Training Manual

INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

IFOAM TRAINING MANUAL
for Organic Agriculture in the Humid Tropics

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COMPILED BY
FiBL

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Feedback and suggestions for improvements are welcome!

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Preface

The first IFOAM Training Manual for Organic Agriculture in the Tropics (the Basic Manual) was published in 2004. The Research Institute of Organic Agriculture (FiBL) together with partners of the organic movement in the Tropics were commissioned by IFOAM to complete two new training manuals that build on the Basic Manual. The new IFOAM training manuals address the two basic climatic zones of the Tropics, the Arid and Semi-Arid Tropics, and the Humid Tropics.

For both new manuals, already existing material was collected, screened and condensed into comprehensive training manuals. Additionally, a large number of farmers, trainers and scientists were asked for their experience. Partner institutions from the Tropics actively collaborated in the development of the manuals. The partners of the manual for the Humid Tropics are from Asia (Philippines), Africa (Uganda) and Latin America (Costa Rica).

The training manuals contain case studies of organic farming systems, describe successful organic marketing initiatives and offer guidelines for the main crops of the Tropics. With the informative text, transparencies and didactical recommendations the training manuals offer a resource basis for trainers with the idea of encouraging individual adaptation and further development of the material according to need. The training manuals are available on separate CDs in English, French and Spanish.

The training manuals were commissioned by IFOAM and funded through its program IFOAM-GROWING ORGANIC II (I-GO II). The Research Institute of Organic Agriculture (FiBL) and the Swiss Import Promotion Programme (SIPPO) provided co-funding.

The development of this manual was a much bigger and longer process than expected. The result is the start of a continuing process. The training manual shall be a living document, modified and further developed by those who use it.

We hope that this training manual will be an inspiring source for all its users. We invite all to contribute their suggestions and material for further improvements of the manual. Contact: headoffice@ifoam.org.

Acknowledgment

The development of this training manual was only possible through the active collaboration of the following organisations, whose contribution is herewith acknowledged:

- IFOAM for funding, facilitating and providing feedback
- SIPPO for co- funding
- FiBL for co-funding; the International Cooperation Division and the Communication Division for the concept, elaboration, review and layout
- The contributing partners, mainly PNAO (Costa Rica) and MASIPAG (Philippines)

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The Authors: Lukas Kilcher, Felicia Echeverria, Gilles Weidmann, Salvador Garibay

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Principles of Organic Agriculture

Preamble

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

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

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

Organic agriculture is based on:

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

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

Principle of health

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

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

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

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

Principle of ecology

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

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

Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. Organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources.

Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

Principle of fairness

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

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

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

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

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

Principle of care

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. Consequently, new technologies need to be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken.

This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

1 Introduction

1.1 Description of climate and soil

Climatic conditions

The humid tropics are located between 10° N and 10° S of the equator. The tropical rainforest is the main ecological zone within this climatic belt and can be found in the Amazon, the Congo basin and Indonesia. The average annual temperature varies from 20 to 27 °C at sea level. Because of vertical radiation, the sunshine is very intense, but heavy rain clouds often cover the sky for several hours per day. The difference between nighttime and daytime temperatures is rather small. In mountainous regions, temperature declines by 0.6 °C per 100 m of altitude.

The average relative humidity of 80 % and the intense solar radiation create a hot and humid climate. Average annual rainfall ranges between 1500 and 2500 mm and in some regions, it can even reach 7000 mm. Near the equator, there are usually abundant daily precipitations, often up to 100 mm per hour. Violent rainstorms are also frequent.

In Africa, around the equator line, there are two rainy seasons, which last from 4 to 5 months each. In the outer tropical regions, there is one long rainy season of 8 to 9 months during the summer months. But even during these rainy seasons, there are sometimes periods of two or more weeks without rain. In Asia and South America, rainfall distribution can vary slightly or greatly. Additionally, local climates are often influenced by other climatic disturbances, such as the tropical rainstorm "El Niño" in the Pacific. Therefore exact climatic descriptions can only be given for well defined microclimates.

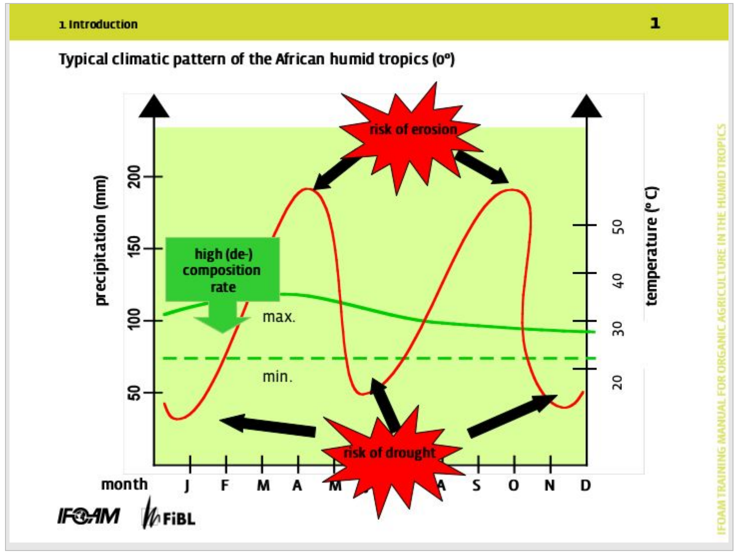
Lessons to be learned:

- *Humid tropical climates enhance vigorous plant growth and high (de-)composition rates.*
- *Violent rainfalls have a strong impact on agricultural issues, especially on soil erosion. Water management is therefore crucial.*
- *Protect and replenish organic matter content of agricultural soils.*
- *Natural ecosystems act as a model for agricultural practices: close the nutrient cycles.*
- *Healthy plants are less prone to various pests and diseases.*

Group work:

Divide the group and let them draw a climate pattern of their region. Ask them to explain in individual presentations the challenges that their climatic conditions pose for agriculture.

1 Introduction



TRANSPARENCY 1 (1): TYPICAL CLIMATIC PATTERN OF THE AFRICAN HUMID TROPICS AT THE EQUATOR

1 Introduction

Soils of the humid tropics

There is a wide range of soil types in the humid tropics. They depend on geology, geomorphology, vegetation and rainfall pattern. There are very productive, but also very weak soils.

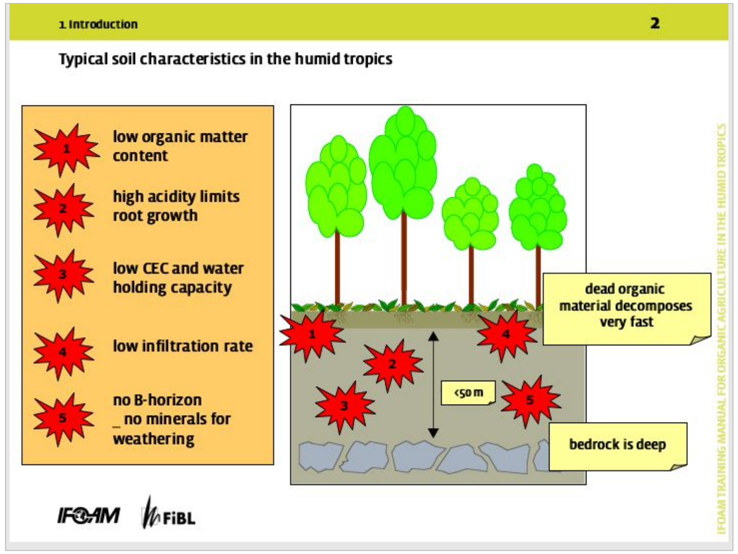
The most dominant soils in many humid tropical regions are weathered ferralitic soils. Oxisols, together with Ultisols, cover over 30 % of the tropics. These soils share a number of common features: they are quite infertile, low in organic matter and have a low water holding capacity. Large amounts of water are therefore lost due to runoff. This is especially true in hilly areas, and is the main cause for erosion and landslides. Many of these soils are very old and reach 20 to 50 m deep. Unfortunately, plants cannot root deeply because of high aluminum toxicity.

- Oxisols are abundant especially in the Amazon and the Cerrado in South America and in Central Africa. One negative characteristic of these soils is the low level of available phosphorous.
- Ultisols are dominant in tropical America, Africa and in the uplands of Southeast Asia. They are in the last stage of weathering, which makes them extremely poor in available minerals. Further limiting characteristics are their acidity (pH 6 or less), a low nitrogen content and low cation exchange capacity (CEC).

Beside these marginal soils, clay or loam soils, such as Alfisols, offer better conditions for agriculture. Alfisols cover approximately 20 % of the tropics and are good agricultural soils. They can be found in Africa, Asia and tropical America.

Probably the most fertile tropical soils are Andisols, which are young and rich in minerals but only exist in volcanic regions. They possess abundant amounts of organic matter and are very productive.

For further information about soil structure, soil organisms and soil testing consult chapter 3 "Soil fertility" of the Training Manual for Organic Agriculture in the Tropics – (hereafter referred to as the Basic Manual).



TRANSPARENCY 1 (2): TYPICAL CHARACTERISTICS OF A TROPICAL SOIL IN THE HUMID TROPICS

Discussion on soils:

- *Which typical problems can appear when cultivating these soils?*
- *Which are possible advantages or opportunities of these soils?*

1.2 The influence of climate and soil conditions on farming practices

Humid tropical conditions such as hot temperatures, high annual rainfall and poor soil properties require well adapted agricultural practices. The tropical rainforest, is the original climax ecosystem. It has closed nutrient cycles and biodiversity, and serves as an ideal model for nutrient management and cropping patterns. Tropical farming can only be sustainable if the main rules of this original system are respected.

Water management

Due to the violence of tropical rainfall and a low soil infiltration rate, water conservation technologies play an essential role in agriculture. Tropical soils generally cannot hold large amounts of water and, even though the yearly rainfall is abundant, crop growth is hindered by drought between the rainy seasons. In addition, water management also plays an important role in preventing erosion. For further information see next chapter.

Soil protection and management

Technologies such as slash and burn cultivation or mechanical forest clearing, which are common in tropical regions, leave land surfaces uncovered and prone to erosion. In hilly areas bare land is also vulnerable to landslides. These factors lead to irreparable soil losses that increase the pressure on arable land. Non-climatic factors such as physical degradation from compaction and soil crusting due to excessive use of machinery and soil pulverization can further aggravate the situation.

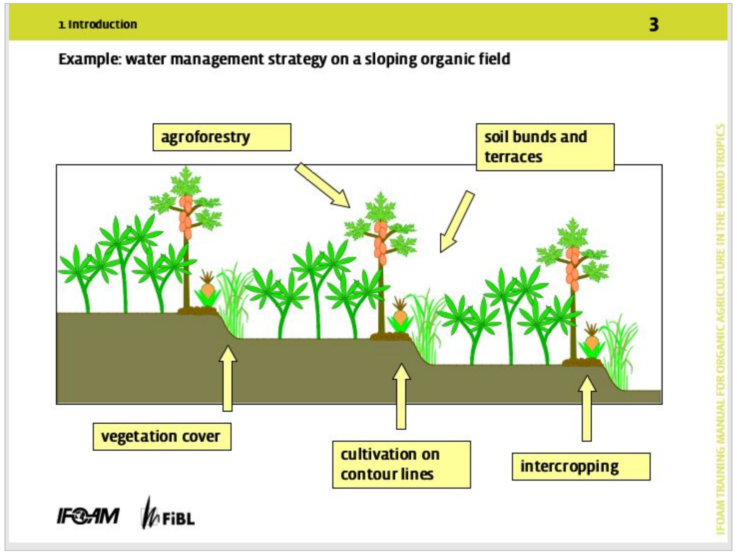
Arable land can be protected from erosion by soil bunds and terraces, minimum tillage and contour cultivation. Planting cover crops, mulching, intercropping and agroforestry can all play an important role in preventing erosion and landslides because plant roots stabilize the soil. Furthermore, these technologies increase the organic matter content of the soil, which also has positive effects on water holding capacity. Additionally, the vegetation cover conserves humidity by protecting the soil from direct solar radiation.

For additional information about soil erosion and practical tips for protective construction read chapter 3.4. "Soil Erosion" of the Basic Manual.

Sharing experiences:

Even in regions with high annual rainfall, drought periods can decrease crop yield. For this reason water conservation systems are fundamental:

- *What effective water collecting systems exist in the participants' regions?*
- *What kinds of reservoirs, wells, cisterns etc. are known?*
- *How are they managed?*



TRANSPARENCY 1 (3): EXAMPLE - WATER MANAGEMENT STRATEGY ON A SLOPING FIELD

Group work:

Divide the participants into three groups. Let each group discuss soil protection strategies against erosion, using examples from their areas. Which are best? Why? Let each group present their results in plenary.

1 Introduction

Soil fertility

The fertility of tropical soils is greatly influenced by their organic matter content. In the natural ecosystem of the rainforest, plant growth is vigorous and biomass is rapidly decomposed into humus and organic matter by soil organisms. Due to the hot temperatures and high air humidity, organic matter is mineralized very quickly. In order to keep the balance in the soil, dead plant material is required as a reservoir for rebuilding humus and organic matter.

On cleared agricultural land this reservoir is often insufficient. Once vegetation cover is removed, the remaining humus is mineralized and the released nutrients are leached out of the soil, washed away by heavy rainfalls.

In order to maintain the essential humus content, tropical agricultural soils should therefore always be covered with vegetation, whether dead or living. This covering biomass not only delivers organic material, but it also protects the soil structure. Organic matter also plays an important role in increasing the water holding capacity, in neutralizing acidity and in improving the workability of tropical soils.

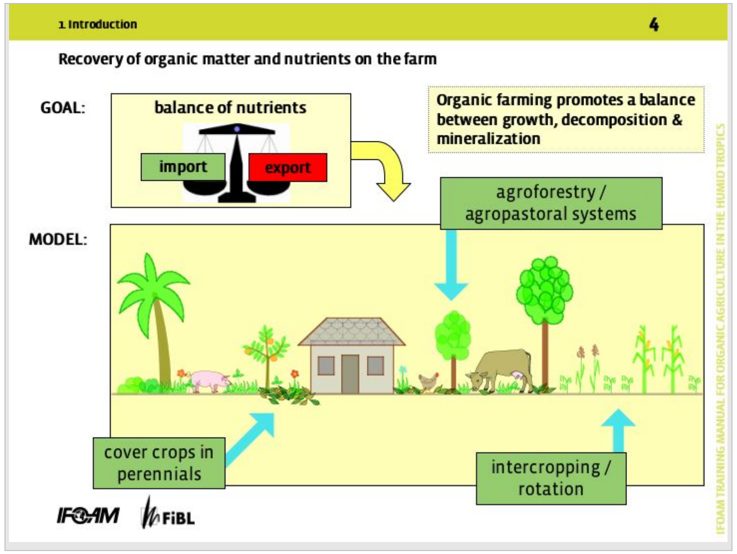
Besides organic matter content, cropping patterns play an important role in maintaining soil fertility. In the soils of the humid tropics, where nutrients are often limited, monocultures should particularly be avoided because they exploit the fragile nutrient pool in an unbalanced way.

See also chapter 3 "Soil fertility" of the Basic Manual.

Organic fertilization

Even in sustainable agricultural systems, nutrient cycles within the field are not closed, as nutrients are taken away in the form of crops and fodder. Marginal soils in the humid tropics are especially prone to nutrient and organic matter loss. Therefore, healthy soil life (the basis of successful production), can only be achieved by importing nutrients. Animal manure, green manure and compost can all be used to replenish the nutrients required by crops and supply the soil with essential organic matter. Legumes are an additional and highly valuable source of nitrogen.

Note: Organic farming in this climate must promote the balance between growth, decomposition and mineralization.



TRANSPARENCY 1 (4): RECOVERY OF ORGANIC MATTER AND NUTRIENTS ON THE FARM

Group work:

Discuss how nutrients that have been exported with the harvested products can be returned back to the soil. Think about possible problems or constraints when using the methods explained in the transparency. Identify suitable solutions.

1 Introduction

For additional information about plant nutrition read chapter 4. "Plant Nutrition" of the Basic Manual.

Pest and disease management

The climate in the humid tropics is favorable to plant growth, for both crops and weeds. It also favors pests and diseases, as well as their natural enemies. Being able to support plant growth throughout the year, the humid and hot conditions ensure an almost year-round abundant supply of food to pests. Pests can breed more frequently thanks to the constant heat and pest outbreaks are common, especially towards the end of the rainy season(s).

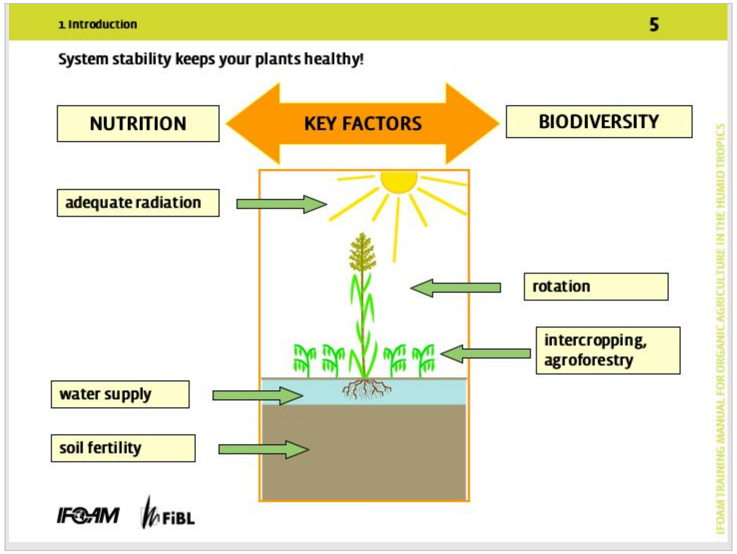
The high relative humidity and warm temperatures also create ideal conditions for humidity related diseases, especially fungal infections.

Given this scenario, organic farmers in the humid tropics have to apply accurate pest and disease management strategies. Primarily, they need to maximize system stability through diversity, rotation and preventive measures. Only then, if necessary, should they apply control and curative measures.

Preventive measures are:

- Use of healthy, clean, seeds and planting material.
- Promotion of natural enemies by providing them habitat such as grass strips and controlled bush hedges.
- Appropriate spacing avoids competition between the crops that could weaken the plants and it ensures good ventilation, thereby avoiding fungal diseases.
- Keeping the soil fertile with a sufficient supply of organic matter improves the conditions for plant growth and resistance to attack.
- Timely planting so that crops develop resistance before pests build up.
- Timely weed control to reduce competition and remove pest and disease sources.
- Intercropping and crop rotation to control pest and disease.
- Good hygiene / sanitation to remove disease and pest sinks.

Curative measures should be applied according to crop and local possibilities.



TRANSPARENCY 1 (5): SYSTEM STABILITY KEEPS YOUR PLANTS HEALTHY!

Sharing experiences:

Let participants tell about their most effective measures in pest and disease management and fill in the table (poster).

Area	Method	Timing	Impact
Soil			
Crop			
Environment			

Recommended readings:

- *Proyecto MAG/FAO/GCP/COS/012/NET. 1996. Agricultura Conservacionista: un enfoque para producir y conservar. Ministerio de Agricultura y Ganadería y Organización de las Naciones Unidas para la Agricultura y la Alimentación. Informe Técnico 1.*
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- *Wilhelm-Gunther Vahrson. 1991. Taller de erosión de suelos: resultados, comentarios y recomendaciones. Revista Agronomía Costarricense (15) 197-203.*
- *G. Meléndez, G. Soto y L. Uribe. 2003. Abonos orgánicos: principios, aplicaciones e impacto en la agricultura. En memoria de taller sobre abonos orgánicos. Universidad de Costa Rica.*
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- *W.C. Beets.1990.Raising and Sustaining Productivity of Smallholder Farming Systems in the Tropics. AgBé Publishing, Holland. 176 – 225.*
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2 Organic Farming Systems: Examples from the Humid Tropics

2.1 Organic Farming and Self-Sufficiency: a Costa-Rican Perspective

Introduction

Organic farming is guided by the general principles of environmental protection, social justice, and economic and ecological sustainability. In order to stay close to these principles, sets of standards have been developed to describe what is or is not permitted within an organic farm. These were first developed by IFOAM and later by other organizations and governments. These standards are more or less similar, providing a well-defined framework of regulations that define what is, and is not, permissible within organic production. These standards do not however, specify or prescribe how each activity should be carried out within the farm.

From a technological and, even more, from a philosophical point of view, many approaches have been developed, which propose to some extent different ways of putting the organic principles into practice. These perspectives include for instance biodynamic agriculture, permaculture, natural agriculture, biointensive agriculture, etc.

This chapter presents a perspective that guides many of the development efforts of the Costa Rican stakeholders of the organic movement: this perspective highlights the benefits of working towards self-sufficient organic farms in the context of developing countries. It emphasizes local traditional knowledge and practices of farming families who derive most of their livelihoods from organically managed smallholdings.

This approach emphasizes its distinction with large scale export-oriented organic enterprises. These large scale organic enterprises usually exhibit a relatively high degree of specialization (even if they are working with crop rotation and diversification), which enables them to deliver the volume and product qualities required to meet the demands of importers and large retailers such as supermarkets. Self-sufficiency-oriented small scale farms are centered around the use of family labor and family consumption of organic food produced on the farm. They are therefore only partly integrated into the market economy. Although such farms are usually not completely self-sufficient, they can often achieve a high level of self-sufficiency and diversity (two concepts that go hand in hand).

Lessons to be learnt:

- *Organic farms run by peasant farmers are often composed of several inter-related sub-systems or components, which together form a nearly self-sufficient system, centered around the farming family and its farm based sustenance.*
- *Self-sufficient organic farms are based on the sustainability observed in interdependent relationships of natural ecosystems, but are designed and managed by the farming family, according to its needs and possibilities.*
- *Self-sufficient organic farms seek to achieve conservation of natural resources (soil, water, biodiversity and environment), optimum use of the farms' resources (including family labor and energy), and minimum waste output.*
- *Developing and maintaining a self-sufficient organic farm requires the farming family to be well informed and the process towards achieving self-sufficiency to be carried out gradually*

2 Organic Farming Systems: Examples from the Humid Tropics

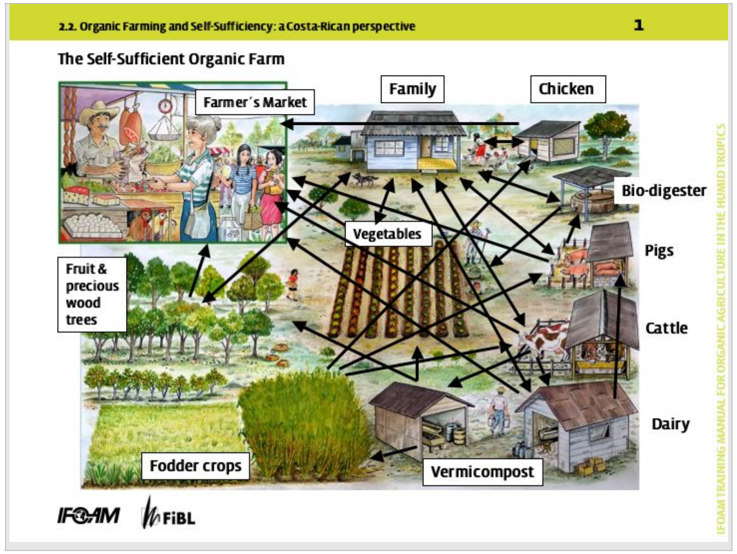
Highly diverse production systems are generally less vulnerable to both market prices fluctuations and harvest losses due to pests and diseases or adverse climatic circumstances.

To simplify matters, throughout this chapter the term "self-sufficient farm" is used to describe self sufficiency orientated farming system.

2.2 How can Organic Farms Achieve More Self-Sufficiency?

The concept of a self-sufficient farming system is strongly related to that of agro-forestry systems, which have evolved in many developing countries, particularly in South and Central America (Brazil, Colombia, Venezuela, Ecuador, Nicaragua, Costa Rica), but also in the Philippines and some African countries. These systems mimic the structure and functions of the rainforest, the natural climax ecosystem in the humid tropics. Similar examples can be found in many other countries around the world. Agro-forestry is a practice that can often provide a good basis for the development of self-sufficiency in organic farms. Like for any organic farm it should be of key importance to make the best possible and most sustainable use of the natural resources available at and around the farm. The integration of trees and crops can provide the farm and the family with an even more diversified and ecologically stable agro system. Self-sufficiency implies the integration or complementarity of the different productive components, or sub-systems, within the farm, including the family as one of the central components of the whole system.

The idea of a self-sufficient farm has to do with taking advantage of the farm's natural resources and local conditions, in order to design a highly diversified production system in which inputs for all the productive activities are produced within or around the same farm. There is minimal or no use of external inputs. Thus, production costs are kept very low. The farm products, food and energy, are produced primarily for the family's consumption. Surplus products are bartered or sold at the market. The aim is to create a naturally balanced farming ecosystem by developing a self-sustaining, highly productive, nearly closed system. In order to assure future availability of resources and the sustainability of the system damage to the environment has to be minimized. Two examples of how some farming communities in Latin America successfully work towards increasing the self-sufficiency of their organic farming are presented below.



TRANSPARENCY 2.2 (1): THE SELF-SUFFICIENT ORGANIC FARM

Motivation: Must a self-sufficient farm be organic?

Promote a class discussion, asking participants to give examples of how synthetic fertilizers and pesticides (even if used sparingly and rationally) could hamper the sustainability and self-sufficiency of an organic farming system, in the context of their own regions.

Example 1: A traditional production system managed by indigenous communities of Talamanca, Costa Rica

Some indigenous communities in Talamanca, on the south Atlantic coast of Costa Rica, manage their natural environment through traditional production systems. These prototype systems, which include aspects of family organization for work, cultural and social traditions, indigenous production technologies, and natural resource conservation strategies, are self-sufficient systems composed of several interrelated and mutually supportive sub-systems.

These indigenous communities use simple and small-scale forms of production. Based on diverse polyculture, crops are grown within a certain area, combining the cultivation of grains (beans, corn, rice), roots and tubers (cassava, ñame, ginger), fruit trees (lychee, zapote, guava, avocado, pejibaye, citrus), other trees that help conserve the agro ecosystem's fertility and stability, together with domestic animals (chicken, pigs, cows, horses, etc.), and wild animals (birds, monkeys, rodents, cats, etc.).

This system has made it possible to preserve forests, water resources and wild fauna for thousands of years, while providing food and shelter for the indigenous families, all through the rational use of these resources.

Forest wood is used for construction and as a sustainable source of firewood. Diversified crops are managed on small production areas within the forest, taking lunar movements into consideration when making decisions on crop planting and harvesting. Seeds and planting materials are selected, conserved and passed on from generation to generation.

Indigenous people use more than 160 plant species in their diet and as medicines. Production is distributed throughout the year, and they utilize more than 20 types of domestic and wild animals.

Surplus production of cacao, banana and plantain is sold on national or international markets, thus generating an income which is used to buy salt, sugar, matches, clothes and tools for agricultural work.

ILLUSTRATION: REPRESENTATION OF THE COMPONENTS IN AN INDIGENOUS TRADITIONAL PRODUCTION SYSTEM IN COSTA RICA

Example 2: Agri-silvi-pastoral systems in Latin America

A large part of Latin America's agricultural and livestock systems exist on, often steep, hillsides with different degrees of rainfall and dryness. Organic agri-silvi-pastoral systems have a huge potential to play in removing the constraints and enhancing the sustainability of agriculture under these conditions. The agri-silvi-pastoral system is a self-sufficiency-oriented farming system which has been developed, and is being promoted within the tropics, and which is particularly relevant for farmers in marginal areas.

Its objective is to optimize the beneficial effects of the interactions between tree and fodder components, farm animals and crop components, in order to obtain a sustainable production system. These systems integrate the concurrent production of diverse agricultural crops, forest trees and fodder species for domestic animals. The diverse multi-storey vegetation makes efficient use of solar radiation and the diverse root systems growing to different depths allows for the recycling of leached nutrients.

Profuse vegetation at lower levels can improve the physical properties and structure of the soil and the tree system can moderate temperatures, reduce air movements and facilitate balanced water management. Thus, all plants, insects, macro and microorganisms benefit from the system.

Discussion:

Ask each participant to name the specific conditions in which self-sufficiency of agricultural systems could be developed in their location.

2.3 The Socio-Economic Context of Self-Sufficiency Strategies

Organic farming systems range from rather specialized farms that produce for international markets to subsistence systems that produce a wide variety of products for the family consumption. With exception of subsistence agriculture, most farming systems have as their main objective the production of goods to sell at market. In the case of organic farms this produce will normally, though not always, be certified as organic. These systems support the farmer's family, but the whole family is not necessarily involved in the farming process.

Self-sufficient farms do not have cash crop production as the main goal even if they do produce surplus products for the market. The self-sufficient farm is primarily a long term "survival strategy" for the farming family. The main goal is to manage the farm resources in such a way that the farming family's sustenance and quality of life is guaranteed on, and from, the farm in the long term. The strategy is often derived from the fact that the farm and the community are the sole or main sources of sustenance for the family. Therefore, for this kind of farm, developing a specific product to be competitive at the market place would rarely be a priority. However, integrating a new activity (or sub-system), such as a small processing unit, into the farm may be of interest, especially if it can add value and help generate labor opportunities for family members, particularly to offer the children an opportunity to remain involved in the farm as they grow older.

In the context of a self-sufficient farm, sustainability refers specifically to the ecological interrelations of the farm's subsystems. The farm becomes a system where each and everyone of the subsystems and energy flows are interconnected (either directly or indirectly). Products or by-products of one subsystem become inputs for another subsystem. Some farms might be highly diversified, but when looking more deeply into the relationship between crops or activities, one often finds that they are rather a collection of unarticulated activities, which may be highly dependent on external inputs for their maintenance.

2.2. Organic Farming and Self-Sufficiency: a Costa-Rican perspective **2**

Self-sufficiency-oriented farms vs. market-oriented farms: different strategies

	Self-sufficiency-oriented organic farms	*Market-oriented organic farms*
Goal	Develop a self-sustaining system that guarantees food security and quality of life for the farming family, as well as risk minimization.	Produce good quality, healthy and environmentally safe products for organic markets, and meet market requirements in terms of volumes and regularity of supply.
Approach	Farming family centered. Family "survival" strategy.	Market centered. Profit maximization strategy.
Activities/ Inputs	High level of interconnection between the different farm component. Outcome and waste products from one or more subsystems are inputs to others. Minimal or no use of external inputs.	Few interconnections. Waste products are recycled and may be used as inputs for other activities, but the use of external (organic) inputs may be important.
Labor	Mainly family labor.	Labor is contracted as needed according to economic optimum production level.
Diversification	Very intense. Based on family's food security needs and abilities to manage the system.	Some. Depending on crop mixing and rotation techniques, market demands and availability of financial resources.
Production costs	Usually lower than in conventional production (depending on the opportunity cost of family labor).	Usually higher than in conventional production (depending on the cost of labor vs. other inputs).
Environmental sustainability	Usually high.	Variable, although clearly more environmentally friendly than non-organic farms.

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Transparency 2.2 (2): Self-Sufficiency-Oriented Farms vs. Market-Oriented Farms: different strategies

Group work: Identifying potential linkages between sub-system components

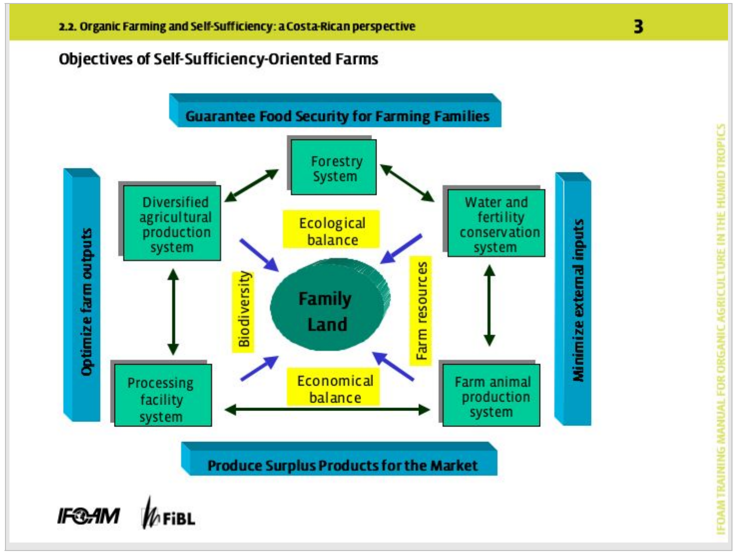
Form 3 or 4 groups with all participants. Ask one participant in each group to describe an organic farm he or she knows in her/his region. The group should try to identify the level of integration between the different activities that take place at this particular farm, and propose changes (if necessary) to improve interconnections existing between the activities so as to reduce the use of external inputs.

Participants should then share their examples with the rest of the class.

2.4 What are the Objectives of Self-Sufficiency-Oriented Farms?

Self-sufficiency-oriented farms are intended to meet a range of economical, ecological and cultural objectives for the farming family. These will include the following.

- Guarantee food security and basic needs for the family, by producing a wide variety of products for home consumption and for increasing the number of surplus products to sell at market.
- Reduce crop specialization, to avoid the dependence of the farming family on just one, or a few, product(s) which may be susceptible to pests and diseases, extreme climate changes or market fluctuations.
- Optimize the sustainable use of the natural resources available at the farm, developing independence from external inputs and lowering production costs and cash expenditures to the minimum possible level.
- Minimize the production of wastes from the farm by recycling and integrating all waste materials from the different productive subsystems, thus closing the energy cycles within the farm and avoiding environmental contamination.
- Recover and conserve biodiversity in order to achieve an ecologically balanced system in which the control of pests and diseases is mainly a natural process.
- Develop a system that is ecologically and economically sustainable in itself, and provides small and medium size farmers with the possibility of making a living from the farm's resource bases, over the long term.



TRANSPARENCY 2.2 (3): OBJECTIVES OF SELF-SUFFICIENCY-ORIENTED FARMS

2.5 Sub-Systems or Components of the Self-Sufficient Farm

There is not one single "model" for a self-sufficient farm. Rather, the system should be designed according to local conditions, including the family's interests, abilities and work opportunities. Nevertheless, common, widely employed, components or subsystems within highly self-sufficient farms will usually include the following.

- **Land.** The basic element for farming. Preferably, it should be owned by the family because developing a self-sufficient farming system is a long term investment that involves much time and dedication. It is not a project that a family can start all over again without losing a great deal of investment.
- **Farming Family.** Committed to agriculture and, preferably, living at the farm.
- **Productive sub-system for home consumption.** Diversified mixed crops and some breeding, including vegetables, roots and tubers, grains, fruits, minor animal species, bee keeping, etc. This sub-system guarantees food security for the family.
- **Productive sub-system for the local market.** Several crops, which are well adapted to the local climatic and soil conditions, which can be efficiently produced, and for which there is a strong demand at a readily accessible market. This may also include some products or by-products from breeding, such as: chicken meat, eggs, goats' or cows' cheese, butter, honey, etc. This sub system provides the main source of regular income.
- **Animal breeding sub-system**. Cattle, pigs or other animals, which are usually semi-stabled, fed on small (rotated) grazing lots, complemented with high protein (farm grown) fodder. Manure from these animals can be used to produce biogas energy for the house (through a methane bio-digester), and organic fertilizers for all the farm's crops (including the pastures and fodder crops). Also, meat from these animals may be an extra occasional income.
- **Forestry sub-system**. Composed of a multi-storey variety of native tree species (including precious wood and fruit trees). This subsystem can be integrated with other crops or activities (providing shade and nutrient recycling), located on the farm's limits (as buffer zones), on the banks of rivers or creeks (helping protect water sources), or used as live fences. Products from this sub-system can provide an occasional income, an investment for the future or a capital reserve (in the form of wood).
- **Farm processing unit sub-system**. Small, family run industries to process fresh produce, both for family storage and later consumption, or to sell at the market place as a value added product.

TRANSPARENCY 2.2 (4): SUB-SYSTEMS OR COMPONENTS OF A SELF-SUFFICIENT ORGANIC FARM

2.6 Increasing Self-Sufficiency on a Farm

The development of a self-sufficient farm depends on a number of specific local factors and conditions. These will include: family (size, economic situation, cultural preferences, labor availability), agro-ecological characteristics (climate, soil, biodiversity), farm resources (land, water, local flora and fauna), and marketing possibilities (community, local, national or international).

When intended, the transformation from a conventional, or even from a market-oriented organic farm, into a self-sufficient farm should be a gradual process.

The first step is to carry out, ideally with participation of all the family members, a creative analysis of the farm to identify the present conditions. Some basic issues to discuss could be:

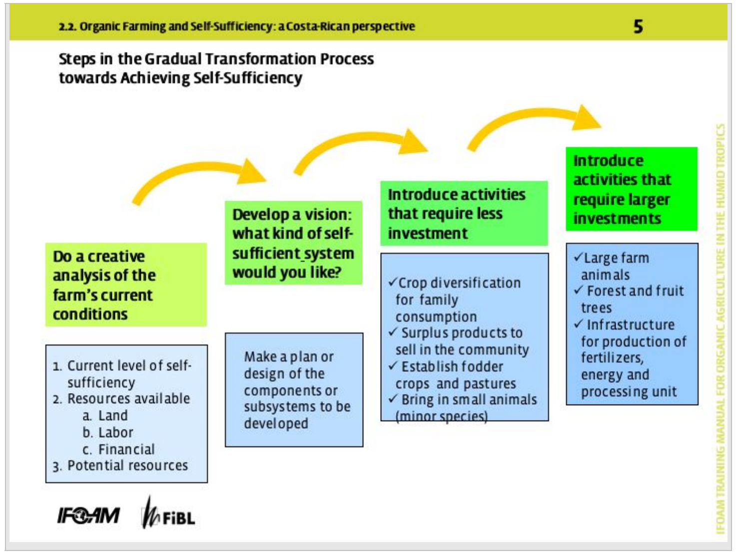
- **Level of self-sufficiency of the current production system**: How many activities are carried out at the farm and what products or byproducts from each one of these activities are inputs for other activities at the same farm? Of the total expenses, what is the percentage spent on external inputs needed to maintain the system (including food for the family)?
- Actual resources available for the farming family:

Land and natural resources: Does the family own the land? What is the size of the holding? Taking into consideration conditions of the soil and topography, how much of this land could be dedicated to crops? How much to buildings for animal shelter? How much could be for fodder crops or for forestry systems? Is there sufficient availability of clean water all year round? How efficient is the production of green biomass in the region?

Labor: Is the family small or large? Are all the family members capable or willing to get involved in the farming process? How many hours of work can each one offer? What are the main interests and abilities of each family member?

Economic situation: Does the family have some savings to invest in the changes needed at the farm? If not, does the family have the possibility of accessing credit? Is any one of the current activities generating surplus money that could finance small investments over a certain period of time?

Potential resources: Are there NGOs, government offices or cooperation funds that could support this kind of enterprise within the community where the family lives?



TRANSPARENCY 2.2 (5): STEPS IN THE GRADUAL TRANSFORMATION PROCESS TOWARDS ACHIEVING SELF-SUFFICIENCY

Motivation: How can we design a self-sufficient farm?

Ask each participant to make a design for a self-sufficient farm, taking into account the systemic approach (farming family's capacities, components, limits, inputs, outputs and interactions).

After this analysis, the family should have increased their awareness of their current situation and should, then, be better placed to create a vision of the kind of self-sufficient farming system they would like to develop. To do this, they should consider how they can achieve the economical, ecological and cultural objectives of the self-sufficiency oriented farm (as mentioned in section 2.4), as well as their own interests and opportunities.

Once there is a general plan of the desired self-sufficient farm, the family should start by introducing activities that do not require high investments but, rather, which optimize the use of land and family labor (for example, increasing crop diversification to provide food for the family and some surplus products to sell within the community). The savings from not having to buy food at the local stores, and some earnings from the sales, can be used to plant fodder crops and grains in preparation for the introduction of some small animals. Over time, infrastructure can be built for bigger animals, for organic fertilizers and energy production, or for food processing.

Gradual transformation, in addition to being less expensive, lets the farming family get slowly used to the new technologies, have a better understanding of the transition process, and develop personal experience, before moving on to a new levels of transformation. As usual in organic agriculture, there are no strict steps or recipes to follow, it should all come from the farmer's ability to understand and optimize the particular potentialities of their own farm, in the context of economic sustainability and environmental protection.

Example 3: Improving self-sufficiency on a low input coffee farm in Costa Rica

Conditions before the transformation

The farm, 3 hectares in size, is located at the community of San Jeronimo in Perez Zeledon, Province of San Jose, about 175 km from San José city.

Rainfall ranges from 3000 to 5000 mm per year and average temperature varies from 23°C for lower lands to 10°C for high lands. The farm is located at an altitude of approximately 1100 m.

The family is composed of 5 members, 3 of whom are children under 18 years of age. All the family members help with the farm's chores, the children doing so as much as their studies allow.

Before the transformation process began, the house (located at the farm) was in good condition, cooking was done with electricity and commercial gas. There was a storage room and a small building to make bocashi (fermented organic fertilizer). The farm has always been essentially a coffee farm. A small area was dedicated to annual crops (green beans and coriander) and approximately 300 citrus trees among the coffee plants. At the time, 30% of the coffee plantation was fertilized with organic fertilizers made at the farm, and the rest with commercial synthetic fertilizers. The forestry component consisted of some 200 trees used as windbreaks or shade within the coffee plantation. Tree species were mainly *E. deglupta, E. saligna, Cupressus sp. Pinus sp.* and *Casuarina sp.* There were no alternative marketable products to coffee, other than a small quantity of citrus trees.

Changes implemented after the farm's analysis

The possibility of substituting coffee with any other crop was very limited because most of the steep and stony nature of the land. In addition, the family was unwilling to give up coffee production. Therefore, the decision was to strengthen organic coffee production and give it added value by processing it on-farm. A very small processing plant was installed. Coffee shade was improved, by planting *Musa paradisíaca, Erythrina poeppigiana* and forestry species like *Terminalia amazonia*. Total transition to organic production was given priority. A gas flame-thrower was introduced for weed control, and adaptations were made to the building where organic fertilizers were made. Production of bocashi was abandoned as this required some external inputs, like semolina and charcoal. Instead the family started producing vermicompost, which would recycle the coffee pulp left over from the coffee processing and would not need any additional materials.

... **Continuation of Example 3**

In addition to optimizing the organic coffee production and processing, other activities were introduced. Corn, fodder crops and sugar cane (all to feed small animals) were substituted on a small area of the oldest coffee plantation. Three small separate buildings, to host goats, pigs and chickens, were built. A biogas bag was installed, to be fed with the pig's dung, and to produce enough gas for the family's cooking needs. Effluents from the biogas system were used to fertilize the coffee plants. Some of the milk from the goats was consumed by the family, and some transformed into cheese and sold within the community. Surplus production of eggs, chicken and pig meat is also sold within the community.

Later, another small area of the oldest coffee plantation was used to grow a wide variety of vegetables. These vegetables were fertilized with vermicompost, which in addition to coffee pulp also incorporated the goats' dung. For all year round production, and the most difficult crops, a 60 m2 green house was built and a hydraulic ram was installed to bring water up from the river, located at a much lower level than the land. Today, in addition to milk, cheese, eggs and meat, the family has a large variety of vegetables and some fruits to enrich their diet. Other community members appreciate these vegetables and come to the farm weekly to buy the surplus production.

Finally, the forestry component was also enhanced by planting precious wood species like *Ocotea* sp. and *Terminalia amazonia*. These trees will provide an important source of income for the family in the mid to long term.

Today, the farm is still mainly a coffee farm but is now wholly organic and has many other alternative activities, which produce both food for the family and additional income for other needs.

Adapted from: CURZEL, N. La Finca Integral Conservacionista: una Experiencia en Costa Rica. Roma 2003.

2.7 What are the Overall Advantages of a Self-Sufficient Farming System?

Some of the specific advantages of self-sufficient systems for farming families have been mentioned (and the economic benefits will be analyzed in more detail in the next section). There are also other overall advantages (or positive externalities), present in most agro-forestry systems, which also apply to self-sufficient farms. These include:

Ecological advantages: Protection of existing forests, carbon dioxide fixation, biodiversity conservation, water conservation, soil improvement and conservation, nutrient mobilization and recycling, nitrogen fixation, micro-climatic improvement, optimum use of physical space, optimum use of natural energy and green biomass, and natural weed control.

Economic advantages: Diversification of production, contribution to food security, diversified market possibilities and alternatives, additional income from other products (wood and non-wood forestry products), less dependence on external inputs, more production per unit of space, sustainability of the agricultural and forestry components, tree services to associated crops (protection, shade, support), decrease in pests and diseases, less dependence on the overall economic conjuncture.

Social advantages: Development of an agro-forestry culture, maintenance and promotion of local knowledge, optimum use of family and local labor, increased economic and social stability for farming families.

Some concrete examples of how ecological advantages have a positive impact on production:

- Solar energy use improvement: There is a wider foliar coverage distributed over the land, which takes advantage of the sunlight, thus producing more green biomass.
- Soil structure improvement: Multi-storey plant production increases soil porosity, soil aeration, rainfall infiltration, and stabilizes soil temperature

- Nutrient mobilization: The diversity of plants and their different root systems favors nutrient mobilization and prevents leaching and other losses.
- Organic matter and green biomass production: Soil fertility is improved through rotations and polycultures, bushes and wood trees supply leaves and branches that decompose on the soil
- Control of weeds, pests and diseases: Proliferation of biological controllers is promoted, and natural control over weeds takes place through competition by other plants.

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Overall Advantages of Self-Sufficient Farming Systems

Ecological advantages	Economic advantages	Social advantages
✓ Protection of existing forests	✓ Product diversification	✓ Development of an agro-forestry culture
✓ Carbon dioxide fixation	✓ Contribution to food security	Maintenance & promotion of local knowledge
✓ Biodiversity & water conservation	Diversified market possibilities and alternatives	✓ Optimum use of family and local labor
✓ Soil improvement & conservation	✓ Additional income from other products (e.i.wood and non-wood forest products)	✓ More economic and social stability for farming families
✓ Nutrient mobilization & recycling	✓ Less dependence on external inputs	
✓ Nitrogen fixation	✓ More production per unit of space	
✓ Micro-climate improvement	✓ Sustainability of the agricultural and forestry components	
✓ Optimum use of physical space	✓ Tree services to associated crops (protection, shade, support)	
✓ Optimum use of natural energy and green biomass	✓ Less dependence on the overall economic conjoncture	
✓ Natural weed control	✓ Pests and diseases decrease	

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TRANSPARENCY 2.2 (6): OVERALL ADVANTAGES OF SELF-SUFFICIENT FARMING SYSTEMS

Motivation:

Ask each participant to name other advantages that could be obtained from self-sufficiency-oriented management in their own regions.

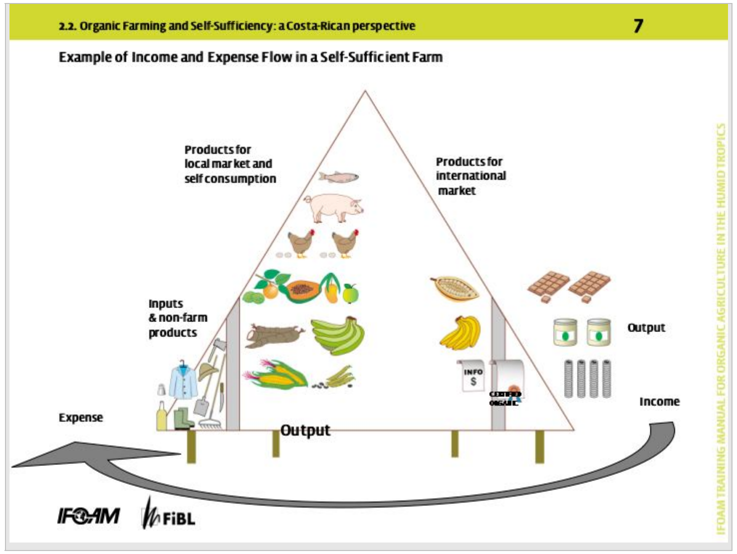
2.8 Are Self-Sufficient Farming Systems Financially Profitable for Small and Medium Scale Farms?

Self-sufficiency strategies in organic farming systems are being spontaneously adopted by many small scale farmers in developing countries, often spreading by word of mouth, as these farmers get information about success stories from other farmers. Many such experiences, though, need further financial and technical support to make the transition from poorly diversified systems, where pest and disease management may be a difficult and expensive task to a really self-sufficient and stable system which is both profitable and giving the family the prospect of long term economic security.

Two important aspects that should be taken into consideration when analyzing the financial profitability of self-sufficient farms are: 1. Optimizing financial profit from each and every one of the sub-systems is not necessarily a priority, 2. Financial profit from the same sub-systems or activities may vary considerably from farm to farm.

- Optimizing the financial profit obtained from each subsystem is not necessarily a priority, as long as the whole system delivers a satisfactory profit level for the family. Often there may be activities that, when analyzed independently from the whole system, appear to have a financially negative balance, but which are essential for the ecological balance of the farm and, therefore, have a strong impact on the efficiency of other activities that make a positive contribution to the whole farm's profitability. As a simple example, milk production is often not a good business, especially if most other people in the community have a cow of their own, but processing the manure from the milking cows could be the most efficient way to produce fertilizers for vegetable crops for which there is a strong demand within the same community.
- Related to the above, a productive activity or sub-system that is profitable on one farm could be uneconomic on another farm, even if under very similar agro-ecological conditions. This may reflect the ability of the family to achieve an efficient integration of one sub-system within the whole farm system. For example, if a family wants to breed hens to produce eggs and some chicken meat, but does not want to produce fodder or grain crops at the farm, they will have to buy concentrates to feed the hens, and this activity could produce a loss. Another family could use residues from vegetable crops along with some corn and Erythrina sp. leaves, to feed the hens at a lower cost, and thus obtain considerable profit from this activity.

Thus, the level of success and efficiency of self-sufficient farming systems is highly dependant on the farming family's creativity and its ability to utilize the natural resources available at the farm, to assess the potential resources that can be developed through diversification and management, and to design, develop and manage the whole system based on a deep understanding of possible natural interactions between the sub-systems.



TRANSPARENCY 2.2 (7): EXAMPLE OF INCOME AND EXPENSE FLOW IN A SELF-SUFFICIENT FARM

Recommended web-sites

- *http://www.pcarrd.dost.gov.ph/CIN/AFIN/R&D_directions_CIS_features_2.htm*
- *http://www.agriculturaorganica.org/finca_daniel.htm*
- *http://www.infoagro.go.cr/organico/16.Finca_integral_EARTHl.htm*
- *http://proades.tripod.com.mx/proades/id10.html*

3 Examples of Successful Organic Initiatives from the Humid Tropics

3.1 El Ceibo, Bolivia

Introduction

The El Ceibo case study tells the story of how a group of cocoa farmers in Alto Beni, Bolivia, overcame a situation of dependency and exploitation by intermediaries who paid extremely low prices for their cocoa production. The farmers decided to search for better alternatives and, with clear goals in mind, determination and support from national organizations and international cooperation agencies, they became part of the cooperative, organic and fair trade movements.

The name they chose for their cooperative, El Ceibo, is the name of a jungle tree that grows back very quickly after it has been cut down. This is the spirit with which they began their difficult, but successful, journey some 28 years ago.

Lessons to be learned:

- *Strengthening organizational values and sharing clearly defined objectives is a basic element of success for small farmers' organizations.*
- *Sometimes, approaching production and marketing from an integral chain perspective and having the flexibility to adapt to market and production demands can be more important than having a strong long term strategic plan.*
- *When governmental and local institutional support is scarce or lacking, organized small farmers are capable of developing internal technical and economic support structures.*
- *The development of national and international alliances (technical and financial cooperation) is crucial for small farmers in developing countries in order to develop sustainable production and marketing models.*

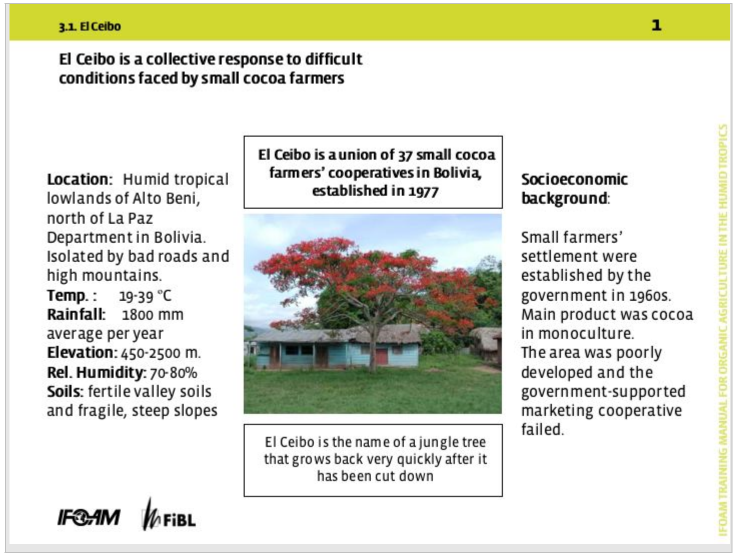
3 Examples of Successful Organic Initiatives from the Humid Tropics

3.1.1 Background and organization description

El Ceibo is a cooperative formed by a union of around 37 small cocoa farmers' cooperatives in the region of Alto Beni, located in the northern area of the La Paz Department in Bolivia. This region features both fertile valley soils and fragile, steep slopes with altitudes ranging from 450 to 2500 meters. Annual rainfall averages 1800 mm, relative humidity is 70-80% and temperatures range from 19 to 30ºC.

The Alto Beni was colonized by small farmers, who were given land by the government in the 1960s. The average farmer received 12 hectares of land, and because of the favorable ecological conditions (humid tropical lowlands), they were encouraged by the government to plant at least 4 hectares with cocoa. The government also established a cocoa marketing cooperative, which farmers were encouraged to join.

However, this cooperative soon went bankrupt and, individual farmers started selling fermented and dried cocoa beans to intermediaries who, taking advantage of the farmers' lack of information and means of transportation, paid extremely low prices. In the 1970s many farmers seeking a solution to this unfair situation started organizing themselves into new small cooperatives, four of which united in 1977 to form the El Ceibo cooperative ("Central Regional de Cooperativas Agropecuarias Industrial El Ceibo Ltd."). Later, more cooperatives joined.



TRANSPARENCY 3.1 (1): EL CEIBO IS A COLLECTIVE RESPONSE TO DIFFICULT CONDITIONS FACED BY SMALL COCOA FARMERS

From the beginning, the objectives of this organization were economic, as opposed to many other campesino organizations in Bolivia, whose main objective is to represent its members´ interests on the broader context of policy and rural development.

El Ceibo's overall objective was not to represent its members, but rather to serve their needs and help them improve their living conditions. This goal led to the emergence of very concrete and specific objectives:

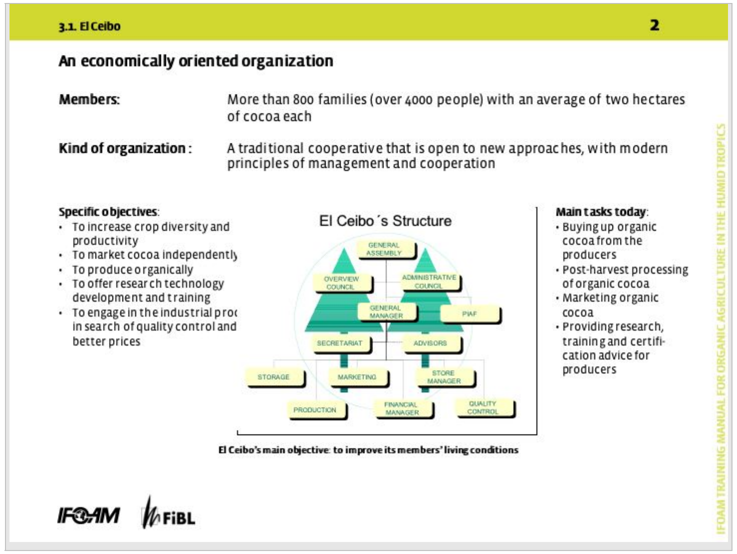
- *to increase crop diversity and productivity,*
- *to market cocoa independently,*
- *to produce organically,*
- *to offer research, technology development and training,*
- *to engage in the industrial process in search of quality control and better prices.*

These specific objectives sprouted naturally as El Ceibo reacted creatively to alternative markets opportunities and technological difficulties.

Today, cocoa is still the main cash crop in the area. More than 800 families (over 4000 people) are members of El Ceibo and grow an average of two hectares of cocoa each. This association of cooperatives is a traditional cooperative that is open to new approaches, especially modern principles of management and cooperation. Members organize themselves in a democratic manner, and the 37 cooperatives co-determine their collaboration within the El Ceibo umbrella organization according to democratic principles. A General Assembly meets twice a year to make decisions on issues important to all members, such as the use of profits and the election of the Administrative and Overview Councils.

A special agricultural research and extension program focusing on agroforestry called PIAF (*Programa de Investigación Agroforestal*) has been designed by El Ceibo for developing technology and for training farmers on how to meet the markets' demands in terms of product quantity and quality. PIAF is implemented by Coopeagro, the research and training arm of El Ceibo.

El Ceibo's policy is that any leadership or paid staff position should be filled by its own members, who receive appropriate training for this purpose. Currently, there are over 70 permanent jobs in administrative/managerial positions or in providing technical advice and training, and they are all being performed by El Ceibo members. The aim of this measure is to remain largely independent from external personnel and to strengthen the organization's knowledge and expertise.



TRANSPARENCY 3.1 (2): AN ECONOMICALLY ORIENTED ORGANIZATION

Today, the main tasks carried out by El Ceibo are:

- buying organic cocoa from the producers,
- post-harvest processing of organic cocoa,
- marketing organic cocoa,
- providing research, training and certification advice for producers.

As an association of cooperatives, El Ceibo is a founder member of the Bolivian organic producers federation (Asociación de Organizaciones de Productores Ecológicos de Bolivia - AOPEB), a member of Naturland (Germany), Max Havelaar Germany and the Latin American network for small and medium-sized cocoa producers (Red latinoamericana de pequeños y medianos productores de cacao) founded in Costa Rica.

3.1.2 What does it take for an organization of small farmers like El Ceibo to improve living conditions for its members?

From the first days of El Ceibo's foundation, its leaders shared a vision that, in order to improve living conditions for its members, the main objective should be to change the unfair situation they were exposed to: high dependence on intermediaries who paid extremely low prices for their main cash product (about 40% less than the price paid in La Paz and as much as 65% less when exported).

A number of factors had contributed to the emergence of this situation:

- The agroecological zone was optimal for cocoa production and, therefore, this was the main product that farmers in the region were encouraged to produce.
- The region was newly settled with a very low level of economic development. Farmers depended completely on selling cocoa to earn their living.
- Although cocoa was a highly appreciated cash crop, the marketing channels (national or international) were centered in La Paz.
- The region was isolated, with few roads, and farmers were too poor to have their wn means of transportation.

However, some of these challenges also represented opportunities for turning the situation around. With the help of technical cooperation, first from the Swiss NGO Caritas and later from the German Development Service (DED), they realized that their priority should be to improve the production and marketing options for their cocoa. That implied avoiding intermediary traders, getting into product transformation and procuring technical assistance services for their members.

At first, El Ceibo's activities concentrated mainly on direct marketing of cocoa beans for domestic and export markets. They started doing so at a favorable time as there was a 400% increase in international cocoa prices between 1976 and 1980. Nevertheless, by the end of the 1970s, major quality problems, resulting from disease attacks, prevented El Ceibo from exporting cocoa. The government temporarily withdrew their export license, as the quality of their product did not meet the required export standards.

Then, in 1980, a grant from the Inter-American Foundation supported and strengthened the organization. The money made it possible for them to buy a truck and to have enough operating capital to purchase cocoa at better prices, thus competing effectively with local traders. By the end of 1984, El Ceibo controlled about 70% of the local market and had initiated the production of good quality chocolate at a new cocoa factory in La Paz.

Motivation exercise:

Divide the class in two groups according to regions of origin. Ask one group of participants to identify, analyze and share with the rest of the class at least one case where small farmers face unfair marketing conditions in their own region. The factors (implicit or explicit) that influence the farmers' reality and make it difficult to overcome the unfair conditions should be pointed out.

Then, ask the second group of participants to propose creative and feasible approaches to turn the presented situation around and improve the farmers' overall quality of life.

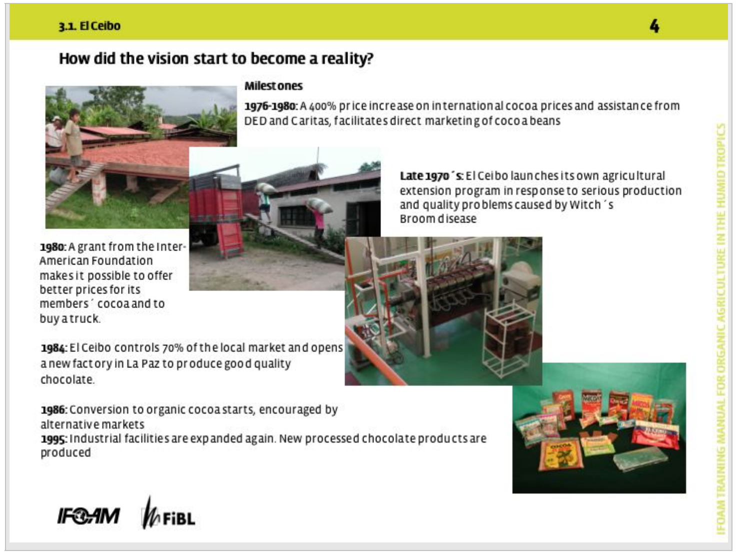
Transparency 3.1 (3): Understanding production and marketing from an integral perspective

Initially, before 1984, El Ceibo processed cocoa in a very small and outdated plant in Alto Beni, where fermentation was the main process. Later, at El Ceibo's branch in La Paz, cocoa was roasted, peeled and ground using the simplest technology to obtain raw chocolate.

The new factory, equipped with high standard second hand machines, also made it possible to press cocoa butter. Thanks to this processing step, 'defatted' cocoa powder could be produced and was marketed in Europe through the Swiss alternative trade organization OS3. In 1995, these industrial facilities were again expanded and modernized, allowing the production of more processed chocolate products. From the very outset, the aim was to establish a value-adding capacity for the product to be sold both domestically and abroad.

In the late 1970s, Witch's Broom (*Crinipellis perniciosa*) disease led to serious difficulties in cocoa production and the collapse of cocoa yields and quality. In response to this, El Ceibo launched its own agricultural extension program and began to train members intensively in techniques for controlling the disease. Conversion to organic farming practices began in 1986, and in 1987, they marketed the first certified organic cocoa available in the world. Support for this development was provided by both OS3 and the Rapunzel company in Germany, the latter buying El Ceibo's raw cocoa and its processed products at very favorable prices. At around this time, El Ceibo received substantial further support in the form of human and financial resources from German and Swiss development cooperation organizations.

Today, El Ceibo members receive good returns from their crops thanks to good yields in organic cocoa production and the premium price paid by organic and fair trade markets. The cooperative gives incentives for organic production; it has a fund for education and community projects and another one for medical emergencies. In addition, all members are shareholders of the cooperative and many of them have a paid job in the administrative or technical structure, which employs over 70 people (all El Ceibo members). At the end of the year, profits that are not reinvested in strengthening the organization are distributed among its members.



TRANSPARENCY 3.1 (4): HOW DID THE VISION START TO BECOME A REALITY?

3.1.3 El Ceibo's technology development and capacity building strategy

At the end of the 1970s, El Ceibo decided to establish its own technology generation and transfer program. This was partly a reaction to the positive signs from the alternative markets and partly to the constraints posed by production problems.

The main production problems faced by cocoa farmers were those of pests and diseases (mainly Witch's Broom) that came about mainly as a result of the rapid increase of monocultural cocoa plantations, excessive use of pesticides and the subsequent deterioration of the soils; all of which caused a decline in cocoa yields and quality. This happened at a time when the Bolivian agricultural research institute (IBTA) and the government extension services had been weakened and did not have the human resources to be able to provide the technical assistance needed by El Ceibo's cocoa farmers.

In light of this situation, El Ceibo set up a technical assistance branch called Coopeagro and trained an initial group of seven campesino promoters. For this project, they were supported by donor-funded training programs (mainly from the Swiss Development Cooperation SDC) and the presence of volunteers from the DED, who have provided technical and economical advice on a constant basis since El Ceibo was established.

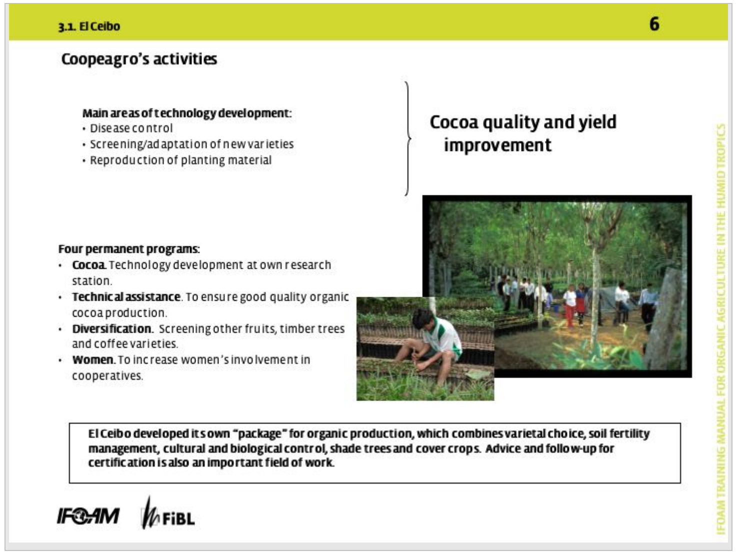
Human capital formation has always been an investment priority for El Ceibo. Four staff members received two years training in agronomy and cocoa production in Brazil and, at one point, there were as many as 22 El Ceibo members trained as promoters and working for Coopeagro. However, the cost of maintaining this number of staff was too high and the program is currently run by three promoters and one agronomist.

Infrastructure for technological development has been another major area of investment. A 10 ha lot was purchased for carrying out trials, reproducing planting material and conducting farmers' training visits. From the start, and until today, the main areas of technology development in Coopeagro have been disease control and the screening and adaptation of new varieties in order to improve cocoa quality. Planting material has been brought in from Costa Rica, Ecuador, Brasil and other areas of Bolivia. Diversification of cocoa varieties (i.e. some 25 varieties from IBTA and other Latin American countries), and of other fruit and timber trees, has been given much priority.

Discussion:
Ask participants to give their opinion on the advantages and challenges of having technology development and capacity building programs run by trained farmers.

TRANSPARENCY 3.1 (5): TECHNOLOGY DEVELOPMENT AND CAPACITY BUILDING

El Ceibo has also prioritized disease and pest control. They first worked on a pruning technique developed by IBTA on the late 1970s. Over time, and as El Ceibo was introduced into fair trade and organic markets by its European contacts and supporting donor organizations, the orientation of the program moved from the rational use of agrochemicals to organic techniques. It developed a package that combined varietal choice, soil fertility management, cultural and biological control, shade trees and cover crops.



TRANSPARENCY 3.1 (6): COOPEAGRO´S ACTIVITIES

In the beginning, the extension and research strategy of Coopeagro consisted mainly in adapting technologies and methodologies from the Bolivian or other Latin American countries public research and extension institutes and disseminating them. However, unlike these agencies, they used the campesino to campesino approach for the dissemination. This approach has the advantage of reducing costs and facilitating communication. There are also disadvantages to this approach, as sometimes the campesino promoters might not be well trained or might be inexperienced.

As El Ceibo became more involved in organic production, motivated by the organic market's beneficial conditions, they found out that the public institutes lacked knowledge of this approach and were forced to generate their own applied research and to disseminate their own technologies. Thus, their technical assistance program became more complex. Promoters now have the task of identifying farmers who want to produce organically, help them prepare an agreement to produce under the required standards and visit the farmers two or three times a year to follow up on the technical recommendations, in order to assure that each farmer produces good quality organic cocoa. Advising farmers on organic certification is also included in their tasks.

Today, Coopeagro has established alliances and specific research projects with different local and international public or private institutes, but its main focus is in managing four permanent programs[1]:

- **The cocoa program**, funded partially by Bread for the World, carries out technology development work at the research station and a project to rejuvenate the cocoa plantations of all El Ceibo members over eight years.

[1] From "Technology and Rural Development Strategies in a Base Economic Organisation: 'El Ceibo' LTD Federation of Agricultural Cooperatives". Anthony Bebbington, Javier Quisbert and German Trujillo.

- **The technical assistance program**, run by three promoters, its main goal is to ensure good quality organic cocoa production.
- **The diversification program**, screening other fruit and timber trees, and coffee varieties for potential expansion.
- **The Women's program** is funded completely by El Ceibo and aimed at increasing women's involvement in the cooperatives.

3.1.4 What has been the role of strategic alliances in El Ceibo's experience?

El Ceibo has received continuous and loyal support from donors for a period of over 20 years and this has been identified and highlighted by many as one of the main elements of its success. Nevertheless, this donor support has not only consisted of a permanent flow of subsidies and these donor agencies have not been the only source of financial and human capital for development initiatives within El Ceibo.

First, it is important to note that the organization's structure, the technology and capacity building activities, as well as the infrastructure investments, were always closely linked to the objective of facilitating market access. By building on this clear objective, El Ceibo has managed to assure that the grants given by donors, as well as the volunteer technical and economic advisors that have accompanied the organization on a continued basis, understood, respected and supported the organizations concerns and character. In this sense, El Ceibo has not only been a beneficiary of the international cooperation agencies, but has been able to develop long-term alliances with them.

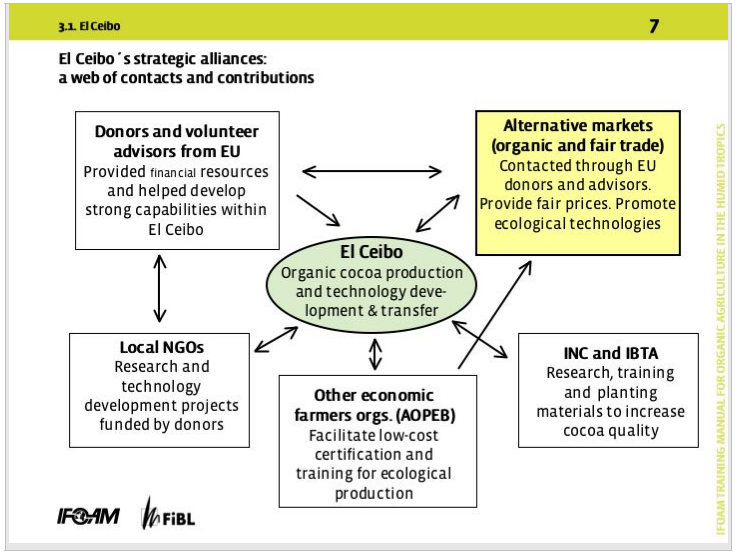
In turn, the long-term relationship with these agencies has facilitated contacts and new strategic alliances with the fair trade and organic markets, especially in Europe. Working together over such a long period of time has helped to develop a deep mutual understanding and sense of trust on both sides. In a sense, and especially in the beginning, the cooperation agencies played an important role in building trust between buyers (in import countries) and sellers (the farmers of El Ceibo).

On one side, buyers feel secure that the producers are being supported technically and financially and that they will be able to develop the kind of structure and products needed by the market. On the other side, the producers feel confident that a long-term relationship can be developed with trustworthy buyers, which justifies the investment of time and resources in developing tailored products for these new markets. In turn, access to these high value export markets has helped increase El Ceibo´s income and that has helped the self financing of some of the capacity building activities.

An additional and very important feature of these strategic alliances with alternative markets is the fact that they motivated the technological change towards ecological methods of production and processing. As mentioned before, Coopeagro developed its own research and technology transfer program on organic cocoa production to support their members in producing high quality organic cocoa and cocoa products for these markets.

Motivation:
Ask participants to identify the key elements of success in the kind of relationship that El Ceibo has developed with donors, institutions, marketing partners and other organizations.

Motivation question: which actors played the most important role in helping El Ceibo to develop an ecologically and economically sustainable production and marketing experience?



Transparency 3.1 (7): El Ceibo´s strategic alliances- A web of contacts and contributions

Fair trade and organic markets promote environmentally safe practices such as soil recovery and protection through the use of cover crops; green manure and composting; shade cultivation; crop diversification; and the elimination of toxic substances and synthetic agrochemicals (fertilizers or pest and disease control).

El Ceibo has also developed important links with national public institutions and NGOs: these local actors have also played an important role in El Ceibo's success. At the outset, the governmental INC (the National Institute for Colonization) was responsible for widely distributing the first cocoa planting material and establishing the plantations in the 1960s and 1970s.

Later, during El Ceibo's early years, when it did not have the capacity to do research or train its members, it collaborated with the National Institute for Research (IBTA). Because this institution was not strong in terms of human and financial resources, the work on the field had to be supported by campesino promoters who were thus able to gain knowledge and experience. Today, the relationship between El Ceibo and IBTA remains a good one and IBTA still provides plant material.

The relationship of El Ceibo with national and international NGOs has not been as intense. El Ceibo leaders have been committed to their goal of maintaining their autonomy, both administratively and ideologically, and they see NGOs as sometimes wanting to influence their decision making processes or trying to mediate between the administration and the members. Nevertheless, alliances do happen with NGOs for specific activities, usually related to research and technology development projects, funded by donors.

Finally, it is important to mention that, in an effort to obtain organic certification for its members at reasonable prices, in 1991, El Ceibo and the National Association of Quinoa Producers (ANAPQUI) approached other farmers' organizations involved in organic production and decided to create the Association of Organizations of Ecological Producers of Bolivia (AOPEB). AOPEB now provides training and information to promote ecological production. Today, this organization has 46 affiliated organizations and supports the work of over 25000 organic farmers throughout the country.

AOPEB is a member of IFOAM and of RAPAL-BOL (the local network of action against pesticides). It has also drafted and published the "Bolivian Basic Standards for Ecological Production and Processing".

3.1.5 Challenges and need for further development

Determination, clear goals, flexibility to adapt to market demands and an ability to attract committed support from donors and institutions seem to be the key elements that have made El Ceibo the strong and respected organization it is today.

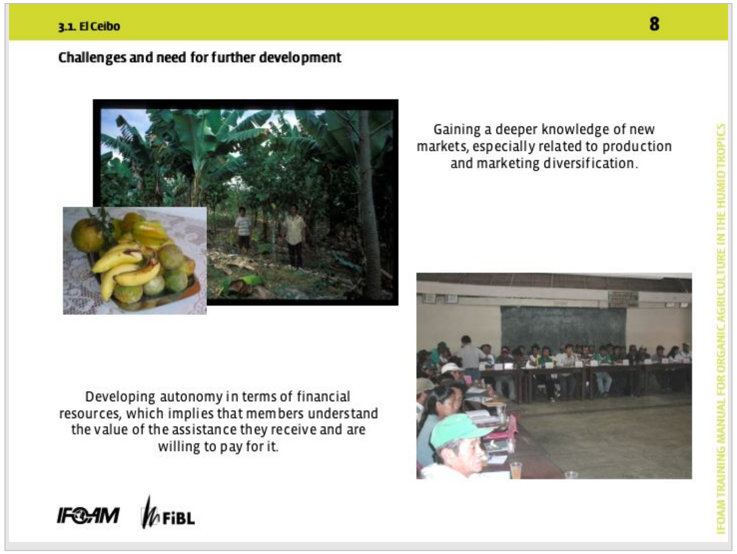
Nevertheless, as in any real life story, there are also lessons learnt through negative experiences, as well as challenges that have yet to be overcome.

In the 1980s, El Ceibo received support from the government to buy ten trucks to facilitate the marketing (in La Paz) of a diversified range of products produced by its members, other than cocoa. This initiative failed because administration of the trucks was difficult. In the end, the trucks were sold to avoid losing more money and the initiative was terminated. Later, El Ceibo tried to set up a consumers' food market, but this experience was not successful because of inappropriate choice of location for the market, which was inconvenient for consumers. It seems that gaining a deeper knowledge of new markets, especially related to production and marketing diversification, is one of the challenges that El Ceibo faces in the future.

Another challenge is to develop financial autonomy and self-reliance. Even though El Ceibo's organic and fair trade production and marketing activities are quite successful, and the goal of providing a better income for its members has been achieved, El Ceibo still relies on donors support for many of its human and capital investments. This is a danger, in the sense that donors somehow have created a dependency situation for El Ceibo, which could weaken the organization should the international cooperation agencies withdraw in the future.

The self-financing of Coopeagro's activities, for example, has been a challenge that has involved getting the members of El Ceibo to understand the value of the assistance they receive and the relationship between this assistance and the improvement in their income. With this understanding, willingness to pay for this assistance has increased, thereby increasing the possibility for completely self-financing the research and training activities of El Ceibo.

Final discussion:
Is El Ceibo's experience, including either the positive and negative aspects or the unmet challenges of it, useful for groups of small farmers in your own region? Ask participants to give some concrete examples.



TRANSPARENCY 3.1 (8): CHALLENGES AND NEED FOR FURTHER DEVELOPMENT

3 Examples of Successful Organic Initiatives from the Humid Tropics

3.2 MASIPAG, Philippines

Introduction

MASIPAG (Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura - or the Farmer-Scientist Partnership for the Development of Agriculture) is a farmer-led network of 542 farmers/people's organizations, university-based researchers/scientists, 33 development workers / non-governmental organizations (NGOs) and 40 church-based organizations in the Philippines. The word MASIPAG means industrious in Filipino. The MASIPAG network started in 1985 in response to the environmental damage and increased poverty, indebtedness and landlessness of farmers caused by the chemicals and high input methods of the green revolution. It aims for an alternative approach to development that stresses social, economic and environmental sustainability and farmer empowerment.

The network works with a "bottom-up" structure that builds on the experiences, leadership and needs of its members. This bottom-up approach is more effective because solutions to farming problems come from farmers, who know farming better than anybody else. Partnerships between farmers, scientists and NGOs not only build trust among the different sectors, but also empower the farmers, as they are part of the team. Every year, a General Assembly draws together the full membership that includes farmer organizations, NGOs and scientists. This forum serves as the highest policy and decision-making body of the network and determines the direction and thrust of the program. Decisions made at the General Assembly are implemented by the elected Board of Directors, made up of farmers, scientists and NGO representatives. The network is decentralized with a Regional Project Management Team (RPMT) in every region. The RPMTs spearhead the program implementation in the three regions of the Philippines; Luzon, Visayas and Mindanao. At a national level, coordination of the network's activities is assisted by a secretariat based in Los Baños, Laguna.

Currently, the MASIPAG network has over 30000 farmer members throughout the Philippines. These members work with sustainable agriculture methods to improve their livelihoods in a way that empowers local communities and protects the environment.

Lessons to be learned:

- *Giving access and control over the seeds and farm diversity into the hands of the farmers improves their income and food security.*
- *Organic networks based on a bottom-up structure are effective because solutions come directly from the organic producers.*
- *A strong organization, which shares a clear vision and a strategy, serves as a support element for small farmers during difficult periods.*

TRANSPARENCY 3.2 (1): MASIPAG.

Motivation :

Start the training by explaining the importance of networks in developing the organic movement in a region or country. Use the MASIPAG transparency for the introduction. Afterwards, ask the participants if anyone is member of a farmer-led network. Discuss with them why it is important that networks should have a bottom-up structure.

3 Examples of Successful Organic Initiatives from the Humid Tropics

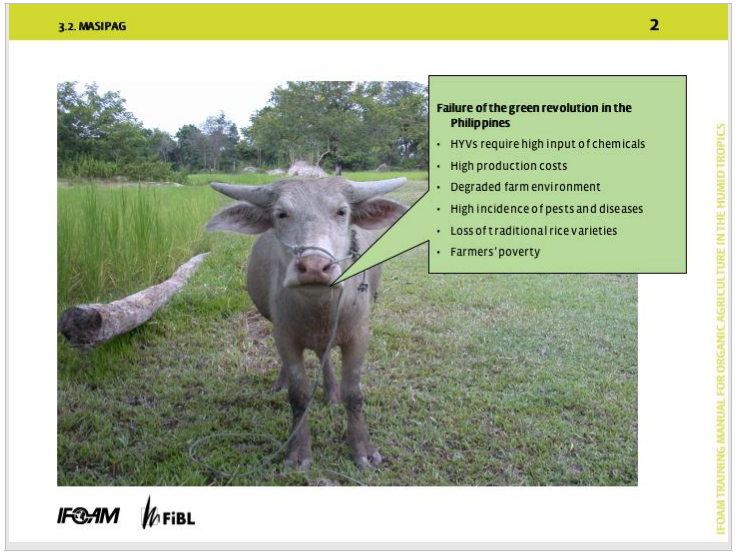
3.2.1 Milestones

The failure of the green revolution in the Philippines pushed farmers and scientists, in 1985, to form an alternative agricultural research program that would respond to the poor farmers' needs for appropriate seeds and technology. The high yielding varieties produced by the International Rice Research Institute (IRRI) demanded increasing levels of chemical inputs, whose costs were also increasing, leading to compacted, infertile soils, degraded farm environments, and a higher incidence of pest infestation. These problems were pushing farmers further along a downward spiral of debt and poverty. Farmers were also concerned about the loss of the traditional rice varieties; more than 4000 varieties had been collected by the IRRI and replaced with High Yielding Varieties (HYVs).

From their communities, **farmers initially collected 54 traditional rice varieties** and pooled resources in a project called "Piso-Piso Para sa Binhi" (A Peso for the Seeds) to initiate research on the genetic conservation and improvement of traditional rice varieties. Scientists from the University of the Philippines in Los Baños developed accessible and appropriate research designs and tools for farmers, using trial farms to create a "school and laboratory without walls".

MASIPAG became synonymous with the rice program; it brought 751 Traditional Rice Varieties (TRVs) back into the hands of farmers' communities and introduced 565 MASIPAG-bred selections that have been created for specific agricultural conditions. Farmers' groups avail themselves of the seeds by establishing trial farms, managed by people's organizations (POs - membership-based, grassroots groups) where they select varieties for local adaptability, study genetic traits and performance and undertake conservation and breeding.

The **conservation and improvement of maize** was started in 1998; 42 traditional maize varieties are now in farmers' trial farms and in MASIPAG back-up farms. Back-up farms are farms run at a regional level by MASIPAG that protect the diverse varieties of seeds by storing and planting them in small sample plots to maintain their viability. This is a 'backup' measure as the farmer members are the primary custodians of the seeds. Farmers have also developed maize varieties that have shown resistance to maize borers and other pests, and the capacity for survival in marginal environments.



TRANSPARENCY 3.2 (2): FAILURE OF THE GREEN REVOLUTION IN THE PHILIPPINES

Discussion:

Ask participants to analyze the importance of a crisis as the trigger for a change in conventional organization and production systems. Participants can give examples of similar crisis situations that are happening or that could potentially happen in their communities, and how these could be "used" to build environmental and social awareness.

On-site trainings on soil fertility management, making organic inputs, conversion of farm and household waste into fertilizers, alternative pest management and diversification are also provided. The current emphasis on diversification promotes more systematic integration of livestock and planting of indigenous vegetables, fruit trees, medicinal herbs and spices.

MASIPAG also encourages the **development and innovation of agricultural technologies** by farmers. These technologies are presented to and validated by natural scientists in farmer-scientist forum exchanges. Likewise, there is a programmed effort to involve scientists from agricultural colleges to collaborate with farmers in conducting area-specific research.

MASIPAG is known for its **farmer-centered approach to conservation, breeding, research and training**. The farmer-to-farmer mode of extension and the bottom-up approach are intrinsic to MASIPAG's processes, resulting in farmers' active leadership and participation in decision-making and management at various levels of the organization. A large number of MASIPAG farmers consequently become politicized, strengthening their involvement in social and political development of their communities, and raising issues of food security and sovereignty in the public arena.

Farmers join MASIPAG through their community associations, with an average membership of 15 to 50 households each. An estimated 30000 farmers are directly involved.

3.2.2 Vision and objectives

MASIPAG aims to improve the quality of life and to empower resource-poor farmers: those who have no control over the land they till or who lack the capital and other resources for production. It enables them to regain control over strategic economic factors, particularly seeds and the production process. It also wants to ensure a legitimate process for meaningful participation in policy formulation and decision-making processes. Farmers should be active participants in technology generation, rather than its passive recipients. This means that farmers should be able to control and develop their own seeds and innovate by themselves so that they are not mere consumers of seeds and related technologies by agri-corporations. MASIPAG also promotes social justice and humane communities. MASIPAG sees humane communities as agricultural communities that practice organic agriculture, enjoy food security, are cohesive and do not harm the environment or consumers of their agricultural products. Humane communities and an improved quality of life are important principles of sustainable agriculture, especially among marginalized food producers in the country. The sustainability of production by small farmers and the sustainable development of local economies are the bedrock for the future of agriculture in the country. MASIPAG advocates PEOPLE BEFORE PROFIT.

Objectives

MASIPAG capitalizes on its holistic outlook to catalyze a genuine, multi-dimensional social transformation process. The framework for its intervention involves raising farmers' social, cultural, philosophical, religious, environmental and political consciousness towards empowerment and self-determination.

For the sustainable use and management of genetic resources, MASIPAG seeks ecological balance on the farm by using local and renewable resources and promoting people's control over biodiversity.

MASIPAG also imparts to farmers the fundamental skills of breeding and farmers' research, in order for them to participate in the continuing efforts of agricultural researchers in promoting crop improvements. Moreover, it draws out a sense of national pride among farmers by encouraging them to adopt cultivar diversity, in effect establishing a nationwide natural gene bank. In this way, farmers can take an active role in conserving a national patrimony: the seeds.

TRANSPARENCY 3.2 (3): EMPOWERMENT OF FARMERS

Discussion:

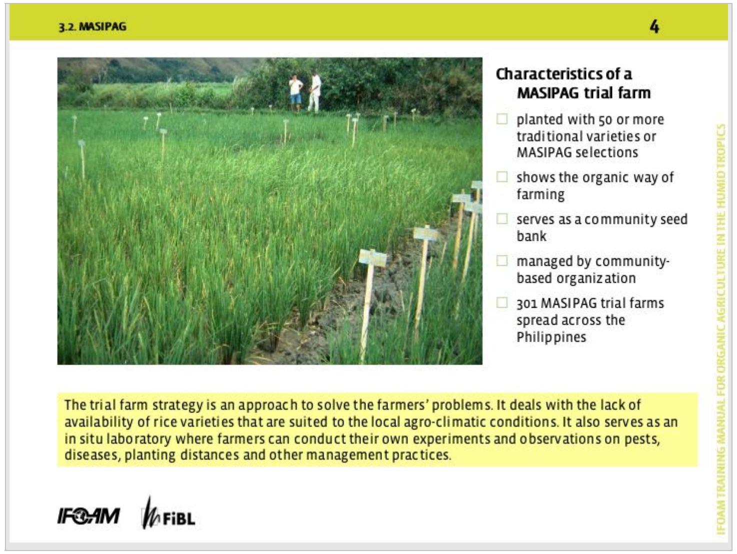
Ask participants to reflect on the vision and objectives of MASIPAG and to summarize the key elements that can be applied in their conditions. Note the results on paper cards and stick them on a poster. Then, try to select which key elements are more important for the local conditions and might be implemented in the short, medium and long term.

Through the PO managed Trial Farm (TF) strategy, rice cultivars are always accessible to farmers, who can select those best suited to local conditions. Such a strategy increases the range and selection of rice varieties that are appropriate to the factor endowments of a given locality.

MASIPAG broadens perspectives, reinforces knowledge and hones the skills needed by farmers to develop their own farming system that is directed towards improved nutrition and income. It also assists network members to formulate and advocate policy alternatives that will create an environment conducive to the promotion of MASIPAG's aims.

Furthermore, MASIPAG:

- promotes farmers' access to, and control over, seeds and farm diversity;
- supports farmers through technical and organizational mechanisms (local MASIPAG group, NGOs, local government units, the church);
- protects and restores the environment through non-chemical pest management and soil fertility management using green manure and compost;
- ensures food on farmers' tables by reducing farm expenditure and ensuring sustainable yields.



TRANSPARENCY 3.2 (4): CHARACTERISTICS OF A MASIPAG TRIAL FARM

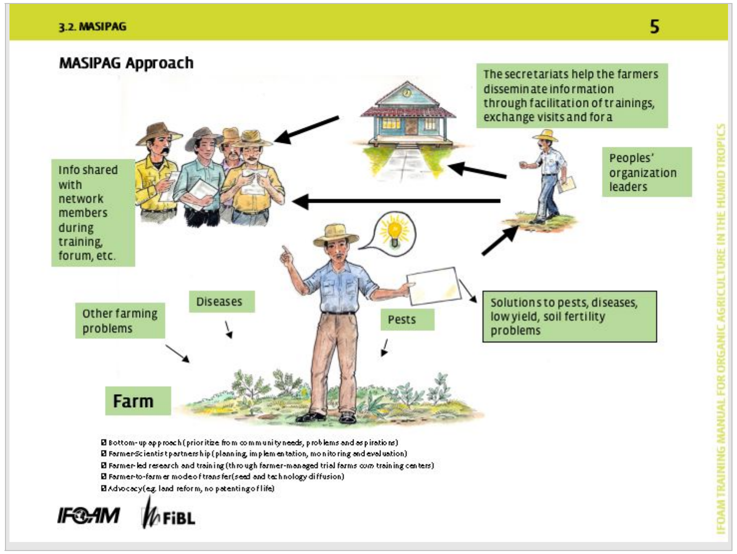
3.2.3 Approach

Bottom-up approach – a community knows what works best for its own development and how to achieve this. Projects must give priority to expressed needs, problems and aspirations of the people themselves, and start with their own knowledge and capabilities. The bottom-up approach can be best understood by contrasting it with the top-down approach employed by most mainstream agricultural institutions (e.g. Monsanto, the Philippine Rice Research Institute or Philrice, all of whom produce hybrid rice and treat farmers as mere markets for, or recipients of, the seeds that they have developed). Farmers are never consulted in the process. In MASIPAG, the farmers themselves set up and manage the trial farms, and they are able to select from among the 50 or more varieties that are adapted to the agroecosystems of the community where the trial farm is located. If the farmers deem it necessary to further improve the varieties they have selected, then MASIPAG can facilitate the conduct of rice breeding in the community, with the farmers setting the objectives of the program.

Farmer-scientist partnership – a partnership of farmer organizations and scientists from the social and natural sciences translates into a bottom-up approach to planning and implementation. Agricultural technologies that have been developed and adapted by farmers are presented to and validated or re-affirmed by scientists. One example is the native chicken conservation and improvement program, where the scientists offer theoretical insights and practical advice, while the farmers' organization provides the breed of native chickens and does the breeding to develop the desired characteristics.

Farmer-led research – on-farm research is done by farmers in different agro-environmental and sociocultural settings, encouraging them to become farmer-scientists. In the trial farms, the farmers select which varieties they will mass produce, set the breeding objectives and maintain the trial farm. Farmers also apply the principles that they learn from their training to come up with innovations in natural pest management, soil fertility management. These are then presented to other farmers and partner scientists for validation and dissemination.

Farmer-to-farmer and PO-to-PO mode of transfer – trained farmers reach out to other farmers, give trainings and facilitate the conduct of MASIPAG in other farms and villages. Farmers themselves act as trainers for other farmers, encouraging them to adopt the agri-development concepts of MASIPAG (for example the trial farms) and teach them the basic concepts and practices of MASIPAG farming and organic agriculture.



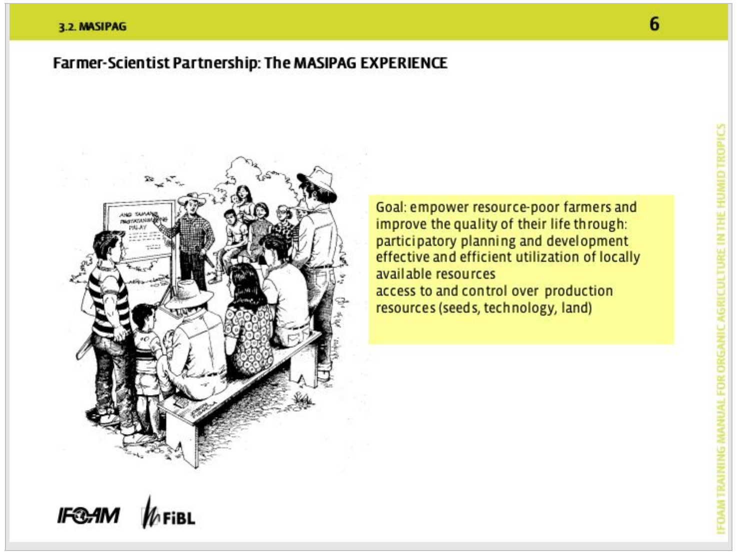
TRANSPARENCY 3.2 (5): MASIPAG APPROACH

Group work:

Form different working groups. Each working group should select a MASIPAG approach and discuss:

- *Advantages and disadvantages of each approach and if this could be implemented under local conditions.*
- *What practical steps are necessary in order to implement this approach?*
- *Which aspects should be kept on eye so that the activities are successful?*

Advocacy on issues affecting farmers' rights - MASIPAG farmers are imbued with a sense of mission to reform agrarian conditions. For example, local farmers' groups educate neighboring farmers on the nature and hazards that genetically engineered crops pose to biodiversity, the environment and human and animal health. They also petition local government councils to ban or issue moratoriums on the planting of Bt maize and other GMOs, and set up community-protected sites for traditional maize and other indigenous crops. Other issues that MASIPAG farmers are actively lobbying for include: genuine agrarian reform to improve farmers' access to, and control over, land; and on farmer's rights to save and reuse seeds, against commercial breeders' rights and Intellectual Property Rights (IPRs).



TRANSPARENCY 3.2 (6): FARMERS-SCIENTIST PARTNERSHIP - THE MASIPAG EXPERIENCE

3.2.4 MASIPAG programs

- **Collection, Identification, Maintenance, Multiplication and Evaluation (CIMME)** of cultivars of rice and maize, indigenous vegetables, poultry and livestock. CIMME ensures that collected species and varieties are maintained in on-field seed banks for farmers' access. Farmers maintain in situ collections of rice, maize, vegetables and other food crops. They collect and study data on these crops in their trial farm. They use the MASIPAG characterization tools to help them select the locally adapted varieties that they will plant in their individual farms.

- **Breeding Farmers** select and breed rice and maize cultivars and livestock, enabling them to develop selections from traditional varieties that are adapted to local conditions and that have enhanced resistance against adverse conditions, such as droughts, soil and water salinity, pests and diseases. The MASIPAG Network now includes farmers who have become rice and maize breeders in their own right and farmers that have already produced their own bred lines, developed from the parental materials from the rice collection that they have in their trial farm.

- **Developing Sustainable Agroecosystems** encourages farmers in both upland and lowland ecosystems to shift from monocropping to diversified and integrated cropping; from chemical to organic farming; and to shift their focus from the individual farm ecosystem to community/agroecosystem-wide conversion. Technical support and information is provided on critical aspects such as soil fertility management, alternative pest management, cropping systems and diversification and farm integration. For example, in the upland communities of Alimodian, Iloilo, MASIPAG farmers have increased the biodiversity of their farms and ecosystem with more than a hundred varieties of rice, maize, peanuts, vegetables and many other crops. They have also built a community gene pool of indigenous chickens, water buffaloes and pigs. The conversion from chemical to organic farming has allowed them to have food all year round, bring surplus products to the market and be free from debt to traders.

TRANSPARENCY 3.2 (7): THE MASIPAG MODIFIED RICE BREEDING PROGRAM (MRBP)

- **Documentation and Dissemination of Farmer Developed/Adapted Technologies (FDATs)** refers to the reaffirmation, systematization and practical application of traditional knowledge in agriculture systems, giving members additional farm management options. On the island of Mindanao, MASIPAG farmers meet twice a year to exchange organic farm technologies that they have discovered or improved. These farm practices and experiments are discussed by partner scientists from agricultural universities and validated through more trials. Dissemination of the technologies to other farmers is done later through printed publications and inclusion in seminars/trainings.

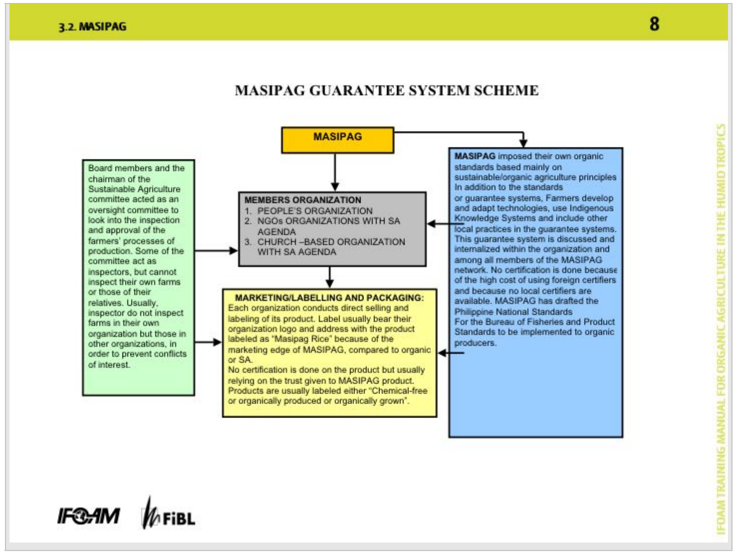
- **Local Marketing and Processing Support** in the form of technical assistance is provided to member organizations that are engaged in alternative and PO-managed marketing and processing initiatives. The MASIPAG Farmers' Guarantee System is an alternative guarantee system that provides certification from the farmers' communities and from the MASIPAG network, bringing organically-grown products to local consumers. Provincial groups of MASIPAG farmers work together to set up inspection and evaluation committees for the Internal Quality Control System and shared market outlets in the nearest market center. The network provides technical assistance in setting the standards and the IQCS (Interviewer Quality Control Scheme), packaging and promotion, etc..

- **Education and Training** enables network members to acquire knowledge, skills and attitudes to better equip themselves to sustain MASIPAG's programs and activities within their organizations and provinces. On-farm training is based on needs' analysis and is structured in response to the farmers' actual situations. Farmers' training starts with the MASIPAG Orientation, which explains the underlying philosophy and principles of MASIPAG that unites all its members. It also sets out the basic points of MASIPAG's cultural management practices for rice and maize breeding, including the management of the trial farm and implementing the CIMME (Collection, Identification, Maintenance, Multiplication and Evaluation). Participating farmers are also given small packets of seeds with 50 or more varieties of rice and/or 8-10 varieties of maize. During the next four cropping seasons, they do their own varietal characterization and multiplication, and learn the basics of soil fertility management, water management, pest management, etc..

Group work:

The working groups may select the MASIPAG programs that are relevant to their local conditions. The participants should explain the following aspects:

- *Why did they select a specific program(s) and why not?*
- *They should rank the selected program(s)*
- *For each selected program(s), they should elaborate practical activities that can be implemented, and are necessary, in their zone, for example, CIMME of pepper cultivars.*
- *They should also explain how the chosen activities could be organized in their region.*



TRANSPARENCY 3.2 (8): MASIPAG GUARANTEE SYSTEM SCHEME

- **Program/Project Benefit Monitoring and Evaluation System (PPBMES)** is an internal database system for monitoring progress and assessing the socioeconomic impacts of the project, serving as a basis for improving efficiency and effectiveness. The gathered data is about the socioeconomic situation of the farmers, their crops and farming systems, the adaptability of their rice and maize selections and their organizational status. Farmer leaders visit the communities and document these aspects, which are then reported to the provincial and regional levels and serve for future planning.

- **Networking and Advocacy – MASIPAG** takes an active, stand on national and global issues that affect the food security and sovereignty of resource-poor Filipino farmers. Some examples are: genuine agrarian reform, biopiracy and the patenting of life forms, genetic engineering and the entry of GMOs into the country. MASIPAG farmers are active in resisting the entry of GMOs into their communities. They do so by participating in crafting the local legislation that bans GMO planting and by setting up, and guarding over, protected sites for crop biodiversity. MASIPAG works with other people's organizations, with students, consumers and the church to achieve solidarity against GMOs at the local, provincial, regional, national and international levels.

3.2.5 Results and Impact

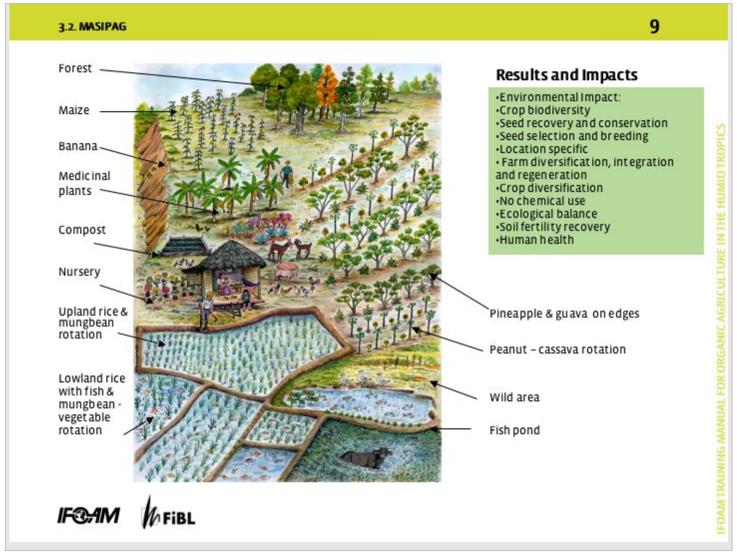
The most significant impact of MASIPAG has been the recovery, conservation and improvement of genetic diversity in the farmer's fields. This has been achieved through the seed recovery and conservation program, or CIMME (Collection, Identification, Multiplication, Maintenance and Evaluation) and the seed improvement program (MASIPAG's breeding program). MASIPAG has made significant headway in the research and development of rice and maize seeds, as well as sustainable production systems. Since 2003, MASIPAG has developed a collection of 1570 traditional and improved rice cultivars (826 MASIPAG-bred selections and 744 TRVs), of which 32 are specifically adapted to Luzon, 133 to Visayas and 59 to Mindanao.

There are 286 MASIPAG Trial Farms in 41 provinces, spread across the whole country. These are community seed banks with different rice varieties that are managed by farmers' organizations. Farmers are able to select varieties of rice that are best adapted to their particular agro-climatic conditions. These sites have been conducting varietal trials for several years. In addition, MASIPAG also maintains three national backup research farms in Nueva Ecija (lowland rice), Negros Occidental (upland rice, maize and vegetables) and Cagayan de Oro (maize).

Over 100 orientation and technical training workshops have been conducted for more than 8000 farmers, without counting Echo trainings/workshops. In Echo trainings, the farmer participants of a particular training conduct a similar activity in their own community to be able to transfer (echo) to other farmers what they have learned.

The total membership of MASIPAG in the Philippines now totals 32809. Of this, 3106 MASIPAG farmers no longer use chemicals in their rice fields. They farm a total of 2294 ha. They are not formally organically certified, but employ an Alternative Guarantee System in which organic integrity is established trough the participatory involvement of both the consumer and the producer. Farmers' groups work with church organizations, labor unions, consumer and professional groups to educate them about the situation of poor farmers, the benefits of organic products, the perils of GMOs, etc.. Consumers are made aware of the process of transformation that poor farmers have undergone (from the green revolution to MASIPAG farming), and the contribution that they can make to the rural economy.

An additional 388 farmers, working on an area of 298 hectares, are Diversified Integrated Farming Systems (DIFS) practitioners, while a total of 47 POs in the Visayas Islands have adopted organic diversification and integration on a community-wide basis.



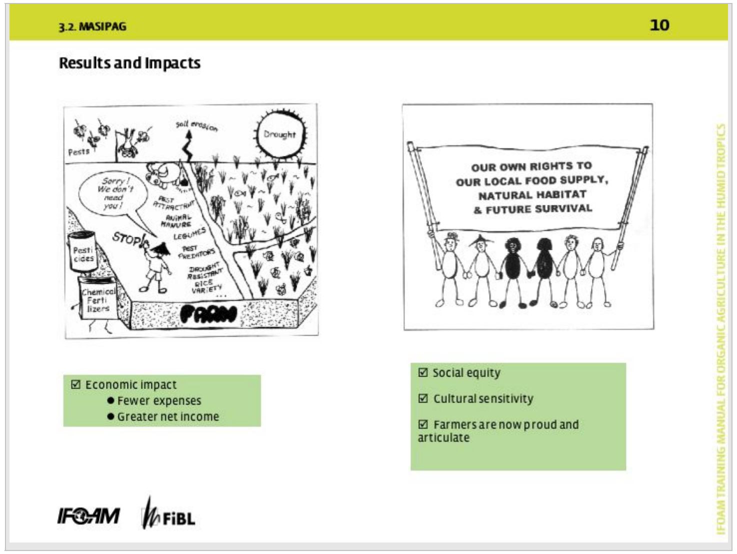
TRANSPARENCY 3.2 (9): RESULTS AND IMPACTS

Discussion:

- *In this age of corporate control over agriculture, how can poor farmers work to protect their rights to the seeds, agricultural knowledge, biodiversity and resources for production?*
- *Could the outputs of a diversified production be sold at the community level or at a local farmers market?*
- *How can poor farmers of a poor country build economic self-reliance while maintaining national political unity and sociocultural cohesion?*

MASIPAG farmers have deep concern for food safety and security and it influences their long-term goal of producing organically. Many farmers and their farms can be considered as undergoing the conversion process (approximately 4000 hectares are in conversion). In many instances, the fruit and vegetable crops of MASIPAG farmers are already organic although they are not sold as such; no estimate of this total figure has been made.

The lack of governmental support for organic agriculture manifests itself by the absence of infrastructure, marketing and processing support. It is one of the structural constraints of the farmers' that prevent their total conversion to organic methods.



TRANSPARENCY 3.2 (10) RESULTS AND IMPACTS

3.2.6 Rice Marketing

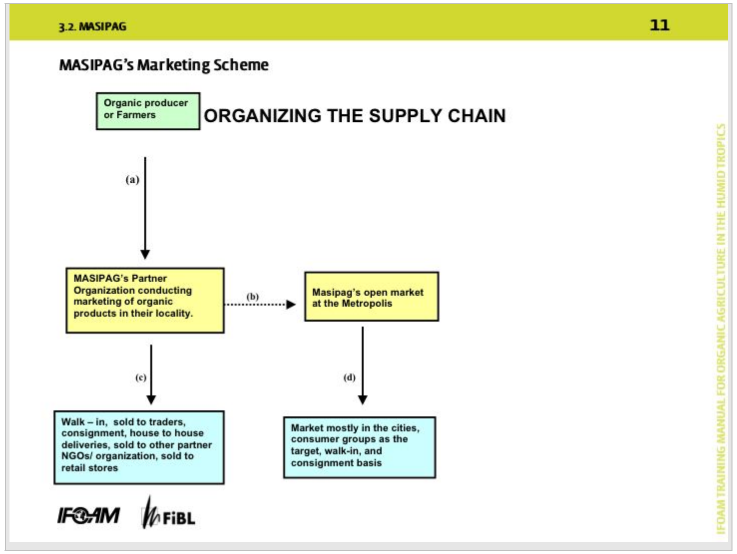
The marketing of rice in the Philippines is monopolized by trading cartels. To sell their rice as organic, farmers have to engage in direct marketing to their consumers, individually or through their cooperatives. Farmers selling their products to the traders in their locality, prices are paid the prevailing ('spot') price at any given time. Some farmers' cooperatives sell their rice (milled or unmilled) to the National Food Authority, but the NFA has limited purchasing power. Farmers generally sell their products to traders or to those cooperatives that have a marketing system. These marketing cooperatives sell their product as milled rice, to local retailers or to sub-traders. Sometimes, farmers also sell their product as milled rice to small retail stores or, more often, to traveling or contacted traders. Supply chain constraints include the lack of proper processing facilities such as dryers, silos/storage and good milling machines. Studies conducted by the Department of Agriculture revealed that from harvesting to drying alone, farmers incurred losses of between 13.7 to 23.5% of their harvest. In addition to these problems, road access between farms and markets is often poor and transport costs can be very high.

Product line management

Organic rice is sold directly from farmers to consumers in their locality. Farmers keep enough of their own harvest to sustain them until the next harvest and only sell the surplus. Farmers with larger farms (2-7 hectares) sell their products to bigger traders at the prevailing market price. Currently, no premium price is paid for organic produce. Supermarkets sometimes stock and sell organic products, although their prices are slightly higher than in the public markets. They also have very strict quality thresholds for the products, including packaging requirements. Usually, supermarkets specify the type of packaging material required for any product they will purchase and this creates an additional expense for the farmers.

Product and packaging

Products are labeled in various ways and sold as organically-grown, pesticide-free, or chemical-free. Rice (white and brown), maize and vegetables are the most commonly available products. Consumers prefer to buy rice in 5, 10, 20 or 25 kilogram packages, while the 50 kg bags are for consignment. Design of the packages, labels, and choice of packaging materials is chosen by the sellers, but all carry the MASIPAG Farmers' Guarantee System label. Information brochures are always available with the product sold. The most common packaging materials are plastic bags, cartons and containers such as bamboo crates.



TRANSPARENCY 3.2 (11): ORGANIZING THE SUPPLY CHAIN

Group work:

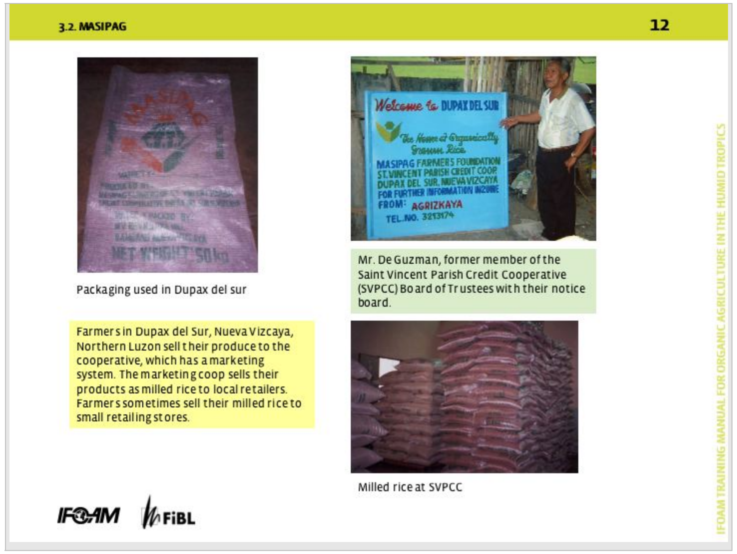
- *The participants should elaborate a possible marketing scheme and marketing strategies (as promotion) for a range of products that are organically-grown in the region.*
- *They should also explain if it is possible to implement the MASIPAG Guarantee System (see transparency in 3.2.4) and explore its advantages and disadvantages compared to the organic certification carried out by inspection bodies.*

Handling and stock management

Buyers receive the products directly from their producers and store them in their own storage areas. The buyers are generally responsible for the post harvest and processing of the raw products. When farmers deliver their products to the buyer, they are given receipts indicating the date when they can expect to receive payment. Centralized stock records are kept at the storage facilities: responsibility for this usually rests with the marketing managers, or in the case of co-operatives with the Chairman of the Board. There are no stock inventory planning procedures. Documentation is generally very crude and proper forms are unavailable. However, a monthly inventory based on the average monthly product sales is kept and these records are posted on organizational notice boards for the information of members.

Promotion

MASIPAG participates in some trade fairs conducted by local government units that showcase both organic and conventional products. In some municipalities, local officials declare one day a week as an organic day: organic producers can display and sell their products. In other municipalities and cities, there are auction markets for organic products, although the bigger consumer organizations are the major players. These auctions are usually shortly after the harvest of most crops. MASIPAG generally participates in Agrilink, a trade show sponsored by the Department of Trade and Industry (DTI), where both organic and conventional products are displayed and sold. MASIPAG also actively participates in the Biosearch fair, which showcases organic and herbal products and which is widely advertised in the newspapers and on television. Provincial harvest festivals and food fairs are widespread and provide another promotional opportunity, particularly if the local government policy is sympathetic towards organic agriculture.



Transparency 3.2 (12): Organizing the supply chain

3.2.7 Lessons learned

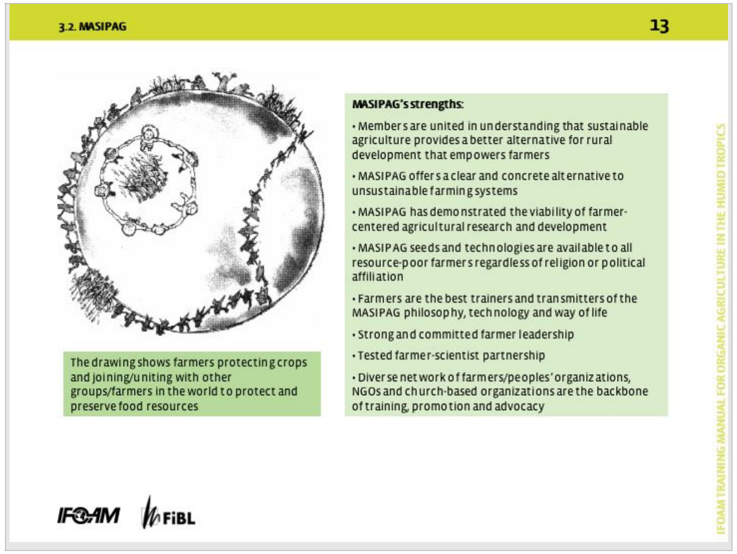
Strengths

- Members are united in understanding the need for sustainable agriculture as an alternative strategy for rural development and empowering farmers.
- MASIPAG offers a clear and concrete alternative to unsustainable farming systems.
- MASIPAG has demonstrated the viability of agricultural research and development centered around farmers.
- MASIPAG seeds and technologies are available to all resource-poor farmers, regardless of religion or political affiliation.
- Farmers are ideal trainers and transmitters of the MASIPAG philosophy, technology and way of life.
- Strong and committed farmer-leadership.
- Tested farmer-scientist partnership.
- Diverse networks of farmers/peoples' organizations, NGOs and church-based organizations provide a backbone for training, promotion and advocacy.

Challenges

Aside from the challenges brought about by globalization, industrial agriculture and the entry of genetically modified and hybrid crops, the following are the main challenges that MASIPAG has to confront:

- High demand from farmers for MASIPAG-bred selections and traditional rice varieties (TRVs) leads to an uncontrollable spread without the proper technical orientation. This leads to the misconception that MASIPAG is a package of technology and thus, some farmers do not actively participate in technology generation.
- Marketing: with organic products finding a niche on the market, MASIPAG has to strengthen its marketing strategy to synchronize volumes of supply and demand and to establish good contacts.



TRANSPARENCY 3.2 (13): MASIPAG'S STRENGTHS

Final discussion:

Draw conclusions from this case study. What lessons do you learn for your own work? How could you use this information to try to motivate changes in your communities?

Recommended website:

- *http://www.masipag.org*

3 Examples of Successful Organic Initiatives from the Humid Tropics

3.3 AFAPROSUR, Costa Rica

Introduction

This case study is about a group of small farming families in Costa Rica, who have successfully made the transition from a conventional, high input, monoculture production to an organic, self-sustained, highly integrated and diversified production system in less than 5 years.

Their success is measured by improved family and community integration, better food security, higher incomes and a better general quality of life.

Lessons to be learned:

- *Conventional monoculture systems harm the economy of small farming families: a strong source of motivation for change.*
- *A strong organization that shares a strategy and a clear vision serves as a support element for small farmers during the difficult transition period.*
- *The diversified integral organic farming approach can bring economic benefits for small farmers both through food security and through access to local markets.*
- *Agroecological diversity at the farm provides new and diverse market opportunities.*

TRANSPARENCY 3.3 (1): AFAPROSUR - AN ORGANIZATION OF SMALL FARMING FAMILIES IN COSTA RICA

3.3.1 Background and description of the organization

AFAPROSUR (Asociación de Familias Productoras Agroecológicas del Sur) is an organization of farmer families. It currently involves 14 families (with an average of 5 to 7 people per family). Both the children and the women actively participate in General Assemblies and Board meetings, with important decisions usually being made at the family level. They have been associated since 1999 and started working organically since 2000.

Their family farms, which average 5.5 ha in size, are located in the community of San Rafael de Platanares, Perez Zeledon County, San José Province (approximately three and a half hours drive from San José City). Situated at an elevation of 800 to 900 meters, the temperatures range from 24 to 27°C. Average annual rainfall is 2400 to 2700 mm and the zone consists of a very humid forest, where the main soils are ultisols.

This group of families decided to create an organization mainly because they were worried about environmental degradation and its impact on agricultural productivity and on their household economies. When they decided to organize themselves, the main problems they had to resolve were: pollution and degradation of the soils because of the misuse of synthetic agrochemicals (some people also had experienced pesticide poisoning); the agricultural yields had gone down, as had their incomes. Monoculture, mainly coffee or sugar cane, was widely practiced and families depended completely on these crops to meet their needs. When the coffee price crisis began, it was virtually impossible to make a living off the farm anymore. As a result of all this, migration - mainly of men - to the city or to other countries began to be a strong tendency in the community, and families started to break apart.

Today, the majority of AFAPROSUR members manage their farms under the concept of agroecological organic farming[2]. In addition to their traditional crop, coffee, they keep farm animals and grow trees, fruits, grains, tubers and a wide variety of vegetables. This diversity of products provides the basis for the family's dietary needs as well as a constant source of income, as they sell the surpluses at the local market every week. Coffee and some seasonal fruits provide an annual income, and precious wood trees are seen as a long-term source of income, or even as a sort of "retirement or life insurance" fund.

Transparency 3.3 (2): Background and organization description

[2] Highly biodiverse integral farming systems that integrate agroforestry, permanent crops, animal husbandry and seasonal crops. Self-sufficiency and independence from external inputs are important values in these systems.

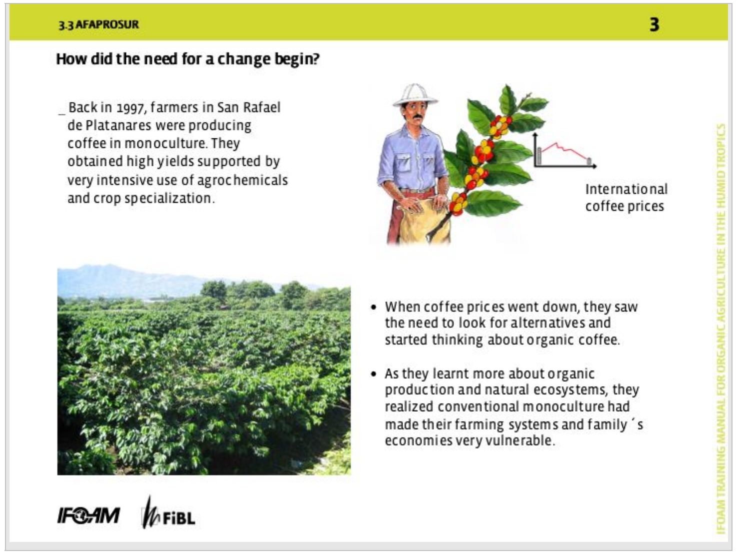
3.3.2 How did the need for a change begin?

In 1997, these farmers were producing coffee as a monoculture. They obtained high yields supported by a very intensive use of synthetic agrochemicals and crop specialization. Sometimes, even the traditional fruit trees used for shade in the coffee field were cut down because it was thought that they would compete with coffee. When coffee prices went down, they needed to look for alternatives and started thinking about organic coffee.

Since they knew nothing about this farming method, one of the group leaders organized a field trip, in 1998, to a friend's organic cocoa farm in Talamanca, Limón (on the South Atlantic coast). In addition to organic cocoa and banana for export purposes, the farm's owner, Luis Rodriguez, a forestry engineer, had established an agroecological system very much like the ones nurtured by indigenous people, in which, banana, cocoa and other products are produced under the tropical forest shade.

Luis Naranjo, the current president of AFAPROSUR, remembers how, on that field trip, they were impressed about how productive this system was. That day, they talked about soil balance, the action of microorganisms and natural fertility. Naranjo says that he remembered when he was a little boy, some 30 years ago, his father's and neighbor's fields were incredibly productive and that they grew a wide variety of crops all year long. Soon, they realized that, at that time, there was a natural balance and no degradation of their soils.

He also remembers the day that his father received the first bag of synthetic fertilizer from a salesman. They applied it to a cornfield and the yield doubled: his father was very happy and soon he also started applying herbicides, which made his work easier. "But what we didn't know then", says Naranjo, "was that we were creating imbalance in the soil and in the whole system". Sure enough, over time, the yields started to decrease and they never reached the same levels again.



TRANSPARENCY 3.3 (3): HOW DID THE NEED FOR A CHANGE BEGIN?

When they returned from the field trip, they shared this experience with other farmers in the community and they all reflected on how vulnerable conventional monoculture system had made their farming system and their family's economies. Not only did they have to spend a lot of money on inputs, but their soils also became poorer and less productive every year. Thus, productivity was lower and, when prices were not good, they could not get enough money to buy the food their families needed, much less meet other needs. Yet, their soils depended on these inputs to produce coffee and they depended on selling coffee to eat.

They noticed that it made no sense to keep working that way, being scarcely able to pay the bills from the agrochemical store, while their soils kept on degrading. A strong vision began to grow within the group: that they could make changes in their farms and start by producing the food for their families. They created an organization to support each other with this new vision and searched for training courses, as well as advice from other organic groups.

Motivation:

Ask participants to analyze the importance of a crisis as the trigger for a change in conventional organization and production systems. Participants can give examples of similar crisis situations that are happening, or that could potentially happen in their communities, and how these can serve to build environmental and social awareness and create the motivation for change.

Transparency 3.3 (4): Are conventional systems sustainably productive?

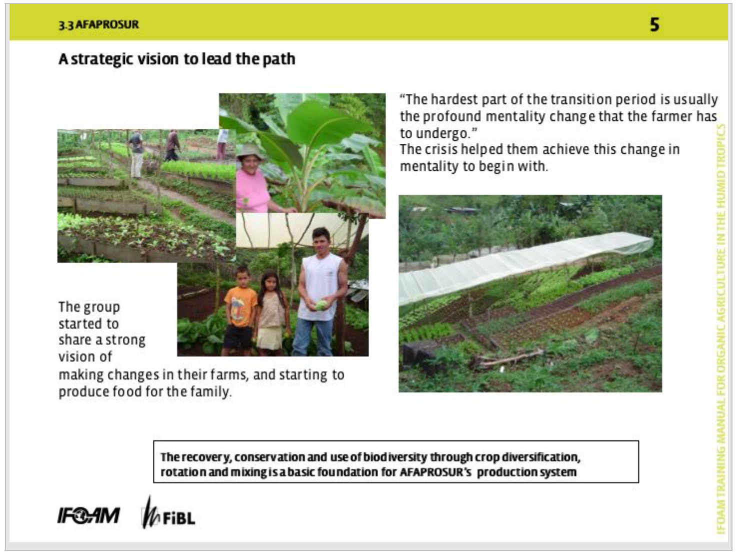
3.3.3 A strategic vision to lead the path

According to AFAPROSUR´s members, the transition period was not so difficult because they were very committed and clear about what they wanted to do. As they say, the hardest part of the transition period is usually the profound mentality change that the farmer has to undergo. The crisis helped them achieve this mentality change from the outset.

Implementing the technical changes took some time. In the beginning, they received a basic course on organic manure processing from the National Training Institute[3] (INA) and participated in many farmer-to-farmer exchange activities. It was not until 2000 that they started to farm organically. After that start, they advanced very quickly and their knowledge and experience is now quite impressive. The recovery, conservation and use of biodiversity through crop diversification, rotation and mixing are the basic foundations of their production system.

Furthermore, the group shares a very clear strategy for farm planning. From an economical point of view, their production is organized into what they call the farm's accounts. **The short term account or "petty cash"** consists of milk, eggs, cheese, horticulture, vegetables, some fruits, grains and tubers, which they sell at the local farmers market every week. This is a constant source of income and, together with other non-cash crops (**the food security account**), this income makes it possible to cover all basic needs for the family. From a philosophical and logistical perspective, these are the more important "accounts" as they make it possible to be independent from the fluctuating conditions of specialized export markets.

The mid-term or annual account is made up of coffee, seasonal fruits and meat products, which are harvested once a year. The organization recently received funding from SGP-UNDP[4] to set up a processing plant and so in the near future, they will be able to process coffee and to sell it as a value added product to either the local or international market.



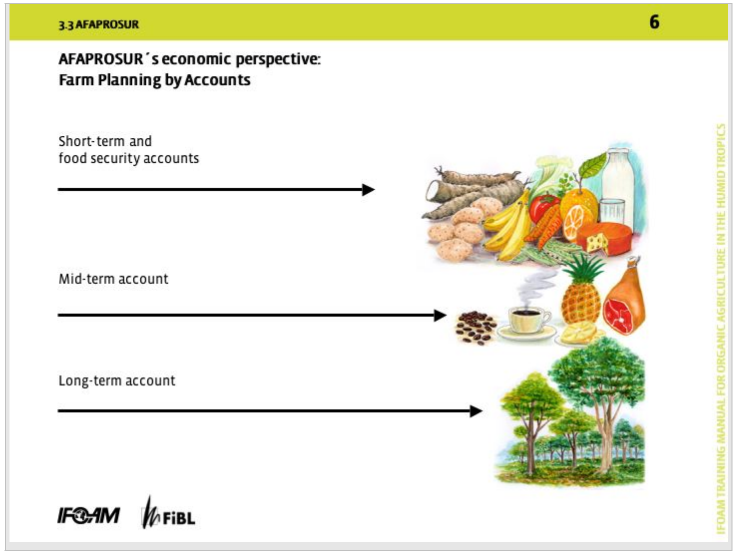
TRANSPARENCY 3.3 (5): A STRATEGIC VISION TO LEAD THE PATH

[3] A governmental technical training institute that has a specialized program on organic agriculture and has been giving short courses to farmers during the past 10 years or so. Training is free of charge.
[4] Small Grants Programme of the United Nations Development Programme

The long-term account consists of a variety of precious wood trees that, in addition to completing the agro-ecological system, are considered by the farmers as "savings" that they can use in the future for special investments needed on the farm or the house, or to help support other expenses as they get older and cannot work so much.

Once a month, the organization's members meet to share ideas, new knowledge from recent trainings or experiments, and to follow up on collective projects. Some individual needs, such as acquiring materials to set up irrigation systems, building structures for protecting crops from excessive rain, assuring constant availability of compost and manure, or being able to process coffee, have been met through the group approaching local donors for assistance.

The board and the more active members keep close contact with other organizations, NGOs, government officials and cooperation institutions to lobby for support. Once the assistance is obtained, especially when construction is involved, all members must collaborate by contributing an agreed amount of labor for both collective and individual projects.



Transparency 3.3 (6): AFAPROSUR's economic perspective. Farm planning by accounts

3.3.4 Can diversified production for the local markets be profitable?

As in many organizations, not all members are at the same level of development and not all are equally active. Nevertheless, Naranjo says, the majority of the members have made great progress in little more than 4 years.

When asked what makes the difference between members, he replies: "the ones who are more convinced and committed today are those who could diversify production and, thus, could go to the farmers market every week. It is important for a farmer to be able to see short term positive results in relation to good market opportunities. This has to do with the diversification of production. Organic production of an export product, for example organic coffee, could be an important solution but it does not solve the short term needs".

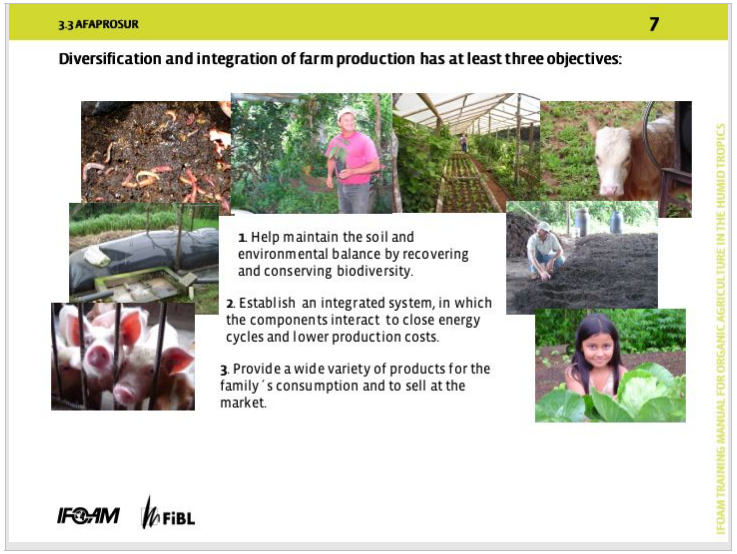
Diversification and integration of farm production has at least three objectives:

- Help to maintain the soil and environmental balance by restoring and conserving biodiversity.
- Establish an integrated system, whose components interact to close energy cycles and lower production costs.
- Provide a wide variety of products for the family's diet and for increasing the range of products to sell at the market.

At a typical farm in AFAPROSUR, farmers have been able to establish a system that includes: some farm animals (cattle, hens, pork, and pond fish), vegetables (lettuces, green beans, zucchinis, cucumbers, tomatoes, green peppers, onions, beets, carrots, squashes, cabbages, corn, etc.), roots and tubers (cassava, sweet potatoes), wild medicinal and aromatic plants, fruits (pineapples, mangos, papayas, bananas, guavas, passion fruits, oranges, sweet and sour lemons, tangerines, etc.), coffee, pasture and fodder crops, legume and precious wood trees.

Motivation exercise:

Ask participants to reflect on this experience and to summarize the key elements for the successful transition to organic agriculture. Note the results on paper cards and stick them on a poster. Then, try to select the most important success factors or those that have the strongest impact. Order the cards accordingly.



TRANSPARENCY 3.3 (7): DIVERSIFICATION AND INTEGRATION OF FARM PRODUCTION HAS AT LEAST THREE OBJECTIVES

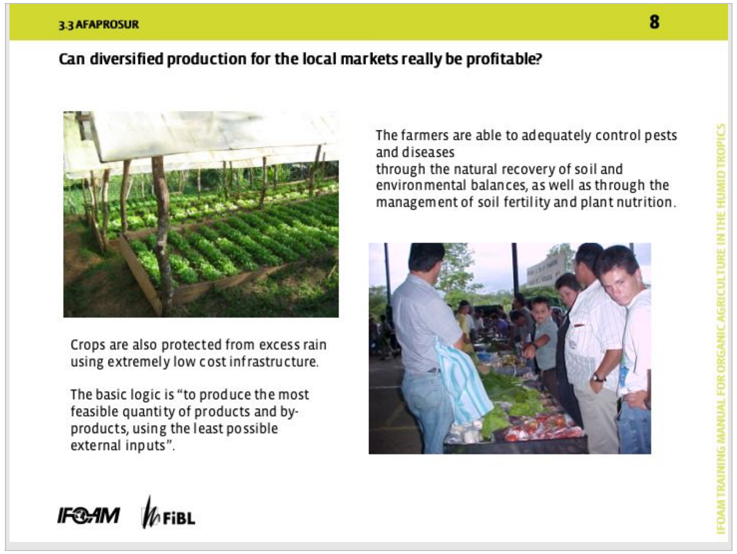
On this kind of farm, pests and diseases are pretty much controlled through the natural recovery of soil and environmental balances, as well as through the management of soil fertility and plant nutrition. Manures from livestock are processed into organic fertilizers, both solid and liquid (biofertilizers)[5]. In turn, the animals are mainly fed with fodder crops and on pastures. Very little supplementary commercial animal food needs to be given. Crops are protected from excess rain by using extremely low cost infrastructure, mostly made of trimming wood or bamboo branches from the farm and recycled materials. Only a small amount of plastic has to be bought for the "micro-roofs".

As one can imagine, the logic behind this kind of farm is "to produce the most feasible quantity and variety of products and by-products, using the least possible quantity of external inputs". From an ecological point of view, this is a sustainable approach as the system "feeds" itself. From an economical point of view, this means production costs are very low, especially for those farms that can be managed with family labor.

The output from this kind of farms is a wide range of products in quantities that exceed the requirements to feed the family, but that are not sufficient to justify individual farmers making a trip to a distant market in order to sell them. For this reason, surpluses are gathered from all the members' farms each week, which are then sold collectively at the local farmers' market. Profit levels on these products (mainly the short term crops), can be as high as 95%.

Discussion:

Ask participants to think about a small conventional farm that they know in their community and to identify what inputs, which the farmer is currently buying, could be produced on the farm through production diversification. Could the outputs of this diversified production be sold at the community level or at a local farmers' market??



TRANSPARENCY 3.3 (8): CAN DIVERSIFIED PRODUCTION FOR THE LOCAL MARKETS REALLY BE PROFITABLE?

[5] For further information on soil fertility and plant nutrition management techniques refer to chapters 3.2, 4.3 and 4.4 of *IFOAM Training Manual on Organic Agriculture in the Tropics* (Basic Manual).

3.3.5 Is the local market the only option for small agroecological organic farmers?

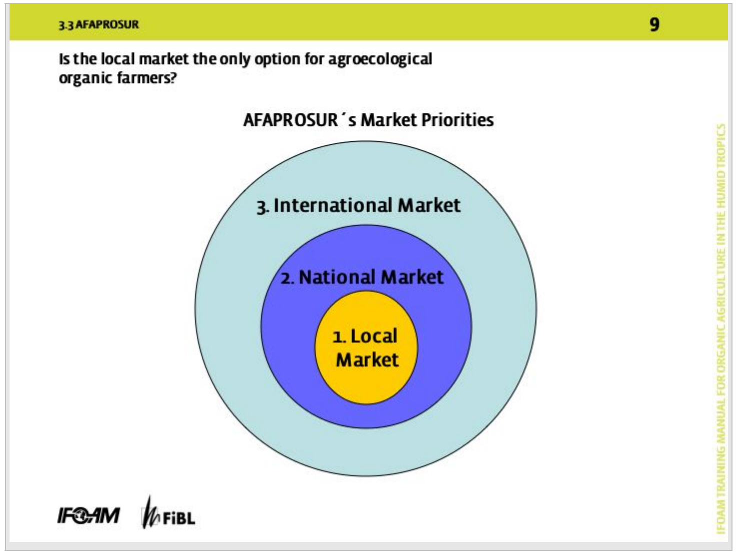
According to AFAPROSUR´s marketing strategy, the answer to this question is no. Their first priority in their market strategy is to increase the range and quantity of products so they can meet the whole demand at the local market. As they continue to grow, they will try to produce for regional or national markets and, at last, for the international markets (without however abandoning the local market).

This is because they are primarily interested in growing a wide range of products in order to meet household consumption needs. They are not looking for organic premia, as they have learnt from experience that organic farming is not more expensive for them but, on the contrary, that they improve their incomes through cost reductions. They are equally concerned about the health benefits of eating organic, and that it should be as accessible as possible in their local communities.

In reality, the combination of an export product (for example coffee), which can be produced and marketed by the whole group (thereby producing sufficient quantities for export), and other crops for food security and local markets, seems to be the best way to maximize the use of ecological, land and labor resources, which are usually the main production aspects that small farmers must rely on.

Final discussion:

Draw conclusions from the case study. What lessons do you learn for your own work? How could you use this information to try to motivate changes in conventional monoculture systems in your communities??



TRANSPARENCY 3.3 (9): IS THE LOCAL MARKET THE ONLY OPTION FOR AGROECOLOGICAL ORGANIC FARMERS?

Recommended website:

- *http://www.farmradio.org/en/publications/voices/v2000apr_en.php*

3.4 Sano y Salvo, Nicaragua

3.4.1 The initiative

"Sano y Salvo, Primera Asociación Campesina de Cultura y Producción Ecológicas en la Región Autónoma del Atlántico Sur y Central", is an organic small farmers' organization in Southeast Nicaragua, whose head office is located in Nueva Guinea, RAAS - 280 km from the capital, Managua.

Sano y Salvo was founded in 1998 by some 20 farmers working together with Nicaragua's organic farming pioneers Gerd Schnepel and Elba Rivera, who had started organic agriculture in this country in 1984.

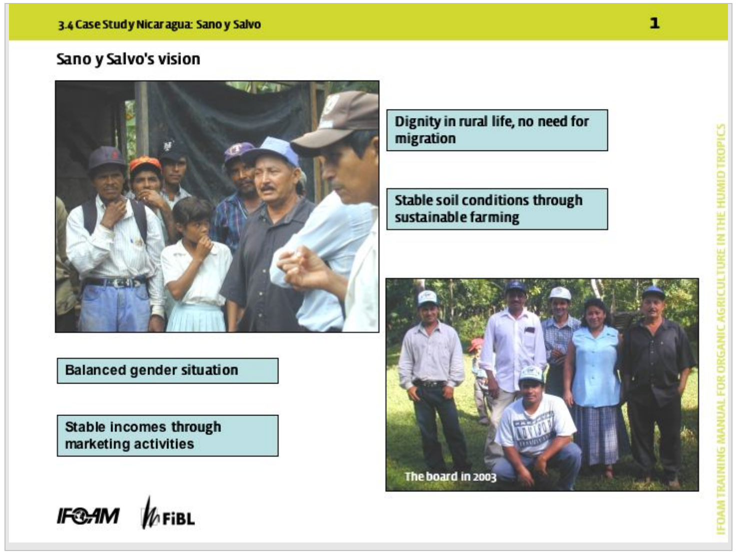
Sano y Salvo promotes ecological agriculture, providing support in animal and plant production and adult education. The local marketing and processing, as well as the internal inspection system are under the control of the farmers' organization that aims for export of certified produce in the near future.

Lessons to be learned:

- *Inappropriate farming systems lead to a collapse of the nutrients cycle and water resources. This provokes rural exodus and increases the pressure on virgin land, leading to social problems.*
- *Agroforestry is a cropping system well suited to the humid tropics. It is a way of farming that does not reduce biodiversity or interrupt natural nutrient cycles.*
- *The exchange of experience with other farmers across the world is particularly important for extension that works following the "from peasant to peasant" method.*
- *Reconsidering the family members' roles is very important for a gender balanced rural society.*

3.4.2 The vision

The vision of Sano y Salvo is to increase the quality and dignify rural life, through organic production. This involves the improvement of degraded soils and protection of the fertile soils within the rainforest's buffer zone. The member farmers live on their farms, respect nature as the basis of their rural life and agriculture and are not obliged to consider migrating because of economic necessity. The association creates jobs thanks to processing and marketing facilities and by supporting initiatives in "eco-edu-agro-tourism". The life of the peasant families is improved through gender balanced education and the promotion of partnership between men, women, sons and daughters, thereby improving communication and exchange of experiences.



TRANSPARENCY 3.4 (1): SANO Y SALVO'S VISION

3.4.3 Context

The area where Sano y Salvo is based is home to about 25000 to 30000 small farmer families. One hundred of them are already part of Sano y Salvo's inspection scheme and are on their way to certification. The farmers live relatively far away from each other, some a couple of hours apart, others separated by four to five days of walking, horseback riding or boat journey. Most of them live far from roads or public transport and have no electricity on the farm. Illiteracy is high; 40%, and another 40% with limited reading and writing capabilities.

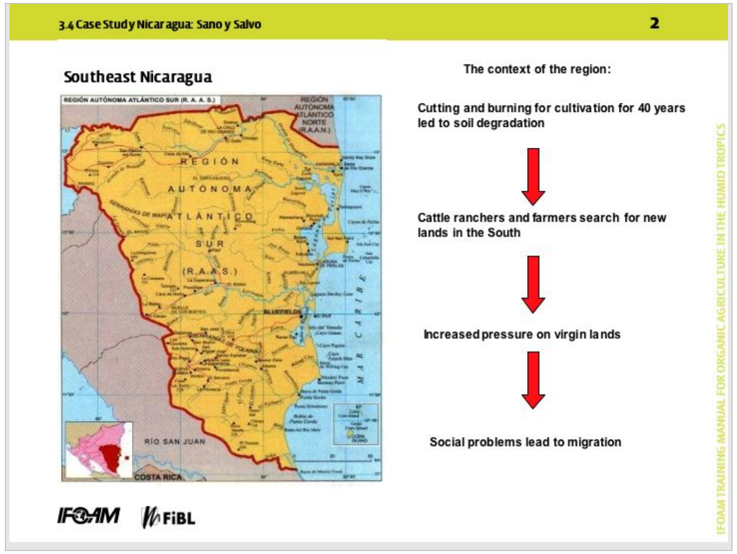
Most of the region is less than 200 m above sea level. Average temperatures lie between 24° and 27°C. It rains for 10 months a year, with precipitation varying between 2500 mm in the Northern part, to more than 4000 mm in the Southern part of the area. July is the rainiest month with 500 to 750 mm of rainfall.

The Biosphere Reserve in the Southeast of Nicaragua is part of UNESCO's global Man and Biosphere (MAB) program. The original natural vegetation is tropical rainforest, a giant biomass of trees, shrubs and lianas of all kinds. There is an extremely high biodiversity of plants and animals. As always in this kind of forest, the major part of the biomass is above the soil level: it is a closed cycle of dead and decomposing organic matter that provides nutriments to the relatively thin humus and thereby to the plants. Plant and animal life exists at many different levels between the topsoil and canopy. The largest animals in this ecosystem are tapirs and crocodiles. The majority of the territory where Sano y Salvo works today is cultivated or used for pasture. There are some rainforest reserves and some protected "natural areas", but they are under serious threat by the permanently advancing agricultural frontier.

In the last 40 years, most of the forests in Nicaragua were cut and burnt to be used for cultivation. Now, land is mainly use for cultivation of grains, tubers and grazing. This has resulted in significant loss of soil fertility, surface erosion and high losses of biodiversity. Yields have declined drastically and there is pollution of soil, water and air by agrochemicals, and in some cases changes in local climate.

Discussion:

Ask the participants about their experience with similar situations as is described on the chart. Encourage them to suggest how such problems could be solved.



TRANSPARENCY 3.4 (2): CONTEXT

The region where Sano y Salvo is active is now threatened by cattle ranchers coming from the degraded Northern and Western regions in search of new pastures. As this humid region offers even less adequate conditions for cattle rearing, the ecological consequences of slashing and burning the forest for grazing are tremendous.

Disturbances to the social and ecological systems lead to rural exodus to Managua or abroad (Costa Rica). It also forces the remaining population to push the agricultural frontier further South, endangering the rainforest reserve.

3.4.4 Field work

Agroforesty

The overall goal of this cropping method, also known as sequential agriculture, is a productive and sustainable agroforestry system.

At the outset, all parts of the plot are planted or sown with a number of different plants: maize and beans ("pioneer plants") papaya, cowpea, lemon grass ("secondary I"); chili, bananas and bixa ("secondary II"); orange, cashew, coconut ("secondary III") and finally mahogany, cocoa, coffee, cortez ("primary"). Consideration is given to the canopy layer that they will occupy within the agroforestry system. The pioneer plants can be planted twice before the succeeding groups outcompete them. Varieties of the later secondary group stay on the plot throughout their productive lifespan. At the end, only the last group, the primaries, form the "final" forest.

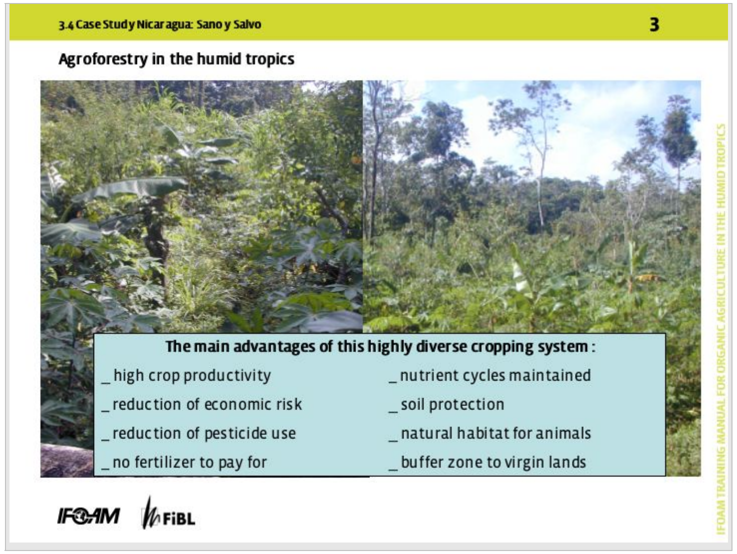
The farmer starts a new plot every one or three years, depending on how many hectares he or she owns. The main challenges in agroforestry are the choice and composition of the varieties and shade management. As a consequence, pruning is the most important activity to maintain the productivity of agroforestry systems.

Sano y Salvo considers this system suitable for all small farmers in this region – not just something that a few can engage in. Poor farmers with a sense for marketing can make good profits from the highly productive system and its plants diversity. Food plants meet self-consumption needs and there is a wide range of products to be marketed (e.g. medicinal plants, citrus, cocoa, vanilla, timber, firewood and materials for arts and crafts). Sano y Salvo helps organizing the farmers to produce enough of each variety to make it a marketable product and gives support for processing (fermentation, drying, etc.), packaging and transportation. In this way, biodiversity does not only provide the key for ecologically balanced agricultural production, but also results in economical diversity. By spreading the risk of crop failure, the family's economic situation does not depend only on one or two cultivars. When marketing the products, Sano y Salvo aims to avoid intermediate traders. The association organizes farmers to sell directly to buyers- be it at the local market, or to European organic importers.

Group work:

Divide the group in four. Let each group organize one task within the management of a typical agroforestry farm. These would be the establishment and the maintenance of the system and the marketing of the produce.

Give them enough time to do this and provide them with the necessary information. Let them present the results in plenary.



TRANSPARENCY 3.4 (3): AGROFORESTRY IN THE HUMID TROPICS

Métodos de capacitación

Training methods

Most farmers have settled in the region within the last two generations and do not have long-standing, detailed, knowledge of the humid tropical environment in which they live and work. Their agricultural practices are based on the advice that they received when they migrated there. They were told that the rainforest should be opened and cleared for cultivation with machetes and chainsaws in order to make productive use of the land.

Four decades of "agricultural tradition" were built in this way, and changing peasant's convictions, modes, and ways of life and work is very difficult. Small farmers' perceptions of reality, their ways of understanding, learning and applying this knowledge are very different from other social groups. Sano y Salvo recognizes this and places great emphasis on pedagogy. The training centers around methods such as "From peasant to peasant" and "Learning by doing" and is adapted to meet the life situations, circumstances and conditions of the rural people. Farmers who have completed workshops at Sano y Salvo understand the principles of the biosphere in which they live and feel remorse when they don't respect nature's rules.

Specific training programs on organic cultivation help professionalize our farmers. Everyone needs to successfully complete five courses before he or she can ask for certification:

- The basic training workshop on ecological agriculture in the humid tropics (4 days)
- Training course on ecological, diversified agroforestry in the humid tropics (4.5 days)
- Training course on administration and management of the organic farm (2.5 days)
- Workshop on "the peasant family on the organic farm" (2 days)
- Course on participative impact monitoring (2.5 days)

Motivation:

Take a flip chart and let the participants brainstorm all the factors that influence a farm. Arrange the items on the chart in groups of social, political, natural, economical factors. Discuss with the participants, which of these should be considered in extension activities. Work out proposals for the extensionists' methods.

TRANSPARENCY 3.4 (4): LEARNING FROM THE FOREST

Challenges

The primary challenge facing Sano y Salvo is the mindset of much of the local population and the difficulty in convincing them of the urgent need for a change of direction in agriculture. From the 1970s onwards destruction of the natural environment has outpaced any measures designed to defend it.

A second challenge facing the association is to maintain links and coordinate the activities of six regional groups that are located at considerable distances from each other. Primarily, this consists in planning the production, logistics and processing in order to have the right amounts of produce of suitable quality, available at the right time. While diversity is desirable and necessary, it does complicate the management of an economically profitable supply chain. Sano y Salvo is aware of being still in the phase of gathering experience and exchange among the members in order to improve these processes.

Another challenge is the lack of available capital, as all of the participating farmers are "poor". External help and support from outside are less available than 20 years ago. Additionally low literacy levels handicap farmers' ability to manage tasks such as farm record keeping, bookkeeping and marketing.

Last, but not least, there is the "cattle rancher challenge". They come into an area, buy the land and then destroy the forests, water supplies and soil. Even Sano y Salvo peasants can be tempted by the prospects of ranching and may even dream of becoming a rancher: imagining owning huge green steppes, grazed by large herds of cattle and earning lots of money with minimal input of energy or manpower. Unfortunately, Nicaragua's government and some international development agencies support further cattle production, seeing the opportunities for fast profits and overlooking the fact that it is a business from which only a few people benefit. Moreover, these profits are realized at the costs of future generations, who will have to pay for the social and environmental consequences.

The limited returns to conventional agriculture, which only generates low yields despite high input use, strengthen the credibility of Sano y Salvo's approach. The adopted agroforestry system implements organic production principles, provides a healthy soil management system for the region and enhances economic prospects by strengthening diversity and attracting better market prices.

Discussion:

Ask the participants if they know about similar challenges facing farming projects. Write them down on a chart and develop ideas about how to successfully deal with them in a plenary session.

TRANSPARENCY 3.4 (5): CHALLENGES OF THE PROJECT

3.4.5 Social activities

Religion

Nicaraguan farmers are very religious people, practicing both Catholicism and Protestantism. In Southeast Nicaragua the number of adherents of each faith is about equal. Sano y Salvo has been active in involving the pastors and the priests into the educational work and into the reflection about the meaning of agriculture. The association's yearly General Assembly include ecumenical services, where members of both religions reflect about the responsibilities of human beings toward Creation. In the field practice, the trainer explains God's way of seeding and planting. He shows the forest and lets the participants count the varieties within 100 square meters in order to appreciate the richness of nature. He gives another perspective to considering some species as "pests" and "weeds", and explains the symbiosis between trees, shrubs and lianas that help each other to grow. The message is that when humans try to improve on God's way to of doing forestry, it is often a futile endeavor. He invites discussions about the wisdom of seeking to "improve" on God's natural design by planting monocultures and spraying poison on his creation.

Gender issues

Another aspect of Sano y Salvo's work is enhancing the role of women in (organic) agriculture. Generally, Nicaragua is a very patriarchal country, where men dominate and women have very poor self-esteem. These patterns are particularly pronounced in the countryside. Most of the Sano y Salvo farms are owned legally by men. So, they are the voting members in the association and sign the organic certification contracts. Traditionally, women don't work in the fields and prefer to restrict their activities to the house and kitchen.

Sano y Salvo tries to include women in agricultural issues because they think about the children and grandchildren's future, which is extremely valuable in sustainable farming. But it is quite difficult to get them interested in organic farming, as working in agriculture means additional work to the existing heavy burden of caring for a house and family.

Discussion:

- *Discuss the efforts of Sano y Salvo to change traditional roles in Nicaragua.*
- *Ask the participants about traditional roles in their region and their opinion about gender aspects.*

(If you think the discussion might raise problems and lose objectivity, you may start it with listing the advantages and inconveniences of including women in farming and men in family affairs.)

TRANSPARENCY 3.4 (6): GENDER ISSUES AND FAMILY ROLES

Unfortunately, programs of many organizations working for women include only *small*-scale production in the yard (a pig, some hens and medical plants) with *small* amounts of money or credit provided. By contrast, men can often start big projects with sufficient credit. However, in general, women are more responsible with money or credit, with the certification rules, and are more honest and more future-oriented.

Sano y Salvo adopts a different approach, particularly through its courses on "The peasant family on the organic farm", which addresses the following issues:

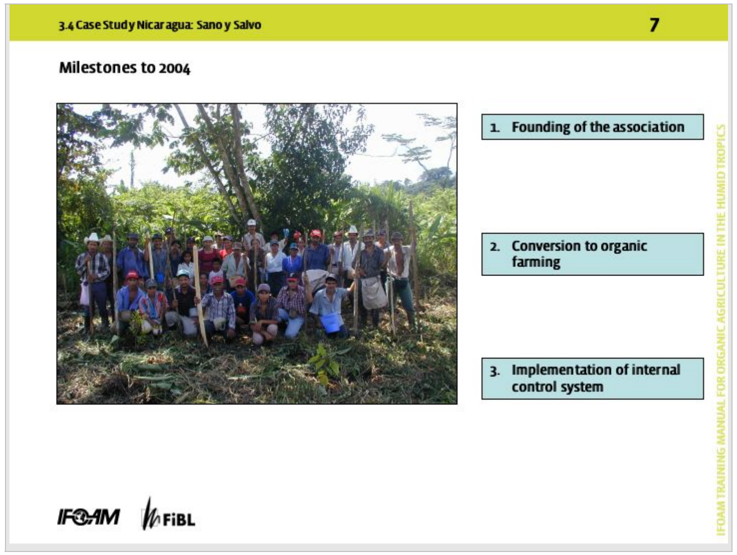
- Men learn that they must share housekeeping and family care to give women space to extend their role.
- Women have to allow men to participate actively in housekeeping.
- Mothers have to change the way they educate their sons and daughters, teaching them new and changed roles.

To date, practices have not changed greatly, but the aim to include all peasant wives as full members, as co-signatories of the contracts, and for them to take on more prominent roles remains an important long-term objective.

Discussion:

Ask the participants about their personal experiences with farming organizations and about their impression of the association Sano y Salvo. Let them consider the following points in particular:

- *Promotion of agroforestry*
- *Training methods*
- *Inclusion of religion in extension work*



Transparency 3.4 (7): Milestones to 2004

3.4.6 Milestones to 2004

The first milestone was the establishment of the producers' association. Through this organization with activities on all levels of the rural life (from cultural issues in education to agricultural extension), they created the foundation for sustainable organic agriculture.

The second milestone was when Sano y Salvo moved beyond "traditional organic agriculture" and adopted a new concept, very well suited for the humid tropics with forest cover. Monoculture plantations with leguminous ground cover were replaced by mixed cultivations, with a diversity of species ranging from pioneer plants to primary trees.

The third milestone was the successful implementation of the internal control system. With the first external inspection in 2004 by the certifier Eco-Lógica S.A. from Costa Rica, a serious and recognized transition period had started.

4 Management Guide for Crops

4.1 Rice

Introduction

Rice (Oryza sativa) has been grown in Asia for at least 10000 years and has shaped the cultures, diets and economics of billions of people. Today, rice is cultivated across a wide range of sociocultural and biophysical environments. It is the most important staple food in the world, the center of Asia's culture and rural economy, and feeds more than half of humanity. Rice is planted in tropical, subtropical and temperate environments across a wide range of soil conditions, water management systems, levels of mechanization and levels of inputs. This results in a tremendous variety of production methods.

Most traditional rice production methods might fulfill the criteria of "organic production". Examples of production systems without external inputs still exist in many Asian countries such as the mountain rice in Bhutan, as well as upland and rainfed rice in Laos. However, it is important to realize that these are mostly subsistence production systems resulting in little or no surplus for marketing.

The green revolution, which widely promoted high-yielding varieties and technologies that depend on chemicals, has resulted in large-scale agronomic, ecological, health and economic problems. As a result, there has been a growing awareness of the benefits of organically produced rice, especially in China, Vietnam, Thailand, the Philippines, Indonesia, South Korea, India, and Japan. However, organic rice production is still less than 1% of the total rice produced in these countries. Aside from the fact that only a few countries are producing organic rice, one of the most important challenges in organic rice production is the chemical contamination from nearby conventional farms. Even when there are buffer zones, it is still difficult to ensure that the produced rice is organic if neighboring farmers are using harmful chemicals.

Lessons to be learned:

- *Rice is one of the oldest crops and is the most important staple food in Asia.*
- *It can be grown both in lowlands and uplands, as well as in flooded conditions and in extreme climatic conditions.*
- *Some of the main difficulties in organic rice production are the lack of access to processing facilities and marketing mechanisms: for consumers, it is the lack of quality guarantees.*
- *A range of options are available for weed regulation. Water management is one the most important strategies.*

Pricing is also a problem, as premium prices for organic rice are generally not realized. Most of the produced organic rice is still mixed with and sold at the same prices as conventional rice. Market demand for organic rice is higher in developed economies like Japan and Korea; where the demand often exceeds the supply, especially in big cities where the premium price is higher. To a limited extent, this pattern of higher urban demand is repeated in most rice producing countries. Yet often, producers do not have central handling and processing facilities to meet this demand. Direct selling remains the most common type of market for organic rice and is typical of the early stages of organic marketing, where a close relationship between the consumers and producers is necessary. Consumers prefer organic rice primarily for health reasons. It is also environmentally safe to produce and has longer shelf life.

TRANSPARENCY 4.1 (1): ORGANIC RICE PRODUCTION IN THE TROPICS

Motivation:

Ask the participants to explain how important rice production is in the region. What potential do they see for producing organic rice and why?

The 10 big facts about rice

FUEL FOR ASIA. More than 90% of the world's rice is grown and consumed in Asia, where people typically eat rice two or three times a day.

THAT'S A LOT OF RICE. Asians ate about 300 million tons of rice in 1996. The average person in Myanmar eats 195 kg of rice annually; in Laos PDR and Cambodia, it's about 160 kg; the average European eats 3 kg; the average American, 7 kg.

RICE ALONE. Hundreds of millions of poor people spend half to three quarters of their incomes on rice- and only rice.

MUD, SWEAT, AND A BUFFALO'S BACK END. To plough 1 ha of land in the traditional way, a farmer and his water buffalo must walk 80 km.

THIRSTY CROP. It takes 5000 liters of water to produce 1 kg of irrigated rice.

THAT'S DIVERSITY! Scientists estimate that rural communities have developed more than 140000 varieties of cultivated rice with diverse capabilities to withstand different climatic conditions (the grass family *Oryza sativa*), but the exact number remains a mystery.

RICE COUNTRIES. Three of the world's four most populous nations are rice-based societies: People's Republic of China, India, and Indonesia. Together, they have nearly 2.5 billion people- almost half of the world's population.

NEW RICE EATERS. Every year, 50 million people are added to Asia's soaring population of 3.5 billion.

BOUNTIFUL RICE BOWLS. Improved varieties are planted on three quarters of Asia's rice land and are responsible for producing most of the continent's rice.

TINY FARMS. Asia is home to 250 million rice farms. Most are less than 1 ha.

Discussion:

Discuss with the participants if organic rice producers should obtain a premium price under local market conditions. They should evaluate what will happen if premium prices are introduced, reduced or eliminated.

TRANSPARENCY 4.1 (2): THE 10 BIG FACTS ABOUT RICE

Due to the tremendous variety of production methods, it is not possible to provide a comprehensive training manual with detailed recommendations and technologies for the different rice production systems. This chapter is written with the assumption that the target clients (rice producers, extension workers, etc.) have experience in rice production and have access to information on the practices best adapted to their local conditions. The focus of the manual is to provide specific information techniques and methods in organic farming.

4.1.1 Agroecological requirements

Rice was domesticated in Asia, possibly in Thailand, in an environment with a rich diversity of plant species. With the development of puddling and transplanting, rice became truly domesticated. Gradually, the plant spread throughout the world and was adapted to a wide range of conditions. The extremes in rice growing environments are represented by the rice production in Nepal at elevations above 3000m, the deepwater rice growing in flooded conditions in Assam, and the salt tolerant rice-fish systems in many Asian coastal areas.

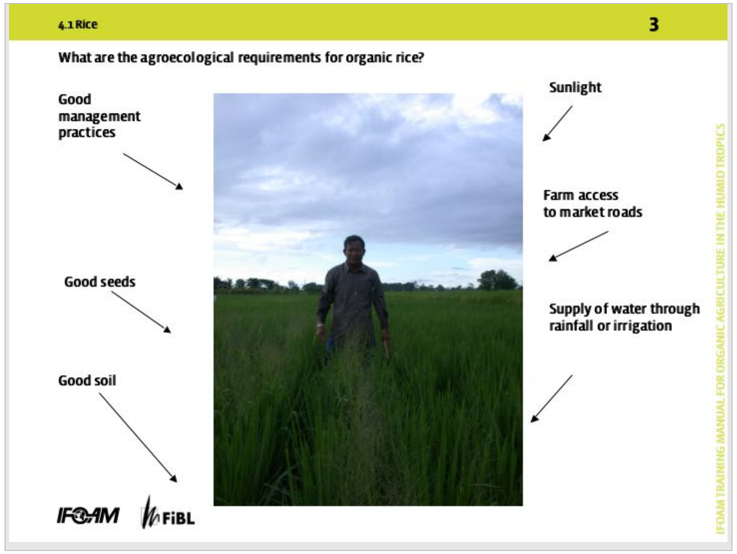
The most common practice for paddy or lowland rice is to puddle the soil before rice seedlings are transplanted. Puddling is the most important soil management strategy for rice production. Where irrigation is not available, rice is generally grown during the rainy season. It is possible for upland crops to be planted after lowland rice in rainfed areas. However, the yields are very low and the previously puddled soil layer poses considerable restrictions on cropping after rice. Therefore, developing suitable management practices to grow legumes after the rice crop on these puddled soils would be particularly advantageous.

Soil characteristics

Rice prefers a clay soil that can hold water for a longer time, with pH levels of 4.3 to 8.7. Preferably, there should be a hard pan below the clay type soil to avoid excessive seepage, thus maintaining the volume of water needed by the rice plant. The terrain should be level enough to permit flooding, yet sloped enough to drain readily.

Climate

Rice is a tropical, subtropical and warm temperate crop, growing best in full sun where summer temperatures of 24–25°C prevail. Rice grows as far north as Japan and as far south as Queensland (Australia). Different varieties of rice can tolerate annual precipitation of 42 to 429mm although, in general, most varieties require at least 80-100mm of water during the growing season in order to get good yields.



TRANSPARENCY 4.1 (3): WHAT ARE THE AGROECOLOGICAL REQUIREMENTS FOR ORGANIC RICE?

Activity:

Ask the participants:

- *to list rice production ecosystems used in the region.*
- *which ecosystems are more likely to have potential for organic rice production? Why?*
- *to discuss examples of farmers producing organic rice in the region.*
- *to describe which requirements they would consider important when selecting a site for organic rice production.*

Availability and quality of irrigation water

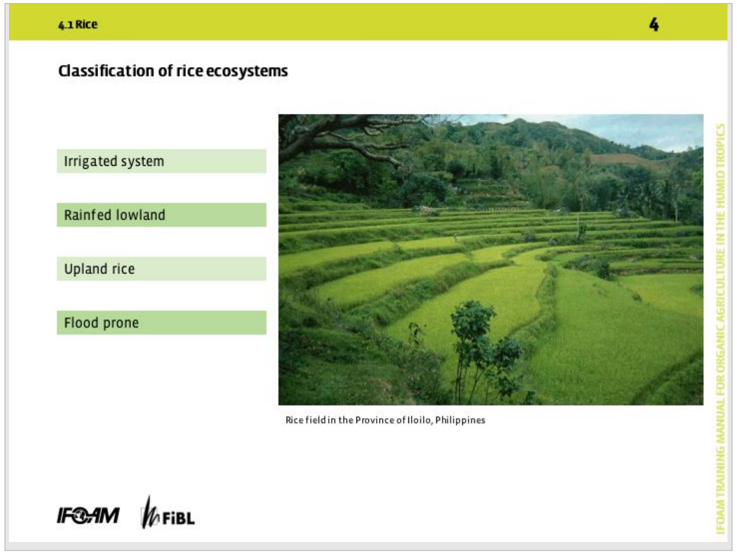
Lowland organic rice production faces the problem of contaminated irrigation water from conventional production, which generally contaminates the gravity fed irrigation water running in rivers or irrigation channels. The safest logical sources of uncontaminated irrigation water for organic rice are deep wells. Yet, irrigation water can still be taken from rivers, provided adequate buffer rows are installed near the irrigation canal. However, it is preferable if the farmers in an area organize themselves so that they can assure themselves of good water quality.

Other aspects of site selection

Based on water management and topography, rice ecosystems can be classified into upland, irrigated, rainfed and flood prone systems. The descriptions below are based on those used by the International Rice Research Institute (IRRI). Generally, the production systems are more uniform in the irrigated environment, but extremely diverse in upland environments. The green revolution has brought more changes in production methods over recent decades, leading to increases in productivity, the erosion of traditional varieties and a higher use of external inputs. Rice production in the other environments, especially in Asia, is still largely dependent on traditional varieties with low external inputs.

Irrigated system

Irrigated rice is grown in bunded, puddled fields with assured irrigation for one or more crops a year. Some areas are served by supplementary irrigation only during the wet season. Rainfall variability is the basis for subdividing the irrigated ecosystem into 1) irrigated wet season, and 2) irrigated dry season. Irrigated wet season areas are those where irrigation water may be added to the rice fields during the wet season as a supplement to rainfall. Relatively small volumes of water early in the season or during a mid-season dry period can assure the success of a crop threatened by erratic precipitation. Irrigated dry season areas are those where no rice crop can be grown without supplementary water in this season.



TRANSPARENCY 4.1 (4): CLASSIFICATION OF RICE ECOSYSTEMS

Group work:

Organize the participants in groups. Each group may develop a strategy that supports the farmers to produce organic rice in their region (for example: organization of the farmers in a cooperative to use and improve infrastructure and logistical facilities). The results should be discussed.

Rainfed lowland

Rainfed lowland rice grows in bunded fields that are flooded for at least part of the cropping season. The water depths may exceed 50 cm, but for no more than 10 consecutive days. Rainfed lowlands are characterized by a lack of water control, with floods and drought being potential problems. Adverse climate and poor soils further limit the production potential for many farmers. Most rainfed lowland rice farmers have small land holdings and must cope with unstable yields and financial risks. They adapt their cropping practices to the complex risks, potentials and problems they face. They typically grow traditional cultivars sensitive to the photosynthetic period and invest into labor instead of purchasing inputs. Farmers bund the fields to store water. Many tasks, such as weeding, redistributing seedlings to ensure good crop stands, and harvesting are usually done by hand.

Upland rice

Landforms where upland rice is grown vary from low-lying valley bottoms to steeply sloping lands with high runoff potential. In South and Southeast Asia, most upland rice is grown on rolling and mountainous land with slopes that can be in excess of 30%. In many Asian and African countries, the slash-and-burn system remains the dominant upland rice production techniques. Although upland rice constitutes a relatively small proportion of the total rice area globally, it is the dominant rice culture in Latin America and West Africa. Upland rice soils are predominantly acidic (pH varies from 4 to 7) and depleted of major elements. In South and Southeast Asia, more than half of the upland rice is grown in infertile soils. In most upland soils, P rather than N is the most common limiting nutrient.

Flood prone

The flood prone ecosystem covers many different environments and incorporates many types of rice. Deepwater and floating rice are mainly grown in unbunded fields on the flood plains and deltas of rivers such as the Ganges and Brahmaputra Rivers in India and Bangladesh, the Irrawaddy in Myanmar, the Mekong in Vietnam and Cambodia, the Chao Praya in Thailand and the Niger in West Africa. Rice is sown or transplanted before the floodwaters rise and it flowers about the time when water is at maximum depth. The rice varieties used are adapted to the particular conditions of the region, such as periods of submersion and of standing water, and potential ability for fast growth. Some varieties can grow at rates of up to 20 cm per day to adapt to the rising water level.

4.1 Rice 5

Rice ecosystems, their importance, influence on diversity and potential problems for organic rice production

Rice ecosystem	Importance		Diversity		Problems for organic agriculture
	Area (%)[1]	Production (%)	Varieties	Production methods	
Irrigated	55	75	low	low	pest control, soil fertility
Rainfed	25	17	high	high	water management
Upland	13	4	very high	very high	weed control, soil fertility, remote locations
Flood prone	6	4	medium	medium	water management

[1]Proportion of global production

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TRANSPARENCY 4.1 (5): RICE ECOSYSTEMS, THEIR IMPORTANCE, INFLUENCE ON DIVERSITY AND POTENTIAL PROBLEMS FOR ORGANIC RICE PRODUCTION

Group work:

Ask the participants to discuss and exchange experiences on how they can avoid contamination by chemicals (e.g. pesticides) if farmers use irrigation in an intensive rice production region? Which strategies can be suitable for the local conditions??

Requirements for organic rice production; site selection

Organic production is possible in all these agroecological systems. The most favorable conditions for organic rice production are when:

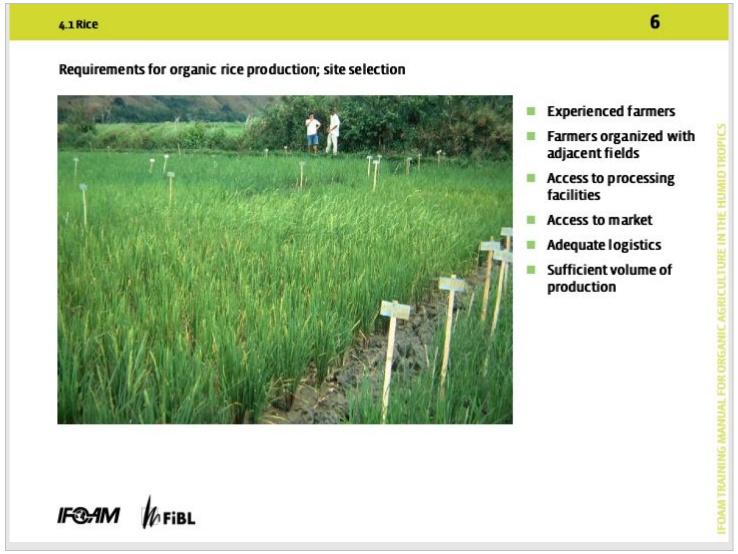
- farmers are experienced in rice production and are interested in adopting organic production methods;
- a group of farmers of the same village, with adjacent fields, forms a producers' association;
- the producers have access to processing facilities (drying, milling, parboiling and packaging) or can produce enough quantity to justify acquiring their own processing facilities;
- the farmers have access to markets;
- the farmers have suitable land of sufficient size to produce rice beyond the household requirements. The land should be owned by the producers, or they should have assured its long-term tenure.

Based on the diversity of cultivars and the level of inputs used, one would expect to find more potential for organic rice production in the rainfed lowland and the upland environments. Yet, currently, most of the organic rice sold to the USA or European markets is produced in irrigated systems. Producers in irrigated environments appear to have an advantage because of a range of socioeconomic factors:

- Better market access.
- Stronger integration in the market economy (many farmers in the rainfed and upland environments are still largely subsistence farmers).
- Capacity to respond faster to emerging opportunities.

Group work:

Ask the participants to explain which strategies can farmers use in rainfed and upland ecosystems to achieve success with their organic products? Participants should evaluate the local conditions and elaborate possible strategies for these farmers.



TRANSPARENCY 4.1 (6): REQUIREMENTS FOR ORGANIC RICE PRODUCTION; SITE SELECTION

4.1.2 Diversification strategies

Diversification through crop rotation, variation in cropping methods or plant species used and/or using a combination of plant varieties represents an important strategy to prevent the buildup of pest populations, diseases and weeds. Yet, in many rice growing systems, especially in lowland systems, rice is the only crop grown and farmers have only limited choices for diversification. Better opportunities for diversification exist in upland production systems.

The following diversification strategies can be use in organic rice production systems:

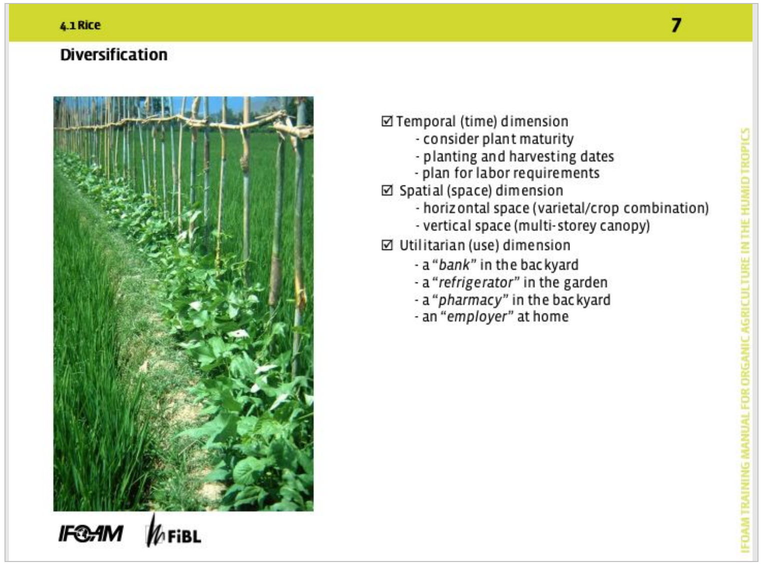
Crop diversification

Crop diversification can be achieved through crop rotation and relay cropping. In rainfed areas, and in places where water can be drained during the second cropping, legumes and vegetables are grown. Draining the water to plant other crops provides additional benefits because soil aeration prevents buildup of toxic levels of iron and aluminum and it increases micro and macro-organisms' activity. Some microorganisms, free-living or not, are fixing nitrogen, e.g. Azotobacter, Azospirillium, and Pseudomonas. Legumes also produce root nodules and are host to Rhizobium, a group of nitrogen-fixing microorganisms.

Rice diversity, rice varieties, variety selection and varietal diversification

Cultivated rice is generally considered as a semi-aquatic annual grass; although in the tropics it can survive as a perennial, producing new tillers from its nodes after harvest. As a result of the wide diversity in environmental and cultural environments, there are many rice varieties. It is estimated that 140000 rice varieties exist in the world. Laos has a very rich diversity in rice production systems and varieties, one that reflects its wide ethnic and environmental diversity. The country, with a population of about 6 million, has 3000 different rice varieties. These varieties were selected for adaptability to local conditions, extreme environments, yield potential, resistance to pest and disease, good tillering capacity, and desired grain quality.

Varietal diversification in the fields is achieved by each farmer planting at least three varieties of rice. This creates a mosaic pattern of varieties even in extensive rice farm areas. Because these varieties have different resistances to pests and diseases, outbreak of any single pest or disease can be reduced or avoided and, likewise, the need for pesticides. Similarly, the different plant maturity duration and planting and harvesting dates help spread labor requirements more evenly across the year.



TRANSPARENCY 4.1 (7): DIVERSIFICATION

Use the above transparency to explain to participants the importance of diversification in cropping systems. For more information see the Basic IFOAM Manual, chapters 2 and 4.

Activity:

- *Ask the participants about the rice varieties (list their characteristics) grown in each participant's area and their climatic requirements.*
- *what is varietal and crop diversification for them?*
- *what are the advantages of varietal and crop diversification?*
- *different farmers may have different practices in growing rice. Encourage the farmers to draw their diversification strategies. Post them on the wall to serve as exhibit materials. From these, other farmers can get ideas on how to improve and diversify their farms.*

Diversification in irrigated rice

Rice should be planted on a smooth seedbed, and the seed covered by 3.7–5 cm of soil. In some countries (India, Malaya, Philippines, China, Japan, and Spain), rice is transplanted onto fields when it is 25 cm high. It is planted in very shallow water. The water level is later increased in order to flood and eliminate weeds. Organic fertilizers used include: rice straw, rice ash, stable manure, buffalo dung, green manure, guano, fish meal, and natural manure. Diversification in irrigated rice is possible by employing the rice-fish system (see below) or incorporating a crop rotation with mungbean (as green manure) and vegetables.

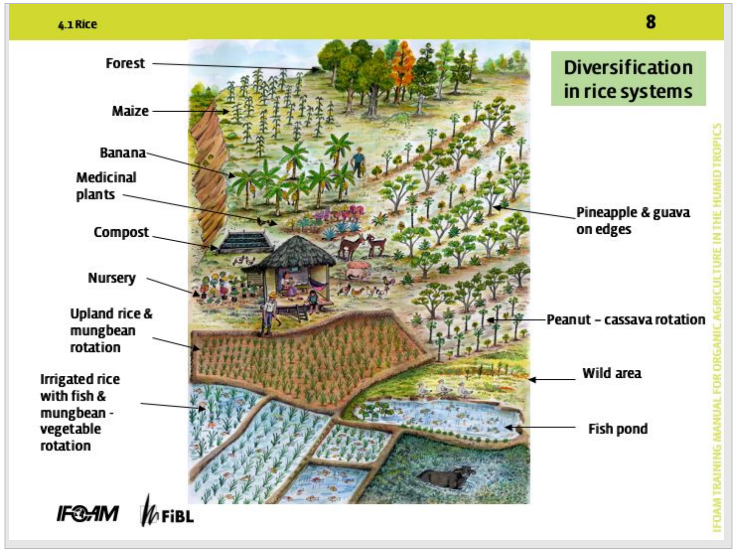
Rice-fish systems

This system allows simultaneous production of fish and other aquatic animals and rice, without a reduction of the rice yield. It may be set up either by modifying the rice field or building a rice field/pond complex. The field may be deliberately stocked with fish or the fish may enter the field with the irrigation water. A wide range of fish species is used including white fish, catfish and carp. This system is specially suited for organic rice producing systems as the farmers do not use toxic chemicals.

Diversification in upland rice

Tipar (Upland) culture is still found in Sumatra, Thailand, Borneo and the Philippines. In this system, rice is sown 3–4 cm deep in holes 15 cm apart on hillsides where no irrigation is possible. The fields are worked like maize fields and yields are small. Continuous rice culture depletes soil nutrition and lowers yields. Organic growers therefore use rotations with soybeans, grain sorghums or small grains, vetch, safflower, field beans, bur clover, horse beans, bananas, sugarcane, cotton, lespedeza or maize.

For example, organic rice farmers in the Philippines (MASIPAG, see chapter 3.2 of this manual) practice relay cropping during the second cropping. This is done at a time when there is still sufficient soil moisture to allow for the germination of seeds. Mungbean seeds are usually broadcast a couple of weeks before harvesting so that, after the harvest, the mungbean plants will emerge above the remaining rice stubbles.



TRANSPARENCY 4.1 (8): DIVERSIFICATION IN RICE SYSTEMS

Perennial peanut in rice systems

Perennial peanut can be best planted in the rice farming system when conditions allow for one or two cropping periods. It will perish when the rice paddies are flooded, so there is no danger of persistence.

The runners and roots will decompose when the ploughed-under perennial peanut is submerged in the flooded rice paddy. The soil fertility in the one-season crop can be enhanced by incorporating cut green manure such as Sesbania, Crotalaria, Ipil-ipil (Leucaena), Mangium, and Acacia. The beneficial effects of incorporating perennial peanut can be demonstrated by doing soil analysis prior to planting and before the start of the next rice crop. These tests should show large increases in organic matter and N, P and K. Incorporation can be done in a number of ways.

- One-season rice crop (in rainfed areas) – perennial peanut is planted after harvesting the main crop to take advantage of the residual moisture. Let the peanut grow to full maturity. Then, at the start of the rainy season, let the field be saturated with water to kill the legume before plowing it under the soil.
- Two-crop season of rice followed by perennial peanut – after harvesting the second crop of rice, perennial peanut is then planted to serve both as cover crop and green manure. After 3 months, it can be ploughed under to serve as green manure for the next crop. Farmers can also irrigate and saturate the field before plowing the perennial peanut into the soil.
- Lowland rice – perennial peanut is grown on paddies to control weeds. To avoid the spread of the legume, it is cut and shredded then scattered onto the field to serve as green manure.

4.1 Rice 9

Perennial peanut in rice systems

NO. OF CROPPING / YEAR	SEASON 1	SEASON 2	FALLOW PERIOD
A. One cropping	Rice planting 4 months	After harvest, plant mani-mani	Plow mani-mani after maturity (2 months)
B. Two cropping	Rice planting 4 months	Rice planting 4 months	Plant mani-mani, after harvesting and plow under after 2 months, followed by land preparation for the next planting

IFOAM TRAINING MANUAL FOR ORGANIC AGRICULTURE IN THE HUMID TROPICS

Transparency 4.1 (9): Perennial peanut in rice systems

4.1.3 Organic rice management practices

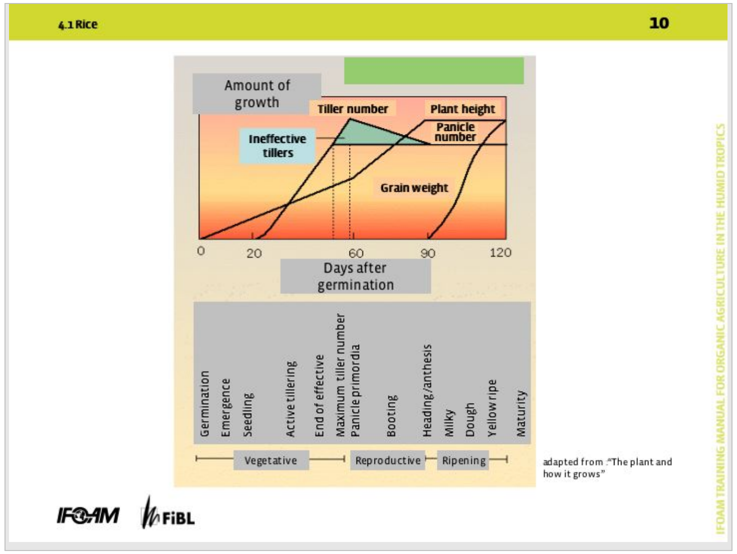
Growth of rice

The growth duration of the rice plant is 3-6 months, depending on the variety and the environment under which it is grown (use transparency). During this time, rice completes two distinct growth phases: vegetative and reproductive. The vegetative phase is subdivided into germination, early seedling growth and tillering. The reproductive phase is subdivided into the time before and after heading. Hence, agronomically, it is convenient to regard the life history of rice in terms of three growth phases: vegetative, reproductive, and ripening. A 120-day variety, when planted in a tropical environment, spends about 60 days in the vegetative phase, 30 days in the reproductive phase, and 30 days in the ripening phase.

Production practices

Organic production practices differ greatly in different localities, but in most Asian countries lowland rice farmers use simple manual practices supported by draught animals. The fields are prepared by plowing (typically with simple ploughs drawn by water buffalos or bulls), applying organic fertilizer, and leveled with a leveling beam. The seedlings are raised in seedling beds and, after 30 to 50 days, are transplanted by hand to the fields that have been flooded by rain or river water.

Optimal production practices vary with the environment and cropping system. It is not possible to provide recommendations that are applicable across all of the wide range of production systems. All steps in the production process are important and need to be given full attention. Locally adapted practices and recommendations for optimizing production and for soil fertility management should be followed.



TRANSPARENCY 4.1 (10): GROWTH OF RICE

Motivation (group work):

Explain the graph above. Afterwards, ask the participants to elaborate a graph that includes the growth stages of rice, calendar period and precipitation period. This graph can be used for subsequent activities that can include agronomic organic practices, periods of high pest and diseases pressure, etc.. Post the graphs on the wall for further use.

For organic rice production special attention has to be given to:

1. Selection of varieties

Choice and number of varieties: market requirements and disease and pest resistance or tolerance should be taken into consideration in variety selection. If feasible, at least 3-4 varieties should be used.

2. Seed production and handling (selection of good seeds)

Success in organic production starts with the seed production and handling, and continues through the process until post-harvest activities. Follow traditional methods of selecting healthy and superior plants for seeds. Make sure seeds are free of weeds and well dried before storing.

- At harvest, select rice from a part of the farm where the plants are uniform, healthy and disease-free with productive panicles.
- Thresh immediately, clean and gradually dry for 3 days, avoiding the hottest period of the day (11 am - 2 pm).
- From the harvested seeds, set aside 30 to 40 kg for planting per hectare.
- The dry season harvest is usually a better source of good seed because it has reached full maturity and therefore the seeds are viable for longer than seeds harvested during the wet season.
- Store seeds for the next dry season. Store in dry, aerated, and pest-free places. For example, in India, storage and preservation is done in wooden granaries mixed with neem and castor leaves.
- When available, select at least four varieties. "Diverse seeds for diverse needs." Traditional varieties or improved varieties from traditional varieties are well suited for organic rice production. This is because they are resistant to major stresses even in extreme conditions of wetness or dryness. In the Philippines, some good varieties for organic production are M45-1, M5-BD, M30-10-1B, AG10 and AG5.
- If seeds are brought in from outside, they should have been produced following organic production rules.

TRANSPARENCY 4.1 (11): SELECTION AND SEED PRODUCTION OF RICE VARIETIES

Sharing experiences:

There are several methods in selecting good seeds. Let the participants share their methods by writing them down in a card and posting these on the wall.

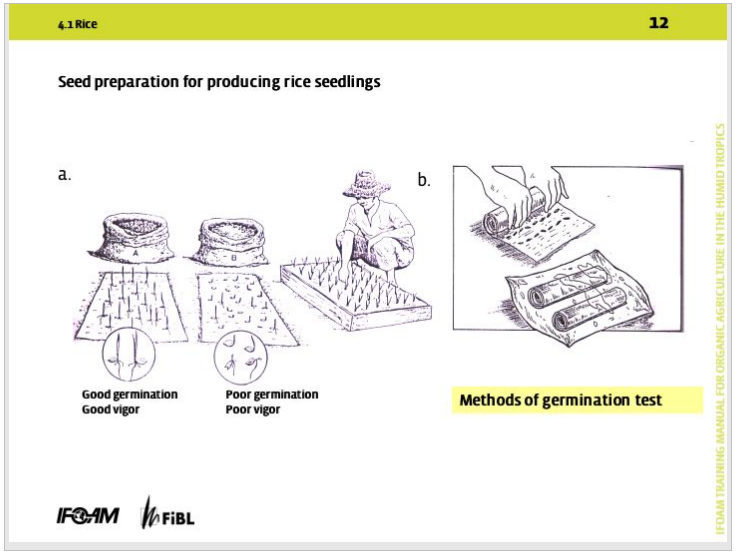
3. Seed preparation for producing rice seedlings

Seed preparation is very important, particularly for transplanted rice, which should have a higher germination percentage in order to come up with the proper number of plants per hectare and the right population density. Often, rice yields are negatively affected by a low population density of rice seedlings.

- Before soaking, test a tablespoonful of seeds to check if these are viable with uniform germination. Place the seeds in a boxful of sand, water them daily. Then, after 7 days, record the number of seeds that have germinated. Wait for another 3 days, then, count again the total number of seeds that have germinated and compute germination percentage using the formula:
- Number of geminated seeds – ungerminated seeds X 100
- Number of germinated seeds
- Seeds that were stored for 3 months or more need to be awakened by warming them in the sun for about 3 hours. Allow them to cool off before soaking. Seeds warmed in the morning may be soaked late in the afternoon. Seeds warmed in the afternoon may be soaked in the evening or early the next day.
- Soak for 24 to 36 hours. Those seeds that float should be removed. Those that sink should be used.
- Rinse the seeds if they were soaked in turbid or standing water. Start incubation in the morning. Morning incubation takes advantage of sunlight to hasten rapid germination. Starting the incubation in the afternoon lacks this advantage.
- Fill containers halfway (sacks, etc.). Tie sacks tightly during the first day. Place the sacks under the sun and cover with sacks, plastics or 5 - 8 inches of rice straw. Check in the afternoon. Loosen the sacks and mix the seeds if the heat is too much. Pile the sacks one on top of another. Reduce the cover. Repeat checking and mixing on the next day (day 2 for incubation).

4. Seedbed preparation for growth of rice seedlings

- Prepare a seedbed 60-80 cm wide, elevated 3 cm from the ground. This will be easier to prepare and level, and easy to manage during sowing and taking care of the seedlings.
- Level beds allow uniform growth of the seedlings.



TRANSPARENCY 4.1 (12): SEED PREPARATION FOR PRODUCING RICE SEEDLINGS

Discussion:

Ask the participants which methods they use for seedbed preparation and for sowing the seeds. They should describe the advantages and disadvantages of their methods. Prepare a chart on the board with the information. Analyze and discuss the different methods in plenary.

- About 30 - 40 kg of seeds will be needed to plant one hectare. If germination is good and the seedlings are healthy, only about half, or even less, of the seedlings will be enough.
- Label the varieties and make a seedbed plan before leaving the field.

The guide discussed here is intended for the WET BED method of raising rice seedlings. This is widely used in areas with an abundant water supply. In places where water is insufficient, the DRY BED method is commonly practiced. Here, the seeds are first soaked overnight before they are sown on prepared dry beds. Incubation is not necessary especially if rain is not forthcoming.

5. Sowing

- Sow thinly and uniformly. Avoid mixing varieties. Space the seeds 20 cm apart. As a guide, use 5 - 6 square meters of bed for 1 kg of seeds. Small seed varieties need wider areas.

Do not "drown" the seedlings. Keep the beds just saturated until about 3 days before transplanting. More water then may be allowed to soften the beds and make lifting easier.

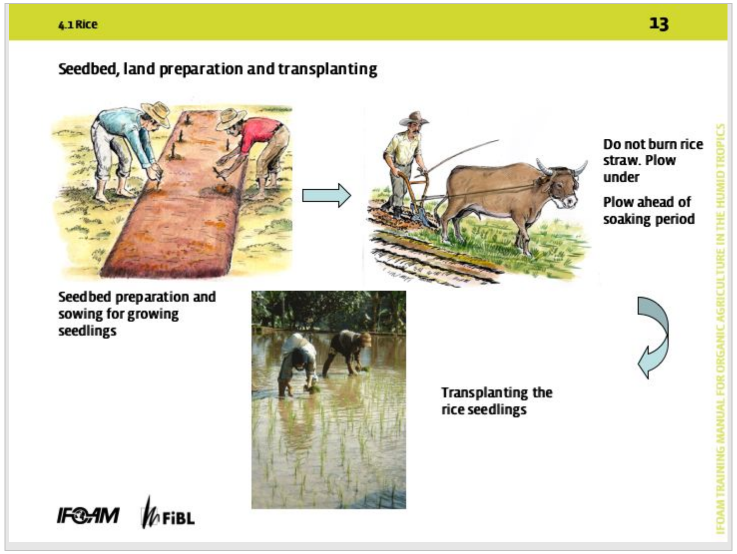
6. Land Preparation

- Do not burn rice straw. Plough it under.
- Plough ahead of soaking time. Native ploughs and water buffalos are preferred because these can work the land more deeply. Tractors can be used, but an attempt should be made to get a furrow depth of 15 to 20 centimeters. If tractors are used attention should be paid to avoid any oil spillages or leaks.
- It is very important to have the field properly leveled, to minimize water requirements and to facilitate weed management.

7. Transplanting the rice seedlings

About 30 days after plowing, the soil nutrient supply is near its peak. This will favor the new transplants.

- Age of seedlings: 25 to 30 days after sowing (DAS). This age favors most traditional rice varieties, especially the medium-late or late-maturing ones. This can also help minimize damages by Golden Apple Snails. Dwarf and early-maturing varieties should be transplanted at a younger age (10 to 18 DAS).



TRANSPARENCY 4.1 (13): SEEDBED FOR GROWING SEEDLINGS, LAND PREPARATION AND TRANSPLANTING

Sharing experiences:

Ask the participants to describe how they prepare the seedbed, the land and how they carry out the transplanting. Find out the advantages and disadvantages of the different alternatives and discuss this with the participants.

- Spacing: try any of the following planting distances (in centimeters): 40 x 10, 30 x 20, 30 x 25, and 25 x 25 on average soils. Use closer spacing in shallow, poor or sandy soils. Use wider spacing for deep, rich or clay and loamy soils; waterlogged or poorly drained soils. Closer planting is suitable for the short and early-maturing varieties. Wide spacing is suitable for tall, late-maturing and lodging-prone cultivars.
- No. of seedlings per hill: plant 1 to 3 seedlings per hill (closer spacing needs 1 seedling per hill, farther spacing needs more than one seedling).
- Row orientation: a row oriented in an East to West direction may favor the rice plants more during the wet season than during the dry season. This is recommended when a spacing of 40 cm x 10 cm is used during both seasons. If the farmers are planting in a square pattern, then the East-West direction is not important.
- If the farmer plans to use a rotary hoe, the rice has to be planted in rows with the help of planting string.

4.1.4 Soil protection and weed management

Traditional rice cultivation in Asia is one of the longest established forms of cultivation practices in the world and has sustained soil fertility and yields for over thousands of years. Upland rice production in slash-and-burn systems may be equally old and was sustainable as long as population densities were low and fallow periods long. With changes in the production methods, and with rice cultivation expanding into less favorable environments, soil fertility management and soil conservation has become crucial. In organic production systems, it is of utmost importance to reduce soil erosion and the loss of soil organic matter.

Soil conservation

Well maintained, terraced and bounded rice fields retain water and sediments, and protect the land from erosion. But when neglected, they are prone to landslide and erosion damage. Similarly, upland rice production on sloping land can lead to serious erosion, especially if tillage is part of the production system. Soil conservation practices suitable for organic rice production in upland systems include: minimum tillage, erosion barriers (hedgerows, contour strips with grass or weeds) and mulching.

Weed management

Weeds can reduce rice yields by competing for moisture, nutrients, and light. Weed competition varies across environments, but weed regulation is generally necessary to prevent yield loss, to maintain the purity of harvested grain and to prevent clogging of irrigation channels. Rice farmers can control weeds through a range of management practices, as well as manual or mechanical weed control. Available weed regulation practices include:

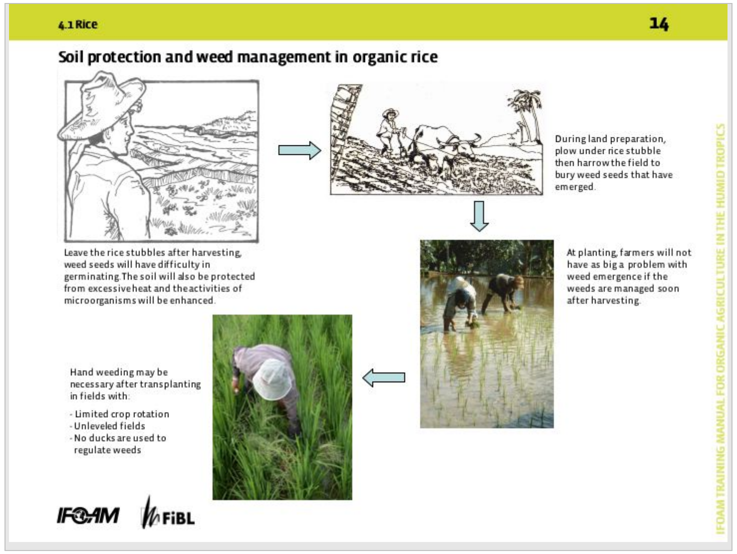
Land preparation: good preparation of the land will reduce problems in weed management (i.e. repeated weed cures by tilling the soil). This will eliminate weed seeds that are remnants of the last season and those weed seeds that were transferred or carried in by wind.

Leveling: a good leveling allows better water management and will reduce weeds by up to 40%.

Mulch: if the rice straws are left in the field after harvesting, then the weed seeds will have difficulty in germination. This practice also helps protect the soil from excessive heat and enhances the activity of microorganisms.

Lesson to be learned:

Well prepared land can delay initial weed emergence. Poorly prepared fields will require an early weeding job.



TRANSPARENCY 4.1 (14): SOIL PROTECTION AND WEED MANAGEMENT IN ORGANIC RICE

Crop rotation and fallow management: to reduce weed pressure try for example lengthening the standard two-year rice/soybean/mungbean rotation to a three-year rotation of rice/soybean/mungbean. The longer rotation allows additional time to break weed life cycles and reduces the number of weed seeds in the soil. Prevent weed seed formation in fallow fields.

Reduce weed entry into the field: prevent introduction of weeds by 1) using clean seed, 2) keep the seedling nursery weed free, 3) using clean equipment, 4) keeping the irrigation channels, and field boundaries free of problem weeds, 5) using composted animal manure.

Crop-weed competition: use varieties with early seedling vigor and high tillering capacity to suppress weeds. Transplant healthy, vigorous seedlings and maintain adequate plant density

Water management: water is the best weed control agent. Other weed-control options centre on the use of field flooding to suppress weeds directly and to give the crop a competitive advantage. This will also help in preventing heavy infestations of black bug, which is prevalent in Asia. Flooding will be more effective if fields are leveled well. Leveling makes the water depth uniform and facilitates rapid flow onto and out from the field. Maintain continuous water levels of 2-5 cm as many weeds cannot germinate or grow under flooded conditions. Through temporary changes in the water level it is possible to target specific weed species.

Manual weed regulation: this is very labor-intensive and hard work. Farmers may

- start weeding with a mechanical rotary weeder about 10 - 12 days after transplanting (10 to 12 DAT). Follow with hand weeding immediately or within one week;
- complete the weeding within 20 to 30 DAT;
- bury the weeds in between the plants. They will rot and provide additional nutrients during the panicle stages. Be careful in the case of some very hardy grasses and cyperoids, which cannot be suppressed this way. Such plants should be left in the sun to dry out and, when dead, could be buried or composted;
- keep the field drained or just saturated after weeding (tillers will develop better).

Group work/field visit:

Visit different rice fields and record the following:

- *Do the participants know of any soil conservation problem in the region? What are the problems visible in the field? What measures could be taken to minimize those problems?*
- *What are the major weed species? List the local names of major weed species and try to get their botanical names.*
- *What are the major weed control strategies used? List the advantages and disadvantages for each strategy used.*

4.1.5 Nutrient management and organic fertilization

Organic production emphasizes nutrient recycling. Thus it is a general practice to return as much as possible, i.e. all the non-edible portions of the biomass of the crop plant. Soil fertility management aims at maintaining soil fertility and at providing the nutrients necessary for optimum rice yields. The major plant nutrients required are N, P and K. In many rice growing areas, N and P availability are the main factors limiting production. In organic production, the use of inorganic N and P sources is not allowed, except for the use of rock phosphate. However, organic rice producers have many options for maintaining and improving soil fertility and for providing plant nutrients by managing soil organic matter.

Nutrient management strategies

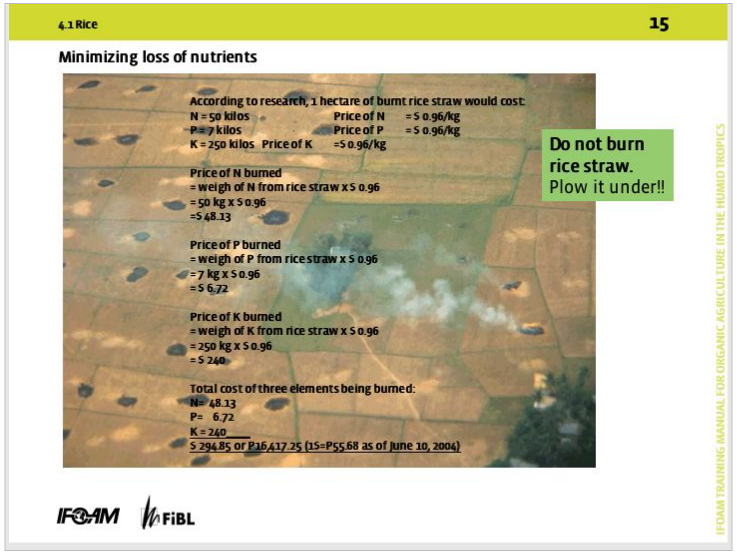
Minimizing loss or export of nutrients and organic matter

- **Reduce loss of soil** and organic matter by reducing soil erosion (especially important in upland rice production), avoiding excess flows of water in and out of the paddies etc..
- **Do not remove rice stems** or other crop residues from the field unless it has some economical value (used as feed, for making paper etc.). For example: during harvest, cutting is usually done at half the height of the rice straw to maximize the standing crop refuse remaining on site, which will be ploughed under in the next land preparation. The other half of the rice straw after threshing is left in a corner of the rice field to decompose. This is later spread in the field to return all nutrients in the biomass and maintain the nutrient balance.
- **Burning of the rice straw is not allowed** because 99% of the nitrogen content of the plant biomass is lost when burned. Traditionally, many farmers burn their rice straw in the field or on the threshing floor. A good rice crop may produce about 4 t of straw per ha, containing about 30 kg N and 3.6 kg P. Burning organic biomass is like burning money.
- Even **weed biomass should not be removed** from the field unless the weeds are causing problems. Instead, it should be ploughed in or left to decompose.

Questions:

- *What is the importance of leaving the rice stubble in the field?*
- *Are there problems? If so, what are the solutions?*
- *What is the advantage of not burning the rice straw?*
- *What are the other costs of burning rice straw?*

Show the transparency to support your arguments.



TRANSPARENCY 4.1 (15): MINIMIZING LOSS OF NUTRIENTS

4 Management Guide for Crops

Maximizing closed nutrient cycles

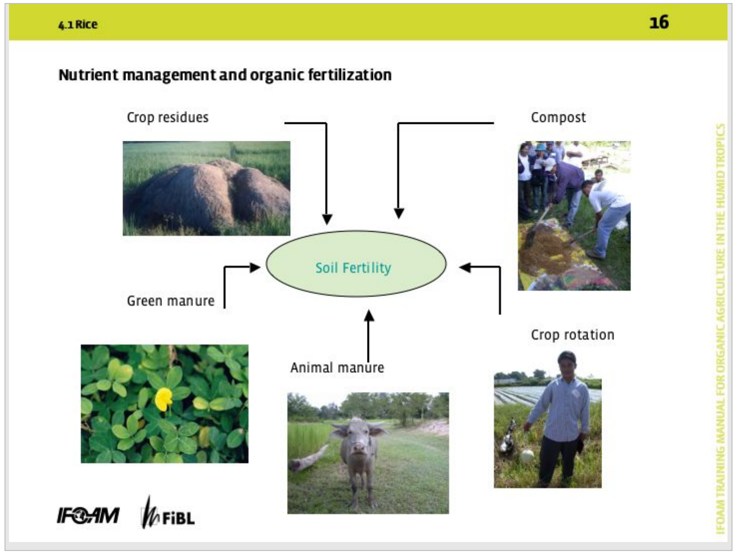
Crop rotation using legumes (e.g. perennial peanut) is also done in organic farming to maintain soil fertility. Rotation with leguminous crops, or crops that add large quantities of biomass, can be used to increase N availability and soil organic matter. The most widely used system in China in the past was the rotation with milk vetch. Good opportunities exist in upland rice systems with crops such as stylo, pigeon pea, soybean, etc.. Another example is sowing sword bean (Canavalia ensiformis) early in the rainy season or after the rice harvest.

Green manuring practices have a long tradition in Asian countries. Green manure leguminous crops can be planted or sown before transplanting rice. Generally, green manure should be buried into the soil a minimum of 3 weeks before rice planting/sowing (the time needed for decay depends on the C/N content of the plant material). When incorporating green manure into the soil, it should be chopped and spread before and plowed in to a depth of 10-15 cm. In some areas of India, farmers use the practice of mixing liquid manure (fermented cow urine) with the green manure in order to improve the fertility of the soil. The following legume crops are suggested in organic rice farming:

- Green gram (Vigna radiata L.) broadcasting (at the same time as the rice), used in India.
- In many environments, Sesbania rostrata has proven very successful. It can produce up to 4 t of dry matter and 100 kg of nitrogen per ha in just 45 days of growth. For example, Sesbania is used as a green manure crop (Sesbania rostrata) in Thailand, where it is sown early in the rainy season in the rice-soybean system.
- Other promising green manure crops include species of Crotalaria, Sesbania, Tephrosia, Aeschynomene, Vigna, Indigofera, Vigna radiata, etc..
- Use of perennial peanuts (see 4.1.2 of this manual)

Green leaf manuring. Fresh biomass from weeds, shrubs and trees are applied before transplanting. This method is suitable if the plant material is available close the field. Used/recommended species include: Leucaena leucocephala, Azadirachta indica (Neem), Gliricidia sp., Cassia sp., Accazia sp., Cajanus cajan, etc.. Woody parts should not be used, as they take too long to decompose. In upland rice systems, these crops can be planted as hedge rows.

As green manure crops only supply 30 to 50 % of nitrogen requirements, other sources of nitrogen and minerals should also be used, such as rock minerals, animal manures, compost and other approved organic amendments. The amount of nitrogen provided by green manure crops depends on the quantity, quality (C/N) and type of green manure crop; the time and method of application; soil fertility; and the cropping method used.



TRANSPARENCY 4.1 (16): NUTRIENT MANAGEMENT AND ORGANIC FERTILIZATION

Group work:

Ask the participants to:

- *List potential reasons for and sources of loss of soil organic matter in the rice production system in the region. Describe current residue management and nutrient management practices in the region.*
- *What are the specific crop rotation practices that the farmers are aware of or have experienced? What are the advantages and limitations?*
- *Propose a fertilizing concept for organic rice in the region, considering the available resources and the cropping systems used.*
- *What are the preferred plants for green manuring in the localities where the trainees came from? Why are they preferred?*

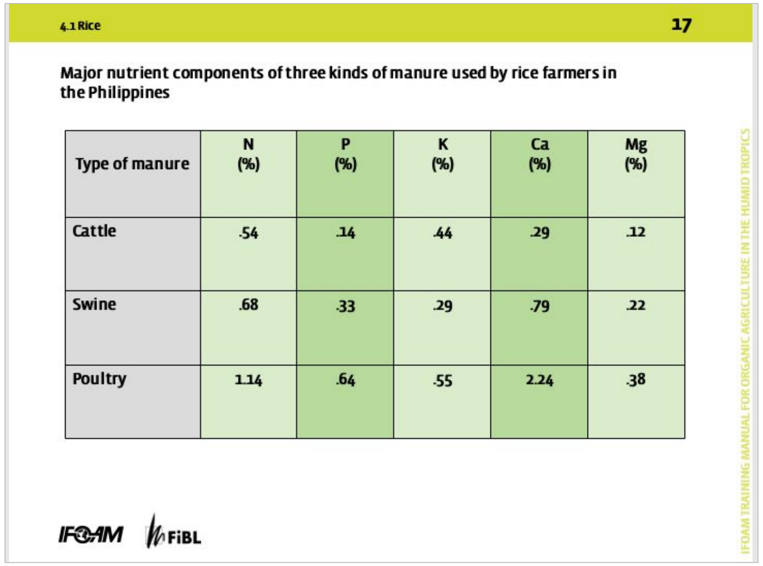
For more details, see the IFOAM Basic Manual Chapter 3 and 4

It is important to have a farming calendar for the years' cropping to plan when the green manure should be planted. This will lighten the farmers' activity and will allow them to manage their procedure systematically. Furthermore it is important that:

- Farmers take into account that some organic materials are bulky, resulting in high transport and handling costs.
- Fresh organic plant material and crop residues require time to decompose. The N requirement for building up the microbial populations needed for plant decomposition may result in an N deficit if they are applied to soon before the planting of rice crops.
- Broadcast compost, animal manure, farm wastes or green leaf manure preferably before the first harrowing, or at least before the final harrowing, and level to incorporate the compost into the soil.
- Conserve the water in the paddy: it conserves the nutrients as well. Irrigate when needed, but avoid excess water freely flowing in and out of the paddies.
- Where suitable and relevant, try Azolla, or Sesbania (Sesbania rostrata) or green manures or broadcast leaves of leguminous trees such as acacia (Samanea saman), ipil-ipil (Leucaena leucocephala), madre de cacao (Gliricidia sepium) mangium (Acacia mangium), flemingia (Flemingia congesta), etc..

Azolla is a freshwater fern that lives in ponds, swamps and streams in tropical and subtropical conditions. *Azolla* in association with blue-green algae can fix atmospheric N. It has been widely used in traditional rice growing systems in Southern China and Vietnam. Its growth is often limited by P availability, as *Azolla* floats in water and is not able to extract P from the soil. This problem can be addressed by introducing ducks which have a plowing and muddying effect, causing phosphate in the soil to dissolve in the water, making it available to Azolla.

Applying animal manure. Animal manure is the traditional fertilizer in many rice growing areas. Animal manures are relatively good sources of N fertilizer. Many farmers usually tend a couple of swines, cows or buffalos, as well as chickens, and the manure from these animals can be collected periodically and applied to the rice field. The availability of animal manure is controlled by the number of livestock on the farm or on neighboring farms. In some places, guano is collected as it is a good source of organic fertilizer. In some countries deposits of birds or bats can be found in caves and other rock formations. These deposits have a high N content and can be used as N fertilizer. However in organic agriculture, the use of guano is limited due to the risk of over-fertilization and requires permission from the certification body.



Type of manure	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Cattle	.54	.14	.44	.29	.12
Swine	.68	.33	.29	.79	.22
Poultry	1.14	.64	.55	2.24	.38

TRANSPARENCY 4.1 (17): MAJOR NUTRIENT COMPONENTS OF THREE KINDS OF MANURE USED BY RICE FARMERS IN THE PHILIPPINES

Discussion:

Discuss and evaluate with the participants which animal manure has best potential for use in organic rice production according the local conditions. Find out how they prepare it and what strategies can be implemented to improve its quality.

For more details, see the IFOAM Basic Manual, Chapter 4.3.

In Laos, some farmers apply animal manure at the rate of 10 tons per ha. If farmers do introduce animal manure from other farms, it is recommended that they compost it before applying it in order to reduce the risk of introducing weeds, pest and diseases.

Manure releases its nutrients slowly, so that even succeeding crops, up to the fourth, can benefit from its application. For example, the estimated nitrogen available from manure is as follows:

Cropping applied	50 - 80 %
Second cropping	5 %
Third cropping	2 %
Fourth cropping	1%

Compost applications. In general, non-edible biomass should always be returned to the field to minimize nutrient loss. Nutrient augmentation can also be done by collecting plant biomass off-farm, composting it and then applying it to the field. For example, the leaves of Gliricidia, Acacia, sunflower, etc., can be collected to augment soil nutrients. Kitchen wastes can also be composted and applied to the rice farms to replenish the nutrients taken away through harvest. In general, the amount of compost needed within rice systems varies between 5 to 10 ton per ha.

Phosphate fertilizers. While N can be added to the system through fixation by legumes and can be added through rain and irrigation water, P is more difficult to replace and, in many places, limits the yields of rice growing systems. Typical symptoms of P deficiency are stunted plants, reduced tillering and leaf discoloration.

Application of P is frequently necessary to get the optimum benefits from practices aimed at N addition such as growing of green manure crops, crop rotation with legumes or Azolla. In this way, Azolla should have enough P to have optimum growth.

Rock phosphate is generally a very slow acting fertilizer. Its solubility depends on the soil acidity, the type of rock and its fineness (quality of grinding).

Bone meal has a P content of about 12%. It is generally faster acting than rock phosphate, but may also be more expensive and available in limited quantities only.

4.1.6 Water management and irrigation

An abundant supply of good quality irrigation water is needed for optimum organic rice production. Poor quality water can cause soil-related problems, including salinity, zinc and phosphorus deficiencies, which have a negative impact on rice. Unlike in most other cropping systems where water is mainly used for productive purposes (evapotranspiration), the rice cropping system uses water in numerous ways, both productively and non-productively. In general, the water requirement for productive and beneficial use in rice systems is divided into three categories:

- crop water requirement for evapotranspiration (evaporation and transpiration);
- water lost through seepage and percolation; and
- land preparation and drainage of water prior to the tillering stage.

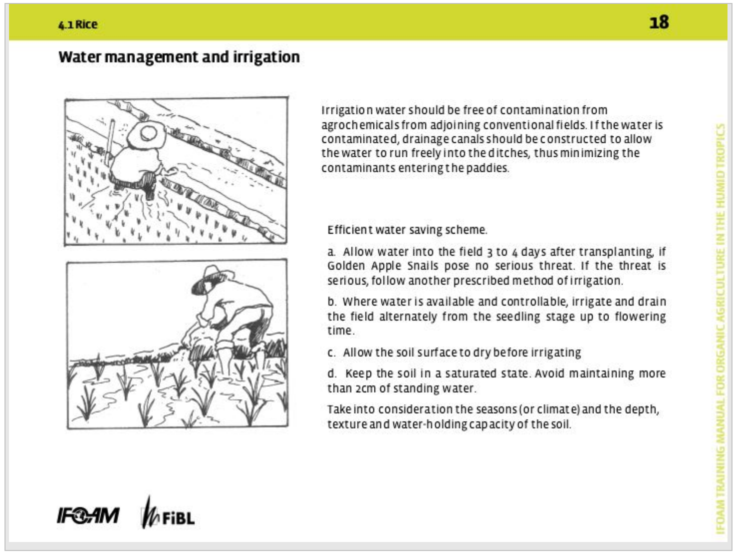
The total water requirement for a rice crop may be in the range of 600-2300mm, equivalent to a volume between 6 and 25 million l/ha. A rice crop yield of about 4000 kg will require about 20 million l/ha. Thus, it takes about 5000 l of water to produce 1 kg of rice.

Origin of irrigation water

Traditionally, irrigation systems depended on water from rivers, canalized through gravity. Increasingly, nowadays, water is pumped from rivers, lakes or reservoirs, and in countries like Bangladesh and India, from groundwater. In rainfed rice production system, water flows by gravity from one rice field to lower lying fields.

Water management practices

The prevailing water management practices depend on local conditions, especially water availability, soil properties, rice varieties and the production system. Ideally, the water level in the field should be maintained at about 2 cm. However, this is possible only if the producer is assured of access to water whenever needed. In many situations this is not the case, as irrigation water may be shared with other users, or availability may fluctuate with rainfall. In systems of rainfed lowland rice and upland rice, farmers often have limited or no control over water.



TRANSPARENCY 4.1 (18): WATER MANAGEMENT AND IRRIGATION

Sharing experiences:

- *What are the sources of irrigation water in your region?*
- *What is the degree of control of the water and access to the water by the individual producer?*
- *Is water adequate for optimal rice production?*
- *Summarize local water management practices.*
- *What strategies do rice farmers use to optimize water use?*
- *Is the water quality and the control over incoming water sufficient for irrigation of organic rice fields? If not, what can be done to improve water quality?*

For organic rice production, it is necessary to avoid inflow of water from adjacent fields that are being cultivated conventionally. In some situations, this can be problematic. For this reason, it may often be necessary for households having fields sharing a common water supply to jointly participate in organic production.

The irrigation water should be free from contaminants from conventional fields. If the water is contaminated by agrochemicals, drainage canals should be constructed to allow the water to run freely into the ditches, thus minimizing contaminants from entering the paddies. Conventional farmers should not be allowed to wash their sprayers in the irrigation canal.

Efficient water saving scheme

- If there is no threat from Golden Apple Snails, allow water into the field 3 to 4 days after transplanting. If the threat is serious, follow other prescribed methods of irrigation.
- Where water is available and controllable, irrigate and drain the field alternately from the seedling stage up to flowering time.
- Allow the soil surface to dry before irrigating.
- Keep the soil in a saturated state. Avoid maintaining standing water of more than 2 cm.
- Take into consideration the seasons (or climate) and the depth, texture and water-holding capacity of the soil.
- Trimming the borders of the rice plots should be done regularly to facilitate proper drainage.

4.1.7 Direct and indirect pest and disease management

Pests and diseases can affect rice yield and quality. In extreme cases, yield losses can be very high. Pest management is one of the biggest challenges in organic production. Fortunately, rice is generally not as vulnerable to pest and disease as some other crops.

In order to manage pest and disease, it is very important that the farmer and the extension advisor are familiar with the prevalent pests and diseases, especially their population dynamics or epidemical pattern. Management practices will vary according to the type of pests/diseases. Normally, all cultivation practices that enhance plant vigor contribute towards reducing the impact of pests/diseases.

There are many methods to control pests and diseases, both directly and indirectly. Cultural, physical, mechanical and preventive methods are used instead of resorting to chemical methods. The following are some of the popular and widely used methods in organic cropping systems:

Pest management practices in rice

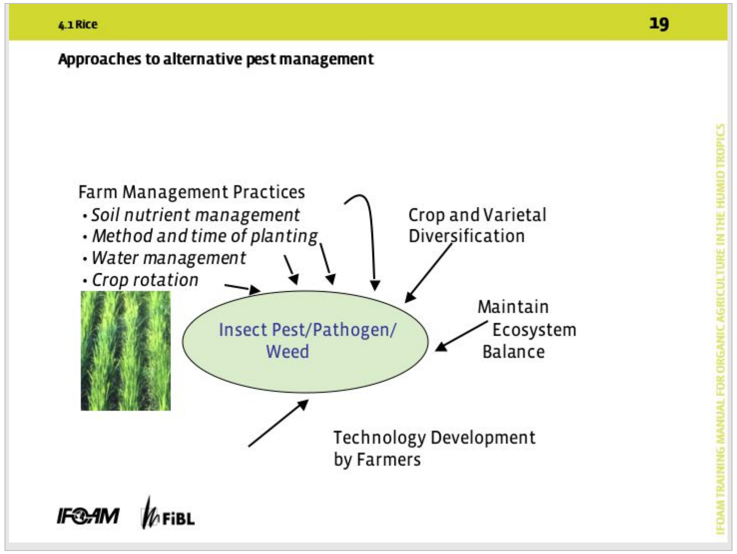
Land preparation: good land preparation, fallow periods after early maturing varieties, cutting, good spacing, plant alignment and plowing of stubble after harvest. This last method minimizes stem borer incidence as they are ploughed under the soil.

Crop rotation: another method is crop rotation with vegetables or leguminous crops. This method breaks the cycle of rice pests while legumes add nutrients to the soil. In the Philippines, the use of visual, physical and acoustic "scarers" like; scarecrows, bamboo drums, empty tin cans and physical barriers to keep out pests, like birds, is practiced.

Pest management strategies: farmers can also develop their own pest management strategies as in the case of MASIPAG (see chapter 3.2 in this manual). Their pest management strategy is called Alternative Pest Management (APM). It is alternative because management is focused on the root causes of the increase of pests and diseases rather than curing the symptoms. The main objective is to maintain the internal balance of the agroecosystem and denying the pest its favored environmental or nutritional conditions. The agroecosystem can also be redesigned to favor beneficial organisms that keep pest populations under check. In cases where organic farmers use only preventive measures and have not developed their own pest management strategies, and where the pest pressure is too high, they can use organically compatible practices from IPM (Integrated Pest Management systems).

Lessons to be learned:

- *The best pest control is pest management.*
- *Spraying biocides disrupts natural insect population balances.*
- *When infestation is serious, try fallowing the land by rotating rice with other crops.*



TRANSPARENCY 4.1 (19): APPROACHES TO ALTERNATIVE PEST MANAGEMENT

It is not true that the only good bug is a dead bug. Only about 5 - 6% of the more than 1 million kinds of insects are pests. About 94% are beneficial or harmless. Many insects play valuable roles as decomposers, pollinators, parasites or predators. Therefore, the most economic and effective means of pest control is to enhance the occurrence of these useful insects. In order to predict the development of insect pest populations, it is very important to monitor the population dynamics of the target pest and the dynamics of its major enemies.

Synchronized planting: major pests in rice fields can be managed or controlled by synchronized planting (early or late), whereby the majority of the farmers should plant within a given period to avoid continuous development of the pest. A recommended way of controlling rice bug is to synchronize planting so that all the fields flower at the same time, thus reducing the possibilities for the rice bug population to build up.

Sanitation: crop rotation, crop sanitation, shredding or cutting of rice straws into pieces kills the pupae of stem borers in the straw.

Collecting pests: this method is specially suited for pests occurring in the seedbed and for slow moving pests such as the Golden Apple Snail. Other examples include: the use of a net to skim stem borer larvae swimming on the water surface or the use of light traps to attract plant hoppers. Collecting pests can be very time consuming, and is generally not suited for pest control in large fields.

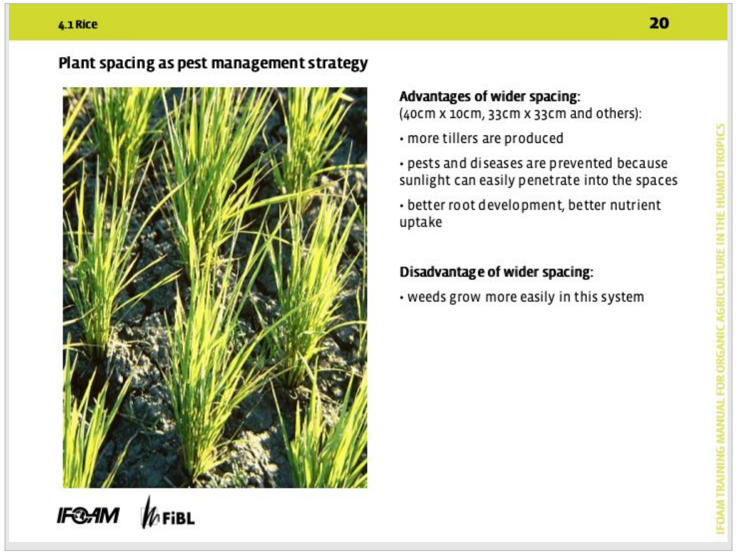
Water management: raising the water level to up to 10-15 cm and then draining it, can help drown and wash out black bug and leafhoppers.

Plant spacing: leaving larger spaces between rows allows sunshine to penetrate into the basal portion of the rice plant warming the area and reducing humidity. This creates an environment that is less favorable for the development of leafhoppers.

Many biological methods can be used to manage rats and snails. These include trapping, hand picking, release of predators, etc., but the success of these methods is largely determined by cooperation between farmers over a large area. For these pests, preventive and direct measures should be applied even when populations are low.

Discussion/Questions:

- *What are the most important rice pests in the region?*
- *What are the most important rice diseases in the region?*
- *What is the extent of damage due to diseases and pests?*
- *What are the local management strategies used in the region?*
- *Formulate preventive and direct management strategies to control pest and diseases.*
- *Do you know the threshold levels for the major pest used in your region (usually provided by IPM extension)?*



TRANSPARENCY 4.1 (20): PLANT SPACING AS PEST MANAGEMENT STRATEGY

Disease management practices in rice

Choice of variety: as much as possible, choose varieties that are known to be tolerant or resistant to a particular disease. This is by far the most economical and the most effective disease control. Mixing different varieties in the same field is another recommended strategy.

Timely planting: diseases often affect crops that are planted outside the optimum planting dates for a particular region.

Nutrient management: provide balanced nutrients (including micronutrients) and avoid an excess of available N. Excess N promotes luxuriant plant growth, which not only reduces tolerance to disease, but also negatively influences the microclimate in the crop (higher humidity and leaf moisture).

Increase plant silica (Si): high Si levels in the plant increase resistance to some diseases, such as rice blast.

Crop rotation: this is especially useful to reduce the incidence of soilborne diseases.

Remove host plants: some diseases survive on alternative host plants present in the fallow vegetation of the rice field or in the vegetation surrounding the rice fields. By removing these plants, the cycle of the disease may be broken.

Rice blast and sheath blight diseases can often be controlled by selection of the appropriate rice variety. Excessive nitrogen levels, rarely a problem in organic production, can encourage sheath blight, kernel smut and other diseases. Plant spacing is another important preventive measure to reduce the spread of diseases. Some virus diseases, such as tungro, can be transmitted by insects (leafhoppers). Therefore, for this disease, vector management is important, mainly by stimulating the natural enemies of these insects or the application of botanical pesticides.

Discussion:

Discuss with the participants whether and how the above strategies can be adapted to the local conditions, and if the rice farmers/producers would accept these methods. Evaluate the advantages and disadvantages.

See IFOAM Basic Manual, chapter 5, for pest and disease management.

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Examples of pests and diseases and their practical regulation

Major rice insects, pests and diseases	*Practical regulation measures*
Rice bug (*Leptocorisa oratorius*)	Plant early-maturing varieties
Whorl maggots (*Hydrella philippina*)	Drain irrigation water, avoid high nitrogen levels
Rice stemborers (*Scirpophaga incertulas*)	Use light trap, avoid high nitrogen levels
Caseworm (*Nymphula depunctalis*)	Drain irrigation water
Green leafhopper (*Nephotettix virescens*)	Avoid high nitrogen levels
Brown planthoppers (*Nilaparvata lugens*)	Avoid high nitrogen levels, wider spacing, drain water
Leaffolders (*Cnaphalocrocis medinalis*)	Avoid high nitrogen levels
Black bug (*Scotinophara coarctata*)	Plough under rice stubbles, drain water 5 days before and after full moon
Rice blast	Avoid high nitrogen levels

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TRANSPARENCY 4.1 (21): EXAMPLES OF PEST AND DISEASES AND THEIR PRACTICAL REGULATION

Approaches in alternative pest management (case study of MASIPAG)

1) Farm management practices

a) Soil nutrient management

Many pest and disease outbreaks were related to nutrient imbalances, especially high levels of nitrogen application. Insects that thrive under high Nitrogen levels include planthoppers, stemborers, leaffolders and gall flies. Diseases that thrive under high nitrogen levels include rice blast, bacterial leaf blight and sheath blight. A proper nutrient balance, avoiding an oversupply of nitrogen, will help control the levels of these insect pests and diseases.

b) Method and time of planting

Instead of the normal 20 x 20cm planting distance, rice can be planted 10 x 40cm with an East-West direction of rows. This modifies the canopy microclimate as sunlight will be penetrating into the rice canopy during most of the day.

This will make the microclimate unfavorable for rice planthoppers. Also, larger distances between the rows makes it easier to search for predators and parasitoids, and to weed between the rows.

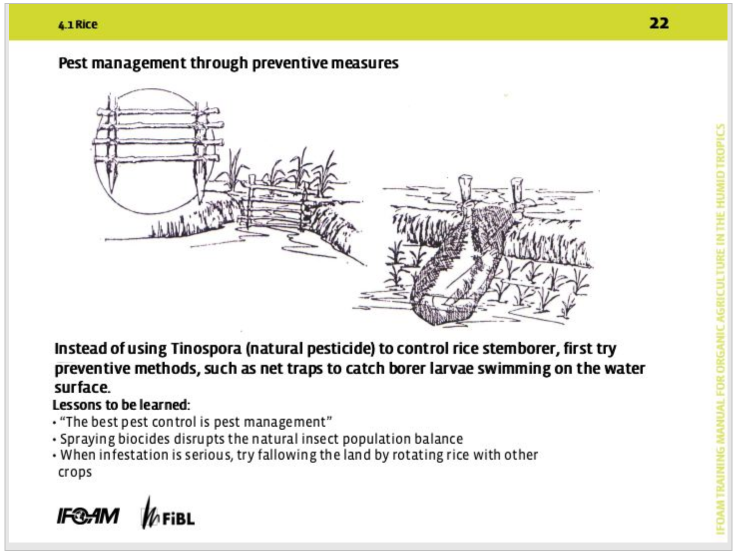
- Early planting can also be done if the dominant pest is rice bug as this bug is most abundant later in the season.
- Coordinated planting can remedy the problem of pests that usually move from one field to another.

c) Water management

Many insect pests prefer cool and humid conditions. Draining the water 25 days after transplanting (DAT), followed by alternate flooding and draining, makes the microhabitat unfavorable for such insects. This method is effective against brown planthoppers and whorl maggots.

d) Crop rotation

Crop rotation stops the buildup of pest populations and disease inoculums. It is also important for nutrient management.



Transparency 4.1 (22): Pest management through preventive measures

Motivation/Question:

Ask the participants if they agree with the ideas in the transparency.

2) Diversified varieties and crops

MASIPAG organic rice producers plant three to five rice varieties to avoid outbreak of any single pest. This creates a mosaic pattern of varieties that offer differential resistance against pests and diseases.

3) Maintaining ecosystem balance by not using pesticides

Studies have shown that some pest outbreaks had been attributed to pesticides:

- BPH outbreaks in rice were attributed to pesticides.
- FAO studies in Vietnam, Thailand, Indonesia and the Philippines showed more planthoppers when pesticides and high N were applied.
- Pesticides had been reported to induce pest problems such as:
  -pest resurgence;
  -secondary pest outbreak;
  -pest resistance and the killing of beneficial insects.

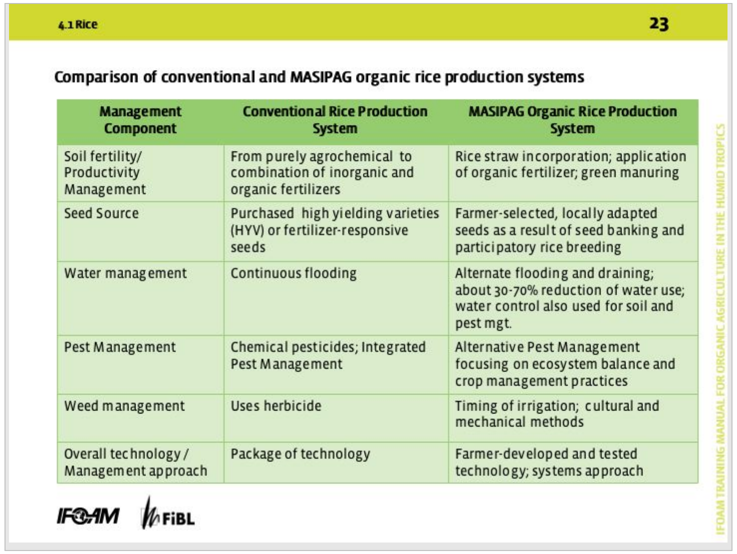
The question is: do we really need pesticides in rice production? Studies have shown that pests are not always present in damaging numbers, with:

- Only 50% of 330 farmers monitored over 9 years reaching ETL (Economical Threshold Level)
- Only 50% of 105 farmers monitored over 4 years reaching ETL
- Only 12% of 58 monitored farmers reaching ETL

Avoiding pesticides not only prevents disruption of the agroecosystem, but also minimizes health, environmental and economic problems.

4) Technology development by farmers

One unique nature of MASIPAG is that farmers are active participants in technology development, not passive recipients of technology. This accelerates the development of technologies that are inexpensive and site specific.


4.1 Rice 23

Comparison of conventional and MASIPAG organic rice production systems

Management Component	Conventional Rice Production System	MASIPAG Organic Rice Production System
Soil fertility/ Productivity Management	From purely agrochemical to combination of inorganic and organic fertilizers	Rice straw incorporation; application of organic fertilizer; green manuring
Seed Source	Purchased high yielding varieties (HYV) or fertilizer-responsive seeds	Farmer-selected, locally adapted seeds as a result of seed banking and participatory rice breeding
Water management	Continuous flooding	Alternate flooding and draining; about 30-70% reduction of water use; water control also used for soil and pest mgt.
Pest Management	Chemical pesticides; Integrated Pest Management	Alternative Pest Management focusing on ecosystem balance and crop management practices
Weed management	Uses herbicide	Timing of irrigation; cultural and mechanical methods
Overall technology / Management approach	Package of technology	Farmer-developed and tested technology; systems approach

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Transparency 4.1 (23): Comparison of conventional and MASIPAG organic rice production systems

Discussion:

Discuss with the participants if there are other maintenance methods used in the region that were not mentioned in this part of the course..

4.1.8 Other maintenance methods

Regular crop monitoring is necessary to react promptly to possible infestation by pests or infections by diseases. Most field observations by farmers, such as checking the water level, will provide information on these issues.

Given the variety in rice production systems and the condensed nature of this manual, other important maintenance methods that have not been discussed here may be employed in the region.

4.1.9 Harvesting and post-harvest handling

Harvest and post-harvest methods aim to maximize grain quality and minimize losses. The steps involved may include: harvesting, threshing, drying, milling, storing, parboiling and packing. Some of these post-harvest processes may be carried out by traders or entrepreneurs specialized in rice drying or milling.

Harvest

In order to prolong its shelf life, rice should be harvested only when it reaches full maturity. Farmers are generally aware of the maturity period of different rice varieties and avoid early harvesting, thus preserving the organic quality. The date is chosen by taking into consideration the stage of maturity, the shattering characteristics of the variety and the weather conditions. The most common harvest methods are cutting with a sickle or with simple rice harvesters.

Weed seeds should not be allowed to be mixed with the harvested rice grains. Weeds with fully matured seeds should be removed prior to harvesting. Machines or tools for harvesting organic rice must be kept away from contamination and from substances prohibited by organic standards, and should be cleaned before harvesting organic rice.

Harvest the crops from the buffer rows before harvesting the main organic crops. Separate the harvest from the buffer rows to avoid mixing with the main organic crop.

Threshing

For threshers that were used in threshing conventional materials; thresh two sacks of organic rice to clean out the inside of the thresher. The two sacks will be considered as conventional, and the succeeding sacks will be considered as organic. Conventional machines or tools shall be cleaned completely before threshing organic rice.

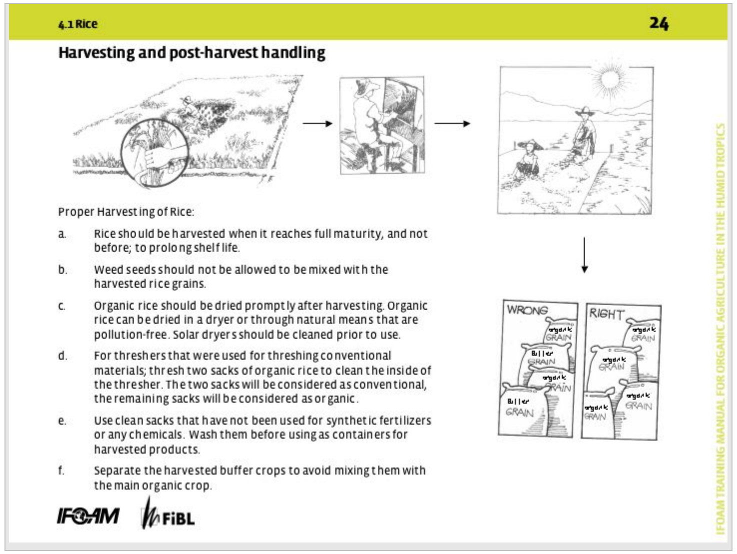
Threshing methods range from simply beating the rice sheaves on a stone to fully mechanized combine harvesting. Smallholder farmers in Asia often use simple pedal threshers or simple threshers powered by small engines. Harvested rice may be stored in piles in the field or near the house for longer periods before threshing, or threshed immediately after harvesting.

Use clean sacks that have not been used for synthetic fertilizers or any chemicals and wash and dry them before using them as a container for harvested products.

Group work:

Describe the post-harvest methods used in the region.

Form Groups. Each group should formulate different practical strategies for handling organic rice during the harvest and post-harvest periods, in order to avoid damage by storage pests, to avoid contamination and to comply with the requirements for organic rice. The results should be presented by each representative of the groups and discussed in plenary.



TRANSPARENCY 4.1 (24): HARVESTING AND POST-HARVEST HANDLING

Drying

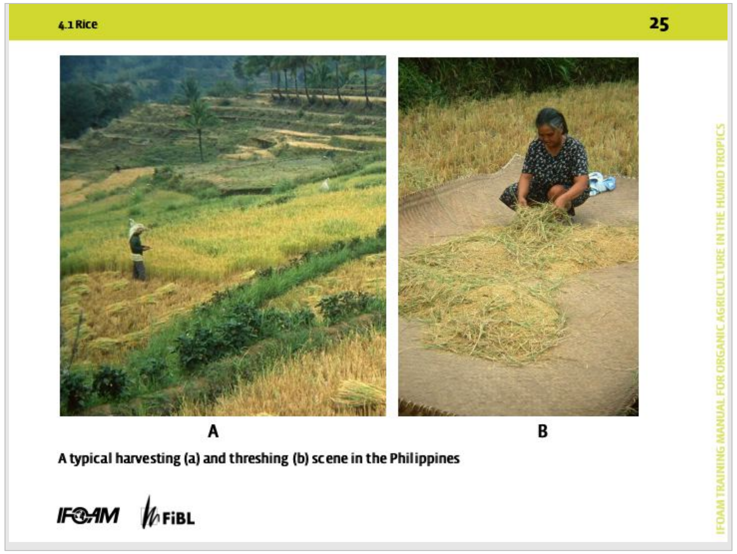
Rice is usually harvested at a moisture content of 24-26%. Grain should be dried immediately after harvest to reduce the moisture content below 18%. For storing or milling, the moisture content has to be below 14%. Delays in drying, or uneven drying, result in qualitative and quantitative losses by discoloration of grains, mold development, higher insect damage, etc..

A common method is to leave the harvested sheaves in the field for a few days before collecting. Another widely used method is sun drying. Sometimes these two methods are used in combination with each other. Organic rice must be dried promptly right after harvesting, using natural means or a solar dryer. It should be cleaned prior to scattering the grains. Leave at least two feet vacant around the perimeter of the solar dryer, to prevent contamination from stones or other grains.

Milling

The rice husk and the bran are removed by milling to obtain the edible seed. Most rice varieties roughly consist of 20% rice hull, 11% bran layers and 69% starchy endosperm, or milled rice. Rice mills can either be very simple or a multi stage process. In the simple method, mostly used at the household or village level, rice is milled in a one-step process. In larger enterprises the milling involves two main processes: 1) removing the hull and 2) removing the bran layer. The following terminology is used in rice milling:

- Rough rice: also called paddy rice, the grains with the hull after threshing.
- Brown rice: also called husked rice. Rice with the hull removed. The bran layer gives it a characteristic tan color and nut-like flavor. It has a chewier texture, must be cooked for longer than milled rice and dishes take on a brownish appearance. Once cleaned and graded, brown rice is sold on the market as "natural rice" or "brown rice".
- Milled rice: also called white rice, or polished rice. It is white in appearance and has a flat, shiny surface. The rice is cleaned in special mills and then graded. Cooking characteristics depend on the biological variety. White rice has a particularly subtle taste and does not respond well to overcooking or too much pressure.
- Milling recovery: total rice obtained out of the paddy, expressed as weight % of milled rice (including broken grains). The maximum milling recovery is 69-70%, depending on the rice variety. Because of grain imperfections and the presence of unfilled grains a recovery of 65% is considered as very good. Some village mills have recovery rates of only 55% or less.
- Head rice: milled rice with a length greater or equal to three quarters of the average length of the whole kernel.



TRANSPARENCY 4.1 (25): A TYPICAL HARVESTING (A) AND THRESHING (B) SCENE IN THE PHILIPPINES

The rice mill should be cleaned properly prior to milling organic rice. For example: five sacks of organic rice should be milled first to clean the mill and should be classified as conventional. The succeeding milled rice will be organic.

Parboiling

Parboiling refers to a process in which the paddy rice is subjected to steam and pressure. This forces the vitamins to migrate from the bran to the inner grain, preventing their loss during the milling process. Moreover, this treatment makes parboiled rice particularly easy to cook. Even after long cooking times and high pressure, this rice remains crunchy and dry and yields more rice than normal white rice, which is why professional cooks and private households prefer parboiled rice. It is slightly yellowish in appearance and has a dull surface.

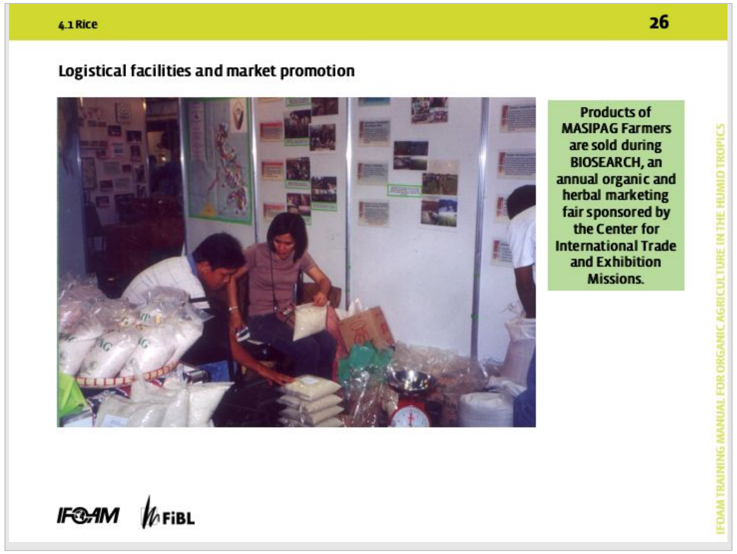
Special post-harvest consideration for organic rice

It is very important to avoid any contamination between conventional and organic rice. Organic rice must be kept apart from sources of contamination and substances prohibited by organic standards. Machines and tools used for commercial production need to be cleaned completely before handling organic rice. Ideally, all post-harvest equipment used for handling organic rice should not be used for conventionally grown rice. It is also very important to use clean sacks that have not been used for synthetic fertilizers or any chemicals, and to wash them before using as container for harvested products.

Harvest the buffer rice crops before harvesting the main organic crops. Separate the harvested buffer crops to avoid mixing with the main organic crop.

Logistical facilities, market, investments and know-how requirements

Organic rice that comes to market should be of the best quality. However, this requires good facilities like mechanical dryers and storage facilities. In Asian countries, like the Philippines, a combination of mechanical and sun drying are employed. Mechanical dryers are more important during the rainy season; while during the dry season, a combination of both the mechanical and solar dryers works well. Good milling machines are also necessary to minimize damage.



TRANSPARENCY 4.1 (26): LOGISTICAL FACILITIES AND MARKET PROMOTION

Discussion:

Use the transparency to explain the importance of farmers having access to markets, market know-how, and why they should be able to implement appropriate marketing strategies to promote their products. Use the example of the MASIPAG farmers and discuss this topic with the participants.

4.1.10 Economic and marketing aspects

The average annual rice consumption in some Asian countries is close to 200 kg per person, but in European or North American countries, it is less than 10 kg. Most of the rice produced in Asia is consumed in the producing country.

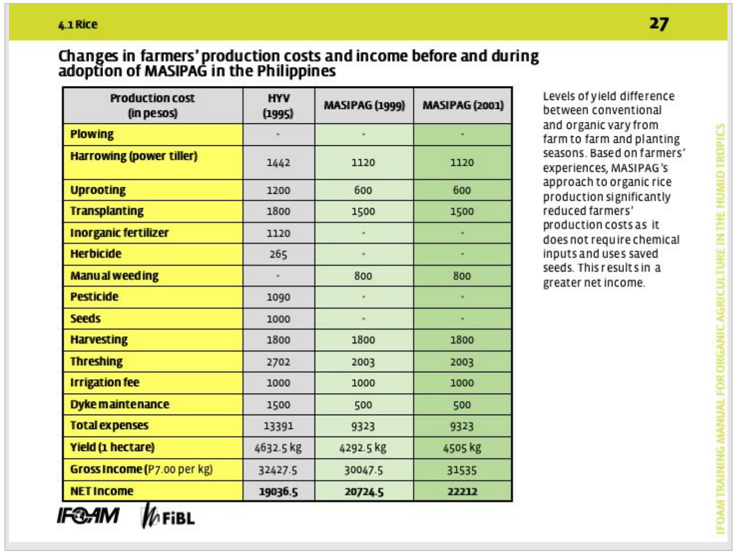
Only about 7% of the total rice production is traded in the global market. Within this, the proportion of organic rice traded is still very low (2-4%). Predictions forecast an increase in volume of the international rice market and a stronger increase in market demand for organic rice and for organic rice with the fair trade label.

Use the transparency to explain the changes in farmer costs and incomes before and during adoption of MASIPAG Programs in the Philippines.

National markets

Organic rice is mainly sold directly to consumers or in niche and specialty markets. In some countries such as Japan, consumers' organizations are very active in promoting and selling organic rice. These consumers' organizations buy organic rice from farmers at an agreed price (based on organic quality rating), and then sell it to consumers with a price premium. Recently, organic rice has also found its place in some of the major supermarkets.

For example, in the Philippines, organic rice is usually sold in bags of 1, 5, 10 and 25 kg. The usual volume required by mainstream buyers is between 200 and 1000 bags of 50 kg each on a monthly basis. However, since most producers are small scale (with an average farm size of less than 1 ha) and lack organization, they are not able to meet these demands and have to resort to direct selling.



Production cost (in pesos)	HYV (1995)	MASIPAG (1999)	MASIPAG (2001)
Plowing	-	-	-
Harrowing (power tiller)	1442	1120	1120
Uprooting	1200	600	600
Transplanting	1800	1500	1500
Inorganic fertilizer	1120	-	-
Herbicide	265	-	-
Manual weeding	-	800	800
Pesticide	1090	-	-
Seeds	1000	-	-
Harvesting	1800	1800	1800
Threshing	2702	2003	2003
Irrigation fee	1000	1000	1000
Dyke maintenance	1500	500	500
Total expenses	13391	9323	9323
Yield (1 hectare)	4632.5 kg	4292.5 kg	4505 kg
Gross Income (P7.00 per kg)	32427.5	30047.5	31535
NET Income	**19036.5**	**20724.5**	**22212**

Transparency 4.1 (27): Changes in farmers' production costs and income before and during adoption of MASIPAG in the Philippines

Group work:

Ask the participants what local marketing scheme they are implementing. Also ask what the market challenges are and how they have addressed them.

For further information about MASIPAG, see chapter 3.2 in this manual.

International markets

The classification of rice in the international market is based on the grain type (show transparency and explain this). Organic rice is available in all 3 types, but the most popular are the aromatic long grain type rice varieties.

Organic rice receives a premium price which is 10-50% higher compared to conventionally grown rice of the same quality. For specialty rice varieties, the prices can be higher, but the quantity sold will be small.

Problems specific to organic rice export

- The minimum quantity for export will be 40 t (one container).
- Importers expect high milling quality, which can only be achieved through commercial milling.
- The need for processing facilities and the cost of certification limit the opportunities for individual smallholder farmers to benefit from the organic export market.

4.1 Rice 28

Classification of rice varieties based on grain type

Long grain (*indica*) Examples are Basmati (India, Pakistan) Jasmin (Thailand)	• Long grain rice is 6–8 mm long and 4-5 times longer than it is thick. • The kernel is hard and glassy and dry when cooked. • Most long grain varieties have a long maturation period under hot temperatures. • The best types of long grain rice come from the southern United States, South America, India and Thailand. • In Europe, consumption of long grain rice is rising steadily. On the market, this rice is often referred to as "Patna rice".
Round grain (*japonica*) Examples are Arborio. Vialone, Arvorio, Carnaroli (Risotto rices from Italy) Calrose (California)	• Round grain rice is 3-5 mm long and only 1.5–2 times longer than it is thick. • The kernel is soft and chalky. Round grain loses up to 15% of its starch in the water during the cooking process and is quite soft when fully cooked. • Round grain thrives predominantly in subtropical climates. On the market, it is often sold for rice puddings
Medium grain Examples are Avorio, Camolino	• Medium grain rice is 5–6 mm long, but considerably thicker than long grain rice. • Biologically speaking, it is a mix between the long grain and the round grain. • The kernel is soft and chalky and has cooking characteristics similar to the round grain. • Medium grain rice isn't marketed or sold under any particular name.

IFOAM TRAINING MANUAL FOR ORGANIC AGRICULTURE IN THE HUMID TROPICS

TRANSPARENCY 4.1 (28): CLASSIFICATION OF RICE VARIETIES BASED ON GRAIN TYPE

Group work:

The participants should discuss and elaborate a checklist indicating the procedure and requirements to export organic rice to a specific international market. The results should be presented and discussed.

Recommended websites:

www.riceweb.org

IRRI fact sheets. http://www.irri.org/

www.masipag.org

4.2 Perennial Peanut

Introduction

Arachis pintoi, popularly known as perennial peanut is a legume that originates in Brazil. It has since been distributed to Argentina, Australia, Colombia, the United States, and more recently to South East Asia, Central America and the Pacific. It is a persistent, small, crawling vine that is highly adapted to moist, well-drained and moderately fertile soils. The perennial peanut has a strong taproot, with equally strong rhizomatous along the more prostrate stems. These enable the perennial peanut to spread underground even under heavy grazing conditions, sending up shoots some distance from the base plant in friable soils, and forming dense mats up to 20 cm deep. Although best suited to a moist environment, perennial peanuts can also survive dry seasons. Because of their high adaptability and tolerance to drought, they can effectively compete with aggressive creeping grasses to form highly productive pastures for both beef and dairy cattle. They are also shade tolerant, and can grow with tall grasses and be used as cover crops in tall crops.

Uses of perennial peanut

Perennial peanut is used as a cut-and-carry forage, as pure stands of grazing pasture or combined with erect or stoloniferous grass crops.

It is also used as ornamental ground cover, living mulch and a cover crop in perennial plantations, such as coffee, orchards of citrus fruits, banana, macadamia and African palm (for example in Hawaii). In the Philippines, it is mainly used as a green manure or cover crop. It can also be used for soil erosion control in sloped areas and as a weed regulator.

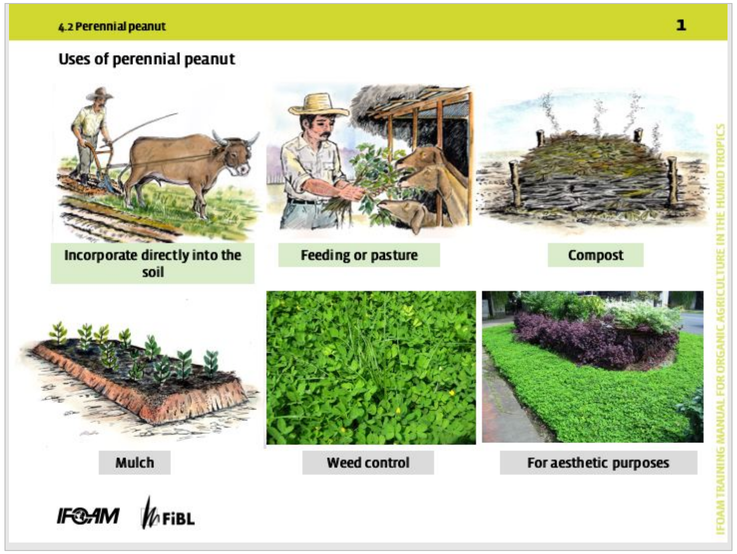
The perennial peanut's ability to spread underground and shoot away from the base plant enables it to effectively cover a large area of ground and form dense mats of stolons up to 20 cm deep. These dense mats are held down by roots and fruiting pegs, which enable the plant to protect the soil from high intensity rainfall. Given its preferred growing conditions of moist, well-drained and slightly fertile soil, perennial peanut can effectively outcompete weeds, which find it difficult to push through the heavy canopy of dense mats.

Lessons to be learned:

- *Some green manure crops can also be used for other purposes, such as animal fodder, weed control, for soil and moisture conservation, as well as aesthetic purposes.*
- *Perennial peanut can be included in different cropping systems to improve the soil protection, organic content etc..*

Motivation:

Collect information about perennial peanut and its uses among the trainees. Ask them for more details about the uses of perennial peanut in the region. For example, how they use perennial peanut for animal feeding or in compost (preparation), etc..



TRANSPARENCY 4.2 (1): USES OF PERENNIAL PEANUT

As a green manure, perennial peanut has several advantages over other green manure crops. These are:

- Versatility - it can be used as a cover crop, green manure, forage and pasture crop.
- High palatability - it has soft vines that can be easily chewed and swallowed by most animals (e.g. cattle, sheep and horses) and does not cause bloating like other legumes. The protein content ranges between 15 to 20% and dry matter digestibility between 65 and 70%.
- Workability - since perennial peanut has soft vines, the plants can be easily cut and plowed under the soil during land preparation.
- Easy propagation - it has runners that reproduce freely upon incorporation in the soil.
- Tolerance to shade (it is suitable to use in agroforestry systems) and to drought.
- Nitrogen-fixing ability - compared to other legumes, perennial peanuts have a relatively higher nitrogen-fixing ability. It is able to fix nitrogen between 30-40 kg/ha.

TRANSPARENCY 4.2 (2): ADVANTAGES OF PERENNIAL PEANUT OVER OTHER GREEN MANURE CROPS

Discussion:

Discuss with the participants the advantages that perennial peanut has over other locally used green manure crops. Elaborate a comparison table for cover crops similar to that in the IFOAM Basic Manual (chapter 3.4.2). For further information about green manures read the chapter 4.5 of the IFOAM Basic Manual.

4.2.1 Agroecological requirements and site selection

Climate

Arachis pintoi peanut is essentially a (sub) tropical lowland species, but it also grows well in more temperate areas. It is best grown in the warm rainy season and can survive in forests with a fairly dense canopy (70-80% shade).

Soil

Although *Arachis pintoi* is a legume and thrives in most soil types, with varying levels of fertility, it is best grown in well-drained sandy to clay soils, with pH 5.5 - 7.5 and > 3% organic matter content. While it does not survive for long in waterlogged conditions and has low tolerance to salinity, it can withstand high levels of aluminum and manganese. It can tolerate soils with 70% or more aluminum toxicity.

Rainfall requirements

Arachis pintoi grows best in humid tropical areas with an annual rainfall of 1100 mm or more and where there are not intermediate dry periods. It can withstand four months or more of drought, but will suffer yellowing of leaves and moderate defoliation. The perennial peanut will start to die under heavy rains and in waterlogged soil conditions.

TRANSPARENCY 4.2 (3): AGROECOLOGICAL REQUIREMENTS

Sharing experiences:

Ask the participants what they know about perennial peanut requirements, how they select the growing sites, and which aspects the farmers should pay attention to if they wish to introduce perennial peanut in their farms.

4.2.2 Diversification strategies

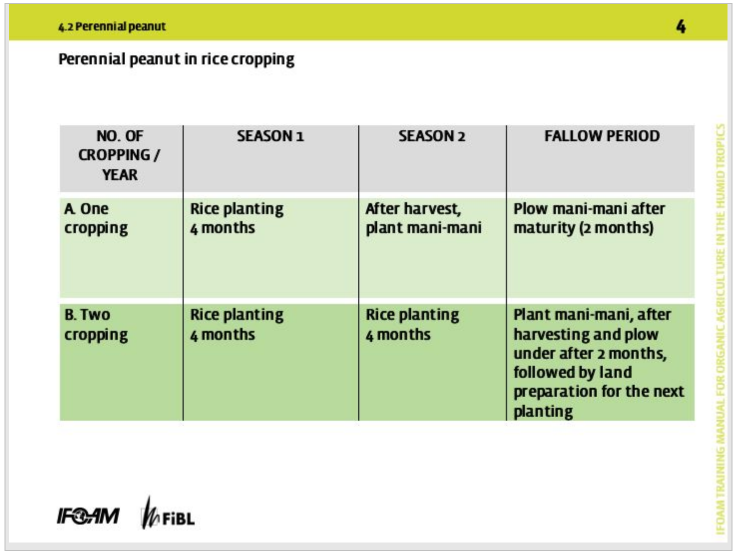
Possible diversification

In some countries, perennial peanut is used as cover crop in plantations of coffee, banana, oil palm, coconut, cacao and citrus. It is also used in establishing grass/legume pasture areas and serves as a forage for cows, buffaloes, horses, goats and sheep. In the Philippines, it is primarily used as a cover crop or green manure. Tissue analysis of perennial peanut reveals that it stores up to 40 kg of nitrogen per hectare. This can be used as protein or returned to the soil as green manure. It is well-suited for sloped agricultural land as it helps to control soil erosion and weeds and increases soil fertility. One management technique for ensuring a constant supply of green manure is to mow the vines every four months. Unproductive areas of the farmland can be brought back into productive use through the use of perennial peanut.

Perennial peanut in rice systems

Perennial peanut can be best applied in rice farming using a one or two cropping period system. It will die when the rice paddies are flooded, so there is no danger of persistence. The runners and roots will decompose when the plowed-under perennial peanut is submerged in the flooded rice paddy. Soil fertility from this one season crop can be further improved by incorporating cut green manure, such as *Sesbania*, *Crotalaria*, Ipil-ipil (*Leucena*), *Mangium* or *Acacia*. It is important that soil analysis be done prior to planting the perennial peanut and before the start of the next rice crop to determine the increase in organic matter and in the elements N, P and K.

- One season rice crop (rainfed areas) – perennial peanut is planted after harvesting the main crop to take advantage of the residual moisture. Let the peanut grow to full maturity then, at the start of the rainy season, saturate the field to kill the legume before plowing it under the soil.
- Two crop season of rice – perennial peanut is planted after harvesting the second rice crop, to serve both as a cover crop and green manure. After three months, it can be plowed under to serve as green manure for the next crop. Farmers can also irrigate and saturate the field before plowing it under the soil.
- Lowland rice – perennial peanut is grown on paddies to control weeds. To avoid the spread of the legume, it is cut and shredded then scattered back on the field to serve as green manure.


4.2 Perennial peanut 4

Perennial peanut in rice cropping

NO. OF CROPPING / YEAR	SEASON 1	SEASON 2	FALLOW PERIOD
A. One cropping	Rice planting 4 months	After harvest, plant mani-mani	Plow mani-mani after maturity (2 months)
B. Two cropping	Rice planting 4 months	Rice planting 4 months	Plant mani-mani, after harvesting and plow under after 2 months, followed by land preparation for the next planting

TRANSPARENCY 4.2 (4): PERENNIAL PEANUT IN RICE CROPPING

Discussion:

Collect information about perennial peanut and its cultivation among the trainees. Organize working groups and ask them to discuss the following topics:

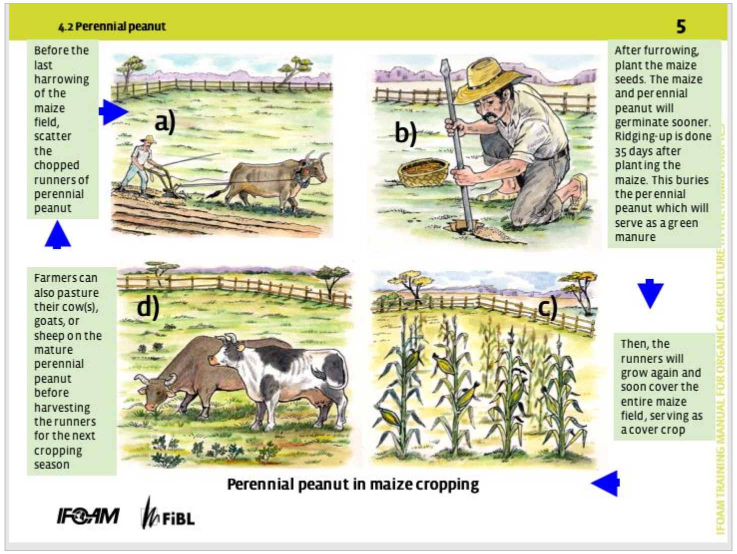
- *Advantages of local practices. Are these practices suitable for organic production?*
- *To which other local cropping systems is it possible to add perennial peanut and what functions can it play?*
- *They should describe the cropping cycle in the different local cropping systems when perennial peanut is included.*

A one season rice crop gives ample time for other nutrient fixing plants to be grown, for example the velvet bean. If there is enough moisture in the field, the velvet bean could be grown after the perennial peanut is harrowed under the soil. It is important to harrow the perennial peanut first, or else it will compete for space and nutrients. If the perennial peanut looks like it will cause a delay in the next rice cropping, the green manure should be plowed under even if it is only a half-month-old. The important thing is to incorporate the green manure prior to planting or during land preparation.

Perennial peanut in maize cropping

Perennial peanut can be planted right after ridging up of maize plants. Since it is tolerant of shade, this will not inhibit the growth of the legume. To enhance the growth of the perennial peanut, use pregerminated seedlings. Maize distance should be 50 cm between hills and 75 cm between furrows. This ensures that the roots of the maize plants are not damaged by planting perennial peanut. The perennial peanut will not only serve as a green manure crop, but it will also control weeds and help conserve soil moisture. Other, alternative methods include:

- If perennial peanut is intercropped with maize this must be done before the last harrowing of the previous season's maize field. Scatter the chopped runners of perennial peanut before the field is harrowed. At furrowing time, these runners will be covered by soil between the maize rows.
- After furrowing, maize seeds are planted. Ridging up is done 35 days after planting the maize. This will bury the perennial peanut, which will then serve as a green manure.
- Since perennial peanut runners are profuse, the runners will grow again and soon cover the maize field serving as a cover crop. This will prevent loss of moisture, suppress germinating weeds and ultimately escape drought.
- After harvesting, the maize stalks left on the field will cover the perennial peanut. The peanut can then be treated again as a green manure. Farmers can also pasture their cows, goats or sheep on the mature perennial peanut before harvesting the runners for the next cropping season.



TRANSPARENCY 4.2 (5): PERENNIAL PEANUT IN MAIZE CROPPING

Discussion:

Ask the participants to describe the benefits of diversification in organic maize production and to say which diversification criteria are relevant to local conditions (refer to the IFOAM Basic Manual, chapter 4.2). Support the discussion with the above slide..

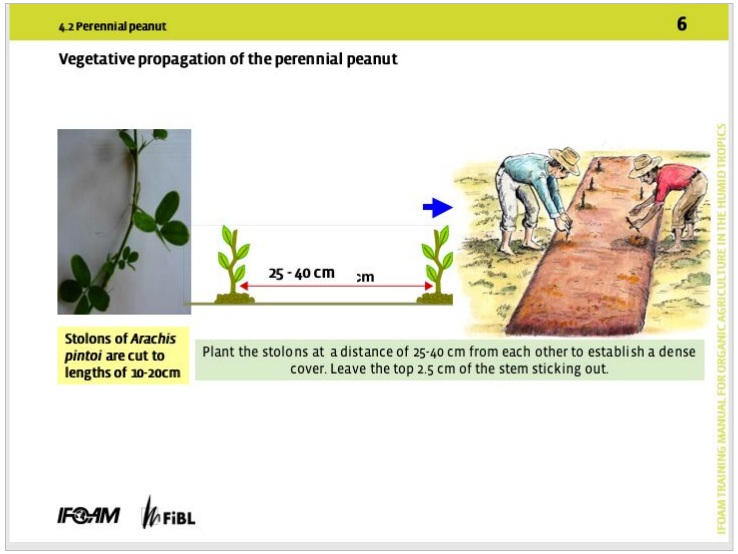
4.2.3 Crop management

Perennial peanut can be established by planting well-developed stolons or by seeds.

Vegetative Propagation

Stolons are cut stem sections of the plants that serve as planting material. They are cut near the base of the plant to ensure a higher survival rate. Perennial peanut stolons that have lots of root hairs have a higher chance of survival and development. Cuttings of 10-20 cm long are planted in the soil, leaving the top 2.5 cm of the stem sticking out. Establishment of dense cover of perennial peanut is achieved at 25-40 cm plant spacing. Do not allow perennial peanut stolons to dry before, during or after planting. To avoid this, ensure a regular supply of water to the field.

Another method of propagation is to pregerminate runners on plastic bags before transplanting them into the field. This is usually done if perennial peanut will be used for landscaping.



TRANSPARENCY 4.2 (6): VEGETATIVE PROPAGATION OF THE PERENNIAL PEANUT

Sharing experiences:

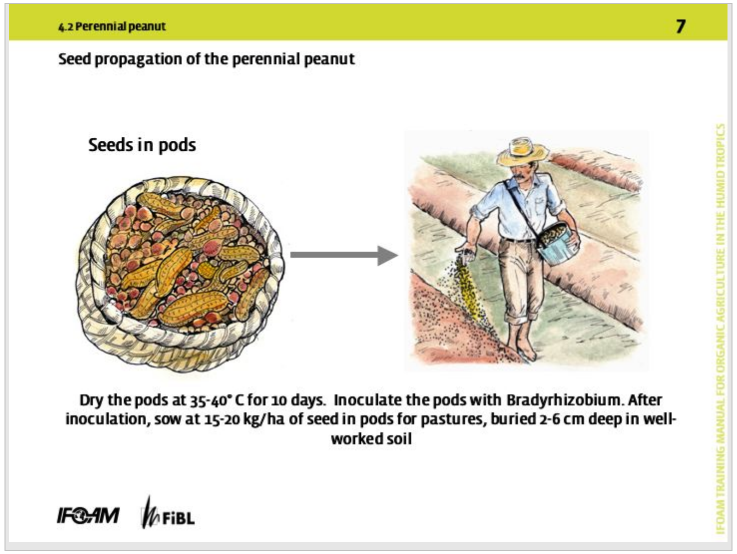
Ask the participants to describe and explain their experiences in the vegetative propagation of perennial peanut. When do they select this method? Which aspects should farmers consider when seeking to implement this technique in their fields?

Seed propagation

This legume produces very few seeds, which have a high level of dormancy. To counter this, seed pods should be dried (the seeds are inside of the pods of the legume). Drying the pods at 35-40 °C for ten days can reduce seed dormancy. After drying, the seeds should be stored under cool and dry conditions.

For pastures, the seed pods should be sown at a density of 15-20 kg/ha and buried 2-6 cm deep. They should never be left on the surface. Immediately before sowing, the pods should be inoculated with the highly specific strain of *Bradyrhizobium* to hasten nitrogen-fixing capacity. Otherwise, one has to wait for the seeds to develop their own N-fixing capacity and it will take much longer for the fixed nitrogen to become available in the soil. After inoculation, seed pods can be directly sown in well worked out soil bed.

Under good growing conditions, seedlings will develop quickly and complete ground cover can be achieved in six months. Properly dried and stored perennial peanut seed pods are still viable after one cropping season. Complete ground cover can be attained in 4 - 5 months (in the Philippines). Once established, weeds will be suppressed and will no longer grow. Flowering begins 1 to ½ month after planting. Animals can then start feeding on the flowers and leaves.



TRANSPARENCY 4.2 (7): SEED PROPAGATION OF THE PERENNIAL PEANUT

Sharing experiences:

Ask the participants to describe and explain their experiences in seed propagation of perennial peanut. When do they choose this method, and what aspects should farmers consider if they intend to implement this technique in their fields?

4.2.4 Supplying nutrients and organic fertilization

Fertilization

Perennial peanut does not require any nitrogen inputs due to its association with nitrogen-fixing *Rhizobium* bacteria. The association of perennial peanut with mycorrhizal organisms in the soil environment also improves phosphorus availability, even in phosphorus-impoverished soils. However, the persistence of this legume is directly proportional with the organic matter content in the soil. When the organic content is low, its ability to persist or survive in the soil is also low and vice versa. Application of organic fertilizer, for example animal manure, can increase the organic matter content, thus increasing the ability of perennial peanut to establish itself and survive. Therefore, if possible, apply animal manure to improve the establishment and growth of new young perennial peanut plants.

Sharing experiences:

The participants should say if they use organic fertilization when establishing and growing perennial peanut. If so, they should describe its advantages, the amounts, techniques and timing. If they do not use any organic fertilizer, they should state their reasons. Discuss the factors that contribute to the establishment, growth and nutrient supply of perennial peanuts.

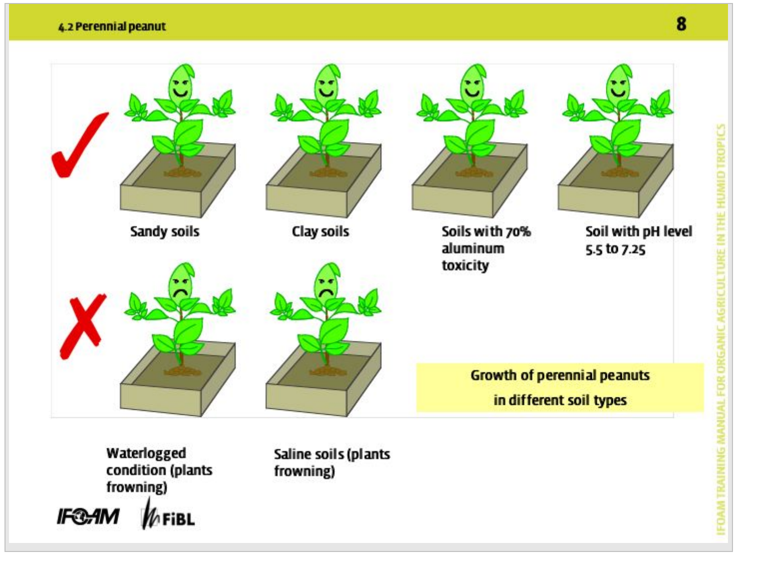
4.2.5 Pest, disease and weed management

Pests

Aside from the common diseases, field rodents also pose a problem, as they are often attracted to the nuts. Damage prior to planting can be controlled by proper storage of seed (e.g. in sealed bags) while regular field visits may be necessary to control damage in the field.

Diseases

Diseases do not pose any long-term or serious threat to the perennial peanut. However, it is best to plant resistant varieties like Amarillo. Amarillo is resistant to the major groundnut diseases, rust (*Puccinia arachidis*) and leaf-spot (*Mycosphaerella* sp.). Amarillo also has a moderate to high resistance to the various root-knot nematodes (*Meloidogyne* sp.), although it is susceptible to the root-lesion nematode (*Pratylenchus brachyurus*). When such diseases occur, plow the perennial peanut under to avoid further spread of the diseases. Root-knot nematode cannot be easily controlled. If the crop (perennial peanut) does suffer from this kind of disease, do not plant any legume for two consecutive years. Planting another legume will only make the problem worst because it will serve as alternative host. Instead, plant other crops such as vegetables and grain crops.



TRANSPARENCY 4.2 (8): GROWTH OF PERENNIAL PEANUT IN DIFFERENT SOIL TYPES

Weeds

Weeds can be a problem in growing perennial peanut, especially during its seedling to early vegetative stages. Weeding is required after planting as the newly planted perennial peanut is not as competitive as when it is already matured. Thorough plowing of the field before sowing could lessen the incidence of weeds (weed cure). During and after germination, mechanical and physical methods such as hand weeding can also be used. During the vegetative stage, weeding is not necessary as the legumes will have developed sufficient competitiveness against the weeds.

4.2.6 Water management and irrigation

Cuando sea necesario aplique riego al maní forrajero recién establecido. Para ahorrar agua y mejorar el establecimiento y crecimiento del maní, siémbrelo al inicio de la estación lluviosa.

4.2.7 Other maintenance methods

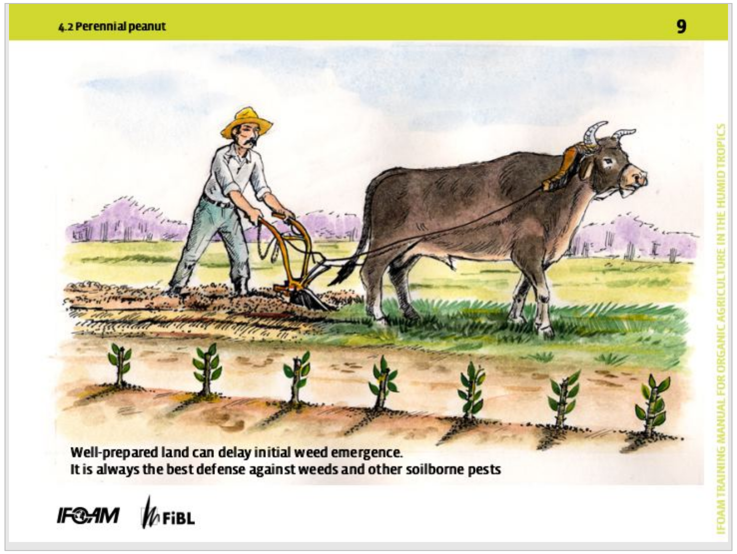
Durante el primer año mantenga la planta de maní podada a una altura de 5 a 7,5 cm. para así reducir las malezas y estimular el crecimiento lateral. Las podas subsiguientes se deben realizar a una altura de 15 a 20 cm., si el maní se va a utilizar como cultivo de cobertura.

4.2.8 Harvesting and post-harvest handling

El maní forrajero por lo general no se cosecha, aunque se puede utilizar para hacer heno o como "forraje de corta".

Questions:

Which diseases and pests do you know about in perennial peanut? Can you suggest any possible preventive measures? The IFOAM Basic Manual (chapter 5.1) transparency 5.1.2b may be shown to illustrate preventive measures. What methods are used to regulate weeds under local conditions?



Transparency 4.2 (9): Pest, disease and weed management

Sharing experiences:

Ask the participants to list the main pests that attack perennial peanuts in their region. Participants should propose preventive measures and direct control methods compatible with organic production.

Recommended websites:

http://www.capetrib.com.au/thefarm.html

http://rcrec-ona.ifas.ufl.edu/or2-02.html

http://www.tropicalgrasslands.asn

4 Management Guide for Crops

4.3 Cassava

Introduction

Cassava (*Manihot esculenta*) is a native of Brazil and during the 16th and 17th centuries, the Portuguese dispersed it across tropical and subtropical areas of Africa, Asia and the Caribbean.

Cassava is a perennial shrub, which produces enlarged tuberous roots. It is also called yuca, manioc and mandioca, and has the capacity to grow on marginal lands where other crops do not grow well; it can tolerate drought and can grow in nutrient-poor soils. These capacities make cassava a good component of organic production systems operating under low input conditions. When cassava is grown in fertile soils with enough irrigation, high yields can be attained.

Cassava is produced mostly by smallholders in the humid tropics and subtropics. It is the basis of many different products for human consumption, animal feed and industrial products. In Africa and Latin America, cassava is mostly used for human consumption, while in Asia and parts of Latin America it is also used commercially for the production of animal fodder and starch-based products.

Cassava is an essential part of the diet of more than half a billion people. Cassava tubers are rich in calories and the leaves are a good source of protein and vitamins A and B.

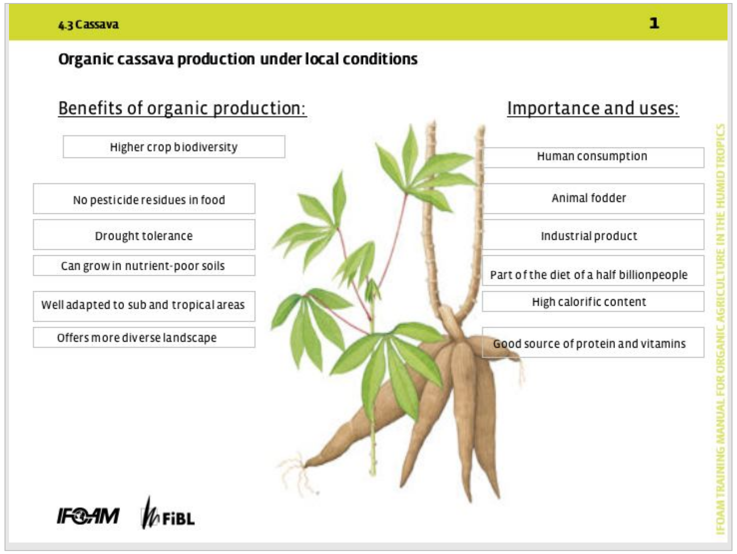
Cassava is produced on many organic farms as a subsistence crop and/or for the local market. However, only a little organic cassava is sold on international markets. This may be due to low demand for cassava for direct human consumption in importing countries (Europe and North America). However there is much potential within agroindustry for its use as a fodder component in mixtures.

Lessons to be learned:

- *Cassava is ideal for growing on poor soils where other crops cannot grow properly.*
- *The basis for a good organic cassava production is to choose healthy stems and the right period for planting.*
- *Cassava is an important crop that has long been used as a famine and food security crop in poor rural areas.*

Discussion:

- *Uses of cassava in the local area.*
- *Possible benefits of organic cassava production.*



TRANSPARENCY 4.3 (1): ORGANIC CASSAVA PRODUCTION UNDER LOCAL CONDITIONS

4.3.1 Agroecological requirements

Climate

Cassava is adapted to the hot lowland tropics; the optimum temperature range is 25-30 °C, although it resists temperatures in excess of 30 °C. The minimum temperature for growth is 18 °C. Growth stops below 10 °C and it is sensitive to frosts. Short days promote root enlargement. The crop is not adversely affected by strong winds but a windbreak will always be beneficial in organic cropping. It grows well under direct sun.

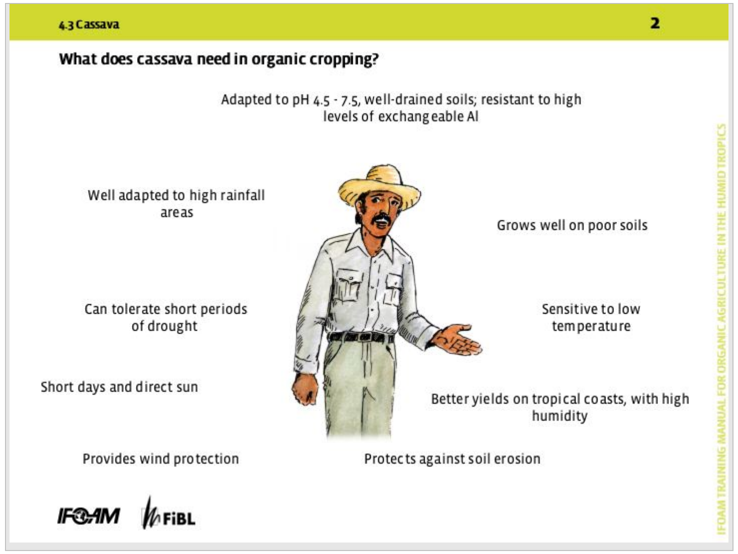
Rainfall

A well-distributed annual rainfall of 1000-1500 mm is ideal, but the crop can be grown successfully in areas with rainfall ranging from 500-2500 mm, although it does need a good supply of water shortly after planting. Cassava can withstand both short and prolonged periods of drought, although in longer periods yields will be reduced.
Cassava grows better in tropical coastal areas as it prefers high relative humidity.

Soil characteristics

Cassava prefers well-drained loam or sandy soil. High soil organic matter content enhances cassava growth. It is well adapted to pH 4.5 to 7.5; with high levels of exchangeable aluminum. The plant is also well adapted to low levels of available P, but requires fairly high levels of K.

Cassava grows rather well on poor soils, although it will not give high yields under these conditions. Light sandy loams with medium fertility give good yields. When grown on clay soils, the stem above ground grows at the expense of the tubers. Saline and swampy soils are unsuitable. While cassava can tolerate relatively infertile soils, deep cultivation is recommended before planting.



TRANSPARENCY 4.3 (2): WHAT DOES CASSAVA NEED IN ORGANIC CROPPING?

Discussion:

Discuss with the participants what are the best conditions for growing organic cassava in their local area. Write down the information on a pin board and show the transparency.

4.3.2 Diversification strategies

Organic cropping promotes an approach that increases biodiversity (plants and crops), does not exhaust the soil and competes against weeds, diseases and pests (for more information see the IFOAM Basic Manual). Cassava fits well with these features.
Organic cassava is mostly grown on small farms and is grown under different cropping systems:

1. Rotational cropping
2. Intercropping
3. Establishment of young agroforestry system

Rotational cropping

Usually, cassava follows several other crops. A typical rotation might be green manure, maize, vegetables, groundnuts and then finally cassava. A rotation system generally improves fertility and protects the soil against erosion. Cassava is often grown at the end of the rotation cycle because it has lower nutrient requirements than other crops.

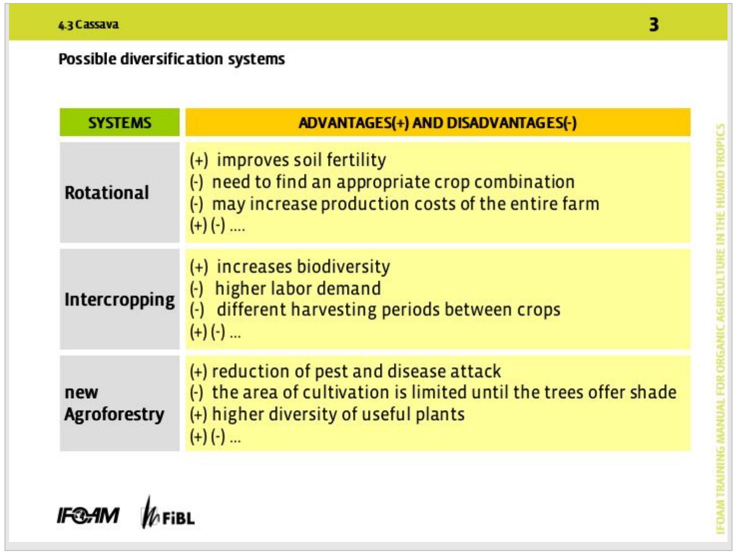
Some rotations examples that are used in organic production of cassava:

1. Africa: maize/beans/yam/vegetables/cassava.
2. Indonesia: nursery of *Hevea brasiliensis* plants/cassava.
3. Indian Ocean: 1-3 years sugar cane/cassava/leguminous.
4. Costa Rica: pineapple-cassava (intercropping)/groundnuts/sugar cane.

Group work:

Divide participants into working groups and give them the following task:

- *Ask them which would be the best system for organic cassava production under the local conditions. The participants should describe the advantages and disadvantages of each cropping system. Complete the transparency with the information presented by each group.*
- *The participants should create a crop rotation designed for local conditions. The results should be discussed in plenary.*


4.3 Cassava 3

Possible diversification systems

SYSTEMS	ADVANTAGES(+) AND DISADVANTAGES(-)
Rotational	(+) improves soil fertility (-) need to find an appropriate crop combination (-) may increase production costs of the entire farm (+) (-) ....
Intercropping	(+) increases biodiversity (-) higher labor demand (-) different harvesting periods between crops (+) (-) ...
new Agroforestry	(+) reduction of pest and disease attack (-) the area of cultivation is limited until the trees offer shade (+) higher diversity of useful plants (+) (-) ...

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TRANSPARENCY 4.3 (3): POSSIBLE DIVERSIFICATION SYSTEMS

Intercropping

Because cassava initially develops slowly, intercropping during early crop development is feasible and helps to reduce soil erosion. However, cassava is a poor competitor and can easily be shaded out by taller intercrops, e.g. maize, or suffer from nutrient and/or water competition from intercrops that are planted too close. Therefore, attention must be paid that competition from the companion crops do not inhibit the growth of cassava during the intercropping period.

Organic cassava can be intercropped in different ways:

Multiple cropping with cassava is most common in the humid tropics. Multiple cropping includes various forms of farming practices where a field produces many crops simultaneously, single crops in sequence, or a combination of both forms. Multiple cropping can be:

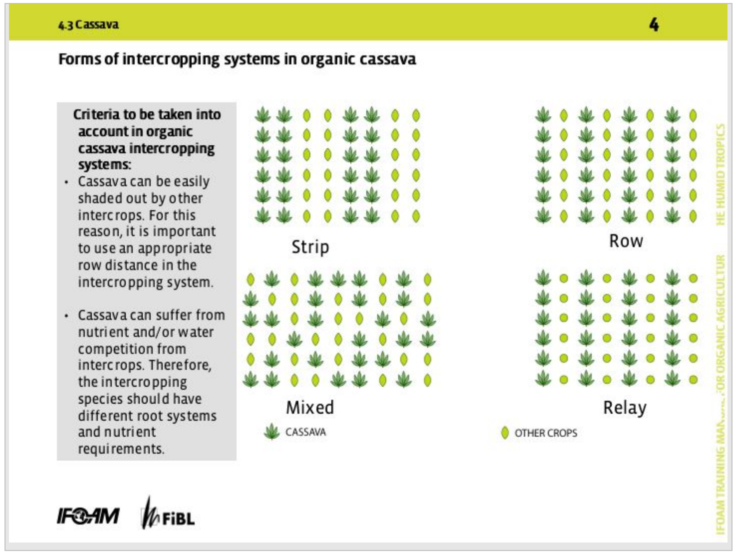
- Strip intercropping: growing two or more crops in strips wide enough to allow independent cultivation and yet narrow enough to induce crop interaction.
- Row intercropping: growing two or more crops in a well-defined arrangement of rows.
- Mixed intercropping: growing two or more crops in an irregular arrangement.
- Relay intercropping: planting one or more crops within an established crop so that the final stage of the first crop coincides with the initial stage of the next crop.

Mixed intercropping is most common in the cassava-growing areas of the humid tropics. Farmers adapt to changes in soil fertility by first planting crops that require the most nutrients, such as maize. Root, tuber, and legume crops, which have lower nutrient requirements, are planted later.
Farmers usually intercrop cassava with vegetables, plantation crops (such as coconut or coffee), maize, rice, groundnuts or legumes. The intercropping pattern depends on the environmental conditions and food preferences of the people in the region.

In simple mixtures (consisting of only two crops), farmers select arable crops on the basis of differences in growth habits and time of maturity. For example, cassava (with slow initial growth and taking 9-18 months to mature) is often intercropped with: maize (rapid growth and about 100-120 days to maturity), cowpea (rapid growth, 70-80 days to maturity), groundnut (rapid growth, 120 days to maturity), okra (harvested over a period of 50-100 days) and pineapple.

Group work:

Ask the participants to design an intercropping system according to the practices and possibilities of the farmers in the region. Each group should present their results and discuss them in plenary.



TRANSPARENCY 4.3 (4): FORMS IN INTERCROPPING SYSTEMS IN ORGANIC CASSAVA

Cassava is suitable for combination with many other crops, with the optimal combination depending on soil and climatic conditions, varieties used, availability of labor and market conditions. In complex mixtures (consisting of three, four, or more crops), high yields can be obtained with mixtures of:

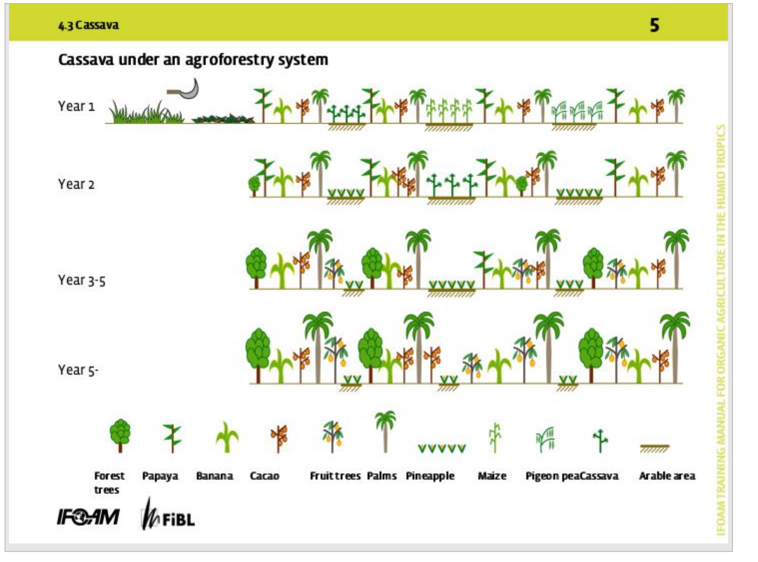
- maize/cassava
- maize/cassava/okra
- maize/cassava/okra/cowpea

Complex mixtures improve weed suppression, reduce soil temperature, retain more moisture in the topsoil and produce more organic matter than single cropping or simple mixtures. Nutrient loss from erosion in complex mixtures is less than in single cropping.

Agroforestry systems

When cassava is planted as an intercrop along with cowpea or groundnut among tree crops such as *Leucaena*, it has an overall effect of reducing soil runoff and soil loss. Soil erosion, which is normally accelerated by the clearing of tropical rainforests, can be successfully minimized by properly combining agricultural crops with forest species.

Cassava can play a valuable role in the creation of young agroforestry systems in which grassland is progressively transformed into an agroforestry system (see chapter 4.6.2 of this manual).



TRANSPARENCY 4.3 (5): CASSAVA UNDER AN AGROFORESTRY SYSTEM

Group work:

Divide the participants into two to three groups. Ask them to discuss the feasibility of growing cassava within a young agroforestry system in their region and to design a system for doing so. They should present the advantages and disadvantages of such system. The results should be discussed in plenary.

Suitable cultivars

Classification of cultivars is usually based on the pigmentation and shape of the leaves, stems and tubers. Different cultivars vary in yield, diameter and length of the tubers, disease and pest resistance levels, harvest time, cooking quality and temperature adaptation. Some cultivars require 18 months or more of growth before they can be harvested. The flesh of the tuber is usually white in color. A few cultivars have yellow-fleshed tubers.

There are over 200 cultivars and very much variation in the form of the plant and in the number, shape and size of the tubers. Most commonly, each plant has 5-10 tubers. Cassava varieties are often classified by taste as 'sweet' or 'bitter'. The bitterness is associated with a glucoside, more prevalent in bitter varieties than sweet ones. This forms the poisonous hydrocyanic acid. This matter disappears when cassava is cooked.

Varieties can be divided into two groups: bitter varieties, with tubers containing 0.02-0.03% prussic acid (these have to be processed before they are used as feed) and sweet varieties, with tubers containing less than 0.01% prussic acid (these can be used raw for animal fodder). Most commercial varieties belong to the sweet group.

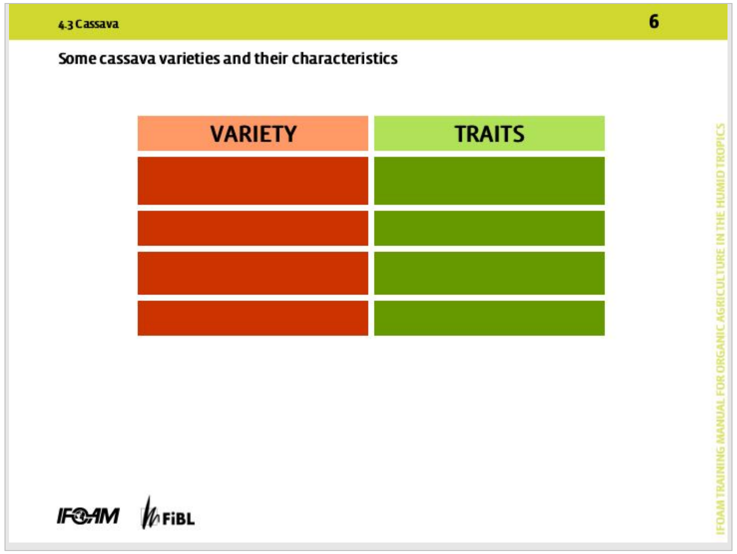
Farmers usually select cultivars from their regions. Each growing region has its own special cultivars, with farmers generally growing several different varieties in the same field. It is important that farmers be careful and select cultivars that have not been genetically modified.

The best cassava varieties are those that are preferred by consumer, grow fast, give good yields, store well in the soil and are tolerant to major pests and diseases. Use the following criteria when selecting cassava varieties:

- Good adaptation to the local conditions.
- Varieties with high dry matter content and of good food quality. Cassava tubers with 30% or more dry matter are said to have high dry matter content.
- Varieties with good cooking characteristics.
- Varieties that bulk early. Bulking refers to the swelling of the storage tubers.
- Varieties with good ground storability.
- Resistance to pest and diseases. For example, in Brazil there are several tolerant cultivars, such as Phytopthora and Fusarium sp..
- Competitive with weeds and with low nutritional requirements.
- The market and the intended use (food or animal fodder).

Sharing experiences:

Note down the common varieties grown in the region and involve the participants in the discussion about the differences of these varieties: talk about tubers (form, size, texture and use), propagation methods, resistance to pests, diseases and weed competition. They should explain the advantages and disadvantages of the varieties to be grown organically. Fill the transparency with the information.



TRANSPARENCY 4.3 (6): SOME CASSAVA VARIETIES AND THEIR CHARACTERISTICS

Propagation

Cassava seed is difficult to germinate and is used only for breeding work. Cassava is propagated by cuttings, by planting pieces of stem. Choosing and planting healthy stem cuttings is an important way of reducing the spread of, and damage caused by, diseases and pests. In order to select healthy cassava stem cuttings you can do the following:

- Select healthy cassava plants with robust stems and branches, lush foliage, and minimal stem and leaf damage by pests and diseases. From each plant, select the middle brown-skinned portion of stem (2 to 4 cm thick) for the cuttings.
- After the harvest, tie the selected stems in bundles. Wait at least 10 days before planting them. During this period it is very important to keep the stakes in a cool, dry and clean place until planting time.
- Planting material can be stored for up to 4 months before planting. If you need to store them this long, they should be placed in the shade with the tips of the stakes buried in the soil.

Good propagation material permits faster development of the crop and provides the best control of weeds, pests and diseases.

Steps for obtaining stakes

Cut each stem into pieces 20-30cm long. There should be 4-6 growth buds on each piece. The stake length depends on the purpose for which cassava is being grown. For the production of tubers, a stake length of 25-30cm (5-7 nodes) is ideal.

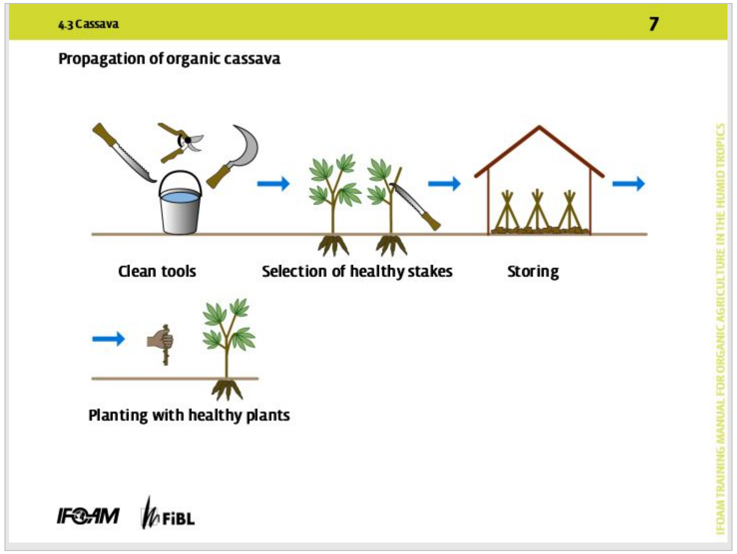
Planting cassava

The important factors to consider when planting are the time of the year, land tillage methods, breed type and preparation, and planting mode of the stem cuttings.

- Select suitable planting dates. Plant cassava early at the beginning of the rainy season to ensure healthy sprouting. Some farmers used to plant cultivars with different life cycles (6, 6-10 and more than 12 months) in order to assure cassava products year round.
- Use appropriate seedbed preparation methods. Improve with tillage and soil drainage.
- Prepare and handle stem cuttings properly. Immerse them in warm water for 5-10 minutes just before planting.
- Adopt a planting mode appropriate to the soil type (vertically in sandy soils, at angle in loamy soils).

Discussion:

Participants should explain the organic propagation management within their local conditions. Write down the results of the discussions and share these with the participants.



TRANSPARENCY 4.3 (7): PROPAGATION OF ORGANIC CASSAVA

4.3.3 Soil protection and weed management

Soil protection

For organic cassava, a fast-establishing simultaneous cover crop may be advantageous for soil protection. Grain legumes, such as common bean, cowpea, mungbean or groundnut, grown as intercrops simultaneously with cassava can provide rapid ground cover without being overly aggressive competitors.

- Green manure covers the soil and adds organic matter, improving the soil stability. Groundnuts, beans, cowpeas make good green manure.
- Animal manure enhances the soil structure.
- Mulch on cassava seedbed reduces the impact of raindrops on the soil and protects against soil erosion, improves the fertility and increases water retention capacity (especially in dry regions). Sources of dead mulch can include alley crops, leguminous plants, rice husk, coffee hull and weed residues.
- Intercropping helps cover the soil surfaces more effectively than a sole crop and improves the soil properties by providing living mulches (i.e. legume plants Mucuna pruriens). *Tephrosia candida* is used as an erosion control in North Vietnam.

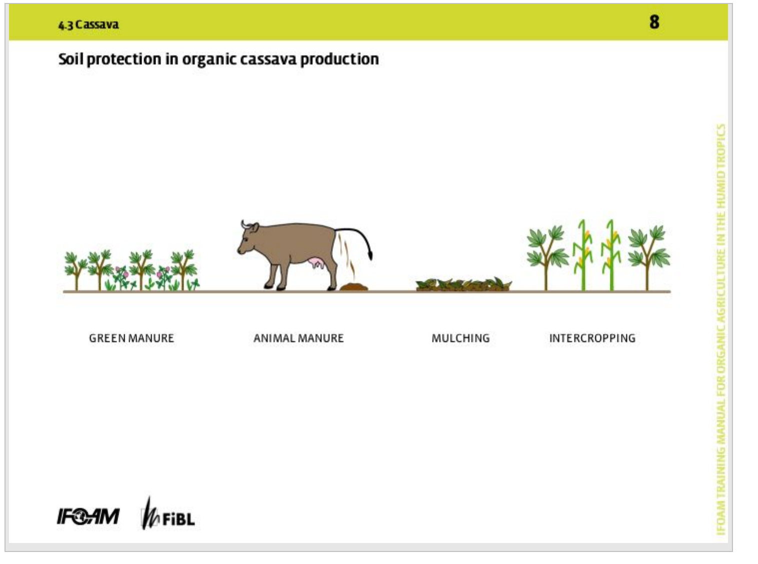
Weed management

The main weeds that compete with cassava are:

- Grasses: Imperata cylindrica, Cynodon dactylon, Panicum maximum and Pennisetum polystachion.
- Sedges: Mariscus alternifolius and Cyperus rotundus.
- Broadleaf weeds: Chromolaena odorata, Euphorbia heterophylla, Mimosa invisa, Tridax procumbens, Ageratum conyzoides, Talinum triangulare and Commelina benghalensis.

Sharing experiences:

Ask the participants what other measures they have used in soil protection and weed management in organic cassava. Write down the results and discuss the advantages and disadvantages of the mentioned measures.



TRANSPARENCY 4.3 (8): SOIL PROTECTION IN ORGANIC CASSAVA PRODUCTION

Group work:

Divide the participants into two or three groups. Ask them to formulate weed management strategies according the local cropping conditions. Each group should present their results.

Under organic farming conditions, weeds are commonly controlled by slashing or hand or hoe weeding. The best way to control weeds in organic cassava is to combine different cultural practices such as weed cures, seedbed preparation, planting and post-planting. The most important strategy is based on preventive control. Weed management strategies:

- Practices at planting: prepare the land properly, grow suitable cassava varieties (with early, low and much branching habits), mulch the cassava seedbeds with dead plant foliage, use cover crops as a live mulch on seedbeds (providing soil protection) and plant cassava in association with other crops.
- Practices after planting: it is important to weed at the right time, in the early stages of the weeds' development, to prevent weeds from competing with cassava storage root formation and bulking, and to reduce other damage that weeds may cause to cassava.

The frequency and labor required for hand weeding will be reduced if the cassava seedbeds are first cleared of rhizomes, stolons and tubers. The need for weeding can also be reduced by selection of cassava varieties that are capable of suppressing weeds, adopting suitable intercrops and mulching where necessary.

4.3.4 Supplying nutrients and organic fertilization

Initially, the root system of cassava develops slowly and has limited nutrient uptake. Therefore, it is important to improve the nutrient availability of the soil by adding organic matter to the soil in order to maintain a good nutrient balance during the cassava cropping period.

Organic farmers use different strategies to maintain optimal soil fertility, such as cattle or chicken manure, green manure, crop residues, crop rotation (legume crop-cassava) etc. The type and quantities of organic fertilizers required by a cassava crop depend on several conditions, such as soil type, climate, region, type of manure, etc.. Cassava is particularly sensitive to deficiencies of potassium, phosphorus, magnesium, manganese and boron.

Although animal manure tends to have a low nutrient content, it does contain calcium, magnesium, sulfur and some micronutrients and improves the physical condition of the soil. Some examples of animal manure applications on cassava in different countries include:

- Vietnam and South China: 5-10 t/ha of pig manure. This must be well composted in order to avoid contaminations with E. coli and salmonella.
- Indonesia: up to 9 t/ha of cattle manure.
- Colombia: 4-5 t/ha of chicken manure. Local studies have shown that chicken manure is more effective than cattle manure for growing cassava.

"Parcagem" system:

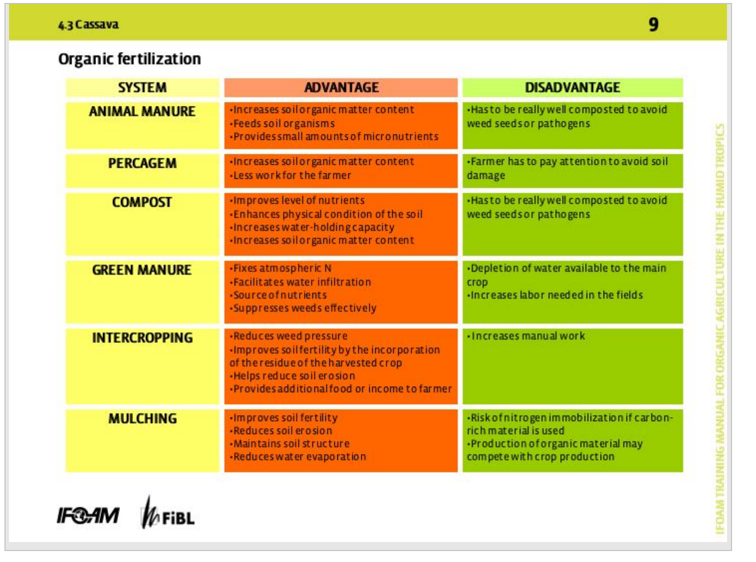
In Brazil very high yields of cassava have been obtained using the "parcagem" system. This system consists of *in situ* application of cattle manure, by leaving a high number of cattle overnight on a small area of land (30 animals/ha during 60 nights) after which the cassava will be planted in the already manured land.

Another strategy is the application of compost. For cassava, applications of 10-20 t/ha of compost are recommended. The use of compost improves the amount of nutrients as well as the soil's physical conditions and water-holding capacity. Colombia has made experiences of using compost in cassava. Applications of 5 tons/ha of composted chicken manure or vermicompost resulted in good yields.

The planting of green manures and their subsequent mulching or incorporation into the soil is a traditional way to improved soil fertility. Examples of the most effective green manure species in organic cassava can be found on the next page.

Group work:

Organize working groups. Each group may discuss and formulate how organic fertilization strategies for cassava can be best implemented under local conditions. They should include the advantages and disadvantages of each recommended strategy.



4.3 Cassava 9

Organic fertilization

SYSTEM	ADVANTAGE	DISADVANTAGE
ANIMAL MANURE	•Increases soil organic matter content •Feeds soil organisms •Provides small amounts of micronutrients	•Has to be really well composted to avoid weed seeds or pathogens
PERCAGEM	•Increases soil organic matter content •Less work for the farmer	•Farmer has to pay attention to avoid soil damage
COMPOST	•Improves level of nutrients •Enhances physical condition of the soil •Increases water-holding capacity •Increases soil organic matter content	•Has to be really well composted to avoid weed seeds or pathogens
GREEN MANURE	•Fixes atmospheric N •Facilitates water infiltration •Source of nutrients •Suppresses weeds effectively	•Depletion of water available to the main crop •Increases labor needed in the fields
INTERCROPPING	•Reduces weed pressure •Improves soil fertility by the incorporation of the residue of the harvested crop •Helps reduce soil erosion •Provides additional food or income to farmer	•Increases manual work
MULCHING	•Improves soil fertility •Reduces soil erosion •Maintains soil structure •Reduces water evaporation	•Risk of nitrogen immobilization if carbon-rich material is used •Production of organic material may compete with crop production

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TRANSPARENCY 4.3(9): ORGANIC FERTILIZATION

- Colombia: Kudzu (*Pueraria phaseoloides*), Zornia (*Zornia latifolium*), groundnuts (*Arachis hypogea*), Canavalia (*Canavalia ensiformis*) and local spontaneous vegetation.
- Thailand: Crotalaria (*Crotalaria juncea*) is the most productive and highly effective in increasing yields of organic cassava.

Planting cassava in intercrops with maize, groundnut, cowpea, common bean, mungbean or pigeonpea, and incorporating the crop residues after harvest improves soil fertility, helps reduce soil erosion and provides the farmer with additional food or income, without reducing cassava yields too seriously.

Application of mulch of local spontaneous vegetation or crop residues, such as rice straw or maize stalks, may also improve soil fertility and moisture retention, and reduce soil erosion. Different ways of mulching used in cassava are:

- Africa: application of mulch especially of leguminous species (common bean, pigeonpea, mungbean, groundnuts, etc.), increases cassava yields in acidic sandy soils.
- Colombia: annual applications of 12t/ha of dry Panicum (Panicum maximum) grass as a mulch significantly increases cassava yields in sandy soils.

Annual mulching gradually increases soil P and especially soil K, and prevents depletion of soil Ca and Mg. In addition, the mulch cover reduces soil temperatures in its top 20 cm and helps to maintain soil C. Therefore, application of mulch, where it is available, is a very effective strategy for improving soil productivity.

Inoculation with mycorrhizas

Cassava can grow well in low P soils because of a highly efficient symbiosis with VAM (vesicular arbuscular mycorrhizae), which occur naturally in the soil. *Glomus manihot* is one of the most effective VAM species for increasing cassava growth and yield in acidic soils, and competes strongly with other species. In organic cassava fields, a native VAM population in the soil is very desirable. The effects of mycorrhizae are more pronounced in poor soils than in fertile soils.

4.3.5 Indirect and direct pest and disease management

Diseases

The main diseases in organic cassava can be divided into two groups: leaf and stem diseases and stem and root diseases.

Leaf and stem diseases:

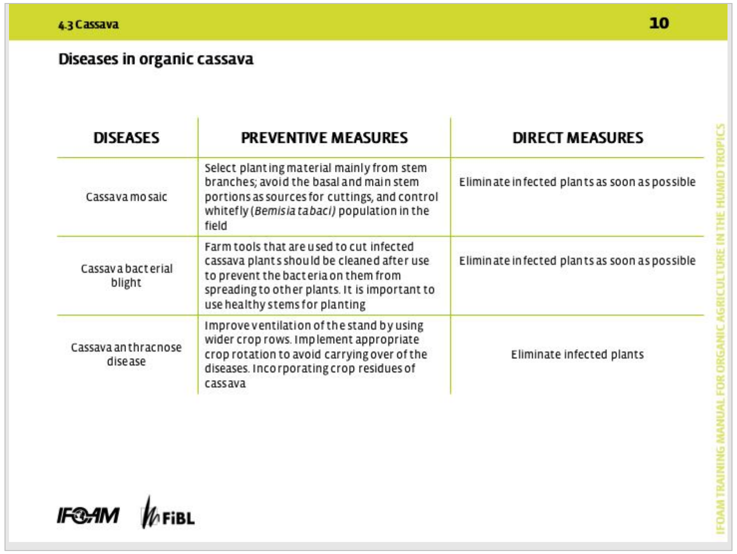
- Cassava mosaic disease: caused by a virus that occurs inside cassava leaves and stems. The symptoms are discolored leaves with patches of normal green color mixed with light green, yellow, and white areas (chlorosis). The symptoms are more pronounced on younger plants, especially those under 6 months.
- Cassava bacterial blight: caused by a bacterium that occurs inside cassava leaves and stems. Damage appears as water-soaked dead spots. The lesions occur between leaf veins and are most evident on the lower surfaces of the leaves. The symptoms are more evident in the wet season than in the dry one. The disease is more severe in young plants than in older ones.
- Cassava anthracnose disease: caused by a fungus that occurs on the surface of cassava stems and leaves, causing defoliation and dieback of the shoots and tips, or complete death of the shoot. The disease usually starts at the beginning of the rains and worsens as the wet season progresses.
- Cassava bud necrosis: caused by a fungus that occurs on the surface of cassava stems and leaves. The disease appears as patches of brown or grey fungal matter covering the stem.
- Leaf spot diseases: caused by fungi. There are three different types: white leaf spot (circular white or brownish-yellow spots on the upper leaf surfaces), brown leaf spot (small brown spots with dark borders on the upper leaf surfaces) and leaf blight disease (light brown lesions on the upper surfaces of the leaves).

Stem and root diseases:

- Cassava brown streak disease: caused by a virus. Damage symptoms appear on the leaves (yellow patches), stems (dark brown streaks) and tubers of cassava plants (cracks and discoloration).
- Cassava root rot diseases: caused by various kinds of fungi living on or in the soil. The fungi occur mainly in soils that do not drain. The leaves turn brown, wilt and the plant appears scorched.

Questions:

Which cassava diseases do you know about and which are the most troublesome in this area? With the participants, formulate preventive measures that can reduce disease infestation, as well as possible direct strategies for disease control. Write down a table with this information.



4.3 Cassava 10

Diseases in organic cassava

DISEASES	PREVENTIVE MEASURES	DIRECT MEASURES
Cassava mosaic	Select planting material mainly from stem branches; avoid the basal and main stem portions as sources for cuttings, and control whitefly (*Bemisia tabaci)* population in the field	Eliminate infected plants as soon as possible
Cassava bacterial blight	Farm tools that are used to cut infected cassava plants should be cleaned after use to prevent the bacteria on them from spreading to other plants. It is important to use healthy stems for planting	Eliminate infected plants as soon as possible
Cassava anthracnose disease	Improve ventilation of the stand by using wider crop rows. Implement appropriate crop rotation to avoid carrying over of the diseases. Incorporating crop residues of cassava	Eliminate infected plants

TRANSPARENCY 4.3 (10): DISEASES IN ORGANIC CASSAVA

4 Management Guide for Crops

The best way to control diseases is to grow a healthy crop of organic cassava. And in order to grow a healthy cassava crop production and plant protection, strategies need to be combined. The principal strategies are:

- Use a planting system (rotation, intercropping) that is adapted to local conditions.
- Identify the common cassava diseases, their symptoms, and know the conditions under which they will cause severe losses.
- Grow cassava on sites with deep loamy soils and flat or gently sloping land, to avoid water lodging and to improve the soil drainage.
- Improve the soils by manuring, mulching, and intercropping, to encourage cassava plants to grow vigorously and offset damage by cassava diseases.
- Grow cassava varieties that tolerate the cassava diseases most common in the local area.
- Plant stem cuttings from healthy plants without leaf chlorosis, shoot tip dieback, cankers, fungus patches or streaks on the stems.
- After harvesting the roots, destroy any discarded cassava stems and tubers that show any symptom of disease.
- To control cassava mosaic disease, select planting material mainly from stem branches. Avoid the basal and main stem portions as sources of stem cuttings.
- Plant cassava mainly at the beginning of the wet season; try to avoid late planting.
- Avoid transferring diseases from damaged areas to healthy cassava crops by tools, machinery and people.

Pests

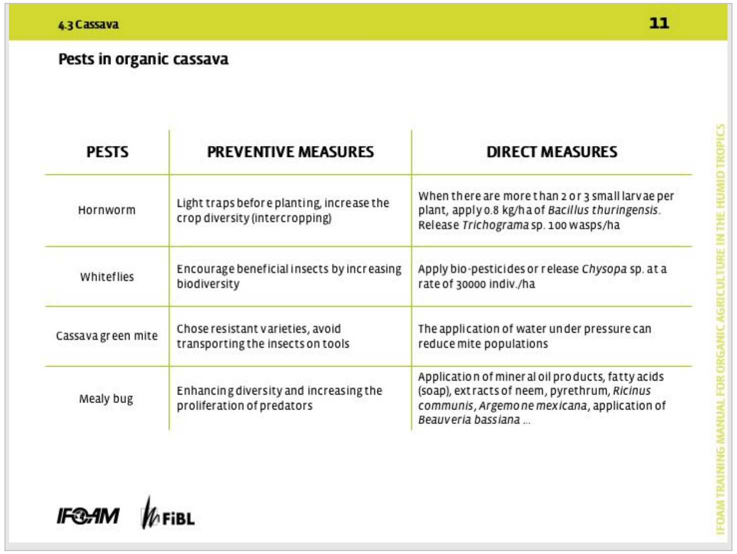
The main pests that *affect* cassava are insects, mites and vertebrates. They attack and feed on different parts of the plants. Some feed on the leaves and stems, while others feed on the stems and roots.

Leaf and stem feeders:

- Cassava mealy bug (Phenacoccus manihoti): reduces the length of the internodes and causes the leaves to clump together into "bunchy tops".
- Cassava green mite (Mononychellus tanajoa): causes tiny yellow chlorotic spots, the size of pin pricks, on the upper leaf surface.
- Variegated grasshopper (Zonocerus variegatus): chews cassava leaves, petioles, and green stems. It defoliates the plants and debarks the stems.
- Spiraling whitefly (Aleurodicus dispersus): secretes large amounts of honeydew as it feeds, which supports the growth of black mold on the plant.
- Bemisia whitefly (Bemisia tabaci): injects the plant with viruses as it feeds, which causes cassava mosaic disease.

Stem and root feeders:

- Termites: many different kinds of termites damage cassava stems and tubers. They chew and eat stem cuttings. Cassava grows poorly, dies and rots.
- Cassava hornworm (Erinnyis ello): the most important pest of cassava, which generally occurs at the beginning of the rains. Most damage is caused by large populations of the larva (worm), which can defoliate large amounts of cassava plants in a short time. The adult female is nocturnal and lays eggs on the leaf surfaces. Larvae vary in color (green, yellow, black, etc.). They feed on the leaves and migrate to the soil at the time of pupation. The pupae remain in the soil until adulthood.
- Cassava root scale (Stictococcus vayssierrei): causes the tubers to be deformed and smaller than normal.
- Cassava white scale (Aonidomytilus albus): causes the stems to lose a lot of water and die.


4.3 Cassava 11

Pests in organic cassava

PESTS	PREVENTIVE MEASURES	DIRECT MEASURES
Hornworm	Light traps before planting, increase the crop diversity (intercropping)	When there are more than 2 or 3 small larvae per plant, apply 0.8 kg/ha of *Bacillus thuringensis*. Release *Trichograma* sp. 100 wasps/ha
Whiteflies	Encourage beneficial insects by increasing biodiversity	Apply bio-pesticides or release *Chysopa* sp. at a rate of 30000 indiv./ha
Cassava green mite	Chose resistant varieties, avoid transporting the insects on tools	The application of water under pressure can reduce mite populations
Mealy bug	Enhancing diversity and increasing the proliferation of predators	Application of mineral oil products, fatty acids (soap), extracts of neem, pyrethrum, *Ricinus communis*, *Argemone mexicana*, application of *Beauveria bassiana* ...

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TRANSPARENCY 4.3 (11): PESTS IN ORGANIC CASSAVA

Sharing experience/Local experience:

Ask the participants to make a list of the main pests that attack cassava in their region. They should also propose preventive measures and direct control methods compatible with organic production.

Vertebrate pests:

Birds, rodents, monkeys, pigs, domestic animals, cattle, goats and sheep defoliate cassava by eating the leaves and green stems.

To control pests and grow a healthy crop of cassava:

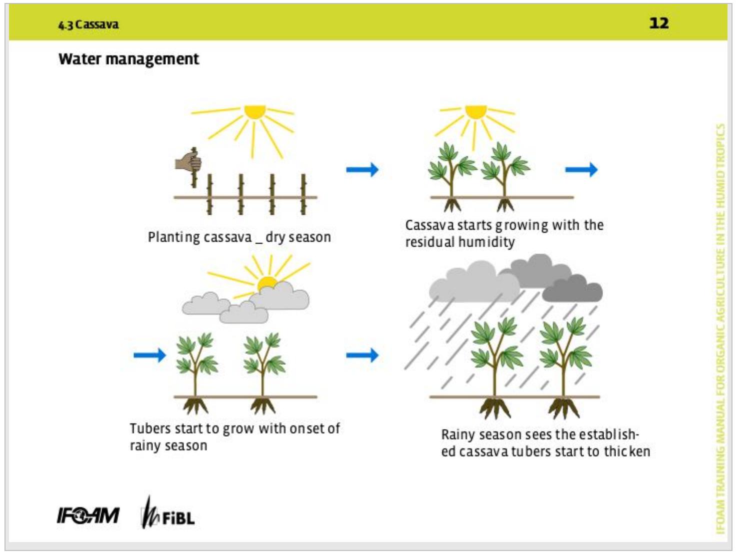
- Correctly identify the common pests, their damage symptoms and natural enemies; know the conditions under which the pests will cause severe losses.
- Plant healthy stem cuttings or treat the stem cuttings against pest damage. Avoid transporting and planting cassava stems infested with stem-borne pests; after harvesting, destroy cassava stems infested with stem-borne pests.
- Use natural enemies against cassava pests.
- During soil bed preparation, expose the pests' eggs (e.g. variegated grasshopper) to the surface so they can be destroyed by the sun and by birds.
- To control bird, rodent and other vertebrate pests, use fence farms and set traps in the fence. Cover exposed tubers with soil. Apply appropriate weed management of the cassava crop to discourage rodent pests in fields. Harvest cassava tubers as soon as they are mature.
- Select sites with a high plant diversity to improve the proliferation of beneficial insects.
- Maintain strong and healthy plants by adequate conditions (e.g. application of organic matter, absence of infected planting material, etc.).
- Grow cassava varieties that are tolerant to common local pests.

4.3.6 Water management and irrigation

Cassava has relatively low requirements for irrigation. However, during the active growth stages, it might be necessary to irrigate it if extended dry periods occur. Subsequent irrigation requirements are reduced during the last few weeks of growth. This usually coincides with the dry season, when cassava is most likely to be affected by mites. Irrigation can discourage the mites, but the benefits of this need to be valued considering other factors.

In organic cassava, the crucial aspect in water management is to choose the proper planting period. It is very important that the plants have enough humidity at the critical period of growth, when the tubers start thickening. For this reason, it is recommended to plant cassava at the middle or at the end of the dry season, or at the beginning of the rain season.
In Cuba, the optimal period for planting is in the middle of the dry season (January-February). This means that the period of the tubers' thickening (June-July) is during the abundant precipitations period.

High water quality (preferably filtered), free of chemicals, heavy metals, toxic bacteria and with low salinity levels is essential. Regular water analysis is compulsory for organic certification.



TRANSPARENCY 4.3 (12): WATER MANAGEMENT

4.3.7 Harvesting and post-harvest handling

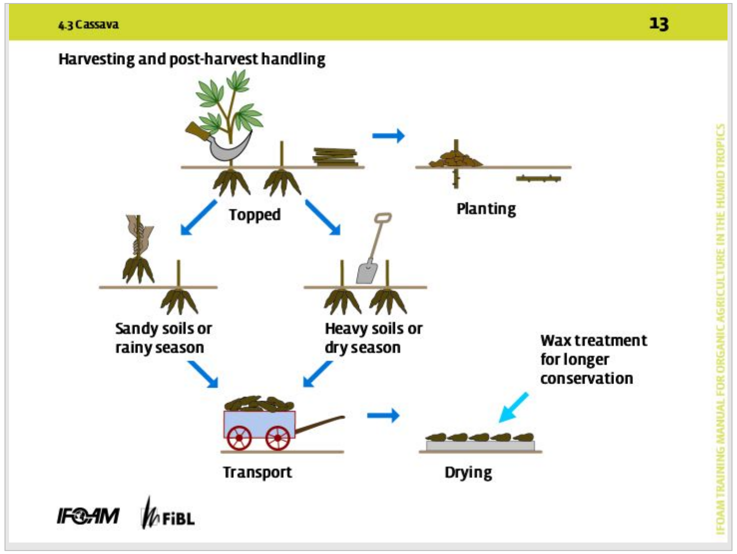
Harvest

Harvest of cassava tubers can be done at any time of the year or may be delayed until the market, processing or other conditions are more favorable. Some farmers harvest as early as six months after planting, while others may leave the crop for 18 - 24 months. This mainly depends on the precocity of the cultivars (cassava has not definite maturation point). Farmers often keep different cultivars to maintain a year-round supply of fresh tubers ready for direct consumption. For flour making, the cassava plants can be kept in the soil for longer periods. The stage for harvesting is when the leaves turn yellow and fall, and the seeds are mature. Once cassava reaches this stage of maturity, it should be harvested. If the tubers are left in the ground for any longer, their quality deteriorates due to the hydrolysis of starch into sugars. Damage to tubers should be avoided. It is important to take care not to break the tubers during harvesting. The harvesting of cassava tubers is usually done by hand and is easy if the soil is sandy or if done during the rainy season. In heavier soils or during the dry season, harvesting usually requires digging around the tubers to free them and then lifting the plant. The day before harvest, the plants are normally "topped": the stalks are cut off 40-60 cm above ground and piled at the side of the field. The stalks for the next planting are selected from this material. However, hand harvesting is intensive and hard labor. Colombia and Thailand have developed mechanical harvesting systems that have proved effective and yielded good results. The young leaves and shoots of cassava are also harvested and consumed as vegetables, and may be as important as the tubers for generating cash income. However, excessive harvesting of the leaves can have a negative effect on the yield of tubers. In smallholder farms, families can harvest the tubers as they need them. Without cutting the stems, they begin by taking the biggest tubers from each plant, leaving the smaller ones to mature.

Post-harvest

Transport

The first thing to be done after the harvest is to transport the tubers from the production and harvest field to the processing and utilization site. These are two of the most labor-intensive activities in organic cassava production.



TRANSPARENCY 4.3 (13): HARVESTING AND POST-HARVEST HANDLING

Discussion:

With the participants, discuss the best technique(s) according to the soil conditions of the region. How can they minimize problems at harvest and what strategies do they or can they use to reduce damage to the tubers during the post-harvest period.

Drying

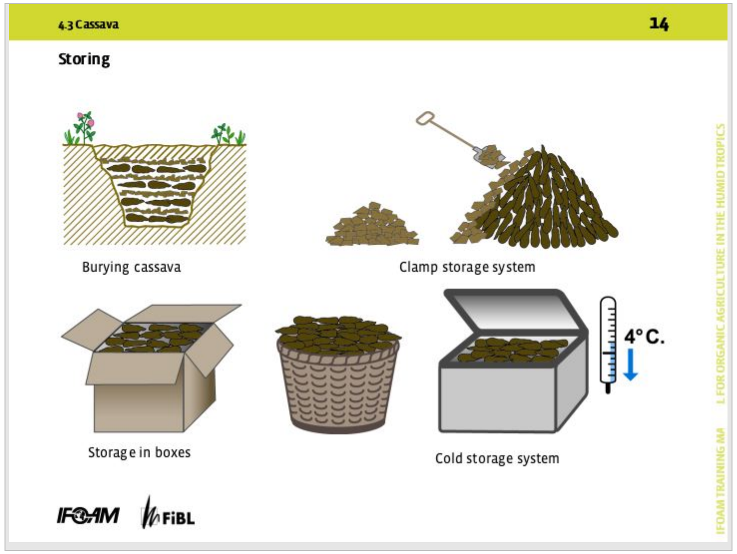
Cassava tubers need to be dry so as to reduce their moisture levels to the point where further physiological reactions and microbial growth are completely inhibited. This process is carried out by sun drying (mostly done by small farmers), drying ovens, chamber dryers, drum dryers, bell dryers or tunnel dryers. Treatment with natural wax can also extend their shelf life.

Storing

Once cassava is harvested, it cannot be kept for a long period. The tubers begin to spoil as soon as they are out of the ground. That is why small producers should not harvest more tubers than can be eaten while they are fresh, or be sold immediately. Cassava keeps longer when it is left in the ground, but the soil must not be too wet. Once harvested, the tubers should be immediately stored wholly under moist and cold conditions.

When cassava fields are completely harvested, the tubers should be placed in storage using one of the following systems:

- Store fresh cassava roots by burying them in the soil: fresh cassava tubers can be stored in straw-lined trenches for periods of up to 12 months.
- In a clamp storage system: a conical pile of 300-500 kg of fresh cassava roots is placed on a circular bed of straw and covered with more straw. The whole unit is covered with soil to a thickness of 10-15 cm, the soil being dug from around the clamp so as to form a drainage ditch. With this storage system, acceptable levels of loss (0-20 %) were achieved for periods of up to 2 months. This system is not compatible with transportation.
- Storage in boxes involves packing the tubers into boxes containing adsorbent material such as sawdust. The relative humidity inside the box is critical for a successful storage: too high humidity causes rapid deterioration due to bacteria and fungi; too low humidity causes vascular deterioration.
- A polyethylene bag packing system is not recommended in organic cassava storage because of the high incidence of microbial deterioration.
- Cold storage by keeping the cassava tubers below 4 °C greatly reduces cassava deterioration.
- A deep freeze storage condition is a satisfactory method to conserve the tubers but the problem is that the texture of cassava tubers changes and it is a very costly method.
- Wax treatments can be used to preserve and lengthen the shelf life of cassava tubers.



TRANSPARENCY 4.3 (14): STORING

4.3.8 Economical aspects

Global cassava production was more than 160 million tones in 1999 and could increase a further 30% by 2005 (to 208 million tones). Experts have agreed that cassava could contribute to increased agricultural transformation and economic growth in developing countries, but that the crop would have to become more competitive in domestic and international markets. In this context, organically grown cassava may play an important role if the markets are stimulated.

The development of high quality cassava flour could help many developing countries reduce their dependence on imported grains, particularly in Africa, but also in the Caribbean where bread made entirely from imported wheat dominates the market. Additionally, if cassava is produced under organic conditions, this will increase the added value (healthy food, no contamination, preservation of the environment, etc.).

New products are appearing on the market, for example: cakes soaked in coconut milk and grilled are now being packaged, frozen and exported to Europe and North America. Cassava is now being imported into Jamaica to satisfy increasing demand. Organic farmers can positively use this potential to position organic cassava products in the international market.

Latin America, has seen the marketing of cassava snack foods, similar to potato chips, as well as frozen 'heat and serve' cassava products. The growing demand for cassava products in Brazil, in particular, has led to the creation of franchising stores that sell cassava cheese bread and coffee.

In Thailand and elsewhere in Asia, where rice is the most popular staple, commercial cassava production has focused on animal feed, mainly in the form of chips and pellets for export. In Africa and Latin America, the domestic market for similar products shows potential for growth although cassava roots and leaves are already widely used in half of Brazil's production of animal feed for pig, poultry and fish farming. However, the main constraints to the use of cassava in animal feed are a current lack of reliable supply throughout the year and inconsistent quality. Improving its competitiveness with grain products by lowering the cost of production will be an important focus for future development if cassava is to become an industrial crop.

Recommended websites:
www.cgiar.org/iita
http://www.iita.org/crop/cassava.htm
http://www.ciat.cgiar.org/

4.4 Citrus

Introduction

Citrus is widely distributed in tropical as well as in subtropical and Mediterranean climates. While fresh fruit is produced mainly in Mediterranean climates, citrus for juice predominates in tropical and subtropical climates because of higher possible sugar contents. The main production areas of organic citrus – oranges, mandarins, grapefruit, limes and lemons – are Latin America, North America, Europe and the Near East. Smaller quantities are produced in Africa and Asia.

The production of organic citrus is still less than 1% of the global citrus production. However, it is increasing year by year in parallel with the increasing demand for organic products. Major markets include most European countries. The market offers good opportunities for future growth: consumption of organic juices doubled between 1998 and 2002, and there is no indication of less dynamic growth in the near future. As a reaction, many tropical countries in the Americas are extending their organic citrus production. Successful organic citrus production requires high sugar rates for juices and top quality for fresh fruit.

4.4.1 Agroecological requirements and site selection

Citrus trees can be grown over a wide range of climatic and edaphic conditions but proper site selection remains the key to successful organic production. Important factors are:

Climate

Optimum production of citrus is between the latitudes 40°N to 40°S where minimum temperatures do not fall below -7°C. Climate has a significant effect on nearly all aspects of citrus growth and quality development:

- Yields in Mediterranean climates increase gradually with the age of the orchards, peaking at 20-25 years. Yields in low lying tropical regions reach a maximum when the trees are 10-15 years old. Higher pest and disease pressure accounts for the lower longevity in these regions.

Lessons to be learned:

- *Diverse orchard designs and appropriate soil management are key factors for successful organic citrus production.*
- *Additional manpower for compost production and application needs to be well planned.*
- *Find ways to substitute expensive imported inputs by low-cost local alternatives*
- *Successful organic citrus production requires high sugar rates for juices and top quality for fresh fruit.*

Motivation:

Work in groups. Start with a field excursion to a conventional citrus plantation and make observations. Then, analyze the following questions:

- *Observation of plant diversity; discuss possible effects on system stability and plant health.*
- *Observation of soil and (spontaneous) cover vegetation; discuss possible ways to manage the soil in an orchard. Use soil-testing methods such as the spate-sample diagnosis (see Basic Manual, chapter 3.1).*
- *Observation of single trees and their leafs; discuss issues of plant health and the different perspectives of organic and conventional production in terms of density, nutrient deficiencies, pests and diseases, etc.).*
- *Interview the farmers about economic issues and ask them their opinion regarding conversion to organic citrus production.*

- Highest yields are achieved in the humid subtropics.
- High temperatures and a water deficit in early summer can cause physiological drop of fruit (when they approach 0.5-2 cm in diameter).
- Yields vary considerably from year to year due to climatic factors.
- In tropical regions (between 23.5° North and South), warmer nighttime temperatures can increase respiration losses leading to decreased levels of soluble solids and acidity in the fruits.
- Adequate soil moisture provided by rainfall or irrigation improves fruit size.

Soil characteristics

Citrus can be grown:

- In coarse sands with a low nutrient content, sandy loams, moderately to heavy loam soils and on ferralitic tropical soils.
- At a soil pH of 5.5-7.0 with adequate availability of nutrients.
- On a site with adequate drainage, as tree growth is reduced in poorly drained soils or where compacted soil layers are present in the root zone. Furthermore, poor drainage also causes problems with Phytophthora and other soilborne diseases.
- In soils with less than 50% clay content: at higher levels root and tree growth are restricted.
- Citrus prefer rather deep soils (> 1 m A/B horizon).

In case of larger plots, the topography of the land should be suitable for mechanization, otherwise labor for soil management, compost application and harvest becomes too expensive.

Availability and quality of irrigation water

Availability of good quality irrigation water is important for economically viable yields, even in the humid tropics. The distribution of rainfall determines whether irrigation is necessary or not. Citrus can withstand dry periods lasting several weeks. However, in the period after flowering, sufficient water supplies are necessary for fruit setting and growing.

For organic citrus growing, water salinity, heavy metal contamination and absence of toxic bacteria should be checked. Therefore, a water analysis is essential before selecting a site for organic citrus production.

Transparency 4.4 (1): Agroecological requirements

Logistical facilities and markets

The processing (juice) and packaging (fresh fruit) facilities should be near the citrus fields. This is especially true for fresh fruit production because organic citrus producers do not use post-harvest fungicide applications.

Market distance is important for fresh fruit production. Juice is mainly deep frozen after its production and is transported by vessels over large distances. In this case, market distance is a less important factor. However, the distance from the field to the processing plant is important: citrus fruit should be processed less than one day after harvesting in order to maintain the quality.

Investments

Soil management and compost production require significant additional labor in organic citrus production compared to conventional systems. On larger farms (more than 10 ha), significant investments in compost production (compost mixer, etc.), compost application (manure distributor) and soil management (seeds for leguminous cover crops, mover) may be necessary.

It is therefore important to carefully plan the conversion and to seek cooperation with other organic farmers in the area for sharing equipment, etc..

Motivation, know-how and labor

Organic citrus production is a knowledge-intensive business. It requires planning of the conversion, selection of suitable planting material and of seeds for cover crops, management of the cover crops, pests and diseases, planning of investments and marketing of the organic citrus (and eventual associated crops).

Some elements of organic citrus production require significant additional labor, especially for the care of cover crops and the production and application of compost. In many countries in the humid tropics, additional labor is not a limiting factor, but has to be planned carefully.

Organic citrus production will be a success where the farmers are motivated to improve their know-how to develop an organic regime that is adapted to their farm's circumstances and where there are possibilities for recruiting additional workers.

Discussion: what are the factors for successful organic citrus production?

Activate the participants by having a brainstorming session on factors for successful organic citrus production. Encourage them to list the different factors, rank them and discuss proposals as to how to develop a feasibility study for conversion of a conventional citrus farm..

TRANSPARENCY 4.4 (2): SUCCESS FACTORS OF ORGANIC CITRUS PRODUCTION

4.4.2 Diversification strategies

Citrus growing is a long-term investment. Most orchards are productive for 25 - 50 years, but some citrus trees are fully productive for 100 years or more. The useful economic life of a plantation will depend on tradition, climate and management methods. Organic growers aim to achieve longevity of their trees, this is part of their sustainable land use strategy. Due to this fact, most organic growers are in the situation of converting an already existing plantation into organic production. Only a few growers will have the possibility of establishing new orchards.

Pest and disease management tools in organic citrus production are less effective than in conventional (chemical-synthetic) systems. Thus the organic citrus grower depends on a successful combination of preventive and direct management methods. The first and most important measure is the design of the organic orchard, based on the following ecological principle: the higher the diversity of species, the higher the stability of the agroecosystem. The high level of biodiversity will create habitats for the natural enemies of pests.

1) Establishing a new organic citrus orchard

Design of the orchard

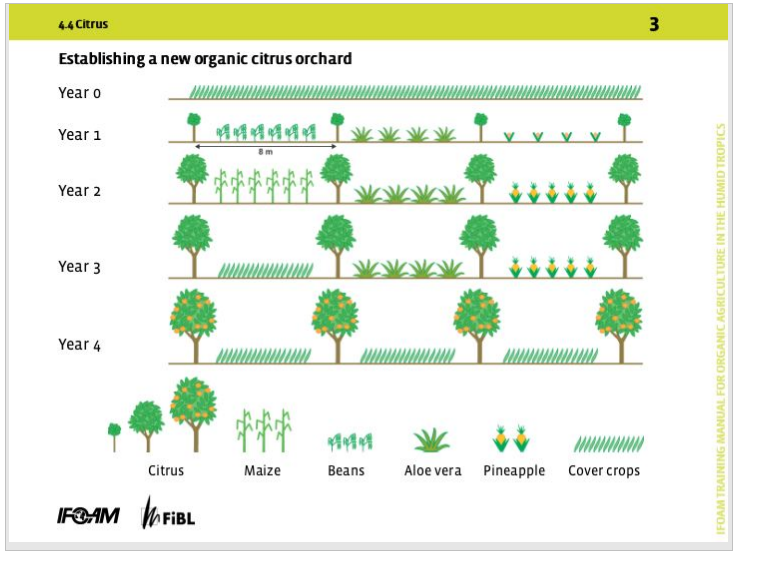
Farmers who can plant a new citrus orchard have the advantage that they can start by creating an optimal organic system, applying the following strategies:

- Creating a **diversified mosaic** of citrus units, mixed with ecological compensation areas, such as specific cover crops in the alleys and under the trees, as well as hedges and wild flower fallow plots in and around the orchard;
- **Intercropping**: it is better for smallholders not to rely on the citrus production alone. The space to grow additional crops is limited to the alleys. Successful examples of intercrops are beans and maize for self-sufficiency (e.g. in Cuba) or Aloe vera (e.g. in Mexico). The Aloe vera extract finds multiple uses in the cosmetic, pharmaceutical and fruit juice industries. The advantage of Aloe vera is that it is quite shade tolerant and can be planted among citrus and other fruit trees with great success. Intercropping can also be limited for the startup phase of the citrus trees (e.g. combination with pineapple, see chapter 4.6).

Group work:

Visit a field destined to become an organic citrus orchard and work out several issues in groups:

- *Analyze the advantages and possible limiting factors of this site for organic citrus production.*
- *Propose a possible orchard design, creating a mosaic of production units.*
- *Propose intercropping possibilities during period of establishment of the citrus trees.*
- *Propose a green manure that can be used before planting citrus trees.*



TRANSPARENCY 4.4 (3): ESTABLISHING A NEW CITRUS ORCHARD

Note: producers who select an intercropping system have to be aware that this involves considerably different cultural practices compared to monocultural citrus orchards. Much more manual work is necessary in intercropping systems. However, the combination of the citrus orchard increases diversity and provides additional income during the period when the citrus is being established.

- A **plant density,** which permits optimal light interception and aeration. Tree spacing for new organic oranges should be around 8 x 8 m (156 trees per ha), for grapefruit even 1 to 2 m more space; for limes and mandarins less space. Organic cultural practices are considerably easier in low-density plantations: organic growers need space to sow in a cover crop and to care for it, to apply compost, to manage pests and diseases.
- Plant a diversity of cultivars and scions.

Suitable cultivars

- Most citrus orchards consist of budded trees that combine favorable attributes of the scion and the rootstock.
- The choice of the rootstock should depend on local climate, soil conditions, cultivar and intended use (fresh or processed fruit). Sour orange (Citrus aurantium L.) is the most widely planted rootstock in the world. It is an excellent rootstock for areas that are free of Citrus tristeza virus. Rough lemon should be avoided in areas known to have blight. Carrizo is a widespread rootstock, but burrowing nematodes pose a problem.
- When choosing the cultivars for organic production, factors like disease, drought resistance and quality are as important as yield performance. Valencia is an important cultivar for orange juice and does well under organic management.
- Trees that are grown in specialized nurseries and are certified to be free of diseases, pests and viruses, and for which there is a guarantee of the authenticity of the rootstock and cultivar.

Propagation and nursery management

The use of virgin sites for nurseries is very important in organic production; it reduces the risk of soilborne diseases and pests such as *Phytopthora, Pythium* or nematodes, which are harmful to citrus seedlings. Use non-GMO seeds.

Before planting the rootstock in the nursery, well-fermented compost should be applied (based on soil analysis, e.g. 10 t/ha). At sites low in phosphorus, the application of mycorrhizal fungi will support the uptake of phosphorous. Fertilization, irrigation and pest control practices must comply with organic standards (see Basic Manual).

Transplanting

- Some months before planting the citrus trees, organic growers can sow vigorous legumes (e.g. Canavalia sp. or Cajanas cajan) and mulch them shortly before planting the citrus
- trees. Then, the soil will be enriched with organic matter and nitrogen, both stimulating microbial activity.
- Before planting, the irrigation system is laid out, if needed.
- Then, planting holes are dug and the citrus trees are planted at the same depth as in the nursery or else the scion is exposed to root rot diseases or can start rooting itself.
- In tropical areas with high rainfall, the juvenile period is considerably shorter than in arid subtropical regions with suboptimal irrigation.

Group work:

Visit a conventional citrus orchard destined for conversion and discuss the following issues in groups:

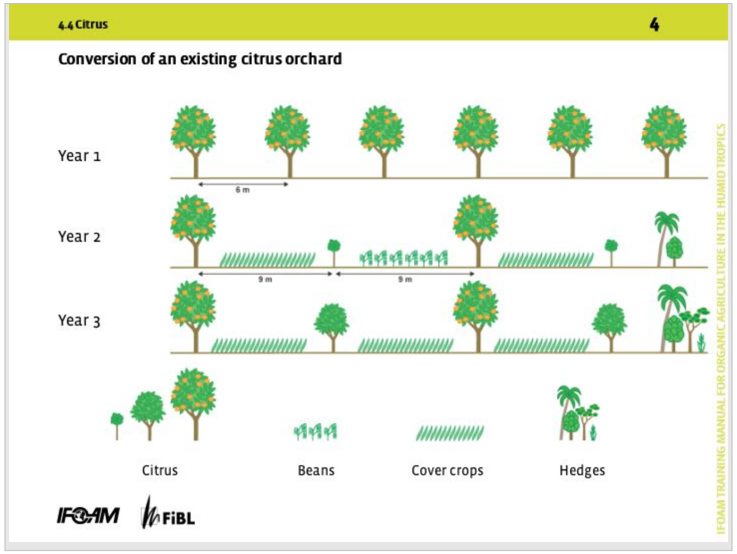
- *Analyze the advantages and possible limiting factors of this site for organic citrus production.*
- *Propose steps for the conversion of this orchard, creating a mosaic of production units.*
- *Propose intercropping possibilities and discuss their advantages and disadvantages.*

2) Conversion of an existing citrus orchard

Orchard design

Almost every orchard can be converted to organic production except orchards with contaminated soils, contaminated irrigation water or inappropriate soil and climate conditions. One of the most important tasks on the way to organic production is to find strategies for increasing biodiversity:

- Create a **diversified mosaic** of citrus units and other crops from an existing plantation. Generally, it will be necessary to cut down several rows of citrus trees and replace them with hedges or other fruit trees, creating citrus plots of about 1-2 ha in size (or smaller).
- Between the rows (in the alleys), it might be possible to **intercrop** with pasture (for sheep), beans or other crops. However, this might be difficult in case of older plantations where the trees are adapted to a certain management; in this case, a step-by-step procedure is recommended (introduction of new crops and elements year by year), because the root systems of the citrus trees have to adapt to new competition in the soil.
- The **density** of existing plantations might be decreased to 8 x 8 m (156 trees per ha) if the existing density is too high. For example, in central China, trees are planted as close as 1.5 x 3 m (2222 trees per ha). High-density plantings reduce ventilation and light interception and thus increase disease pressure. Low-density plantings are better adapted to the organic production system (see above).



TRANSPARENCY 4.4 (4): CONVERSION OF AN EXISTING CITRUS ORCHARD

Agroforestry

As examples show in Eastern Cuba or the Mexican peninsula of Yucatan, it is also possible to produce organic citrus successfully in polycultural systems. In agroforestry systems, citrus trees are mixed with other fruit trees, leguminous trees, banana, palm trees, coffee, cocoa, beans and other species that cover the soil.

Effects of diversity:

- The high degree of diversity decreases the risks of disease infestation and enhances ecological pest control through the appearance of a highly diverse bird and insect community.
- Citrus yields per ha in such systems are considerably lower than in classical orchards.
- The grower can count on a number of crops throughout the year for his self-sufficiency.

4.4.3 Soil protection and weed management

The building up and maintenance of a fertile soil is a central goal in organic citrus growing. Careful soil management is especially important in the humid tropics, where heavy rainfall and strong solar radiation accelerate soil degradation, leaching of nutrients and erosion. In everyday practice, there are three main agronomic questions related to soil management that need to be kept in mind during the conversion to organic management of citrus orchards:

1. How to improve soil fertility?
2. How to cover the soil and how to control undesired plants?
3. How to provide sufficient nutrients to the soil and citrus trees?

The basic tools of organic soil management are interdependent and influence tree health, tree development, fruit yield and quality. Therefore, organic citrus growers combine these three questions. Relevant soil management techniques for organic citrus orchards include:

- Use of cover crops (under storey plants) or mulching;
- Agroforestry and intercropping methods;
- Mechanical techniques for weed control.

Soil cover systems

A permanent soil cover is an important component of the organic orchard cultivation system. Locally-adapted leguminous crops for the humid tropics, such as *Teranamus labialis, Arachis pintoi or Neonotonia wightii*, help restore degraded soils very fast, successfully suppress weed, fix nitrogen and prevent erosion (see Basic Manual, chapter 3.4). Suitable management of the cover crop is necessary to avoid too much competition between the cover crop and the citrus. Measures are:

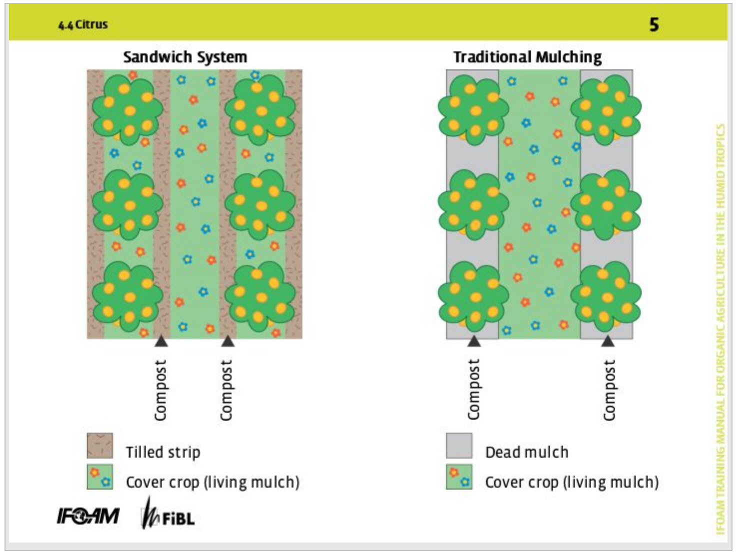
- Mulch the cover crops before the dry season to prevent competition for water.
- Reduce the percentage of living soil coverage to optimally adapt the cover system to the soil, the crop and the climate conditions. One possible solution is the FiBL sandwich-system, which is currently in testing phase.

Weed Control = Soil Cover + Management of Undesired Plants

Discussion:

If possible, go to an orchard or show photos of an orchard and ask the following questions:

- *How can soil fertility be improved?*
- *How can the soil be covered and undesired plants controlled?*
- *How are sufficient nutrients provided to the soil and to the citrus trees?*
- *Discuss different soil cover systems (traditional method, sandwich system).*



TRANSPARENCY 4.4 (5): SHOWING THE LAYOUT OF THE TWO METHODS FOR COVER CROPS

The Sandwich-system is readily feasible for young plantations and in orchards with deep soils, where tree roots are not too close to the soil surface. However, in orchards formerly established with herbicides and soil erosion "dug out" citrus roots are sometimes present. In this case, it would be too harmful for the trees to change to a cultivation system. In these cases, systems with cover crops or organic mulches should be used. In such orchards, the traditional cover crop system is the suitable method.

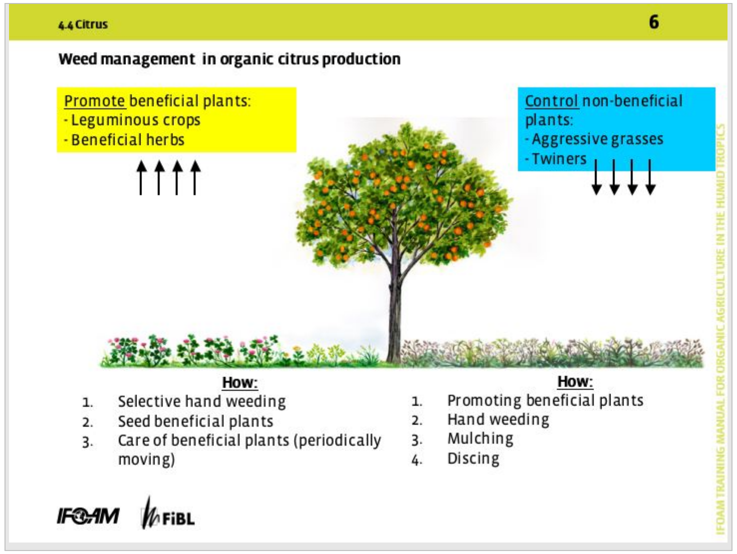
Organic citrus growers distinguish between desired and undesired cover plants, and speak of cover crop management instead of weed control. They do this by sowing competitive cover crops (legumes and other desired plants) to suppress undesired plants such as perennial grasses: e.g. Panicum sp., Paspalum sp. or Amaranthus. Many plants provide good habitats for beneficial insects (especially flowering plants) and/or improve soil conditions without competing with the citrus trees (e.g. Centrosema pubescens, Desmodium, Cassina obtusifolia and Alysicarpus vaginalis). Such cover plants should be encouraged in organic citrus production. However soil cover plants can also provide a habitat for pests and have to be selected carefully.

Undesired plants are best suppressed by:

- regular mowing of the (leguminous) cover crops
- hand weeding if they begins to dominate the cover crops or citrus trees
- mulching and traditional discing

Different types of mowers are available: most can be operated as attachments to a tractor. Specially constructed mowers for organic orchards permit mowing in the alleys and under the trees with sensor controlled bat wings.

Selective biological weed control, e.g. with *Phytophthora palmivera* to control *Morrenia odorata*, and allopathy, e.g. with extracts of Lantana to control rye grass, are considered as future potential methods.



Transparency 4.4 (6): Weed management in organic citrus production

4.4.4 Supplying nutrients and organic fertilization

Tree nutrition in organic citrus growing has the following objectives:

- Guaranteeing sufficient yields and ensuring ideal fruit quality;
- Improving soil microbial life and strengthening plant vitality;
- Minimizing pest and disease problems;
- Avoiding nutrient losses by leaching or volatilization.

Fertilization in organic citrus growing is based primarily on compost. Only if necessary – on the basis of soil and leaf analysis –should additional organic commercial fertilizers be brought in. Appropriate strategies need to be planned according to the soil conditions. For example applications should to be made 2-4 weeks before the expected nitrogen demand of the trees (2-4 weeks before flowering) as mineralization of nitrogen from compost is slow. If nitrogen demand is high (> 50 kg/ha) it cannot be met solely from compost applications.

Ensuring adequate supply of basic macro- and micronutrients

Nitrogen (N):

- Compost: at 10 t/ha around 150 kg N total/ha and 75kg N effective/ha is applied (1-2 applications, mainly in mid-winter);
- N-fixation through leguminous cover crops yields between 40 and 60 kg N/ha;
- Azotobacter bacteria fix additional airborne N;
- Based on soil and leaf analysis, other commercial N-sources can be applied: algae products, vinasse (malt extract) fishmeal or oil, horn meal or guano.

Phosphorus (P) and Potassium (K):

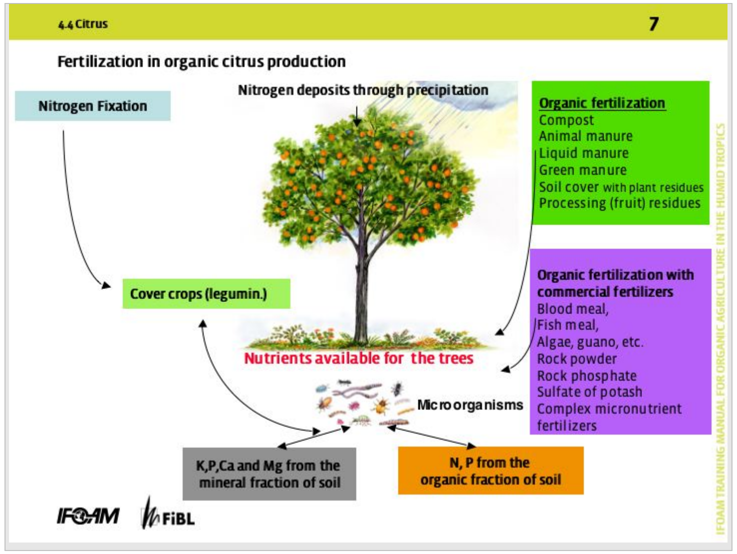
Compost applications mostly provide enough P and K. In case of P-deficiencies, use materials with high P-content (e.g. citrus pulp and peel, chicken or pig manure) or rock phosphate. In case of K-deficiencies, use wood ashes or stone powder.

Magnesium (Mg) and micronutrients:

- Generally abundant in soils of pH 5.5-7. Deficiency symptoms appear only when soil conditions are not favorable. They may be corrected by optimizing pH and improving soil structure and aeration, and by avoiding excessive applications of N, P and K.
- Abundant quantities are applied through compost. If deficiency symptoms persist, magnesium and foliar micronutrients may be applied (e.g. Algae, ground shells, $ZnSO_4$, $MnSO_4$, Borax). Please ask for prior permission with your certifier.

Exercise:

- *Design a compost mixture for your citrus groves, based on available local raw materials (manure, straw, citrus pulp, etc.). Use the Basic Manual as a guide.*
- *Propose how to combine this compost with other nutrient sources.*



TRANSPARENCY 4.4 (7): FERTILIZATION CONCEPT IN ORGANIC CITRUS PRODUCTION

4.4.5 Pest and disease management

Most mites, insects and nematodes that attack citrus cause economic damage only occasionally. Many pest problems in conventional citrus production are related to the almost complete elimination of natural enemies by the excessive use of synthetic pesticides. Organic growers make use of natural control agents to the maximum extent possible. Many pest problems can be controlled effectively with biological control methods. Generally, bio-control methods and agents reduce the levels of pests, rather than eradicating them. Pest and disease management in organic citrus production relies primarily on indirect control methods.

The pressure of pests and diseases in organic citrus groves depends very much on local conditions and indirect management methods. Favorable conditions are:

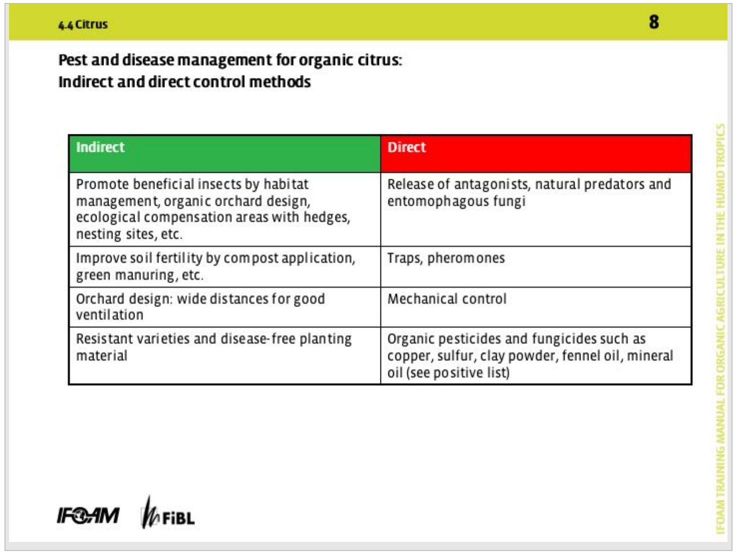
- Ideal design of orchard (wide distances for good ventilation; see chapter 4.4.2);
- Mosaic of production units;
- Diversity of crops and habitats;
- Resistant varieties;
- Farmer's know-how and experience;
- Local availability of bio-control agents, etc..

Examples of pests and organic control methods

The following table (not complete) shows examples of some pest families, featuring only one important species per family (for detailed and complete description of citrus pests, please refer to literature).

Discussion:

- *As a group, exchange knowledge on pest and disease management. Which pests and diseases are predominant? Which approaches do the farmers use to control them? Which antagonists are known?*
- *Discuss the effectiveness of bio-control. The subject may be discussed with reference to, for example, Atta sp., the leaf eating ant that is controlled by the spread of Beauveria bassiana.*



4.4 Citrus 8

Pest and disease management for organic citrus:
Indirect and direct control methods

Indirect	Direct
Promote beneficial insects by habitat management, organic orchard design, ecological compensation areas with hedges, nesting sites, etc.	Release of antagonists, natural predators and entomophagous fungi
Improve soil fertility by compost application, green manuring, etc.	Traps, pheromones
Orchard design: wide distances for good ventilation	Mechanical control
Resistant varieties and disease-free planting material	Organic pesticides and fungicides such as copper, sulfur, clay powder, fennel oil, mineral oil (see positive list)

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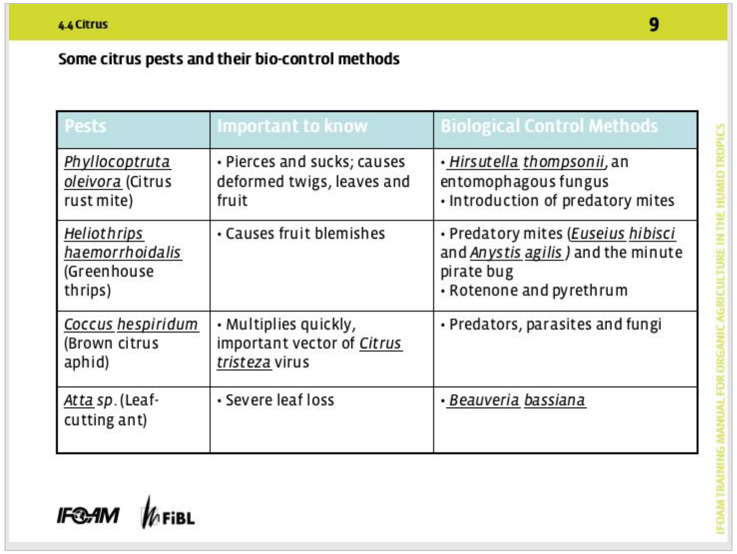
TRANSPARENCY 4.4 (8): PEST AND DISEASE MANAGEMENT FOR ORGANIC CITRUS – INDIRECT AND DIRECT CONTROL METHODS

Citrus pests and organic management

Pests	Important to know	Biological control methods
Eriophyidae: *Phyllocoptruta oleivora* (Citrus rust mite)	• Damage results from feeding by piercing and sucking • Causes deformed twigs, leaves and fruits • Mites can only be observed with a lens	• Application of *Hirsutella thompsonii*, an entomophagous fungus (in many cases this fungus is present naturally) • Introduction of predatory mites
Aphididae: *Toxoptera citrisidus* (Brown citrus aphid)	• Population increases very fast on spring leaves and flushes • Usually does not cause economic damage, but an important vector of Citrus tristeza virus (CTV)	• A number of predators, parasites and fungi can help to control the brown citrus aphid • Bio-control methods and agents usually decrease pest levels, rather than eradicate them
Curculinoidae: *Pachneus citri* (Citrus root weevil)	• Larvae fall to the ground and infest the root system	• Apply entomophagous fungi such as *Beauveria bassiana,* or *Metarrhizium anisopliae* that attack the larval stage in the ground • Introduce predators and parasites
Formicidae: *Atta sp.* (Leaf-cutting ant)	• Cause severe leaf loss	• Application of *Beauveria bassiana* to the soil; the fungi parasitize the nests of the ants
Lepidoptera (order): *Phyllocnistis citrella* (Citrus leaf miner)	• Generally does not cause economic damage • Occasional leaf or fruit damage	• Release of several predators and parasites
Trypetidae: *Ceratitis capitata* (Mediterranean fruit fly)	• Adults oviposit in the immature fruit and the larvae feed and develop in the fruit pulp	• Mass trapping (combination of food baits with organic insecticides, such as Spionosad) • Release of the braconid parasite *Diachasmimorpha tryoni* and nematodes • Sterile insect technology (STI) is not permitted in organic agriculture


4.4 Citrus 9

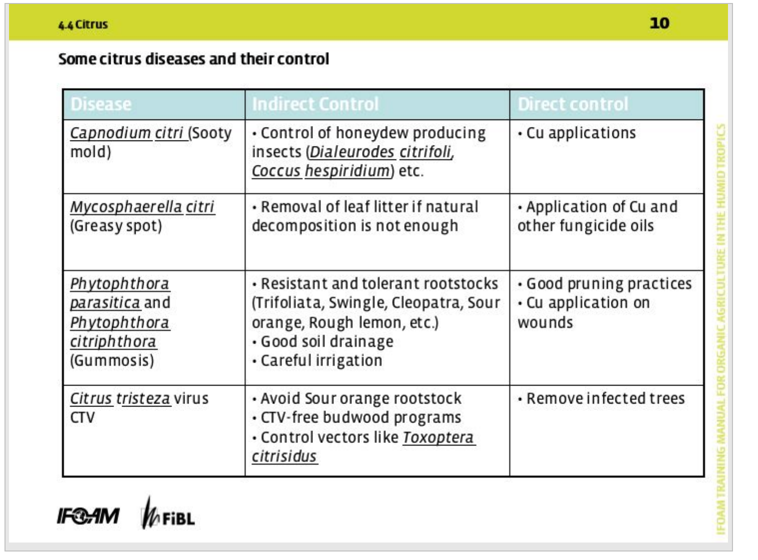
Some citrus pests and their bio-control methods

Pests	Important to know	Biological Control Methods
Phyllocoptruta oleivora (Citrus rust mite)	• Pierces and sucks; causes deformed twigs, leaves and fruit	• *Hirsutella thompsonii*, an entomophagous fungus • Introduction of predatory mites
Heliothrips haemorrhoidalis (Greenhouse thrips)	• Causes fruit blemishes	• Predatory mites (*Euseius hibisci* and *Anystis agilis*) and the minute pirate bug • Rotenone and pyrethrum
Coccus hespiridum (Brown citrus aphid)	• Multiplies quickly, important vector of *Citrus tristeza* virus	• Predators, parasites and fungi
Atta sp. (Leaf-cutting ant)	• Severe leaf loss	• *Beauveria bassiana*

TRANSPARENCY 4.4 (9): CITRUS PESTS AND THEIR CONTROL

Citrus diseases and organic management

Disease	Important to know	Indirect control	Direct control
Capnodium citri (Sooty mold)	• Fungi that grows on leaf surface • Honeydew from insects promotes sooty mold	• Control of honeydew producing insects (*Dialeurodes citrifoli, Coccus hesperidium, etc.)*	• Cu applications
Mycosphaerella citri (Greasy spot)	• Causes serious yield loss in humid climates • Yellow module on the upper and lesions on the lower surface • Blotchy areas on grapefruit	• Removal of leaf litter if natural decomposition is not sufficient (this practice may not be economically feasible)	• Applications of Cu and other permitted fungicide oils
Phytophthora parasitica and *Phytophthora citrophthora* (Gummosis)	• Causes root rot and gummosis • Root and trunk infections decrease tree vigor and productivity	• Resistant and tolerant rootstocks (Trifoliata, Swingle, Cleopatra, Sour orange, rough lemon etc.) • Good soil drainage • Careful irrigation (avoid flood irrigation and irrigation directly on the trunk)	• Good pruning practice • Cu applications on wounds (Bouille bordelaise 2% and cover with wax)
Citrus tristeza virus CTV	• Virus is transmitted by budding and by aphid vectors • Trees are stunted and remain small, leaf chlorosis, reduced fruit size	• Avoid sour orange rootstock • CTV-free budwood programs • Control vectors like *Toxoptera citrisidus*	• Remove infected trees



Disease	Indirect Control	Direct control
Capnodium citri (Sooty mold)	• Control of honeydew producing insects (*Dialeurodes citrifoli, Coccus hespiridium*) etc.	• Cu applications
Mycosphaerella citri (Greasy spot)	• Removal of leaf litter if natural decomposition is not enough	• Application of Cu and other fungicide oils
Phytophthora parasitica and *Phytophthora citriphthora* (Gummosis)	• Resistant and tolerant rootstocks (Trifoliata, Swingle, Cleopatra, Sour orange, Rough lemon, etc.) • Good soil drainage • Careful irrigation	• Good pruning practices • Cu application on wounds
Citrus tristeza virus CTV	• Avoid Sour orange rootstock • CTV-free budwood programs • Control vectors like *Toxoptera citrisidus*	• Remove infected trees

TRANSPARENCY 4.4 (10): SOME CITRUS DISEASES AND THEIR CONTROL

4.4.6 Water management and irrigation

Citrus trees are water-conserving plants: they have leaves covered with epicuticular wax and are capable of withstanding long periods of drought. However, even in humid subtropical and tropical regions with sufficient total rainfall, irrigation is important during the dry periods to achieve good yields. Regular, moderate irrigation reduces physiological fruit drop, improves flowering, fruit set, fruit size and juice content. On the other hand, excessive irrigation can negatively affect fruit quality as the soluble solids and acidity decrease through dilution.

High water quality (preferably filtered) with no chemicals, heavy metals, toxic bacteria and with low salinity levels is essential. Regular water analysis is compulsory for organic certification.

4.4.7 Other maintenance methods

Pruning

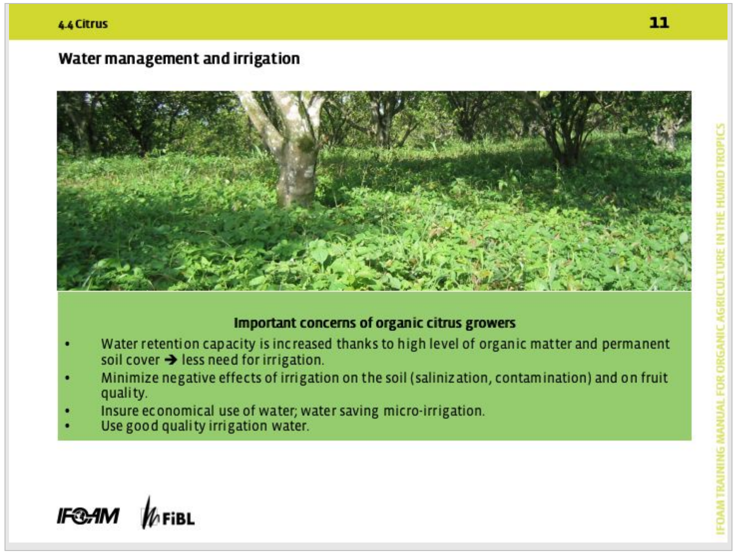
As the trees grow, the inner and lower branches become shaded. Most of the fruiting occurs on the outer periphery of the canopy and the inner parts, suffering from shading, have bad or no fruits. This problem can become especially severe in high-density plantings. Therefore, a yearly pruning is essential to maintain light and air penetration. Good aeration also contributes to the prevention of pests and diseases. It is advisable to maintain the tree height at no more than twice the planting distance in the row.

Common methods of tree size control include hand pruning, mechanical hedging and topping. Three major types of pruning cuts are heading back, thinning out and selective pruning, the later especially after Phytopthora infections.

Pruning is done in winter or during the vegetative resting period of the trees. Hedging and topping to control tree growing is carried out during the vegetation phase. If alternate fruit bearing is a problem, it can be controlled by fruit regulation (picking out excess fruit) after flowering.

Sharing experiences:

- *Go to a farm and get participants and farmers to discuss the need for irrigation and its advantages and disadvantages.*
- *Propose water-saving irrigation systems.*



TRANSPARENCY 4.4 (11): WATER MANAGEMENT AND IRRIGATION

4.4.8 Harvesting and post-harvest handling

Harvest

Unlike some other fruit species, all citrus only ripens on the tree. Before harvest, samples of oranges from a particular block should be tested for Brix (= total soluble solids TSS) and acidity content. With oranges, the ratio varies during the season, but generally a minimum of 8.50 Brix and a ratio of Brix to acidity content of 10 to 1 or more is required. Citrus orchards are harvested by hand. Fruit is loaded into packing containers and transported to the packing house (for fresh fruit) or processing plant (for juice).

Packing house procedures

Most packing houses follow the same procedure. However, certain treatments applied to conventional fruit are not allowed for organic fruit:

1. **Degreening:** Conventional citrus are treated with ethylene in order to remove chlorophyll so the carotenoid pigments of the skin become brightly visible. This treatment is not allowed for organic citrus. Most customers of organic citrus accept a reduced homogeneity of fruit color. If they don't, fruit will have to be graded for color.
2. **Dumping:** Conventional citrus may be dumped into water that usually contains chlorine and a fungicide to prevent post-harvest diseases. This treatment is not applied to organic fruit, as neither product is permitted in organic fruit handling.
3. **Pre-sizing:** Fruit are presorted manually to remove trash and fruit with obvious defects.
4. **Washing:** Fruit are washed with a mild detergent and rinsed with a water spray in order to remove dirt, insects and loosely adhering mold.
5. **Waxing:** Wax is applied to the fruit after drying. Only natural carnauba waxes are allowed for organic citrus. Synthetic waxes or waxes with fungicides are not allowed for organic products.
6. **Selection:** Fruits are selected by hand for packing.
7. **Packing:** Fruit are packed into several types of containers. Some organic label regulations require, or forbid, specific packing materials.
8. **Storage:** Citrus can be cold stored for 2 months at 0-4°C with very little loss of fruit quality. Controlled atmosphere (CA) storage is an alternative to cold storage, but in many cases it is not interesting because of high costs.

Motivation:

Visit a packing house or/and a processing plan, or invite companies to your training site. Discuss the requirements of organic citrus processing and traceability with the technicians.

TRANSPARENCY 4.4 (12): POST-HARVEST HANDLING OF CITRUS FRUIT

Juice processing

Generally, juice processing is – compared to fresh fruit handling – quite simple under organic rules because juice processing does not require any additives. However, it is important to consult all the processing regulations of a specific label before starting a project (see step 10.):

1. At the processing plant, the trailer load of oranges will be unloaded onto a conveyor belt. From this belt, a random fruit sample is **tested** for juice content and maturity. The most desirable qualities for orange juice are when it contains > 12 % Brix, a 14-16 sugar : acidity ratio, and a juice color score of at least 36.
2. The fruit is then transferred to **storage bins** and labeled according to the juice specification. Later, to achieve optimal juice quality, the oranges are selected and **blended** from the most suitable bins.
3. The fruit is conveyed on a transport belt for a **washing** process.
4. Then, it enters into the processing plant where it is **graded** for bad or damaged fruit. The fruit is then sorted by size and sent to the juice extractors.
5. Inside the **extractors**, before juicing, the peel is pricked to gain its aetheric oils (in a separate process). Then, the juice is extracted.
6. As a next step, the pulpy juice is pumped through a **finisher** (screen) where the pulp and seeds are separated, which, together with the peel, are used for by-products, such as cattle feed or compost (important for organic citrus production).
7. From this point on, the juice may either go directly into a **pasteurizer**, in the case of **Not From Concentrate (NFC),** or to the evaporators, where most of the water is taken out of the juice by heating under vacuum. Then, the juice is chilled until it becomes frozen concentrated orange juice (FCOJ). This process also strips out certain essences and oils.
8. The concentrated juice contains 60-70% Brix. It is pumped into the tank farm, where it is **stored** at about -28 °C, separated by variety and by the Brix (acidity ratio).
9. When ready to ship, the frozen orange is **blended** from the various tanks to meet the customer's demand.
10. The juice is **transported** deep frozen in 200 liter barrels or in bulk tank ships to the destination port, and from there to the packager, where juice is bottled and labeled. A few organic label organizations do not allow the reconstitution of concentrate with water to single strength juice. In this case, single NFC-juice has to be produced right from the start.
11. **Re-dilution**: some labels do not accept re-dilution of concentrate (filling industry).

4.4.9 Economic and marketing aspects

For the majority of citrus producers, economic and commercial considerations are of great importance. The decision to convert to organic production is always related to the future development of a farm and generally towards ways of increasing the farm's profitability.

Economic challenges

- Find additional labor for intensive organic management practices (e.g. compost production and application, cover crops).
- Find ways to substitute expensive imported inputs by low-cost alternatives (e.g. own production of seeds for cover crops).
- Factors that increase (e.g. compost) and factors that decrease (e.g. plant protection) production costs.
- During the conversion process, yields may be lower and investments higher.

Marketing and trade challenges

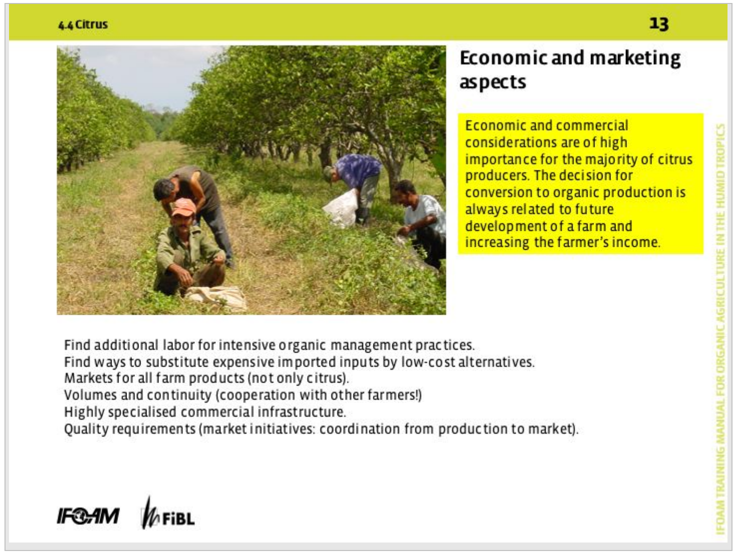
- Distance (transport, competition, post-harvest treatments).
- Success of an organic farm: markets for all farm products (not only citrus).
- Volumes and continuity (large quantities for juice, cooperation with other farmers for fresh fruit).
- Limited access to a premium market (market information is important).
- Highly specialized commercial infrastructure (fresh fruit and juice logistics).
- Quality requirements and organic certification (market initiative: coordination from production to market).
- Tariffs and import fees.

Further reading

Organic Fruit and Vegetables from the Tropics. Market, Certification and Production Information for Producers and International Trading Companies, United Nations, New York and Geneva, 2003.

***Group work**:*

- *In groups, analyze the most important economic and marketing challenges for organic citrus production.*
- *Propose ways to substitute expensive imported inputs by low-cost alternatives.*
- *Propose a market initiative and way to cooperate in citrus marketing in a producer group.*



TRANSPARENCY 4.4 (13): ECONOMIC AND MARKETING ASPECTS

4.5 Mango

Introduction

The mango tree (*Mangifera indica* L.) originates from the Indo-Burma monsoon region. Organic mangos are produced in many different countries in the Americas (e.g. Mexico, Costa Rica, Peru, etc.), Asia (India, Sri Lanka, etc.) and Africa (South Africa, Ghana and Rwanda, etc.). Due to its sensitivity to transport, there is limited international trade in fresh fruit. However, there is considerable market interest for processed organic mango (e.g. juices).

Lessons to be learned:

- *Agroforestry in combination with small animals is advisable and works well in organic mango production.*
- *Mango is ideal for low-input agriculture.*
- *Adequate pruning helps to keep diseases under control and to maintain a healthy organic plantation.*

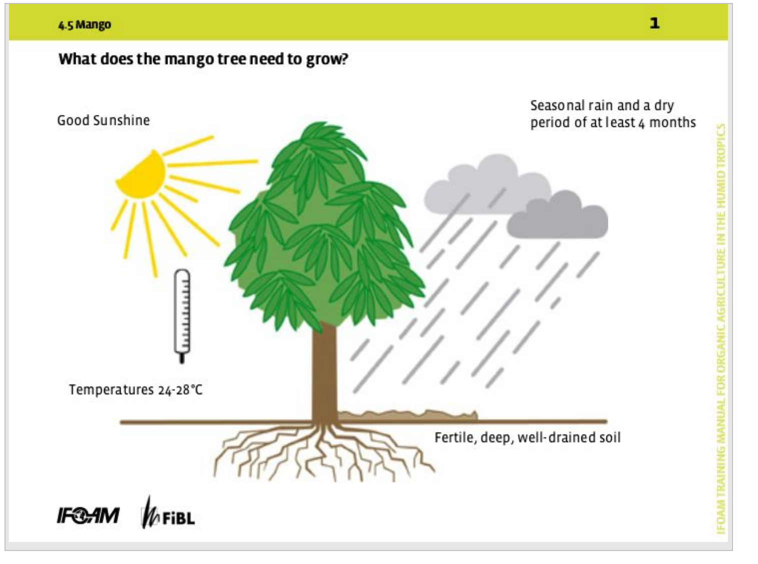
4.5.1 Agroecological requirements

The ideal climate for mango ranges from sub-humid tropical to sub-arid subtropical, wherever a dry period exists. Mango trees show excellent growth in tropical summer, rainy areas with precipitation between 800-1000 mm and temperatures ranging 24°C - 28°C. Even though mango has extensive foliage, it surprisingly resists drought periods. Mango needs dry periods of at least 3-4 months and cool temperatures to foster the flowers and fruit formation. A period of respite in the growth of vegetation is necessary to induce flowering.

Mangos can be grown successfully in a wide range of soils. A healthy high yielding plantation is nevertheless possible only on fertile, deep (at least 1 m) and well-drained ground. Most cultivars are sensitive to frost.

Motivation:

Collect information from the trainees about the local mango varieties, their attributes, such as taste and aroma, and their cultivation. Ask them what they know about its requirements, and the advantages of local practices. Are these practices suitable for organic production? Explore the marketability.



TRANSPARENCY 4.5 (1): WHAT DOES THE MANGO TREE NEED TO GROW?

4.5.2 Diversification strategies

Orchard design

The method of planting depends on the way that they are being cultivated and the site conditions. In humid tropic areas, where mango is the main fruit in the orchard, a 10 X 10 m spacing of trees together with good fertile soil and plenty of precipitation are desired.

Since mango trees grow slowly, it can take a relatively long period (up to 15 years) until the trees cover the area that was left for their development. During this development period, there are several possibilities to use the available unoccupied cropping area. The importance of diversification in organic mango production offers the following advantages:

- Better use of the ground and aerial space
- Diversification of the products in the farm, which helps assure the income of the farmer
- Protects the soil from erosion
- Improves the soil fertility (e.g. use of legumes)
- Helps to reduce pests and diseases, thanks to higher density of beneficial insects and plants
- Improves the regulation of weeds and undesired plants through higher competition
- It is possible to include animals onto pasture grasses growing under the mango trees

Possible diversification

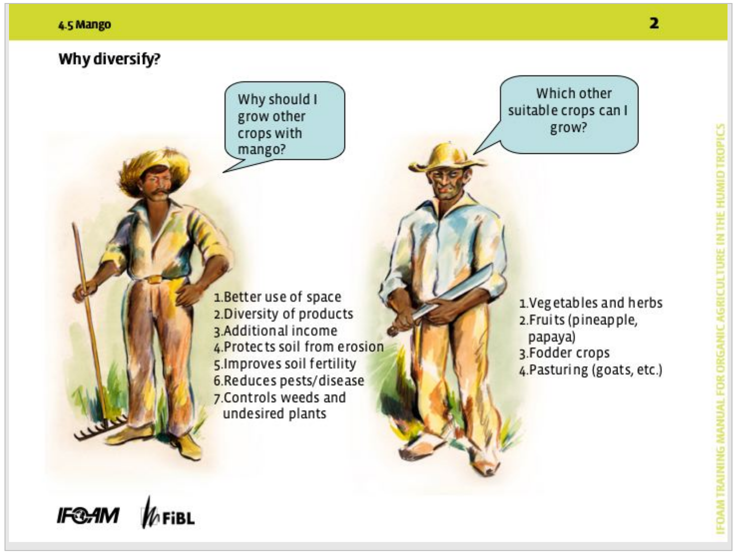
Different plants can be grown under the foliage of the mango tree if the local conditions (soil, precipitation, air humidity) permit. Therefore, mango can be grown organically in plantations, as a border tree in cultivated areas, in home gardens, in intercropping systems, (e.g. mango used as a superstructure tree), in very diverse agroforestry systems or in silvi-pastoral systems (using small animals, such as goats).

Diversification of mango plantations

Organic mango plantations should preferably be intercropped for two reasons: intercropping reduces pest and disease pressure by stimulating higher populations of beneficial organisms and the yield fluctuations in alternate good and bad years can be compensated by the harvest from the companion crop.

Discussion:

Ask the participants to describe the benefits of diversification in organic mango production and which diversification strategies are relevant to local conditions (refer to IFOAM Basic Manual, chapter 4.2). Support the discussion with the following slide.



TRANSPARENCY 4.5 (2): WHY DIVERSIFY?

If the area between the organic mango trees is to be used as arable land, a proper system of crop rotation should be planned. During the early stages of development of the mango trees, a crop rotation with annual crops such as herbs, hibiscus, bush beans, vegetables, cereals and fodder crops can be grown. Depending on the amount of shade given by the trees, it can be possible to grow crops such as tomatoes, eggplants and bell peppers. If the local climatic and soil conditions permit, the growth of crops like papaya (3-5 years cropping vegetation period) and pineapple (2-3 years) can be included in the plantation (intercropping).

Another possibility to enhance diversification in mango orchards is to allow the spontaneous growth of flora (bushes, flowers, etc.) on the borders or between the trees, to create ecological niches.

Criteria to be taken into account in organic mango intercropping systems:

Intercropped plants and green cover crops should not be irrigated during the dry period (at least 2 -3 months) because mangos will not form enough blossoms.

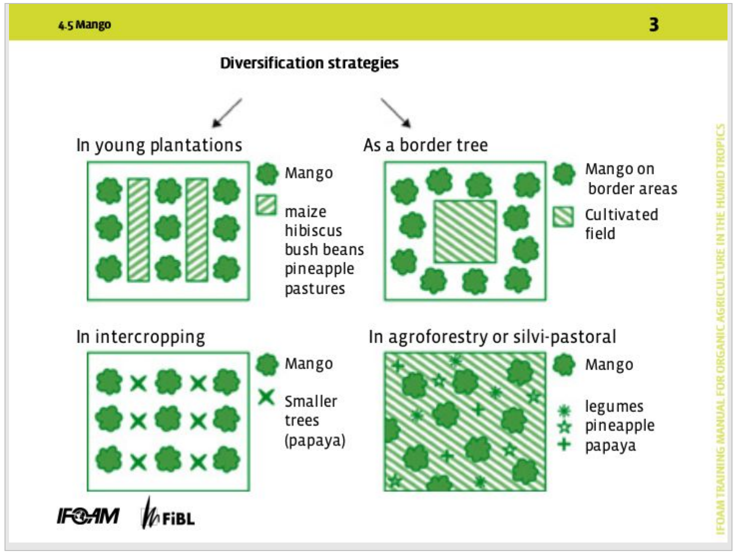
The bottom crop should not contain a high percentage of legumes because nitrogen accumulation in the soil will promote vegetative growth and limit fruit production. Excessive fertilization of the companion crops, or the mango trees, with organic nitrogen fertilizers (compost, liquid manure etc.) may cause the same effect.

Mangos in border areas of cultivated fields

Mangos can also be used as border trees and help improve farm diversification. They can protect the soil and crops against wind and enhance the income of the farmer.

Mango in agroforestry or silvi-pastoral systems

Agroforestry systems with mangos can also include banana, papayas, pineapple, cacao, etc.. Another alternative is a silvi-pastoral system in which animals graze on grasses growing under the trees.



TRANSPARENCY 4.5 (3): DIVERSIFICATION STRATEGIES

Group work:

Divide the participants into two to three groups. Ask them to draw on a sheet the diversification types as they may have seen or think would be appropriate in mango, according to their cropping conditions. Ask the participants what factors they must consider while deciding on the suitable crops for intercropping, in agroforestry or silvi-pastoral systems.

Suitable cultivars

The main characteristics that differentiate varieties are the fruit shape, size, aroma, sourness, color, fiber content, taste, seeds and resistance to disease. The selection of a mango cultivar for an organic plantation has to take into account the following:

- Good adaptation to the local conditions (e.g. precipitation and dry periods)
- Alternation of the flowering and fruiting (depends much of the variety)
- Resistance to pests and diseases (e.g. Anthracnose, bacterial black spot, etc.)
- The market and the use (e.g. fresh, dry, pure)

Sharing experiences:

Note down the common varieties grown in the region and involve the participants in the discussion about the difference of these varieties, in fruit (form, size, texture and use), flowering time, propagation methods, resistance to pest and diseases, etc.. They should explain the advantages and disadvantages of the varieties to be grown organically.

4.5 Mango **4**

Some mango varieties and their traits

Varieties	Fruit size (grams)	Degree of alternation	Susceptibility to Anthracnose[1]	Susceptibility to bacterial black spot[1]	Maturation
Haden	300-450	Low	Susceptible	Highly susceptible	Early
Irwin	300-450	**	Highly susceptible	Susceptible	Early
Keitt	450- >600	Regular	Moderately resistant	Highly susceptible	Late
Kent	450-600	Low	Highly susceptible	Highly susceptible	Intermediat e
Tommy Atkins	450-600	Low	Moderately resistant	Susceptible	Early

***= No data*

Source (1): Plant Pathology Fact Sheet

IFOAM TRAINING MANUAL FOR ORGANIC AGRICULTURE IN THE HUMID TROPICS

TRANSPARENCY 4.5 (4): SOME MANGO VARIETIES AND THEIR TRAITS

Propagation and nursery management

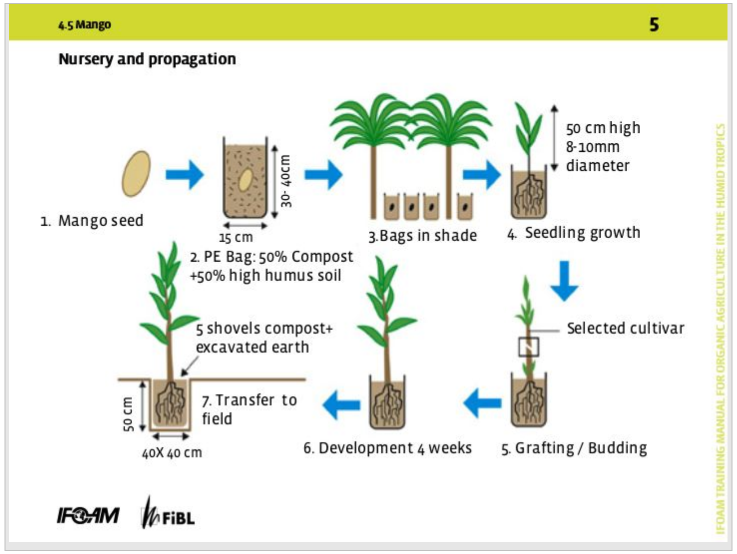
Organic mango producers can obtain their own planting material by using seeds for the rootstock and by grafting with a selected cultivar. Mango seeds for rootstock are selected from healthy mother plants with strong growth. The producer should take care that the seeds are free of any infection, without dry soil particles on them (a preventive measure to avoid possible infestations with diseases). They should be slit a little to help the embryo to germinate (or eliminate the endocarp, the hard part of the seed). For the nursery, polyethylene bags (PE-bags) with a diameter of 15 cm and a depth of 30 to 40 cm are used. These bags should be filled with a mixture of 50% good compost and 50% of soil with a high humus content (this soil should not be taken from intensively used land). The nursery should preferably be in the shade (e.g. shaded roof, palm leaves). When the seedlings are about 50 cm in height and 8-10 mm in diameter, they are grafted with the selected cultivar.

The cultivar is selected from a mother plant with strong foliage development, the desired fruit type and a good flower formation and fruit production history. For grafting, young and woody cultivars should be selected which should be less thick than the seedlings. The length of the scion should be about 10 cm. One week prior to the cutting of the cultivar, all of its leaves should be removed. During the nursery period, care should be taken to avoid possible pest and disease infestations by using preventive measures (e.g. flora diversification around the nursery area, good protection of the seedlings in shaded areas, appropriate watering of the seedlings, using a soil mixture substrate of good quality, etc.) and, if necessary, direct control of pests and diseases.

After grafting, the seedlings are grown for 4 weeks in the nursery before they are planted in the field. The plant hole should be, depending on the local conditions, at least 40 x 40 cm wide and 50 cm deep. The soil should be mixed with about 5 shovels of good compost. One part of this soil mixture is placed at the bottom of the plant hole to improve contact with the soil. Then, the seedling is planted using the rest of the soil to fill up the hole. To reduce irrigation needs the planting may be carried out at the beginning of the main rainy season.

Steps for obtaining mango seeds

- Select mature fruits.
- Eliminate the endocarp of the seed (hard part) to obtain a higher germination rate and eliminate possible pests.
- Sow the seeds as soon as possible in polyethylene bags.



Transparency 4.5 (5): Nursery and propagation

Discussion:

Participants should discuss the organic nursery management according to their local conditions. Write down the results of the discussion and make this available to the participants.

Alternation of flowering and fructification

Alternation of flowering and fructification is still a problem in organic mango production, especially in humid areas. This problem is characterized by alternate production cycles of abundant flowers and fruits in one year, with low flowering and fructification the next year. The productive year is called the "on" year and the unproductive year is called the "off" year.

Young grafted trees may flower in the first years, but fruit formation should be avoided as it can considerably affect the growth of the tree. All blossoms should be plucked away until the fourth year. Afterwards, the flowers should be permitted to develop naturally.

The alternation of flowering and fructification in mango tree is caused by many different factors. For example:

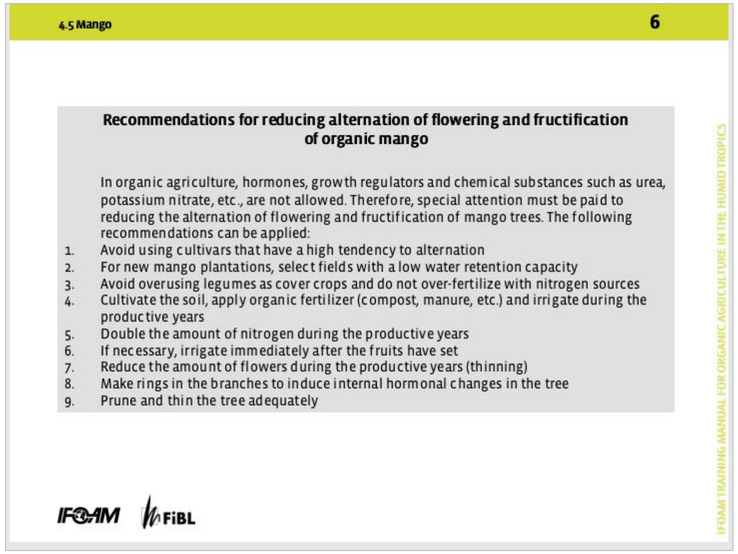
Biological factors: varieties differ in the level of alternation, younger plants tend to have more pronounced alternation and environmental growing conditions can affect the varieties (e.g. varieties that flower regularly in one region can have a strong alternation in different regions).

Physiological factors: the high C/N ratio in the plant promotes flowering, and the balance of available nutrients plays an important role in the flowering and fructification stages (e.g. there is a critical relationship between the nitrogen content in the plant and the alternation of flowering in mango). Phytohormones have an important function in all physiological processes.

Environmental factors: mango is sensitive to climatic variation (e.g. a reduction in the radiation causes an alteration in mango flowering and fructification), low temperatures at night and a dry climate improve flower formation. Strong rains and soils with high water retention capacity limit the production of mango by encouraging excessive vegetative development. Strong winds may cause the flowers to drop.

Regulation of the alternation of flowering and fructification

In commercial organic mango, good organic agricultural practices (fertilization, pruning, control of pests and diseases, etc.) may reduce the alternation of flowering and fructification. However, other alternatives can be used in organic production. Show the transparency to the participants and explain the issues.



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Recommendations for reducing alternation of flowering and fructification of organic mango

In organic agriculture, hormones, growth regulators and chemical substances such as urea, potassium nitrate, etc., are not allowed. Therefore, special attention must be paid to reducing the alternation of flowering and fructification of mango trees. The following recommendations can be applied:

1. Avoid using cultivars that have a high tendency to alternation
2. For new mango plantations, select fields with a low water retention capacity
3. Avoid overusing legumes as cover crops and do not over-fertilize with nitrogen sources
4. Cultivate the soil, apply organic fertilizer (compost, manure, etc.) and irrigate during the productive years
5. Double the amount of nitrogen during the productive years
6. If necessary, irrigate immediately after the fruits have set
7. Reduce the amount of flowers during the productive years (thinning)
8. Make rings in the branches to induce internal hormonal changes in the tree
9. Prune and thin the tree adequately

IFOAM TRAINING MANUAL FOR ORGANIC AGRICULTURE IN THE HUMID TROPICS

TRANSPARENCY 4.5 (6): RECOMMENDATIONS TO REDUCE THE ALTERNATION OF FLOWERING AND FRUCTIFICATION OF ORGANIC MANGO

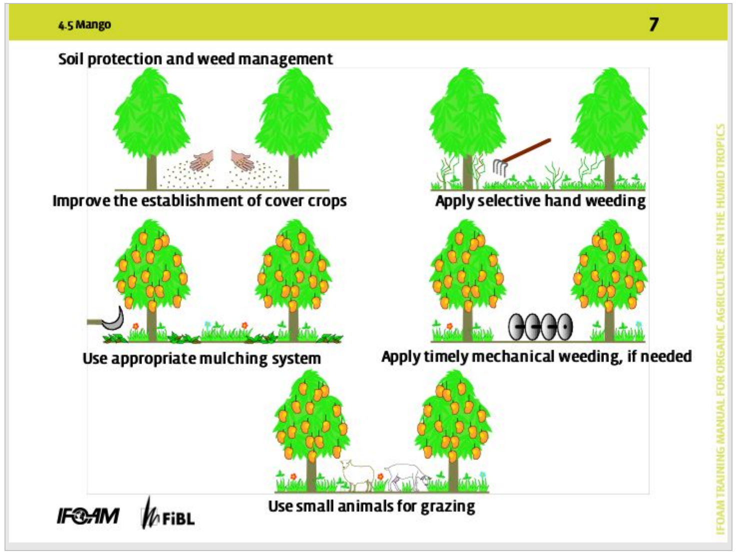
Sharing experiences:

Ask the participants which other measures they have used in order to reduce the alternation of flowering and fructification in organic mango. Write down the results and discuss the advantages and disadvantages of the mentioned measures.

4.5.3 Soil protection and weed management

One of the main challenges in organic mango production is maintaining the soil fertility in areas with heavy rainfalls and high temperatures. Farmers have to implement proper management strategies to avoid the degradation of their land and soils. The following management strategies for soil protection and weed management in organic mango are recommended:

- Promote and improve the establishment of cover crops, especially legumes (Teranamus labialis, Arachis pintoi, Neonotonia wightii) and other desired spontaneous plants in order to have a permanent soil cover. The management of cover crops generally consists of regularly mowing and, if necessary, selective hand weeding of undesired plants that compete with the cover crops or mango trees (especially climbing herbs and tall grasses). The vegetative organic material left on the soil surface provides a mulching layer that protects the soil and positively influences its water retaining capacity. Spontaneous vegetation may be left to grow and then cut down when it blossoms in order to encourage the establishment of useful insects and to allow higher floral diversification.
- Use an appropriate mulching system, for example the sandwich system. See chapter 4.4.
- When intercropping is practiced, weed management strategies have to be planned according to the under crop used. For example, apply mechanical weeding where the under crops will grow.
- Another method to control weeds is to use small animals (goats, geese, turkeys, etc.) or cattle to pasture under the mango trees. The farmer must be careful in not over-pasturing and in keeping the animals under control in order to avoid damage to the mango trees, especially in their early stages of development.



TRANSPARENCY 4.5 (7): SOIL PROTECTION AND WEED MANAGEMENT

Group work:

Divide the participants into two or three groups. Ask them to formulate weed management strategies according to the local cropping conditions. Each group should present its results.

4.5.4 Supplying nutrients and organic fertilization

The nutrient requirements of mango are relatively low. Nevertheless, the availability of nutrients for growth and flowering is an important concern in organic mango production. The periods of highest uptake of nutrients coincide with the stages of intensive vegetative development, which is the critical period for applying organic fertilizer. The Haden cultivar (selected and named in Florida), for example has three intensive vegetative cycles: after harvest, before flowering and at the end of the fruiting stage. Fruits account for about one third of the mango tree's nutrients uptake, in particular nitrogen and potassium. For example, a yield of 16 tons of fruit per ha represents an extraction of 23 kg N, 3 kg P and 25 kg of K per ha. Annual yields of mango trees under optimal conditions can be between 10 - 30 t/ha. Under suboptimal production conditions, they vary between 5 and 15 t/ha. However, single tree yields can vary from 100 to 500 kg, even when all optimal conditions, agroecological and nutritional, are met (depending also on the varieties). The demand for nutrients also depends on the stage of growth. The following growth periods can be distinguished in mango trees:

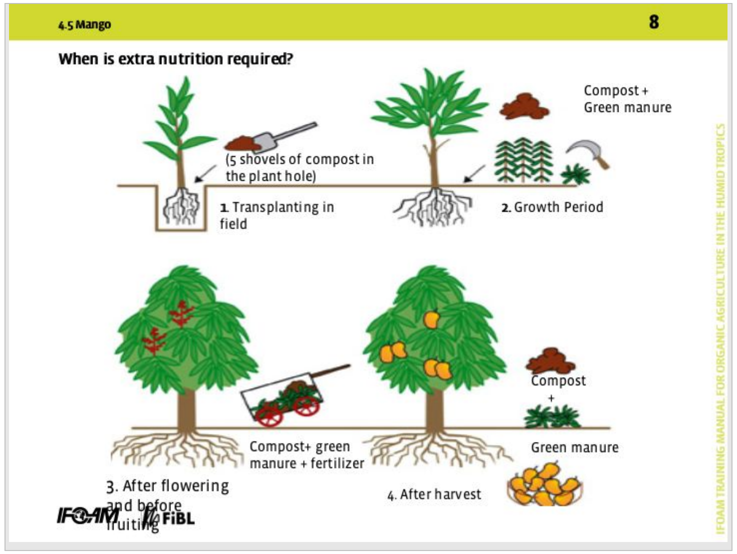
- Growth period: strong leaf growth and continuous increments in fruit production. This period lasts from 2 to 8 years.
- Full production period: stage where there is a fine relationship between the increment of the foliar volume and the number of produced fruits. The trees' maximum yield period is when it is 9-14 years old.
- Production period: characterized by a gradual increase in the foliar volume and a tendency to maintain broadly consistent fruit production levels from year to year (15 - 28 years old).
- Senescence period: characterized by a low foliar increment and strong diminution in yields.

Depending on the agroclimatic characteristics, soil conditions, morphological development and varieties, the following general nutrient supply measures might be taken:

- During the early development of the mango tree (the first three years), a regular supply of compost and green manure is provided to improve the foliage development.
- As soon as the mango tree produces fruits (from the fourth year onwards), a supply of organic fertilizer (compost, manure, etc.) should follow the flowering, so that enough nutrients are available for fruit formation and development. After harvesting, a second application of organic fertilizer can be carried out to foster a new vegetative growth.

Group work:

Organize working groups. Each group should discuss and formulate how an organic fertilization program for mango trees can be implemented according to the local conditions.



TRANSPARENCY 4.5 (8): WHEN IS EXTRA NUTRITION REQUIRED?

Excessive application of nitrogen induces excessive vegetative development of the tree and lead to low yields. This needs to be taken into account when planning green manuring and intercropping of crops such as beans. In addition, while mango has generally low requirements for phosphorus (P), its applications are recommended in new mango plantations in order to improve the root formation of the young trees and to compensate for P fixation in the soil. A further source of P, besides manure and compost, is rock phosphate, which has the benefit of slow dissolution. Potassium plays an important role in the photosynthesis, respiration and circulation of the plant sap and it is the most important element in the fruiting period.

4.5.5 Indirect and direct pest and disease management

Diseases

Most diseases of mango are caused either by fungi or bacteria. The first preventive measure is to obtain healthy vegetative propagation material, free of diseases and pests.

- Anthracnose, caused by the fungus Collectrichum gloeosporioides, is the most common disease of mango, especially in regions with high rainfall and heavy dews. It affects leaves, stems and floral panicles, but damages fruits the most. The fungus causes brown spots on leaves and black spots on fruits and flowers and makes the young branches brittle. The infestation can be reduced if dead material (branches, leaves and infested fruits) is removed from the orchard. The fungi can be controlled with the application of copper compounds. After harvest, anthracnose can be controlled if the fruits are given a water bath for 3-5 min at 55° C.
- Bacterial infection with Erwinia sp. can infect the stems, branches, flowers and young fruits. The symptoms are similar to the spots on the fruits and leaves caused by anthracnose. These bacteria can survive in the soil. During precipitation, the bacteria spores are carried by the water drops to the under leaves and fruits of the tree. Cover crops can reduce infestation of the leaves and fruits. An active and living soil can also reduce bacterial multiplication. Erwinia sp. does not explosively propagate in the soil, but can be a problem if it rains during the period when the mango trees are flowering.
- Young fruits and flowers can be damaged by powdery mildew (Oidium mangiferae). This fungus appears mostly in warm humid weather (temperatures of 22°C or more and relative humidity of 65%). In severe attacks, the entire blossom panicle may be involved and the fruit may fail to set (thereby affecting yields). An open, well-ventilated and faster drying orchard, where the foliage (crown) is regularly thinned out, hinders mildew infestation. In acute cases, mildew can be regulated with a sulfur preparation. During application, the leaves should be still wet from dew and there should be no wind.
- Symptoms of the leaf spot disease (Cercospora mangiferae) are spots on the leaves and fruits. An open, well ventilated and faster drying orchard is the best prevention measure against Cercospora infestation. Infested fruits are not marketable. In addition, the infestation of leaves with Cercospora may help anthracnose disease to establish itself. The fungi can be controlled with the application of copper compounds.

Questions:

Which diseases do you know in Mango? Which are the most troublesome in this area? Have you been able to identify the reasons for the infections and can you suggest possible preventive measures? The IFOAM Basic Manual (chapter 5.1) transparency 5.1.2b may be shown for preventive measures.

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Diseases in organic mango

Diseases	Effects	Preventive Measures	Direct control
Anthracnose Colletotrichum gloeosporioides	•Brown spots on leaves, drop of flowers, brittle branches and black spots on ripe fruit	•Resistant varieties •Regular and sanitary pruning •Open, fast-drying orchard and good ventilation •Avoid damage to fruit	•Application of Cu compounds •Post-harvest treatment of fruits in a water bath (3-5 min. at 55°C)
Erwinia sp.	•Flecks on young leaves and fruits	•Use certified plant material •Active soil life •Cover crops to avoid rain splash •Disinfect pruning tools	•Elimination of damaged trees
Powdery mildew Oidium mangiferae	•White powder on fruits, blossoms and leaves	•Open, fast-drying orchard and good ventilation •Regular and sanitary pruning	•Sulphur application (avoid application at temp. above 31°C to avoid burning)
Cercosporae mangiferae	•Spots on leaves and fruit	•Good ventilation and open, fast-drying orchard •Sanitary pruning	•Application of Cu compounds

TRANSPARENCY 4.5 (9): DISEASES IN ORGANIC MANGO

Pests

The main pests of mango are scales, mealy bugs, fruit flies and black flies (the later forms honey dew, in which a black coating also builds up). These are sucking insects that live on the leaves, young branches and buds and can cause great damage. However, all of them have natural enemies, such as ladybug larvae, wasps and spiders. Some parasitic fungi also predate cicada and black fly. Therefore, improving diversity promotes beneficial insects. In acute cases, the following measures may be taken:

- **Scales** suck the plant sap. Leaves become stunted and turn yellow. Scales can be regulated with an application of paraffin oil (white oil) shortly before the larvae appear. The paraffin oil can be sprayed as a 3% water emulsion.
- **Mealy bugs** deposit their eggs on the trunk under the soil. The dissemination of the larvae can be avoided by wrapping a smooth slippery plastic band around the trunk. Infestations can be controlled by spraying 1% soap solution mixed with 1% pure alcohol.
- **Fruit fly** egg-laying females puncture the fruits leaving scars and holes on the fruit surface. Larval feeding causes premature fruit drop and destroys the pulps of the fruit. Keep the orchard clean; apply plant extracts (neem, garlic, chili, derris, etc.).
- **Cicada** can be regulated with a preparation spray of neem or stinging nettles. The highest damage occurs during flowering. Therefore, the orchard should be carefully checked before and during flowering to ensure timely application of the preparations.
- **Black flies** can also be regulated with beneficial insects, such as *Prospaltella* species. In areas, where *Prospaltella* is not available, sprays with paraffin oil may reduce the infestation. The applications can be carried out shortly before the larvae emerge.

Example: Bio-control of mealy bug in Togo

The mealy bug *(Rastrococcus invadens)* was so serious in countries like Ghana, Benin, Nigeria and Togo that complete trees had to be destroyed. This insect sucks sap from leaves, and its honeydew deposits cause the development of a sooty mold on the foliage. Surveys for bio-control agents identified the wasp species *Gyranusoidea tebygi* (about 1mm in length and yellow brown in color). This wasp develops inside the mealy bug. In 13-16 days the mealy bug mummifies and 7 days later the adult *G. tebygi* emerges. The females begin oviposition 48 hours after emergence and during their 20 day-long life, they parasitize between 70-90 mealy bugs. Since *G. tebygi* has a shorter development time than *R. invadens*, it can pass through almost two generations for each generation of the mealy bug.

4.5 Mango 10

Insects pests – effects and regulation

Pest	Effects	Regulation
Scale Insects	•Loss in vigor and vitality, lower yields	•Check plants for scale infestations regularly •Prune and eliminate infested branches, twigs and fruits •Encourage the establishment of natural enemies •Spray neem leaf extracts, neem seed oil or paraffin oil
Mealy Bugs	•Suck sap	•Clean pruning tools to avoid transporting mealy bugs •Apply adequate sanitation •Wrap smooth slippery band around trunk to avoid spread of larva •Spray 1% soft soap solution (K soap), or chilli extract
Fruit fly	•Cause fruit drop	•Dump infected fruits in 80-100cm deep hole with quick lime or feed to pigs or poultry •Clean soil under trees, avoid refuges, pick up ripe fruit •Set insect traps (jar traps, yellow sticky traps, pheromone traps) •Application of plant extracts (basil, chilli, derris, garlic, neem, etc.)
Cicada	•Damage flowers	•Open, well-ventilated orchards •Avoid flooding soils •Plant mixture of stinging nettles or neem for spraying

IFOAM TRAINING MANUAL FOR ORGANIC AGRICULTURE IN THE HUMID TROPICS

TRANSPARENCY 4.5 (10): INSECT PESTS - EFFECTS AND REGULATION

Sharing experiences:

Ask the participants to identify the main pest that attacks mangos in their region. Make a list. Participants should propose preventive measures and direct control methods that are compatible with organic production..

4.5.6 Water management and irrigation

Generally, young mango trees (1 – 3 years) growing in highly humid tropical regions will not need irrigation for their development. However, the farmer should pay attention that the small trees have enough water during the first three years. For example, newly transplanted plants need about 20-30l of water every 4-5 days during the first 2-3 months of establishment. For the rest of the year, 40-50 l water per mango tree every 10 days is desirable. In the second year, the water requirements increase to 100-150 l water per tree every 10 days. By the third year, a rate of 200-300 l water per tree, every 15 days may be required. Of course, these rates can vary according to local conditions (type of soil and rainfall) and varieties.

At the beginning of the fourth year, the mango trees should be considered as adult and be managed as such. Mango trees that begin to form fruits (4-5 year-old grafted trees), especially in the tropics, should have at least 3-4 months of dry period before the start of flowering, in order to reduce the vegetative phase. After the fruit has set, water can be given, but it should be stopped again as the fruit approaches ripening as dry conditions give higher sugar contents. After harvest, it is recommended to provide a heavy irrigation in order to induce a new vegetative phase.

High quality water (preferably filtered) with no chemicals, heavy metals, toxic bacteria and with low salinity levels is essential. Regular water analysis is compulsory for organic certification.

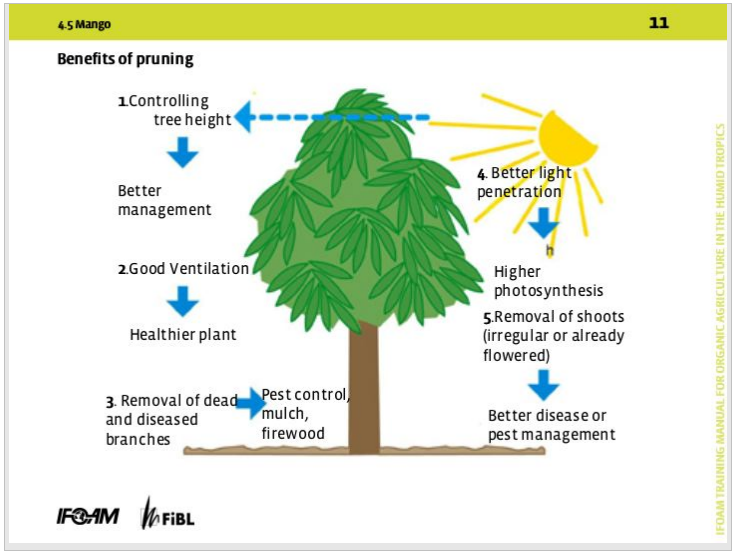
4.5.7 Other maintenance methods

Mango trees usually grow very densely, therefore annual pruning becomes necessary to reduce diseases and pests, to guarantee good ventilation and light penetration. Pruning will involve removing from the orchard, shoots that have flowered (irregular), dead and diseased branches and it will give some control over the trees' height.

If young trees produce too many branches in their early growth period it may be necessary to trim back the tree to single trunk after transplanting. For this purpose, all branches from the base to approximately 1 m height should be pruned. Upon further development of the tree, three or four branches should be left to grow from the leader at different levels and directions.

Demonstration:

Request the participants to move to one corner of the room with all of their things (notebook, umbrella, bag, whatever) and stand as close as possible in an area of say 1m X 1m for 5 mins. Get them to try to move about without leaving the area. How do they feel after 2 mins? Are they comfortable and relaxed, or do they feel like stretching. Then, give the example of a mango tree, with all its old branches, dead and decaying matter around it and describe how important it is to have fresh air. Use this to illustrate the principle of pruning. The participants should describe what pruning strategies they use, and when.



TRANSPARENCY 4.5 (11): BENEFITS OF PRUNING

4.5.8 Harvesting and post-harvest handling

Harvest

An organic mango orchard may produce its first marketable harvest after 4-5 years, depending on the variety and location. The maturity of the fruit is determined with the changes in color, fullness of fruits and a hardened endocarp. The fruits are ready for harvest when the color changes from green to red or yellow. One indicator of maturity is when the endocarp has hardened and there is a yellowing of the flesh near the seed. Since the fruits do not ripen homogenously, continuous checking of changes in the color of the fruits is necessary.

Mangos to be sold fresh are harvested by hand, using scissors. If trees are too high, ladders may be used or a long pole with a cloth bag attached to the tip to hold two or three fruits. If collecting the fruits in a bag, care should be taken not to put too many fruits inside because the pressure can damage the skin and the fruits will lose their market value. Injured or damaged fruits should be separated from healthy ones to avoid possible infection with fungi.

Post-harvest

- **Fresh fruits**

Generally, if the mangos are to be sold as fresh fruits, they must be dipped in a hot water bath (55 °C, 3-5 min) to clean them and then slowly cooled to room temperature. Afterwards, the mangos are dried, sorted, classified, packed and stored before shipment. Stem sap, if any, on the fruit surface should be removed within 24 hours by hand washing to avoid sap burn. Dipping newly harvested fruits in warm water minimizes fruit damage, anthracnose, and stem-end rot infestations.

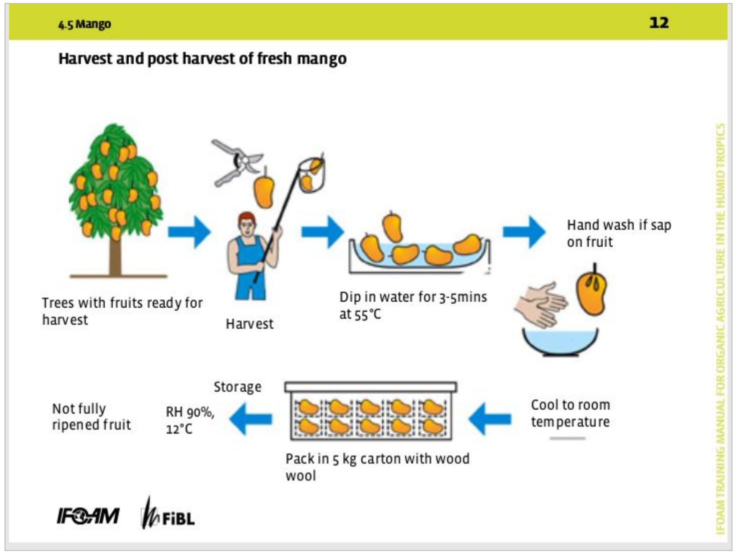
The fruits are assorted and packed in sturdy cartons. Packaging is mostly based upon size, color and features such as defects or damage. For export, the preferred fruit weight is 270 g to 355 g. During packaging, care must be taken that the fruits are not too close to each other. The fruits are packed in single or double-layered cartons with adequate protective material (e.g. wood wool).

Storage

The not fully ripe mangos destined for shipping by sea should be stored at 90% relative humidity and at temperatures of not less than 12°C. This will give them a storage period of about 30 days.

Discussion:

Ask the participants how they harvest the fruits (any special techniques or instruments?), whether they market their fruits locally, what they use to carry them to the market and whether they clean or sort them. Then suggest simple tips on harvest and post-harvest and, if possible, end the class with a slice of mango.



TRANSPARENCY 4.5 (12): HARVEST AND POST-HARVEST OF FRESH MANGO

- **Dried fruits**

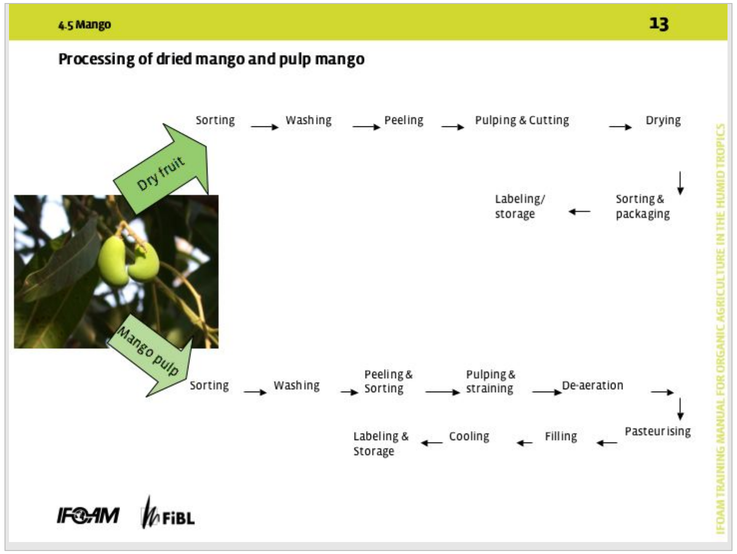
The drying of fruits and vegetables makes it possible to store food for longer periods. Drying makes use of the principle that microorganisms tend to cease growing below a certain level of humidity content. The quality of dried fruits will depend on whether the process to extract the water is carried out as carefully as possible (e.g. with a good circulation of air and not too high temperature).

Sorting: after harvesting, the fruits are sorted, as only fresh unripe and unfermented fruits can be used for drying.
Washing and peeling: mangos must be washed very carefully in order not to damage them. Then, the leaves, seeds, pips, heartwood and skin are removed.
Pulping and drying: the fruits are cut into pieces of the same size and laid out in thin layers on racks, in solar dryers (drying tunnels) or drying ovens (at 70°C) to dry in the air and sun.
Sorting and packaging: before packaging, the fruits are sorted again, to rid them of skin remnants, etc..

Labeling and storage: the packaged fruits are labeled and stored prior to being shipped. It is forbidden to treat the fruits at any time with methyl bromide, ethylene oxide, sulfur oxides or with ionizing radiation.

- **Manufacture of mango pulp**

1. Only fresh, ripe and mold-free fruits are used for mango pulp.
2. The fruits are sorted, carefully washed and peeled. Heat treating makes peeling easier. This can be done by placing them in a 90°C bath for 5 minutes, or for 2-3 minutes in steam.
3. Next the fruits are placed in a straining machine with strong rotors and a sieve with large mesh, where they are reduced in size without harming the pips. The pulp is pressed out while the pips and peel residues are removed at the outlet of the machine.
4. Small pieces of skin and fiber are removed by using machines with different sieves (0.8, 0.6 and/or 0.4 mm). Sieves smaller than 0.5 mm remove all fibers and produce a homogenous product with a longer storage capacity. (To avoid discoloration and loss of vitamin C during storage, it is advisable to aerate the pulp with a suitable aeration device).



TRANSPARENCY 4.5 (13): PROCESSING OF DRY MANGO AND MANGO PULP

5. Finally, the pulp is heated in a heat exchanger up to 95°C for 2 minutes, to kill any microorganisms and to deactivate any enzymes. The mango pulp is poured into tin cans while it is still hot, the cans are sealed while being steamed and the temperature maintained for 5 minutes, before they are rapidly cooled down

After pasteurizing, the pulp can also be cooled down and poured into polyethylene bags placed in 50-200 kg barrels. These are then rapidly frozen, and can be stored at -18°C for up to 18 months. Pulp that has been produced under antiseptic conditions (bag-in-box) can be stored for up to 1 year at room temperatures.

Recommended websites:

- *http://members.tripod.com/Shanthap/mbcover.htm*
- *http://www.agronegocios.gob.sv/comoproducir/ComoProd.htm*
- *http://www.hort.purdue.edu/newcrop/nexus/Mangifera_indica_nex.html*

4.6 Pineapple

Introduction

Pineapple (Ananas comosus (L.), Bromiliaceae family) originates from the South American tropics. Its importance in organic agriculture lies in its suitability for intercropping and agroforestry, utilizing the under space without any special requirements. Organic pineapple is widely cultivated, for example, in Mexico, Central America, Brazil, Ghana, Tanzania, Cameroon, India, Sri Lanka, etc.. The market for organic pineapple is still relatively undeveloped, partly due to challenges in growing techniques (especially induction of flowering).

Lessons to be learned:

- *Pineapple is a half-shade plant ideal for intercropping.*
- *Induction of flowering is a big challenge in organic pineapple cultivation.*
- *Organic pineapple production needs to be well planned.*

Introduction:

Begin the training with simple questions to the participants on how they take decisions to grow organic pineapple. What are the benefits and challenges in growing organic pineapple? What are the differences between organic and conventional pineapple cultivation?

4.6.1 Agroecological requirements

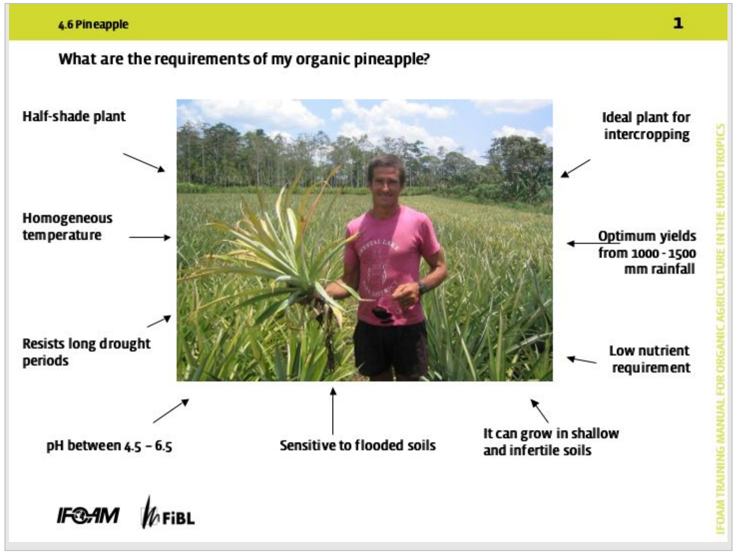
Pineapple is a half-shade plant that naturally grows under trees of a secondary forest ecosystem. Pineapple has the special characteristic that it can close its stomata in the daytime, thus reducing water loss; it can resist long dry periods and take up and retain rain, fog and dew by its leaf axils.

Soil characteristics

The ideal soil for pineapple is friable, well drained, sandy loam with a pH of 4.5-6.5. Pineapple can also be grown in relatively infertile soils and, with appropriate management practices, can be planted in already degraded soils and used to help improve soil fertility. Pineapple is sensitive to flooded soils: good drainage is needed for acceptable growing conditions.

Climate

The pineapple growing zone lies between 25° N and 25° S of the equator. High yields can be obtained in locations where precipitation ranges between 1000-1500 mm (under 600 or up to 2500 mm are the extreme limits). Pineapple prefers homogeneous temperatures. Temperature under 20 °C can disturb the internal metabolism process. Under high solar radiation, the fruits can get sun burn. In warm and humid regions (near the equator), the growing period until harvest is 14-16 months on average.



TRANSPARENCY 4.6 (1): WHAT ARE THE REQUIREMENTS OF MY ORGANIC PINEAPPLE?

4.6.2 Diversification strategies

Pineapple cropping systems

In organic pineapple production there are three cropping systems:

Cropping Systems
1. Rotational cropping with leguminous green fallow, different crops and undersowing of leguminous (e.g. Costa Rica, Nicaragua and Ghana).
2. Pineapple intercropped with mango / papaya / citrus (e.g. Ghana, Mexico, Brazil, Costa Rica).
3. Agroforestry system (e.g. Costa Rica, Uganda, India).

Organic pineapple under rotational cropping system

Field preparation

The maximum potential of pineapple plants can be reached if the planting is carried out on good soil under agroecological conditions. The following preparation creates ideal starting conditions:

- If necessary, subsoil (deep tilling without turning the soil) to improve drainage and soil aeration.
- Sow leguminous crops as a green manure (e.g. Crotalaria juncea, Mucuna capitata, Stisolobium digerianum, Canavalia pubescens and Cajanus cajan).
- Cut or mulch the green manure (3-5 months after sowing).
- Leave the green manure material on the field for some days to dry out.
- Incorporate the green manure superficially (10-15 cm) into the soil.
- If necessary, carry out weed cures and expose the soil's pests and diseases to the sun during soil preparation.
- Compost or animal manure may be added before the final field preparation and planting of pineapple. If necessary, amendments to correct the pH of the soil can be also applied (e.g. application of dolomite rock, according soil analysis).

Discussion:

Discuss the advantages and disadvantages of the three cropping systems: Rotational, Intercropping and Agroforestry, and explain them by giving examples of the different production systems

TRANSPARENCY 4.6 (2): ORGANIC PINEAPPLE CROPPING SYSTEMS

Crop rotation

Organic pineapple should be integrated in a crop rotation with alternative crops, e.g. groundnut, beans, vegetables and rice. After the pineapple has been harvested, an interval of at least 3-4 years must follow. The reasons for establishing pineapple in a crop rotation are:

- Use of leguminous crops as green manure aims to provide nutrients during the development of the new crop and to reduce weeds before the pineapple is established.
- Plants that can be used as under seeding (e.g. Arachis pintoi) may help to suppress weeds during pineapple shoot development.
- Use crops that reduce the risk of soilborne diseases (e.g. nematodes: Rotylenchus reniformis, Meloidogyne javanica, Pratylenchus brachyurus). Avoid crops that are natural habitat for nematodes, such as cow pea, cotton, tobacco and rather use crops that repel them, such as sugar cane, maize, sorghum, pangola grass (Digitaria eriantha) and fox tail grass (Setaria viridis).
- Use crops that can improve the soil fertility after pineapple plantations (e.g. groundnuts, beans).

See also IFOAM Basic Manual, chapter 4.

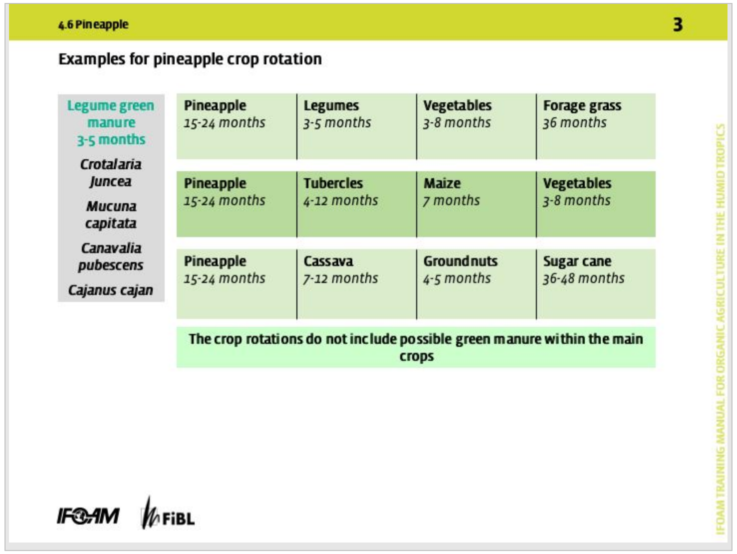
Planting

The selection of the plant material plays an important role in the success in the establishment and development of organic pineapple. Remember: organic pineapple producers do not have the same tools as conventional pineapple producers (rapidly soluble fertilizer, chemical pesticides and fungicides with faster and stronger effects). Therefore, the following points must be kept in mind:

- Prior to planting, select healthy, disease-free offspring of homogeneous size (about 400-500 g), with undamaged suckers and slips and at the same stage of morphological development. This will help establish a uniformly sized plant population and as much uniformity as possible in the ripening of the fruits.
- If possible, obtain the offspring from your own nursery (see establishing propagation material of pineapple) in order to assure the quality of the plant material.
- There should be no soil remaining on the offspring. This is to prevent infection by soilborne fungi such as Phytophthora or nematodes (Rotylenchus reniformis, Meloidogyne javanica, Pratylenchus brachyurus). Care should also be taken that pineapple shoots are not infested with mealy bugs (Dysmicoccus brevipes).

Group work:

Ask the participants to work in groups and design a rotational cropping system that includes pineapple and locally adapted ground crops. The design should take account of advantages and possible limiting factors (pest, diseases, resources for plant nutrition, labor, etc.). The results should be presented by one person from each group and discussed in plenary.



TRANSPARENCY 4.6 (3): EXAMPLES FOR PINEAPPLE CROP ROTATION

- Prior to planting, the pineapple offspring might be dipped in mixture of neem+soap solution as measure against pests (e.g. Dysmicoccus brevipes). Other farmers use extracts of garlic and gavilana (Neurolaena lobata). Please check with your certifier for possible input restrictions.

Planting methods

No single specific planting method is used for organic pineapple. For practical reasons, (plant weeding, undersow of a leguminous, plant protection, etc.), the following methods are used:

- Single, double and multiple row systems (of which the double-row system is most common). The single-row system might be the most appropriate for organic production because it facilitates carrying out a range of different agricultural practices (fertilization, undersowing management, etc.).
- The spacing between plants and between rows depends on the variety (large or small plants), as well as the principal use (plant density for canned pineapple may be less than for the fresh fruit).
- The spacing between plants is 25-35 cm (if plant positions are alternate), with 40-60 cm between the rows and about 75-90 cm between the double rows. For large pineapple varieties, the spacing can be wider (for example: Cayenne requires 90 x 90 cm between plants and 120 cm between double rows).
- The **best planting time** for pineapple offspring (suckers, slips and crowns) is during the rainy season. The soil should not be too wet or too dry and the bud or 'heart' of the sucker should not be buried. Fruit formation during the rainy season should be avoided because this can intensify the incidence of diseases such as Fusariosis (Fusarium subglutinans).

Sharing experiences:

Ask the participants which criteria they use for selecting the proper pineapple plant material. Arouse their interest by asking them their local planting densities and planting methods, and discuss the advantages and disadvantages of the row systems, as well as low and high densities.

TRANSPARENCY 4.6 (4): PINEAPPLE PLANTING METHODS.

Results of a study on the impact and spread of pineapple mealy bug wilt showed that minimizing the plant density reduced the spread of the virus PMWaV-2 and MWP. Therefore, in regions where there is a higher incidence of mealy bug wilt, lower plant density (with less rows) can help prevent the spread of such diseases (e.g. *Fusarium*, virus) and also of some pests (e.g. *Techla basilides*).

After planting, pineapple is harvested for two to three cropping periods. However, shorter cropping periods may assure that plants are more vigorous and less susceptible to pests and diseases (if plants are left to produce for more than three fruiting cycles, the fruits become smaller). Replanting aerial suckers on new ground is the best way to get a new vigorous crop. Planting a different crop on the old pineapple area helps prevent the buildup of weeds, pests and diseases. In some regions (e.g. Mexico), pineapple are left to produce the first harvest, after which the farmers permit the sucker and slips to grow in order to obtain new planting material. For faster development of pineapple shoots, the mother plants are pruned to allow more light and liquid humus is applied to the axils of the plants. The grasses and the broad-leaved vegetation that grow in the pineapple fields are used for pasturing cattle. After pasturing, farmers leave the fields fallow for 3 - 4 years.

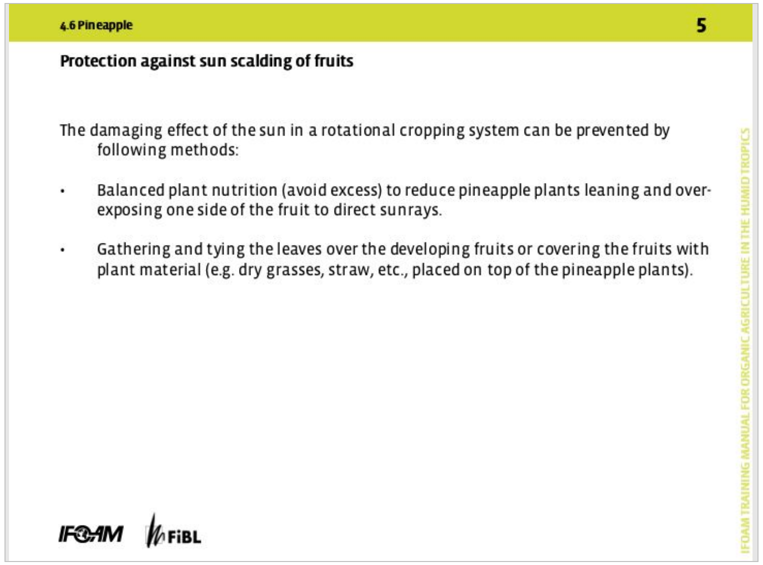
Plant density

- Plant density affects pineapple fruit size, yields per unit area and diseases/pests incidence. In Costa Rica, for example, a group of organic farmers prefers densities of 25000 to 30000 plants/ha because, according to their experience, this gives optimum conditions for fruit formation. Other farmers prefer a higher density, between 35000 and 40000 plants/ha, as this reduces weed incidence by competition. In Mexico, farmers use a plant density of 30000 plants/ha.
- Plant density and other cultural measures (design of plantation) should focus on achieving an appropriate fruit size according to final use (fresh fruit market or processing).

Protection against sun scalding of fruits

In the rotational cropping system, there is no shade for the pineapple plants and intense sunlight can affect the fruits by excessively heating one side of the fruit, especially during the maturation stages. The damaging effects can be prevented by following certain methods (explain transparency).

Discussion:
Discuss with the participants the best planting time in the region, the advantages or disadvantages of leaving pineapple for one or more fruiting cycles and the methods that they use to avoid sun scalding.



TRANSPARENCY 4.6 (5): PROTECTION AGAINST SUN SCALDING OF FRUITS

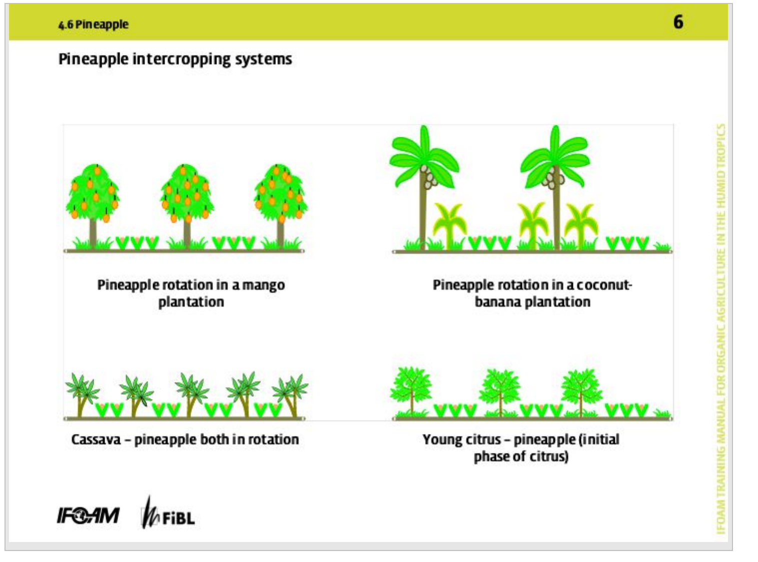
Pineapple grown under an intercropping system

If suitable crops are combined, mixed cultivation can lead to a higher total yield per area. This is basically due to the more efficient use of space (on and under the ground) and because of beneficial interactions between the mixed crops (see IFOAM Basic Manual, chapter 4).

Pineapple can be grown quite well in a mix with other crops. For example:

- In Ghana, organic pineapple is intercropped with mango trees (pineapple is planted in a crop rotation after production of herbs) for three years, at a period when the mangos make little shade in the areas where the pineapple is growing. The first harvest of pineapple is used for full fruiting production. In the following two years, pineapples are produced extensively for further yields and for new plant material (suckers and slips). At the same time animals are left to pasture.
- Pineapple and cassava intercropping is common in regions of Costa Rica. The intercropping is arranged so that the cassava plants shade and protect the pineapple. Both crops can be grown in rotation with beans, sugar cane and grasses.
- In India, pineapple is intercropped with coconut and banana. The pineapple is planted in rotation with ginger/leguminous fodder/medicinal/aromatic plants. This system helps in keeping pest populations at low levels.
- Intercropping of pineapple with oranges (8 x 8 m) is possible in the initial phases of the citrus development (before orange trees enter fruit production, at the age of 3-4 years).

Other crops that can be used for intercropping with pineapple are, papaya (Brazil, Mexico) and cacao (Costa Rica). When intercropping pineapple, attention should be paid to the principles of crop rotation and the characteristics and requirements of the plants so that a high pest and disease pressure and adverse effects on the soil fertility are avoided.



TRANSPARENCY 4.6 (6): PINEAPPLE INTERCROPPING SYSTEMS

***Discussion*:**
Discuss the advantages and disadvantages of intercropping organic pineapple with other crops. Ask the participants to design their own model of intercropping and get them to discuss their reasons for choosing such system, its advantages and possible limitations.

Organic pineapple under agroforestry systems

Pineapple is ideal for production in agroforestry systems. Pineapple, like papaya, is ideal as a ‘nurse plant’ when growing other trees because of its low demand for nutrients. Pineapple needs plenty of light in its early stages, but later, it can do well under thick canopy. Pineapple yields per ha in agroforestry systems are much lower in comparison to field production systems because plant density is lower, between 5000 and 25000 plants/ha.

However, agroforestry systems have greater stability, as they include many crops besides pineapple that also produce yields. Additionally, agroforestry improves the soil fertility (adding nitrogen to the soil if the trees are nitrifying species, such as Leucaena sp.), protects the soils against erosion, adds organic matter by distributing leaf litter, keeps the soil humid by shading the area and covering it with leaf litter (mulch), reducing the weed growth, enhancing diversification of flora and fauna. Overall, it is a more sustainable cropping system.

Example of growing pineapple under agroforestry systems:

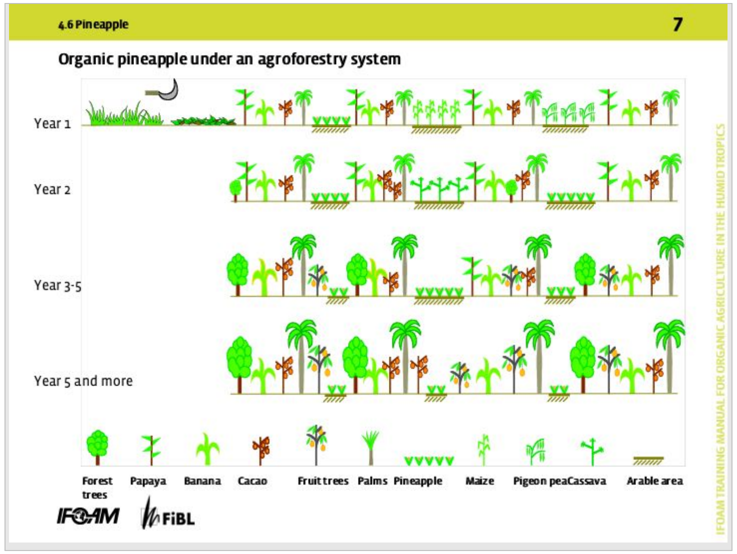
Transformation of grassland into an agroforestry system

- Year 1: begin to transform the grassland into agroforestry. Mulch grass areas and leave the plant material on the surface of the soil as a cover. In alternate cultivated areas (e.g. alley cropping), pineapple, maize, and leguminous plants (e.g. pigeon pea) can be grown alone or intercropped (it is important to maintain an appropriate crop rotation in the cultivated areas). In areas where grass is left as mulch, local and less demanding shrubs and trees are planted in prepared holes (e.g. papaya, banana, cacao, fruit tree, palm tree and seeds of forest trees).
- Year 2: the trees and shrubs that thrive should be cut back and the vegetation spread over the surface. The vegetation of the well-developed trees can then be regularly pruned. Pineapple and cassava can be planted in the areas where other crops (maize and legumes) were grown in the previous year.
- Years 3-5: nutrient-demanding tree species can be sown in places where accumulations of organic material is observed. The areas of pineapple will be reduced progressively.
- Year 5 and after: as soon the trees and fruits shade more areas, pineapple can be planted in appropriate spaces (half shaded areas). If necessary, regulate the shade of trees.

Group work:

Visit a field suitable for implementing an agroforestry system and discuss the following issues:

- *Why is pineapple in agroforestry successful?*
- *When is agroforestry and crop diversification successful?*
- *Can the participants mention examples, based on soil conditions and plant diversification, where agroforestry is a better solution than rotation or intercropping?*
- *Can the participants find examples of how agroforestry systems are implemented in their region and how can pineapple be included (areas of production, companion species, limitations etc.)?*



TRANSPARENCY 4.6 (7): ORGANIC PINEAPPLE UNDER AN AGROFORESTRY SYSTEM

4.6.3 Establishing propagation plant material

a) Suitable cultivars

Important criteria in selecting organic pineapple plant material are:

- Varieties resistant to diseases and pests, that can compete well with weeds (faster establishment, wide leaf area, etc.).
- Varieties that flower naturally and faster than others (e.g. the varieties Rondon and Perola naturally flower earlier and more uniformly than Smooth Cayenne and Turi Verde).
- Varieties that are adapted to prevailing patterns of pineapple cropping and the agroecological conditions in the region. For agroforestry systems, it is better to use varieties that are shade tolerant (e.g. the cultivar Monte Oscuro, which can be grown under Mauritia palms).

The species Ananas comosus can be divided into five groups, based on leaf and fruit characteristics: Cayenne, Queen, Spanish, Pernambuco and Mordilona.

- Varieties of the Cayenne group are usually resistant to fruit collapse and heart rot diseases caused by Erwinia chrysanthemi. New varieties are being developed that are resistant to mealy bug wilt. Some cultivars include Smooth Cayene, Hilo, Kew, Champaka and Sarawk. Leaf spines are present only at the tip of the leaves. These varieties are used for both canned and fresh fruits.
- Queen cultivars include Moris, Mauritius, MacGregor, Ripley, Queen and Alexandra. They are used for fresh fruits. The leaves have spiny edges.
- Spanish varieties are usually susceptible to fruit collapse and heart rot diseases (Erwinia chrysanthemi), but are resistant to marbled fruit caused by Erwinia ananas and Pseudomonas ananas. The most common varieties are Singapore, Spanish, Ruby, Red Spanish, Masmerah, Gandul, Hybrid 36, Selangor, Green, Nangka and Betik.
- The varieties of Pernambuco and Mordilona group are mainly cultivated in Brazil, Ecuador, Peru and Colombia. Pernambuco has long spiny leaves; Mordilona varieties have a completely spineless leaf form. The Perola is the best known variety in this group. It has a high vitamin C content and shows resistance to Phytophthora.

4.6 Pineapple 8

Pineapple varieties and their susceptibility to diseases, pests and other factors

Variety	Susceptibility
Smooth Cayenne	Sensitive to fruit borers, mites, symphillids, nematodes Susceptible to *Fusarium subglutinans*, mealy bug wilt, fruitlet core rot, butt rot and internal browning. Tolerant to *Phytophtora* sp. and resistant to fruit collapse caused by *Erwinia chrysanthemi*.
MD2	Resistant to internal browning, but susceptible to fruitlet core rot, and more sensitive to *Phytophthora* than Smooth Cayene.
Red Spanish	Vigorous and tolerant to high temperature, drought, internal browning (fruit rot), butt rot, wilt and *Phytophthora*, but not to high manganese in the soil or nematodes. Highly susceptible to the lepidopter *Strymon basilides*.
Singapore Spanish	Tolerant to *Phytophthora*. It shows severe chlorosis when exposed to high manganese concentration in the soil. Sensitive to fruit collapse and nematodes.
Queen	Generally more tolerant to stress, pests and diseases than Smooth Cayenne. Susceptible to *Phytophthora* and fruit collapse, and highly susceptible to chilling and internal browning if harvested before maturity and to fruitlet core rot and butt rot.
Perola	Very resistant to *Phytophthora* and tolerant to drought, mealy bug wilt and nematodes, but highly susceptible to *Fusarium subglutinans*.

Sources: Fruits from America, an ethonobotanical inventory (CIRAD) and others.

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TRANSPARENCY 4.6 (8): PINEAPPLE VARIETIES AND THEIR SUSCEPTIBILITY TO DISEASES, PESTS AND OTHER FACTORS

Other cultivars as Perolera, Manzana, and Primavera have been reported as having tolerance to Fusarium disease and the Samba cultivar is resistant to the fruit borer. The following varieties are already cultivated organically: Smooth Cayene, Champaka and MD2 in Mexico; Montelirio, Champaka and MD2 in Costa Rica; Sugarloaf, Smooth Cayene in Africa; Red Spanish and Queen in India; and Mauritius in Sri Lanka.

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Pineapple varieties and their susceptibility to diseases, pest and other factors

Variety	Susceptibility
Manzana	Susceptible to the nematode *Pratylenchus neglectus*, but tolerant to *Meloidogyne incognita*.
Samba, Roja trujillana	Resistant to *Strymon basilides*.
Josapine	Josapine fruits have good storage life and are resistant to black disorder or internal browning caused by low temperatures.
RL41	Susceptible to fruitlet core rot.
P.R. 1-56, P.R. 1-67	Both have good resistance to gummosis and mealy bug wilt.
Cabezona	Resistant to gummosis.
Pernambuco	Disease resistant, sensitive to sunburn even when plant is erect.
Perolera	Resistant to fusariosis, but susceptible to fruitlet core rot and the fly *Melanoloma canopilosum*.
Rondon, Roxo de Tefe	Highly resistant to *Fusarium subglutinans*.

Sources: Fruits from America, an ethnobotanical inventory (CIRAD) and others.

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TRANSPARENCY 4.6 (9): PINEAPPLE VARIETIES AND THEIR SUSCEPTIBILITY TO DISEASES, PEST AND OTHER FACTORS

Sharing experiences: varieties

List locally known and available varieties. Discuss their advantages and disadvantages for organic production and which cropping systems they can be used in. Discuss decision making factors for selecting varieties in organic pineapple production.

b) Propagation and nursery management

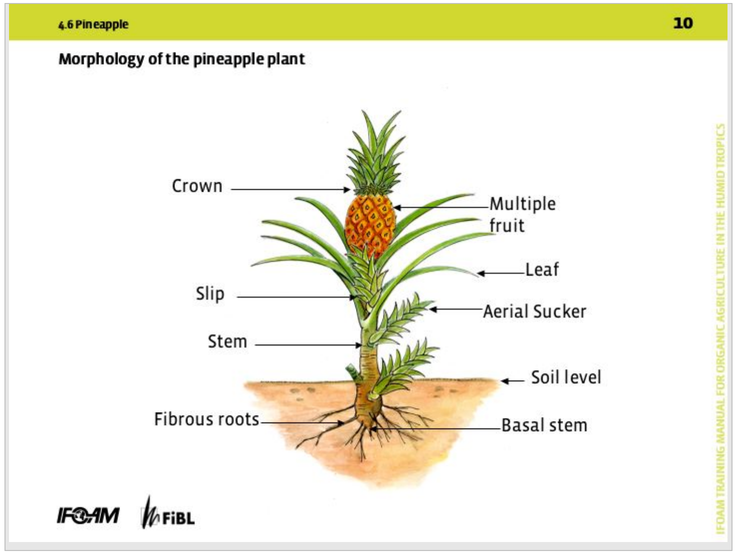
Pineapple can be vegetatively propagated. Two types of planting material (shoots) are mostly used:

- Suckers, coming from the stem of the plant (both the aerial and earthed part of the stem) and;
- Slips, produced under the fruit;

The fruit crown can also be planted to generate new plant material. Suckers are preferred because they quickly bear fruit, whereas plants grown from slips can take about two years. Mother plants should be selected for their health and vigor. Those mother plants that do not meet these standards should be uprooted and composted, the others should be left until the shoots can be separated. During this time, the mother plants and shoots have to be regularly checked for cultural measures (e.g. pruning), plant nutrition (foliar liquid organic fertilizer), diseases and pests, with the necessary control measures being applied if required.

The separation of shoots from the mother plant can be done with a clean knife. They should be selected according to their size and weight. It is important that wounds on the shoots are able to dry and heal quickly, in order to avoid infection by Fusarium fungi. Under appropriate storage conditions (dry and shaded), and avoiding contact with the soil, shoots can be stored for up to three months without losing their propagation power.

Smallholder farmers generally use shoots from their own crops. By utilizing slips, a relatively large number of plants can be produced in a short time, as one plant will produce about 7-8 suitable shoots (depending on the cultivar). Due to their small size, the slips are first planted in a shady nursery for one year before being transplanted. This is especially important if the plants are to be incorporated into an agroforestry system, where they will have to compete with other, secondary, crops.



TRANSPARENCY 4.6 (10): MORPHOLOGY OF THE PINEAPPLE PLANT

Sharing experiences: propagation and nursery management

Ask the participants how they manage an organic pineapple nursery. Write down the information and summarize the different management alternatives. Discuss the advantages and disadvantages of each mentioned alternative.

4.6.4 Flower induction

Flowering in pineapple occurs when plants reach a certain size and age: about 7-12 months in equatorial areas, or 15 - 36 months in subtropical areas. This period also depends on the varieties. The process of inducing flowering is regulated by indolacetic acid, which inhibits flowering. When the pineapple plant reaches the flowering stage, the content of indolacetic acid is low. The first symptoms of flowering initiation are accompanied by an increase in the diameter of the apical tip (growing end tip), after 5-6 days the peduncle (the stalk that will carry the flower) begins to elongate. Flowering initiation to harvest takes about 5 - 7 months.

Strategies for flower induction in pineapple

There are different opinions about the factors that influence the flowering of the pineapple. Some researchers think that the pineapple needs long nights to flower, others think that it is cool night temperatures, and others a combination of the two. However, sensitivity to relatively long and cool nights depends on the cultivar, the plant size, the age and the planting material. Others have noted for example, that the Smooth Cayenne is a short day plant and if the dark period is interrupted with illumination, flowering will be inhibited. However, no reports have yet been made on the effectiveness of using darkness as a method to create short day conditions in order to initiate the flowering of pineapple. Researchers have also reported that stress conditions (e.g. water stress) may influence the flowering induction in pineapple. Flowering can also be artificially induced by using different materials (e.g. ethylene and calcium carbide used in conventional production) to allow a simultaneous flowering and a uniform harvesting period.

The EU Organic Regulation and the IFOAM Basic Standards do not allow the use of ethylene or carbide to induce flowering in pineapple. However, the USA Organic Regulation does. Organic farmers apply different strategies to induce flowering in pineapple, with different degrees of success. Strategies 1, 2, 3, and 4 on transparency 4.6 (11) were successful in inducing 20-30% flowering. Many organic farmers do not use any flower induction method; they just let the plants produce their own inflorescence. In this case, it is important that farmers select faster inducing flowering cultivars.

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Strategies for flower induction of pineapple

1. Producing ethylene by depositing rest of fruits on the field and on the pineapple plant. Pineapple rows might be covered with plastic during night to enhance the effects;
2. Producing smoke by burning wood in a wood smoker (application during the night). The pineapple plants must be covered with a plastic to keep the smoke around the plants for longer;
3. Applying ice cubes to the uncovered pineapple plant (during the night);
4. Applying cold water to the uncovered pineapple plant (during the night);
5. Using natural substances, such as enzymes extracted from plants (Mexico, India, Costa Rica), no results published yet.
6. Leaving the pineapples to flower naturally. Select regional varieties that flower faster than others. This strategy is widely used by organic farmers
7. Create temporary agroforestry conditions (shade/light).

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TRANSPARENCY 4.6 (11): STRATEGIES FOR FLOWER INDUCTION OF PINEAPPLE

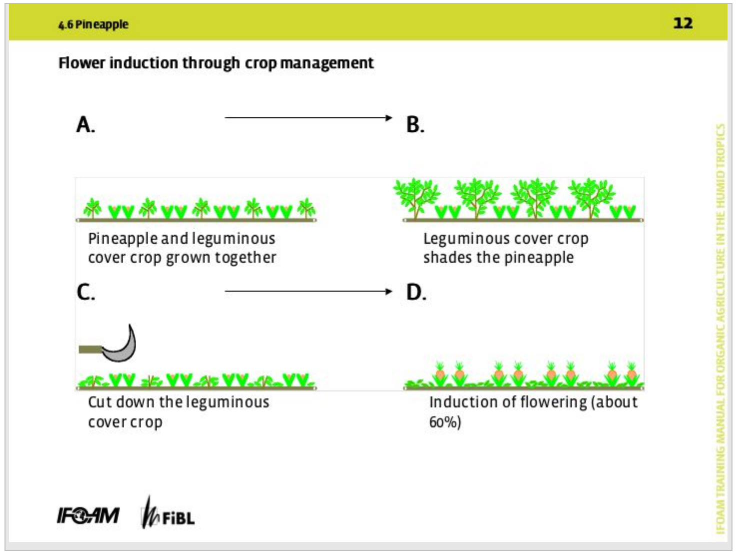
An alternative, based on creating temporary agroforestry conditions (shade/light)

Steps:

1) Pineapple grown together with canavalia or *Cajanus cajan*.
2) The vigorous leguminous cover the pineapple plants.
3) Cut down the leguminous cover two months before blossoming is supposed to occur (at the stage when pineapple is ready for flowering).

This strategy can be used equally well in rotational cropping systems, intercropping and agroforestry systems. In intercropping and agroforestry, additional pruning of trees may be necessary to produce the same effect, a sudden influx of high sunlight and irradiation incidence to the pineapple plants. Such strategies have shown a success rate of about 60% flowering induction. In agroforestry systems, any shading should be thinned out six months before a planned harvest in order to induce flower formation.

Note: avoid inducing pineapple flowering during the drought period as it may cause defective fruits. Fruits formed during rainy periods may have higher incidence of *Fusarium subglutinans*, but will be less prone to attack by *Techla basilides*, *Dymicoccus brevipes* and *Thielaviospis paradoxoa*.



TRANSPARENCY 4.6 (12): FLOWER INDUCTION THROUGH CROP MANAGEMENT

Group work:

Make groups and ask them to explain or evaluate the following topics:

- *Which constrains are involved in leaving pineapple to initiate its flowering naturally?*
- *Is it suitable to use leguminous crops to create temporary agroforestry conditions?*
- *What alternative methods have been tested in the region? Have they proven successful?*

Soil protection and weed management

Weed management in organic pineapple production requires the application of both preventive and direct methods. The best strategies will depend on the planting system used (rotational, intercropping and agroforestry).

a) Before planting pineapple:

- Select appropriate preceding crops in the crop rotation that will suppress weeds.
- If needed, apply weed cures during the soil tillage for the bed preparation.
- Use green manures (e.g. Crotalaria juncea, Mucuna capitata, Stisolobium digerianum, Canavalia pubescens, Cajanus cajan) that can compete strongly with weeds.
- Cut or mulch the leguminous green manure to cover and protect the soil and avoid the germination of new weeds.
- Use composted material (animal manure or compost) to avoid infestation with new weed seeds.
- Select appropriate cultivars (fast establishment, wide leaf surface) and plant densities that will best compete with weeds (according to farmers' experiences, plant densities of 35000 to 40000 suppress weeds through competition).

b) During the growth period:

Pineapple grows very slowly during the first three months after planting, and does not compete well with weeds, therefore the following strategies are recommended:

- Most weeds need to be manually eliminated as mechanization is not an optimal solution (due to narrow rows and possible damage to plants during cultivation). In some regions (e.g. Costa Rica), producers have developed their own tools that allow weeding in wide beds (e.g. large hoe shown in the transparency).
- Mulching the rows of pineapple with pruned plant material or harvest residues may offer some degree of weed control, especially in agroforestry systems where residues of organic material can be obtained regularly. The use of plastic mulches is also an alternative but creates some difficulties for carrying out cultural practices, such as organic fertilization.
- Use plants as cover crops (e.g. Arachis pintoi) between the rows to suppress weeds during the early stages of pineapple development.
- Growing high leguminous plants to help flowering induction also helps to control weeds.

TRANSPARENCY 4.6 (13): HOEING TO CONTROL WEEDS IN ORGANIC PINEAPPLE.

Group work:

Visit different pineapple fields and discuss the following topics:

- *Which strategies for weed regulation can be used, given the prevailing conditions and opportunities on the visited farm?*
- *How can the soil be covered to avoid erosion and to reduce weed germination?*

4.6.5 Supplying nutrients and organic fertilization

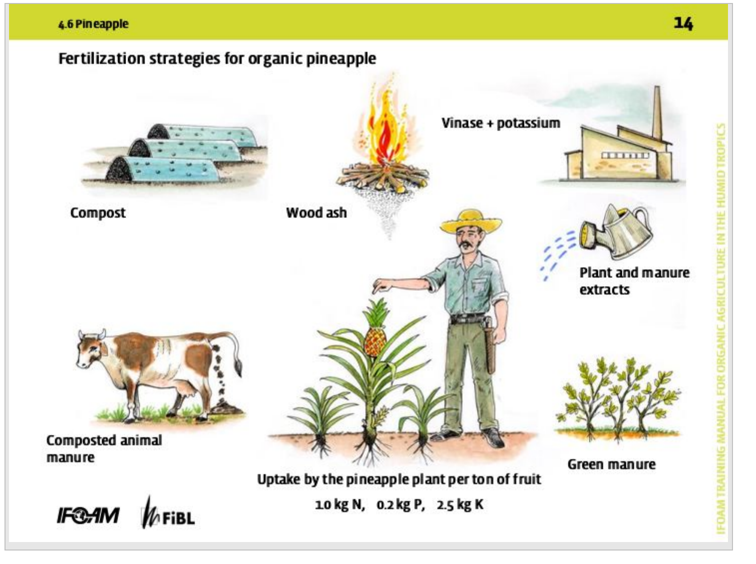
The main fertilization strategies in organic pineapple production are the use of green manures and application of composted materials before sowing, and the low application of composted materials during the development stages of the pineapple plant. The approximate nutrient uptake by a ton of pineapple fruits averages 1.0 kg of N, 0.2 kg of P, 2.5 kg of K, 0.3 kg of Ca, and 0.1 kg Mg. Therefore, a yield of 35 t/ha of fruit per year is equivalent to 35 kg of N, 7 kg of P (16.0 kg P_2O), 88 kg of K (105 kg K_2O), 11 kg of Ca and 4 kg of Mg. However, yields of organic pineapple vary according to the different cropping systems used: rotational cropping system yields about 40 t, intercropping system about 30 t and agroforestry systems about 20 t. Therefore, the amount of nutrients taken up by pineapple fruits will vary according to the production system.

The nutrient supply of pineapple in a **rotational cropping system** can be partially met through green manure (e.g. *Crotalaria juncea, Mucuna capitata, Stisolobium digerianum, Canavalia pubescens* and *Cajanus cajan)*. In general, N fixation through leguminous green manure yields between 40 and 60 kg N/ha. Farmers also have the possibilities to apply compost or animal manure before planting pineapple. Shortages in potassium can be compensated with the application of wood ash, mixed with compost or animal manure. The certification bodies might allow the use of potassium magnesia if soil analysis show low contents, but it will be necessary to obtain permission first (be careful with restrictions imposed by different regulations, check with your certifier). If possible, the remnants of processed pineapple should be brought back to the crop fields and applied as compost. When calculating the amount of compost or animal manure required, it should be kept in mind that the use of leguminous crops can lead to considerable mobilization of the nitrogen available within the soil. In this case, it will be necessary to apply compost with a relatively high C/N relationship. The compost or animal manure might be spread in two applications: half before planting, and half in time for the induction of flowering.

Pineapple grown in **intercropping systems** may have the same requirements as when it is grown alone. However, it is important to plan the fertilization of pineapples, especially if pineapple is grown under sensible crops, such as mango, because over-fertilization can increase fruit alternation among the mango trees, resulting in yield loss. In Ghana, pineapples grown under mango trees are fertilized with farmyard manure and compost made from a mixture of manure and plant material.

Questions:

Ask the participants to propose a fertilizing strategy for organic pineapple in the region. Take into consideration the available resources and the cropping systems used.



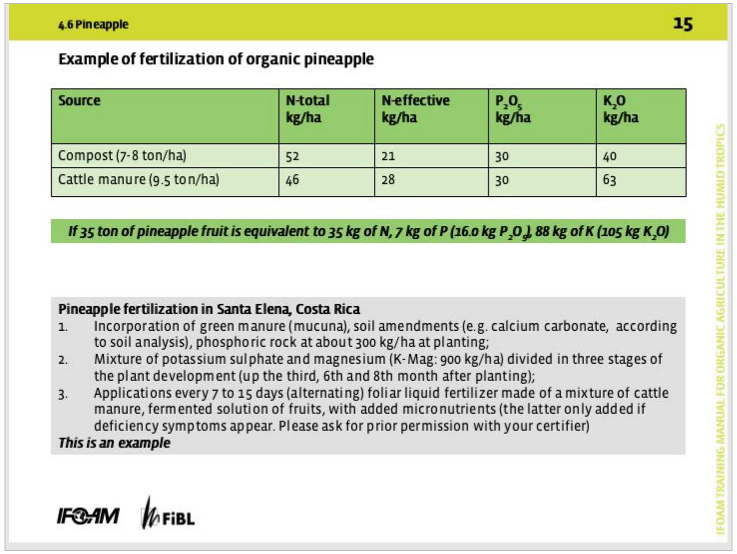
TRANSPARENCY 4.6 (14): FERTILIZATION STRATEGIES FOR ORGANIC PINEAPPLE

Pineapple grown in a varied **agroforestry** system might not need any additional organic fertilizer. However, if the agroforestry is poor in species, there may be a need for additional compost-based fertilizers. In such cases, application of a handful of composted material near to the pineapple plant during important stages of development might be recommended.

It is important to keep in mind that some organic regulations contain restrictions related to fertilization. For example, Bio Suisse limits the fertilizer input of nitrogen and phosphorus to pineapple at 100 kg N-total and 30 kg P_2O_5 (13 kg P) per ha. It is also necessary to gain their prior permission before applying soluble salts of potassium, magnesium and micronutrients. Permission will be given based on the results of soil and plant analysis. Please check with your certifier about possible restrictions in other regulations.

The example in the transparency shows fertilization pattern according to Bio Suisse. Calculations for compost (7-8 t/ha) and cattle manure (9.5 t/ha) were carried out: 40% of the total N in the compost and 60% of that in cattle manure was taken as available. Therefore, this will not meet all the N requirements of the pineapple fruits (given a yield 35 t/ha). In this case, it will be necessary to find supplementary sources of N. For example, bean cake (remember that if you have included a leguminous green manure, an additional amount of N might be available for the pineapple plants). On the other hand, the compost or cattle manure will cover the uptake of P by the pineapple fruits. Soil analysis will show whether the supply of potassium is enough to cover the demands of the pineapple fruits

Explain the organic fertilization method used in Costa Rica (see box in the transparency).



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Example of fertilization of organic pineapple

Source	N-total kg/ha	N-effective kg/ha	P_2O_5 kg/ha	K_2O kg/ha
Compost (7-8 ton/ha)	52	21	30	40
Cattle manure (9.5 ton/ha)	46	28	30	63

If 35 ton of pineapple fruit is equivalent to 35 kg of N, 7 kg of P (16.0 kg P_2O_5), 88 kg of K (105 kg K_2O)

Pineapple fertilization in Santa Elena, Costa Rica

1. Incorporation of green manure (mucuna), soil amendments (e.g. calcium carbonate, according to soil analysis), phosphoric rock at about 300 kg/ha at planting;
2. Mixture of potassium sulphate and magnesium (K-Mag: 900 kg/ha) divided in three stages of the plant development (up the third, 6th and 8th month after planting);
3. Applications every 7 to 15 days (alternating) foliar liquid fertilizer made of a mixture of cattle manure, fermented solution of fruits, with added micronutrients (the latter only added if deficiency symptoms appear. Please ask for prior permission with your certifier)

This is an example

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TRANSPARENCY 4.6 (15): FERTILIZATION OF ORGANIC PINEAPPLE ACCORDING TO BIO SUISSE

Group work:

Organize groups. Each group should formulate fertilization strategies, taking into account the local production conditions. The results should be presented by one person from each group.

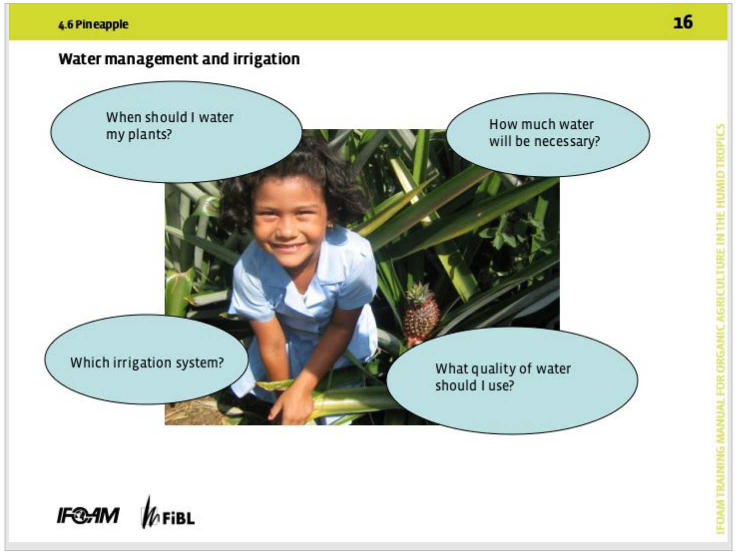
4.6.6 Water management and irrigation

The pineapple has low transpiration rates because it closes its stomata during the day and vice versa. However it is still sensitive to low water conditions, especially during the vegetative growth period when the size and fruiting characteristics are being determined. Water deficit during this period retards growth, flowering and fruiting. A water shortage during flowering has a less serious effect. Too much water at flowering will lead to vigorous growth and a large core, which is disadvantageous if the fruit is to be used for canning. Irrigation is only necessary during long periods of drought. Farmers should take care to avoid water deficits during the period of vegetative growth and they should restrict water during the ripening period. Irrigation should be discontinued during the month prior to harvest. Sprinklers are a good method of irrigation as they help avoid water lodging; however, drip irrigation may be more effective and may lead to some water savings. Additionally, less contact of water with the leaf surface may prevent the spread of diseases. Basin irrigation must be avoided.

High water quality (preferably filtered), containing no chemicals, heavy metals, toxic bacteria and with low salinity levels is essential. Regular water analysis is compulsory for organic certification.

Discussion:

Ask the participants if irrigation is necessary in their region, and what methods and criteria they use to apply water to pineapple.



TRANSPARENCY 4.6 (16): WATER MANAGEMENT AND IRRIGATION

Sharing experiences:

Do any participants have experience of an inadequate or oversupply of water that affected the fruits? Was the quality affected or were other symptoms detected? Which are the correct stages for irrigation?

4.6.7 Direct and indirect pest and disease management

Organic pineapple production can be carried out successfully if preventive strategies against pests and diseases are planned and implemented. These strategies can include the following:

- Selection of pineapple cultivars adapted for: local agro-climatic conditions (amount and precipitation periods), the chosen production system (crop rotation, use of green manure, avoidance of host plants, etc.) and to locally prevalent diseases and pests.
- Selection of a cropping system that offers adequate protection to the pineapple against pests and diseases (e.g. through higher plant diversity), cropping systems adapted to the local conditions (agroecological conditions, pressure of pests and diseases) and to the resources of the farmer (know-how, experience, human and financial resources).
- Evaluation of potential risk of pests and diseases in the region. Elaborate specific strategies to diminish the risk of infestation and infections (selection of plant densities, exposure of soilborne vectors to the sun during soil preparation, obtaining plants that attract predators or repel pests etc.).
- Proper care (protection against diseases and pest, fertilization, etc.) of pineapple nursery (from the mother plant to establishment of new plants) with the objective of obtaining healthy, vigorous and disease-free offspring.
- Adequate nutrition of pineapple plants during early development stages to obtain vigorous and healthy crop, and during flowering to fruit development to improve fruit formation.
- Proper handling of the fruits during harvesting and post-harvest, to avoid damage and injuries that can increase the chances of infection with diseases (see 1.1.8).

Questions:

What practices do local farmers commonly use to control pests? What are the most serious pests in the region? Make a list of experiences in controlling pineapple pests, and identify the preventive and direct organic control methods that are used in the region.

Discuss with the participants other possible methods that can be implemented.

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Common pests and diseases of pineapple

Pest	Preventive measures	Direct control
Mealybug *Dysmicoccus brevipes*	Enhance diversity of flowering plants, regulate ant colonies through use of neem, quassia, clay powder, sugar traps, etc.; lower plant densities to reduce spread, eliminate host weeds, select resistant cultivars.	Dip offspring plants in neem + soap solution, apply mineral oil products, fatty acids (soap), extracts of neem, pyrethrum, *Ricinus communis*, *Argemone mexicana*, apply *Beauveria bassiana*.
Nematodes *Pratylenchus brachyrus, Meloidogyne javanica, Rotylenchus reniformis*	Keep offspring nematode-free; crop rotation (3 to 4 years); use repellent crops (sugar cane, maize, pangola grass and cover crops, such as marigold - *Tagates sp.*); avoid host plants, (cotton, tobacco, cow pea); select resistant pineapple cultivars; improve soil fertility, soil solarization methods.	Dip offspring in garlic extracts before transplantation, use neem cake as substrate or add to the soil while planting, dried leaves of garlic can be incorporated.
Symphylids *Hanseniella, Scutigerella sp.*	Let plant material dry out before incorporating it into the soil, crop rotation (3 to 4 years), during drought periods do not let the soil dry out.	During soil preparation, add extracts of *Argemone mexicana or Ricinus communis*, use neem cake as substrate or add to the soil while planting.

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TRANSPARENCY 4.6 (17): COMMON PESTS AND DISEASES OF PINEAPPLE

Under favorable growth conditions, pineapple is not greatly susceptible to disease or attacks of pests. The following diseases and pests may occur, especially in systems with low diversity:

- **Mealy bug** (Dysmicoccus brevipes) may be responsible for transmitting a virus that damages the root system and causes symptoms of wilt. Mealy bugs are protected from predators and are transported from plant to plant by ants. Mealy bug colonies are rare in the absence of ants. If ant populations are not well regulated by their natural enemies (e.g. predatory wasp, parasites, birds, small mammals, etc.), then it is possible to use sugar-water ant traps to reduce the spread of the bugs or to apply neem, quassia or clay powder.
- **Nematodes** are a serious problem in pineapple monoculture plantations. Problems with nematodes in organic plantations arise mainly due to inappropriate rotations. Take care when buying vegetative plant material.
- **Symphylids** are small white myriapods that attack roots, reducing water and nutrient absorption: leaves become yellow and red, and lose turgidity. They move very rapidly in the natural cracks and tunnels of the soil and proliferate in aerated soils. The incorporation of former the pineapple crop may encourage growth of the symphylid population. To avoid this, leave the plant material to dry before incorporation into the soil and implement appropriate crop rotation (3-4 years). Do not let the soil dry out during drought periods.
- **Techla** is a butterfly that deposits its eggs on the inflorescence of the pineapple plant. The larva bore into the pineapple fruit, making galleries. The fruit becomes deformed and shows a segregation of cream color
- **Thrips** (carrier of the virus disease "yellow spot") are not a problem in a balanced cropping system. In cases of high infestations, an application of herbs, mixed with liquid manure, sulfur or natural pyrethrum should be sprayed. Please ask for prior permission with your certifier.

Questions:

- *What are the most serious diseases in the region?*
- *What practices are most commonly used by local farmers to control diseases?*
- *List their experiences with the control of pineapple diseases; identify the preventive and direct organic control methods used in the region.*
- *Discuss with the participants other possible methods that can be implemented.*

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Common pests and diseases of pineapple

Pest/disease	Preventive measures	Direct control
Techla basilides	Enhance diversity of flowering plants, confuse the butterfly with other red flowered plants.	Application of *Beauveria bassiana*, *Bacillus thurigiensis subsp. Kurstaki*, extracts of *Argemone mexicana*.
Rot root *P. cinnamomi*	Use healthy and disease-free plant material, avoid soil water logging. Rotate crops, select resistant cultivars, enhance soil fertility.	Application of calcium hydroxide, sulfur, copper mixture, *Trichoderma* and extracts of citric seeds.
Base rot *Thielaviopsis paradoxa*	Select healthy planting material, plant material should not be allowed to accumulate in a pile, but should be turned upside down to expose the base to the sun and wind.	Soak planting material in copper mixture.
Fusariois *Fusarium subglutinans*	Selection of resistant cultivars, selection of healthy and disease-free planting material, implement adequate crop rotation, infected plants should be eradicated.	

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TRANSPARENCY 4.6 (18): COMMON PESTS AND DISEASES OF PINEAPPLE

- **Root rot** caused by Phytophthora cinnamomi and other fungi, is a problem in high rainfall areas, with low temperatures, poor drainage and alkaline pH. The infection occurs through the root tip, at any stage of development. The symptoms can be recognized as a change in color of the leaves from normal green to yellow, then brown. Preventive methods are: plant the pineapple during the season that is unfavorable to P. cinnamomi, correct the pH if it is high; grow the plants on raised beds; choose soils that are light, well aerated and have good drainage. Soil improvement can be achieved by well-planned crop rotation and the application of compost material. As a measure before planting, treat the plant material by soaking it in Cu mixture. Please ask for prior permission with your certifier.
- **Heart rot** is caused by Phytophthora nicotiana, P. cinnamommi and P. palmivora. Symptoms appear mainly in younger leaves (which change from green to yellowish green to brown, starting from the tip); the older leaves keep their normal color. At the final stage, the disease shows as a soft rot, afterwards secondary bacteria infest the tissues giving a putrid odor. Preventive methods are similar to those for root rot.
- **Base rot**, caused by Thielaviopsis paradoxa, is a disease that affects the planting material. Infection occurs through wounds when the offspring are removed from the mother plant. The infected parts turn to a black color due to the sporing of the pathogen. Base rot appears a short time after planting. It can be controlled through cultural practices and by soaking the plant material in Bordeaux mixture. Thielaviopsis paradoxa can also cause rot of the fruit (**black rot**). The infection occurs in wounds in the base of the fruit resulting from harvesting (proper handling is essential). Symptoms are that the fruit turns to a dark yellow color and starts to rot and to lose its shape.

- **Fusariosis**: enfermedad causada por Fusarium subglutinans. Este patógeno tiene capacidad para infectar cualquier tipo de tejido de la planta de piña que contenga una herida, causando la exudación de una goma. En los estadios avanzados de infección, la planta deja de crecer y las hojas exhiben un color rojizo. Los métodos preventivos son: evitar transportar material de plantación infectado de una zona de producción a otra, incrementar la diversidad floral para reducir la incidencia de posibles vectores (tales como la techla, ya que las flores de piña son la principal fuente de infección para el patógeno), y mantener bajas las poblaciones del vector mediante métodos de control directo apropiados.
- **Pudrición bacterial del corazón:** enfermedad causada por Erwinia chrysanthemi. Las hojas del corazón se vuelven blandas y se pudren. Pocos días después de la infección inicial, el corazón completo se puede separar fácilmente del resto de la planta. Esta enfermedad se puede prevenir mediante la aplicación de prácticas culturales apropiadas.

Discussion:

Discuss with the participants if there are further maintenance methods used in the region that have not been mentioned in this part of the course.

4.6.8 Other maintenance methods

Regularly crop monitoring is necessary to react promptly to possible infestation or infection by pests and diseases.

4.6.9 Harvesting and post-harvest handling

Harvest

During harvest and post-harvest, special care should be taken to avoid potential infection with diseases. The fruits must be cut off with a clean knife. To avoid any potential infection, the pineapple fruit should not come into contact with the soil. Use appropriate disinfected baskets to carry and transport the pineapple out of the field. Transport the fruits in clean container to the packaging or processing plants. The fruit must be harvested at the optimal time. This will depend on the marketing method. Fresh fruit for the local market should be harvested almost mature. Fresh pineapple for export should be harvested green, mature or half-mature (when the coloring of the fruit starts on the fruit base). If pineapples are harvested too early (pineapple does not ripen after picking), customers may not accept them because of the low sugar content. Such specific conditions for harvesting the fruits make it necessary to have an optimal closed cycle of cooling facilities and an efficient transport infrastructure.

Manufacturing pineapple juice

Only fresh fruits with no signs of mold may be used in manufacturing pineapple juice. These should be washed carefully and the inedible parts (e.g. the stalk, leaf crown, etc.) removed.

All the edible parts are fed through a hammer mill or worm screw press. The collected juice is then heated to 60°C and poured into tin cans before being sealed, pasteurized at 88°C and rapidly cooled down again.

Fresh pineapple

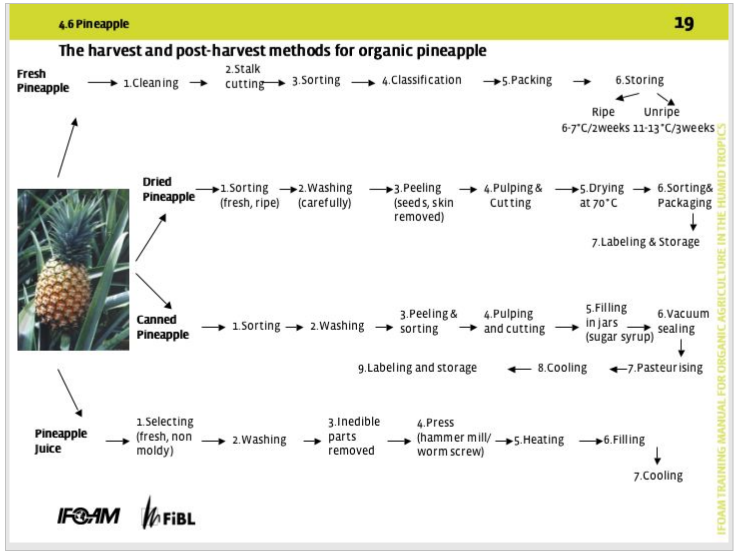
Depending on the quality and variety, pineapples weigh approximately 0.9 - 4 kg. Baby pineapples weigh 500 g. For the export market, the fruit should be harvested when the half mature stage is reached. The juice from the middle of the fruit should have a Brix value of at least 13%. After harvest, the pineapple fruit should be cleaned and the fruit stem can be cut off approximately to 2 cm in length. The fruit should be graded according to size, and finally packed.

Unripe fruits that are not yet ready to be sold can be stored at 11 to 13° C and 90 – 95% air humidity for up to 3 weeks.

Ripe fruits can be stored at 6 to 7° C and 90 – 95% air humidity for up to two weeks.

Group work:

Form groups. Each group should formulate different practical strategies for handling pineapple during harvest and post-harvest to avoid damage and possible infestation with diseases. The results should be presented by a representative from each of the groups.



TRANSPARENCY 4.6 (19): THE HARVEST AND POST-HARVEST METHODS FOR ORGANIC PINEAPPLE

Precautions should be taken to avoid temperatures below 5° C, which can cause brown and dark spots in the fruit pulp.

Dehydrated pineapple fruits

Dehydration is one of the oldest methods to conserve food for longer periods. While dehydrating, it is important to use low temperatures and to have appropriate aeration that permits the fruits to dry very gently. For export, dehydrated pineapple is sent directly to the customers (small bags) or in bulk, packed in permeable water vapor and sealable bags. Before sealing the bag, a protective gas (nitrogen) may be added.

The packed dehydrated pineapple should be stored at low temperature, with low air humidity and in the dark. In ideal storage conditions, the dry fruit can be kept for approximately one year.

Canned pineapple

The process of turning fresh pineapples into canned products is as follows:

- Sorting: the fruits are sorted. Only the fresh, ripe fruits, with no trace of rot are selected.
- Washing: the fruits are washed very carefully, as they can be easily damaged.
- Peeling and sorting: peeling is often done manually with knives or may be done using steam to loosen the skin and then rubbing it away. Finally the fruits are sorted again to remove any blackened pieces, bits of peel, seeds, etc..
- Pulping: the peeled fruit can be cut into a variety of shapes according to type. The shape of the fruit must be specified on the can.
- Filling into jars and cans: the cut pieces are now put into jars or cans and covered with syrup. Additional information needs to be provided on the can about the concentration of the sugar syrup.
- Vacuum sealing, pasteurizing or sterilizing: after the jars or cans have been vacuum sealed, they are either pasteurized (temperatures above 80°C) or sterilized (temperatures above 100°C).
- Cooling: after the heating process, the canned fruits are first cooled to 40°C and then subsequently down to storage temperature.
- Labeling and storage: finally the canned fruits are labeled and stored.

4.7 Organic High Altitude Coffee Farming

Coffee is one of the most important organic products exported by developing countries. It is produced mainly in Latin America (e.g. Mexico, Central America, Andean countries, Caribbean and Brazil). Smaller quantities are produced in Africa (e.g. Kenya, Ethiopia, Madagascar, Malawi, Tanzania, Togo and Uganda) and Asia (e.g. India, Indonesia, Papua New Guinea, Philippines and Sri Lanka).

Organic coffee production first took off in those countries where producers lacked the resources to purchase conventional agricultural inputs (fertilizers, pesticides). This applies, most of all, to places where small farmers are organized in cooperatives (Mexico, Colombia, Central America, etc.). The high premiums for organic coffee are nudging increasing numbers of large scale producers towards conversion (e.g. Brazil).

Today, good quality organic coffee is mainly produced under diverse agroforestry management systems in mountain areas. Therefore, this chapter concentrates on high altitude organic coffee farming.

Lessons to be learned:

- *Diversified coffee production systems are highly sustainable.*
- *Climate and production systems have a strong influence on coffee quality.*
- *Coffee quality is very important in the organic market and, therefore, for farmers' incomes.*

Diversified coffee production systems permit closed nutrient cycles and promote soil fertility. Most pests and diseases can be avoided by indirect measures, and only a minimum of external inputs is necessary.

What is high altitude coffee farming?

Coffee originates from the subtropical forest ecosystem of the Ethiopian highlands, where it grows under diversified agroforestry systems, in the shade of a variety of trees in a summer rain region. Coffee is a half-shade plant, which can also be grown in full sun. The rate of photosynthesis of a shaded plant is actually higher than that of a plant fully exposed to the sun. Its shade loving agroforestry nature and climatic adaptations help it to grow successfully in these regions. Even if yields may vary greatly between shade cultivation and open cultivation, the benefits of the former cannot be overlooked.

In the mountains of Central America a coffee known as "high altitude coffee" is grown. There is not really a definite limit to mark the beginning of this high altitude coffee, but it is usually grown above 900 meters. This coffee is recognized as a very high quality product, especially when organic, and is grown mainly by small and medium-sized farmers who have developed agroforestry systems that try to recreate coffee's natural growing conditions.

Coffee can also be produced in monocultures, with high inputs of agrochemicals. In practice, though, organic coffee cultivation has proven that cultivation in monocultures is barely possible in economical and technical terms, and in ecological terms, is highly undesirable.

Worldwide organic coffee cultivation is quite disparate, and has been adapted to suit different site conditions. Three main types of systems can be differentiated:

Traditional extensive systems, with essentially closed nutrient cycles, predominantly cultivated by indigenous farmers and smallholdings, sometimes with low yields per ha (no import of organic fertilizer).

Diversified systems, which try to combine the sustainability principles of the traditional systems (ecological and economical benefits of biodiversity and crop mixing, and closed nutrient cycles) with some cultivation practices oriented towards the achievement of higher yields and quality. There is a rapid growth in the number of small and medium-sized organic farmers using these systems.

Commercial intensive systems, with nutrient imports, predominantly on medium to large holdings, which prioritize high yields and quality, and give less importance to sustainable use of biodiversity (e.g. importing organic fertilizer).

Motivation:

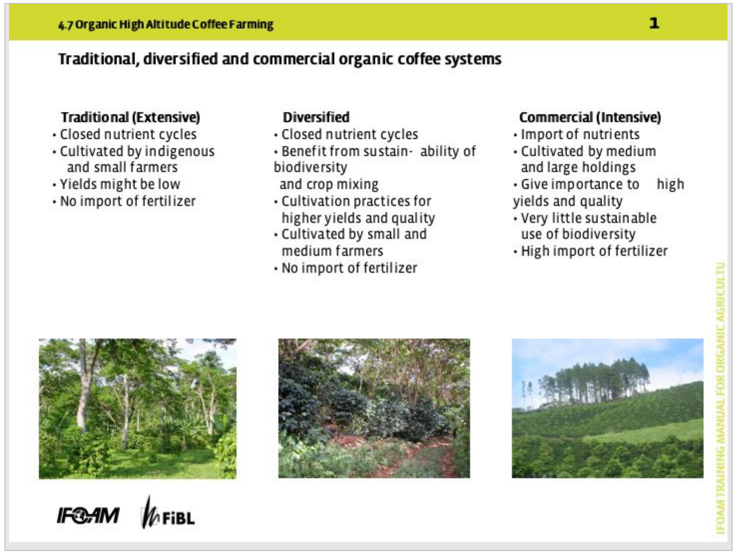
Introduce the topic in reference to the Basic Manual and start by asking participants what they know about organic coffee cultivation. Then, mention organic high altitude coffee farming and the differences between traditional, diversified and intensive cultivation.

Visit:

Select an area or micro-watershed where you can visit coffee farms that use different methods of production: conventional and organic (traditional extensive, diversified or commercial intensive). Make a checklist of the most important characteristics that are observed during the visits to the three farms. It is recommended to divide into several groups, with each one visiting a farm that uses a different method of production. Each participant or group should prepare a summary of their observations, which is to be presented to and discussed with the rest of the group. Important issues for the discussion:

- *Use of locally-produced inputs/recycling*
- *Use of external inputs*
- *Organic matter in the soil*
- *Fruit, wood or shade tree species*
- *Soil erosion control*

Organic high altitude coffee is usually grown under diversified systems, which highlight all the successful principles of organic cultivation (see Basic Manual). Its intensively diversified agroforestry system makes for closed nutrient cycles without external inputs. The three-storey structure, with each storey creating a large amount of humus and organic matter, positively influences the quality of coffee and protects the soil against erosion by naturally binding it with an extensive natural mulching. The understory plants naturally control pests and weeds, and the diversified tree system produces additional food and wood products, which improve the farmers' diet and income. Shade trees also create a pleasant working environment by modifying the microclimate. Nutrient recycling involves returning the endocarp and pellicle to the field, assisting with ensuring fertilizer management and minimizing waste. Selective weed management can be used to help build the soil and to provide a source of food for the insects that help maintain the balance of the ecosystem.



Transparency 4.7 (1): Traditional, diversified and commercial coffee systems

4.7.1 Agroecological requirements and site selection

Climate

The ideal temperature range for Arabica coffee plants lies between 17°C during the night and 23°C during the day, with a maximum daily oscillation of 10°C. The standard minimum is between 15 to 17°C and the standard maximum, between 25 to 28°C. Temperature is the most important factor related to growth. Low temperatures are responsible for a slow plant development and a slower ripening of the berry. Temperatures below 10°C inhibit growth and coffee plants are susceptible to frost. On the other hand, high temperatures accelerate ripening of the fruit, cause flower anomalies and limited fruiting. They also favor the appearance of pests and diseases, which decrease quality. Robusta plants can withstand higher temperatures and are more resistant to infection.

> Presence of the berry borer and other coffee pests are important indicators of whether the coffee variety is suited to the site conditions. An Arabica plantation at 600 m, heavily infested by coffee rust and berry borer, despite sufficient shade, is probably ill-suited to the site, and should be replaced with Robusta. As a rule: Robusta is planted in lower regions and Arabica in higher regions.

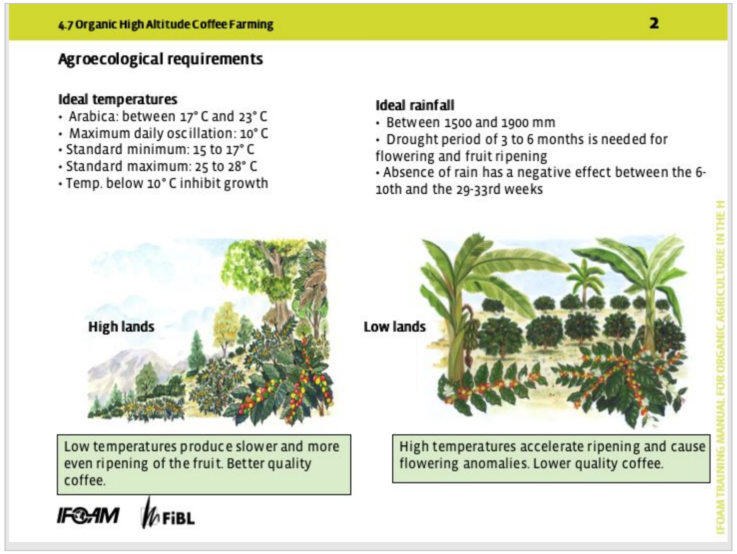
The ideal amount of rainfall is between 1500 mm and 1900 mm. Coffee plants react positively to a drought period that may vary from three to six months, during which it develops the roots, branches and leaves; flowering is also stimulated and fruits ripen. Critical periods when the coffee plant is affected by the absence of rain are mainly the period between the 6th and 10th week (when there is a rapid growth of the fruit) and, not so importantly, from the 29th to the 33rd week (ripening after fecundation). Rainfall should be evenly spread throughout the rest of the year. Irregular rainfall causes uneven blossoms and fruit maturity, which negatively affects the quality.

Coffee is a half-shade plant that utilizes only around 1% of the sunlight. The plant makes best use of the morning sunlight. The least efficiently processed sunlight is that of the vertical rays during midday.

Discussion:

Discuss coffee growing in your region: the special characteristics of coffee, its climatic requirements, soil, etc.. Ask the farmers the following questions:

- *Why and how is coffee suitable here?*
- *Is the coffee being grown out of tradition, are the farmers motivated by the price or does the local coffee have particular characteristics that make it interesting to grow?*
- *What are the special features of high altitude coffee farming?*

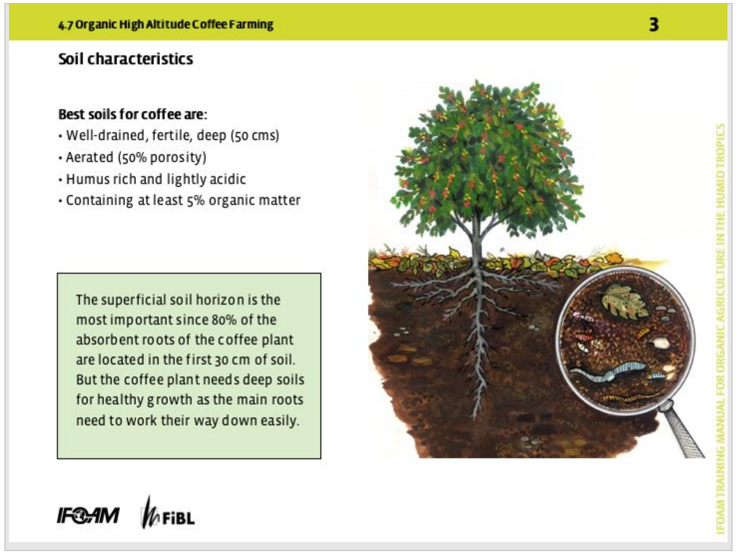


TRANSPARENCY 4.7 (2): AGROECOLOGICAL REQUIREMENTS

Soil characteristics

Coffee plants prefer well-drained, fertile, deep (over 50 cm) and aerated (50% porosity) soils. Organic matter in the soil should be at least 5%. Humus-rich, slightly acidic soils are beneficial; the ideal conditions are found on virgin soils of volcanic origin.

The superficial soil horizon is the most important one, since 80% of the absorbent roots of the coffee plant are located in the first 30 cm of soil. Nevertheless, the coffee plant needs deep soils to grow healthy because the main roots need to work their way into the soil easily and if they are not able to do so, diseases are more likely to appear and harder to eliminate.



TRANSPARENCY 4.7 (3): SOIL CHARACTERISTICS.

4.7.2 Diversification strategies

One of the most important advantages of a diversified system is that during periods when the coffee price is high, the system can be cultivated more intensively to produce higher yields, yet when the price is low, production can be slowed down, without harming the plantation. The coffee yield will drop off slightly, but at the same time, the other crops in the system will gain in importance.

Nevertheless, it is necessary to recognize and understand that these biodiverse systems can have some disadvantages if they are to be avoided. Some of the most important potential disadvantages are:

- Competition between coffee and different crops for available resources, especially labor.
- Negative effects, caused by excessive shading of the coffee by the forestry component.
- Certain crops mixed with coffee can be hosts for some coffee pests and diseases.

A diversified coffee system can be implemented under two possible cropping systems:

- Coffee mixed with other crops.
- Coffee in an agroforestry system.

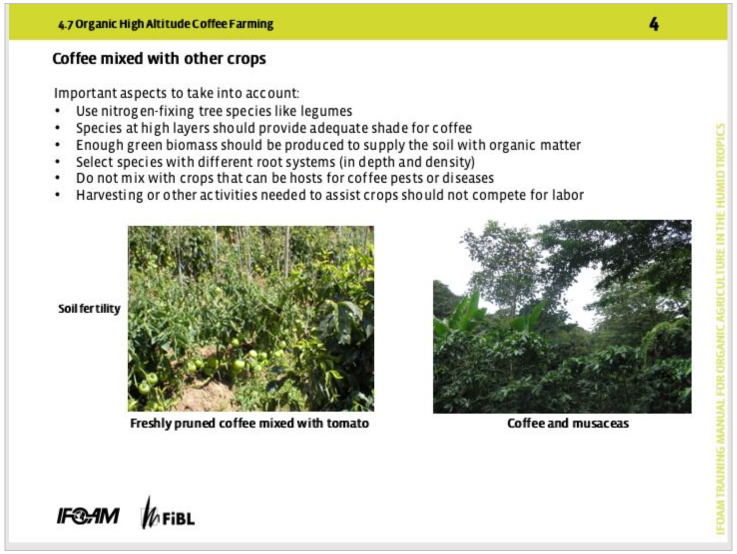
In both forms of diversified systems, it is important that each element within the system complements the others and helps to achieve a more efficient use of resources, rather than having elements that compete for the same resources. Both types of diversified system have a number of advantages over the monoculture system. In particular, when trees indigenous to the region are selected, the system will produce additional products such as fruits, firewood and sources of timber for construction, as well as helping to establish a complete ecosystem.

The plant diversity that develops at different layers provides an excellent green cover, which helps to decrease soil erosion. Other problems associated with monoculture, such as weed control and returning organic matter back to the soil, are also reduced in these diversified systems.

The density of the coffee bushes and the method of cultivation may largely depend on local experience and knowledge. The shade gradient varies and can be **rustic**, in which case the coffee trees are planted under the natural forest with little alteration to the existing vegetation, or it can involve the selection and planting of local tree species with the coffee trees in order to "recreate" a natural forest (**agroforestry system**), or it can involve polyculture plantation that involves the deliberate integration of beneficial plants (**coffee mixed with other crops**).

Motivation:

- *Ask participants to think about different coffee systems that exist in their regions and to answer the following questions:*
- *Are there systems that mix coffee with other crops? Which crops? Why do you think farmers have specifically chosen those crops? Do you think this association is efficient?*
- *Are there coffee plantations under agroforestry systems? Which tree species are usually planted with coffee in your region? Why?*
- *Which system (coffee mixed with other crops or in an agroforestry system) do you think would work better in your region? Give at least three reasons to justify your answer.*



TRANSPARENCY 4.7 (4): COFFEE MIXED WITH OTHER CROPS

The system in which coffee is **mixed with other crops** lets the farmer make a more efficient use of the soil, since different crops can be grown on the same land. As a result, there is a better utilization of soil nutrients, water and solar energy. Coffee can be mixed with a great variety of other crops, but it is important to consider some aspects when selecting them:

- Use nitrogen fixing tree species like Erythrina sp. and trailing plants like Canavalia and other legumes.
- The species in high layers should provide adequate shade for the coffee.
- Enough green biomass should be produced to supply the soil with organic matter.
- Select species with different root systems, in terms of depth as well as root density.
- Do not introduce crops that can be alternative hosts for coffee pests or diseases.
- Harvesting or other activities required by the other crops should not compete for labor with coffee.

In mixing coffee and other crops there are different possibilities, for example:
New coffee or just pruned coffee mixed with short-term crops like beans, corn or tomato (between coffee rows).
Coffee mixed with some fruit trees like avocado, citrus and often with *Musaceas*.

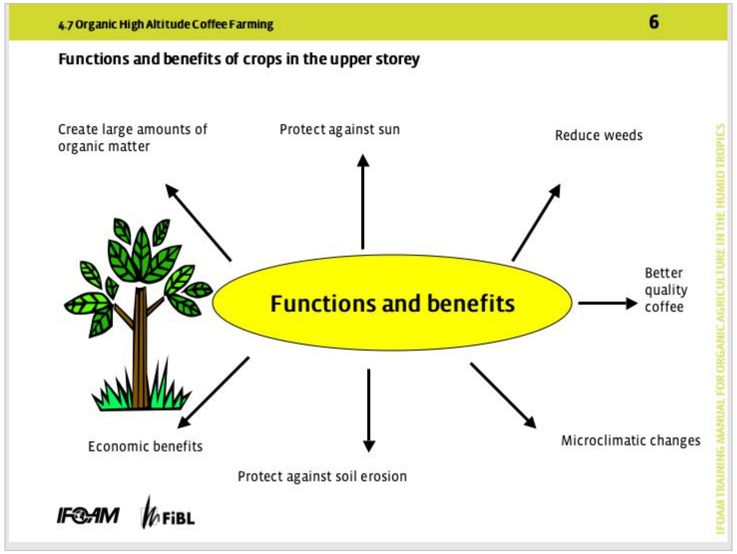
Coffee in an agroforestry system

The possibilities for diversification within an **agroforestry system** are numerous. The selection of tree species to "mix" with the coffee will vary depending on the region, forestry species and even the age of the coffee plantation.
In agroforestry systems, in addition to fruit trees and *Musaceas*, high growth species can be used to carry out different functions, such as making shade, nitrogen fixation, biomass production, wood and firewood production, windbreaks and a safe environment for birds. Each one of these functions can be met by a diversity of species:

- For nitrogen fixing and biomass production, Erythrina sp. and Inga sp. are suitable.
- Commonly used species for wood and firewood production are Cedrella odorata and Cordia alliodora.
- Species like Casuarina, Eucaliptos and other can be planted as windbreaks.
- To develop a bird-friendly environment, at least three different layers should be developed, besides coffee.
- Fruit trees or plants like avocado, orange, guava, banana, etc..

Group work:

- *Ask the participants to divide into two groups, preferably grouped by similar agroecological regions. Then have the first group design a system where coffee is mixed with other crops and the second group, a coffee agroforestry system.*
- *Have each group share their organic coffee farm design with the whole class. Each one should explain why they chose the specific crops or tree species, in accordance with the aspects already discussed in this chapter.*



TRANSPARENCY 4.7 (6): FUNCTIONS AND BENEFITS OF CROPS OF THE UPPER STOREY

The most suitable distance between the different species is very variable. This depends on the height of each species, pruning management, the specific use, etc..

The crops of the middle storey: the combination of varieties must be adapted to local conditions and must also suit the needs of the individual varieties for providing fruits and additional products. Functions of the crops in this storey include:

- They provide temporary shade.
- They dry out wetter parts of the plantation (e.g. banana).
- They mobilize nutrient reserves, making them available to the shallow roots of the coffee plants.
- The diverse produce gives additional benefits.

Examples of crops suited for the middle storey include banana, citrus, mangosteen, rambutan, jackfruit and avocado.

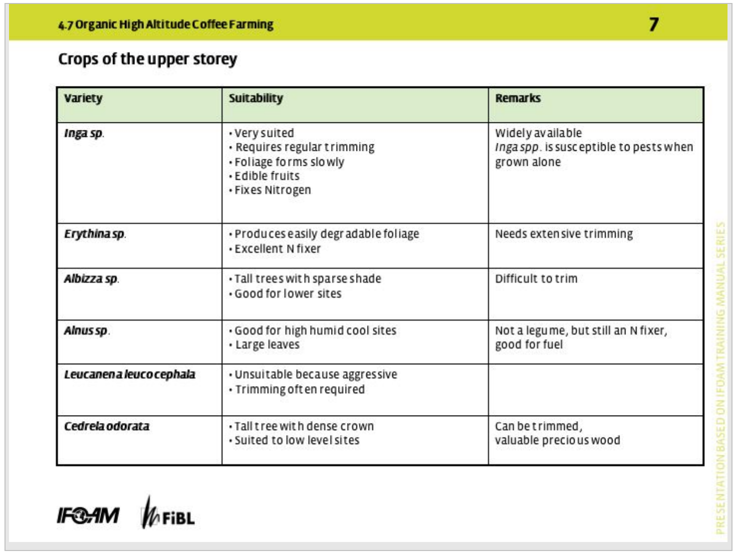
The crops of the understory are selected according to the shade they provide, the soil conditions and rainfall. Their functions include:

- Green manuring plants (e.g. legumes in sites that are too dry or are poor in nutrients).
- Slow growing and perennial crops that do not overshadow the coffee bush, but provide shade and mulch.

Discussion:
In group, discuss two important aspects:

- *The addition of organic matter to the soil and its advantages.*
- *Identification of the most commonly used local species.*

Making reference to the Basic Manual (chapter 4.2), ask the participants if they know what diversification means? What is it good for? What are the types of diversification processes and can they suggest any other crops in which such diversification is done? What are the functions of the different crops in this process?


4.7 Organic High Altitude Coffee Farming 7

Crops of the upper storey

Variety	Suitability	Remarks
Inga sp.	• Very suited • Requires regular trimming • Foliage forms slowly • Edible fruits • Fixes Nitrogen	Widely available *Inga spp.* is susceptible to pests when grown alone
Erythina sp.	• Produces easily degradable foliage • Excellent N fixer	Needs extensive trimming
Albizza sp.	• Tall trees with sparse shade • Good for lower sites	Difficult to trim
Alnus sp.	• Good for high humid cool sites • Large leaves	Not a legume, but still an N fixer, good for fuel
Leucanena leucocephala	• Unsuitable because aggressive • Trimming often required	
Cedrela odorata	• Tall tree with dense crown • Suited to low level sites	Can be trimmed, valuable precious wood

PRESENTATION BASED ON IFOAM TRAINING MANUAL SERIES

TRANSPARENCY 4.7 (7): CROPS OF THE UPPER STOREY

Discussion:

- *Ask the participants which plants are most popular in their regions and which provide the maximum benefits. The participants may either discuss the advantages of these plants in depth or come up with the names of other plants.*
- *Ask the participants to discuss the differences that they understand between the plants in the three stories.*

4.7 Organic High Altitude Coffee Farming **8**

Crops of the understory and their features

Variety	Suitability	Remarks
Arachis pintoi	• Needs much rain and light, but cannot tolerate direct sunlight • Deep roots • Covers a large surface area, highly competitive and prolific foliage production • Highly N fixing and good for fodder for small animals and chickens	Seeds very expensive, but can be easily self-cultivated, good vegetative growth, once established, is difficult to remove, slow initial growth
Desmodium ovalifolium	• Fodder plant, needs little rain, yet relatively large amount of light • Competitive and prolific foliage production with rapid turnover	Can grow to 80 cm tall and certain lines might begin to climb, slow initial growth
Glycine wighti	• Fodder plant, needs little rain, yet realtively large amount of light • Prolific foliage production with rapid turnover • Climber, yet not too aggressive	Slow initial growth up to 80 cm tall
Centrosema macrocarpum	• Grows well with little light • Withstands drought periods • Competitive stubby growth	Seeds relatively expensive, difficult to cultivate, slow initial growth
Indigofera suffructicosa	• Can tolerate shade • Also grows on wet sites • Little foliage production (with rapid turnover)	Seeds difficult to obtain, slow initial growth, often grows naturally and can be encouraged through selective weeding

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TRANSPARENCY 4.7 (8): CROPS OF THE UNDERSTORY AND THEIR FEATURES

Establishment of new plantations

When starting a new plantation, maize can be sown as a pioneer crop. Depending on the initial conditions (soil fertility, consumption habits, market access), this can be sown in a mixed crop including beans, manioc, pigeon peas or jack beans, all of which can provide a suitable temporary cover crop. Also, soil conservation work should be considered, especially on sloped lands.

Bananas may be planted before the pioneer crop. The distance between the plants should reflect the foreseen coffee variety, density and type of cultivation. The density and type of cultivation of the coffee bushes should be determined by local experience and according to variety and intensity of the planned cultivation, The density of the coffee bushes should not exceed 1000-2500 plants/ha. It is important to cover the ground as soon as possible.

The seeds should be selected from healthy organic plantations, if possible from the same altitude and region. General criteria such as choosing only large, ripe fruits from middle-aged (5-6 year-old) plants should be respected. Seedling nurseries can be established according to well-known methods: in shaded nursery beds or in pricked polyethylene sacks. The best approach for the latter method has proven to be the direct sowing of two or more seeds in each sack, which are later thinned down to a single healthy plant. The substrate should consist of at least 30% good quality compost, with additional fresh forest soil.

The amount of shade covering the seedling nursery should be similar to that of the final plot. Green manure and liquid manures, as well as other cultivation methods, should be the same as those to be used on the future plantation. It makes no sense to provide intense measures to the young coffee plants in the nursery if the plantation itself will later be extensively cultivated. When transplanting, an application of compost is recommended.

Discussion:

Have a group discussion on the importance of using best quality genetic material (seeds and seedlings) to start a new plantation in ensuring the future success of the organic coffee farm.

TRANSPARENCY 4.7 (9): ESTABLISHMENT OF NEW PLANTATIONS

4.7.3 Soil protection and weed management

Soil protection

An agroforestry system that is permanently covered with mulching material provides ideal protection against erosion. Sites located on steep slopes might need additional protective measures, especially when establishing a new plantation. In some countries where rocks are abundant, stonewalls can be erected along the contour lines. An alternative practice could be the deliberate cultivation of erosion preventing plants along the contour lines. Shade tolerant pineapple varieties and light intensive grasses such as lemon grass (*Cymbopogon citrates*) may be planted. Constructing terraces on existing coffee plantations is not recommended. Coffee roots run close to the surface, therefore groundwork should be avoided if possible.

Weed management

The density of foliage under the coffee bushes will vary according to the density of the coffee bushes, the amount of light that the shading trees let through, and the amount of mulch created by falling leaves. In a coffee ecosystem with optimum plant and shade density, tilling weeds is barely necessary. Some weeds will always be present – especially on young plantations – but they can also offer protection against erosion on steep slopes.

Working the soil to regulate weeds should be avoided to prevent damaging the shallow roots of the coffee bushes. Hoes should on no account be used. Grasses and other flora can be pulled out when the soil moisture content allows it. Weeds should be cut down to a height of 5 cm with a knife, motor scythe or mulching machine. They should not be cut any lower, so that their root system helps to hold the soil together. Selective trimming of the foliage of weeds is very important. Beneficial varieties should be cut back less. The undesired weeds can be radically cut back or pulled out. Some of this accompanying flora should be kept as a food source for insects.

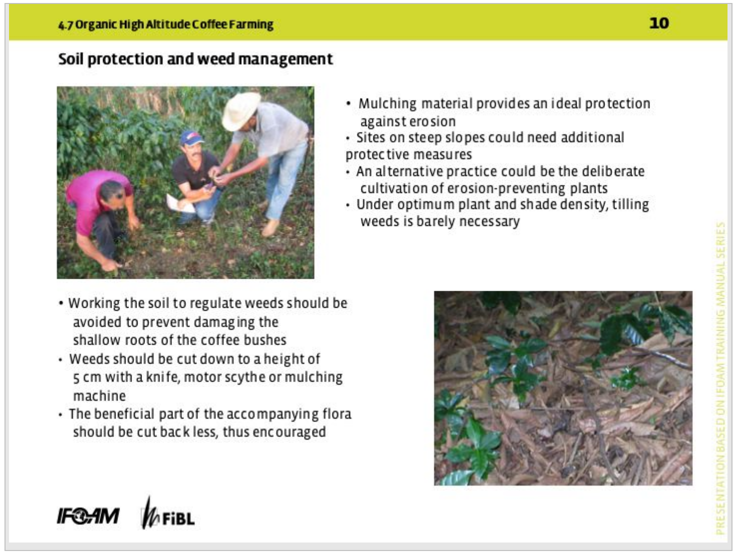
All plant material should be kept on the plot as mulching material. The trimming of the accompanying foliage should be timed to coincide with the nutrient requirements of the coffee plants. The frequency of trimming will depends largely on local site conditions and may be more necessary after rainfall, but it should however be done at least twice a year. Blossoming weeds should be cut down.

Visit:

Visit three coffee farms, looking for different kinds of weed management. One farm should be treated with herbicides and soil should be completely uncovered, a second farm should be organic, but with insufficient plant and shade density, and a third one should be a highly diversified coffee farm with optimum plant and shade coverage. (This exercise could be done during the same visit suggested on page one of this chapter).

Participants should discuss weed control activities with the farm owners and examine the soil quality at each farm.

After returning to class, each group should share their findings and discuss which system seems to be more efficient and sustainable in the long run.



Transparencia 4.7 (10): Protección del suelo y manejo de hierbas adventicias.

4.7.4 Supplying nutrients and organic fertilization

Fertilization in organic coffee production is mostly done with components naturally available on the farm. Generally, external inputs are not necessary. Organic matter and nutrients come from natural sources:

- Mulch: cover crops and falling leaves of coffee and shade trees of the upper storey.
- Compost: the endocarp and the pellicle of the fruit are composted after bean extraction.

A high performance coffee ecosystem, with good site conditions and optimum yield, should be capable of fixing the nutrients removed in the harvest (34 kg N), or to be able to mobilize them from the soil or subsoil (6 kg P_2O_5 and 8 kg K_2O per year).

Compost is added when:

- New plantations are being set up. In cases of very low phosphorus reserves in the soil, rock phosphate can also be added (but not using bone meal, as this will draw mice and other animals that may damage the young plants).
- The coffee bushes have been trimmed for the healthy development of new growth (add compost).
- In times of high coffee prices, when the substantial work involved in using additional organic fertilizers can be justified.

The compost and organic fertilizers are not worked in, but rather placed on the soil as a thick layer of mulching material to prevent injury to the shallow coffee roots.

Activity:

This can be a good activity for after lunch. Ask three volunteers to bring soil samples from a plantation near the coffee plant. They should be taken at a depth of no more than 25 cm and in an area of 50 cm X 50 cm. Lay the samples out on a white sheet of paper or cloth, spread them and ask the participants to elaborate on what they see there. Can they identify the special characteristics and see that anything is missing? Discuss with them what else could be there? What is the texture of the soil like? Can they spot any insects or worms?

Discussion:

Discuss differences between local methods of compost preparation and methods of compost application and those presented in the Basic Manual (chapter 4.4). Ask the participants if they have encountered any special problems in composting especially of the endocarp and pellicle, and what they have done to solve these?

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Supplying nutrients and organic fertilization

Fertilization in organic coffee production is mostly done with components available from the farm´s natural sources:

1. Mulch: cover crops and fallen leaves of coffee and shade trees of the upper storey
2. Compost: the endocarp and the pellicle of the fruit are composted after bean extraction

Compost is added when:

Event	Objective of fertilization
New plantations are being set up	Help the soil to obtain appropriate balance of nutrients and microorganisms
Coffee bushes have been trimmed	Help healthy and strong development of new growth
Times of higher coffee prices	Use additional organic fertilizer to increase yield can be justified

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TRANSPARENCY 4.7 (11): SUPPLYING NUTRIENTS AND ORGANIC FERTILIZATION

4.7.5 Shade Regulation = Pest and Disease Management

Infestations of pests or diseases are always an indication that the coffee ecosystem is unbalanced and the causes must be investigated. They might include:

- Unsuitable site (low altitude, too warm, too humid, stagnant water, too dry)
- Degenerated and poor soils, lack of organic material.
- Too little diversity and too few shading trees.
- Non-adherence to the natural succession of the forest system.
- Varieties that have an identical status in the system are too close together.
- Failure to trim the shading trees.

Common coffee pests and diseases:

- Coffee Rust: occurs when the variety is susceptible, the bushes are planted very close together, the shading is not correct and the nutrient supply is unbalanced.
- Brown Spot: occurs when there is dense cultivation in a tree nursery, when the irrigation and the shading are incorrect, the site is very wet or the trees are very close together.
- South American Leaf Spot: occurs when the site is very cool and wet, there is too much shade, too many weeds and the distance between the coffee bushes and the tree crown is very small.
- Pellicularia koleroga: appears in warm humid sites that have too much shade.
- Coffee Berry Borer: can infect plantations at a low altitude, especially if there are infected or abandoned plantations nearby or if there are several blossoms over a long period.
- Coffee Leaf Miner: occurs when there is too much sunlight and the microclimate is dry.

Fungal infections can be dealt with by:

1. radically tilling weeds;
2. a bottom crop trim;
3. trimming the shading trees, which would regulate the air circulation and humidity.

4.7 Organic High Altitude Coffee Farming 12

Coffee diseases and how to control them

Disease/Vector	Cause in an ecological system	Possible measures
Coffee Rust (*Hemilela vasatrix*)	• Susceptible variety • Coffee bushes planted too close together • Too much or too little shade • Unbalanced nutrient supply	• Plant resistant variety or graft with Robusta rootstock • Change density • Regulate shade • Trim plants; supply organic fertilizer to young plants; • Treatment with Cu preparations makes little sense ecologically and economically; little is known about treatments with *Verticillium* sp. preparations.
Brown Spot (*Cercospora coffeicola*)	• Too dense cultivation in tree nursery; wrong irrigation and shade • Site too wet/trees too close together • Too much shade	• Change density • Trim, produce more air circulation • Change shade
South American Leaf Spot (*Mycena citricolor*)	• Site too cool and wet • Too much shade or weeds • Distance between coffee bush and tree crown too small	• Regulate shade and weeds • Plant taller shading trees
Pellicularia koleroga	• Warm humid sites with plenty of shade	• Regulate shade and „dry out" site, e.g. with bananas, plant trees with large leaves to provide shade • Complete harvest and collection of all coffee cherries (harvesting hygiene)
Coffee Berry borer (*Hypothenemus hampei*)	• Plantation at too low altitude • Abandoned or infected plantations nearby • Several blossoms, coffee cherries which ripen over long period	• Infect the plantation with the entomophageous fungi *Bauveria bassiana*. Generally, 2-3 settings suffice, then the infection will have worked; • Release of chalcid wasps *Cephalonomia stephanoderis* is very involved and only makes sense on dry sites where *Bauveria bassiana* does not work well enough. • Improve shade
Coffee Leaf Miner (*Leucoptera coffea*)	• Too much sunlight and too dry micro-climate	

Source: L. Kilcher et el, SIPPO / FiBL / Naturland 2002

IFOAM FiBL

PRESENTATION BASED ON IFOAM TRAINING MANUAL SERIES

TRANSPARENCY 4.7 (12): COFFEE DISEASES AND HOW TO CONTROL THEM

Sharing experiences:

The participants should be asked to describe real situations when infections occurred and what steps they took. Were the steps similar to the ones described above or were they different? Did they find a difference in yield in the following year? Were there situations in which this did not help?

4.7.6 Other maintenance methods

Pruning

The coffee plants should regularly be trimmed after harvest, although this varies from site to site, and with local tradition, and it is also dependant on the variety. Arabica varieties allow themselves to be bent down quite far during harvest, and therefore do not need to be cut back so much. Every 8-16 years, a cure of radical trimming is recommended (down to approximately 40 cm above the soil), yet the precise time depends on the site and condition of the plantation. Care should be taken to always trim whole portions of the plantation (10 % of the plot), so that the positive results of renewal can take effect in the coffee ecosystem. All plant material should remain on the soil after the trimming and acts as mulching material.

Shade regulation

The shading trees must also be regularly trimmed. Old trees should be felled at the same time as the coffee plants are radically trimmed, so that damage caused by falling branches can be minimized, and the new influx of light can bring about a new growth dynamic on the plantation.

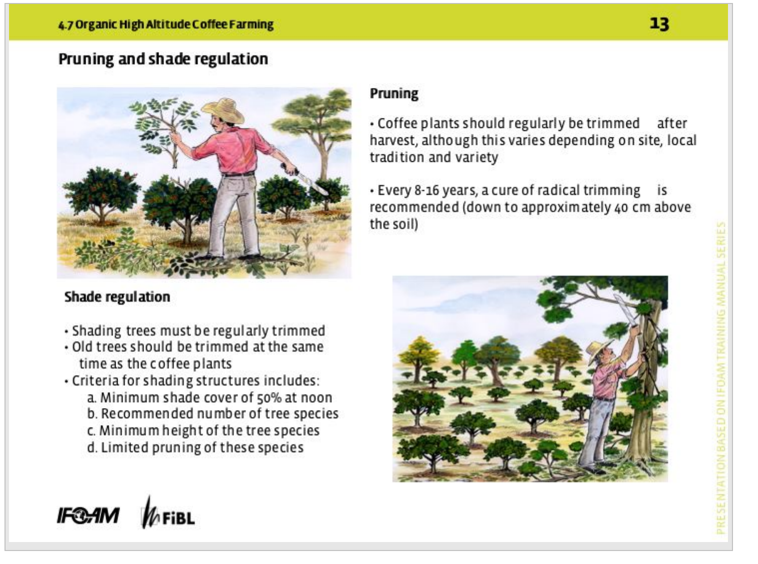
The typical shading structure in the diversified high altitude coffee system is three layered and is based on the following criteria:

- Minimum shade cover of 50% at noon
- Recommended number of tree species
- Minimum height of the tree species
- Limited pruning of these species

However the optimum shadow density depends on the local site conditions and the state of the plantation.

Motivation:

Ask the participants from different regions to share the pruning and shade regulation methods that are traditionally used in their regions. Discuss with the whole group whether these methods accord with the needs of a diversified high altitude organic coffee farm.



TRANSPARENCY 4.7 (13): PRUNING AND SHADE REGULATION

4.7.7 Harvesting and post-harvest handling

The entire community, which includes all members of the family, are involved in the harvesting process. The beans that are now pink-red in color are placed in sacks and baskets. Organic coffee is usually sold through local cooperatives or small farmers' associations, which is the most practical way to do it considering the location and terrain of these regions.

Importance of quality

High quality requirements are placed on organic coffee, either for local consumption or for exports. Optimal care of the coffee plants and of their production is necessary, all the way from planting to the harvest and processing time.

Harvesting

Only ripe fruits should be harvested. Depending on the frequency of blossoming, up to five stages may be necessary. In order to maintain a homogeneous quality when harvesting coffee, other important tips to keep in mind are:

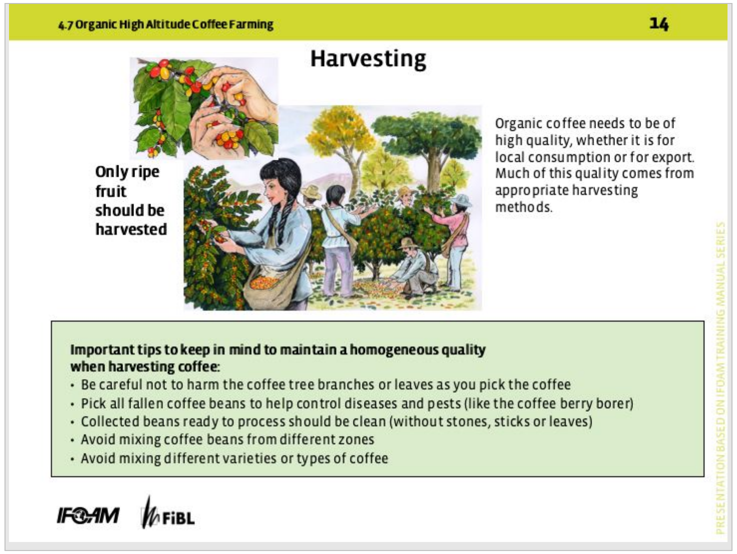
- Be careful not to harm the coffee tree branches or leaves as you pick the coffee.
- Pick all fallen coffee beans to help control diseases and pests, like the coffee berry borer.
- Collected beans ready to process should be clean (without stones, sticks or leaves).
- Avoid mixing coffee beans from different zones.
- Avoid mixing different varieties or types of coffee.
- Harvest and process only ripe coffee.

The following aspects need to be heeded when sorting the beans into grades:

- Processing method (wet or dry).
- Color of the beans (green, blue-green).
- Growing site (altitude).
- Style (outward appearance).
- Number of defects (foreign particles, damage, shells, grass beans, etc.).

Motivation:

- *Ask the participants to talk about the coffee processing method used most widely in their own regions, analyzing the sustainability of this method and considering aspects like: water conservation and management, availability of energy sources, weather, management of by-products, etc..*
- *Have them make suggestions about the best processing method for their region in order to improve sustainability.*



TRANSPARENCY 4.7 (14): HARVESTING

Post-harvest treatment

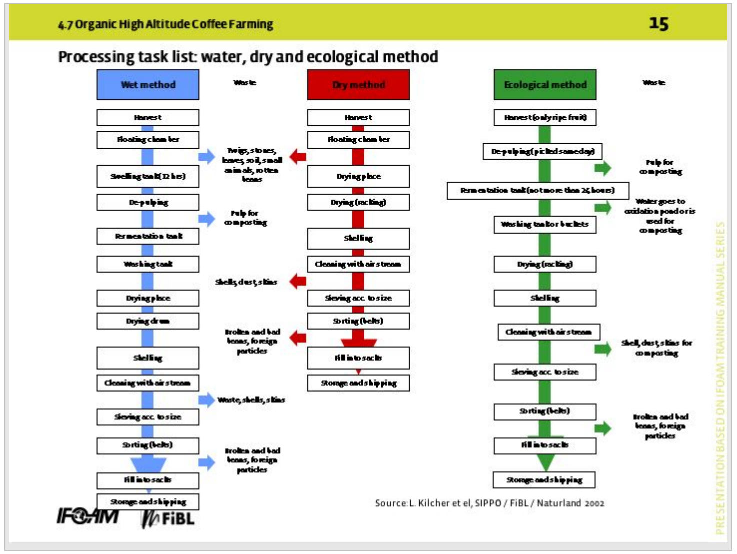
The wet stage of processing Arabica must start on the same day that the coffee is picked. Care should be taken to provide adequate drying places for coffee beans (concrete drying surfaces; or transparent, plastic roofed structures to offer protection against rain). Coffee beans stored in a wet state (after insufficient drying), or storage areas that are not well protected against rain and humidity, will promote the growth of fungi. This can strongly influence the quality of the coffee or even, in extreme cases, if the fungi is a toxic one, make it impossible to sell.

The ripe, red cherries of the bush-like coffee tree are processed to make raw coffee. This is the stage at which most coffee is traded on the world markets. Roasting and blending the raw coffee is mostly carried out in the importing countries. There are a few recent examples of small organic farmers, organized in associations or cooperatives, that have learned to roast good quality coffee and sell it as a final product.

Two different procedures are used to process coffee cherries, the ‘dry and the wet methods’. The required stages are listed below:

Dry processing

During the dry processing, small stones, twigs and leaves, etc. are removed from the harvest in a type of floating chamber. The remaining coffee cherries are then spread out on a large rack and laid out in the sun to dry, being turned over occasionally with a rake, in order to prevent molds from developing. Depending on the weather, the drying process can take up to eight days. It is complete when the beans rattle around in their shells when shaken. Under unsuitable weather conditions, the beans may begin to rot, which can result in a drop in quality.



TRANSPARENCY 4.7 (15): PROCESSING TASK LIST: WATER, DRY AND ECOLOGICAL METHOD

Ecological processing

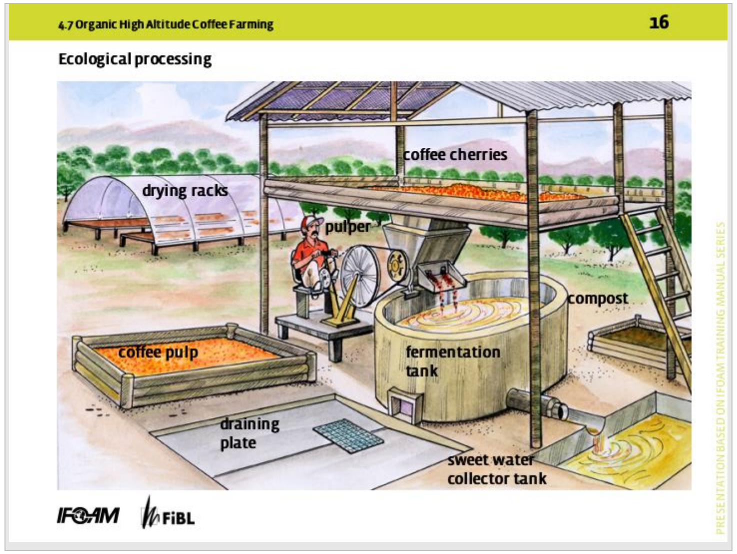
More and more small organic farmers in Latin America are using what is called the ecological processing method. This method is a different kind of dry processing. No water is used during the first stages of processing (transporting, classifying the ripe grains and separating the pulp from the pellicle membrane). Instead, the freshly harvested ripe coffee beans are directly thrown into a hopper, which feeds them through a special pulper. It is very important that the process is done on the same day as harvesting to assure that the pulp is easily removed. Then, the coffee beans go through a brief fermentation process, which, depending on the desired flavors, temperature and specific technology available, can vary from a very short period to almost a whole day. Finally, the coffee beans are washed with clean water and are put out to dry under the sun on concrete floors or on racks. Usually, farmers build small plastic roofs over the drying surface to protect coffee beans from the rain.

Wet processing

During the wet processing procedure, the freshly picked coffee cherries are placed in large water containers. The healthy, ripe cherries sink immediately to the bottom of these tanks (which are usually built of raised concrete), while twigs, leaves and damaged or moldy coffee cherries float on the surface and can be easily collected. This also means that the harvest is simultaneously washed. The coffee cherries are then fed into a swelling tank via a water channel, where they remain for a maximum of 12 hours. In the next stage, the slightly swollen cherries are fed into a pulper, where the majority of the fruit pulp is separated from the pellicle membrane of the beans. The remaining, slimy flesh residues are separated from the coffee beans through a brief fermentation (12 – 24 hours, or up to 2 – 4 days in cool weather). Finally, the coffee beans are washed and dried out on concrete floors or large racks in the sun, or with hot air in drying drums. In order to correctly store the coffee beans, it is useful to reduce their water content to 10%.

Shelling

The pergamine coffee, which has been dried to a glass hard finish, is then shelled and polished by putting it through a coffee sheller. Both 'wet and dry' processed coffee are shelled and polished in the same way.



TRANSPARENCY 4.7 (16): ECOLOGICAL PROCESSING

Sorting into trading categories

Before the raw coffee can be traded on the world market, it needs to be graded according to established criteria. The coffee is mechanically sorted, by sieving it to obtain beans of the same size. It is not the length of the beans, but their width that is important for the size of the holes in the sieve (waist). The sieves are graded from size 20 (with holes that are around 8 mm across), down to size 10 with 4 mm holes. Sieve number 17 is viewed as the average size.

Cleansing, sorting and packaging

After sieving, the coffee goes to a large ventilator, where all the remaining foreign particles, such as skins and shells from the polishing process, are blown away by a stream of air. The final processing step is to pack the raw coffee into natural fiber sacks of 48 or 60 kg, which is the size preferred by the international markets. Sacks of coffee for export, should display the following details:

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested
- Net weight
- Batch number
- Destination, with the address of the trader and /or importer
- Visible indication of the organic source of the product

Storage

The raw coffee should be stored in well-ventilated, dark areas at low temperatures and low relative humidity. Coffee should never be stored if not completely dry (10% humidity), to avoid fermentation or fungal infection. It should be stored in clean, natural fiber sacks placed on wood racks to assure proper ventilation.

Under optimum conditions, dried fruits can be stored for up to 1 year.

If the organic product is being stored in a single warehouse together with conventional coffee, mixing of the different qualities must be avoided. This is best achieved by using the following methods:

Discussion:

- *Bring coffee samples from different production zones and qualities. Have participants try the different coffees.*
- *Discuss the differences found, especially in aroma and flavor.*

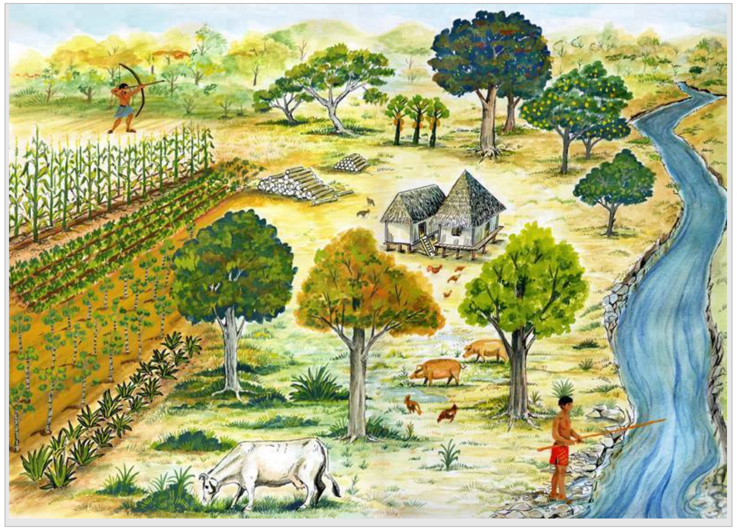


ILLUSTRATION 1 : DRYING COFFEE ON WOODEN RACKS PROTECTED FROM RAIN BY USING PLASTIC ROOFS BUILT WITH LOCAL MATERIALS

Informing and training of warehouse staff

- Explicit signs in the warehouse (silos, pallets, tanks, etc.)
- Color differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

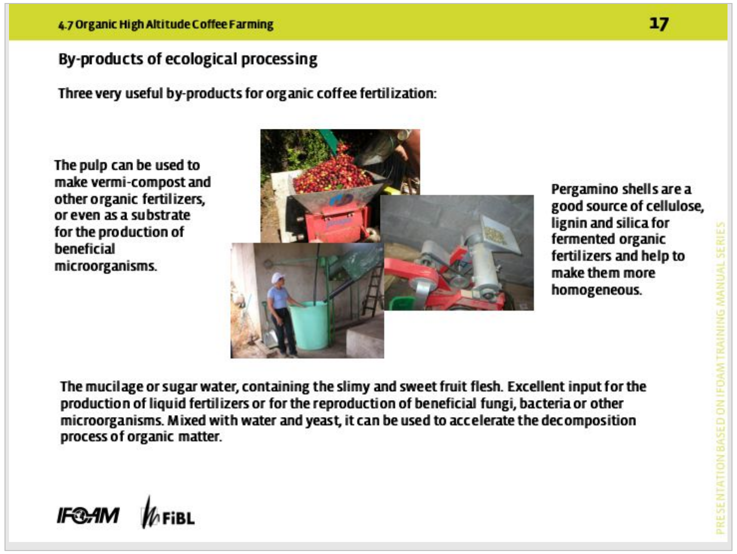
Recycling the processing by-products

Coffee processing, especially when using the ecological method produces three by-products that can be very usefull for organic coffee production:

The pulp can be used to make vermicompost and other organic fertilizers. It can be even used as a substrate for the production of beneficial microorganisms like *Aspergillus oryzae, Bacillus megatherium* and *Saccharomyces carevisae*, which are desirable for the production of high quality organic fertilizers.

The mucilage or sugar water, which is the remaining water from the final wash, contains the slimy and sweet fruit flesh. This water is also an excellent input for the production of liquid fertilizers or for the reproduction of benefical fungi, bacteria or other microorganisms. Mixed with equal parts of water and some yeast, it can be very efficient to accelarate the decomposing process of mulch or prunning remains.

Pergamine shells are a good source of cellulose, lignine and silica for fermented organic fertilizers. As well they help make fertilizers from organic matter more homogeneous.



TRANSPARENCY 4.7 (17): RECYCLING BY-PRODUCTS OF THE ECOLOGICAL PROCESSING

4.7.8 Economic and marketing aspects

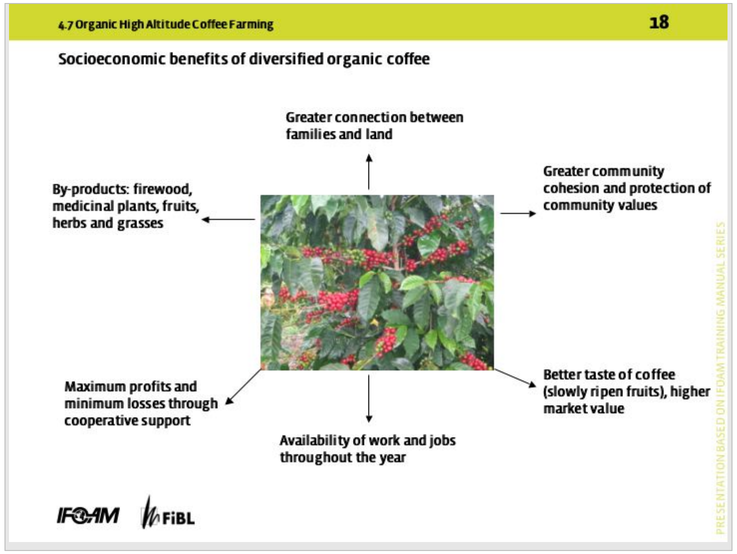
Benefits of diversified organic coffee production

- The diversification process delivers multiple benefits to the producers and their families besides the revenue from coffee. Other benefits include firewood, medicinal plants, fruits, herbs and grasses.
- Social benefits include a greater connection between families and land, thus greater community cohesion and a protection of community values. The whole family, from elders to children, is involved in the process.
- Organization of the farmers into cooperatives helps them to get maximum profits and minimize losses , to share and learn from each other's experiences and to help each other.
- Diversified organic coffee farming in the mountains provides jobs and work in the field throughout the year and is economically realistic.
- This coffee is widely appreciated for its better flavor as the fruits ripen slowly allowing them to develop a high sugar content, which produces a smoother and richer taste.

Economic aspects of organic coffee production

For most conventional coffee farmers, coffee as a monoculture has been the only source of income. In these systems, productivity is highly dependent on a high use of agrochemicals for fertilizing, as well as for pest and disease control. These systems, which are "forced", tend to degrade soils and create a growing dependency of the coffee plants on these inputs. This situation, combined with the downward trend in international coffee prices, creates a vicious circle for small farmers, in which they try to increase production to get a better income, but higher productivity means increasing use of synthetic inputs (the price of which is also usually increasing), and the decreasing prices for the harvested coffee mean they will be left with less net income every year.

By contrast, organic coffee farming under mixed cropping or agroforestry systems may offer lower productivity, but since the use of external inputs is much lower (decreasing production costs considerably) and prices for organic coffee are higher, these systems give the farmers a higher net income. In addition the soil's quality improves with time, as does the productivity of the plantation. Other products from the diversified production are sold at local or national markets, also contributing to increases in the farmers' net incomes, making them less dependent on a single crop.



TRANSPARENCY 4.7 (18): SOCIOECONOMIC BENEFITS OF DIVERSIFIED ORGANIC COFFEE

For example, in 1996 the cooperative Coopemontes de Oro, in Costa Rica, made a comparison between organic and conventional coffee and found out that, in spite of 33% less yield, organic coffee produced a net income almost 3 times higher than conventional. (See illustration 2: Coopemontes de Oro net income comparison).

Marketing and trade

Roughly 50% of the world supply of organic coffee is produced by small farmers' organizations that are members of FLO-International (Fair Trade Labeling Organization). The other half of world production is supplied by small farmers' organizations that are not FLO-registered (although some are members of fair trade programs) and by private small, medium and large-scale farmers not belonging to fair trade programs. In Europe, about 25% of fair trade coffees are sold as organic. The proportion of organic coffee is steadily growing, because the price differential of fair trade over conventional coffee is so great that the organic premium barely registers. North America and Europe are the largest markets for organic coffee. In both continents, organic coffee – unlike the conventional coffee industry – has experienced notable growth in recent years.

The organic label generally provides a premium of around 20–40% on the commodity market value. The premium is even higher if the market price falls below the cost of production. The fair trade mechanism of FLO works as follows (FLO-International established conditions for the purchase of fair trade coffee): it guarantees small farmers a fair price for their coffee, which is calculated considering production costs (but there is no guarantee that the cooperative will be able to sell the coffee under FLO conditions, even if the cooperative is entered in the registry). It provides access to affordable credit facilities and helps them to stay out of debt to local lenders. It creates direct trade links between farmers and their cooperatives and importers. It promotes a new relationship that links consumers and buyers with farmers. Buyers and sellers will endeavor to establish a long-term and stable relationship in which the rights and interests of both are mutually respected. A standard extra premium is paid for fair trade plus organic coffee (contact www.flo-international.org).

High price differentials will be the main limiting factor for development of the organic coffee market in the coming years. The second big limiting factor is the inefficient distribution of organic coffee in Europe: as ever, the bulk of it is still sold in natural food stores. This results in smaller cargos and more costly structures.

Comparison of net income between organic and conventional coffee in 1996. By Coopemontes de Oro, Costa Rica

	Coffee	
	Conventional	Organic
Yield (qq/ha)	60	40
Price (colones/qq)	16.000	20.000
Gross income (colones)	960.000	800.000
Costs (colones/qq)	15.000	15.000
Total costs (colones)	900.000	600.000
Net income (colones/ha)	60.000	200.000

Adaptado de: Morera R., G. (1996).

ILUSTRACIÓN 2: COMPARACIÓN DE INGRESOS NETOS DE COOPEMONTES DE ORO.

From the perspective of producers, organic and fair trade coffees provide many advantages and can help to improve the risk management strategies of smallholders:

- Diversification of production (multi-cropping) on a sustainable coffee farm offers several advantages to a farmer.
- Coffee certification can be an excellent hedge against market price downturns since most forms of certification can generate premiums although there are no guarantees.
- Reducing or eliminating the use of purchased inputs limits the farmer's expenses and therefore his subsequent market exposure.

However, for many producers, conversion time, preparation and certification are costly and sometimes difficult. It is clear that professionally organized producer groups and producers with a clear strategy for quality production and a flair for coffee specialties have the best potential for the future. One of the biggest challenges for organic coffee producers is to reduce the price differential between conventional and organic to a competitive level, (as long as conventional prices are not below the production costs, of course). Long term contracts with reasonable price differentials can play an important contribution in this respect.

Growth prospects for the organic food market are very good for the next years and the organic coffee market will grow in parallel with this. Consequently, there is likely to be a demand for future new organic coffee projects. Two considerations are necessary:

1. Public or private programs and initiatives to support organic coffee production should always consider sustainable development of the market and prepare the producers to market their organic coffee successfully.
2. If, in the rush for new business, quality and consistency are not maintained, then consumers will reject organic coffee.

4.7 Organic High Altitude Coffee Farming 19

Major criteria for purchasing decisions by European importers

Major criterion for purchasing decisions	Improvement measures for production and trade
1. Coffee quality and taste	Quality of coffee production, fermentation, prevention of high acid content, optimum taste, optimum varieties, new blends, good assortment and consistent coffee, etc.
2. Reliability of partners	Marketing and communication, management of producer groups and producers, personal contacts with buyers; win-win cooperation between producers and buyers.
3. Consistency of supply	Steady and predictable supplies (quality and quantity)
4. Stable and fair prices for farmers, processors, traders and retailers	How long will it be possible to pay constantly increasing price differentials for organic as opposed to conventional? A solution would be long-term contracts between producers and buyers with semi-fixed prices (moving within a defined band)
5. Experience of export business	Know-how, efficient export structures
6. Demand: customers are asking for it	Create unique or different product lines
7. Desire to have simpler sourcing criteria and clearer messages	Many are in favor of a simpler way of communicating sustainability in the marketplace, in effect a super-sell, which combines organic and fair trade
8. Distribution and availability to consumers	Market responses are lower than expected probably due to the limited product availability and consumer education
9. Quality of organic certification	Set up local certification systems, improve certification trust and quality
10. Authorities	Reduce bureaucracy and paperwork in the country of origin and in the import country

PRESENTATION BASED ON IFOAM TRAINING MANUAL SERIES

TRANSPARENCY 4.7 (19): MAJOR CRITERIA FOR PURCHASING DECISIONS BY EUROPEAN IMPORTERS

Recommended reading:

- *Guia para la Caficultura Ecologica- Beatriz Fischersworring Hömberg and Robert Rosskamp Ripken, GTZ Publication 2001*
- *Café Orgánico: Guía del Caficultor Ecológico – Proyecto Café Orgánicos Colombia, GTZ, Asociación Nuevo Futuro. Publication 1998.*
- *Curso Taller Latinoamericano sobre Café Orgánico en Énfasis en Biofertilización, Nutrición, Certificación y Situación Actual del Cultivo – CEDECO. Publication 2000.*
- *Dilemas de la Reconversión del Beneficiado de Café en Centroamérica. – BUN-CA. Publication 1999.*
- *Organic Coffee, Cocoa and Tea-Market, certification and production information for producers and international trading companies- Lukas Kilcher et el, SIPPO / FiBL / Naturland Publication 2002*
- *Feasibility Organic Coffee and Cacao UBACC El Jobo (Cuba) –Lukas Kilcher*

Recommended websites:

- *www.beantrends.com*
- *www.rainforest-alliance.com*
- *www.coffeeuniverse.com*
- *www.coffeeresearch.org*

4 Management Guide for Crops

4.8 Cacao

Introduction

The natural habitat of cocoa plants is the tropical rainforest where it predominantly occurs in alluvial forests within the sphere of influence of the rivers. Both the annual floods and the higher wind speeds above the water lead to a regular rejuvenation of these ecosystems.

With a height of up to 9 meters, the cocoa plant is a small understory tree of the primary forest. It is associated with a vast mixture of tree species providing a stratified forest structure. The lifecycle of a cocoa tree can span well over a hundred years.

Organic cocoa is grown mainly in Latin America countries (e.g. Dominican Republic, Cuba, Bolivia; see case study, chapter 3.1 of this manual). Organic cocoa, grown in a sustainable multi-layer forest system, has a good economical potential. No considerable yield depression has been reported in organic cultivation. Additionally, it holds an enormous potential for environmental and cultural conservation in regions under intense pressure from conventional monocrop agriculture.

4.8.1 Agroecological requirements

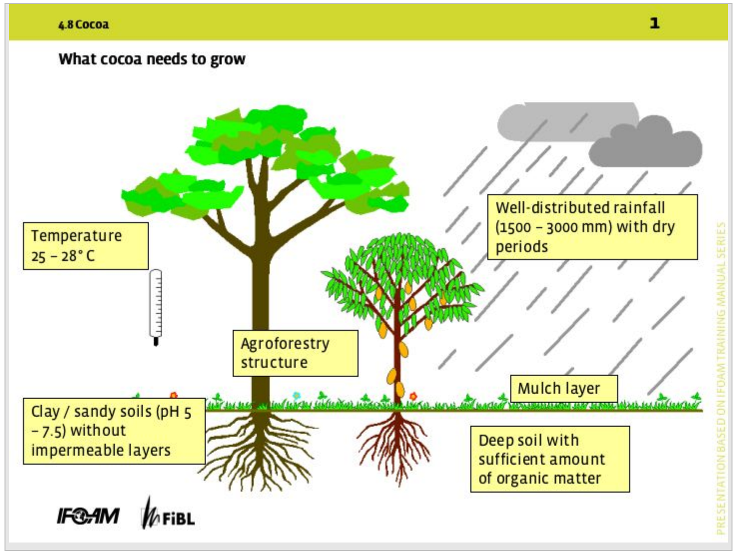
The optimum temperatures for cocoa should be high and relatively stable over the year, ranging from 25 to 28°C and should not be less than 20°C in the coldest month. Shorter cold spells with temperatures of 10°C damage sprouting seedlings. Long periods over 30°C affect the physiology of the cocoa trees.

Precipitation of 1500 to 3000 mm, well distributed throughout the year is ideal. However, dry periods are important in restricting the spread of fungal diseases. Under natural site conditions, the plants tolerate periods of three to four months with a deficit in precipitation. When such periods occur, the cocoa plants display a more distinct rhythm of flowering and fruiting.

The optimum humidity is 85%. Shading from 40 to 70% from overstory trees is ideal. Strong and steady winds can severely damage cocoa.

Lessons to be learned:

- *The guild structure is a key concept in the cocoa ecosystem.*
- *Organic cocoa has a considerable economic potential.*
- *The conversion process should be planned accurately.*
- *A stable system provides healthy plants.*
- *Harvest and post-harvest techniques are crucial for quality maintenance.*



TRANSPARENCY 4.8 (1): WHAT COCOA NEEDS TO GROW

Optimal climatic conditions for cocoa can be found in the humid and calm tropics with well distributed profuse rainfall and stable high temperatures.

Motivation:

Start with a discussion about local organic cocoa cultivation. Let the farmers speak about the prevailing agroecological conditions and the most popular cropping systems in their areas, and note the examples on a board. Use the transparency to discuss the degree to which the cocoa plantations mentioned by the participants provide the required conditions for cocoa cultivation. Highlight in red those examples on the board that do not provide the required conditions. Use the transparency later in the chapter; in the section entitled "Improvement and conversion of established plantations into agroforestry systems".

In order to develop a good root system, cocoa requires deep soil with sufficient amounts of organic matter (mulch layer), roughly equal proportions of sand and clay, and coarser particles retaining a reasonable quantity of nutrients. It is desirable to have no rocks, hardpans or other impermeable material below a level of about 1.5 m so that excess water can drain away through the profile. The ideal pH is 5.0-7.5 and exchangeable bases in the soil should amount to at least 35% of the total cation exchange capacity (CEC).

4.8.2 Diversification strategies

A large diversity of species is important for the stability of the agroforestry ecosystem. Each individual occupies an appropriate niche and thereby fulfills a particular eco-physiological function within the system. The more complex the design of an agroecosystem the fewer interventions are required to regulate diseases and pests in cocoa production: intercropped organic cocoa plantations have a higher population of beneficial organisms. Additionally, harvesting the companion cash crops can offset the risks of low yields.

Propagation and nursery management

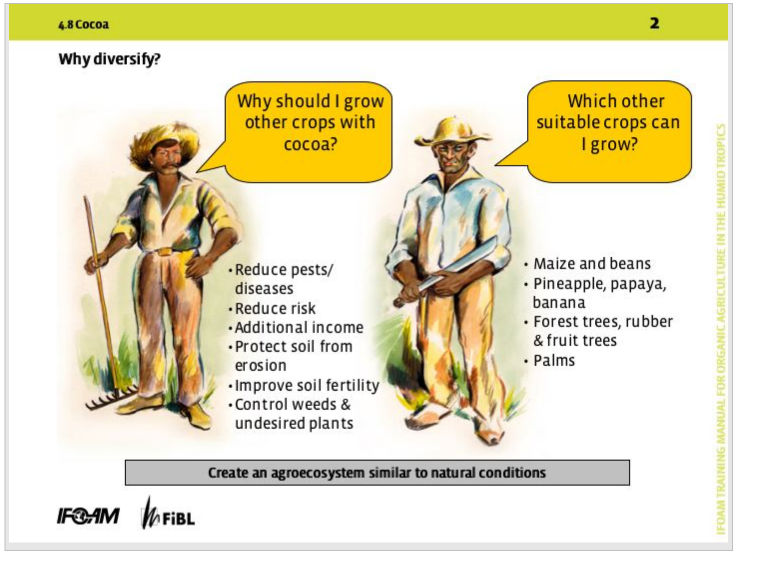
Cocoa can be propagated both by generative and vegetative methods. But being easy, safe and cheap, generative propagation is given preference.

Generative propagation

Most cocoa is raised as seedlings from a nursery. A cocoa nursery requires shade, ample water availability and protection from wind. Fresh beans of ripe pods are planted directly into black polythene bags, filled with a fertile loam topsoil. No fertilizer application is required. Relatively dense initial shade is recommended (> 50%), but can be decreased as the seedlings grow. Apart from watering, the plants do not need much attention in the nursery. Watering should not be overdone, as it may promote attack by fungal diseases (*Phytophtora palmivora* or Anthracnose). Seedlings can be kept in the nursery for up to six months. To meet the water demand of the nursery it is necessary to have a year-round supply of clean water.

If growth conditions are suitable, self-fertilizing cocoa varieties or mixes of hybrids can be directly sown. Three cocoa beans are placed in a group just under the surface of the soil at the intended position of a future cocoa tree. After some time the strongest seedling is allowed to develop. This method is successful and requires little labor, but its disadvantages are the higher quantity of seed required and the risk of rodent damage.

Discussion:
Ask the participants to describe the benefits of diversification in organic cocoa production and what criteria for diversification are appropriate to local conditions (refer to the IFOAM Basic Manual, chapter 4.2). Support the discussion with the following slide.



Transparency 4.8 (2): Why diversify?

Vegetative propagation

Vegetative propagation should be done only if generative methods are likely to produce very variable progeny. This is mainly done by rooting cuttings and buds taken from fan shoots. These give a spreading bushy growth and will require pruning. The planting material is put into pots. Young plants are raised in the nursery as in generative propagation.

Varieties

Three large groups of cocoa can be distinguished, each with several varieties and strains:

Forastero: is the most widely grown (80% of total area under cocoa), gives high yields but has weak taste. The **Amelonados** variety is self-compatible.

Criollo: has a strong fine flavor and highest cocoa quality, but the yields are low and therefore it's rarely cultivated. Its habitat requirements are demanding.

Trinitario: is a hybrid of the Forastero and Criollo types. It is hardier and more productive than Criollo. It has a share of roughly 10 to 15% of the total world production and can fertilize self-incompatible species of other groups.

Discussion:

- *Ask the participants to mention the common varieties that they propagate and their characteristics. Discuss in plenary the advantages and disadvantages of these varieties.*
- *Ask the participants about the common techniques of propagation used in their areas. Discuss in plenary the advantages and disadvantages of these techniques.*

TRANSPARENCY 4.8 (3): ORGANIC COCOA NURSERY

Establishment of organic cocoa farms

When establishing new plantations, attention must be paid to the natural habitat of cocoa. This includes climatic and soil requirements as well as ecological forest structures, such as deep growing vegetation, shade and fruit trees. With the early establishment of a proper association of plants, biological soil activity can be maintained and the cocoa mycorrhizae can develop immediately.

Cocoa grows best in agroforestry conditions, alongside other forest trees (leguminous tress, palm trees, fruit trees), that are adapted to the natural topography and climate. The establishment of new cocoa plantations in organic farming should be understood as the establishment of "cocoa agroecosystems". A number of different production systems can be found:

1. Planting into thinned primary or secondary forest

Mostly practiced in Asian and African countries, this plantation system has the disadvantage that the structure of a thinned primary forest is damaged to such an extent that it loses much of its dynamic and the cocoa plants do not find optimal production conditions in the understory. This practice can only be recommended for very young secondary forest systems, provided that the local existing species composition is known.

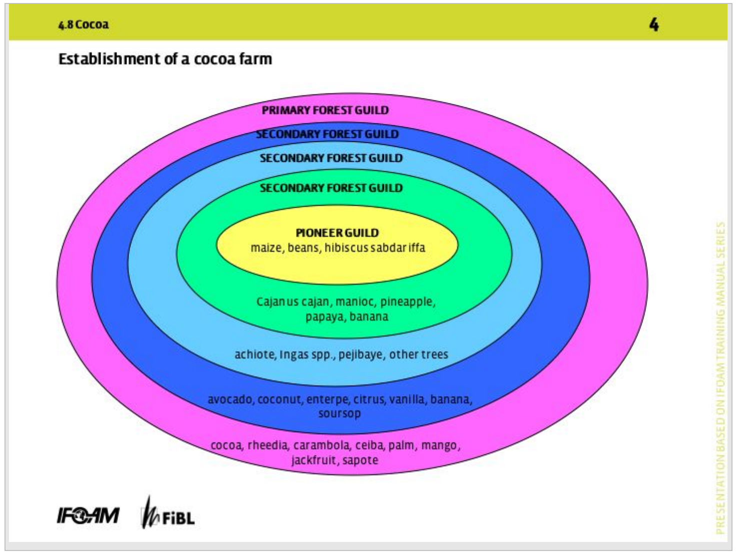
2. New plantations on clear-felled sites

Sometimes new plantations are set up on sites of clear-felled primary or secondary forests that have been burnt to open them up for cultivation. The burning of the fields cannot be recommended.

Nevertheless, the following form of cultivation has given good results on clear-felled sites. Since it is not possible to establish such complex systems straight away, it is important to note the principles involved and apply them step by step. Based on the natural succession, pioneer plants would dominate the system immediately following clear-felling. The options for species compositions and combinations of crops are so varied and examples of a few possible approaches are given below:

A. Pioneer Guild (cycle of a number of months):

Maize (*e.g.* at 1m x 1m) + beans (0.4m x 0.4m) or *Canavalia ensiformis* + *Hibiscus sabdariffa* instead of beans.



TRANSPARENCY 4.8 (4): ESTABLISHMENT OF A COCOA FARM

B. Secondary Forest Guild I (cycle of up to 10 years):

Cajanus cajan (0.5m x 0.5m) + manioc (1m x 1m) + pineapple (0.4m x 1.80m) + papaya (2m x 2m) + bananas (different varieties at 4m x 4m) + pepper

C. Secondary Forest Guild II (cycle of up to 50 years):

Achiote/urucú (*Bixa orellana*), *Ingas* sp. + pejibaye (Bactris gasipaes – palmacea) + other tree species of various heights. All tree species are sown as a seed mix between the rows of pineapples with ca. 20 cm distance between seeds.

D. Secondary Forest Guild III (cycle of up to 80 years):

Avocado, coconut, *Euterpe* sp. (Palmacea), citrus fruit, vanilla, long-living banana varieties, guanabana (soursop, *Annona muricata*).

E. Primary Forest Guild (cycle of >80 to 1500 years):

Cocoa (*Theobroma cacao*), *Rheedia* sp., carambola (*Averrhoa carambola*), copuazú (*Theobroma grandiflora*), *Ceiba* sp., brazil nut (Bertholletia excelsa), palm species, mango, jackfruit (*Artocarpus heterophyllus*), caoba (*Swietenia macrophylla*), sapote (*Manilkara zapota*), para rubber tree (*Hevea brasiliensis*) and many others.

Constituent tree species of the local ecosystem must also be sown together with the crops of economic interest listed above.

The selection of companion crops

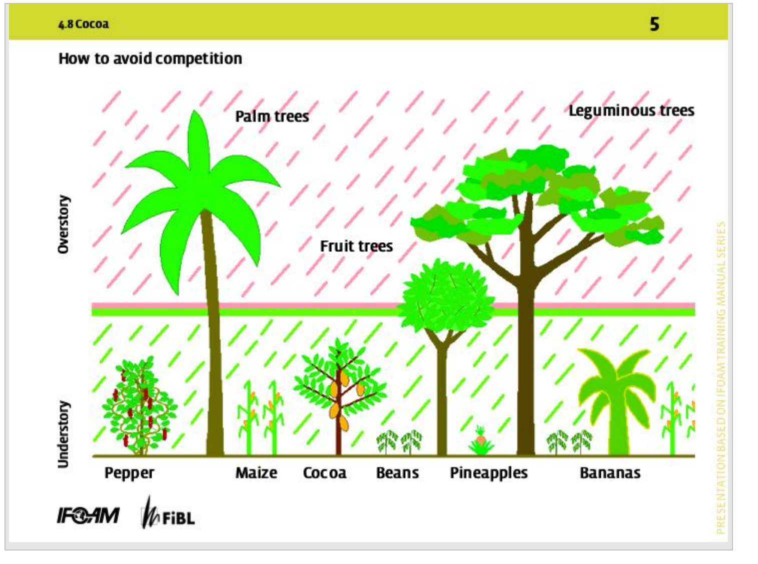
It is important to select species from each of the guilds, to permit a multi-tiered, vertically diverse forest system. There will be excessive competition between individual plants if, within the same guild, more than one species occupies the same stratum (grows to the same height).

The system should be set up at a high density, of about 8 trees per square meter. The more densely planted the system, the less the maintenance work is required and the more dynamically the system develops.

Combinations can include a mix of fruiting trees such as avocado, carambola, mango and jackfruit (higher understory), which can be interspersed with sapote (overstory) and para rubber trees (*Hevea brasiliensis*). Trees that shed their leaves (*e.g. Ceiba pentandra*) should be planted to provide the overstory. An overall density of 150 trees per hectare enhance cocoa production.

Sharing experiences:

Ask the participants how any organic cocoa farms that they know, were established. Divide the participants into groups and ask them to draw up a scheme to establish an organic cocoa farm. Let the groups present their results in plenary.



TRANSPARENCY 4.8 (5): HOW TO MANAGE COMPETITION

Spacing and planting patterns

When cocoa is intercropped with other commercial crops, the optimum spacing will vary greatly and will largely depend on the choice of companion crops. For shaded cocoa plantations, a spacing of 2.5 m x 2.5 m is used (1600 plants/ha). In unshaded ones, the density should be 5 m x 5 m (400 plants/ha). The results of numerous spacing trials point to a spacing of between 3.0 m x 3.0 m and 2.3 m x 2.3 m as giving the highest yield. However, rodent damage to pods is greater in closely spaced cocoa. A wider spacing of rows (3 m) allows easy tractor access.

Under highly humid conditions where pod diseases are common, it is advisable to thin the canopy by increasing the distance between the rows and planting closer within the rows. A suitable spacing might be 3.7 m x 2.4 m. The wider row spacing allows better aeration of the plantation.

Land preparation and planting

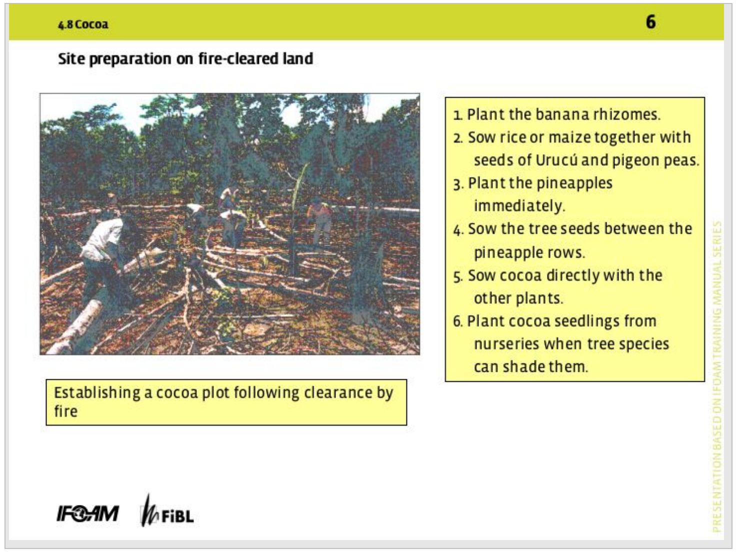
There are two ways to prepare a site for planting:

A. Using fire to clear land

Many small farmers prepare their fields for growing crops by burning the existing vegetation, and they plant the cocoa plants only after the harvesting of the first set of crops.

Method:

1. The banana rhizomes are planted (400-800 rhizomes/ha).
2. Then, rice or maize is sown. Urucú (Bixa orellana) seeds should be planted along with the rice, at a ratio of 10 (rice) to 1 (Urucú), together with pigeon peas (Cajanus cajan). In the case of maize, pigeon peas should be supplemented with non-climbing bean varieties or Canavalia ensiformis
3. If pineapple is to be integrated, it should also be planted at this time (at ca. 0.4 x 1.8m).
4. Tree seeds are sown between the pineapple rows. A wide variety of inexpensive and easily obtained species from the secondary forest guilds II and III (short and medium lifecycles), e.g. Inga sp. and Erythrina sp. should be selected.



TRANSPARENCY 4.8 (6): SITE PREPARATION ON FIRE-CLEARED LAND

Discussion:

Ask the participants their opinion regarding the use of fire to clear land. Note the advantages and constraints of this method on a board. Discuss probable risks for the natural ecosystem..

5. If the cocoa is to be sown directly, it should be sown at the same time as all the other plant species. If the cocoa is started off in nurseries, planting is only carried out when the other sown or planted tree species can shade the cocoa plants.

Planting holes should be just large enough to allow the cocoa seedling to be planted easily.

B. Site preparation without burning

On sites with a relatively young secondary forest cover and in areas where maize cultivation plays an important role, burning should preferably not be carried out.

Method:

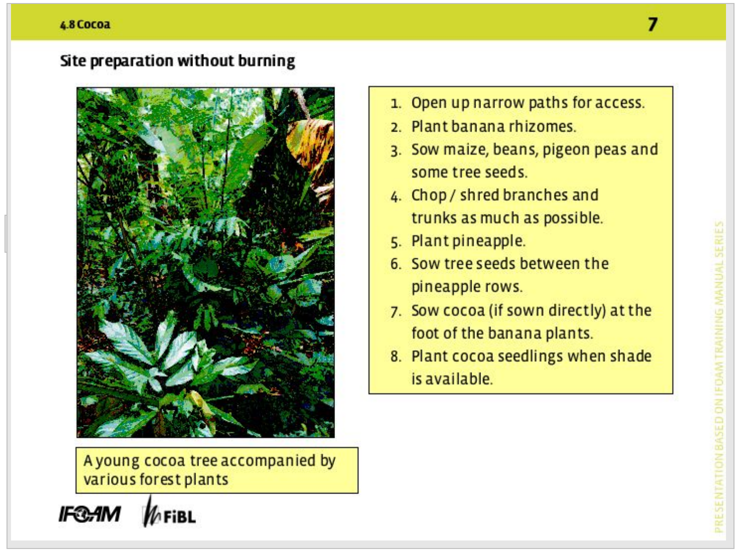
- Opening up of narrow paths (approx. every 3 meters), to allow easy walking access.
- Clearing the entire site, chopping / shredding branches and trunks as much as possible.
- Planting of banana rhizomes.
- Sowing of maize, beans, pigeon peas and readily available tree seeds.
- Planting of pineapple.
- Sowing of tree seeds, available in smaller quantities, between the pineapple rows.
- Sowing of cocoa (if sown directly), preferably at the foot of the banana plants.

Improvement and conversion of established plantations into agroforestry systems

Existing cocoa plantations can be converted into agroforestry systems in a number of ways. The approach to be taken will depend on the existing situation of the plantation.

A) Young, already productive plantings (up to ca. 15 years) with shade trees

It is not possible to simply plant extra trees within an existing plantation that already has established shade trees (*Inga sp.*, *Erythrina sp.*). The system can be improved by creating small patches called 'agroforestry islands' of more complex plantings within the plantation.



TRANSPARENCY 4.8 (7): SITE PREPARATION WITHOUT BURNING

Activity:

Take the participants for a short walk in a young plantation. Describe how the site was cleared and how the plantation was established. Make notes on a poster.

Back in the lecture room, show and explain the transparency below and compare this system with the practical example from the field. Discuss advantages and constraints of both systems.

Procedure:

- Unhealthy or unproductive cocoa trees and gaps in planting are identified.
- The unproductive trees are felled and the adjoining cocoa trees are heavily pruned. All the shade trees in the sphere of influence of the 'island' are pruned back to the crown and these prunings are evenly shredded and dispersed on the ground.
- A variety of species representing all the guilds should be planted in this gap (if the area is big enough, pioneer plants such as maize may also be planted). Bananas and palms should not be left out. The plants of the different guilds and of different heights are planted at distances of 0.5 - 1m from each other.

B) Old productive plantations with shade trees of the secondary forest system

As long as such plantations have good productivity and do not have "pest" or disease problems, no major interventions should be undertaken. They can be converted to organic cocoa plantations through the normal conversion processes.

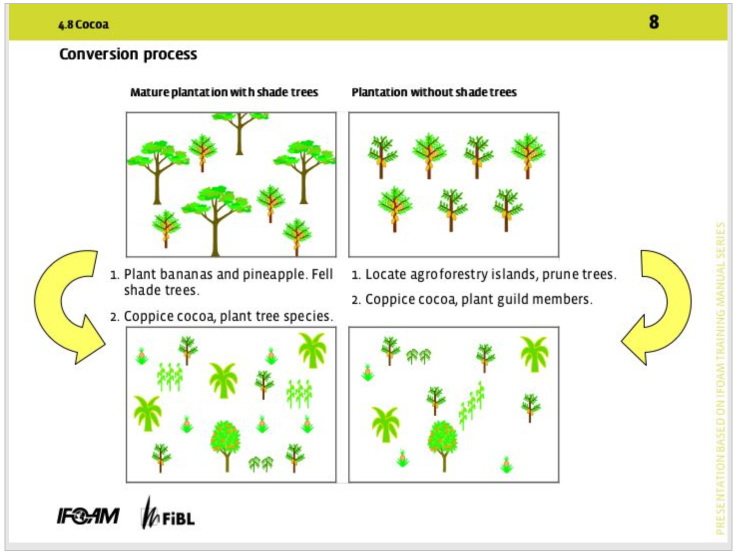
C) Old unproductive plantations and plantations prone to diseases, with shade trees

In the case of plantations that used to be productive but now display problems, such as a loss of productivity, or are infested with pests or disease, the entire plantation should be rejuvenated.

- Prior to the felling of trees, the approach described above for site preparation without burning should be adopted.
- Bananas, pioneer species and tree species from the various guilds are planted.
- The old shade trees are felled and the cocoa trees are coppiced to a height of ca. 40cm. All the branches are chopped or shredded and spread on the ground.
- Next, pineapples are planted, interspersed with the seeds of various tree species. Papaya grows very well in such plantations.
- If the planting distances of the old cocoa planting do not require correction, the selected sucker can be left to develop its own root system and all the other suckers are removed. This planting regime will produce cocoa again in its third year.
- If the plantation contains disease-prone material and has a low productivity, the stock of cocoa plants should be replenished completely, either by grafting onto suckers or by replanting.

Suggestions and motivation:

Several farmers may be encouraged to discuss how to improve and convert their existing plantations to organic: to make them more sustainable and profitable. Give them the chance to describe their existing plantation in plenary and encourage the group to make suggestions as to how they might do so. Conclude by showing your transparency.



TRANSPARENCY 4.8 (8): CONVERSION PROCESS

D) Plantations without shade trees

Plantations without shade trees can also be improved by introducing ‘agroforestry islands’. Depending on the age of the plantation, groups of trees should either be severely pruned or coppiced and completely rejuvenated from suckers. Species from the relevant guilds are then planted into the resulting clearings.

Management of bananas

Bananas play an important role in the dynamics of cocoa agroforestry systems. The banana substitutes the *Heliconia* species as well as species of the *Musaceae* family, which occur in the natural ecosystems of the cocoa plant. Bananas in cocoa agroecosystems should be treated as they are in commercial plantations. This includes regular removal of old leaves, and the removal of surplus shoots and watersprouts. After the harvest the pseudo stem is split lengthwise and placed on the ground, which helps to conserve water in times of low rainfall.

4 Management Guide for Crops

4.8.3 Maintenance of cocoa

The maintenance of the cocoa plant during its formative years is decisive for the later yields. During the early unproductive years after planting, it is of utmost importance to create excellent preconditions for the development of the young cocoa plants through providing adequate shade, careful weeding and soil cultivation as well as plant nutrition. The continuous thinning of maturing individual plants, as well as harvesting, opens up the system and, at the same time, continuously adds organic matter and woody material to it.

Pruning

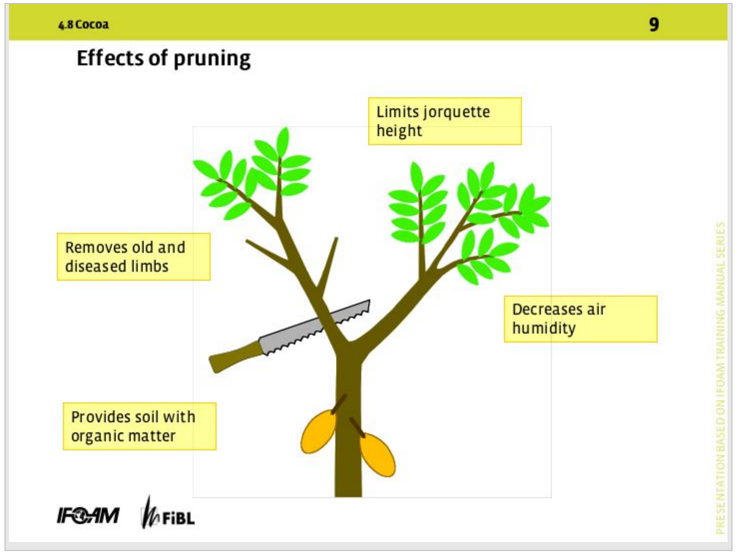
The basic aim of pruning cocoa trees is to encourage the desired tree structure and to remove old and diseased limbs.

Young plants should develop a jorquette at an appropriate height of 1.5 to 2.0 m. The height of the jorquette varies from tree to tree. Increasing the light intensity decreases the jorquette -height. The strongest of the regrowing chupons (buds) should be selected. In due course, this chupon will produce a jorquette at a higher level. Vegetatively propagated plants generally form a jorquette at ground level, which may be removed after a chupon has grown and a second jorquette has formed at a more convenient height.

Fan branches should be removed, maintaining a minimum of three, in order to allow more light to enter and to decrease the humidity within the canopy. Basal chupons should be removed at regular intervals and low branches should be trimmed, cut back or removed to provide better access to the tree. Dead, diseased and badly damaged wood should be removed during regular inspections. Whereas diseased parts of plants should always be removed, other prunings should be left in the field to rot.

Formation of flowers and pollination

Exposure to light positively influences the generative phase of cocoa. A thorough thinning of the shade, roughly six months before the expected main harvest, actively stimulates flower formation. The output of mature pods is dependent on the degree of pollination of the flowers. Experimental results have shown that a light manual pollination (ten flowers per tree on alternate days) can approximately double the yield.



TRANSPARENCY 4.8 (9): EFFECTS OF PRUNING

Activity:

Have a walk in a cocoa plantation and demonstrate on a cocoa tree how to do the pruning work correctly. Divide the participants into groups of three and let them prune cocoa trees by themselves. Discuss the results in plenary.

Synchronizing the agroforestry system

Shade trees that do not shed their leaves (*e.g. Inga sp*.) should be pruned back hard to increase the available light. Adding ligneous organic matter to the soil also contributes to soil fertility,

In young systems with pineapples, intensive selective weeding and pruning of the short-lived secondary forest plants should be carried out to induce flowering.

4.8.4 Soil protection and weed management

In a sustainable cocoa plantation, the soil is mostly covered by spontaneous vegetation and cocoa leaves (dead mulch). Living barriers (e.g. Magnolia) protect the soil against erosion. One of the most important measures for the improvement and maintenance of soil fertility is the continuous addition of woody (ligneous) organic material, generated in large amounts every year as a result of pruning.

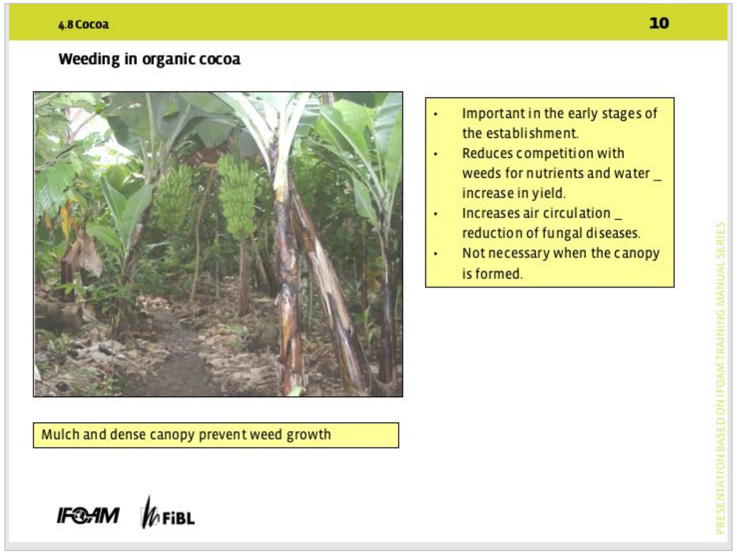
Weed management is an important part of cocoa farm management and is critical in the early stages after establishment. Because weeds compete with cocoa for soil nutrients and water, their removal usually increases the growth and yield of cocoa. Weeding also increases air circulation, reduces relative humidity and thereby reduces the incidence of Black pod disease. Weeds include annual and perennial grasses and weeds, woody plants and climbers. Their relative prevalence will vary from place to place and according to the degree of shade.

Common weeds during establishment include: *Brachjaria mutica, Chromolaena odorata, Cyperus haspar and Paspalum conjugatum.* However, once a canopy is formed, weed growth should be completely suppressed. Traditionally, weeding is done manually by slashing around trees. Clear weeding is rarely done; selective weeding is more common.

Plants that are ripening or wilting should be removed in time. Pigeon pea, for example, should be pruned back severely when about 1/3 of the pods have ripened. This increases light penetration, and the subsequent intensive sprouting improves the dynamics of the system and enhances the growth of all other species.

Sharing experiences:

Refer to the typical climatic features of cocoa regions. Refer participants to chapter 3.4 of the IFOAM Basic Manual and the techniques for soil protection. Let the participants discuss why soil protection measures are necessary.



TRANSPARENCY 4.8 (10): WEEDING IN ORGANIC COCOA

4.8.5 Supplying nutrients and organic fertilization

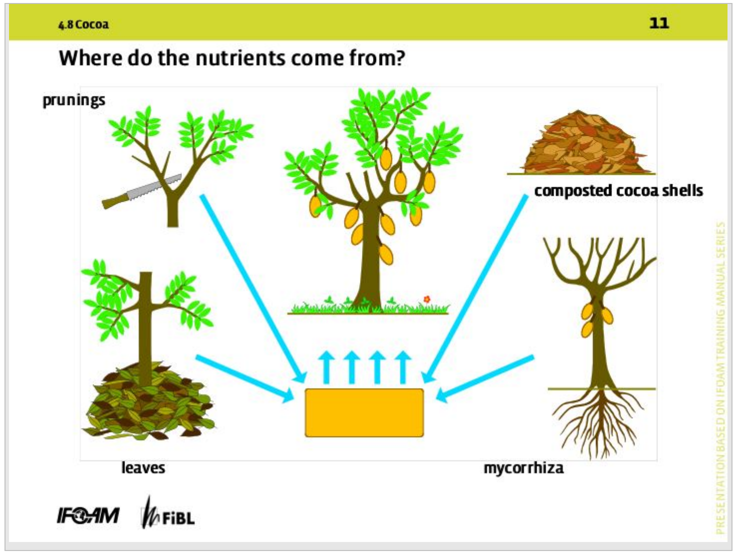
The nutrient demand of shaded cocoa is considerably lower in comparison to open cocoa. The use of shade in organic cocoa cultivation is an essential strategy for saving on nutrient use.

By promoting the turnover of organic material within the plantation, the level of soil fertility required for successful organic cocoa production can generally be maintained. Regular pruning of trees and maintenance of a multi-tiered, diverse and densely populated agroecosystem is generally sufficient for profitable cocoa production. It is also essential to return the (composted) cocoa pods to the plantation. Palms integrated into the cultivation system are able to break down phosphorus and other nutrients through mycorrhizal symbiosis. In addition, mycorrhiza fungi are capable of binding any heavy metals in soil, thus reducing their uptake by cocoa. This is important, because the heavy metal contents in cocoa beans can, in many cases, reach critical levels.

The use of organic manure or compost is likely to be beneficial for cocoa and for the soil structure, but it might not be worthwhile in economic terms since it is highly labor-intensive.

To maintain and enhance soil fertility, it is necessary that the soil has a high energy turnover. The lignin composition of the organic material applied plays an important role here. It is important to maintain a balanced ratio of old and new wood (each of them contains different lignin components). Besides supplying the required energy to the soil organisms, the lignin is a substrate for soilborne fungi (especially basidiomycetes), which are important in the faunal food chain.

Composted cocoa pods should be evenly distributed across the plantation and allowed to rot down as mulch so that the nutrients return to the soil. On average 1000 kg of cocoa pods contain about 23 kg N, 6 kg P, 20 kg K, 10 kg Ca and 7 kg of Mg.



TRANSPARENCY 4.8 (11): WHERE DO THE NUTRIENTS COME FROM?

Motivation:

Ask the participants about the importance of organic fertilization and soil organic matter. Write it down on a board and fill in any gaps. Refer to the IFOAM Basic Manual, chapter 4.1.1.

4.8.6 Indirect and direct pest and disease management

Cocoa is at high risk from many pests and diseases that thrive in the warm, humid climate in which it grows. The proportion of cocoa lost due to these factors is higher than for any other major crop grown in the world.

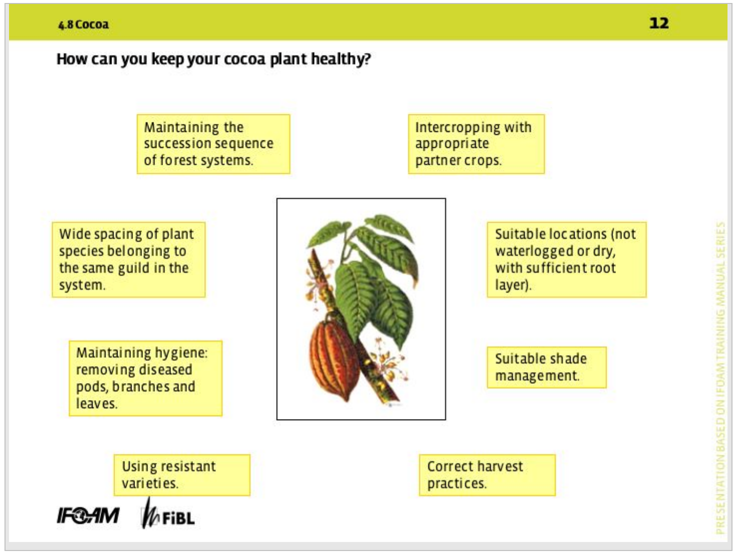
Indirect measures

Indirect methods of pest and disease management play a very important role in organic cocoa production. There is a direct relationship between the supply of light, air, water and nutrients available to the cocoa and the appearance of diseases and pests. Keeping the plants healthy is the best means to prevent pest and disease attacks.

Pests

There are numerous pests of cocoa. The following are those that cause the highest economic damage in organic cocoa production, along with recommended control measures:

Name of pest	How to recognize / important to know	Control measures	
		Preventive*	
Mirids or capsids Sahlbergella singularis Distantiella theobroma Helopeltis sp.	• Sap sucking bugs • Suck on young shoots and fruits • Brown or black sap lesions that are later infected by disease	• Shade • Increased humidity	Mirids or capsids Sahlbergella singularis Distantiella theobroma Helopeltis sp.
Thrips Heliothrips Selenothrips	• Brown spots on dry or silvered leaves	Avoid: • Nutritional imbalance, • Poor soil conditions • Sudden changes in shade level	Thrips Heliothrips Selenothrips
Leaf-cutting ants Atta insularis	• Destroy leaves	• Destruction of nests • Living barriers with *Canavalia*	Leaf-cutting ants Atta insularis



TRANSPARENCY 4.8 (12): HOW CAN YOU KEEP YOUR COCOA PLANT HEALTHY?

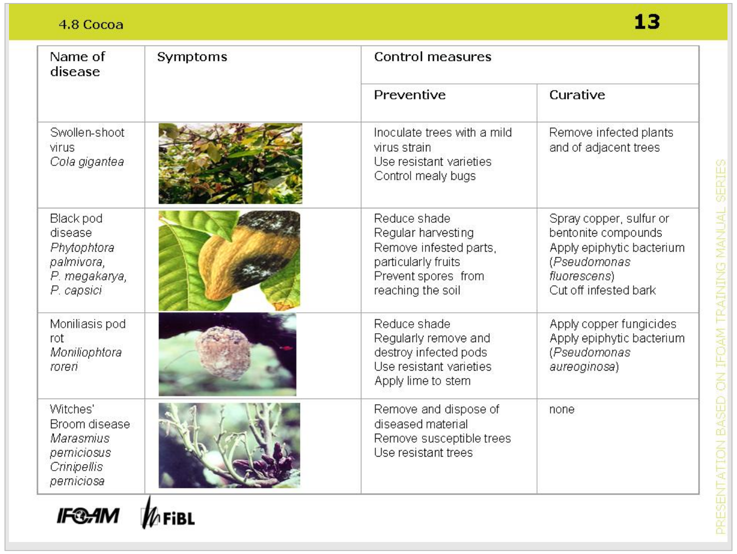
Sharing experiences:

Get the participants to name the most important pests in cocoa and write these down on a board. Divide the group into parties of three and let them prepare a short presentation about the chosen organism. Provide each group with the respective information from the table on the right side.

Diseases

Lack of air, excessive moisture, as well as physical disorders of the cocoa plant (inadequate nutrition), often cause fungal diseases. The following are the most important diseases:

Name of disease	Symptoms	Control measures	
		Preventive*	
Swollen-shoot virus Cola gigantea	• Swellings on roots, chupon and jorquette shoots • Chlorosis of leaves • Mottled pods with fewer beans • Transmission by mealy bugs	• Inoculate trees with a mild virus strain • Use resistant varieties • Control mealy bugs	Swollen-shoot virus Cola gigantea
Black pod disease Phytophtora palmivora, P. megakarya, P. capsici	• Spots then brown patches and then whole pod surface turns black • White / yellow sporulation, fishy smell • Sometimes cankers, pink-red discoloration below diseased bark • Root infection	• Reduce shade • Regular harvesting • Remove of infested parts, particularly fruits • Prevent spores from reaching the soil	Black pod disease Phytophtora palmivora, P. megakarya, P. capsici
Moniliasis pod rot Moniliophtora roreri	• Infections on young pods • Dark brown spots gradually cover the whole pod • White sporulating mycelium	• Reduce shade • Frequently remove and destroy infected pods • Use resistant varieties • Apply lime to stem	Moniliasis pod rot Moniliophtora roreri
Witches' Broom disease Marasmius perniciosus Crinipellis perniciosa	• Brooms: thicker branches with short lateral shoots • Thick stalks of flowers • Distorted young pods, old pods with speckles • Small pink mushrooms	• Remove and dispose of diseased material • Remove of susceptible trees • Using resistant trees	Witches' Broom disease Marasmius perniciosus Crinipellis perniciosa



TRANSPARENCY 4.8 (13): HOW CAN YOU KEEP YOUR COCOA PLANT HEALTHY?

Activity:

Bring some damaged pods to the classroom and lay them out on the table. Ask the participants to classify if the damage is caused by disease, if it's rotten or if it's from a pest attack. Support with the information from the transparency and discuss the mentioned control measures.

4.8.7 Harvest and post-harvest handling

Quality characteristics of the cocoa depend upon correct processing, which begins with the harvesting process and ends with the storing of the processed product.

Harvesting

Depending on temperature, ripening takes between 4.5 and 7 months. Since the flowering and setting of the pods are stimulated by periods of higher temperatures, the main harvest will take place several months after such periods.

Pods are harvested when fully ripe, visibly recognizable by the orange or yellow shell. Ripe pods should be removed as soon as possible, to avoid pest attack and to prevent ripe beans from germinating inside the pod. Harvesting is carried out at regular intervals of 1.5 to 3 weeks. Pods are cut off the tree with knives without damaging the cushion, on which further fruits will form. Pods can be further ripened for a few days between harvesting and opening.

Pods are opened by cracking them on a stone or piece of wood or hitting them with a piece of wood. Care needs to be taken when removing the beans to avoid damaging them.

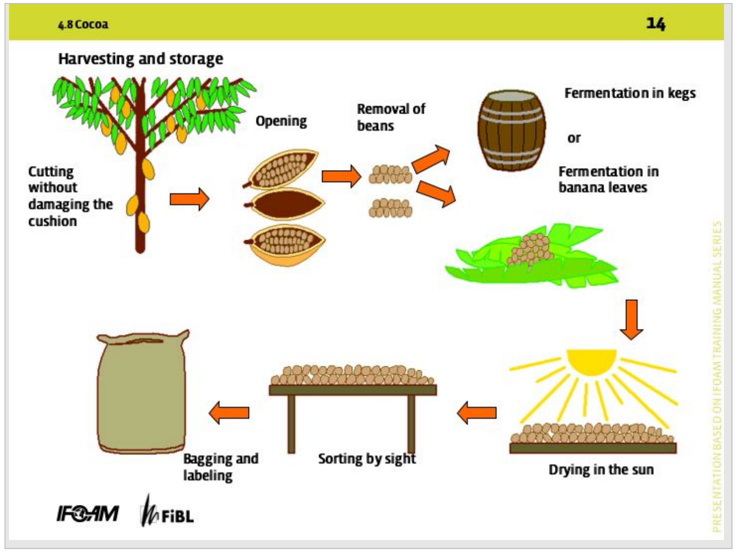
Post-harvest treatment and processing

Beans must be fermented as soon as they are removed from the pod in order to:

- remove the mucilage attached to the beans
- kill the embryo so that the beans cannot germinate
- encourage chemical changes within the bean, which produce the substances responsible for the chocolate flavor.
- reduce the moisture content of the beans

Fermentation is carried out either by heaping the beans and covering them with banana leaves or putting them in a series of rectangular wooden kegs that are covered with banana leaves. Kegs arranged like steps simplify the turning and transfer of beans from one keg to the next by using gravity. The size of heaps or kegs is determined by the need to have a sufficiently high temperature (40 to 50 °C) to permit liquid to drain out and to let air circulate freely around the beans.

To ensure a uniform fermentation, heaps are turned every two days. After 10-15 days, the fermentation temperature will decrease to 40 °C and most beans will be brown in color.



TRANSPARENCY 4.8 (14): HARVESTING AND STORAGE

Group work:

After having presented the transparency, divide the participants into groups of three. Assign one step of the harvesting and processing chain to each group. Let them work out the specific risks of "their" step and how economical losses can be prevented. Let them briefly present their results

To prevent deterioration, the fermented beans are dried by spreading them out in the sun on concrete floors or on raised mats. Sun drying takes at least a week and can be supplemented by drying with hot air. Foreign matter can be picked out from the beans while they are spread out. The dried beans should have a moisture content of 6 to 7%.

Storing

Because of the high temperature and humidity in the moist tropics, stored cocoa is highly susceptible to attack by storage pests and infestation by molds. To prevent the humidity content of the hygroscopic cocoa rising above 10%, the store must be well aerated. In the production areas, cocoa should be stored only for short periods in air-permeable bags. These should be stored one on top of the other on wooden boards.

Bagging

Cocoa beans destined for export are usually packed in bags of 60 to 70 kg, with detailed and clear information about the product, the producers and the certification.

The bags are kept at low temperatures, in dark, dry and well-ventilated stores. For short-term storage, these can be maintained at ca. 16 °C and 55% humidity. For longer-term storage, at ca. 11 °C and 55% humidity.

Further processing of organic cocoa

There is no difference in the procedure for processing organic cocoa compared to conventional cocoa.

Due to the usually heterogeneous quality of the organic cocoa, the processors have to take special care when it comes to ordinary processing. For example, the roasting of cocoa with different sizes of cocoa beans is delicate since there is a tendency to burn small beans.

Other ingredients (e.g. sugar, milk, cream, etc.) used in the further processing of cocoa that will be sold as an organic product also have to be organic or be listed on the positive list of permitted ingredients (e.g. enzymes).

4.8.8 Economic and marketing aspects

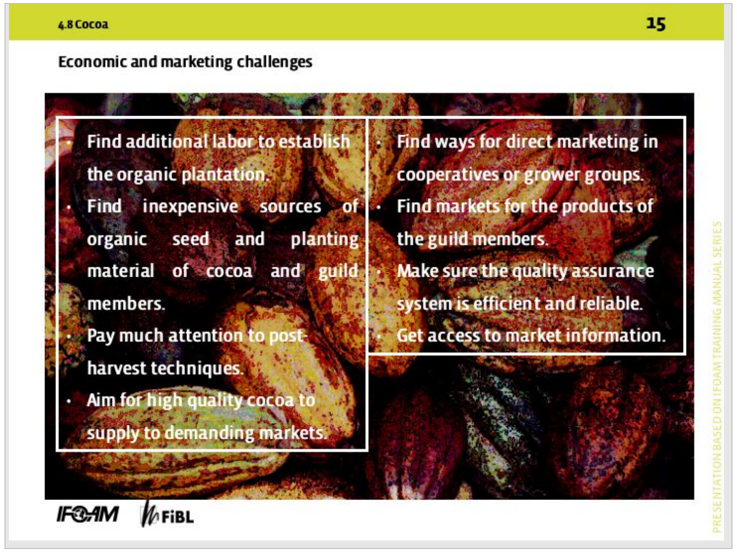
An organic cocoa plantation must not only be sustainable, but also satisfy the farmers' subsistence and cash needs. Cocoa is well-suited for commercial production in a biologically rich and diverse "forest" environment. Such an environment can also give farmers a range of subsistence products such as fruits, cereals, beans, root crops, timber, firewood, animals and other materials. Some of the guild members of the cocoa agro-system can also serve as additional cash crops.

Economic challenges:

- Additional labor for the establishment of the organic cocoa plantation (clearing land, planting guild members, pruning existing plants, etc.).
- Inexpensive sources of organic seed and planting material for cocoa and guild members (e.g. own cocoa nursery).
- Importance of post-harvest techniques to avoid losses in quality and quantity.
- Markets demand high quality cocoa.

Marketing and trade challenges:

- Direct marketing through cooperatives or grower groups gets better prices than those paid by intermediate dealers.
- Success of the whole organic farm. Other products from the agroforestry guild members should be marketed for additional cash income.
- Quality requirements and organic certification (quality assurance should be efficient and inexpensive).
- Access to market information to help with the right choice of the guild members in the agro-systems.
- Tariffs and import fees.



TRANSPARENCY 4.8 (15): ECONOMIC AND MARKETING CHALLENGES

Motivation:

Analyze in groups the most important economic and marketing challenges for organic cocoa production.

Propose an initiative to market local cocoa production through a cooperative or grower group.

Discuss the possibilities to market the production from the guild members of the agroforestry system.

Propose ways to get access to important market information.

Recommended reading:

ITC, 2001. Cocoa. A guide to trade practices. Int. Trade Centre UNCTAD / WTO, Geneva.

SIPPO / FiBL, 2002. Organic Coffee, Cocoa and Tea. Frick / Gräferling, Zurich.

Recommended websites:

- *www.cocoaresearch.com*
- *www.icco.org (International Cocoa Organization)*

4 Management Guide for Crops

4.9 Black Pepper

Introduction

Black pepper is probably the best known and most used spice in the world. It is native to India, where its cultivation dates back thousands of years. At present, the main producers are India, Indonesia, Vietnam and Malaysia, which each produce 20000 t/year. Black pepper is also grown in Latin America, with Brazil being the main producer.

Black pepper is a shade crop of the humid tropics. When it is produced intensively, this crop demands management and fertilization. Traditional, less intensive production is less demanding, less productive, but more durable.

As a crop, pepper mixes quite well with many other crops. This characteristic, in addition to its relatively high price, has given it a place in organic farms of the humid tropics, either as the main commercial crop for export or as a mixed crop for the national or local markets, or even just for the farmer’s family consumption.

Several pepper products can be marketed: black pepper, which is harvested just before it ripens and sun dried, keeping the pulp and skin; white pepper, which is harvested ripe and sun dried, without the skin; and green pepper, which is harvested at four months, when grains are still in a "milky" state and which, instead of being sun dried, is marketed frozen or canned. Red pepper, which is the fresh and ripe fruit, is another "exclusive" product for which there is great demand.

Description and origin

Pepper is a perennial climbing woody vine. The stem is divided by nodes every 5 - 12 cm. At each node grows a wide leaf, which varies in form and size. These leaves grow alternately on each side of the stem. On the opposite side of the leaf, a fruiting branch and an adventitious root, which clings to the support, may sprout. In its natural state, pepper can grow up to 10 meters high. However, when it is cultivated, it should be pruned regularly to control its height and to promote production.

Lessons to be learned:

- *Pepper, on commercial scale, demands management and fertilization (especially nitrogen and potassium)*
- *Pepper is a tropical forest plant: it thrives in recreated diversified agroforestry system, similar to a wild forest.*
- *Pepper needs to be processed before market. The different processes give different products: green, black, white or red pepper.*

TRANSPARENCY 4.9 (1): BLACK PEPPER

Flowers appear on the lateral branches. They are hanging spikes and are green in color. There are female, male and hermaphrodite flowers. Each spike produces between 50 and 60 small berries, each ½ cm in diameter, which become red in color when ripe. Each berry contains a seed that is the pepper grain.

There are many varieties of pepper. The most common ones are divided into two large groups: large leaved pepper and small leaved pepper.

Large leaved pepper: known as "Lampong" or "Kawur" type, they have large leaves, long spikes and small fruits. They are very productive, but also very sensitive to diseases. Some varieties of this type are: Balamcotta, Kuching and Belantung.

Short leaved pepper: known as "Muntok" or "Bangka" type, they have small leaves, short spikes and larger fruits. Some varieties of this type are: Kalluvalli, Cheriakadan and Bangka. These are more resistant and less demanding than the large leaved varieties.

Pepper is a climbing plant; therefore, it should be cultivated on live or dead supports. In organic production, however, using live supports is recommended.

4.9.1 Agroecological requirements and site selection

Pepper is a forest plant of the humid tropical zones, and is best cultivated under the following agroecological conditions:

Temperatures: from 23 to 26 °C, on average.

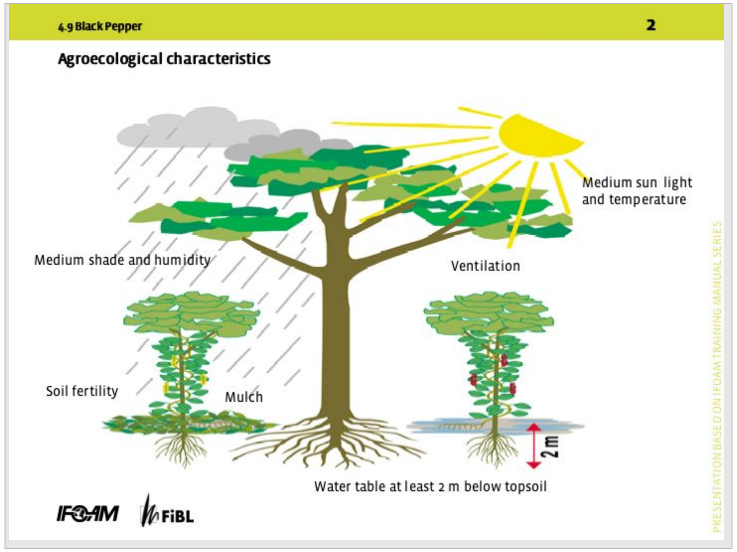
Rainfall and Humidity: from 2000 to 4000 mm per year. It needs a dry season (less rainy) of approximately 4 - 5 months duration, but there should not be drought periods. Relative air humidity should be between 80 and 90%, it is very important that the air is always humid.

Altitude: the optimum is from sea level up to 400 m. Above this altitude, yields decrease considerably, although pepper is able to survive as high as 1000 m of altitude.

Light: because it is a forest plant, pepper needs a "soft" light. It should grow under the shade (30 to 50%). Direct sunlight and dense shade will affect it negatively.

Soil: pepper grows better in deep, well-drained soils that are cool and rich in organic matter and minerals, with a pH of 5.5 to 7. It prefers loamy or sandy clay soils. Pepper is very sensitive to water stagnation and to excessive humidity in the soil. Therefore, in zones where rainfall is high and soils drain slowly, it is recommended to plant pepper on the slopes or to carry out drainage works. The water table should be at least 2 m below the topsoil.

Winds: Pepper does not stand strong winds.



TRANSPARENCY 4.9 (2): AGROECOLOGICAL CHARACTERISTICS

Didactical recommendations:

The agroecological factors that we can modify (up to a certain extent) are: LIGHT – SOIL – WINDS.

Start a discussion with farmers, asking them in which ways these factors can be modified.

Light: *What trees in the area provide good shading to the crops? Which characteristics of shade trees are beneficial and which are harmful?*

Soil: *How can soil characteristics be improved? Is it necessary to do drainage works? Is it necessary to carry out soil and water conservation works?*

Winds: *How could the intensity of winds be diminished? What plants or trees can be used as windbreaks? What products can be obtained from the windbreak?*

Irregular or insufficient rainfall can also be modified by irrigation (drip irrigation in the case of pepper). Discuss the pros and cons of establishing an irrigation system (investment, production costs, environmental implications, etc.).

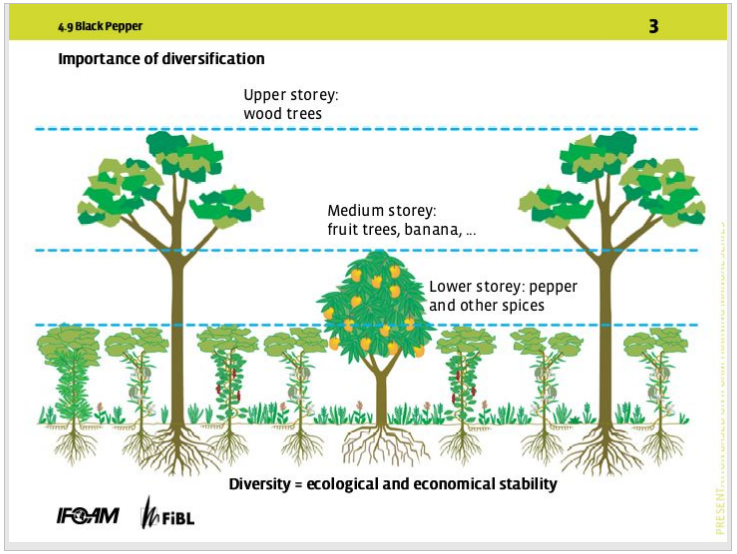
4.9.2 Diversification strategies

Mixing with other crops

Diversity is a fundamental element in any tropical organic farm. It increases both ecological and economic stability. Economic stability is increased because the farmer family's economy does not depend on only one product.

Pepper can readily be integrated in a diversified system and mixes well with other humid tropical crops that need or tolerate light shade, such as cacao, banana or ginger. When selecting the shade trees for the pepper plantation, one should favor those that can bring some economical benefit: wood, fruits, ornamentals or nitrogen fixation.

Pepper can also be mixed with many other spices, creating a spice garden or farm. It mixes well with vanilla, cinnamon, allspice, nutmeg, ylang and others. This kind of farm can be developed in a similar way to a botanical garden and can become an attraction for tourists and naturalists.



TRANSPARENCY 4.9 (3): IMPORTANCE OF DIVERSIFICATION

Didactical recommendations:

Discuss with participants the importance of biodiversity and genetic diversity for disease and pest prevention. Also consider the importance of adequate fertilization (plant nutrition) in relation to disease resistance..

4.9.3 Crop management

Planting material

Pepper can be reproduced by stalks, by seeds or by layers. The most recommended and commonly used technique is by stalks.

Finding the right vegetative material

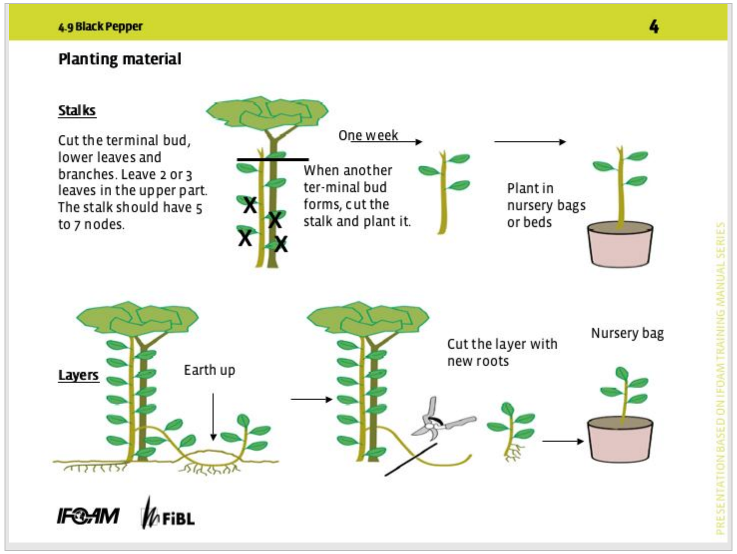
Before making the decision to cultivate pepper, one has to do some research on availability of vegetative material and its quality. As much as possible, select varieties that are disease resistant and, in all cases, select the healthier and more productive plants. Try to obtain genetically diverse vegetative material and, whenever possible, plant several varieties in your farm.

Propagation by stalks

Stalks from the main stem, which are 50 - 70 cm long with 5 - 7 nodes, are used. Before cutting the stalk, the terminal bud of the stem has to be eliminated. Leaves and branches from the third to the seventh node, counting from the upper end, have to be cut off (only two leaves must remain on the upper part of what will be the stalk). When the terminal bud forms again (after about ten days), the stalk is cut under the seventh node. In traditional cultivation, the stalks are planted directly in the soil at the bottom of a support or standard, but this technique is not recommended since only a few plants are able to develop roots. Instead, the stalks should be planted in plastic bags or nursery beds. In nursery beds, the stalks should be planted at a slanting position with 3 - 4 nodes under the ground. Both systems require shade and moisture for the stalks to root. The stalks need about two months to develop roots. Success is about 30%. This means that if the farmer needs 100 plants, he or she should prepare and plant some 300 stalks. When the stalks are rooted, they are planted at the base of a support tree.

Propagation by layers

Layering is mostly done through the technique of earthing up. Parts of the runner shoots (stolons) that grow on the soil are covered with soil and, after two months, when roots have developed, the stolon is cut and planted.



TRANSPARENCY 4.9 (4): PLANTING MATERIAL

Didactic recommendation:

- *Discuss with farmers the importance of planting different varieties of pepper at the farm, in terms of biodiversity.*
- *Evaluate the most feasible propagation technique according to the local conditions, discussing the advantages and disadvantages of propagation by seeds..*

Propagation by seeds

Usually, in commercial production, it is not recommended to propagate pepper by seeds since the process is quite lengthy: the plants obtained are very variable and could include both male and female plants. However, this possibility should not be totally rejected. Reproduction by seeds is a good way to increase the genetic diversity of plantations and it could be useful in areas where there is a shortage of plants to multiply.

A farmer in Costa Rica prefers this technique because he believes that the resulting plants are stronger and more resistant than plants obtained from stalks. According to him, this resistance is an advantage that compensates for the longer time that one has to wait to have productive plants.

Reproduction by seeds is carried out in nursery beds. Fruits (berries) have to be picked when ripe (red colored), selecting the larger ones. They are soaked in water for two days and the pulp taken off. Then, seeds are left to dry in the shade and they are planted at a density of 400 seeds per square meter. The germination period is from 5 to 6 weeks. When the small plants have three leaves, they are to be transplanted to plastic bags. When plants in the bags reach about 20 cm in height, they are permanently planted on the field.

A farmer in Costa Rica recommends the following mix as a substrate for the nursery bags used for stalks or small plants germinated from seeds:

Vermicompost – river sand – wood charcoal – soil

Planting

Pepper is a climbing plant: it needs to grow on a support. Supports should be live (stalks or trees) and strong, since pepper can grow abundantly and be quite leafy.

The characteristics of a good support for pepper are:

- It develops roots easily
- It branches
- Its shade is not too dense
- It can grow in a shaded environment
- It has deep roots
- It grows quite fast and tolerates pruning

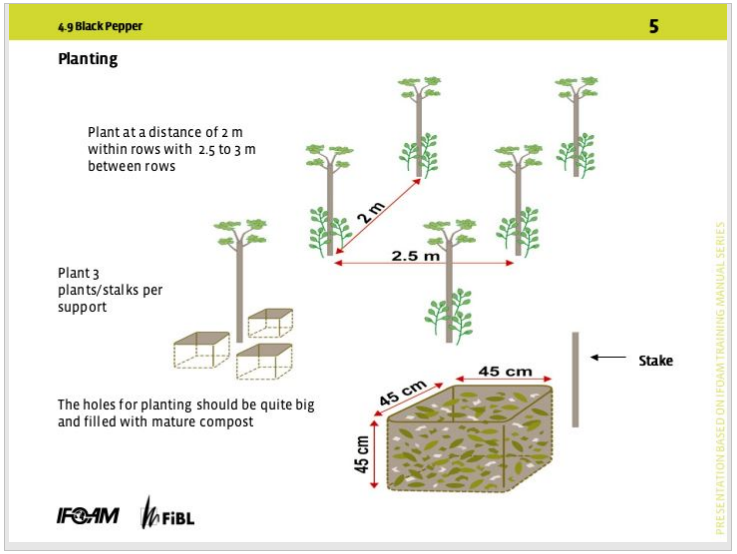
In monoculture, pepper plants are usually planted 2 m apart from each other, with 2.5 m between rows (giving a density of 2000 plants/ha). However, for reasons that have already been discussed, it is not recommended to plant organic pepper in monoculture, but rather to mix it with other crops. In India, it is quite common to mix pepper with coconut trees. The coconut trees serve to both support and shade the pepper. Later on, we will discuss different crop mixing possibilities.

If the land is sloping, pepper should be planted along the contour (following the contour plowing structures). Using several different types of support trees will increase biodiversity. Nitrogen-fixing support trees (legume trees: *Gliricidia sepium, Erythrina* sp.) are highly recommended since pepper is a nitrogen-demanding crop. Nevertheless, one should be careful to plant more than one species of tree.

Whenever possible, support stalks should be planted before planting pepper, to make sure all supports are sufficiently strong and will live to support the pepper plants. If supports die and dry out, they may become hosts to ants, which, according to farmers in Costa Rica, can favor the appearance of fungal diseases.

Two or three pepper stalks or small plants are planted around the base of each support. For planting, holes 45 cm wide and deep should be made and filled with mature compost or vermicompost. It is very important to use well decomposed (stabilized) compost. If the compost used is still in the process of decomposing, the plants will die or get diseases.

Rock phosphate, as well as a source of potassium and magnesium (K-Mag, Langbanite, double potassium sulfate and magnesium), should be added to compost for best results.



TRANSPARENCY 4.9 (5): PLANTING

Didactic recommendations:
Promote a dialogue with farmers about the kind of plants and trees in the area that could be used as supports, considering the advantages and disadvantages of each. Remember that one hectare of pepper needs 2000 supports! Where to find them? How to transport them? During what moon phase should they be cut and planted?

4.9.4 Supplying nutrients and organic fertilization

Pepper is highly demanding of nutrients. Its commercial cultivation requires significant additions of organic fertilizers and, in a smaller proportion, minerals. It is also useful to apply organic foliar fertilizers.

It is also recommended to mix pepper with green manure crops (*Arachis pintoi, Flemingia, Canavalia* and others).

Organic fertilization

- With compost or vermicompost. Apply about 5 kg of compost or vermicompost to each plant at the beginning of the rainy season. If there is not a well-defined dry season, it is preferable to split fertilization: 2.5 kg of compost or vermicompost per plant twice a year (see IFOAM Basic Manual for preparation of compost).
- With mulch at the base of the plants. Fallen leaves and cut weeds from support trees are gathered in a 1 m circle around the bottom of each plant.

Cut weeds and leave them to decompose for two or three days before gathering them around the bottom of pepper plants. "Green" or fresh mulch promotes the development of bacteria on the soil. "Brown" or dry mulch, promotes the development of beneficial fungi on the soil. Pepper, being a forest plant, needs a soil that is rich in fungi. Therefore, "brown" mulch must be used.

Mineral fertilization

If the farmer wants intensive production, organic fertilization has to be complemented with mineral fertilizers.

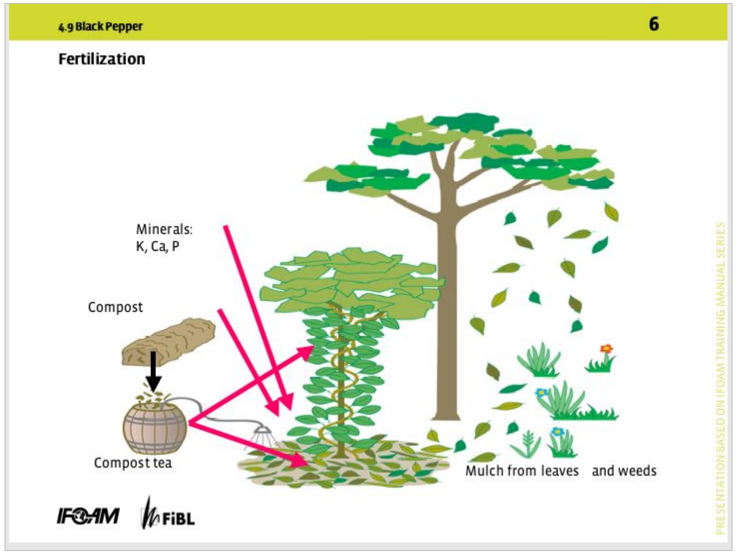
- Apply rock phosphate once a year (1)
- Apply a source of potassium and magnesium in fractions (4 times or more per year) (1)
- Apply a source of calcium once a year (1)(2)

(1) The dose has to be adjusted considering the soil's chemical composition, nutrient availability and pH.

(2) And expected production volume. Some authors report that pepper does not respond to phosphoric fertilization.

Didactical recommendations:

- *Discuss with farmers the availability of materials for making compost in the area.*
- *Discuss the meaning of mature compost and how to recognize if compost is mature or not?*
- *Compost tea (to use as a foliar fertilizer) can be made. A light air pumping system (such as an air compressor for a fish tank) will be needed to aerate the mixture. If the farm has no electricity, farmers should use creativity to invent a mechanical system to aerate the compost tea.*
- *For foliar fertilization with micronutrients, analyze the local possibilities of using fruit extracts, bio-fermented preparations, etc..*



TRANSPARENCY 4.9 (6): FERTILIZATION

Farmers in Costa Rica have observed that potassium fertilization, on the soil as well as on the leaves, helps flower fertilization, thus increasing production. (For more information on fertilizers, consult the IFOAM Training Manual for Organic Agriculture in the Tropics – Basic manual). Micronutrients are also important in intensive pepper cultivation.

Foliar fertilization

Another Costa Rican farmer recommends foliar applications of aerobic compost tea as a complement to soil fertilization. Besides being a foliar fertilizer, compost tea supplies microrganisms for the soil and leaves. These microorganisms have a preventive or suppressive effect on diseases.

Aerobic compost tea elaboration

The key element in making compost tea is to aerate the mixture and to supply food for the microorganisms that live in it (bacteria and fungi).

To make compost tea, we need a barrel or large bucket, a small air compressor (such as those used for fish tanks) and, of course, compost.

To feed the microorganisms, we will use molasses and oats (or a substitute that provides energy). If available, it is also useful to use Kelp (a marine alga) and liquefied raw fish (whole and fresh).

To make a 200 L barrel, you need 5 to 10 pounds of compost (4 pounds of compost for a 20 L bucket), one cup of molasses, one cup of oats, one cup of liquefied fish and some Kelp. This mixture has to be aired with the fish tank compressor for about 18 to 24 hours.

The mixture, then, has to be filtered at a rate of 10 gallons per ha. It is important to use a wide spray nozzle for the fumigating pump (broad flow) in order to avoid killing the microorganisms.

Plants should be sprayed in the morning or afternoon, never during the hottest hours. The compost tea should be used within 6 hours of finishing the aeration. As long as it is being aerated, the tea can be kept in good condition for several days.

To increase the amount of mycorrhizae in the compost tea, you may do the following: mix ½ kg compost and ½ kg milled oats, rice flour or corn flour. Cover this mixture and let it stand in a cool and dark place for five days. After this period, compost will be full of white filaments (mycorrhizae). Since mycorrhizae are very frail, this mixture should be applied to the compost tea barrel not more than two hours before using it.

It is recommended to apply compost tea 6 - 12 times during the year. Nevertheless, if there is any kind of disease on the leaves, the stem or the soil, compost tea should be applied once a week until the problem is solved.

In the case of certified organic production, it is always important to consult the organic production regulations to make sure the fertilizers being used are permitted by the certification agency.

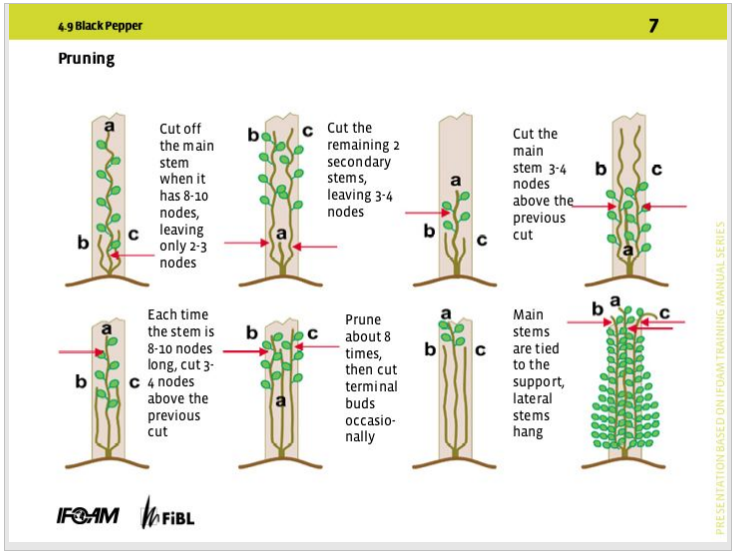
4.9.5 Maintenance and pruning

On a commercial farm, pepper should be carefully pruned during the first four years to promote the development of the lateral fruiting branches and to strengthen the main stem.

In general, pepper develops three stems. When the main stem has about 8 - 10 nodes, leaves are cut out leaving only two or three at the end. One week after, the stem is cut off at 20 cm above the ground, leaving the planted stem with 2 - 3 nodes. The part that was cut serves as a stalk that can be planted. When the other two stems have 8 - 10 nodes, the operation is repeated on them. Each time the stems develop 8 - 10 nodes, they are pruned in this way, leaving 3 - 4 nodes above the previous cut. Stems are pruned alternatively.

After being pruned about eight times, pepper reaches approximately 3 m in height and its final form. From that moment on, terminal buds are pruned occasionally to keep the plant from growing too high and to favor the development of lateral fruiting branches. Only the main stems are tied to the support, lateral branches are left to hang.

During the first two years, flower spikes are peeled (flowers are cut out, leaving the small bunch) to avoid premature production, which would weaken the plant.



TRANSPARENCY 4.9 (7): PRUNING

4.9.6 Pest and disease management

Pepper is susceptible to several fungal diseases of the soil and leaves: *Fusarium*, *Phythophtora* and Anthracnose. The most serious pests are nematodes. Additionally, there could be attacks of caterpillars, thrips and cochineals.

Generally, soil diseases (*Fusarium* and *Phythophtora*) are a consequence of the damage caused by nematodes: therefore, it is important to control nematodes in the first place. Maintaining biodiversity at the plantation, using compost and compost tea, as well as using mulch and mixing pepper with crops like *Eupatorium odoratum* and *Crotalaria spectabilis*, is usually enough to prevent nematode attacks and the collateral problems caused by *Fusarium* and *Phythophtora*.

To control and prevent fungal diseases, tools must be disinfected (using heat or soap), compost needs to be applied in good quantities, calcium carbonate should also be applied (50 grams per plant per year), standing water around the plants should be avoided and infected plants should be pulled out and burnt outside of the plantation.

If, despite applying these preventive measures, nematodes still appear, some natural nematicides, which are permitted by organic regulations, are available on the market. On the other hand, if *Fusarium* or *Phythophtora* do develop, it is necessary to:

- Isolate the area where Fusarium and Phythophtora appears by pulling out the infected plants and neighboring plants and burning them outside of the orchard.
- Try to improve soil drainage, foliar aeration and light penetration by pruning the shading trees in the orchard.
- Do not plant pepper plants in the infected area for at least one year. Till the soil where the infected pepper plant was growing and sow a leguminous cover crop to be later incorporated into the soil.

To combat Anthracnose, antagonist fungi can be used. But, to avoid this risk, whenever possible, resistant varieties should be planted.

With regards to pests, caterpillars can be controlled with the use of *Bacillus thuringiensis* and thrips and cochineals with fungi.

Sometimes, there might be aphid (*Mysus* sp.) attacks on the terminal buds. To control these, sources of nitrogen fertilization should be decreased and a water-based extract containing soap and hot pepper should be applied.

4.9 Black Pepper 8

Pest and disease management

Most common pests and diseases	Reasons for appearence	Solutions (progressive steps)
Pests: Nematodes (main pest) Caterpillars Thrips Cochineals Aphids	Nematodes appear when diversification and organic matter on the soil are insufficient	**1. Prevention:** Use resistant varieties Use different varieties Use diversified agroforestry systems Use compost and compost tea Regulate shade to encourage aeration Drain humid soils
Diseases (of the soil and leaves): Fusarium Phythophtora Antracnose	Fungal diseases mainly appear because of harm caused by nematodes or because of poor drainage	**2. Cultural Management:** Remove and burn infected plants Disinfect tools **3. Use of permitted inputs:** Calcium carbonate Botanical extracts Cupric products

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Transparency 4.9 (8): Pest and disease management

Other kinds of "pests" that may cause economic harm are the birds that eat the ripe fruits when they are intensely red colored. A way of controlling this is to harvest pepper at different times, and always before it becomes red colored. In a diversified agroforestry system, the farmer may plant different kinds of trees and shrubs that produce berries that are equally appreciated by birds thus, reducing the attacks on the pepper.

Generally, the most serious diseases and pests problems appear in monocultures or on insufficiently diversified farms, or during times of extreme rain conditions.

The best way of controlling pests and diseases is **prevention**:

- Use resistant varieties
- Use different pepper varieties on the farm
- Diversify the agroforestry system
- Use compost and compost tea
- Regulate shade and help aeration of the plants
- Drain humid soils

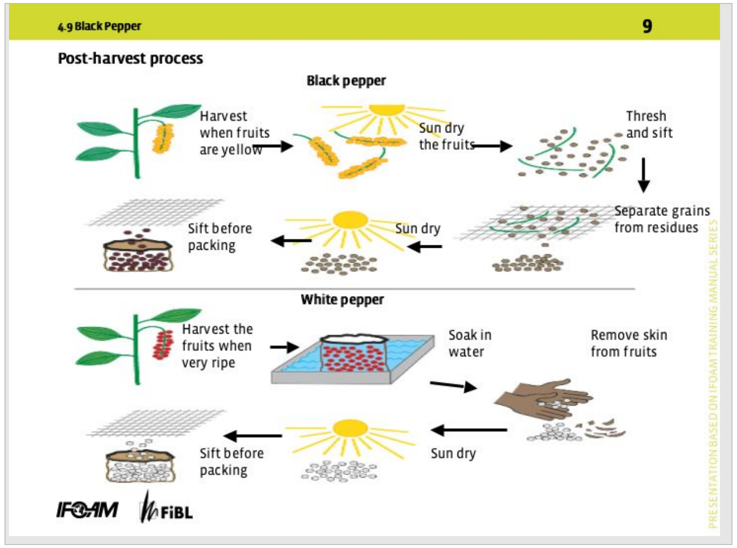
4.9.7 Harvesting and post-harvest handling

Harvest

In general, pepper vines will start to bear fruit three years after being planted: the pruning cycle for plant shaping lasts about one year and then, during the next two years, flower spikes are peeled.

In intensive cultivation, at its first bearing, a plant can yield from 1 to 2 kg of fresh pepper per year. In traditional, less intensive cultivation, it can yield 0.5 kg. After 5 - 7 years, production can climb to 10 kg (intensive) or 2 kg (traditional) and then it will decrease from the tenth year on.

In intensive systems, it is recommended to replace plants every 12 - 15 years, while traditional systems enable production to keep on steadily for 25 years or more. In terms of productivity, 100 kg of fresh pepper gives around 35 kg of black pepper or 25 kg of white pepper.



TRANSPARENCY 4.9 (9): POST-HARVEST PROCESS

Post-harvest processes

The farmer should process pepper according to the kind of product he or she wants to sell at the market. Preparation of pepper is easy and it does not require any sophisticated equipment.

Black pepper

The whole spikes are harvested when some of the fruits start to turn yellow or pink. Then they are put under the sun to dry. When the spikes with their fruits are dried, they should be threshed and sifted to separate grains from residues. Once the grains have been separated, they should continue to be sun dried. Before packing them for the market, grains are sifted one last time to assure that they are completely clean.

Black pepper should be black colored, wrinkled and free of stains or mold. In general, 100 kg of fresh pepper gives around 35 kg of marketable black pepper.

White pepper

Pepper berries are harvested when ripe (red colored). They are put into burlap bags that are only half-filled. Then, these bags are put into large basins for one week, with a constant and slow flow of running water (to prevent water from getting rot). This process is called soaking.

Soaked berries are rubbed by hand or feet and are washed with running water. This takes the skins off of the fruits and eliminates any hollow grains. This is referred to as the washing process

By this time, we already have white pepper. To dry it out, the grains should be put under the sun on thin layers on a cement floor, a wooden platform or clean mats. The drying lasts from two to three days until the humidity in the grains is as low as 11 - 15%.

White pepper should be sifted and "blown" before it is packed to eliminate any kind of impurities. Usually 100 kg of fresh pepper gives 21 to 26 kg of white pepper.

Green pepper

Green pepper is harvested four months after the flowers bloom. At this stage, pepper berries are at a milky state (the berries pass through the stages of being milky, pasty and finally hard). Green pepper has to be harvested before the berries turn pasty. These berries are washed, dried and they can be sold fresh or frozen, vacuum packed, preserved in vinegar or canned.

Red pepper

Red pepper is a "gourmet" product, which has an extremely small market. This is made from the ripe fruits of pepper, which are used fresh in some luxury restaurants.

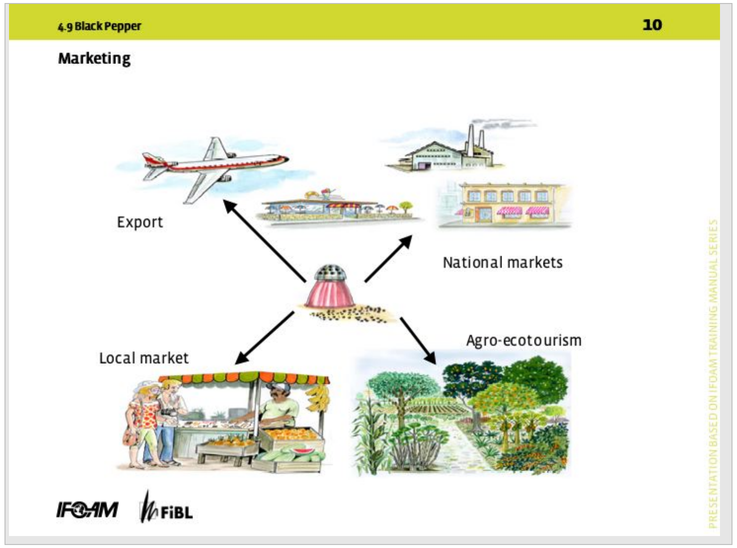
4.9.8 Economic and marketing aspects

Pepper is the most sold spice in the world. The global market is worth approximately 5000 million USA dollars per year. There are relatively few producers and many buyers.

According to the "Foodnews Magazine", conventional pepper production decreased by 11% in 2001, and therefore there seems to be potential for the organic production of this spice.

Pepper needs three years to yield its first commercial harvest and is very demanding on labor and fertilization. These characteristics should be taken into account before one decides to set up an intensive production of this plant.

As well as with any other product, the farmer that intends to produce organic pepper for the export market should carry out feasibility and market studies before making costly investments. Pepper is essentially an export product, but it can also be marketed at the national and local level.



TRANSPARENCY 4.9 (10): MARKETING

Requirements and demands of production for export purposes

The export market is very demanding. Basic requirements to access and maintain this market are:

- Organic and other certifications (Eurepgap, good practices, etc.)
- Quality and homogeneity
- Volume
- Supply guarantee

These requirements have direct implications on production practices: large areas of pepper have to be planted, they need to be certified, they need to receive a relatively homogeneous treatment and production methods have to be mastered. This can be achieved if an individual farmer makes important (although risky) investments or if a group of organized farmers plan the production together.

Additionally, in both cases, it is indispensable to receive training in international trade and to have the guarantee, or at least enough assurance, that the product will be sold.

Production for the national market

Medium quantities of pepper can be sold at national markets. Potential clients are:

- Food industries, spice traders
- Restaurants
- Macrobiotic, "green" and health stores

In this market, organic certification is not always necessary and other international certifications are not required. Clients do not need large volumes and they are more flexible about product homogeneity. But, quality and supply guarantee factors continue to be very important. This kind of market can be accessible for medium-size individual farmers and organized farmer groups.

Production for the local market

This spice is used in almost every home and restaurant, but only in small quantities. Therefore, production of pepper for this market will be a secondary activity of the diversified farm. The farmer keeps some pepper plants, which may give him/her the possibility of obtaining an extra income without too much cost and without using too much land on the property.

A particular case for the local market is that of the tourist areas. In these areas, the small farmer can sell pepper as a typical local product or even as a "souvenir" for tourists, specially when taking good care of the presentation (attractive packaging, best made in an artisanal manner, using local and natural materials). Also, the farmer can think of processing pepper (ground black or white pepper, green pepper preserves).

On the other hand, the farmer can take advantage of tourism to develop an agro-ecotourism or ethno-tourism project at the farm. In fact, tourists from northern countries consider pepper a very "exotic" product, and the diversified agroforestry model creates a biodiverse environment, abundant in flora and fauna, which represents another attraction for visitors. When hosting tourists at the farm or the cooperative, other farm or handcraft products can be offered to them. In this case, it is more the production means, rather than the product itself, that generates an income. This kind of market is appropriate for small individual or organized farmers.

Recommended websites:

- *http://www-ang.kfunigraz.ac.at/~katzer/engl/generic_frame.html?Pipe_nig.html*
- *http://www.napagrinfo.com/pages/spices/pepper.html*
- *http://www.pepperexchange.com/opeprodu/*

4 Management Guide for Crops
4.10 Vanilla

Introduction

Vanilla (*Vanilla fragrans*) is well known across the whole world and it is highly appreciated by those who love good cooking. Because of its high price and fine taste, it is considered a luxury product. The vanilla plant is delicate and it requires a good deal of assistance and management. However, if one knows how to recreate an environment similar to that of its origin, the tropical humid forest, it can be easily cultivated without the use of too many inputs.

Vanilla may be cultivated in any organic farm in the humid tropics. If it is to be produced for the export market, it should be grown as the main crop in an agroforestry system. If the goal is to export in association with other farmers, it should rather be grown as a secondary crop on a diversified farm. But it can also serve to create an extra source of income, by cultivating just a few plants to be sold on the local or national market.

The vanilla plant is a climbing orchid with shallow roots and few supports. It has a green stem of 1 - 2 cm in diameter. At every 5 - 15 cm, there is a node with an adventitious root to cling to the support tree or surface, and a fleshy and elongated leaf that is 12 - 25 cm long.

The vanilla plant makes white-green flower bunches (with 6 - 20 flowers each), which bloom and stay open for only one day. Each day, 1 - 3 flowers open. Natural pollination of a vanilla flower is very rare. A bee of the *Melipona* genus and, it is believed, hummingbirds can promote natural fertilization, but in commercial plantations manual pollination is indispensable. A fertilized flower will produce an elongated green pod, which contains very small seeds and opens up when it is ripe. The cycle from blooming to harvest (before the pods open) lasts about nine months.

Lessons to be learned:

- *For commercial cultivation, it is very important to select varieties of vanilla that are resistant to fungi in order to avoid diseases.*
- *Vanilla is a plant of the humid forests. Thus, a diversified agroforestry system similar to a forest should be created at the farm.*
- *Manual pollination is indispensable to obtain a good yield, while pruning is necessary to avoid overloading of the plants and to reduce their susceptibility to diseases.*

TRANSPARENCY 4.10 (1): THE VANILLA PLANT

4.10.1 Agroecological requirements and site selection

Climate

The ideal temperature for vanilla is between 20 and 35 °C. Temperatures should be as uniform as possible, with little variation between day and night.

Appropriate annual rainfall is from 1500 to 3000 mm. A dry season of about 2 months is necessary to promote blooming. Vanilla is not recommended in places where it rains intensively during the 12 months of the year, nor where it does not rain for periods longer than 2 months. Relative air humidity should be around 80 %. Although vanilla is mainly grown in areas of high rainfall, it can also be grown in areas with less rainfall (between 1500 and 2000 mm), if the soil around the vanilla plants is kept covered with mulch and if the plants are shaded.

Commercial vanilla cultivation is recommended from sea level up to 700 meters. Above this altitude, yields drop substantially.

Vanilla is a shade-loving crop, since it is a forest plant. When thinking of establishing vanilla, one should start by thinking of shade (30 to 50 % of light). Direct light and dense shade will affect it negatively.

Soil characteristics

Vanilla grows best on light and well drained soils, rich in organic matter and with pH of 6.5 to 6.9. But it can also be grown on a wider range of soils. It is important that the soil is covered by mulch or any kind of organic matter to permit the development of the roots that are very superficial.

Vanilla will not grow well on burnt soils, nor on soils that get waterlogged. Soils of volcanic and alluvial origin are best for this crop.

Winds: vanilla does not stand up to strong winds. Nevertheless, good aeration is important to prevent fungal diseases.

Didactical recommendations:

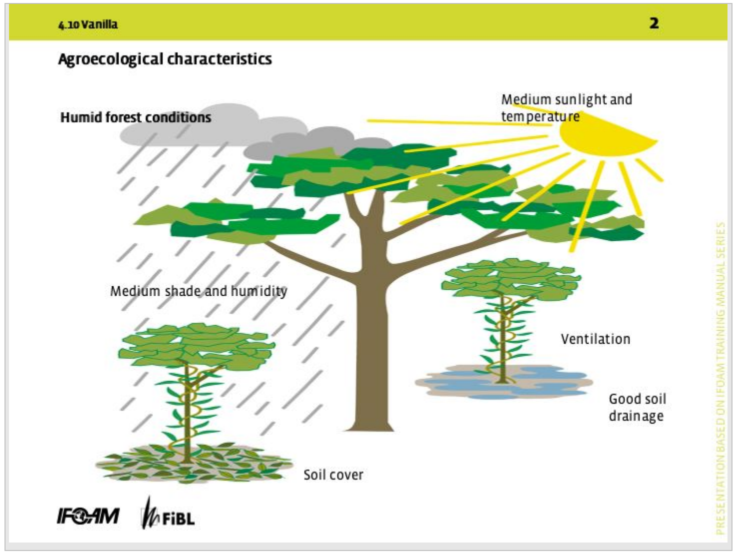
The agroecological factors that we can modify (up to a certain extent) are: LIGHT – SOIL – WIND. Encourage the farmers to discuss how they can modify these factors.

Light: *which local tree species are appropriate to provide shade for crops? What characteristics of the shade trees are beneficial or harmful?*

Soil: *how can soil characteristics be improved? Is it necessary to do some soil and water conservation works?*

Winds: *how to diminish the intensity of winds? What plants or trees can be used as windbreaks?*

Irregular or insufficient rainfall can also be modified through irrigation (drip irrigation in the case of vanilla). Discuss with farmers the pros and cons of establishing an irrigation system (investment, production costs, environmental implications, etc.).



TRANSPARENCY 4.10 (2): AGROECOLOGICAL CHARACTERISTICS

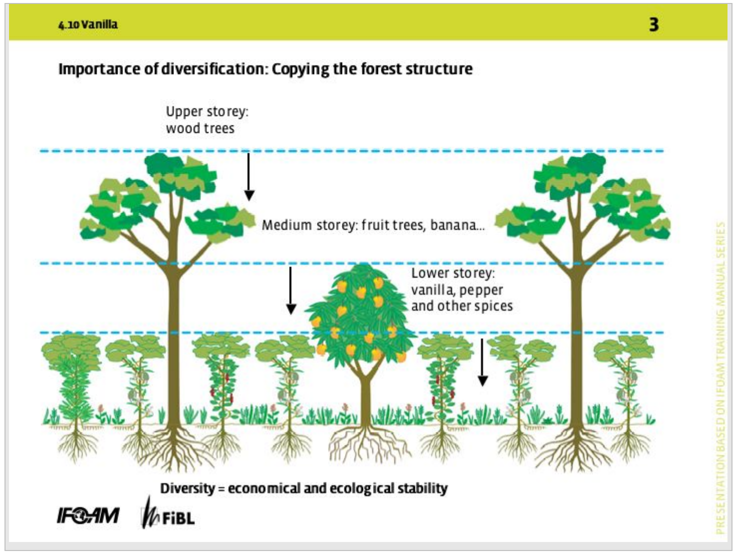
4.10.2 Transparency 4.10 (2): Agroecological characteristics

Mixing with other crops

Diversity is a fundamental element in any tropical organic farm. It increases both ecological and economic stability.

Vanilla is a crop that can be integrated quite well within a diversified system. It can be mixed with other crops of the humid tropics that need or tolerate light shade, such as cacao, banana or ginger. When selecting the trees for shading the vanilla plantation, one should favor those that can bring some economical benefit: wood, fruits, ornamentals or nitrogen fixation.

Vanilla can also be mixed with many other spices, creating a spice garden or farm. It mixes well with pepper, cinnamon, allspice, nutmeg, ylang and others. This kind of farm can be developed in a similar way to a botanical garden and can become an attraction for tourists and naturalists.



TRANSPARENCY 4.10 (3): IMPORTANCE OF DIVERSIFICATION

4.10.3 Crop Management

Planting

Shade is a prerequisite for vanilla growing. Thus vanilla cultivation starts with shading. If there are no (or not enough) shade trees, they must be first planted. Banana trees can be used to quickly provide a source of shade.

Planting material

Vanilla has always been propagated through stalks. Today it can also be multiplied in laboratory using *in vitro* cultivation technology.

For planting purposes, choose vanilla vines that grow upwards. Vines facing downwards are at the stage of producing pods and should not be used for planting.

Finding the right vegetative material

Before deciding to grow vanilla, one should investigate the availability and quality of vegetative material. As far as possible, select disease resistant varieties and plants that are healthy and productive. The vegetative material should be as genetically diverse as possible. Also, several varieties should be planted in a farm.

Direct planting: long stalks

For direct planting, select stalks of 1 - 1.5 meters in length, with 12 - 24 nodes each. Before planting, cut away the leaves on the three nodes at the lower end. Plant the stalk into a ditch that is 40 cm long, 10 cm wide and 3 cm deep. If you plant vanilla in a very rainy season, just loosen the soil superficially and cover the stalk with a layer of dry leaves. Tie the upper part of the stalk to a support.

Planting in nursery bags: short stalks

First, plant short stalks, 30 - 40 cm long, with 4 nodes each into nursery bags. Cut off the leaves on the two lower nodes and tie the top end of the stalk to a short support. After 2 to 3 months, when the vanilla plants are well rooted, transplant them onto the field.

Didactical recommendation:

- *Discuss with farmers the value of planting different vanilla varieties at the farm, relating this issue to that of biodiversity.*
- *At places where there are many, or wild, vanilla varieties, discuss the advantages of creating gardens (banks) of germplasm.*
- *Promote a discussion with the farmers about the local types of plants or trees that could be used as supports, discussing their advantages and disadvantages.*
- *Remember that a hectare of vanilla needs 1666 supports! Where to find them? How to bring them? At what moon phase to cut them and plant them?*

Before planting the stalks, leave the cuttings to heal during one week. Some farmers from Guatemala recommend doing the node cuttings by hand and not with a knife, and curing them with dolomite. For healing, the stalks should be left in a dry, shaded and cool place.

In vitro multiplication

The *in vitro* multiplication technique has the advantage of producing many plants from only one selected plant. It is useful when there is not enough material to reproduce plant material in other ways. The disadvantage is that the small plants grow too slowly and that there is no genetic diversity.

A Costa Rican farmer recommends the following mix as a substrate for the nursery plastic bags for short stalks or *in vitro* plants: vermicompost – river sand – wood charcoal – soil (and optionally, coconut fiber).

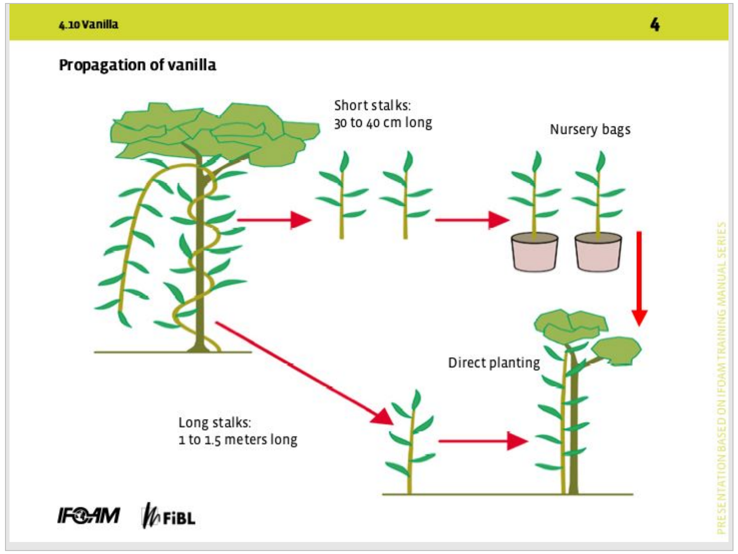
Being a climbing plant, vanilla needs a support to grow. In the nursery bags, dead supports must be used to avoid root competition. In the field, the support can and even should be a living plant.

The best support for vanilla has the following characteristics:

- It develops roots easily.
- It ramifies.
- Its shade is not too dense, but it does not loose all its leaves during dry season.
- It can grow in a shaded environment.
- It has deep roots.
- It does not grow too fast or it tolerates pruning.

Support plants must be planted before the vanilla and should reach about 2 m high, with branches at that height. Branches are required at this height to provide support where the upward growing vines can loop around before starting to grow downwards. This height is necessary in order to provide enough space for the flower-bearing clusters to develop. Any greater height makes it difficult for the operator to reach the highest flowers during hand pollination.

Ideally, different kinds of supports are used, in order to increase the farm's biodiversity. It is recommended that some of the support trees should be nitrogen-fixing (legume) varieties.



TRANSPARENCY 4.10 (4): PROPAGATION OF VANILLA

4.10.4 Supplying nutrients and organic fertilization

Humus is the best fertilizer for vanilla and the plants are best fertilized with compost or vermicompost at a rate of one liter per plant, twice a year.

After fertilization, the bases of the vanilla plants should be covered with a layer of fallen leaves and cut weeds that are gathered around the base of the plants.

Important

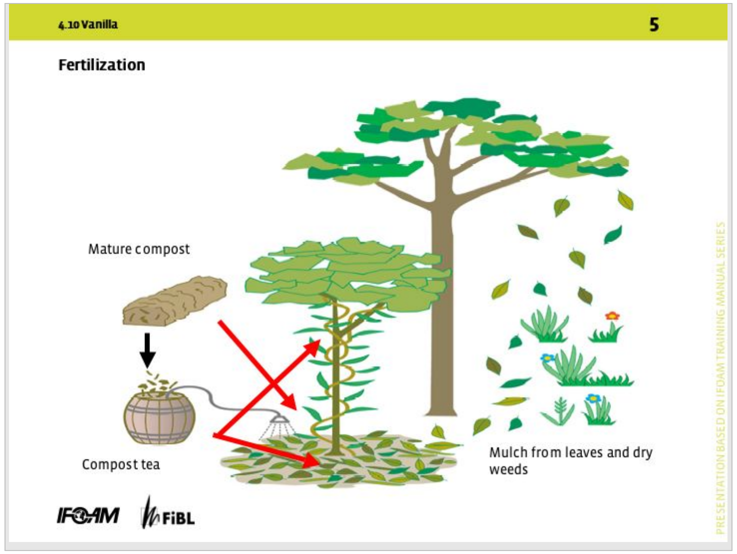
Vanilla is sensitive to excess nitrogen and to decomposing organic material. Thus, no fresh manure or plant material should be applied to the vanilla plants. Cut weeds should be left to decompose for two or three days before gathering them at the base of the vanilla plants.

"Green" (fresh) soil cover or mulch promotes the development of bacteria in the soil.

"Brown" (dry) mulch promotes the development of fungi in the soil. Vanilla, being a forest plant, needs a soil rich in fungi. Therefore, "brown" mulch is used.

Since vanilla has very superficial roots, the soil should not be tilled or "scraped".

To complement fertilization via the soil, some farmers use foliar applications of aerobic compost tea. In addition to being a foliar fertilizer, compost tea supplies microorganisms to the soil and leaves. These microorganisms have a certain preventive or suppressive effect against diseases.



TRANSPARENCY 4.10 (5): FERTILIZATION

Didactical recommendation:

Discuss with farmers the availability of materials in the area for compost making.

Compost tea (for use as a foliar fertilizer) can be made. A light aerating pumping system (such as an air compressor for a fish tank) will be needed to bring oxygen to the mixture. If there is no electricity, farmers should use creativity to invent a mechanical system to aerate the compost tea.

4.10.5 Manual pollination

Vanilla starts to bloom one or two years after it has been planted, when using long stalks. If it is planted from short stalks, it takes three to four years.

Flowers appear in bunches. Each adult plant in good health can produce from 10 to 15 bunches of 6 to 20 flowers each.

The blooming season depends on the geographical location but always lasts 2 - 3 months. Flower buds will open during this period. Each day, one, two or three flowers in the bunch open and they stay open for only one day before they die.

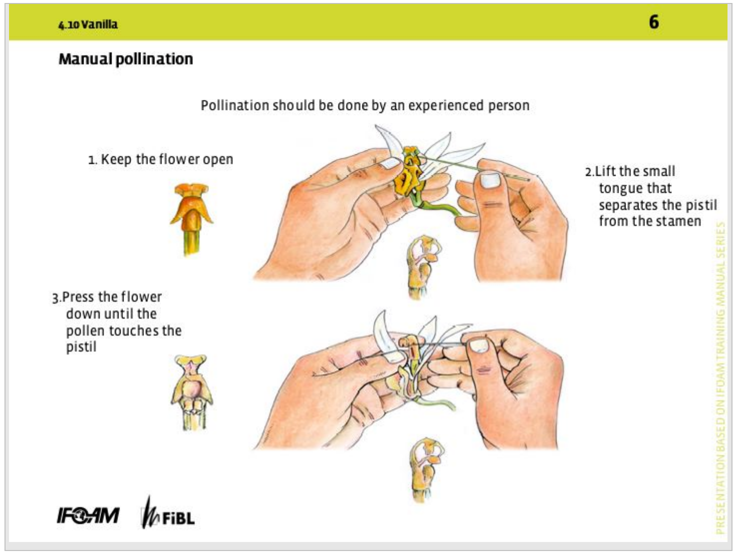
The flower should be pollinated by hand. Each morning, the person in charge must walk through the farm and pollinate the flowers that are opened. To do this a stick, as wide as a match and 15 - 20 cm long, is used. A bamboo stick or a needle made of pejibaye (*Bactris gasipaes*) or other material that is locally available can be used.

Using the index finger and thumb of one hand, the flower should be kept open while, with the stick in the other hand, one lifts the small tongue that separates the pistil from the stamen. Using the fingers of the other hand, the flower should be pressed down so that the stamen makes contact with the pistil until the small pollen grains are stuck to the pistil. An experienced person can pollinate as many as one thousand flowers per day.

Pollination should be done in the morning, when air humidity is high. Very dry conditions or rainfall will decrease the success rate of pollination.

The flower bunches hold from 6 to 20 flowers. To obtain high quality vanilla, it is recommended to have 6 - 10 pods per bunch at harvest time. Since pollination is never 100 % successful, one may decide to pollinate all the flowers in a bunch. If they all give fruit, the upper pods in the bunch should be eliminated (they will be curved and top quality vanilla must be straight) until only 8 - 10 pods per bunch are left. A general rule says that for high quality vanilla, ten clusters with 8 - 10 pods each are the optimum. Any more will place excessive demands on the plant and will make it more susceptible to disease. In Mexico, farmers are recommended to leave a maximum of 6 pods per bunch.

The pod reaches its final size four to six weeks after flowering. Seven or eight more months will pass before it is ready to harvest.



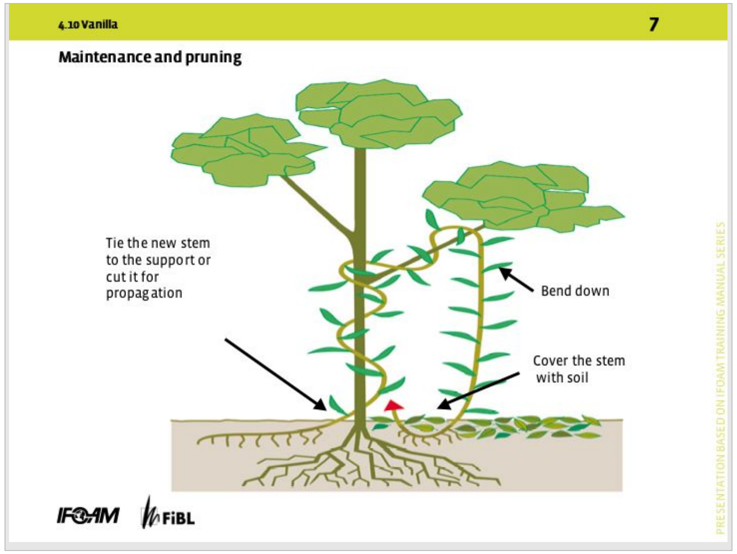
TRANSPARENCY 4.10 (6): MANUAL POLLINATION

Didactical recommendation:

Practice is indispensable when learning to pollinate. If there is a vanilla farm in the proximity, try to get each participant to pollinate one or two bunches of flowers.

4.10.6 Maintenance and pruning

Vanilla plants grow fast (0.5 to 1 m per month). When the plants grow out of reach of the workers, the stem is bent down and allowed to grow "hanging down". When the stem touches the soil again, it should be bent back up and the part that is in contact with the soil should be covered with compost so that it will develop roots. The part of the plant that grows upwards is tied to the support.



TRANSPARENCY 4.10 (7): MAINTENANCE AND PRUNING

4.10.7 Pest and disease management

Diseases

Vanilla is susceptible to several fungal diseases of the soil and leaves: Root rot caused by *Fusarium batatis*, rot and wilt diseases caused by *Fusarium oxysporum*, *Phytophthora* and Anthracnose caused by *Calaspora vanillae*. Generally, these appear when vanilla is grown in monoculture, when the farm is not sufficiently diversified or during periods of high rainfall.

The best way of controlling diseases is prevention. This includes the following measures:

- Use of resistant varieties
- Cultivation of different vanilla varieties in the farm
- Diversified agroforestry system
- Avoid excess nitrogen or applying fresh organic matter
- Use of compost tea
- Appropriate pruning
- Proper shade regulation and plant aeration
- Draining of heavy soils

In case of a disease infection, the vanilla plants should be treated with compost tea or copper. Alternatively, it may be worthwhile to experiment with antagonistic fungi.

On the other hand, if *Fusarium* or *Phythophtora* do develop, it is necessary to:

- Isolate the area where Fusarium and Phythophtora appear by pulling out the infected plants and neighboring plants, and burning them outside of the orchard.
- Try to improve soil drainage, foliar aeration and penetration of light by pruning the shading trees in the orchard.
- Do not plant pepper plants in the infected area for at least one year (or more), till the soil where the infected pepper plant was growing and sow a leguminous cover crop to be later incorporated into the soil.

Pests

A vanilla crop growing in a diversified agroforestry farm is not usually attacked by pests. However, the most commonly mentioned pests are snails and a worm that attacks the flowers. Snails are controlled by laying out fruit traps on the soil surface and collecting them. Worms can be controlled by applying *Bacillus turingiensis,* or any other kind of biological control available in the area.

4.10 Vanilla 8

Pest and disease management in vanilla

Most common diseases	**Reasons for appearance**	**Preventive measures**	**Treatment**
• Root rot (*Fusarium batatis*) • Rot & Wilt (*Fusarium oxysporum*) • *Phytophthora* • Anthracnose	• Monoculture or insufficient diversification • Prolonged periods of strong rain	• Use resistant varieties • Use different vanilla varieties at the farm • Diversified agroforestry system • Avoid excess nitrogen or applying fresh organic matter • Use compost tea • Do not overcharge plants • Regulate shade and favor plant aeration • Drain humid soils	• Compost tea • Approved cupric products • Abandon area and replant (if heavily attacked by *Fusarium*)
Pests			
• Snails • Worms (in the flowers)	• Monoculture or insufficient diversification	• Develop strongly diversified agroforestry system	• Fruit traps (against snails) • *Bacillus turingiensis* (against worms)

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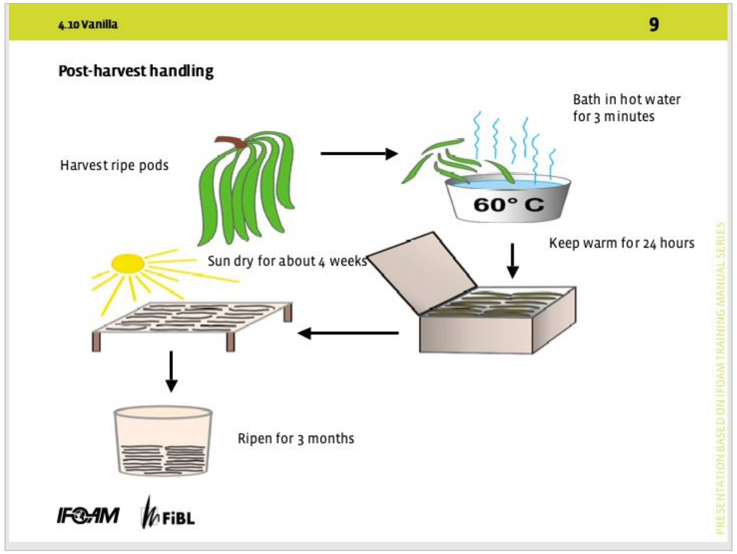
TRANSPARENCY 4.10 (8): PEST AND DISEASE MANAGEMENT

Didactical recommendation:

Discuss with participants the importance of biodiversity and genetic diversity for disease and pest prevention. Also consider the importance of adequate fertilization (plant nutrition) in relation to disease resistance.

4.10.8 Harvesting and post-harvest handling

Approximately 9 months after pollination, vanilla pods will start to turn brown at the lower end. This indicates the time when the pods should be cut off. The pods must be harvested before they open and should be harvested at least once a week. The harvest period can last for 10 to 12 weeks. Under good conditions, a plant can yield between 600 and 800 grams of fresh pods. This corresponds to 1000 to 1300 kg of fresh vanilla per hectare. In Mexico, average yield of fresh vanilla is 200 - 300 kg per hectare. But organic vanilla production projects under development expect to yield as much as 2000 kg of fresh vanilla per hectare.



TRANSPARENCY 4.10 (9): POST-HARVEST HANDLING

Post-harvest handling

Vanilla must be processed before it can be marketed. Post-harvest treatments aim at developing the vanilla scent of the pods, to assure good preservation and to give them an adequate appearance.

Management stages:

- Weighing the fresh pods.
- Pods should be bathed in hot water (65 °C) for three minutes.
- After draining the water, and while still hot, the pods should be put in a closed box for 24 hours, trying to conserve the heat as much as possible.
- Sun drying for 4 weeks: whenever possible, pods should be exposed to the solar heat and when it rains or during the nights, they are to be kept under a roof.
- Ripening under the shade for 3 months: once the pods are completely dry, they are put in a plastic bag and stored in a cool and dry place for three months.
- Sorting pods by size.
- Packaging.

To obtain 1 kg of vanilla ready to be sold, 3 to 4 kg of fresh vanilla are needed.

Top quality vanilla cannot be opened, has long pods, is straight and has a bright black color.

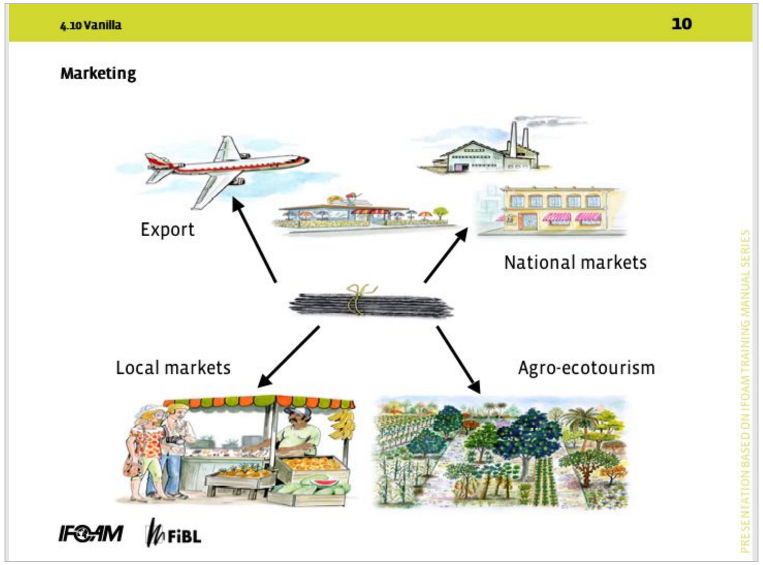
4.10.9 Economic aspects and marketing

At present (2005), prices for vanilla in general, and for organic vanilla in particular, are extremely high. This, however, is probably a temporary phenomenon, brought about by a combination of political problems and adverse climatic conditions in the major producer countries.

High prices are motivating many farmers around the world to plant vanilla. Therefore, it is likely that the supply will increase significantly in the short term and that prices will level out or even decrease. It is important to take this situation into consideration before making the decision to invest in planting large areas of vanilla.

On the other hand, markets for processed organic food continue to grow and the demand for organic vanilla may also continue to grow. Before making costly investments to produce organic vanilla on a large scale for the export markets, it is recommended to carry out feasibility and market studies.

Vanilla is essentially an export product and the main buyer is the United States, where it is used primarily to supply the ice cream industry. Vanilla can also be marketed at a national level in some countries and, in a few and very specific cases, it can also be marketed at the local level.



Transparency 4.10 (10): Marketing

Quality requirements and demands for export purposes

The export market is very demanding. Basic requirements to access and maintain this market are:

- Organic and other certifications (Eurepgap, good practices, etc.)
- Quality and homogeneity
- Volume
- Supply guarantee

Thus, vanilla suppliers should be able to provide the needed quantities, they must certify their production, insure a relatively homogeneous treatment of the crop and need to master the production methods.

Although it is possible for an individual farmer to fulfill these requirements, it involves major investments and risks. Alternatively, vanilla may be grown by a group of organized farmers. It is indispensable for all growers to receive training on international trade and to have the guarantee, or at least enough assurance, that the product will be sold.

Production for the national market

Medium quantities of vanilla can be marketed at national markets in some countries. Potential clients are:

- Food industries (cookies, ice cream, tea and infusions, natural medicines)
- Expensive coffee shops and restaurants, ice cream artisans
- Macrobiotic and health stores

In this market, organic certification is not always indispensable and other international certifications are not required.

Clients do not need large volumes and they are more flexible about product homogeneity.

On the other hand, quality and supply guarantee factors continue to be very important.

This kind of market is accessible for medium-size individual farmers and organized farmers' groups.

Production for the local market

Selling vanilla at the local market is limited to very specific cases: tourist areas. In these areas, the small farmer can sell vanilla as a local typical product or even as a "souvenir" for tourists. Processed vanilla (extract) can also be a possibility.

Furthermore, the farmer can take advantage of tourism to develop an agro-ecotourism or ethno-tourism project at the farm. In fact, vanilla is quite an "exotic" product (it is an orchid) and the diversified agroforestry model creates an environment, which is abundant in flora and fauna.

All these factors may be exploited. In this case, it is more the production unit, rather than the product itself, which generates an income.

This kind of market is appropriate for small individual or organized farmers but, in this case, we are talking about a very narrow market niche and vanilla will only be a secondary product at the diversified farm.

Recommended websites:

- *http://www.sdahldtp.com/vanilla.htm*
- *http://www.sdahldtp.com/pollinate.htm*