Naturland

Cultivation Guidelines

BASIC PRINCIPLES OF ORGANIC AGRICULTURE

These cultivation guidelines have been published by Naturland e.V. with the kind support of the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ, German Agency for Technical Cooperation) financed by the Bundesministerium für Wirtschaftliche Zusammenarbeit (BMZ, Federal Ministry for Development Cooperation). The cultivation recommendations at hand for 20 crops of the tropics and subtropics being of significant importance for the world economy were written by various authors.

Naturland would like to mention the following authors and thank them for their contributions:
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The cultivation guidelines are available in English, Spanish and German for the following crops:
banana, brazil nut, cashew nut, cocoa, coconut, coffee,
cotton, hibiscus, macadamia, mango, papaya, peanut,
pepper, pineapple, sugar cane, sesame, tea, vanilla.

The cultivation guidelines were published in 2000. Some of them (Bananas, Mangoes, Pineapples and Pepper) were revised for the United Nations Conference on Trade and Development (UNCTAD) by Udo Censkowsky and Friederike Höngen in 2001.

In 2002 two more guidelines (for rice and date palms) were published in English.

All the authors emphasize, that the cultivation recommendations at hand can just provide general information. They do not substitute technical assistance to the farmers with regard to the location.

Furthermore, the authors kindly call upon for critical remarks, additions and other important information to be forwarded to the address below. The cultivation guidelines will be updated regularly by Naturland e.V.

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We pass our gratitude to Peter Brul of Agro Eco for his helpful comments on the manuscript. Our best thanks are also devoted to all supporters of this publication, in particular Mrs Sybille Groschupf who cleaned up the text from errors in strenuous detail work and did the attractive layout.

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1. INTRODUCTION

The roots of organic agriculture developed from differing systems of thought, philosophies of life and agro-political motivations. One thing they all have in common is the desire to form a method of production capable of generating healthful foodstuffs while limiting any damaging effects on the natural ecosystem. It has in the meantime been scientifically proven beyond doubt that organic farming systems are the most environmentally friendly, and thus sustainable, agricultural methods. This method of production actively assists in preserving eco-systems and the variety of species, protecting the soil, keeping the water clean and reducing the impact of agriculture on the atmosphere.

Organic agriculture is concerned not only with leaving out technical production aids, such as pesticides or synthetically produced chemical, mineral fertilisers, or simply replacing them with aids permitted in an organic farming system. But is rather more a holistic cultivation system whereby an agricultural site is viewed as an organism. This method of planting has little in common with the "Ancient's agricultural system", but has been developed from a process based on **technical-biological progress**. Organic agriculture consciously avoids trying to maximise the yield per cultivation area. The total productivity of a farm (including the ecological aspects), optimally adapted to the site conditions, is the most important aspect.

The following basic principles should be closely followed:

- Sustaining and improving the soil
- Realisation (near as possible) of nutrient re-cycling (farm, village, region)
- Intensive use of legumes/leguminous trees to provide nitrogen supply
- Biological plant protection through prevention
- Diversity of crop varieties and species grown
- Site and species-appropriate animal husbandry
- Prohibition of Genetic Engineering and products thereof
- Maintenance of the surrounding natural landscape (sustainable eco-agro systems)
- Least possible consumption of non-renewable energy and resources
- Ban on synthetic, chemical fertilisers, plant protection, storage and ripening means as well as hormones and synthetic growth regulators (also harmful processing aids in food processing).

Each individual farmer, whether in the tropics or more temperate zones, must decide personally how exactly he can practically apply these basic principles to his daily work. A variety of solutions can be developed, depending upon the specific site and farm conditions. Intensive levels of specialisation (monocultures) within a farm (a village or region) should be avoided to the same degree as the destruction of an intact natural ecosystem through agriculture (e.g., slash and burn method in tropical rainforests). Rather, sustainable eco-agro systems should be aspired to, which are integrated with the flora and fauna present at the site.

Finally, it should also be noted that a consensus exists within the International Federation of Organic Agriculture Movements (IFOAM), that organic agriculture must also take the socio-economic conditions of the people in a region, village or on a farm into consideration. The degree to which organic agricultural systems can thrive in a region depends to a large extent upon the opportunities the people who live there have to participate in them. In this respect, due to its inherent diversity, organic agriculture can be applied as an instrument with a range of uses in rural development strategies. By utilising this instrument, developmental perspectives can be generated for a rural population.

2. SOIL FERTILITY AND NUTRIENT CYCLES

2.1. Soil Performances

An important objective in organic farming systems is the achievement and sustenance of the soil's fertility. The fertility of soil can be measured by the variety of species that grow in it. The soil is more than just a growth medium for plants. It is a decisive agricultural production factor which, when fertile, can fulfil a variety of purposes:

- Growth medium for plants
- Water storage and supply for plants
- Decomposition for organic material
- Anti-phytopathogenic potential (suppression of soil-borne diseases)
- Nutrient reservoir and availability

The soil's capacities are not inexhaustible. False methods (wrong land usage systems, tillage, irrigation, etc.) are leading to a reduction of the soil's fertility on a global scale and not seldom to irreversible soil destruction (soil degradation). Examples of this are the intensively developed coffee plantations in Costa Rica, cocoa plantations in Brazil near to Bahia and over-grazing in the Sahel. The people who often suffer the most from these methods are the small and marginal farmers living in the region, who invariably have no alternative sources of income.

2.2. Fertilization of the soil

In contrast to conventional agriculture, fertilisers and manures are used in organic farming systems to feed the soil and the organisms living within it. These have no need for mineral fertilisers, but for the organic matter which they can turn gradually into plant-available nutrients. Satisfying the edaphon (the sum of all soil organisms) thereby also provides the optimum requirements for a sufficient and continuous supply of nutrients to the crops. This is achieved through the maximum production (depending on site conditions) of biomass per unit area.

NOTICE: *The most important requirement for the improvement and maintenance of soil fertility is a continuous supply of organic matter.*

Regarding the nutrition of crops, the following questions are most relevant to the farmer:

A. How can I maximise the production of organic matter (surface or subterraneous organic material)?

In organic farming, not only the crops (cash crops/ self-consumption/ fodder) have to be grown on the available ground but also the organic matter required. A few measures are listed in this respect below:

- Strive to have soil coverage in the growing area the whole year round (in annual and perennial crops).
- Incorporate annual and perennial green fallow periods into the crop rotation (plus the planting of legumes), to regenerate the soil.
- Integrate annual and perennial forage cultivation (root biomass and manure) into the plantation system.
- Develop mixed cultivation systems (e.g., alfalfa rows in cotton, beans and maize, beans in young sugar-cane plantations).
- In permanent cropping, it is important to provide a sufficient number of leguminous trees and shrubs (agroforestry systems for bananas, coffee, cocoa, mango, tea etc.) as well as leguminous green manure plants covering the soil.
- Alley cropping, e.g., with Leucaena (usage of the pruning material to fertilise the crops growing between the rows of Leucaena).
- Leave single trees standing in the field, such as e.g., the legumes *Prosopis cineraria* and *Acacia tortilis* in arid regions.
- Hedgerows (one or more rows of trees/shrubs) with a wide range of functions, such as windbreaker, prevention of erosion, habitat for natural enemies of pests, timber for construction and fuel, fodder and pruning material for mulching and/or composting, protection against side-contamination with pesticides from conventional farms nearby etc.

B. How can I provide enough nutrients for my crops by supplying organic material?
B.1. Nitrogen:
The supply of nitrogen (N) in organic farming is usually provided by legumes. Through a symbiosis with nodule bacteria, these plants are capable of fixing atmospheric nitrogen and making it available to plants. Other bacteria can also fix nitrogen (Actinomyceten which are present in dead wood, soil-bound Azotobacter or Beijerinckia bacteria, which live in association with the tropical fodder-grass *Paspalum notatum* and other Gramineen). In paddy rice, the bacterium *Anabena azollae*, which forms a symbiosis with the water fern Azolla, is used and can fix up to 400 kg N/ha and year under tropical conditions, and which is very often used as green manure for rice crops.
As already mentioned, most important is the planting of site-appropriate legumes in crop rotation or agroforestry systems (there are over 12,000 types of legumes in the world). In crop rotation systems, <u>at least</u> 20% of the entire cultivated area should be planted with legumes.

B.2. Phosphorous
The phosphate content of the soil varies just as much as the availability of phosphates (P) for the plants (e.g., tropical soil with its high acid, iron and aluminium content has a very high rate of P fixation, thus applied P-fertilisers become unavailable for the plants). On organic farms emphasis is placed upon increasing the availability of the phosphate content of the soil for the plants. This is achieved by biological conversion of insoluble to soluble P-compounds in the soil (enzymes and plant acids):

- In fertile soils with sufficient organic matter the conversion to soluble P-compounds is most efficient: Fertile soils have a more intensive growth of roots and subsequently a more developed network of fine roots increasing the interaction between fine roots and phosphate compounds in the soil. Acids released by the fine roots then dissolve the fixed P-compounds and improves the availability for plants.

- Fertile soils with a high organic substance content encourage the growth of VA-Mycorhizza, a fungus that lives in symbiosis with plants having a high capacity to dissolve fixed P-compounds.
- Use of plants that are particularly capable to break up fixed P-compounds (e.g., onions in mixed crop systems with cotton, palms and vanilla in agroforestry systems).
- Organic matter (mulching material, compost) increases the availability of phosphates
- High pH values and poor phosphate availability can be alleviated by applying silicates.

Adding rock phosphates is still allowed on organic farms. If composting, then the compost can be directly prepared with the rock phosphate. With some crops (e.g., cotton) the seeds are infested with bacteria that can break up phosphate compounds, in order to ensure that the plants have enough supply during the important early stages of growth.

B.3. Potassium

Potassium (K) is easily leached out of sandy soils which contain little organic matter (humus compounds). The following strategies are important in organic farming to ensure a sufficient supply of K for the plants:

1. Regular applications of organic matter will improve the absorption of potassium in the upper soil layers, where it can be reached by the plants' roots.
2. Use of deep-rooting plants to mobilize K in lower soil layers.
3. Integration of plants with a high K-uptake in mixed cultivation systems (e.g., bananas on coffee plantations).
4. A permanent mulching layer, especially in the wet tropics in order to reduce leaching of K.
5. In arid regions with soils poor in K, it can be useful to mix pulverized rock containing mineral clay into the compost (e.g., as. practised in Egypt, Israel).

In case of potassium deficiencies showed by soil analysis it is permitted to use certain potassium salts with a low chlorine content (Muriate of potash/ potassium chloride is **not** allowed). Wood ash from untreated wood is also allowed.

C. How can the resulting organic matter be best utilised?

One of the main objectives in organic farming is to minimise the loss of nutrients and to keep them recycling within the farm (and/or to use them).

The following criteria should be heeded in this respect:

- Burning of crop residues (e.g., common practice on sugarcane plantations) is not allowed in organic farming (exceptions may be permitted by the certification body, e.g., in cases of heavily infested crop residues). When crop residues are burnt, important nutrients and energy is lost.
- Crop residues should be left on the soil's surface (agroforestry systems) or mulched into the upper layer of the soil (arable farming). Alternatively, they can also be used as fodder or bedding for animals or used directly as compost material.
- Organic matter is created during the production and processing of several types of cash crops (coffee, bananas, sugar cane etc.). These residues should be returned into the cycle of nutrients on the farm. This is best achieved by mulching or composting, or by creating biogas with the resulting usage of any organic material left over.
- Large amounts of pruning material are regularly given, especially in agroforestry systems, which are then also used as fuel. The nutrient-rich ashes (minerals like e.g., potassium) should then be fed back into the nutrient cycle via compost.

- Farmers will need to decide just how much of the organic material created on their farm should be composted, depending on the site's requirements. Each form of composting will inevitably lead to a certain level of nutrient losses and will increase the working costs (see also the chapter on composting).

Note: *One objective in organic farming systems is to realize nutrient cycles within a field or farm (or even in a local/ regional) system, closed as much as possible, and to reduce unnecessary losses of nutrients.*

With the following examples, describing the situation in "arid climates" and "humid tropics", the context mentioned above can be illustrated:

Site	Basic principles of agriculture that protects the soil
Humid tropics	Growth and decomposition processes are accelerated in these regions due to their high average temperatures with few fluctuations, high rainfall and humidity. Organic material in and on the ground is rapidly degraded and nutrients are set free. In humid tropics, covering the ground with a thick layer of organic material and a humus-rich topsoil are the most important sources of nutrients and water. It is therefore essential that this layer of soil is conserved, by leaving it continually covered (if possible) with organic material, by not carrying out any deep or involved tillage, and also, by implementing agroforestry systems to protect against erosion. In addition, planting, and if at all necessary, tillage on sloping sites should only take place along the hang parallel (contour planting). Special arrangements for composting are usually unnecessary, as the organic material can be degraded "on site', i.e., where it falls. The aim is not to disturb the upper, fertile, humus-rich layer of soil through agricultural activities, which would lead to the humus being depleted and the resulting loss of soil fertility and the additional danger of the soil drying out. Cattle-raising is not advisable in such areas. Clearing of land by burning organic material is not advisable (slash and burn) because enormous quantities of valuable nutrients/energy are then lost to the agro-ecosystem.
Arid sites	Growth conditions for plants are, more often than not, highly limiting in these areas due to high daily temperatures with large fluctuations, slight rainfall and often very dry winds. The careful use of water as the most important limiting growth factor under these conditions is the key to the realization of a site-appropriate farming system.

	All possible measures to reduce the losses of water – especially through evaporation and transpiration – should be consequently realised, e.g., sufficient quantities of hedges to act as windbreaks as well as good permanent coverage and shading of the soil. In addition, the water-conserving capacity must be increased or at least maintained through the continual application of compost (humus compounds). Furthermore, it is worth noting that living plants are efficient freshwater savers and can be effectively integrated into the system as a whole. The irrigation system used must also be capable of minimising water losses and avoiding soil salinity. This system is also characterised by a partial utilisation of the organic matter through animal husbandry and a respective arable fodder cropping system including legumes. Because of the limited biological activity of the soil, the organic matter cannot be degraded in the field (due to a lack of continual water supplies) but because of composting.

With the contrary examples given, it becomes evident that in practice, the nearer a farm is to the continuously humid tropics, and away from the changeable climates with their arid periods, the more the agricultural system chosen should adhere to the characteristics of an agroforestry system.

2.3. Soil management and protection against erosion

The soil is usually tilled in order to:

- prepare a seedbed (or plantation),
- work crop residues into the soil and
- for weeding.

In **permanent cropping systems,** no tillage is needed, normally. Instead, a system should be introduced based on green manure plants (by e.g., local species of legumes) and mulching (green soil coverage and pruning material). In agroforestry systems in the tropics, soil tillage is also unnecessary. Soil cultivation is only carried out when the permanent cropping /agroforestry system is to be newly planted (either manually, using animals or machines, according to conditions).
In this respect, we need to take a critical look at the usual and traditional methods of slash and burn applied in the subtropical and tropical regions. Because this "technique" is one of the main reasons for the huge areas of primary and secondary forests which are constantly being destroyed in tropical regions (by setting fires and using the wrong form of soil management). Especially when the area is not then used as an agroforestry system. Slash and burn methods are not allowed in organic farming. Burning down of fallow land should be avoided and is only permitted when an agroforestry system is to be established (a detailed description can be found in the section "Organic cocoa cultivation").

In the case of **arable crops,** deep and over-turning soil tillage (using a plough) should be avoided. Should a plough be used, the lines must be parallel to the lines of elevation (across the slope) in order to reduce the risk of water erosion (contour planting). Simple mulching of the organic matter into the soil's upper layer is usually sufficient – crop residues should not be dug deep into the soil. (currying once or twice, rotary tillage etc.).
By carefully designing the crop rotation (which crop follows which) and encouraging the growth of soil organisms (e.g., earthworms) by continually applying organic matter, mechanical tillage of the soil can be largely replaced by biological measures. Crop rotation will also help to suppress the unwanted growth of weeds. In this way, the soil texture is protected, whilst soil tillage procedures, which are costly in both energy and man-hour terms, can be reduced.

Note: *In order to protect the soil against climatic conditions (sun, wind, rain), all cultivation methods should be aimed to realize a constant coverage of the ground (green coverage and/or mulching layer).*

Sites that are susceptible to heavy soil erosion require special additional measures to ensure that the fertile upper layers of the soil are not depleted (wind and water erosion). If these measures are not carried out, sometimes even outside of the farm itself, whole regions can become endangered by irreversible soil degradation (desertification). Quite often, for this reason, the measures required are performed together by the population of a village or region as the only possibility to protect the own farm.

In practice, both mechanical and biological measures are put to use:

Examples of erosion protection measures	
Mechanical measures	Stone walls erected along the lines of elevation of a site to slow down the water flow.
	Stone barriers in water channels to slow down the outflow of water.
	The building of stone terraces on steep slopes (wood should not be used in the tropics because it rots too quickly)
Biological measures	Planting of hedges (e.g., in the Sahel, several species are planted alongside stone walls, such as *Cajanus cajan*, *Euphorbia balsamifera* or *Jatropha curcas* (flax nuts), which are resistant against animal bites; in Egypt, rows of *Casuarina equiseti folia* help to protect against the extreme desert winds)
	The cultivating of rows of plants running across the main slope direction of the site, (mix of grass & legumes suited to the site)
	The reforestation/planting of the edges of extremely steep slopes (e.g., in Darjeeling, with elephant grass and a variety of shrubs/trees)
	Large scale reforestation including protective methods against harming animals and uncontrolled use of wood for fuel

Since mechanical methods of providing protection against erosion are work-intensive (e.g., construction of terraces), it is worth considering whether the same effect could be achieved with biological methods (e.g., green fences).

Experience shows that problems with erosion are caused by a variety of factors – including socio-economic ones. This becomes evident when using the Sahel as an example:

- Heavy and intense localised rainfall,
- Those soil characteristics that promote erosion,
- Growing population, with accompanying increase in demand for food and fuel,
- Change in soil tillage methods (mechanization with animals instead of manual tillage),
- Shortening of the fallow land period and/or abandonment of fallow land,
- Intensification of cash crop production for export with the result that food production for domestic consumption more and more takes place in remote and marginalized areas,
- Not an appropriate number of livestock.

It has been proven that protection measures against erosion can only be successfully implemented when the local population is included in the development of the regional strategies and that their requirements are also sufficiently met.

3. LIVESTOCK AND ANIMAL HUSBANDRY

The integration of animal husbandry in organic farms in the temperate and arid zones is one of the basic principles behind organic farming. It is of less importance in the tropics. In these regions, micro-organisms (and rapid decomposition rates) take over the ecological function played by the larger animals.

Animal husbandry enables the recycling of organic matter to be further optimised in agro-ecosystems, e.g., by using crop residues as fodder for the animals, and by using animal dung for the crops. It is not absolutely necessary that each individual farm keeps its own animals. It is just as practical for neighbouring farms with and without animal husbandry to cooperate.

The number of livestock kept on a particular farm or region is therefore dependent upon the amount of fodder available, or the size of crop area used to grow fodder on the site itself.

Planting fodder crops (especially legumes) is of particular help in improving the fertility of the soil, and in diversifying the crop rotation. Hedges can be useful not only as windbreaks and as protection against erosion, but they can also act as a constant source of forage for cattle.

Industrialized large-scale livestock farming (many animals – not enough land) are not permitted in organic farming systems, because an optimal synergistic effect between the plants, soil and animals cannot be achieved with them. Strategies will always have to be adapted according to the prevailing site and regional conditions, and these also include the way that animals are kept. For example, it is important to check that over-grazing or damage through bites do not occur, as these could cause problems with erosion (see the Sahel as an example).

If animals are to be introduced into a functioning farm unit, care must be taken, not only to choose the correct race of animal suited to local conditions, but also to make sure that the species itself can be adapted to the existing ecosystem without causing any damage. For example, the introduction of sheep and goats into the Andean regions has had serious consequences for the soil and vegetation. The expansion of cattle-rearing in the tropics has had a similar effect.

Cattle-rearing is a special case (they have no direct natural competition for food because they eat plants that are not consumed by humans; they produce protein in form of milk and meat, and leather and wool; they can also be used for transport purposes; they produce dung). Cattle-rearing has a long tradition in many regions worldwide, and it should be remembered that large areas are required (stables, outdoor runs and forage areas e.g., pasture or arable forage cultivation). Pigs can be easily adapted to a small farm structure, as they will feed on crop residues and organic waste products. Nevertheless, stalls must be provided with plenty of space for them to roam outside, to protect the environment – especially delicate ecosystems– against the animal's natural tendency to root around.

In principle, animal husbandry in organic farming rejects the concept of maximising the short-term performance of the animals. Instead, an attempt is made to achieve the optimum life performance of the animal.

Productive livestock must be kept according to their behavioural needs. Animals kept in ways that disregard their behavioural needs adversely affects them, makes them more susceptible to illness, and also reduces their overall efficiency (e.g., production of milk or meat). For these reasons, in organic farming, care is taken to ensure that the animals have sufficient free movement, fresh air, natural daylight, suitable food and access to fresh water.

It is also important to only keep animals suited to the region who will be able to cope with the local climatic conditions and are capable of withstanding the potential presence of diseases.

Medication used in a preventive manner is forbidden in organic farming (except for vaccinations).

4. COMPOSTING

Throughout the previous chapters, it has often been mentioned that it is largely dependent on the specific site and farm conditions whether composting makes sense as a strategy or not. A farmer should heed the following aspects before making his decision:

a) Nutrients will also be lost even when composting is optimally organised (e.g., potassium in drainage water, or loss of gaseous nitrogen and carbon).
b) Successful composting generally goes hand in hand with keeping livestock.
c) Workload caused by composting (production, application).

4.1. Selecting composting materials

The most basic requirement for every type of composting method is the correct choice and preparation of the used compost materials. Factors that are important include the ratio between carbon and nitrogen (C : N ratio), humidity and ventilation. Decomposition will only take place to produce nutrient-rich compost when all of these factors are correct. The ratio between carbon and nitrogen in the materials chosen should ideally be 25-30 : 1, this may be a little higher at warm, humid sites.

A selection of C : N ratios in materials usually used for composting:

Material	C : N- ratio
Saw dust	Up to 400
Maize stalks	50 - 150
Straw	50
Green material from legumes	20 - 30
Dung including bedding	20 - 25
Straw from legumes	15
Farm Yard Manure	15
Topsoil	10 - 12

In practice, the necessary C : N ratio for each of the materials used can only be reached when a sufficient quantity of manure is added (ca. 50%).
Rock phosphate (phosphorous compounds which have not been broken up and are thus not readily available to plants) can be used by mixing it directly into the compost. During the composting process, and especially in an acidic milieu, the rock phosphate is partly turned into forms that the plants can access. Furthermore, Mycorrhiza fungi can also dissolve phosphates in compost.

The following points should be cleared up before organic material is used from sources other than the farm itself:

- The origin of all organic material must be ascertained. Manure is only acceptable if it originates from organic or at least extensive animal husbandry and/or organic material if it is not polluted with pesticide residues or other contaminating substances.
- The importation (bought-in) of organic material into the farm system is limited, with the main proportion being produced on site.
- Every instance of organic material purchase (both, type and amount must be approved beforehand by the certification body).

4.2. Selection of a compost site

In principle, every compost heap must be protected against heavy sunlight (drying out) and too heavy rainfall (leaching). A suitable site would therefore be in the shade, under trees. In extreme regions, such as e.g., the Sahel, the dung needs to be protected in compost pits against drying out too quickly.
In addition, the location of the compost site must be chosen carefully for different technical reasons. By necessity, this includes both the method of transporting the organic material to the heap and also the distribution of the finished compost within the farm.

4.3. Construction of a compost heap

The construction of compost heaps which measure ca. 1.5 m high, 2 m wide and are as long as desired have proven themselves in practice, because they produce a roof-type of structure, that helps to drain off any rainwater and thus prevent waterlogging – especially in wet climates. In extremely dry regions, it can make sense to dig compost pits.

The following basic rules should be heeded:

a) The organic material needs to be mixed by chopping it up (into small pieces, yet not too small) or layered alternately.
b) Plant remains that are very woody need to be chopped to aid decomposition.
c) The foundation needs to be well-drained. If the ground has a tendency towards waterlogging, the first layer should consist of loose material (e.g., branches).
d) The compost heap should be protected from drying out and/or leaching by covering it with natural materials (e.g., straw or banana leaves) or with perforated foil (the perforations allow gases to escape and prevent internal sweating).

4.4. Regulating the rate of decomposition

Compost worms and other microorganisms are necessary for the efficient decomposition of the compost material. The process can be accelerated by adding bits of old compost heaps. Special compost preparations can also be added which will support the process. The time required for the material to decompose depends on:

- the temperature of the air
- the composition of the composting material
- the moisture content composting material
- the ventilation

Disease carriers and weed seeds are killed off by the high temperatures inside the heap. The insides can attain a temperature of up to 80°C, which can then lead to a loss of N, and is therefore not desirable. The temperature should therefore not exceed 60°C. The inner temperature can quite easily be established, yet a so-called compost thermometer is also sometimes used. If the temperature exceeds 60°C, action must be taken to lower it again (e.g., removing the covering, watering the heap or even turning it over to ventilate it).

The factors ventilation and moisture can be counteracted by manually turning the heap, uncovering it or watering it. A compost heap should be turned over around 3 times during its 3–6-month decomposition cycle. A basic rule states that the longer the decomposition takes, the more nutrients are lost. Losses are caused by the gassing out of nitrogen or carbon compounds or by leaching of nutrient-rich draining water (e.g., potassium).

4.5. Uses for compost

The finished compost has a crumbly structure. It smells pleasantly of earth and only contains traces of rotting material. Large residual pieces can eventually be sieved out. Now the compost can be spread over the fields or beds (or tree trunks) and lightly worked in (being careful not to damage any roots) or covered over with mulching material to prevent premature from drying out on the soil's surface.
The time that compost is added is most important. This depends upon the growing period of the crop and its respective nutrient requirements. It should be noted that nutrients stemming from compost are released slower than those from mineral fertilisers.

The following weights of contents give a general indication of how to integrate the dosing of compost material into the total nutrient cycle:

Substance	Percentage weight in dry matter
Organic substance	60
Carbon	35
Nitrogen (as pure N)	2,8
Phosphorous (as P_2O_5)	2,2
Potassium (as K_2O)	2,6
Calcium (as CaO)	3,1
Ash	40

5. BIOLOGICAL PLANT PROTECTION IN ORGANIC AGRICULTURE

In organic farms, preventive measures have absolute priority. The whole point is not how to eradicate a pest or disease, but how to prevent them from appearing. When a plant becomes diseased or is overcome with pests, the farmer needs to ask himself how it is that the plant is too weak to thrive in the actual ecosystem without significant damage occurring. The central question therefore remains what the underlying causes are.

Possible causes include:

a) **The variety used is unsuited to the site:** In such cases, it is advisable to try out different varieties on-site. Yet in addition to its suitability to the conditions on-site, a variety must also meet market demands (quality requirements).
b) **The cultivation system is unsuitable:** This can have many causes. Soil-borne diseases (root rot, nematodes) are often the cause behind a poor crop rotation or failing secondary vegetation. Certain fungus types thrive when the plants are set too close together, or in agroforestry systems that are ventilated too poorly. Pests can appear in large numbers when there are no habitats for their natural enemies (useful insects) to grow. Existing hedges or trees on the farm or near the crops can offer pests hibernation possibilities or hosts during certain of their life-cycle stages.
c) **Reduced soil fertility:** Healthy growth can only come from healthy soil. Poor soil fertility, compression of the soil, waterlogging or too high salinity can all be stress factors for the crops. Stress in plants always results in a higher susceptibility to diseases and pests.

A precise analysis of the actual situation and an alleviation of the causes will lead to the most success in both, the middle and the long term. This is also because treating the causes will keep the farm largely independent of the use of biological plant protection materials, and thus cut running costs.

NOTE: *The main method to protect plants in organic farming is treat the causes.*

In order to help combat pests/diseases that turn up on certain occasions, a multitude of traditional methods exists throughout the world. For example, the manufacture of watery extracts from neem seeds, bitter ginseng extracts, chilli extracts, stinging nettle mixtures etc... These plant protection products can be manufactured on the farm without much effort (time and cost).
Above a certain limit, the appearance of pests or diseases in plantation crops calls for measures to protect the harvest. The products for pest and disease control allowed in organic agriculture are listed in the regulation for organic agriculture (EEC) No. 2092/91 as well as the IFOAM Basic standards. It needs to be stressed, that plant protection products, including those allowed on organic plantations, can only have a limited effect and are not capable of combating the actual root causes.

6. DIVERSIFICATION STRATEGIES

Diversification of the agro ecosystem is one of the basic requirements in organic agriculture: It is not unusual for a farmer's income to be entirely dependent on the sale of harvest from one single crop (especially on small farms). When prices fall, this will inevitably lead to very serious problems. Diversified agro ecosystems consisting of a variety of crops that can either be sold (local market, export) or are grown for personal use (food, fodder, building material and fuel) have a far better crisis-resistant structure. Yet such diversified systems require efficient planning and organisation of the available workforce. In general, there are two forms of diversification:

- Horizontal diversification
- Vertical diversification

Horizontal diversification: A new crop is to be introduced into a farm. During the planning stage it is necessary to satisfy the requirements for success within the farm. In addition to the first, basic question of whether the crop in question can be planted at the site or not, the following must also be ascertained:

- Are the technical requirements for post-harvest treatment (e.g., drying, storage, etc.) present, in order to fulfil the market demands for quality?
- Does the parallel cultivation of different crops place too much strain on the available manpower (e.g., if different crops should need to be harvested at the same time)?

An example of this would be if vanilla or pepper were to be integrated into tea plantations (growth on the shade trees).

Vertical diversification: When a farmer decides to not only sell his crops in an unprocessed state, but to process them himself. This would be a way to increase his income or to achieve a higher net profit. This strategy is of particular interest to smallholder farm cooperatives or groups of producers (larger amounts of harvested product), who then either invest in their own processing plant, or use the service of a sub-contracted and qualified processor.
One example of this would be when smallholder coffee farmers were to have instant coffee produced for their domestic market or for export.

Whether and in which framework diversification opportunities have a chance of success must be decided by each farmer individually. But what basically needs to be established, is whether sufficient capacity to successfully expand exists on-site, or whether this can be easily achieved. This is especially true for products with high market quality requirements.

7. **STANDARDS** AND CERTIFICATION REQUIREMENTS

In this chapter, a brief orientation shall be given referring to the internationally valid standards for organic agriculture as well as to the requirements for inspection and certification. Compliance with these standards/regulations is the prerequisite for certification and access to the organic market. In annex the reader will find the sources for some legal regulations as well as for the IFOAM Basic Standards.

7.1. Standards for Organic Agriculture

Organic agriculture (cultivation as well as processing) is regulated by a complex set of standards in the meantime. At an international level, the basic standards for organic agriculture defined by IFOAM (International Federation of Organic Agriculture Movements) are most relevant.

These basic standards are defining not only the fundamental requirements for the production of organic foodstuff but also minimum requirements for the inspection and certification of organic producers. Furthermore, the basic standards of IFOAM are the obligatory basis for detailed production standards set by private certification bodies, who are evaluated on behalf of IFOAM within the frame of the IFOAM Accreditation Programme. Actually, about 16 private certification bodies are accredited by IFOAM worldwide (see list in the annex).

Out of the IFOAM Basic Standards also official regulations for the organic industry were developed in different countries for instance in the European Union (EEC-regulation for organic agriculture (EEC) 2092/91), in Turkey, in Argentina and in Japan. Furthermore, the Codex Alimentarius also took the IFOAM Basic standards for defining minimal requirements for organic plant cultivation (animal husbandry will follow).

Finally decisive for producers is to follow the legal requirements for organic agriculture as far as they are existing in the country of production and/or in the country of importation.

7.2. Inspection and Certification

Every producer, processor and exporter who intends to produce and sell organic products shall fulfil all requirements laid down in the internationally valid standards for organic agriculture as well as in existing regulations in the country of importation. Therefore, the precondition to enter the organic market is to follow the inspection and certification procedure of an internationally accredited certification body for organic agriculture. At least once per year all production units have to be inspected by the certification.

7.3. Conversion Plan

Prior to the conversion of a farm or a processing plant, it is of utmost importance to acquire sufficient information about all certification requirements. This can be done best by selecting a qualified certification body with the objective to develop a conversion plan for the operation. Furthermore, prior to the first inspection it has to be clarified which information is needed by the certification body and/or which records have to be taken constantly (e.g., Bought-in of raw materials and production means, sales documentation etc.).

7.3.1. Farm operations

In the context mentioned above, the producer must be aware of the conversion requirements (besides all detailed standards for production) at first. For example, the EEC-regulation for organic agriculture (EEC) 2092/91 requires a conversion period for all permanent crops of 36 months and for all annual crops a conversion period of 24 months (products can be sold as „organic in conversion“ after 12 months of organic production, however, for most of the products it is very difficult or nearly impossible to sell „products in conversion“). This conversion requirement is therefore very important for the short- and midterm planning of any farm operation. In this context, it is also important to know that the EEC-regulation for organic agriculture does count the conversion period from the date of the first external inspection. That means that in case the history of the farm cultivation was in line with the requirements of the EEC-regulation this normally cannot be taken into consideration when calculating the conversion time.

7.3.2. Processors and Exporters

To get processed foodstuff certified as organic it is not sufficient to use only organic ingredients of agricultural origin. Besides the used agricultural ingredients, a couple of other aspects must be taken into account. In this context, the use of ingredients of non-agricultural origin (e.g., food additives, carriers, flavourings, water and salt, micro-organisms preparations, minerals and vitamins), the use of processing aids (e.g., tannic acid, silicon dioxide gel, gelatine), the use of disinfectants as well as the application of specific processing methods (e.g., ionising radiation is prohibited) is regulated in a very restrictive manner. As already stated for the farmers, processors interested in the processing of organic foodstuff are also recommended to contact an accredited certification body in time, to develop a conversion plan.