DOSSIER

Organic Agriculture and Food Security

DOSSIER

IFOAM
INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

Organic Agriculture and Food Security

Author: GUNNAR RUNDGREN (Sweden)
Revised and updated by NICHOLAS PARROTT, December 2005
Approved by the IFOAM World Board

Please Note:
The opinions expressed in this publication do not necessarily represent an IFOAM approved position

Published in Germany by IFOAM.

The development and revision of the publication was supported by the "IFOAM-Growing Organic" programme (I-GO), funded by Hivos and the Dutch Government, both from the Netherlands.

Die Deutsche Bibliothek – CIP Cataloguing-in-Publication-Data
A catalogue record for this publication is available from Die Deutsche Bibliothek
ISBN 978-3-934055-66-7

Price: 6 Euros for download
IFOAM Dossier Organic Agriculture & Food Security

ORGANIC AGRICULTURE AND FOOD SECURITY

TABLE OF CONTENTS

Organic Agriculture and Food Security

Executive Summary

While affluent regions and social classes struggle with surplus production and surplus consumption, close to one fifth of the global population lives in a state of constant undernourishment. In many regions subsistence production of basic foods is restricted by lack of access to capital, land and water. At the same time, more favored growing areas within the same countries are used for commercial production of specialty crops or animal feed destined for export to affluent regions. Thus the major constraints to achieving universal food security, now enshrined as one of the Millennium Development Goals (MDGs) are found in social, economic and political conditions more than in problems regarding productive capacity. The main solutions to food security problems will therefore be found in social, economic and political improvements.

Nevertheless, demand for food will increase in the future, and choices about production methods do also influence access to food, so there are reasons why production issues need to be addressed. This dossier highlights the relevance of organic agriculture in helping meet food security:

- The main strategy for increasing both food production and access to food should be through farmers in developing countries increasing production and productivity.
- Conventional agriculture may provide short-term gains in production, but in most cases it is not sustainable in the long term, undermines the viability of small farm units and does not guarantee safe food.
- In particular, conventional production methods are inappropriate for disadvantaged farming communities and are thus not a suitable solution for many of those who face food shortages.
- Organic production has the potential to produce sufficient food of a high quality. It is, as we demonstrate here, particularly appropriate for those rural communities that are most exposed to food shortages.
- Organic agriculture contributes to food security through a combination of many features, most notably by:
    - Increasing yields in low-input areas
    - Conserving bio-diversity and natural resources on the farm and in the surrounding area
    - Increasing farmers' incomes and/or reducing costs
    - Producing safe and varied food
    - Being sustainable in the long term

Organic agriculture should be an integral part of any agricultural policy aiming for food security.

ORGANIC AGRICULTURE
PRINCIPLES AND DEFINITIONS OF ORGANIC AGRICULTURE
Principles of Organic Agriculture

Preamble
These Principles are the roots from which organic agriculture grows and develops. They express the contribution that organic agriculture can make to the world, and a vision to improve all agriculture in a global context.

Agriculture is one of humankind's most basic activities because all people need to nourish themselves daily. History, culture and community values are embedded in agriculture. The Principles apply to agriculture in the broadest sense, including the way people tend soils, water, plants and animals in order to produce, prepare and distribute food and other goods. They concern the way people interact with living landscapes, relate to one another and shape the legacy of future generations.

The Principles of Organic Agriculture *(IFOAM 2005a)* serve to inspire the organic movement in its full diversity. They guide IFOAM's development of positions, programs and standards. Furthermore, they are presented with a vision of their world-wide adoption.

Organic agriculture is based on:

The principle of health
The principle of ecology
The principle of fairness
The principle of care

Each principle is articulated through a statement followed by an explanation. The principles are to be used as a whole. They are composed as ethical principles to inspire action.

Principle of health
Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems - healthy soils produce healthy crops that foster the health of animals and people.

Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but the maintenance of physical, mental, social and ecological well-being. Immunity, resilience and regeneration are key characteristics of health.

The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings. In particular, organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well-being. In view of this it should avoid the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects.

Principle of ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes, and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in the case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms, the aquatic environment.

Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. 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.

Principle of fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.

This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties - farmers, workers, processors, distributors, traders and consumers. Organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty. It aims to produce a sufficient supply of good quality food and other products.

This principle insists that animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behavior and well-being.

Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

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 jeopardizing 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 states that precaution and responsibility are the 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.

Definitions

Organic agriculture has been well defined in a number of documents, most notably by the 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 fibers. 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 optimize 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. Organic agriculture adheres to globally accepted principles, which are implemented within local social-economic, climatic and cultural settings. As a logical consequence, IFOAM stresses and supports the development of self-supporting systems on local and regional levels." (IFOAM 2000)

Organic agriculture is also often referred to as ecological or biological agriculture or by similar names in languages other than English.

It is important to note that organic farming does not, as is widely misunderstood, merely refer to a form of farming that does not use chemical inputs. Rather it implies "understanding the farm as an organism, in which all the components, the soil minerals, organic matter, micro-organisms, insects, plants, animals and humans interact to create a coherent, self regulating and stable whole. Reliance on external inputs, whether chemical or organic, is reduced as far as possible" *(Lampkin et al 1999)*.

This distinction is particularly important to make in the context of the developing world, where traditional unimproved agriculture, using few or no artificial inputs, can often misleadingly be equated with an organic approach. Organic farming implies a degree of awareness of the functioning of, and inter-relationships within the farm system.

Organic agriculture is the only agricultural production method that is based on international standards, i.e. the democratically developed IFOAM Basic Standards *(IFOAM 2005b)* that have existed for more than twenty years. During the 1990s CODEX Alimentarius (a joint FAO/WHO body) also developed international organic guidelines, which are very similar to the IFOAM Basic Standards in their scope. The EU, the USA and many other developed, and increasingly developing, countries have enshrined these guidelines within their own legislation.

THE CURRENT SITUATION

Broadly speaking there are two different kinds of organic farms in the world:

1. Certified organic farms producing for a premium price market.
2. Non-certified organic farms producing for their own households and for local markets.

Most organic farms in developed countries, where markets are more developed, are certified by a third party and produce for a premium price market.

In recent years there has been a substantial growth in the number of certified farms in developing countries, although these still (with the exception of a few countries) represent a very small percentage of total farm numbers.

Apart from third party certification there are other methods of organic quality assurance for the market place. These can be in the form of self-declarations or participatory guarantee systems. There are also situations where the relation between the consumer and the producers are strong enough to serve as a sufficient trust building mechanism, and no particular other verification is needed. There are organic farmers for whom certification does not have any advantages: this is true for farmers who practice subsistence farming, basically catering for the food security of their families or their community. It is also true for farmers who want to sell their produce as organic, where a demand for organic products does not exist in their region or where the intermediary or processor does not want to handle organic products.

While there are reasonably comprehensive statistics regarding the extent of certified farms, there is little available data regarding the extent of non-certified farms. However, it is not unrealistic

to assume that certified organic production is probably the tip of the iceberg, representing only a small fraction of the numbers of farmers in the world who do farm organically. For example Walaga and Hauser (2005) estimate that number of non-certified farmers in Uganda is probably three to four times more than those with certification.

In total there are more than 31 million hectares of certified organic agricultural land today. The countries with the largest areas of organic land are: Australia, China, Argentina, Italy, the USA and Brazil. Some countries have reached a substantial proportion (close to or more than 10%) of organic land. These are mostly grouped in and around the Alps (Liechtenstein, Austria, Switzerland and Italy) and Scandinavia (Finland, Sweden and Denmark). In several developing countries the proportion of organic land has been rapidly increasing in the last five years, with several Latin American countries (Uruguay, Chile, Argentina, the Dominican Republic, Tunisia, Belize and Bolivia) as well as Uganda (Africa), all now having more than 1% of their agricultural land under certified organic production *(Willer and Yussefi, 2006)*

The value of the organic market was valued at circa US$ 27.8 billion in 2004 *(Sahota, 2006)* have been growing at rates of between 5-10% for at least a decade. The market share for certified organic products is between 0.5-4% in industrial countries with the highest market shares found in Denmark, Austria, Switzerland, Germany and Sweden. In overall terms the North American, German and British markets are the largest. The rapid and continued growth in organic markets in the developed world provides an impetus for farmers in both developed and developing countries to change practices to meet this demand. *(Willer and Yussefi 2005, Grolink 2001, ITC 2001)*. In China the Green Foods label, which adopts some of the same principles as organic farming is reported to be worth $150 million (retail sales) *(IFAD, 2005, p.9)*.

Food security

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." **WORLD FOOD SUMMIT 1996**

Current situation

Over the past 40 years, per capita world food production has grown by 25%, and global food prices have fallen by 40% in real terms. Between the early 1960s and mid-1990s, average cereal yields grew from 1.2 t/ha to 2.52 t/ha in developing countries whilst total cereal production has grown from 420 to 1,176 million tonnes per year *(Pretty and Hine 2001)*.

Yet, despite increases in average per capita consumption of food (up 17% in the past 30 years to 2760 kcal), 36 countries still have an average per capita calorie consumption of less than 2200 Kcal per day- the minimum level considered for maintaining good health *(Millstone & Lang 2003)*. The majority of these are located in sub Saharan Africa. Under nutrition, caused by lack of vitamins and/or minerals continues to blight the lives of many more millions, contributing to a wide range of diseases.

Progress towards reducing hunger has been painfully slow in recent years. Between 1990 and 2002 the number of hungry people in developing countries fell by just 1%, from 824 million to 815 million. If we remove China from this equation the number actually rose: from 630 million to 673 million. In sub Saharan Africa the picture is particularly dire, with a 20% increase in the number of hungry people since 1990 *(von Braun, 2005)*. Africa is the only continent where the number of malnourished children continues to grow, by some 10-15% between 2000 and 2005 (von Braun, 2005). It is clear that humanity is far from realizing the target set in the Millennium Development Goals of halving the number of hungry people by the year 2015.

Yet paradoxically, at the same time, 1.2 billion people, mostly in the developed world, are over-eating giving rise to a new range of health concerns related to over consumption *(Worldwatch Institute 2000)*.

"There is enough for everybody's need but not enough for everybody's greed." **MAHATMA GANDHI**

Contributory factors

Social and economic determinants

Where are the solutions to food security to be found? There is no lack of food on a global scale, yet millions of people are still starving. Within many countries food production is sufficient to meet national needs yet people are still starving or under-nourished. It is apparent that **sufficient food supply and production, while an important precondition for providing sufficient food for all does not guarantee it.** What is more important is **who** produces the food, **who** has access to the resources, the technology and knowledge to produce it, and **who**

has the purchasing power to acquire it. As the Nobel Prize winning economist AMARTYA SEN (1982) notes *„Starvation is the characteristics of some people not having enough food to eat. It is not the characteristic of there not being enough food to eat.“*

The causes of starvation and malnutrition are mainly social, political and economic. Most prominent among these are:

- Poverty, inequality and discrimination (on the grounds of class, ethnicity, age, sex etc.)
- lack of money to buy food or lack of access to resources (such as land, inputs, water or credit) to produce food.
- War or civil unrest
- Food production fails to deliver economic returns. The lack of a developed food market gives farmers no incentive to increase production.

Other factors can include a lack of labour, or healthy labour, bad governance, lack of distribution capacity, poor infrastructure, and policies that discourage or undermine food production. Global trade relations and rules, international and national policies, structural adjustments and trade concentration affect food security in a number of ways. The inequitable terms of competition between producers in industrial countries and those in developing countries severely constrains production in developing countries. The most direct effects are caused by developed countries 'dumping' their agricultural surpluses in developing countries. When sold on the world market at below production cost (because of production and export subsidies), these surpluses depress local prices, thereby lowering production. Three rounds of WTO talks in the past few years have failed to produce any tangible resolution to this issue. In the current climate it is often more profitable for farmers in developing countries to produce specialty crops for export markets with high purchasing power than to produce staple food crops for a domestic market, where only low prices can be obtained.

Food security issues are very complex, and cause and effect are not easy to clarify. What is good for one group is not necessarily good for another group. Increased prices for food crops will quite certainly lead to an increase in food production. However, higher food prices may be unbearable for the urban poor. Yet, better economic conditions in agriculture would have kept many of the people now dwelling in urban slums in the rural areas.

"Nearly 80 percent of all malnourished children in the developing world in the early 1990s lived in countries that boasted food surpluses." *World Watch 2000*

More than half of the world's food is produced by women, and in rural areas in developing countries as much as 80 percent. Yet women have little access to land, credit, training and education. In five African countries Kenya, Malawi, Sierra Leone, Zambia and Zimbabwe women receive less than 10 percent of the credit awarded to smallholder farmers and just 1 percent of agricultural credit overall. *(FAO 1998)*

The total amount of subsidies to agriculture in OECD countries is declining somewhat: from circa US $ 250 billion in 2000 to US $ 235 in 2002. The World Bank estimates that these subsidies cots farmers in developing countries more than $30 billion a year in lost trade opportunities *(FAO, 2003)*. While agriculture is a net recipient of public funds in the developed world, in most developing countries direct and indirect taxation of agriculture usually brings about a net transfer of resources out of the agricultural sector *(FAO 2000)*.

While it is clear that **the main causes of starvation and malnutrition are not to be found in the area of production**, there are a number of production related factors to consider.

Most prominent are:

- Unsustainable production methods – erosion of soil, depletion of fertility and ground-water, poisoning of land and water, salination and water-logging
- Loss of bio-diversity on the farm (seeds, breeds etc.) and in the surrounding environment, the diversity of which often provides important environmental services (e.g. pest predation)
- Inefficient use of production resources (unutilized, or underutilized, natural resources). This is often particularly pronounced on large holdings or when markets are not encouraging farmers to produce sufficiently
- Natural disasters

Future challenges

Food demand will both grow and shift in the coming decades for three reasons:

- Increasing numbers of people means that the absolute demand for food will rise. Despite steadily falling fertility rates and family sizes, the world population is expected to grow to 8.3 billion by 2025. By this time, 84% of people will be in those countries currently making up the 'developing' world.
- Increasing incomes mean people will have more purchasing power to buy more food.
- Increasing urbanization means people will be more likely to adopt new diets, particularly consuming more meat, eggs and dairy products - demand for these products is expected to double by 2020 in developing countries, and to increase by 25% in industrialised countries, resulting in a total and per capita increase in demand for cereals *(Pretty and Hine, 2001)*.

It is clear that today the main reason for malnutrition is not to be found in the lack of food that is produced. Yet, in the future new competing demands will emerge increasing the need for additional production. In addition, there are increasing expectations that agriculture will also be a producer of energy (e.g. bio-gas, oils or alcohol for fuel), industrial raw materials, fibers and services (tourism, landscape, carbon sequestration etc.). Sooner or later production capacity will become a real limiting factor. Bearing this in mind we need to ask: **Where** will the food be produced? **How** will it be produced? And **who** will produce it? This paper examines the question of whether **organic agriculture can produce sufficient food, and in particular, whether it is the best option for farmers in developing countries.**

By shifting global diets to vegetarian or vegan food, or by affluent consumers reducing their meat intake, substantially more people could be fed on the same area of land. A meat based diet requires an annual average of 930 kg of grain, whereas a vegetarian one needs a mere 180kg. *(Millstone and Lang, 2003)*

SCENARIOS AND CHOICES FOR INCREASED FOOD PRODUCTION

Considering the increased demand for food in the future there are three main options that might be pursued in order to increase production:

- Area expansion
- Increased productivity in industrialised countries and export of surplus production
- Increased productivity in developing countries

Obviously these options are not mutually exclusive. However, there is a need to understand the advantages and disadvantages of each one in order to assess which proves the most acceptable, economically, socially and environmentally.

AREA EXPANSION

One option for increasing production could be to expand the area used for agriculture, by converting new land to agriculture. While there is agricultural expansion of this nature in some areas like Argentina and Brazil *(see Knudsen et al, 2006)* the overall trend is for a substantial loss in agricultural areas, due to construction, desertification, salinization, waterlogging and erosion. Figures from OECD countries *(OECD, 2001)* and many developing countries show a decline in agriculture areas. China is one example, where the eastern provinces are losing 400,000 hectare of agricultural land per year, mostly to other competing land uses *(UN, 2003, cited in IFAD 2005)*. An expansion of the area used for agriculture is likely at most to balance out this loss. In addition, with few exceptions, the most suitable land is already taken into production and there are very real ecological constraints on the use of most "virgin" land *(Pimentel 2000, FAO 2000)*. Further agricultural expansion is likely to push already marginalised people into the role of "pioneers", cultivating less fertile and less suitable lands (e.g. rain forests), which will only further confirm their poverty and marginalization and accelerate environmental degradation.

This strategy would also result in agriculture occupying even more land and an even greater expansion of human domination over global ecosystems. It will result in even greater biodiversity losses than we have already experienced. Apart from the ethical question of whether we have the right to utilize even more resources at the expenses of other species, the result is also that ecosystem services from forests, grasslands and other areas of important bio-diversity will be lost, threatening our future well-being and survival. Therefore the option of area expansion is not a globally acceptable approach, even though it may be applicable in some areas. What is more important is to maintain fertility on existing land and to restore fertility on degraded lands. Organic agriculture has a role to play in both these approaches.

Increased productivity in high potential areas.

The second option for increased production is to increase production per hectare in agricultural exporting countries (mostly industrialized), so that food can be transferred or sold to those who need it.

This is not a viable solution for several reasons:

- The people who are short of food have no money and are therefore not able to buy food. Food aid, other than in short term emergencies, has been shown to be counterproductive and is not likely to increase.
- The pressure on the environment and on bio-diversity and the external cost of conventional farming in developed countries is already far too high and there is a recognized need for a radical change in the production systems of the industrialized countries. This is likely to result in lower, rather than higher, levels of production.
- Food production systems need to re-cycle nutrients in order to become sustainable. Large scale transport of food from one part of the world to another undermines efforts to close these nutrient cycles. Soils are mined in some parts of the world, while in other parts of the world the concentration of nutrients is creating environmental problems.

> Agricultural soils are degraded - fifty percent or more of the natural nutrients and organic matter from much of Canada's once rich prairie soils have been lost in a century of mechanized export agriculture – and we are forced to substitute non-renewable artificial fertilizers for the once renewable real thing.
> *(Rees and Wackernagel, 2000)*

- There is little reality in the idea that the 'surplus' workforce in developing countries, not needed to produce the food that will be imported from abroad, will find suitable occupations in other sectors. The social implications of even further marginalizing the poorest will be unacceptable from a humanitarian perspective and also unsustainable from a social/political perspective, contributing to an accelerated flow of rural-urban migration with all its attendant problems.
- The energy consumption implied by an even larger-scale global food trading system will not be sustainable. We need to lower global energy consumption – not to increase it. In particular it should not be increased in those countries that are already consuming the most energy resources.
- The large-scale distribution system is too vulnerable to disturbances from price fluctuation caused by energy crises, war, civil strife etc. In addition, distribution to the rural poor is costly, sometimes risky and often, in more remote areas, liable to breakdown.

Current patterns of global trade in agricultural products are the result of a distorted trading system. 'Surplus' production in some countries is, to a large extent, imaginary. For example the exports of surpluses from the European Union are balanced (and supported) by comparable imports of feedstuff *(Einarsson 2001)*.

Although there will always be a need and a role for international trade in agricultural products, it should be in value-added products or in high value commodities rather than in staple foods. The complex global trading regime currently reflects a complex web of trade barriers – which

often permits trade in unprocessed commodities but which restricts trade in processed, value added goods *(Byrne et al, forthcoming)*. It is also largely based on the widespread availability and relative cheapness of fossil fuels: a capital resource that is being used with little regard for long term sustainability.

The average EU cow receives state subsidies of circa $2 per day. Almost half the population of sub Saharan Africa, and about 32% of the population of South Asia, lives on less than half of this amount.

Increased productivity in developing countries

The third option for increased production involves increasing total farm productivity in those developing countries most in need of food. In some developing countries there are agriculture areas with high potential. In many of these areas export oriented production, using high levels of external inputs (agrochemicals, capital and, sometimes, mechanization) has been established. These production systems were often established during colonial times. They are often owned and managed by large companies and often do little to benefit the poor. In addition, the sustainability of these operations is often questionable. As will be shown below, conventional agriculture is not a feasible option for increased productivity in developing countries.

The central issues are, therefore, the extent to which farmers can improve food production with cheap, low-cost, locally available technologies and inputs, and whether they can do this without causing further environmental damage. There is a growing recognition that this strategy, often referred to as sustainable or Low External Input Sustainable Agriculture (LEISA) is the most feasible, especially if it targets the smallholder sector *(see for example Reijntjes et al., 1992, Pretty et al., 2002)*. Small farms are generally more productive (per area unit) than large farms *(Rosset, 1999)*. By increasing the productivity of small farms, not only will there be more food produced by those who need it most, but small holders and rural communities can also be lifted out of poverty. **Organic agriculture fits very well within this approach, as will be shown below.**

However it must be realized that farmers in the developing world cannot be considered as homogenous grouping, but have very different motivations, and aspirations and a different range of assets (both physical and human) to draw upon. These may vary according to geography (e.g. soil fertility or access to markets) as well as to social and economic factors. For some, producing for markets is a main objective – for others it is attaining food year-long security. Either way farmers need to be able to benefit from the food that they produce, by eating it, selling it or exchanging it. Strategies for enhancing food production need to be combined with other poverty alleviation measures to ensure sufficient demand for food in developing countries that, in turn, stimulates production. National and international policies, and terms of trade need to be changed in order to stimulate the development of local markets.

THE DOWNSIDES OF CONVENTIONAL AGRICULTURE

CONVENTIONAL AGRICULTURE HAS FAILED TO DELIVER FOOD SECURITY

In most cases where the Green Revolution was adopted, the introduction of synthetic chemical fertilisers and pesticides has boosted productivity per hectare and helped increase food production. It has played a major role in meeting the growing demands of a world population that has doubled in the past forty years. However, these increases in production have slowed down in recent years, and in some cases there are indications that production is going down. The main reasons for this are:

- Decreasing soil fertility
- Damage to bio-diversity and the environment
- Degradation or destruction of water resources
- The build up of pest populations and resistance

Moreover the success of industrial agriculture and the Green Revolution in recent decades has often masked significant externalities, affecting natural resources and human health, as well as agriculture itself. Environmental and health problems associated with agriculture have been increasingly well-documented, but it is only recently that the scale of the costs has come to be appreciated.

THE SYSTEM ERROR

The root cause of the problems in conventional farming is that the introduction of chemical fertilizers and pesticides has stimulated a production system that increasingly tries to be independent of natural regulating processes and local resources, and that is heavily dependent on nonrenewable resources. It has stimulated mono-cropping and regional specialization. As natural cycles are broken this leads to increases in the severity of pests and disease outbreaks and greater problems with nutrient management. To solve these problems even more pesticides and more chemical fertilizers have to be used and a vicious cycle is established.

LONG TERM EFFECTS ON FERTILITY OF SOILS AND SOIL EROSION

More difficult to assess than other factors, but perhaps most important, is the long-term effect of this process on the fertility of soils. As we are dealing with a wide variety of soils, climatic conditions and many different production systems, it is difficult to make general statements – but there are clear indications that fertility is dropping, and that farmers try to compensate by increasing fertilizer applications. This serves to aggravate the problem, as one of the reasons for the decline in fertility is the lack of proper management of the soil organic matter. When synthetic fertilizers replace more natural ways of nutrient management – such as crop

rotation, recycling of organic matter and the integration of animals and crop production – soil organic matter declines. This makes the soil more vulnerable to physical erosion by wind or water, diminishes the water retention capacity and reduces the potential for nutrient uptake. Inappropriate tillage and cultivation practices can exacerbate soil erosion problems.

"In India 30% of the arable land is irrigated and under intensive production with Green Revolution high input agriculture. However these lands are showing a decreasing trend in productivity. 70% of the arable land is dry land with low soil fertility where small and marginal farmers practice traditional agriculture. High external input has very little to offer in improving productivity of these marginal soils. Under the pressure of high costs of production, purchased inputs and increasing debts, many impoverished farmers have committed suicide in two southern states of India." (Mahale 2001)

Negative health effects and reduced food safety

The use of pesticides in agriculture is a major health hazard in developing countries, in particular for farmers, farm workers and their families. In 1990 the WHO estimated an annual figure of 20,000 deaths that are unintentionally caused by pesticides. More recent estimates published by the same organization suggest that this figure may be twice as high *(Moy, 2001 cited in IFAD, 2005, p. 43)*. In addition a further 200,000 deaths are caused by farmers using pesticides to commit suicide *(WHO 1990)* and a reported 3-4 million people annually suffer from severe or acute poisoning from agrochemicals *(Moy, 2001)*. These last figures are almost certainly underestimates, as they do not include many unreported cases, of people who do not receive treatment *(WHO, 1990)*.

Exposure to toxic agrochemicals and the associated risks are closely correlated to poverty *(World Bank, 2002)*. The causes of direct accidental poisoning include high levels of illiteracy among peasant farmers, lack of training, adequate equipment and protective clothing as well as inappropriate or untimely usage *(see for example, Ton, 2002)*. Farmer suicides most often occur as a result of crop failure and the prospect of indebtedness, loss of family land and possible imprisonment *(Shiva et al., 2000)*.

In addition, indirect exposure to these toxic chemicals can occur through contamination of food supplies and of watercourses. The long term effects of lower levels of a broad range of different pesticides within our food are not fully known, but it is a fair assumption that there may be considerable risks, particularly when these are ingested in combination - potentially creating a cocktail-effect. In addition, the use of chemical fertilizers often leads to a higher content of undesirable substances in food, such as increased nitrate content of foodstuffs, which is linked to the use of nitrogen fertilizers.

Decreased nutritional values and deterioration of diets

The increase in production incurred by increased used of fertilizers coupled with new varieties specially developed for a more intensive system has lead to a reduction of essential micronutrients of protein quality, of shelf life and other key aspects of food quality. A change in diet brought about by the comparative advantage of Green Revolution crops and varieties over traditional crops and varieties also contributes to a decline in dietary balance. In addition, the monocultures that result from these technologies are leading to a less varied diet on farms, or in areas, where much of the food consumed is locally produced, leading to malnutrition.

Loss of bio-diversity and environmental degradation

Intensive farming patterns affect bio-diversity in three distinct ways:

- In the crops or breeds themselves (genetic diversity)
- In the diversity of farm production
- In the surrounding areas

Farmers within traditional and low input systems favor diversity on the farm. They rely on a wide range of locally adapted varieties of crops and livestock and often plant crops and/or varieties to diversify their production and to spread risk. The introduction of mono-cropping, and modern varieties and breeds which are selected on the basis of being responsive to Green Revolution technologies means that only 10% of the crops that were developed in the past are still being farmed, with many local varieties having been lost *(Millstone and Lang, 2003)*.

The effects of the combination of pesticides and mono-cultures on on-farm bio-diversity are most evident in increasing susceptibility to pests and disease, necessitating ever greater doses of pesticides. The effects of pesticides and chemical fertilizers are also felt outside of farming areas. This takes place both directly through spray drift and leaching, but also as a result of fewer wildlife habitats and less food for wildlife in the farm environment. As the 2004 IUCN Red List of threatened species highlights, habitat loss is the main threat to bio-diversity, with agricultural activities playing the largest role affecting more than 50% of all threatened bird species *(IUCN, 2004)*.

One of the most obvious direct negative effects of conventional agriculture is the pollution of water with nitrates, phosphates and pesticides. 60 percent of all nitrogen fertilizers applied are not taken up by the plants but are lost, mainly to ground or surface water *(OECD, 2000)*. Nitrate levels in drinking water are rising and pesticides are now found in groundwater in most places in the world. Apart from the poisoning of aquatic organisms and disruption of aquatic ecosystems, this contamination incurs high costs that arise from the need for water purification, damage to crops and need for health care provision.

In 2000 Pretty et al. estimated that the external costs of agriculture in the UK to be between £1.1- 3.9 Billion per annum (Pretty et al., 2000). As only some of these external costs of farming are internalized in the price of food, tax payers - or more likely, future generations - will pay the bill that is getting bigger every day.

'New' solutions?

The bio-tech industry is now promoting genetic engineering with arguments that follow the same logic as those that drove the Green Revolution. As with all new technologies it is difficult to prove that they are harmless or harmful until after they have been used for a longer term. But in this case that may be too late! There are many reasons to resist the introduction of GMO crops, since there are no convincing benefits associated with the technology (except, of course, for the companies producing them) but there are a large number of risks and disadvantages that have already been identified. These include:

- Agricultural risks – erosion and pollution of the genetic base, creation of super weeds, development of resistance
- Environmental risks – affecting non-target organisms – cross over of genes
- Undermining alternative methods – e.g. the introduction of Bt crops is a threat to the moderate use of Bt by organic farmers, as the Bt crops are likely to induce resistance
- Health risks – allergy potential and undesirable compounds in food
- Dependency on seed companies – reducing the farmers' control of their own seeds
- High costs

In addition to the general concerns outlined above, genetic engineering is even less appropriate for developing countries. The development of GMO crops requires massive investment in research. Consequently it drains resources from much needed research in the development of low cost alternatives.

- Poor countries do not have the capacity to carry out the impact assessment, testing and monitoring that growing GMO crops will necessarily entail.
- Because of the high costs, GMO crops will be more expensive. Poor farmers cannot afford to buy new seeds every year. Their production system depends on saving their own seeds - with occasional exchange or renewal, - not on yearly purchase of expensive patented seeds.
- The 'solutions' offered by GMO crops are largely irrelevant to the barriers to increased productivity that poor farmers face.

'You cannot solve the problem with the same kind of thinking that created the problem.'
ALBERT EINSTEIN

ORGANIC AGRICULTURE AND FOOD SECURITY IN DEVELOPING COUNTRIES

There is growing recognition of the unintended but deleterious consequences of the capital and chemical input-intensive approaches to farming. In varying combinations such approaches impact negatively on the well being of farming communities, the environment and on the quality and safety of food. For some time arguments have been made to develop forms of agriculture that favor bio-diversity, recycling of nutrients, synergy among crops, animals, soils, and other biological components, the regeneration and conservation of natural resources. In addition such approaches should accord with the strategies, capacities and aspirations of small-scale farmers, who will otherwise not be interested in them. Such approaches, variously termed Sustainable or LEISA approaches have been widely advocated and the subject of much research *(see for example Reijntjes et al, 1992, Pretty et al. 2002)*.

Pretty et al. (2002) identified that some 9 million farmers are practicing sustainable approaches (although definitions of sustainable are sometimes quite loose). While sustainable agriculture has been widely adopted, this has, in general, been on a piecemeal and localized rather than a systemic basis. In general sustainable approaches to agriculture have not received the institutional support – particularly from policy makers- that its advocates argue it deserves *(Anon, 2005)*. While there may be a number of reasons for this, it is at least partly because there are very strong doubts about whether it can meet future, or even current, global food needs *(see, for example, Smil, 2000)*.

The same is true of organic agriculture. Resistance to the idea that organic farming might play a role in helping to feed the world stems from a number of reasons. Some of these stem from popular misconceptions about organic farming - others require more careful consideration. These include:

- The experiences of the north - where transition from intensive to organic farming almost invariably leads to a decline of yields- at least in the early years, when the soil is recovering its natural fertility and farmers are learning new management techniques.
- Partly, related to lower yields (but also higher transaction costs and less economies of scale) certified organic products are generally more expensive in the north. As such they are not seen as offering much of an option for poor people in the South.
- Confusion about the meaning of organic farming – as implying farming without chemicals – and the failure of many unimproved traditional systems (that don't use chemical inputs) to meet food security needs.
- Concern that natural soil fertility techniques and crop protection methods are not sufficient to ensure adequate food supplies either now or in the future.

Yet on closer examination organic farming offers solutions to a range of, often inter-connected, problems. In so doing it has the potential to address issues that dominate the policy agenda,

whether at a global or national level, and to meet the livelihood strategies of farming households. Indeed, one of the main features of organic agriculture is how well it integrates a number of important issues. Even if there are other solutions to each individual problem, these other solutions do not provide such an integral approach that simultaneously addresses the range of economic, social, political and environmental problems currently facing rural communities. Thus, organic agriculture should not be seen as an isolated technology but as a systemic approach that embodies the principles of human ecology and sustainable development.

According to the records of a former revenue inspector in Karnataka State (India) rice farmers using high yielding varieties and chemical fertilizers saw their crops reduced by more than 50% during the 2001-2 drought, whereas the region's organic farmers lost less than 20%. Similarly sugarcane losses were 58% and 1% respectively. These developments drew the attention of the other farmers who began to adopt organic methods and convert the following year *(IFAD 2005, p. 24)*.

The synergistic benefits of organic farming

Evaluating the benefits and the limitations of organic agriculture is complex. The impact of a conversion to organic practices will greatly depend on the starting point of the farmer and farming community, their skills and the resources available to them. However a number of key relevant potentials can be identified.

- Organic agriculture can increase productivity, especially in situations where farmers are vulnerable to food shortages.
- Organic agriculture can increase income and/or returns to labour. This can be achieved through higher yields, higher (premium) prices, lower costs (for inputs) or combinations of these three.
- The diversification of production inherent in organic agriculture reduces the risk of crop failure and attendant economic and food security problems. This accords strongly with the risk aversion strategies adopted by low income farming households.
- Organic agriculture produces safe food and a more varied and nutritious diet.
- Organic agriculture eliminates the very real risks associated with exposure to pesticides and other toxic chemicals.
- Organic agriculture has a major role to play in assisting with resource management, such as reducing water demand and run-off, soil erosion and in maintaining and enhancing biodiversity.
- Organic agriculture makes farmers and consumers more aware of the need for sustainable production and consumption, of the importance of clean and safe food and of the need to protect the environment.
- Organic agriculture brings clear benefits to women in agricultural communities, to other marginalized groups, as well as offering new employment opportunities for the landless poor.
- Organic agriculture recognizes the value of traditional and indigenous knowledge and integrates this in its production methods, thereby increasing social capacity and self-value.

- Organic agriculture is sustainable in the long term. It enhances environmental resilience against, for example, drought, flooding or other climatic catastrophes. There are also several examples where it has been used to bring degraded and abandoned land back into production *(see case study below about Zai in Burkina Faso and Niger)*.
- Organic agriculture has a clear role to play in helping meet a range of global environmental policy objectives, including those relating to combating desertification, to maintaining biodiversity and offsetting the consequences of global warming (through carbon sequestration).

Recent years have seen a growth in publications analyzing the potential and benefits associated with organic farming in the developing world *(see for example, Parrott and Marsden, 2002; Scialabba and Hattam, 2002, Naturland, 2005)*. In addition IFAD has recently carried two extensive and detailed evaluations on the effects of the adoption of organic agriculture in Latin America and in Asia *(IFAD, 2002 and 2005 – see box 2 below)* and researchers at the University of Michigan, Ann Arbor (USA) have been modeling the potential impact on global food supplies of expanding organic production *(Badgley et al. manuscript)*.

Organic agriculture and productivity

It is not possible to make simple statements about the productivity implications of a conversion to organic agriculture. In general this will depend upon the system previously employed by the farmer. Farm systems that intensively use agrochemicals can expect to see a decrease in yields, often estimated at between 5 and 20% - (though some authors give higher figures). These declines mostly occur in the initial years – as the soil recovers its natural fertility and farmers learn new management techniques. This is the most likely scenario associated with conversion in most developed countries, where intensive agriculture has been the norm, as well as in those parts of the developing world, where Green Revolution technologies have taken hold.

By contrast the transition from 'traditional' agriculture in rain-fed areas, to organic farming very frequently leads to increased yields. The analysis of Badgley et al (manuscript), whose work draws heavily on case studies evaluated by Pretty and Hine (2002), Altieri (1999) and Uphoff (2003), suggests that this is almost always the case. IFAD's reviews (2003, 2005) of transitions to organic production in Latin America and Asia also support this contention (see box 2).

Yet yield comparisons can be misleading, for technical as well as social reasons. In the first place intensive agriculture often focuses upon (one variety of) one crop, whereas organic systems tend to be more diverse – and should thus be evaluated on the basis of total farm productivity, rather than yields of single crops. Farmers may have a preference for multi-functional crops, for example, rice varieties that yield high quality straw (for livestock fodder) as well as grain.

Secondly resource poor farmers often adopt risk aversion strategies that, rather than seek to maximize yields in good years, prioritize insuring against complete crop failure in bad years (i.e. those of drought, disease or pest outbreaks). Thus in terms of food security for the poorest it may be important to think of yields in bad years, when the survival of farm families and

rural communities is most at stake. In addition yields in rain fed areas can vary substantially from year to year and thus long-term data, and/ or comparison between neighboring organic and non-organic systems are required. Finally yields only play a part in determining farmers' incomes. The expenses incurred in production and the prices that they receive for their produce are more important factors *(these issues explored below)*.

The increased productivity associated with conversion to organic production can arise from one or more of a number of different mechanisms. As stressed before, there is no one single pathway of transition to becoming organic. Farmers may choose one, or a combination of these strategies according to their situation, available assets and skills.

Box 1. Pathways of transition to Organic Production

The diversification that is generally linked to a conversion to organic agriculture can in itself lead to increased income (or reduced expenses). Typical examples are:

- Intensification of a single component of the farm system- such as home garden intensification with vegetables and trees.
- Addition of new productive elements to a farm system- such as fish or ducks in paddy, fruit or fodder trees planted in fields or products from N fixing crops- that boosts total food production, but does not affect the productivity of staples.
- Better use of natural capital to increase total farm production, by water harvesting or irrigation scheduling enabling growth of additional dryland crops, increased supply of water for irrigated crops or both.
- Improvements in per hectare yields of staples through the introduction of new regenerative elements into farm systems (e.g. integrated pest management) or locally appropriate crop varieties and animal breeds.

Adopted from Pretty, 2002

One major critique raised against organic farming by conventional agronomists is that in terms of nutrient management, it is not sustainable in the long term, as chemical fertilisers are needed to replace the nutrients that are taken away from the soil. In theory this argument may have some merit, but in practice, the long-term experience from organic farms contradicts this. Studies conducted in temperate climates have shown that there is no evidence that soils on farms that have been organically managed for decades are depleted of nutrients. On the contrary such studies normally show an increase in soil organic matter, available nutrients and fertility *(see for example Mäder et al, 2002)*.

However, there is no data available from equivalent long-term studies undertaken in tropical climates, although such work is underway *(Kilcher, pers. comm.)*. In the agronomic community there is a general consensus that organic farming may be an option in medium to high potential areas but of limited value in low potential and degraded areas *(see for example Pender & Mertz, 2006)*. By way of example, the Kenyan Institute for Organic farming initially focused on training farmers in more favored areas – but later switched its focus to include those in less favored areas and was surprised by its level of success *(Njorge, Director KIOF, pers. comm.)*. Equally organic techniques have been used to reclaim degraded agricultural land in a wide variety of settings, including the Sahel *(see box on Zaï in Burkina Faso and Niger, below)*, India *(IFAD, 2005)* and in Ethiopia *(Belay et al, 2003)*.

Different opportunities exist for recycling and (in cases of severe depletion) importing nutrients within the farm. These can include use of N fixing leguminous crops, manure, compost and mulching. Tree planting can also help recycle nutrients from deeper in the soil. Primary processing (e.g. de-hulling coffee beans) can be done on farm and reduce the flow of nutrients away from the farm. However, not all these options are open to all farmers: some resource poor farmers need to use animal manure as fuel. Those with small plots may find it difficult to give space over to legumes, unless they also provide a useful product that can more directly be utilized *(Bunch, 2003)*.

There remain misgivings amongst agronomists over the extent to which organic farming in tropical conditions can maintain or replenish levels of Phosphorous (P) *(Giller, 2003)* and Potassium (K). These concerns are exacerbated by the fact that lack of these minerals can affect the efficiency of N uptake. Finding ways of maintaining these balances may be one of the greatest challenges for the long-term productivity of organic farms, especially those in the tropics *(Johannsen, 2005)*.

Box 2. IFAD's Evaluations of the Potential of Organic Agriculture

IFAD (the International Fund for Agricultural Development) is a UN body, with the specific remit of helping the rural poor in developing countries overcome poverty. In recent years they have commissioned two evaluation reports of the effects of (mostly) smallholder farmers converting to organic production techniques. The first focused on Latin America *(IFAD, 2003)* and the second on Asia (mostly China and India – *IFAD 2005*).

Organic Farming in Latin America

The first review of organic farming systems in Latin America (2003), documented the experiences of 14 different farmers' groups in 6 countries. The survey covered more than 5,000 farmers managing 9,000 hectares. They found that nearly all the farmers involved in organic production (with the exception of one group) were small holders, suggesting that this group has a comparative advantage in organic production. Some farmers (those using low or no input techniques prior to becoming organic) experienced increases of up to 50 % in yields. Others maintained their yields at approximately the same level. Farmers who converted from relatively intensive use of agrochemicals experienced a drop in yields in the short-term. However all farmers experienced an increase in the prices that they received. This was partly because of the premia for organic produce, but also partly because the farmers built longer term, and more stable, relationships with buyers. Costs changed in different ways. Some experienced higher costs – because of the introduction of labour intensive technology, certification costs and in some cases bigger harvests. Farmers who had previously been applying chemical inputs experienced a decrease in costs. The study showed a beneficial impact on the health of producers, workers and the environment- an important factor for many in deciding to convert. It also highlighted a number of environmental benefits, in terms of erosion control, soil fertility and cover and biodiversity. Organic systems also drew on local knowledge, thereby improving social capacity and involved developing organizational capacity to deal with longer term trading arrangements as well as internal control systems.

Organic Farming in Asia (China and India Focus)

This study includes evaluations of the experiences with organic agriculture of nearly 18,000 farmers in China (in seven projects) and in excess of 10,000 farmers in India (six projects) as well as reviews of 100+ articles of

literature. The projects varied considerably in terms of their size, agro-ecological conditions, products, market orientation and forms and level of support. These factors all influence the effects and success of conversion.

The authors made more complex comparisons of traditional, organic and conventional systems under different agroecological systems and knowledge regimes – and found more divergence in the results. In the dryland areas of Karnataka (India), costs for organic systems were higher (or the same as) neighbouring conventional systems in year 0, while yields were lower (by around 25%). However by year 4 this has completely changed – the organic costs of production had fallen by between 10-50% to being lower (in all cases) than conventional production, while yields had increased by 10-50% and in all cases were outperforming conventional systems. In the mountainous regions of China more mixed results were obtained, with conventional systems giving higher yields than organic ones – but with this difference often being compensated for by higher prices for organic produce. In general they conclude that "the switch to organics from a traditional or rustic form of cultivation tends to have positive consequences in terms of yields or outputs. However when switching from intensive forms of agriculture, first year losses in yields were notable. By the third year yields had typically stabilized, but often somewhat below conventional yields. Both forms of farmers improved their overall incomes when switching to organics, but for some farmers this was only due to higher premiums paid for organics. The potential benefits of organics are not always immediate and require several years of commitment. Some of the related externalities, including resource conservation and soil fertility may be even more valuable in the long term and ought to be a primary focus of organic development strategies" *(Giovannucci, 2006)*.

Organic Agriculture as a means to increase farm and rural incomes

There are at least four mechanisms, through which organic farming can improve incomes, profitability and returns to labour.

- By removing or reducing the need for purchased inputs
- By diversifying and optimizing productivity (see Box 1 above)
- By maintaining or improving on-farm and off-farm bio-diversity
- By sales on a premium market

Reduction of inputs and costs of inputs

For small holders in developing countries the cost of inputs is a major expense that is often financed by high interest credit. This is a high-risk strategy and there may be social barriers to some groups (especially women) being able to do this at all. Organic agriculture, by contrast, is based on local resources and recycling of nutrients, through for example, N-fixing legumes, mulching or composting. These mostly use on farm resources (or nearby ones) greatly reducing the need for purchased inputs. These reduced costs may be partially offset by increased labour demand (e.g. for manual weeding or composting). This is particularly true in the early years of conversion, when labour may be needed to make initial improvements to the land or soil. However, it is very rare that the costs of increased labour are higher than the costs of inputs. Therefore organic farming is often more profitable, especially in countries with low opportunity costs for labour. When organic farming yields additional returns it can also generate new labour demand – benefiting the landless poor – often the most vulnerable rural group – and reducing the push factors that drive rural out migration to the cities.

Maintenance, or improvements, in on, and off, farm biodiversity

By protecting or improving on-farm bio-diversity and the surrounding natural areas, organic farmers are able to utilize and/or market 'wild' or non-cultivated crops, such as medicinal herbs, insects, mushrooms, fruits etc. Those products may also provide an income opportunity for the landless rural poor. In addition they can contribute to the diet. The elimination of toxic agrochemicals can enable the introduction of new productive components (e.g. fish or ducks in paddy) and these can increase the productivity and resilience of the system. In addition organic farmers prefer local seeds, varieties and breeds that are adapted to local conditions and thereby contribute to maintaining global genetic diversity as well as their own cultural patrimony. Bartering and exchanging these resources also contributes to improved economic well-being.

Sales on a premium market

In addition to its advantages as a means of producing food for consumption among farming communities, organic agriculture also has a substantial potential to offer increased income through the production of premium priced crops for a demand driven organic market. In many cases, farmers are not farming to their full potential, as there is simply no market for their products. This forces farmers into a vicious cycle, whereby farm activities are kept to the level required for self-consumption. Often there is reliance, to a greater or lesser extent on off farm work in order to earn the cash needed for things that cannot be produced on the farm; clothes, fuel etc. and for school fees etc. Increasing farm productivity and marketing crops can reduce reliance on sporadic, and often exploitative and geographically distant income earning opportunities *(IFAD, 2001)*.

Selling organic products for a premium price can be a very attractive proposition. There are a number of successful projects involving exports of organic production, where farmers' income has increased by 20-30% or more. Examples include the export of organic coffee, cotton, sesame etc. Naturally, export production should not compete with the production of food for local markets, but these two strategies are not always in conflict with each other. Many crops for export markets are grown in a rotation with food crops (cotton with corn, millet, beans etc.) or by a system of intercropping with food crops (coffee with bananas, other fruits etc). In this way such projects can both improve income and safeguard local consumption.

IFOAM is encouraging the development of local and regional markets, both in developed and developing countries. Domestic marketing of organic food in developing countries is currently expanding rapidly in countries such as Costa Rica, Brazil, the Philippines and Thailand. Attempts are being made to foster local, regional and national marketing channels that are appropriate to local circumstances. One of the key aspects of this process is setting up certification and inspection systems that can be managed and overseen using local personnel and resources. Participatory guarantee systems are an example of this. They are non-certified initiatives that use standards written by the producers themselves, often based on IFOAM's Basic Standards. In many cases there is also a verification component, although the precise method varies. These systems are localized and diverse, so while some general principles can be agreed upon, they are not standardized to the same extent as third party certification. *(see Ecology and Farming, 2004 a & b, Kotschi et al, 2003, IFOAM, 2005b)*.

Enhancing Social Capacity

Organic agriculture is a form of agriculture that is highly knowledge intensive and that integrates traditional and indigenous farming knowledge. Possibly the greatest impact of all is on the mindset of people. It connects to traditional and indigenous farming knowledge while introducing selected modern technologies to manage and enhance diversity, to incorporate biological principles and resources into farming systems, and to ecologically intensify agricultural production. Instead of being an obstacle to progress, traditions may become an integral part of progress. By adopting organic agriculture farmers are challenged to take on new knowledge and perspectives and to innovate. This leads to an increased engagement in farming, which can trigger further improvements. Through the emphasis on local resources and self-reliance, conversion to organic agriculture contributes to the empowerment of farmers and local communities.

Limitations

The introduction of organic agriculture alone cannot solve all production problems. For example, in most cases organic agriculture offers the most practical way to restore agricultural lands that have been degraded by conventional practices; however, where soils and the surrounding natural area are severely degraded, the implementation of organic agriculture alone will not be a guarantee of increased productivity. In these cases there is a need to combine the introduction of organic agriculture with landscape reconstruction and targeted bio-diversity remediation.

Organic agriculture - sustainability put into practice

As has been shown above, organic agriculture is clearly a more sustainable production method than conventional farming. Currently there are three different approaches to the development of organic agriculture in developing countries:

- A development approach for resource poor communities, mainly oriented to self sufficiency and community development.
- An income generation approach, giving farmers access to a premium market.
- A nature conservation approach where organic agriculture is seen as a tool for biodiversity protection, nature conservation and natural resource management.

Simply put, these three approaches emphasize the three aspects of sustainability:

- Social sustainability
- Economic sustainability
- Ecological sustainability

However, organic agriculture is not only about self-sufficiency or only about nature conservation or only about premium markets. Even though the entry point may be different, there is no fundamental contradiction between these different approaches. IFOAM's opinion is that they can, and should be, joined-up in practice. By properly integrating all these aspects of sustainability, the multi-functional benefits of organic agriculture can be fully realized.

CASE STUDIES
THE POTENTIAL OF ORGANIC AGRICULTURE TO INCREASE PRODUCTIVITY, INCREASE INCOME OR FOOD SECURITY IN DEVELOPING COUNTRIES

Below are some examples of successful organic approaches. In some of the case studies production may not be fully to organic standards, even though they take an organic approach. In the case of production for local markets or for self-consumption, organic agriculture is not defined through standards, but rather by the system approach:

MADAGASCAR
System of Rice Intensification (SRI)

The System of Rice Intensification (SRI) has been promoted since 1990 by the Tefy Saina Association, and has been evaluated by the Cornell International Institute for Food, Agriculture and Development. The system improved local rice yields from some 2 t/ha to 5, 10 or even up to 15 t/ha on farmers' fields. This has been achieved without recourse to purchased inputs of pesticides or fertilisers. It is estimated that some 20,000 farmers have now adopted the full SRI in Madagascar. Cornell has helped research institutions in China, Indonesia, Philippines, Cambodia, Nepal, Ivory Coast, Sri Lanka, Cuba, Sierra Leone and Bangladesh to test SRI. In all cases, rice yields increased significantly. In China, for example, yields of 9-10.5 t/ha were achieved in the first year (compared with a national average of 6t/ha). In India the Ministry of Agriculture has advised farmers to adopt this method wherever possible and in Nepal an SRI project was recipient of a National Development Marketplace award in 2005. *(Details about the methods, effects and spread of SRI can be found on the Cornell University website: http://ciifad.cornell.edu/sri/index.html)*

PERU
Revitalizing indigenous knowledge

NGOs in Peru have studied pre-Columbian technologies in search of solutions to contemporary problems of high-altitude farming. A fascinating example is the revival of an ingenious system of raised fields surrounded by ditches filled with water that evolved in the Peruvian Andes about 3,000 years ago. These waru-warus were able to produce bumper crops despite floods, droughts, and the killing frosts common at altitudes of nearly 4,000 meters. The combination of raised beds and canals moderates soil temperature, thereby extending the growing season and leading to higher productivity on the waru-warus than on chemically fertilized normal pampa soils. In the district of Huatta, the waru-warus have produced annual potato yields of 8-14 metric tons per hectare, contrasting with the average regional potato yields of 1– 4 metric tons per hectare. *(Altieri, 1999)*

HONDURAS
intercropping of green manure and environmental resilience

The systems of intercropped green manure in Honduras have proven themselves capable of fitting into numerous traditional maize and sorghum based farming system. In most cases they

have controlled most or all weed pests naturally, used no land that had an opportunity cost, and the only extra expenses occurred have been a one-time purchase of a handful of seed, increased soil fertility significantly and increased organic matter content.

Subsequent comparative research in Honduras found agro-ecological farms, with better ground cover, were far more resilient to, and able to recover from, Hurricane Mitch than conventional farms. This study looked at 442 paired sites of agro-ecological and conventional farms and assessed four key features: topsoil; depth of humidity within the soil; vegetation cover and erosion. It found that agroecological farms had 40% more topsoil than the conventional ones, had more than 20% vegetative cover, had a 49% lower incidence of landslides and lost 18% less arable land to landslides. *(Bunch, 1990 and Holt-Giménez, 2002)*

Senegal

Improving the quality of soils

In Sahelian countries, the major constraints to food production are related to soils, most of which are sandy and low in organic matter. Where they are heavier and better in quality, they are subject to intensive use and so are exposed to erosion by water and wind. Since 1987, the Rodale Institute Regenerative Agriculture Research Center has worked closely with farmers' associations and government researchers to improve the quality of soils in Senegal by using agroecological methods. The RARC works with about 2000 farmers in 59 groups to improve the soil quality, integrate stall-fed livestock into crop systems, add legumes and green manures, improve the use of manures and rock phosphate, incorporate water harvesting systems, and develop effective composting systems. The result has been a 75-195% improvement in millet yields – from 330 to 600-1000 kg/ha, and in groundnut yields from 340 to 600-900 kg/ha. Yields are also less variable year on year, with consequent improvements in household food security. As Amadou Diop has put it: „Crop yields are ultimately uncoupled from annual rainfall amounts. Droughts, while having a negative effect on yields, do not result in total crop failure". *(Diop, 2000)*

Organic Production and Food Security in Cuba

Much has been written about Cuba's experiment with organic farming in the 1990s. At one time the country was highly dependant on growing a few export commodities (sugar, tobacco etc.) for the Soviet Bloc of countries, mostly in monocultural plantations. In return, Cuba received agricultural inputs (agrochemicals, petrol and machinery) and many essential foodstuffs through a very favourable trading relationship. Prior to 1990, Cuba was importing 100% of its wheat, 90% of beans, 57% of all calories consumed, 94% of fertilizer, 82% of pesticides and 97% of animal feed. The economy was highly dependant on distant markets for its survival.

The collapse of the Eastern Bloc cut off Cuba's markets and supply lines, and this coupled with trade sanctions imposed by the US, forced the country to make a radical experiment in near self-sufficiency, with very few agro-chemical inputs or petrol to ease the transition. The government's response was to develop an „Alternative Model"– an agriculture focused on resource-conserving technologies that substitute local knowledge, skills and resources for the imported inputs.

One of the most celebrated aspects of this model was the emergence of urban organic horticulture. This took several different forms: self-provisioning gardens in schools and workplaces (autoconsumos), raised container-bed gardens (organoponicos),and intensive community gardens (huertos intensivos). These made a significant contribution to the country's food production. In 1994, they were estimated to be producing some 4200 tonnes of fresh food per year. An estimated 26,000 people were involved in working on the organoponicos.

Many other changes also occurred: restructuring of large collective farms and marketing structures to foster a sense of ownership and receptiveness to market prices; restructuring of production systems away from single crop specialisation; developing a local biological fertilizer and pest control industry (which had been started before the crisis); use of animal traction in place of machinery, as there were insufficient petrol resources. Other changes were slower to occur but awareness was raised on the need to restructure agricultural extension and support, and to use locally appropriate varieties, cropping techniques and water management strategies. With a combination of such strategies, domestic food production, which had reduced by more than a third in the early 1990s, made a turn-around and doubled between 1994 and 1999.
(Rossett and Benjamin, 1994, Institute for Food and Development Policy, 2000, Scialabba & Hattam, 2000 and Wright, 2005)

The Sahel

Zaï in Burkina Faso, and Niger

Zaï (or tassa) is a traditional agricultural method used in Burkina Faso to restore arid and crusted areas of fields. The technique involves making seed holes 20-30 cm wide and deep and using the earth to make a raised 'demi-lune' barrier on the down-slope side. Compost and/or natural phosphate is placed in each hole and sorghum or millet seeds planted when it rains. This technique improves the organic structure of the soil, helps retain moisture and, through promoting termite activity, increases water filtration into the soil. The crops are planted relatively densely to increase ground cover and prevent water loss through evapotranspiration. Stones removed from the field while digging the holes are often used to make contour bunds to further stabilize the soil and reduce run-off and erosion.

Estimates of the success of this technique vary, but all suggest very favorable results. Ouedraogo (1989) estimates yield increases of 30-35% and emphasizes the resilience of this system especially in dry years. Other reports suggest that Zaï, combined with contour bunding, can lead to yield increases from an average of 150-300 kg/ha to 440 kg/ha in a dry year and 700-1000 kg in a wet one. Reij et al (1996) estimate that the families using these techniques move from an average cereal deficit of 644 kg p.a. (equivalent to more than a 6 month shortfall) to a 153 kg surplus.

In Burkina Faso some 100,000 hectares of degraded land have been restored through this technique. Use of the technique has largely spread via word of mouth, even to neighboring countries such as Niger. Reports there again suggest great success in shifting food deficits into food surpluses, restore abandoned land and helping slow the process of rural/urban migration.
(Parrott and Marsden, 2002, Hassane, et al 2002)

India

The Maikaal organic cotton project

In the Maikaal organic cotton project in Madhya Pradesh, India more than 1000 households are participating in an organic cotton project that started 1992. Average yields for cotton are 20% higher on the organic farms than in the conventional farms in the area. The yields of wheat, soy and chili grown in the rotation with cotton are equal to, or up to 20% higher than, on conventional farms; Yields in sugar cane are up 30%; The production costs in the organic system are only 30-40% of the costs for conventional production, even labour costs have been reduced; The crops need one or two rounds of irrigation, less than in conventional farms; Soils have become softer and crumbly and pests do not pose any major problems. *(Caldas, 2000. IFOAM, 2006)*

Mexico

ISMAM fair-trade coffee

ISMAM was formed by smallholder coffee growers to meet problems of low productivity, poor marketing conditions and extreme poverty of farm families. By adopting organic techniques and improving quality, the co-operative was able to overcome soil degradation and low yields and move into a privileged specialty market that rewarded their extra efforts towards an ecologically sound production. Through sound, participatory management of the organization and hard work, ISMAM was able to capitalize their enterprise, overcome initial government disinterest and repression to become a major agro-industry with their own processing facilities and direct export markets in the US, Europe and Japan. They have begun to produce blends and soluble coffee for the national market and to diversify their agro-production for greater food security. Besides expanding their business, part of ISMAM's profits are returned to regional committees of the co-operative for investment in social works. In 1995 ISMAM received the National Agro-Export prize from the hands of Mexico's President. They now enjoy a privileged position with respect to credit and government support and have diversified their business into a number of areas including eco-tourism. *(Nigh 2000, in Pretty and Hine 2001)*

India

Organic Farming as a Central Plank of Rural Development

The Morarka Foundation has embarked on an ambitious programme of rural development in the semi desert conditions of Rajasthan, the central focus of which is converting hundreds of small conventional farm to certified organic production. The Foundation realised from the outset the potential of organic farming to address the problems of aridity and erratic rainfall and those arising from the use and sometimes abuse of agrochemicals. Since 1995 the Foundation has provided hundred of training days, identified markets and mobilized farmers to organize themselves. Over 1000 farmers have now become certified organic. The Foundation has worked together with State government to involve scientists in researching organic methods for improving soil quality.

They have been developing vermicomposting techniques (using worms in compost). These have been widely developed not only within the region but elsewhere within India and today Morarka is the single largest producer of vermicompost in the world – an industry that helps

create much needed jobs and related business opportunities in the region. Other programs have targeted women and those suffering from HIV/AIDS – promote agri-tourism and promote and sustain the regions rich cultural heritage. The Foundations' director Mr. Mukesh Gupta now assists the Indian Department of Agriculture in its efforts to promote organic agriculture in every state. *(Brozena, 2004)*

DEVELOPMENT OF STRATEGIES FOR PESTS

Organic techniques adopted in conventional production – Cotton in Egypt

Cotton is one of the worlds most pesticide hungry crops. Some 18% of world pesticide production is used on cotton, although the crop accounts for less than 1% of the world's cultivated areas. In Egypt pesticide use increased dramatically from the 1970s onward while yields remained stable. The SEKEM project was already successfully producing a range of crops using biodynamic methods and in 1990 was approached to provide help with applying the same approach to mainstream cotton.

They have worked together closely with scientists, researchers and farmers to come up with a number of organic approaches to controlling cotton pests. Their methods, which they have been developing and experimenting with for more than ten years combine the use of on pheromones, natural substances and intercropping with onion. These have proved extremely effective against three major pests, the leaf worm and pink and spiny bollworms. They are now employed on more than 80% of Egypt's cotton crop and as a result pesticide use has fallen by more than 85%, while yields have increased. *(Scialabba & Hattam, 2002, p.120)*

Kenya: Vutu-sukumu (Push-pull) pest management in smallholder systems

The work of ICIPE is explicitly focused on designing low-cost integrated pest management technology. It works closely with farmers to test and adapt technologies. One activity is investigating novel habitat management approaches to suppress cereal stem borer and Striga populations in maize and sorghum. This project is developing novel 'push-pull' strategies to repel stem borers from the cereal crop and attract them to intercrop or barrier forage grasses. It has found extra-ordinary multi-functionality in a range of fodder grasses and legumes in cereal systems. The strategy involves trapping pests on highly susceptible trap plants (pull) and driving them away from the crop using a repellent intercrop (push). *(Khan et al, 2000)*

China: control of rice blast

In Yunnan, China farmers had serious problems with rice blast in the production of their traditional rice. Farmers almost doubled their rice yields when they interplanted their traditional rice with a blast resistant variety in blocks instead of growing just one variety. The yield increased because rice blast was unable to spread through the barriers of a resistant variety. *(Zhu et al, 2000)*

POLICY MEASURES TO PROMOTE ORGANIC AGRICULTURE AND FOOD SECURITY

With the increasing evidence and awareness of the advantages of organic farming, a number of measures can be adopted to encourage its take up on a wider scale. Major changes must be made in policies, institutions, research and development to make sure that organic agriculture is adopted, made broadly accessible, and multiplied so that its full benefit for sustainable food security can be realised. In addition, participatory, farmer-friendly methods of technology development must be incorporated. The challenges involve increasing investment and research in organic agriculture and scaling up projects that have already proven successful, thereby generating a meaningful impact on the incomes, food security, and environmental well-being of the world's population, especially the millions of poor farmers that in any case will not be able to access the industrial agricultural technology.

REQUIRED POLICY MEASURES

Again, it must be emphasized that as the main reasons for food insecurity are to be found in the social and economic areas, most of the solutions will also be found there. Even if all the policy measures below were implemented these would not guarantee food security for all in societies where inequalities and discrimination are rife, or where international trade rules and /or national policy work directly or indirectly against efforts to develop the local food sector.

The following measures are those that relate to food and agricultural policy. Their enactment at national or international level would do much to create a level playing field in which the benefits of organic farming could be more widely realized.

General

- Identify, recognize and enumerate the benefits of existing organic production systems
- Define a clear policy for sustainable agricultural development and the role of organic farming within it
- Provide support to farmers converting to organic agriculture, or for the introduction of certain technologies

Economic measures

- Reform national economic indicators for the agricultural sector to reflect depletion and degradation of natural resources
- Implement the 'Polluter Pays' principle: Internalize "external" costs for environmental and health damage in the price of products
- Eliminate subsidies that encourage natural resource degradation or depletion
- Eliminate agricultural support programs that create commodity surpluses and lower global commodity prices
- Abolish distorting incentives, such as governmental pesticide or synthetic fertiliser promotion programs and/or subsidies, or special incentives for exports

Food and markets

- Prioritize safe food crops and investment in the food sector
- Develop local and regional food markets
- Promote sustainable consumption patterns and local food
- Promote local value adding capacity

Research, extension service, farming education and information exchange

- Prioritize research into organic agriculture, livestock and food crops
- Provide closer links between farmers, researchers and extension services
- Reform extension service and agriculture education and re-train staff both in knowledge and methodology
- Support farm based research, Farmer-to-Farmer exchange and other participatory methods

Empowering people

- Include a clear commitment to government-NGO partnerships and to the democratic process and a clear commitment to and inclusion of women, small farmers, indigenous people and other frequently disadvantaged groups
- Support producers' organisations, women's and community organisations to play a leading role in development

Access to resources

- Secure farmers' land tenure
- Make credits accessible for organic projects and production
- Reject privatization of genetic resources and keep seeds in the public domain
- Protect Farmers' Rights to save, develop and exchange seeds

References

ALTIERI, M. (1999) Applying agroecology to enhance the productivity of peasant farming systems in Latin America. Environment, Development and Sustainability 1 pp.197-217

ANON. (2005) Editorial: Practice and Policy. LEISA 21(4) December 2005.

BADGELY, C., J. MOGHTADER, E. QUINTERO, E. ZAKEM, M. JAHI CHAPPELL, K. AVILES-VAZQUEZ, A. SAMULON & I. PERFECTO (manuscript) Organic agriculture and the global food supply. Submitted to Renewable Resources and Food Systems.

BELAY, M., S. EDWARDS & B.G.E TEWOLDE (2003) Healing the earth: an Ethiopian story. LEISA 19 (4) p.12-13

BROZENA, C. (2004) The 'big picture ' in Northern India. Ecology and farming 36 pp. 1-12

BUNCH, R. (2003) Adoption of green manures and cover crops. LEISA 19 (4) p.16-19

BUNCH R. (1990) The Potential of intercropped green manures in Third World villager agriculture, Paper presented to IFOAM conference on the socio-economics of organic production. Budapest 1990

BYRNE, J., L. GLOVER & H. F. ALRØE (forthcoming, 2006) Globalisation and sustainable development: a political ecology strategy to realize ecological justice. In N. Halberg et al (2006, forthcoming)

CALDAS, T. (2000) A glimpse into the largest organic project in Asia. Ecology and Farming March pp.18-20.

DIOP, A. (2000) Sustinable Agriculture: new paradigms and old practices? Increasing production with management of organic inputs in Senegal. Environment, Development and Sustianability 1 (3-4) pp.285-296.

DJIGMA, A, E. NIKIEMA, D. LAIRON AND P. OTT (Eds.) (1989) Agricultural Alternatives and Nutritional Self-sufficiency. Proceedings of 7th IFOAM Conference, Ouagadougou, Burkina Faso.

ECOLOGY AND FARMING (2004a) Formal Organic Certification – not the only answer. Ecology and Farming 36 p.39-40.

ECOLOGY AND FARMING (2004a) Development of Local Organic Markets. Ecology and Farming 37 pp31-2

EINARSSON, P. (2001), Agricultural trade policy as if food security and sustainability mattered. Church of Sweden Aid, Forum Syd and the Swedish Society for Nature Conservation.

FAO (1998), Women Feed the World. FAO, Rome

FAO (2000), Food For All. FAO, Rome

FAO (2003) Subsidies, food imports and tariffs key issues for developing countries. FFAO newsroom focus http://www.fao.org/english/newsroom/focus/2003/wto2.htm. Viewed 9/02/06

GILLER, K. (2003) Kick starting legumes. LEISA 19(4) p19

GIOVANNUCCI, D. (2006). Answering important questions about Organics in Asia. In Ecology and Farming 39

HALBERG, N., H.F. ALRØE, M.T. KNUDSEN AND E.S. KRISTENSEN (Eds) (2006, forthcoming) Global Development of Organic Agriculture: Challenges and Promises. CAB International, Wallingford, Oxon.

HASSANE, A., P. MARTIN & C. REIJ (2002). Water harvesting, land Rehabilitation ad Household Food Security in Niger. IFAD/ Vrije Universteit Amsterdam.

HOLT-GIMÉNEZ (2002). Measuring Farms' Agroecological Resistance to Hurricane Mitch. In LEISA 17 pp.18-20.

IFAD (2001) Rural Poverty Report 2001. IFAD, Bonn.

IFAD (2003) The Adoption of Organic Agriculture Among Small Farmers in Latin America and the Caribbean: Thematic Evaluation. Report 1337. Office of Evaluation, IFAD, Rome.

IFAD (2005), Organic Agriculture and Poverty Reduction in Asia: China and India Focus: Thematic Evaluation. Report 1664, Office of Evaluation, IFAD, Rome.

IFOAM (2005a), The IFOAM Basic Standards for Organic Production and Processing. IFOAM, Bonn.

IFOAM (2005b), The I-GO Program. http://www.ifoam.org/partners/projects/i-go/i-go_goal4.html Viewed 6/02/06

IFOAM (2006) Training Manual for Organic Agriculture in the Arid and Semi-Arid Tropics.

INSTITUTE FOR FOOD AND DEVELOPMENT POLICY / FOOD FIRST (2000) Cultivating Havana: Urban Agriculture and Food Security in Years of Crisis. Oakland, CA. Institute for Food and Development Policy / Food First.

ITC (2001) World Markets for organic fruit and vegetables. ITC, Geneva.

IUCN (2004) A Global Species Assessment. IUCN 2004 Red List of Threatened Species. http://www.iucn.org/themes/ssc/red_list_2004/GSA_book/Red_List_2004_book.pdf. Viewed 25.01.06

JOHANSSEN, J. (2005) Organic farming: A contribution to sustainable poverty alleviation in developing countries? German NGO forum on Environment and Development. Bonn http://www.naturland.de/englisch/n1/downloads/2005_11_28_oekoplan.pdf
Viewed on 20/01/06

JORDBRUKSVERKET 2000, Annual Report 2000:19 Jordbruksverket (Swedish Board of Agriculture), Jönköping.

KHAN, Z.R., J.A. PICKETT, J. VAN DER BERG & C.M. WOODCOCK (2000) Exploiting chemical ecology and species diversity: stem borer and striga control for maize in Africa. Pest Management Science 56 91) 1-6

KNUDSEN M.T. N. HALBERG, J. E. OLESEN, J. BYRNE, V. IYER & N. TOLY (2006) forthcoming Global Trends in Agriculture and Food Systems. In In N. Halberg et al (2006, forthcoming)

KOTSCHI, J., W. BAYER, T. BECKER & B. SCHRIMPF (eds.) (2003) AlterOrganic: Local Agendas for Organic Agriculture in Rural Development. (Proceedings of an International Workshop at Bonn-Koningswinter, October 2002). Agrecol, Marburg.

LAMPKIN, N., C. FOSTER, S. PADEL AND P. MIDMORE (1999) The Policy and Regulatory Environment for Organic farming in Europe. In Dabbert et al (Eds.) Organic Farming in Europe: Economics and Policy Vol 2. Stuttgart-Hohenheim University.

MÄDER P., FLIESSBACH A., DUBOIS D., GUNST L., FRIED P., NIGGLI U. (2002) Soil Fertility and Biodiversity in Organic Farming. Science 296, 1694-1697

MAHALE, PRABHA (2001) Organic Agriculture - an Alternative Means to Alleviate Hunger. Nature 2000, vol. 406

MILLSTONE, E. AND T. LANG (2003) An Atlas of Food: Who eats what, where and why. Earthscan, London.

OECD (2001), Environmental Indicators for Agriculture. OECD, Paris

OUEDRAOGO, A. (1989b) Zaï; Traditional Technique as a source of Sahelian soil productivity increase. In Djigma et al. pp.97-101.

PARROTT, N. AND T. MARSDEN (2001) The Real Green Revolution: Organic and Agroecological farming in the South. London, Greenpeace Environmental Trust.

PARROTT, N., J. E. OLESEN & H. HØGH-JENSEN (2006, forthcoming). Certified and non-certified organic farming in the developing world. In Halberg et al (eds.)

PENDER, J. & O. MERTZ (2006, forthcoming) Soil Fertility Depletion in Sub-Saharan Africa: What is the Role of Organic Agriculture? In N. Halberg et al (eds.) (2006, forthcoming)

PIMENTEL, D. L. WESTRA & R.F. NOSS (Eds) (2000), Ecological Integrity: Integrating Environment, Conservation and Health. Washington DC: Island Press, 2000, pp. 428,

PRETTY, J. (2002) Lessons from Certified and non Certified Organic projects in Developing Countries. In Scialabba, N & C. Hattam (Eds)

PRETTY, J.N., MORRISON, J.I.L. & HINE, R.E (2002). Reducing Food Poverty by Increasing Agricultural Sustainability in Developing Countries. Agriculture, Ecosystems and the Environment 95 pp. 217-234.

PRETTY J.N AND R. HINE (2001) Reducing food poverty with sustainable agriculture; A summary of new evidence. Centre for Environment and Society, Essex University. http://www2.essex.ac.uk/ces/ResearchProgrammes/SAFEWexecsummfinalreport.htm Viewed on 19/1/06

PRETTY, J. C. BRETT, D. GEE, R.E. HINE, C.F. MASON, J.I.L. MORISON, H. RAVEN, M.D. RAYMENT & G. VAN DER BIJL (2000) An Assessment of the Total External Costs of UK Agriculture. Agricultural Systems 65 113-136

REES, W. AND M. WACKERNAGEL (2000), Urban ecological footprints. In Pimentel et al 2000

REIJ, C., I. SCOONES AND C. TOULMIN (Eds.) (1996) Sustaining the Soil: Indigenous Soil and Water Conservation in Africa London, Earthscan.

REIJNTJES, C., B. HAVERKORT & A. WATERS-BAYER (1992) Farming for the Future: An introduction to Low External-Input and Sustainable Agriculture. MacMillan / ILEIA London / Leusden.

ROSSET, P. 1999, The multiple functions and benefits of Small Farm Agriculture. Food First Policy Brief no. 4. Institute for Food and Development Policy, Oakland (CA.)

ROSSETT, P.M. & M. BENJAMIN (1996) The Greening of the Revolution Cuba's Experiences with Organic Agriculture. San Francisco Ocean Press.

SAHOTA, A. (2006) Overview of the Global Market for Organic Food and Drink. In Willer & Yussefi (2006).

SCIALABBA, N. AND C. HATTAM (eds.) (2002) Organic Agriculture, Environment and Food Security. Roma, FAO.

SEN, A. (1982), Poverty and Famines: An Essay on Entitlement and Deprivation, Clarendon Press, Oxford.

SHIVA, V., A. H. JAFRI, A. EMANI & M. PANDE (2000) Seeds of Suicide: The ecological and human costs of globalisation of agriculture. Research Foundation for Science, Technology and Ecology, New Delhi.

SMIL, V. (2000) Feeding the world- A challenge for the 21st century. MIT Press, Cambridge (MA).

STANHILL, G. (1990) The Comparative Productivity of Organic Agriculture. In Agriculture, Systems and the Environment 30 pp.1-26

TON, P. (2002) Organic Cotton Production in Sub Saharan Africa. Pesticide Action Network (UK), London.

UPHOFF, N. (2003) Higher yields with fewer external inputs? The system of rice intensification and potential contributions to agricultural sustainability. International Journal of Agricultural Sustainability.1 pp.38-50

VON BRAUN, J. (2005) The World Food Situation- An Overview. Presentation to the CGIAR Annual Meeting, Marrakech (Morocco) December 6th 2005. http://www.ifpri.org/pubs/agm05/jvbagm2005.asp#dl. Viewed 7th January 2006

WALAGA, C. AND M. HAUSER, 2005, Achieving household food security through organic agriculture: Lessons from Uganda. Journal für Entwicklungspolitik XX1(3) pp.65-84

WHO (1990) Public Health Impact of Pesticides Used in Agriculture. World Health Organisation, Geneva.

WHO (2006) Agriculture, health and the environment; directory of resources. http://www.who.int/heli/risks/toxics/chemicals/en/ Viewed 10.01.06.

WILLER, H. AND M. YUSEFFI (eds) (2006), The World of Organic Agriculture: Statistics and Emerging Trends. IFOAM, Bonn.

WORLD BANK (2002) Toxics and Poverty: The impact of toxic substances on the poor in developing countries. World Bank, Washington. http://lnweb18.worldbank.org/essd/envext.nsf/50ByDocName/ToxicsandPovertyTheImpactofToxicSubstancesOnthePoorinDevelopingCountries/$FILE/TOXICStext917w.pdf. Viewed 10.01.06

WORLDWATCH INSTITUTE 2000, State of the World 2000. Norton Publishing, New York / London

WRIGHT. J. (2005) Falto Petreleo! Perspectives on the Emergence of a More Ecological Farming and Food System in Post Crisis Cuba. PhD Thesis, University of Wageningen.

ZHU, Y. ET AL (2000) Genetic Diversity and Disease Control in Rice. Nature 406 (7)