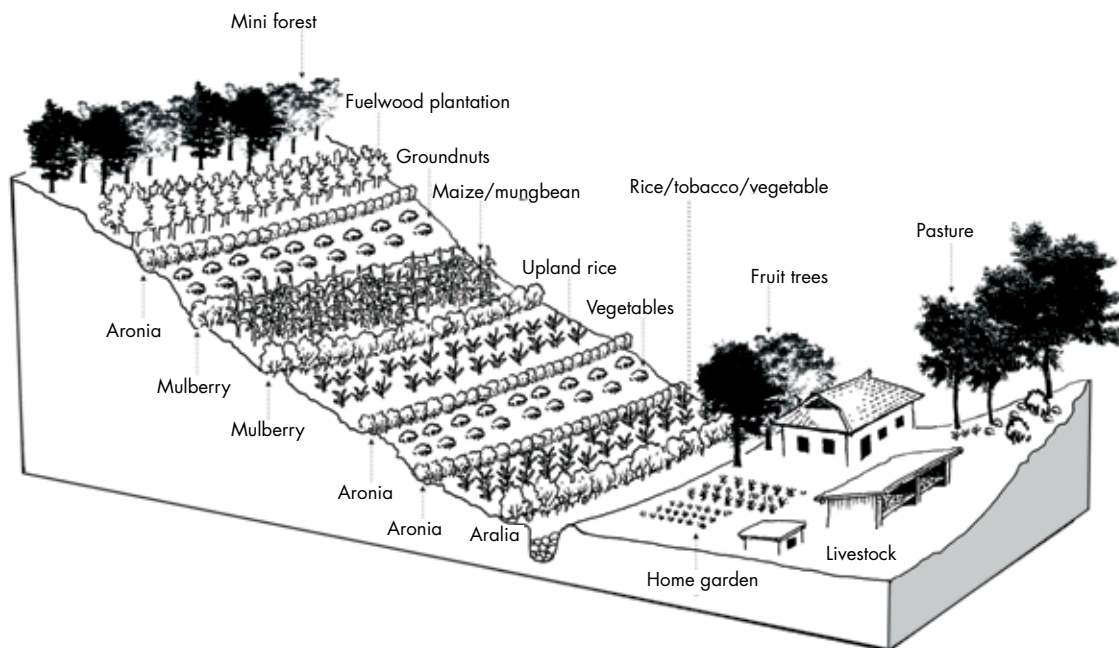


4

Managing the Agroforestry System

4.1 Crop diversification

One of the most important aspects of agroforestry is diversification. Benefits include a wider range of food products to eat and sell, improved nutrition, and the ability to spread risk in production due to varying weather including floods, drought, etc.. Since different species occupy different spaces in the system, their production can be complementary (overall yields are greater for the system as a whole than if one species only was present) and even synergistic (total yields are greater than the sum of the individual components if they were grown separately). Diversification can also reduce the risk of pest attack. These benefits are not however automatic – it all depends on what range of trees, crops and animals are brought together.

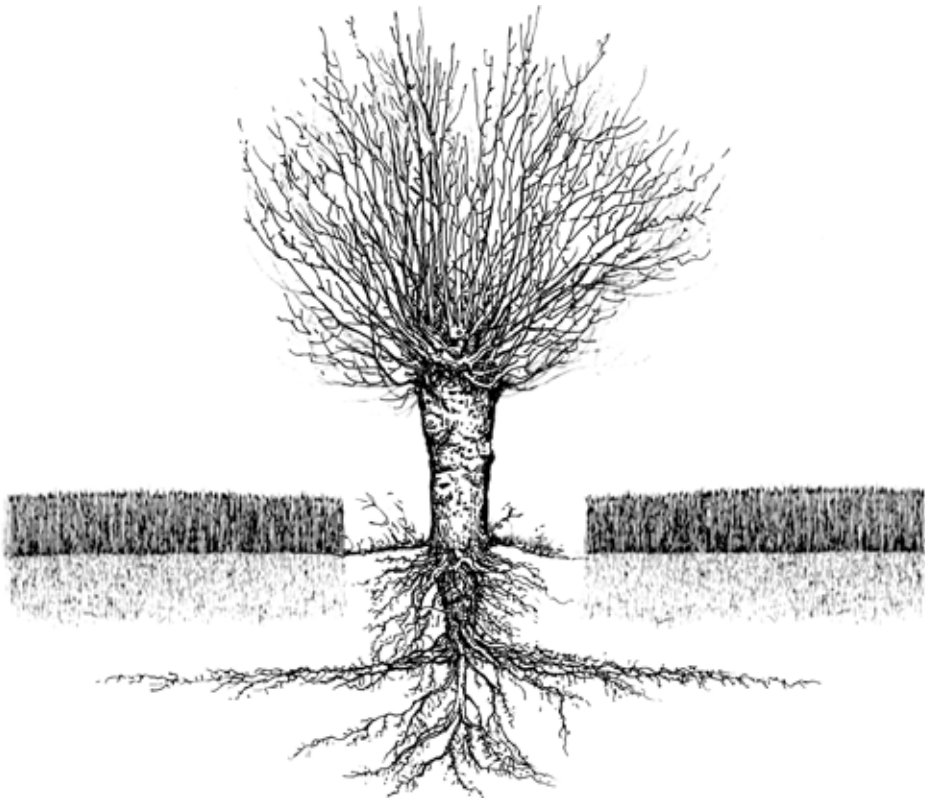


The Sloping Land Transect with agroforestry practices

4.2 Tree-crop interactions

Tree-crop interactions are a key consideration when designing an agroforestry system and a layout for planting. Basis principles include to:

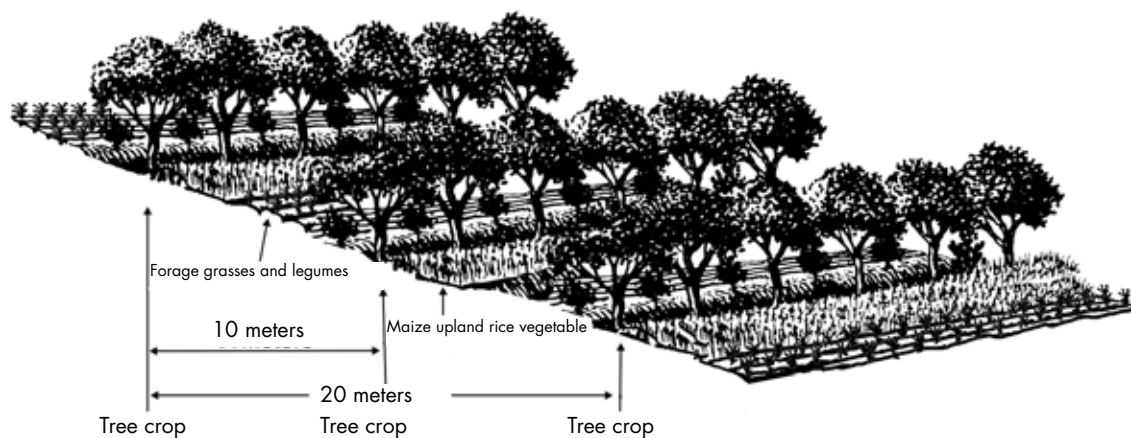
- increase the overall value of the system,
- maximize complementarity,
- decrease or eliminate competition; and
- minimize crop displacement, through appropriate tree management.



Root system of agroforestry species

4.3 Tree choice and planting arrangement

This includes considering the particular space or niche the tree occupies in the farming system, as well as the total number of trees of that species that need to be planted. Getting this right is important to maximize the ecological and socioeconomic benefits from the tree itself and simultaneously to reduce the potential competition with other components of the system such as annual crops. Choosing the right species with the right form and rate of growth is important, as well as considering at what density to plant it and how to subsequently manage it.



Well-established agroforestry system along the slopes

4.4 Using perennial tree crops

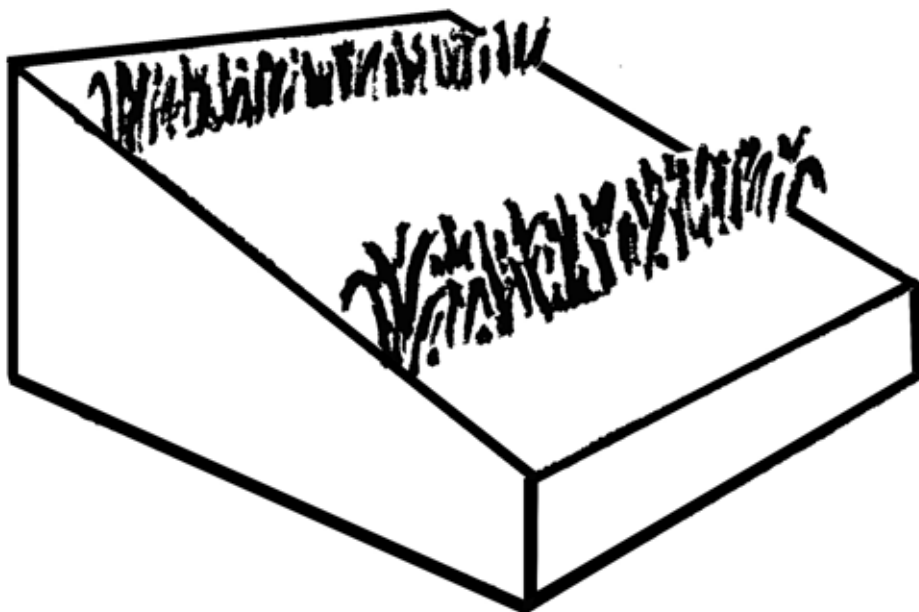
In comparison to annual crops, the use of perennial tree crops is less expensive in terms of inputs: time, seeds, fertilizer, and land. Agroforestry system, which uses perennial plants (both tree, shrub and cover crops), provides food and useful materials for humans (fiber, medicinal, dyes, edible leaves, spices, poles, honey, fuel wood, fodder, mulches, game, sap products, etc.) as well as benefits to the other plants (soil fertility). Thus, a well-managed agroforestry system is self-sustaining and efficient space where, once established, farmers only need prune and harvest, when used perennial crops. Agroforestry is building a layered garden from ground cover to canopy trees that are all useful to user groups with little maintenance.



Perennial crops

4.5 Contour strips

The use of contour strips in agroforestry systems is an effective way to prevent soil erosion in sloping land management. The common agroforestry practice of developing contours strips from trees, grasses and/or other plants is cost effective (with low initial establishment and annual maintenance costs compared to other methods) and provides other important ecological functions such as habitat for birds and insects.



Vegetative contour strips

4.6 Soil and water conservation

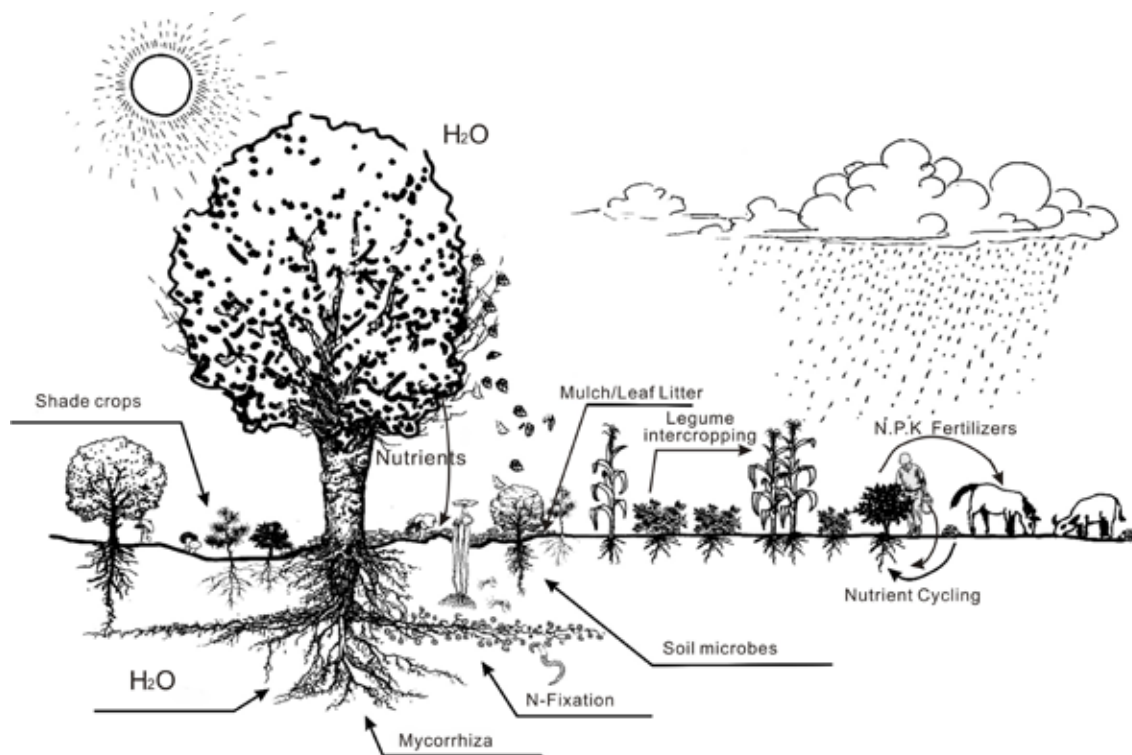
Agroforestry landscapes have an important function in improving soil and water conservation. Agroforestry systems can reduce soil erosion caused by wind and water, and prevent the runoff of sediment and potential pollutants into rivers, whilst keeping nutrients such as fertilizer in farmland. Agroforestry systems slow water runoff and enhance infiltration, stabilize soil and reduce river bank erosion.



Soil and water conservation along the landscape

4.7 Soil fertility management

Agroforestry systems can be critical in improving soil fertility. Leguminous trees planted as fallows or interspersed with crops can accumulate significant amounts of nitrogen in their leaves and roots, which is then made available to crops. Incorporating leaves into soil can increase crop yields several-fold. Improved fallows can also contribute to the control of weeds and provide wood for cooking and stakes for climbing crops. Some of the species used to improve soil fertility also have fodder value and can improve animal manure quantity and quality.



Nutrient cycles in agroforestry system

5

Linking Agroforestry to Livelihoods

5.1 Mushroom production

Many mushrooms or fungi are deliberately grown within forest or grassland habitats, a practice defined as 'fungi agroforestry'. Facilitation thereof exploits positive ecological interactions, minimizes undesirable interactions and protects or enhances the sustainability of natural ecosystems and the productivity of the land for the people who use them. Many introduced mushrooms can be cultivated by user groups in the field huts and homegarden for income generation.



Mushroom farming has a lot of potential

5.2 Bee-keeping

Bee-keeping not only provides honey but bees pollinate fruit trees, oil plants and other perennial and annual crops. Sometimes, these pollination services can be much more important economically than the honey that is also produced. Productivity and household income can therefore be much enhanced through cultivating and retaining trees in landscapes to provide habitat for bees. When designing agroforestry systems, the use of a range of tree species flowering at different times can provide better forage for bees, therefore enhancing both honey and tree and annual crop production.



Beekeeping supports agricultural productivity and income generation

5.3 Agribusiness activities: the case of mulberry and the silkworm

Mulberry tree was originally domesticated in Asia as forage for feeding silkworms for silk production; this represents an important small-scale agribusiness. Primarily, mulberry is grown in combination with annual crops such as maize, wheat, upland rice, beans, sweet potato and vegetables. There are now three main forms of mulberry agroforestry systems: (1) mulberry is grown in a form of 'alley cropping' on terraces with a 4 to 6 m interval between rows and a 0.2 to 0.4 m interval within rows; (2) mulberry is planted along farm boundaries as a fence, initially at a close spacing of 0.2 to 0.3 m, then later thinning to 0.4 to 0.6 m between trees; and (3) scattered mulberry trees are established among annual and perennial crops to resemble a multi-storey agroforestry system in which mulberry occupies the second layer.



Women's participation in silkworm farming

5.4 Agro-industry from agroforestry: the case of resin

Resin from pine is an example of an agroforestry and forestry product widely used for industrial purposes; for example, resin tapping in many remote villages in China has significantly contributed to local livelihoods. In Korea, resin tapping can be practiced in the production season from June to September. The technique has to be practiced correctly to ensure that tapping does not negatively affect the growth of trees. For example, tapping should be from one side of the tree only using a “v” shape cut, while trees should be tapped only when growth exceeds 20 cm in diameter.



Resin tapping is one of income sources

5.5 Fish farming and agroforestry

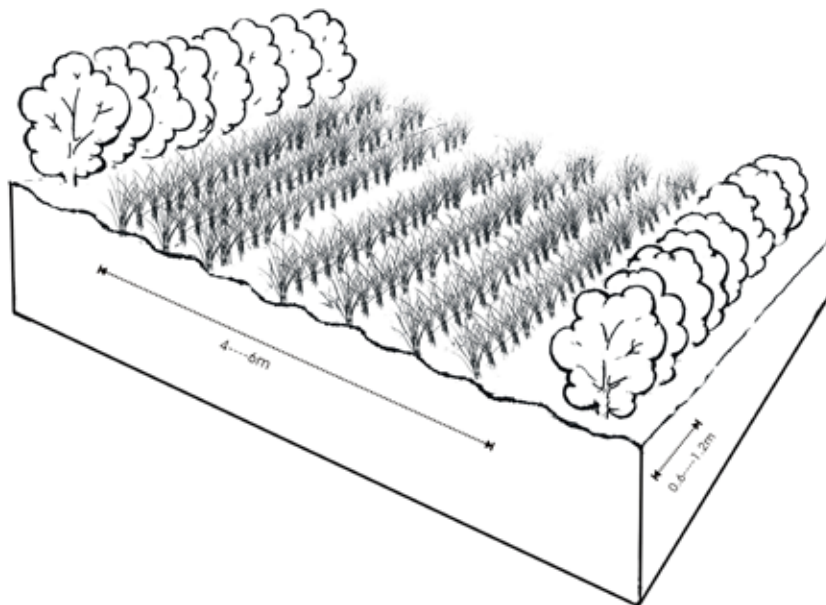
Fish farming or aquiculture plays a significant role in livelihood development. Aquiculture in agroforestry practices can involve paddy rice cultivation with fish culture and trees, as well as fish ponds in farmland with trees. In many cases, trees support the banks of ponds and rice paddies, and enhance the habitat for fish through providing a windbreak, organic nutrition and supporting the presence of microorganisms.



A combination of water harvest/storage and fishery

5.6 Medicinal plant production in agroforestry systems

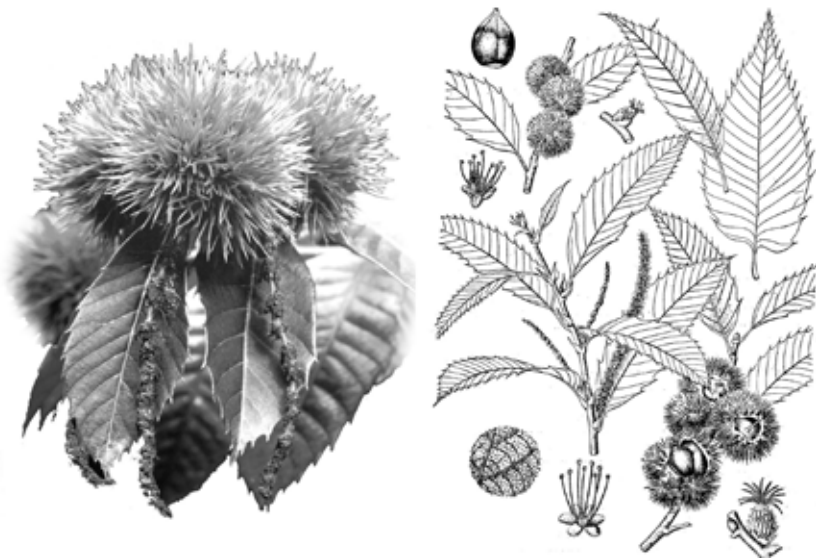
Agroforestry provides important habitat for the cultivation of medical plant products that may be herbs (e.g., ginseng) or trees (e.g., mulberry). Many medicinal products are derived from trees and much traditional health care around the world is supported by their cultivation. The wide cultivation and utilization of medicinal plants in agroforestry contributes to health support systems locally and provides livelihood opportunities through sale locally and more widely.



Incorporating medicinal plants (*Aronia* spp.) into agroforestry

5.7 Fruits, berries and nuts

Tree on farms produce a wide range of edible products including fruits (pear, apple, apricot, mulberry, etc.) and nuts (pine nuts, walnuts, chestnuts, etc.). Many indigenous fruit and nut trees provide edible products rich in vitamins and other micronutrients and their cultivation should also be considered. By growing a range of species that fruit in different seasons, it is possible to provide important sources of nutrients over a large part of the year, combating malnutrition. In comparison to timber production, the management and harvest of these products may be more environmentally friendly and provide for more sustainable incomes because harvest does not involve cutting the tree. At the same time, the cultivation of fruit and nut trees may be more complementary with growing annual crops and other trees than timber-oriented agroforestry.



Fruit trees support food security and income generation

5.8 Livestock and fodder production

The use of trees and shrubs as animal feed is probably as old as the domestication of animals. Through experience, perhaps through observing their grazing behavior when shifting animals between fields, smallholders have learnt which tree fodders are useful feed for their livestock. A tree species may be used for fodder in some places and for particular animals but not used in other locations and for other stock. What trees are appropriate as fodder depends on the digestive system of the animal. Many tree (and other) legumes provide nutritious animal fodder. Some fodders can be collected and stored for feeding in the winter. As well as food, and just as tree products are used for human medicine, some tree products are important for veterinary treatment.



Livestock enhances soil fertility, food nutrition and income

5.9 Adding value to agroforestry products

The value of raw agroforestry products can be added to significantly through the selection of the right tree varieties to grow (providing product of good quality), though proper harvesting and processing, and through appropriate packaging before sale. Often, groups of farmers working together (e.g., collections of user groups) can establish small-scale enterprises or small processing plants more easily than individual farmers can. Working together provides scale and can allow knowledge on processing methods, market requirements, etc., to be accessed more easily. Groups can be supported more easily by extension agents than individual farmers can be.



Food processing for local user groups and farmer's cooperatives

5.10 Value chain and market access

Smallholders in developing countries often find it hard to sell their products in the market for a good profit because of poor infrastructure. The transaction costs in reaching markets are therefore high for small volumes of product, and there is often no guaranteed sale on reaching the market. A lack of power in sale negotiations also means that smallholders tend to be 'price takers' rather than 'price makers'. Grouping together to transact sales is a way to deal with these constraints. Sufficient quantities of product can be delivered to meet the demands of large buyers and bargaining power is increased. It is also easier for groups to obtain information about the real value of their products though one member being responsible for this role and then sharing information with the whole group. Without such income from sales, farmers do not have the capital to develop their farms further through the purchase of inputs such as new crop varieties, fertilizer, pesticides and equipment. Emphasis on ways to improve the 'value chain' for smallholders, such as through establishing seller groups, establishing market information systems, and developing secure means for financial transactions, are very important.



Marketing agroforestry products locally

