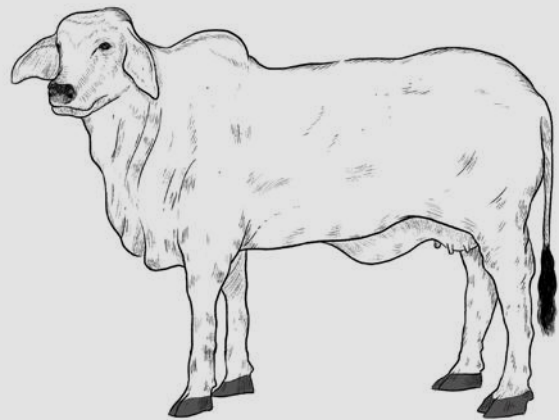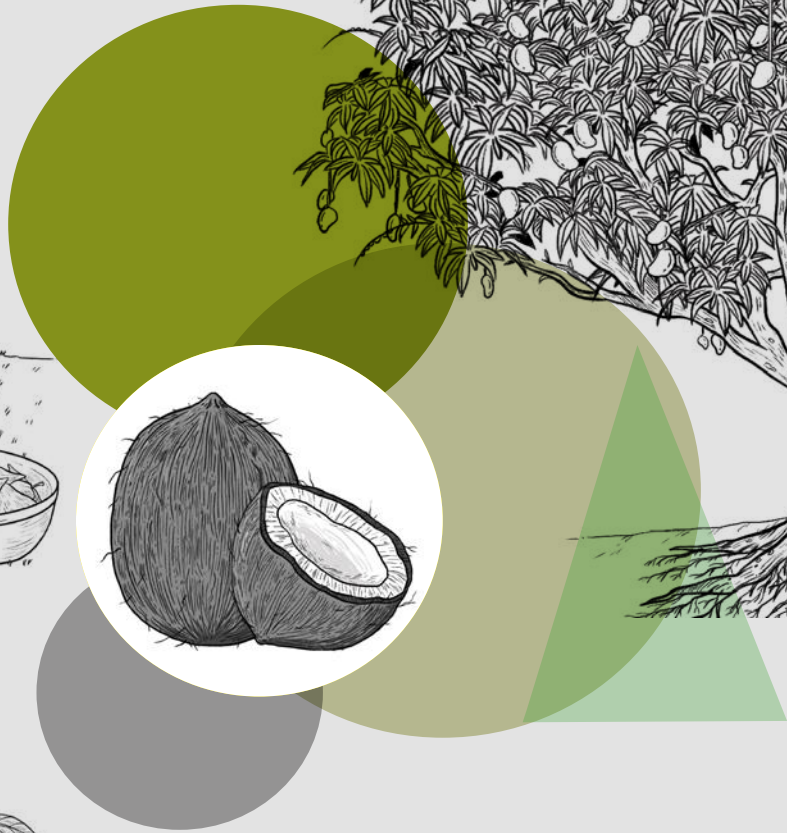# INTRODUCTION

Why agroforestry?

Conventional agriculture is very productive. But high productivity comes at a cost: soil that is depleted or eroded, watercourses that are polluted or drying up, and a food system that produces 20–40% of greenhouse gas emissions. Many people now agree that we urgently need to transform the food system, including agriculture. Agroforestry, as a nature-based approach to production and land use, will play an important role in this transformation.

Agroforestry is land use that combines trees with crops, trees with livestock, or trees with both crops and livestock. This mix of components creates an **agroforestry system** in which the components interact in a beneficial manner, improving agriculture in many ways; for example, by improving farm yields, increasing farm incomes, and contributing to soil and water conservation. Agroforestry is a form of 'trees-on-farms' (see Box 1).

Box 1. Agroforestry and trees-on-farms

We use the term 'agroforestry' to mean the use of trees in combination with crops, livestock, or both crops and livestock on the same area of land. Other ways of using trees-on-farms are also common: for example, woodlots; fruit trees planted next to a homestead; riparian buffer strips; and patches of natural forest. Some authors include these and other forms of trees-on-farms within a wider, '**landscape**' concept of agroforestry.

Trees on private farmland are an important part of global tree cover: 45% of the world's farms have more than 10% tree cover. Global carbon storage on agricultural land has been estimated at 45.3 billion metric tons, of which trees contribute more than 75%.[1] These figures exclude large areas of agroforestry on land usually classified as forest.

Trees-on-farms, including all types of agroforestry, have many different functions. They provide habitat that increases the biological diversity of agricultural land, including soil biodiversity and **agrobiodiversity**. They enhance the viability of protected areas by making it easier for animals, pollen and seeds to move between them. They contribute to nature-based solutions to conservation and food production challenges, despite being invisible in most countries' current 'green growth' strategies. Crucially, they supply useful and profitable goods and services to farmers and the community-at-large, including timber and fuelwood; improvement of soil fertility; water regulation; fruit, nuts, and edible leaves; and livestock fodder.

[1] Zomer RJ, Bossio DA, Trabucco A, Noordwijk M, Xu J. 2022. Global carbon sequestration potential of agroforestry and increased tree cover on agricultural land. *Circular Agricultural Systems* 2:3. https://doi.org/10.48130/CAS-2022-0003.

Conventional farming is often based on the production of a single crop. Agroforestry also often focuses on a single **flagship species** (which may be a tree species), but adds (other) trees to the system too. There are many ways in which trees can be incorporated. For example, a farmer may grow a cereal or vegetable crop combined with widely spaced trees. Or, the farmer might plant timber trees around the farm perimeter or along a watercourse. Agroforestry systems range from simple – such as one crop species and one tree species – to complex, with various crops species, tree species and livestock all meeting different needs.

Agroforestry is not new. Farmers have practised it for thousands of years, and scientists have recognized it since the 1970s as a productive and ecologically sustainable form of agriculture and land use. But now agroforestry is suddenly at centre stage. It is promoted as a land-use strategy to support **climate change mitigation** and **climate change adaptation**, biodiversity conservation, sustainable agriculture and other goals. Many organizations recommend or use it as a tool for restoring ecosystems, not only agricultural ones, but also forest landscapes.

Why another agroforestry publication?

Although not a cure-all, agroforestry has great potential to contribute to all the goals mentioned above. However, agroforestry is not just a matter of adding trees to farms. To realize its potential, practitioners need to understand its principles. *Agroforestry: A primer* is a guide to agroforestry principles and concepts, and how to use them effectively.

We took this approach partly because high-quality 'how-to' manuals and guides are already available – not just those with 'agroforestry' in their titles, but many too from the fields of forestry, horticulture and social sciences. More importantly, though, our approach reflects two basic needs.

1   First, it is important to avoid the preconceived '**technological package**' approach that can come from too much reliance on a specific manual. Instead, agroforestry practitioners and those supporting them need to understand how to use principles and concepts to design and adapt practices to their local conditions.

2   Second, it is critical to ensure that the aspirations, capabilities and dreams of farming families are central to the design and promotion of agroforestry. Agroforestry must support not only environmental goals, but also – and most importantly – rural people's goals and aspirations for better lives. Farmers rarely have the luxury of investing their time or their land in activities that do not give them direct, tangible benefits. The trees must contribute to food or nutritional security, or generate income.

Payments for **ecosystem services**, such as carbon credits, are usually of low value and are insufficient to persuade smallholders to plant and manage trees. Trees can be an important instrument to restore and maintain biodiversity and ecosystem services on farmland, but they need to be planted as part of a long-term development strategy. This should include the development of tree-based enterprises and markets for tree products.

Our aim is to support practitioners as they work to realize agroforestry's full potential to contribute to the local and global challenges of the twenty-first century.
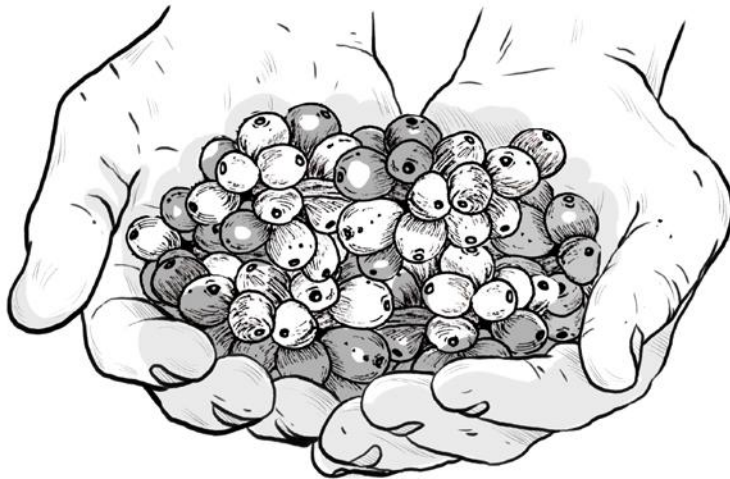
Who will find this publication useful?

This book aims to guide professionals who are supporting farmers in implementing agroforestry systems, such as:

extension workers

planners and managers

researchers

trainers

teachers and students of agroforestry

and professionals from a range of disciplines working on projects and programmes that use agroforestry. These disciplines may include agroecology, biodiversity conservation, land restoration, rural development and others, as well as agroforestry itself.

How this publication is organized

Chapters 2–7 detailing different aspects of agroforestry systems follow this introduction:

2   **Components of agroforestry systems** describes the most important attributes of four key elements of agroforestry systems: crops, livestock, trees and soil life.

3   **Agroforestry systems as circular systems** describes how agroforestry promotes soil health and conservation.

4   **Principles of agroforestry design** outlines three guiding principles that are fundamental to successful agroforestry **interventions**.

5   **Co-design and establishment of agroforestry systems** explains some important considerations in implementing design principles and translating design into practical action.

6   **Planting material in agroforestry** presents guidance on ensuring adequate quality and quantity of seed and planting stock.

7   **Management of trees in agroforestry systems** describes the main activities needed to ensure that trees interact favourably with the other components of a system.

These are followed by **chapters 8 and 9** that provide different sorts of overviews of several agroforestry systems:

8 **From principles to practice: Key systems** presents generic characteristics of several widely used agroforestry systems.

9 **Stories from the front line** uses a series of synthetic case studies to illustrate how farmers, and those that support them, can apply the principles and concepts described in the previous sections.

We recognize that farmers are diverse and include people across genders, age groups, cultures and resource levels. The messages in this book are relevant to all, and we use the term 'farmer' to cover this diversity.

The appendices include a glossary and a list of scientific and common names used in the text. Words and terms included in the glossary are written in **bold blue type**.

Key resources

We have used many sources in preparing this publication. The following have been particularly useful:

1. Tengnäs B. 1994. *Agroforestry extension manual for Kenya*. Kenya: World Agroforestry (ICRAF). http://apps.worldagroforestry.org/downloads/Publications/PDFS/B08037.pdf.
2. Somarriba E and Quesada F. 2009. *Agroforestry farm planning: Manual for farming families*. 1st Edition. Turrialba, Costa Rica: Tropical Agricultural Research and Higher Education Center (CATIE). http://canacacao.org/wp-content/uploads/Manual-Agroforestry-Farm-Planning.pdf.
3. Miccolis A, Pereira AVB, Peneireiro FM, Marques HR, Vieira DLM, Arco-Verde MF, Hoffman MR, Rehder T, Pereira AVB. 2016. *Agroforestry systems for ecological restoration: How to reconcile conservation and production*. Options for Brazil's Cerrado and Caatinga biomes. Brasília: Instituto Sociedade, População e Natureza (ISPN) and World Agroforestry (ICRAF). http://apps.worldagroforestry.org/downloads/Publications/PDFS/B19034.pdf.
4. Somarriba EJ, Orozco-Aguilar L, Cerda R, López-Sampson A. 2018. *Analysis and design of the shade canopy of cocoa-based agroforestry systems*. *In* Umaharan P. ed. *Achieving sustainable cultivation of cocoa*. London: Burleigh Dodds Science Publishing,1–31. https://doi.org/10.1201/9781351114547.
5. Raintree JB. 1987. *The state of the art of agroforestry diagnosis and design*. Agroforestry Systems 5(3):219–250. https://doi.org/10.1007/BF00119124.
6. Kitalyi A, Miano DM, Mwebaze S, Wambugu C. 2005. *More forage, more milk: Forage production for small-scale zero grazing systems*. Nairobi, Kenya: Regional Land Management Unit (RELMA) of World Agroforestry (ICRAF). http://apps.worldagroforestry.org/downloads/Publications/PDFS/MN13558.pdf.