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# Annex 4

# Case study
# Organic Farming

## Final Report
## Agricultural Technologies for Developing Countries

STOA Project "Agricultural Technologies for Developing Countries"

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European Technology Assessment Group
- Institute for Technology Assessment and Systems Analysis (ITAS), Karlsruhe
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- Flemish Institute for Science and Technology Assessment (viWTA), Brussels
- Parliamentary Office of Science and Technology (POST), London
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# Gutachten

im Auftrag des Instituts für Technikfolgenabschätzung
und Systemanalyse (ITAS) Forschungszentrum Karlsruhe

## STOA Project

## "Agricultural Technologies for Developing Countries"

## Case Studies Production System "Organic Farming"

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# Table of Contents

## Table of Figures

## Table of Tables

# 1. Characteristics of the Production System

## 1.1. Definition

The fundamental distinction of Organic Farming from conventional agriculture consists in its focus on input optimization rather than output maximization. It aims at more efficient nutrient use and re-use by optimizing the scope of nutrient recycling. Fertilizers are primarily used for the regeneration and maintenance of soil fertility. Findings and knowledge from the field of ecosystem analysis are therefore considered and applied to the concept of Organic Farming. This also implies the recognition of agricultural enterprises as entities with a certain level of closure (comparable to organisms). For bio-dynamic agriculture this perception is even extended towards individuality. Exemplary, the control of nutrient and energy flows within the respective cycles highlights the concept of this approach. Likewise, enterprises operate on a high level of economic autonomy, which is particularly relevant in terms of food security.

Numerous definitions of Organic Farming have been developed, varying in different aspects. However, they are all related through a fundamental consensus. The umbrella organization of the worldwide organic movement, IFOAM (International Federation of Organic Agriculture Movements), has therefore taken the task to facilitate the international harmonization of standards for organic production.

The World Board has brought a new common definition for ratification to the General Assembly of IFOAM during its last session period in June 2008 in Vignola, Italy. The definition of Organic Farming given by IFOAM is:

***"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to the benefit of the shared environment and promotes fair relationships and a good quality of life for all involved."***

http://www.ifoam.org/organic_facts/doa/index.html 4.11.08

## 1.2. Principles and Key Elements

There are several compelling principles that characterize certified Organic Farming. They include

- *Biodiversity,*
- *Diversification and Integration of Enterprises,*
- *Sustainability,*
- *Natural plant nutrition,*
- *Natural pest management*, and
- *Integrity.*

Most organic operations will reflect all of these to a greater or lesser degree. Since **each farm is a distinct entity**, there is a large degree of variation.

"The Principles of Organic Agriculture 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. The guidelines include four principles:

- 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.*

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*

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.

The principle of fairness insists that animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behaviour 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.*

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."

http://www.ifoam.org/about_ifoam/principles/index.html

**Key elements of Organic Farming systems are:**

- protecting the long term fertility of soils by maintaining organic matter levels, encouraging biological soil activity, and careful mechanical intervention;
- providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms;
- nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures.

### 1.3. Key Technologies

Key technologies in Organic Farming management are:

- Management of crop rotation and mixed cropping
- Using of legumes for N-fixation
- Conservation tillage, which respects the soil organism
- Composting and using of manure in nutrient management
- Biological plant protection.

The tools and practices of Organic Agriculture include traditional alternatives - crop rotation, manuring, liming, etc. - long recognized as important to a sound production system. They also include more contemporary practices and materials that research and keen observation over time have contributed.

Each farm operation will employ its own combination of tools and practices to build a working organic system.

However, Organic Farming does not include the application of shifting cultivation. Organic Farming only works well when the soil is permanently cultivated and covered with plant biomass, and, when nitrogen is supplied to the system via leguminous nitrogen fixation. The goal of this approach is not only the production of food and raw material for the daily use, but also to maintain the production basis intact.

**ORGANIC CROP PRODUCTION**

**Foundational Principles and Practices**

| Biodiversity | Diversification & Integration of Enterprises | Sustainability | Natural Plant Nutrition | Natural Pest Management | Integrity |
|---|---|---|---|---|---|
| Rotation | Rotation | Rotation | Rotation | Rotation | Buffers |
| Green Manure | Animal Manure | Green Manure | Green Manure | Green Manure | Records |
| Cover Crops | Composting | Cover Crops | Animal Manure | Cover Crops | |
| Animal Manure | Intercropping | Intercropping | Composting | Composting | |
| Composting | Farmscaping | Biocontrol | Natural Fertilizers | Intercropping | |
| Intercropping | Mulching | Farmscaping | Foliar Fertilizers | Biocontrol | |
| Biocontrol | | Animal Manure | | Farmscaping | |
| Farmscaping | | Composting | | Sanitation | |
| Buffers | | Mulching | | Tillage | |
| | | Buffers | | Fire | |
| | | | | Natural Pesticides | |

Figure 1: Foundational Principles and Practices of organic crop production
[http://www.attra.org/attra-pub/PDF/organiccrop.pdf, p. 8](http://www.attra.org/attra-pub/PDF/organiccrop.pdf)

### 1.4. Involved Knowledge (High-tech, standard agricultural, local/indigenes knowledge)

The numerous Organic Farming systems worldwide show the involved knowledge in different forming. In industrialized countries, especially in Europe, the technical assessment is widespread from regional knowledge and so called old fashioned experiences like draught horses to high-tech strategies like precision farming. Fields of precision farming in Organic Farming systems are for example:

- Habitat surveying and mapping for registration of surface heterogenity
- Selective grain harvest
- Site-specific organic fertilization
- Biological pest control
- Early diagnosis of plant diseases
- Site-specific weed control.

Organic Farming systems in developing countries often show elements and further development of indigenous and imported traditional land use systems, e.g. agro forestry systems are frequently managed organically.

People working according to traditional systems produce their own seeds, do not buy additional fertilizers, and do not use industrially produced pesticides or herbicides. Instead, mechanical weed control as well as plant protection based on plant extracts is applied. Nevertheless, if the intensification of organic production is aimed at, a respective amplification of plant protection methods becomes necessary.

### 1.5. Key Actors

Typical actors engaged in Organic Agriculture are the farmers themselves. In most countries it is referred to as a typical grass root movement where farmers often get support from NGO‘s and, in some cases, also by scientists. In Asian countries such as South Korea, Japan and China, Organic Farming is even supported by the government. Environmentally friendly land-use systems are particularly appreciated for the management of water catchments areas in these countries.

Key initiatives for the development of such Organic Farming systems for developing countries are undertaken by foreign NGO‘s, scientists or Organic Farming institutes from developed countries.

## 1.6. International Cooperation

The IFOAM (The International Federation of Organic Agriculture Movements) is the umbrella organisation of the international cooperation in the field of Organic Farming. In form of a democratic grass root organization, it unites currently 750 member organizations in 108 countries. [http://www.ifoam.org/about_ifoam/index.html].

In order to achieve its mission and address the complexity of the various components of the organic agricultural movement worldwide, IFOAM has established official committees and groups with very specific purposes from the development of standards to the facilitation of Organic Agriculture in developing countries. The IFOAM World Board has established the following official structures:

- The Norms Management Committee, which includes members of the Standards Committee and the Accreditation Criteria Committee
- The FAO Liaison Office
- Various Working Groups and temporary Task Forces
- IFOAM Regional Groups.

IFOAM member organizations have also established professional bodies such as the IFOAM Organic Trade Forum, the Organic Retailers Association, the IFOAM Aquaculture Group and the IFOAM Forum of Consultants and initiatives like the Farmers' Group [http://www.ifoam.org/about_ifoam/index.html].

## 1.7. Potentials for Sustainability

Organic farms perform well on different of the measurable indicators associated with sustainability, such as

- energy consumption and
- environmental protection.

However, sustainability is an ideal, and the best that can be said is that current organic farms are closer to the ideal than most alternatives.

Recent studies has found that organic methods could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without putting more farmland into production [Badgley et al., 2007]. Badgley et al examined a global dataset of 293 examples and found that in developing countries, however, organic systems produce 80 % more than conventional farms. Moreover, contrary to fears that there are insufficient quantities of organically acceptable fertilisers, the data suggests that leguminous cover crops could fix enough nitrogen to replace the amount of synthetic fertiliser currently in use.

In a review of in 286 projects in 57 countries, farmers were found to have increased agricultural productivity by an average of 79 % by adopting "resource-conserving" or sustainable agriculture [Pretty et al., 2006]. A variety of resource conserving technologies and practices were used, including integrated pest management, integrated nutrient management, conservation tillage, agroforestry, water harvesting in dryland areas, and livestock and aquaculture integration into farming systems. These practices not only increased yields, but also reduced adverse effects on the environment and contributed to important environmental goods and services (e.g., climate change mitigation), as evidenced by increased water use efficiency and carbon sequestration, and reduced pesticide use.

The work relies on preview research, which assessed 208 sustainable agriculture projects. This research found that for 89 projects for which reliable yield data was available, farmers had achieved substantial increases in per hectare food production through adopting sustainable agriculture practices: The yield increases were 50 - 100 % for rain-fed crops, though considerably greater in a number of cases, and 5 - 10 % for irrigated crops [Pretty and Hine, 2001 p.48]. Disaggregated data shows:

Average food production per household rose by 1.7 tonnes per year (up by 73 %) for 4.42 million small farmers growing cereals and roots on 3.6 million hectares.

Increase in food production was 17 tonnes per year (up 150 %) for 146,000 farmers on 542,000 hectares cultivating roots (potato, sweet potato, cassava).

Total production rose by 150 tonnes per household (up by 46 %) for the larger farms in Latin America (average size 90 hectares).

There are numerous other specific examples of increased yields following the application of sustainable agricultural practices, which are reported by Parott and Marsden [2002] and Pretty and Hine [2001].

### 1.8. Key Restrictions/ Unused potentials

Occasionally, Organic Farming is considered as a backward approach leading to unsure production, which refuses modern technology or proceedings. Actually this holds true for the transition period from Conventional Farming to Organic Farming, where yield reductions need to be compensated by the farmers. Often, the available residues are insufficient to restore the nutrient cycle by composting or manure application. Furthermore, limited expertise in biological pest/disease management or unavailability of required technology might lead to the use of pesticides.

Market access is a particular obstacle to small-scale farmers who usually lack facilities for product certification.

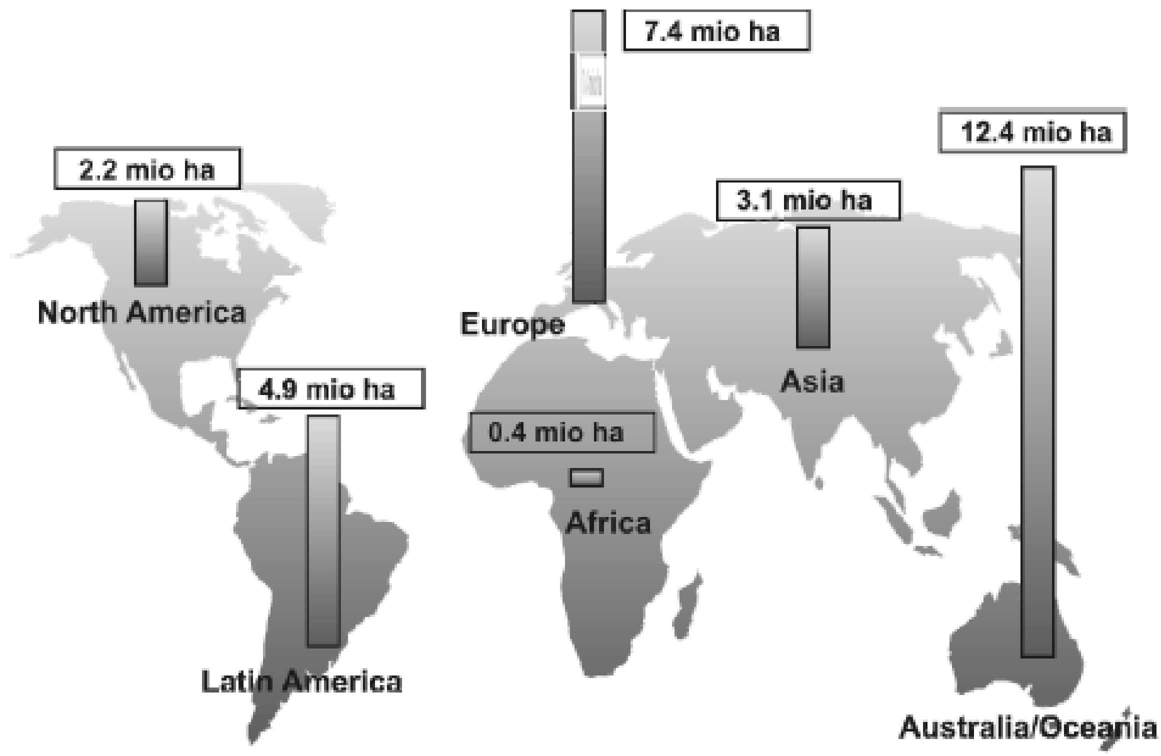
In addition, the general development is constrained by non-existing possibilities for knowledge exchange through networking and the provision of basic technical equipment.

## 2. Current Relevance / Basic Data on Use

### 2.1. Globally

"Organic agriculture is developing rapidly, and statistical information is now available from 138 countries. Its share of agricultural land and farms continues to grow in many countries. According to the FiBL Survey 2008, more than 30.4 million hectares were managed organically by more than 700'000 farms worldwide in 2006. This constitutes 0.65 percent of the agricultural land of the countries covered by the survey.

In total, Oceania holds 42 percent of the world's organic land, followed by Europe (24 percent) and Latin America (16 percent). Currently (as of the end of 2006), the countries with the largest organic areas are Australia (12.3 million hectares), China (2.3 million hectares), Argentina (2.2 million hectares) and the US (1.6 million hectares)." [Willer, Sorensen, Yussefi-Menzler, 2008, p.15].




© SOEL, Source: FiBL Survey 2008

Figure 2: Organic agriculture worldwide 2006. FiBL Survey 2008, Graph: Minou Yussefi-Menzler, SOEL in Willer, Menzler-Yussefi, Sorensen 2008, p.15.

Table 1 shows the organically managed land and farms by continent.

Table 1: Organic agricultural land and farms by continent in 2006

| Continent | Organic land area (hectares) | Share of total agricultural area | Organic farms |
|---|---|---|---|
| Africa | 417’059 | 0.05 % | 175’266 |
| Asia | 3’090’924 | 0.17 % | 97’020 |
| Europe | 7’389’085 | 1.62 % | 203’523 |
| Latin America | 4’915’643 | 0.68 % | 223’277 |
| North America | 2’224’755 | 0.57 % | 12’064 |
| Oceania | 12’380’796 | 2.70 % | 7’594 |
| Total* | 30’418’261 | 0.65 % | 718’744 |

Source: FiBL Survey 2008 in Willer, Yussefi-Menzler, Sorensen, 2008, p.26

The ten countries with the most organic land have a combined total of almost 24 million hectares, constituting more than three quarters of the world’s organic land.

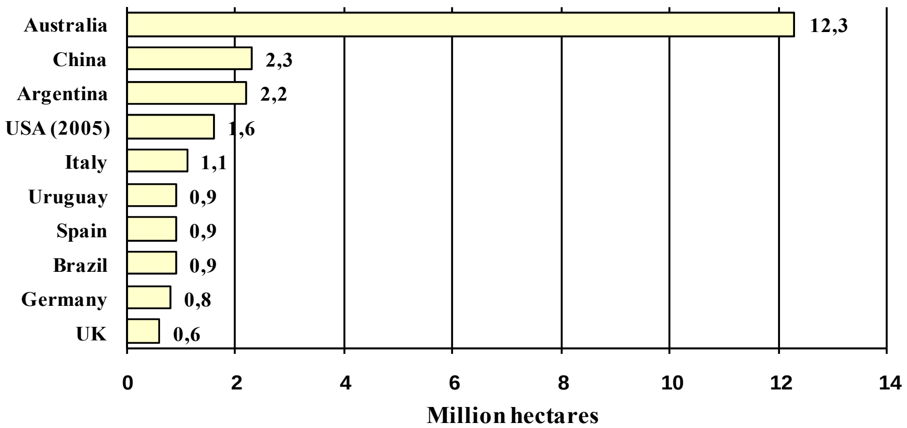



Figure 3: The ten countries with most organic land 2006. FiBL Survey 2008, In: Willer, Yussefi-Menzler, Sorensen 2008, p.27

## 2.2. Area in Developing Countries

“More than one quarter of the world’s organic land is found in developing countries (8.8 million hectares). Most of this land is located in Latin America, followed by Asia, Africa and Europe. The leading countries in terms of organic land are China, Argentina, Uruguay and Brazil. The highest percentages of organic land are found in several pacific island countries, East Timor, Uruguay and Argentina. In these countries, the relative shares of organic land are comparable to those in Europe. These high shares can probably be attributed to a high potential for exports and several support activities in these countries. Out of the developing countries covered by the survey, only few have a share of organic land higher than one percent of the agricultural area. Thus, compared to developed countries, Organic Farming lags behind.” [Willer 2008. In: Willer, Menzler-Yussefi, Sorensen 2008 p.40].

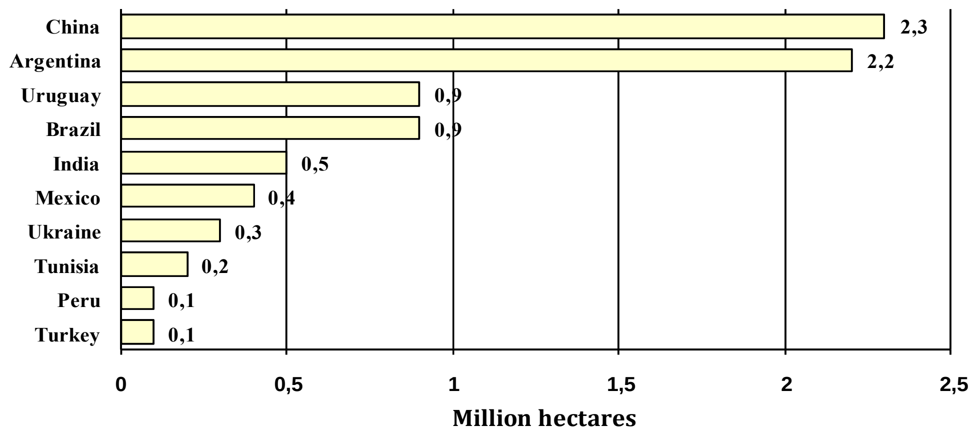



Figure 4: The ten developing countries with most organic cultural land 2006. FiBL Survey 2008. In: Willer, Yussefi-Menzler, Sorensen 2008, p.40

“Even though land use details were not available for all developing countries, the statistics show that the shares of grassland (more than half of the organic land in these countries) and those of permanent crops are, compared to Europe and North America, relatively high. Arable land is of minor importance. This can be attributed to the fact that export plays an important role - either for meat products (mainly from Latin America) or for permanent crops. The most important permanent crops are export crops, such as coffee, olives, cocoa and sugarcane.” [Willer, 2008. In: Willer, Menzler-Yussefi, Sorensen, 2008, p.40]

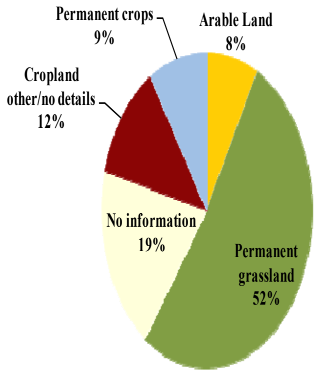



Figure 5: Use of organic agricultural land in developing countries 2006. FiBL 2008. In: Willer, Yussefi-Menzler, Sorensen 2008, p.41

### 2.3. Main land use by Organic Farming/ Important differentiations for global regions, major cultivation conditions and farming systems

At least some information on land use was available for more than 90 percent of organic land, showing that permanent grassland accounts for two thirds of the organic agricultural land and cropland for one quarter.

In the context of the global survey on Organic Farming, data on certified organic wild collection is also gathered. Thirty-three million hectares are certified for wild harvested products (2006). The majority of this land is located in developing countries – quite the opposite of agricultural land, of which more than two thirds is found in industrialized countries.

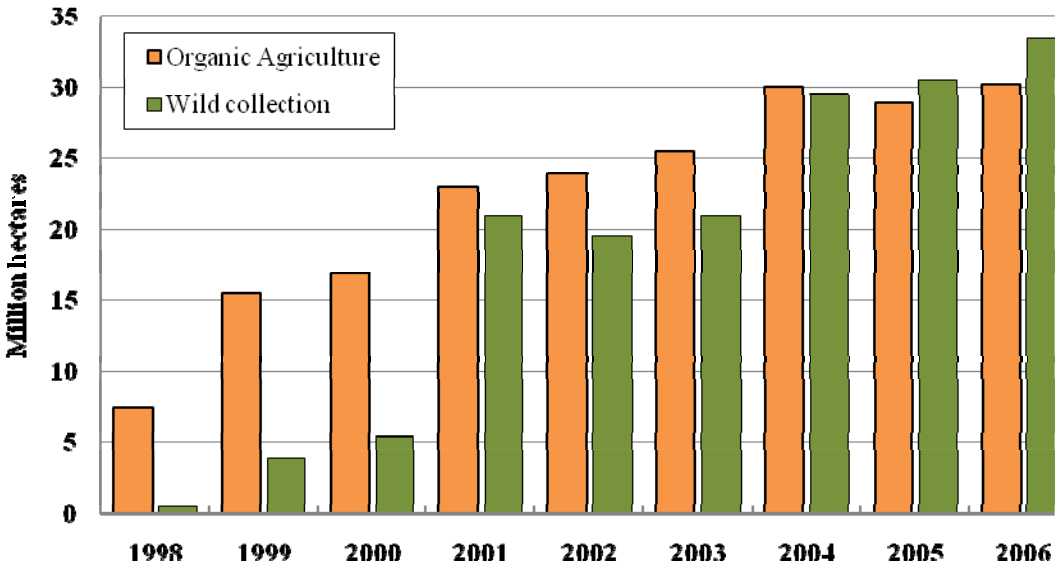



Figure 6: Development of certified organic land 1998 to 2006. FiBL 2008. In: Willer, Yussefi-Menzler, Sorensen 2008, p.30

“With a total of 4.45 million hectares, arable land accounts for one sixth of the organic agricultural area. Most of the world’s organic arable land lies in Europe, followed by North America and Asia. Most of the arable land is used for cereals, including rice, followed by field fodder crops.

Permanent crops account for five percent of the organic agricultural land (1.5 million hectares). Most of this land is in Europe, followed by Latin America and Africa. The most important crops are olives (almost a quarter of the permanent cropland) followed by coffee, fruits and nuts. Permanent pastures/grasslands (more than 20 million hectares) account for two third of the world’s organic land. More than half of this grassland is in Australia. Furthermore, large areas of permanent pastures are in Latin America and Europe.

Looking at the land use at a continental level, a different pattern emerges for each continent.” [Willer, 2008. In: Willer, Yussefi-Menzler, Sorensen 2008, p.33]

Table 2: Global organic agricultural land by main land use and crop categories. Willer, Yussefi-Menzler, Sorensen 2008, p.34

| Main use | Main crop category | Agricultural area [ha] |
|---|---|---|
| **Arable land** | Arable crops, no details | 359'459 |
| | Cereals | 1'722'617 |
| | Fallow land as part of crop rotation | 269'209 |
| | Flowers and ornamental plants | 366 |
| | Green fodder from arable land | 1'324'747 |
| | Industrial crops | 13'120 |
| | Medicinal & aromatic plants | 81'987 |
| | Oilseeds | 124'742 |
| | Other arable crops | 11'582 |
| | Protein crops | 211'913 |
| | Root crops | 33'304 |
| | Seeds and seedlings | 14'484 |
| | Textile fibers | 109'150 |
| | Vegetables | 178'014 |
| *Arable land total* | | *4'454'696* |
| **Permanent crops** | Citrus fruit | 41'624 |
| | Cocoa | 93'308 |
| | Coffee | 340'722 |
| | Fruit and nuts | 323'425 |
| | Grapes | 107'425 |
| | Industrial crops | 83 |
| | Medicinal & aromatic plants | 7'375 |
| | Nurseries | 550 |
| | Olives | 381'337 |
| | Other permanent crops | 22'545 |
| | Permanent crops, no details | 25'428 |
| | Sugarcane | 24'285 |
| | Tea | 3'697 |
| | Tropical fruit and nuts | 98'985 |
| *Permanent crops total* | | *1'470'789* |
| *Cropland, other/no details total* | | *1'136'706* |
| **Permanent grassland** | Cultivated grassland | 74'778 |
| | Pastures and meadows | 3'890'681 |
| | Permanent grassland, no details | 15'539'844 |
| | Rough Grazing | 1'136'706 |
| *Permanent grassland total* | | *20'642'010* |
| **Other** | Aquaculture | 4'222 |
| | Fallow land | 39'528 |
| | Forest | 191'114 |
| | Unutilized land | 40'071 |
| Other total | | 274'934 |
| *No information* | | *2'052'352* |
| Total | | 30'418'261 |

Source: FiBL Survey 2008; Please note that information on land use, crop categories and crops was not available for all countries.

**Africa:** For Africa (more than 400'000 hectares), information covering about half of the organic agricultural land was available. Most of this land is used for permanent crops. The main permanent crops are cash crops like olives (North Africa), coffee, cocoa, medicinal and aromatic plants.

**Asia:** Some land use details are known for two thirds of the organic land in Asia (3.1 million hectares). Arable land is mainly used for cereals, including rice. The most important permanent crops are coffee, fruits and nuts. Large areas of extensive grazing land are in China.

**Europe:** In Europe (7.4 million hectares), the organic land usage is relatively well known, and the main crop categories are well documented. Permanent pastures and arable land have almost equal shares of the organic agricultural area. The main uses of the arable area are for cereals (1.2 million hectares), followed by the cultivation of field fodder (1 million hectares). Permanent crops account for nine percent of organic agricultural land. More than half of this land is used for olives, followed by fruits, nuts, and grapes.

**Latin America**: Most of the organic land in Latin America (4.9 million hectares) for which information was available, is permanent pasture. Permanent crops account for about eight percent of the agricultural area. The main crops are coffee, fruits, nuts and cocoa.

**North America**: In North America (2.2 million hectares), crop information was available for most of the land. Like in Europe, arable land and permanent grassland have almost equal shares. A major part of the arable land is used for cereal production.

**Oceania/Australia**: Most of the land in Australia is used for extensive grassland. Little or no information is available about the remaining land. Some land use details were available for New Zealand." [Willer, 2008. In: Willer, Yussefi-Menzler, Sorensen 2008, p.35]

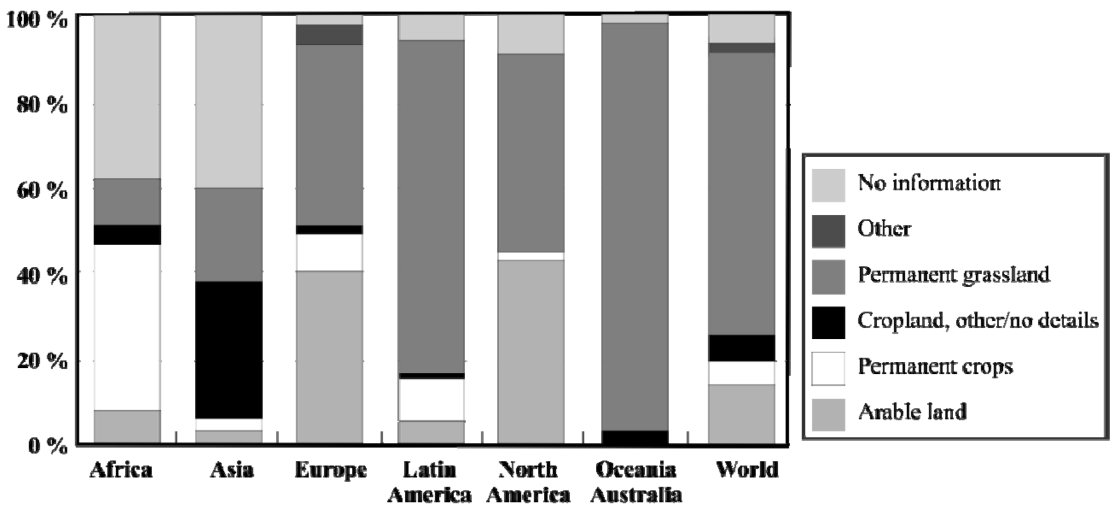



Figure 7: Land use in Organic Agriculture by continent 2006. FiBL Survey 2008. In: Willer, Yussefi-Menzler, Sorensen 2008 p.36

# 3. Restricting framing conditions

## 3.1. Land rights, land ownership

Land rights and land ownerships are different in developing countries.

In Kenya for example, over 70 per cent of agricultural activities are undertaken by women, especially in the small-scale producer sector. On a small scale, women mainly undertake the production, sometimes primary processing, and the marketing of organic produce/products at the national level. Men usually take charge of larger scale cash crop production and sales to informal and organized markets at both local and national levels [KOAN – informal discussions].

Also in the organic smallholder sector of Uganda, the majority of work is carried out by the women, supported by other family members. The direct ownership of the land, however, is generally held by the men. The men also control the monetary benefits resulting from the farm, especially where a cash crop such as coffee is being produced. If a farm is organically certified it is normally registered in the name of the husband [NOGAMU/ SATNET 2004]. Due to such lack of land rights, women are often more prone to poverty and unemployment, as it is generally the case in the Tanzanian region.

Research must therefore also focus on how Organic Agriculture benefits to resource poor households. Especially the allocation aspects within the household structures need to be analysed to whether commercialisation in smallholder production really improves the situation of the whole family, or whether the man of the household remains the only beneficiary of the extra income.

In Uganda, respective research on social implications of certified and non-certified Organic Agriculture has already been initiated through the ‘Linking Farmers to Markets’ initiative spearheaded by the International Center of Tropical Agriculture (CIAT), the Makerere University, Kampala University and the BOKU University, Austria.

In Tanzania, action has already been taken by Organic Agriculture projects, which adopted a policy of promoting women and employing them in various processing operations. Almost 100 per cent of casual workers in various processing operations are women. This stance has tremendous impact on the social status of women in communities and is an added input for the poverty reduction policy of the country.

Future Organic Agriculture projects should also improve the framing conditions by the support of basic social services in areas such as improvement of water facilities, provision of support materials for local storage facilities and housing.

### 3.2. Availability of markets, agricultural product prices

Sahota 2008 reports in Willer, Yussefi-Menzler, Sorensen 2008 p.53ff:

„Organic Monitor estimates international sales to have reached 38.6 billion US Dollars in 2006; this is over double that of 2000 when sales were at 18 billion US Dollars. Consumer demand for organic products is concentrated in North America and Europe; these two regions comprise 97 % of global revenues. Other regions like Asia, Latin America and Australasia are important producers and exporters of organic foods.

The global organic food industry has been experiencing acute supply shortages since 2005. Exceptionally high growth rates have led supply to tighten in almost every sector of the organic food industry: fruits, vegetables, beverages, cereals, grains, seeds, herbs, spices, etc. The organic meat & dairy sector have been adversely affected because of the lengthy conversion process to organic methods and shortages of organic inputs. Organic feed shortages are preventing farmers to raise production levels. Indeed, a large rise in organic milk production in the US in spring 2007 was directly because of farmers completing their conversion period before a new ruling on organic feeds went into effect.

With supply lagging demand in most sectors, growth in the global organic food industry is expected to be stifled by supply shortages for a number of years. Organic Monitor expects supply-demand imbalances to continue throughout this decade.

*Europe*

Europe has the largest and most sophisticated market for organic food & drink in the world, valued at about 20 billion US Dollars in 2006. Its leadership is partly because of the depreciation of the US dollar in the foreign exchange; North America generated over half of global revenues until 2005. The growing weakness of the US dollar is expected to make Europe more prominent in the coming years. Even within Europe, organic food sales are concentrated with the bulk of sales coming from Western Europe. Indeed, four countries - Germany, France, Italy and the UK - comprise over 75 percent of regional revenues. Other countries like Denmark, Sweden and the Netherlands are showing high growth however they have much smaller markets because of their small consumer markets.

… Scandinavian and Alpine consumers are the largest spenders on organic foods. The Swiss are the largest organic food consumers, with average spend of over 140 US Dollars per capita. The Danes, Swedes and Austrians are the next largest spenders. In contrast, Southern, Central & Eastern European consumers are the lowest spenders on organic foods …

*North America*

Organic food & drink sales in North America continue to surge, with retail sales estimated at 17.3 billion US Dollars in 2006. The US has the largest market for organic products in the world, worth over 16 billion US Dollars. Significant increases in organic farmland are making it a leading producer. Almost all types of organic crops are grown in the country; however, imports are necessary because of supply falling short of demand. Latin American countries like Mexico, Argentina and Brazil export large quantities of organic foods to the US market …

*Oceania*

Australasia is an important producer of organic foods, though it is not yet a large consumer. Valued at about 340 million US Dollars, the Australasian market for organic food & drink comprises less than one percent of global sales. Small consumer markets and export-focus of producers are responsible for the small market size.

Australia and New Zealand are leading exporters of organic products. Important exports include organic beef, lamb, wool, kiwi fruit, wine, apples and pears. Although exports continue to increase, the portion of exports to total production is in decline as internal markets for organic food & drink develop ….

*Conclusions*

Global sales of organic food & drink surpassed the 40 billion US Dollar mark for the first time in 2007. With demand for organic foods outpacing supply, high growth rates are envisioned to continue in the coming years.

Most demand is concentrated in Europe and North America where organic food production is increasing at a relatively low rate. Farmers are showing low interest in Organic Farming because of rising prices of agricultural products, partly due to high fuel costs and growing interest in bio-fuel crops.

Organic Agriculture in developing countries is rising at a much faster rate than in the developed world. For instance, the size of organic farmland has increased in triple digits in Africa, Asia and Latin America since 2000 whereas double-digit growth has been mostly observed in other regions. This disparity between production and consumption is putting the global organic food industry in a fragile condition. A dip in demand from Europe and /or North America would have a major impact on global production of organic foods. The industry could lose confidence as export markets close, resulting in oversupply and a decline in organic food prices.

Organic food producers in regions like Asia, Africa and Latin America are advised to become less reliant on exports and develop internal markets for their products. By developing local markets, producers can spread the business risk of organic food production. Consumers can also benefit by having access to regional produced organic foods. The conversion rate towards Organic Farming in North America and Europe also needs to keep pace with organic food sales. Only when production and demand is more evenly spread can the organic food industry be considered truly global."

### 3.3. Political support

Agricultural production is linked to broad economic interests who dominate the discussion on the right pathway for intensification. Ecologisation is a matter of power. Therefore, on the producer‘s level, the focus has to be drawn on the linkage of agricultural consultancy with political consciousness-raising, lobbying and legal assistance. Subjects of discussion are e.g. the consequences of the WTO- in combination with the TRIPS-Agreement on: Intellectual property rights increasingly claimed by the seed-producing industry, farmer‘s rights documented in the international treaty on seeds, and, biological safety in the context of genetically modified seeds as declared by the convention on biodiversity (Cartagena Protocol) (Kotschi 2008]. Such combination of political education linked with agricultural consultancy has shown to be a promising approach for agricultural development and should be further extended.

This is demonstrated by an exemplary case from Himachal Pradesh in the north of India: More and more families are convinced that Organic Farming represents a realistic alternative to conventional production. The respective breakthrough was achieved by innovative methods of alternative pest- and disease management in rice production and by an efficient use of animal manure through composting. A field study conducted in co-operation with farmers showed the following results on marginal returns from organic compared to conventional rice production: Physical yields of both systems achieved an equal level of 5t/ha. Nevertheless, the variable costs have been identified to be higher in the conventional system. Reasons are higher use of mineral fertilisers and chemical crop treatments. Consequently, the marginal revenues of farmers who adopted the organic principles were increased by approximately 90 %. Although this represents an extreme case, it underlines the experiences frequently made during the consultancy of such groups: Organic Farming has potential for competition, whereby higher prices in form of a „quality premium“ is not necessarily the driving force. Farmers also set great value upon being recognised as organic producers. Therefore, the improvement of self-consciousness is of equal significance for the development than obtained economic revenues are. Consequently, development and ecological orientation becomes also an issue of dignity and independence from the state and industries [Kotschi 2008].

## 4. Technical potential for improvements – Case studies

Experience has shown that Organic Agriculture has competitive potential, also on economic comparisons. The steadily deteriorating Terms of Trade - disproportional raising costs of conventional production against stagnating or even decreasing producer prices – strengthened this trend. Another aspect is the reduced drought-susceptibility of Organic Farming, particular relevant for the fight against hunger in poor African regions.

However, even Organic Agriculture is not yet sufficiently sustainable and requires further development. The most frequent problems mentioned for organic production sites are: Lack of techniques, small fields, marginal soil conditions, and dry climate. From a technological perspective many potential remains unexploited, e.g.:

- Improvement of the humus content and biological soil activity, leading to fostered nutrient cycles and dynamics. In agro-sylvan systems, for example, composting of wooden residues containing lignin might facilitate a jump/lift in intensity [Lermieux 1996].
- The method of evolutionary plant-breeding could create varieties which not only dispose of a higher yield potential, but also of better drought and heat resistance. Participatory approaches including farmers in the process further allow a significant reduction of the timeframe of such breeding programmes. According to Ceccarelli (2006), 4 to 5 years can be saved – acceleration, which is urgently required in response to the rapid environmental changes induced by the global warming.

### 4.1. Case studies from Africa

Parrot and van Elzakker [2003 cit. in Abele et al. 2007, p.145] identified four different organic agricultural categories in Africa, according to their dependency on formal development aid and institutions:

- "Commercialised, certified Organic Agriculture without any significant development funding. This is generally practiced on large-scale farms and oriented towards organic markets in industrialized countries.
- Export-oriented certified Organic Agriculture, supported by development funding, and aimed at improving incomes of small farmers.

- Poverty-reducing and environment conservation-oriented agriculture based on organic principles, assisted by development agencies. This system addresses soil degradation and water scarcity as well as food security, and usually supports local initiatives.
- Organic Agriculture initiatives developed by farming communities and local organizations without foreign assistance as a means of addressing pressing social, economic and environmental problems.”

*Key Actors*

Key actors are export-oriented large scale farmers, NGO’s and Organic Farming groups, which are often inspired and influenced by foreign initiatives. Gender roles prevailing in East Africa are another factor which is generally detrimental to the development of the entire agricultural sector, including the organic subsector. Usually responsible for the generation of income, men are prone to either cultivate cash crops or to migrate into urban areas to look for work. Such induced migration lead to a high share of female-headed households in rural areas, accounting for e.g. 44 % in Nyanza Province and for 40 % in the Eastern and Western Province of Kenya [The Government in Kenia 1995. In: Bues 2007, p.18]. This strict separation of tasks, accompanied by an unequal workload distribution, poses an obstacle towards extension works which is often referred to as “extension gap” [Amalu 2004, 28. In: Bues 2007, p.18]. Although women undertake over 70 % of all agricultural activities [KOAN 2005a. In: Bues 2007, p.18), men are usually participating in provided trainings. Hence, woman are mostly not entitled to the lands they cultivate and, therefore, often unable to obtain credits [Amalu 2004, 28. In Bues 2007, p.18].

*Area under organic management*

In a worldwide comparison, Africa’s organic subsector accounts for the smallest proportion of total land under organic cultivation. However, these numbers refer to certified organic land, disregarding non-certified or informal Organic Farming. Viable information on the Organic Farming sector in Africa is therefore still limited since respective products are usually traded through conventional markets and hardly certified.

Willer, Yussefi-Menzler and Sorensen [2008, p.18] report: “... there are more than 400'000 hectares of certified organic agricultural land in Africa. This constitutes about one percent of the world’s organic agricultural land. There are at least 175'266 organic farmers. The countries with the most organic land are Tunisia (154'793 hectares), followed by Uganda

(88'439 hectares) and South Africa (50'000 hectares). The highest shares of organic land are found in Sao Tome and Prince (5.2 percent), Tunisia (1.6 percent) and Uganda (0.7 percent). It should be noted that some of the organic land in Africa that was previously classified as ‘agricultural land’ turned out to be certified wild collection, which plays a major role in Africa (more than eight million hectares). Important wild collection products are honey and gum Arabic.”

It can be stated that in most countries Organic Farming is not undertaken by average farms, but by (in an African context) relatively large farms. In Western Uganda for example, the average farm has less than one hectare [Okech et al. 2004], whereas the average Ugandan organic farm has 3.6 hectares. In Kenya, farm sizes are at average 2 to 3 hectares [Qaim 1999], whereas the “organic” average in Kenya lies slightly above 6 hectares.

*African organic market*

Organic food production in Africa, which is also the majority of certified organic produce, is destined for export markets, with the large majority being exported to the European Union.

Middle-Eastern cities like Dubai, Riyadh and Kuwait City are becoming important consumers of organic products. Reason is the increasing health consciousness among the high societies that take up residence in such fast developing centres.

The African market for organic products is still small. Certified organic products are currently only recognized in a few domestic markets, including Egypt, South Africa, Uganda, Kenya and Tanzania.

The access of small-scale farmers to specific organic markets is generally limited by the costs of certification [Bues 2007, p.30]. According to Bues [2007, p.22ff] such certification is a prerequisite for the access of most national outlets and always for the entry to the flourishing export market. Lack of certification bodies, on the other hand, is not a primary obstacle. Bues [2007, p.30] actually mentions five international and two national certification bodies operating in Kenya and concludes the cost of certification to be the principal barrier for smallholder involvement.

*State support, standards, and regulations*

For exports most African countries rely on foreign standards. To date, the majority of certified organic production in Africa has been certified according to the EU regulation for organic products. Three countries have an organic regulation and seven are in the process of drafting one. Certification services are mainly offered by foreign-based certification bodies, some of which have established regional representations or developed closer cooperation with national bodies. In many African countries, Organic Agriculture is not integrated into state agricultural policies. In some countries, mostly in East Africa, policy development is being undertaken and the national organic movements are strongly involved in the process. A good example is the East African Organic Products Standard (EAOPS) and the associated East African Organic Market (EAOM), which were developed by a public-private sector partnership and supported by the IFOAM, and the UNCTAD-UNEP Capacity Building Task Force on Trade. Both, the mark and the standard, were officially launched by the Prime Minister of Tanzania at the East African Organic Conference in May 2007.

That fact that smallholders' presence on international markets can be realistic has already been proven by Bues's [2007, p.24] note that this has already been achieved for the conventional sub-sector. Furthermore, the potential to increase smallholders' income through Organic Farming and thus deriving general economic benefits have already encouraged organisations as the KOAN, KPCU and Tradecraft to launch programs, which promote national and international marketing [Bues 2007, p.27].

One way to overcome the obstacle of certification costs can be the facilitation of access to credits, either by the creation of special institutes or by the assignment and recognition of land rights to women. A second approach is to reduce the respective costs through a system of group certification with an incorporated Internal Control System, as described by Bues [2007, p.31] for the Kenyan farmer group Meru Herbs. Since experience showed that many groups also perceive certification as prohibitively expensive [Bues 2007, p.32], a combination of both approaches seems most promising. In any case external help will be required as groups are further reported by Bues [2007, p.32] to be unable to organise themselves properly.

Although not named in the first place, certification bodies of the national markets are still unsatisfactorily developed. Particularly, the lack of an officially protected label has been mentioned [Bues 2007, p.28]. Thus, the establishment of such an officially protected label becomes an interesting point, especially once the consumer's awareness is raised. However, an alternative approach to exploit the local/national market represents box schemes. The respective concept consists in the direct connection of the small-scale producers to the urban consumers. This is achieved via a subscription box by which the consumers order organic products directly to their homes. In Kenya this has already been initiated by the KIOF and

KOAN and shown to be a promising approach [Bues 2007, p.21]. It offers the possibility to obtain premiums for organic production without costly certification by a third party. Consumers subscribe to the direct delivery of organic products to their home, whereby quality is guaranteed through a Participatory Guarantee System [IFOAM 2006 in Bues, 2007, p.21]. A further advantage is the avoidance of the strict trading conditions set up by outlets such as supermarkets.

*Key restrictions / Unused potentials / Restricting framing conditions*

Abele et al [2007, p.153] cite Parrot and van Elzakker [2003], when they describe the constraints in Africa as: "poor quality and badly maintained roads and vehicles, rail links and rolling stock all pose problems for transportation. Lack of refrigeration, erratic power supplies, poor communication systems, underdeveloped banking and credit systems and, sometimes, political and economic instability, all raise serious and often insuperable problems."

According the FAO/ITC/CTA Abele et al [2007] assumed that the following constraints apply to the establishment and sustainability of commercial Organic Agriculture in Africa:

"Such constraints are:

- Lack of experience in intensive organic production in general and especially of fruits and vegetables
- Lack of experience in handling and exporting fresh produce
- Lack of professional management
- Diseconomies of scale in exporting small quantities, e.g. for test exports
- Poor communication between foreign importers and exporters
- Competition from technically more advanced neighbouring countries (e.g. South Africa)
- Poor negotiation skills and judgement of negotiation power of exporters, e.g. cases where prices are increased significantly after first successful trial shipments, and markets were lost
- Lack of familiarity with international markets, including knowledge of the organic marketplace overseas
- Lack of information for the potential importers, for example, on timing of production (Which is locked into the main harvest), and estimated quantities of supply and prices

- Lack of up-to-date market information
- Lack of governmental action to support exports
- Lack of knowledge on improving soil fertility, pest and disease control” [Abele et al 2007, p.154].

*Potential for improvements / Technical / organisational solutions*

Yussefi & Willer [2002, p.54] report an increasing interest in organic production in Africa due to several reasons: low affordability of technologies promoted within the Green Revolution, possible reconsideration of available traditional knowledge, potential of organic systems to stop problematic erosion and desertification aggravated by conventional techniques, and the economic given by the international market.

In order to understand the significance of each of these arguments, three production systems will be analysed in the following section. Each of these production systems applies to different ecological and socio-economic frameworks. The first corresponds to smallholder production under unfavourable conditions of the Sahel Zone, followed by a concept applicable for a more affirmative organic production of valuable crops under slightly more favourable conditions. Finally, a more sophisticated production approach for professional certification and international marketing will be analysed using the example of the organic sector in Egypt.

### 4.1.1 The Tassa Method – an example of rainfed production in the Sahel Zone

*Characteristics of the production system*

Rainfed agriculture based on water-harvesting techniques and minimum tillage represent the main land-use system described for the production of cereals (Sorghum, Millet) and leguminous crops (cow peas) during the short rainy season in the Sahelian region of Niger. Hence, it represents the traditional cropping system of all ethical groups of the region [Kriegl 2001, p.73]. Water harvesting is understood as the collection of precipitation runoff of a larger area in order to provide it in higher quantity to a smaller cropping area [Prinz and Wolfer 1989, in Kriegl 2001 p.153]. Since climatic conditions of the Sahel belt are characterised by low and unevenly distributed precipitation rates of 200 to seldom 600 mm [Leisinger and Schmitt 1992 in Kriegl 2001 p.31], the water-harvesting approach forms the central feature for rainfed agriculture production system of this region.

The respective method is called “Tassa” or “Taska”, where the cropping area is reduced to digged holes which are surrounded by little dams facing the valley in order to hinder the water runoff resulting in increased infiltration into the respective holes [Kriegl 2001, p.160ff]. Generally, the 20-30 cm wide and 20 - 30 cm deep holes are digged in rows with offset pattern in order to cover the whole runoff front (Figure 8). Apart from representing a water-harvesting approach, the Tassa Method is also based in the concept of minimal tillage. With an untilled space of about 100 cm between the holes, tillage is reduced to the punctual soil preparation and application of dry manure followed by two mechanical weed controls [Kriegl/Mabrouk 1997]. The fertilizing effect of the manure then lasts for two to three harvest periods [Kriegl 2001, p.160]. Livestock-keeping consequently forms a central component of the production system as it represents the source for the organic fertilizer. Accordingly, nomad pastoralists traditionally form the essential partner for the farmers [Kriegl 2001, p.119]. Indeed, nomad pastoralists have been forced to settle or they have been displaced by settled livestock-keepers [Bliss 1991. In: Kriegl 2001, p.120].

Figure 8: Tassa Method. http://www.fao.org/DOCREP/006/Y4690E/y4690e1t.jpg

*Organic background*

Although literature does not cite it as a specifically organic production system, it is described in detail within a bio-dynamic approach of sustainable land-use in the Sahel (compare Kriegl 2001). Besides, the techniques are evaluated to have the potential to comply with the standards of IFOAM. This assumption is based on the stated conformance of a lot of African agricultural production with organic standards [Yussefi & Willer 2002, p.54] and on the traditional origin of the system mentioned by Kriegl [2001, p.73].

*Involved Knowledge*

Generally, the technique evolved out of indigenous knowledge of farmers who started with the Tassa Method, with stone-rows, and with the application of dry manure as a mean method for soil recuperation [Kriegl/Mabrouk 1997. In: Kriegl 2001, p.156]. Generally, Burkina Faso is stated as the region where the Tassa Method has first been developed. But these remains unclear since Burkina people, in turn, mention the Niger as the region of origin [Kriegl 2001, p.160].

*Current Relevance*

The development and application of the water-harvesting principle is reported until far back in history. According to Prinz and Wolfer (1998) it has been of great importance in many dry regions worldwide about 2000 years ago. During the times of the second part of the last century, this technique regained attention by governments and organisations, especially in India and North Africa (Tunisia) [Prinz and Wolfer. 1998. In: Kriegl 2001, p.152f]. Nowadays, successful application of different methods, including the Tassa Method, has been reported for all countries of the Sahel-zone [Rochette et al. 1998. In: Kriegl 2001, p.153]. The Tassa Method is, thereby, particularly interesting for smallholder production. Reason is its traditional origin, and relatively high labour requirement. Hence, the Tassa Method has been developed for to the cultivation of sorghum and millet, the most important crops in the Sahelian areas. Being particularly adapted to the extreme regional climatic and soil conditions, these crops became an essential part of the regional diet [Kriegl 2001, p.75].

*Yield potential*

Investigation proved optimal results of the Tassa Method for the application on plateau surfaces and contingently also on glacis soils [Kriegl & Mabrouk 1997. In: Kriegl 2001, p.165].

The effect of the method is a moist soil for up to 3 weeks after rainfall. Therefore, the system promotes favourable conditions for seed emergence and root development. Additionally, the dams protect plants against harmful winds [Kriegl S.161]. Such cumulative effects may consequently lead to a better establishment of the crop and consequently to significantly higher yields. Regarding this potential, Kriegl [2001, S.73] reports exemplary millet yields of up to 2 t/ha and cow pea yields of 800 kg/ha compared to unsecured average millet yields of 150 - 400kg and cow pea yields of 50 - 200 kg achieved by conventional cultivation practices.

*Potential for Sustainability*

As stated by Kriegl [2001, S.4], the reason for the broad soil degradation is to be seen in the loss of humus content due to massive erosive processes which are caused by conventional agricultural land use practices. Here, to large cultivation areas, inappropriate cultivation practices and exaggerated withdrawal of residues are named as specific sub-causes [Kriegl, S.8]. Within this context, the Tassa production system can generally be evaluated as a suitable method for the recultivation of respective landscapes that have been devastated by inappropriate cultivation practices [Kriegl 2001 S.207]. According to Rochette et al. [1989 in Kriegl 2001 p.161], the created Tassa-holes function as mini compostures which feature an acceptable decomposition of the fresh manure as well as good water infiltration and little evaporation. This leads to further improvement of the soil conditions and water-use, especially on soils tending to siltation [Kriegl 2001, p.305].

Regarding the soil conditions, the content of organic matter is a very critical aspect in the regions of the Sahel, where reported contents is very low and generally not exceeding 0,2 % on cultivated or pastoral lands [Kriegl & Mabrouk 1997, Evequoz & Guero 1998. In: Kriegl 2001, S.327].

The application of manure is, therefore, a suitable form as it allows a considerable increase of the organic matter content at the planting sites of the crops. Although the comparison of punctually fertilised Tassa-holes to the previous season is somehow critical, Kriegl & Mabrouk [1997 in Kriegl 2001, S.170] report for Tassa-holes respective organic matter contents of 0.72 % during the first and 1,5 % during the second cultivation period. These values refer to the application of dry manure, leaving further potential to increase the first value by partial utilisation of pre-composed material or compost.

Although no specific study could be found, it is further stated by Kriegl (2001, p.113) that the efficiency of manure application is also considerably increased by the Tassa Method. Since livestock manure production is very low due to the low production potential of the Sahel, the more rational use of scarce manure meets the precondition for desired sustainable land-use in this region. High stocking rates are considered as the most serious cause for the degradation of the local soil [Kriegl 2001, p.113ff] and might be reduced where they are determined by the fertilizer demand. Kriegl reports that the stocking rates exceeding the ecological resilience of the grasslands by three times. Nevertheless, such high stocking rates can regularly be traced back to socio-economic reasons. Capital and food assurance or the represented social status is usually higher incentives for livestock-keeping than the manure production [Kriegl 2001, p.116]. The problematic issue of over sticking can therefore not be tackled by the application of the Tassa Method alone.

*Improvement potential and technologies*

It has to be considered that the hydrological performance of a Tassa-hole is limited. Holes of the shape as described above are capable to absorb 13 - 14 litres of water [Evéquoz und Guéro 1998. In: Kriegl 2001, p.162].

The application of a mulch layer is also done with to prevent the accelerated sedimentation of the Tassa-holes and is therefore of particular importance on glacis or more sandy soils [Kriegl 2001, p.190]. Additionally, the used residues from millet and sorghum, tree branches and dry manure have been observed to stimulate biological activity, especially the formation of *rhizobia* and *mycorrhiza*, promoted by the slow decomposition through termites. In this context it has been concluded that one third of the biomass should remain on the field for soil protection purposes, allowing one third to be used as fodder and one third for other purposes such as construction [Kriegl, p.116].

Low stone walls are traditionally created with varying shapes (rectangles, triangulars, etc.), but never on a large scale as small structures have the advantage of breaking winds from different directions. Exact alignment according to contour lines is generally impracticable due to their complicated determination. Furthermore, the walls have to be replaced after some years in order to maintain their effectiveness; otherwise sedimentation would cover them over time. As the construction requires stone, this extension option is especially adopted to the rocky areas of plateau surfaces [Kriegl 2001, p.186ff]. In regions where no stones are available, similar effects can be achieved by “green barriers”. The establishment is simple and realised by leaving 30 - 60 cm wide strips untouched. Vegetation will evolve itself, incorporating the further advantages of spontaneous overgrowth of sediments accumulating in the buffer strips.

Also the sedimentation of the Tassa-holes through sand is problematic. To shorten this process, the establishment of Tassa holes can be postponed until some weeks before the beginning of the cropping season. This variation has also been reported to be making the

utilization of compost or precomposed manure more promising for the Tassa System. Reason is the reduced time span between the application of organic fertilizer and the sowing.
Generally, combinations of different adopted techniques should be preferred instead of drawing the focus on one single approach. By accumulating different positive effects, an adopted set of approaches may has the potential to considerably increase the benefits of the production system [Kriegl 2001, p.186].

### 4.1.2 The Double-Digging Method – an example of additional income creation for small-scale farmers in Kenya

Market-oriented organic production in Kenya is, according to Bues's distinction [2007, p. 11f], the main purpose of specialised large- and medium-scale farms, with the large-scale producers serving the international market. Medium-scale producers are characterized by producing for the national market. Nevertheless, the author also describes a mixed form of subsistence and commercial production, where small-scale farmers who achieve marketable surpluses or produce small shares of cash-crops also operate on the national market. The importance/scope of these market-oriented smallholders in Kenya can be estimated to be considerably high since small-scale farming is described by Omondi [2006 in Bues 2007, p. 6] to account for more than 85 % of the agricultural sector. Just like large-scale commercial farms, many of these smallholders are also organized in groups such as the Kenya Organic Farmers Association (KOFA), (founded as a national representative organisation) [KOAN 2005].

*Characteristics of the Double-Digging Method*

Double-Digging is a method of deep soil preparation in which the soil is loosened to a depth of 60 cm (2 feet) and fertilized with organic matter [Mundy 1998]. This technique implies the inversion of the soil by removing the topsoil of one segment using it as subsoil for an adjacent segment of a seedbed of about 150cm width. Finally, the whole seedbed consists of topsoil covered by the former subsoil. Compost incorporation is realized by mixing it with the topsoil used to fill the pits. The whole seedbed can be constructed either as a sunken bed for the dry season or as a raised bed for the rainy season in order to facilitate optimal water management. Under regular soil conditions, a repetition of the Double-Digging every 3 years is regarded as sufficient [Bues 2007, p.41; Mundy 1998].

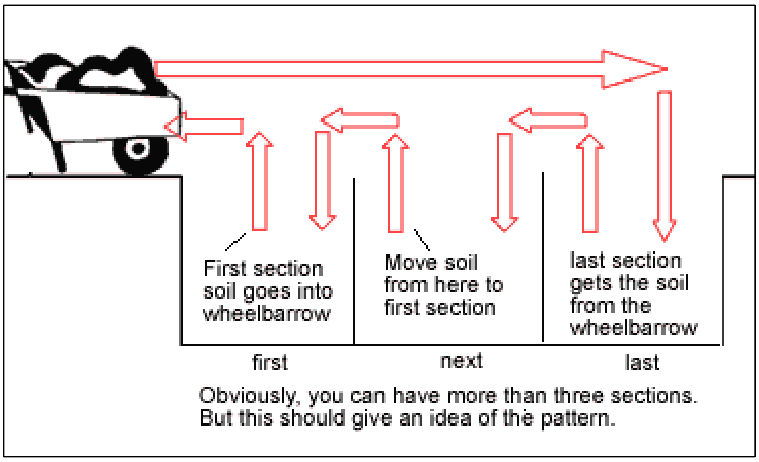



Figure 9: The Double-Digging Method. http://davesgarden.com/guides/articles/view/57/

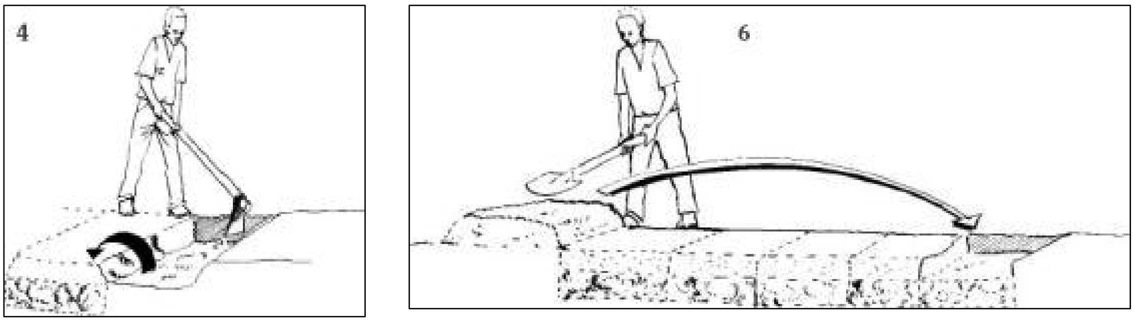



Figure 10: The Double-Digging Method II. http://www.iirr.org/book.htm

Since the term Double-Digging in this context also refers to composting as a sub-element, it will/can be considered as a production system approach for e.g. vegetable production, rather than a farming technique. There are also further examples for semi-intensive organic production systems applied by small-scale farmers. Double-Digging is simply introduced here as an appropriate exemplary approach for the elaboration of the following aspects, which can similarly be applied to other semi-intensive organic production systems relevant for small-scale market oriented production.

*Potential for Sustainability*

Next to urban waste and industrial production, the agricultural sector represents one of the driving factors of pollution/degradation [CIA 2007 in Bues 2007, p.7]. One aspect is the exaggerated use of agrochemicals like fertilizers and pesticides among commercially oriented plantations and contracted smallholder farms as reported by KNBS [2006 in Bues 2007, p.7]. Other than environmental degradation, Bues [2007, p.14] also describes health hazards as a consequence of the inappropriate use of such chemicals.

In this context, deep soil preparation by Double-Digging represents one approach towards more sustainable land cultivation since the incorporation of compost/manure improves soil fertility and structure via an increased organic matter content. This deep loosening of the soil, thereby, can lead to two beneficial effects: First, to facilitate the establishment of an optimal soil structure for the nutrient and water supply of the crops, and second, to the prevention of soil erosion, leaching, and organic matter losses [Bues 2007, p.40]. The Double-Digging Method is recommended for use in compacted, heavy, or rocky soils, and soils whose structure has been degraded by chemicals and frequent ploughing [Mundy 1998].

*Constraints*

The system of Double-Digging has not been mentioned as a traditional farming system. Thus, successful adaptation may be constrained by farmer's scepticism. The farmer's acceptance of the method can be regarded as critical since Mundy (1998) already mentions the required labour intensity as a disadvantage. This is particular problematic for relatively high-input systems, where a initial decline in yields is expected according to Parrot et al. [2006 in Bues 2007, p.13].

*Improvement potential and technologies*

The use of natural insecticides incorporates considerable potential for production improvements. This is due to Kenya's favourable position as an important producer of Pyrethrum daisy (*Chrysanthemum cinerariaefolium*), which is used effectively for the production of natural insecticides. Currently, extracts are only exported to developed countries and Kenyan farmers are left with the option to prepare their own insecticide from flowers combined with soapy water. A more professional local processing and commercialisation of the plant could therefore significantly raise the use of such a natural product [Omare and Woomer 2003].

*Effects for small-scale farmers*

For the adaptation of organic farming practices such as Double-Digging, several general advantages have been identified for the specific case of Kenya. Less health risks and yield increase for farmers without means are described as a primary motivation to engage in Organic Farming [Bues 2007, p.13]. Also do the lower input-costs reduce the risk of farmers falling into debt through credit raising. The better off small-scale farmers can be even able to convert the saved input-costs into some additional surplus [Bues 2007, p.47]. The argument of lower input-costs, however, is not necessarily applicable since additional costs for certification arises when a premium wants to be charged to customers for organic production. Nevertheless, once the entry to the organic market is achieved, the mentioned economic benefits from higher retail prices are attractive. Thanks to these economic benefits, organic production further bears potential to make on-farm income creation more attractive, which finally reduces migratory incentives for men of small-scale households [Bues 2007, p.44].

### 4.1.3 Export-oriented intensive organic production – an example from Egypt

Today, Egypt's agriculture has a well developed and steadily growing organic sub-sector. In 2006, approximately 24.548 ha have been managed in compliance with organic standards, accounting for 0, 72 % of the total agricultural area. The respective production basically falls under the responsibility of 500 organic producers [IFOAM & FiBL 2006]. Most of these socalled desert farms are located in New Land and rely on irrigation from the Nile. In some rare cases also groundwater is used.

Cultivated crops include a variety of fruits such as grapes, lemons, mangos and strawberries, several cereals, vegetables and spices, as well as non-food products including medicinal herbs and cotton [IFOAM 2003]. Almost 80 % of Egypt's cotton is produced organically. The ban on pesticides had a side-effect of a 90 % reduction of the agrochemicals used in cotton production. Time ago this amounted to about 35.000 t of chemicals spread over the agricultural farmland. Besides crop production, dairy, cattle and pigeons are kept.

Most of the organic products are exported, especially to Europe. But the Indian market is also supplied with organic products from Egypt, such as tea and dairy products. Buyers are part of Egypt's middle and upper class society.

The focus on the export market leads to the establishment of a sophisticated network of quality controls. The product certification is mainly carried out by two local organisations: the ECOA-Egyptian Centre of Organic Agriculture and the COAE-Center of Organic Agriculture in Egypt. Both are members of the International Federation of Organic Agriculture Movements (IFOAM) and accredited by EUROPGAP, a privately organised system of quality control which sets worldwide standards on the certification of agricultural products http://www.eurepgap.org/Languages/English/about.html.

Apart from the ones mentioned above, the EBDA, the Egyptian Biodynamic Association, has to be named as one of the most important associations which facilitated the early development of the sector. The programme consists of training, research seminars and consulting services on Organic Farming. This is offered to the more than 400 members consisting of small- and medium-scale companies responsible for a total of about 3200 ha land under organic production http://www.intracen.org/Organics/Country-Profile-Egypt.html.

Further illustration will be given by the following three examples. All of them operate on areas mostly located in the so-called New Land, describing the desert areas around the valley and delta of the Nile as well as the Sinai-Peninsula. Each farm produces to different shares for contractual partners from the world market. Their water demand is covered through available groundwater and Nile water delivered through large irrigation canals. Modern irrigation techniques such as drip-, subsoil- and sprinkler systems are standard.

Sales opportunities for organic products are promising since producer-client relations are still relatively strong and advantageous within the organic sector. However, the recent increase in input prices of up to 40 % creates more difficult conditions since sales prices have hardly changed.

Organic farmers do not receive direct support from the government. While some producers have complained about this, others appreciate the maintained independence from the state. A comparative disadvantage of organic farmers is only created by the indirect support of conventional producers, deriving from the subsidisation of fertilizers and pesticides. Nevertheless, this present reduction of such subsidies again increases the competitiveness of organic production.

The most essential governmental support on the other hand is granted to both production types: The delivery of Nile-water to the farmers. The bulk water supply and primary canal system is financed by the state, giving farmers the possibility to extract and further distribute irrigation water. Most agricultural production in New Land relies on this service and would otherwise be impossible or more expensive as it would require groundwater extraction.

*Example: The SEKEM – Farm*

The SEKEM-Farm which is known far beyond Egypt’s borders is its pioneer in Organic Agriculture. The first farm was founded in 1977 by Dr. Ibrahim Abouleish on an area of 70 ha located in New Land. Four years later, the first organically produced medicinal herbs, which still represent an important line of production, were exported to the USA. In 1990, the first fruits and vegetables were exported to Europe. Furthermore, organic cotton production and local processing to clothing represents a significant branch of production as well. At 80 % most of the products are exported, whereas 20 % are destined to the local market. Presently, the SEKEM Group and contracted farmers manage approximately 10000 Fedan in accordance to the high standards set by Demeter.

The production is realised within a closed system. The production of vegetables, fruits, cereals, herbs and medicinal plants is accompanied by the integration of dairy-keeping.

Product certification is carried out according to the standards set by Demeter or other respective trademarks such as BioSuisse and FairTrade. The required quality management follows the ISO norms and HACCP standards. This has been initiated in 1997, when, the production branches of the SEKEM-Group were certified according to ISO 9001 for the first time. Additionally, the SEKEM-Group and subcontractors/external suppliers are members of the „Egyptian Biodynamic Association“ (EBDA) which also certifies EU-Standards. The group states to be the only Egyptian company having received the certificate of Demeter (the Bio-Dynamic Association of traders). Its products are exported to 17 member states of the European Union.

Education and further training of the employees and contracted farmers is organized by the EBDA.

Besides the company‘s management, SEKEM further impresses by the anthroposophical philosophy embodied by its founder. This does not only refer to the careful treatment of the environment but also to the attentive recognition of the human being. Respectively, medical attendance and comprehensive education is locally provided to the employees and their families.

Kledal, El-Araby and Salem [2008 p.163] describe the following future prospects for Egypt: “Growth in the Egyptian organic sector aimed primarily for export could be expected to take place in the eastern part of the Nile Delta, northern part of the Sinai desert, as well as in the

Upper Nile. These areas are connected to governmental land reclamation plans, and are supported by a good infrastructure linked to both harbour and airport facilities. Likewise, the tourism industry, which has become the most important contributor of foreign funds to the Egyptian economy, could be an area of future domestic growth. Organic farms in the Upper Nile are expanding through sales to hotels and restaurants in tourist places like Luxor, Hurghada and Sharm el Sheikh on the Sinai Peninsula. However, the individual market actors face high transaction costs in searching, coordinating and establishing trustworthy partnerships, as well as in achieving the critical supply demanded by modern supermarket chains, whether domestically or for export. In this regard, small farmers often complain that they can only sell one or two of their products with premium prices. The rest, which are necessary parts of the crop rotation system, are often sold through conventional channels. Similarly, the lack of a regulation for Organic Agriculture in Egypt automatically creates higher costs and necessitates additional control measures for producers and exporters. Therefore, there is an urgent need for governmental action to ratify the regulation to govern Organic Agriculture and to begin building institutions to support organic farmers. The government can also play a crucial role in improving market access and helping smallholders to establish marketing or producer associations, which would aid in the development of supply chains."

*Conclusion*

- The organic sub sector in Africa is mainly based on few large-scale producers who operate successfully on the export market. Nevertheless, the existing structures such as certification bodies and institutes working on Organic Agriculture also provide considerable potential for small-scale farmers to become more involved in the organic sub-sector.
- Furthermore, a central criterion for successful extension is already fulfilled by farmers' openness towards self-organisation. The farmers' interest in and acceptance of Organic Farming is also considered as promising since advantageous effects on the risk of indebtedness, health, and yields can be obtained. Additionally, organic farming systems are often reflecting concepts that have already been applied by traditional systems.
- Among the market entry options, the incorporation into the export market can be evaluated as most promising since respective networks and structures already exist in Africa. Reports on national demand, on the other hand, are uncertain.

- The agricultural sector of the Sahel Zone is dominated by smallholder production practiced by the different ethnical groups. Such smallholder production is generally characterised by low input availability, which in turn can be seen as one factor for the little success of the Green Revolution in the past. Within this context and considering that genetically improvement of seeds is not possible under marginal soil conditions yield augmentation will only be achievable through melioration by simple, locally applicable methods.
- The yield potentials have been proving promising and may even be increased through the mentioned additional measures for further system improvement. Due to its specific adaptation the system hence provides a practicable approach of sustainable land-use allowing the melioration of degenerated soils in semi-arid to arid regions. Even if yields are not increased considerably, the production system is likely to be accepted. Actually, Kriegl (2001) reports that no complaints arose on this issue and emphasizes farmers' superior interest in secured harvests, as assured by the Tassa Method.
- The potential for market-oriented production is particularly given for local markets since the system is especially adapted/ developed for the production of crops (sorghum, millet) with high importance in the societies of the Sahel Zone. It can, therefore, be concluded that a considerable demand for such crops produce under organic certified standards is existent.
- The exemplary system of Double-Digging can be evaluated as promising since it is applicable to the production of several horticulture crops which are already exported by large-scale producers.
- Characteristic for a successful export-oriented production is the strict adherence to the principles of Organic Farming. As the example of the SEKEM farm shows, it is especially a combination of agroforestry systems with a targeted humus management that allows a sustainable and profitable production under arid conditions.

### 4.2. Case studies from Asia

*Area under organic management*

"The total organic area in Asia is nearly 3.1 million hectares, managed by almost 130'000 farms. This constitutes ten percent of the world's organic agricultural land. The leading countries are China (2.3 million hectares), India (528'171 hectares) and Indonesia (41'431 hectares). The highest shares of organic land of all agricultural land are in Timor Leste (6.9 percent), Lebanon (1 percent), Sri Lanka and Israel (0.7 percent). Wild collection plays a major role in Azerbaijan, India and China (all with more than one million hectares)." [Willer, Yussefi-Menzler, Sorensen 2008, p.18].

*Asian Organic Market*

"The Asian market continues to show high growth in terms of organic food production and sales. Organic crops are grown across the continent, with some countries becoming international suppliers of organic commodities. China is well-established as a global source of organic seeds, beans, herbs and ingredients. India, Thailand and the Philippines are also becoming important producers and exporters ... ."

Demand is concentrated in Japan, South Korea, Singapore, Taiwan and Hong Kong, the most affluent countries in the region.

As in other parts of the world, demand is surpassing supply with large volumes of organic foods imported into each country. The number organic trade fair is also on the rise, a reflection of the growing demand." [Willer, Yussefi-Menzler, Sorensen 2008, p.18-19].

"The Asian market is showing high growth because of widening availability and rising consumer awareness. A growing number of conventional food retailers, especially those in the big cities, are introducing organic products. The number of dedicated organic food shops is also rising, with many new store openings in countries like Singapore, Malaysia and Taiwan.

Some large food companies are also coming into the market and introducing organic lines. Consumer awareness for organic foods is rising partly because of the high incidence of health scares in recent years. The scares, some involving food, are raising consumer awareness of health issues and stimulating demand for organic products. Important health scares were the

Avian flu, the Severe Acute Respiratory Syndrome (SARS) while those involving food included cola drinks (India) and tofu (Indonesia).

Although organic food sales are rising, consumer demand remains subdued partly because of the low spending power of most Asian consumers. Organic food prices are exceptionally high in some Asian countries. In Japan, Taiwan and Singapore, some organic foods are priced 4 - 5 times as much as non-organic foods. Since most finished organic products come in from countries like Australia and the US, distribution costs and import tariffs inflate product prices." [Willer, Yussefi-Menzler, Sorensen 2008, p.55-56].

*Policy support, regulations*

Organic regulations have been established in eleven Asian countries, and another eight countries are in the process of drafting organic regulations. Organic regulations tend to be mandatory in importing countries and voluntary in exporting countries. Israel and India have attained equivalency status with the EU regulation on Organic Farming.

Organic Farming increasingly receives government support, which is often reflected through the establishment of national regulations. Several countries, however, also have support programs for Organic Farming (India, Indonesia, Japan, Republic of Korea, Thailand, and Vietnam).

*Key restrictions / Unused potentials / Restricting framing conditions*

By establishing itself as viable alternative, the organic movement has become a multi-billion dollar business in Europe and North-America and has become a so called "The industrial Organic Complex". Yet, Asian farmers have not been included in this global picture. The idea of growing food that captures high-value market to boost farm incomes simply has not reached many farmers in Asia, especially farmers growing rice.

Mentioned problems in Vietnam are (own investigations):

- Small production area per household/Very small production units (Organic crop must be at a minimum 2 meters away from conventional crops)
- Export of raw products / no processing
- Lack of infrastructure / few investment incentives
- Low technology level

- The use of pesticides and fertilizers by the farmers is often not regulated in conventional farming systems
- Quality and origin of seeds cause problems.

In China, addressed problems are to develop the organic food standards. Currently, it is showing in three aspects: low standards, low degree of standard and poor identical with international standards. Lu Zhenhui [2002, p.123f.] reported the following persisting problems in Organic Farming in China:

- "… The overall quantity of organic production and trading is rather small at present. Organic operations are scattered throughout China and their production scales are limited.
- The domestic market for organic food is underdeveloped. Thus, most producers and trading companies depend on overseas importers and markets; they are producing organic food on request which carries high economic risks.
- Organic products from China are mostly raw materials; processing and packaging are of low quality. Therefore, producers earn comparative low prices and the margins for international traders and processors are high. This creates no incentives for establishment of local production systems.
- There is no legal framework for Organic Farming and a decision has not yet been taken by the government which authority should have the mandate for the elaboration of regulations and laws or setting up a certification authority. Without a regulatory framework, foreign traders and certifiers are operating according to the importing countries' requirements only; this leads to contradicting and arbitrary decisions on what should be "organic".
- Producers and processors lack the special knowledge on organic production technologies. Qualified advisors are virtually non-existent, and the lack of professional know-how in China probably forms the biggest constraint for the extension of the area under organic cultivation."

Pahnwar [2004, p.404] reports follow constraints for Organic Farming in Pakistan:

- "... Restrictive trade policies perverse subsidies and bureaucratic regulations ...
- Farmer´s rights and protection of traditional plant varieties."..."Small farmer have little access to information on World market prices, lack of transparency and politically inspired distortion, small farmer usually receive low prices for their produce. Farmer has insufficient information on improved technologies and scientific understanding of the process involved in their farming system, in efficient extension service ...

- Government price policies, monopolies on market of agriculture produce, causing low agricultural income.
- Organic Agriculture requires time and well trained extension workers. Since Organic Farming is a new practice it needs competent and reliable management."

*Desirable / necessary changes in framing conditions*

The differences in the social economic conditions, geological conditions and in some cases cultural practices between Asia and western agricultural systems need to be recognized by the global organic community and amendments made to the IFOAM basic standards.

Policy needs for action [Lu Zhenhui 2002, p.124-125]:

- "Establishment of a legal framework for organic standards
- Co-ordination and standardization of organic certification
- Development of policy incentives
- Better information networks among producers and traders
- Development of professional support services
- *Development of vocational training*: Specialized technical knowledge would have to be developed and disseminated both in agricultural universities and among the practitioners within the extension system. Building up the know-how in Organic Farming would like a strong link between theory and practice."

*Potential for improvements / Technical / organisational solution*

Typical organic crops are rice, tea and cotton in Asia. The following case studies describe different organic rice production systems.

Rice is the stable diet of more than 3 billion people in Asia. The respective production and consumptions accounts for 90 % of the world's rice sector. In India it represents the main stable food crop, covering an area of about 45 million ha and contributing to approximately 45 % of the total cereal production [Raman and Kuppuswamy 2004 p.129].

Due to its major importance, rice also becomes increasingly relevant to the organic sub-sector. In Kerala, India, respective organic practices for paddy cultivation have already been adopted long time ago. Many of those are still relevant and are also suitable for application to other Asian countries [Devadas 2004]. In the following, two systems of organic rice production will be presented and analysed for their potential.

### 4.2.1 The Kootumundakan System - an example of mixed cropping in India

Mixed cropping of rice varieties with differing photo sensitivities is the traditional form of rice cultivation practiced in many rice-producing regions [Mathew and Elsy 2004, p.104]. One example described by the authors Mathew and Elsy [2004, p.104] represents the Kootumundakan system found in Kerala, South India. It is characterized by the cultivation of a mostly photosensitive dry season variety with a long live cycle in coexistence with a photo insensitive wet season variety with a short live cycle. Both are sown simultaneously in the wet season. The early maturing wet season rice is already harvested when the dry rice is still in its vegetative stage of the shooting. The cut of the crop is done at an elevated height in order to leave more residues on the fields, which facilitate the increase of organic matter formation and encourage ratoon growth during the dry season. To encourage the decomposition of the stubbles remaining after the harvest of the wet season, the water level in the fields is raised for about 10 - 15 days up to a level of 15-20 cm. After this, no more cultural measures or manuring is done for the dry season crop. The dry season crop then behaves as a ratoon crop and develops shoots. Harvesting is finally done at the end of the normal dry season [Mathew and Elsy 2004, p.104].

According to the description given by Mathew and Elsy [2004, p.104], the system is generally applied to traditional cultivars. For the wet season, Aryan (PTB 1), Ponnaryan (PTB 2), Chenkazhama (PTB 26), Aruvan Vella, Tula, Vella, Kayama etc. are used as photo insensitive local cultivars with a long life cycle. The photosensitive local varieties with short life cycles used for the dry season include e.g. Vellari (PTB 4), Chettadi, Kutti cheradi and Mundon.

*Benefits/Yield potential*

Among the benefits of the Kootumundakan system ranks the considerable reduction of production costs resulting due to the no longer required expenditures for field preparation and transplanting of the dry season crop. Bridgit et al. [1994 in Mathew and Elsy 2004, p.104] reports this savings to amount for a range of 139 – 159 dollars. The cost-benefit ratio will be improved, increasing the respective net income. Advantageous effects on the sustainability of the soil as production base will then further add to the long-term benefits. These derive from the nutrient recycling by crop residues which facilitates the formation of organic soil matter. It is also due to this low input character and independency from mineral nutrient supply that

Kootumundakan is finally considered as a unique and suitable system for organic rice production despite its moderate yields [Mathew and Elsy 2004, p.104].

*Improvement potential and technologies*

The their declining availability of organic inputs such as fertilizers raises their prices, which consequently demands for the application of cost-saving technologies in organic rice production. Among these, alternative choices of economically and agronomical effective organic manure represent one option. Another even more comprehensive approach consists in the avoidance of external organic inputs. As practiced in India, this can be achieved through the adaptation of traditional systems as effective models for organic nutrient recycling [Mathew and Elsy 2004, p.99].

In this context, In-situ green manuring in rice has been revealed as one possible technique providing considerable long-term benefits. Mathew et al. [1996 in Mathew and Elsy 2004, p.99] conducted a 12-year study from 1978 - 1979 to 1989 - 1990 on a sandy loam soil where four rice-based cropping systems have been evaluated. Those included Rice-Rice-Fallow, Rice-Rice-Daincha (*Sesbania unguiculata*), Rice-Rice-Sesamum (*Sesamum indica*) and Rice-Rice-Cowpea (*Vigna unguiculata*). The obtained results were green manure yields of 15.1 and 20.1 t/ha for cowpea and daincha respectively, which have been accumulated within a short time span of six to eight weeks.

Variation among the cropping system was shown for the grain yield of wet season rice, which immediately followed the fallow and other crops in the sequence. The highest yield was achieved by rice-rice-daincha, closely followed by rice-rice-cowpea. Consequently, Mathew et al. attributed this significant increase in yields to the N-fixation and organic matter supplied deriving from the cowpea and daincha. Other authors have also been reporting similarly raised yields from growing green manure and leguminous crops in rice systems [Antil et al. 1989 in Mathew and Elsy 2004, p.100]

For the following dry season on the other hand, no influence of the cropping system on grain yields has been recorded. According to the authors, this emphasises the necessity of a constant manure application during each season in tropical soils. Mentioned background is the very fast decomposition of the organic matter in tropical soils, which consequently requires additional supply in order to maintain its productivity-level. This is particularly highlighted for coarse textured soils with low organic matter input. For a respective manure application the Kerala Agricultural University [2002 in Devadas 2004, p.111] recommends the antedated application/ land preparation to allow a 15 days period for proper antecedent decomposition of the incorporated material.

Apart from the rotational approach, IRRI [1992 Mathew and Elsy 2004, p.100] further concludes in-situ integration of green manure / leguminous crops as an appropriate measure to economize organic manure application and to facilitate the maintenance of soil fertility, increase organic carbon content and improve physical soil properties. Among others, Sunnhemp (*Crotalaria juncea*), daincha (*Sesbania aculeate*), *Sesbania rostrata* and Wild Indigo (*Tephrosia purpurea*) are mentioned as ideal green manure crops for respective in-situ growing of rice. Similarly, the Kerala Agricultural University [2002 in Devadas 2004, p.111] recommends intercropping of cowpea for dry-seeded paddy rice. The respective ratio is defined by 12.5 kg cowpea seeds per hectare, spread along with the paddy rice.

Seed management is another approach suggested by the Kerala Agricultural University [2002 in Devadas 2004, p.111]. Starting from the purchase of certified quality seeds, this covers appropriate storage and possible enhancement of the storability. Besides the recommendations of optimal moistures with less than 13 % and the use of herbal insect repellents, alternate hydration-dehydration is described as a particular technique to retain the viability of storage for further 2-3 months. Soaking seeds in water for 4 hours and subsequent drying under shady conditions back to the original moisture content is the respective method indicated.

To improve pest and disease control, the establishment of perennial trees and shrubs along field boundaries is stated as a measure with beneficial effects from increased biodiversity. Devadas (2004, p.109) particularly refers to the promotion of bird populations in the production site. Furthermore, the author recommends physical barriers in the form of compound walls of 1.50 metres height and underground walls of 1 metre depth. Using thick polyethylene sheets, these should be constructed along the field boundaries. A roper fertilization policy is also mentioned as an accompanying measure, particularly relevant for nitrogenous material. Over dosage has to be avoided since it results in pest and disease infestations.

Finally, plant protection can be extended through additional measures recommended by the Kerala Agricultural University [2002 in Devadas 2004, p.111]. These include:

- Usage of light traps.
- The control of leaf folder by opening the leaf folding using a thorned twig.
- Destruction of collateral weeds and hosts of pests and diseases.
- Control of the stem borer by insect pheromones like hexadecanol or hexadecemol.
- Drainage of water from fields in order to control case worms.
- Spray of fresh cow dung extract on plants to control bacterial leaf blight (supernatant liquid from 20g cow dung dissolved in one litre of water).
- Usage of *pseudonomas fluoresces* for seed treatment and foliar spraying in order to control fungal diseases.
- Application of neem cake as manure in order to control insect pests.

Devadas [2004, p.109] further indicates that the risk of yield losses from pest or disease infestations can be overcome by the application of the measures mentioned above. He refers to a study described in Naturland (2002) which revealed the potential of rice to compensate leave damages of 30 - 40 % and tiller damages of 10 - 20 %.

### 4.2.2 The Rice - Duck Farming System – an example of integrated organic rice production in Southeast Asia

Duck farming is a traditional backyard activity developed by small-scale farmers in order to supplement household income, similarly to the keeping of indigenous chicken. Respectively, traditional practices of incubation using charcoal or by individual brooding were used for the hatch of the ducklings. Once the nests are left, the ducklings were raised in paddy field areas, near lakes, used tin-mine ponds, canals, streams, or along coastal areas. Required supplementary feed was provided from residual rice-bran or broken rice from harvesting. Shrimp, snails, trash fish or seashell are also fed as a source of calcium [Hossain 2004, p.153].

Nowadays, such smallholder duck production is still largely dominating the duck industry in Southeast Asia. Only a very small number of intensively producing commercial farms engaged in this particular sector [Hossain 2004, p.153].

Figure 11: The Rice-Duck Farming System. Santamaria 2006

The rice-duck farming system refers to organic combination of rice cultivation with duck rearing, which releases ducklings into paddy fields and takes advantage of the *polyphagia* and hearty appetite of the ducklings who eat up weeds and insects in the paddy fields. Furthermore, the incessant activities of the ducklings bring about the effects of intertillage and turbid water which stimulates growth of rice. At the same time, dropping from the ducks is left in the paddy as manure. Therefore, the rice-duck farming system is a kind of ecology-oriented comprehensives agricultural technology that combines crop cultivation with duck rearing, saves labour and cost, and increases benefits.

*Potentials for sustainability*

Benefits of the Rice-Duck Farming System have, among others, been observed by Furuno [1996 in Hossain 2004 p.163]. He describes a better development of the root system accompanied by enhanced tillering. The occurrence of such effects might be explained by the following processes:

- The animals nourish themselves as "all-eaters" of weeds and noxious insects in the field and thereby fulfil an important phytosanitary function.
- The excrement of ducks contributes to the nutrient supply of the rice plants.

- As result of the movement of the ducks in the watered rice field an aeration and a mixing of the soil-similar as with harrows takes place. At the same time the soil structure is improved.

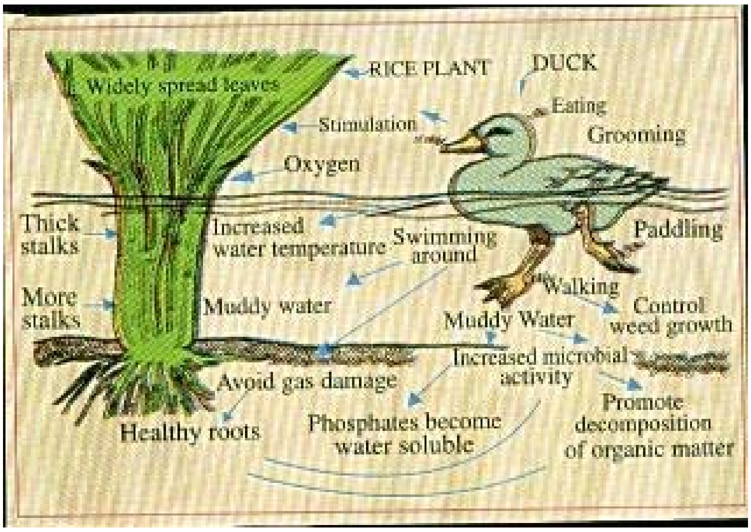



Figure 12: Benefits of ducks
http://www.knowledgebank-brri.org/rice-duck/Rice-cum-duck %20Farming %20-%20an %20Abstract.pdf

The basic principle of this cultivation system is to profit from the natural behaviour of the ducks. Except for the establishment of a protection fence around the field no employment of additional technique and no increased work is necessary, which is why the crop farming system combined with duck farming in the ecological rice cultivation is currently widespread in South Korea. Approximately one third of the enterprises which produce environmentally sound rice use this procedure [Chang 2004].

*Yield potential*

The economic success of environmentally sound enterprises depends on their yields, production prices and costs. The average yields from the studied organic rice stands were 36.07 dt/ha. These were significantly lower than the yields from conventional rice cultivation, which were 66.40 dt/ ha [Chang 2004].

Economically, the lower yields were compensated by significantly higher producer's prices. The producer's prices for organic rice were on average 51 % higher than for conventional rice. Thus, in the enterprises analyzed, an average gain of 256.25 EUR/dt was obtained [Chang 2004].

Data on operating costs was not available. But according to the statements of the plant managers the profit situation is not satisfying despite the higher producer price. This was owed to different reasons: the cost of labour, organic fertilizer and marketing in the examined organic farms was higher than in the conventional rice cultivation.

However, these results stand in contrast with the statement of Hossain [2004, p.163], characterising duck raising to reduce costs of fertilisers, pesticides and labour. The related evidence is given by Kim (1997 in Hossain [2004, p.163] who reports income increase of 73 - 77 % achieved through rice-duck farming as alternative to conventional rice farming in South Korea.

*Improvement potential and technologies*

The integration of fish as another component into the organisation of the rice-duck system could, according to Hossain [2004, p.163], improve its nutrient recycling and provide a second cheap source of protein. So improved nutrient use efficiency will finally be reflected by a higher productivity of the system. Causes are the elevated level of integration incorporating additional synergic effects on nutrient enhancement, pest control (weeds, insects, and golden apple snails), feed supplementation and biological control.

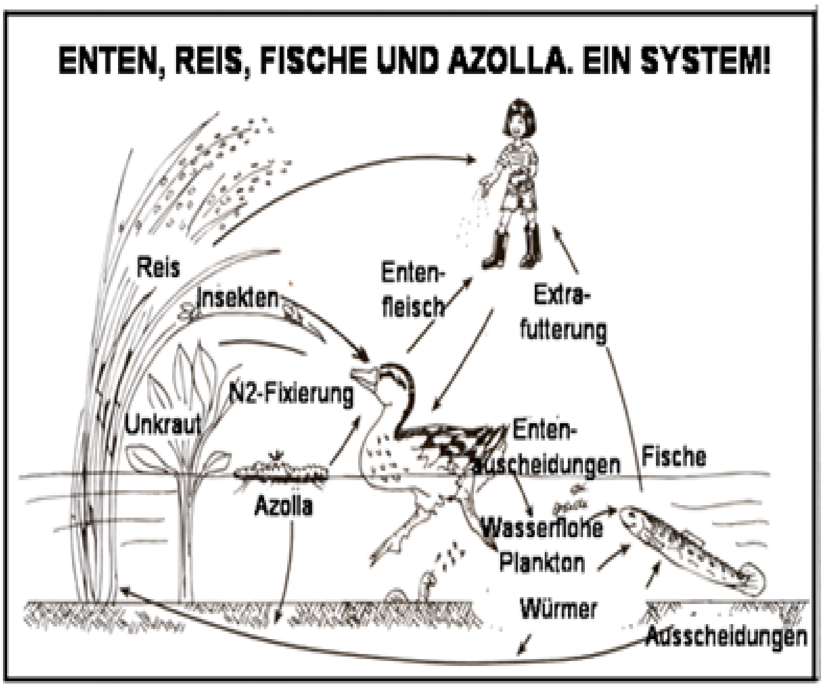



Figure 13: Improvement of the rice-duck-farming system. Santamaria 2006

*Conclusion*

According to Zhang Jibing et. al [2004, p.3-8] and Chang [2004], the economic, ecological and social benefits are significant. Especially the rice-duck farming system is an excellent model for agricultural production that brings about bump harvests from both the ducks and the rice, and both the output and the profit as well.

Chang [2004] described the following opportunities for organic rice production in South Korea:

- South Korean consumers have a particularly high interest in nutrition and health questions.
- Ecological agriculture has been supported since 1991 with public subsidies.
- Public programmes for the protection of the environment create a positive image for the consumer.

She identified the following weaknesses of the Korean Organic Farming system in her study:

- The farmers' knowledge of innovative organic cultivating techniques is not sufficient.
- The working funds for organic manure are scarce.
- There is not enough labour force.
- Capital for investments, e.g. for processing and marketing, is lacking.
- The cost of production is high.

She noticed as risks:

- The absence of special professional marketing structures for ecological agricultural products is often causing sales problems.
- Because of the growing number of ecological farms and imports of ecological products the competition on the national market is increasing.
- After the introduction of the Codex Alimentarius in July 2003 the control of ecological products in international trade has become even more severe.
- The national system of certification for ecological food is not sufficiently known to the consumers.

## 4.3. Case studies from Latin America

*Key actors*

Two main types of Organic Farming are differentiated in Latin America as well: First, there is the export-oriented Organic Farming and second, there is the bottom-up development from small farmers.

The first one is supported by international trade organizations. Most are big estates or farms, which often produce a single product (for example coffee, bananas or avocados). The regulations for this organic production are the same as in the import countries (e.g. Europe, Japan or USA) [Hoffmann 1998, Hoffmann and Kachel 1999].

Export-oriented companies are usually well equipped with capital and their owners have good relationships to international trade organizations. They can afford to pay the fees for the control and certification organizations were the price for organic production is higher than for conventional products. The owners are often typical self-made men. They contact the traders directly and cooperatives are uncommon.

The second direction is often supported by international NGOs, especially churches or private foundations. The idea is to help the inhabitants improve their livelihood as well as stopping the destruction of nature. Café Mexico for example, is organically grown and processed by over 1000 indigenous peasant families, or “Campesinos” in the remote highlands of southern Mexico. “In a recent study by Jorge Vieto, from Centro de Inteligencia Sobre Mercados Sostenibles (CIMS), there are around 63’000 organic coffee producers in Latin America, averaging 2 to 4 hectares of certified land. These small producers are responsible for 90 percent of the total production. There are more than 300 certified exporters, mainly cooperatives and farmers’ associations, but also some private companies. A large part of Peru’s and Bolivia’s coffee production is already organic. When, as in 2001, the price of the coffee is too low, farmers derive more income from their diversified production, selling tropical fruits to small processing plants. In Costa Rica this alternative is called ‘Organic Integrated Farms.’“[Willer, Yussefi-Menzler, Sorensen, 2008, p.170-180].

Depending on the kind of crops the size of the farms is different. In Argentina for instance, 76 % of the organic land is found in Patagonia with an average size of 2.700 to 55.000 ha per farm. 606 certified farms with an average size of 28 ha are located in Misiones Province, in the North east. 80 % of the organic land is devoted to livestock and especially sheep production [Hillebrecht 2005, p.11].

*Area under organic management*

“In Latin America, 223'277 farms managed 4.9 million hectares of agricultural land organically in 2006. This constitutes 0.7 percent of the agricultural land in Latin America. Sixteen percent of the world's organic land is found on this continent. The leading countries are Argentina (2'220'489 hectares), Uruguay (930'965 hectares), and Brazil (880'000 hectares). The highest shares of organic agricultural land are in Uruguay (6.1 percent), followed by Argentina (1.7 percent) and the Dominican Republic (1.3 percent)” [Willer, Yussefi-Menzler, Sorensen, 2008 p.19-20].

*Latin American organic market*

“Most organic production in Latin America is for export. From the coffee grains and bananas of Central America to the sugar in Paraguay and the cereals and meat in Argentina, the trade of organic produce has been mostly oriented towards foreign markets. Countries like Argentina, Brazil and Chile have become important producers; however, over 90 percent of their organic crops are destined for export markets. In Argentina for example, 90 % of the organic production is for export, and 69 % of the export is for the EU.

The most important exports to the EU are cereals, oilseeds, fruits, beef, wool and honey. The domestic market has been constantly growing in the last years.

Most organic food sales in these countries take place in major cities like Buenos Aires and São Paulo” [Willer, Yuseffi-Menzler, Sorensen 2008, p.20].

*Policy support, standards, and regulations*

“Fifteen countries have legislation on Organic Farming, and three additional countries are currently developing organic regulations. Costa Rica and Argentina have both attained third country status according to EU regulation on Organic Farming.

Apart from regulatory support, many governments are now drafting action plans or similar programs. Furthermore, there is support for export promotion and for research” [Willer, Yussefi-Menzler, Sorensen 2008, p.20].

“No Latin American country has subsidies or economic support for organic farmers. There are however, several other forms of government support for Organic Farming. In many Latin American countries, Organic Farming is legally protected through laws.

- Costa Rica, Brazil and some others have funding for research and teaching.
- Some countries have programs for the promotion of Organic Farming, such as Brazil.
- Argentina, Bolivia, Chile and other countries have had official export agencies helping producers attend international fairs and print product catalogues.

In general, however, the organic movement in Latin America has grown on its own accord, with some seed funding for extension and association building by international aid agencies, especially from Germany, the Netherlands and Switzerland. International trade has been stimulated by buying companies and fair trade agencies, focusing especially on some basic products like coffee, bananas, orange juice and cocoa” [Willer, Yussefi-Menzler, Sorensen 2008, p.173].

With more less three million hectares, Argentina accounts for almost 50 % of all organically managed land in Latin America. Advantages are a wide range of organic products and export of fresh perishable products during the northern winter (Hillebrecht, 2005). “Argentina was the first third world country to have adapted a national regulation to the EC guidelines in 1992. There are 12 national certifiers, three of them with a strong international activity” [Willer, Yussefi-Menzler, Sorensen, 2008, p.175].

One of the peculiarities of the Cuban Organic Farming movement is that scientists from different universities founded it together. These people founded the first Cuban organization for Organic Agriculture called ACAO (Associacion Cubana de Agricultura Organica). Cuba had a very sophisticated teaching and research project carried out by ACAO. The group has been awarded with the alternative Nobel-Prize. ACAO is a member of the IFOAM. The Ministry of Agriculture in collaboration with ACAO is developing rules for production and certification. It is planned to erect an international certification institution. In Cuba, the leading personnel are well educated and supported by the national research institute INIFAT. Scientists of INIFAT developed special handbooks for the producers and organize courses for them [Hoffmann 2000].

*Potential for improvements / Technical / organisational solution*

In Latin America, typical organic crops are coffee, cocoa, fruits and vegetables. The following case studies describe the organic coffee production and two low input Organic Farming systems which are based on traditional indigenous production systems. Furthermore, an experimental organic garden in Argentina it will be explained. Finally, the urban Organic Agriculture which is a particularity in Cuba will be introduced.

### 4.3.1 Export oriented organic coffee production – an example from Chiapas/ Mexico

Coffee is one of the most important products in world trade. There are more than 70 producing countries worldwide. 20 – 25 million persons are linked to coffee production and coffee trading. Arabica coffee *(Coffea arabica)* and Robusta coffee *(Coffea canephora)* are typical varieties of coffee.

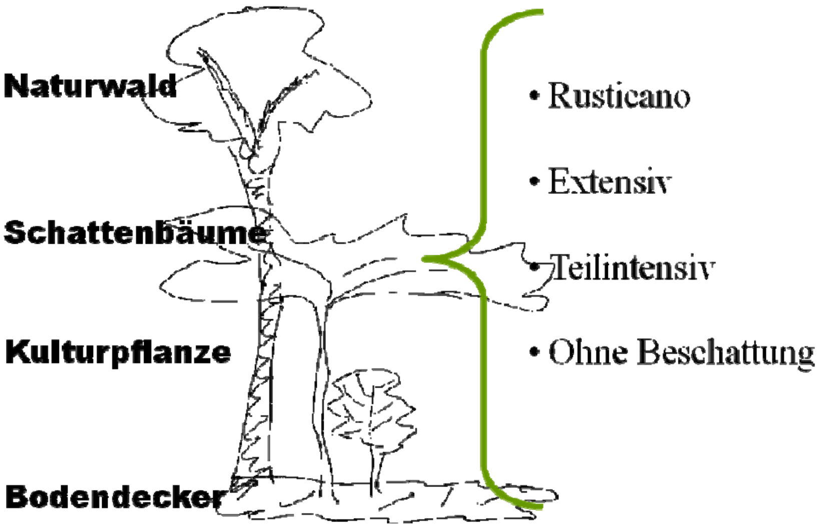



Figure 14: Current coffee cultivation systems. Pohlan 2002, p.251

For economic and ecologic reasons, coffee plantations do commonly manage their own proper coffee nursery. The annual replacement of old coffee plants amounts to 5 % of the stands. The plant density is 2000 coffee tress/ ha which are cultivated in a distance of 2 m x 2, 5 m. The tree-rows are established in alignment with the contour lines of the hillside (inclinations of 30 - 45°). Shadow trees are used (500 - 600 trees/ha). The management and cultivation practices include: Regulation of shading, care of coffee trees and, after the dry season, manual weed regulation done 3 to 4 times per year. Manuring is done by the application of organic compost which consists of 60 % pulp, 15 - 20 % semi-liquid manure,

manure, 5 – 10 % granite culm for the potassium content, and slaked lime to balance the pH since pulp tends to acidification. These components are added in layers to a clamp silo and stored for about 6 weeks until the conversion process is finished.

The pest management against the coffee berry borer is done through the application of Ichneumon wasps and the fungy *Beauveria bassiana*. Fungal diseases, such as Coffee rust *(Hemileia vastatrix*) and American leaf spot (*Mycena citricolor*) are prophylactically combated during planting. Solar radiation and wind circulation are used to dry the respective areas.

The harvest of the ripe coffee beans takes place from September/October until February/March. Further processing of the coffee bean is usually done on the farms, immediately after harvesting [Gäbler 2003].

*Yield potential*

The productivity of large-scale organic coffee farms is often lower compared to the conventional producers (Table 3):

The yields of coffee vary significantly over the years. The figures are recorded by smallholders and represent average yields.

Again it is to be noted that the numbers are to be seen as estimates since exact data is virtually non-existent.

Table 3: Comparison of yields in organic and conventional coffee farming systems in Mexico/area Chiapas/Soconusco. Gäbler 2003

| Yields (raw coffee with 12 % water content, kg/ha) | | | | | |
|---|---|---|---|---|---|
| **Smallholder production (≤ 2ha)** | **Conventional production** | | | **Organic production** | |
| | Ejidos | Semi-intensive* | Intensive** | Bio-dynamic (Finca Irlanda) | Cooperatives |
| 184 -368 | 276-552 | 460-1012 | 920-1288 | 644-828 | 460-736 |

* Semi-intensive refers to coffee production below shadow trees. Agrochemicals (frequently including herbicides) are applied according to the requirements.

** Intensive refers to single crop coffee production without shading trees. Agrochemicals are generally applied.

Table 4: Advantages and disadvantages of the organic cultivation system. Gäbler 2003

| **Advantages** | **Disadvantages** |
|---|---|
| Improvement of the soil fertility | High labour input |
| Resource conservation | Reduced yields |
| Increased biodiversity | |
| Reduction of soil erosion | |
| Better marketability of “Special Coffee”, implicating potential of higher product rewards | |

### 4.3.2 The Chacra System – an example of Organic Farming based on traditional indigenous production systems in the lowlands of Ecuador

The Chacra represents a traditional production system as shifting cultivation in tropical low-lands of Ecuador and is derived from the pre-Columbian age. Nowadays it continues as a central element of the quichuan culture, the prevailing local ethnic group. One reason for its remaining importance as a production system [Dimter 2003, p.30] might be found in the particularity regarding the actors involved in the production system. As pointed out by Dimter [2003, p.14], all responsibilities and management authorities of the system are given to the women who are further described to identify themselves proudly with this exceptional role [Dimter 2003, p.29].

Furthermore, cassava represents the most important crop and dietary basis for the ethnical quichua groups of the Amazonian region in Ecuador [Dimter 2003, p.23].

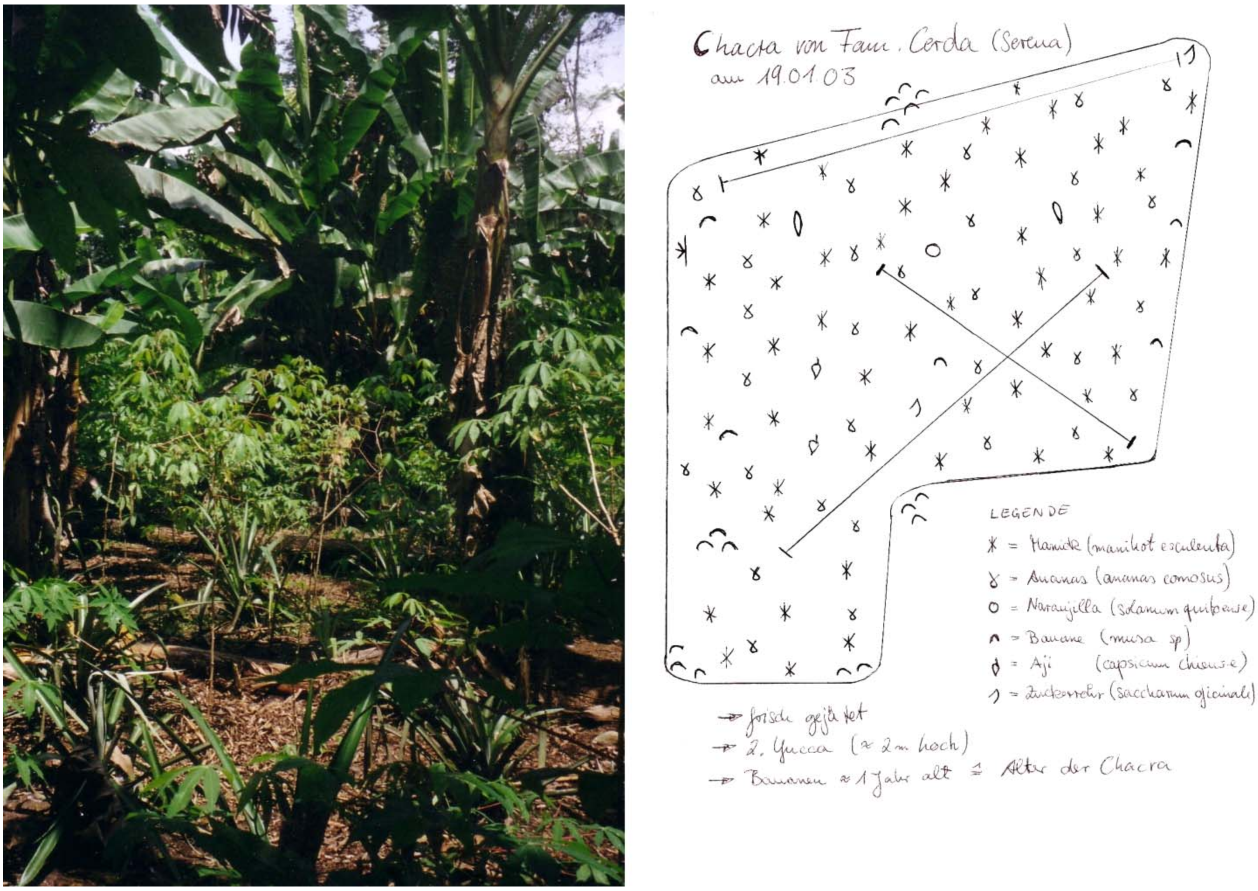



Figure 15: The Chacra-System – Example from the Quijos-Quichuas Indigenas, Ecuador [Dimter 2003, p.17]

Originally developed from slash-and-burn peasant farming, the Chacra system constitutes of the sequential cultivation of cleared lands for a short period of 2 to 3 years, finally followed by a long-lasting fallow period of between 5 to 20 years [Dimter 2003, p.14]. The respective parcels with a size of 0.2 to 0.5 ha are cultivated with traditional crops, particularly cassava and banana. Within these, diverse other crops (Pineapple, beans) are grown in mixed cropping systems (Table 5).

Table 5: Crops in a Chacra System in Ecuador [Dimter 2003, p.24]

| **Botanical name** | **English** | **Spanish** | **Quichua** | **Variety** |
|---|---|---|---|---|
| *Anona muricata* | Soursop | Guanabana | Anona | 1 n |
| *Arachis hipogaes* | Groundnut | Mani | Inchi | 9 |
| *Hylocerus triangularis* | | Pitayaya | | |
| *Bixa orellana* | Achiote | Arnatto | Manduru | 10 n |
| *Capsicum chinense* | Chillie | Aji | Uchu | 10 n |
| *Carica papaya* | Papaya | Papaya | Papaya | 1 n |
| *Citrus* | Lemon | Limon | | |
| *Coffea sp.* | Coffee | Cafe | cafe | 2 i |
| *Colocasia esculenta* | Cocozam | Papa china | Papa china | 4 |
| *Inga edulis/sp.* | Ice cream beans | Guaba | Pakay | 1 i |
| *Lycopersicon sp.* | Tomato | Tomate | Tomati | 1 n |
| *Manihot esculenta* | Manioc | Yuca | Lumu | 31 |
| *Musa sp.* | Banana | Platano | | 29 i |
| *Ananas comosus* | Pinapple | Piña | | |
| *Persea americana* | Avocado | Aguacate | Aguacate | 1 n |
| *Phaseolus vulgaris* | Common bean | Frejol | Puruntu | 14 |
| *Pouteria caimito* | | Caimito | Caimito | |
| *Saccharum officinarum* | Sugar cane | Caña de azucar | | 4 i |
| *Solanum quitoense* | Naranjilla | Naranjilla | Naranjilla | 1 n |
| *Theobroma cacao* | Cacao | Cacao | Cacau | 2 n |
| *Thoebroma subincanum* | Wild cacao | Cacao silvestre /del monte | | 1 n |
| *Xanthosoma sp.* | | Pelma | Mandi | 15 |
| *Zea mays* | Corn | Maiz | Zara | 5 n |

*Yield potential*

Rhody [2008, p.20] resumes from archaeological findings on population data that even the traditional slash-and-burn system ‘Milpa’ has been able to provide food for a higher population than the present one in Yucatan, Mexico. According to the mentioned numbers of Dunning [1994 in Rhody 2008, p.20], the system has had the potential to feed at least 267 people per square kilometre within this region during the pre-colonial era.

*Constraints*

Potential of income creation through the production of valuable organic cash-crops using the Chacra System is rather low due to its limited production intensity. Nutrient requirements for such crops can hardly be met by an organic Chacra System on the respective soil conditions. This is exemplified by Dimter's [2003, p.16] findings which, for rice or maize production, show farmer's preference for burning the weed instead of mechanical clearing. This is a logical consequence since the alkalifying effects of the ash provide hardly extractable nutrients such as phosphor, which are required by such crops.

*Potential for sustainability*

Tropical lowland soils are generally characterized by a low fertility due to low cation exchange capacities of the 2-lime-layer minerals. High decomposition rates result in nutrient losses as nutrient retention of 2-lime-layer minerals is very low. Consequently, the humus content represents a critical sustainability factor as a nutrient buffer. It has a much higher importance for soil fertility than it already has in moderate or upland climates.

Regarding general trends of the socio-economic development, the maintenance of the humus content/soil fertility cannot be assured anymore by the commonly used slash-and-burn production system in Latin America. The reason is the increasing land pressure due to population growth and an observed tendency of increasingly desired income generation, which finally leads to a reduction of the fallow period required for soil recovery [Gündel 1998, p.2].

The Chacra System, on the other hand, can already be categorized as an innovative modification of the Milpa System. Necessary improvements in nutrient management have partly been responded to by the incorporation of innovative techniques aiming at the maintenance of soil humus contents. Burning practices have been replaced by mechanical clearing which reduces carbon losses through emission, erosion and potentially provides more biomass for decomposition. Hence, minimum-tillage practices which delay the oxidative decomposition of organic soil matter after biomass incorporation have been adopted [Dimter 2003, p.31] and therefore facilitate a less concentrated but more prolonged nutrient supply.

The Chacra System has also a promising potential to meet the challenges of a sustainable humus management. Organic matter accumulation is facilitated through the small dimension of the cleared parcels which allows their fast re-colonisation by pioneer plants [Dimter 2003, p.16], and, through the mixed cropping pattern and its potential to reduce erosion. A restricting framing condition is the land availability: Limits of the production system are related to the required fallow period which is strongly dependent on sufficient land availability. When there is not enough land available or when the objective of self-sufficiency shifts towards income creation, as reported for Mexico [Dzib-Aguilar 1987, p.11. In: Gündel 1998, p.43], families start to re-cultivate fallow fields whose soil fertility has hardly recovered since their last use. This becomes particularly problematic for the more innovative Chacra System when land tenure constitutes of less than 5 acres [Dimter 2003, p.14f]. If the land productivity cannot be increased, continuous loss of soil fertility will then require further expansion into the primary forest, as it is described by Jempa [1995, p.89-98. In: Gündel 1998, p.40].

*Improvement potential and technologies*

The potential of mechanical clearing and nutrient provision is still unsatisfactory. Although big tree trunks and stubs are generally left on the fields, Dimter [2003, p.17] assumes problematic nutrient losses from exaggerated clearing techniques. These have been observed as a preventive measure against snake injuries and were attributed to increased decomposition and water erosion. It is therefore recommended to retain some vegetative cover during clearing in order to protect the soil surface. In this context, the adoption of mulching and green manure would be a promising approach as it has been promoted by Gündel [1998, p.53] for a permanent Milpa System. The respective practice of intercropping N-fixing green manure legumes (*Mucuna, Canavalia*) is recommended with focus on improved weed control and soil fertility.

Actually, the far-reaching recommendation of the both authors mentioned above goes even beyond these improvements towards a complete change of the Milpa shifting cultivation approach towards permanent cropping systems. According to them, this represents the logical consequence to respond to the increasing land pressure without horizontal expansion into the tropical rainforests [Dimter 2003, p.49f; Gündel 1998, p.52ff]. Nevertheless, this conclusion is not unconditionally applicable to the organic approach, where production relies on nutrient supply by the environment. Generally, satisfactory nutrient supply from decomposition of minerals can only be expected in hilly border areas of the flat lowlands. As for the organic cultivation of soils with marginal nutrient release the shifting approach based on a fallow period needs to be maintained. Reasons are the edafo-climatic conditions of the Amazonian ecosystems, as it explained by Puhe [1997, p.174ff]. In tropical lowlands, high decomposition rates create very profound soil with almost no parent rocks left for nutrient release. Consequently, nutrient intake is mostly limited to the quantities tied to rainfall which is why nutrient surpluses over time are very low. For the northern part of the Amazon, Reichholf [1990, in Puhe 1997, p.175] reports respective deposition rates of 12.6 kg K, 2.7 kg P and 11 - 16 kg Ca per hectare per year. For Potassium, Reichholf [1990, in Puhe 1997, p.175] further mentions $3/4^{th}$ of the input to be lost through water flows. Consequently, these low surpluses need to be accumulated over a fallow period to quantities sufficient for production.

*Effects for small scale farmers*

Since the smallholders in the Ecuadorian lowlands are usually unable to purchase any chemical products [Dimter 2003, p.33], the Chacra System provides a promising approach to achieve reasonable production with little additional input. Since the labour intensive activity of clearing is traditionally realised through community group work [Dimter 2003, p.28], the system requires only a rather tolerable amount of labour for minimum tillage. Hence, this labour has to be evaluated in its context of representing an activity and responsibility of women. It might be problematic to raise a similar status of women for other activities, because of what a promotion of the system would contribute to the role of the woman. The financial burden of the Chacra System is also low since the most important crops cassava and banana are reproduced in a vegetative way [Dimter 2003, p.31].

Nevertheless, apart from being appropriate and applicable, the successful and sustainable establishment of the Chacra System faces some risks due to the farmers' behaviour. Unless manioc and bean represent important dietary crops, Dimter [2003, p.36] reports those crops to be increasingly displaced by cash crops in order to meet a growing need for purchasable market goods. The higher requirements and lower competitiveness of such substitute cash crops such as maize and rice cannot be met by the system. In fact, the same author reports burning to be preferred over mechanical clearing for the cultivation of rice and maize. The background is the alkalifying effect of the ash, providing hardly extractable nutrients as phosphorus. The focus on high value crops thus represents a negative tendency of farmers' behaviour which can lead to inappropriate modifications/adoptions of the Chacra System. This would further impede the potential for sustainability.

### 4.3.3 The Methods "Cultivos en revelos" and "Wachu rozadu" – examples of organic potato production based on traditional indigenous production systems in the highlands of Ecuador

**Cultivos en revelos** defines a specific pattern of relay cropping of faba beans (*Vicia faba*) and a leguminous-graminaceous pasture in initially established potato in tropical highlands of the Andes.

Similar to monoculture stands, the potatoes are established in rows of 0, 90 – 1, 10 m width. Between these rows, the faba beans are intercropped by direct seeding five months later. Consequently, the potato harvesting activity is combined with the first mechanical weed control of the faba stands. The leguminous-graminaceous pasture seeds are then spread out on the fallow potato rows during the last huddling of the faba plants four months after faba seeding [Chancusig 1999, p.47–72].

**Wachu rozado** on the other hand has been described by Sherwood [2000, p.2f] as a traditional (pre-Columbian) method of minimum tillage for the establishment of potatoes in pasture lands. It consists of the formation of potato seedbeds from lifted and folded pasture sods. The sward is cut off in the desired row distance, lifting one quarter of the sod on each side, which is then folded towards the centre. 30 days later the potatoe seed tubers are laid into the furrow created by the contact point of the folded sods [Sherwood 2000, p.2 f].

Potatoes represent one of the most important crops of the Andean Highland of Ecuador, being cultivated on altitudes between 2.400 – 3.800 m [Pumisacho & Sherwood 2002, p.24]. Particularly in regions exceeding altitudes of 3000 m the respective agricultural sector is largely dominated by smallholders who often rely on potato production as their only income source [Toapanta, 2004]. As little alternative frost-resistant crops are available, potato and faba beans represent major components of the smallholder's diet in these altitudes.

Both methods described above have been characterized as traditional production practices of indigenous communities in the Ecuadorian Andes [Chancusig 1999, p.35ff; Sherwood 2000, p.2]. The present relevance of relay cropping cannot be evaluated since no respective reports could be found. However, this might be interpreted as an indicator for the status of the current relevance to be low. The present application of the Wachu rozado method is also rather uncommon and most farmers of the Andean Paramo highlands make use of conventional tillage [Sherwood 2000, p.5]. Nevertheless, the Wachu rozado method has been reported to be used by 20 % of the farmers in Carchi [Sherwood 2000, p.2], the principal province of potato production in Ecuador. Besides, recent spontaneous adaptation of the system have also been observed in other provinces [Sherwood 2000, p.2]. This indicates a re-evolving interest of local farmers in this traditional practice. Unfortunately, the scarce literature on these two production methods does not provide information on their yield potential in organic production.

*Constraints*

Potato production in the Andes is facing enormous phytopathological problems. Due to the persistent favourable conditions and year-round production, the fungi *Phytophthora infestans* became the major limiting biological factor for potato production in Ecuador [Uquillas et al., 1992, Crissman et al. 1998b, Fortipapa-INIAP 1996. In: Oyarzun et al. 2001, p.1]. Characteristically, control is very difficult and the disease is capable to spread very quickly destroying complete stands within a few days [Oyarzun et al. 2001, p.1]. For farmers who possess additional capital, the adaptation of organic principles in production systems might therefore often result unreasonable. Only the particular climatic conditions of the upper regions of the Andean highland appear to support organic production since high altitudes have been stated as detrimental to the epidemic behaviour of the fungi. Forbes [unpublished in Grünwald et al., p.2] observed the probability of epidemic occurrence to be strongly reduced in altitudes of 3.600 m.

*Potential for sustainability*

The cultivation of the inclined lands of the Andes characteristically goes along with a high risk of soil degradation through erosion. In the case of Ecuador, this is actually considered as one of the most severe environmental problems. Here, the agricultural use of these areas in general is stated as one critical factor, especially the use of monocultures, agrochemicals and deep tillage [Pumisacho & Sherwood 2002, p.28].

Within this context, systems of relay cropping can generally be considered as a promising approach since they are characterized by Altieri [1983, in Chancusig 1999, p.94f] to improve soil protection and fertility as well as biological pest and weed. Respective causes named by the author are increased water infiltration, decreased evaporation through the more continuous soil coverage, and the involved minimum tillage practices.

In fact, Chancusig [1999] reports similar effects for the described system “cultivos en revelos”, concluding its promising potential for the use and improvement of marginal soils [Chancusig 1999, p.107f]. Utilizing the amount of carbon fixed in residuals as an indicator for the effect on organic soil matter content, he found higher potential for organic matter formation for the relayed cropped stands [Chancusig 1999, p.119f]. Although he only compares the relay cropped stands to monoculture stands followed by a fallow period, the reported 44.254 kg fixed carbon /ha/year compared to 7.308 kg/ha/year in the respective monoculture stands indicate a promising potential. Even if the monoculture stands would be followed by another cultivar, carbon sequestration seems to be higher in the traditional system. Reason is the high amount of carbon left on the field from Faba Bean stands with 23.901 kg/ha/year and pasture with 12.116 kg/ha/year given by Chancusig [1999, p.120]. In continuation he also concludes benefits due to less water and wind erosion which he traces back to higher and more continuous soil coverage in the system, particularly pronounced by the pasture [Chancusig 1999, p.130f].

The **wachu rozado** method has also been described as a more sustainable alternative compared to conventional tillage practice. Sherwood [Ed., 2000, p.4f] concludes this mainly from general advantages of minimum tillage practices and from its long lasting approbation as a traditional system. Additionally he refers to farmers’ statements according to which erosion problems from the partial removal of pasture soil cover have not been observed.

*Improvement potential and technologies*

The cropping pattern and temporal extend to which two cultivars are coexisting is a central factor determining the scope of benefits obtained from systems of relay cropping. The most important benefit from interactions between leguminous crops and non-leguminous crops result from the occurrence of nutrient exchange, particularly N, from the N-fixing leguminous crop to the non-leguminous crop [Kass 1978, in Benzig 2001, p.318]. This might be of particular interest since, for conditions of high inoculation pressure as it is the case in the Andes, increased N-supply has been concluded by Metzler [2007, p.44] to reduce the effects of *Phytophthora infestans* incidence on potato yields (through higher leaf growth rates). Modifications in the association pattern and seeding times of the Cultivos en revelos system might therefore comprise potential for further improvements in potato yields. The underlying theory is an increased N-supply by the leguminous crop through higher temporal or special proximity of coexistence based on processes described by Cruz and Martins [1997, in

Benzing 2001, p.319] as well as by Gallotti et al. [1992, in Benzing 2001, p.318]. One exemplary approach could consist in earlier sowing dates of the beans to such extend that their second mechanical weed control is combined with potato harvest.

*Effects for small scale farmers*

Apart from the potential of long term effects on soil fertility, one primary benefit for the smallholders relying on internal available labour inputs is the potential of both methods to increase the efficiency of the labour used. According to Chancusig [1999, p.101], the Cultivos en revelos system facilitates this by the combination of necessary cultivation activities of the two crops as well as by labour savings in weeding. The latter is explained by substances with suppressive effects on weed germination which are liberated through the decomposition process of Oats (*Avena sativa*). The wachu rozado method, on the other hand, has been reported by farmers to require 50 to 75 % less labour than conventional deep tillage [Sherwood 2000, p.4].

Additionally, for smallholders who cannot afford respective treatments, the risk of production can be reduced by a certain potential to control important pests and diseases.

Compared to conventional tilling the **wachu rozado** method has been mentioned by many farmers for *Premnotrypes vorax* as well as for *Phytophthora infestans* [Sherwood (Ed.) 2000, p.3]. Although these effects have not yet been investigated, Sherwood [Ed., 2000, p.3] gives reasonable explanations for their occurrence. It is assumed that the pasture cover has antagonistic effects on the locally most important pest *Premnotrypes vorax* and that it might delay the development and spread of the devastating fungi *Phytophthora infestans* due to the increased drainage (of the downwards sloping furrows) reducing the humidity of the microclimate.

The **Cultivos en Revelos** system, in continuation, has the potential to additionally reduce *Premnotrypes vorax* incidence. This is indicated by the results of Chancusig [1999, p.128], who found a reduction of tubers damaged by the *Premnotrypes vorax* from 10 % in monoculture stands to 4 % in the relay cropped stands.

### 4.3.4 The Bio-intensive Method – an example in a demonstration project in Argentina

The establishment of a demonstration project plays an important role for the development of Organic Farming. As an example, Hillebrecht [2005] describes the garden "*Ing. Jacobacci*" located in the arid Patagonia/Argentina. The objectives are to support Organic Farming, the Bio-Intensive Method and sustainable systems, to develop an alternative of self-sufficiency to the massive emigration from the rural areas to the cities, and to create mini family-gardens.

Figure 16: Experimental garden in "*Ing. Jacobacci*". Hillebrecht 2005, p.634

The soil is very poor regarding the content of organic matter and nutrients. The experimental goal is to test new crops less sensible to frost. Tools are:

- Deep soil preparation and use of natural fertilizer
- Use of seed flats for germination
- Composting and compost crops
- Intensive planting and triangular spacing patterns
- Crop rotation and companion plants
- Use of hand tools and a mechanical watering system.

The organic matter had increased at 30 cm from 3 % to 7 % after 6 years of the implementation of the bio-intensive method in another the experimental garden in *Las Golondrinas*.

*Yield potential*

For many tested crops, yields in the experimental garden were higher as the average yields from the regional conventional production:

Table 6: Yields in "*Ing Jacobacci*" compared to the region average in kg/10 m². Hillebrecht 2005, p.44

| **Crops** | **Region average (conventional)** | **"Ing. Jacobacci" average** | **Difference** |
|---|---|---|---|
| Tomato | 50 | 75 | +50 % |
| Potato | 25 | 39 | +56 % |
| Cabbage | 60 | 130 | +117 % |
| Celery | 50 | 37 | -26 % |

This demonstration garden is a very good multiplier for the people who are interested in organic gardening.

### 4.3.5 Organipónicos – an example of Organic Urban Agriculture in Cuba

Cuba is a very good example for a fast and efficient development of Organic Farming practices. Organic Farming in Cuba has taken off especially since 1989, which was the year of the breakdown of socialism in Europe and in the Soviet Union. This created a complicated situation for the Cuban people, as more than 80 % of foreign trade was cut off. Cuban agriculture was based on large-scale, capital-intensive monoculture. When trade relations with the socialist bloc collapsed, pesticides and fertilizers virtually disappeared, and the availability of petroleum for agriculture dropped by half. Food imports also fell by more than half. The challenge for the Cuban people was essentially to double food production while more than halving inputs. This was one of the reasons why the organic movement developed very quickly.

A peculiarity in Cuba is the development of Organic Farming as Urban Agriculture. Eighty percent of the Cuban population lives in urban and only 20 percent in rural areas. "Urban and periurban farming is producing, processing and selling food and means of production on land and sea, mainly to meet the needs of a city or metropolis" [Smit, Ratta & Nasr 1996, p.108]. In order to produce a variety of vegetarian and animal food, use of intensive production methods, recycling of natural resources as well as urban waste is common. The predominant production system is the horticulture. Further systems are cattle-keeping, fruit-growing, forestry and aquaculture.

Organoponicos are the most common type of garden found in Cuba since the majority of urban soil is of poor quality. These are facilities located in free spaces in the Cuban cities. It is a very intensive but strictly organic plant production. Various vegetable, condiments and medicinal plants provide the bulk of the produce cultivated in these gardens. Typical crops are vegetable like onions, tomatoes, carrots, and leek. Rotation and mixed cropping are common and only organic fertilizer and organic plant protection is used.

Figure 17: Organoponico in Havanna. Hoffmann 2003a, p.82

Cultivation takes place inside containers (*canteros)* or raised beds filled with an organic matter and soil mix. The organic matter is usually transported to the city from rural or periurban farms. Many gardeners combine equal proportions of compost and soil while others mix cachaza (a waste product from sugar cane productions) and soil. The containers are made of cement blocs or discarded construction columns. The size of the gardens varies between 0.5 and 10 ha. Their success is attributed to the use of few external inputs, the application of agroecological principles and their reliance on locally available resources. Each Organoponico has a container that is dedicated to the production of worm humus. After harvesting, residual plant materials are added to the worm compost container and transformed into humus.

The Organoponicos follow an integrated pest management approach:

- *Crop rotation and intercropping*

Crop rotation and inter-cropping are important practices in the Organoponicos. It is recommended that at any given time there should be at least 15 varieties of crops in every Organoponico and gardeners are encouraged to follow crop rotation and cultivate more than one crop in each cantero.

- *Biological control in the form of entomopathogens, fungi and bacteria*

This involves the application of bacteria, fungi and viruses for the control of pests. Examples include *Bacillus thuringensis* (bacteria) for the suppression of various lepidopteron insect pest species and *Trichoderma harzianun* for the control of various bacterial and fungal diseases.

- *Beneficial insects and antagonists*

Various beneficial insects are released in the Organoponicos including *Chrysopa spp*. for the control of aphids and leafhoppers. Antagonists are micro-organisms that protect plants from pathogens.

- *Planting and application of botanical pesticides*

Solutions are prepared from insecticidal plants and applied to infected crops. Some insecticidal plants include Neem (*Azadirachta indica*), which is effective on a wide range of insect pests and Solasol (*Solanum globiferum*), which kills slugs and snails.

- *Insect traps*

There are various innovations that Cubans use to attract and trap pests such as yellow boards coated with a sticky substance. Another trap is made by setting out rays of beer and salt that attract snails and drowns them. Crops such as sorghum are planted around the periphery of the organoponicos or the canteros to attract beneficial insects and deter insect pests from feeding on the main crops.

- *Tillage to reduce the incidence of nematodes*

After the crops are harvested, the canteros are tilled and left to dry in the sun to get rid of nematodes [Altieri et al., 1999, Hoffmann 2003a and b]

*Conclusions*

Typical organic production types in Latin America are export-oriented organic production found mostly in large farms and production for auto consumption by smallholder farmers.

Latin America, one of the biodiversity reservoirs of the world, is just beginning to become aware of the large opportunities of Organic Agriculture. It has the farming traditions, the fertile lands and the varied climatic zones that allow it to produce almost anything in an ecological way. Typical traditional farming systems like the Chacra System and the systems Wachu Rozado and Cultivos en Revelos are based on organic principles which have been developed for subsistence production under marginal soil conditions.

Considering the unfavourable soil conditions and very limited availability of financial capital of smallholders, the Chacra System can be evaluated as a promising system in order to achieve a secured livelihood of the smallholders. Its particular value consists of its applicability for the provision of cassava and also banana as principle dietary components. However, an alternative focus on more intensive production of valuable organic cash crops is hardly reasonable for smallholders under such conditions.

Furthermore, the promotion and ongoing innovative development of the Chacra System involves potential to foster women's status within the society of the communities.

Positive since low nutrient availability does not allow permanent cropping in lowlands.

Although the approaches of Wachu Rozado and Cultivos en Revelos have not yet been described in relation to each other, their combination to an organic production system could create a reasonable alternative for smallholders without financial resources, particularly in upper regions of the Andean Highlands.

Even market-oriented organic production may result feasible, especially in the surroundings of bigger cities with supermarkets.

Furthermore, farmers' acceptance of the system is expected to be high since its components represent traditional practices.

The traditional systems have a potential for technical improvement.

The Cuban urban organic farming practice is well developed. The Cuban association for Organic Farming holds that the previous model was too import-dependent and environmentally damaging to be sustainable, and that the present change is long overdue and that further transformations are needed to develop truly rational productions systems.

*Summary:*

- Important for international competitiveness: Developing own guidelines for the production of typical fruit. Knowledge transfer and orientation towards resource sparing (actually sustainable) production methods are as important as a political agricultural frame concept. Benefits from soil restoration require long term perspectives for farmers. Organic system allows autochthon production.
- It is very difficult for small organic producers in Latin America to meet the quality standards and regulations of the demanding international markets, due to lack of information and support from governments and traders to develop quality control mechanisms.

## 4.4. Case studies from Central and Eastern Europe

*Area under organic management*

“Since the beginning of the 1990s, Organic Farming has rapidly developed in almost all European countries. As of the end of 2006, 7.4 million hectares in Europe were managed organically by more than 200'000 farms. In the European Union, 6.8 million hectares were under organic management, with almost 180’000 organic farms. 1.6 percent of the European agricultural area and 4 percent of the agricultural area in the EU is organic. Twenty-four percent of the world's organic land is in Europe.

The countries with the largest organic area are Italy (1'148'162 hectares), Spain (926'390 hectares) and Germany (825'539 hectares). The highest percentages are in Liechtenstein (29 percent), Austria (13 percent) and Switzerland (12 percent). Compared to 2005, the organic land increased by more than 0.5 million hectares. The increase is due to growth in most European countries, particularly in Spain, Italy, Poland and Portugal” [Willer, Yussefi-Menzler, Sorensen 2008, p.19].

*Organic market*

“There is a small but growing market for organic food in new EU accession countries. Central & Eastern Europe (CEE) comprise about 2 percent of European revenues. Although organic food production is increasing in these countries, mostly organic primary crops are grown and usually exported to Western Europe. As a matter of fact, countries like Romania and the Ukraine are becoming important sources of organic cereals and grains. The lack of organic food processing in CEE countries, however, causes most finished goods to come into the region from the West.” [Sahota, 2008, p.54].

“The biggest market for organic products in 2006 was Germany with a turnover of 4.6 billion Euros, followed by the UK (2.83 billion Euros). The highest market shares of organic products of the total market with around five percent are in Austria, Denmark and Switzerland.

The highest per capita consumption of organic food is found in Switzerland with more than 100 Euros spent on organic food per year and citizen. Some countries are currently experiencing a shortage of supply.“ [Willer, Yussefi-Menzler, Sorensen 2008, p.19].

The majority of the consumers of Central and Eastern Europe (CEE) have little initial interest in organic products. Personal health care is a much stronger driver for consumption than the aspect of environmental conservation. Furthermore, the consumers' behaviour is strongly related to the respective income situation. Upper societies of higher income are the major source of demand for organic products. These consumers typically have a higher level of education and belong to young or intermediate age classes [Frühwald 2000].

*Policy support, standards, and regulations*

"Support for Organic Farming in the European Union includes grants under the European Union's rural development programs, legal protection under the recently revised EU regulation on Organic Farming (since 1992) and the launch of the European Action Plan on Organic Food and Farming in June 2004. Countries that are not EU members have similar support. Furthermore, research on Organic Agriculture is supported both at a country as well as an EU-level, reaching at least 65 million Euros in 2006" [Willer, Yussefi-Menzler, Sorensen 2008, p.19].

During the process of transformation, former soviet countries of Central and Eastern Europe (CEE) frequently incorporated the regulatory or subvention established by the EU into their agro-environmental programmes. This was done in order to take advantage of the export potential given by the organic sector. Respectively, the Hungarian legal conditions for Organic Agriculture are based on the legislation of Germany, Austria, France, Denmark, Switzerland, Netherlands and the USA [Németh 2002].

Characteristic for CEE-Countries has been the existence of agricultural cooperatives, public enterprises and large-scale farms. After the political change, this was altered by the privatization and restitution of public and cooperative property. Organic farms founded after 1990 are mostly privately administered. Respective farm sizes comprise 20 to 70 ha on marginal sites and 200 ha on better soils [Anyan 2000].

Organic crop production is prevailing, whereas organic animal husbandry is still far less developed.

*Potential for improvements /Technical / organisational solution*

Characteristic for most of the CEE is the export-oriented horticulture production of e.g. vegetables, fruit and herbs. Even though the management of Organic Farming focuses on the assurance of the cultivation system as a whole, the use of existing technical solutions is easily possible. Alternative solutions may be especially useful for smaller farms with less capital. One of these methods is the use of workhorses in the cultivation of vegetables.

### 4.4.1 Example: Production of herbs and vegetables by work of draught horses

Vegetable and herb production is realized on relatively small areas. Tillage is mostly done mechanically. Sprinkler systems are often necessary and generally purchased. Weeding is done by hand since mechanical solutions are usually not affordable. Nevertheless, labour input might be reduced by the utilization of workhorses. First experiences have already been published in Germany, which confirm equivalent quality of cultivation works realized by workhorses compared to tractor utilization in horticulture. Soukoup, Hoffmann & Herold [2008] report about investigations concerning the time needed for hoeing. One of the main fields of work for the horses was the hoeing of the one-, three- and four-row plantations, which is done using a hoe made by I & J, USA. The hoe was originally designed as a two-row corn-hoe, but was changed for use as a multiple-use row-crop-tool. Now, a 45 mm steel bar can be used as an interchangeable hoe. The implement is equipped with a seat placed in a way that the teamster sits behind the shares having a good overview. The steering of the hoe's axle is done by feet (fig. 18). The hoe is designed for use with a team of two horses. In these plans the horses are not only favoured for the presumed advantages with regard to soil structure and yields, but also because of their potential in saving fossil energy, as well as producing manure very worthwhile for the farm. Last but not least, using horses on the farm is very popular with the public [Soukup, B, Hoffmann, H.; Herold, P. 2008].

Figure 18: Hoeing in four-row crops. Soukup, Hoffmann, Herold 2008, p.297

*Focus on technology development, adaptation, and introduction*

Central aspects for the further development of the Organic Agriculture sector in CEE are the progress in organic animal husbandry and the development of simple technical solutions that are affordable for the farmers. An equally well-developed organic animal husbandry is important since fertilizers and the cultivation of legumes are required for the nutrient management of organic farms. In terms of simple mechanization techniques, workhorses may represent one possible solution.

*Focus on framing conditions*

Many farmers of CEE are still associating Organic Agriculture to the socialistic economy of scarcity, characterized by a very low availability of fertilizers and pesticides. Its potential for the production of harmless goods in alignment with resource and environmental conservation is frequently not yet recognized. Profound knowledge of organic production is still missing. Thus, advances in education and consultancy are of major importance. Within this context, more advantage should be taken of existing EU programs such as the ELER. One example is the Rural Extension Network in Europe (R.E.N.E.), which provides a platform for international knowledge exchange, facilitating the knowledge acquisition of consultants.

Also within the agricultural policies of CEE, the organic orientation of agriculture with emphasis on regional development should be fostered more intensively. Officials have to communicate Organic Farming as a progressive approach rather than as a step backwards. This will increase farmers' acceptance and also the populations' sensibility for aspects of Organic Agriculture.

In terms of knowledge transfer, an important role corresponds to the consultancy service. However, vast geographical distances and lacking personnel and financial means hinder its performance. These conditions constrain even the development of an efficient organic consultancy system.

Positive experiences could be adopted from West-European countries. In Germany for example, a network of 208 demonstration farms has been established since 2002. They function as multipliers for Organic Farming and as connectors of scientists and practitioners. An exemplary approach of separating consultancy roles has been followed in Switzerland. The consultancy on adaptation remains a public business, whereas responsibilities for consultancy on special issues are given to the private sector, e.g. the Institute of Biologic Agriculture (FiBL).

# 5. Conclusion

## 5.1. Effects for smallholders

*Chances*

The production system Organic Farming is relatively easy to adopt and requires little investment. Own research in rural areas (mainly in Mexico, Ecuador and Argentina) shows that especially the „soft“ and hardly quantifiable principles of Organic Farming are being met exemplary by smallholders. Some examples for these principles are the establishment of a balance between livestock breeding and plant production, the use of preferably renewable resources in locally organized production systems, or the use of regional diversity in species and races. These consensuses often originate from the knowledge and written records of traditional economic advisors.

*Risks*

Freyer (2007) identifies five general driving forces which are not specific to Organic Farming systems and lead to unsustainable land use:

- “Lack of techniques which are not linked to a specific land use system (e.g. none or obsolete irrigation systems; no water harvesting systems)
- High labour input for the daily organisation of firewood and water
- Lack of education, information and knowledge
- Lack of financial resources for
  - basic investments in natural resource management,
  - basic input for production.
- Limited land resources: The more a farm is market oriented (certified organic farms) the more there is a risk
  - to use all land capacities for the market production, while at the same time neglecting the natural resource management,
  - to intensify the production in an environmentally unfriendly way.” [Freyer 2007, p.23].

Another aspect is the dependence in contract farming. Organic exporters often are the actual operators of Organic Farming initiatives in developing countries. They use Organic Farming as a vehicle allowing them preferential market access. [Hauser 2008 p.34].

In this context the main risks for smallholders lie in the dependence as producers in contract farming. Due to the lack of knowledge the farmers often only fulfil the minimum standards for production and certification without using the necessary ecologic synergies.

Often the costs for control, certification and possible decrease in profits during the conversion of production are not compensated by the price difference between organic and conventional products, which is while a conversion is seen as existence- jeopardizing.

### 5.2. Desirable / necessary changes in framing conditions

*Land rights*

As uncertain land rights are one reason for permanent land cultivation, one step towards establishing a sustainable production system like the Tassa Method is the clarification of land rights [Kriegl 2001, S.303]. As described above, this represents a requirement for the successful application of the system. Furthermore, clarified land rights would also be the precondition for the reintroduction of fallow periods and their advantages for soil improvement or stabilisation in the land use system [Kriegl 2001, p.315]. A reasonable framework allocating the land rights should therefore imply the recognition of fallow periods as part of a production system as well as the adaptation of laws regulating forest use.

The latter should allow the use of emerging shrubs and trees [Kriegl 2001, p.316]. In many countries conversion costs are a major constraint for the adoption of organic practices for smallholders wishing to be certified for the domestic market. Commonly, farmers who convert to Organic Farming in Asia are supported in some way via an aid project that is aimed at crop export.

It is almost impossible for smallholders to complete the translated application forms and management plans unassisted, as many of them are illiterate or have only limited education. The new experience and requires new skills and behaviours and a great deal of follow-up to ensure the system works adequately [May 2004].

Government aid including the facilitation of access to credit would facilitate conversions.

The organic control system in developing countries is to be extended by the degree of food supply assurance on a plant level [Hauser 2008, p.34].

## 6. Favourable settings for the promotion and sustainability of the agricultural production system (Summary of results)

*Characteristics of the production system Organic Farming*

- A distinctive feature of Organic Farming is the fact that it acts according to principles which are opposed to essential fundamentals of our society today. While one of the principles of a market economy is undamped growth with the most efficient use of resources possible, Organic Farming restricts itself. I.e. farmers work according to strict legal guidelines. The objective is to create typical agro-ecosystems where a natural development of economic plants and farm animals is possible. At the same time the use of system-unspecific methods and means, especially readily soluble mineral fertilizers, synthetic pesticides and performance stimulants and thus maximum proceeds are renounced.
- Organic Farming is thus at first a legally defined production method for food and may also be part of a lifestyle, e.g. a movement with agro-political and ideological-philosophical influence.
- Due to the self-restriction of the cultivation system and the respect for the cycle and system character, Organic Farming is especially suited for ecologically fragile ecosystems either in marginal locations or in areas with a high biodiversity.
- A special advantage is the fact that the principles and technologies of Organic Farming allow the integration of technical solutions of conventional farming as well as the further development of traditional land use systems.

*Principles*

- The principles of Organic Farming are formulated in a very broad sense and include the way how people treat soil, water, plants and animals to produce, process and trade food and other goods.
- They also concern the way how people treat the man-made landscape, their behaviour amongst each other and how they shape the heritage of future generations. Organic Farming is not only about considering ecologic and economic coherences, but also about social aspects. Organic Farming is thus based on the principles of health, ecology, justice and welfare.
- Yet, there are also significant constraints on its potential for development. In part these are external such as the cost of certification, infrastructure problems, maintaining links with distant markets and the uncertainties of world markets. But there are internal

constraints as well. The overarching priority for agriculture in developing countries is attainment of sustainable food security. Organic Agriculture has a huge potential in helping meet this objective.

*International tendencies in Organic Farming*

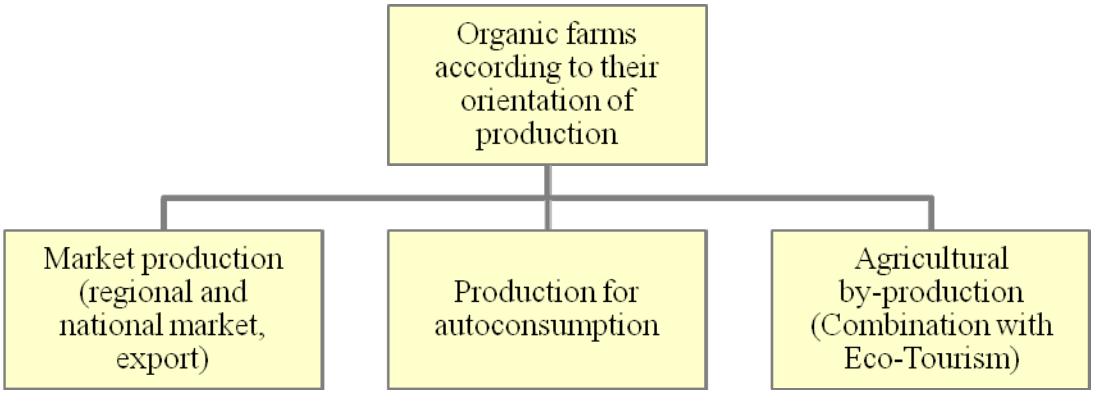
- Organic Farming systems exist worldwide on all continents.
- As a part of the environmental movement Organic Farming had its start with different schools, smallholders producing for local markets e.g. biodynamic farming in Germany [Steiner, 1924] or low external input sustainable agriculture in the United States [LEISA, 1985].
- Organic Farming succeeded in establishing alternative production systems and created new markets worldwide.
- Due to the growing international demand for healthy food and its global trading there is a need for the standardization of Organic Farming systems.
- This standardization turns out as highly controlled certification based on precepts and rules for production.
- As it is possible to produce big quantities of organic food simply by following the rules of organic certification and utilising public subsidies, organic farmers may today be divided into
    - committed organic farmers, and
    - pragmatic organic farmers.

*Classification of organic farmers*

This production system is suitable for large-holder farmers as well as small-holder farmers

- due to the size of the farm in small-, middle- and large-scale producers; where small producers are supposed to be separated from small-scale farmers,
- due to orientation of production in market production (home market, global market → export) and production for autoconsumption (marginalised locations) and in agricultural by-production,
- due to variety of products (not every organic farm has great biodiversity) into one-
- product-farms (e.g. wine) and farms with high diversity of products (e.g. intercropping).

**One type of classification**




*Key technologies*

The analyzed production systems show similarities concerning their key technologies on all continents:

- Use of a high biodiversity through crop rotation, agro-forest systems; and combination of plant and livestock production
- High ranking of compost and, if available animal dung
- Often a high proportion of manual labour
- Openness towards new technical solutions (Organic Farming is not technology-hostile). The cultivation system allows the use of simple mechanization solutions as well as the application of modern machines that may be combined with animal power up to the use of precision farming elements.

*Support of food supply assurance and health*

- Organic Farming for autoconsumption is an important contribution for the assurance of food supply in rural regions.
- As the level of education of the smallholders is still very low in many cases (e.g. illiteracy or helplessness in handling manuals in foreign languages) intoxications due to inappropriate use and distribution of fertilizer and pesticides are possible.
- In this context Organic Farming is a clean and safe production system.

- Even wageworkers that work on big organic farms are protected from harmful contamination of drinking water with pesticides and readily soluble fertilizers. As the provisioning with food is often part of the pay, their alimentation is also safe.

*Linkage to other production systems*

- The fact that traditional agricultural systems (like the Tassa Method or the Chacra System) are low external input provides a potential basis for Organic Agriculture as a development option for developing countries. Organic Farming practices deliberately integrate traditional farming methods and make use of locally available resources. As such, they are highly relevant to a majority of smallholders who often derive significant benefits, improve their incomes, nutritional status and livelihoods as a result.

## 7. Areas of action / Options for action

*Support of education and counsel*

- The main objective of Organic Farming in cropland is to develop the farmer's understanding of the causes of agro-ecosystem degradation and a scientific explanation of the adverse effects they experience. Training, education and counsel are to be developed. Example farms have a positive effect especially in countries with a low level of education of the farmers.
- Official counsel should be taken over by public bodies, while specialized counsel should be done by Organic Farming organizations or associations themselves.

*Support by the policy during the conversion phase*

- Public support is needed especially during the conversion phase when a decrease in profits is possible or when additional costs arise through the certification which may not be compensated by higher yields and prices.
- The recent expansion of organic production in developing countries with their specific agricultural constraints has not been adequately reacted to by the organic community. Organic standards applied there address the problems of agriculture.

*Support of the development of a local market*

- If, after successful establishment of organic production, market-oriented production is becoming a reasonable objective, priority has to be set on the development of (yet in-existent) local markets for organic products. This implies the organisation of local product certification and the development of required infrastructure for market accessibility. Infrastructure and mobility regularly represent constraining factors since the demand for organic products evolves generally within well-suited societies found in urban and sub-urban areas. The establishment of product certification on the other hand will often be hindered by frequent illiteracy making daily documentation impossible for affected smallholders. Therefore, corresponding programs facilitating education are needed to support product marketing initiatives.
- The improvement of infrastructure such as the development of a road and path network also belongs here.
- Concerning the price policy a long-term rethinking is necessary. In the past, organic products yielded a significantly higher price as conventional products due to their higher quality and environmental benefits. If their consumption is to be made possible

for poor and low-income groups (establishment of a regional and national market), these products need to be cheaper than conventional products.

*Support of socio-economic effects*

- The public recognition of Organic Farming in politics as a cultivation system that is particularly environmentally friendly and progressive may improve its reputation. A positive effect would be the end of migration of younger people from the rural regions. Thanks to more use of manual labour there would be possibilities for employment in rural areas.
- As examples from all over the world show, Organic Farming may be sense-making. The central position of soil as a living organism, the operating individuality and the attentive handling of nature – including economic plants and animals, creates identification with the home region, the conservation of cultural and traditional values of the local community and promotes their sense of responsibility for natural resources.
- The principle of regionality may be served through the promotion of regional market access, but also through the use of local species and races.

*Support of the development of technical and technologic solutions*

- Easily affordable and relatively straightforward technical solutions need to be provided especially for smallholders in developing countries. The principle applies that the technology needs to be able to optimize the system output of organic cultivation methods while at the same time lowering external inputs.
- The biggest weaknesses / obstacles for smallholders are currently seen with the nutrient and pest management. The acquisition and use of composting methods are extremely important for the preservation of soil fertility in tropical and subtropical areas. In areas where livestock breeding has been disconnected from plant cultivation (many areas in Southeast Asia) it may be necessary to leave behind the strict principles of Organic Farming and allow the marginal use of particularly mineral N-fertilizers (elements of the LISA-Agriculture).

*Current need for and fields of research*

- A politically volitional promotion of Organic Farming on the one hand, the increased demand for organic products by consumers worldwide on the other hand, and the possibilities that Organic Farming offers for the cultivation of sensitive ecologic areas worth protecting brings new challenges to the praxis and philosophy of Organic Farming. A systematic support through research is especially seen in the following areas:

- Preservation of soil fertility, especially the humus balance,
- Further development of nutrient and pest management,
- Improvement of animal nutrition and health,
- Assurance of product and process quality (especially stock keeping and conservation methods),
- Improvement of marketing for organic products.

# 8. Literature


ABELE S., DUBOIS, T., TWINE, E. SONDER, K. COULIBALY, O. (2007): Organic Agriculture in Africa: A critical review from a multidisciplinary perspective. In: Hülsebusch, Ch.; Wichern, F. Hemann, H. and P. Wolff (eds.) Organic Agriculture in the Tropics and Subtropics – Current Status and Perspectives, JARTS, Suppl. 89, p.143 – 166

ALTIERI, M., N. COMPANIONI, K. CANIZARES, C., MURPHY, P., ROSSET, M, BOURQUE, AND C. NICHOLIS (1999): The greening of the "barrios": Urban agriculture for food security in Cuba, Agriculture and Human Values 16, p. 131-140

BADGLEY, C., MOGTHADER, J., QUINTERO, E., ZAKERN, CHAPELL, M.J., AVILÉS-VÁZQUEZ, SAMULON, A., PERFECTO, I. (2007): Organic Agriculture and the global food supply, Renewable Agriculture and Food Systems, Cambridge University Press, 22, p. 86-108

BENZING, A. (2001): Agricultura Orgánica – Fundamentos para la región andina. Neckar-Verlag, Willingen, Germany, 682 pp

BUES, A. (2007): A Study of Organic Agriculture in Kenya and its Prospects. Tesis (B.Sc.), Humboldt-University Berlin, Germany, 56 pp

Chancusig Espin, E. M. (1999): Evaluación del sistema tradicional de cultivos en relevos de papa en las comunidades andinas de Cotopaxi, Ecuador. Tesis, Universidad Catholica de Temucu, Temucu, Chile

CHANG, CH. L. (2004): Ökologischer Landbau in Südkorea, Diss., Humboldt-Universität zu Berlin, Germany. 234 pp

DEVADAS, V. S. (2004): Organic rice cultivation – Some considerations under humid tropical conditions. In: Development of basis standards for organic rice cultivation. Proceedings of the 3rd RDA/ ARNOA International Conference, 8-10 September 2004, Yangpyung, Korea, p. 108-128

DIMTER, S. (2003): Chacras, die traditionelle Landnutzung der Quichuas del Oriente, Humboldt-Universität zu Berlin, Tesis (Bsc.), 75 pp

FREYER, B. (2007): Traditional and ecological farming systems. In: Hülsebusch, Ch., Wichern, F. Hemann, H. and P. Wolff (eds.) Organic Agriculture in the Tropics and Subtropics – Current Status and Perspectives, JARTS, Suppl. 89, 2007, p. 1-30

FRÜHWALD, F. (2002): Biokultura Verband, mdl. 22.05.2002, Budapest, Hungary

GÄBLER, J. (2003): Ein Vergleich zwischen ökologischem und konventionellem Kaffeeanbau im privatwirtschaftlichen Sektor in Soconusco, Chiapas/Mexiko"

GRÜNWALD, N. J., ROMERO MONTES, G. AND FRY, W. E. (2002): Epidemiología Comparativa del Tizón Tardío de la Papa. Implicaciones de Manejo Contrastando Climas del Trópico Alto y Climas Templados. – In: Fernandez Northcote, E. N. (Ed.) (2002): Memorias del taller internacional Complementando la resistencia al tizón (*Phytophthora infestans*) en los Andes, 13 – 16 February 2001, Cochabamba, Bolivia, GILB, 1. Latin-American Workshop - CIP, Lima – Peru, p. 133-138

GÜNDEL, S. (1998): Participatory innovation development and diffusion: adoption and adaptation of introduced legumes in the traditional slash and burn peasant farming system in Yucatan, Mexico, Dissertation, Weikersheim: Margraf - Verlag, 1998, 133 pp

HILLEBRECHT, E.C. (2005): Entwicklung des ökologischen Landbaus in Argentinien unter Berücksichtigung sozialer Aspekte anhand des Beispiels CIESA, Tesis (Bsc) Humboldt-Universität zu Berlin, 65 pp

HAUSER, M. (2008): Potenziale der Öko-Landbaus nicht voll ausgeschöpft, 14/2008/ Ökologie & Landbau, p. 33-34

HOFFMANN, H. (2003A): Urbane Landwirtschaft – Ein Beitrag zur Biodiversität in Städten, In: Korn, H. and Feit, U. (eds.): Treffpunkt Biologische Vielfalt III: Interdisziplinärer Forschungsaustausch im Rahmen des Übereinkommens über die Biologische Vielfalt, Bundesamt für Naturschutz, Bonn-Bad Godesberg, p. 79-88

HOFFMANN, H. (2003B): Ecological agriculture in Latin-America – Experiences from Cuba and Mexico, Proceedings, 2nd. RDA/ ARNOA International Conference, 11-15 November 2003, Cheonan/ Korea, p. 10

HOFFMANN, H. (2000): The model of organic farming in Germany, Mexico and Cuba, Proceedings 13th International IFOAM Scientific Conference, Basel, p. 616

HOFFMANN, H. (1998): Ecological Agriculture as a strategy to sustainable rural development as demonstrated in a Mexican Project. International Conference on Ecological Agriculture, Chandigarh, Proceedings, p. 458 -464

HOFFMANN, H. AND KACHEL, A. (1999): Ökologischer Landbau in Mexiko, Zeitschr. Ökologie & Landbau, 3/1999, p. 43-46

HOSSAIN, ABUL (2004): Integrated Rice-Duck farming for sustainable and environmentally compatible agriculture development in Bangladesh, In: Development of basis standards for organic rice cultivation. Proceedings of the 3rd RDA/ ARNOA International Conference, 8-10 September 2004, Yangpyung, Korea. p. 148-165

IFOAM & FiBL (2006): The World of Organic Agriculture. Statistics and Emerging Trends 2006. International Federation of Organic Agriculture Movements (IFOAM), Bonn & Research Institute of Organic Agriculture FiBL, Frick, p. 27–35

IFOAM (2003): Organic and Like-Minded Movements in Africa. International Federation of Organic Agriculture Movements (IFOAM), Bonn, p. 102–108

KOTSCHI, J. (2008): Welchen Beitrag kann der Ökolandbau für die globale Ernährungssicherung leisten? Vortrag BÖLW Herbsttagung, 23.10.2008, Berlin, Germany

KRIEGL, M. (2001): Wie optimal wirtschaften im Niger? Eine Möglichkeit zur Desertifikationsbekämpfung im Sahel. Dissertation, Weißensee-Verlag, Berlin, 333 pp

MATHEW, J. AND ELSY, C. R. (2004): Low cost technologies for organic rice production. In: Development of basis standards for organic rice cultivation. Proceedings of the 3rd RDA/ ARNOA international conference, 8-10 September 2004, Yangpyung, Korea, p. 99-107

MAY, CH. (2004): IFOAM Basic Standard and Organic Standards of Asia, Proceedings of the 3rd RDA/ ARNOA international conference, 8-10 September 2004, Yangpyung, Korea. p. 9-15

METZLER, E. (2007): Kartoffelanbau in Rein- und Mischkultur im Ekuadorianischen Hochland – Auswirkungen auf Erträge und Krankheitsbefall mit *Phytophthora infestans* (Mont.) de Bary. Tesis (B.Sc.), Humboldt-Universität zu Berlin, Germany, 81 pp

Mundy, P. (Ed.) (1998): Sustainable extension manual for Eastern and Southern Africa. International Institute of Rural Reconstruction (IIRR), Nairobi, Kenya, 241 pp http://www.iirr.org/book.htm

NEMETH, L. (2002): Ungarisches Ministerium für Landwirtschaft und ländliche Entwicklung, Abt. Gesundheit und Lebensmittelkontrolle, mdl. 28.05.2002, Budapest, Hungary

OMARE, M. N. AND WOOMER, P. L. (2003): The Organic Agriculture Movement in Kenya. In: Savala, C. E. M., Omare, N. M. and Woomer, P. L. (Eds.) (2003): Organic Resource Management in Kenya – Perspectives and Guidelines, Chapter 22. Forum for Organic Resource Management and Agricultural Technologies (FORMAT), Nairobi, Kenya http://www.formatkenya.org/ormbook/Chapters/chapter22.htm

OYARZUN, P. J., TAIPE, J.A. AND FORBES, G.A. (2001): *Phytophthora infestans* su Actividad y Particularidades en el Ecuador, Perfil de País. – In: Fernández- Northcote E. N. (Ed.): Memorias del taller internacional Complementando la resistencia al tizón (*Phytophthora infestans*) en los Andes, 13 – 16 February 2001, Cochabamba, Bolivia, GILB, 1 Latin-American Workshop - CIP, Lima – Peru, p. 17-27

PAHNWAR, F. (2004): Organic products, social qualities with equal and fair trade it’s constrain and future – why Organic Farming is necessary, 6th IFOAM-Asia Scientific Conference “Benign Environment and Safe Food”, 7th-11th September 2004, Yangpyung/Korea, p.400-405

PARROTT, N. AND T. MARSDEN (2002): The real green revolution. Organic and agroecological farming in the South. Greenpeace Publications, London http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/4526.pdf

PARROT, N. AND VAN ELZAKKER, B. (2003): Organic and like-minded movements in Africa. Development and status.- IFOAM, In: Abele S., Dubois, T., Twine, E. Sonder, K. and Coulibaly, O. (2007): Organic Agriculture in Africa: A critical review from a multidisciplinary perspective. In: Hülsebusch, Ch., Wichern, F. Hemann, H. and P. Wolff (eds.) Organic Agriculture in the Tropics and Subtropics – Current Status and Perspectives, JARTS, Suppl. 89, 2007, p. 143 – 166

POHLAN, J. (2001): Pautas el cultivo ecológico del café (*Caffea arabica* :L.) In: Poahlan, J. (ed.): La fruiticultura orgánica en el cauca, Colombia – manual para el campesinado, Shaker Verlag, Aachen 2001, 314 pp

PRETTY, J. & HINE, R. (2001): Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence. Final Report from the "SAFE-World"-Research Project, University Essex http://www.essex.ac.uk/ces/esu/occasionalpapers/SAFErepSUBHEADS.shtm

PRETTY, J.N., NOBLE, A.D., BOSSIO, D., DIXON, J., HINE, R.E., PENNING DE VRIES, F.W.T. & MORISON, J.I.L. (2006): Resource-conserving agriculture increases yields in developing countries. Environmental Science and Technology (Policy Analysis) 40(4) p. 1114-1119

PUHE, J. (1997): Ecologia y Sistemas Naturales – con enfasis en Sudamerica. QR Producciones Graficas, Asuncion, Paraguay, 322 pp

PUMISACHO, M. UND SHERWOOD, S. (EDS.) (2002): El cultivo de la papa en Ecuador. Edition 2002, CIP-INIAP, Ecuador

RAMAN, R. AND KUPPUSWAMY, G. (2004): Production technology for organic rice. In: Development of basis standards for organic rice cultivation. Proceedings of the 3rd RDA/ ARNOA International Conference, 8-10 September 2004, Yangpyung, Korea, p. 129-137

Rhody, B. (2008): Landnutzungsformen der Maya am Beispiel der Region Tetiz, Yucatan. Tesis (B.Sc.), Humboldt-University Berlin, Germany, 148 pp

RYE-KLEDAL, P., EL-ARABY, A. SALEM, S. G. (2008): Country Report: Organic Food and Farming in Egypt. In: Willer, H., Yussefi-Menzler, M. and N. Sorensen (Eds.) (2008): The World of Organic Agriculture. Statistics and Emerging Trends 2008, International Federation of Organic Agriculture Movements (IFOAM) Bonn, Germany and Research Institute of Organic Agriculture (FiBL), Frick, Switzerland, Earthscan, London, UK, 2008, p.163

SAHOTA, A. (2008): The Global Market for Organic Food & Drink, In: Willer, H., Yussefi-Menzler, M. and N. Sorensen (Eds.) (2008): The World of Organic Agriculture. Statistics and Emerging Trends 2008, International Federation of Organic Agriculture Movements (IFOAM) Bonn, Germany and Research Institute of Organic Agriculture (FiBL), Frick, Switzerland, Earthscan, London, UK, 2008, p. 53–57

SANTAMARIA, M. (2006): Entenhaltung in Nassreisfeldern und deren Erweiterungs- und Übertragungsmöglichkeiten für die Ernährungssicherung der einkommensschwachen Nassreisbauernfamilien der Kolumbianischen Republik, Tesis (Diplom), Humboldt Universität zu Berlin, 100 pp

SHERWOOD, S. G. (ED.), MONAR, C., SUQUILLO, J. (2000): Wachu rozado: Vestigio del pasado, oportunidad para el futuro - Reporte para el Centro Internacional de Información sobre Cultivos de Cobertura (CIDICCO). CIP-INIAP/UVTT, Apartado Postal 17-21-1977, Quito – Ecuador

SMIT, J.: RATTA, A.; NASR, J. (1996): Urban Agriculture: Foods, Jobs and Sustainable Cities, United Nations Developement Program (Publication Series for Habitat II, Vol 1). New York

SOUKUP, B, HOFFMANN, H., HEROLD; P. (2008): Arbeitspferde im Gemüsebau Untersuchungen zum Zeitbedarf von Hackarbeiten mit moderner Pferdetechnik, Landtechnik 5 (2008), p. 296-297

TOAPANTA TORRES, W. R. (2004): Caracterización de la eficiencia y eficacia de los sistemas de producción de los medianos y pequeños agroproductores de la localidad de Cachi Alto, Pujilí-Cotopaxi. Tesis, Universidad Central del Ecuador, Quito – Ecuador

WILLER, H. (2008): Organic Agriculture Worldwide: Current statistics, In: Willer, H., Yussefi-Menzler, M. and N. Sorensen (Eds.) (2008): The World of Organic Agriculture. Statistics and Emerging Trends 2008, International Federation of Organic Agriculture Movements (IFOAM) Bonn, Germany and Research Institute of Organic Agriculture (FiBL), Frick, Switzerland, Earthscan, London, UK, 2008, p. 23-46

WILLER, H., YUSSEFI-MENZLER, M. AND N. SORENSEN (EDS.) (2008): The World of Organic Agriculture. Statistics and Emerging Trends 2008, International Federation of Organic Agriculture Movements (IFOAM) Bonn, Germany and Research Institute of Organic Agriculture (FiBL), Frick, Switzerland, Earthscan, London, UK, 2008, 276 pp

YONONHAPNEWS (2002): Fünffache Zunahme des umweltfreundlichen Reisanbaus innerhalb von zwei Jahren. Tageszeitung Yonhap, am 29.07.2002, Seoul

YUSSEFI, M. AND WILLER, H. (2002): Organic Agriculture Worldwide 2002: Statistics and Future Prospects. Foundation Ecology and Agriculture (SÖL), Publication No. 74, Bad Dürkheim, 155 pp

ZHANG JIBING, XIE BIAO, ZHOU ZEJANG (2004): Application and effect of rice-duck symbiosis. In: Development of basis standards for organic rice cultivation. Proceedings of the 3rd RDA/ ARNOA international conference, 8-10 September 2004, Yangpyung, Korea, p. 3-8

ZHENHUI, L. (2002): Production and Market of Organic Foods in China, Proceedings of the 1rd RDA/ ARNOA International Conference, 12-15 November 2002, Suwon & Cheonan, Korea. p. 119-125

*Internet sources:*

http://www.ifoam.org/about_ifoam/principles/index.html
http://www.ifoam.org/organic_facts/doa/index.html
http://www.ifoam.org/about_ifoam/around_world/aosc_pages/pdf/ditcted200516_en.pdf
http://www.intracen.org/Organics/Country-Profile-Egypt.html