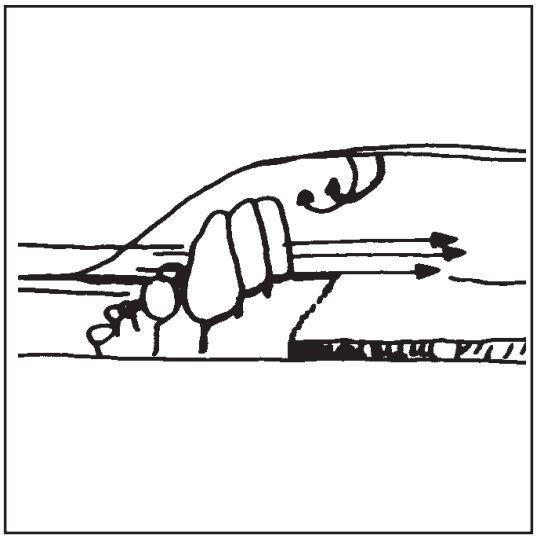
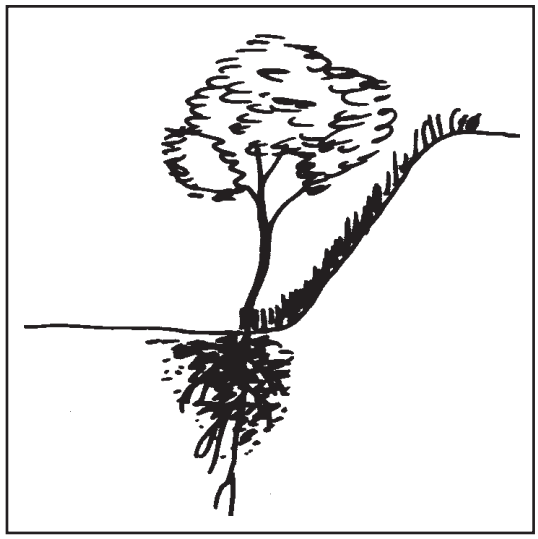
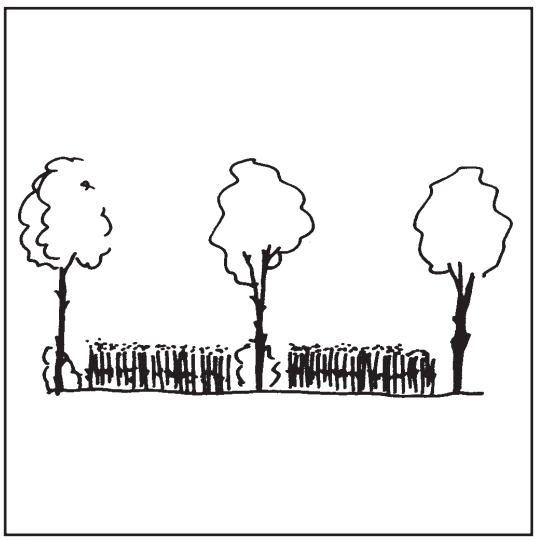
Agroforestry in the Tropics







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What is agroforestry?

Agroforestry is a broad term for land-use systems where;

- woody perennials such as trees, shrubs or bamboos are grown and used in fields and farming landscapes. This can be carried out at the same time as in intercropping systems where trees and crops are grown together, or at different times such as in rotational practices.

- livestock or crops are introduced as part of forest systems.

This booklet looks at the first aspect and describes ways in which crops and trees can be grown together in an attempt to increase productivity and diversity whilst ensuring sustainability.

It is important to remember that there is no simple recipe for success and techniques need to be developed to suit each particular situation, including the needs of the community and the use of local tree species if available. Good planting material, tree management practices and soil conservation techniques are important for the success of the agroforestry practice.

Agroforestry has particularly useful applications in arid and semi-arid conditions and for the reclamation of saline or alkaline soils.

Benefits of agroforestry systems

When land is scarce or when soil has a low fertility or is sensitive to erosion, agroforestry techniques offer considerable benefits for long term agricultural sustainability. Trees and shrubs have an important ecological and economic role in farming systems. Agroforestry is useful in the following ways:

Soil

- Protecting soil from erosion.
- Increasing nutrients in poor soils.
- Improving the structure of soil so that it holds more water.

Energy supply

- Providing cheaper and more accessible fuelwood.
- Producing better quality fuelwood depending on the species planted.

Shelter and structures

- Providing cheaper building materials.
- Protecting animals, crops and humans from wind and sun.
- Providing fencing to protect crops from livestock and wild animals.

Plant resources / biodiversity

- Improving local environmental conditions for naturally occurring plants to grow.
- Maintaining and increasing the number of species of plants.

Cash income

- Providing additional or off-season employment.
- Enabling the sale of tree products.
- Providing investments such as orchards, tree products, agro-business and long-term supply of materials for the production of crafts.

Dispersed trees on cropland

Trees may be grown in fields while crops are grown alongside or underneath. The practice of growing trees in this way can be done either by protecting and managing the trees that are already there or by planting new trees.

These trees are usually grown to provide a product of commercial or subsistence value, such as food, fuel, building poles, fodder or gum. They also provide nutrients and organic matter for the soil and provide shade for crops and livestock.

There are different spacing patterns and densities of placement depending on the type of tree chosen and also the type of crop grown, but trees are generally planted at least 8-10m apart and often much further apart.

Advantages:

- Growing trees with crops can increase crop yields due to shading and the addition of nutrients and organic matter to the soil.
- Trees can be a breeding place for beneficial insects and other creatures that can reduce crop pest numbers.
- Trees can provide products of commercial and subsistence value.

Disadvantages:

- Trees can attract birds and crop pests, which can damage crops.
- Competition with crops for water, nutrients. It is important to plant trees with deeper roots than those of the crops grown alongside.

Alley cropping

Alley cropping is also known as alley farming or hedgerow intercropping. Rows of woody plants are grown with annual crops planted in the alleys in between. The main purpose of this method is to maintain or increase crop yields by improving the soil and micro-climate through the cycling of nutrients, mulching and weed control. Alley cropping is mostly used in humid or sub-humid tropical areas on fragile soils and seems to work best where farmers need to intensify crop production but have soil fertility problems.

The technique of alley cropping requires careful planning and management. It is preferable that the species used have a light open crown that lets sunlight pass through onto the crops that are being grown. It is also possible to prune species with a denser crown. The trees used must also be capable of rapid resprouting after coppicing.

This is how the alley cropping cycle proceeds:

Alley cropping management cycle

1. The trees are planted in lines and crop grown between the rows.

2. When the shade from the trees begins to interfere with the crops they are coppiced or pollarded.

3. The coppiced branches are placed between the rows. Leaves will fall to the ground adding organic matter to the soil when they breakdown. Branches and twigs can be gathered for fuel or other purposes.

4. Trees resprout.

5. The cycle is repeated.

Alley cropping

Advantages:

- Improvement of soil fertility and structure and micro-climate conditions, thereby benefiting crops.
- A longer cropping period and higher land use intensity.
- Trees used can provide products of commercial and subsistence value.

Disadvantages:

- The technique will take some years to establish, so farmers will have to wait for the benefits.
- Farmers may not have the capital available for the investment in trees.
- Alley cropping requires considerable labour and management - results will be poor if planting and pruning schedules are not carried out properly.
- Competition with crops for water, nutrients. It is important to plant trees with deeper roots than those of the crops grown alongside.

Improved fallow

Improved fallow is the replacement or enhancement of natural fallow vegetation by the introduction of selected trees or shrubs. The purpose of improved fallow is to shorten the fallow period and/or increase the yield of subsequent crops. This is done by planting trees or shrubs which can help to restore nutrients to the soil and to suppress weeds as well as providing useful by-products. The trees therefore enrich the fallow both biologically and economically.

In this practice the cropping period usually alternates with the tree-growing period. However, it is possible to keep some trees standing during the cropping period and many farmers have combined the method of improved fallow with alley cropping.

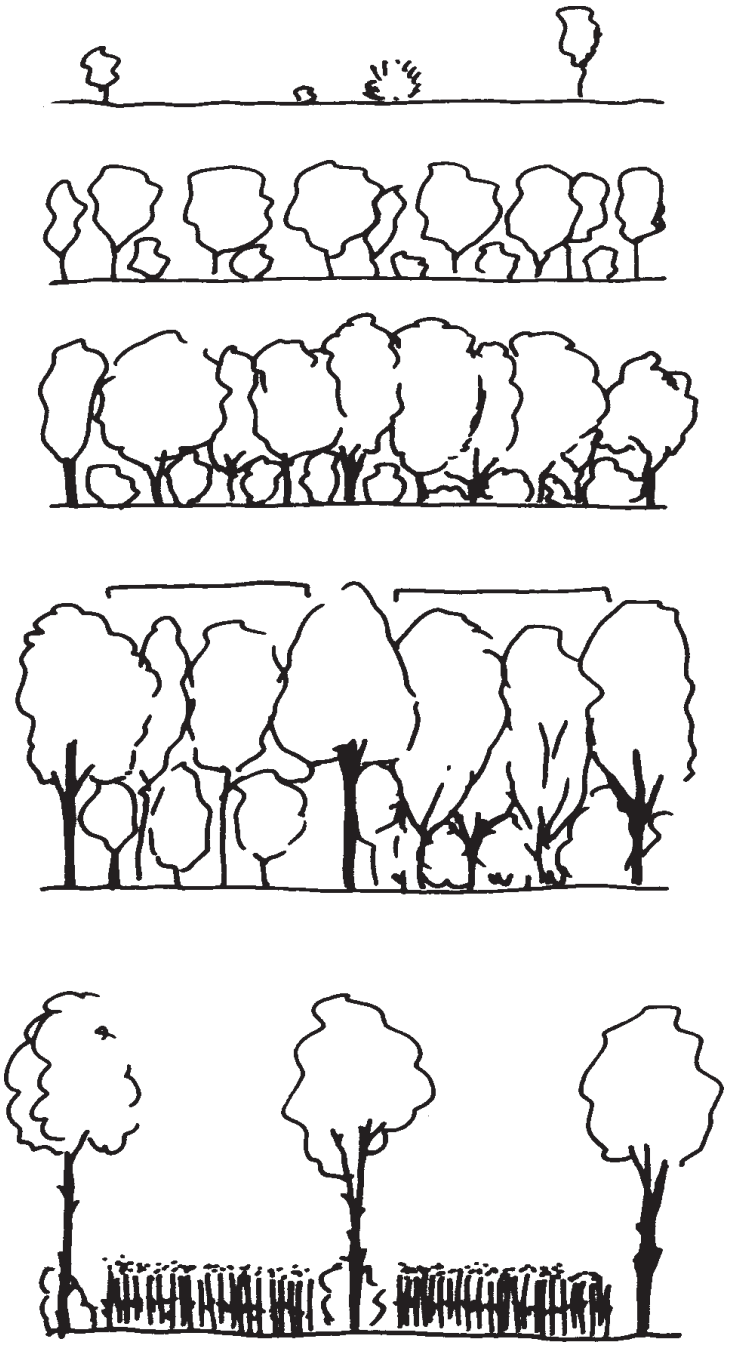
By planting mainly soil enriching species, the minimum fallow period can be shortened from 15 to 20 years to about 8 to 10 years. However in Kenya, Sesbania is grown in a 3 year rotation and Tephrosia in a 1 year rotation.

Advantages:

- The time required for soil enrichment can be shortened; the tree canopy and fast growing species can suppress weeds.
- Soil erosion is minimised.
- The use of a wide variety of species can reduce pests, weeds and diseases.
- This method is relatively inexpensive to establish and maintain.
- The wood can be used or sold at the end of the fallow period.

Disadvantages:

- The planting of seedlings and tree cutting must be done during the same period of crop planting - labour may be a limiting factor at this time.
- The fallow will need protection from browsing animals.



Improved fallow

Home gardens

In a home garden, perennial crops and annual crops are grown side by side. Animals are also usually included in the system. The home garden is able to provide an extra and continuous flow of products for daily use. They are common in the humid tropics and are characterised by the intensive use of multi-purpose trees, shrubs, food crops and animals.

They have a complex, layered structure. The upper storey is usually about 20 metres high and consists of trees for fruit, fuel, timber, shade and fodder. The middle storey consists of small trees that tolerate some amount of shade such as coffee, tea, banana. The under storey consists of plants such as beans, pulses, root crops and grasses which grow to about 1.5 metres. To ensure a constant flow of produce from the home garden it is important to maintain the distribution of these layers.

Advantages:

- Production of food is continuous and diverse.
- Farmers have easy access to food, timber, fuel, fodder, spices and medicines.
- Home gardens protect the soil and conserve water.
- Labour can be used efficiently because home gardens are situated close to houses.
- Produce may be sold locally and act as a financial buffer in times of need.

Disadvantages:

- The high diversity of plants in a home garden can provide a habitat for species that could become pests or introduce diseases.

Contour vegetation strips

In traditional systems, lines of grasses, stones, crop residues and other organic debris are placed along hillsides to control water and soil erosion. Contour vegetation strips are living barriers of trees and shrubs which are planted along the contour lines of a slope. These lines of vegetation can serve the same purpose and can also provide useful products such as food, fuel, building poles, fodder or gum.

There are many factors to consider when building contour strips as bad design can lead to even more severe erosion. The effectiveness of the strip depends on the type of tree planted, the spacing of the trees and the width of the strip, the steepness of the slope, the amount of rainfall and the type of soil.

Contour vegetation strips

Advantages:

- Strips can provide additional nutrients and organic matter into the soil. This can be increased by using nitrogen-fixing plants.
- Excess vegetation can provide food for animals. These can be allowed to browse through the strip to feed on crop remains after harvesting.

Disadvantages:

- Contour strips take up land which could be used for crops.

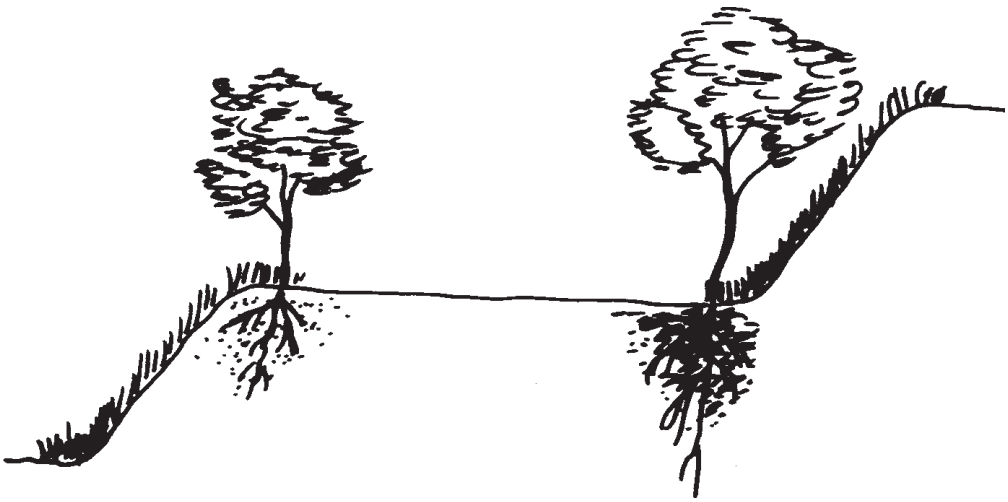
Planting on terraces

Terraces are usually put in place as soil and water conservation measures on slopes and hills. They provide flat areas of land that can be planted with crops.

Building terraces involves digging ditches and making ridges along the contours of a slope. Grasses, trees and shrubs can be planted on the ridges to stabilise the ground, provide leaf mulch and protection from wind for crops and provide other useful products such as food, fuel, building poles or fodder.

Trees can be planted on the ridge of the terrace or at the back of the terrace. If the tree is planted at back of the terrace it will get all of its water requirements. If a tree is planted on the ridge of the terrace, it will be on drier ground but the leaves will spread around more evenly and provide more nutrients for crops. Trees can be planted in both locations if the terrace is wide enough.

The type of tree or hedge used will vary according to the site it is planted on and what products or services you wish it to provide. If the aim of the terrace is to stabilise the soil, trees and shrubs with strong roots systems should be planted. These will be able to withstand the movements of soil and water.



Planting on terraces

Advantages:

- Stabilisation of the slope, which results in soil and water conservation and a better environment for crops to grow in.
- Shelter from wind.
- Pest control by providing a breeding place for beneficial insects.
- Increased area of land that can be cropped.
- Useful by-products such as food, fuel, building poles or fodder.

Disadvantages:

- As the structure of the land is changed quite dramatically, land tenure rights may first need to be established or secured.
- Building terraces require adequate skills and material, labour and capital and also the capacity to maintain the structures for years to come.

Living fences

Living fences are lines of trees or shrubs planted on farm boundaries or on the borders of farmyards, pasture plots, animal enclosures or around agricultural fields. They have been used by farmers for hundreds of years and they are becoming more and more popular in areas where materials for fenceposts are scarce or expensive.

Living fences serve mainly as field boundaries. They can be made of single or multiple, densely planted rows consisting of a mixture of plant species. Alternatively, one row of trees can be planted widely spaced with wire, sticks or dead branches twisted between them - these are termed 'living fenceposts'. Both types of living fences are regularly pollarded and trimmed. A wide range of vigorously sprouting species of trees and shrubs can be used to create a living fence.

Advantages:

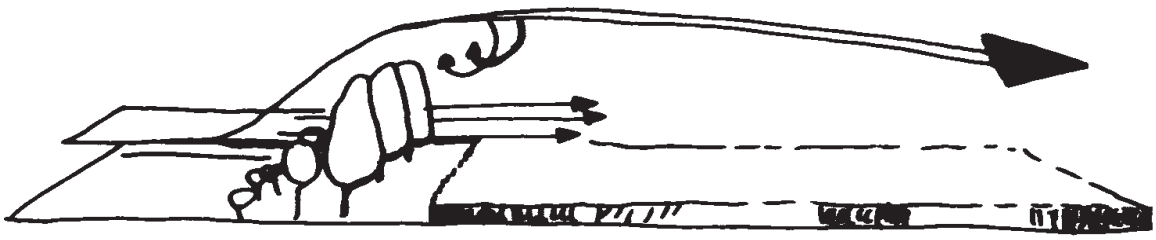
- Animals are kept away from growing crops.
- The fences offer shade for animals.
- Trees provide a micro-climate with a higher humidity and more shade, which will improve pasture growth.
- Legumes used in fences can improve the soil by fixing nitrogen.
- Pruned materials can be used as a mulch; foliage can be used as fodder.
- An established living fence can be harvested for fuelwood.
- Prunings can be used as cuttings to replenish the fence at very little cost.

Disadvantages:

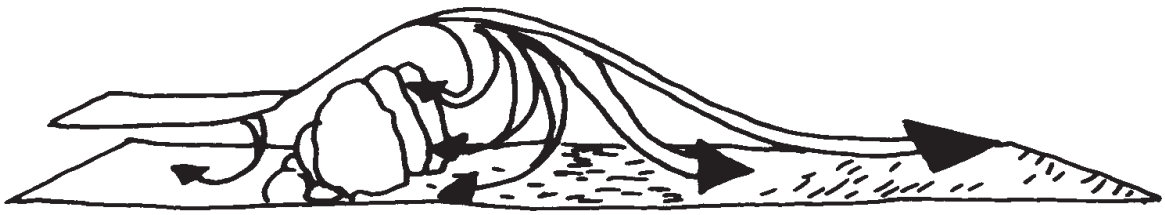
- Trees may need protection from animals during their early stages of growth.
- Trees may compete with crops and pasture for light, water and nutrients.
- Living fences can act as a refuge for pests and diseases.
- Animals walking close to the fence compact the soil and may cause damage to the root system.
- Pruning may be necessary depending on the species chosen.

Shelterbelts

A shelterbelt, or windbreak, is a barrier formed by trees and shrubs strategically planted to reduce wind speed in order to protect agricultural lands, people, animals and buildings. They can also be used to support sand dune stabilisation. Shelterbelts are most successfully introduced in areas where there are high wind speeds and/or prevailing winds for long periods, or where the soil is dry for a large part of the year and/or where loose soil structures are present.



A well managed shelterbelt



A badly managed shelterbelt can worsen the effect of wind

Shelterbelts are made up of strips of trees, shrubs and grasses planted in single or multiple rows. Ideal species are those that are bushy and withstand harsh environmental conditions such as hot or cold winds, salt-laden winds, wind-borne sand, or drought. Evergreen species are recommended unless trees and shrubs are in full foliage during the period of winds. Grasses and herbaceous plants can be planted at the base of the shelterbelt to protect the wind from eroding the surrounding soil. The shelterbelts are sited on the upwind side of the land to be protected and are most effective when planted perpendicular to the prevailing wind direction. Sometimes large areas are protected by several parallel shelterbelts. Research shows that wind speed is reduced on both sides of the barrier.

Advantages:

- Physical damage to soils, crops, pasture and animals is reduced.
- Temperature of soil and air behind shelterbelts is modified.
- Moisture loss (caused by high winds) is reduced.
- Leaves from shelterbelt can help to fertilise fields.
- Soil erosion can be prevented.

Disadvantages:

- The space that the shelterbelt takes up reduces the overall land available to the farmer.
- The trees that make up the shelterbelt may compete with crops for water or nutrients, leading to decreased production.
- Pests and diseases may develop in the trees and shrubs and spread to nearby crops.
- Shelterbelts need continual maintenance to ensure maximum efficiency.
- A badly designed shelterbelt, or one which has developed gaps, will allow wind to be funnelled through at a very high speed, resulting in serious soil erosion.

References

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Notes

Notes

Further information on agroforestry and further information on organic farming can be obtained from HDRA. Other publications include booklets covering composting, natural pest and disease control, green manures, weed control and the neem tree. Please write to:

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The aims of HDRA - the organic organisation, are to carry out scientific research into, collate and disseminate information about, and promote interest in organic gardening, farming and food in the UK and overseas. For more than a decade, HDRA's international programme has been involved in the support and extension of sustainable farming practices; supporting research on aspects of tropical organic agriculture, providing advice and literature on appropriate organic techniques and providing tree seeds and technical information to organisations involved in tree planting and research.

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