Holland

TRAINING MANUAL
SAFFRON

ABAC Holland bv

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Content

Principles of Organic Agriculture

-Production of goods of high quality

-Conservation of the natural resources fertile soil, clean water and rich biodiversity

-Make use of ecological principles and processes

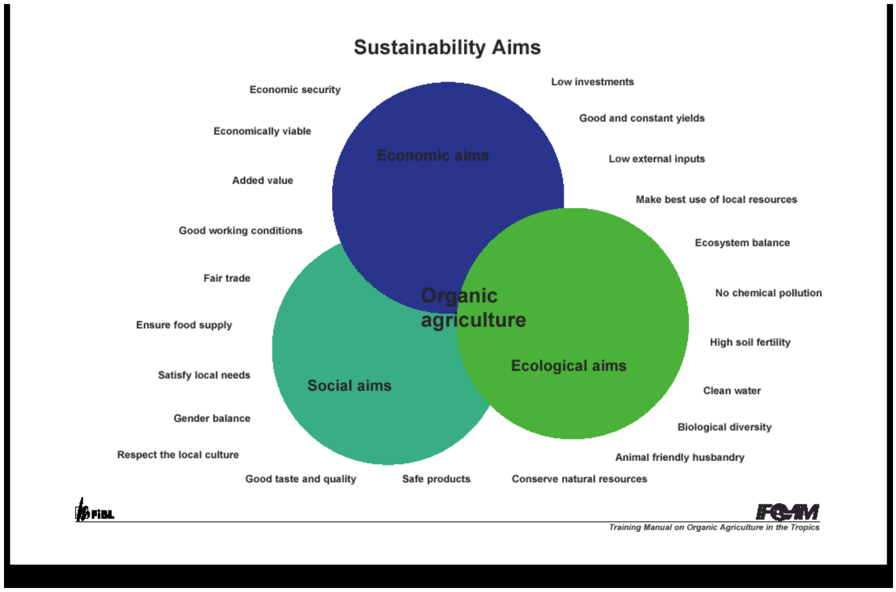
1.1.

Organic and sustainable

- Ecological aspects
- Economical aspects
- Social aspects

Only if the three dimensions are fulfilled, an agricultural system can be called sustainable.

1.1.



1.1.

Organic general principles

-Improve and maintain the natural landscape

-Avoid over-exploitation and pollution of natural resources

-Minimize consumption of non-renewable energy and resources

-Produce sufficient quantities of nutritious wholesome and high quality food

-Provide adequate returns, within a safe, secure and healthy working environment

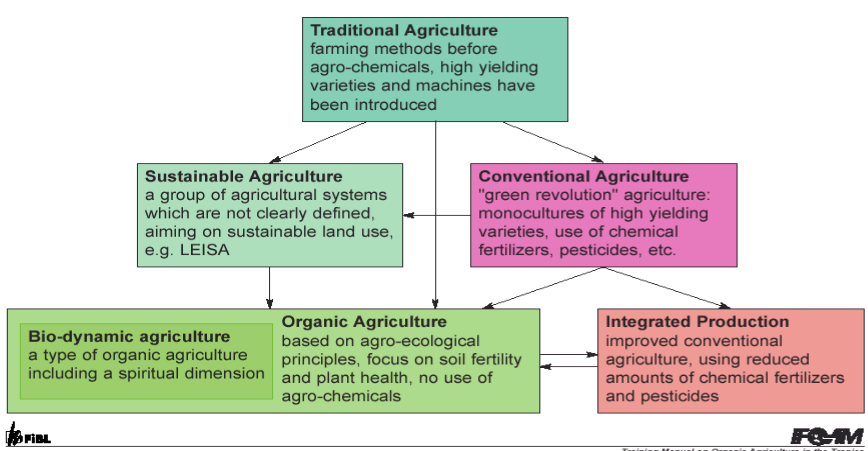
-Acknowledge indigenous knowledge and traditional farming systems

1.1.

Organic practical principles

-Maintain and increase the long-term fertility of the soil
-Enhance biological cycles within the farm, especially nutrient cycles
-Provide nitrogen supply by intensive use of nitrogen fixing plants
-Biological plant protection based on prevention instead of curing
-Diversity of crop varieties and animal species, appropriate to the local conditions
-Animal husbandry appropriate to the needs of the animals
-Ban on synthetic chemical fertilizers, plant protection, hormones and growth regulators
-Prohibition of Genetic Engineering and its products
-Ban on synthetic or harmful methods, processing aids and ingredients in food processing

Definition of Some Farming Systems



Comparison of Integrated Production (IP) and Organic Agriculture

Criteria	Integrated Production	Organic Agriculture
Chemical insecticides, fungicides and herbicides	permitted, with certain restrictions	not permitted
Chemical fertilisers	permitted, with limitations on maximum application	not permitted
Use of GMO	permitted	not permitted
Treated seed material	permitted	no chemical treatment
Animal friendly keeping	some regulations	strict regulations
Fodder purchase	no limitations	defined limits
Use of growth promoters	permitted	not permitted
Animal breeding	high performance, embryo transfer permitted	life performance, no embryo transfer
Animal health	preventive use of chemo-therapeutic medicine permitted	no preventive use of chemo-therapeutic medicine

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The Organic Quality Control System

- Organic certification
- Specific organic standards define the way of production
- Authorized producers and processors
- Labels and certification marks help the consumer to recognize trustworthy organic products easily

Organic Standards:

Nutrient Management:

- Shall be based on organic material, with defined maximum amounts
- Mineral fertilizers only to be used as a supplement
- No synthetic fertilizer allowed

Plant protection

- Use preventive methods to maintain plant health
- Botanical pesticides only to be used as a supplement
- No synthetic pesticides allowed

Composting

1.2.1.

Composting

Composting is the process of transforming organic material of plant or animal origin into humus in heaps or pits.

Within the process of composting 3 main phases can be distinguished:

1. The heating phase
2. The cooling phase
3. The maturing phase

These phases can not be clearly separated from one another.

1.2.1.

1. The heating phase

- Most of the decomposition occurs during the heating phase.
- Within 3 days of setting up the compost heap, the temperature in the heap rises to 60 to 70 °C and usually stays at this level for 2-3 weeks.
- In this phase, it is mainly bacteria which are active. The high temperature is a result of energy released during conversion of easily decomposable material by the bacteria.
- The heat destroys diseases, pests, weed roots and seeds.
- If there is not enough air in the heap, bacterial development will be hindered and the compost will develop an unpleasant odour.
- Humidity is also essential to the composting process as bacteria require humid conditions for their work.

1.2.1.

2. The cooling phase

- Once the material which is easily digested by the bacteria has been converted, the temperature in the compost heap declines slowly and will remain at 25-45 °C.
- With the decline in temperature, fungi settle and start the decomposition of straw, fibres and wooden material.
- As this decomposition process is slower, the temperature of the heap does not rise.

1.2.1.

3. The maturing phase

- During the maturing phase nutrients are mineralised and humic acids and antibiotics are built up.
- Red compost worms and other soil organisms start to inhabit the heap during this phase.
- At the end of this phase the compost has lost about half of its original volume, has the colour of dark, fertile soil and is ready to use.
- The longer it is stored from now on, the more it looses its quality as a fertilizer, while its capacity to improve soil structure increases.

1.2.1.

Why make compost?

- It is a well balanced fertilizer.
- It is not costly to make.
- The heating phase destroys weed seeds and disease germs.
- It suppresses soil borne disease germs.
- It raises the pH in acid soils
- It increases soil organic matter content.

1.2.1.

Different compost systems

- Continuously fed systems: These systems do not heat up during the composting process. They are handy if there is a continuous supply of wastes.
- Batch fed systems (all material is composted at once): They offer the advantages of reduced nutrient loss, death of weed seeds and diseases as a result of the high temperature of composting. The process is fast (within a few weeks) and it results in a compost of superior quality.

1.2.1.

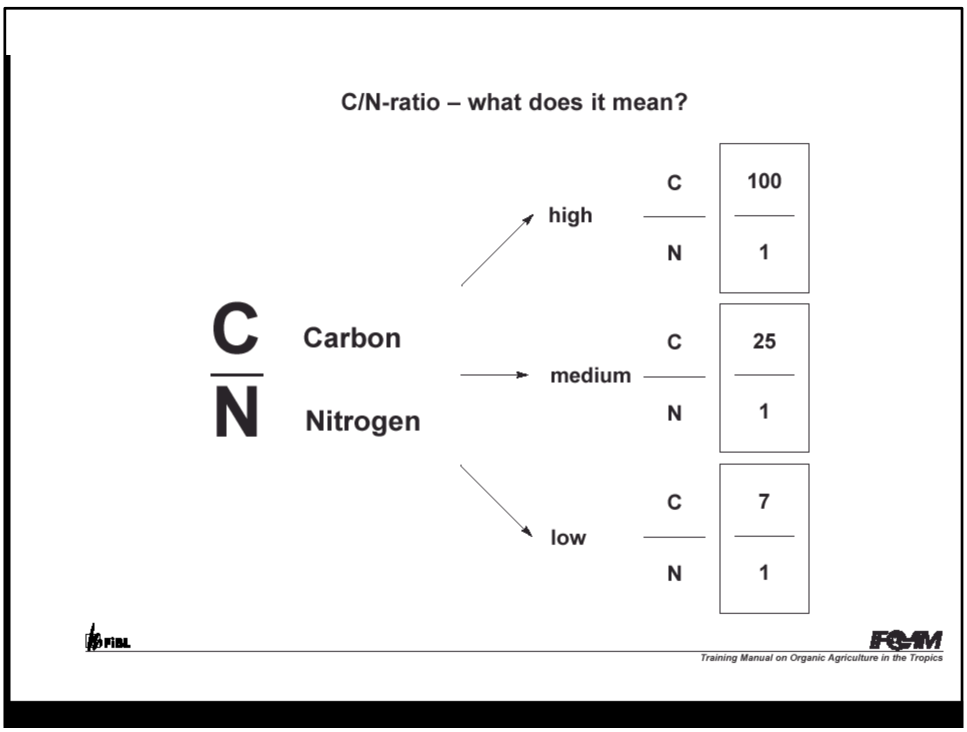
Composting materials

1.2.1.

Composting materials

- The C/N-ratio and the structure of the material have a major influence on the composting process.
- Material which is rich in nitrogen (low C/N-ratio) does not usually contribute to a good structure and thus does not allow for good aeration if composted separately.
- Material which has a good structure, usually has a low nitrogen content (high C/N-ratio) and does not offer enough nitrogen for the bacteria to feed on.
- Mixing different materials thus helps to achieve a balanced nutrient composition and a structure which allows for good aeration.

1.2.1.



C/N-ratios of composting materials

	Nitrogen content (% of dry matter)	Carbon to nitrogen ratio (C/N ratio)
Low C/N ➜ high N content		
Chicken manure	3–6	10–12
Young grass hay	4	12
Cassava leaves	4	12
Farmyard manure	2–3	14
Groundnut straw	2–3	20
Medium C/N ➜ medium N content		
Crotalaria	2	26
Cassava stems	1.3	40
Fallen leaves	0.4	45
Maize stalks and leaves	0.7	60–70
High C/N ➜ low N content		
Wheat or rice straw	0.4	100
Sugar cane trash	0.2	150
Saw dust	0.1	500

To allow an ideal composting process, the mixture should consist of approximately:

- One third bulky material with a rich structure (chopped branches and tree bark, bulky material separated from previous composts)
- One third medium to fine material with a high C/N-ratio (straw, leaves, crop residues etc.)
- One third fine material with a low C/N-ratio (household wastes, animal manure etc.) of which 5 to 10 % soil.

1.2.1.

Possible Problems and solutions in the composting process

Diagnosis	Problem	Possible Reasons	Solutions
Temperature does not rise	Microorganisms can not develop	• Material too dry or too wet • Lack of air or too much air • C/N-ratio is not correct • Too much earth	• Wetten with water or urine • Pile looser • Mix more fresh green material or dung to it
Sudden decrease of the temperature	Transformation process stops	• Material has become too dry • All available nitrogen used	• Wetten with water or urine • Add nitrogen rich material
Composting material gets dusty white	Too strong development of fungi	• Material too dry • Material not mixed for a longer time	• Mix and set up the pile again • Wetten with water or urine • Add nitrogen rich material
Material gets blackish-greenish, foul smelling	Composting material is fouling	• Lack of air and structure • C/N-ratio too low • Material too wet • Material has not been mixed sufficiently	• Set up pile again adding bulky material with high C/N-ratio • Turn compost more often during heating phase

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1.2.1.

Compost Materials

1.2.2.

Why Make Compost?

- Compost is one of nature's best mulches and soil amendments.
- Compost is cheap, you can use it instead of commercial fertilizers.
- Using compost improves soil structure, texture, and aeration and increases the soil's water-holding capacity.
- Adding compost improves soil fertility and stimulates healthy root development in plants.

1.2.2.

Why Make Compost?

- Most farmers have long understood the value of this rich, dark, earthy material in improving the soil and creating a healthful environment for plants.
- There is an interest in conserving existing landfill space and in developing alternative methods of dealing with waste.
- Don't throw away materials when you can use them to improve your Crocus sativus field.

1.2.2.

Why Make Compost?

- With a small investment in time, you can contribute to the solution to a community problem, while at the same time enriching the soil and improving the health of the plants on your soil.
- The organic matter provided in compost provides food for micro organisms, which keeps the soil in a healthy, balanced condition.

1.2.2.

The Decomposition Process

- Compost is the end product of a complex feeding pattern involving hundreds of different organisms, including bacteria, fungi, worms, and insects.
- What remains after these organisms break down organic materials is the rich, earthy substance your garden will love.
- Composting replicates nature's natural system of breaking down materials on the forest floor. In every forest, grassland, jungle, and garden, plants die, fall to the ground, and decay.

1.2.2.

The Decomposition Process

- Humus is our goal when we start composting.
- By providing the right environment for the organisms in the compost pile, it is possible to produce excellent compost.
- By knowing the optimum conditions of heat, moisture, air, and materials, we can speed up the composting process.

1.2.2.

Following is a chart listing common composting materials

- Type of material
- Is it good for composting?
- Carbon/ Nitrogen details
- Remarks

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Newspaper
- Yes
- C
- Shred it so it breaks down easier. It is easy to add to much newspaper, so recycle if you have a lot. Don't add slick colored pages.

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Ashes from coal or charcoal
- No
- n/a
- May contain materials that are bad for plants

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Ashes from untreated, unpainted wood
- Careful
- Neutral
- Little amounts. Can make the pile too alkaline and suppress composting process

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Beverages, kitchen rinse water
- Yes
- Neutral
- Good to moisten the middle of the pile. Do not over-moisten the pile

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Bird droppings
- Careful
- N
- May contain weed seeds or disease organisms

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Cardboard
- Yes
- C
- Shred into small pieces. Wetting it makes it easier to tear. If you have a lot, consider recycling instead.

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Cat droppings or cat litter or dog droppings
- No
- n/a
- May contain disease organisms

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Coffee grounds and filters
- Yes
- N
- Worms loves coffee grounds and filters

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Compost activator
- Not required, but ok
- Neutral
- You don’t really need it, but it doesn’t hurt

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Cornstalks, corn cobs
- Yes
- C
- Best if shredded and mixed well with nitrogen-rich materials

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Diseased plants
- Careful
- N
- If your pile doesn't get hot enough it might not kill the disease organisms, so be careful. Let it cure several months, and don't use this compost near the type of plants that was diseased.

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Dryer lint
- Yes
- C
- Compost away! Moistening helps

1.2.2.

Common composting materials

- Type of Material
- Use it?
- Carbon/ Nitrogen Details
- Remarks

- Eggshells
- Yes
- O
- Breaks down slowly. Crushing the shells helps

1.2.2.

Compost Materials

- Almost any organic material is suitable for a compost pile.
- The pile needs a proper ratio of carbon-rich materials (“browns”) and nitrogen-rich materials (“greens“).
- Among the brown materials are dried leaves, straw, and wood chips.
- Nitrogen materials are fresh or green, such as grass clippings and food scraps.

1.2.2.

Compost Materials

- Mixing certain types of materials or changing the proportions can make a difference in the rate of decomposition.
- Achieving the best mix is more an art gained through experience than an exact science.
- The ideal ratio approaches 25 parts browns to 1 part greens. Judge the amounts roughly equal by weight.
- Too much carbon will cause the pile to break down too slowly, while too much nitrogen can cause odour.
- The carbon provides energy for the microbes, and the nitrogen provides protein.

1.2.2.

Compost Materials
Leaves

Leaves represent a large percentage of total yard waste.

If you can grind them in a gas or mow over them, they will reduce in size making them easier to store until you can use them in the pile, and they will decompose faster - an issue with larger leaves.

1.2.2.

Leaves

Leaves are loaded with minerals brought up from the tree roots and are a natural source of carbon.

A few leaf species are too tough and leathery for easy composting.

1.2.2.

Compost Materials
Grass Clippings

Grass Clippings break down quickly and contain as much nitrogen as manure.

Since fresh grass clippings will clump together, become anaerobic and start to smell, mix them with plenty of brown material.

1.2.2.

Grass Clippings

If you have a lot of grass clippings to compost, spread them on the driveway or other surface to bake in the sun for at least a day.

Once it begins to turn pale or straw-like, it can be used without danger of souring.

1.2.2.

Compost Materials

Home Refuse

- Home Refuse includes: carrot peelings, tea bags, apple cores, banana peels - almost everything that cycles through your kitchen.
- The average household in Afghanistan produces compost material. You can successfully compost all forms of kitchen waste.

1.2.2.

Home Refuse

- However, meat, meat products, dairy products, and high-fat foods like salad dressings and peanut butter, can present problems. Because this is not all the time viable in Afghanistan we see this not as a main problem.
- Meat scraps and the rest will decompose eventually, but will smell bad and attract pests. Egg shells are a wonderful addition, but decompose slowly, so should be crushed.
- All additions to the compost pile will decompose more quickly if they are chopped up some before adding.

1.2.2.

Compost Materials

Wood Ashes

- Wood Ashes from a wood burning stove or fireplace can be added to the compost pile.
- Ashes are alkaline, so add no more than 2 gallon-sized buckets-full to a pile with 3'x3'x3' dimensions.
- They are especially high in potassium.
- Don't use coal ashes, as they usually contain large amounts of sulphur and iron that can injure your plants. Used charcoal briquettes don't decay much at all, so it's best not to use them.

1.2.2.

Compost Materials

- **Land Refuse** should make the trip to the pile. All of the spent plants, thinned seedlings, and deadheaded flowers can be included.
- Most weeds and weed seeds are killed when the pile reaches an internal temperature above 130 degrees, but some may survive.
- To avoid problems don't compost weeds with persistent root systems and weeds that are going to seed.

1.2.2.

Compost Materials

- **Hay or Straw** makes an excellent carbon base for a compost pile, especially in a place where few leaves are available.
- Hay contains more nitrogen than straw.
- They may contain weed seeds, so the pile must have a high interior temperature.
- The straw's little tubes will also keep the pile breathing.

1.2.2.

Compost Materials

Manure

- Manure is one of the best materials you can add to any compost pile. It contains large amounts of both nitrogen and beneficial microbes.
- Manure for composting can come from bats, sheep, ducks, pigs, goats, cows, pigeons, and any other vegetarian animal.
- You should avoid manure from carnivores, as it can contain dangerous pathogens.

1.2.2.

Compost Materials
Manure

- Most manures are considered "hot" when fresh, meaning it is so rich in nutrients that it can burn the tender roots of young plants or overheat a compost pile, killing off earthworms and friendly bacteria.
- Manure is easier to transport and safer to use if it is rotted, aged, or composted before it's used. Layer manure with carbon-rich brown materials such as straw or leaves to keep your pile in balance.

1.2.2.

Compost Site Selection

- Any pile of organic matter will eventually rot, but a well-chosen site can speed up the process.
- Look for a level, well-drained area. If you plan to add kitchen scraps, keep it accessible to the back door. Don't put it so far away you'll neglect the pile.
- In cooler latitudes, keep the pile in a sunny spot to trap solar heat. Look for some shelter to protect the pile from freezing cold winds which could slow down the decaying process.
- In warm, dry latitudes, shelter the pile in a shadier spot so it doesn't dry out too quickly.

1.2.2.

Compost Site Selection

- Build the pile over soil or lawn rather than concrete or asphalt, to take advantage of the earthworms, beneficial microbes, and other decomposers, which will migrate up and down as the seasons change. Uncovered soil also allows for drainage. If tree roots are extending their roots into the pile, turn it frequently so they can't make headway.
- Look for a spot that allows you to compost discretely, especially if you have neighbouring fields in close proximity. Aim for distance and visual barriers between the pile and the fields.

1.2.2.

Troubleshooting Composting Problems

1. Problems
2. Possible Causes
3. Solution

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Damp and warm only in the middle of the pile
2. **Possible Causes**
   Pile could be too small, or cold weather might have slowed down composting
3. **Solution**
   If you are only composting in piles, make sure your pile is at least 3 feet high and 3 feet wide. With a bin, the pile doesn't need to be that large.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Nothing is happening. Pile doesn't seem to be heating up at all.
2. **Possible Causes**
   a. not enough nitrogen
   b. not enough oxygen
   c. not enough moisture
   d. cold weather
   e. compost is finished
3. **Solution**
   a. make sure you have enough N-rich resources like manure, grass clippings or food scraps.
   b. mix up the pile so it can breath.
   c. mix up the pile and water it with the hose so that there is some moisture in the pile. A completely dry pile doesn't compost.
   d. wait for spring, cover the pile or use a bin.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Matted leaves or grass clippings aren’t decomposing.
2. **Possible Causes**
   Poor aeration, or lack of moisture.
3. **Solution**
   Avoid thick layers of just one material. Too much of something (like leaves, paper or grass clippings) don’t break down well. Break up the layers and mix up the pile so that there is a good mix of materials. Shred any big material that isn’t breaking down well.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Stench, like rancid butter, vinegar or rotten eggs.
2. **Possible Causes**
   Not enough oxygen, or pile is too wet, or pile is too compact.
3. **Solution**
   Mix up the pile so that it can get some aeration and can breathe. Add course dry materials like straw, hay or leaves to soak up excess moisture. If smell is too bad, add dry materials on top and wait until it dries out a bit before you mix the pile.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   ammonia odor.
2. **Possible Causes**
   Not enough carbon.
3. **Solution**
   Add brown materials like leaves, straw, hay, shredded newspaper etc.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Pile attracts rodents, flies or other animals.
2. **Possible Causes**
   Inappropriate materials (like meat, oils, bones) or food-like material is too close to the surface of the pile.
3. **Solution**
   Bury kitchen scraps near the center of the pile.
   Don’t add inappropriate materials to compost.
   Switch to a rodent-proof closed bin.

1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Pile attracts insects, millipedes, slugs etc.
2. **Possible Causes**
   This is normal composting and part of the natural process.
3. **Solution**
   Not a problem.

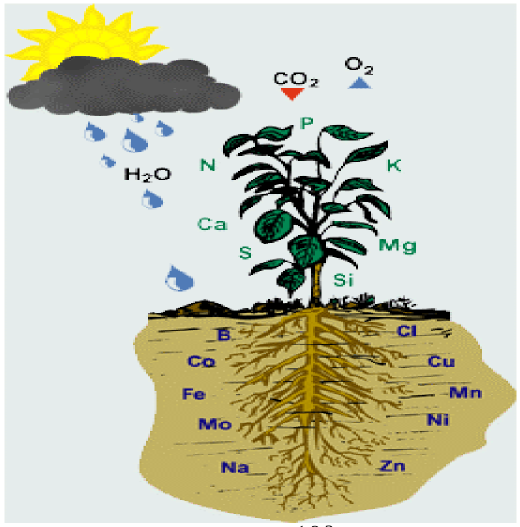
1.2.2.

Troubleshooting Composting Problems

1. **Problem**
   Fire ant problems.
2. **Possible Causes**
   Pile could be too dry, not hot enough or has kitchen scraps too close to the surface.
3. **Solution**
   Make sure your pile has a good mix of materials to heat up, and keep it moist enough.

1.2.2.

Plant Nutrition and Fertilization



1.2.3.

Important nutrient: Nitrogen

- Part of the chlorophyll (green)
- Most important nutrient for growing

- If not bound to OM it easily gets lost by:
  - –Leaching in the soil to groundwater
  - –Volatilisation to the air
  - –Volatilisation when burning the land in spring

1.2.3.

How to ensure nitrogen supply?

On a short term

- By mobilisation from the organic matter
  - by soil cultivation
  - by irrigating in dry conditions
  - by incorporating fresh and easily decomposable plant material
- By applicating organic manures
- By applicating plant teas or other liquid manures

Sweet potato with nitrogen deficiency

On a medium to long term

- By growing nitrogen fixing plants
- By encouraging a deep rooting of the plants
- By ensuring a continuous supply of organic matter
- By practicing a conserving soil cultivation

1.2.3.

Source of N

- Fixation from the air (Rhizobium bacteria)
  - Legumes
- Deposition from the air
- Organic matter (manure/compost)

- Quick sources of N
  - 'opening' the soil eg by tillage (oxygen supply)
  - Bring fresh and easy degradable plant material in the soil
  - Irrigation when it is dry

1.2.3.

Phosphorus

•Important for root growth

•Needed for transport within the plant

•Not very mobile in soil (roots must find it)

•pH of 6.0-6.5 needed

•Myccorhiza help the plants to mobilize P

1.2.3.

How to improve the availability of phosphorus in the soil?

Potato plant showing phosphorus deficiency symptoms

- By incorporating organic matter of plant or animal source.
- By raising the pH in acid soils through step-wise liming.
- By mixing rock phosphate with compost or animal manure.
- By minimising the loss of topsoil.
- By enhancing a dense root system.
- By ensuring humidity in the soil.
- By encouraging colonisation of the plant roots with mycorrhiza.

1.2.3.

Sources and Positive effects P

- Rock phosphate can be given: via compost or manure
  - Otherwise the P gets fixed in the soil and is not available for plants
- Plants grow deep roots
- Raise the organic matter of the soil

1.2.3.

Potassium (K)

- Synthesis of amino acids
- Photosynthesis
- In resistance for diseases
- Storing quality of the harvest
- N and K in 1:1 ratio ideally for the plants
- Both N and K are very mobile (soluble)

1.2.3.

Sources and positive effects K

- Recycle crop residues
- Avoid leaching from the soil by keeping the land permanently covered
- Cover the soil with mulch

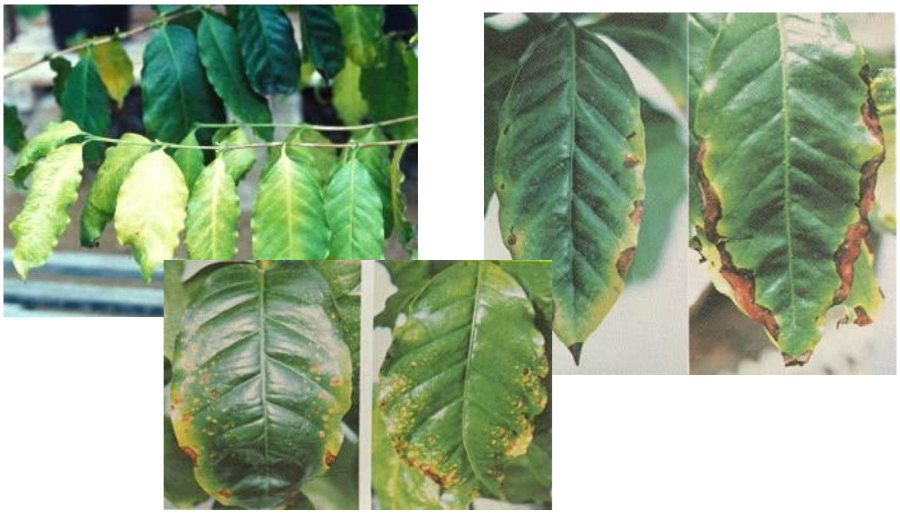
1.2.3.

Nutrient deficiency key

1. Location on plant (nutrient mobility)
   – Older and lower leaves: N, P, K, Mg, Mn
   – Young leaves and growing points: Fe, S, Zn, B, Cu, Ca
2. Colour and appearance, necroses
3. Pattern and other symptoms

1.2.3.

Nutrient deficiency symptoms



Chemical fertilisation:

The negative impact

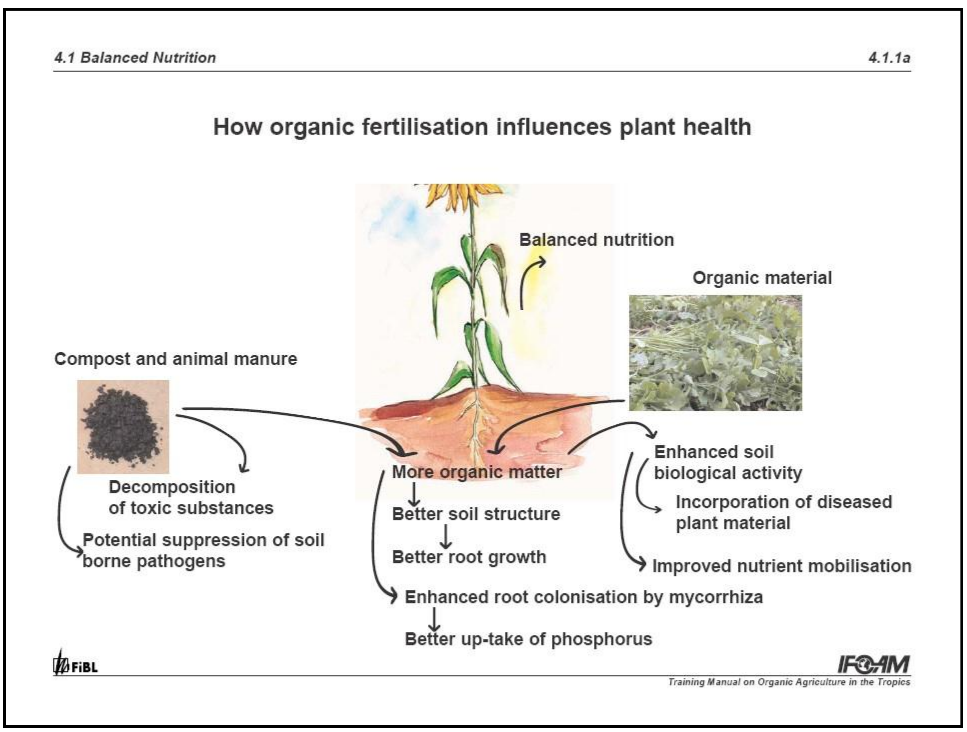
- Oversupply of nitrogen leads to a softening of the plants' tissues resulting in plants which are more sensitive to diseases and pests.
- Chemical fertilisation reduces the colonisation of plant roots with the beneficial root fungus mycorrhiza.
- High nitrogen fertilisation stops symbiotic nitrogen fixation by rhizobia.
- The exclusive use of NPK-fertilizers leads to a depletion of micro-nutrients in the soil as these are not replaced by such fertilizers.
- Decomposition of soil organic matter is enhanced, which leads to a degradation of the soil structure and a higher vulnerability to drought.

1.2.3.

Organic fertilization

Feeding the soil with organic matter has the following positive effects:

- The supply of nutrients is more balanced, which helps to keep plants healthy.
- Soil biological activity is enhanced, which improves nutrient mobilisation from organic and chemical sources and the decomposition of toxic substances.
- Mycorrhizal colonisation is enhanced, which improves the supply of phosphorus.
- Compost has the potential to suppress soil borne pathogens, when applied to the soil.
- Due to better soil structure root growth is enhanced.
- Humus improves the exchange capacity for nutrients and avoids soil acidity. 1.2.3.



Continuous nutrient supply from soil organic matter

1. Varying the input of organic material: A regular supply of organic matter provides the best conditions for a balanced plant nutrition. In semi arid areas 2 ton of biomass is needed per hectare per year to maintain soil carbon levels of 2 to 0.5 %.
2. Suitable crop rotation: The farmer arranges the rotation in such a way that demand and supply of nutrients fit in the best possible way.
3. Influencing nutrient mobilisation: Soil cultivation improves aeration of the soil and enhances the activity of soil micro-organisms. The farmer can influence the nutrient release from humus by cultivating the soil at the appropriate time, to the appropriate depth, and with the appropriate intensity and frequency.

1.2.3.

How to optimise nutrient management?

- 1: Minimise losses

-Raising the content of soil organic matter.

-Maintaining a dense plant cover with constructions such as terracing.

-Practice mixed cropping or crop rotation with species of high nitrogen demand.

-When there are no plants present or able to take it up, there are considerable nutrient losses.

-Nitrogen is easily lost by volatilisation (in the form of ammonium). The highest losses occur during the first two hours after manure is applied to the field. Farm yard manure and slurry should be brought out in quantities which the plants can take up in a short time. It should be worked into the top soil soon after application.

1.2.3.

- 2: Closed nutrient cycles

-Maximise recycling of plant residues, by-products, dung and farm wastes.

-Compost can be made out of almost any organic material from the farm.

-Mulching is a simple way of recycling nutrients. It helps to keep moisture in the soil and feeds soil organisms.

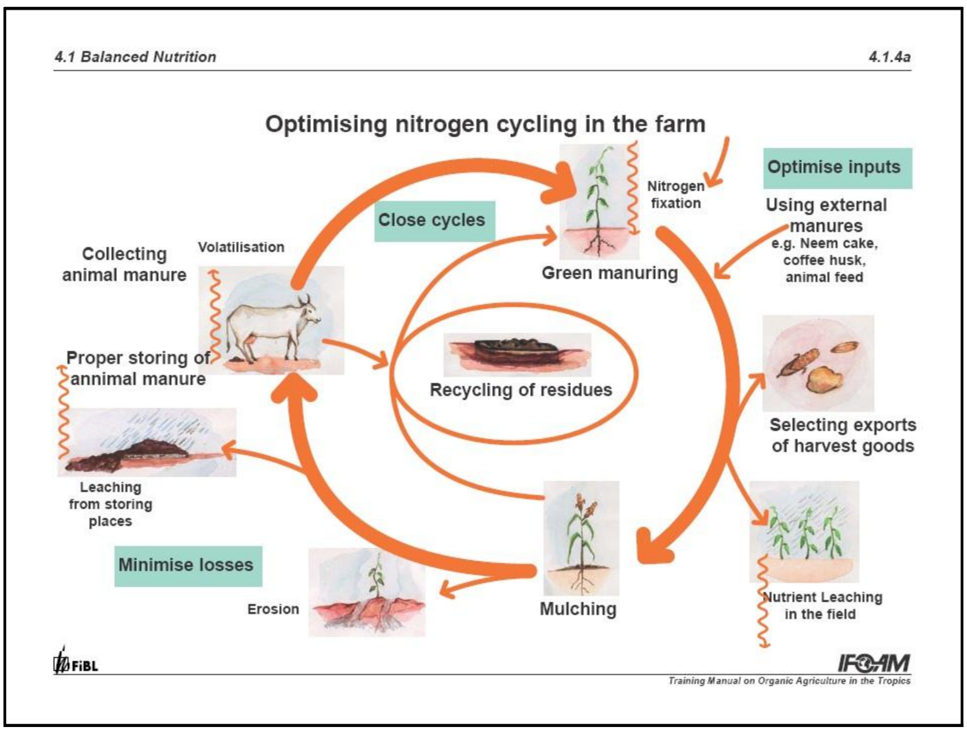
-Different plants have different requirements for nutrients; mixed cropping and crop rotations help to optimise the use of nutrients in the soil.

- 3: Optimise inputs

-Introduce external organic "wastes", if available.

-Natural products like rock phosphate or dolomite help to supply scarce nutrients

-Nitrogen fixing plants provide free-of-cost nitrogen.



Saffron nutrient requirements

- Saffron is believed to be a low nutrient requiring plant. Fertile soils with high nutrient contents cause excessive vegetative growth which is not advantageous for saffron.
- Each kg of total dry matter of saffron removes 12 grams N, 3 grams P and 22 grams K from the soil.

1.2.3.

Saffron nutrient requirements

- 16 to 80% of yield variation in saffron could be attributed to edaphic (soil type & topographic position) factors and the crucial soil factors.

In order of importance:

-soil organic matter

-available P

-available N

-exchangeable K

1.2.3.

Green Manures

Green Manures

- Green manures are plants grown to accumulate nutrients for the main crop.
- When they have built up maximum biomass, they are worked into the surface soil.
- They are usually cut before flowering, growing a green manure is thus different from growing a legume crop in the rotation.
- Once worked into the soil the fresh plant material releases nutrients quickly and will be fully decomposed within a short period of time.

1.2.4.

Benefits green manures

- They penetrate the soil with their roots, make it more friable and bind nutrients, which otherwise be washed away.
- They suppress weeds and protect the soil from erosion and direct sunlight.
- If legume plants are used, nitrogen is fixed from the air into the soil.
- Some green manures can be used as fodder plant.
- The incorporated plant material encourages the activity of soil organisms, and builds up organic matter in the soil.

1.2.4.

Nitrogen Fixing Plants

- Plants in the legumes family are capable of fixing nitrogen from the air with their roots to use as a nutrient.
- Legumes do this by living in association (symbiosis) with bacteria called rhizobium, which are histed in visible nodules growing on the roots.
- The bacteria take up nitrogen form the air, transform it and make it available for the host plant.

1.2.4.

How nitrogen fixation works

Green Manure

- Rye
- Mustard/rapeseed/horseradish
- Clover (under crop?)
- Lupine

N delivery green manure

Crop	Ploughing	N-delivery
Non legumes	before winter	15
	after winter	30
Legumes in gras	before winter	40
or grain stems	after winter	40
legumes	before winter	20
	after winter	40

1.2.4.

N delivery from the soil

	N delivery in kg N/ha in growing season			
Soil type	march-jun	march-jul	march-sep	whole year
	grains	potatoes	beets	gras-clover
Sand 2% OM	30	50	75	100
Clay 2% OM	25	40	60	80
Clay 3% OM	40	60	100	120

1.2.4.

How to improve nitrogen fixation

- Avoid strong shading of the legumes.
- Improve availability of phosphorus.
- Avoid nitrogen deficiency of the legumes in an early stage. High inputs of manures or fertilizers stop the nitrogen fixation process.
- Ensure a good supply with potassium.
- Avoid sulphur deficiency.
- Avoid water logging and water stress.

1.2.4.

Clover

1.2.4.

How to use green manures?

- If green manures grow within a crop rotation, the time of sowing must be chosen so that the green manure can be cut down and worked into the soil before the next crop is sown.
- Green manures need water for germination and growth.
- Seed density depends on the species.
- In general no additional fertilization is necessary.
- If legumes are grown in a field for the first time, inoculation of the seeds with the specific rhizobia may be necessary to profit from nitrogen fixation of the legume.
- If undersown, the green manure is sown at the same time as the main crop.
- If it grows faster than the main crop competition is too high, it can be sown later when the crop has established.

1.2.4.

Working the green manure into the soil

- The time gap between digging in the green manure and planting the next crop should not be longer than 2 to 3 weeks to prevent nutrient losses from the decomposing green manure.
- Green manures are worked in most easily when the plants are still young and fresh.
- To allow easier decomposition chop the plant into pieces.
- The best time to dig in green manure plants is just before flowering.
- Green manures should only be worked into the surface soil.

1.2.4.

Organic Manure

1.2.5.

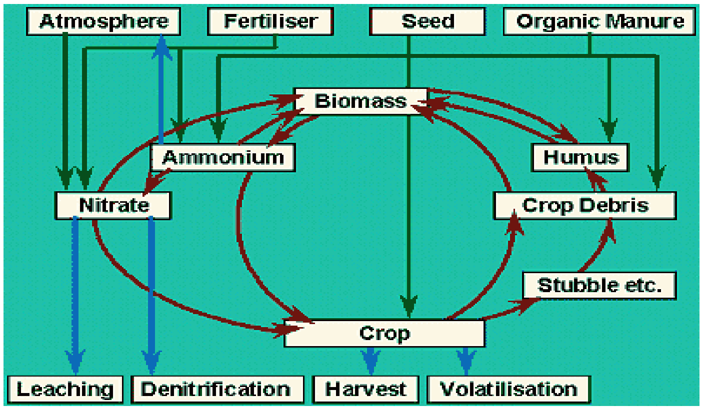
Organic manures

Organic manures are very different from chemical or mineral fertilizers:

- They contain organic matter.
- They are a slow source of nutrients and supply several nutrients at once.
- They mainly improve the quality of the soil.

1.2.5.

Organic Manures feeding the soil and plant



1.2.5.

Mineral (chemical) fertilizers:

- -Contain selected nutrients and may lead to deficiencies.
- -Decrease the content of soil organic matter.
- -Disturb soil organisms.
- -Are easily leached.
- -Are expensive.
- -Need a lot of energy to be produced.
- -Frequently do not show the expected success.

Organic manures:

- -Offer all the nutrients the plant needs.
- -Increase the content of soil organic matter.
- -Feed the soil organisms.
- -Bear little risk of leaching of nutrients.
- -Are cheap or free of cost.
- -Are in many cases waists.
- -Continuously release nutrients over a long period of time.

1.2.5.

Manure, crop residues and compost

- Animal manure
  - Nutrients readily available
  - Low C:N ratio (18)
  - High N losses
- Crop residues
  - Nutrients slowly released
  - Diseases, weeds
  - High C:N ratio (e.g. cereals: 80)
  - N-immobilisation
- Compost
  - Nutrients available
  - Non-aggressive, stable, clean (when mature)
  - Good C:N ratio (at start: 25; when mature: 10)

1.2.5.

Farmyard manure

- It contains large amounts of nutrients.
- Only part of the nitrogen content of manure is directly available to plants.
- The remaining part is released as the manure decomposes.
- The nitrogen in animal urine is available at short term.
- When dung and urine are mixed, they form a well-balanced source of nutrients for plants.
- Chicken manure is rich in phosphorus.
- Organic manures contribute to the build up of soil organic matter and thus improve soil fertility.

1.2.5.

N content of manure in kg per ton

Type of manure		DM	OM	N-total	N-min	N-org
Solid manure						
	Cows strawstable	210	156	6,5	-	-
	Cows manure without u	235	153	6,9	1,6	5,3
	Sheep	290	205	8,6	2,0	6,6
Urine-manure						
	cow	25	10	4,0	3,8	0,2
	pig	20	5	6,5	6,1	0,4
	sows	10	10	2,0	1,9	0,1
Liquid manure						
	cow	90	66	4,9	2,6	2,3
	pigs	90	60	7,2	4,2	3,0
	sows	55	34	4,2	2,5	1,7

1.2.5.

Nitrogen via manure

- Max allowed 170 kg/ha

- Cow manure 1.5 – 2.5 kg/mT
- Horse manure 1.7
- Chicken manure 0.8
- Pig manure 3.5

1.2.5.

N from organic manure

Solid manure from cow and pig

- In spring: 20 – 40 %
- Autumn: 10 – 20 %

Liquid manure

- Spring: 30 – 50 %
- Autumn: 15 – 25 %

1.2.5.

Phosphate (P)

- Fixated in the soil or available?
- Input via organic manure:
- Cow manure 3 kg/mt
- Horse manure 3 kg/mt
- Pig manure 6 kg/mt
- Chicken manure 20 kg/mt
- Rock phosphate (acid soils)

1.2.5.

Potassium (K)

- Via organic manure:
- Cow manure 3.5 – 13 kg/mt
- Horse manure 5.5 kg/mt
- Pig manure 3 kg/mt
- Chicken manure 11 kg/mt
- K20 fertilizers (K-Mg)

1.2.5.

Night Soil

1.2.6.

What is night soil?

- human excrements (faeces and urine) turned into manure.
- by process of composting.
- Night Soil: the excrements used to be collected and transported at night.

1.2.6.

Why night soil?

- Rich in N-components.
- Availability of the basic material: excrements.
- Night soil can improve the fertilising quality of domestic waste by adjusting the compost humidity.

1.2.6.

Night soil and health issues

- Night soil contains various kinds of pathogenetic bacteria, virus and parasitic ova.
  (e.g. pathogen of typhoid, dysentery, hepatitis A, poliomyelitis)
- So, potential health risk exists in the practice of using excreta.
- Take precautions to minimize the risk of spreading diseases.
- For import to the U.S.A. usage of night soil is not allowed.

1.2.6.

Make safe use of night soil

- High temperatures during composting:
- At least 66 °C for about 24 hours.
  This should kill most bacteria and worm eggs in the night soil.
- Night soil should age for about 2-6 months to further reduce pathogen activity.
- Keep children away from the pile.

1.2.6.

Composting night soil

- Mixing with C-rich material like straw is essential to maintain the C/N ratio.
- Aeration is necessary for good decomposition.
- Make sure temperatures get high enough to kill pathogenic organisms.

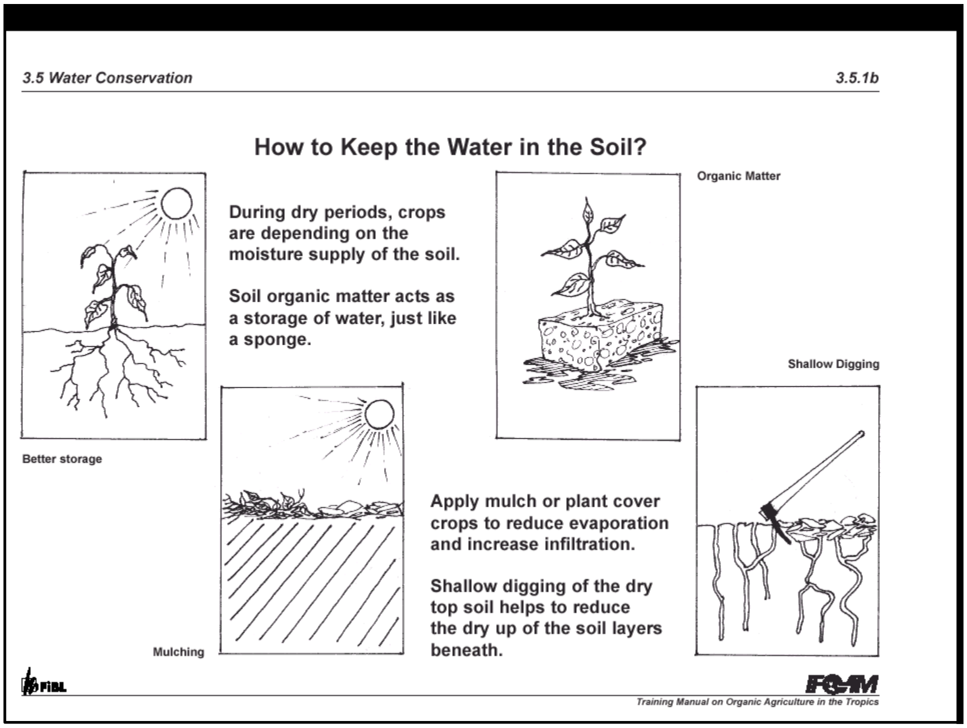
1.2.6.

Irrigation

Irrigation / water conservation

- The ability of a soil to absorb and store water largely depends on the soil composition and on the content of organic matter.
- A thin layer of mulch can considerably reduce the evaporation of water from the soil.
- Shallow digging of the dry top soil can help to reduce the drying up of the soil layers beneath.
- To achieving a high infiltration it is important to maintain a topsoil with a good soil structure containing many cavities and pores.

1.3.1.



Irrigation negative impacts

- Excessive irrigation in dry or semi-arid areas can cause salinity of the soil, which in the worst case can make the soil unsuitable for agriculture.
- Intense irrigation can cause soil erosion.
- Irrigation by sprinkling or flooding can harm the structure of the topsoil. The crumb structure of the soil may get destroyed and soil particles may accumulate in the pores, resulting in the formation of a hard crust.
- Improper irrigation may cause stress to the crops, making them more vulnerable to pests and diseases. Application of irrigation water during the hot period of the day can cause a shock to plants.

1.3.1.

Saffron and Irrigation

- Saffron is an ideal plant for semi-arid regions with water limitation because its corms have a 5-month dormancy period without irrigation requirement, which starts from early May when spring rainfalls are almost finished.
- Once out of dormancy, saffron have to be irrigated.
- Irrigations starts form mid-October tot early November.
- Growth of saffron starts immediately after the first irrigation and flowering is the first stage of growth.

1.3.1.

Timing of irrigation is crucial

Four irrigations should be enough to harvest a good saffron yield (in Afghanistan).

1. The first irrigation (mid October to early November) is required to start the growth and facilitation of flowering. If scheduled at a proper time, flowers will appear immediately after irrigation and vegetative growth will start later.
2. The second irrigation is delayed until flowers are harvested and leaves appear. Normally this is about a month after the first irrigation.

1.3.1.

Timing of irrigation is crucial

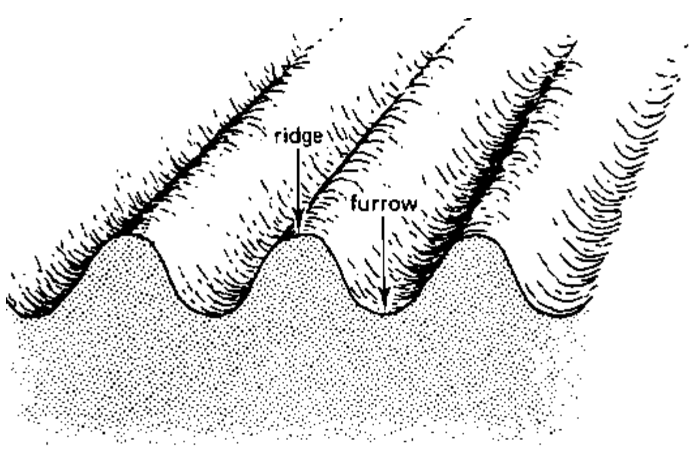
3. The best time for the third irrigation is after weeding and manuring.
4. The last irrigation should be scheduled by the end of the growing season (usually May).

Summer irrigation has positive effects on saffron yield.

It is not recommended because of the high risk of fungal diseases.

1.3.1.

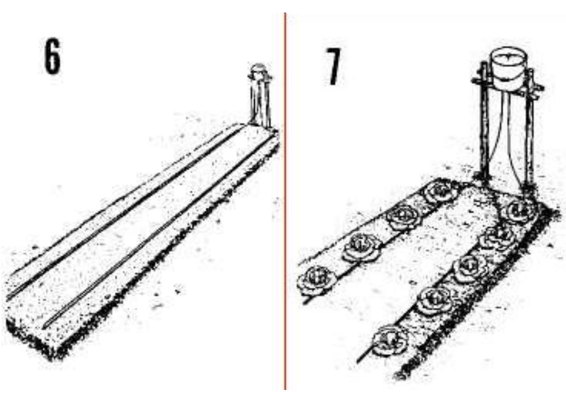
Ridge tillage is compatible with furrow irrigation



1.3.1.

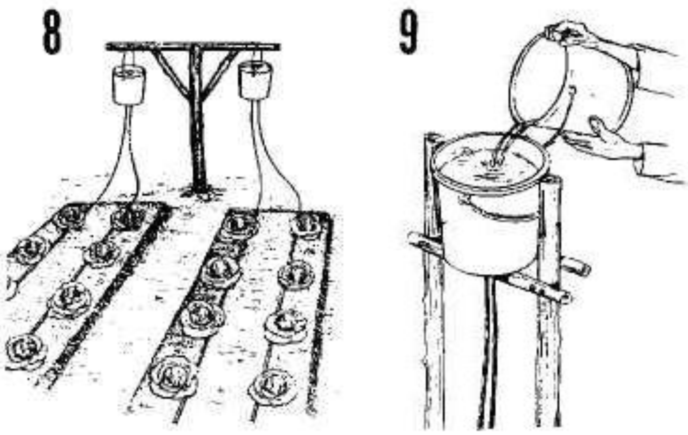
1.3.1.

Small scale drip irrigation



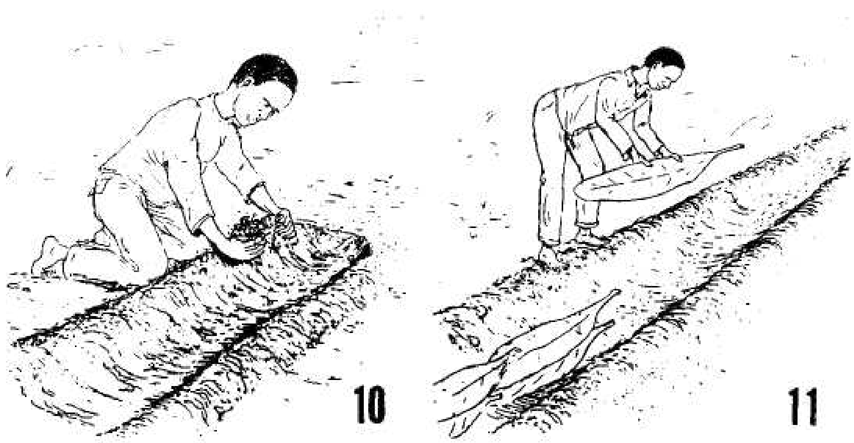
1.3.1.

Small scale drip irrigation



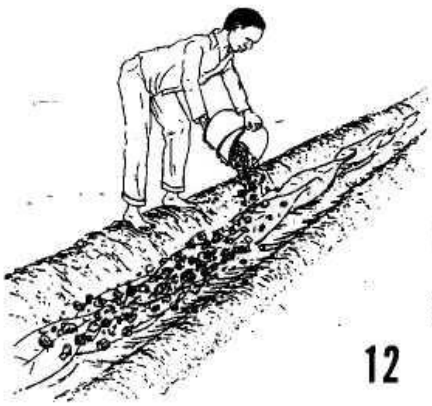
1.3.1.

Preparing raised beds with crop residues / compost (1)



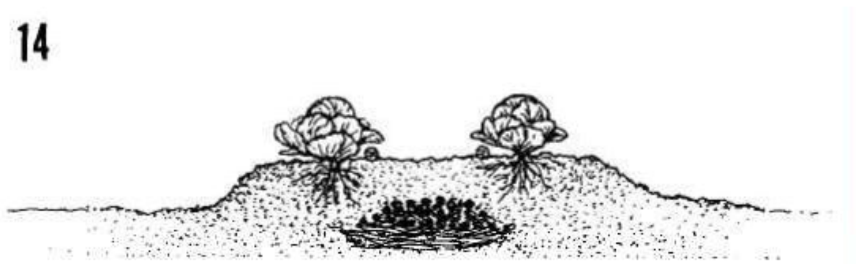
1.3.1.

Preparing raised beds with crop residues / compost (2)



1.3.1.

Cross section raised bed



1.3.1.

Improved capture and use of rainfall in dryland farming

(FAO 1995)

1.3.2.

Increase rainwater use

- Increase time for infiltration
- Prevent erosion
- Cover soil
- Increase infiltration
- Increase water storage

1.3.2.

DETAIN WATER ON THE SURFACE TO INCREASE THE TIME FOR INFILTRATION

Rough-surface tillage on contour
Ridge-and-furrow on contours, with or without cross-ties
Backslope or level bench terraces
Planting on contour
Contour strips of vegetation (eg. vetiver grass to spread and slow runoff and promote infiltration)

1.3.2.

PREVENT SPLASH EROSION AND LOSS OF SOIL DEPTH DUE TO RILLING AND GULLYING

Increased live cover by crop plants;
increased dead covers
Conservation banks on gradient;
waterways;
dams to store unavoidable runoff

1.3.2.

COVER SOIL AND/OR REDUCE DIRECT EVAPORATION FROM SURFACE

Shade (natural or artificial) above soil surface
Scarified "dust mulch"
Crop residues retained on surface
Prevention of the burning or removal of residues
Minimise burial of residues : use of tines rather than discs for tillage
Addition of organic materials, mulches etc.
Non-inversion of topsoil

1.3.2.

INCREASE SOIL CAPACITIES FOR INFILTRATION AND PERCOLATION

Reduced and minimum tillage on contour with vertical tines or horizontal blades
No-till systems without or with organic residues, mulches, subsoiling on contour
Scarification or subsoiling on contour to break crust and compacted surface and subsurface layers
Minimise severity and frequency of current tillage and other compacting or pulverising practices
Plant aggressive-rooted crops (In rotation?)
Fencing for animal control

1.3.2.

INCREASE SOIL'S CAPACITY FOR MOISTURE STORAGE

Tillage, deep ripping or scarification on contour to crack hard layers and make large voids
Broadcast or increase amounts of organic materials, to increase structural aggregates' size and stability
Improve environment for meso- and micro-organisms and organic matter formation
Change proportions of sand:silt:clay:organic matter by deep inversion (ploughing), or import of new materials
Add to soil depth from above with soil and/or organic materials
Plant aggressive-rooted crops, grasses (rotation?)
Add hydro-gels at planting positions

1.3.2.

Erosion Control

The removal of top soil with the nutrients

1.3.3.

Agents of Erosion

- Wind
  - Blows away top soil
- Water
  - Washes away top soil and in extremes causes landslides
- Animals
  - Reduces vegetation creates potential for water and wind erosion
- Humans
  - Removes vegetation creates potential for water and wind erosion
  - Poor methods of cultivation creates potential for erosion.

1.3.3.

Poor Methods of Cultivation

- Bush burning
- Deforestation
- Poor Cultivating

1.3.3.

Fire control

- Avoiding bush burning unnecessarily
  - It removes useful rooting systems
  - It removes potential wind breaks
  - Removes potential sources of nutrients and mulching materials
  - Kills predators
  - Burning destroys micro organisms in the soil
  - Eposes top soil to sunlight and drying
  - Poor water retention

1.3.3.

Deforestation

- Removes deep rooting systems holding the land
- Prevents recycling of nutrients
- Removes wind breaks
- Exposes soils to sunlight (plants stop growing in high soil temperatures)
- Increases water losses through evaporation
- Destroys natural habitats thus reducing bio diversity
- Promotes environmental degradation
  – Global warming, change of seasons, flooding

1.3.3.

Poor Cultivation

- Ploughing down the slopes
- Cultivating on steep slopes with no protective measures which leads to landslides
- Over cultivation creating fine soils that are easily washed or blown away
- Mulching materials placed badly on slopes increases water run off.

1.3.3.

Trees as a methods of control

- Forestation and reforestation
  - Planting trees across the slopes and at the top of slopes
- Cutting trees unnecessarily should be avoided
- Planting trees in areas prone to water run off (gully erosion)
- Planting the right types trees at the appropriate sites

1.3.3.

Method of cultivation for control

- Ploughing along contours
- Round weeding
- Intercropping
  - Cover crops
  - Strip cropping
- Do not over-cultivate and don’t make soils fine
- Maintain organic material in soil to hold soil together
- Bury weeds in soil if no couch grass

1.3.3.

Contour Systems

- Cannels
- Bands
- Terracing

1.3.3.

Contour Cannels

- Suitable for gentle slopes
  - Used to retain water in the fields
  - Ditches dug along the contours reduces water and soil run off

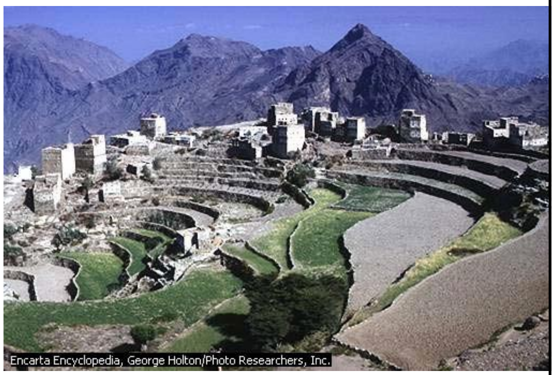
1.3.3.

Bands

- Lines of plants planted along the contours to slow down water run off.
  - Can be grasses, shrubs and trees
- These plants can also provide mulching materials and fix nitrogen
- Other materials for bands can be
  - Crop or weed trashes
  - Stones

Terraces

- Ground dug to make horizontal growing platforms



Making an “A” Frame

– Materials required
- Three poles 2.5 meters long (250cm)
- Three 2 inch nails
- Four meters of string
- A fist sized piece of rock
- Two pegs, 50cm long

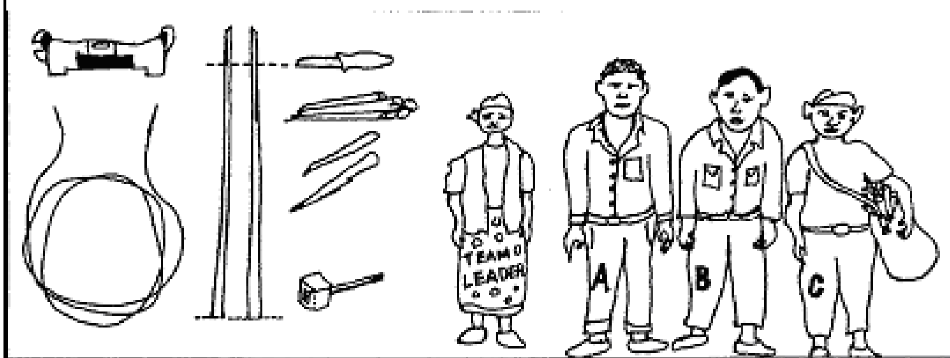
1.3.3.

Making an “A” Frame

Making an A-frame

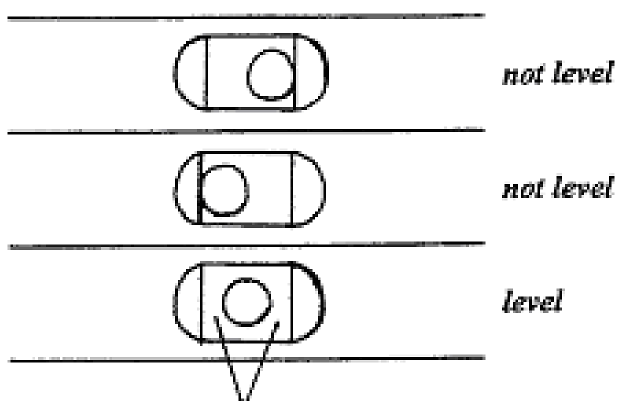
1.3.3.

Using the line level: tools



1.3.3.

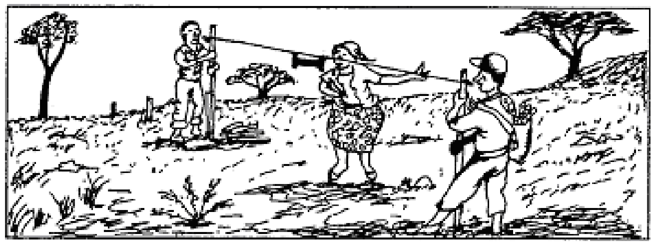
Line level: reading



1.3.3.

Reading line level in the field (1)

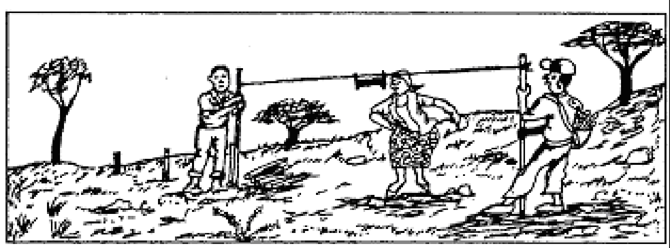
The bubble points to Mr. A.
The team leader says:
"up" to Mr. B.



1.3.3.

Reading line level in the field (2)

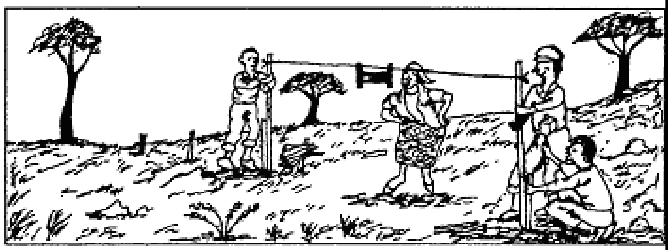
After Mr. B has moved up,
the bubble points to Mr. B.
Now, the team leader says:
"Down" to Mr. B.



1.3.3.

Reading line level in the field (3)

Mr. B. moves down slowly until the team leader says: "OK". The bubble is now perfectly centred and C inserts the peg

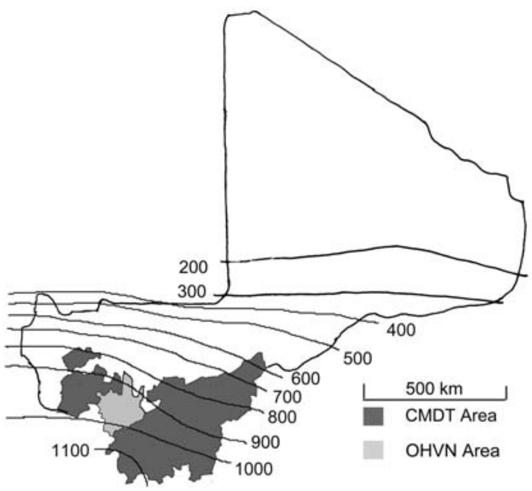


1.3.3.

Evaluation of 20 years SWC in southern Mali

1.3.4.

Southern Mali



1.3.4.

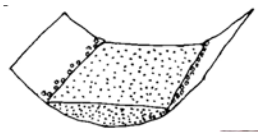
Sheet erosion

1.3.4.

Gully erosion

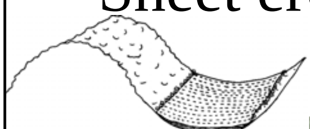
1.3.4.

Sheet erosion: coarse sand sediment



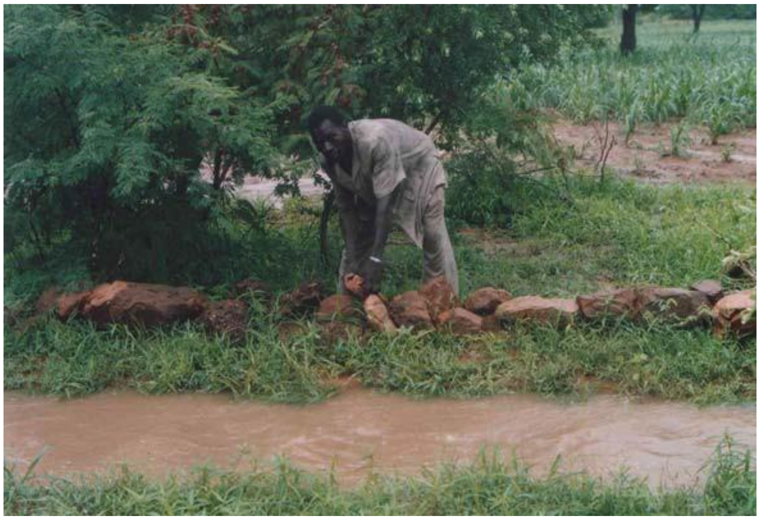
1.3.4.

Sheet erosion: loam sediment



1.3.4.

Stone Rows



1.3.4.

Stone barrier

1.3.4.

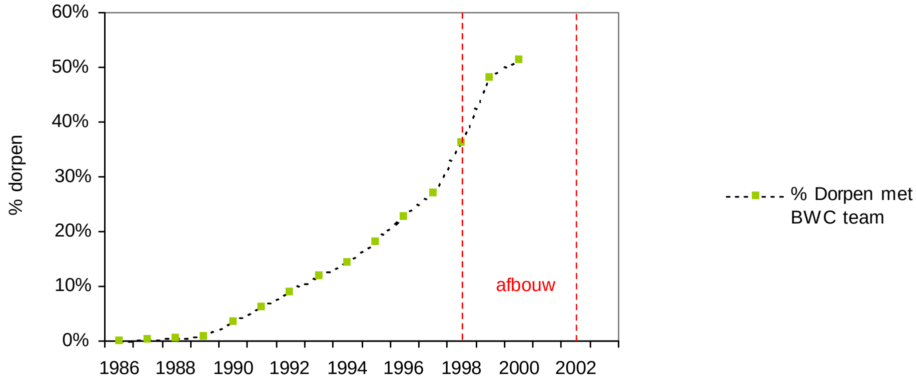
Live fences

1.3.4.

Live fences: *Euphorbia* cuttings

1.3.4.

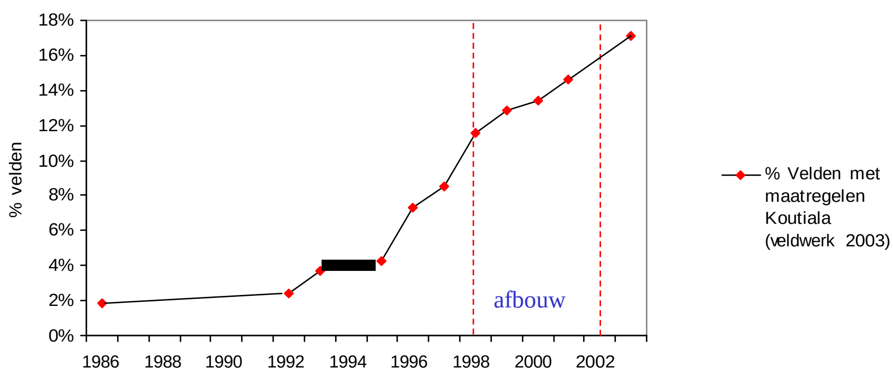
Project results: training of farmers



•Through national extension service >2500 villages targeted

1.3.4.

Project effects: farmers apply SWC



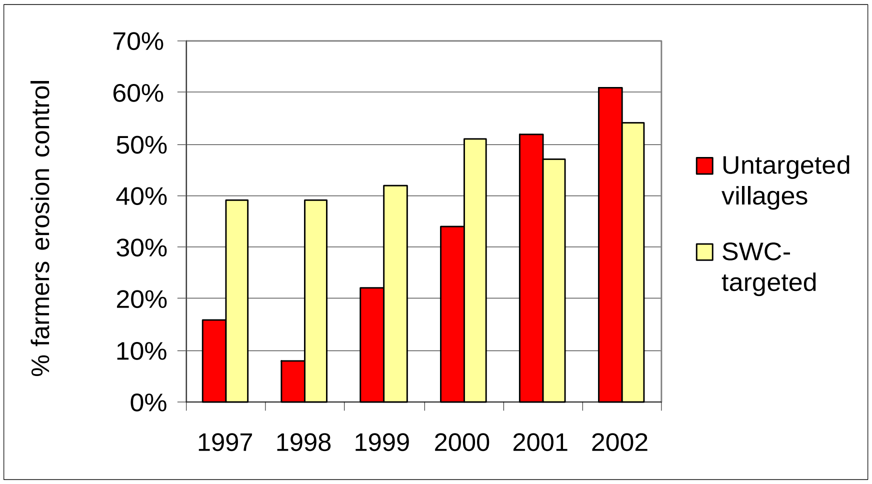
Project sustainability:

•Farmers continue to install

•Also in un-targeted villages

1.3.4.

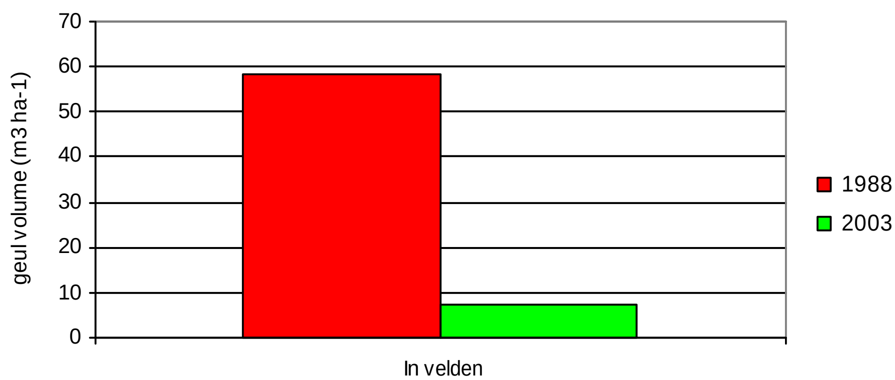
Evaluating effectiveness of SWC team



1.3.4.

Project impact: reducing erosion (1)

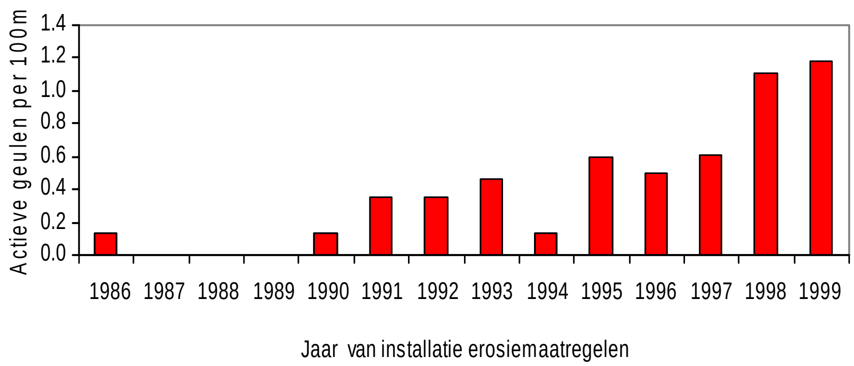
Kaniko village: gully map 1988 and 2003



1.3.4.

Project impact: reduced erosion (2)

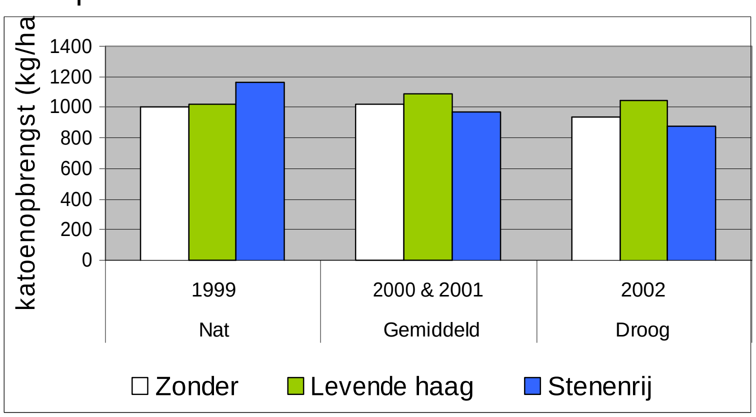
Virtual time series



1.3.4.

Project impact: crop yield (1)

Comparison with and without SWC

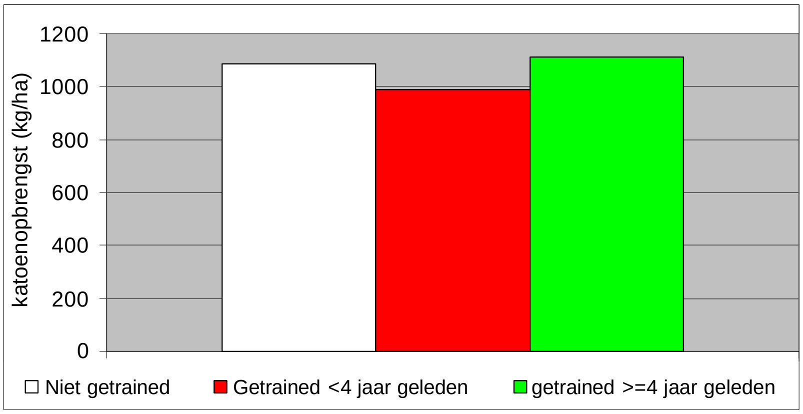


With erosion control: +4,8% (underestimation)

1.3.4.

Project impact: increased crop yield (2)

Comparison ‘old’ with ‘new’ project villages



Old SWC villages: +12,5%

1.3.4.

Project efficiency: project costs en farmer benefits

Estimated annual project costs:	Euro 600.000

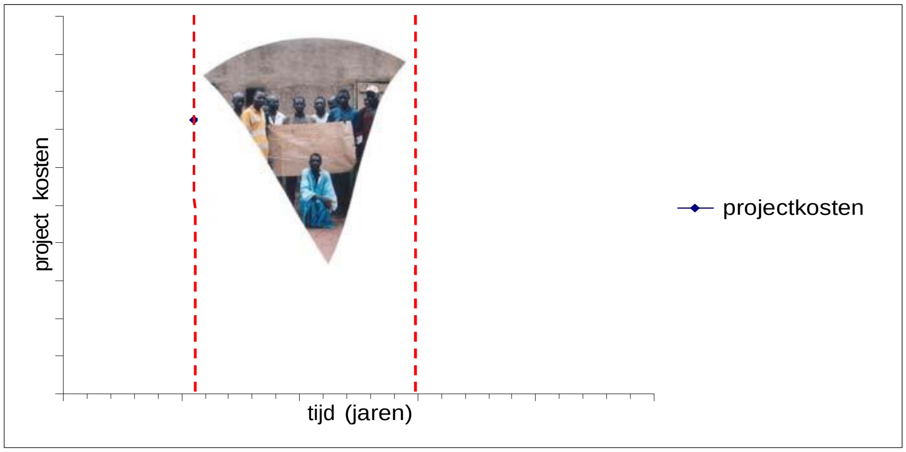
Estimated annual benefits: farmer income from cotton:

•Low estimate (+4.5%)	Euro 1.200.000
•Hight estimate (+12.5%)	Euro 7.500.000

1.3.4.

Delayed impact after temporary project

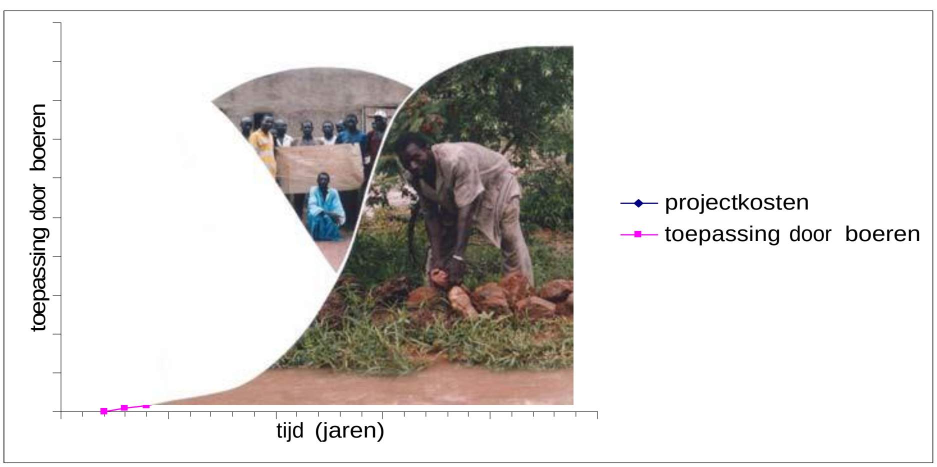
1. Temporary project



1.3.4.

Vertraagde impact na tijdelijk project

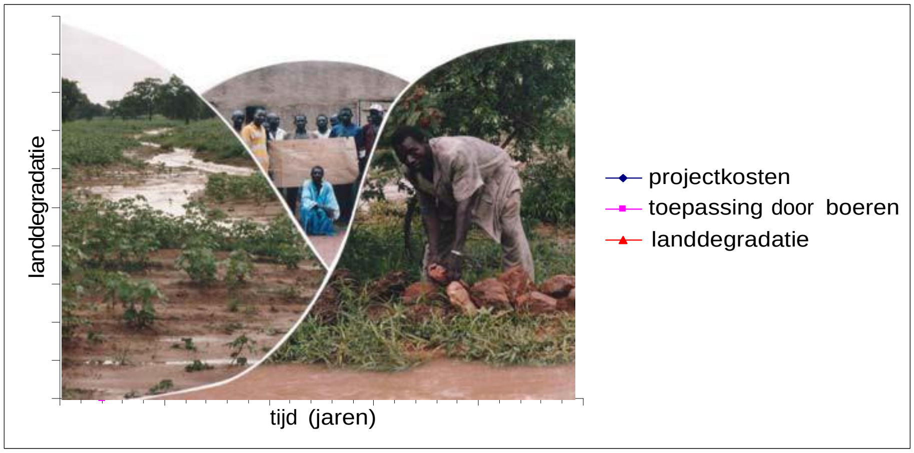
2. Gradual adoption by farmers



1.3.4.

Geleidelijke afname van land degradatie

3. Gradual decrease land degradation



1.3.4.

Compost pits

1.3.4.

Water harvesting

(FAO 1991)

1.3.5.

Water harvesting structures

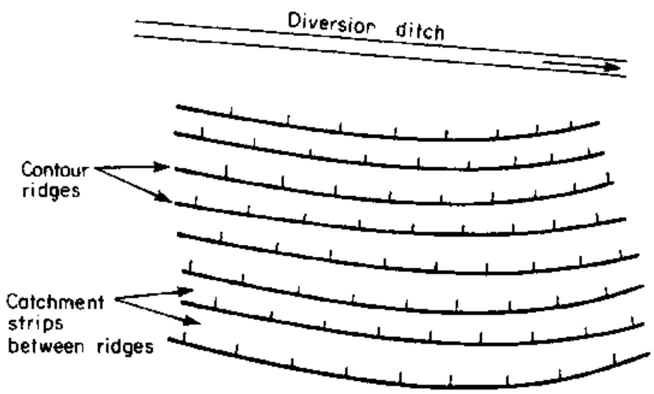
- Earth structures:
  - Contour ridges
  - Trapezoidal bunds
  - Water spreading bunds
- Stone structures
  - Contour stone bunds
  - Permeable rock dams

1.3.5.

Contour ridges

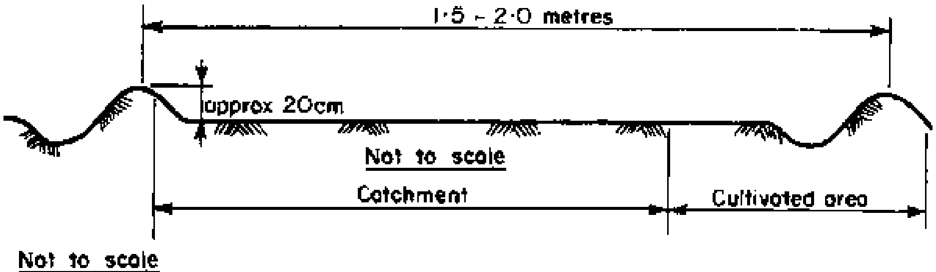
<5% slope; 350-750 mm rainfall

Lay out contour ridges



1.3.5.

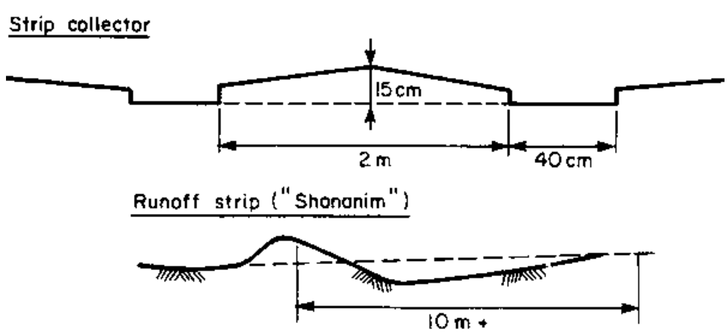
Cross section contour ridges



1.3.5.

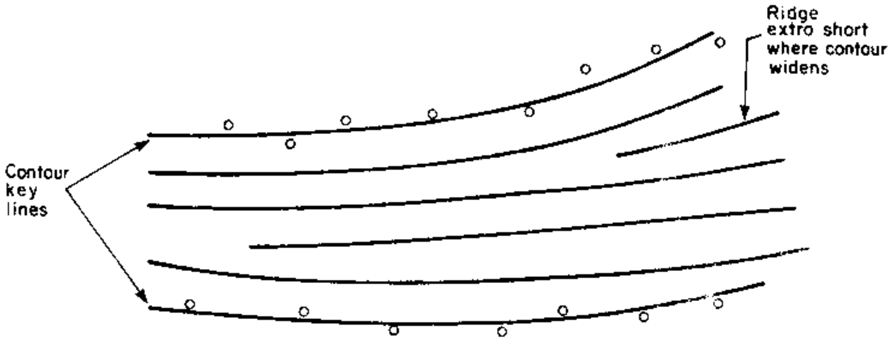
Cross section contour ridges

(variations)



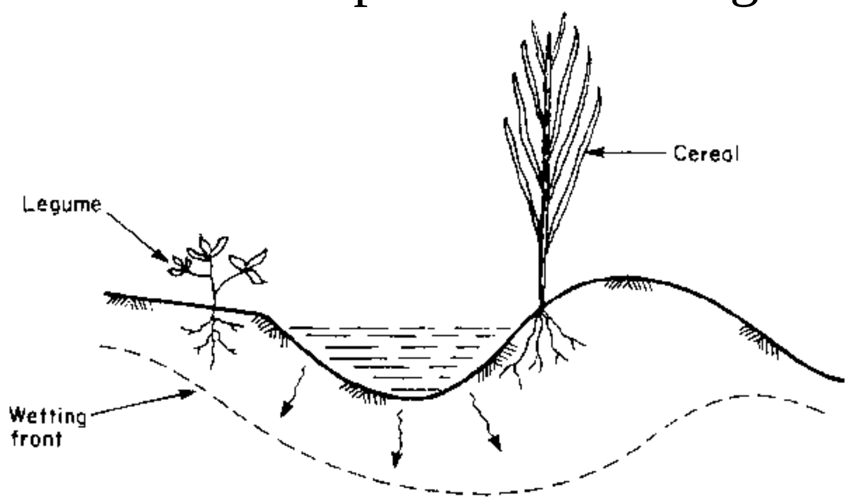
1.3.5.

Lay-out non parallel marker ridges



1.3.5.

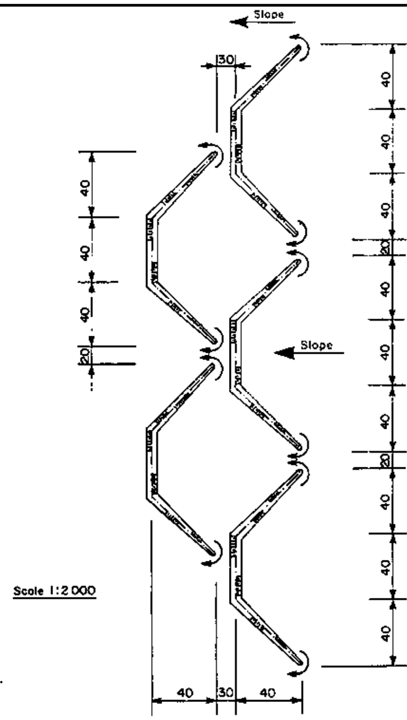
Position crop on contour ridge



1.3.5.

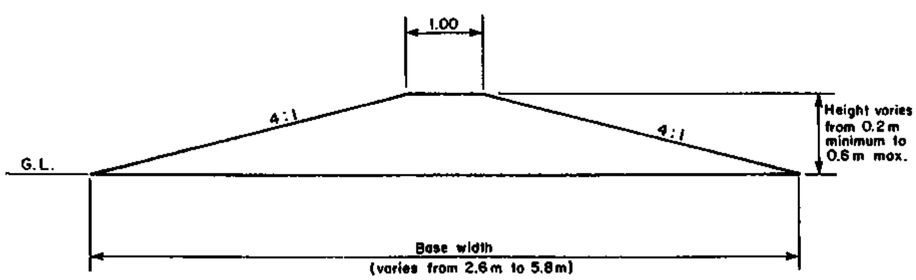
Trapezoidal bunds

(<1.5% slope; 250-500 mm rainfall)



1.

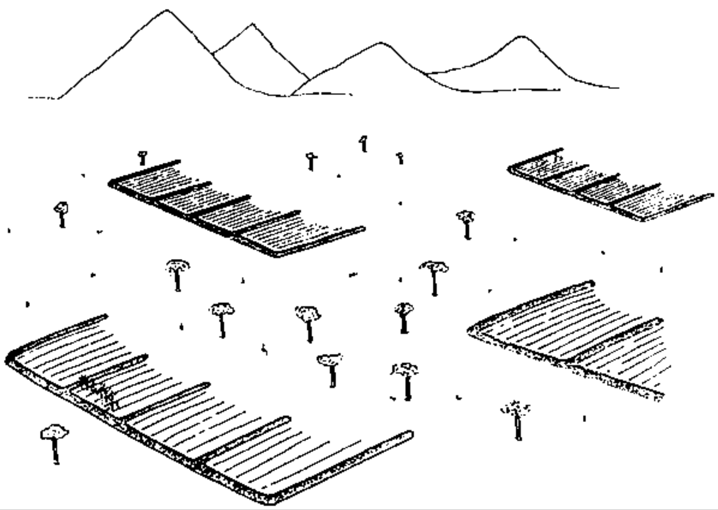
Cross section trapezoidal bund



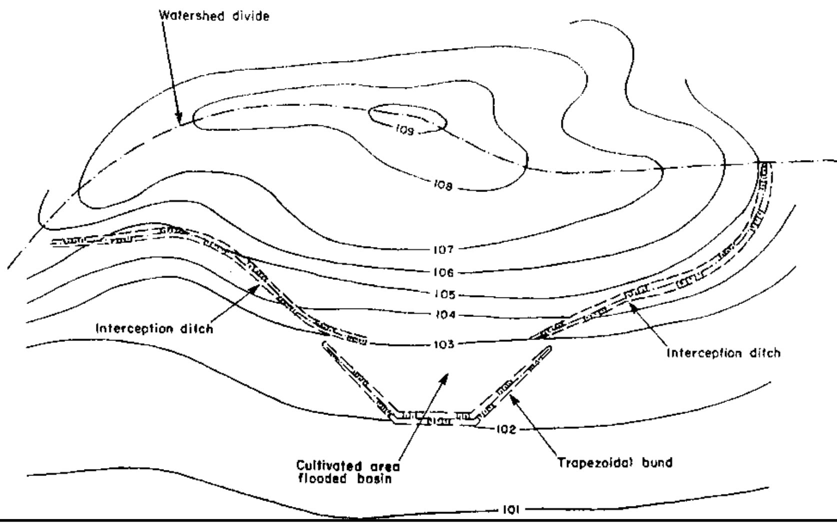
1.3.5.

Trapezoidal bund

example Somalia

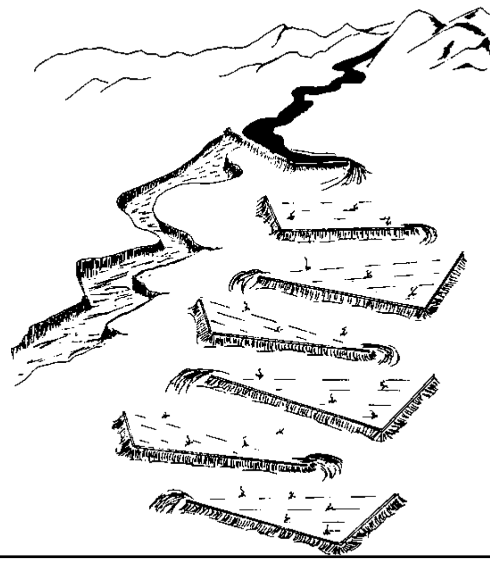


Trapezoidal bund and interception ditches



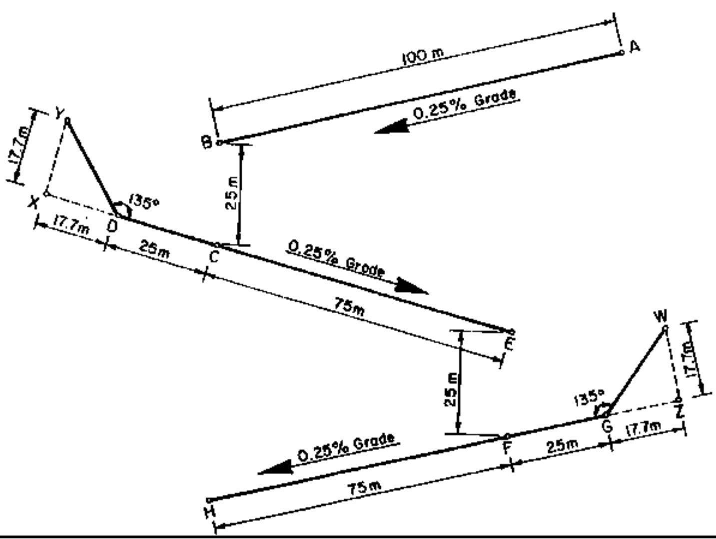
Water spreading bunds

<1% slope; 100-350 mm rainfall



Water spreading bunds

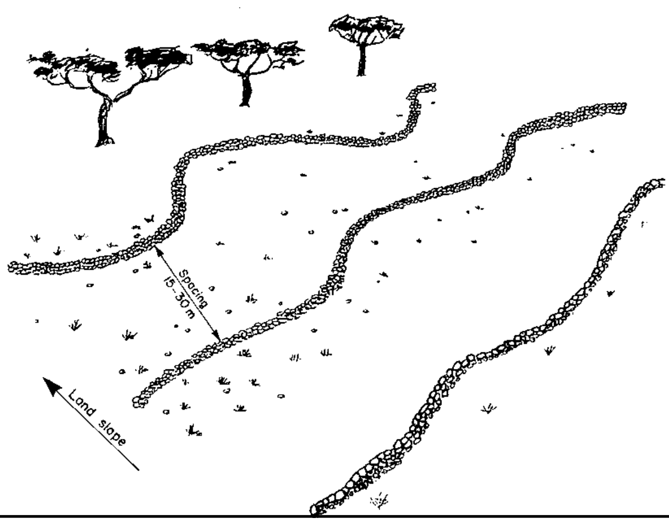
layout (slopes 0.5-1.0%)



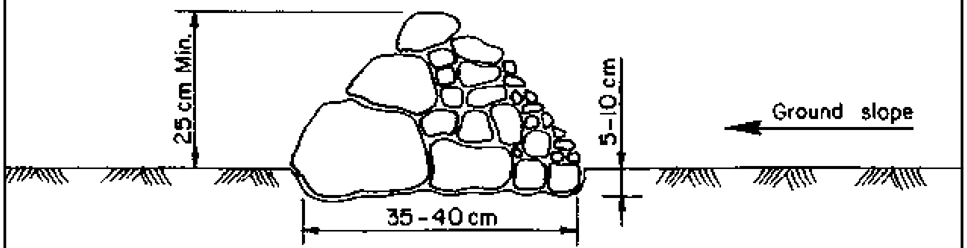
Contour stone bund

<2% slope; 200-750 mm rainfall

Lay out contour stone bunds

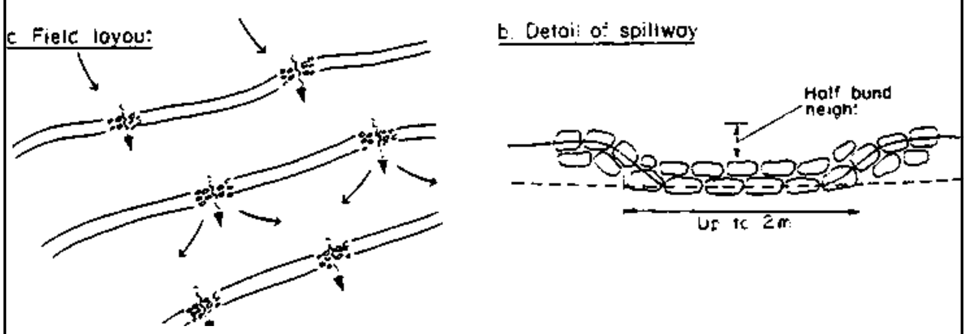


Cross section contour stone bund



1.3.5.

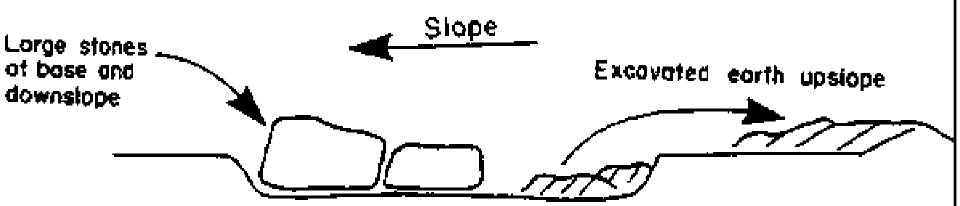
Contour stone bund with spill way



1.3.5.

Contour stone bund under construction

Construction contour stone bund

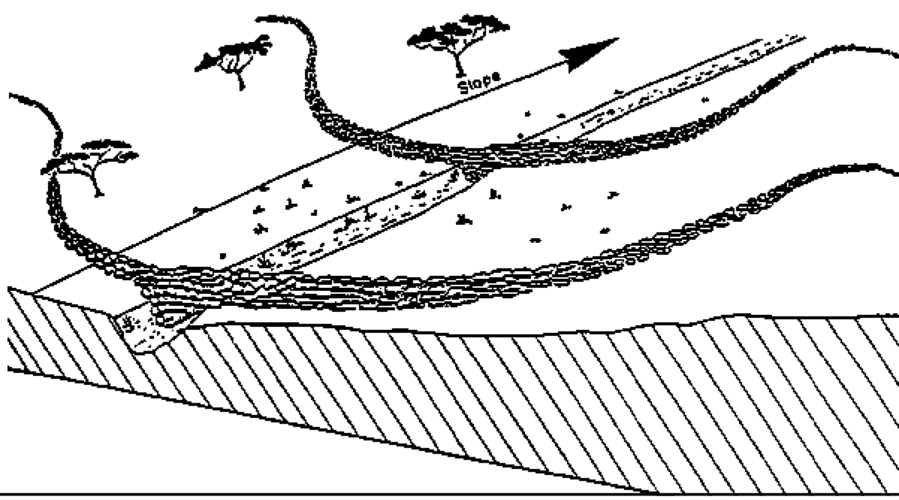


1.3.5.

“Zai” Fertilised planting holes

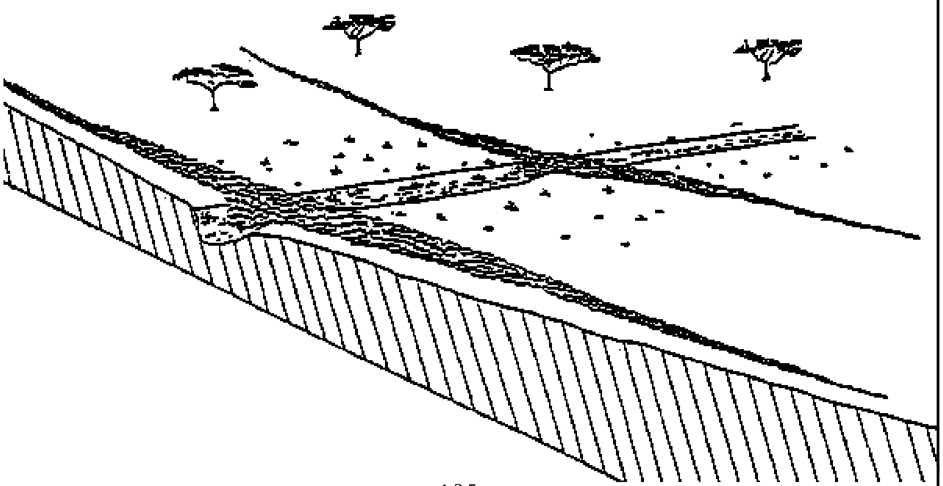
Permeable rock dams

lay out (on contour)Slope<2%; 200-750 mm rainfall



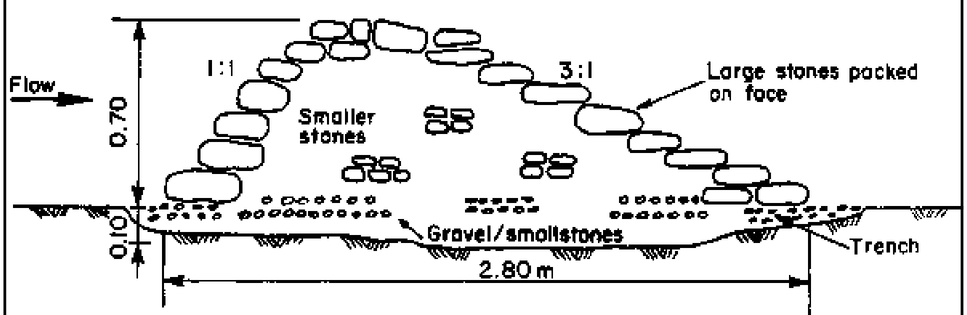
Permeable rock dam

Alternative lay out, straight



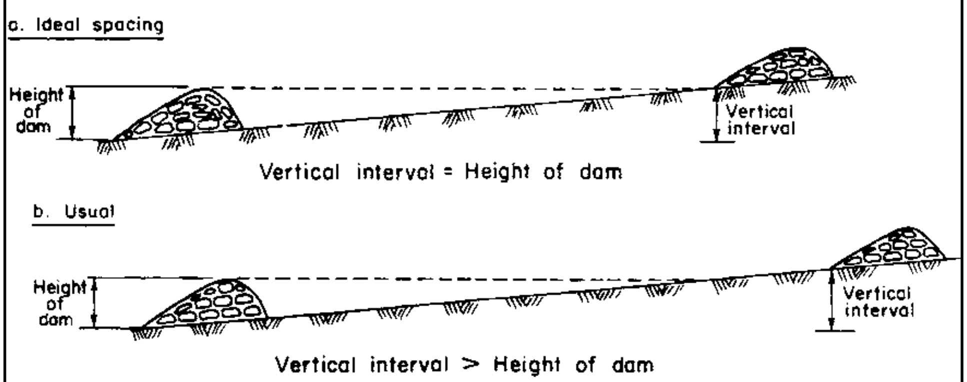
1.3.5.

Cross section permeable rock dam



1.3.5.

Distance permeable rock dams



1.3.5.

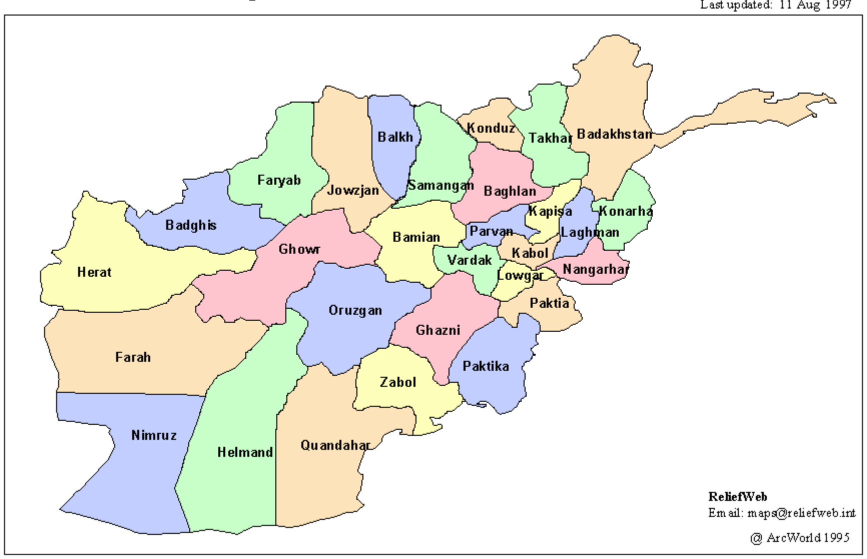
Land degradation in Afghanistan

(maps FAO)

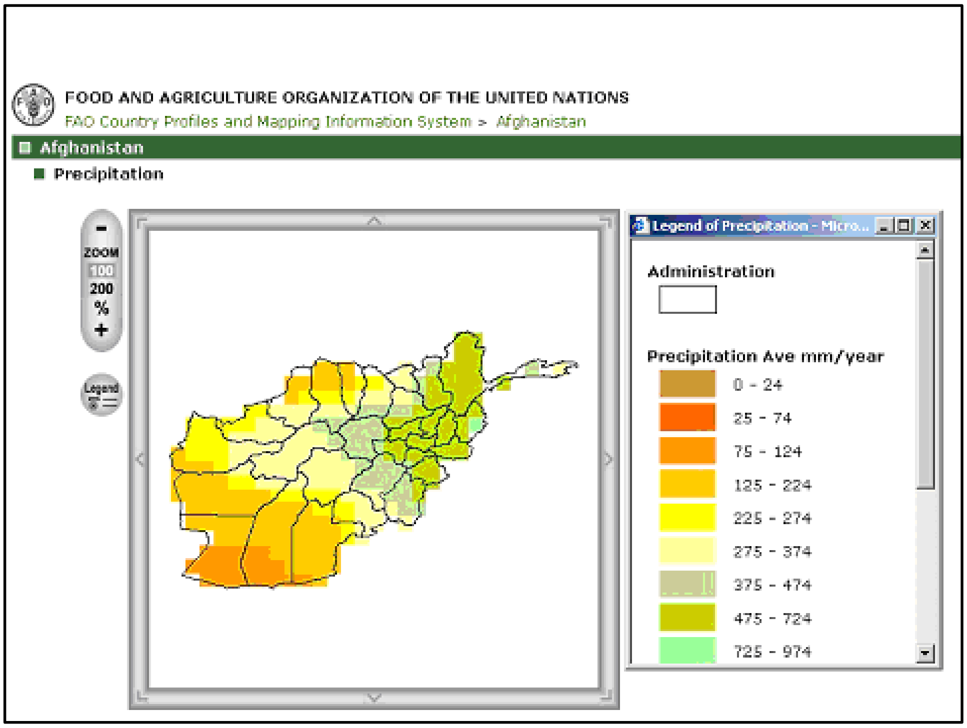
1.3.6.

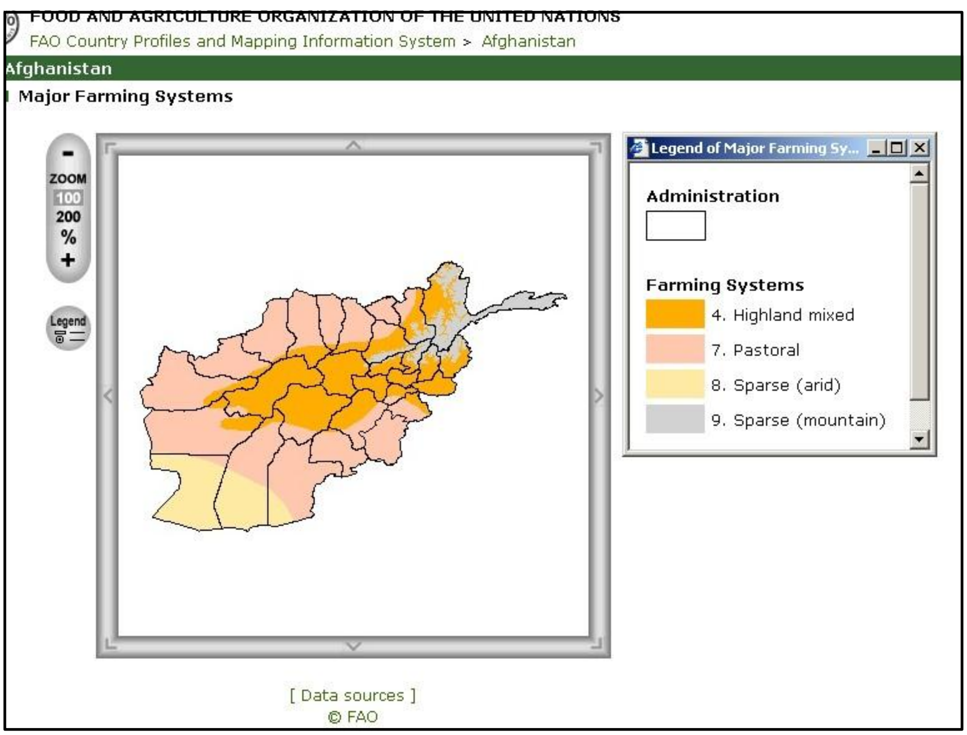
Afghanistan: Provinces

Last updated: 11 Aug 1997

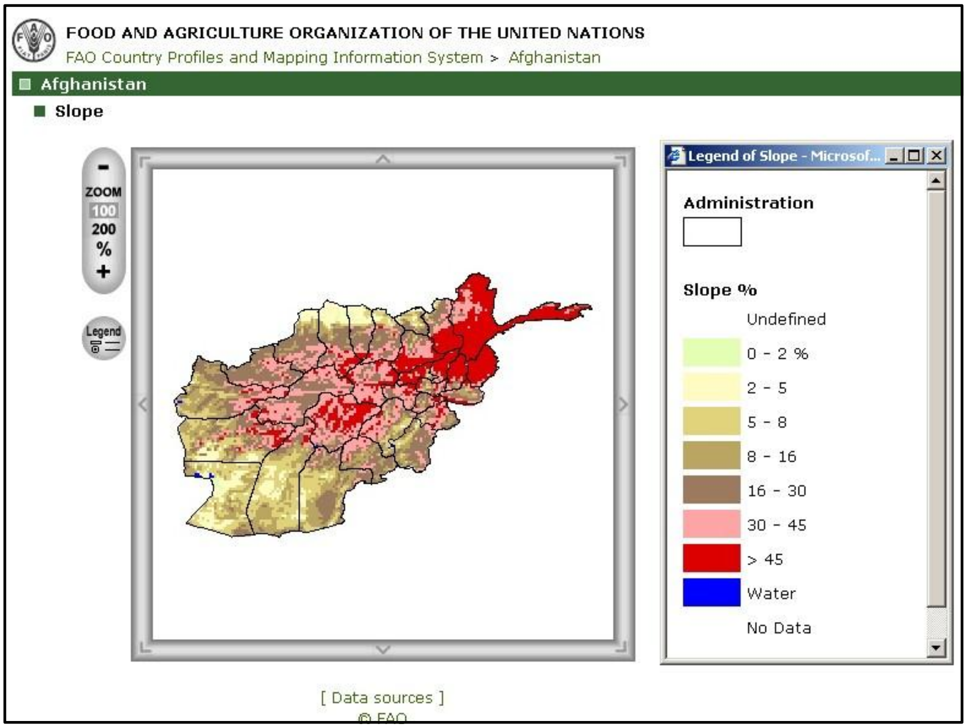


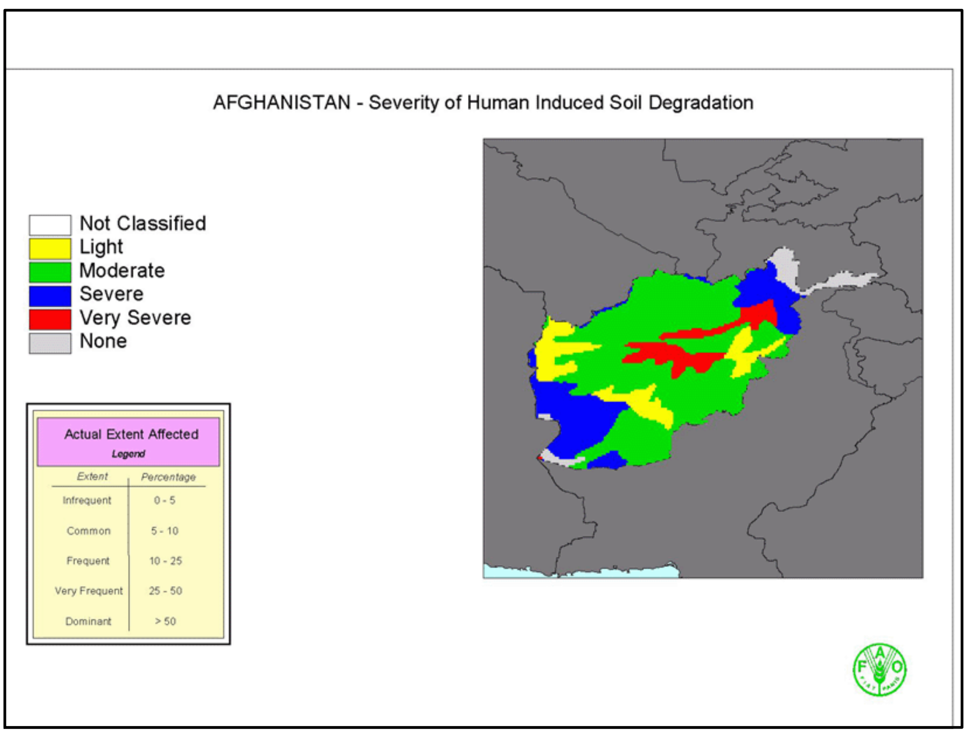
The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations or ReliefWeb. These maps may be freely distributed. If more current information is available, please update the maps and return them to ReliefWeb for posting.


FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
FAO Country Profiles and Mapping Information System > Afghanistan
Afghanistan
Precipitation
ZOOM
100
200
%
Legend
Legend of Precipitation - Micro...
Administration
Precipitation Ave mm/year
0 - 24
25 - 74
75 - 124
125 - 224
225 - 274
275 - 374
375 - 474
475 - 724
725 - 974


FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
FAO Country Profiles and Mapping Information System > Afghanistan
Afghanistan
Major Farming Systems
ZOOM
100
200
%
Legend
Legend of Major Farming Sy...
Administration
Farming Systems
4. Highland mixed
7. Pastoral
8. Sparse (arid)
9. Sparse (mountain)
[Data sources]
© FAO

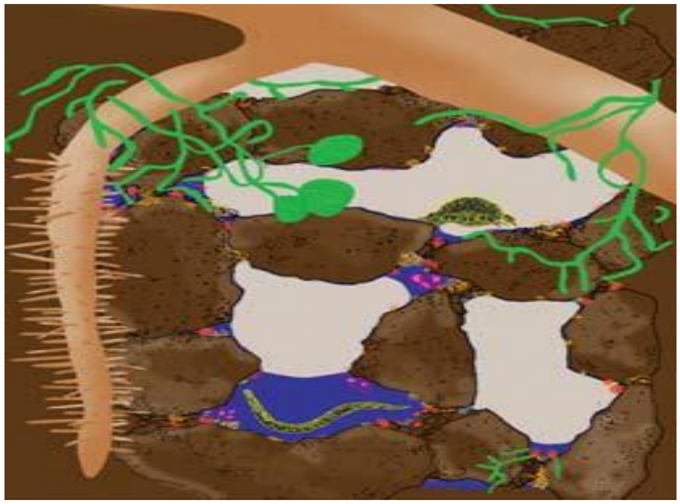
1.3.6.


FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
FAO Country Profiles and Mapping Information System > Afghanistan
Afghanistan
Slope
ZOOM
100
200
%
Legend
Legend of Slope - Microsof...
Administration
Slope %
Undefined
0 - 2 %
2 - 5
5 - 8
8 - 16
16 - 30
30 - 45
> 45
Water
No Data
[Data sources]
© FAO


AFGHANISTAN - Severity of Human Induced Soil Degradation
Not Classified
Light
Moderate
Severe
Very Severe
None
Actual Extent Affected
Legend
Extent | Percentage
Infrequent | 0 - 5
Common | 5 - 10
Frequent | 10 - 25
Very Frequent | 25 - 50
Dominant | > 50

1.3.6.

Soil Fertility



Soil Fertility

- The fertility of the soil is the central focus in organic farming
- Feeding the crop means feeding the soil
- Only a fertile soil can yield healthy crops
- The soil is the most important resource of every farm

1.4.1.

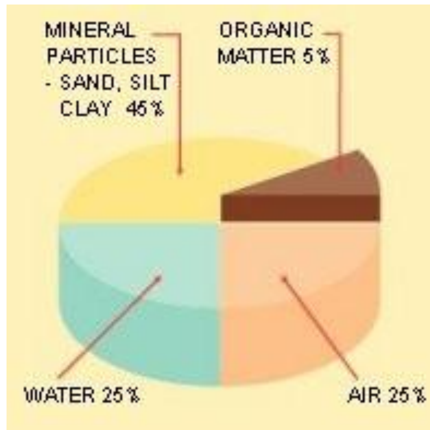
Soil Fertility

Soil consists of:

-mineral particles

-organic matter

-pores (filled with air of water)



1.4.1.

Mineral particles

- Originate from subsoil and rock, which gets crushed to smaller and smaller pieces through physical and chemical weathering processes.
- The mineral soil particles are divided into four groups according to their size:

  -Gravel and stones: particles larger than 2 millimetres

  -Sand: particles from 0.05 to 2 millimetres; they can be felt between the fingers

  -Silt: particles from 0.002 to 0.05 millimetres

  -Clay: particles smaller than 0.002 millimetres

1.4.1.

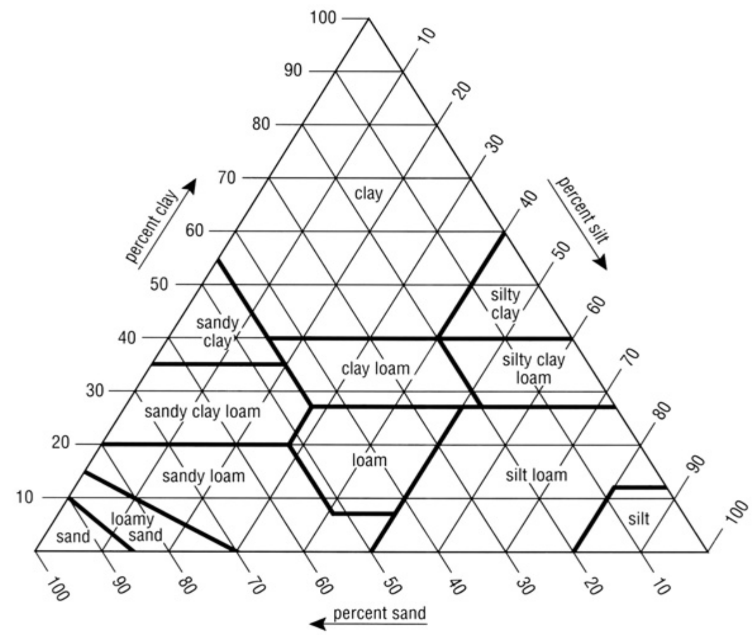


Chart showing the percentages of clay, silt, and sand in the basic textural classes.

Mineral particles

Loamy soil (in Afghanistan):

-<u>Loam</u> is a textural class name that is often misused.

-<u>Loam</u> has a specific range of sand, silt and clay.

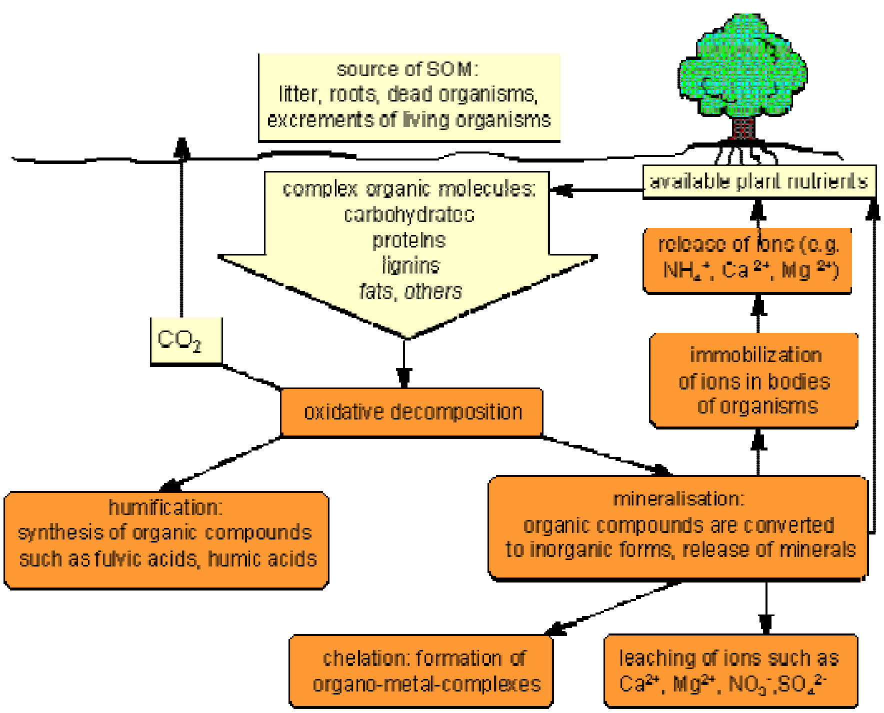
-Loam may have 7% to 27% clay, 28% to 50% silt, and 23% to 52% clay.

1.4.1.

Soil organic matter (or humus)

- Results from decomposition of biomass
- Mostly a few percent organic matter of the total solid material is humus
- Tremendous importance for the soil fertility en structure
- Mainly present in the top layer of the soil
- The active part of soil organic matter can be further decomposed by soil organisms
- The resulting structures can recombine themselves to form very stable humus structures, which can remain in the soil for many years

1.4.1.



Pores (tiny hollows)

- Minute pores filled with air of water.
- The spatial arrangement of particles and pores is summarized as "soil structure".
- Small pores are good in preserving moisture while de larger ones allow a fast infiltration of rain or irrigation water, but also help to drain the soil and ensure aeration.

1.4.1.

Soil structure

- In soils of good structure, mineral particles and soil organic matter form stable crumbles (aggregates).
- Organic matter works as a kind of glue, sticking together soil particles.
- This process is supported by soil organism such as earth worms, bacteria and fungus.
- The soil structure can be improved by supplying organic matter to the soil.
- It can also be ruined by wrong management (e.g. tilling the soil in wet conditions causes compaction).

1.4.1.

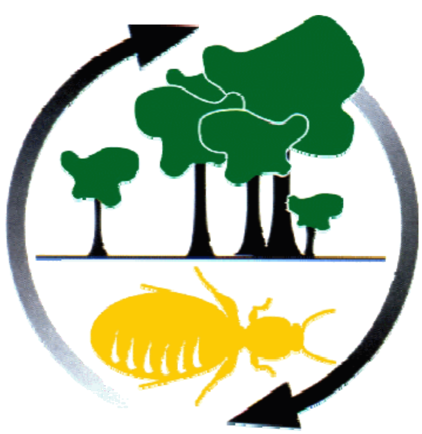
Micro-organism in soil

- Soil organisms are important because they:
  -help to decompose organic material and build up humus
  -mingle organic matter with soil particles and thus help to build stable crumbs
  -dig tunnels, which encourages deep rooting of plants and good aeration of the soil
  -help to release nutrients from mineral particles
  -control pest and disease organism affecting the roots of the crops
- Most soil organisms are very sensitive to changes in moisture and temperature.

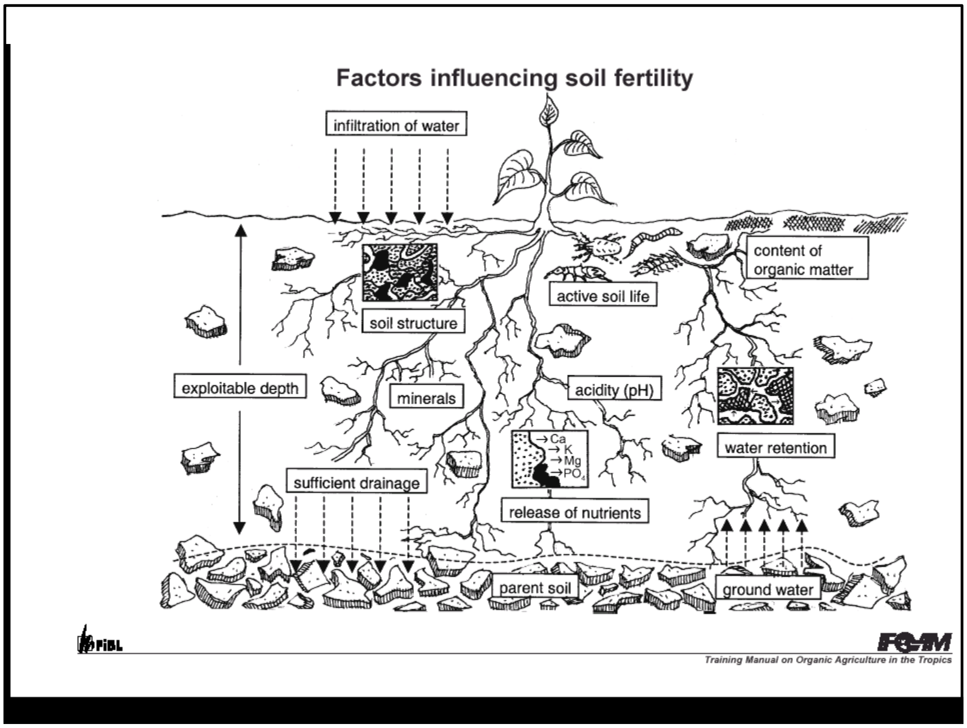
1.4.1.

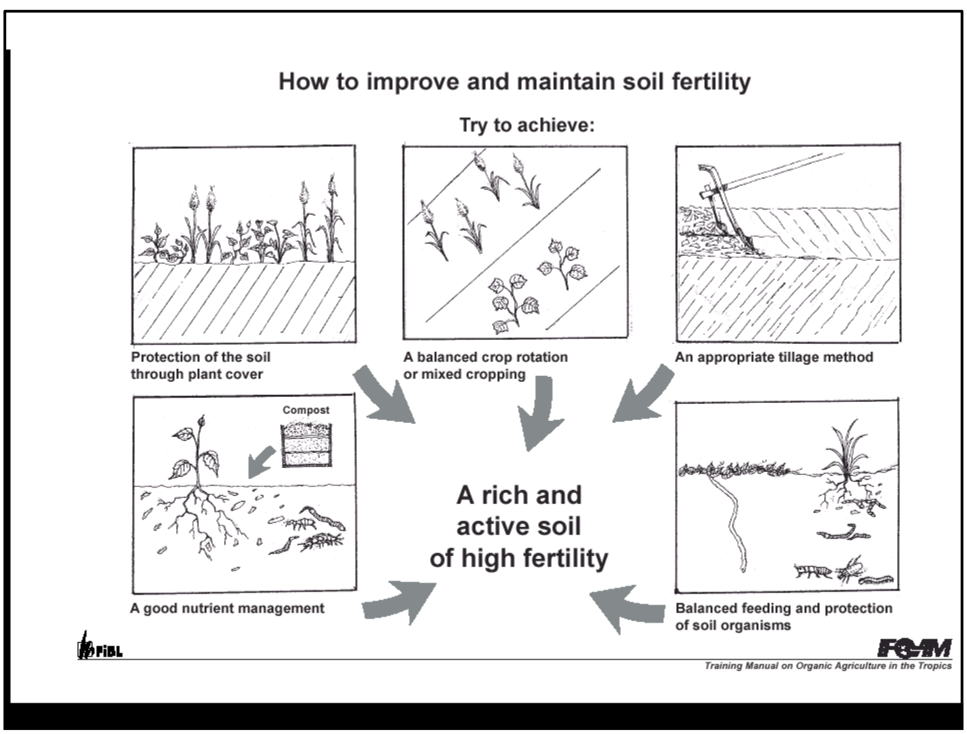
Micro-organism in soil

The greater the variety of species and the higher their number, the greater is the natural fertility of the soil.



1.4.1.


Factors influencing soil fertility
infiltration of water
content of organic matter
active soil life
soil structure
exploitable depth
minerals
acidity (pH)
water retention
sufficient drainage
→Ca
→K
→Mg
→PO4
release of nutrients
parent soil
ground water
FiBL
IFOAM
Training Manual on Organic Agriculture in the Tropics


How to improve and maintain soil fertility
Try to achieve:
Protection of the soil through plant cover
A balanced crop rotation or mixed cropping
An appropriate tillage method
Compost
A rich and active soil of high fertility
A good nutrient management
Balanced feeding and protection of soil organisms
FiBL
IFOAM
Training Manual on Organic Agriculture in the Tropics

1.4.1.

Plants roots need

-a loose soil structure

-sufficient nutrients

-adequate amounts of water

How to support root growth?

-applying compost or mulch

-deep tillage

-planting on bunds

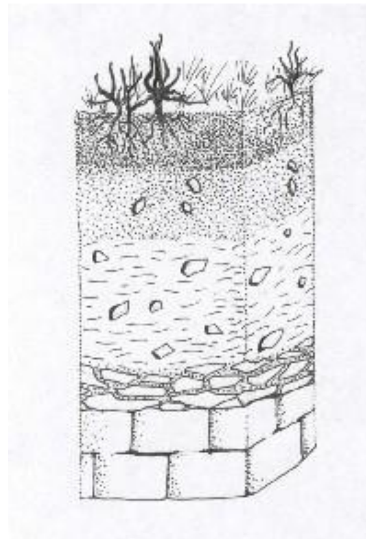
-trenches against water logging

Shallow root growth can be related to

-compaction

-acidity

-water logging



1.4.1.

How to improve the soil structure?

A good soil structure is important for:

- easy penetration of roots
- good aeration
- sufficient infiltration of water
- active soil life

To improve the soil structure you can:

- keep the soil covered to prevent splashing
- avoid tillage in wet conditions
- increase the organic matter content
- apply mulch or compost to feed soil organisms

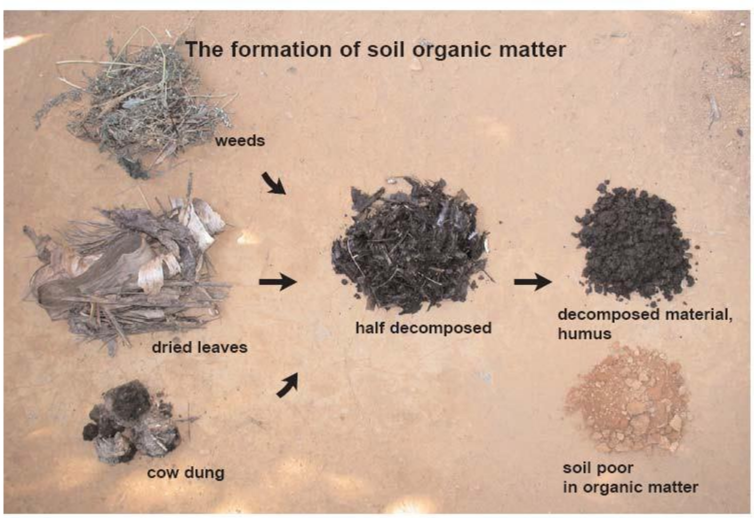
FiBL IFOAM

Training Manual on Organic Agriculture in the Tropics

The formation of soil organic matter

- Decomposed components are released again as nutrients or gases, and are available for new plant growth.
- These half rotten components join together to build up “soil organic matter”.

1.4.1.



1.4.1.

The formation of soil organic matter

- Not all material of plant or animal origin will decompose at the same speed:

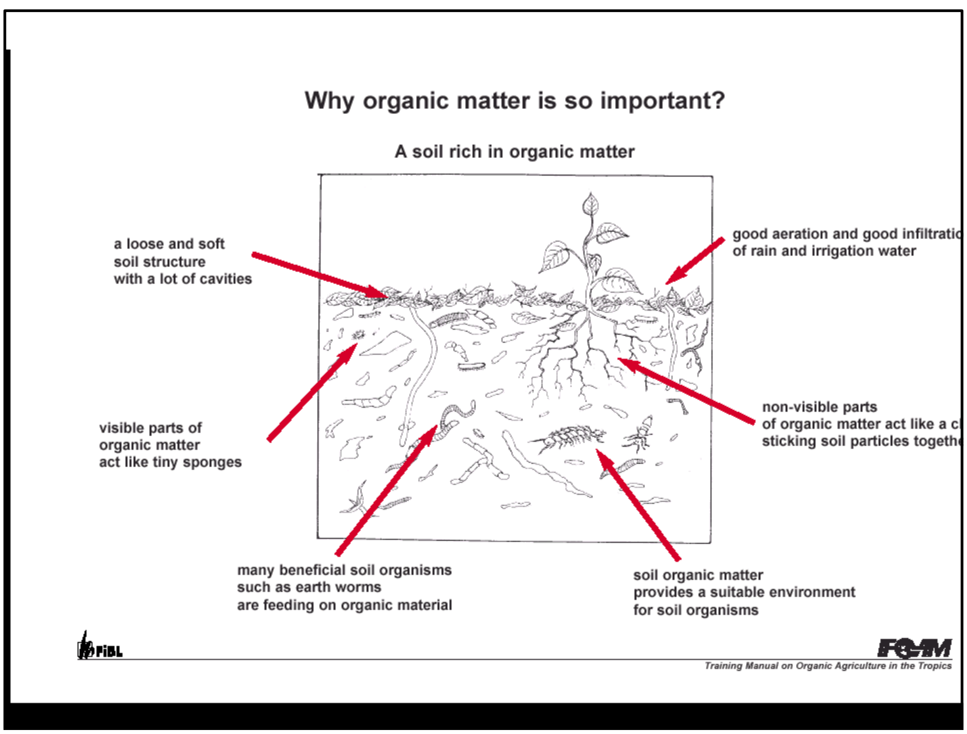
-The more nutritious the material is, the faster and the more completely it will be eaten up by soil organisms and microbes.

-The hardier the material is and the fewer nutrients it contains, the longer it will take to decompose.

-The speed of decomposition also depends on the soil humidity and the temperature.

-When decomposition is fast and complete, a lot of nutrients are released but less humus is built up.

1.4.1.



How to increase the amount of organic matter in the soil?

- leaving crop residues on the field
- applying compost; compost is already stabilized and will remain in the soil for a longer time than fresh plant material
- applying organic manures
- mulching with plant materials or agro-wastes
- Using green manures or cover crops
- suitable crop rotation
- reducing soil tillage

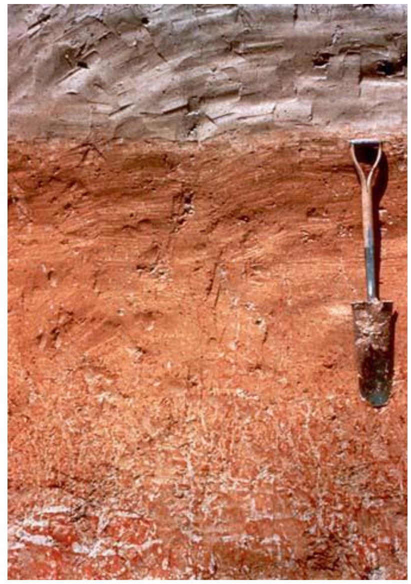
1.4.1.

Saffron soils

- Saffron can be grown in a wide range of soils, with moderate structure and good infiltration.
- Soils rich in calcium are recommended, because a deficiency of calcium carbonate in the soil may have a negative impact on the productivity of saffron.
- Calcium carbonate has been reported to facilitate availability of trace elements for saffron.

1.4.1.

Saffron cultivation:
Loamy soil
(Afghanistan)



Loamy soil:

- Salt affected and/or excessively calcareous soils
- Low soil organic carbon content
- Shortage of surface water
- Water scarcity leads to irrigation, soil degradation (compaction, salinization and water logging).

Soil Cultivation and Tillage

1.4.2.

Soil Cultivation and Tillage

Reasons for cultivating the soil :

- Loosen the soil to facilitate the penetration of plant roots.
- Improve the aeration (nitrogen and oxygen from the air).
- Encourage the activity of the soil organisms.
- Increase infiltration of water.
- Reduce evaporation.
- Destroy or control weeds and soil pests.
- Incorporate crop residues and manures into the soil.
- Prepare the site for seeds and seedlings.
- Repair soil compaction caused by previous activities.

1.4.2.

Advantages of tillage:

- Improves aeration
- Incorporates crop residues
- Facilitates root penetration
- Suppresses weeds

Advantages of zero-tillage:

- Improves soil structure
- Soil maintains organic matter
- Supports soil organisms
- Prevents soil erosion

1.4.2.

Soil Compaction Symptoms and Effects

- Air and water movement and storage in the soil are restricted, causing shortages to the plant.
- Roots do not develop and/or penetrate well in compacted soil.
- Plants are generally stunted, and moisture and nutrient stresses may occur.
- Crop growth and yield will probably be reduced.

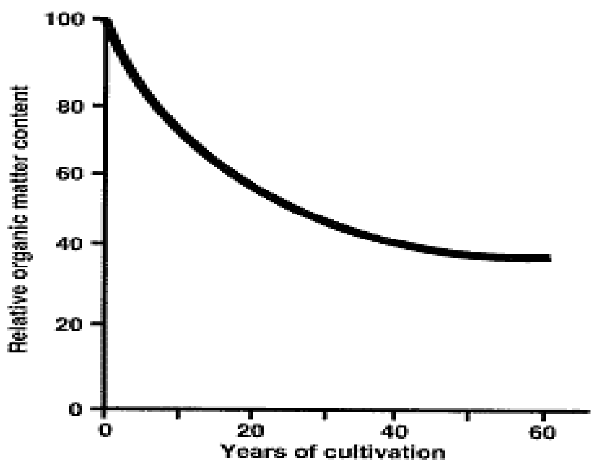
1.4.2.

Soil Compaction Symptoms and Effects

- Formation of large soil clods after tillage may indicate compacted soil.
- Shallowly compacted soil may form a crust after rainfall or irrigation owing to poor soil structure and reduced infiltration.
- Overworking (tilling) soil at the surface can destroy soil structure and increase crusting.
- New wet spots in field may indicate that a plough pan is forming and the compaction is inhibiting drainage.
- Standing water on the surface can indicate that the soil profile has inadequate pore space and therefore less water storage capacity.

1.4.2.

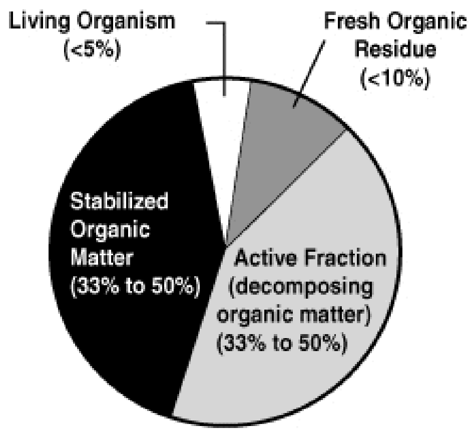
Change in soil organic matter content with cultivation



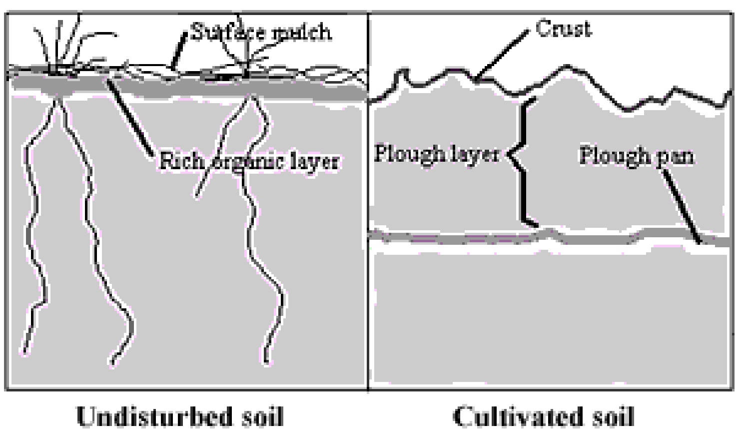
Organic compounds in soil

Chart represents organic matter in soil before cultivation.

When land has been cultivated for one or two decades, much of the active fraction is lost and stabilized organic matter makes up more than half of the soil organic matter.



1.4.2.



1.4.2.

Soil Compaction

- **How to avoid soil compaction:**

-Do not cultivate in wet conditions

-Do not use heavy vehicles on sensitive soils

-Maintain a plant cover and a high content of organic matter

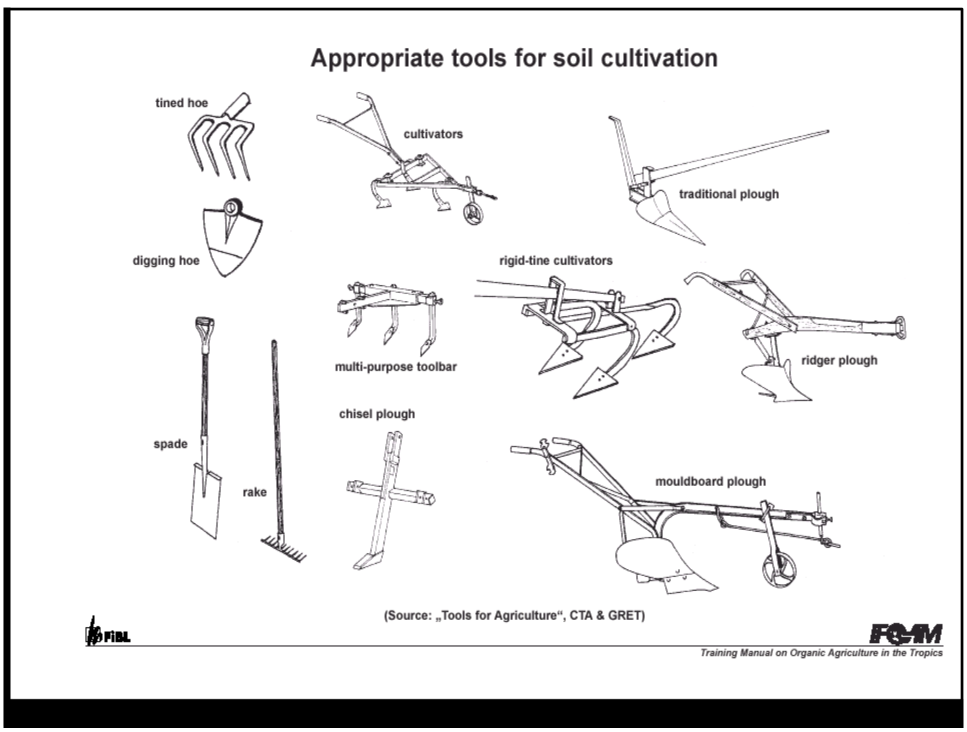
- **How to repair soil compaction:**

-Deep tillage in dry conditions (this encourages earth worms)

-Applying organic matter

-Grow deep rooting plants (e.g. green manure)

1.4.2.



Types of soil cultivation

Different cultivation practices are implemented during different stages of the cropping cycle:

Post-harvest

In order to accelerate decomposition, the residues of the previous crop are incorporated into the soil before preparing the seedbed for the next crop.

Primary tillage

In annual crops or new plantations, primary tillage is usually done with a plough or a similar instrument. Soil cultivation should achieve a flat turning of the top soil and a loosening of the medium deep soil.

1.4.2.

Types of soil cultivation

Seedbed preparation

Before sowing or planting, secondary soil cultivation is done to crush and smoothen the ploughed surface. If weed pressure is high, seedbeds can be prepared early, thus allowing weed seeds to germinate before the crop is sown. Shallow soil cultivation after some days is sufficient to eliminate the young weed seedlings.

In-between the crop

Once the crop is established, shallow soil cultivation (e.g. hoeing) helps to suppress weeds. It also enhances the aeration of the soil and at the same time reduces the evaporation of soil moisture from the deeper soil layers.

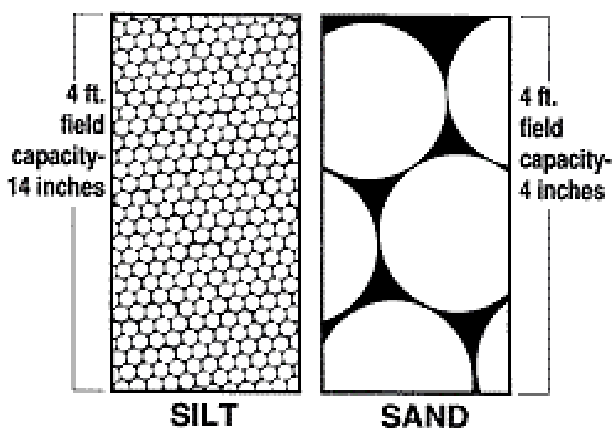
1.4.2.

Problems with a loamy soil in Afghanistan

- Not enough pores (tiny hollows filled with air) in the soil layer
- Soil compaction
- Oxygen deficiency for the roots
- Irrigation can harm the structure of the topsoil. The crumb structure of the soil may get destroyed and soil particles may accumulate in the pores, resulting in the formation of a hard crust.

1.4.2.

Approximate relationships between soil texture and field capacity



Loam has a specific range of sand, silt and clay.

1.4.2.

Loamy soil (Afghanistan)
Conservation tillage for sustainable agriculture

- Soil management systems which aim to conserve natural resources
- Minimalisation of soil disturbance
- For a fine seedbed don't pulverise the soil with increasingly powerful and destructive equipment
- Evaporation losses from the soil surface increases with intensity of cultivation and soil degradation

1.4.2.

Loamy soil (Afghanistan)
Conservation tillage for sustainable agriculture

- Conservation tillage can slow surface water by increasing soil surface roughness and water infiltration rate.
- Reduce evaporation losses by reducing soil disturbance and mulching
- Increase soil water holding capacity by increasing the volume of soil macro pores and reducing the oxidation of organic matter.

1.4.2.

Crocus sativus: Tillage before making ridges

- Loamy soil
- Soil layer become hard in summer-cultivation is difficult
- Tillage in early stage (before summer)
- Make soil free of stones
- The last tillage, making the final ridges, is practiced in late April.

1.4.2.

Different tillage proceedings Saffron

- Ploughing, Harrowing
- Crumble the soil layer
- Make a fine soil structure
- Making ridges

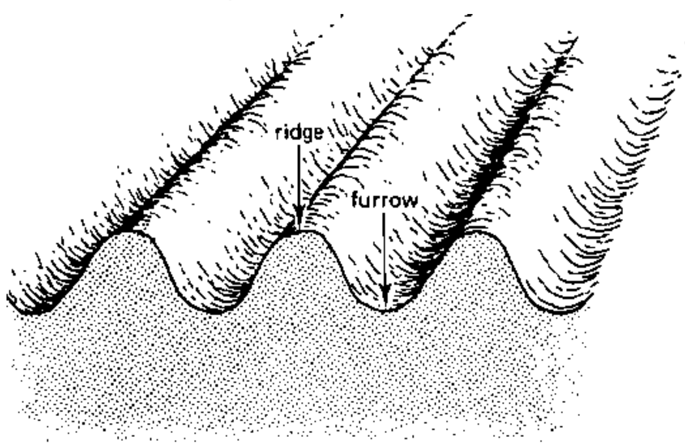
1.4.2.

Corms on Ridges

- Well-developed ridges should be made where:
  -the crop is to be irrigated, especially furrow irrigation.
  -high rainfall occurs, in order to prevent corms lying in water-logged soils.
- Large ridges provide better protection against high temperature and pest and diseases.
- The time between planting and earthing up of the final ridges should be short.

1.4.2.

Corms on ridges - makes irrigation easier



1.4.2.

Soil Quality Test

1.4.3.

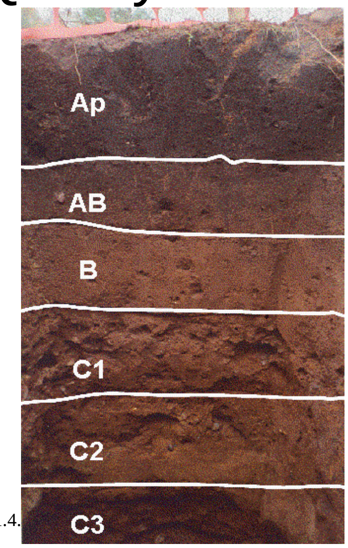
Soil Quality

- Soil Quality is simply defined as "the capacity of a specific kind of soil to function."
- Soil Quality includes physical, chemical and biological properties of the soil.

1.4.3.

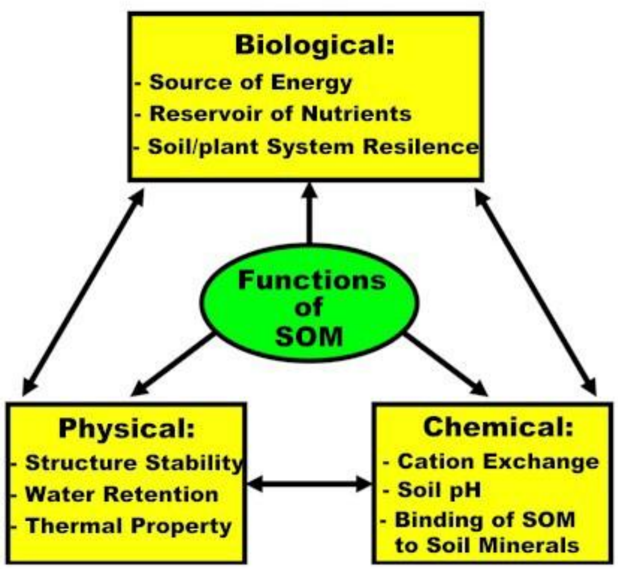
Soil Quality

- -**Physical** = bulk density, water content, infiltration rate, aggregate stability, slaking.
- -**Chemical** = PH, electrical conductivity, and soil nitrate levels.
- -**Biological** = soil respiration, micro-organisms, earthworms.



1.4.

Soil Organic Matter (SOM) important for soil quality



1.4.3.

Fundamental in assessing soil quality

- Important: When, where an how deep to sample?
- Take measurements periodically to monitor changes or trends in soil quality.
- Compare measured values to a standard or reference soil condition.
- Make side-by-side comparisons of different soil management systems to determine their relative effect on soil quality.
- Compare problem areas in a field to the non-problem areas.

1.4.3.

When to sample?

- For the overall assessment of soil quality, an annual sampling of the field is recommended.
- Timing of sampling is important, because soil properties vary within a season with management operations, such as tillage.
- A good time of the year to sample is when the climate is the most stable and there have been no recent disturbances, such as after harvest or the end of the growing season.

1.4.3.

Where to sample?

- Soil properties naturally vary across a field and even within the same soil type.
- Soil variability across a field is also affected by management operations.

Where to sample?

- Field characteristics to consider are:

  -row versus inter-row areas

  -differences in soil type

  -differences in management

  -wheels versus non-wheel tracked areas

  -differences in crop growth
- Select sample sites within a field that are representative of the field

1.4.3.

Soil structure & tilth

- When the soil is neither too wet nor too dry, dig a hole 15 to 25 cm deep.
- Separate an intact section about the size of a soup can and break it apart with your fingers.
- Determine whether the soil is cloddy, powdery, or granular.
- Ideally, your soil should be made up of different sized crumbs that will hold their shape under slight pressure.
- Crumbs or aggregates that break apart only with difficulty mean your soil is too hard.

1.4.3.

Soil structure & tilth

- Soil rich in organic matter tends to form relatively round aggregates, which leads to porosity.
- Open, porous soils allow the free movement of water and oxygen, so plants can develop strong, healthy roots.

1.4.3.

Compaction

- Plunge a wire flag vertically into the soil at different locations.
- Mark the depth at which the wire bends. The sooner it bends, the more compacted the soil.
- A foot or more of easily penetrable soil is ideal.
- Compacted soil inhibits root growth and water availability, and keeps earthworms and other vital soil fauna from circulating freely.

1.4.3.

Workability

- If tilling or digging the soil produces cloddy or plate-like clumps, the workability is low.
- Measure workability by monitoring how much tractor fuel is used.
- Soil that's easy to work allows water to reach roots efficiently and is less prone to compaction.

1.4.3.

Soil organisms

1.4.3.

Soil organisms

- Measure the animal life in your soil by digging down at least 15 cm and peering intently into the hole for four minutes.
- Tick off the number and species of each organism observed, such as centipedes, ground beetles, and spiders.
- Because most soil organisms spurn daylight, gently probe the soil to unearth the more shy residents.

1.4.3.

Soil organisms

- If you count less than 10, your soil does not have enough active players in the food chain. A thriving population of diverse fungi, bacteria, insects, and invertebrates is one of the most visible signs of soil quality.
- Each level of soil life does its part to break down plant residue and to make more nutrients available for plant growth.

1.4.3.

Earthworms

1.4.3.

Earthworms

- When the soil is not too dry nor wet, examine the soil surface for earthworm casts and/or burrows.
- Then dig out 15 cm of soil and count the number of earthworms squirming on the shovel.
- Three worms are good, five are better.

1.4.3.

Earthworms

- The absence of worms means the soil does not have enough of the organic matter they feed on.
  Not only do earthworms aerate the soil, but their casts infuse the soil with enzymes, bacteria, organic matter, and plant nutrients.
- They also increase water infiltration and secrete compounds that bind soil particles together for better tilth.

1.4.3.

The earthworm – an invaluable helper

eating
dead
plant
material

excreting
soil rich
in organic
matter and
nutrients

1.4.3.

Plant residue

- The range of organic material is important to notice and is the single most important component of healthy soil.
- The presence of recognizable plant parts as well as plant fibres and darkly coloured humus indicates an ideal rate of decomposition. But plant and other organic materials decompose only when soil organisms are there to do the work.
- Fast decomposition is another indicator of soil quality.
- In poorly aerated soil, plants break down slowly, a condition that gives off a faintly sour scent.

1.4.3.

Root development

- Use a shovel or hand trowel to dig gently around a selected plant.
- Once you've reached root depth, pull an annual plant up and check the extent of root development, searching for fine strands with a white healthy appearance.
- Brown, mushy roots indicate serious drainage problems—and a poor outlook for this year's harvest.
- Stunted roots might also indicate disease or the presence of root-gnawing pests.

1.4.3.

Root development

- Roots have the most immediate connection with and reliance on soil quality.
- Without air, water, biological activity, and crumbly soil to grow in, roots can't do their job.

1.4.3.

Water infiltration

- Take an empty coffee can with the bottom removed and push it into the soil just until 8 cm remain above the surface.
- Fill the can with water, marking the water height, and then time how long it takes for the water to be absorbed into the soil.
- Repeat this several times until the rate of absorption slows and your times become consistent. Anything slower than 1,5 to 3 inch per hour is an indication of compacted soil.

1.4.3.

Water infiltration

- Good infiltration gets water to plants where they need it - at their roots
- Prevents runoff and erosion
- Good water infiltration indicates a more efficient air move into soil pores

1.4.3.

The soil nutrients

- Soil test used to evaluate fertility measure the soil nutrients that are expected to become plant-available.
- Measurements of total nutrient content are not useful indicators of sufficiency for plant growth, because only a small portion of the nutrients are plant available.

The soil nutrients

- Nutrient concentrations vary with soil depth.
- To estimate nutrient availability for a crop prior to planting, sample the soil to the depth where the most root activity will occur.

Plant-available nitrogen

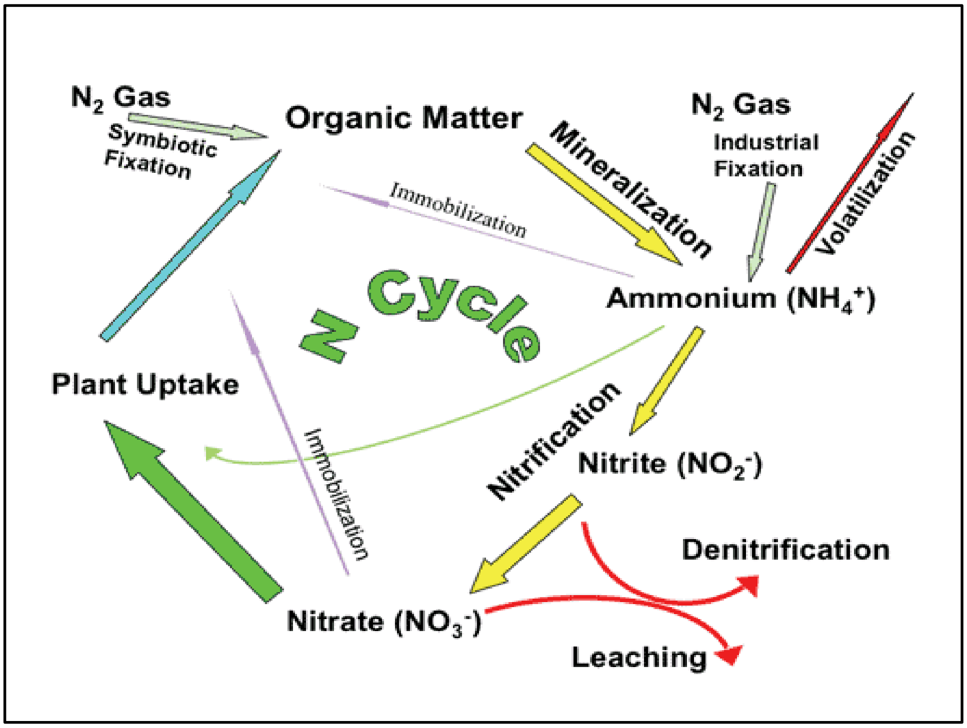
- Total nitrogen analysis measures N in all organic and inorganic forms. Total nitrogen does not indicate plant-available N, which is not included in standard soil testing programs.
- Plant-available forms of nitrogen are nitrate ($NO3-$) and ammonium ($NH4+$)
- Soil concentration of nitrate and ammonium fluctuate with changes in conditions such as temperature and moisture.

1.4.3.

Plant-available nitrogen

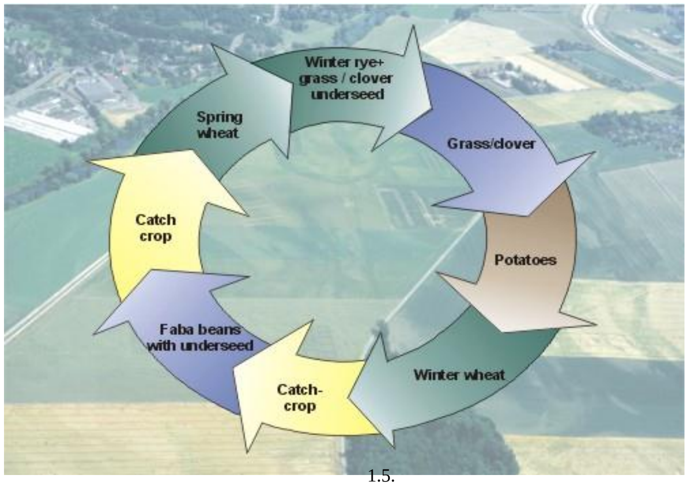
- Nitrate is easily leached from the soil with high rainfall or excessive irrigation.
- Nitrate remaining in the soil after harvest can leach during winter rains, contaminating surface and groundwater. If residual nitrate levels are consistently high, reduce fertilizer N inputs in growing seasons.
- Proper irrigation increases N use efficiency and reduces nitrate leaching.

1.4.3.


N2 Gas
Symbiotic Fixation
Organic Matter
Mineralization
N2 Gas
Industrial Fixation
Volatilization
Immobilization
N Cycle
Ammonium (NH4+)
Plant Uptake
Nitrification
Nitrite (NO2-)
Immobilization
Denitrification
Nitrate (NO3-)
Leaching

1.4.3.

Crop Rotation



1.5.

Crop Rotation

- Different plant species, or even varieties, have different needs for:
  - -nutrients
  - -light
  - -temperature
  - -air
  - -water

1.5.

Problems of mono-cropping

The same crop is grown for several consecutive years on the same land

- The extraction of a specific combination of nutrients leads to an impoverishment of the soil.
- Soil borne crop specific diseases and pests may develop.
- Weeds which are well adapted to the conditions offered by the crop, may spread and require increased efforts to be controlled.

1.5.

Benefits of crop rotation

Different crops are grown in sequence in the same field

- Each crop uses the soil in its own particular way and thus reduces the risk of nutrient depletion.
- A well-balanced alternation of crop species prevents the development of soil-borne diseases.
- To avoid the development of persistent weeds, plants with a slow youth growth should be grown after crops with a good weed suppression.
- A change between deep and flat rooting crops and between crops building high stalks and species producing a great leaf mass which covers the soil quickly also helps to suppress the weeds.
- Crop rotation is also an important instrument to maintain soil organic matter.

1.5.

The ideal crop rotation...

...uses all the available knowledge.

...satisfies the demands.

...can be managed labourwise.

...maintains soil fertility.

...avoids coincidence of sensitive growing periods of the crop with the appearance of pests.

...supplies enough fodder for the farm animals.

...uses the climatic growing conditions of different seasons in the best possible way.

...contains only crops well adapted to local climate and soil.

...avoids a build up of soil borne pests and diseases.

...efficiently suppresses weeds.

...does not have long periods of bare soil.

...makes best use of the value of the previous crop.

FiBL IFOAM
Training Manual on Organic Agriculture in the Tropics

Associating crops

Growing of two or more crops in the same field simultaneously

- -A greater diversity of crops helps the farmer to not become dependent on only one crop.
- -The deterring or attracting effects of some plant species helps to prevent pest attack on other crops
- -Improving soil fertility management: mixed cropping with legumes improves nitrogen supply of the non-legumes in a later term.
- -Weed control: associated crops cover the soil faster and grow more densely and thus suppress weeds more efficiently.

1.5.

Different possibilities to associate crops

- Mixed cropping: Two or more crops are sown at the same time sharing the same space, or they are sown at the same time in neighbouring rows.
- Cropping in lines: Two or more crops are sown at the same time in neighbouring lines with wide spacing.
- Graduate cropping: A second crop is being sown before the harvest of the first one.
- Combined cultivation of trees and annual crops.

1.5.

Criteria for a Crop Rotation plan

- Structure builders + structure eaters
  – grains – potatoes
- N-binding + N-demanding
  – legumes – potatoes
- Weed suppressing + weed sensitive
  – grass-clover – open growing vegetables
- Labour division over the years
- Income generating crops most needed

1.5.

Main steps
making a Crop Rotation Plan

1. Choose a minimum of 5 main crops

   depending on:

   - market
   - gross margin
   - knowledge, skills, machines
   - labour availability
   - soil and farm type

1.5.

Main steps
making a Crop Rotation Plan

2. Soil borne diseases

- leaf / root / flower / fruit crops
  – older groups, rooted in organic dynamic
- family related crops

1.5.

Main steps
making a Crop Rotation Plan

3. Weed control

- weed suppressing
  - closed canopy, quick growth, early start
- Weed stimulation
  - open crop, slow growth
- hard or easy to control in the crop
- labour available

1.5.

Main steps
making a Crop Rotation Plan

4. Soil structure

- crops improving structure
- crops declining structure
- crops needing good structure
- harvest time of crops
- change of wet conditions

1.5.

Main steps making a Crop Rotation Plan

5. Nutrient demand

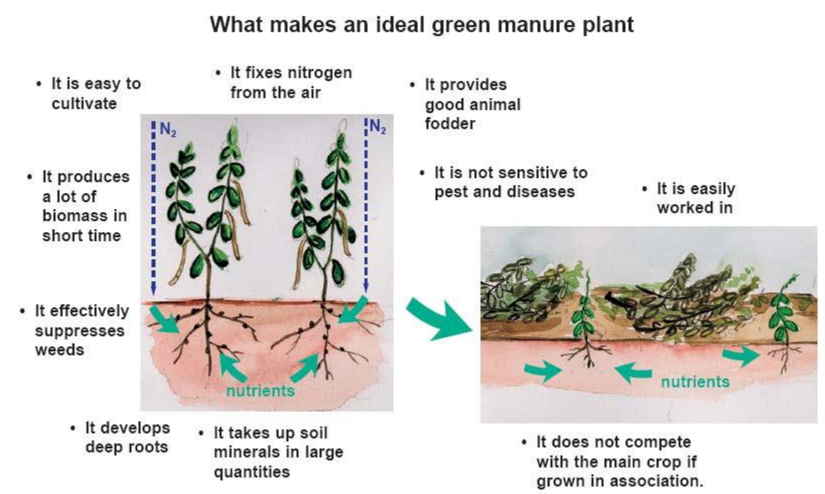
- high demanding crops
- low demanding crops
- damage of heavy manure to crops

1.5.

Green manures in the crop rotation

- Where possible and needed Green Manures are very welcome
- Especially if they bring in N via N-binding

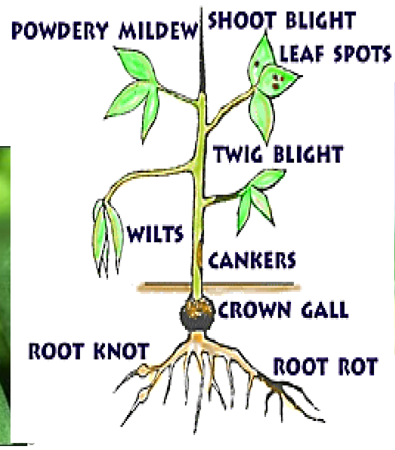
1.5.


What makes an ideal green manure plant
• It is easy to cultivate
• It fixes nitrogen from the air
• It provides good animal fodder
• It produces a lot of biomass in short time
• It is not sensitive to pest and diseases
• It is easily worked in
• It effectively suppresses weeds
N_2
N_2
nutrients
nutrients
• It develops deep roots
• It takes up soil minerals in large quantities
• It does not compete with the main crop if grown in association.

1.5.

1.5.

Organic Pest & Disease Management



Pest & Disease Management

- Management focuses on keeping existing pest population and diseases low.
- Control on the other hand is a short-term activity and focuses on killing pest and disease.
- Organic agriculture deals with the causes of a problem rather than treating the symptoms, this also applies for pest and diseases.
- Management is of a much higher priority than control.

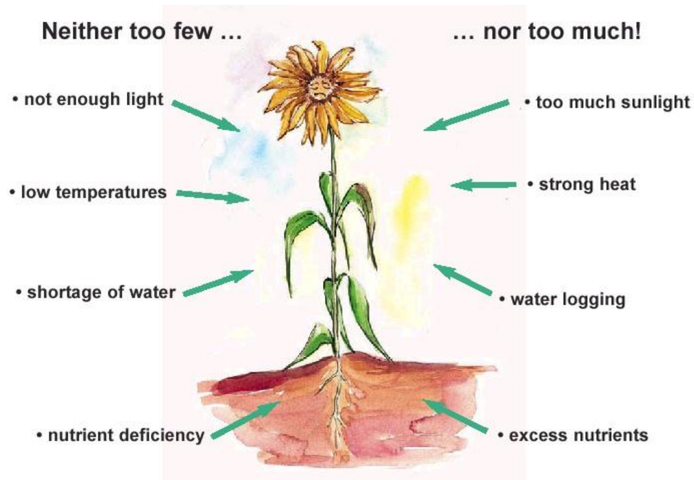
1.6.

Plant Health

- A healthy plant is less vulnerable to pest and disease infestation.
- Therefore, a major aim for the organic farmer is to create conditions which keep a plant healthy.
- The interaction between living organisms and their environment is crucial for a plant's health.

1.6.

Factors influencing plant health



The immune system of plants

- Some plants have the ability to prevent or restrict infection by one or several disease or pest. This is called resistance.
- The cultivation of resistant varieties is an important preventive measure in organic farming to reduce the damages caused by pests and diseases.
- There are different defence mechanisms of plants, which makes them resistant against certain pests and diseases.

1.6.

1. Defence mechanisms of plants

Non-preference: These are factors which either deter pests or lack the stimulation to attract them. Such mechanisms include:

- A colour which doesn’t attract a certain pest.
- Lack of certain nutritional factors essential for the pest or disease.
- Long or sticky hairs on the leaves which hinder insects' ability to walk or feed on a plant.
- A strong smell of aromatic oils which keeps pests away.
- Leaves covered with wax which can not be penetrated easily.

1.6.

2. Defence mechanisms of plants

Active Defence: The plant is resistant by preventing, harming, or even destroying the attacking pest. Such mechanisms include:

- Substances in the leaves which inhibit essential steps in the pest's or disease's metabolism.
- Toxic substances in the leaves which harm or disease the pest feeding on it.
- Hairs excreting sticky substances which hinder pests' movements.

1.6.

3. Defence mechanisms of plants

Tolerance: Tolerant plants reproduce leaves fast enough to recover from the attack without being much affected in their growth and yield production.

1.6.

Preventive Measures

Some important preventive crop protection measures are:

1) Selection of adapted and resistant varieties

a. Choose varieties which are well adapted to the local environmental conditions (temperature, nutrient supply, pests and disease pressure), as it allows them to grow healthy and makes them stronger.

2) Selection of clean seed and planting material

a. Use safe seeds which have been inspected for pathogens and weeds at all stages of production.

b. Use planting material from safe sources.

1.6.

Preventive Measures

3) Use of suitable cropping systems

a. Mixed cropping systems: can limit pest and disease pressure as the pest has less host plants to feed on and more beneficial insect life in a diverse system.

b. Crop rotation: reduces the chances of soil born diseases and increases soil fertility.

c. Green manuring and cover crops: increases the biological activity in the soil and can enhance the presence of beneficial organisms

1.6.

Preventive Measures

4) Use of balanced nutrient management

a. Moderate fertilization: steady growth makes a plant less vulnerable to infection. Too much fertilization may result in salt damage to roots, opening the way for secondary infections.

b. Balanced Potassium supply contributes to the prevention of fungi and bacterial infections

1.6.

Preventive Measures

5) Input of organic matter:

a. Increases micro-organism density and activity in the soil, thus decreasing population densities of pathogenic and soil borne fungi.

b. Stabilises soil structure and thus improves aeration and infiltration of water.

c. Supplies substances which strengthen the plant's own protection mechanisms.

1.6.

Preventive Measures

6) Application of suitable soil cultivation methods:

a. Facilitates the decomposition of infected plant parts.

b. Regulates weeds which serve as hosts for pests and diseases.

c. Protects the micro-organisms which regulate soil borne diseases.

1.6.

Preventive Measures

7) Use of good water management:

a. No water logging: causes stress to the plant, which encourages pathogens infections.

b. Avoid water on the foliage, as water borne diseases spread with droplets and fungal diseases germinate in water.

8) Conservation and promotion of natural enemies

a. Provide an ideal habitat for natural enemies to grow and reproduce.

b. Avoid using products which harm natural enemies.

1.6.

Preventive Measures

9) Selection of optimum planting time and spacing:

a. Most pests or diseases attack the plant only in a certain life stage; therefore it's crucial that this vulnerable life stage doesn't correspond with the period of high pest density and thus that the optimal planting time is chosen.

b. Sufficient distance between the plants reduces the spread of a disease.

c. Good aeration of the plants allows leaves to dry off faster, which hinders pathogen development and infection.

1.6.

Preventive Measures

10) Use of proper sanitation measures:

a. Remove infected plant parts from the ground to prevent the disease from spreading.

b. Eliminate residues of infected plants after harvesting.

1.6.

Curative Crop Protection Methods

Curative action means controlling the pest or disease once it has already infested the crop.

Several options exist in organic agriculture:

1) Biological control with natural predators or antagonistic microbes.
2) Natural pesticides based on herbal preparations or other natural products.
3) Mechanical control with traps or hand picking.

1.6.

Impact of pesticides

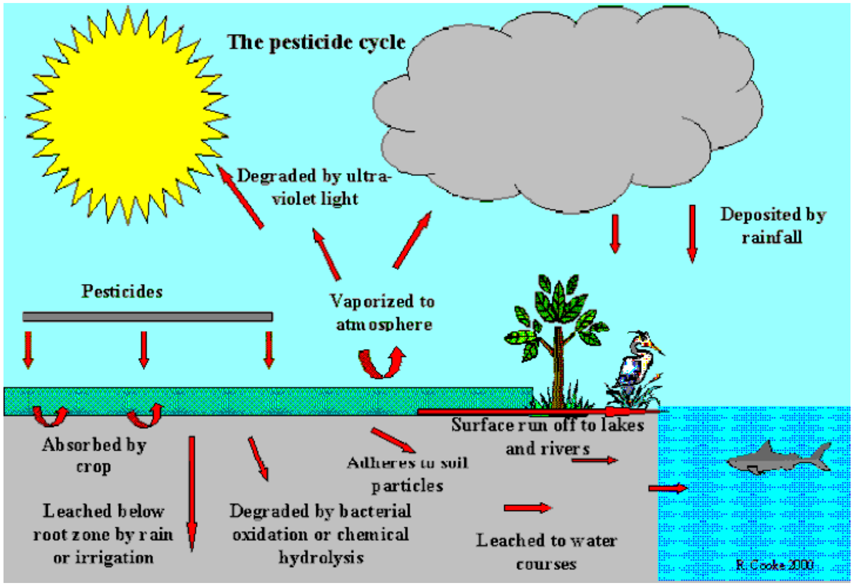
Negative impacts of pesticide use on pest and disease populations are:

1. The resurgence of pest populations after elimination of natural enemies: In some cases, pesticides can be the cause of pest problems, rather than the cure. As many pesticides also kill beneficial organisms, pests may reproduce quicker after spraying, since no natural enemies are there to control their population growth.

2. Development of insecticide-resistant populations: When pesticides are used continuously, the target pests can adapt themselves to the chemical and become resistant to it. Resistance means that an insect can tolerate a pesticide without being killed.

1.6.

The pesticide cycle



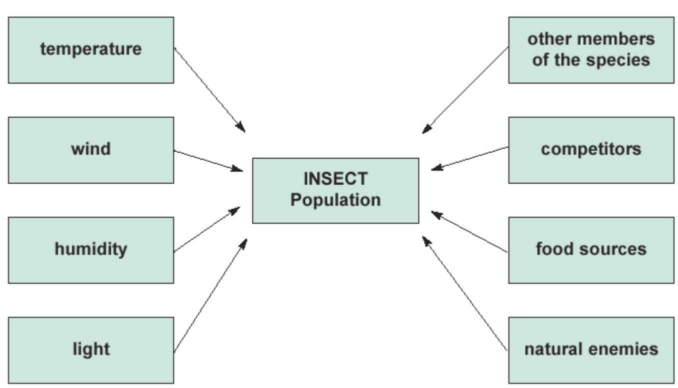
Natural Enemies

- It is important to know the life cycle of pest and disease organisms and their interaction with the environment.
- Knowing the factors which influence pest and disease populations will give you a clue on how to manage them.
- Natural enemies that kill or suppress pests or diseases are often fungi or bacteria. They are called antagonists or are referred to as microbial insecticides or bio-pesticides.

1.6.

Natural Enemies

Factors influencing insect ecology



Characteristics of natural enemies

Predators

- Common predators are spiders, lady beetles, ground beetles, and syrphid flies.
- Predators usually hunt or set traps to catch a prey to feed on.
- Predators can feed on many different species of insects.

Parasitoids

- Parasitoids of pests are commonly wasps or flies.
- Only the larvae are parasitic and they develop on or inside a single insect host.
- Parasitoids are usually smaller than their host.

1.6.

Characteristics of natural enemies

Pathogens

- Insect-pathogens are fungi, bacteria, or viruses that can infect and kill insects.
- Pathogens require specific conditions (e.g. high humidity, low sunlight) to infect insects and to multiply.
- Commonly used insect-pathogens are Bacillus thuringiensis (Bt), and NPV virus.

Nematodes

- Nematodes are a kind of tiny worm.
- Some nematodes attack plants (e.g. rootknot nematode). Others, called entomopathogenic nematodes, attack and kill insects.
- Entomopathogenic nematodes are usually only effective against pests in the soil, or in humid conditions.

1.6.

Conserve and enhance natural enemies

- Minimize the application of natural pesticides (chemical pesticides anyway are not permitted in organic farming).
- Allow some pests to live in the field which will serve as food or host for natural enemies.
- Establish a diverse cropping system (e.g. mixed cropping).
- Include host plants providing food or shelter for natural enemies (e.g. flowers which adult beneficial insects feed on).

1.6.

Natural Pesticides

- In some cases, however, preventive measures are not sufficient and the damage by a pest or a disease may reach a level of considerable economic loss.
- At this stage direct control measures with natural pesticides may become appropriate.

1.6.

Botanical Pesticides

- Some plants contain components that are toxic to insects.
- When extracted from the plants and applied on infested crops, these components are called botanical pesticides or botanicals.
- The toxicity of botanical pesticides is usually not very high and their negative effects on beneficial organisms can be significantly reduced by selective application.
- Botanical pesticides are generally highly bio-degradable.

1.6.

Other Natural Pesticides

- Some other natural pesticides are allowed in organic farming.
- Some of these products have limited selectivity and are not fully biodegradable.
- There are situations, when their use is justified.

1.6.

Examples Natural Pesticides

Disease control:

-Sulphur: against fungal disease

-Copper: against fungal disease (gets accumulated in the soil and harm soil organisms)

-Sulphuric acidic argillaceous earth: against fungal disease

-Ashes: against soil-borne disease

-Slaked lime: against soil-borne diseases

-Clay: against fungal diseases

-Backing soda: against fungal diseases

1.6.

Examples Natural Pesticides

Pest control:

-Soft soap solutions: against aphids and other sucking insects

-Light mineral oil: against various insect pests (harm natural enemies).

-Sulphur: against spider mites (harm natural enemies).

-Plant ashes: against ants, leaf miners, stem borers etc.

1.6.

Weeds

1.7.

Weeds

- Weeds compete with the crop for water, nutrients, and sunlight.
- Weeds may also directly reduce profits by hindering harvest operations, lowering crop quality, and by producing seed or rootstocks which infest the field and affect future crops.
- Competition by weeds doesn’t harm the crop throughout the whole cultivation period in the same way.
- The most sensitive phase to weed competition is in the crop’s early growth stage.

1.7.

Benefits of Weeds

- Important function as indicators for soil condition
- Nutrition for beneficial organisms
- Refuge for insects, spiders, carabids
- Making blocked nutrients available in the soil
- Preserving nutrients
- Protection against erosion

1.7.

Suppression of weeds

- Mulching: the weeds find it difficult to receive enough light to grow and may not be able to pass through the mulch layer.
- Living green cover: The cover competes successfully against the weeds for light, nutrients and water and therefore helps to prevent weed growth.
- Crop rotation: Changing the conditions of the crop interrupts the living conditions of the weeds thus inhibiting their growth and spread.
- Sowing time and density: Weed pressure during the critical period (youth stage of the crop) can be reduced by choosing an optimal sowing time .

1.7.

Suppression of weeds

- Balanced fertilization: it can support an ideal growth of the crop, which promotes the growth of the crop over the weeds.
- Soil cultivation methods can influence the total weed pressure as well as the composition of weeds.
- Prevent dissemination of weeds by eliminating them before seed dispersal.
- Prevent insemination of crops by weeds by avoiding the introduction of weed seeds into the fields through tools or animals and using only weed free seed material.

1.7.

Machines

- Ploughing
- Seed bed preparation
- Hoeing
- Harrowing
- Flame weeder
- Weed bed

1.7.

Timing

- Weeding is a race
- Once you are behind it is almost lost
- React on first signs
- Check for the white small new roots of weed seeds
- Weather conditions are very important:
  – dry when weeding
  – irrigating can enhance weeds strongly

1.7.

Saffron weeds

- Saffron, a perennial crop, is a short plant with upright narrow leaves and it is not a competitive plant.
- Weed control is an important step in promoting the quantity and quality of saffron.

1.7.

Saffron weeds control

- The most important weeds in saffron are *Cardaria draba* and *Hordeum spontaneum*
- Weed control is traditionally hand weeding
- Weeding in early stage is important, because the most sensitive phase of saffron to weed competition is in its early growth stage.
- Eliminating them before seed dispersal.
- Take the weeds out of the field

1.7.

Cardaria draba

Hordeum spontaneum

1.7.

Crocus Sativus
Ecophysiology and Corms

2.1.

Introduction

- The saffron plant *Crocus sativus* is a short stature perennial herb with a spherical underground corm (or bulb) and six or more radial arranged narrow and elongated leaves.
- The violet-blue flowers grow singly and bear elongated pale yellow styles divided at the top into three-branched orange-red stigmas.
- These stigmas along with their styles are dried to form the most precious spice in the world.

2.1.

The saffron plant: The Crocus sativus

Saffron is a plant with ecological, physiological and phenological differences when compared with other conventional cultivated plants.

Differences are:

-Flowers appear before development of other plant organs, this process is dependent on the food reserves stored in the corms.

-Beginning of flowering periods coincides with cold temperature in the fall.

2.1.

The saffron plant the Crocus sativus

- Economic yield is only a small part of the flower: the stigma.
- The Harvest Index (HI) calculated as a proportion of biological yield which is used as economic yield is in saffron less than 0.5%.

2.1.

Crop with specific criteria

- Low water demand
- Water requirements at periods of high water availability
- Ease of transportation
- Low demands of expensive machinery
- Labour requirement at the time of harvesting, therefore job generation for local people

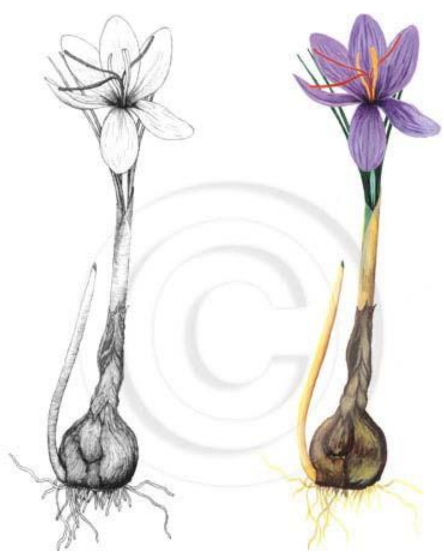
2.1.

Saffron Corms

- Corms act as a source of nutrients for flowers and newly formed corms
- Corm size has a significant effect on the production of daughter corms and on the production of flowers and the yield of saffron.

2.1.

The larger the mother corm, the more daughter corms will be produced in the annual cycle, which increases the potential for higher yield in subsequent years.



2.1.

Selection of corms

- Selection of proper corms is crucial for production
- Large corms with no injury from 2 to 4 year old are preferred.
- Large corms produce more flowers.
- Large corms produce more and larger corms in two consecutive years.

2.1.

Selection of corms

- Only the size of corms up to a particular point increases the flowering potential.
- Corms can be classified in 4 categories:
  - 2-4 g (small)
  - 4-6 g (medium)
  - 6-8 g (large)
  - more than 8 g (very large)
- Corms with 2,5 cm diameter (6 g weight) are recommended.

2.1.

Phenological Stages Saffron

<u>A- Generative phase</u>

3 months July-October

This phase starts with the onset of cold weather in fall and is an important stage for growers. The main stimulating factor in this phase is irrigation in late summer and early fall.

2.1.

Phenological Stages Saffron

<u>B- Vegetative phase</u>

7 months November-April

This phase is the longest period in the life cycle of saffron and starts immediately after the flowering stage. At this stage leaves are developed and provide necessary nutrients for the corms.

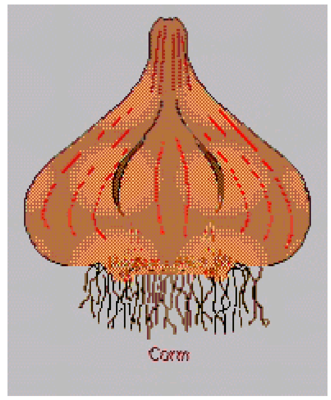
2.1.

Phenological Stages Saffron

C- Dormant phase

2 months April-June

This phase starts with leaf withering and senescence in the spring and ends with the first irrigation in late summer and early fall. This period lasts for five months.



2.1.

Corms development

Development of new corms starts with initiation of new buds and ends by production of mature corms.

2.1.

Corms development

- On the surface of each mother corm there are several meristemic points (eyes), which are the base of buds for new corms.
- Activity of these eyes starts after termination of flower emergence in mid-autumn.
  These eyes are located at the upper part of the mother corms.

2.1.

Semi - arid climate

2.2.

Semi-arid climate / Loamy soil (Afghanistan)

- Afghanistan faces many obstacles in achieving sustainability in its agricultural systems (water scarcity and soil restriction).
- Situated in one of the agricultural unfavourable parts of the word (i.e. too cold, too dry, too hot).
- The output from any crop production system is dependent on the most limiting input.
- The monthly precipitation exceeds the potential evaporation in only 7 months of the year.

2.2.

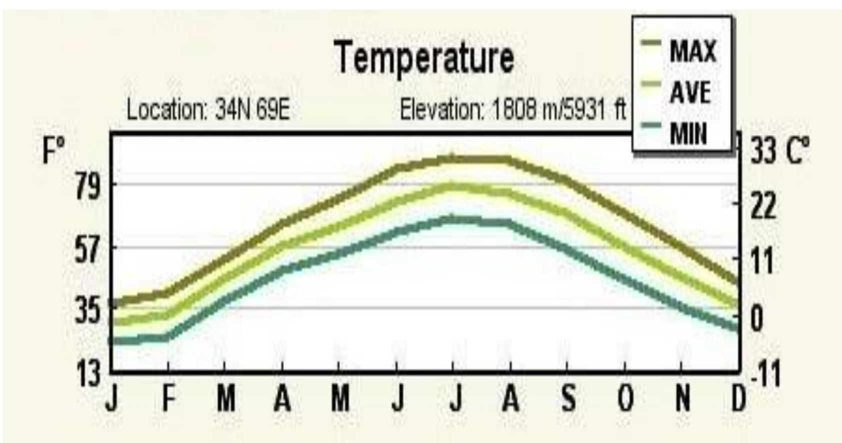
Semi Arid Climate

Semi-Arid regions:

- Dry climate
- Alternating warm and cold seasons
- Variation in temperature are considerable
- Day and night temperature are strongly contrasting

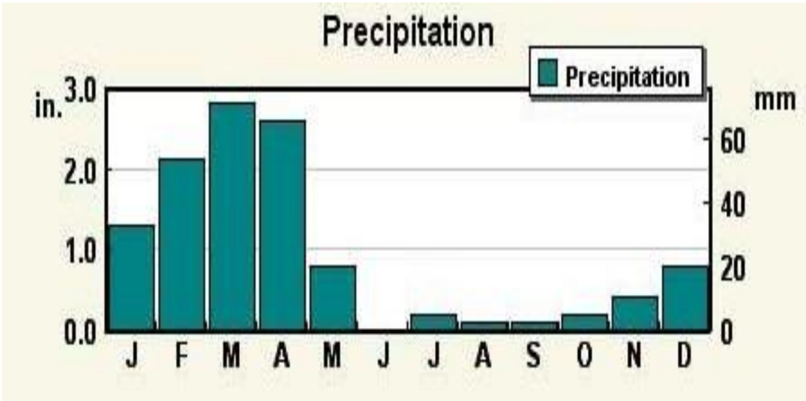
2.2.

Afghanistan (Kabul)



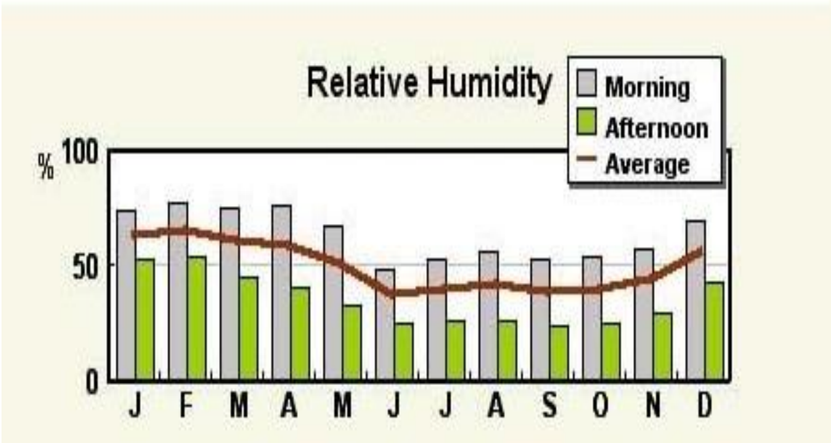
2.2.

Afghanistan (Kabul)



2.2.

Afghanistan (Kabul)



2.2.

Interaction between soil cultivation and climate

- Surface crusting is widespread in semi-arid regions and may be the primary reason for low infiltration.
- Low rates of infiltration lead to high run-off and hence less effective utilization of the rainfall.

2.2.

Interaction between soil cultivation and climate

- Dense packing of soils may reduce infiltration and also increase the traction requirement for tillage operations.
- The deep cracking of vertisols can lead to increased moisture by evaporation, and cultivation problems.
- Many semi-arid soils have low moisture-holding capacity, especially shallow or sandy soils.

2.2.

Saffron

- Saffron is native to the Mediterranean environment, characterized by cool to cold winters, with autumn-winter-spring rainfall, and warm dry summers with very little rainfall.
- In can withstand substantial frosts (-10 °C), and can tolerate occasional snow in the winter.
- Saffron needs more than 500 mm annual rainfall, usually the crop should be irrigated.

2.2.

Saffron

- Spring rain is considered favourable for corn production, while rain immediately before flowering encourages high flower yield.
- Rain or cold weather during flowering spoils the saffron and persistent wetness and high temperatures encourage disease.

2.2.

Crocus soil preparation

2.3.

Soil preparation

Preferred for saffron planting:

- Medium textured soils with a good natural drainage potential
- Fairly deep and smooth surface area with no salinity
- Work with equipment, if possible

2.3.

Ploughing of saffron

- Ploughing will only turn the soil, it makes no ridges and will not plant your bulbs.
- It is important how deep you plough.
- Soil is ploughed in autumn or winter and animal manure of 20 to 100 tons per hectare is applied.

2.3.

Tillage of saffron

- Soil preparation is practiced in February and March with 3 to 4 tillage operations and application of 5 to 6 tons per hectare of animal manure

2.3.

The field

- The best fields are started well in advance of planting saffron bulbs.
- Create a weed free soil on well-prepared ground.
- Ridged seed bed is not required as long as the bulbs come into contact with the soil.
- See that the soil is firm, yet fine and crumbly for the bulb to send out its tiny roots.
- Before you start watering apply a light raking or harrow to finish the ridge and create a freshly moved soil to increase the soils biological activity.
- Roll or stamp with your feet after planting.

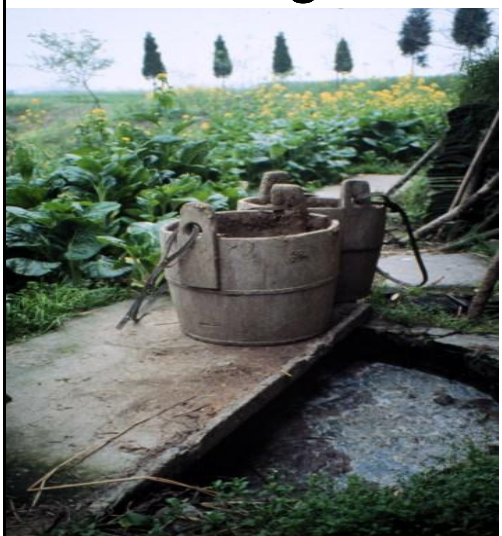
2.3.

The practice to Crocus sativus cultivation

- fertilise the soil with organic material and try to make it rich and healthy again, because Herat has poor soil and organic material is not
- we are planning to make a program with Night soil.

2.3.

Program of night soil



- All the human pie and shit you can collect we put in a hole close by the field of crocus sativus
- We mix the night soil with weeds and some straw and after about 5 months we use it as organic fertilizer in the fields

Early ridges

- If water is not enviable in July and the soil is to firm (hard like stone) than it is better start making ridges in March or April.
- The scientist of growing sales exchange will together with the farmers decide about this matter

2.3.

Making Ridges

•Well-developed ridges should be made where:

-the crop is to be irrigated, especially furrow irrigation.

-high rainfall occurs, in order to prevent corms lying in water-logged soils.

2.3.

Making Ridges

- Large ridges provide better protection against high temperature and pest and diseases.
- The time between planting and earthing up of the final ridge should be short.

2.3.

Corms on Ridges

- Making ridges is easy in light soils and far more difficult in heavy soils.
- In heavy soils it will be necessary to loosen the soil in the furrow, in order to have enough tilth to make a good ridge.

2.3.

Corms on Ridges

- This can be done with inter-row harrows, which are placed before the ridges bodies and with inter-row cultivation, used when the soil is particularly heavy.

2.3.

Corms on Ridges

- The required height of the ridge depends on depth of planting and the required distance between the seed tuber and the top of the ridge. For Saffron ridges about 25-30 cm height should be made.
- After ridges have been made corms are planted manually on 20-25 cm depth.

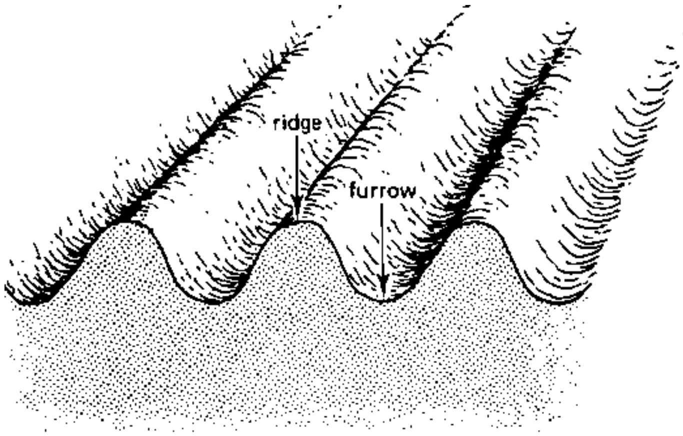
2.3.

Corms replanted periodically

- Each season saffron corms creep toward the soil surface by 1-2 cm each year. Therefore, the corms needs to be lifted or more soil must put over the corms and replanted periodically.

2.3.

Corms on ridges - makes irrigation easier



2.3.

The ridger

- The ridger is operated in tilled soil by a tractor.
- Ridger body displaces the soil to both sides and a furrow is created.
- The soil mass between furrows forms a ridge.
- The depth of operation is controlled by the hydraulic system of the tractor.

2.3.

2.3.

Crocus pests and diseases

2.4.

Saffron pests and diseases

- Rodents; rats and mice attack the plants and eat saffron roots and corms

Control measures:

- Building barriers
- Predation
- Using mouse/rat traps

2.4.

How can I keep animals from eating bulbs?

-Bulbs are not usually a preferred food of animals, but they can take a liking to them. Especially in Herath where it is the only green fresh leave available in the winter.

-Mostly we advice to make a wall around the field.

The mouse problem is a difficult one.

-Sprinkling dried blood, tobacco or a similar repellent on the ground is effective only until the next rain washes it away.

-Owning a cat that enjoys walking through your flower beds is a very effective deterrent.

2.4.

Saffron Insects

Harmful insects that have the ability to cause economic damage to saffron plantations:

- Saffron Bulb Mite (Rhizoglyphus robini)
- Corm thrips (Trips tabaci)

2.4.

Saffron Bulb Mite
(Rhizoglyphus robini)

2.4.

Saffron Bulb Mite
(Rhizoglyphus robini)

- The mite is about 0.6-0.8 mm long with a bulging oval body, dark appearance, and slow mobility.
- The eggs are oval, initially clear but gradually turn dirty white.
- About 24 hours before hatching a red spot appears on one side of the egg.

2.4.

Saffron Bulb Mite (Rhizoglyphus robini)

- Saffron bulb mite is active throughout the year and is able to produce several generations per year.
- The maximum numbers in population and generations is during spring and fall when optimum conditions exist for growth and development.
- During summer and winter the population reduces considerably.
- Irrigation in summer season, when saffron is in resting stage, will result in providing suitable conditions for growth of saffron bulb mite and rapid increase in numbers.

2.4.

Damage due to bulb mites

- Wounds in sometimes healthy parts of the corm.
- Bores and tunnels and cavities in corms.
- The mites starts reproduction within this cavity.
- The plants infested with mites have short and slender leafs.
- The infested leaves die earlier than healthy ones.
- The gradual damage of this pest is thinning the saffron field.

2.4.

Prevention and control of saffron bulb mites

In new fields:

-when you pull up saffron corms for planting in new field avoid irrigation to facilitate the action.

-Choose healthy and uniform corms for planting.

-The depth of planting should be 15 to 20 cm depending on soil texture.

-During summer of every other year add 1-2 cm light soil to the ground in order to keep depth of planting constant.

2.4.

Prevention and control of saffron bulb mites

In new fields:

-Do not remove superficial soil for saffron reseeding.

-Use high rate of corms per unit area to reach economical harvesting levels.

-Use rotten, seedless organic cow manure (experience indicates that sheep and chicken manure are not suitable)

-Do not transfer contaminated corms to other areas.

2.4.

Prevention and control of saffron bulb mites

In established fields:

-Do not irrigate saffron during the summer, because the most important factor for mite activity, soil moisture becomes then available.

-In fields with shallow corms, add light soils up to 15 cm depth during summer when corms are in resting stage.

-The first irrigation (before flowering) and the second irrigation (after flowering) should be done adequately and carefully.

-Weed control must be done with care.

2.4.

Corm thrips (Trips tabaci)

2.4.

Corm thrips (Trips tabaci)

- Insect and polyphages which is active on saffron leaves from beginning of saffron growth up to the point they die.
- Peak activity is from early March to late April.
- The adult is about 0.8-1 mm long, yellow to light brown; wings narrow and sharp, pointed with long hair at the rear and 2 longitudinal veins on front wings.

2.4.

Corm thrips (Trips tabaci)

- Adults insect in winter on the leaves of host plant (such as saffron), and weeds or on the soil surface and plant debris.
- After flourishing, the female lays eggs by early March.
- Nourishment is done by rupturing plant epidermis, scraping tissues, penetrating stylet into plants tissues, and sucking plant sap.

2.4.

Damage due to corm thrips

- Weaken and inhibit plant growth and also transform viral pathogens from infected plants to healthy plants.
- Yellow to white spots on saffron leaves are an indication of thrips damage.
- The severely infected leaves senesce earlier and result directly in saffron yield reduction

2.4.

Prevention and control of corm thrips

Since the high population of this pest is observed at the end of the saffron growing season, chemical control is not necessary.

2.4.

Saffron Diseases

Most important saffron diseases:

- Stigma twister
- Corm rots
- Corm root rot
- Saffron smut (Tacon)
- Saffron leaf chlorosis

2.4.

Stigma twister

- The stigma twists like a spring, and in some cases the frilled stigma falls off.

Considered reasons:

-The age of corms

-Plant nutrition and soil type

-Plant physiological conditions

-Presence of plant viral and mycoplamatic agent's type

2.4.

Saffron corm rot
due to soil borne fungi

- All of the corm rotting fungi hibernate in the soil and in or on diseased corms in storage
- Infection occur in storage and especially in the field during damp weather, where planting are dense and growing in wet, poorly drained soils.

2.4.

Corm root rot

- Phythium root rot is favoured by cool, wet poorly-drained soils and by too much water.
- Phythium infects the younger feeding roots and often advances into the rest of the root system.
- Species of Phythium survive for several years in soil.

2.4.

Corm root rot

- The intact plants and corms are smaller than normal.
- The reason is due to consuming a considerable amount of energy to develop spindle shape tubers under the corms.

Considered reasons:

-improper conditions of irrigation and soil fertility.

2.4.

Control corm rotting fungi

- Purchase only top-quality, disease-free-corms.
- Before planting, inspect the corms carefully and discard all those with rot lesions.
- Plant the corms in a well drained soil where air movement is good.
- Store the corms at 3.5 to 10 °C, with relative humidity of 70 to 80 %.
- Avoid damp storage conditions that can lead to infection of the corms.

2.4.

Saffron smut (Tacon)

- This agent is a fungus named fumago, which grows on leaves and corms.
- The control measure is burning the infested leaves and corms.

2.4.

Saffron leaf chlorosis

- Leaf chlorosis may occur due to poor nutritive elements or limiting of the soil or iron deficiency.

2.4.

Holland

The Marketing Concept

- Successful production will create spin-off activities for local communities.
- Guarantee good plant stock and fixed price take-off contacts.
- Learn farmers locally how to produce a good crop and process harvested saffron in such a manner that premium quality can be guaranteed.
- Good branding concept, like ‘Colombian Coffee’, is crucial to the success of Afghan saffron.

3.1.

Afghanistan unique location

- Location has the optimal conditions for the production of Saffron crocus (Crocus sativus)
- The harvesting and processing of the Saffron is feasible, and fulfils a need at local community level to secure income and stability by offering income and employment.

3.1.

Optimal conditions Saffron in Afghanistan

- Hot dry summers (water conservation)
- Low labour costs
- Cold winters
- High price per gram enables low cost distribution
- Possibility of access to international market; located close to key markets

3.1.

Alternative solution for grower?

- Income restrains and lack of a good option, tempt grower to produce heroine instead of food and other cash crops.
- Heroine production increases violence and instability for the region and international arena because it is used for funding terrorist activities and undermines civil societies.

3.1.

Alternative solution for grower?

- Development can finance other activities to develop income diversity and halter erosion by overgrazing and chopping local vegetation for fire fuel.
- Increase soil fertility by incorporating compost and green manures, leading to stabile and disease resistant soils.Use water wisely, in a conscientious way, balancing the community needs, farming and natural surroundings.

3.1.

Limiting factors

- Good planting stock is not enough available.
- Losing the crop due to poor soil conditions, diseases, pests and weeds.
- Knowledge and expertise of growing and processing is lacking.
- Political conditions are fragile.
- Lacking of a developed marketing structure.

3.1.

Sustainable Development

Positive aspects are:

- Employment
- Fair trade policy concerning labour:
  - involving women with respect to culture and beliefs (in line with their Islamic beliefs)
  - no child labour
- Stimulating local economy and rural development
- Environmentally friendly production (certification)
- Introduction of track and trace system to promote transparency

3.1.

Sustainable Development

Risks are:

- Damage to the imported corms due to poor transportation
- Transportation costs
- Fragile political circumstances
- Opposition from Warlords
- Overproduction, causing prices to fall

3.1.

The women

- Working on saffron plantations is labour intensive and extremely tiring.
- Because the crop is so fine, delicate and precious, expertise is essential.
- Experience of the growing sales exchange scientist is that collecting the saffron from the flowers is women's work.
- We shall train en explain the farmer about this important matter.

3.1.

Abstract

- Afghanistan has suffered from several wars, losing infrastructure and know how.
- At this moment farmers are trying to start up saffron production and are looking for experts who have experience in producing and marketing saffron.
- Farmers will be trained to achieve their goal.
- Within five years Afghan farmers should be capable of producing and maintaining high and consistent quality saffron.
- Produce should sell at a high stable international price given quality coupled with branding, while fixed price take-off contracts are envisaged.

3.1.

Saffron Planting

3.2.

Planting method

- Corms are planted 25 cm apart in hills. The distance between each hill is 15 to 20 cm
- Saffron is grown on raised drills to allow good drainage and easy access for picking.
- In Afghanistan corms are planted in August, but in some cases early planting may be carried out.
- Planting in the hot months of summer may cause desiccation of corms and is therefore not recommended.

3.2.

Planting

3.2.

Planting

3.2.

Planting

3.2.

Planting

3.2.

Planting




3.2.

Replanted periodically

- New saffron corms also grow above the old ones each season, so they creep toward the soil surface by 1-2 cm each year.
- Therefore, the crop needs to be lifted and replanted periodically.
- This occurs about every 5 years. Replanting is normally done when yields begin to decrease due to overcrowding or damage to corms that are too close the soil surface.

3.2.

Yield and corms lifting

- Highest yield of saffron is normally obtained from the third year.
- With increasing age, the crowding of corms caused reduction of their size and production of more corms with smaller size.
- It is therefore recommended to lift the corms for replanting not later than five years.

3.2.

Planting Density

- Flower yield is highly dependent on corm density.
- Number of corms required per unit land depends on the planting method and size of corms. It varies between 1,5 and 10 tons per hectare.
- In Afghanistan the corm quantity per hectare is 5,000 kg. That is 0,5 kg per square meter.
- Increasing plant density increases the yield and 50 plants per m^2 are recommended.
- Based on an optimum size of corm for planting, which is 8 gr, this plant density requires 4 tons per hectare.

3.2.

The field

- The growing sales exchange scientists usually recommend that you do not damage the bulbs in the ridge when you work in the fields.
- The bulbs are planted for at least 4 years so do not walk or plough in the ridge but walk en work between the ridges.

3.2.

Questions and Answer

- **Which side of the bulb goes up at planting time?** It doesn't matter.
- **When can I plant crocus sativus bulbs?** Between middle July and middle October; best is middle August till middle September.
- **How often do you have to dig up hardy bulbs?** Dig up bulbs only as often as you desire to move them to a new location, or when they are becoming crowded and/or flower production decreases. Normally after 5 years you harvest and replant the bulbs.

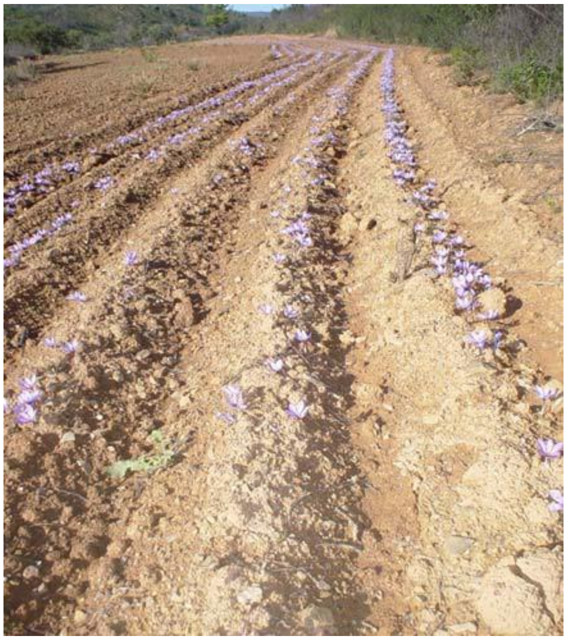
3.2.

Questions and Answer

- **How should I fertilize hardy bulbs**? The most important time to fertilize is right after the bulbs bloom. Use compost or manure or viable a commercial organic fertilizer. Work fertilizer lightly into the soil surface.
- **How should I protect crocus sativus leaves from a hard frost?** Don't! The leaves are usually not damaged by temporary cold and freezing temperatures.

3.2.

Harvesting Saffron



Conditions for high productivity

1. Most important: good corms (bulbs).
   Corm quality affects yield in kg by:
   -numbers of flowers per corm
   -size of stigmas
2. Planting at proper depth and spacing (e.g. 15-20 cm deep and 15 x20 cm spacing)

Conditions for high productivity

3. Adequate irrigation (testing needed to find methods best adapted to Afghanistan)
4. Ridges or raised beds for good drainage
5. Proper fertilizing & disease control (organic would be best)
6. Mulching to keep down weeds

3.3.

Conditions for high productivity

Regular digging up and replanting corms in new ground (e.g. every 5 years) to:

- Reduce threat of pests and disease
- Replant the best corms at proper depth (new corms form above earlier ones, creeping towards the surface)
- Sell the good quality surplus corms. Use inferior (i.e. small) ones as animal feed

3.3.

Harvesting saffron

- Flower of Saffron Crocus: Styles are the raw source of Saffron
- Harvesting saffron includes picking the flowers and separating the stigma
- Picking flowers starts as soon as they appear in the field
- Picking flowers is on a daily basis because flowers are short-lived and if they are left for a longer period, not only can they be damaged, the quality of saffron also decreases

3.3.

The first Saffron

- By October the crocuses are in full bloom. The stigmas are bright orange-red and are clearly visible among the lilac flowers.
- Timing of harvest and speedy processing is important, as there can be a rapid loss of quality. Particularly in the morning before the sun is full the flowers should be collected.

3.3.

Picking flowers

- Picking flowers begins from October to November
- Harvest time depends on climate variability and time of first irrigation
- Flowering period of a field lasts for 15 to 25 days (reaching a peak from the seventh to the tenth day).

3.3.

Picking flowers

- While the crocus blooms are being collected, the stigmas are separated from the flowers.
- The stigmas are naturally and slowly dried, a process that shrinks the stigma to one fifth of its original size and enhances its bright red colour.
- Now the stigma is rigid, without wrinkles and ready to use.

3.3.

Recommendation for picking flowers

- Time of flower picking should in the early morning hours and before sunrise (low temperature).
- The labourers who pick flowers should be healthy, particularly their hands should be clean and they must not have any skin disease or infection.

3.3.

Question and Answer

- **Why didn't my bulbs bloom this fall?**

There are only a few reasons that bulbs do not flower:

-If the bulbs were planted in the summer than it is normal that in the same year (3 months later) a few bulbs are flowering.

-If leaves appeared with no flowers, question the source and the storage technique of your bulbs. If you stored the bulbs near apples or in a garage, ethylene may be the cause.

-If there is a hot summer and there is no rain till fall.

3.3.

Question and Answer

- **What should be done with flowering bulbs in spring?** The crocus sativus bulbs should be flowering in fall. If they are flowering in spring they are fake, it is not the real saffron crocus. Remove the plant with bulb and throw it away.

3.3.

Question and Answer

- **How should late-arriving bulbs be handled?** Plant them immediately. Do not attempt to carry them over until fall. Plant in an area where the soil is prepared for saffron farming. When you are expecting a late shipment, you get in contact with the sale company for detail.

3.3.

Processing Saffron

All stages after flower harvesting in order to deliver an acceptable product to the market.

3.4.

Crocus sativus corm and stigma

3.4.

The processing of saffron passes through several stages or procedures

1. Saffron flowers
2. Harvesting
3. Separation of stigma
4. Drying process of saffron
5. Transporting saffron to packing plants
6. Sampling and testing
7. Weighing
8. Packing
9. Sampling and testing of the final product
10. Sale

3.4.

Transportation

- Either straw baskets or clean and dry plastic buckets should be used for the purpose of transporting picked flowers.

- Transportation of flowers should be done in such a manner that flowers do not suffer any damage and are kept safe from pollutants.

3.4.

Transportation

- The piling should be done carefully and flowers should not be pressed while transporting.
- The flowers should be kept at a clean and cool place, far away from sunlight up to the time of separating the stigmas.

3.4.

The Separation of Stigma

- After flower picking the separation of the stigma should start as early as possible otherwise the rapid decay of the flower makes it useless.
- The place where the separation work is done must be clean and hygienic.

3.4.

Forms in Separation of stigma

1. Zafrab-e-Dasta (handled saffron)

-The three-branched stigma along with the style is separated.

-They are placed in order on each other.

-They are dried in the same manner.

3.4.

Forms in Separation of Stigma

2. Sar-Gol (saffron from the top of the flower)

-When the flowers are picked, the style and stigma are separated.

-The stigma is cut at the point where it is joined with the style.

-Each one is collected separately and dried.

3.4.

Forms in Separation of Stigma

3. Zafran-e-Pushali (straw saffron)

-The three-branched stigma along with a small part of the style gets separated from the other parts of the flower.

-This is placed in a clean vessel to dry.

-The length of each style along with the stigma depends upon the quality of saffron and the requirements of the customer (varies from 1 to 10 mm)

3.4.

Drying saffron

- To keep saffron preserved for a longer period of time, it should be dried.
- The process of drying has great effect on the quality and the value of the final product.
- There are different ways to dry saffron.

3.4.

Recommendation for drying

- Indirect heat should be used to dry saffron
- That process of drying should be chosen which takes the shortest time.
- At the time of drying, the temperature should be uniformly maintained and it should not go higher than 60 degrees.
- Metal surfaces and unhygienic plates should not be used for drying purposes.
- The final moisture content of saffron, i.e. when the drying process is over, should not be more than 10%.

3.4.

Iranian method of drying

- When the stigma and style are being separated from the flower, it is spread in rows either on cloth or a piece of paper and is dried in the shade.
- This system is not free from defects.
- Is takes a longer time to dry, which increases the probability of growth of micro organisms and also pollution.

3.4.

Spanish method of drying

- Silken net sieves of 30 cm diameter are being used
- The fresh stigma is placed in layers of 2-3 cm thick on the net.
- After that the sieve is held above a heating system at a proper distance.
- The sieves are placed one upon the other in rows and their position is changed.
- With this process the product dries uniformly and evenly.

3.4.

Indian method of drying

In India saffron two methods are being used:

1. The stigma and style are separated from the other parts of the flower and are then placed directly in sunlight. It takes 3-5 days to evaporate the moisture till the water content of stigma reaches 10-12%.
2. The whole flower is dried in sunlight rather than drying the stigma and style. After that the stigma is separated from the flower by hand.

3.4.

Electric oven for drying

- Drying saffron in electric ovens
- The temperature of these oven can be regulated from 50 to 60 degrees
- These ovens are equipped with special trays on which silken nets are placed.
- In this system the saffron is kept in layers of 1-2 cm thickness for a period of 30-40 minutes while the saffron dries in the oven.

3.4.

Packing and Storage

- After saffron is dried and sorted, it is ready for packing and display.
- For storage pay attention to:

-The moisture of the product and the relative humidity of the store.

-The temperature of the place where saffron is kept

-Light, particularly direct sunlight

-Oxygen

-Type of container

3.4.

Packing and Storage

- The storage conditions of saffron have great effect on the balance of colour and smell
- Storage temperature should be kept low to keep quality
- If the moisture content of the product is less, the quality of saffron is better
- When the saffron is well maintained, the number of micro organisms reduces gradually (saffron is strongly polluted by micro organism)

3.4.

Packing of Saffron

- Method of packing has effect to maintain the colour, taste and aroma of saffron.
- Different types of packing:

  -glass bottles

  -low density polythene

  -high density polythene

  -layered aluminium foils
- Glass bottles and polythene preserve the quality better than layered foils.

3.4.

Drying Saffron

3.5.

Drying saffron

- A dehydration post-harvest treatment is necessary to convert Crocus Sativus stigmas into saffron spice
- The process of drying has great effect on the quality and the value of the final product.
- There are different ways to dry saffron.

3.5.

Drying saffron

- During the drying process, the stigmas lose about 80% of their weight.
- Drying brings about the physical, biochemical, and chemical changes necessary to achieve the desired attributes of saffron.
- This process also plays an important role in preserving the spice.

3.5.

Drying saffron

- A lower moisture content, at least below the 12% value established by the International Standard ISO 3632 (1), maintains the quality of the product for a longer time.

- The drying process differs from country to country as a result of the experience gained through trial and error and the resources that are available.

3.5.

Saffron Dehydration Process

Different dehydration treatments:

-dehydration at room temperature

-dehydration with hot air at different temperatures

-dehydration with different heating sources (following traditional processing in Spain).

3.5.

Dehydration at room temperature

- In India, the stigmas are solar-dried for 3-5 days until their moisture content is reduced to 8-10%.
- In Morocco, the stigmas are spread on a cloth in a very thin layer and dried under the sun for several hours or in the shade for 7-10 days.

3.5.

Dehydration with hot air at different temperatures

- In Italy, drying is carried out by spreading the stigmas in a sieve placed about 20 cm above live oak-wood charcoal.
- Halfway through dehydration, the stigmas are turned to ensure uniform drying.
- The process is considered to be finished when saffron stigmas do not crumble and still possess a certain amount of elasticity when pressed between the fingers.

3.5.

Dehydration with hot air at different temperatures

- In Greece fresh stigmas and a part of the stamens are spread on shallow layer trays of 40x50 cm with a silk cloth bottom. These trays are piled on frames with shelves 50 cm apart.
- During the first hours of the process, the room temperature is maintained at 20 °C and then increased to 35-40 °C ; relative humidity should not exceed 50%.
- The dehydration process is finished when a moisture content of 10-11% is achieved, generally after 12h.

3.5.

Dehydration following traditional processing in Spain.

- In Spain saffron is drying by a process called "toasting".
- Stigmas are placed on a sieve with a silk bottom that is placed over the heating source, which can be a gas cooker, a live vineshoot charcoal, or an electric coil.
- The process is finished when the sample has lost between 85 and 95% of its moisture, after being gently dried at 35 °C for 30 min.

3.5.

Saffron Dehydration Process

- Samples dehydrated following the traditional process had higher colouring strength than samples dehydrated using hot air procedure.
- The highest colouring strength was achieved by the sample dehydrated over vineshoot charcoal.

3.5.

Saffron Dehydration Process

-From a chemical point of view, differences between the samples dehydrated at low and high temperatures, under sunlight or in shade, can be explained as photochemical degradation, or isomerization of the carotenoids responsible for saffron colour may take place.

3.5.

Saffron Dehydration Process

-The time required for the dehydration process is as important as the temperature reached.

-If saffron with the highest colouring strength is desired, it is better to submit it to a higher temperature and lower times.

3.5.

Saffron Dehydration Process

- The dehydration rate may therefore also be responsible for higher colouring strength, probably due to the significant changes in the structural properties of the material when water is removed.

3.5.

Saffron Dehydration Process

- In the early stages of the dehydration process, the cellular tissues are elastic enough to shrink into space left by the evaporated moisture, creating the final rigid network as the process proceeds.
- If the process takes place rapidly, the intracellular interstices are not filled and the vegetable material results in a more porous material, affecting the quality of the final product.

3.5.

Conversion to Organic Farming

Organic Saffron Cultivation

PHYSIOLOGIKE

ECO - QUALITY GUARANTEE

Nr.: 040202002

Master Certificate of Organic Production

Cooperative De Safran

GR 50010 Krokos Kozani , (Reg.Nr. MAK-OF-003)

Organic Greek Red Saffron

According to valid inspection contract, a.m. Operator is under inspection following requirements of C.Reg.(EEC) 2092/91 by officially authorized inspection body

PHYSIOLOGIKE ltd. (EL-BΓ-003)

Alexandria 4th February 2002

4.1.

Conversion to Organic Farming

- Social aspects

Farmers compare their personal values with the principles of organic farming.

- Technical aspects

Soil, nutrient and weed management, pest and disease control etc.

- Economic aspects

Investments, labour requirement, lower quantity of production, new marketing channels.

4.1.

Questions before a conversion

- Which adaptations are required on the farm?
- Which difficulties can be encountered in the production?
- How can we cope with the additional work load?
- Can we make necessary investments?
- Which economic problems are to be expected?
- Can we manage to pass the conversion period?
- Who can support and advise us?
- Who will buy or market my organic products?
- How can we get prepared for the conversion?

4.1.

- Organic Standards are regulations that describe which practices are to be followed and which practices are allowed or not allowed in organic agriculture.

- Organic Certificates are provided when a product is produced following the organic standards. This certificate proves to customers that the product they buy is organic.
  To get an Organic Certificate the farms are inspected.

- Organic conversion takes time. Farmers who never used chemicals before have to be monitored for one year (sometimes longer) to prove that they follow organic standards. Farmers who did use chemicals have to be monitored for at least three years, to prove that they stopped using chemicals and to give the chemical residues time to disappear from the soil and water.

4.1.

History of Certification

- First organic products were bought directly from the farm by the customers.
- As market grew and retail outlets developed in cities the customers were separated from the supplier and the customers could not know if the products were really organic.
- Thus a need arose for an independent body to certify that the product was really organic.

4.1.

Development of Certifying Bodies

- First Certifiers developed as National bodies.
- KRAV (Swedish)
- IMO (Swiss)
- Skal (Dutch)
- Soil Association (British)

4.1.

IFOAM

International Federation of Organic Agriculture Movement

- Sets international standards for the certifying bodies.
- Approves certifying bodies.

4.1.

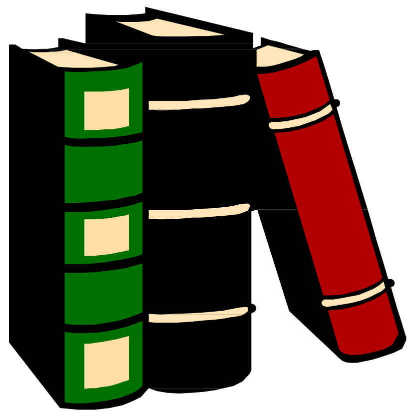
What the IFOAM Basic Standards say on conversion

- All crop production and animal husbandry on the farm should be converted to organic management.
- Step by step conversion is only possible with a clear plan and when production units are clearly separate and inspectable.
- Standards requirements shall be applied from the beginning of the conversion period onward.
- Start of conversion period is calculated from the date of application to the certification body (exceptions possible).
- Converted land and animals shall not get switched back and forth between organic and conventional management.
- Duration of the conversion period: for annual crops standards must be met at least for twelve months before the start of the production cycle; for perennial plants at least eighteen months before the first harvest.
- Declaration «in conversion» is possible, when the Standards requirements have been met for at least twelve months.

4.1.

Certification Systems

- **On large farms**
- Direct between certifier and farmer
- **Small Holder Farms**
- Via exporter
- Exporter Internal Control System.



4.1.

Internal Control System (ICS)

- A system developed by the exporter to ensure that the crop meets the international Organic Standards and is a genuine product.
- The system design is inspected by the certification organization.
- The system implementation is inspected and monitored by the certification organisation.

4.1.

What does the certifier need to know to certify

- Who has produced the crop? (*Registration*)
- Where is the producer? *(Mapping)*
- Did the producer sell what was expected? *(Yield Estimates)*
- How did the produce get from the farmer to the exporter? *(Buying Records)*
- Where has the produce been stored on the way? *(Store Registration)*

4.1.

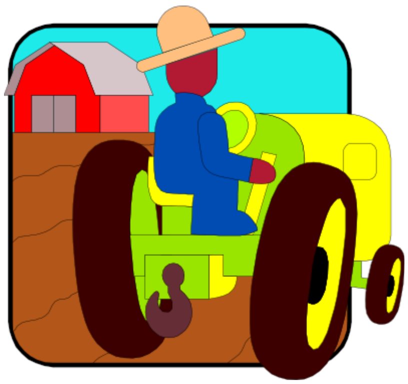
What dose the certification organisation need to know

- Where did the produce come from (is there any risk of contamination)
- Who collected the produce (is there any chance of non-wild/organic produce being infiltrated)
- Where was the produce stored (any risk of contamination or infiltration).

4.1.

Certification of the Farmer

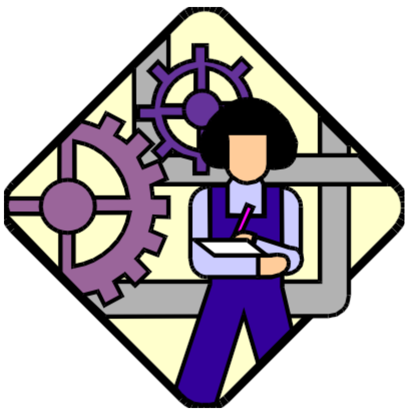
- Is the farmer using artificial fertilizers?
- Is the farmer using artificial insecticides?
- Is the farmer using artificial herbicides?
- Is the farmer growing crops in a sustainable manner?
- Are the workers being exploited?



4.1.

Certification of the Processor

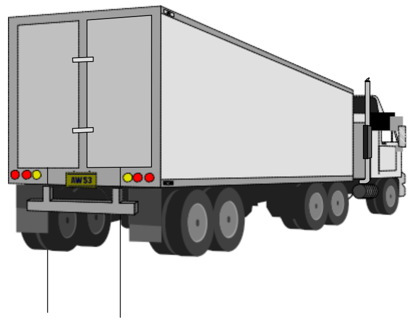
- What substances are used in the processing?
- What is the risk of contamination or infiltration?
- When is the produce processed?
- Where is the produce stored after processing?



4.1.

Certification of Exporter

- How did the exporter get the produce?
- Where has it been stored?
- How and when was it transported?
- Where was the produce delivered to?



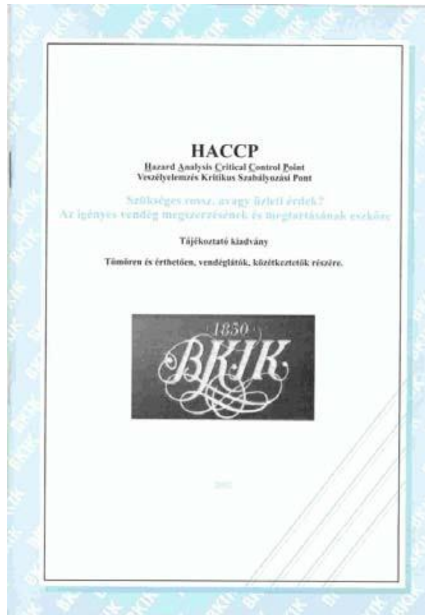
4.1.

Inspections

- Check if the records are correct
- Verify by interviews with the farmers if the farmers are organic
- Confirm by soil and leaf samples
- Check stores, including taking dust samples
- Check the processing

4.1.

HACCP in organic processing



4.2.

HACCP

H = Hazard

A = Analysis

C = Critical

C = Control

P = Point

4.2.

HACCP is a system which identifies, evaluates, and controls hazards which are significant for food safety

4.2.

The HACCP System

- Is Systematic
- Identifies specific hazards and measures for their control
- Focuses on prevention
(rather than relying mainly on end-product testing)
- Requires full commitment and involvement of management and workforce
- Can be applied throughout the food chain
("from farm to fork")

4.2.

Why HACCP?

Globally there has been an increasing demand for HACCP to reduce food borne incidents caused by contaminated products that have implications for human health, and increased costs to the supplier and to the community

4.2.

The Major Causes of Food Borne Incidents are:

- Contaminated raw materials
- Mishandling raw materials
- Change in product formulation
- Change in the product process
- Cross-contamination
- Inadequate cleaning
- Inadequate maintenance
- Addition of incorrect ingredients

4.2.

The Benefits of HACCP...

- Applied throughout the food chain
- Reduces food poisoning incidents
- Meets food quality and regulatory requirements
- Meets commercial requirements
- Helps to improve business (productivity)
- Forms the basis for a food quality system
- Helps demonstrate due diligence

4.2.

Hazards (Food Safety)

A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect

(CODEX definition)

4.2.

Hazards (Quality)

A quality hazard is a factor that has the potential to cause an adverse affect on product or process quality and hence profitability

4.2.

Food Safety Hazards

1. Biological
2. Chemical
3. Physical

4.2.

Biological Hazards

The 5 types of biological hazards

- Bacteria - (Clostridium spp., Salmonella spp., Listeria monocytogenes)
- Viruses - (Hepatitis, Rotavirus)
- Fungi - (Aspergillus spp., Fusarium spp.)
- Parasites - (Fasciola hepatica, Giardia lamblia, Med. fly)
- Algae - (dinoflagellates, blue-green algae, golden-brown algae)

4.2.

Factors Affecting the Growth of Biological Hazards

Intrinsic Factors

- pH
- Moisture content
- Nutrients
- Anti-microbial constituents
- Biological structures

Extrinsic factors

- Temperature
- Humidity
- Gases

4.2.

Chemical Hazards

Chemical compounds are used frequently in the food supply chain and can present food safety risks if their use is not managed:

- Cleaning Chemicals
- Pesticides
- Allergens
- Toxic Metals
- Nitrites, Nitrates &N-nitroso compounds
- PCB's
- Chemical Additives

4.2.

Physical Hazards

Physical hazards are objects not normally found in food that may cause illness or injury to the consumer:

- Glass
- Metal
- Stones, twigs, leaves
- Wood
- Pests
- Jewellery
- Plastic

4.2.

Quality Hazards

Quality Hazards can cause food products to fail to meet agreed finished product specifications, but do not cause illness:

- Product Quality hazards
- Environmental hazards
- Animal welfare hazards
- Production hazards
- Occupational health and safety hazards
- Regulatory hazards

4.2.

HACCP Pre-requisite Programs

HACCP pre-requisite programs (or HACCP support programs), are control measures that are important in reducing the likelihood of hazards occurring, and can take place before or during production.

4.2.

HACCP Pre-requisite Programs

- GAP - Good Agricultural Practices
- GMP - Good Manufacturing Practices
- Calibration
- Cleaning and Sanitation
- Premises and Equipment
- Water Quality

4.2.

HACCP Pre-requisite Programs

- Product Identification & Traceability
- Product Recall
- Pest Control
- Training
- Approved Suppliers

4.2.

DIAGRAM 1

LOGIC SEQUENCE FOR APPLICATION OF HACCP
(CODEX GUIDELINES)

The 12 Steps

The Seven (7) HACCP Principles

1. Assemble the HACCP Team
2. Describe Product
3. Identify Intended Use
4. Construct Flow Diagram
5. On-site Verification of Flow Diagram
6. List all Potential Hazards **Conduct Hazard Analysis** **Determine Control Measures** — *Principle 1*
7. Determine CCPs — *Principle 2*
8. Establish Critical Limit for Each CCP — *Principle 3*
9. Establish a Monitoring System for Each CCP — *Principle 4*
10. Establish Corrective Action for **Deviations that may occur** — *Principle 5*
11. Establish Verification Procedures — *Principle 6*
12. Establish Record Keeping and Documentation — *Principle 7*

Codex Guidelines Step 1 (a)

Define the Scope & Purpose of the HACCP Plan

4.2.

Scope

The Scope of the HACCP plan defines the product, the start and the finish of the process under HACCP study.

4.2.

Purpose

The Purpose of the HACCP plan defines the reason/s why you are implementing HACCP.

4.2.

Codex Guidelines Step 1 (b)

Assemble the HACCP Team

4.2.

The HACCP Team

„ Develops and drives the company HACCP or food safety policy
„ Ensures the HACCP project continues to move forward and remains valid
„ Elects a HACCP team leader
„ Reports on Progress Regularly
„ Ensures a correct balance of technical/industrial experience
„ Assesses the need for specialist expert knowledge and
„ Engages this resource as required

4.2.

Team Requirements

Specialist knowledge may be required of:

- Raw materials and ingredients
- Finished product
- Processing equipment
- Processing procedures
- Pre-requisite programs
- The production environment (premises and surroundings)

4.2.

Management Commitment

- Provide resources
- Approve and drive the company HACCP or food safety policy
- Approve the business issues and ensure the project continues to move forward and remains valid
- Appoint a Project Manager and HACCP team
- Ensures adequate resources are made available to the HACCP team
- Establishes a progress reporting procedure
- Ensures that the project plan is realistic and achievable

4.2.

Codex Guidelines Step 2. Describe the Product

Step 2: Describe the product providing details of its composition, physical /chemical structure, packaging, safety information,processing treatments, storage and method of distribution.

4.2.

Codex Guidelines step 2

A full description of the product should be drawn up, including relevant safety information such as:

- Composition,
- Physical / chemical structure
- Mode of preservation (e.g. heat treatment, freezing, brining, smoking etc.)
- Packaging and Durability (shelf life)
- Storage conditions

4.2.

The product description contains the following information:

- Product name
- Composition
- End Product Characteristics
- Method of Preservation
- Packaging - Outer
- Packaging - Inner
- Storage Conditions
- Distribution Method
- Shelf Life
- Special Labeling
- Customer Preparation

4.2.

Exercise

- Produce a production description for one of your products

4.2.

Codex Guidelines Step 3

Identify the intended use of the product and its target consumers with reference to sensitive sectors of the population.

4.2.

Codex Guidelines Step 3

- The intended use should be based on the expected, normal uses of the product by the end user or the consumer.
- In specific cases, vulnerable groups of the population: e.g., the old, the very young, the sick or hospitalized have to be considered.

4.2.

There are five sensitive or vulnerable groups in the population:

The:

- Elderly
- Infants
- Pregnant
- Sick
- Those with compromised immune systems

4.2.

Sensitive Population

Include in the Product Description and Intended Use:

- The product is intended for "General consumption"
- The product will be consumed by one of the sensitive groups in the population, e.g., infant formula marketed for infant consumption.

4.2.

Exercise

- Identify the intended use for the same product

4.2.

Codex Guidelines Step 4

Construct a Process Flow Diagram covering the full scope of the HACCP study.

4.2.

Codex Guidelines Step 4

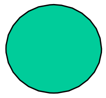
- The flow diagram should be constructed by the HACCP team, with the help of the people working in the immediate areas.
- The flow diagram should cover all steps in the operation.
- When applying HACCP to a given operation, consideration should be given to steps preceding and following the specified operation.

4.2.

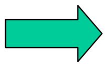
The process flow diagram should depict:

- Details of all process activities including tasks, inspections, transportation, storage and delays in the process.
- Inputs into the process in terms of raw materials , packaging, water, and chemicals.
- Outputs from the process e.g., finished product, waste product - in - progress, re-work and rejected products.

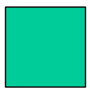
4.2.



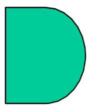
Operation
An operation occurs when a material is intentionally changed in any of physical, sensory, chemical or microbiological properties which brings it nearer to completion e.g., mixing ingredients, cooking.



Transportation
Transportation occurs when a material is moved from one remote location to another without any changes to its properties.
e.g., transferring grain from the harvester to a silo.



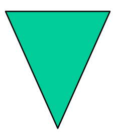
Inspection
An inspection occurs when a material is examined to check its identity, the quantity, or its quality. It helps to control the process but it does not change the material (i.e., is not an operation).
e.g., checking the use-by date, weight.



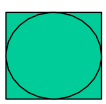
Delay
A delay occurs when conditions do not permit you to immediately perform the next part of the process.

A delay is an uncontrolled aspect of the process.

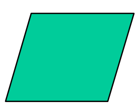
4.2.



Storage
Storage occurs when a material is deliberately kept for a period of time.
e.g., raw materials are kept in the storage area.



Combined Activity
This occurs when two or more activities are performed at the same time.



Process Input/Output
Raw materials, packaging, water, chemicals, etc., that will be an input at a process step.

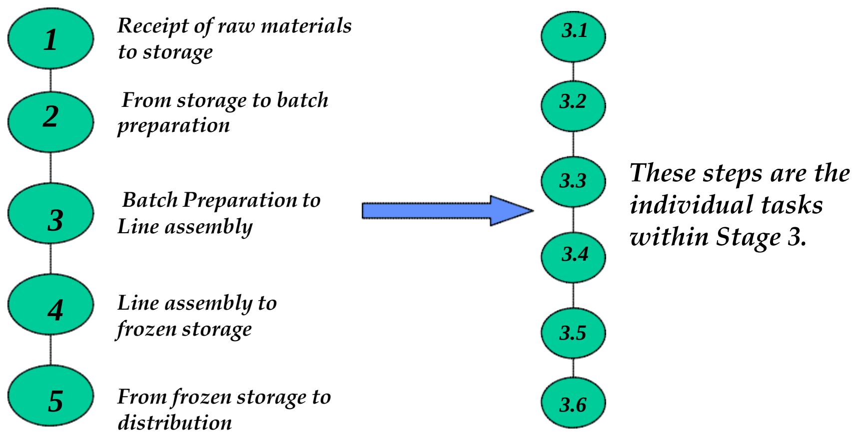
Whichever flow chart style is chosen, one must be careful to ensure that no steps are omitted. It is very easy to miss steps when different teams are developing different flow charts for the one process, or different organizations in the food chain are developing their own HACCP plans.

4.2.

Scope: Receipt of Raw Materials to Destination of Finished Goods

STAGES: ***STAGE 3: Batch Preparation to Line Assembly***

STEPS



4.2.

Exercise

- Construct a flow diagram for the same product

4.2.

Codex Guidelines Step 5

The HACCP team should confirm the process against the flow diagram during hours of operation and amend the flow diagram where appropriate.

4.2.

Verify the Process Flow Diagram
A HACCP team responsibility

- Observe process flow
- Sample activities
- Conduct interviews
- Cover all Routine / non-routine operations

4.2.

Codex Guidelines Step 6, HACCP Principle 1

- List all potential hazards associated with each step;
- Conduct a hazard analysis; and determine the significance of each hazard.
- Consider any measures to control identified hazards.

4.2.

Part A. Hazard identification

List All Potential Hazards

4.2.

Sources of Potential Hazards

1. Raw materials
2. Plant and equipment design
3. Intrinsic factors in the product or raw materials
4. Process design (Procedures)
5. Personnel (Staff / Visitors)
6. Storage and distribution

4.2.

Exercise

- Use the flow diagram to identify potential hazards in the process
- Think of Biological, Chemical and physical hazards

4.2.

Part B. Hazard evaluation

Conduct Hazard Analysis and Determine the Significance of the identified Hazards

- Determine Likelihood of occurrence
- Determine Severity Influence of Prerequisite Programs
- Determine Significance

4.2.

A significant hazard has the potential to cause serious illness or injury when the food-stuff is consumed.

4.2.

Part C. Identify Control Measures

- Control Measures are any factors, actions and activities that can be used to control an identified food safety or quality hazard.
- Control measures must eliminate, control or reduce the effect of a hazard to an acceptable level

4.2.

Control measures for Biological hazards

- Pasteurisation - application of time/temperature
- Fermentation
- Acidification - ph control
- Pickling - addition of salt
- Drying - Aw reduction
- Freezing/cooling
- Training to prevent cross contamination

4.2.

Control Measures for Chemical Hazards

- Supplier Quality Assurance Programs
- Certificate of Analysis - signed and meet specification
- Sanitation Program - approved food grade chemicals, visual inspections
- Pest Management Program - approved pesticides
- Antibiotic Testing
- Correct Labels - for products containing allergens

4.2.

Control measures for Physical Hazards

- Sieves - use nitex (not metal wire)
- Screens
- Magnets
- Filters
- Metal Detectors
- Glass Control Policy
- Good Manufacturing Practices - personal hygiene procedures
- Use of Plastic (not Wooden) Pallets.

4.2.

Exercise

- Use the flow diagram with the potential hazards and determine the control measures

4.2.

Codex Guidelines Step 7 – HACCP Principle 2: Determine the Critical Control Points (CCPs)

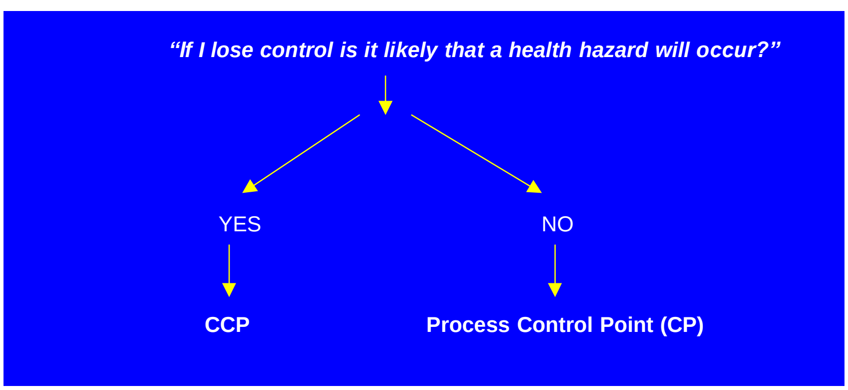
- A Critical Control Point (CCP) is a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.
- A “must do”

4.2.

Critical Control Points

- For every significant hazard identified during hazard analysis there must be one or more Critical Control Points (CCPs) where the hazard is controlled
- A CCP can be used to control more than one hazard. Likewise, more than one CCP may be needed to control one hazard.

4.2.



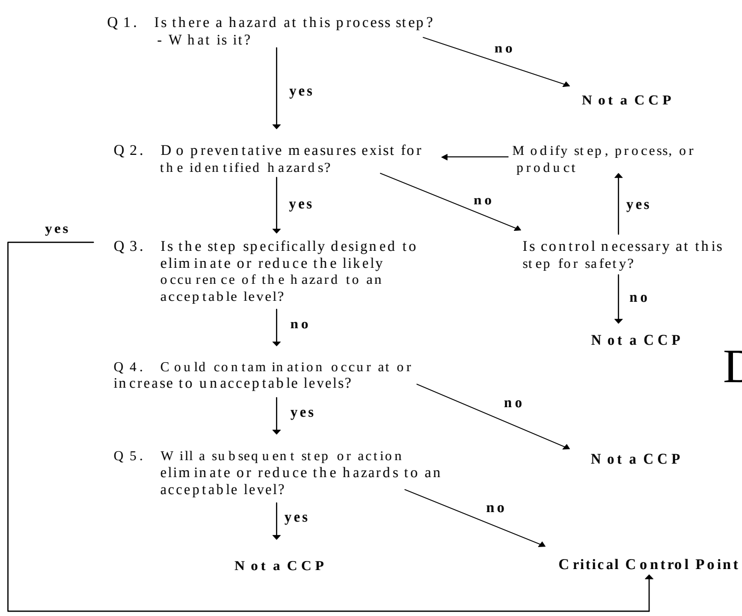
4.2.

CCP Decision Tree

A logical sequence of questions that is applied to each hazard in order to aid in the determination of CCP's and CP's.

4.2.

CCP Decision Tree



4.2.

Raw Material Decision Tree

Q1. Is there a significant hazard associated with this raw material?

- **no** → **Not a CCP**
- **yes** ↓

Q2. Are you or the customer going to process the hazard out of the product?

- **no** → Sensitive raw material. High level of control required. **CCP**
- **yes** ↓

Q3. Is there a cross contamination risk to the facility or to other products which will not be controlled?

- **no** → **Not a CCP**
- **yes** ↓ Sensitive raw material. High level of control required. **CCP**

4.2.

Food safety and quality descriptors

FOOD SAFETY	CCP: Critical Control Point	Contorl measure(s) that must be in place to address food safety of significance
	CP: Control Point	Conrol measure (s) that are in place to address food safety hazards of lesser significance
QUALITY	CQP: Critical Quality Point	Control measure (s) that must be in place to address food quality issues of significance.
	QP: Quality Point	Control measure (s) that are in place to address food quality issues of lesser significance.

4.2.

Codex Guidelines Step 8: HACCP Principle 3

Establish Critical Limits

4.2.

What is a Critical Limit?

- Critical limits are criteria which separate acceptable from unacceptable, safe from unsafe.
- They are the tolerance parameters for safety or product acceptance; the boundaries of control.

4.2.

Codex Guidelines

- Critical limits must be specified and validated for each critical control point.
- In some cases more than one critical limit will be elaborated at a particular step.
- Criteria often used include measurements of temperature, time, moisture control measures for Quality Hazards, pH, etc. Sensory parameters such as visual appearance, maturity indices and texture can be used.
- For quality hazards

4.2.

Critical Limits

- Must be applied to all CCP’s and CQP’s
- Must be validated
- Must be measurable

4.2.

Types of Critical Limits

- Physical limits
  - time, temp, weight, grade, brix, absence of metal/wood/glass
- Chemical limits
  - pH, moisture, salt, sugar, fat, residues
- Microbiological limits
  - food standards code
  - $<10^6$ Total Plate Count /ATP
- Quality Limits
  - number, size and type of blemishes present in product

4.2.

Exercise

- Use the flow diagram with the potential hazards and the control measures and set control measures

4.2.

Codex Guidelines Step 9, HACCP Principle 4

Establish a monitoring procedure for each CCP/CQP.

4.2.

Codex Guidelines Step 9, HACCP Principle 4

Monitoring is a the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a critical control point or a critical quality point is under control.

4.2.

Why monitoring is important

- Know when CCP's & CQP's are out of control
- Identify problems before they occur
- Pinpoint the cause of problems
- Part of verification
- Proves due diligence

"If it isn't written down, it didn't happen"

4.2.

Who, How and When to Monitor

- *WHO*
  - *Trained*
  - *Unbiased*
- ***HOW***
  - ***Observation***
  - ***Sight***
  - ***Smell***
  - ***Taste***
- ***Measurement***
  - ***Weight***
  - ***Time***
  - ***Temperature***
- ***WHEN***
  - ***Continuous***
  - ***Discontinuous***

4.2.

Exercise

- Set monitoring procedures for the control measures you have identified

4.2.

Codex Guidelines Step 10, HAACP Principle 5

Specific corrective actions must be delivered for each critical control point (CCP or CQP) in the HACCP system in order to deal with deviations when they occur.

4.2.

Corrective actions

- The actions must ensure that the critical control point (CCP or CQP) has been brought under control.
- Actions taken must also include proper disposition of the affected product.
- Deviation and product disposition procedures must be documented in HACCP records.

4.2.

Corrective Action

Any action to be taken when the results of monitoring at a critical control point, critical quality point, or process control point indicate a loss of control.

4.2.

Exercise

- Set corrective actions for your CCP’s

4.2.

Codex Guidelines Step 11 HACCP Principle 6

Establish procedures for verification to confirm that the HACCP system is working effectively.

4.2.

Verification

•A system or series of systems that are designed to ensure the HACCP plan is working effectively.

•It is the HACCP teams responsibility to ensure verification procedures are in place and they are effective

•Verification schedules should outline the method and frequency of verification

4.2.

Verification

• differs from monitoring in that Monitoring gives us immediate feedback on the process, the CCP's & CQP's.

• is a check on the entire system to ensure it is capable of producing safe, quality food.

4.2.

An Audit...

- Is a systematic and independent examination to determine whether activities and related results comply with planned arrangements.
- To determine whether these arrangements are implemented effectively and are suitable to achieve objectives.

4.2.

Codex Guidelines Step 12: HACCP Principle 6

Record Keeping

4.2.

Record keeping

- Efficient and accurate record keeping is essential to the application of a HACCP system.
- HACCP procedures should be documented.
- Documentation and record keeping should be appropriate to the nature and size of the operation.

4.2.

Records

- Records are written evidence that an act has taken place.
- A form is the template on which the results of acts are recorded.
- A completed form becomes a record.

4.2.

The type of HACCP records that should be kept as part of a HACCP system are:

- HACCP Plan and Support Documents
- Monitoring Records
- Corrective Action Records
- Verification Records

4.2.

HACCP plan
Process category:
Product:

Process step / CCP	*Critical limits*	*Monitoring procedures (who, what, when, how)*	*HACCP records*	*Verification procedures*	*Corrective actions*

4.2.

Standards and Quality Control of Saffron

4.3.

Saffron Product

Saffron is an apparently simple product, but its characteristics are complex.

- High quality, cost effective production requires close attention to detail.
- Quality can be disguised and cheating is common.

4.3.

Product: Conditions for Good Quality

- Picking flowers in early morning before they wilt
- Careful separation of stigmas from flowers and styles
- Careful drying (to 12% moisture)
  - (Too much moisture, spoil, mould)
  - (Too little moisture, brittle threads and weight loss)
- Proper packing (to preserve moisture level and attract consumers)

4.3.

Product: Objective Quality Criteria

- Examples from ISO, especially ISO 3632
- Moisture 12%
- Floral waste: 0.5%
- Extraneous matter (e.g. dust): 0.1%
- Solubility in cold water 65%
- Flavour (picrocrocine) 70*
- Aroma (safranal) 20-30*
- Colour strength (crocine) 190*

*spectrophotometer reading in nm

4.3.

Standards and Quality Control

- Saffron is a very expensive spice, it is therefore important that the quality of the product matches national and international standards.
- The quantity of colouring strength, flavour, aroma and smell of saffron is now measurable using spectrophotometry.

4.3.

Standards and Quality Control of Saffron

- The most important pigment of saffron is crocin and is one of the best colouring agents of food industry.
- The main factor in saffron flavour is a colourless glycoside namely picrocrocin. This compound changes during drying and storage of saffron in safranal (responsible for aroma and smell).

4.3.

The testing standards ISO

- The testing standards for saffron are written by the International Organization for Standardization (ISO).
- Saffron types are graded by quality according to laboratory measurements of such characteristics as crocin (colour), picrocrocin (taste), and safranal (fragrance) content.
- Other metrics include floral waste content (i.e. the saffron spice sample's non-stigma floral content) and measurements of other extraneous matter such as inorganic material ("ash").

4.3.

Standards ISO

ISO

- A uniform set of international standards in saffron grading was established by the ISO, which is an international federation of national standards bodies.
- ISO 3632 deals exclusively with saffron. It establishes four empirical grades of colour intensity: IV (poorest), III, II, and I (finest quality).

4.3.

Standards ISO

- Saffron samples are assigned to one of these grades by gauging the spice's crocin content, which is revealed by measurements of crocin-specific spectroscopic absorbance.
- Market prices for saffron types follow directly from these ISO scores.

ISO 3632-1

Table 10-19 *Chemical characteristics of dry filament and powder of saffron based on ISO 3632-1 (17)*

Characteristics	*Requirements*		*Test Methods*
	Filament	*Powder Form*	
Moisture & volatile matter % (m/m) max.	12	10	ISO 3632-1 Clause 9
Total ash % (m/m) on dry basis max.	8	8	ISO 928 & ISO 3632-2 Clause 10
Acid insoluble ash % (m/m) on dry basis max. Categories I & II Categories III & IV	1.0 1.5	1.0 1.5	ISO 930 & ISO 3632-2 clause 11
Solubility in cold water % (m/m) on dry basis max.	65	65	ISO 941
Bitterness expressed as direct reading of the absorbance of picrocrocin at about 257 nm, on dry basis min. Categories I Categories II Categories III Categories IV	70 55 40 30	70 55 40 30	ISO 3632-2 clause 13
Safranal expressed as direct reading of the absorbance at about 330 nm. on dry basis All categories Min. Max.	20 50	20 50	ISO 3632-2 clause 13

(Table 10-19 Contd.)

Saffron standards differ in countries

Scales and standards of saffron in USA

-Dried yellow stamens and extraneous matter of saffron should not be more than 10%.

-When saffron is dried at 100 °C, the volatile and moisture content should not exceed 14%.

-The total ash content should be less than 7%.

-The acid insoluble ash should not be more than 1%.

Based on these standards saffron could be used as natural colouring agent and there is no limitation to use it in food material.

4.3.

Methods of standardization and test of saffron in Spain

All methods of quality measurements classify saffron into six grades:

1. Mancha saffron: The length of stigma must be more than the length of style and the colour strength of this grade must be more than 180 units. The maximum flower content should not exceed 4% by weight.
2. Rio saffron: The length of stigma should be at least equal to style, which is connected to it, the colour strength should be more than 150 units and the extraneous flower component should not be more than 7% by weight.

4.3.

Six grades of saffron

3. Sierra saffron: Length of stigma is less than style, maximum 10% of flower component and colouring strength should not be less than 130 units.

4. Common saffron or Standard: This saffron is a mix of Mancha, Rio and Sierra saffron, colour strength should not be less than 130 units and the remaining flower parts should be less than 7% by weight.

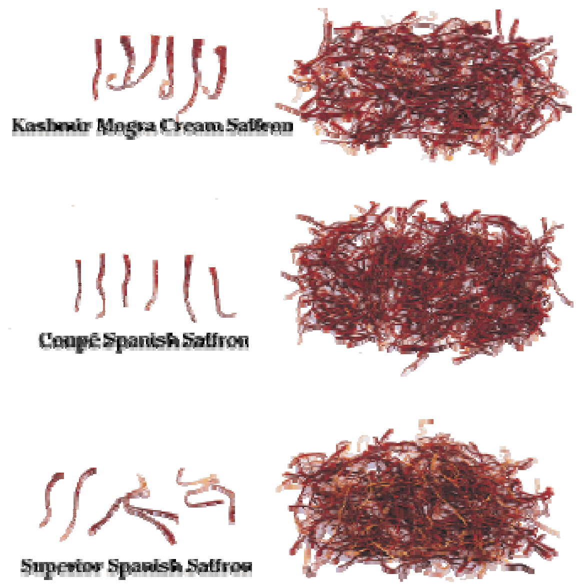
4.3.

Six grades of saffron

5. Cupe saffron: This saffron is free of style and it is pure stigma, minimum colouring strength of this type of saffron should be 190 units.

6. Molido saffron: Is the powder of above types of saffron and it should be mentioned which type of saffron and its specification match with this type of saffron. The moisture content of this saffron must be less than 8%.

4.3.



4.3.

Quality Control

Drying:

- Train and help equip local enterprises to dry saffron for all nearby farmers.

Quality testing:

- There is widespread adulteration (outside Afghanistan) and confusion in judging quality.
- Equip a laboratory in Kabul or an other main centre for ISO testing. (Could be private, earning fees for testing.)

4.3.

4.3.

To establish a separate Afghan brand:

- Quality essential, with ISO certification.
- Get Organic and Fair Trade certifications.
- Show samples in international food fairs.
- Establish an Afghan saffron boutique in Dubai's "Gold Souq".

4.3.

Process flow diagram Saffron

Corms

▼

Storage in crates

▼

NGO: distribution to farmers in rented truck

▼

Farmers planting

▼

Irrigation

▼

Harvesting in baskets

Potential hazards:	Control measure:
• Dirty hands and nails	personal hygiene
• Dirty basket	regular cleaning, basket of right material
• Dust	cover baskets; early morning harvesting
• Temporary storage	limit time span; clean storage
• Sunlight; temperature, dust	early morning harvesting

▼

Separation by hand

Potential hazards:	Control measure:
• Dirty hands	personal hygiene
• Dirty area	clean area and clean cloth
• Damage stigma	training
• Wrong handling	training

▼

Drying stigma on plate/paper/plastic

Potential hazards:	Control measure:
• Underdrying; overdrying	proper equipment
• Dust	good instruction
• Pests	good facilities
• Sick people	refuse at work
• Contamination residues, wood etc.	proper material

▼

Store in glass jar/plastic can

▼

Sell

▼

Middlemen

▼

Storage

▼

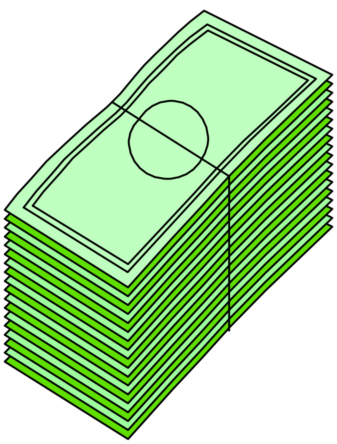
Market

International Organic Markets

- What are they?
- What are the benefits?
- Where are they?
- How did they develop?
- What type of products?
- What is the size and growth of the market?

5.1.

Producer Benefits of Organic Market



- Premium price on produce
- Less competitive market
- Long term producer-consumer relationships
- Sustainable land use
- Clean environment
- Better health

5.1.

Where are the Organic Markets

- **Established in**
- Northern America
- Western Europe

- **Developing in**
- Japan
- Eastern Europe

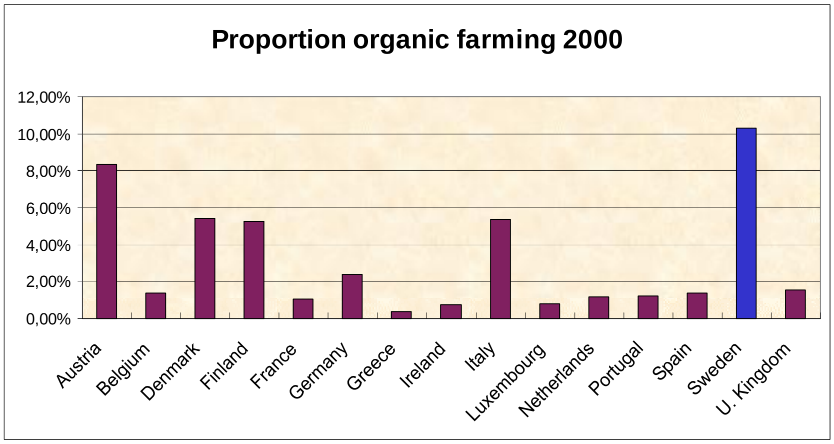
5.1.

Leading countries organic agriculture

Australia	7 700 000
Argentina	3 000 000
Italy	1 002 000
Canada	1 000 000
United States	900 000
Brazil	600 000
Germ any	546 023
U. Kingdom	425 000
Spain	380 838
France	370 000
Austria	345 375
Sweden	320 000
China	200 000
Denm ark	165 258
Finland	147 423
Czech Rep	110 756

5.1.

Proportion organic agriculture



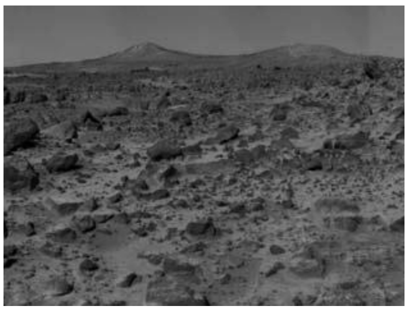
5.1.

History of Organic Markets

- Started in Mid 1960’s, from concern about chemical usage and effects.
- Market limited to small shops off the main street.
- Main market in organic teas, skin oils and medicinal potions.

5.1.

Development of Organic Markets



- In 1980's concern raised about environmental issues.
- End of the 1980's concern raised about social issues.
- More chemical usage concerns.
- In 1990's genetic manipulation concerns.

5.1.

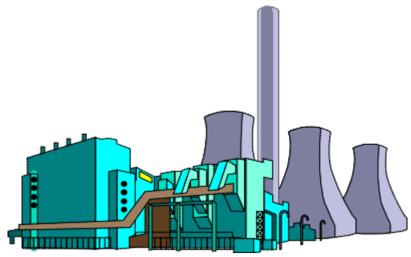
Organic Markets in the 1990's

- Organic section in most supermarkets.
- Large manufacturers advertise the environmental nature of their products.
- Consumers demand organic guarantees on products.
- Consumers willing to pay more for organic products.

5.1.

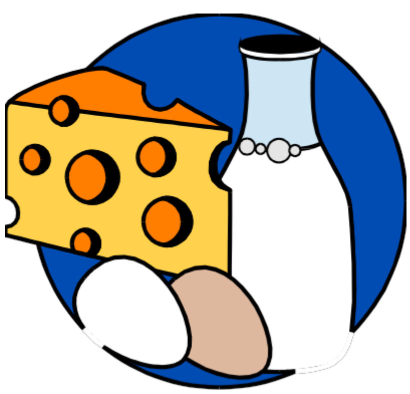
Large Manufacturers

- Levi Strauss *(jeans)*
- Nike *(sports wear)*
- Ikea *(furniture)*
- Volcafe *(coffee)*
- Novatex *(textiles)*
- Sainsburys *(supermarkets)*



5.1.

What type of produce



- Dairy Products
- Poultry Products
- Cereal crops
- Skin care treatments
- Timber products
- Cotton products

5.1.

Organic Market Trends

- Since organic products got into the supermarkets growth has been rapid.
- The environment has become fashionable and large companies want to advertise their commitment to the environment.
- In countries like Sweden 8% of the goods on sale are certified organic.

5.1.

Marketing of Organic Products

5.2.

Overview

- 1 Fact&figures Organics
- 2 Conversion to organic agriculture
- 3 Marketingmix
  - Place (point of sale, distribution)
  - Price
  - Product
- 4 Trends
  - Consumer
  - Retail

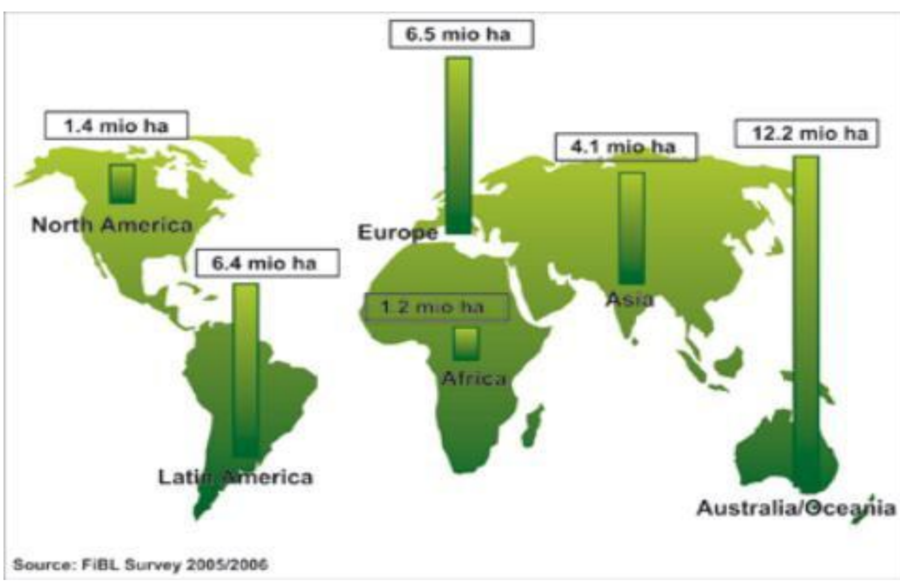
5.2.

Organic Facts& figures

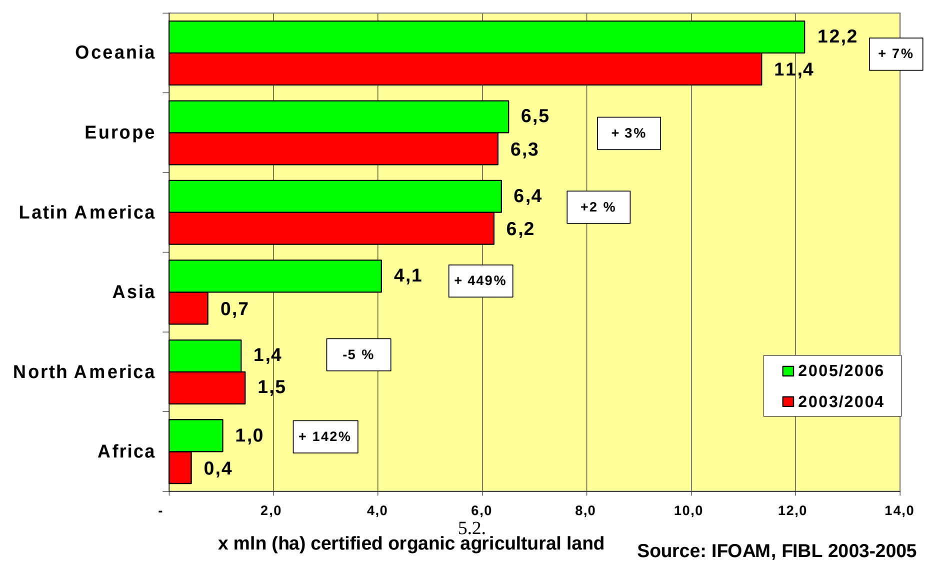
5.2.

Organic Production Worldwide: 31,8 mln ha

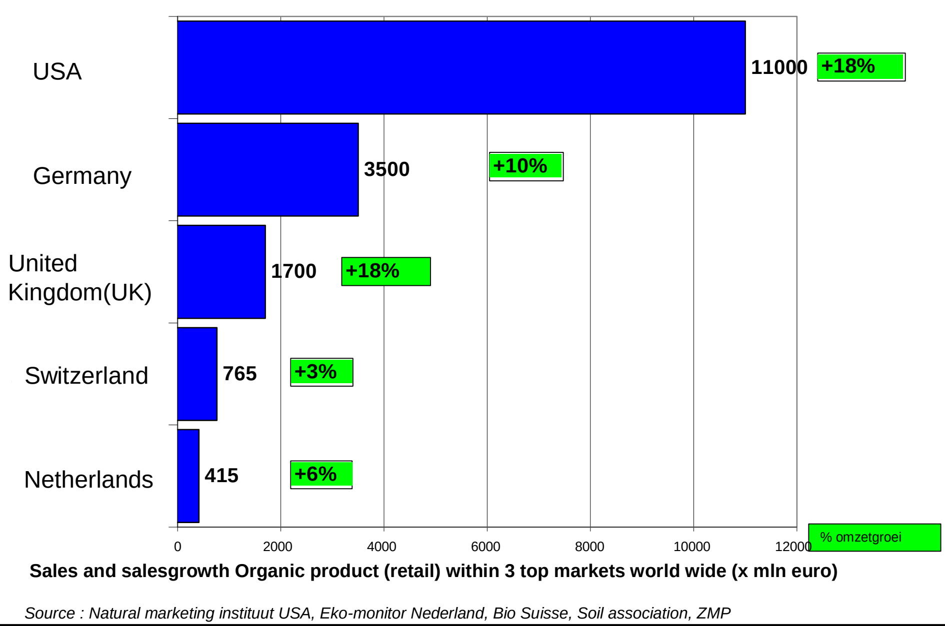
Growth from 26,5 to 31,8 mln: +19%



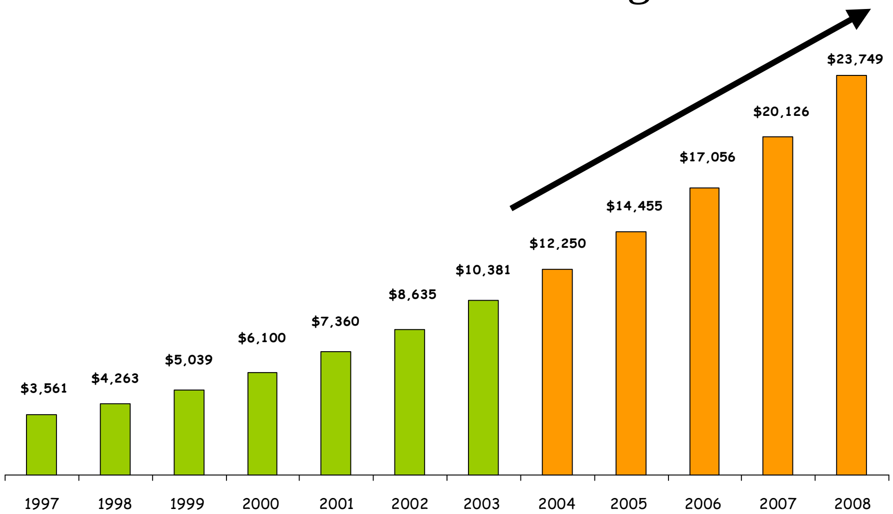
Growth organic area in Asia: +449%



Organic markets growth +9% to 23,5 mrd euro



USA market shows high growth rates and estimations double digit

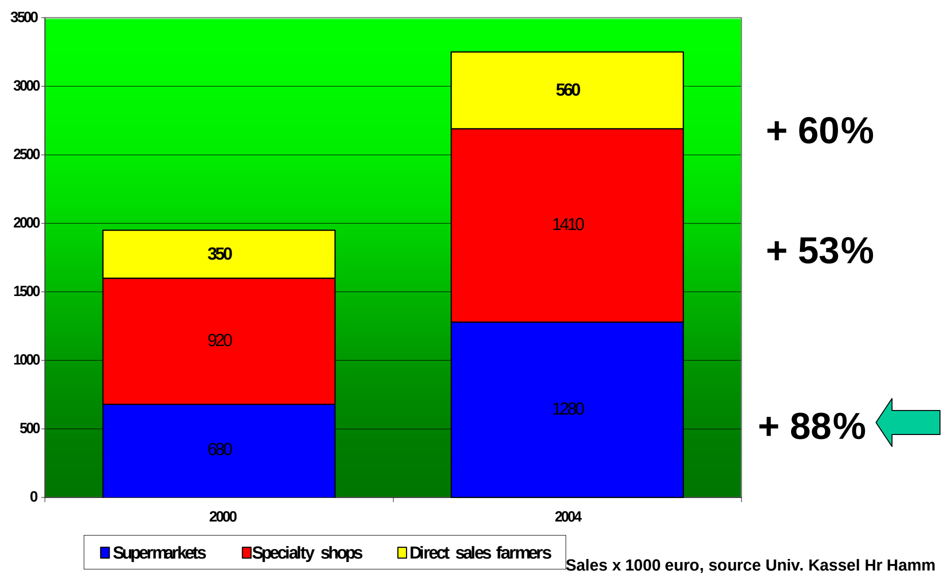


5.2.

Source: OTA's 2004 Manufacturer Survey & Nutrition Business Journal's Organic Industry Model

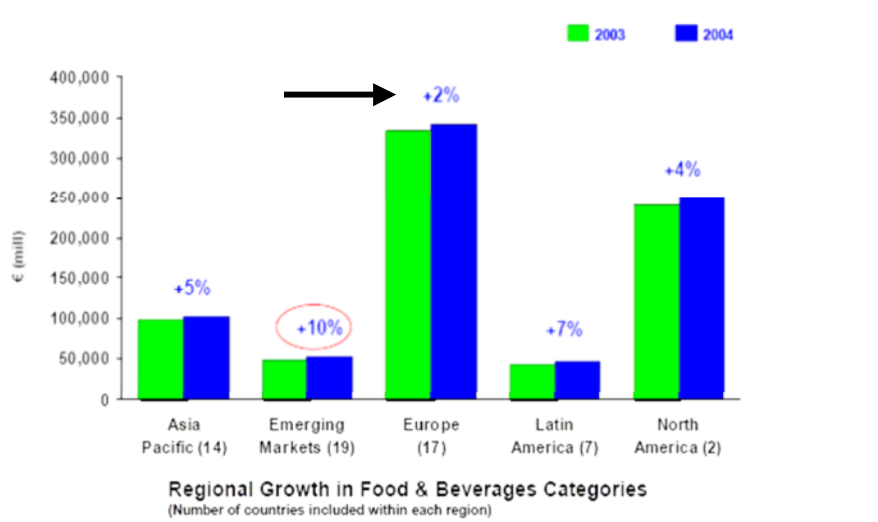
X mln US dollar

Germany Supermarkets shows fastest growth rates:



Sales x 1000 euro, source Univ. Kassel Hr Hamm

“Conventional” food sales just + 2% in Europe



5.2.

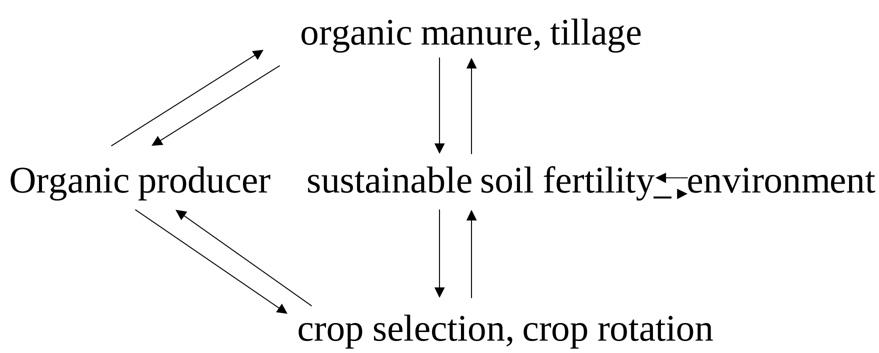
Source: AC Nielsen global

Conclusions Fact&figures

- **Organic area is growing with 19% to 31,8 mln ha**
- **Organic consumer market is growing fast (+9%)**
- **Organic production and the main consumer markets are geographic not equal**
- **There is a growing international trade in organic products**
- **Conventional food sales has slow growth rates**
- **Supermarket chains are more involved in organic**

5.2.

From conventional agriculture to organic food production



5.2.

Living soil

- Basic principle: feed the soil not the plant
- Compost, organic manure and green manure
- Mineral needs for crops are in balance with type and volume of manure
- Application depends on yield level, climate and weather conditions, nitrogen fixation
- Set up a soil fertility strategy

5.2.

Prevention of plant diseases (1)

A plant disease:

is not cause / reason of bad growth

but

the result of bad growing conditions

The plant should fit in its surrounding

This leads to various strategies

5.2.

Prevention of plant diseases (2) Interaction

Plant ⟷ **Environment**

↕

Disease / Symptom

5.2.

Marketing Tools

5.2.

Marketing : Distribution

- Retail:
  - Supermarkets chain
  - Specialty shops (natural, organic)
  - Direct sales from farmer side
- Food Service
  - Restaurants
  - Catering
  - Institutional market(companies)

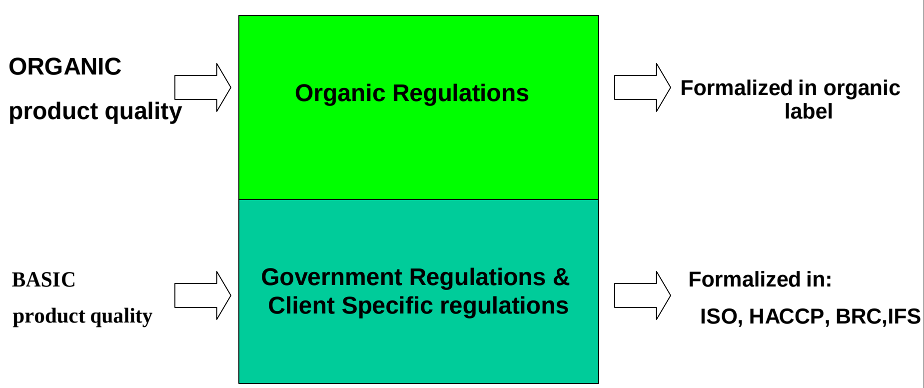
5.2.

Marketing : Distribution

Organic sales by channel within 3 countries (2004)			
channel	**USA**	**Germany**	**Netherlands**
Supermarkets	44%	37%	44%
Specialty shops	47%	40%	46%
Direct sales farmers	9%	23%	10%

5.2.

Marketing: Product 1 Quality



5.2.

Marketing: Product 2
Organic Certification

- **Organic: focus on food quality guaranteed by**
  - **By EC regulations**
  - **By USA NOP regulations**

5.2.

Organic certification

- Rules set by organic movement: IFOAM
- Rules set by regulations (EU, US, Japan)

- Each farmer inspected annually by certifier
- When that is not done:

  Smallholder Group Certification
  using an Internal Control system = ICS

5.2.

Smallholder group certification

- ICS is an internal audit, a quality assurance protocol managed by the project operator itself (co-operative, farmer association or exporter).
- All actors are identified, instructed on the requirements, contracted, inspected and if needed sanctioned by the operator itself.
- The external certification body evaluates whether the internal audit functions well, based on file review and risk assessment and does a number of re-inspections.
- ICS is combined with extension and research

5.2.

Marketing : Price

- Organic is niche market with higher price level: in general 20%-50%
- Market demand is not in line with production:
  - Surplus production is sold in conventional market
- Pricing system :
  - Market driven
  - Cost price driven

5.2.

Farmers price

- Fair trade – fair price
- Farmers need to organize in cooperatives
- Purchase of large volumes of organic products by big supermarkets
- Farmers cooperatives be market- and network orientated
- Farmers cooperatives are able to satisfy the demand of the consumer

5.2.

Trends

5.2.

Consumer Trends

- More “light” users are involved in Organic consumption
- Communication from pure product ”plus” to Organic “values”
- Multi claims also for Organic products
  – Health (planet and person)
  – Convenience
  – Pleasure

5.2.

Retail/Trade Trends

- International raw material trade for growing demand supermarket chains
- More “umbrella” brands used within retail channel
- Local-regional assortment trends
- Fair price

5.2.

Saffron Marketing

5.3.

Saffron Marketing

- The dried stigma of saffron are packed and presented on internal and external markets.
- In the present marketing system, saffron planters would produce premium quality saffron. Due to difficulties with transportation and distribution, producers receive the least profit.
- Domestic users of saffron pay high prices for the product, and the maximum benefit goes to buyers of saffron outside the country.

5.3.

The price of saffron

- Prices have declined due to poor marketing, packaging and distribution of saffron produced in Asian countries.
- When management and distribution fails, the product continues to be ignored, giving countries such as Spain the opportunity to import the spice and sell it expensively in global markets in eye-catching packets.
- The spice is offered at 450-500 dollars per kilo under Iranian brand names while the Spanish are selling it at 1,100 dollars per kilo under their own brands.

5.3.

-Mainly US Internet spice dealers.

-Prices are high and highly variable.

Prices of saffron

Prices taken, 16 May 2005. All prices are for filaments (not powder)

$/€ = 1,2634

1oz = 28.35 g. 1lb = 435.6g

		$/1g	Suppliers location	Source
www.saffron.com	$	1,27	San Francisco, CA, USA	Iran.
www.tienda.com /food/s	$	1,57	Williamsburg, VA, USA	Spain.
www.butcher-packer.co	$	1,23	Detroit, MI, USA	Spain.
www.sfherb.com/cart/w	$	2,05	San Francisco, CA, USA	Spain.
	$	1,01		
www.bulkfoods.com/se	$	1,30	Toledo, OH, USA	
	$	1,17		
www.amazon.com	$	1,57	Seattle, WA, USA	Spain
www.penzeys.com/cgi-	$	8,18	somewhere in the USA	Most from Spain.
	$	4,79		

-Dubai: Saffron dealers in “Gold Souk”.

-Prices are lower but still highly variable.

DH/US$ 3,65

		DH/1g	US$/1g*	Source
Shop 1	red, whole	3	0,82	Iran
Shop 2	crushed red	1	0,27	Iran
	mixed red, yellow	5	1,37	Iran
	red, whole (Khorasan)	3	0,82	Iran
	"Best" (with styles)	6	1,64	Iran
Shop 3	red, whole	3,5	0,96	Iran
	"Second quality"	2	0,55	Spain
Shop 4	SAFINTER (sealed)	4	1,10	Spain
	red, whole	1,9	0,52	Iran
Shop 5	red, whole (Badiee, Zabihi)	1,4	0,38	Iran
Shop 6	red, whole	1,5	0,41	Iran

The price of saffron

Implications of these tables:

- Variability in price due to variability in quality, but also in understanding of quality (adulteration common).
- The US and European markets are clearly better in terms of price.
- To benefit from those prices good direct contacts and a good reputation are necessary.

5.3.

Saffron Marketing

- Since saffron producers act individually the cost of grading, packing and advertising increases and they have to cope with minimum income.
- Lack of coordination is due to lack of having unity and a solid organisation concerning buying, selling, distributing, and packing.
- Because plant producers lack information about demand and supply, market situation and fluctuating costs, some people who are not involved in saffron production gain maximum benefit.

5.3.

Exporting saffron

- Saffron is a traditional export crop in Iran, India, Spain and some other Asian and European countries. Iran with 90% of saffron production is the largest saffron producer in the world.
- Almost 80% of its production is being exported.
- Due to illegal exporting, exact statistics of its export are not available.

5.3.

The problem of exporting saffron

- High contamination by micro organisms: considering the safety standards that exist at international level.
- The presence of competitors: more countries may contribute to the world market in the near future.
- Lack of coordination in production and marketing

5.3.

The problem of exporting saffron

- Saffron adulteration: because of high prices, saffron adulteration resulted in a loss of reputation. The most common type of adulteration is staining the styles with stigma dye or with synthetic colours. Considering the modern analytical an control quality techniques, such adulteration can be identified.
- Improper method of harvesting and processing: results in lower saffron quality and reduction in world demand for saffron

5.3.

The problem of exporting saffron

- Improper display of saffron in word markets: The necessity of exposing saffron standards to acceptable world standards such as ISO Standard.
- The price of saffron in world market is identified by Spain, whilst Iran is with 90% of saffron production the main saffron producer of the world.
- Illegal export of saffron in bulk reduces the price on the word market
- Most people do not know the medicinal properties of saffron

5.3.

Market system

- The current system did not provide support between acreage development and production with marketing and export system.
- Saffron was not distributed through a proper channel and marketing system.
- Some steps such as establishing saffron corporation and stock markets are promising, but their activities require appropriate investments in production, distribution, export and coordination.

5.3.

Market system

- Saffron has a potential market. The question is how Afghanistan can make the most of it.
- Promote high productivity through good corms and other “best practices”.
- Guarantee good fixed prices to farmers and ensure good planting stock.
- Educate local community how to grow and process saffron.

5.3.

Market system

- Build up a separate, high quality Afghan brand to improve potential returns
- Develop links with the companies in the US and Europe (for production and marketing)
- Encourage specialized local enterprises for drying
- Establish a laboratory for ISO certification
- Obtain organic and fair trade certification
- Set up an outlet in Dubai
- Exhibit at international food fairs

5.3.

Extension techniques

Training and Visit

The training and visit system is one of the most widely utilized of all extension techniques. It consists of training sessions for producers to introduce specific technologies and techniques, which are then followed by farm visits to observe their implementation and outcome. The training session can take a number of forms, including producers' meetings, conferences, workshops, and method demonstrations. This has been one of the important models of extension methodologies used. The training and visit system was widely accepted by survey respondents as an appropriate extension technique for cooperatives, private producers, and subsistence producers.

Demonstration farm

Many countries have successfully used demonstration farms. They incorporate two main attributes, namely they recognize the importance of demonstrated success of any new technique and its subsequent adoption by farmers, and the importance of farmer-to-farmer communication. A technology, which has been successfully developed by researchers to the point where there is good potential for success on the farm, is selected for implementation on a co-operator’s farm. The co-operator is selected on his or her willingness to devote space and time to the activity, and with resources to meet particular requirements of the new technology. Implementation of a new technology on a farm in an area with favourable conditions demonstrates to the local producers the viability and potential benefits to be derived from it. Demonstration farms were mentioned by most respondents for all types of producers, and were regarded as one of the most useful extension methodologies.

Farmer Field Schools

In general, Farmer Field Schools (FFS) consist of groups of people with a common interest, who get together on a regular basis to study the “how and why” of a particular topic. The topics covered can vary considerably - from IPM, organic agriculture, animal husbandry, and soil husbandry, to income-generating activities such as handicrafts. FFS are comparable to programmes such as Study Circles, religious studies at a church, mosque or temple, or specialised study programmes for any skill. The FFS, however, are particularly adapted to field study, where specific hands-on management skills and conceptual understanding is required.

Meetings

Producers' meetings are important techniques used by extensionists. They provide a mechanism to transfer information to a group of producers at one time. They also provide a mechanism for mutual support and interchange of ideas among producers.
For work with cooperatives, respondents from Africa and Asia often selected producers' meetings, but in Latin America only Panama used meetings with cooperatives. Educational materials and mass media were widely used for work with cooperatives. Also farmer-to-farmer communications for extension work with cooperatives falls is considered as meetings.
Demonstration farms and meetings are seen as most important for working with commercial producers. However, African respondents are less enthusiastic about demonstration farms for commercial producers.

Educational materials

Educational materials are essential to add an additional element to extension efforts. Newsletters, bulletins, fact sheets, and pamphlets can be passed or mailed to producers without farm visits, and can be used to reinforce information presented at producers' meetings or through farm visits. In societies with a high rate of illiteracy, educational materials must be designed carefully with illustrations, which convey information without relying extensively on text.
Availability of simple written manuals and audiovisuals are important in any extension programme. A series of manuals on the following subjects is recommended: organic production, organic certification, organic markets, soil fertility, manures, irrigation, quality control, processing, pest and disease control, weed control, etc. These manuals should be based completely on experiences within the country.

Mass media

Mass media techniques can be used effectively in almost all countries. In countries with high rates of illiteracy, radio announcements can be extremely effective, and television is becoming an increasingly important means of communication.

Training farmer groups

1. Know your target group.
   – Whom are you training?
   – What is their knowledge?
   – What do you want to train them?
   – How do you make sure these people are participating?
   – What is the motivation of the participants?
   – What is the maximum number of participants?

6.2.

2. Know the objective of the training
   - Define what you want to achieve.
   - What do you feel the participants need training in?
   - Do the participants want to learn this?
   - Check during the training but always at the end of the training if your objectives have been reached.

6.2.

3. Topics to be covered.

– Arrange topics in logical order.
– What are participants expectations and see if those can be included.
– Point out main points participants must remember.
– Use illustrative examples.

6.2.

4. Training methods

– People learn more when they are allowed to see, feel, experience and discover.
– Use different training methods.
– Participants should participate in the training.
– Use resource persons for specific topics.

6.2.

Appropriate timing

- Participants can not concentrate more then 20 minutes.
- Include visual material, exercises, stories, contributions of participants, jokes etc.
- Stick to the timing
- Avoid lecturers after lunch but schedule exercises, games, excursions etc.

6.2.

Training site

- Can all participants see you?
- Can participants interact?
- Are presentation aids available?
- Are there chairs or seats for all participants?
  - Seat arrangements must be comfortable during training.

6.2.

Training aids

- Overhead projector
- Slides / pictures
- Video
- Blackboard/white board
- Coloured papers
- Markers
- Demonstration materials
- Books / reading materials

6.2.

Training methods

- Classical lessons
- Individual work
- Group work
- Presentations
- Participants contributions
- Exercises
- Using cards
- Brainstorming
- Role plays
- Panel discussion
- Excursions

6.2.

Extension Techniques

- Training and visit
- Demonstration farms
- Farmer Field Schools
- Meetings
- Education material
- Mass media

6.2.

Adult education

- Creating awareness
- Transferring knowledge, skills and methods
- Problem solving
- Active involvement

What I hear I forget
What I see I remember
What I tried, I shall know how to do
What I discover, I shall use

6.2.

Adults are in practical life situations	problem oriented
	learn with a goal
	learn what they can use in practice
Adults bring along their experience	have a lot of knowledge
	new information must match with experience
	connection of theory with practice
Adults take part voluntarily and invest their scarce time	high expectations of content and relevance
	they want to make decisions about what they learn
Adults want to take part actively	ask questions and discuss
	contribute with their own opinion and experience
	treated equally

6.2.

Increase Motivation

- Appropriate target group
- Selecting suitable participants
- Be clear on aims and content of training
- Keep on motivating people
- Awake participants curiosity
- Encourage their participation
- Avoid motivation killers

6.2.

Motivation killers

- Ready made solutions
- Giving orders
- Using threats
- Ridiculing participants
- Cheating on participants

6.2.

No Motivation

- Is not there if participants are too busy.
- Is minimal if pressure to attend comes from others.
- If lecturers are known already.
- Is not bought.
- If misconception about you or your organisation.

6.2.

To convince a farmer (1)

- Have your information well prepared
- Give reasons why this is good or bad
- Ask questions to understand the farmers reasons
- Involve farmers in identifying problems and prepare action plan
- Remind farmers to village meetings or visits made
- Keep on explaining the advantages of a certain activity
- Avoid victimising or talking badly about others

6.2.

To convince a farmer (2)

- Make several visits and accept that changing needs time
- Make timely visits to farmers, follow the calendar and action plan
- Take farmers on farm visits
- Carry out farm demonstrations
- Give examples of other successful farmers

6.2.

Your behaviour

- Do not visit the farmers field without the farmers permission.
- Be patient and flexible
- Keep promises
- Be skilled and creative
- Be social, polite, kind and loyal to everybody

6.2.

Farmer economics

Influenced by:

Climate, location, farm size, manpower and other factors.

6.3.

Costs and Returns

- Inputs
  - Plant materials
  - Manure/mulch
  - Farm Tools
- Labour
- Land

• Sale of product
• Sale of by products
• Own consumption

6.3.

Reducing farm expenses

- Optimise recycling
- Minimize external inputs
  - Use local plants for pest and disease control
  - Produce own planting material through selection
  - Use local available manures and mulches
  - Keep animals to produce food and manure
  - Use locally available materials

6.3.

Increasing returns

- Increasing production (through use of manure)
- Diversification
- Value addition (proper drying)
- Improve quality

6.3.

Crocus Budget Farm level

Costs

- Planting material
- Manure
- Shovel / hand-fork
- Tractor/oxen
- Basket/wheelbarrow
- Drying equipment

Returns

- Corm
- Spice
- Fodder (recycled on farm)
- Flower leaves (invest if possible to use as compost)

6.3.

Organic Saffron production by smallholders in Afghanistan

6.4.

Organic certification

- Rules set by organic movement: IFOAM
- Rules set by regulations (EU, US, Japan)

- Each farmer inspected annually by certifier
- When that is not done: exception

  Æ Smallholder Group Certification

  Using an Internal Control system = ICS

6.4.

Smallholder group certification

6.4.

Smallholder group certification

- ICS is an internal audit, a quality assurance protocol managed by the project operator itself (co-operative, farmer association or exporter).
- All actors are identified, instructed on the requirements, contracted, inspected and if needed sanctioned by the operator itself.
- The external certification body evaluates whether the internal audit functions well, based on file review and risk assessment and does a number of re-inspections.
- ICS combined with extension, research, other quality management functions.

6.4.

When smallholder group certification?

- Many farmers producing the same crop,
- Similar production practices,
- Small farms = low output value,
- Some organisational structure,
- Common marketing structure,
- Have Internal Control System

6.4.

The Group

- Best to have all farmers certified in one area since it reduces the risk of infiltration
- This means that all farmers both large and small farmers have to be registered and contracted in an area
- On average each farmer will have e.g. 2 acres.

6.4.

ICS

"An Internal Control System is a documented quality assurance system that allows the external certification body to delegate the annual inspection of individual group members to an identified body/unit within the certified operator. (As a consequence, the main task of the certification body is to evaluate the proper working of the ICS.)"

6.4.

Internal Control System

- A documented quality system whereby the Exporter/Group takes the responsibility of ensuring that the produce is organic.
- The certifiers role is verify the ICS and its implementation.
- This means that
  - The certifier will inspect a percentage of farmers (normally the square root of the number of farmers)
  - They will check buying records, documentation etc..
  - They are inspecting the system not the individual farmers
  - Failure in one area means failure of the group as a whole.

6.4.

ICS table of contents

- Description of project, farmer and farm practices
- Description of production and processing
- Organisation
- Risk assessment
- Maps
- Procedures
- Documentation & record keeping

6.4.

Risk assessment Cooperative

Example risk assessment

6.4.

Main Documents ICS

- Risk assessment
- Farm Registration form
  - Contains information on farmer, description of the farm, and a three year crop history on all the fields
- Contract
  - gives the internal standards of the project relating to organic production and normally quality guidelines included
- Grower's list

6.4.

Growers Lists

- Summarises information on farmers
- Given the large numbers of farmers it is best if it is put into a spread sheet
  - This reduces errors in adding up farmers
  - Gives better consistency in data
  - Eases copying costs
  - Makes transmission of documents easier

6.4.

Growers Lists Summary

- The system is computerised using a spread sheet at the head office
- An overall summary generated
  - Giving total farmers
  - Land
  - Yields
  - Estimates
  - Number of farmers delivering

6.4.

New grower

- The following steps are taken in order to get Growers certified:
  - 1) Registration and Growers agreement to participate in project
  - 2) Mapping
  - 3) Contracting
  - 4) Conversion Period
  - 5) Internal Inspections
  - 6) Approval

6.4.

Existing grower

- Internally inspected; 100% annually
- Use Internal inspection form
- In case of violation use violation report

6.4.

Maps

- Maps
  - Normally not possible to map individual fields
- Village Maps
  - Give location of farmers homestead, growing areas, land marks, paths and roads.
  - The map should allow an individual not familiar with the area to locate the farmers homestead.
  - Official maps not available and thus the map is drawn with the communities in a participatory manner
- Area Map
  - Gives locations of villages and farmer groups in the area.

6.4.

Buying Records

- Farmer code and name
- Yield estimate

6.4.

Buying Considerations

- A good recovery rate from a group is 50%
- Even when you have a good price, i.e. well above the conventional price, there are Factors that lower the recovery rate
  - Small farmers have a lot of financial pressure on them and they will often sell to the first person who goes past on a bicycle with cash in their pocket
  - Larger farmers are not so desperate to sell and will speculate
  - Organic products need to be quality products and some of the production will not meet the standard

6.4.

Evaluation of ICS

1. Examination of documentation
2. Verification of smallholder group status
3. Visit the office
4. Inspection of facilities and producers
5. Risk assessment
6. Complementary re-inspections
7. Final meeting

6.4.

Major non-compliances

- Mixing organic and non-organic
- Non-achievement of 100% inspection
- Persistent non-compliances
- Non-detection of non-compliances by ICS
- Serious non-functioning of ICS

Followed by sanctions

6.4.

Re-inspection rate

ISO 62 based calculation:

$$n = \sqrt{N} * \text{risk factor}$$

N=population
n=sample

Number of producers	Normal Factor 1	Medium risk factor 1,2	High risk factor 1,4
minimum	10	12	14
50	10	12	14
100	10	12	14
200	14	17	20
500	22	27	31
1000	32	38	44
2000	45	54	63
5000	71	85	99
10000	100	120	140

Your situation

- What are the steps in the process from primary production to shipment?

6.4.