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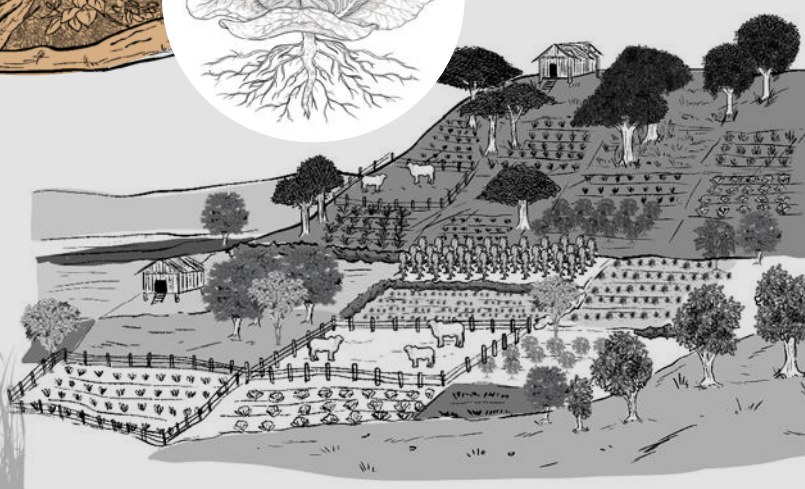
PRINCIPLES OF AGROFORESTRY DESIGN



Agroforestry design involves deciding what will be produced, selecting the components of the system, and determining how they will be arranged. These decisions also define how and when the components will be established, and how they will be managed. It also includes other considerations, such as how to support the enabling environment for agroforestry.

Farmers have been designing agroforestry systems for millennia – sometimes consciously, sometimes instinctively. Professionals can support this process in several ways:

- by advising farmers who haven't managed agroforestry systems before, or farmers who are recent migrants to a given agroecological zone
- by helping to ensure that the systems meet wider goals (particularly environmental ones) in such a way that farmers' interests are not negatively affected
- by introducing farmers to new scientific knowledge
- by organizing or supporting collaborative design processes that include all relevant stakeholders.

In this section, we outline three principles of agroforestry design: farmer-centredness; aptness to people, place and purpose; and synergy. Successful agroforestry interventions follow these design principles. Interventions that ignore them have a high chance of failure.

The principle of farmer-centredness

In designing agroforestry projects and programmes, put the goals and aspirations of farming families first, before considering how you will meet other, wider goals.

Farmers' goals and aspirations

Smallholders and their families are as diverse as the land and living things under their stewardship, but they also often have characteristics and constraints in common. These may include the following:

- Very often, farming is not their sole or even their main source of income.
- Their other commitments may leave limited time to spend on their own farms.
- They tend to avoid risk because they are not wealthy enough to be able to absorb financial losses without losing the ability to satisfy basic needs.
- They tend to favour economic activities with short-term returns.
- They will not necessarily occupy their current property forever; for example, they may want to leave for the city or to acquire a more productive property.
- They may have a deep knowledge of local plants, animals, land and agriculture; on the other hand, if they have recently migrated from another region, they may have little local knowledge of their new surroundings.

These characteristics shape the goals and expectations that lead farmers to grow trees on their land. Their main motivations are to help meet their needs for food and income, and to protect the fertility and productivity of their land. Trees may also have other benefits, such as marking boundaries or establishing the household's rights over land.

Applying the principle of farmer-centredness

Many institutions promote agroforestry to support other goals – particularly environmental ones, such as biodiversity conservation, water management, climate-change mitigation or land restoration. All of these are valid goals, but they cannot override farmers' priorities. Farmers should not be 'steamrollered' by persuasive and enthusiastic professionals into installing agroforestry systems that do not meet their needs.

Rather, institutions should first ensure that their proposed interventions meet the following requirements:

They should generate income or provide useful products.

They should reduce the risks faced by farm households, such as food and nutritional insecurity, threats to land tenure and sovereignty, falling prices, droughts, pests and diseases.

Once these requirements are met, institutions can consider how to further their own goals without reducing the benefits to farmers. For example, to support biodiversity goals, a programme to install shelterbelts in pastureland might prioritize native species, especially **keystone species** – providing that these generate the same benefits to farmers as the alternatives. When these alternatives have higher establishment costs, then farmers should be compensated for the extra expense (see **Incentives** in Chapter 5).

The principle of aptness to place, people and purpose

In designing agroforestry projects and programmes, remember that 'one size fits all' does not apply: all agroforestry systems need to be customized to local conditions.

The principle of farmer-centredness guides the overall approach to the design of agroforestry systems by putting farmers' goals first. The principle of aptness is about delivering on these goals. This requires careful consideration of the specific characteristics of place, people and purpose. Such locally tailored interventions contrast starkly with 'off-the-shelf' interventions based on inflexible technical packages.

Aptness to place

All agroforestry designs must be adapted to each farm's specific agroecological conditions: a system cannot simply be transferred from one farm to the next without considering the characteristics of each farm – and each planting location within that farm. For example, although shade trees can increase the biodiversity of cacao and coffee plantations, as well as fulfilling valuable agroecological roles, the natural shadiness of the site must be considered when deciding how many shade trees to plant per hectare – which depends on which way it is facing, on the surrounding landscape and on the cloudiness of the location. Our sections **From principles to practice: Key systems** (Chapter 8) and **Stories from the front line** (Chapter 9) provide other examples of how agroforestry systems must match specific sites.

Aptness to people

The agroforestry system that is chosen must be adapted to local knowledge, the capacity of the farmer, and the availability of labour. Farmers are usually highly skilled and often have detailed knowledge of local soils, climate, indicator species, pests and diseases, and crop management. However, their knowledge is not boundless, and their skills and intuition may be limited to those crops with which they are most familiar. Also, many farmers are migrants, and they may have moved from areas that are very different to their new locations. In practice, this means either that agroforestry systems should centre on crops or products with which farmers are familiar, or that supporting agencies must provide ongoing support (extension and training), or both of the above. The more integrated the components of an agroforestry system, the more labour is generally required, especially in the first few years. For this reason, it is important to design and implement systems that are not too large to be manageable given the amount of labour that is available to the household or landowner.

Aptness to purpose

In the past, agroforestry has sometimes been promoted to farmers as a 'silver bullet' technology. In this approach, more emphasis has been placed on adoption of agroforestry itself than on specific products and species choice. By contrast, aptness to purpose means that the agroforestry design, particularly the species used and the products they yield, must correspond closely and rigorously to farmers' expectations. It is not enough for a system to be technically effective. The product or products are central, while the agroforestry system is viewed not as an end in itself but as a way of producing them.

Farmers' species preference is strongly affected by available markets. Trees take a long time to grow and to produce, and it is important to consider whether markets are likely to be similar once the product becomes available.

Feasibility

The principle of aptness incorporates the concept of feasibility. Biological, economic, legal, logistic and sociocultural constraints may make it difficult to shift from an existing farming system to agroforestry. Planners must analyse these constraints carefully and realistically, and make sure that the plans they make take them into account.

The design process (see **Design process** in Chapter 5) requires consideration of all these aspects of aptness. Together, they make up the local agroecological, human and economic context to which interventions must be adapted. Design often includes a component of adjustment of generic options (for example, multistrata cacao agroforestry) to specific local contexts.

The principle of synergy

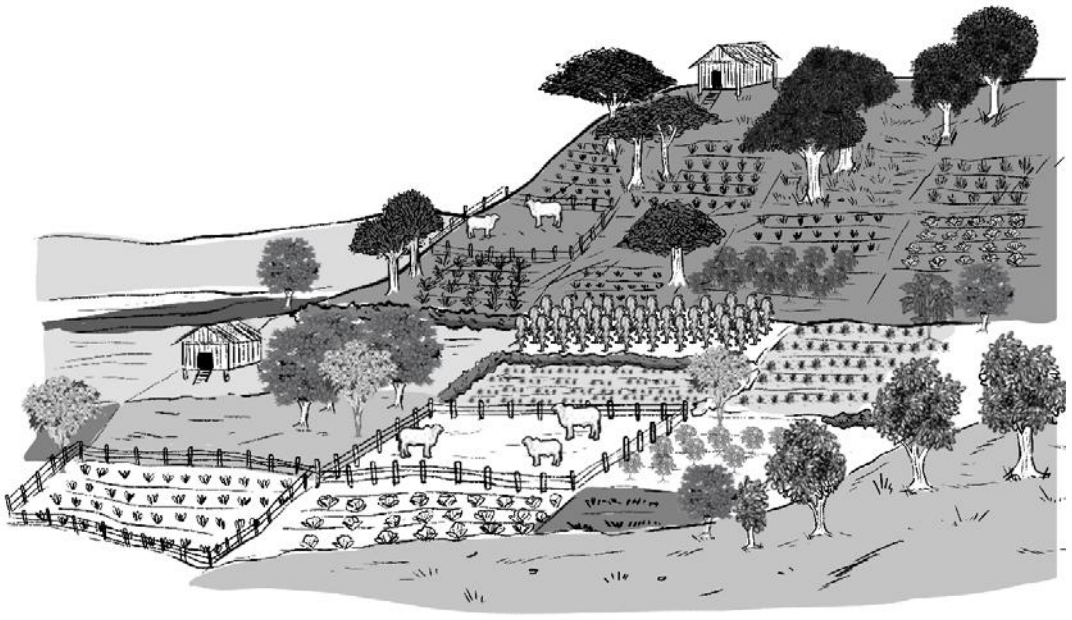
In designing agroforestry projects and programmes, harness the full potential of agroforestry by ensuring that trees, crops and livestock interact in mutually beneficial ways that sustain multiple ecosystem services.

To realize the full potential of agroforestry, systems must be designed so that the components work together in a complementary way. This is referred to as 'synergy'. Basic levels of synergy can be achieved even in simple agroforestry systems in which one crop or a few crops dominate, and trees and livestock are added to provide additional products for the household, income and ecosystem services. To achieve synergy, trees, crops and livestock are arranged to make the best use of nutrients, water and energy within systems, while managing the competition for them.

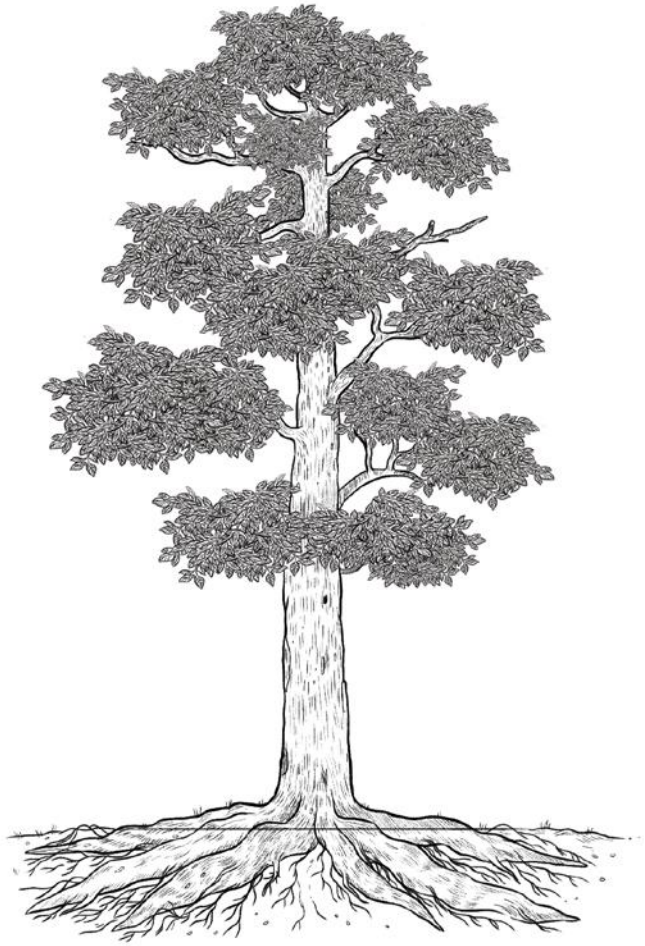
Full synergy is achieved when the productivity from an agroforestry system is greater than it would be if the components were established in separate **monocultures**. These agroforestry systems are 'more than the sum of their parts'. This is usually achieved by arranging trees, crops and animals in

such a way that they have maximum interaction. Competition in these systems is controlled by carefully selecting species that support each other. For example, in **successional systems**, resource sharing between different species is optimized by planting species with different life cycles, which succeed each other over time. These systems are designed to mimic the nutrient and water flows in natural ecosystems, such as forests, and minimize the need to bring fertilizer in from outside the system.

Where possible, agroforestry systems should have a high diversity of species. These not only provide a range of food and income opportunities for farmers, but also increase ecological complexity and support ecosystem services such as pollination, shade, soil fertility and biodiversity conservation. Diverse systems benefit farmers by producing food and products for sale, and improving the long-term productivity of the land – while also contributing to local and global environmental benefits.
Some plant species produce substances that reduce the germination and



growth of neighbouring plants. This is referred to as 'allelopathy'. Trees have more apparent allelopathic effects than other plant types. Local communities usually have knowledge about which plant combinations should be avoided. If that knowledge has been lost, or local people are migrants to the area and do not have it, it is essential to consult a plant specialist before introducing new, unknown combinations.[5]



[5] The science of allelopathy is quite complex. See for example Rizvi SJH, Tahir M, Rizvi V, Kohli R, Ansari A. 1999. Allelopathic interactions in agroforestry systems. *Critical Reviews in Plant Sciences*. 18(6): 773–796. https://doi.org/10.1080/07352689991309487.