by inserting the gene which controls this function in its natural environment, into the genetic code of the host.

The underlying principle of organic production involves the restoring of nature's balance to improve production systems and reduce pest and disease pressures created as a result of man's interventions. Organic farming systems have been designed to produce food with care for human health, the environment and animal welfare. The use of genetically engineered crops is not compatible with this philosophy, a position shared by the organic movement worldwide.

Micro-organisms

There are billions to hundreds of billions of soil micro-organisms in a handful of soil. That single handful contain thousands of different species of bacteria (most of whom have yet to be classified), hundreds of different species of fungi and protozoa, dozens of different species of nematodes plus an assortment of various mites and other microarthropods. Almost all of these soil organisms are not only beneficial, but essential to the life giving properties of soil, helping to:

- Break down plant and animals residues and wastes.

- Breakdown and then convert materials into plant nutrients as well as holding these nutrients in place and making them available to the plants.
- Control plant disease.
- Protect plants and assist in their physiology.

Biotechnology uses these natural organisms and their biochemical processes to enhance growing conditions, improve soil fertility and control pests and diseases.

Micro-organisms and soil nutrition

Soil micro-organisms are very important as almost every chemical transformation taking place in soil involves active contributions from soil microorganisms. In particular, they play an active role in soil fertility as a result of their involvement in the cycle of nutrients like carbon and nitrogen, which are required for plant growth. For example, soil microorganisms are responsible for the decomposition of the organic matter entering the soil (e.g. plant litter) and therefore in the recycling of nutrients in soil. Certain soil microorganisms such as mycorrhizal fungi can also increase the availability of mineral nutrients (e.g. phosphorus) to plants. Other soil microorganisms can increase the amount of nutrients present in the soil. For instance, nitrogen-fixing bacteria can transform nitrogen gas present in the soil atmosphere into soluble nitrogenous compounds that plant roots can utilise for growth. These microorganisms, which improve the fertility status of the soil and contribute to plant growth, have been termed 'biofertilizers' and are receiving increased attention for use as microbial inoculants in agriculture to improve soil fertility. Similarly, other soil microorganisms have been found to produce compounds (such as vitamins and plant hormones) that can improve plant health and contribute to higher crop yield. These microorganisms (called 'phytostimulators') are currently studied for possible use as microbial inoculants to improve crop yield.

Bio-pesticides and Pest Management

Pest management is an ecological matter. The size of a pest population and the damage it inflicts is, to a great extent, a reflection of the design and management of a particular agricultural ecosystem. Therefore, the first step in sustainable and effective pest management is looking at the design of the agricultural ecosystem and considering what ecological concepts can be applied to the design and management of the system to better manage pests and their parasites and predators. The routine use of biological poisons in food systems has become normal and has disrupted the natural balance between pests and their predators creating ideal environments for pests to flourish.

Integrated pest management, as it was originally conceived, proposed to manage pests though an understanding of their interactions with other organisms and the environment. Biological control is the use of living organisms—parasites, predators, or pathogens—to maintain pest populations below economically damaging levels, and may be either natural or applied.

Natural biological control results when naturally occurring enemies maintain pests at a lower level than would occur without them, and is generally characteristic of biodiverse systems. Mammals, birds, bats, insects, fungi, bacteria, and viruses all have a role to play as predators and parasites in an agricultural system. By their very nature, pesticides decrease the biodiversity of a system, creating the potential for instability and future problems. Pesticides, whether synthetically or botanically derived, are powerful tools and should be used with caution.

Applied biological control, also known as augmentative biocontrol, involves supplementation of beneficial organism populations, for example through periodic releases of parasites, predators, or pathogens. This can be effective in many situations—well-timed inundative releases of *Trichogramma* egg wasps for codling moth control, for instance.

Most of the beneficial organisms used in applied biological control today are insect parasites and predators. They control a wide range of pests from caterpillars to mites. Some species of biocontrol organisms, such as *Eretmocerus californicus*, a parasitic wasp, are specific to one host—in this case the sweet potato whitefly. Others, such as green lacewings, are generalists and will attack many species of aphids and whiteflies.

Information about rates and timing of release is available from suppliers of beneficial organisms. It is important to remember that released insects are mobile; they are likely to leave a site if the habitat is not conducive to their survival. Food, nectar, and pollen sources can be "farmscaped" to provide suitable habitat.

Biopesticides fall into three major categories; firstly, microbial pesticides containing a micro-organism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. For example, fungi that control weeds, and bacteria that control plant diseases. Secondly, plant-pesticides which consists of pesticidal substances that plants produce from genetic material. Thirdly, biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are synthetic materials that usually kill or inactivate the pest. Biochemical pesticides include substances, such as pheromones, that interfere with growth or mating of the pest.

Waste Management

Biotechnology plays an integral role in providing a comprehensive system to deal with waste and to manage it so as to incur benefits from it, rather than it becoming a point of contention. Biotechnology can be used to process organic waste so that it may be used in agriculture. There is also the question of the use of the word "waste". There are many useful products that are labelled as waste which can be recycled and reused and are therefore not "waste", but are, in fact, wasted resources.

Sources of Waste

In order to do this, the source of waste needs to be identified and then related to how organic production can use this waste beneficially. Three main sources of waste have been identified; farm waste, municipal waste and processing waste (e.g. abbatoirs, dairy), and their connection to organic production discussed.

Farm "Waste"

Animal manure is one of the products produced by farm animals that is well-known as an animal byproduct because it is used by many farmers to fertilise their land and gardens.

Some farmers also use manure gathered from broiler houses as cattle feed. The manure is rich in protein and energy and can be used as a cheap supplement instead of more expensive protein feed. In South Africa there are fertiliser companies that process broiler and other chicken manure into a balanced pelleted fertilizer that can be utilised as an organic fertilizer. Organic certification requires that the animals from which the manure is obtained are reared under humane conditions in keeping with the principles of organic agriculture. For example, manure from "Factory farmed" animals will not be certified as an organic input.

Recycled organic composts and mulches are used to enhance soils, for water conservation, suppression of weeds in horticulture and viticulture applications, e.g. for cut flowers, fruit trees, vegetables, grapes and turf grass growers.

Municipal "Waste"

The world municipal solid waste (MSW) is estimated to be 1.84 billion tons per annum and this can be expected to accelerate as developing countries become wealthier. According to research conducted in Australia, 60 -75% of MSW going to landfill is organic in origin, mainly consisting of paper/cardboard, food and garden materials. Landfills reach capacity fast in many parts of South Africa, and their rotting organic material leaches acids into groundwater and releases methane gas into the atmosphere. If most of this organic waste was to be used for agricultural purposes, it would reduce the rate at which landfills reach capacity and the use of chemical fertilisers. Less land would be required for waste management purposes and this would alleviate the world wide problem of declining arable land.

Biotechnology and waste management

Biotechnology contributes to the challenge of waste reduction by utilising optimised micro-organisms and enzymes to process organic waste. It can further lead to the development of new generation organic based agricultural products with the following characteristics:

- Nutrient uptake enhancement
- Plant growth promotion
- Biological nitrogen fixation
- Disease suppression

There is also need to change the perception of waste organic matter and encourage the adoption of properly processed waste as an important and safe input into agricultural production. Organic waste may be used to improve agricultural soil fertility for (subject to proper and safe processing, such as effective composting procedures) and can:

- Improve yields
- Increase water use efficiency
- Reduce chemical usage
    - Fertilizers

- o Herbicides
  - o Pesticides
- Fresh healthy food

The products and practices available to organic producers vary somewhat depending on the organic certification association they belong to. Inputs such as composted may not be allowed due to concerns related to the presence of chemical residues. More research is required to determine if this is necessary as proper composting of these materials should breakdown the residues.

Supplying Nutrients Organically

The application of biotechnology in waste management produces many products that contribute to providing nutrients in an organic system. The main products and practices that will supply crop nutrients organically are the following:

- Applying animal manure (Waste product)
- Composting (Waste product)
- Green manuring or green fallowing
- Growing properly inoculated legumes in the rotation
- Rotating high and low nutrient demand crops
- Rotating deep and shallow rooted crops
- Applying acceptable organic crop nutrient products
- Use of registered nutrient solubilizing microbial inoculants
- Fallowing using conservation tillage.

Applying animal manure

Animal waste materials usually contain the primary plant nutrients, nitrogen (N), phosphorus (P), and potassium (K), the secondary plant nutrients calcium, sulphur, and magnesium, and minor plant nutrients zinc, copper, boron, iron, and manganese. However, nutrient analysis can vary, depending on many factors, including the composition of animal feed materials, the type of poultry operation, flock size, flock replacement cycle, animal waste material management, storage method, and moisture content

Applying animal manure to a field is an effective way of increasing both nutrients and organic matter content in the soil. Animals typically pass, as waste, 75-90 per cent of the nutrients they are fed.

The concentration of the different nutrients in the manure varies according to the type of animal, type of feed, how the manure is stored and how it is applied. However, animal manure contains some level of all the essential nutrients. In most places, soil testing laboratories can test manure for its nutrient content and the soil from the field where the manure will be applied so the correct amount can be applied to correct the nutrient deficiencies.

Organic certification may require that manure be composted before application, depending on its source. Certification requirements for off farm (imported) manures are generally as follows:

- Manure from extensive agriculture can be applied directly onto the field
- Manure from intensive agriculture must be composted before application in the field
- Manure from factory farming (such as feedlots and battery chicken farms) may NOT be used.

Properly composted materials reach internal temperatures high enough (ideal temperature range is 54 to 60℃) to kill pathogenic bacteria an d weed seeds. However, temperatures should not exceed 66℃ or the microbes responsible for the composting process will also be killed. Overheating is prevented by turning the pile. Composting stabilises the N in raw manure, thereby reducing N losses. Nutrients from compost are released slowly and steadily for plant use throughout the season. Composting also reduces the bulk and mass of the material, reducing transportation costs.

Poultry manure and poultry litter (manure with bedding) is commonly used as a soil amendment and nutrient source for organic crop production. However, unless a farmer has an on-farm poultry facility, manure must be outsourced and delivered to the farm.

The National Organic Program in the USA defines manure as "faeces, urine, other excrement, and bedding produced by livestock that has not been composted." The USA provides guidelines for the use of raw animal manure which must be composted unless it is:

- Applied to land used for a crop not intended for human consumption.
- Incorporated into the soil not less than 120 days prior to harvest of a product whose edible portion has direct contact with the soil surface or soil particles.
- Incorporated into the soil not less than 90 days prior to harvest of a product whose edible portion does not have direct contact with the soil surface or soil particles.

Since tree crops like citrus may have low hanging fruit that may or may not come into direct contact with soil or soil particles, following the 120 day rule is a reasonable application of the above criteria.

Composting

Composting is the controlled aerobic biological decomposition of organic matter into a stable, humus as a result of intense microbial activity (Jones and Martin, 2003). Composting is a natural process, which is accelerated by mixing organic waste with other ingredients in a manner that optimises microbial growth. During composting, microorganisms use the organic matter as a food source, producing heat, carbon dioxide, water vapour, and humus as a result of their activity. Application of compost to the soil promotes good soil structure, improves water and nutrient holding capacity, enhances soil microbial activity and helps control erosion. Finished compost typically consists of 60% humus.

Effective composting requires that the initial compost mix have:

- A balanced source of energy (carbon) and nutrients (primarily nitrogen), typically with a carbon-to-nitrogen (C:N) ratio of 20:1 to 40:1.
- Sufficient moisture, typically 40% to 60%.
- Sufficient oxygen for an aerobic environment, typically 5% or greater.
- A pH in the range of 6 to 8.

Compost Microbes

The active microbes in compost are predominantly bacteria, actinomycetes and fungi. Most of the microbes that break down organic matter into compost are aerobic. Consequently, presence of oxygen is important for effective composting. The microbes in the compost live in water films that adhere to the organic matter. Sufficient moisture in the compost must be maintained to ensure their survival. If the moisture water content is too low, the microbes will die. If the moisture content is too high, oxygen is excluded from the system creating anaerobic conditions, which is detrimental to the composting process.

Fungi penetrate throughout the composting material and decompose the more persistent organic matter fractions, such as lignins and cellulose. Fungal hyphae[2] physically stabilise the compost into small aggregates, providing the compost with improved aeration and drainage. Ecologically, fungi play a vital role in breakdown of dead plant materials.

Bacteria are the most numerous biological component of compost, which can often exceed 1 billion microorganisms per gram Bacteria (with the exception of actinomycetes) do not contribute as much to the overall microbiological mass as fungi because of their relatively small size. Bacteria are typically associated with the consumption of easily degraded organic matter. They are the dominant population throughout the entire composting process, whereas the actinomycetes and fungi typically proliferate in the later stages.

Actinomycetes are visually similar to fungi in that they have networks of individual cells that form filaments or strands, but are actually a type of bacteria. These filaments allow for a colony* of actinomycetes to spread throughout a compost pile, where they are typically

[2] Root-like structures that penetrate through the soil.

associated with the degradation of the more recalcitrant compounds. Actinomycetes number between 0.1 and 10 million propagules per gram of soil. Their filaments contribute to the formation of the stable organic aggregates typical of finished compost. Actinomycetes are tolerant of lower moisture conditions than other bacteria and are responsible for the release of geosmin, a chemical associated with the typically musty, earthy smell of compost (CIWB, 2001; Rees, 2007).

The Composting Process

Composting occurs in a sequence of three distinct stages, where the type and number of microbes are affected by changes in temperature and nutrient availability. Temperature is a key determinant of the rate at which material is broken down and the type of microbes that facilitate the process in each stage. At temperatures of 10-40^0, mesopilic bacteria dominate and break down

Initial stage

In the process of building the compost pile, the feedstock is exposed to microbes which occur naturally in the surrounding environment. In the initial stage, mesophilic bacteria (bacterial whose optimal temperature range is 10-40^0 C) decompose (oxidise) easily digestible sugars, proteins, fats and starches. These bacteria multiply rapidly, releasing heat from the easily digested compounds. The release of heat from breakdown and the high insulating properties of the compost pile results in a rapid increase of temperature in the pile. Within hours, the temperature can increase to above 40^0 C

Active Stage.

Above temperatures of 40^0 C, thermophilic bacteria (“heat loving” bacteria whose optimal temperature range is 40 – 70^0 C) dominate the microbial community. The active stage is typically the stage where most of the organic matter is converted into carbon dioxide and humus. The micro-organism population grows rapidly and the rate of decomposition in the pile fast, due to the high rate of chemical and biological reactions association with the high temperature. The thermophilic population continues generating heat by decomposing the remaining organic matter. A number of important processes occur during this stage, which are of significance to the organic farmer:

- Pathogens such as human viruses and infectious bacteria are usually unable to persist in such a hostile temperature environment and are destroyed.
- Seeds of plants are rendered non-viable; the temperature in the pile denatures enzymes and proteins required for germination.
- Other undesirable elements, such as GM plant material and some organic pollutants are broken down into their constituent components, rendering them harmless.

During this stage, it is important to ensure that sufficient oxygen is available for the bacteria to continue decomposing the organic material and generate heat. This can be achieved by mixing or turning the pile, which also incorporates the cooler outer surface into the high temperature zone inside the pile. In static compost piles (piles that are not turned), incorporating layers of coarse material in into the pile will assist oxygen to enter the pile. While static piles require less labour and energy, the outer surface is never exposed to the high temperatures within the pile, and consequently, pathogens and weed seeds may persisit in this zone. If a pile overheats (exceeds 75^0C), most microbes will be destroyed and microbial activity will cease.

Curing Stage

As the bacteria run out of easily digestible organic compounds, their activity will decrease significantly and temperatures will return to ambient temperatures. Most of the remaining material consists of cellulose and lignins which are not easily broken down, and humic compounds. During this stage, the fungi and actinomycete populations dominate as they can break these compounds down.

The curing process can vary in duration, but is usually 3 – 12 months. A longer curing period provides more assurance that the compost is free of pathogens and phytotoxins. If the compost is incompletely cured (i.e., not stable), it maintains a higher microbial activity, leading to increased oxygen consumption. When unstable compost is applied in the field, it can thereby decrease the supply of oxygen available to plant roots.

As the curing stage proceeds, there is a gradual increase in the humus fraction. Humus is the major mechanisms for the retention of nutrients (e.g., nitrogen, phosphorus) and micronutrients (e.g., copper, zinc, iron, manganese, calcium) in the soil. This is because of its high surface area to volume ratio, providing a large surface area for adhesion and cohesion of water and nutrients. As a result, humic compounds are also sites of high biological activity, including microorganisms, protozoans, invertebrates (e.g., worms, springtails) and plants (CIWB, 2001).

Compost is commonly perceived mainly as a source of plant nutrients, but it is the combination of nutrients and large diversity of microorganisms that offer significant benefits, such as:

- Nutrient cycling – microbes facilitate the cycling of inorganic nutrients into plant available forms
- Disease suppression – beneficial microbes compete with pathogens for energy and nutrients, decreasing pathogen populations. It is in “dead” or unbalanced soils that pathogenic organisms flourish.
- Degradation of pollutants – properly made compost is an effective tool for reducing organic pollutants in contaminated soils and water, including chlorinated hydrocarbons, solvents, pesticides, and petroleum products.
- Organic material, which
    - Provides food for microorganisms
    - Holds nutrients and water
    - Forms aggregates and increases porosity

Compost and human pathogen concerns

Producing food for human consumption requires management of the production system in manner that ensures that food is safe for human consumption.The introduction of compost into the production system should not introduce human pathogens into the system. The eradication of pathogens from organic wastes during composting is primarily due to

- Heat generated during the thermophilic phase of the composting process
- The production of toxic compounds such as organic acids and ammonia
- Lytic acitivities of enzymes produced in the compost
- Microbial antagonism, such as the production of antibiotics and parasitism

Noble et al (2004) undertook a series of controlled tests for the presence of animal and plant pathogens in composted materials. These included the Endohaeamorragic E. Coli, Salmonella typhimirium and S enteriditis human bacterial pathogens. These pathogens were introduced into the compost at much higher concentrations that would naturally occur. After one hour at 55^0C, these pathogens were not detectable. They results of the study indicated that green compost would not be a significant risk for the spread of most bacterial diseases. Jones and Martin (2003) found that the risk of human pathogens in compost was mostly theoretical. They found that most pathogens were inactivated by the composting process where a residence time 3 days with a temperature greater than 55^0C occurred. It was found that if inefficient compost making procedures were used, there was a danger that E coli and Salmonella species may survive. This highlights the importance of proper and effective compost making practices. Noble and Roberts (2003) found that temperatures of 55^0C were sufficient to eliminate most plant pathogens, but that systems where composts were not turned may allow pathogens in the cooler outer layer to survive.

In conclusion, there appears to be limited risks associated with human pathogens in compost. However, the composting process must be effective and properly managed to ensure the composting process results in thermophilic conditions through the management of aeration, moisture and the C:N ratio. It is further important that all parts of the compost are exposed to the high temperature zone within the compost.

Opportunities for Biotechnology

The use of biological cycles and ecosystems is the basis of organic farming, however conventional farming methods, climate change and the ever reducing areas available for agricultural production requires that biological cycles be enhance and stimulated to restore the natural balance.

Many opportunities exist in organic farming for the research, development and application of biotechnology. Opportunities range from the use of earthworm in waste management to the application of Bt spray to control insects. However the development of commercial products requires much research into developing products which are reliable, of a uniform quality and efficacy and have the required shelf-life. This requires a large investment into research and development programmes.

3 DEVELOPMENT AND ESTABLISHMENT OF ORGANIC CERTIFICATION AND ACCREDITATION

3.1 History

Based on the definition of organic agriculture, there was a need to establish what organic farming systems meant in practice. Consequently, standards were required to ensure that organic production and processing systems uphold the definition of organic farming. Organic standards detail the minimum requirements of the farming system in order to ensure that the definition of organic farming is upheld (FAO, 1998).

Organic certification is a process in which producers and retailers of organic agricultural products, including farmers, seed suppliers, food processors and restaurants can be certified. The process is intended to assure quality and assist organic producers in identifying suppliers of products approved for organic operations and to provide consumers with product assurance.

In the 1960s the organic industry consisted mostly of small independent farms selling to the local market. Organic ‘certification’ was a matter of trust, dependent on the relationship between the farmer and consumer. In the late 1970s, organic certification programs started to develop. The need for certification arose out of the recognition that the term ‘natural’ had lost its meaning in the marketplace and producers and consumers were concerned that term ‘organic’ would end up with a similar fate (Wikipedia - The Free Encyclopedia Website – The Free Encyclopaedia Website). In the 1980s, private organisations, comprised mostly of farmers, developed standards for production, inspection and certification. Many governments took over this task in the 1990s (Yussefi & Willer, 2004).

The number of certification bodies has continued to grow and in 2003, the Organic Certification Directory published by Grolink, listed 364 bodies offering organic certification services. The majority of these organisations are found within the developed countries of the European Union, USA, Japan, Canada and Brazil. Many of these certification bodies offer their services in developing countries. Africa has only 7 certification organisations and Asia has just 13, outside of Japan. In total, only 57 countries have a home-based certification body (Yussefi & Willer, 2004).

3.2 Certification and Labelling

To ensure that the minimum standards are upheld, independent third party assessments are required to ensure that the farming system adheres to the given standards. Consequently producers had to be certified to in order to indicate that they are adhering to minimum standards established for organic production (FAO, 1998).

The generally accepted definitions used by certification bodies are as follows (Institute of Natural Resources, 2006):

- Accreditation

The procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks. In a certification system, an accreditation body will accredit, or approve, a certification body as competent to carry out certification.

- Certification Body

A body that is responsible for verifying that a product sold or labelled as a certified product is produced, processed, prepared, handled, and traded according to the certification standards. Certification bodies should be impartial third parties with necessary technical competence in certification.

- Certification

A procedure through which recognised (or accredited) certification bodies provide written or equivalent assurance that a product conforms to certain principles, criteria or standards.

Certification systems generally comprise two key components:

- A set of principles (usually in the form of a code of conduct), criteria, standards and guidelines against which a product is certified.
- A reporting or monitoring mechanism that assures the product has been produced according to the certification principles.

Certification can be broken down into four broad categories based on who produces the guidelines and conducts the monitoring. These are:

First Party Certification

- A single company, organisation or producer develops its own rules, analyses its performance, and reports on its own compliance.

Second Party Certification

- An industry or trade association fashions its own code of conduct and implements reporting mechanisms. This can be either voluntary or required for membership. Performance can be disclosed either for individual companies or for larger units of industry (e.g. type of product, country, global, etc.).

Third Party Certification

- An external, independent group, sometimes a non-governmental organisation (NGO), is involved in creating and developing rules and compliance methods and measures for a particular firm or industry. This is the certification type that is used for organic certification.

Fourth Party Certification

- This form of certification involves governmental or multi-national agencies. The UN Global Compact, for instance, lists environmental, labour, and human rights principles for companies to follow. Corporations are required to submit on-line updates for others to scrutinise.

Other relevant terminology includes:

- *Chain of custody:* the channel through which certified products move from the production unit through processing, storage, and distribution is defined as the chain of custody. The chain of custody system should provide credible assurance that all certified products are derived from certified production systems.

- *Eco-label (green marketing, green label):* a seal or label which shows that a certified product has been designed to do less harm to the environment than similar but un-labelled products. This labelling may be 1st, 2nd or 3rd party certified but is usually a set of principles that a producer or group of producers subscribes to, with no certification.
- *Environmental management system (EMS):* a management tool that is used to assist companies to improve their environmental performance.
- *Fair trade or ethical labelling:* a certification or labelling scheme designed for products that meet more social and economic (rather than environmental) principles of fair and ethical trade. Fair trade standards do usually have environmental considerations.
- *Label:* defined as a "Piece of paper or other material which gives consumers information about the object to which it is fixed". There are numerous private label schemes established by producers and retailers. These vary in nature but usually try to convince consumers via an attached logo or label that the product meets certain standards.
- *Label of origin:* a label identifying the country/region of origin on products. Often it accompanies imported products. It is used to provide a minimum of information about a product. A label, or mark of origin, is sometimes seen as a preliminary step towards certification or eco-labelling.
- *Organic labelling:* signifies that the product has been produced following standards for organic production.
- *Standards*: the levels of performance that are used to measure whether a product can be certified. A standard is a rule, regulation, or procedure specifying characteristics that must be met by a product. More and more, standards are expressed as measurements that can be used to show overall performance (results) toward achieving specific principles and criteria.
- *Transparency:* an open and publicly disclosed process in which a certification system is developed and operated. Consumers and other stakeholder confidence in certification are increased through transparency of the certification system and processes.

What is the difference between certification and labelling? Certification means that a given product or company has been checked by an independent third party for meeting a given set of standards. Most certification systems will also use labelling as a tool to help consumers recognise products that meet certification standards. A label however is not necessarily backed up by an accredited certification process. Green labelling or eco-labelling is generally focussed on smaller producer groups who supply directly, or through a very short value chain, to discerning end consumers. Labelling in this case may be misused but despite lack of formal certification, there is generally a high set of standards that are applied before such labelling can be approved to the producer/supplier (Institute of Natural Resources, 2006).

3.2.1 Organic Labelling

Certification makes labelling possible. Organic producers, processors and suppliers must be certified in order to use the word 'organic' on their product. The term is legally recognised and is governed by trading standards legislation (About Organics Website). Labelling requirements do vary between countries. The following labelling rules apply for processed products that are made up of a number of different ingredients (such as chocolate, baked and canned goods)

In the EU,

- The product may be called organic in the title if it contains 95% or more organic ingredients
- Products which contain 70-95% organic ingredients may only display the term 'organic' in the ingredients listing
- If less than 70% of the ingredients are organic, then the term 'organic' may not be used anywhere on the packaging.

In the US,

- '100% organic' indicates – all the ingredients are certified organic
- 'Organic' requires 95% of the ingredients to be certified organic
- 'Made with organic' means that 70% or more of the ingredients are certified organic
- If less than 70% of the ingredients are organic the product may not be called organic but certified organic ingredients may be listed in the ingredients listing (The O'Mama Report website).

Organic produce often carries the logos of the accrediting body and in the EU, the EU license code number (About Organics Website).

Woolworths, South Africa:

- The organic label means that a minimum of 95% of the ingredients of agricultural origin in the product, are certified organic. Although the pro-duct may contain approved non-organic ingredients, such as salt, it can still be certified organic.
- A product labelled 'organic in conversion' is a crop of agricultural origin, such as bananas or milk, that is from a farm that has been farmed organically between one and three years, but has not yet reached full organic status. 'Organic in conversion' farms are monitored frequently during the conversion period to assess factors such as soil residues.
- A product that is labelled 'Made with organic...' means that between 70% and 95% of the ingredients of agricultural origin are certified organic.

It can be seen that all the standards for these organic labels systems are the same.

3.3 Institutional and Legislative Arrangements Related to Certification

3.3.1 Standardisation, Accreditation and Certification

3.3.1.1 International Organisation for Standardisation (ISO)

The International Organisation for Standardisation (ISO), a non-governmental organisation, is the world's largest developer of standards consisting of a network of national standards bodies from more than 150 countries (International Organisation for Standardisation (ISO) Website). Established in 1947, ISO aims to facilitate international exchange of goods and services and to develop cooperation in the spheres of intellectual, scientific, technological and economic activity.

The ISO has a set of guides as well as a set of standards. The guides are systems or standards to which a certification body or accreditation body must adhere, while the standards refer to systems and processes that need to be adhered to in order to be certified as compliant to a given standard. The ISO Guides for accreditation are:

- ISO Guide 58: General Requirements for Laboratory and inspection body accreditation
- ISO Guide 61: General Requirements for Assessment and Accreditation of Certification/Registration Bodies

The guides for a certification bodies are:

- ISO Guide 62: General Requirements of Bodies Operating Quality Management Systems
- ISO Guide 65: General Requirements for Bodies Operating Product Certification Systems
- ISO Guide 66: General Requirements for Bodies Operating Environmental Management Systems

ISO Guide 65 is of relevance to the organics industry, in terms of organic certification and may be described as follows:

> "ISO Guide 65 specifies general requirements that a third-party operating a product or service certification system shall meet if it is to be recognized as competent and reliable. Adherence to the ISO Guide 65 Program ensures that the certification body operates a third-party certification system in a consistent and reliable manner." (USDA, Undated).

In addition to guides, ISO has thousands of standards that apply mainly to products, but also to processes. The most notable standards related to processes are the ISO 9000 and ISO 14000 families of standards, which establish quality management systems and environmental management systems respectively. Therefore, if an organisation wished to become ISO 14000 certified, it would approach a certification body that is accredited to ISO Guide 66 for certification.

ISO does not itself publish standards for organic production, however many countries make use of ISO Guide 65 for the accreditation of certification bodies. A certification body therefore has to be ISO 65 (or equivalent) compliant to operate a product certification system, such as organic certification.

3.3.1.2 The International Accreditation Forum

The International Accreditation Forum, Inc. (IAF) is the world association of Conformity Assessment Accreditation Bodies. The purpose of IAF is to ensure that its accreditation body members only accredit competent bodies and to establish mutual recognition arrangements, known as Multilateral Recognition Arrangements (MLA), between its members.

Accreditation body membership of IAF is open to organisations that accredit bodies for certification/registration of management systems, products, services, personnel or similar programmes of conformity assessment. It has programmes in place to ensure certification bodies are competent and ensure the consistent application of conformity standards

Through the MLAs, the IAF aims to provide assurance of the equivalence of the operation of certification/registration bodies in those countries with accreditation bodies that are IAF MLA members (IAF website).

3.3.1.3 The International Laboratory Accreditation Cooperation (ILAC)

The International Laboratory Accreditation Cooperation (ILAC) is an organisation with similar objectives to the IAF, but is concerned specifically with ensuring quality and consistency regarding laboratory testing and calibration. ISO guide 58 relates to the accreditation of certification bodies for laboratories and inspection bodies. (ILAC website).

3.3.1.4 South African National Accreditation System

Most countries have a national accreditation system that has membership with IAF and ILAC. The South African National Accreditation System (SANAS) is the National Accreditation Body that gives formal recognition that an organisation is competent to perform specific tasks in South Africa. SANAS accreditation covers Laboratories, Certification Bodies, Inspection Bodies, Proficiency Testing Scheme Providers and Good Laboratory Practice (GLP) test facilities.

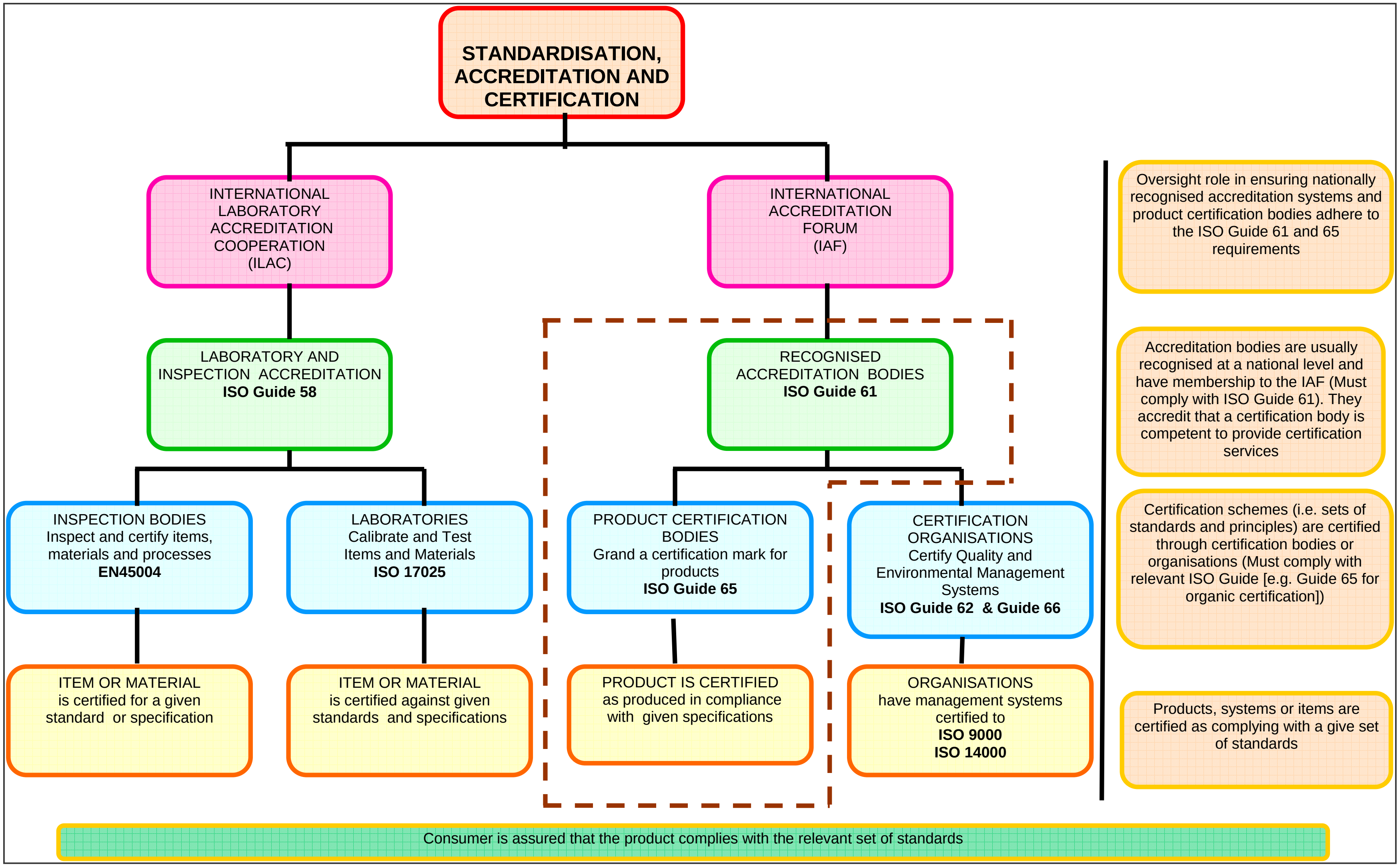
SANAS provides accreditation of Certification bodies to ISO Guide 65 (and the IAF interpretation thereof), and includes accreditation for organic certification. Inspection Bodies are accredited to ISO/IEC/17020 standards. (SANAS Website)

In effect, SANAS is a body that provides assessment and accreditation *to* conformity assessment bodies, such as organic certification bodies. SANAS is a member of the IAF and hence can accredited to certify bodies under ISO guides 62, 65 and 66.

The National Department of Agriculture has officially recognized SANAS as the authority for the regulatory scope covered by the Department of Agriculture, which has significance should South African National Organic Standards be promulgated (see section8.2.2).

3.3.1.5 Certification Bodies

Certification bodies usually provide certification for a range of products or processes. Some certification bodies, such as SGS, certify for a range of standards including organic standards. Others, such as Ecocert, provide certification only for organic standards. In the case of organic certification, a certification body will usually certify to a number of national organic standards, such as EU 2092, USDA NOP, JAS as well as private standards, such as Biosuisse or Soil Association. A certification body has to be *separately accredited* for each standard to which it certifies. In South Africa, a certification body does not have to be accredited by SANAS, but has to be accredited by a formal, recognised accreditation body. This is usually an accreditation body that operates in the country or region to which organic produce is exported. For example, if a certification body certified for the USDA NOP and the EU 2092 standards, it would have to be separately accredited by an approved accreditation body for each standard.



STANDARDISATION, ACCREDITATION AND CERTIFICATION
INTERNATIONAL LABORATORY ACCREDITATION COOPERATION (ILAC)
INTERNATIONAL ACCREDITATION FORUM (IAF)
LABORATORY AND INSPECTION ACCREDITATION ISO Guide 58
RECOGNISED ACCREDITATION BODIES ISO Guide 61
INSPECTION BODIES Inspect and certify items, materials and processes EN45004
LABORATORIES Calibrate and Test Items and Materials ISO 17025
PRODUCT CERTIFICATION BODIES Grand a certification mark for products ISO Guide 65
CERTIFICATION ORGANISATIONS Certify Quality and Environmental Management Systems ISO Guide 62 & Guide 66
ITEM OR MATERIAL is certified for a given standard or specification
ITEM OR MATERIAL is certified against given standards and specifications
PRODUCT IS CERTIFIED as produced in compliance with given specifications
ORGANISATIONS have management systems certified to ISO 9000 ISO 14000
Oversight role in ensuring nationally recognised accreditation systems and product certification bodies adhere to the ISO Guide 61 and 65 requirements
Accreditation bodies are usually recognised at a national level and have membership to the IAF (Must comply with ISO Guide 61). They accredit that a certification body is competent to provide certification services
Certification schemes (i.e. sets of standards and principles) are certified through certification bodies or organisations (Must comply with relevant ISO Guide [e.g. Guide 65 for organic certification])
Products, systems or items are certified as complying with a give set of standards
Consumer is assured that the product complies with the relevant set of standards

Figure 2: The general organisation of standardisation systems for ISO (dashed boundary indicates area where organic certification applies)

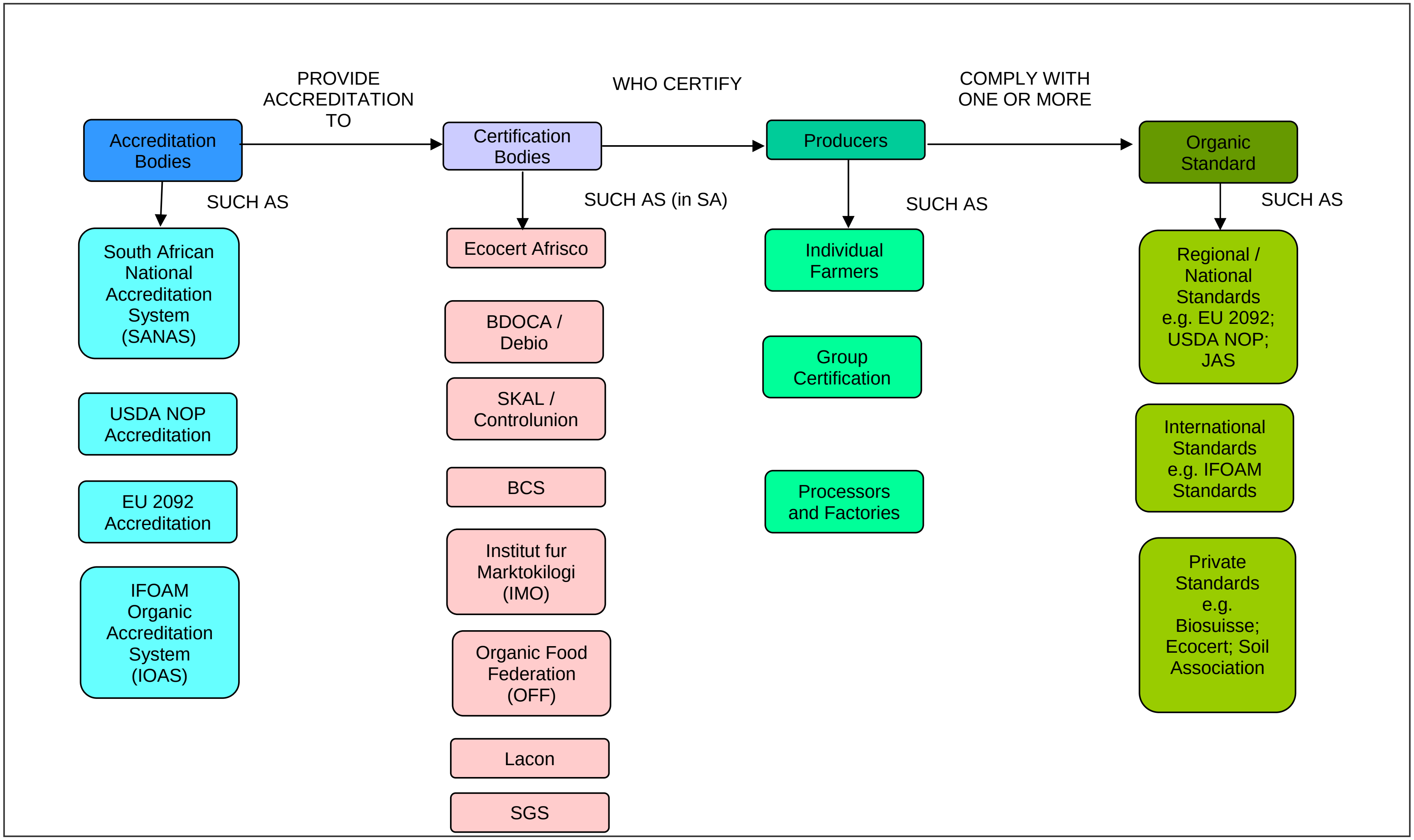


Figure 3: General Organisation of Organic Certification Systems

3.3.2 The IFOAM Organic Guarantee System (OGS) and IFOAM Accreditation

One example of an accreditation system is the the IFOAM organic guarantee system (OGS). The OGS provides a guarantee of organic claims through a common system of standards, verification and market identity. The OGS enables certification bodies to become IFOAM accredited and certified producers to label their products with the IFOAM seal. The OGS is based on the pillars of the IFOAM Basic Standards (IBS) and the IFOAM Accreditation Criteria (IAC).The IBS address the principles, recommendations and standards that guides producers who wish to be organically certified. The IAC are based on ISO Guide 65 (governing operation of certification bodies), and are tailored specifically for the certification of organic production and processing. The IAC is administered through the IFOAM Organic Accreditation System (IOAS), which evaluates and ensures compliance by certification bodies to the IBS and IAC (IFOAM Website).

The assessment includes a review of the applicant certification body's documentation as well as an onsite visit to evaluate the quality of the certification body's performance. If compliant with these requirements, the certification body is awarded IFOAM accreditation. An annual surveillance system comprised mainly of annual visits to the office of the certification body ensures compliance (Yussefi & Willer, 2004).

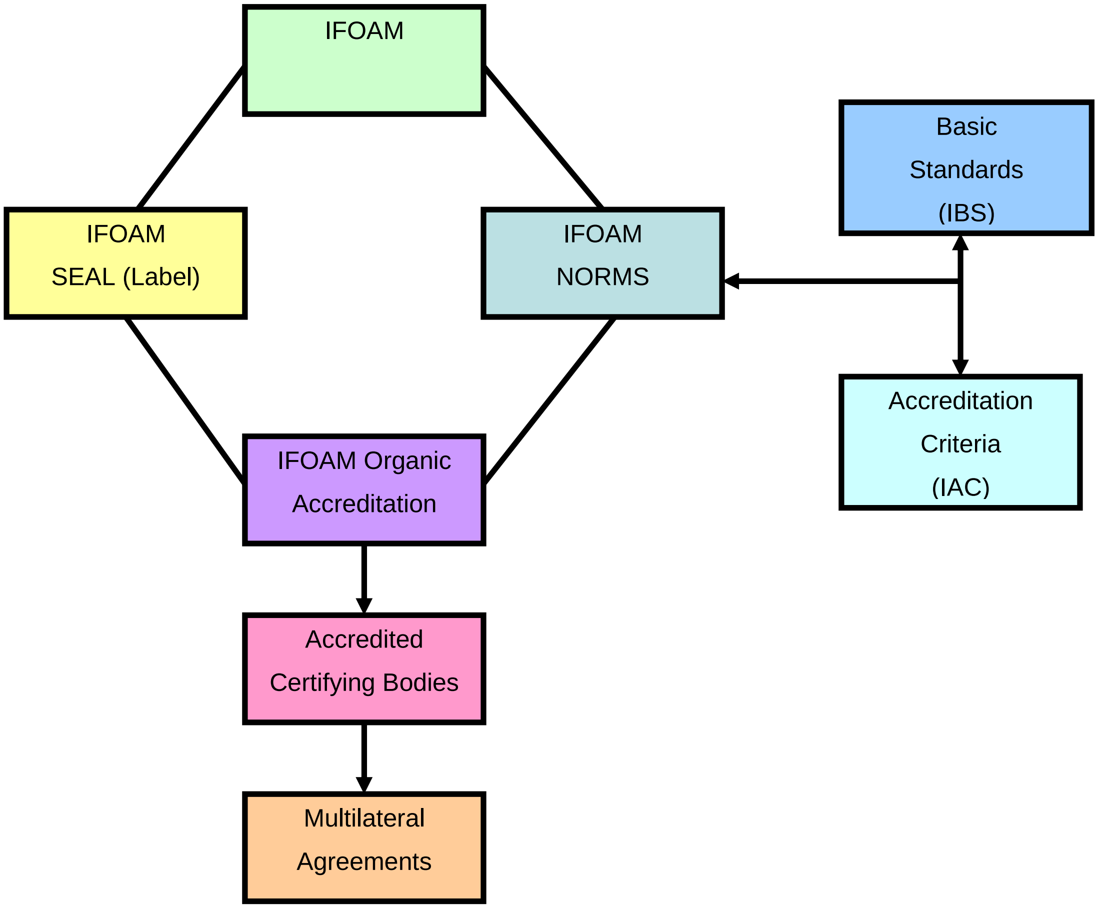


Figure 4 Model of IFOAM's Organic Guarantee System (IFOAM Website)

3.3.3 Standards and Regulations

Organic certification is based on standards. Standards are used, in part, to establish an agreement within organic agriculture about what an "organic" claim on a product means. Regional groups of farmers and supporters began developing standards as early as the 1940's. The organic market is comprised of numerous private sector standards and government regulations and two international standards for organic agriculture, IFOAM and The Codex Alimentarius (commonly known as "Codex")

3.3.3.1 IFOAM Standards

The basic standards for organic production were first published in 1980 by the International Federation of Organic Agriculture Movements (IFOAM). IFOAM identified the need for standards harmonisation to facilitate international trade. The IFOAM Basic Standards (IBS) provide the *framework* for certification bodies and standard-setting organisations worldwide to develop their own certification standards which are more detailed and take local conditions into consideration (Organic Europe website). The IFOAM standards form the basis for the European Union Standards which have been developed using the IFOAM

Basic Standards framework. The South African organic standards have also been based on the IBS framework and the European Union standards.

3.3.3.2 The Codex Alimentarius

The Codex Alimentarius Commission was created in 1963 to develop food standards, guidelines and codes of practice (Codex Alimentarius website). The Codex is a joint FAO and WHO Food Standards Programme initiative. The program objectives include protecting consumer health and facilitating fair trade in food through the harmonisation of food standards. The Codex is comprised of a consortium of global scientists who establish international standards. Two committees of the Codex Commission, the Committee on Food Labelling and the Committee on Food Import and Export Inspection and Certification Systems, are responsible for developing guidelines on the production and certification of organic products (Sawyer, Undated). In June 1999 the Codex Commission approved organic plant production guidelines followed by organic animal production guidelines in July 2001. The requirements in these Codex Guidelines are in line with IFOAM Basic Standards and the EU Regulation for Organic Food (Yuseffi, 2004).

3.3.3.3 Regional and National Regulations

3.3.3.3.1 European Union Standards

The basic framework for the European Union's organic standards were created by the Council Regulation No.2092/91 which was published on the 24 June 1991, commonly known as 'EU 2092' (European Action Plan for Organic Food and Farming). Prior to the introduction of this regulation, six EU countries had a national legal definition for organic farming and eleven EU countries had standards established by private and voluntary sector bodies (Lampkin *et al*, 1999). EC Reg. 2092/91 required that from 1 January 1993, all fresh and processed produce from plant origin, must meet the requirements set out in the regulation. In addition, producers and operators within the industry are subject to an inspection system. The majority of EU countries have designated a single government body to act as the Competent Authority, undertaking inspections and certifications under the Regulation (Lampkin *et al*, 1999; Anon, 2004).

3.3.3.3.2 United States

In 1990, as part of a larger law governing USDA programs from 1990 to 1996, Congress passed the Organics Food Production Act (OFPA) (Rawson, 2006). The Act authorised the formation of the National Organic Program (NOP) to create standards for producers and processors of organic food. The regulations under the OFPA set minimum uniform standards for organic production. The 2002 farm bill also contains provisions related to the organic industry and the USDA commodity research and promotion programs (Rawson, 2006).

3.3.3.3.3 Australia

The Organic Certification Program in Australia functions under the legal framework provided by the Export Control Act of 1982 and the Export Control Orders of 1997. These Acts require every person who produces or manufactures organic produce for export to be certified. Certification of products for the domestic market is optional, but is controlled, in part, by the national Trade Practices Act of 1974 and state laws that afford legal protection against misleading and deceptive practices (Australian Government Department of Agriculture, Forestry and Fisheries, 2004). Australia, one of the first countries to publish national organic standards, did so in 1992 when the Organic Product Advisory Council (OPAC) published The National Standards for Organic and Biodynamic Produce (Sawyer, Undated). The Standards provide guidelines for labelling of organic and biodynamic products.

3.3.3.3.4 Japan

In April 2001, the Japanese government implemented new regulations for plant-based products which required that all organic products carry the mark of the Japanese Agricultural Standard. The regulations also required that certification bodies become Registered Certification Organisations under the Ministry of Agriculture, Forestry and Fisheries (Sawyer, Undated).

3.3.3.4 Private Standards

In many countries in the EU, private organisations had already formulated their own standards and labelling schemes prior to the implementation of national regulations. These standards were mostly guiding principles rather than detailed production and processing standards but were trusted by many consumers. The implementation of national regulations forced private standards to comply with them. Private standards determined the basic content of the IFOAM Basic Standards (Yussefi & Willer, 2004).

3.3.4 Certification around the Globe

Specific requirements for certification vary between countries but generally include a set of production standards for growing, storage, packaging and shipping.

3.3.4.1 United Kingdom

Organic certification in the United Kingdom (UK) is handled by various organisations. The largest of these is the Soil Association which certifies approximately 70% of organic food produced in the UK. The Soil Association operates its own set of standards which are stricter than those prescribed by the United Kingdom Register of Organic Food Standards (UKROFS) (The Natural Collection website). UKROFS is the government authority responsible for the approval and supervision of organic certification bodies. Other UK certification bodies include The Organic Food Federation (OFF); Organic Farmers and Growers Ltd (OF&G); Demeter (BDAA); The Irish Organic Farmers and Growers (IOFGA) and The Scottish Organic Producers Association (SOPA).

3.3.4.2 United States of America

In the USA, California Certified Organic Farmers, founded in 1973, was one of the first organisations to carry out organic certification (California Certified Organic Farmers (CCOF) website). Certification is now handled by the state, private and non-profit organisations which have been approved by the US Department of Agriculture (USDA). The USDA may accredit any organisation or person who complies with their National Organic Program (NOP). To receive or maintain organic certification, the NOP requires that a current organic system plan is in place, applicable records are maintained and regular site inspections are permitted. Since the establishment of the NOP in 2002, all agricultural products sold, labelled or represented in the US must be certified by a USDA accredited certifying agent (Sawyer, Undated). The largest organic certification body in the US is Quality Assurance International (QAI), a private US corporation with a partner in Japan (Wikipedia - The Free Encyclopedia Website).

3.3.4.3 Japan

In Japan, certification bodies are required to be registered under the Ministry of Agriculture, Forestry and Fisheries. In order to qualify as a certifier, a certain level of education in a particular field must have been achieved. Certification is then granted for each individual field rather than the farm as a whole. Registered Certification Officers (RCOs) are required to educate farm mangers on certification and inspection processes and may certify process managers, manufacturers, sub-dividers and importers. Foreign bodies may become RCOs provided they have negotiated equivalency with Japan (Kristiansen *et al*, 2006).

3.3.4.4 Australia

In Australia, organic certification is overseen by The Australian Quarantine and Inspection Service (AQIS), which is a division of the department of Agriculture, Fisheries and Forestry Australia (Madge, 2005). AQIS is the default certification organisation as government only becomes involved with organic certification at export. There are no domestic standards for organic produce and no system for monitoring the labelling of organic produce sold within Australia. Currently, private inspection bodies submit their own private standards or ‘Quality Management Manual’ to AQIS who ensure that these comply with the minimum requirements of the national standards. If AQIS approve these standards, then the inspection agency receives an “Approved Certifying Organisation Certificate” and is registered as an “Approved Certifying Organisation” (Sawyer, Undated). In 2006, there were seven AQIS-approved certifying organisations authorised to issue Organic Produce Certificates and in 2004 there were 2345 certified operators (Wikipedia - The Free Encyclopedia Website)

3.3.4.5 Africa

In 2002, few certification organisations existed in Africa and African organic products for export were certified by European or American certification organisations. Consequently certification costs were high and procedures poorly adapted to local conditions. Lack of local certification capacity is viewed as a major obstacle in the development of the organics industry of developing countries (Rundgren & Lustig, 2002). Developments regarding certification in Africa, and South Africa particularly are discussed I more detail in Section 8.

Table 5 Number of certification organisations operating in African countries (Rundgren & Lustig, 2002)

Country	Development of Organic Agriculture	Certification situation	Local inspectors
Angola	0	0	-
Botswana	0	0	-
Burundi	0	0	-
Ethiopia	++	Several foreign CO active	?
Kenya	++	2 foreign CO active	2
Lesotho	0	0	?
Madagascar	++	1 foreign CO active	2-3
Malawi	+	1-2 foreign CO active	-
Mozambique	++	1 foreign CO active	(2) not active
Namibia	+	1 foreign CO active	-
Rwanda	0	0	-
Somalia	0	0	-
South Africa	+++	6 foreign CO active 2 local CO active	10
Swaziland	+	0	-
Tanzania	+++	4 foreign CO active	3
Uganda	+++	3 foreign CO active	4-5
Zambia	++(+)	2 foreign CO active	?
Zimbabwe	+	2 foreign CO active	1

CO = Certification Organisation
0 = no investigation is done, or the information received was so poor that it has no value
+ = an emerging sector
++ = a sector that is small but under development
+++ = a comparatively strong organic sector

3.3.5 Equivalence / Harmonisation

It can be seen above that there are a huge number of number of standards and regulations for organic production. Furthermore, many national governments are increasingly regulating their organic markets. These factors inhibit trade and standardisation as a result of the proliferation of many different regulations and schemes with different requirements. Consequently, governments now have to work out bilateral agreements with each other to trade in organic produce which acts as a non-tariff trade barrier.

There is a growing recognition that equivalence and harmonisation of standards would reduce the administrative complexity of managing certification and make international trade in organic produce easier. IFOAM are therefore seeking to promote harmonisation through acting as a multilateral equivalence agency to harmonise the range of certification schemes (Figure 5). This should negate the need for individual governments to regulate organic standards. IFOAM's accredited certification bodies are continuously developing functional equivalence with each other in order to streamline trade for clients. This is done formally through multilateral agreements between governments.

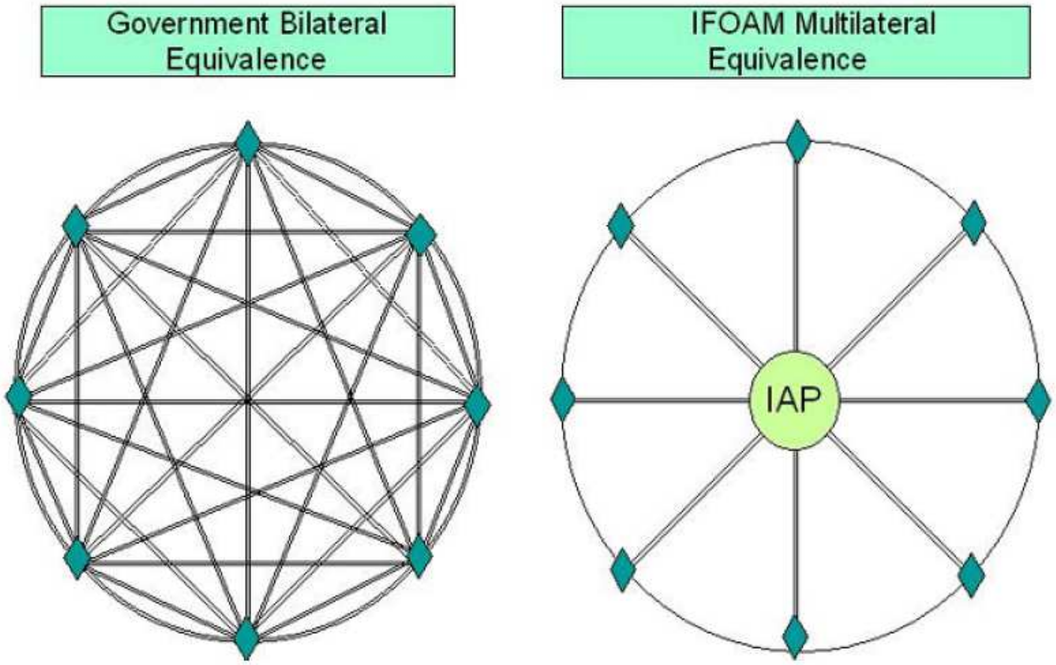


Figure 5 IFOAM Multilateral Equivalence Model. IAP stands for the IFOAM Accreditation Programme (IFOAM Website).

IFOAM suggests that, should all governments adopt their Organic Guarantee System (OGS) (see section 3.3.2) for regulating the organic trade, there could be complete harmonisation between schemes for international trade. However, in the context of current regulations and "other political realities", this will not likely be achieved in the short term.

In 2003, IFOAM formed the international task force on Harmonisation and Equivalence in Organic Agriculture in cooperation with the UN Food and Agriculture Organisation (FAO) and the UN Conference on Trade and Development (UNCTAD). This task force acts as an open ended platform for dialogue between public and private interests to facilitate international trade and access of developing countries to international markets, including the harmonisation of standards (Institute of Natural Resources, 2006; IFOAM Website).

3.3.6 Alternative Certification Models

Organic certification is a formal and highly structured system of ensuring the integrity of organic claims. It is necessary particularly for international trade in organic produce and requires the producer to have proper systems in place to ensure appropriate records are kept and that *all* the requirements of a given organic standard are adhered to. This form of certification is costly and requires high managerial and administrative inputs and is usually not appropriate for smaller growers and those supplying to local markets. This has been recognised and two alternative models are also used. One is the group certification model, which is still a third party certification system, while the participatory guarantee system is a first party certification model. These systems operate as follows:

3.3.7 Group Certification with Internal Control Systems

Most certification bodies offer group certification to smallholder producer groups, with the aim of reducing individual certification costs and administrative burden. In order for a group certification scheme to be recognised, an internal control system (ICS) has to be implemented within the group.

According to IFOAM,

> "An Internal Control System (ICS) is the part of a documented quality assurance system that allows an external certification body to delegate the periodical inspection of individual group members to an identified body or unit within the certified operator. This means that the third party certification bodies only have to inspect the well-functioning of the system, as well as to perform a few spot-check re-inspections of individual smallholders."
>
> (IFOAM Website)

An internal control system is therefore a system established to ensure that organic standards and integrity is maintained within a smallholder group. The system is established in participation with, and implemented and maintained by, the smallholder group. In effect, the group monitors its own performance against the given standard. The ICS must ensure adherence to the organic standard or standards for which the group wishes to be certified. The certification body then ensures that the ICS is functioning properly though systems such as checking ICS records. The certification body then only needs to inspect a sample of the smallholders to ensure that the ICS records reflect what is happening on an individual smallholder's farm to maintain certification.

IFOAM's Indicates the following General Requirements for Group Certifcation

- A central body responsible for marketing and the group's compliance to applicable standards (buyer, processor, or self organized cooperative or association).
- One single certification for all individual production as well as processing and handling activities registered within the group. Individual operators within the group may not use the certification independently.
- Group members operate under contractual or binding membership requirements specifying the commitment to comply with applicable organic standards and permit inspection, etc.
- Presence of an internal control system (ICS), operated by the responsible central body or an external body contracted by the central body. The ICS normally maintains files on all members of the group and inspects each members operation at least once a year.
- A list of all individual member producers.
- Through the ICS mechanism the group decides on members compliance to applicable standards. Non-compliances are dealt with within the group according to set procedures and sanctions.
- Measures to handle appeals and complaints.

It is usually the case that smallholder groups require assistance in establishing and maintaining Internal Control Systems for organic certification. This could be provided through NGO support, or by pack houses or exporting companies, though which the produce is sold. Smallholder groups, particularly in developing countries, often have low levels of education and technical knowledge and sustained, long term support is required to ensure that the ICS is properly established and maintained (Afrisco Website).

3.3.8 The Participatory Guarantee System (PGS)

IFOAM recognises that any system of agriculture based on the Principles of Organic Agriculture (section 2.2) can be regarded as "organic agriculture". Where produce is sold domestically and within a relatively small geographic location it is not necessary to have costly independent third party certification. Kholsa (2006) points out that in many cases, third party certification discourages small producers from being certified limits domestic trade in, and access to, organic produce and limits the growth of the organic movement and a whole. The Participatory Guarantee System (PGS) offers an alternative method of certification for these circumstances.

The PGS is a form of *first party* certification whereby a group of producers agree to uphold a given set of publicly documented standards. It is, in effect, a system similar to the trust system used in the early days of organic agriculture, but has stated standards to which participants in the scheme all agree to abide to.

Kholsa (2006) lists the following benefits associated with the PGS system of certification:

- Low Direct Cost - making it affordable for small farmer groups.
- Less Paperwork and Administration - PGS's rely more on trust and less on affadavits / declarations
- Regionally Appropriate - can be easily adapted to take into account local conditions, unlike rigorous and bureaucratic third party certification systems.
- Peer Appraisals instead of Professional Third Party Inspections – reduces cost, promotes information sharing and capacity building.
- Horizontal (as opposed to hierarchical Organisation of Participants – encourages grassroots participation, sharing of responsibility and promotes equality.
- Building a Movement - designed to encourage the growth of the organic movement. While adhering to strict organic standards and principles, the approach is to minimise barriers to entry, support farmer to farmer networking and provide support and education.
- A Credible Organic Guarantee – with consistent, transparent steps in the certification process.
- Mutual Recognition and Support between Regional PGS Groups - while the PGS is designed for direct and local sales, working with wider networks and cooperative processing can create opportunities that are not available to smaller groups.

- Training and Support Built into the System - because farmers are in control, they invest more in supporting and advising each other as they are ultimately mutually dependent.
- Empowers the farmer with increased capacity building.
- Market Freedom – often, group certification systems, are underwritten by packhouses or exporters and producers are effectively "locked in" to this market channel and are effectively excluded from accessing potentially lucrative market opportunities. This is not the case in PGS. Farmers may, however be encouraged to work cooperatively for the common good.
- A good PGS can transition into a Third - Party Certified Internal Control System in order to take advantage of international marketing opportunities.
- Includes New and In Conversion Organic Farmers.
- Millions of Hectares, Millions of Farms – PGS can bring a much greater number of farmers into certified organic status than conventional third party accreditation systems.

This system is becoming increasingly popular and more widely recognised with large numbers of farmers in Brazil (such as the Ecovida Network which includes 12,000 people organized into 270 groups, associations and cooperatives all working to maintain a shared Brand and Label) and the USA utilising this system. It is also the certification system being used by the Bryanston Organic Market in Johannesburg, South Africa (Callear, *pers comm*.).

3.4 Organic Agriculture Organisations

3.4.1 International organisations

3.4.1.1 IFOAM

The International Federation of Organic Agricultural Movements (IFOAM) is the international umbrella organisation for the organic movement and has about 750 member organisations in more than 100 countries (IFOAM Website). IFOAM, a non-profit organisation, was established in France in 1972. The organisation aims to build a global platform for the organic movement, develop and communicate the principles of organic agriculture and promote the development of organic markets. In 1992, IFOAM established the IFOAM accreditation program to certify organisations involved in certification around the globe. Since 1997, this program has been run by International Organic Accreditation Service (IOAS) an independent accreditation non-profit organisation (Sawyer, Undated).

3.4.1.2 UN/FAO

In 2003, The United Nations' Conference on Trade and Development and the Food and Agriculture Organisations joined forces with IFOAM to create the International Task Force of Harmonisation and Equivalence in Organic Agriculture (ITF). ITF consists of representatives of governments, intergovernmental agencies, and key stakeholders from the private sector. The task force provides a platform for communication between private and public institutions involved in trade and regulatory activities in the organic agriculture sector and aims to facilitate trade and access to organic markets for developing countries (IFOAM Website).

3.4.2 Country Organisations

Numerous organisations have developed in various countries in support of the organics industry. These include growers, shippers, processors, certifiers, farmers' associations, brokers, importers and exporters, manufacturers, distributors, retailers and consultants.

Numerous organic producer groups or associations exist globally including some 30 organic producer groups in the UK and many associations in Europe (EnviroWindows Environmental Information for Business and Local Authorities Website). Links between these groups can be highly beneficial assisting in joint initiatives for trading, information exchange, gathering of market intelligence and branding (Soil Association website).

Producers are required to be certified organic before they can market their product abroad or in some cases domestically. Within the majority of countries, this process is overseen by a competent authority. In the United States, the USDA is responsible, Australia has designated the AQIS and Japan has appointed the Ministry of Agriculture, Forestry and Fisheries to undertake this role. These authorities have in turn approved several other organisations to undertake certification. Some certification organisations have been approved to operate in foreign countries including Quality Assurance International, KRAV and Ecocert. This is particularly beneficial to countries who wish to export their products to foreign markets but which themselves have no certification authority.

This is the case in many African countries; however efforts are underway to determine how certification authorities could be established. The significant development of the organic industry within several African countries has resulted in the organic sector arranging itself into a national agriculture network/movement. National organic agricultural movements represent the organic sector at the national and international levels. The table below details the national organic movements which exist in Africa (IFOAM Website)

Table 6 National Organic Agricultural Movements in Africa

Country	Organic Movement
Ghana	Ghana Organic Agriculture Network (GOAN)
Kenya	Kenya Organic Agriculture Network (KOAN)
South Africa	Organic South Africa (OSA)
Tanzania	Tanzania Organic Agriculture Movement (TOAM)
Uganda	National Organic Agricultural Movement of Uganda (NOGAMU)
Zambia	Organic Producers & Processors Association of Zambia (OPPAZ)
Zimbabwe	Zimbabwe Organic Producers' and Processors' Association (ZOPPA)

4 MARKET DEVELOPMENT AND TRENDS

4.1 Overview

Since the early 1960’s there has been a growing market for organic products. The organic market has grown from US $13 billion in 1998 to US $25 billion in 2005 (Koekoek, 2006). Although organic agriculture is increasing in many countries, organic product sales are concentrated in the developed countries of Europe and the United States (Yussefi & Willer, 2004). These regions are responsible for 97% of organic sales to consumers (Schneider *et al*, 2005). Denmark has the highest market share in the world, followed by Sweden, Austria and Switzerland. The single biggest market is the USA, followed by Germany and Japan (Rundgren & Lustig, 2002)

A study by the International Trade Centre (ITC) indicated that the market share of organic products in most developed countries was not more than 2.5% although market shares in Austria, Denmark and Switzerland were slightly higher. In several markets however, demand was estimated to be growing at about 15 to 20 % per annum (Vossenaar & Wynen, 2004).

According to the FAO (1998), organic agriculture was practised by less that one percent of farmers in most countries prior to 1990. Adoption rates have increased significantly since then, especially in Europe. The increase in western Europe is attributed to changes in government policy, including support in areas such as conversion, education, research, extension and marketing. In the EU, organic agriculture is supported through its agro-environmental programme, that promotes sustainable agricultural practices through fiscal incentives.

The growth in interest in organic agriculture in the developed world can also be attributed to problems experienced with some forms of agriculture, such as (FAO 1998):

- Degradation of soil quality (structure and fertility) pollution of soil, water and food with pesticides and nitrates.
- Health effects on farmers, farm workers, farm families, rural communities.
- Resistance of pests to pesticides.
- Dependence on off-farm agricultural inputs which can increase poor farmers' dependence on credit facilities (to purchase synthetic fertilisers, pesticides and seed), which may result in decreased local food security and self-reliance.
- A growing recognition of problems caused by synthetic fertilisers and pesticides, resulting in some countries abolishing subsidies on such inputs.
- Considerations such as health and awareness of environmental issues are often cited as reasons for farming organically.
- Financial considerations (decreased input costs, increased returns).

Price premiums for organic products can be significant. Such premiums provide an important incentive for many farmers to shift to organic production. Increased production may result in a drop in premiums however increased demand would counteract this. Price premiums should compensate for lower net returns to farming due to lower yields and certification costs. In many developed country markets, marketing of organic products is often concentrated in a few companies. This market structure increases the risk of these companies appropriating and retaining a large proportion of price premiums at a retail level (Vossenaar & Wynen, 2004).

Table 7 Overview of world markets for organic foods and beverages (Trading Opportunities for organic products in from developing countries)

Markets	Retail Sales Estimate (US$ million) 2000	Approximate Share in total food sales (%)
Total	15225 – 16475	-
Europe Total	6950 – 7650	-
Germany	2100 - 2200	2.0 - 2.5
United Kingdom	1100 - 1200	1.8 - 2.3
Italy	1000 - 1050	1.0 - 1.5
France	800 - 850	1.0 - 1.5
Switzerland	450 - 475	2.5 - 3.0
Denmark	350 - 375	2.5 - 3.0
Austria	200 - 225	2.5 - 3.0
Netherlands	275 - 325	1.0 - 1.5
Sweden	175 - 225	1.5 - 2.0
Belgium	100 - 125	1.0 - 1.5
Other Europe*	400 - 600	-
United States	7500 - 8000	2.0 - 2.5
Canada	500	1.5 - 2.0
Japan	275 - 325	<0.5
Oceania	-	<0.5

* Finland, Greece, Ireland, Norway, Portugal and Spain

Organic agriculture in most developing countries is focused on the export market, particularly the EU (Rundgren & Lustig, 2002). Domestic markets in Africa are exceptionally limited but are developing in Egypt and South Africa (Yussefi & Willer, 2004). Emerging markets in Asia include China, Malaysia, Philippines, Singapore and Thailand, which are reported to be maintaining growth trends (Yuseffi, 2004). Local demand in Latin America is growing however the export market remains the main outlet for the majority of organic products (Vossenaar & Wynen, 2004). Major challenges facing the organic industry of developing countries is that products need to compete in countries where there are stringent quality requirements while simultaneously dealing with production and export constraints (Trading opportunities for organic food products from developing countries).

The majority of Australian organic products area also exported mainly to Japan and the United Kingdom (Australian Government Department of Agriculture Fisheries and Forestry, 2004). Recently, Switzerland, USA, Singapore, and Hong Kong have also emerged as promising future export markets for Australian produce (McCoy and Parlevliet, 2001).

Market shares differ strongly by commodity group. Fresh produce, including fruit, vegetables and dairy, generally have the highest shares, sometimes as much as 5 to 10 per cent (Koekoek, 2006). The table below provides a detailed, although not exhaustive, list of countries either producing or importing various organic products.

Table 8 Producing and importing countries of a range of product groups[3]

Product Group	Countries producing	Countries importing
Fresh vegetables	Costa Rica; Philippines; Egypt, Kenya, Madagascar, Malawi, Morocco, **South Africa**, Tunisia, Uganda, Zambia; United States; Canada; Austria; Netherlands; Argentina; Spain; France; Italy; Germany; New Zealand; Switzerland; United Kingdom; United States; Australia;	Japan; Taiwan; Belgium; Demark; France; Germany; Italy; Sweden; Switzerland; United Kingdom; United States;
Processed Vegetables (Pickles, gherkins)	India;	Japan;
Bananas	Costa Rica; Cameroon, Ghana, Senegal; Ecuador, Peru, Columbia	Belgium; Denmark; France; Germany; Italy; Japan; Sweden; Switzerland;
Citrus Fruits, Grapes	Egypt, Morocco, **South Africa**; Brazil; Spain, Italy, Israel; France; Argentina, Chile;	Japan; Taiwan; Belgium; Denmark; France; Germany; Italy; Sweden; Switzerland; United States;
Tropical fruit (fresh)	Costa Rica; Cameroon, Egypt, Ghana, Madagascar, Senegal, **South Africa**, Tanzania, Uganda; Mexico;	Canada; United States; Germany; Japan; Netherlands;
Deciduous fruit (apples, pears)	Netherlands; Argentina; New Zealand; France; Italy; USA; Argentina; Switzerland;	Sweden; Austria; Belgium; Denmark; France; Germany; Italy; Netherlands; Switzerland; United States;
Dried & Processed fruits	Algeria, Burkina Faso, Egypt, Madagascar, Morocco, Tanzania, Tunisia, Uganda; India; Philippines	Japan; Italy; United States;
Soya beans	Brazil; Philippines	Germany, Japan
Coffee	Costa Rica; India; Cameroon, Ethiopia, Kenya, Madagascar, Tanzania, Uganda; Sri Lanka; Brazil; Columbia; Vietnam; Germany; Guatemala; Indonesia, Peru, Honduras and Mexico.	United States; Germany; Japan; Italy; Belgium; France; Spain; Netherlands;

[3]Information used in the compilation of this table was obtained from the following sources:

*Trading opportunities for organic food products from developing countries

* Yuseffi 2004

* Production and export of organic fruit and vegetables in Asia

* Organic Trade Association http://www.ota.com/organic/mt/export_chapter4.html

* Department of Trade and Industry – Philippines http://www.dti.gov.ph/contentment/9/16/25/136.jsp#4-1

* Anon, 2001 - Opportunities for Developing Countries in the Production and Export of Organic Horticultural Products http://www.fao.org/DOCREP/004/Y1669E/Y1669E00.HTM

* Demand for Organic Products from East Africa

* Market Developments for Organic Meat and Dairy Products: Implications for Developing Countries http://www.fao.org/DOCREP/MEETING/004/Y6976E.HTM#P62_20356

Product Group	Countries producing	Countries importing
Tea	India; Tanzania, Uganda; China; Sri Lanka; Kenya; Malawi; Indonesia	UK; United States; Russia; Pakistan; Japan; Germany; France, Canada, Morocco, Australia, Egypt; Netherlands
Cocoa	Costa Rica; Cameroon, Ghana, Madagascar, Tanzania; Sri Lanka; Uganda; Belize, Bolivia, the Dominican Republic, Mexico, Nicaragua, Panama, Peru, Fiji, and Vanuatu	Germany; Netherlands; Switzerland, France, Italy, Spain, United Kingdom; Belgium
Sugar	Costa Rica; Cuba; Brazil; Philippines, Madagascar, Mauritius, Australia;	Europe, United States; Japan
Cotton	Benin, Egypt, Senegal, Tanzania, Uganda; India; United States; Uzbekistan; Australia; Greece; Mali, Cote d'Ivoire, Benin, Burkino Faso; Cameroon	China; Indonesia; Mexico; Thailand; Korea
Rice	India; Philippines; Korea;	
Coconut Oil	Mozambique; India	
Palm oil	Ghana, Madagascar Tanzania	
Olive oil	Tunisia	Europe; Japan; Taiwan;
Ground Nuts (Peanuts)	Zambia	Italy; United States; Germany, UK, France and the Netherlands
Tree Nuts (Cashews)	Kenya, Malawi, Morocco, Tanzania; India; France; Vietnam, Brazil, Nigeria, Cote d'Ivoire, Guinea-Bissau and Mozambique	Italy; United States; Germany, UK, France and the Netherlands
Sesame	Burkina Faso, Uganda, Zambia, Zimbabwe	
Herbs (culinary)	Philippines; Egypt, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Morocco, Mozambique, **South Africa**, Tunisia, Zambia, Zimbabwe; India; Bulgaria, Bolivia, Brazil, Paraguay, Vietnam, Nicaragua, Argentina; Uganda, Egypt, China, Chile;	United States, Germany, United Kingdom, France, the Netherlands Japan and Canada.
Spices (culinary)	Costa Rica; India; Philippines; Cameroon, Egypt, Ethiopia, Madagascar, Malawi, Mozambique, **South Africa**, Tanzania, Uganda, Zimbabwe; India; Argentina, Sri Lanka, Paraguay, Mexico, Vietnam; Cambodia, Laos, Chile, Guatemala, Hungary	United States, Germany, United Kingdom, France, the Netherlands Japan and Canada
Medicinal /Therapeutic Herbs and Spices	Egypt, Morocco, Namibia, Tunisia, Zambia; Germany; Bosnia; Brazil; India; Chile	United States, Germany, United Kingdom, France, the Netherlands Japan and Canada
Medicinal plants	Costa Rica	
Essential Oils	Madagascar, Tanzania; Sri Lanka; Bosnia; Brazil; Bulgaria, Ethiopia, Ghana, Uganda, China, India, El	United States, Germany, United Kingdom,

Product Group	Countries producing	Countries importing
	Salvador, Egypt, Indonesia, Madagascar, Zambia	France, the Netherlands Japan and Canada
Honey	Philippines; Algeria, Malawi, Tanzania, Tunisia, Zambia; Australia; New Zealand; Ethiopia; Kenya; Angola;	Germany; United States; Canada; United Kingdom; France; Japan
Other Forest Products	Uganda, Zambia, Zimbabwe	
Cereals	Egypt; Austria; Germany; Australia;	Japan; Taiwan
Meat products	Philippines; Austria; Australia; Argentina; Brazil; Uruguay	Japan; United Kingdom;
Dairy	Philippines; Austria;	Japan;
Cosmetics; personal care products	Little or no info available. Many East African countries produce these products.	-

4.2 Distribution channels

Distribution channels are generally short (in terms of the value chain – not distance) and only take a few handlers to get the product from the source to the outlet (Anon, 2001). Organic products may be produced locally or imported and are then either moved through a wholesaler or sold directly to a retail outlet or exported.

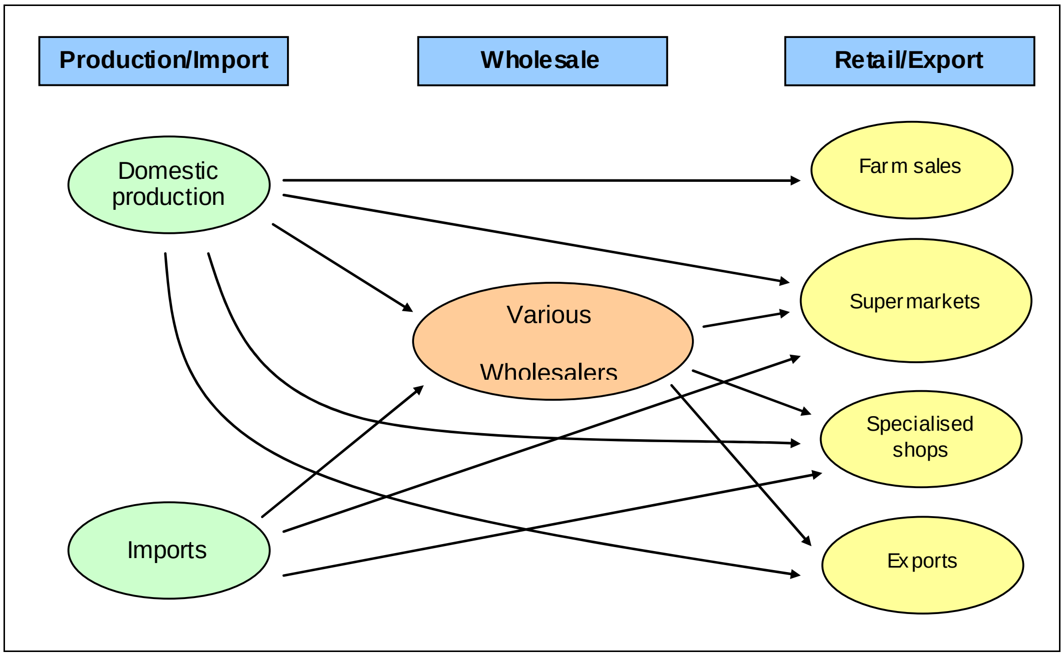


Figure 6 Distribution channels for organic produce

A number of distribution channels exist. A survey of organic marketing initiatives in Europe identified the following market channels and their associated contribution to the overall domestic market for organic products in Europe (Beckie *et al*, 2002).

Table 9 Market distribution channels in Europe

Market Channel	Number	Percentage
Direct sales	106	30%
Supermarket	88	21%
Processing	69	13%
Catering	29	2%
Internet	32	3%

Wholesale	83	18%
Other	72	14%
Total	479	100%

4.2.1 Supermarkets

Traditionally, in most European countries and the US, farm stalls and the natural food store dominated the market channel for organic products. However, more recently, awareness of most consumers to the availability of organic fruit and vegetables increased when various supermarket chains included these products in their range (Anon, 2001). Today retail chains have become a popular outlet for organic products and include both conventional and organic supermarket chains.

Table 10 Examples of conventional supermarket chains

Country	Retail Chain
Germany	Tegut, Metro, Rewe
Austria	Billa, Spar
Denmark	FDB, Dansk Supermarket
Italy	Esselunga, CO-OP Italia, Finiper
France	Carrefour, Auchan
England	Waitrose, Sainsbury, Tesco

Table 11 Examples of dedicated organic supermarket chains

Country	Retail Chain
England	Planet Organic
France	Satoriz
Germany	Alnatura
United States	Wild Oats, Whole Foods

An international study on marketing strategies of retail chains identified three basic strategies for marketing organic products. The *maximum strategy* involves expanding the range of organic products to more than 400 articles, the *basic strategy* entails settling on a range of approximately 20 – 200 organic articles and the *minimum strategy*, employed by most supermarkets, includes less than 50 items in the range. Generally there is a trend to expand the organic range and many large retail outlets now carry their own organic label (Richter, 2000).

Developing countries, particularly those in Latin America have only recently begun to use supermarkets to sell organic products. However, the range of products is often limited due to the difficulties of obtaining large enough quantities of organic products for processing. (Vossenaar & Wynen, 2004).

4.2.2 On-farm shops, market stalls and box schemes

Many consumers like to buy directly from the producer. Organic producers often run market stalls at local markets and some have initiated box schemes. Box schemes entail the delivery of a box of assorted of organic products to a consumer's home based on regular orders (Anon, 2001). Various threats to the development of box schemes have been identified. The Soil Association (2001), states that the biggest threat to the growth of box schemes is from schemes that do not offer a good service. This in turn leads to disillusioned customers, thus hurting the potential market for boxes in general. Furthermore, many farmers are unsure about the value of their products, service and benefits for the customers and often sell their produce cheaper than the retailer. This is particularly prevalent in the UK and the Netherlands whereas in Germany they gain higher prices because of their service efforts (Haldy, 2004).

4.2.3 Other trade channels

4.2.3.1 Catering

Although not very common, fresh fruit and vegetables are sometimes sold directly to catering companies. Specialised processing companies wash, cut and package fresh fruit and vegetables before selling. The lack of good processors and packagers prevented the development of this channel however it has started to increase in some European countries, particularly Germany (Anon, 2001).

4.2.3.2 Internet

Some companies have started to trade organic produce via the internet. Fresh products may be ordered and delivered to the consumer's home (Anon, 2001). Examples of such companies include United Nature X (www.unitednaturex.com) in Germany and Best of the Midlands (www.bestofthemidlands.co.za) in South Africa.

5 Potential Benefits of Organic Farming

5.1 Food Security and Long Term Productivity

According to the FAO (2003), food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern.

Rundgren (2002) provides a balanced analysis of organic farming and its potential contribution to food security. The key points from this analysis are outlined below.

While there are many complex drivers affecting food security, they can be distilled into three fundamental causes: social, political and economic. Some of the more prominent factors impacting negatively on food security include.

- Poverty, inequality and discrimination (lack of money to purchase food or resources to grow food; inequality / discrimination in access to land, water, inputs and credit)
- War or civil unrest
- Policies that discourage food production
- Global trade relations and structures
- Production
- Unsustainable production methods
- Loss of farm biodiversity
- Inefficient use of production resources
- Natural disasters

Conventional agricultural systems, through the use of chemical inputs try to be independent of natural systems, are capital intensive and reduce biodiversity. In developing countries, it is often the case that conventional systems are not appropriate due to factors which negatively impact on food security.

- Long term effects on fertility and soil erosion – decreased productivity
- Reduced food safety and negative health effects
- Decreased nutritional value and deterioration of diets
- Loss of biodiversity and environmental degradation

Of three options for increased food increased production,

- Increase area under production;

- Increased productivity in industrialised countries and export of surpluses or
- Increased productivity in developing countries,

Rundgren considers it is most appropriate to increase productivity in developing countries as these countries are the most food insecure, and stand to benefit the most from improving food production, particularly if this can be achieved with low cost, locally available technologies and inputs. He finds that organic agriculture can contribute to food security in the following ways:

- Increased productivity, particularly in areas prone to food shortages[4]
- Safe food that supports a varied diet
- Increased income or return on labour
- Reduced costs of production
- Risk reduction through diversification
- Increased awareness of the need for sustainable production and consumption and the need to protect the environment
- Supports innovation and recognises and integrates of traditional and indigenous knowledge
- Long term sustainability

To prove the point, Rundgren summarises a number of case studies from credible sources who point the potential of organic production to improve productivity and / or food security

Table 12 Some Organic / Ecological Interventions that have improved food production in developing countries (After Rundgren, 2002)

Country	Practice / Crop	Result
Madagascar	Rice Intensification	Increased rice yields from 2 t/ha to 5-10 t / ha, without the use of purchased fertilisers or pesticides. System estimated to be adopted by over 20 000 Madagascar farmers
Peru	Vitalising Indigenous Knowledge	Use of traditional raised beds and canals increased productivity e.g potatoes 8-14 t/ha compared with regional average of 1-4 t/ha.
Honduras	Green Manure	Improved weed control in traditional maize and

[4] Rundgren points out that converting from intensive conventional systems, a yield drop of 5-20% can be expected, while on irrigated land, yield tends to stay the same. Importantly, however in “traditional” rainfed systems, it is often the case that yields are increased after conversion to organic farming systems.

	Intercropping	sorghum based farming systems
Senegal	Agroecological Soil Improvement	Significantly increased groundnut and millet yields, less year on year yield variation.
Colombia	Range of green technologies	Generally improved productivity
Cuba	National Policy for Sustainable Agriculture	After collapse of soviet bloc, on which Cuba relied heavily for food and inputs, focus on local sustainable food production. Significant increase in local food production as a result.
India	Maikaal Organic Cotton Project	Average cotton yields 20% higher than their conventional counterparts in the region. Wheat, Soy and Chilli grown in rotation with cotton up to 20% higher. Productions costs 30-40 % of that of conventional, which includes a reduced labour cost, reduced water use and improved soil structure.
Mexico	ISMAM Fair Trade Coffee	Improved productivity by smallholder growers, reduced soil degradation, premium for organic, ultimately resulting in the establishment of a processing facitlty and direct exports to US, Japan and Europe.
Kenya	Push - Pull Pest management	Success in controlling stemborer infestations in cereal crops.
China	Control of Rice Blast	Interplanting traditional rice with blast resistant varieties doubled rice yield.

In summary, organic agriculture can enhance food security through:

- Increasing and stabilising yields
- Improving resistance to pests and disease
- Reducing debt and increasing returns on labour
- Maintaining crop genetic diversity
- Maintaining and improving environmental services
- Building on local skills and resources assist farmers to be food self sufficient and to combat poverty

5.2 *Environment*

5.2.1 Biodiversity

Biodiversity refers to the variety of life on earth and is usually assessed at three distinct levels

- Genetic diversity – a measure of the variation with in a given species in an area or across areas
- Species diversity – diversity of species within a given area
- Ecosystem diversity – the diversity between or within a given ecosystem

Biodiversity provides important ecosystem services, such as nutrient cycling, water production, flood mitigation, carbon absorption, oxygen production and regulation of species numbers. Efforts to preserve biodiversity have, until recently, focussed on natural (undisturbed) ecosystems, which is important, but these only account for 10% of the earth's surface whereas 37% of the earth's land surface is under some form of agricultural production (bearing in mind a large proportion of this is extensive grazing). There exists, therefore a significant opportunity for agricultural systems to contribute to biodiversity conservation and management (Stolton, 2002).

5.2.1.1 Does Organic Farming Affect Biodiversity?[5]

This is the title of the most recent comprehensive study on biodiversity benefits of organic agriculture. Hole, Perkins, Wilson, Alexander, Grice and Evans (2005) undertook a full literature review of scientific papers that explicitly compared the impacts of organic and conventional systems in terms of biodiversity. Conventional in this case referred to "any non organic farming system" that was typical of farming systems in the regions where the studies was undertaken, and relied on external inputs to achieve high yields. The study did not research the specific impacts in terms of biodiversity of particular farming practices within the organic and conventional systems. 76 individual studies were identified, and qualitative reviews of these were undertaken. The general findings of the review are summarised as follows:

5.2.1.1.1 Flora

[5] Other detailed or long term studies include

www.fao.org/organicag/doc/soil_biodiversity.htm

www.soilassociation.org The Biodiversity Benefits of Organic Farming

www.newscientist.com Organic farming boosts biodiversity

With the exception of one of the fifteen studies that directly or indirectly investigated the flora composition, a higher species richness and weed abundance was found in fields under organic management, irrespective of the crop being grown (the presence of certain weeds over others can be an indicator that a farmer is using herbicides and is sometimes used by organic inspectors to indicate if herbicides are being used).

5.2.1.1.2 Soil Microbes

Of fourteen studies that specifically investigated soil microbe compositions and five that included soil microbes in the study, overall differences between conventional and organic systems were found to be limited. It was, however, noted in some cases, that there was “a general trend towards elevated bacterial and fungal abundance/activity under organic systems”. This may be attributed to manuring on farm, which increased soil organic carbon

5.2.1.1.3 Invertebrates

Thirteen studies either specifically investigated or included earthworms in their investigations. Studies observed higher earthworm abundance, a higher density of earthworms and larger earthworms. Reganold et al (1993) is cited as observing densities as high as 175 m^{-2} in a biodynamically managed soil, compared with 21 m^{-2} under a conventional system. These higher numbers are attributed to the use of manures as well of the lack of pesticide use that may affect juvenile earthworms and anecic earthworms that live close to the soil surface.

Two studies compared butterfly populations. One recorded a significantly higher total abundance on organic farms although there was no significant difference in the abundance of two major pest species of butterflies between the organic and conventional system. The other found no significant differences in species abundance, richness or diversity.

Three studies directly compared spider populations, while a further seven recorded spider abundance as part of a broader study. The three direct studies found that either abundance and species richness, or a combination of both, to be higher under organically managed systems. One study found that the two generally most common spider species for the area were present in higher densities in conventional systems but at the expense of less common groups.

The seven more general studies all reported a higher abundance of spiders in organic systems, but it should be noted that differences between study sites and across years were not always statistically significant.

Eleven studies directly investigated beetle populations, and an additional ten studies included beetles as part of their study. Twelve of these studies found a higher abundance of beetles on organic lands as well as some indication of increased species diversity. Four studies found that the opposite was true. Other studies found no clear patterns or differences. Most of the studies did find inconsistencies in the beetle communities, with some groups or individual species of beetles preferring organic fields and others conventional fields.

Of ten studies that looked at other arthropods, all the results indicate that organic fields have a higher abundance and richness of arthropods than conventionally managed lands.

5.2.1.1.4 Vertebrates

There are less studies on mammals and birds. These studies tend investigate farm-scale differences, probably due to the higher general mobility of these species.

Two directly comparative studies on mammals were found. In one study, activity levels of small mammals were higher in organic, although overall there was not much difference in density. The other study looked at bats and found that bat activity and foraging activity was higher on organically managed habitats, although again no difference was found between species richness. Nevertheless, two rare species of bats were found only on organic farms.

Five major studies compared bird communities as a whole, through assessing bird abundance and / or species richness. The five studies all found that there was either greater abundance or species richness, or a combination of both, on organically managed systems.

5.2.1.2 Findings

The study did note that the were methodological issues in the reviewed research that may have affected the results, such as

- General landscape differences (soil, microclimate, slope etc) may have caused some of the differences found.
- Some studies were only carried out over one season or year, which would not take into account stochastic / seasonal variations.
- Different studies used different methods of measuring biodiversity, preventing direct comparisons across studies.

Several factors were may also have resulted in the underestimation of the biodiversity benefits of organic farming:

- Large conventional farms tended not to be used as there were few organic farms of equivalent size in a similar region.
- A possible time lag between conversion to organic farming and the environmental response to conversion.
- Organic farms tend to be islands in a sea of conventional farms resulting in the lack of spatial continuity. Should organic farming be practiced at the landscape scale, the benefits may be greater and more readily identified.

The study found the need for more rigorous, long term scientific research on the issue of biodiversity comparisons. Nevertheless, it was found that the majority of studies "clearly demonstrate that species abundance and/ or richness, across a wide-range of taxa, tend to be higher on organic farms than on locally representative conventional farms". It further found that many of the positive differences applied to species that have experienced declines as a result of agricultural intensification, some of which are now protected through biodiversity conservation legislation.

It should be pointed out that these studies were undertaken in the US and Europe. Nevertheless, given the differences in approach and philosophies between organic and conventional farming systems, it is likely that such differences would be identified in other places where large scale conventional farming systems have developed. All evidence appears to point to organic farming contributing positively to biodiversity.

5.2.2 Soil

Most agricultural systems require soil in which crops must grow. They are therefore one of the most important assets of a farming enterprise. Pfiffner (Undated) confirmed that soil is one of the most important natural resources for agriculture and therefore soil fertility enhancement is a key objective of any farming enterprise, particularly organic farming. It was found that organic farming tends to conserve soil fertility better than conventional systems, indicated by a higher richness and quantity of soil life in organic soils. These soils usually have a higher organic content, which drives the richness of soil biodiversity. Most organic farming practices were also found to have high erosion control potential.

Horticultural Research International (2002) examined key functional indicators of soils to compare and contrast organic and conventional farming systems using vegetables and arable crops. Vegetables have more rapid rotations and usually involve more soil disturbances (ploughing etc) as opposed to arable crops. They found that there were differences between organic and conventional systems as well as within organic systems in chemical and biological soil characteristics.

- Organic vegetable rotations had no effect on soil chemical quality relative to conventional arable management, but organic arable rotation appeared to improve soil chemical quality.
- Organic arable (field crops e.g. wheat) had a higher composition of light fraction organic matter and labile N[6] when compared with organic vegetable and conventional arable systems. These factors are beneficial for long term nutrient retention and soil organic matter development.
- Organic systems had increased presence and volume of fungi, a larger proportion of 'active" compared with 'resting' biomass (indicator of soil health and increased available carbon) and increased metabolic diversity
- In terms of soil structure, it was found that rather than the benefits of one system over the other, it was the damaging effect of vegetable production. It was considered likely that increased levels or organic matter in organic systems would mitigate the damaging effects of vegetable production.
- The study also found the need to measure a range of indicators to get a true picture of soil quality, as many of the 'traditional' measures such as soil organic matter and biomass nitrogen do not indicate changes in soil functional attributes. They point out that analysing biomass N alone would have indicated limited differences between the organic and conventional systems in terms of microbial communities.

[6] Nitrogen in a readily available or changeable form, such as NH_3 or NO_3 (As opposed to stable N_2)

- Productivity of newly converted organic vegetable systems could be negatively affected by inherited low fungal and innoculum diversity following conventional management.

5.2.3 Climate, Air and Carbon

Global climate change is an extremely urgent and real environmental problem. According to FAO (2002), agriculture contributes 20% to the total anthropogenic sources of greenhouse gas emissions which consist primarily of carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N_2O). While carbon dioxide is present at much higher concentrations in the atmosphere than, the other gases, methane and nitrous oxide have a much higher global warming effect.

Pfiffner (Undated) found that CO_2 emissions were 40-60% lower on organic farms, although emissions on a per unit output of production basis, may be higher than on conventional systems. There is little research into N_2O and CH_4, emissions, although calculations indicate that these emissions probably show the same trends as CO_2 emissions. El-Hage Scialabba and Hattam (2002) state that CO_2 emissions per hectare of organic agriculture systems are 48 to 66 percent lower than in conventional systems. Similar findings were recorded by the Rodale Institute (www.newfarm.org/depts/NFfield_trials/1003/carbonsequest.shtml).

Once criticism of organic farming, as indicated in 2.3.2 remains the reliance on tillage practices that reduce soil carbon content and indications are that no-till farming has a lower global warming potential than organic farming.

5.2.4 Water

Water pollution through nitrate leaching is generally lower in organic agriculture trials from the late eighties showed organic farming practices showed nitrate leaching to be up to 50% less on organically managed farms. Improved nitrogen management on conventional farms has decreased this difference, and leaching rates were found to be on average, 20% lower on organic farms (Pfiffner, Undated). It has been noted that ploughing in of legumes at the wrong time followed by the incorrect crop (that does not have high nitrogen demands, for example) as well as using compost or manure on freely draining soils can potentially cause significant nitrogen leaching in organic systems. Obviously, pesticide contamination in ground and runoff water is reduced in organic systems due to its prohibition.

5.2.5 Summary

Scialabba and Hattam (2002) provide a good summary of the environmental benefits of organic agriculture:

- Soil
    - Organic matter content is usually higher in organically-managed soils, indicating higher fertility and stability of organic soils as well as moisture retention capacity, which reduce the risk of erosion and desertification.

- o Organically-farmed soils have significantly higher biological activity and a higher total mass of micro-organisms, making for more rapid nutrients recycling and improved soil structure. While the proportion of soluble nutrient fractions is lower on organically managed soils, there is no decrease in organic yields since higher biological activity and higher mycorrhizal root colonization counteract nutrient deficiency.

- Water
  - o Organic agriculture poses no risk of ground and surface water pollution through synthetic pesticides.
  - o Nitrate leaching rates per hectare are significantly lower in organic agriculture compared to conventional systems.
- Air
  - o Organic agriculture enables ecosystems to better adjust to the effects of climate change and has a major potential for reducing agricultural greenhouse gas emissions.
  - o Organic agricultural strategies, by recycling organic matter and tightening internal nutrient cycles, contribute to carbon sequestration.
- Energy
  - o Organic agriculture performs better than conventional agriculture on a per hectare scale, both with respect to direct energy consumption (fuel and oil) and indirect consumption (synthetic fertilizers and pesticides).
  - o Efficiency of energy use of organic farms is high.
- Biodiversity
  - o Agriculture genetic resources, including also insects and micro-organisms, have all been shown to increase when land is farmed organically.
  - o Wild flora and fauna within and around organic farms are more diverse and abundant than in conventional or integrated agriculture.
- Ecological services
  - o Organic agriculture offers vast food resources and shelter for beneficial arthropods and birds, thus contributing to natural pest control.
  - o Organic agriculture contributes to the conservation and survival of pollinators, thanks to the banning of synthetic chemical pesticides and herbicides and the enhanced ecosystem diversity.
- Landscape
  - o Organic agriculture systems create diversified landscapes, which contributes to functional diversity and aesthetical values.

- o The establishment of semi-natural habitats within organic systems and the avoidance of pesticide use contribute to maintaining the biological connectivity and the larger ecological web, which benefit both agriculture and nature conservation.

It can therefore be reasonably concluded that (well managed) organic agricultural systems provide better environmental benefits (or less environmental harm) in most respects, when compared with conventional farming systems. Organic systems can counteract resource depletion (soil, water, energy, nutrients), contribute positively to climate change and can help to maintain and enhance biodiversity.

5.3 Social Benefits

It is generally accepted that organic farming operations offer greater social benefits than conventional agricultural systems. For example, IFOAM's basic standards include consideration of "quality of life conforming to the UN Human Rights Charter to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment" as well as consideration of "the wider social and ecological impact of the farming system" (p 16). The broad recommendations from the IFOAM Basic Standards (Chapter 8) are as follows:

- Compliance with International Labour Organisation (ILO) conventions and UN Charter of Rights for Children.
- Access to potable water, food, housing, education, transportation and health services.
- Provision of basic social security needs of the employees, including maternity, sickness and retirement benefits.
- Equal opportunity and adequate wages when performing the same level of work regardless of colour, creed and gender.
- Adequate protection from noise, dust, light and exposure to chemicals within acceptable limits
- Respect the rights of indigenous people, and should not use or exploit land whose inhabitants or farmers have been or are being impoverished, dispossessed, colonized, expelled, exiled or killed, or which is currently in dispute regarding legal or customary local rights to its use or ownership.
- Contracts should be fair, open to negotiation, and honoured in good faith.

These recommendations refer mainly to conventions as defined by the International Labour Organisations (ILO). Within the standards it is clearly indicated that production methods which violate human rights cannot be certified as organic.

According to FAO (1998) the following general social benefits are associated with organic production systems:

- The site specific nature of organic agriculture means that indigenous plant species and indigenous knowledge are important. Further, farmers may welcome a management system more aligned to their own traditions and not driven by the production paradigm (i.e. maximising yields through the use of artificial inputs).

- Relying on local knowledge of complex interactions and variations of conditions from place to place tends not to favour large production areas. With the tendency for reduced farm size, equitable access to land may be enhanced.
- Consistent labour requirements associated with crop diversity can provide income stability.
- Fair trade, where buyers demonstrate a concern for social justice by buying fair trade products, is part of the ethic of organic agriculture and is in the IFOAM guidelines. Currently, fair trade does not necessarily imply organic production, but organic produce can also be fair trade certified. Organic certification does consider reasonable wage conditions in the standards, but it is not clear if organic is clearly aligned with fair trade principles, although it is supported.
- Improving the situation of women in agriculture is an important issue, particularly availability of work, gender distribution of labour and positions of greater responsibility.
- Using local inputs can potentially bring benefits to the community through stimulating the local economy and reducing the need to purchase external inputs on credit.

Again, in an FAO report, El-Hage Scialabba and Hattam (2002) indicate that in changing to organic farming practices, many aspects of the operation, including labour demand, social structures, and decision-making processes change, and that organic systems often require more labour input to replace external energy and capital inputs. Further, as a result of crop diversification, different planting and harvesting schedules associated with crop rotation practices, distributes labour demand through the season. These practices stabilise employment, reduce turnover,and reduce problems related to migrant labour as well as spreading the overhead costs per employee more evenly over the year. Finally, diversity in agricultural production and value added products can increase income-generating opportunities and spread the risks of failure over a wider range of crops and products.

An African example used in this report is the SEKEM initiative of biodynamic farms in Egypt. SEKEM successfully farmed 70 hectares of desert land initially and is noted for its efforts to integrate social, cultural and economic aspects into the initiative. Through this success, other farmers cooperated with the initiative, and the result is that 180 farms were cultivating approximately 2 700 ha using biodynamic agricultural practices throughout Egypt in 2002. Economically, SEKEM developed a value chain from the farmer to the consumer through several specialised companies producing high quality products with justified prices that include social considerations of employees and farmers.

The founder of SEKEM, Dr Ibrahim Aboulish also established the Egyptian Society for Cultural Development (SCD), a private non-profit organisation that is supported by donors as well a portion of the net profits from SEKEM's companies. The SCD has implemented a range of programmes in economic development, health care and education and is considered a sound example of integrated development in Egypt.

Further, the study noted that a growing number of certified organic agriculture commodities produced by small-scale farmers organised in democratic cooperatives meet fair trade requirements whereby farmers are paid adequately to cover costs of production as well as a social premium to improve the quality of life. Finally, it was noted that the organic movement shares a consensus that social requirements are necessary, however specific standards are controversial and there are concerns that imposed social standards may be insensitive to national sovereignty and the cultural context governing social and economic relations. Imposition of such standards could create trade barriers to organic exports in some developing countries. Alternatively, such pressure could also trigger social and economic reforms in many countries.

Lohr (Undated) studied 36 indicators of benefits of organic versus conventional agriculture in counties within in the US. A statistical analysis and comparison of counties with (i.e. at least one) organic farms and without organic farms was compiled. This broad study found that overall, 26 indicators favoured organic systems, three favoured conventional systems and seven were neutral. The findings suggested that even in small numbers, organic farmers are influencing mainstream agriculture to shift toward greater sustainability. In a social context, the statistical results found the following benefits

- Counties with organic farms have stronger farm economies and contribute more to local economies through total sales, net revenue, farm value, taxes paid, payroll, and purchases of fertilizer, seed, and repair and maintenance services.
- Counties with organic farms have more committed farmers and better support rural development with higher percentages of resident full-time farmers, greater direct-to-consumer sales, more workers hired, and higher worker pay.

Getz, Feenstra and Shreck (2005) indicate that the organic movement is debating if and how social criteria can be incorporated into organic standards. In California, the concept has been debated, but has never had sufficient interest, until recently, to be seriously considered. Social certification programmes aim to make working conditions for labour fair, safe, healthy and equitable. Their review of literature found that there little attention given to organic farmworkers in the US and that there was a common misconception amongst both consumers and farmers that that organic certification addresses farm working conditions and due to the absence of pesticides, were inherently “better“ for farmworkers. It was noted in the study that US National Organic standards do not include criteria for workplace conditions.

A survey of 188 organic and mixed farmers in California found that there was little support for adding social certification requirements to the current US national certification requirements, with more than half being opposed to the proposal. It was found that more than one third of employers provided at least one benefit, as follows:

- Paid leave 26.2%
- Health Insurance 19%
- Dental Insurance 9.5%

- Paid Sick Leave 19%

Although organic farmers might philosophically agree with ideas of social benefits, some felt that organic certification was not the best way to address this. It was found that others, who believed organic agriculture should ensure fair and healthy working conditions for farmworkers, felt it was not economically viable given market realities. Most respondents felt that inclusion of these criteria would create an unacceptable financial burden.

The study found no consensus about whether organic agriculture, as practiced in California at the time (2005) was necessarily more socially sustainable for farmworkers than conventional agriculture and three phenomena were offered in explanation of this finding:

- The social dimension of sustainability is interpreted widely. Despite a general perception that organic agriculture is more socially sustainable few respondents felt that criteria regarding working conditions should be codified to ensure this was the case in practice. Interestingly, about 40 % of respondents "strongly disagree" with one of the proposed requirements, to "respect farmworkers' right to bargain collectively" even though it is a requirement of Californian law (under the Agriculture Labor Relations Act of 1975).
- The full costs of making organic agriculture socially sustainable are not being internalised. Most respondents didn't (and perceived they couldn't afford to) provide benefits like living wages and health insurance. It was noted, however, that many of the small-scale farmers like those who participated in this study do not provide insurance for themselves and that many of theses costs are externalised in conventional agriculture as well.
- Interviews and discussions organic farmers and other organic stakeholders did indicate that there were exceptions to these patterns, which would require further investigation.

It was concluded that while the definition of organic agriculture under the USDA's NOP excludes certification criteria concerning farmworkers' rights or working conditions, the broader international organic community, including many in the US, is moving closer to addressing these needs to ensure that organic agriculture is socially as well as environmentally and economically sustainable.

It should be noted that of the approximate 800 000 hired farmworkers in California, 82% are male, 95% are foreign born and more than 42% are not authorised to work in the US.

The study ends by quoting a California Certified Organic Farmers Federation (CCOFF) member: "You go organic and get there and you're still in a system set up for failure. It's failing the farms, and it's failing the farmworkers, and it's failing the farm communities." and concludes that to create production conditions that are favourable to a broader sense of social justice, change is needed in the entire food system and not just at the point of production.

6 CONSIDERATIONS TO BE MADE WHEN CHANGING TO ORGANIC AGRICULTURE

Introducing a new method of production in an agricultural system results in change. Change also brings uncertainty. When converting to organic agriculture, significant changes occur, particularly changes in farm inputs (from synthetic to organic), crop rotations and diversity. Equally important are the management techniques and requirement as well as social changes.

FAO (1998) suggests that farmers consider 5 issues when contemplating changing to organic production.

6.1 Labour input / costs

Labour costs tend to increase as organic systems tend to be more labour intensive than large scale mechanised agricultural systems (that is not to say that organic farms are not also largely mechanised) as a result of practices such as hand weeding, composting and strip farming. Indirect labour costs may also be incurred in improving the working conditions of farm workers, as a requirement of certification is that working conditions meet certain standards. As a result of these additional costs, labour productivity and efficiency becomes an important consideration.

The high cost of labour in developed countries can act as a deterrent to converting to organic systems. Where labour is not a constraint, organic farming can provide employment opportunities. Further, with diverse crops and cropping systems, associated with organic systems, times of intensive labour requirements (e.g at harvesting) may be further spread through the year, reducing the need for seasonal workers and stabilising employment opportunities. Given the variety of crops, and the progressive social attitudes associated with organic agriculture, there exists additional opportunities for women.

6.2 Other inputs

Synthetic inputs need to be replaced with other inputs. These can either be purchased or produced on the farm (or a combination of both). Management practices will also need to be adapted to new planting timings, crop rotations, different seed / animals adapted to local condition. Local knowledge and traditional practices for the area are also key to the success of organic farming systems.

Changes in soil structure and organic matter content can impact positively on other inputs, such as improved water use efficiency, thus reducing irrigation costs, or optimising use of rainfall under dry land conditions.

6.3 Crop rotation

Most farming systems include rotational cropping practices. Organic farming, however, considers rotation to be the cornerstone of organic management. Combinations of different crops within specific, planned rotations are important for managing pests on organic farms as well as maintaining soil fertility. This rotational system may not necessarily allow farmers to grow the most profitable (or marketable) combination of crops in a rotation. While the potential loss of income may be compensated by reduced input costs, it is still important for the farmer to find markets or uses for all crops in the rotation, which may be an additional management input cost.

6.4 Yield

There is a general perception that organic production systems give lower yields than conventional systems.

Lampkin and Padel (1994; cited in FAO, 1998), who gathered a number of studies on the economics of organic agriculture in developed countries, found that organic farm yields were within an “acceptable range”. They also found that organic yields were higher than those on farms prior to 1950, claiming that this dispelled the notion that organic agriculture is “going back to the past”. These higher yields are ascribed, in part, to improved plant varieties and better management of biological processes arising from improved understanding of biological systems (FAO, 1998). The study further found no clear evidence that management was a major factor in the degree of yield and financial variability, hypothesising that external (environmental) factors were more likely to affect yields.

6.5 Total farm production

Whole farm production is an important consideration when assessing the conversion to organic agriculture. This is the total production on the farm and is measured per unit area, usually hectares. However, when other inputs are critical, such as labour or water, these may be more appropriate indicators (i.e water consumption per unit output or labour cost per unit output).

When measuring production, the concept of net production (i.e output vs input) is especially relevant in developing countries. This refers to the production net of specific inputs, such as the costs of nutrients. It is very easy, for example, to increase the yield of a cow by feeding more concentrates, but to determine the whether it was worth the extra input, the net returns need to be calculated.

7 ORGANIC FARMING IN AFRICA

7.1 Current Status and Trends

Africa is more dependent on agriculture than any other continent. Parrott and Elzakker (2003) found in a study of 21 African countries (in Southeast, West and North Africa) that in most cases, 75% or more of the population were reliant on subsistence farming.

In terms of area under production, Africa accounts for 1% of the total certified organic land. It is interesting to note that in terms of numbers of certified farms, Africa accounts for 10% of all certified farms which indicates that farm sizes in Africa are generally smaller than in other parts of the world. The majority of certified organic land occurs in the South and East, with more than 50 % occurring in Uganda and 20% in South Africa. Most certified land in Africa is geared towards export markets, specifically EU markets. South Africa and Egypt do have some domestic interest in organic produce (Parrott and Elzakker, 2003).

Willer and Yuseffi (2004) found that, apart from Egypt and South Africa, who have developing local markets, certified production is geared towards export markets. Statistics compiled indicate that certified organic farming is underdeveloped, even compared with other "low income" continents. They also pointed out that there is a large agro ecological movement which, while not certified is increasingly adopting organic techniques, but qualify this statement by saying that there limited information available for tracking the extent and success of these initiatives on the ground. Generally such initiatives are aimed at:

1. Maintaining and enhancing soil fertility.
2. Combating desertification.
3. Promoting tree planting and agro forestry.
4. Develop low and no input means of combating pests.
5. Promoting the use of local seed varieties.
6. Maintaining biodiversity.
7. Supporting the most vulnerable social groups (particularly women).
8. Combating global warming.

In 2002, the annual study of trends and statistics (Willer & Yuseffi, 2002; Willer and Yuseffi, 2003) provided the following reasons for a growing interest in organic agriculture in Africa:

- Disappointment with "green revolution" technologies, including resource degradation
- Organic farming can build on indigenous knowledge
- The growing environmental movement has raised awareness of Africa and organic farming is practiced to combat desertification
- The export market for organic products with premium prices is an opportunity of farmers to increase their incomes

Parrott and Elzakker (2003) found the following major constraints to agricultural production in Africa:

- Low levels of agricultural inputs (median rate of fertiliser use was found to be 10/kg ha)
- Many of the countries are water scarce (less than 1000 cubic metres per person per year) or water stressed (up to 1 699 cubic metres per person per year)
- Low agricultural productivity, in many cases not sufficient to guarantee all round food security

They further suggest that there is a tendency to promote the use of Genetically Modified crops in Africa and offered four main reasons for organic production systems being marginalised:

- Mindset of most agronomists and agricultural economists

  These tend to remain focussed on production and maximising yields of single crops without taking into account ecological sustainability and social appropriateness. Further, this way of thinking does not consider the political economic context in developed countries where dominant industrial mono-cultural approaches are highly subsidised. This is compounded by the general failure of the organic movement to provide documented and peer reviewed evidence of the achievements (economic, social, environmental) of organic agriculture. Although the mindset of agronomists and economists may be slow to change, there is an increasing body of credible evidence that there are a range of benefits associated with organic agricultural practices (see section 5)

- The social and economic contexts in which organic farming has advanced in the developed countries

  Organic farming has relied on premium markets and, importantly, government subsidies that support more environmentally friendly and healthier production systems. There is also the perception that the cost to farmers of changing to organic systems is a loss in income due to lower yields. This misconception is carried further by assuming that lower yields would apply in different circumstances (such as in Africa) where yields are already considered marginal in many cases. It then follows from this assumption that, with neither the available subsidies and nor universal access to premium markets, that sacrificing yields to promote sustainability is "morally abhorrent", whereas it is likely that the low yields experienced could be a direct result of the failure of conventional agricultural systems.

- Organic farming is widely perceived as simply "farming without chemicals", resulting in misrepresentation

  Organic farming systems involve more than just rejecting the use of chemical inputs – it requires a complete change in the production system. For example, traditional slash and burn may be considered organic in that no chemicals are used, but are socially, environmentally and economically unsustainable and thus do not meet the criteria for organic farming. These systems are commonly misrepresented in research promoting industrial cropping systems as examples of the failure of organic farming.

- The global trading environment and the demand for organic produce in the North

  This has led entrepreneurs and development agencies to identify organic production in the South as an opportunity to supply lucrative niche markets. Many national governments see organic farming primarily as a mechanism for generating foreign exchange. This has resulted in an excessive focus on the role of formal certified organic production supplying the needs of the wealthy North – a form of “green colonialism” and raises the question of whether the purpose of organic farming is to “supply the global trading regime” or to improve food security. Examples of countries such as Tanzania, Kenya and Zimbabwe are cited where substantial organic export industries (often with foreign owned or managed holdings) exist adjacent to high levels of poverty and malnutrition.

In addition to this, Parrott and Elzakker (2003) found that one of the most notable features of the organic sector in Africa was the lack of contact between practitioners (commercial farmers, NGOs and donor programmes) and the research community (national agricultural research institutes, universities and others). This lack of contact presents a number of constraints to the development of organic agriculture in Africa:

- Limited opportunities for independent testing and advancement of research for organics in Africa.
- Limited dissemination of credible information (information is instead shared through direct communication or through so-called “grey” reports, compiled by NGOs and other development organisations).
- Limits the profile of organic research in research institutions.

7.2 Certified Organic Land in Africa

Certification involves costs and risks, a farmer deciding to “go organic” must weigh up these risks against the benefits of this new farming system. Certified organic schemes appear to be driven either by the private sector or by development projects.

Private sector schemes develop out of a financial need to access new markets or as a result of buyers approaching farmers seeking organically produced goods. Private sector schemes tend to be larger and better organised, commercial and may already be export oriented, with a supply chain in place. Often the greatest challenge is the conversion from conventional to organic production.

Development led projects often have different problems and challenges. Firstly, such initiatives usually target poorer and smaller farming households. These farmers are frequently farming organically or in low input systems. This is often by default rather than design. There are therefore usually few difficulties in converting to an organic system of production. Difficulties are encountered on the commercial side. Issues such as establishing viable producer groups, establishing supply chains, quality management and record keeping ensuring traceability are often problematic (Parrott and Elzakker, 2003).

Walaga (2000, cited by Yuseffi and Willer, 2002) outlines the following opportunities for organic agriculture in Africa:

- Potential for organic production is high, particularly in countries with liberalised economies.
- Most production in Africa is traditional and complies more or less with the principles of organic agriculture laid down in the IFOAM basic standards.
- Certification costs can be reduced if local inspectors can be contracted.
- Expertise in organic production is building up as the organic market develops

A number of sources point out the difficulty in establishing the scale of organic production in Africa (Yuseffi and Willer, 2004; Walaga, 2000; E, Gori and Associates, 2004). According to E. Gori and Associates (2004), examples of success and cooperation in organic agriculture in Africa include:

- Sekem Farms in Egypt, which brings together many small scale producers, and has pushed certified organic land in Egypt up to 15,000 ha, much of this producing organic cotton and herbs.
- In Uganda, over 28,000 farmers now farm 122,000 ha organically, producing coffee, cotton, pineapples, bananas, sesame, dried fruit and avocadoes.
- Morocco has also rapidly increased certified organic production, with 555 farmers producing mainly dried fruit, vegetables and herbs on about 12,000 ha.
- Zambia and Tanzania recently became more organised by developing their certification capacity, and each country now has over 6,000 ha certified organic.
- In South Africa, the number of certified producers grew from less than 100 in 1995, to about 250 in 2001, and to about 300 in 2003 (with over 200,000 ha certified organic).

8 ORGANIC FARMING IN SOUTH AFRICA

8.1 General Overview of Agriculture

Parrott and Elzakker (2003) describe South Africa as the most developed economy in Sub-Saharan Africa. The Gross Domestic Product (GDP) per capita is almost $ 3 000 per annum, but gross inequalities exist in the distribution of wealth.

Agriculturally, South Africa has much highly productive agricultural land. Agriculture contributes 4.7 % to GDP, accounts for 7 % of total exports and employs 13.3 % of the population. South Africa is self sufficient and exports many foodstuffs, although it is a water scarce country which is as a major restraint to production in many parts.

Some of the key findings of the 2002 census of agriculture in South Africa are outlined below:

Table 13 Number of Farming Units and Gross Farm Income by Province (Statistics South Africa, 2002)

Farming Units and Gross Farm Income Per Province		
	No of Farming units	**Gross Farm Income**
	Number	**R '000**
Eastern Cape	4,376	3,213,986
Free State	8,531	9,125,579
Gauteng	2,206	3,962,582
KwaZulu-Natal	4,038	6,429,273
Limpopo	2,915	4,577,904
Mpumalanga	5,104	6,186,402
North West	5,349	5,125,343
Northern Cape	6,114	3,578,025
Western Cape	7,185	11,129,958
South Africa	**45,818**	**53,329,052**

There were 45 818 active commercial farming units in South Africa in 2002, which represents a decrease of 12 162 farming units since the last Census of Agriculture in 1993. Although there are fewer farming units, the gross farming income generated by these units was R53 billion compared with R39 billion in 1993 at 2002 constant prices (Statistics South Africa, 2002). There was therefore an increase in farm income between 1993 and 2002, while the number of farming units decreased by 21%.

Table 14 Change in Farm Employment by Province 1993 and 2002 (Statistics South Africa, 2002)

Province	**1993**	**2002**	**Loss / Gain (Numbers)**	**Loss / Gain (%)**
Eastern Cape	88,383	64,654	-23,729	-27%
Free State	161,979	115,478	-46,501	-29%
Gauteng	34,302	29,537	-4,765	-14%
KwaZulu-Natal	165,505	113,401	-52,104	-31%

Limpopo	93,116	101,249	8,133	9%
Mpumalanga	144,519	108,083	-36,436	-25%
North West	126,530	85,992	-40,538	-32%
Northern Cape	75,969	99,251	23,282	31%
Western Cape	202,962	223,175	20,213	10%
South Africa	**1,093,265**	**940,820**	**-152,445**	**-14%**

The number of paid employees in formal agriculture decreased by 13,9% between 1993 and 2002. Limpopo, the Northern Cape and the Western Cape did show increases in employment. The western Cape remains the largest employer in the agricultural sector, followed by Free State (13,1% or 123 429 paid employees), Mpumalanga (12,8% or 120 065 paid employees) and KwaZulu-Natal (12,4% or 117 207 paid employees).

Table 15 Farm Remuneration by Province (Statistics South Africa, 2002)

Province	**Full-time**	**Casual and seasonal**	**Total remuneration**
	R '000		
Eastern Cape	329,351	59,680	389,031
Free State	580,888	69,595	650,483
Gauteng	344,629	20,975	365,604
KwaZulu-Natal	763,436	103,946	867,382
Limpopo	525,390	107,223	632,613
Mpumalanga	599,617	86,242	685,859
North West	409,526	62,653	472,179
Northern Cape	320,598	121,613	442,211
Western Cape	1,378,817	331,406	1,710,223
South Africa	**5,252,252**	**963,333**	**6,215,585**

Table 16 Selected farming current expenditure items and percentage of total current expenditure (Statistics South Africa, 2002)

							Remedies for combating diseases and pests in:		Repairs and Maintenance			
Province	**Total**	**Seed and plant material**	**Stock and poultry feed**	**Fertilisers**	**Fuel**	**Packing material**	**Livestock and poultry**	**Field and horticultural crops**	**Buildings, dams and fencing**	**All machinery, vehicles and equipment**	**Electricity**	**Water purchased**
	R ' 000											
Eastern Cape	2,534,437	68,261	619,971	141,348	168,172	139,886	66,206	91,829	90,130	180,680	74,263	19,936
Free State	7,343,664	536,868	985,086	864,246	734,006	117,534	100,261	295,601	161,935	608,636	122,152	28,250
Gauteng	3,136,770	169,481	1,342,499	149,552	181,432	171,649	62,576	80,711	61,577	119,060	59,831	4,298
KwaZulu-Natal	4,649,703	137,239	1,000,792	474,558	322,255	112,965	85,295	199,741	113,596	365,035	124,984	21,627
Limpopo	3,791,963	165,063	594,008	273,328	258,299	358,774	46,869	229,678	121,954	237,698	133,871	13,124
Mpumalanga	5,125,570	270,058	807,939	558,687	401,236	309,093	74,760	295,096	139,847	342,328	141,286	23,051
North West	4,159,034	257,987	1,062,874	402,959	403,907	73,060	72,288	173,023	95,386	310,284	96,479	12,438
Northern Cape	2,730,673	131,976	213,630	240,654	208,169	183,452	44,391	84,212	106,029	178,309	94,051	44,448
Western Cape	8,620,220	320,367	1,306,511	635,510	509,315	792,679	97,667	578,184	248,281	600,168	274,957	87,939
South Africa	**42,092,034**	**2,057,300**	**7,933,310**	**3,740,842**	**3,186,791**	**2,259,092**	**650,313**	**2,028,075**	**1,138,735**	**2,942,198**	**1,121,874**	**255,111**
Percentage of Total	**100%**	**5%**	**19%**	**9%**	**8%**	**5%**	**2%**	**5%**	**3%**	**7%**	**3%**	**1%**

Table 17 Key Ratios – Expressed as Percentages (Statistics South Africa, 2002)

	Current expenditure/ Gross farming income	Salaries and wages/ Gross farming income
Eastern Cape	81.1	15.8
Free State	80.0	12.5
Gauteng	79.3	8.8
KwaZulu-Natal	81.0	10.9
Limpopo	81.0	12.3
Mpumalanga	81.1	15.3
North West	74.9	9.4
Northern Cape	77.8	7.3
Western Cape	76.1	11.6
South Africa	**79.1**	**11.5**

Total expenditure by the formal agricultural sector amounted to R42 billion. The ratio of farming debt to the market value of farming assets rose from 22,9% in 1993 to 31,3% in 2002. Farming debt amounted to R31 billion. Western Cape was responsible for 23,7% of the farming debt, followed by Free State (16,9%) and Northern Cape (11,2%), while Gauteng had the lowest proportion of debt (3,4%).

The formal agricultural sector generated a gross farming income of approximately R53 billion. Over R21 billion (40,1%) of this was generated from commercial farming in animals and animal products. In 1993, the share of gross farming income generated by formal agriculture from animals and animal products was 49,8%.

Field crops and horticultural products were the second and third largest sources of income in the sector, with contributions of 31,1% and 26,8% respectively. The percentage contribution of field crops and horticultural products has increased at the expense of the animals and animal products (Statistics South Africa, 2002).

Of potential interest to organic agriculture are the following (See tables 14 and 16):

- Current farm expenditure on fertilisers and remedies for combating pests and disease were 9% and 7% (2% for livestock and 5% for field and horticultural crops) respectively (**Table 16**). This amounts to 16% of input costs for 2002. Given that organic farming excludes the use of artificial inputs, organic farming practices can reduce current farm expenditure.
- Fuel, Electricity and water purchased amount to 8, 3 and 1 % respectively, amounting to 12% of current farm expenditure. Organic farming is generally more energy and water efficient than conventional farming and there are potential savings that can be made in this regard.
- Farm employment decreased between 1993 and 2002 (**Table 14**) by 14%, while gross farm income increased to R53 billion from R39 billion at 2002 constant prices (Statistics

South Africa, 2002). This indicates an increasing trend towards mechanisation. Statistics South Africa did however note in their March 2006 survey that employment in agriculture had increased by 147 000. Organic farming is more labour intensive than conventional farming. With unemployment[7] figures of 25.6% estimated in March 2006, organic farming has the potential to create jobs in the agriculture sector and reduce this figure.

It is acknowledged that the statistics provided above are in essence a "snapshot" and do not necessarily denote trends in employment or income in the agricultural sector. However, given the principles and benefits of organic farming there is potential for the organic farming sector to contribute significantly to the broader economy.

8.2 South African Legislative Context

8.2.1.1 Relevant Legislation

The following national legislation applies to the management and control of agricultural produce, including organic produce:

- *Agricultural Pests Act (No 36 of 1983)* – governs the prevention of the introduction of agricultural pest from abroad.
- *Agricultural Produce Agents Act (No 12 of 1992)* – regulates the operations of market agents
- *Agricultural Product Standards Act (No 119 of 1990)* – controls the sale, import and export of agricultural products
- *Animal Health Act (Act 7 of 2002)* – provides for measures to promote animal health and control diseases and includes the regulations controlling the import and export of animals
- *Customs and Excise Act (No 91 of 1964)* – to control the import and export of goods and provide for levies related to customs and excise
- *Fertilisers, Farm Feeds, Agricultural and Stock Remedies Act (No 36 of 1947)* – provides for the registration and regulation relating to the use of farm inputs.
- *Foodstuff, Cosmetics and Disinfectants Act (No 54 of 1972)* – controls the sale, manufacture and importation of foodstuffs, cosmetics and disinfectants
- *Genetically Modified Organisms Act (No 15 of 1997)*

[7] The unemployed are those people within the economically active population who: (a) did not work during the seven days prior to the survey, (b) want to work and are available to start work within two weeks of the survey, and (c) have taken active steps to look for work or to start some form of self-employment in the four weeks prior to the survey. This is referred to as the official definition of unemployment.

- Promotes the responsible development, production, use and application of genetically modified organisms
- Ensure GMOs are appropriate and do not present a hazard to the environment
- Extablish procedures for the notification of specific activites involving the use of GMOs

- *International Trade and Administration Act (No 71 of 2002)* – Establish the Interanational Trade Administration Commission to, among others:
  - Provide for the implementation of aspects of the Southern African Customs Union (SACU) agreement
  - Control of import and export of goods and amendments to customs duties
- *Marketing of Agricultural Products Act (No 47 of 1996)* – authorises regulatory measures relating to the marketing of agricultural products, including levies on agricultural products
- *Perishable Products Export Control Act (No 9 of 1983)* – control of perishable products intended for export from South Africa

There is currently no legislation that applies specifically to organic produce, although the South African Organic Standard has been under development for some time. Organic produce as a subset of agricultural produce, is subject to the laws of South Africa.

For example, under the Fertilisers, Farm Feed, Agricultural and Stock Remedies Act a producer of organic fertilisers, pesticides or biocontrol agents, must register their product under this Act. In terms of exporting organically produced commodities, the Perishable Products Export Control Board (PPECB) aim to ensure that organic claims are authentic through a clause in the legislation regarding misleading claims. Consequently, the PPECB requires a certificate issued by an organic certifying organisation that is accepted in the country of destination to accompany any organic shipment.

8.2.2 The South African Organic Standard

Organic stakeholders have been lobbying the National Department of Agriculture for the development of a South African National Organic Standard since 1994 (Jackson. *pers comm*). The Western Cape Department of Agriculture initially drafted organic standards for the region, but were asked to delay the development of their standards in favour of legally enforceable national standards by the NDA. This was prior to 2000 (van Zyl, 2000).

Parrott and Elzakker (2003) indicated that South Africa had started developing organic standards that were expected to be completed by the end of 2002, drawing mainly on IFOAM, Codex Alimentarius and EU standards. Yuseffi and Willer (2002) also indicated that the National Department of Agriculture had presented a draft that would cover all aspects of organic production and were in line with the EU regulation and the IFOAM standards. They indicated that it was expected to become law by 2002 and represented a strong opportunity for local certification bodies. Again in 2004, Yuseffi and Willer indicated that South Africa had made significant progress in that direction. They further note that the absence of local certification and inspection capacity is a “critical bottleneck” that needs to be overcome to develop the organics industry.

The third draft of legislation for organically produced products for sale in South Africa was closed for public comment on 15 February 2007. This process is being managed by the Directorate: Food Safety and Quality Assurance of the National Department of Agriculture who are responsible for controlling the quality of agricultural produce and management systems used in the agricultural industry under the Agricultural Products Standards Act (Act 119 of 1990).

8.3 Organic Production in South Africa

8.3.1 Studies on Organic Agriculture in South Africa

During the literature review process, it was found that the following research initiatives into organic agriculture in South Africa had been undertaken.

1. “South African Organic Market Study” (Barrow, 2006) Commissioned by Export Promotion of Organic Products from Africa (EPOPA) and funded through the Swedish International Development Agency (SIDA), this study aimed to achieve the following objectives:

    - Get a general understanding of the supply and demand side of the organic market in South Africa
    - Get an understanding of the exports and possibilities ofor re-exports of products from other African countries, particularly Zambia
    - To identify potential buyers of products from the EPOPA projects, especially from Zambia
    - To identify other characteristics of the South African Market for organic products

    The study took the form of a questionnaire, submitted to recipients on a database that was compiled from 14 different sources.

2. The KwaZulu-Natal Department of Economic Development (KZNDED) commissioned the following studies

    - Business plan for the development of organic farming in KwaZulu-Natal (E. Gori & Associates, 2004)
    - A strategy workshop to develop the KwaZulu-Natal Organics Agri-Processing Sub-sector (Mitchell, Undated)

3. An unpublished study was commissioned by the National Department of Environmental Affairs and Tourism, which was compiled by Van Zyl (2000)

These documents have been used to compile a large proportion of the information detailed below. Two additional studies, of which the author is aware of, have not been obtained at this stage. These are:

- A study in the form of a questionnaire / survey was undertaken by OAASA (now OSA) in 2003 / 2004. The results of this study have not been located at this stage, despite exploring available avenues.
- The Western Cape Department of Agriculture undertook research in compiling a database of organic farmers. This document has not been located at this stage.

It is possible that there are other studies that have not been identified.

8.3.2 Status of the Organic Industry in South Africa

Van Zyl (2000) conducted a number of interviews to determine the extent and value of the organic industry in South Africa. He estimated that at the time (2000), there were between 50 and 60 certified organic and an additional 50 to 60 uncertified organic farmers in South Africa, with 350 to 700 ha and 600 to 1000 ha of land under certified and uncertified organic production respectively. The total turnover was difficult to estimate, but one respondent indicated that it could be of the order of R40 million, with up to 95% of production being exported, mainly to European Countries.

According to Parrott and Elzakker (2003), there was 45 000 ha of certified land, with 250 farms in South Africa in 2003. This represents 0.54% of the total farming units (45 818) identified in the 2002 Agricultural census. Certified produce was comprised initially of mangoes, avocados, herbs, spices, rooibos tea and vegetables, but has grown consistently to include a range of other products. There is a robust, if underdeveloped, local market for organic produce with limited premiums for organic products. Local retailers Woolworths and Pick n Pay sell reasonable amounts of organic produce. Exports of South African produce are mostly to European markets.

Mead (Undated) reported that up until 2003, organic sales in South Africa were about R5 million per annum. Significant increases were experience from 2003 to 2004, while the forecast for 2005 was around R135 million. He indicated that there are approximately 200 certified producers, covering 515 000 hectares, broken down as follows:

- 500 000 ha – pasture
- 11 000 ha – rooibos
- Balance - Fruit (59%); Vegetables (32%); Essential Oils (6%); Wine (4%)

The largest fruit crops in terms of hectares were bananas, avocado pears and mangoes, while the largest vegetable crops were cucurbits, tomatoes, asparagus, brassicas and potatoes.

These sales volumes are confirmed by a report (Patel, 2006) that organic sales that were, until recently, negligible shot up to R155 million in 2005. It was reported that there are approximately 515 000 ha of certified land and over 200 certified operators.

Van Zyl (2000) points that that organic farmers choose this production system for a various of reasons. Some believe that it provides them with a healthier lifestyle for themselves and the soil, environment (less pesticides and nutrient pollution) and for consumers (less pesticides and nitrates in foods). Others are attracted by the price premium, which can vary, depending on the commodity and the market. Lower input costs are also a driving factor, especially in the context of increasing input prices and static commodity prices. These are common themes that are discussed elsewhere in this document.

An assessment of the information on the status of the industry in South Africa from information sources is summarised below:

- 50 to 60 certified and 50 to 60 uncertified organic farmers with 350 to 700 ha and 600 to 1000 respectively. Total turnover difficult to identify, but of the order of R40 million, of which 95% is exports (Van Zyl, 2000)
- 45 000 ha of certified land, with 250 farms (Parrott and Elzakker - 2003)
- Until 2003, organic sales about R5 million per annum. 2005 forecast R135 million, consisting 200 certified producers covering 515 000 ha: 500 000 pasture; 11 000 rooibos; 4 000 other (Mead – Undated and Patel, 2006.)

This information demonstrates that there is no precise information regarding the status of the organic industry in South Africa, but a general indication that the industry is growing. Attempts to obtain more accurate information on the organics industry in South Africa were unsuccessful.

8.4 Organic Commodities in South Africa

Barrow (2006) found that the following were the major organic agricultural commodities in South Africa.

8.4.1 Plant Products

- *Vegetables* were considered to the most common organic commodity, with a range of leafy vegetables, legumes, brassicas, squashes and root crops. Most western vegetables were produced locally, as well as vegetables from the east. High value vegetables were typically exported to Europe.
- *Herbs,* including culinary medicinal and aromatic are grown organically in South Africa. The range of plants grown is considered to be very wide. Indigenous cultivated plants are included in this category.
- *Grain and Oil Seeds* were found to be less common, but included maize, soya, wheat, sunflowers, triticale and oats. These were for human consumption or as feed for organic livestock.
- *Deciduous Fruit* consisted mainly of apples which are exported to Europe.
- *Citrus* included oranges, lemons and clementines, the bulk of which are exported and represent a significant organic export market.
- *Berries* included strawberries for local markets and blackberries for export markets.

- *Grapes* are primarily used to produce organic wine for local and export markets, while table grapes are sold locally.
- *Vine fruit* – passion fruit is available on the local market.
- *Sub-tropical fruit* consist primarily of avocadoes and constitute a significant export market. Guavas are grown for pulping and export and bananas have recently become available on the domestic market.
- *Stone fruit* – one group of farmers have received certification for olives.
- *Wild Harvested crops* consist mainly of the Rooibos industry (although some Rooibos is cultivated). Honeybush, Buchu and rosehips are the three other major wild harvested crops, with some medicinal herbs being certified.
- *Cultivated Pastures and fodder* are usually grown buy dairy and poultry farmers to feed their own certified stock.

8.4.2 Livestock Products

- *Beef and Mutton* – there were a number of certified farmers from 2002-2004, however due to various difficulties, this industry no longer appears to exist
- *Poultry* - there do not appear to be any certified poultry meat producers in South Africa
- *Goats* - there do not appear to be any certified goat meat producers in South Africa
- *Pork* - there do not appear to be any certified pork meat producers in South Africa
- *Dairy Products* – Some dairy products are available
- *Eggs* –one certified egg producer was identified

8.4.3 Processed Products

- *Herbs* are sold for processing or packaging and the final product may or may not be certified depending on the processor Medicinal herbs are usually not processed into certified products due to low volumes or their combination with non certified ingredients
- *Deciduous fruit* in the form of organic apple juice is available in the domestic market
- *Subtropical fruit* – one guava puree producer identified
- *Stone fruit* – olives are pickled or processed into a number of different products
- *Grapes* – red and white wine
- *Wild harvested crops* such as Honeybush and Rooibos are fermented, dried and packed as teas
- *Other crops* are cultivated, such as indigenous pelargonium, Rooibos and Buchu

8.4.4 Agricultural Inputs

The variety of certified or accepted organic inputs available to farmers has increased dramatically. The main inputs available are:

- Composted manures
- Bone meal fertilisers
- Microbial products
- Plant oil based plant protection products
- Traditionally conventional inputs that are permissible in organic agriculture, such as mined minerals, sulphur and copper products

8.5 Markets for Organic Produce

The market for organic food is growing. Demand exceeds supply at both a local and international level, which contributes to the price premiums that organic farmers enjoy (Van Zyl, 2000). For example, the UK imports 70% of its organic products and Germany imports at least 50% (E. Gori & Associates, 2004).

In a presentation at the KwaZulu-Natal Organics Agri-Processing Sub-sector Strategy Planning Workshop, Leonard Mead (Undated) indicated that the forecasted growth of the organics industry to 2008 would be at an average of 10-15% per year worldwide. In addition to this, 4 years previously, Datamonitor forecast the value of the organics industry to be $26.5 billion dollars *worldwide* for 2006. Actual figures received for 2004 placed the *European market alone at $23.8 billion*. Now forecasts predict the US alone reaching $30 billion by 2007.

On analysing consumer behaviour towards organic products in international countries, Willer and Yuseffi (2004) found that a typical consumer of organic products has the following attributes:

- Location – lives in urban areas, usually in a big city.
- Buyer Behaviour – discerning towards food and drink purchases, considering factors like quality, provenance and production methods.
- Demographics – typically well-educated and belongs to middle-high social classes.
- Purchasing Power – in a medium to high-income house hold with relatively high purchasing power.

Barrow (2006) indicated that certified organic consumers in South Africa could also be affected by consumer education and awareness and would tend to be of the younger age profile. In addition, he noted that consumers with health conditions and parents of younger children who were more aware of the health risks associated with non-organic and refined foods more actively sought out organic produce. Such people tended to be more concerned with consistent supply and trust rather than organic certification of products. Demand for organic produce can be motivated by idealistic reasons such as concerns for animal welfare and the environment or because organic consumers consider organic products to be healthier, have a better taste and quality (van Zyl, 2000).

8.5.1 Local Markets

Willer and Yuseffi indicated as far back as 2002, that there are growing local markets in South Africa, indicating that large chains such as Woolworths, Pick n Pay, Hyperama and Shoprite Checkers were planning to introduce extensive organic product ranges. Since that time, local consumption of certified produce has been well promoted by major retail chain stores. The main centres of consumption are Gauteng, Cape Town and Durban, reinforcing the buyer profile outlined above (Barrow, 2006).

Other local market outlets identified by Barrow included farmers' markets, box schemes and health shops who sell organically grown products that may or may not be certified. In addition this, there are at least four websites in south Africa where organic produce can be ordered online:

- Best of the Midlands (www.bestofthemidlands.co.za).
- Ethical Coop (www.ethical.org.za).
- Organics Online (www.organicsonline.co.za).
- Earthmother Organics (www.earthmother.co.za).

Unlike their foreign counterparts, suppliers to local markets do not appear to enjoy high premiums for organic produce, in spite of the higher premiums consumers pay at retail outlets. It is this lack of price premiums that is blamed for the failure of the certified meat industry in South Africa.

Producers aiming to access local markets should bear the following in mind:

- They should engage in sound marketing strategies for produce and when marketing through agents / middlemen to do so with due care, as extending the value chain dilutes or even negates premiums.
- Retail supermarket chains do not necessarily provide organic producers with premiums for organic produce.
- Retailer chains require volume and consistency of product. This is achieved through retail chains accessing produce through large producer/packers and independent pack houses to pack the produce that is sold through outlets. Smaller producers may benefit from teaming up or supplying into independent pack houses to access retail markets.
- Farmers markets and box schemes are avenues through which certified or non certified organically produced goods may be directly sold and is a platform for developing trust between producers and consumers through personal relationships.

8.5.2 Export Markets

Barrow (2006) indicates that due to well developed channels and infrastructure for the general export of agricultural produce, organic produce has been successfully exported for some time. Most of the organic goods exported from South Africa are destined for the EU – the major export destination. The second largest market is the USA and to a lesser extent

Japan and Switzerland. In addition, *ad hoc* exports are made to Australia and New Zealand. Direct discussions with some producers have indicated that there is a growing market in Dubai for agricultural produce in general, including organically certified.

Exports are facilitated through two major modes

1. Established export companies in South Africa, such as Katope and Eurafruit. The exporter either takes ownership of the produce and markets it under their own name. In this case the exporter will require certification. Alternatively, the exporter can simply act as an export agent, where the produce is marketed under the producer's name or the name of a retail chain in the destination country.
2. Foreign importers who access organic produce from South Africa. These include organic marketing organisations abroad, foreign retail supermarket chains, and foreign offices of locally represented exporters and manufacturers of medicinal herbal products.

Successful export strategies for local producers include

- Membership of associations that represent organic agriculture (e.g. OSA)
- Supplying contact details in public and company owned databases (e.g go-organic website or Natural and Organic Products Exhibition (NOPE).
- Establish commercial relationships with marketing organisations seeking organic produce (e.g EPOPA, Eosta, Organic Farm Foods).
- Establish direct commercial relationships with foreign supermarket chains and processors.
- Pool produce through cooperative ventures to ensure sufficient volumes to access markets.

Van Zyl (2000) found that there should be potential for expanding the following products in the export market

- Conventional Grains (e.g. wheat, barley, rye)
- Traditional Grains (for the health market, such as sorghum, sesame, millet)
- Nuts
- Legumes (e.g beans, lentils, chickpeas)
- Soya
- Fibres (e.g hemp, cotton)
- Meat (conventional and wild meat products)

8.5.3 Imports

South Africa imports a range of organic produce and inputs. Known countries of origin include the EU, USA, Australia and New Zealand. Labelling for imported products usually identifies country of origin and the producer. Alternatively, imported products have generic supermarket wording (Barrow, 2006).

8.5.4 Additional Trade Information

South Africa has entered into a number of agreements relating to the movement of fresh produce. Key agreements relating to trade include:

Africa Growth and Opportunity Act – relates to accessing the market in the USA (see www.agoa.gov.za)

European Union / South Africa Free Trade Agreement – a trade cooperation agreement between SA and the EU

Southern African Development Community (SADC)

South African Customs Union – an agreement between South Africa, Namibia, Botswana, Lesotho and Swaziland to abolish tariff barriers between member countries

Additional information on trade agreements and protocols may be found on the South African Chamber of Business website (www.sacob.co.za)

8.6 Organic Producers in South Africa

In Barrow's survey (2006), difficulty was encountered in obtaining detailed information on producers and had a poor response (14%) to the distributed questionnaire. In terms of respondents to his survey, he considered the following to be major producers in the given categories. Details such as location and scale of production were not included in the survey results.

- Crop Production
  - Kirklington Organic Farm (Herbs, grains, deciduous fruits)
  - Lorraine Trust (Deciduous fruit)
  - Emerald Acres (Citrus)
  - Modderfontein Farm (Citrus, Rooibos)
  - Datan Boerdery (strawberries)
  - AM Muller and Sons (Avocado pears)
  - Blue Sky Organics (Olives)
- Input Suppliers / Manufacturers
  - AgroOrganics
  - Biological Control Products (bcp)
  - Bioearth
  - Microbial Solutions
- Processors

- Allganix (cider vinegar, coffee, flour, fruit juices, olive oil, sunflower oil, vegetables, whole grains)
- Blue Sky Organics (olive products)
- Cape natural tea Products (Rooibos tea)
- Kirklington Organic Farm (grains, sunflower oil)
- Vital Health Foods (Rooibos tea)
- In addition to these, there are many farm based value added processing activities, ranging from one or two table operations to large scale, employing many workers with various food safety certifications.

8.7 Benefits / Opportunities for Certified Organic Farming

The premium associated with organic farming is one mechanism to directly measure the economic benefits of organic farming. This premium can be as much as 20% above that of conventionally farmed produce.

Premiums are certainly not the only indicator of the benefits of organic farming. Organic farming seeks to substitute external inputs with locally available inputs, which can reduce costs and therefore increase margins. Less external inputs limits the need to go into debt, especially when interest rates are high, thereby reducing financial risk. Organic farming can open access to new markets that did not previously exist.

Engaging in organic farming may also allow new social groups, women in particular, to engage in cash crop production. The historic male dominance in Africa has limited may women's' access to inputs and credit.

Additional benefits cannot be measured in the cash economy. Organic farming techniques are widely recognised to improve food security, particularly on rainfed crops (Parrott and Elzakker, 2003).

The more labour intensive nature of organic farming presents opportunities for job creation. The increase in employment can be relatively small, however. Pickering, cited in van Zyl (2000) indicated that large agronomic production units, labour would increase by 2-3%, while on smaller mixed farming units, could increase by as much as 20%.

8.7.1 Land Reform

Van Zyl (2000) uses the case of Go Organic at Spier near Stellenbosch to demonstrate that there are opportunities associated with land reform and organic farming. Dick Enthoven of Spier made land start up loan finance available and provided rent free access to land, while the Land Reform Credit Facility provided finance for initial operating costs. It was found that the operation broke even after one year and a 100% gross profit was predicted by year three.

No other examples of organic production linked to land reform were found during the literature review process, but such options require further investigation.

Willer and Yuseffi (2003) note that in countries such as Egypt and Uganda, many and in some cases, thousands of farmers are working together to achieve sufficient volumes for export.

8.8 Challenges, Constraints and Considerations

It is suggested by various sources[8], that the following consideration should be borne in mind when contemplating the conversion to organic agriculture.

8.8.1 Agro-ecological considerations

- Availability of natural resources: such as land, soil quality, vegetation, access to material which can be used in compost and mulch, availability of other materials such as rock dust;
- Evaluation of other resources needed, such as machinery and tools;
- Suitability of enterprises, that is, crops to be grown or livestock to be raised, given the availability of natural and other resources;
- Traditional (low input) forms of production are coming under pressure due to growing rural populations.
- Problems to be expected: which pests are common, what is the cause, what can be done to avoid them within available resources? For example, a primary pest may be avoided by planting at a time when the insect cannot complete its life cycle, even though that results in a certain decrease in yield due to non-optimal conditions in other aspects such as heat; a secondary pest could stop after abandoning the use of pesticides and natural predators return;
- Total production of all enterprises, not only of the main enterprise; yield difference in good and bad years (that is, yield variability).

8.8.2 Economic considerations

- Profitability is a key consideration in any agricultural enterprise.
- Labour requirements (quantity and timing of labour).
- Total net return, that is, income (or use) from main crop and other crops and livestock, minus the cost of the inputs used for the production.
- Long-term productivity: the effect of present production on the soil and implications for future yields.

[8] FAO (1998); Wynen (1997) and Gabriel (1994), cited in FAO, 1998; Van Zyl, 2000; Willer & Yuseffi, 2002; E. Gori and Associates, 2004.

- Marketing possibilities: in times when consumers are willing to pay a premium, improved marketing possibilities should be taken into account when production decisions are made.
- Certification costs are high because certification is conducted by foreign bodies.
- Some countries may not be able to establish exports because trade liberalisation has not taken place.
- Farmers should be cautious of making financial decisions based on existing price premiums which may erode over time as more producers enter the market.
- The possibility that organic farmers may experience greater difficulties in obtaining credit, and the possibility that organic farms may not attract premiums when the property is sold.

8.8.3 Social and Institutional Considerations

- Belief systems - many people, including scientists, researchers, extension officers and politicians strongly believe that organic agriculture is not a feasible option to improve food security. This makes it difficult for farmers to obtain information. Allocation of resources for research and extension were limited due to this mindset and consequently limits the possibility and technological advances of organic agriculture.
- Perceptions of food from Africa are a major concern and that African organic produce ‘is often seen by European and American consumers as “possibly unhygienic”, “subject to profiteering by middle men”, and “perhaps unreliable regarding marketing claims”’
- Land tenure - (particularly relevant in South Africa). Security of tenure must ensure that the future benefits of current farm improvements can be achieved to the benefit of the land user. If not, investments which improve sustainability will not be made.
- Vested interests - organic agriculture differs greatly in input use from conventional agricultural systems. Many of the inputs used in organic agriculture are “public goods” (can be used without impeding use by others, such as knowledge about practices i.e. no competing demand for these resources resulting in limited opportunities for profits). As a result, there may be little private sector interest in promoting inputs used in organic agriculture.
- Social obstacles - in developed countries organic producers often refer to social isolation which organic farmers endure as a result of their choice of management system. Farmers may be perceived as “odd” or eccentric, resulting in social pressure.
- Private investment - (as opposed to public investment associated with conventional agriculture) the advancement of organic agriculture to date has to a large extent been due to private investment. This has been in the form of consumers' willingness to pay for organic commodities (price premiums) and farmers' readiness to experiment and innovate, despite the risks involved with such on-farm research.
- Low incomes and level of organisation of the organic movement in Africa

- High illiteracy rates make farm record keeping a problem

8.8.4 Infrastructure

In Sub-Saharan Africa, infrastructure is a major challenge to export marketing initiatives. This applies particularly to rural areas. Poor conditions of roads and vehicles and rail links pose problems for transportation of produce. Lack of refrigeration, erratic power supply, communications and underdeveloped banking and credit systems compound logistical problems associated with the movement of organic produce (Parrott and Elzakker, 2003).

8.8.5 Certification

Formal certification is required to effectively engage in premium export markets. Governments usually dedicate zero or limited resources to the development of local organic standards due to more important pressing issues such as nutrition and food security. As a result, certification is managed by foreign certifiers and standards. In some cases, inspectors fly in while in some cases there are country offices that represent the certifier. Such standards and certification procedures have been created in developed country situations and may not be well adapted to local conditions in Africa (Parrott and Elzakker, 2003). The lack of local standards means that African countries cannot contribute to the development and refinement of standards at an international level and could be seen as a form of neo-colonialism. The lack of local standards for certification is therefore a major impediment to local organic development. In 2004, Tunisia was the only African country that has local standards. These standards are compatible with EU standards.

The high cost of certification and underdeveloped infrastructure for inspection and certification in Africa often means that it does not make economic sense to convert to organic farming. This assertion is confirmed by Van Zyl (2000) that without an effective and low cost certification system, supported by relevant legislation, certification will remain the major stumbling block to organic certification in South Africa.

Formal certification of organic agriculture in South Africa is therefore imperative and is the first step in providing real support to the development of the organics industry in South Africa. A regional East African Organic Standard has recently been launched and warrants further investigation to determine what lessons can be learn from this process that would be applicable to South Africa.

8.9 Support to the Organics Industry

Van Zyl (2000) compares three countries and their approaches to the support of organic agriculture *viz* Denmark, Australia and New Zealand. A more detailed account of this may be found in his report.

8.9.1 Denmark

Denmark followed the route of intensive government support for the development of organic agriculture, driven by their “action plan for the promotion of organic food production in Denmark”. During the period 1995 – 1999, the Danish government provided massive support to organic agriculture, through five different thematic areas

- Secure the implementation of the action plan for the promotion of organic food in Denmark
- Making conversion to organic agriculture attractive to farmers
- Securing demand for organic produce
- Strengthen research, development and education in organic production
- Remove barriers to sustainable organic development

In 1999, action plan two came into operation, with recommendations for further research in the following areas

- Consumption and marketing of organic produce
- Organic primary production
- Quality and health
- Educational aspects
- Use of organic products in institutional kitchens
- Export
- Regulation and laws
- Protection of the environment
- Animal welfare and health
- Research and development

A further R 2 billion was allocated for action plan 2 over a period of five years and indications are that the Danish organic industry is well established.

8.9.2 Australia

In Australia, government support for the industry is limited, but was found to be about R 5 million per year, mainly in the form of research and development for the organic industry. In addition to this, state services providing extension and management of certification, with dedicated departments dealing with organic agriculture and certifications. Over and above this, there are other state research institutions that research the development of sustainable farming systems. At the time of the case study, Australia had a very well developed organic sector worth about R580 million annually and growing at 7-10%. Organic agriculture in Australia has continued to expand rapidly.

8.9.3 New Zealand

New Zealand provided very little support to organic agriculture but, at the time of the study (2000), was beginning to support organic agriculture. This support was focussed around

- Developing specific new Zealand organic standards, or accept EU 2092 standards
- Defining organic agriculture legally to allow for prosecution of unscrupulous operators

- Expenditure into research and development of organic production

8.9.4 South Africa

In all three cases above, the first priority was the definition and institutionalisation of organic agriculture and products through the development of standards, followed by R & D into development, education and training. There does appear to be support for organic agriculture in some spheres of government, but this appears not to be coordinated and occurs without a broader strategy framework for organic agriculture.

In KwaZulu-Natal, the DED and the DAEA supported a workshop to develop a strategy for organic agribusiness in KZN and they share the belief that the sector has sufficient potential to warrant the need for an intervention in the industry, which, if successful would facilitate the coordination and development of the Organics Value-chain and support structures (Mitchell, Undated). The DED and DAEA also support some small grower groups organic projects.

The Limpopo Provincial Department of Agriculture has established an extension programme to support organic agriculture and have facilitated the development of training courses at Further Education and Training (FET) colleges in Limpopo (Callear, Pers Comm; Jackson, Pers Comm). The Western Cape Department of Agriculture also provides some support to organic agriculture.

The organic standard for South Africa which is still under development is seen as the key to facilitating the development of a coordinated support strategy for the development of organic agriculture in south Africa.

8.9.5 Training and Capacity Building

A Biowatch bulletin (Biowatch, 2006) recently reported that Agricultural colleges in Limpopo will include organic farming methods in their curricula. This development is a collaboration between representatives of the colleges, the Limpopo Department of Agriculture, Biowatch South Africa, Organics South Africa, the Organic Farm Group and the South African Council for Organic Development and Sustainability. It is anticipated that the organic farming module will be implemented during 2007. This appears to be the only training that is provided through a state institutional body.

A number of organisations that include organic farming in their training programmes were identified. These are including in the attached stakeholder profile spreadsheet.

9 Stakeholders

A stakeholder profile is provided electronically in the form of a spreadsheet. All stakeholders on this database have been sourced from public domain documents. Producer information provided by certification bodies (only one so far) has not been included in this document due to concerns that have been raised regarding confidentiality. The profile includes:

- State Departments and Institutions
    - National Department of Agriculture
    - Provincial Departments of Agriculture
    - Agricultural Research Council
    - National Department of Agriculture
    - Other State Departments
- Certifying Organisations - the following organic certifiers provide certification services in South Africa:
    - SGS – Operate from offices in South Africa
    - Ecocert / Afrisco – Operate from offices in South Africa
    - BDOCA / Debio – Operate from offices in South Africa
    - SKAL / Controlunion – Operate from offices in South Africa
    - BCS – Certify from offices in South Africa
    - Soil Association – Certify out of EU
    - Institut fur Marktokilogi (IMO) – Certify out of EU
    - Organic Food Federation (OFF) – Certify out of EU
    - Lacon – Certify out of EU
- Private Institutions and NGOs Supporting Organic Agriculture
- Producers and Processors
- Retailers and Market Outlets
- Input Suppliers
- Consultants
- International and Country Organisations Supporting organic Agriculture
    - United Nations Food and Agriculture Organisation (FAO)
    - International Trade Centre (ITC)
    - United Nations Development Programme (UNDP)
    - United Nations Environmental Programme – Global Environment Facility (UNEP-GEF)
    - Gesellschaft fur Technische Zusammenarbeit (GTZ) – Germany
    - Swedish International Development Agency (SIDA) – Sweden
    - Swiss Import Promotion Programme (SIPPO) – Switzerland

- US Agency for International Development (USAID) - USA

10 SWOT ANALYSIS

An initial SWOT analysis table for the organics industry in South Africa is presented below.

Table 18 SWOT Analysis for the organics industry in South Africa.

Strengths	**Weaknesses**
Market demand for organic produce.	No organic standards or legislation for South Africa
Good transport and logistics infrastructure.	Lack of clear government policy regarding organic agriculture.
Already geared towards the export of agricultural products.	Cost of certification.
Existing agricultural product quality assurance mechanisms.	Shortage of local certification capacity.
Established trade relations with other countries.	Limited local research on organic farming.
Inverted production season - can sell off season goods.	Market information and support limited (from crops to grow to distribution channels, to financing possibilities).
Production Season slightly different to competing countries in the Southern Hemisphere (Australia, Brazil).	Skills needed for production are limited, such as extension and training.
Close to and similar time zone with Europe, reducing delivery costs, eases contact with buyers and general administration.	Accessing finance difficult for small farmers.
Organic agriculture is closely aligned with existing rural farming practices.	Farmers tend to work as individuals, when cooperation would be better for volume, consistency and marketing.
Encourages and supports local knowledge systems.	Infrastructure in rural areas.
Reduced reliance on (and credit for) for external inputs.	Illiteracy a barrier to entry, due to record keeping requirements.
Water use efficiency	Perception of reduced yields impacting on

	food security.
	Lack of knowledge, access to information.
	Additional labour cost and costs associated with conversion.
Opportunity	**Threats**
Numerous trading partners and foreign consumers with "social conscience", possibly more likely to support organic produce from SA rather than countries like Australia.	"Food Miles" - the carbon / energy cost of moving food from source to destination.
Traditional cultivation methods aligned with organic production making conversion relatively easy.	Decision to promote GMOs.
Uncultivated and marginal land easier to convert to organic production than conventional.	Competing producers in developing countries rapidly scaling up production.
New trade linkages (e.g. Dube Trade Port and Dubai).	Organic agriculture a threat (perceived or not) to existing business interests.
Donor Agencies are disposed towards Organic Agriculture Projects.	Mindset of farmers, scientists and policymakers.
Opportunities for marginalised groups, particularly women.	National Policy direction for agriculture.
Growing demand for organic produce.	Perception that organic farming is "backwards".
Enhanced food security.	"Peer Pressure" from farmers seeing organic as a "fringe" activity.
Increased and more stable employment opportunities for farm workers.	
Premiums for certified products.	
Increased social benefits associated with organic agriculture.	

11 SUMMARY AND RECOMMENDATIONS

Interest in organic agriculture has shown remarkable growth over the last ten to twenty years, internationally as well as at a local level. The reasons for this growth revolve around environmental, health and social concerns in terms of consumer demand. For producers, factors such as farmers' health and that of farm workers, increased environmental concerns, degradation of resources as a result of conventional farming systems, reduced input costs and price premiums influence their decision to pursue organic farming. There has been much said in this document regarding the environmental damage resulting from conventional farming systems. It should be pointed out here that that these problems arise primarily from flaws in the *production system* and not necessarily with the individual farmer. There are many conventional farmers (and others who practice more sustainable, but not necessarily organic) who are conscientious and responsible farmers. It should further be pointed out that organic farming is not a panacea for the negative environmental impacts of agriculture – any form of agriculture transforms the landscape from its original natural state.

There are also a number of limitations to the adoption of organic farming practices, particularly in developing countries, such as poor infrastructure, lack of government support, technical knowledge required to implement organic farming systems, cost of certification as well as the record keeping requirements which are often beyond the ability of small and emerging farmers. Insecurity of tenure also limits the adoption of organic practices as there is no incentive for considering future returns. Further, there appears to be a limited recognition by governments in developing countries of the potential for organic agriculture to enhance food security, reduce carbon emissions and enhance biodiversity, in addition to the potential for foreign income. Finally, it has been noted that premiums associated with organic production may decrease, or disappear altogether as production rises to meet demand, although the rate of increase in demand continues to exceed the rate of production and it appears that it will continue to do so for some time.

In developed countries, state institutions are increasingly recognising that it may be more cost effective to support organic agriculture than to rectify problems with resource degradation resulting from unsustainable agricultural practices. As a result, many governments provide subsidies for organic farmers. An important factor that has contributed to this is public pressure, arising from environmental and health concerns, as well as a strong and well organised environmental lobby.

The growth of organic agriculture in developing countries appears to arise from two different forces. Firstly, established farmers are attracted by price premiums from lucrative export markets as well as environmental and social benefits. Secondly, development initiatives to address poverty, environmental degradation and other social problems promote more sustainable agricultural practices, including organic agriculture. In some cases, organic production enjoys state support, which has contributed to the growth of organic agriculture in these countries. Governments, therefore, have an important role to play in promoting organic agriculture through legislating certification, market and export advice, research and development, extension and training and land tenure. Organic agriculture should therefore be supported by a clear policy framework to address concerns and unlock blockages.

“Because of the public good properties of many inputs used in organic agriculture, unless a specific attempt is made by public policy bodies, a comparative lack of knowledge in organic agriculture will remain. Therefore, a first step in increasing the availability of knowledge on organic agriculture is to acknowledge that this form of agriculture could be an interesting option for agriculture both in developed and developing countries and that it has a role in improving food security and environmental sustainability, especially in poorly endowed environments. Extensive communication with those who have expertise in the area of organic agriculture is advisable. More active support could be given in the area of implementing projects for the collection of relevant data.” (FAO, 1998)

The market for organic produce is growing rapidly and as outlined above, South Africa has a number of advantages that need to be exploited and broad recommendations and research questions arising from this review include:

Environmental

- Water - South Africa is a water scarce country.
    - Can organic farming contribute to water use efficiency and improved water management in agriculture?
    - In irrigated systems can organic farming improve water use efficiency?
    - In dryland production, can overall yields be improved?
- Biodiversity
    - Biodiversity and agrobiodiversity benefits of organic farming are well documented. Can these benefits be used to promote or provide incentives for farmers to adopt organic practices?
    - Case for ecosystem services payments / Benefits?
- Carbon Sequestration
    - Organic farming practices (along with other more sustainable farming practices like no till farming) emit less carbon than conventional systems. Another case for ecosystem service payments / benefits?

Health

- What are the (human) health benefits of organic farming
    - Less pesticides – farm workers
    - Improved nutritional status of products?
    - Food security link to health

Social

- Does organic farming employ more people than conventional systems
- There are intrinsic benefits (such as no chemicals) but are organic farming systems actually more socially sustainable than conventional
- The commercial export vs developmental sustainable paradigm of organic farming systems also requires investigation
- Are farmer workers acturally seeing any benefits from organic farming systems

Certification

- How can the finalisation of South African Organic standards be fast tracked? Should the dti / FRIDGE / IDC partnership should begin lobbying the NDA immediately to get this legislation enacted.
- How many successful group certification schemes with ICS are there in South Africa? How many have failed? Why?
- The participatory guarantee system and its potential for wide application in South Africa should be investigated.
- The issue of cost of certification should be investigated – it is acknowledged that there is a huge amount of administration and management involved for a certification body – the actual inspections on the ground are a relatively small proportion of the costs for the body. Would an increase in total certifications decrease overhead costs per certification?
- How to enhance local certification capacity – will the establishment of a South African standard improve this? What other measures may be required
- What role will SANAS play in certification, particularly as it is the accrediting body for Department of Agricultural legislation
- Should any other certification models be considered – e.g pesticide free, water friendly etc.

Institutional

- Who are the state roleplayers at a national and provincial level? How can they
- Can a case be made for subsidising organic agriculture, or some form of fiscal incentive for engaging in organic agriculture?
    - Who would the roleplayers / stakeholders be?
- How to establish a policy framework at a national level that supports the development of organic agriculture in South Africa?
- How can land reform initiatives make use of or include organic agriculture in their farm plans / business plans

- What role can lobbying from environmental and social organisations play in promoting the uptake of organic agricultural practices
- There are many stakeholders in the South African organics industry and it appears to be a fragmented industry, with little knowledge and information sharing – how can the organics industry be equitably represented and what kind of forum / institution is the best for this.
- How do you formalise the industry without being interventionist – role of institutions as facilitators rather than gatekeepers
- How to make use of (institutionally sound and well coordinated) grassroots organisations, such as cooperatives to develop small grower groups
- What mechanisms are available for private sector and Non Government Organisation interests to develop a strong and well coordinated lobby with which to encourage suppoprt processes at a national and provincial level.

Technical

- The question of a closed system – how can the system be closed if biomass is being removed from the system
- Are African pests and diseases more destructive / persistent than in other continents
- How to ensure effective participation of farm workers in the study?
- What training and capacity building is needed for
    - Extension support services (Govt and NGO)
    - Emerging / small scale farmers
    - Established commercial farmers
- Funding for research and development for organic agriculture?
- Provision of training and extension to support organic agriculture
- Provision of business planning support and access to finance for organic agricultural development – particularly for emerging farmers and land reform beneficiaries

Trade

- What are the trade barriers to the export of organic produce (tariff and non-tariff)?
- Should imported products be certified to south African standards – what are the alternatives?
    - Would SANAS be the only body accrediting certification bodies for these standards – if not, who else?

- Export markets are growing - how does one rapidly increase access to and production for these markets?
- Domestic markets are growing - how does one rapidly increase local demand and access to and production for these markets?
- Who are the local input suppliers and who is developing organic technologies locally – is investment in response to growth?
- How can traditional crops and foods (non-hybridised, but higher nutrition, drought resistance although lower yields) be included in organic systems? Are there marketing opportunities for these crops?
- Why do there appear to be limited premiums in local markets for organic produce?
- What caused the failure of the organic meat industry in South Africa?
- Can organically certified products provide a market edge in conventional product markets
- What fair trade opportunities exist for organic produce? Fair trade certifies products and not processes.
- The EU and USA account for 97% of organic sales are these markets accessible? What emerging markets (domestic and foreign) present opportunities for south African organic produce?
- Where and how should strategic partnerships be established with countries that have well established organic industries and / or markets
- Support to Trade missions and events to promote South African Organic farmers – BioFach, the largest international trade fair has limited South African representation, while other countries, such as Brazil were well represented, had professional displays and very clear indications of high level government support. Many other countries that South Africa supply goods to also have trade fairs and attendance at these should be supported and encouraged
- Development of market information services / systems.

Traditional Knowledge

- What traditional knowledge is available that can add value to organic agriculture – has this been recorded

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