

Branching out

Technical Guidance for Agroforestry



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The Technical and Operational Performance Support (TOPS) Program is the USAID/Food for Peace-funded learning mechanism that generates, captures, disseminates, and applies the highest quality information, knowledge, and promising practices in development food assistance programming, to ensure that more communities and households benefit from the U.S. Government's investment in fighting global hunger. Through technical capacity building, a small grants program to fund research, documentation and innovation, and an in-person and online community of practice (the Food Security and Nutrition [FSN] Network), The TOPS Program empowers food security implementers and the donor community to make lasting impact for millions of the world's most vulnerable people.

Led by Save the Children, The TOPS Program draws on the expertise of its consortium partners: CORE Group (knowledge management), Food for the Hungry (social and behavioral change), Mercy Corps (agriculture and natural resource management), and TANGO International (monitoring and evaluation). Save the Children brings its experience and expertise in commodity management, gender, and nutrition and food technology, as well as the management of this seven-year (2010–2017) US\$30 million award.



Photograph: Thomas Cole

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Why agroforestry is important

This guide gives practical advice on promoting and supporting agroforestry, and key resources for further reading

Helping farmers enhance crop and livestock performance, with added benefits

Farmers need to protect their land and get more from it.

By including trees and shrubs in their cropping and pastoral systems, farmers can directly and indirectly increase crop and livestock productivity, while getting benefits and value from the trees themselves.

Agroforestry covers a wide range of practices, including:

- planting trees in home gardens or among crops (mixed cropping)
- using leguminous trees among or near crops to fix nitrogen in the soil
- planting trees on slopes or vulnerable soils
- planting hedges and live fences
- regenerating trees from existing stumps.

Agroforestry in smallholder farms has many benefits.

Economic

- Increased and diversified products
- Reduced input costs
- Increased financial returns
- More resilient, diversified systems for crop production and animal grazing

Environmental

- Improved soil fertility
- Reduced soil erosion
- Improved water conservation
- Increased crop and livestock protection from wind
- Restoration of degraded lands
- Contribution to biodiversity conservation and climate-change adaptation and mitigation

Social

- Improved health and nutrition
- Labor and cost savings for firewood and fodder

Adoption of successful agroforestry systems requires program support to enhance farmer knowledge, build a better enabling environment (such as land and tree tenure), and more efficient value chains.

This guidance is mainly for project staff working with smallholder farmers, such as those targeted by USAID/Food for Peace (FFP)-funded programs. Many programs have not focused on agroforestry, but combining agriculture and forestry techniques can yield significant results for smallholder farmers.

Agroforestry

The combining of agriculture and forestry in farming systems.

Key tools

■ *Good nursery practices:*

A simple guide Mborera A, Lillesø J-PB, and Jamnadass R. 2008. Nairobi: World Agroforestry Centre (ICRAF).

■ *The World Agroforestry Centre*

www.worldagroforestry.org

Also known as the International Centre for Research in Agroforestry (ICRAF). Paramount resources in the field of agroforestry. Is research oriented, but has a wealth of materials on agroforestry systems and implementation programs.

■ *Training manual for applied agroforestry practices*

2015. University of Missouri. Designed for natural resource professionals and landowners. Includes worksheets and exercises for use as an educational tool.

■ *An agroforestry guide for field practitioners*

Xu J, Mercado A, He J, and Dawson I. 2013. China: ICRAF.

Contains technical illustrations providing practical, user-friendly information for planning agroforestry practices. Particularly concerned with field-level interventions for sloping land management.

Includes worksheets and exercises for use as an educational tool.

■ *An agroforestry guide for field practitioners*

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Ensuring farmers make the most of agroforestry

Use of trees will depend on farmers understanding the range of benefits agroforestry brings

Before starting agroforestry activities, there are some important points to consider.

Promoting the benefits to farmers

Farmers commonly believe that trees and annual crops compete with one another, which complicates the promotion of trees in cropping systems. These beliefs persist despite the fact that some traditional cropping systems successfully include trees.

Unless farmers have a sound knowledge of the benefits that trees can bring, they may be reluctant to invest in agroforestry activities. This may result in low demand for tree seedlings initially.

Do not respond to low demand by distributing free seedlings or paying people to plant.

Ensure that smallholder farmers understand the long-term benefits of trees in farming. Alongside this, encourage short-, medium- and long-term tree crops, such as fruit and nuts, mixed with leguminous species.

Sustainable local nurseries

Farmer-owned, self-supporting nursery businesses are a critical element of a good agroforestry program.

Most forms of agroforestry involve nurseries. Sustainable tree production depends on farmers wanting seedlings enough to pay the real cost of producing them, so the selection of species must reflect that demand.

Nurseries must offer the species that farmers prefer, and that are appropriate for the local environment.

Fruit trees are often the most popular, especially if they are grafted. Where there is a strong market for timber, wood species are popular.

An agroforestry program is not likely to succeed where farmers are not willing to pay for seedlings, unless demand can be stimulated.

When farmers do not make the minimal investment needed to buy a seedling, they are less likely to plant it correctly, or protect and water it so that it survives.



Photograph: David Snyder

Sustainable village nurseries:

- are owned and operated by farmers as a business
- supply local farmers
- are located next to a water source
- produce the types of trees that local people want to buy
- produce seedlings mostly during the dry season, so production does not conflict with the owner's farming activities, and seedlings are ready for sale when the rains begin
- use inputs (such as seeds, sacks, compost, and grafting scions) that are all accessible to the nursery owner without needing a project to supply them
- sell seedlings at a price that covers all production expenses plus a profit margin
- provide technical advice to customers about planting and caring for seedlings.

Choosing the right location for planting

It is essential that the people caring for the trees have ownership or harvesting rights, and the planting location can affect this.

Planting on **communal land** can be an option but has its challenges. Projects frequently mobilize people to plant trees at schools, along roadsides, and other places where no individual has ownership. Since no specific individuals reap the benefits, or are responsible for looking after them, survival rates are often low.

Tree planting works best on **private land** (fields and home compounds) where the trees are cared for by the owners.

If a project decides to plant on land belonging to a school or other institution, the managers of that institution *must be directly involved and take responsibility for the post-planting care of the trees*, including when the schools are not in session.

Farmers without land tenure are often discouraged from tree planting and care, as they have no guarantee of reaping benefits.¹

Before planting, farmers may want clear and public recognition of their rights to the trees they plant from relevant authorities, even if they do not hold a formal land title.

Consider promoting short- and medium-term tree crops, to reap earlier benefits.

Typical strengths of group versus individual nurseries

An ICRAF comparative study found that group nurseries are good platforms for training, while individual nurseries are far better for producing and disseminating seedlings over the long term (see *Further reading*).

ICRAF has also published *Good nursery practices*, a guide to nursery management (see *Key tools*).

*Agroforestry brings multiple
benefits to smallholder farmers*



Photograph: Thatcher Cook

Agroforestry is relevant to most environments

Agroforestry can be applied in many different contexts, depending on the local environment and the needs being addressed.

Local considerations might include:

- high winds
- high or low rainfall
- pests
- soil erosion
- economic constraints such as labor and the costs of other inputs
- yield requirements.

Different needs can be met by different approaches.

(see *Further reading* for more detailed explanations of these and others)

1 Soil nutrition

Leguminous species can be planted to add nitrogen to soils used for crops. Species commonly used in the tropics and subtropics include *Acacia spp.*, *Leucaena leucocephala* (white lead tree or jumbay), and *Prosopis* (mesquite or malinke).

Leguminous trees need to be managed, to minimize competition with crops for sunlight and soil nutrients. The trees should be:

- grown at some distance from crops (two meters for *Leucaena*, three to five meters for fruit trees)
- pruned two to three times a season, and the foliage spread on soil as green manure.

2 Field protection

Rows of trees are a traditional way of marking field boundaries. Any kind of tree will serve this purpose, even fruit trees if allowed enough space around crops, although small-stature trees and those that can be pruned and trained into narrow hedges are more typical.

Live fences can also be used to **keep grazing livestock out of fields** and gardens. Farmers often prefer to use thorny species like *Acacia spp.* and inedible ones like *Jatropha curcas*, a poisonous semi-evergreen shrub.

In windy climates, farmers can plant hedges as **windbreaks**, also called shelter belts, to protect crops. Dense-canopy trees like *Azadirachta indica* (neem) or *Casuarina* are most useful for this. Hedges also slow the lateral flow of runoff water, reducing the effects of erosion and increasing the amount of rainwater soaking into fields.

Faidherbia albida (winter thorn or apple-tree acacia) a legume native to Africa and the Middle-East, actually enhances nearby crop growth. It does not need a margin of separation from crops, and loses its leaves during the rainy season, which fertilizes the soil and lets sunlight through while crops are growing.



Photograph: Robert Ford, istockphoto.com

Hedge trees should be pruned regularly. The cuttings can:

- be used as an important source of fodder for animals if edible (especially during the dry season)
- provide a critical source of nitrogen and organic material when added to crop lands
- provide important biomass for farmers' compost piles (for example *Tithonia spp.*).

3 Soil conservation

Trees can be planted as a means of stabilizing eroded or vulnerable soils to begin the process of regeneration and reduce soil-nutrient loss.

Early-colonizer species like *Leucaena leucocephala* can grow on badly-eroded soils. The stability and organic matter they provide create the conditions for other plants to grow, further protecting and enriching soils.

These plants are often grown close together in rows along the land's contour. *Leucaena*, for example, can be planted at 0.5 meters spacing when used this way.

Soil conservation advice

Anthony Young's 1989 manual, *Agroforestry for soil conservation* is one of the early and most comprehensive references on this topic (see *Further reading*).

In particular, refer to:

Chapter 6 *Agroforestry practices for erosion control*

Chapter 14 *Agroforestry practices for soil fertility*

Eucalyptus and neem (pictured) have been promoted in many areas because of their fast growth and hardiness. They have some drawbacks, including the tendency of their oil to discourage the growth of crops and other trees nearby (allelopathy). They are still recommended where wood species are rare and they are not in danger of negatively impacting crops, but **use caution**.



Photograph: Yands, istockphoto.com

Trees planted over other crops need to be spaced widely enough to let sunlight through

4 Mixed cropping

Some farms combine trees with other crops. Holistic multi-species farming is an important component of **permaculture**.

Benefits can include:

- increased and diversified production
- reduced lodging of vulnerable crops to wind
- structural support to creeping plants
- suppressed weeds and increased nutrients
- shade for light-sensitive plants.

In home gardens, common in USAID/Food for Peace (FFP)-funded programs, farmers plant fruit trees above:

- middle-level perennial crops like bananas and papayas
- shorter perennials like pigeon peas
- annual crops and medicinal plants.

These trees need to be spaced widely enough so that sunlight can penetrate to the lower levels.

Alley cropping is the planting of trees in widely spaced rows, allowing annual crops to be grown between the rows.

Good tree species for this are ones that produce something useful, such as fruit, nuts, fodder, fuelwood, green manure, construction poles, or roofing fronds. The tree rows may also anchor soil and increase the amount of rainwater soaking into the cropped area.

Annual crops can also be cropped between rows of tree seedlings when establishing orchards and plantations, until the tree canopy closes.

Usually the canopy closes after two to five years.

Alley-cropped trees planted for fodder, firewood, or green manure need to be periodically pruned at about shoulder level (pollarding).

Pollarding at the beginning of a rainy season cropping cycle will:

- maximize the sunlight getting to crops between the rows
- provide foliage as green manure
- send the trees into *recovery shock* and reduce the amount that their roots compete with crops.

Some crops, like coffee, grow best with **shade trees**. Shade trees also have ecological aspects such as bird habitat. Low-shade trees like coconut palms can be grown above annual crops.

Harvesting poles

Tree species grown for poles, such as teak, can be coppiced or cut off near ground level every few years, after which several new poles sprout from the stumps.

Moringa oleifera is a small tree or shrub that grows throughout the tropics and does well in dry climates. It has been promoted in mixed cropping because:

- its pods and leaves are nutritious
- it grows fast and produces firewood
- its seeds contain edible oil
- as a leguminous species, it fixes nitrogen in the soil.



Photograph: bdsprn, istockphoto.com

5 Restoration of degraded lands

Re-greening or **farmer-managed natural regeneration** (FMNR) is becoming popular in semi-arid lands of Africa.

Farmer-managed natural regeneration (FMNR)

FMNR is the systematic regeneration and management of trees and shrubs from tree stumps, roots, and seeds.

Tree stumps that are re-sprouting are selected and pruned, leaving a small number to promote growth by reducing competition for resources.

If there are few or no stumps, trees that naturally sprout from seed within the ground are protected from animals and people until they are large enough to be pruned and managed.

With farmer and community stewardship, FMNR results in:

- greater forest cover
- increased crop and animal production
- a supply of fuelwood, timber, charcoal, trimmings for animal feed, fertilizer, or fencing.

FMNR is an affordable, quick and easy-to-replicate method of restoring and improving agricultural, forested, and pasture lands.

It can be used to return degraded crop and grazing lands to productivity, and restore degraded forests, reversing biodiversity loss and reducing vulnerability to climate change.

FMNR can also help maintain the productivity of land that has not yet been degraded. It can be combined effectively with other sustainable land management practices such as conservation agriculture on cropland and holistic management on rangelands.

FMNR began in Niger in the 1980s and has improved over five million hectares there.

FMNR has since spread to Burkina Faso and other countries of the region.

Among the best documents on FMNR is *Farmer-managed natural regeneration – How to regenerate pasture and farmland on a low budget*.
Abdirizak H, Gudka M, Kibor B, Kinuthia M, Kimeu P, de Leeuw J, Maimbo M, Safriel U, Njenga M, Liyama M, Technical Brief 2013, World Agroforestry Centre.

fmnrhub.com.au

FMNR site managed by WorldVision Australia in conjunction with the World Agroforestry Centre.

Success story

Localized nurseries, technical advice and promotion of benefits led to a momentum of its own

Planting cashew trees for soil conservation and bush-fire reduction in Côte d'Ivoire

Cashew trees were first promoted soon after independence in 1960. Côte d'Ivoire is now the second largest producer of cashew nuts in the world.

Two government agencies (SODEFOR and SATMACI) began promoting *Anacardium occidentale* (cashew trees) as a means of limiting soil degradation and desertification in the Korhogo Department in the dry north of the country.

The dense, spreading crowns of the cashew trees and the broad, leathery leaf litter discouraged the growth of brush beneath, which meant that cashew groves also made effective firebreaks.

SODEFOR and SATMACI provided technical assistance for villagers planting and operating nurseries, and helped publicize the benefits of trees.

Farmers noticed that the cashew trees produced a sweet, astringent, vitamin-rich fruit that ripened at the end of the dry season when other nutrients were in short supply.

Cashew trees caught on among farmers all across northern Côte d'Ivoire. They could easily plant them from seed without the need for nurseries and intercropped them with yams, maize, millet, beans, groundnuts, and cotton.

Cashew-based agroforestry took on a momentum of its own.

Rural families ate the fruit fresh, but nobody knew what to do with the nuts (whose shells contain a caustic toxin), leading to an abundance of discarded cashew nuts. The volume of unused raw nuts attracted traders from India and Brazil.

Now Côte d'Ivoire is one of the largest exporters of raw cashews. It produced 550,000 tonnes of raw nuts in 2014 – about 22% of global production.

Côte d'Ivoire is currently trying to develop local industries to process the nuts and export the finished product, reflecting the economic and ecological benefits that agroforestry can have.

See the ***African Cashew Initiative*** for more information.

SODEFOR

Société de Développement des Forêts

SATMACI

Société d'Assistance Technique et de Modernisation de l'Agriculture en Côte d'Ivoire



Photograph: Paul Cowan, istockphoto.com

Further reading

- *Agroforestry for soil conservation*
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International Council for Research in Agroforestry
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One of the early and most comprehensive references
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- *Agroforestry systems*
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Netherlands-based, peer-reviewed scientific journal
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- Contribution of agroforestry trees to nutrient
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Agroforestry Systems 30: 105–124. Palm CA. 1995.
Research findings on application of leguminous tree
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by crops.
- *Does land tenure insecurity discourage tree planting?*
*Evolution of customary land tenure and agroforestry
management in Sumatra*
Otsuka K, Suyanto S, and Tomich TP. 1997.
Washington DC. EPTD Discussion Paper. Environment
and Production Technology Division, International
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Examines the relationship between land tenure and
tree planting.
- *Forage tree legumes in alley cropping systems*
Kang BT and Gutteridge RC. Rome, Italy: Food and
Agriculture Organization of the United Nations (FAO).
FAO web page on alley cropping. Mostly concerned
with soil nutrition.
- *Growing agroforestry trees: Farmers' experiences with
individual and group nurseries in Claveria, Philippines*
Garcia MB. 2002. Claveria, Misamis Oriental,
Philippines: World Agroforestry Centre (ICRAF).
Comparative study of group nurseries versus individual
nurseries for agroforestry in the Philippines.
- *Les haies vives défensives en zones sèches et
subhumides d'Afrique de l'Ouest*
Yossi H, Kaya B, Traoré CO, Niang A, Butare I,
Levasseur V, and Sanogo D. 2006. World Agroforestry
Centre (ICRAF) Occasional Paper 06.
Describes live fencing systems used in the West
African Sahel (in French).
- *Sustainable Forest Management (SFM) Toolbox:
Agroforestry Module*
Food and Agriculture Organization of the United
Nations (FAO). [www.fao.org/sustainable-forest-
management/toolbox/sfm-home/en/](http://www.fao.org/sustainable-forest-management/toolbox/sfm-home/en/)
Online resource providing an overview of agroforestry
systems, with tools, case studies and further reading.
- *The Overstory Journal*
1997–2016. Agroforestry Net, Inc.
www.agroforestry.net/the-overstory
Free email agroforestry journal for practitioners,
extension agents, researchers, professionals, students,
and enthusiasts. Individual editions focus on a concept
related to designing, developing, and learning more
about trees and agroforestry systems.
- *Training in agroforestry – A toolkit for trainers*
Taylor P and Beniast J. 2003. World Agroforestry
Centre (ICRAF).
Large, detailed course in how to plan for and execute
an agroforestry training program. Includes general
topics like adult learning and stakeholder analysis.

Endnotes

- 1 *Does land tenure insecurity discourage tree planting? Evolution of customary land tenure and agroforestry management in Sumatra.* Otsuka K, Suyanto S, and Tomich TP. 1997. Washington DC. EPTD Discussion Paper. Environment and Production Technology Division, International Food Policy Research Institute. This study documents the well-known relationship between land tenure and tree planting.

