

Agroforestry systems in the Upper Mara River Basin

A practical guide for farmers

October 2017



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1 Why this guide?

Farming is a tough business with a strong competition and high risks. One way to make your farm competitive is to produce more on the same plot of land in a growing season and with lower costs. Innovation can also help. Information that helps you to test new practices to see what works for you, and knowing how to increase farm production sustainability, and respond to market information is key. This guide aims to provide such information for farmers in the Upper Mara River Basin in Kenya, providing practical guidance on agroforestry: growing trees in combination with agricultural crops.

What can I do with this guide?

This manual provides guidance on agroforestry. It gives advice on how to select trees and crops for a healthy agroforestry system, what specific trees can offer, and how to combine them with other crops to generate profit, for family use and that help conserve and protect the environment by producing more with less water.

In particular, the manual helps you to:

- Produce more, and when you identify market opportunities, to also sell more
- Produce more different products. This can help increase your income even if the harvest of some products is small
- Diversify plants for a healthy farming system
- Improve the soil quality and soil water retention
- Identify the useful trees - and which trees and crops can be grown together
- Know the different uses of trees

Applying the techniques shown in this manual can lead to higher plant diversity, and can help conserve water, fertilize the soil, control and reduce soil erosion, reduce chemical inputs so that farming costs less and harm to the environment is limited. A healthy environment is not only the basis for successful farming, but is a way to conserve the beautiful Mara River and Mau forest landscape for future generations.

Where can this guide be used ?

This manual focuses on the Upper Mara River Basin in Kenya (see Figure 2 describing the Mara River Basin) and its soils, climate and water. This means the guide cannot simply be applied anywhere else. If used in other locations, local agricultural agents, farmers, service providers or researchers should be asked for advice about local conditions, as each farmer and field is different.

Implementing different farming practices cannot be done using a guide alone. Improving farming requires continuous innovations and exchanges of experience with other farmers, suppliers, extension staff and service providers. This guide can provide ideas and inspiration for discussion. It can help service providers explain agroforestry, and help farmers recall the explanations and ask questions.

Who is this guide for?





The MaMaSe Project

The Mau Mara Serengeti (MaMaSe) Sustainable Water Initiative is aimed at improving water safety and security in the Mara River Basin to support structural poverty reduction, sustainable economic growth and conservation of the basin's ecosystems. During this four year programme the people and institutions in the basin have been supported in a process of structural change, promoting water-wise economic development that lifts people out of poverty and sets them on a sustainable path to improved well-being and self-reliance.

The MaMaSe Initiative is financially supported by the Netherlands Embassy in Nairobi. This manual forms part of the activities promoting market-driven, water wise commodities in the Upper Mara Basin with the Water Resource Users Associations (WRUAs) and Community Forest Associations (CFAs), promoting innovative and sustainable agricultural practices.

How this guide was developed

This guide was developed based on literature indicating the species suitable for the Upper Mara River Basin and through observations made during field visits and meetings with farmers, agroforestry experts, tree nursery managers, beekeepers, Community Forest Associations (CFAs) and Water Resource Users Associations (WRUAs) in 2016 and 2017, especially during a participative workshop on agroforestry held in Mulot in May 2017. We acknowledge the following people who participated in developing this guide:

Amala WRUA: Joseph Chebusit, Jesca Testot, Moses Kipotich, Livingstone Chepyos, Joseph Ngereshi, Annah Langat

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Using this guide

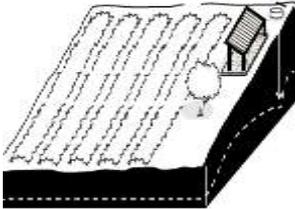
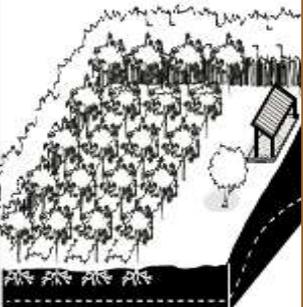
Scientific names of plants are written in *italics*, **local** and **English names** are written either in plain text or in **bold**. The term "Spp." means species.



2 Introducing agroforestry

Agroforestry or agro-silviculture is the name for land-use management technologies and systems in which woody perennials (trees, shrubs, palms and bamboos) are grown around or among crops, pasture land and animals, with specific spacing and timing. Agricultural and forestry technologies are used to create a more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use system. Agroforestry uses polyculture, the simultaneous production or growth of multiple plant and animal species in the same place.

Depending on the needs of the farmer and the local situation (particularly the slope and altitude), a variety of different crops and trees can be selected and combined. We prepared some concepts which you can use as an inspiration to create your own land-use system. Additionally, on steep slopes, terraces should be made and planted with trees and shrubs with deep rooting systems. Cover crops can be temporary, but should be planted year-round, to avoid having bare soil which can lead to a loss of plant nutrients, soil erosion and heavy rainwater runoff affecting water quality in nearby streams and rivers. Cover crops can also help improve soil quality - particularly leguminous cover crops - and can be used to suppress weeds, as green manure and as fodder for livestock. Decayed cover crops increase organic matter, can help retain moisture.

Type of farming	Farmer income	Food for people & livestock	Prevents soil erosion	Increase soil fertility	Increase biodiversity	Retains water	Slope
Traditional monoculture farming 	✓	✓					Eroded slopes 
Agroforestry 	✓	✓	✓	✓	✓	✓	Trees & terraces prevent erosion & catch water 



A **multipurpose tree** is a tree that is deliberately grown and managed for more than one significant output or function. Multipurpose trees can be integrated with crop farming and forestry to improve yields, diversify products, increase economic resiliency, and improve farm viability and sustainability in the long-term. When choosing a species for a particular purpose, it is important to consider the multiple uses and functions the species can provide.

For example: A tree can supply food in the form of fruit, nuts, or edible leaves and at the same time supply firewood, add nitrogen into the soil, and supply some other combination of outputs and products. These products and services are shown in this guide using the following icons:



Good source of nectar and pollen for bees



Acts as a wind break



Helps improve soil structure and permeability



Clothing dye, tannin, cosmetics



Mulch/green manure to increase soil fertility



Shade tree



Good fodder for livestock



Food



Good for timber, fuelwood or charcoal



Medicinal uses



Rodenticide, pesticide or insect repellent



Cash crop



Nitrogen fixing



Soil erosion control, River bank protection



Live fence



Helps biodiversity



Trees can be multipurpose in two ways:

Option 1: Single tree managed for multiple, compatible functions

For example *Gliricidia sepium* can be managed as a living fence and to provide fuelwood, fodder and green manure.



When planted as a live fence or in a hedgerow between agricultural crops, some tree species such as *Gliricidia* reduce soil erosion. When planted on slopes, alley crops slow down runoff rainwater and trap sediment, and can help to create terraces after several years. Alley cropping means growing hedgerows of closely spaced trees (20cm or less) between rows of food crops.

On sloping land, farmers should plant hedgerows along the contours. Hedgerows need to be pruned or cut regularly to prevent competition with nearby crops for sunlight and water. They then provide a reliable source of animal fodder and fuel. Cutting cycles of 4-6 months provide relatively more wood than shorter cycles. Short cycles produce relatively more foliage. Most species should not be pruned more often than once every 30 days.

If planted in double lines rather than single lines, hedgerows can produce almost twice as much foliage and wood, without greatly increasing the competition with nearby crops for water, nutrients, and sunlight. Plant in a north-south rather than east-west direction if possible, this reduces competition for sunlight. Using single or double rows depends on how much land is available and the slope.

Green manure refers to foliage and twigs that are spread among food crops as mulch and organic fertilizer to improve their growth. To obtain green manure, prune the tops of the hedgerows every 6-8 weeks.

Option 2: Different trees of the same species managed differently to serve different functions that are incompatible by themselves

For example, a woodlot of *Leucaena leucocephala* some trees can be managed to produce wood while in other cases the same species are managed to act as windbreaks or fodder banks to produce leaf meal (fodder for animals).



The multiple purposes that a given species can provide may be mutually exclusive. A species such as *Leucana leucocephala* that can be used both for fuel wood and fodder cannot be usually managed to obtain both kinds of products at the same time from the same tree. This is because intensive management for fodder entails frequent coppicing and the amount of fuel wood that can be provided is minimal. However, the foliage of trees that are managed to produce fuel wood can be fed to livestock when the fuel wood is harvested.

In this context, generally, the management given to multipurpose trees favours a particular product or service and often is sub-optimal for the other potential goods and services. There may be trade-offs between species – for example shade from trees can inhibit the growth of other crops grown near the tree.



3 Farmer's stories

William Rono: Nyangores CFA Treasurer



"The better soil from agroforestry gives me more yield, especially because of the goat manure, and the yield keeps on increasing".

Ten years ago William's farm was a barren, monoculture plot of about 4 acres with a slope of about 20 degrees. Today it is terraced, green and fertile with a mix of forage fed (napier grass, clover and weeds), fenced in goats and one cow providing manure for the banana, avocado, yellow passion fruit, pawpaw, chinse gooseberry, maize, a woodlot and timber trees (dombeya, chorwert, merula, prunus and grevillea).

William used to farm maize and beans conventionally with animals grazing extensively. William has seen increases in soil fertility.

Trees actually go with crops! Some experiments didn't work: bananas have been a problem as moles love them. He adopted avocado, where so far no pests have been encountered. Some trees should be avoided as they are not crop friendly, such as the large Prunus tree, which is better by the river bank due to its shade suppressing other crops. Poultry was also difficult, as you need to know where to sell the eggs and to feed them daily. Chemicals are used only for the very stubborn couch grass, star grass and kikuyu grass.



William Langat, Isei WRUA member



“One of the major rewards is that the water table has risen, so that two years ago the spring on my land was replenished and now flows year round” .

Sixty-five year old William used to have a flat, open 24 acre field with no water. He was inspired by the WWF WRUA project ten years ago to start his own nursery and plant trees. SNV capacity building helped train him on how to manage the nursery, to plant the trees, make terraces and farm well. William planted indigenous trees such as seat (*Albizia gummifera*), tendwet (*Prunus africana*), as well as exotic ones such as grevillea and cypress for timber, a eucalyptus woodlot for timber and firewood, and avocado, tea and banana for food.

William’s agroforestry has attracted the attention of donors: he obtained one cow via WWF. From selling the additional production of his crops, William has been able to buy goats and invest in more beehives, banana, avocado and bamboo.

William encourages other farmers in Isei to look at his farm, saying that *naet kufhamu* (knowledge) is the key. William says: “With knowledge you can make changes”.



4 Steps in introducing agroforestry

Introducing agroforestry means planning your farm, changing your farming practices and the way you work and think. Also your timescales: agroforestry can take months and years to become established and for the full range of economic and environmental benefits to be clear, although there are ways to ensure benefits flow early. These steps provide a guide to how you can introduce an agroforestry system.

1. Set your aims and priorities

What do you want to get out of agroforestry and why? What is important to you about your farm? Food, cash, fuelwood, etc.....

2. Determine your personal resources

The resources required will differ for each farm, although some are always needed:

- Plot of land and physical aspects of the terrain
- Soil – soil testing can be requested via SNV or agricultural extension workers and costs about 1300 KES
- Climate
- Seeds or young plants ready to be planted
- Adequate sunlight on the land
- Sufficient rainwater and groundwater

Optional resources include

- Sources of compost such as farm animals
- Irrigation – depending on rainfall in the area

If you don't have one or more of these, think how viable and the cost of obtaining.

3. Inventory available resources and inputs

These resources may be of help to you to improve your agroforestry system, are they available? If so, what do they cost and where can you get them?

- Agribusiness and inputs
- Financial capital
- Current cash crops
- Labour force
- Current livestock
- Equipment, tools and machinery
- Information on agroforestry and markets

4. Analyse risks

Are there foreseeable or possible events that may affect your options?

- Family needs and predicted changes e.g. school fees, wedding costs
- Weather changes
- Land title
- Known pests, diseases and problems with certain crops or products and their markets
- Risk of obtaining credit



5. Identify market opportunities

Is there a market for the cash crops for your agricultural and livestock crops, timber and non-timber products?

If yes, think about:

- Is it local, national and/or international market for the crops and products that you can grow on your farm?
- how people and markets will react to “newer” products such as passion fruit or pumpkins?
- What are the quality, prices, volumes in demand and is there market volatility and seasonality?
- Is there a chain linking you as farmer to the market (i.e. transporters, processors, equipment and service providers, wholesalers, retailers)?
- Can you process or change your product to add value?
- How can you best promote and sell your product(s)?
- Are there groups of farmers you can join, or create a group, to have stronger bargaining power and obtain information?

6. Choose your options

Based on you and your family’s needs, your farm size, the land and local environment, you can select plants by asking yourself the following questions:

- How do taller, woody trees interact with crop plants?
- What effect do the crops have on the soil quality? Think about which crops use lots of soil nutrients (such as maize, tobacco, onions, potatoes, millet) and those that can enrich soil nutrients (such as nitrogen fixing plants like beans, peas, pumpkins or sweet potatoes)
- How do animals interact with crops?
- How do animals interact with the larger trees and bushes?
- What kinds of produce or crops do I want to grow?
- What is my intended purpose for the crops after harvest?
- Is the species a native to the area or exotic (such as Black wattle, bamboo or avocado) – If it is exotic, is it adapted already to the Mara Basin climate, soil, slopes, and plant and animal life (pests and diseases)? If not, it is higher risk.
- Ease of maintenance - how much time do you have to care for the trees and do you need new skills and knowledge to grow a particular species
- Are seeds or seedlings of the tree available in Kenya, or can vegetative propagation be used? Do you need training on how to do this?

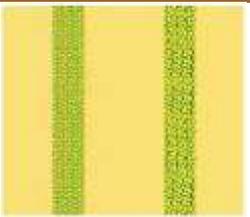
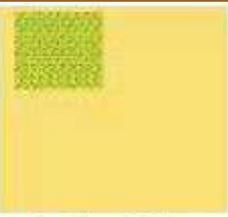
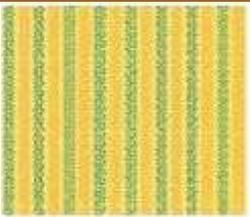
Think of your “best bets” (which species do well) and brainstorm with others. Do a cost benefit analysis- what will be your costs in the set-up and maintenance stages? What and when will be the different benefits? What profits could you expect?

- Make a farm plan: what will you plant, which livestock (if any) where, when and how and how much will it cost?



7. Spacing

Then decide what arrangement would work best. As well as the species, you need to take into account farm boundaries and natural features such as rocks, springs and streams. On steep slopes you may have to make terraces or contour strips (of trees, grasses and/or other plants) to control and avoid erosion.

				
Windbreaks Soil protection, crop protection	Boundary Planting Privacy, less animal interference with crops, biodiversity	Rotational Fallow Better for soil nutrients, easier livestock, crops, & pasture organization	Alley Cropping Nutrient supply, shade, biodiversity	Trees in Cropland (small scale) Plant-animal integration, few materials needed, biodiversity
Shelter belt trees or hedges, Side by side tree/crop interface length=420 m	Side by side tree/crop interface length=820m	Side by side tree/crop interface length=126.49m	Side by side tree/crop interface length=1620m	Side by side tree/crop interface length=371.767m

The interactions of trees with agricultural crops and livestock are important. Interactions between tree can be positive (e.g. increased fertility, protection) or negative (e.g. suppressed growth, competition for resources). The productivity of an agroforestry system depends on these interactions. It is beneficial to adopt arrangements with high tree -crop interface if the resultant interactions are positive; adopt arrangements with low tree - crop interface if interactions are negative but both components are still required e.g. for environmental services.

Benefits will only be obtained through a combination of the right tree species with the right crops in the right spatial arrangements and with the right management practices. Spatial arrangements concerns the physical location of plant on the plot – shown in table 1.

Table 1 Spatial arrangements

Type of tree-crop interfaces	Description	Example
Side by side	Usually horizontal and relative magnitude of interactions is quantified by linear distance measurements	Trees competing with crops planted next to them e.g. through root system
One-above-the other	Shared area of interaction between tree and the crop is above the ground in a multi-storeyed system;	Home garden; tree intercropping plantation crops such as tea and coffee.
One-after the other	Crops and agroforestry tree components share same space but at different times	Improved fallows in shifting cultivation
Below ground	Zone of interaction between tree and crop in the soil mainly rhizosphere or shared rooting zone.	In alley cropping, tree roots can compete with annual crops for available water and nutrients in the top soil
Above ground	Zone of interaction between tree and crop mainly for growth factors absorbed or intercepted through leaves such as solar radiation and nutrient deposition.	Using shade tolerant trees



Temporal arrangements mean that different plants are planted one after the other, or have an overlap in time, shown in Table 2.

Table 2 Temporal arrangements

Arrangement	Description	Example
Separate or relay	Woody and non-woody components do not overlap in time	Shifting cultivation, fallowing, and crop rotation
Overlapping	Crop cycles of the woody and non-woody components partially overlap. Either one may be present first.	Multipurpose woodlot where seasonal shade-tolerant crops are introduced, or tree plantations for improved fallow before the end of the crop's cycle
Interpolated or intermittent	Woody components always present and the non woody component is only present during certain periods	Animals grazing under trees on a seasonal basis or irregular renewal of a part of the understory of a home garden
Concomitant	Woody component is always present and the seasonal component is only present at the beginning or end of the woody component's crop cycle.	Crops grown in association with trees until canopy closure is achieved (PELIS technology), beehives set up in productive orchards

Farmers also need to consider how they arrange different agricultural, tree and livestock components on their farm, and there is a range of possibilities, shown in Table 3.

Table 3 Options for arranging components of agroforestry systems

Arrangement	Types	Description	Example
Mixed/zonal	<i>Mixed</i>	The different components are <i>not geometrically arranged</i> , but are placed irregularly	Scattered trees dispersed on crop land, home gardens, or in aquaculture
	<i>Zonal</i>	The different components are <i>geometrically arranged</i>	Rows of trees and alleys of seasonal crops, windbreaks, hedgerows, rows of trees on terrace risers.
Dense/scattered	<i>Dense</i>	The components are close together throughout the plot	In a forest garden, in alley cropping, or if the canopies of trees that support the climbing crops are contiguous
	<i>Scattered</i>	The components are far from each other	Isolated trees in a pasture, rows of trees on rice paddy bunds; or scattered trees in crop land.
Single-strata/multi-strata	<i>Single-strata</i>	Only <i>one tree layer</i>	Alley cropping, live hedges; or windbreaks with only one species.
	<i>Multi-strata</i>	<i>Several tree layers</i>	In many home gardens or forest gardens, in multipurpose woodlots; or in windbreaks with two or more species having different dimensions.
Simultaneous/sequential	<i>Simultaneous</i>	The different components are <i>present on the same plot at the same time</i>	Trees in a pasture, trees in association with perennial crops.
	<i>Sequential</i>	The different components are not present on the plot simultaneously but <i>follow each other</i> , or they may overlap partially in time	Tree planting for improved fallow before the end of the agricultural cycle



8. Construction and maintenance

Construct your plots, and take account of whether you will rely on rainwater or if you may use irrigation (sprinklers, drip irrigation, etc.) and if you will be using any pesticides or specific fertilizers.

Attend to your land regularly with weeding, mulching and fertilising.

You may need to change the system after a number of years, if yields change, to maintain soil fertility and avoid certain pests and diseases – for example using fallows or changing species or combinations of species.

9. Monitor and evaluate

Develop a yearly calendar of activities

Keep records of what happens- it's easy to forget over the years – and update your farm plan.

Monitor and evaluate: Check and see if your predictions come true, and if not, why not.

Continue researching plant species, soil quality and examples of successful agroforestry systems.

Share information and results with others such as your neighbours, tree nursery staff, agricultural extension staff and learn from others, spread the news about practices which work (and don't).

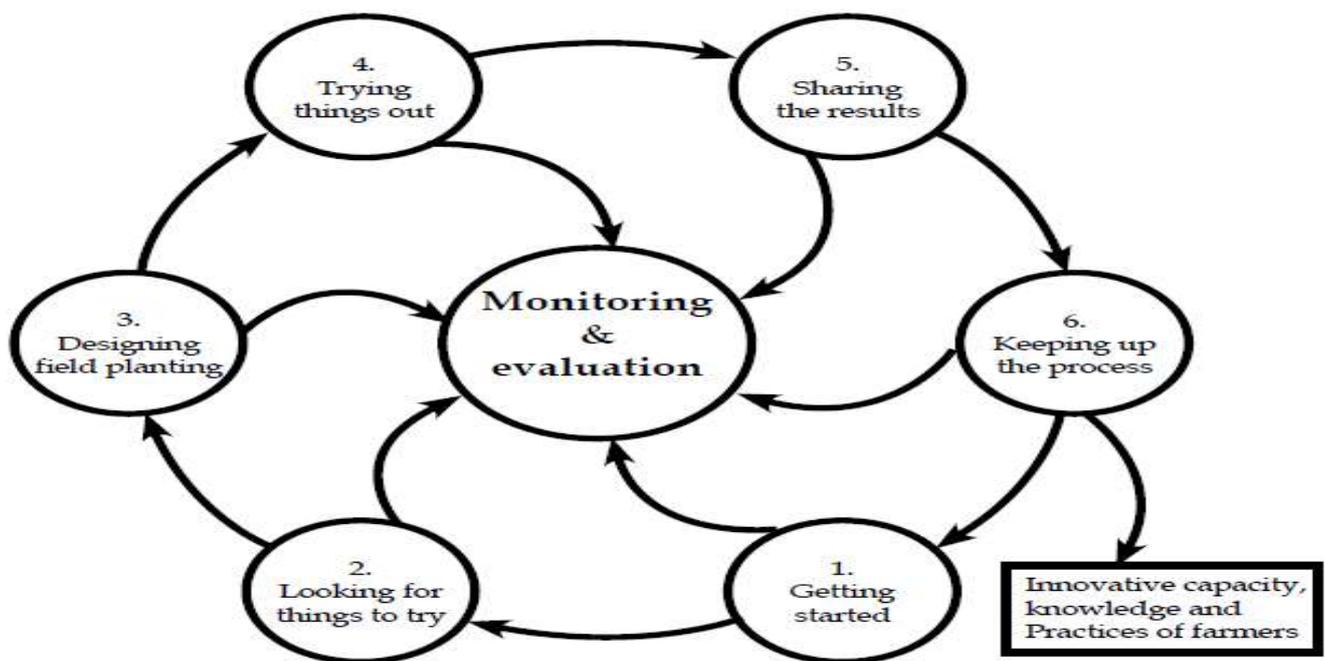


Figure 1 Steps in introducing agroforestry

5 Agroforestry Options

This next part of the guide provides:

- Six options suitable for different parts of the Mara River Basin
- Seven combinations of trees and crops
- Inspiration about which trees and plants can be used in agroforestry



1 Grevillea robusta



3 Prunus Africana



2 Avocado

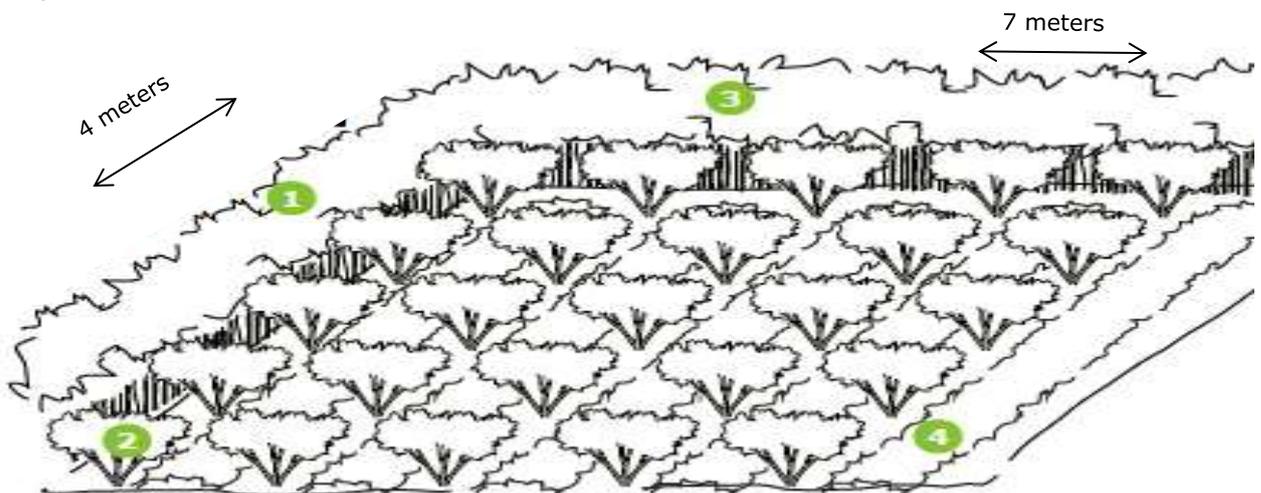


4 Cover crops or fodder bushes



Grevillea and prunus protect avocado trees which are sensitive to wind damage. Prunus is classed by the government as a 'vulnerable' species, so planting contributes to its conservation. Other shallow rooting tree species can be used instead of prunus. Avocado can be under cropped with a cover

crop or fodder bushes in the first years. This provides income until its starts fruiting around the third or fourth year. Plant avocado at a minimum of 2 metres from other trees. *Calliandra calothyrsus*, *Leucaena leucocephala* or *Sesbania sesban* are good fodder and live fence trees and help increase soil fertility. Decayed cover crops increase the humus in the soil. As avocados are shallow rooting, cover crops cannot be dug into the soil. A row of Grevillea can be pruned each year to provide fodder.



1 Grevillea



Fuel-wood and charcoal production



Provides nectar



Regulate shade for other crops and people



Acts as a windbreak



Provides abundant leaf mulch to improve soil fertility, maintains soil temperature.



Deep rooting improves water infiltration. Little interference with shallow-rooted avocado trees.



2 Avocado



Fruits and leaves good for cattle, and other livestock



Provides nectar



Cash crop – local, national and international markets



High fat content, seeds used for edible oil, source of vitamins B, K, C, E and potassium



Pruning and topping doesn't damage the tree and provides mulch



Leaves and seeds can be used for medical purposes. Leaves contain an essential oil



Oil from seed in cosmetics



Good timber

3 Tendwet (*Prunus africana*) or Sanandet/mobet (*Markhamia lutea*)



Acts as a windbreak



Provides nectar (white honey)



Provides shade for people and cattle



Bark and leaves used for medical purposes.



Leaves used for mulch or manure



Biodiversity enhancement



High quality firewood and timber, branches used for hoes and yokes

4 Cover & fodder crops: 1st year: Maize, spring onion (with manure). 2nd year: Peas, beans, cow pea, tree tomatoes, groundnut, sunhemp, lablap bean or clover, water melon, pumpkin, butternut, bush berry, soyot, black nightshade



Fruits are healthy for humans and cattle



Reduces soil erosion. Increased soil water permeability



Pruning and topping doesn't damage the tree and provides mulch

5 Fodder trees: *Calliandra calothyrsus*/ *Sesbania sesban*/ *Leucaena leucocephala*



Good for livestock



Provides nectar



Leaves and wood can be used as mulch



Leaves and seeds for medical purposes.



Live fences



Good for firewood and charcoal

Option 2: Mango, maize, gliricidia & cover crops



1 Mango



2 Zea Maize (year 1-4)



3 Cover Crops

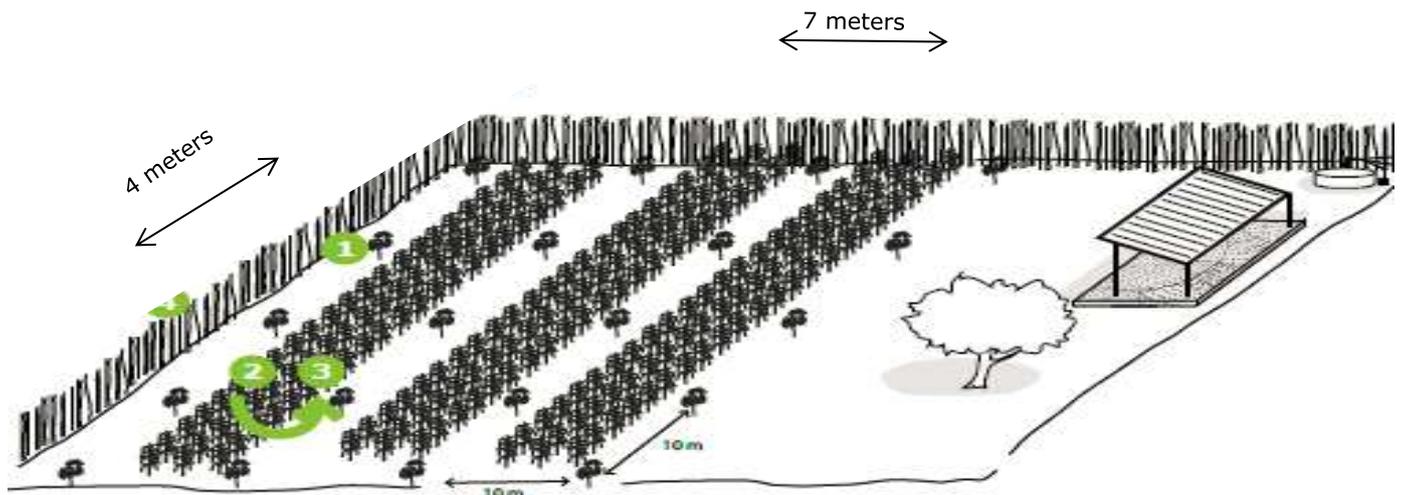


4 Gliricidia Sepium



During the first years mango, maize and gliricidia can be combined. Maize provides income during the first three or four years when grafted mango trees produce start to fruit. After about four years mango trees start to shade maize plants, so another crop should be chosen. Cover crops help improve nitrogen and reduce soil erosion in the first years.

An advantage of Gliricidia is that this tree sheds its leaves in the dry season, providing more water for mango trees and other crops. Gliricidia trees should be pruned, pollarded and /or coppiced regularly to prevent shading mango.



1 Mango



Leaves and seed kernels can be fed to cattle and poultry



Leaves improve soil fertility when used as mulch for crops



Wood for charcoal and firewood



Provides large quantities of nectar



Shade for people and livestock; it also acts as a fire-break



Leaves, seeds and bark can be used for medicinal purposes



Bark is the source of a yellowish-brown dye used for silk



Fruit are rich in Vitamin A and C, eaten as fruit or processed into juice or jam



Cash crop – local, national and international markets



2 Maize



Fodder and food for cattle



Nutritious food



Leaving maize stubble to rot in the field improves soil fertility



Cash crop – local and national markets

3 *Gliricidia* or other nitrogen fixing trees (*Calliandra callothyrus*, *Sesbania sesban*)



Controls soil erosion, improves soil aeration and reduces soil temperature



Capable of fixing atmospheric nitrogen.



Wood for charcoal and firewood



Several medicinal purposes



The litter can be used as green manure



The flowers attract honeybees



Live fences



Applicable as a rodenticide and general pesticide

4 Cover crops: Banana or plantain (*1st and 2nd year*), peas (*Mucuna spp.*), Rattlepod/mito/mitoo (*Crotalaria spp.*), velvet beans, cow pea, tree tomatoes, groundnut, sunhemp, lablab bean, clover, water melon, pumpkin, sun hemp, butternut, bush berry, soyot, black nightshade, napier grass, millet



Stems and leaves can be sold as animal feed or used as mulch



Reduces soil erosion
Resistance to drought
Weed control



Improves nutrients availability
Increase humus in the soil
Increased soil water permeability



Produces food



1 Mango



2 Banana



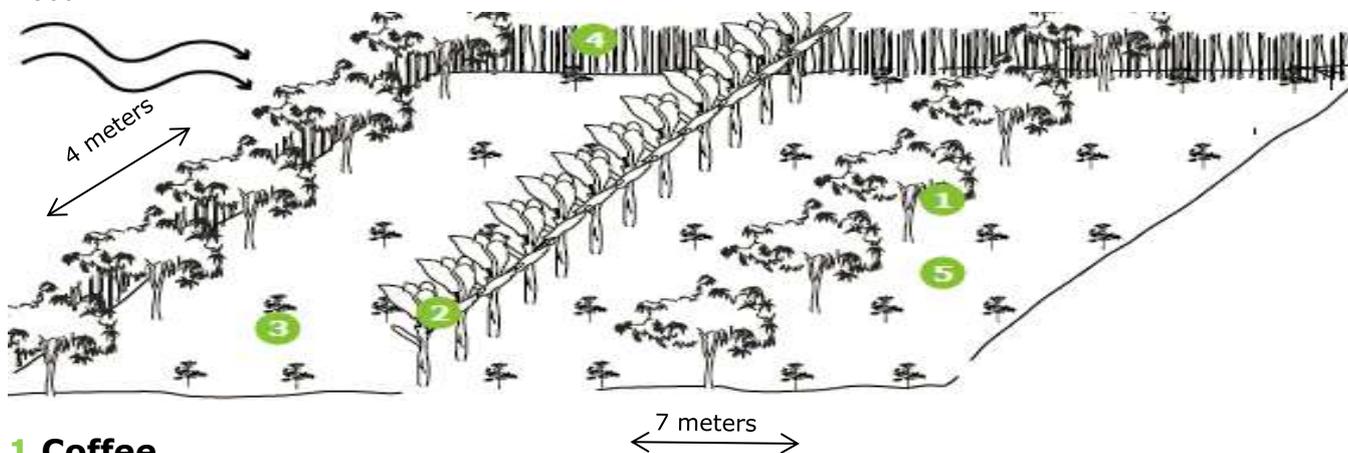
3 Coffee



4 Leucaena leucocephala



Mango and banana provide shade for coffee plants. Coffee provides cash income and for household use. A combination of two or three different fruit tree species provides greater income certainty and spreads risks. During the first years cover crops can be planted between fruit trees. They fertilize the soil and have rapid growth rate, making them suitable for intercropping with slower establishing species. Nitrogen fixing species like Calliandra, sesbania and leucaenea can be planted on field borders. This option is suitable for farmers who need fodder for livestock and fuel wood.



1 Coffee



Cash crop



Wood quality timber wood



Annual litter fall and pruning residues used as mulch and soil cover



Tree barks can be used as manure / mulch to improve the soil. Seeds used as natural herbicide



Provides nectar, white honey



Many medical purposes



2 Mango

(see page 15)

3 Banana and plantain



Provides shade for coffee plants



Leaves (after pruning) left in the field as mulch and ground cover, improves the soil



Dye for cloth



Source of nectar for bees



Fruits used for medical purposes



Provides healthy and nutritious fruits, beer and wine



Fodder

3 Nitrogen fixing trees: *Leucaena leucocephala*/ *Calliandra callothyrus*/ *Sesbania sesban*



Root system breaks up compacted soil layers, improving water permeability & decreasing erosion



Acts as a wind protection



Wood for charcoal and firewood



Production of green manure with very high nitrogen content



High quality and palatable fodder



Pods provide red, brown and black dyes. Gum from the stem has commercial value



Provides nectar throughout most of the year



Capable of fixing atmospheric nitrogen.

3 Cover Crops Banana or plantain (*1st and 2nd year*), peas, velvet beans (*Mucuna* spp.), Rattlepod/mito/mitoo (*Crotalaria* spp.), velvet beans, cow pea, tree tomatoes, groundnut, sun hemp, lablab bean, clover, water melon, pumpkin, sun hemp, butternut, bush berry, soyot, black nightshade, napier grass, millet



Stems and leaves can be sold as animal feed or used as mulch



Reduces soil erosion
Weed control



Improves nutrients availability
Increase humus in the soil
Increased soil water permeability



Produces high nutritious beans for human consumption



1 Carica papaya



3 Acacia nilotica



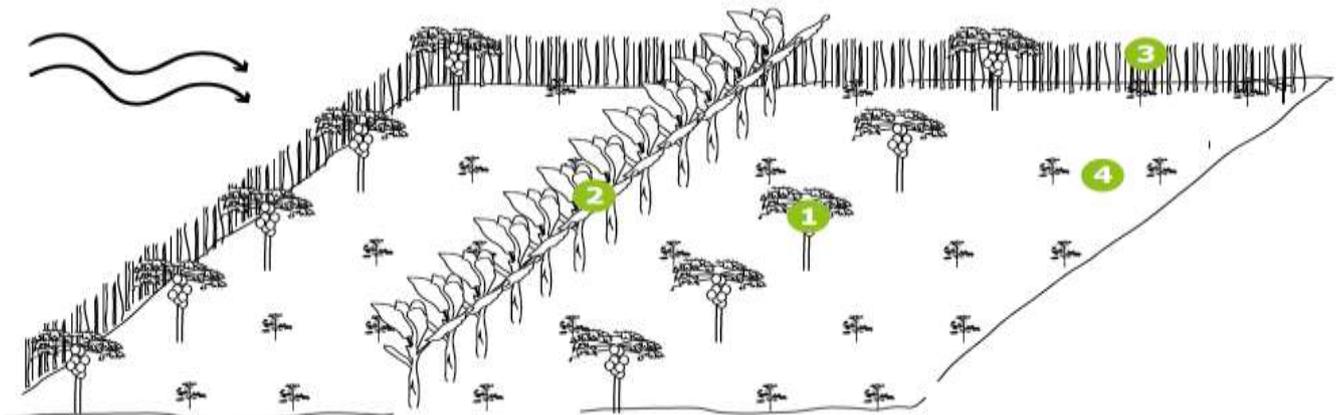
2 Banana



4 Annual crops



Papaya varieties suitable for higher altitudes provide small fruits suitable for jam and preserves. Acacia acts as a windbreak for the sensitive papaya trees, fixes nitrogen and produces mulch and manure, so less chemical fertilizer is needed for nutrient demanding papaya trees. Banana, mango or citrus can be intercropped with many different annual crops especially leguminous such as peas, beans, but also maize, spinach, pepper, onions and strawberry. Citrus requires fertile soil and regular manuring, and combine well with intercropping with legumes and cover crops. Location is important for citrus: t night temperature below 14°C fruits won't colour well and (rain)water should be regular in the flowering and fruiting season. Disease resistant root stock and grafts are strongly recommended. Neem leaves can be used to combat common citrus pests.



1 Papaya, Paipai



Healthy fruits, produces from second year, throughout the year. Use fruits for wine and jams. Fruits used as meat tenderiser



Cash crop local and regional markets



Leaves have medical purposes



Provides nectar



**2 Acacia or other nitrogen fixing trees: *Leucaena leucocephala*/
Calliandra calothyrsus/ *Sesbania sesban***



Acts as wind protection
Protects the sensitive papaya



Fruits used for medical purposes



Provides firewood, charcoal and timber.



Nitrogen fixing, provides manure and mulch. Less chemical fertilizer needed for demanding papaya



Provides nectar



Root system breaks up compacted soil layers, improving water permeability & decreasing erosion

3 Banana or plantain

(see page 18)

4 Annual crops: Peas, beans, spinach, pepper, onions and maize



Produces extra income and food for human consumption



Reduces soil erosion
Weed control



Improves nutrients availability
Increase humus in the soil
Increased soil water permeability

5 Mango

(see page 15)

6 Citrus



Cash crop, as fruit or processed into juice, marmalades, jams



Provides timber wood, firewood and charcoal



Healthy fruits for humans, rich in vitamin C
Essential oil



Provides nectar



Leaves used as fodder
Residues from juice production are used as cattle feed



Medical purposes

7 Neem (*Azadirachta indica*)



Leaves used as natural insecticide



Many medical uses of leaves



Live fence



Produces dark, toffee like honey



1 Grevillea robusta



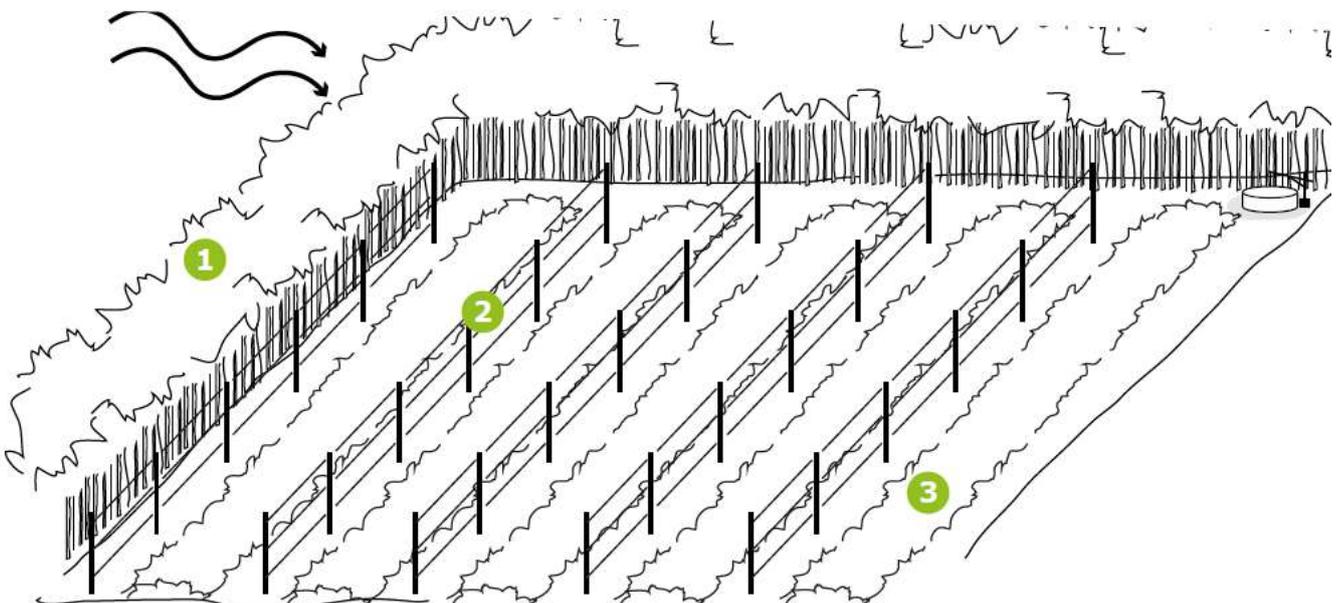
3 Annual crops



2 Passiflora (Forma edulis, purple passion fruit)



A trellis construction should be made to support passionfruit or it can be grown trained to grow up a cypress tree or over water tanks. Grevillea acts as a windbreak for passion fruit as it is sensitive when young. Grevillea can be replaced with a different nitrogen fixing tree. A wide range of vegetables and other crops can be intercropped with passion fruit. Intercropping with annuals is recommended; especially beans, cabbages and tomatoes. Other recommended crops include potatoes, beetroots, carrots, spinach, eggplants, peppers, onions and leeks. However, cucurbits (butternut, cucumbers, pumpkin, and squashes) are not recommended due to woodiness virus and fruit flies. Other crops that should not be intercropped with passion fruit are maize, cowpea, sorghum, okra, sweet potatoes and other creepers.





1 Passion fruit, banana or yellow passion



Cash crop
Produces fruit from the first year onwards



Healthy fruits



Long forage season for bees



Cash crop, as fruit or processed into drinks or jams



Provides shade when trained over a construction

2 Grevillea



Fuel wood and charcoal production



Provides nectar



The deep rooting system improves water infiltration to the soil



Acts as windbreak for the sensitive Passion flower



Provides abundant quantities of leaf mulch. Protects the soil and maintains soil temperature. Improve soil fertility when used as mulch for crops



Live fences

3 Vegetables + Cover crops: cabbages and tomatoes, potatoes, beetroots, carrots, spinach, eggplants, peppers, onions and leeks



Provides extra income and food



Reduces soil erosion, residues used as mulch and soil cover for weed control



Plant rests can be used as manure, mulch. Protect the soil (cover), decreasing evaporation



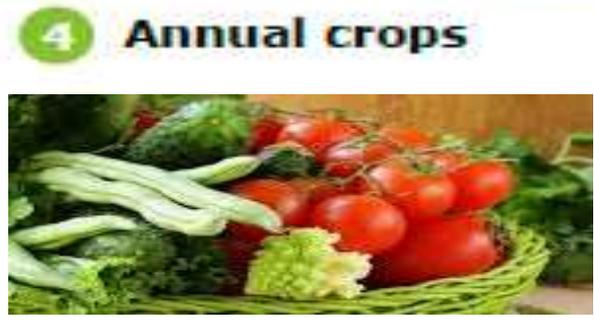
Cash crop



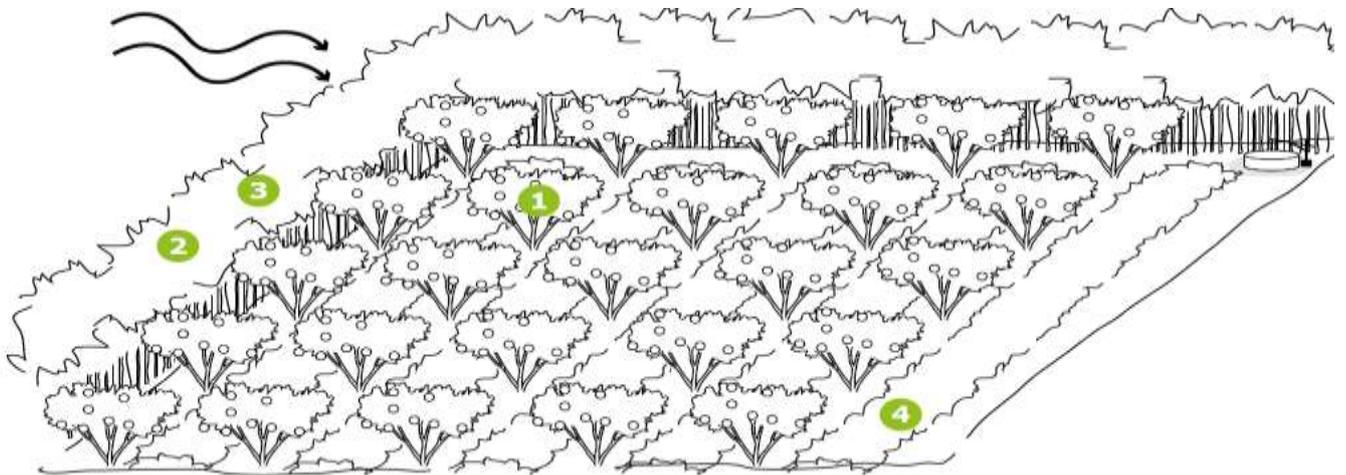
Stems and leaves can be sold as animal feed or used as mulch



Use legumes (beans, peas, sweet potatoes) or cover crops such as clover and vetch to fix nitrogen in soils.



A mixture of citrus (orange, lemon or grapefruit), prunus and *Sesbania sesban* trees can be planted at the edges of the field to act as windbreak. Prunus bark can be harvested for medicinal use, or it can be coppiced for use as fuelwood or carving. Sesbania leaves and branches from can be used as fodder, manure or mulch. Annual crops provide soil erosion and help control weeds. They also provide income until grafted citrus trees start producing fruits at around three years.



1 Citrus



Cash crop

Healthy fruits for humans
Essential oil

Leaves used as fodder
Residues from juice production are used as cattle feed



Provides timber wood, firewood and charcoal

Provides nectar

Medical purposes



2 Prunus



Provides nectar
Good for biodiversity



Provides shade for humans and cattle



High quality firewood



Bark and leaves can be used for medical purposes



Acts as wind protection



Leaves used for mulch or manure

3 *Sesbania sesban*



Medical purposes



Provides firewood and charcoal



Acts as wind protection for the sensitive Citrus trees



Provides nectar



Fodder and forage for animals



Nitrogen fixing
Leaves used for mulch or manure

4 Annual crops: e.g. cassava, watermelon, soybeans, chili peppers



Produces extra income and food



Stems and leaves can be sold as animal feed or used as mulch



Plant rests can be used as manure, Mulch. Protect the soil and provide cover, decreasing evaporation



Reduces soil erosion
Weed control

6 Other options and benefits

Depending on the farmer's needs, farm size, climate conditions and slope, other combinations are possible:

Avocado - Coffee - Acacia - Calliandra

Avocado: shade for coffee, fruits, nectar, charcoal, firewood, mulch, medicine

Coffee: fruits, nectar, mulch, herbicide, medicine

Acacia: fodder - nitrogen fixation, mulch

Calliandra: fodder, firewood, charcoal, soil nitrogen, soil stabilization, medicine

Acacia nilotica



Grevillea - coffee in hedgerows - Cover crops during first years after planting

Grevillea: shade for coffee, firewood, charcoal, timber, prevents erosion,

Coffee: fruits, nectar, mulch, herbicide, medicine

Cover crops to provide soil cover, prevent erosion, nitrogen fixation and food for human and cattle, mulch

Grevillea robusta



Banana - Cape chestnut

Banana: fruits, medicine, clothing, tools, shelter, furniture, paper, handicrafts

Cape chestnut (*Calodendrum capense*): firewood, charcoal, timber, nectar, windbreak, mulch, ornamental, oils can be used on skins, edible fruits

Calodendrum capense



Sesbania - Maize

Maize: food for humans and cattle, green manure

Sesbania (*Sesbania sesban*): fodder, firewood, charcoal, soil nitrogen, stabilize soil, medicine. The leaves contain enough nitrogen to sustain maize crops

Sesbania sesban





Mapagola/kababu (*Faidherbia albida*) and maize

Faidherbia albida: stabilize soil, fodder, nectar, firewood, charcoal, timber, mulch, improves soil
 Maize: food for human and cattle, green manure

Faidherbia albida



African Locust Bean tree- cassava, yams, sorghum and millet

African Locust bean tree (*Parkia biglobosa*): nectar, fodder, firewood, timber, medicine, alcoholic beverages
 Crops: Maize, cassava, yams, sorghum and millet can be grown under the canopy and provide food

Parkia biglobosa



White Tephrosia –cassava/pineapple/maize + other annual crops

White Tephrosia (*Tephrosia candida*): insecticide, soil improver, erosion control, fodder, firewood, fixation of nitrogen and mulch
 Cover crops: Leguminous crops help fix nitrogen, such as velvet beans (*Mucuna* spp.), mito/sunhemp (*Crotalaria* spp.), lablab/field bean (*Lablab purpureus*), clover or cowpea. Sesbania sesban is good for fodder.

Tephrosia candida



Live fences

Plants which can be used as live fences to protect crops against livestock include:

Aloe vera (*Aloe vera*), Whistling thorn (*Acacia brevispica*), mgunga (*Acacia nilotica*), Sisal (*Agave sisalana*), Kotutwo/tugen (*Albizia amara*), Desert date/Ongoswa/ngoswet/jmjunju/muhoromo/mulului (*Balanites* spp), Mysore Thorn* (*Caesalpinia decapetala*), Calliandra (*Calliandra calothyrsus*), mtandambo/ mufumbwe* (*Carissa edulis*), Girigirimu/lakingdirgat (*Croton dichogamus*), Croton (*Croton megalocarpus*), Cypress (*Cupressus lusitanica*), Casuarina (*Casuarina equisetifolia*), Kayaba/kei apple (*Dovyalis caffra*), Cactus (*Euphorbia tirucalli*), Gliricidia (*Gliricidia sepium*), Mulberry (*Morus alba*), Tepindorwet (*Landara camara*)*, guava (*Psidium guajava*), Yellow oleander* (*Thevetia peruviana*), Kuresiei/cactus (*Euphorbia candelabrum*), Desert apple (*Ziziphus mauritiana*)

* Can quickly spread and compete with crops



Croton fence



Euphorbia tirucalli

Ziziphus mauritiana



7 Current & potential tree species

Plants are influenced by altitude. As the height of the land above sea level increases, the climate changes. The air becomes colder and drier, affecting plant life. Altitude plays a large part in determine the development and survival of plants, and determines how plants tolerate the colder, wetter climate as altitude increases. The following lists can be used to help kick off and further discussions about which species can be grown in the different altitudes of Upper Mara Basin (shown in the map in figure 2) and the products that can be used by farmers and their families, and sold to earn cash. The list includes species currently used but not cultivated in the Upper Mara Basin, plants cultivated for own use and sold on a small scale, and species not grown in the area but which can be used in the Upper Mara Basin. Some wild sourced indigenous timber and non-timber species are also included, as they have economic as well as conservation value.

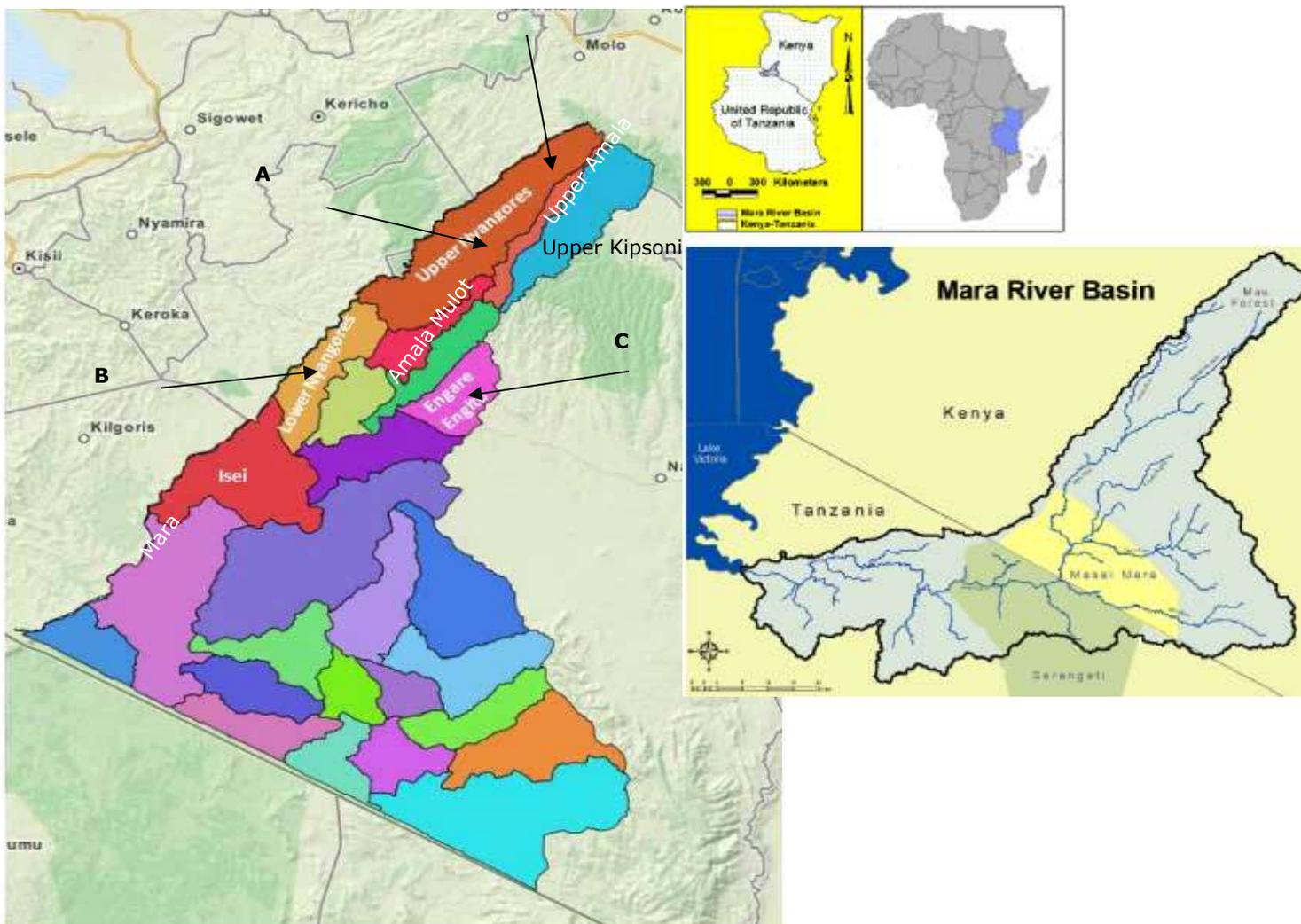


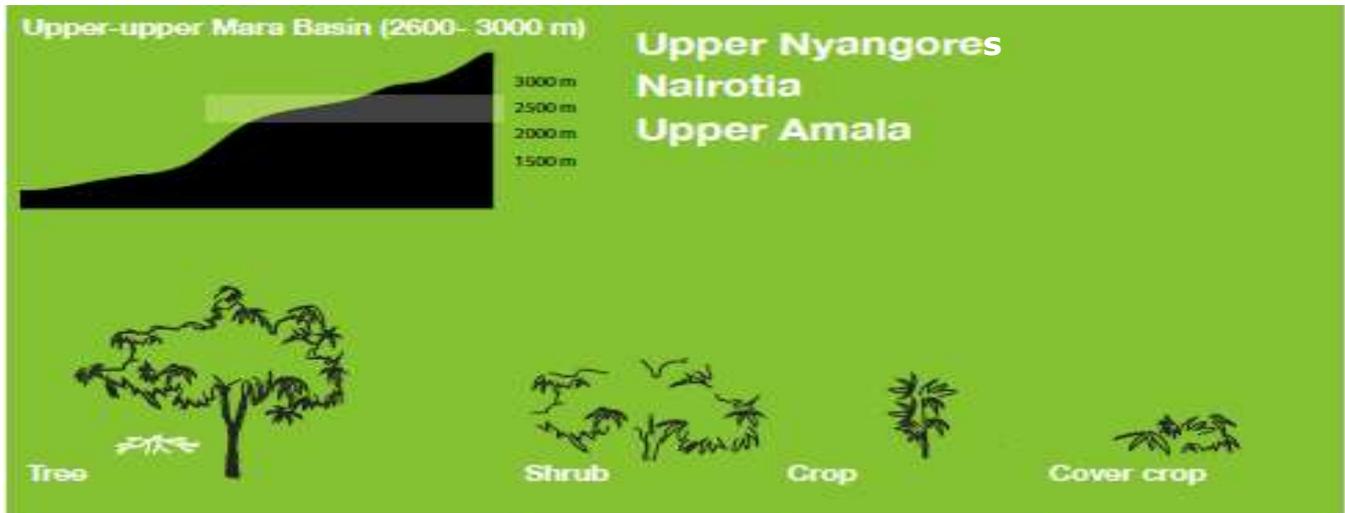
Figure 2 Map of Upper Mara Basin WRUAs and CFAs

Location of Upper Nyangores (A), Lower Nyangores (B) Engara Engito, Mara Farm (C) , Niarito (D)



Higher Upper Mara Basin

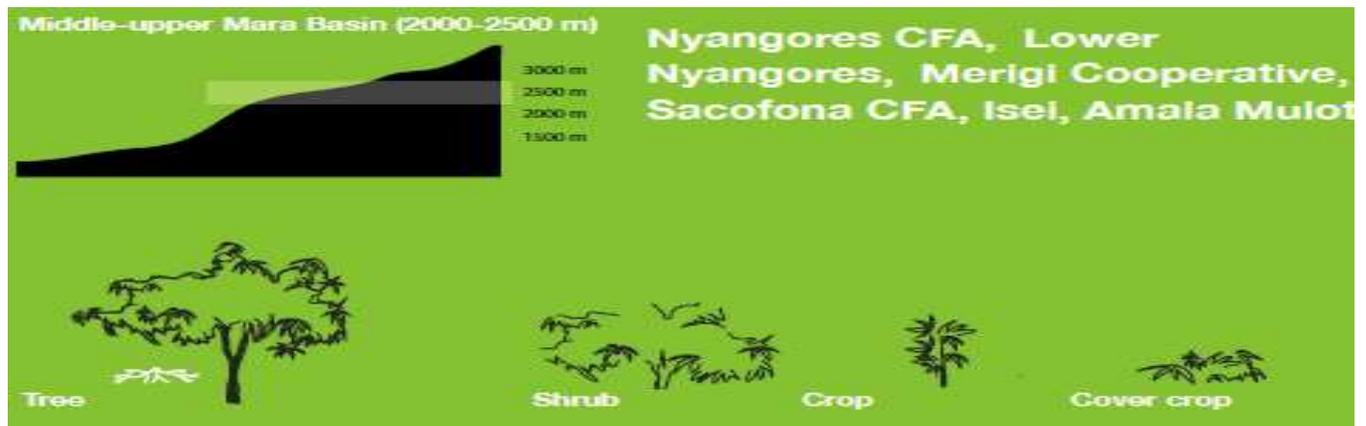
Upper Nyangores - Nairotia - Upper Amala



<i>Yushania alpina</i> / <i>Arundinaria alpina</i> Bamboo		<i>Zea mays</i> Maize	<i>Trifolium</i> Clover
<i>Eucalyptus regnans</i> Eucalyptus		Wheat	<i>Cajanus cajan</i> Pigeon pea
<i>Eucalyptus saligna</i> Eucalyptus		Potatoes	<i>Phaseolus vulgaris</i> Common bean
<i>Eucalyptus grandis</i> Eucalyptus		Onions	
<i>Prunus africana</i> Tendwet, pygeum, mueri, bitter almond			
<i>Pinus patula</i> Pine			
<i>Cupressus lusitanica</i> Cypress			



Middle Upper Mara Basin



<i>Prunus africana</i> Tendwet, mueri, Bitter almond	<i>Sesbania sesban</i> Sesban	Sorghum	<i>Laplap purpureus</i> Tonga bean, Papaya bean
<i>Pinus patula</i> Pine	<i>Combretum molle</i> Mlama, Mgurure	Maize	<i>Trifolium</i> Clover
<i>Calodendrum capense</i> Cape chestnut	<i>Leucaena Leucocephala</i> Leucaena	Wheat	<i>Cajanus cajan</i> Pigeon pea
<i>Grevillea robusta</i> Grevillea	<i>Calliandra calothyrsus</i> Calliandra	Potatoes	<i>Phaseolus vulgaris</i> common bean
<i>Cupressus lusitanica</i> Cypress	<i>Cordia africana</i> Mukumari, Mukebu	Onions	<i>Cicer arietinum</i> Chickpea
<i>Citrus sinensis</i> Washington navel, Sweet Orange	<i>Coffea arabica</i> Coffee	Tomato	
<i>Persea americana 'Hass'</i> Avocado (Hass)	<i>Crotalaria</i> spp. Rattlepod	Cabbage	
<i>Barleria grandicalyx</i> Cheperenet		<i>Lagenaria siceraria</i> Bottle gourd	
<i>Faidherbia albida (Acacia albida)</i> Mapagola, kababu, Apple Ring Acacia			
<i>Acacia nilotica</i> Mgunga, Scented thorn			
<i>Acacia abyssinica</i> Umbrella thorn, altarara			
<i>Carica papaya</i> Pai Pai, Paw Paw, Papaya			
<i>Yushania alpina</i> Bamboo			
<i>Musa acaminita, Musa paradisiaca</i> Banana, Plantain			
<i>Markhamia lutea</i> Mobet, Sanandet, Nile tulip			
<i>Cordia africana</i> Mukumari, Mukebu			
<i>Croton megalocarpus</i> Mukinduri			
<i>Erythrina abyssinica</i> Flame tree, lucky bean tree			
<i>Faurea saligna</i> African beech			
<i>Eucalyptus regnans</i> Eucalyptus			
<i>Eucalyptus saligna</i> Eucalyptus			
<i>Eucalyptus grandis</i> Eucalyptus			



Lower Upper Mara Basin



<i>Pinus patula</i> Pine	<i>Combretum molle</i> Mlama, Mgurure	<i>Passiflora edulis</i> Passionfruit	<i>Mucuna spp</i> Velvet bean
<i>Calodendrum capense</i> Cape chestnut	<i>Sesbania sesban</i> Sesban	Maize	<i>Laplap purpureus</i> Tonga bean, Papaya bean
<i>Grevillea robusta</i> Grevillea, silky oak	<i>Leucaena Leucocephala</i> Leucaena	Wheat	<i>Trifolium</i> Clover
<i>Persea americana 'Hass'</i> Avocado (Hass)	<i>Tephrosia candida</i> White Tephrosia	Onions	<i>Cajanus cajan</i> Pigeon pea
<i>Macadamia integrifolia</i> Macadamia	<i>Calliandra calothyrsus</i> Kaliandra	tomato	<i>Phaseolus vulgaris</i> Common bean
<i>Faidherbia albida (Acacia albida)</i> Mapagola, kababu, Apple Ring Acacia, Winterthorn	<i>Cordia africana</i> Mukumari, Mukebu	Cabbage	<i>Cicer arietinum</i> Chickpea
<i>Acacia polyacantha</i> Mgunga, mkengewa, white thorn, falcon's claw acacia	<i>Coffea arabica</i> Coffee	Sorghum	<i>Crotalaria spp</i> Rattlepod
<i>Acacia nilotica</i> Mgunga, Scented thorn	<i>Camellia sinensis</i> Tea	Millet	
<i>Citrus sinensis</i> Washington navel, Sweet Orange	<i>Rhamnus prinoides</i> Shiny-leaf buckthorn	<i>Lagenaria siceraria</i> Bottle gourd	
<i>Cupressus lusitanica</i> Cypress	Cactus <i>Euphorbia tirucalli</i>	<i>Amaranthus cruentus</i> Amaranth	
<i>Acacia abyssinica</i> Umbrella thorn, altarara	Kuresueu, candelabrum spurge <i>Euphorbia candelabrum</i>		
<i>Eucalyptus urophyll, citriodora, camaldulensis, maculate, paniculata globulus</i> Eucalyptus			
<i>Barleria grandicalyx</i> Cheperenet			
<i>Mangifera indica</i> Mango			
<i>Carica papaya</i> Pai Pai Paw Paw, Papaya			
<i>Bambusa membranacea, Dendrocalamus asper, Bambusa vulgaris, Yushania alpina</i> Bamboo			
<i>Markhamia lutea</i> Mobet, Nile tulip, Sanandet, Siala tree			
<i>Cordia africana</i> Mukumari, Mukebu			
<i>Croton macrostachyus</i> Tobosuet, Tebeswet			
<i>Syzygium cuminii</i> Java plum			
<i>Erythrina abyssinica</i> Red hot poker tree, lucky bean tree			
<i>Sclerocarya birrea</i> Marula			
<i>Faurea saligna</i> African beech, Beechwood			



8 Useful trees

Many of the tree species that can be used in the Upper Mara River Basin produce timber and non-timber products (seeds, fruits, nuts, resins, bark, etc.) that have different uses – both in the home and commercially. This section provides an overview of these uses.

Tree	Purpose	Description
Mtikafu/Murumuyinja <i>Fagaropsis angolensis</i>	Timber	moderately durable to durable and moderately resistant to termite attack.
	Medicinal	The stem bark is used to treat malaria, the root is chewed as an expectorant and to treat male sterility.
<i>Cordia sinensis</i> Nogirwet	Medicinal	The roots used to induce abortion, a decoction of the root and bark is used to treat stomach disorders, boiled root decoction used to treat malaria. The astringent bark is used as a gargle. The leaves are used to treat fever.
	Food	Fruits eaten raw or cooked
<i>Prunus africana</i> Tendwet, red stinkwood, mueri, Bitter almond	Medical use	Liquid extracts from the bark are used to treat men's prostate problems. Leaves are used as an inhalant for fever or are drunk as an infusion to improve appetite. Water is added to pounded bark, and the red liquid is used as a remedy for stomach-ache; bark extract may be used as a purgative for cattle.
	Poison	Bark, bruised leaves and fruits smell strongly of bitter almonds.
	Timber	The hard timber is popular for charcoal, as firewood, for carving, and used to make axes and hoe handles.
<i>Pinus patula</i> Chesarut, Pine	Medical use	Pine-leaf oil is used to treat cold and flu in steam-baths.
	Food	The seeds can be eaten
	Gum	When tapped the tree yields an oleoresin, which is distilled to give turpentine, and rosin which is used in paint and batiks.
	Timber	Timber used for light construction, light flooring, joinery, ceilings, panelling, furniture, fence posts, poles, pallets, veneer and plywood.
<i>Cupressus lusitanica</i> Cheborus, mexican cypress	Timber	The timber saws cleanly and has straight fine grain, source of construction wood and pulp wood and is used for furniture, poles and posts. Good shade or shelter, suitable as windbreaks.. Boundary or barrier or support: It is grown as a live fence.
<i>Calodendrum capense</i> Cape chestnut	Essential oil	The kernel yields a lemon-yellow, rather bitter, fixed oil that can be used for making soap.
<i>Grevillea robusta</i> SepeSepe, silky oak	Fibre	Mean fibre length is about 1.5 mm and width about 26 µm; the wood is suitable for pulping.
	Gum or resin	By virtue of their solubility, viscosity and relatively high resistance to hydrolysis, the gum may have some industrial applications.
<i>Combretum molle</i> Mlama, Mgurure	Medical use	Boiled root decoction is used to induce abortion and treat constipation, leprosy, headaches, stomach pains, fever, dysentery, general pains, swellings and as an anthelmintic for hookworm. The root and leaf together are believed to be an antidote for snake bite; leaves are chewed or pounded, soaked in water and the juice drunk for chest complaints and to expel parasitic worms and other internal parasites, or they are used as an inhalant in hot steam bath. An infusion of the inner bark is taken orally or as an enema to relieve various stomach ailments. The bark exudes a gum that can be used to treat wounds, or crushed dried or fresh leaves can be used for the same purpose.
	Dyestuff	A red dye can be obtained from the leaves and yellow dye from the roots.
<i>Sesbania sesban</i> Sesban	Medical use	Fresh roots and leaves are used to treat scorpion stings, boils and abscesses. Decoctions of leaves as a drench for cattle to repel tsetse fly. It is used to treat sore throat, gonorrhoea, syphilis, spasmodic fits in children and jaundice during pregnancy. The leaves are used in some countries as a tea and are have antibiotic, anthelmintic (expel parasitic worms), anti-tumour and contraceptive properties.
	Gum	The seeds and bark produce gum.
<i>Citrus sinensis</i> Washington navel, Sweet Orange	Medical use	A leaf decoction with salt is taken orally for digestive tract ailments, nerve disorders, fever, asthma, blood pressure, general fatigue and vomiting. Crushed leaves or fruit juice is massaged into the skin to relieve itching. Macerated root, leaf or fruit mesoderm is taken orally for urethritis; macerated fruit mesoderm or bark decoction is taken orally for liver ailments. Fruit juice or leaf decoction with sugar is taken orally for cold and loss of appetite, while crushed leaf decoction as a bath relieves headache and rheumatism. Broken bones are massaged with roasted fruit. The leaf oil relieves flatulence and sedative properties.
	Essential oil	Peels, leaves and flowers contain fine essences of oils that can be used to manufacture cosmetics and medicinal applications.
<i>Persea americana 'Hass'</i> Avocado (Hass)	Medical use	Extracts of leaves and fresh shoots of avocado may be used to treat cancer. Oil extracted from the seeds has astringent properties, and an oral infusion of the leaves is used to treat dysentery. The skin of the fruit is used to destroy parasitic worms. The seed can be ground and made into an ointment to treat various skin afflictions, such as scabies, wounds, lesions of the scalp and dandruff. The flesh is used in traditional medicine.
	Essential oil	Extracts of avocado leaves contain a yellowish-green essential oil.



Tree	Purpose	Description
	Poison	The unripe fruit is poisonous and the ground-up seed mixed with cheese can be used as a rat and mouse poison.
<i>Barleria grandicalyx</i> Cheperenet	Medical use	The leaves are chewed or pulped and rubbed well into snake bites as a treatment.
<i>Faidherbia albida</i> (<i>Acacia albida</i>) Mapagola, Kababul, Apple Ring Acacia, Winterthorn	Medical use	The bark and roots are used externally or internally against respiratory infections, digestive disorders, malaria and other fevers. The bark is used to clean teeth an extract is used for toothache in humans and eye infections in livestock.
<i>Acacia nilotica</i> Chebitet, mgunga, scented thorn	Medical use	The Maasai use a bark decoction as a nerve stimulant, and the root to cure impotence. An astringent from the bark is used for diarrhoea, dysentery and leprosy. Bruised leaves are poulticed onto ulcers. The gum or bark is used for cancers and tumours of the ear, eye or testicles and indurations of the liver and spleen, genital infections, overweight, colds, congestion, fever, gallbladder, haemorrhage, haemorrhoids, eye problems, abnormal hardening of body tissue and smallpox. Bark, gum, leaves and pods are used medicinally. Sap or bark, leaves and young pods are strongly astringent because of the tannin. A bark decoction is drunk for intestinal pains. Other preparations are used for, gargle, toothache, eye problems and syphilitic ulcers.
	Tannin / dyestuff	The pods have been used for tanning and dyeing leather black as the inner bark contains 18-23% tannin. Young pods produce a very pale tint in leather, notably goat hides. Extracts from the bark, leaves and, pods and seeds are used for dyeing cotton, silk and leather.
	Gum	The earliest source of gum arabic, gum tapped from the bark is used to manufacture matches, inks, paints and confectionery.
<i>Acacia abyssinica</i> (<i>Vachellia</i>) Rebeowet, umbrella thorn, Aitarara (Masai)	Medical use	The bark or root is used to treat urinary tract inflammation. The bark has astringent properties and it is used to treat colds, cough, and childhood fever. A decoction of the root is taken as remedy for stomach-ache. The bark, leaves and gums are used to treat tapeworm, bilharzia, haemorrhage, testicle inflammation, colds, diarrhoea, gonorrhoea, kidney problems, syphilis, eye problems, rheumatism and circulatory system problems. It is also used as an astringent. The pods are used as an emollient, and the roots for stomach-ache, acne, tapeworms, urethral problems, and build-ups of fluid in the body.
<i>Carica papaya</i> Paipai, Paw Paw, Papaya	Medical use	Carapine, an alkaloid present in papaya, can be used as a heart depressant, to treat amoeba infections and diuretic. The fruit and juice are eaten for gastrointestinal ailments; a fresh leaf poultice is used to treat sores. The fresh root with sugarcane alcohol can be taken orally or as a massage to soothe rheumatism. A flower decoction is taken orally for coughs, bronchitis, asthma and chest colds. In some countries, the seeds are used in abortions abortifacient and to expel parasitic worms
	Latex rubber	Papain, a proteolytic enzyme present in the latex is collected from green fruit and is used in beverage, food and pharmaceutical industry.
<i>Coffea robusta</i> Coffee	Medical use	Used as a stimulant due to its caffeine content, to relieve pain, to burn fat, diuretic, and may help lower blood sugar.
<i>Leucaena leucocephala</i> Leucaena	Tannin or dyestuff	Red, brown and black dyes are extracted from the pods, leaves and bark.
	Gum or resin	Gum flows from <i>Leucaena</i> stems when it is injured or diseased or from sterile hybrids, especially <i>L. leucocephala</i> x <i>L. esculenta</i> . The gum is similar to gum arabic and of potential commercial value
<i>Macadamia integrifolia</i> Macadamia nuts	Tannin or dyestuff	The hulls (the green covering of the nuts) contain substances suitable for tanning leather.
	Lipids	Macadamia is the richest oil-yielding nut known, the kernel contains more than 75% oil, suitable for human consumption.
	Essential oil	The volatile compounds can be extracted into an oil.
<i>Passiflora edulis</i> Krindilla, Passion fruit	Medical use	The leaves lower blood pressure. The flower can be made into a sedative and antispasmodic. Passion flower is used to treat nervous disorders, bronchial conditions, arthritis, asthma, insomnia, gastrointestinal disorders and menopausal symptoms. Carotenoids and polyphenols in the yellow fruit extract can kill cancer cells.
<i>Camellia sinensis</i> Tea, Chai	Medical use	Tea is astringent, and often used for digestive ailments, to soothe insect bites, treat burns, and reduce swollen eyelids. It is also used as a tonic for the nerves. Green tea has antioxidant properties, making it a popular cancer preventative. It may help people with weight loss and tooth decay.
<i>Tephrosia candida</i> White Tephrosia	Poison	Powdered leaves are used as an insecticide and the bark and roots are used as a fish poison.
<i>Mangifera indica</i> Mango	Medical use	Charred and pulverized leaves make a plaster to remove warts and also can help bleeding wounds stop when applied. Seeds are used to treat colds and coughs, diarrhoea and bleeding piles. The bark is astringent, and used to treat rheuma.
	Poison	Eating the fruit or skin contact with the juice may cause a rash.
	Dyestuff	The bark can be used to dye silk yellowish-brown.
<i>Bambusa vulgaris</i> Teget, Vittata Bamboo	Medical use	Water from boiled shoots is used as a medicine.
	Construction	Poles used in construction, furniture, crafts and can be formed into briquettes for fuel
<i>Cordia africana</i> Samutet, mukumari, mukebu, mukumari	Medical use	The fresh, juicy bark is used to bind broken bones



Tree	Purpose	Description
<i>Markhamia lutea</i> Mobet, Sanandet, Siala tree	Medical use	Leaves have medicinal value for skin-affections, sores and itch. The leaves and bark are pounded up with lemon juice to a paste, and the liquid is expressed for use as a lotion, residual lees may be used with vigorous rubbing. also used as a rejuvenator and diuretic, to treat chancres and rheumatic pain, treatment of the respiratory tract and swamp-fever. The leaves and bark also used for tooth-ache(as a gargle) and for convulsion in children. Roots are used against venereal diseases and for preventing abortion.
<i>Croton macrostachyus</i> Tobosuet, Tebeswet	Medical use	Boiled leaf decoction is drunk or ashes taken orally as treatment for cough; juice from fresh leaves is applied on wounds to hasten clotting. Root decoction is used as an anthelmintic for tapeworm, as a purgative, and for malaria and venereal diseases. Bark from the stems and roots is boiled in water and newly born babies are bathed in the mixture as a remedy for skin rash.
	Poison	Seeds and resin are poisonous.
	Timber	Hard timber.
	Live fences	Popular use as a living fence
<i>Erythrina abyssinica</i> Red hot poker tree, lucky bean tree	Medical use	Pounded parts are used in a steam to treat diseases such as anthrax, and the bark is boiled with goat meat to treat gonorrhoea. The bark of the green stem may be pounded and tied into a fine piece of cloth and the liquid from it squeezed into the eyes to cure inflammation of the lids. The bark is roasted until black, powdered, and applied to burns and body swellings. A decoction is taken orally to kill parasites and to relieve abdominal pains. The roots are used to treat syphilis, and the leaves to cure skin diseases in cattle.
	Tannin or dyestuff	The bark and roots yield useful dyes.
	Poison	Seeds contain a poison that if injected into the bloodstream, acts as an anaesthetic that may cause paralysis and death by respiratory failure.
<i>Faurea saligna</i> African beech, Beechwood	Medical use	The bark is boiled in broth and taken as a tonic, roots are boiled and drunk as a remedy for diarrhoea and indigestion.
	Tannin or dyestuff	A red dye is obtained by soaking the wood in water, and the bark can be used for tanning leather.
<i>Euphorbia candelabrum</i> Kuresueu, candelabrum spurge Milkweed cactus	Logs	Used to make beehives
	Poison	Poisonous sap, used in medicines
<i>Syzygium cuminii</i> Java plum	Medical use	The seeds and bark are used to treat dysentery and hyperglycaemia and glycosuria in diabetic patients. The astringent bark may be used as a gargle. Fruits are used as a relief for colic, the wood yields a sulphate pulp that has medicinal uses.
	Tannin or dyestuff	Bark yields a brown dye.
	Alcohol	Fruits are used to make wine, which is produced in vast quantities in the Philippines.
<i>Rhamnus prinoides</i> Shiny-leaf buckthorn	Medical use	A decoction of the root is taken as a blood purifier, to treat pneumonia, gonorrhoea rheumatism and stomach-ache and as a gargle. The leaves are applied as a liniment to sprains. Leaf decoction may be mixed with <i>Erythrina abyssinica</i> bark to alleviate colic.
<i>Sclerocarya birrea</i> Marula	Medical use	Bark is used to treat fever, boils and diarrhoea. Together with butter, it is applied as an ointment for headache and eye pain. Steam from the bark is used to treat eye disorders. Bark decoction, when mixed with other medicinal plants, treats various infections such as malaria, syphilis, leprosy, dysentery, hepatitis and rheumatism, and is laxative. It is used internally and externally as a prophylactic against anal inflammation. Leaves, bark and roots are used externally (as a rub) for snakebite, and internally (as a beverage) for toothache. It has been used in veterinary medicine.
	Poison	The fruit is used as an insecticide to kills mites and ticks and as a germicide.
	Tannin or dyestuff	The bar has high tannin levels and alkaloids.
	Oil, cosmetics	The nuts yield an oil comparable to olive oil. The non-drying oil burns like a candle. The oil has preservative properties and is used in cosmetics.
	Gum or resin	The gum is rich in tannin and sometimes used in making ink by dissolving it in water and mixing in soot.
<i>Eucalyptus citriodora</i>	Alcohol	A fermented alcoholic beverage is prepared from the ripe fruit, known as marula beer
	Medical use	The oils are used with steam and other preparations as an inhalant to relieve colds and influenza symptoms. Because of the refreshing odour of the oil and its efficiency in killing bacteria, it also finds application as antiseptic.
<i>Eucalyptus citriodora</i>	Essential oil	The commercially important eucalyptus oil distilled from the leaves of this and other Eucalyptus species has medicinal and industrial uses. Eucalyptol is a commercially important eucalyptus oil. A yield of 2750 kg of leaves/ha can be expected. The oil content is 1% of the air-dry weight of the leaves, and the oil normally contains 62
	Medical use	The fruits are diuretic. The bark is astringent. <i>Eucalyptus globulus</i> is used to treat lung infections, gastrointestinal ulcers and angina
<i>Eucalyptus camaldulensis</i> <i>Eucalyptus maculate</i> <i>Eucalyptus paniculata</i> <i>Eucalyptus urophylla</i> <i>Eucalyptus saligna</i> <i>Eucalyptus globulus</i>	Essential oil	The leaves yield an essential oil, Eucalyptol, a commercially important oil which is antiseptic, <i>Eucalyptus citriodora</i> is the main species form which oil is extracted
	Poison	The leaves can be used as an insecticide.
	Tannin or dyestuff	Bark have high tannin levels. <i>Eucalyptus camaldulensis</i> bark is used to produce dyes.



9 Photo identification of tree species

Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Umbrella Thorn Altarara	<i>Acacia abyssinica</i>		Bee forage Shade Arrangement pattern: Scattered in fields
Mapagola Kababu Apple Ring Acacia Winterthorn	<i>Acacia albida</i> (<i>Faidherbia albida</i>)		Apiary (bee forage) Timber Fuelwood Soil conservation medicinal Arrangement pattern: Boundary tree Scattered in field
Mgunga, Scented Thorn	<i>Acacia nilotica</i>		Bee forage Soil conservation Arrangement pattern: Boundary tree Scattered in field
Mgunga Mkengewa White Thorn Falcon's Claw Acacia	<i>Acacia polyacantha</i>		Bee forage Soil conservation Arrangement pattern: Boundary tree Scattered in field



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Golden wreath wattle	<i>Acacia saligna</i>		Bee forage Dye Animal fodder Firewood Mulch
Mgunga	<i>Acacia tortilis</i>		Live fences
Baobab	<i>Adansonia digitata</i>		Fruit tree
Kotutwo/tugen	<i>Albizia amara</i>		Live fences



Common/ local name	Scientific name	Photo		How to use in agroforestry systems
Mugavu	<i>Albizia coriaria</i>			<p>Apiary (bee forage) firewood, charcoal, ornamental, forage and medicinal</p> <p>Arrangement pattern: Along rivers / banks</p>
Seat	<i>Albizia gummifera</i>			<p>Apiary (bee forage) Ceremonial Mulch Shade Nitrogen fixing Shade for coffee</p> <p>Arrangement pattern: Along rivers / banks</p>
Kipkoibet	<i>Aningeria adolf friedricii</i>			<p>Apiary (bee forage)</p>
Chesimbolyet	<i>Apodytes dimidiata</i>			<p>Bee forage</p>



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Shoofly Mauritius/Mysore thorn	<i>Caesalpinia decapetala</i>		Live fences Medicine
Calliandra	<i>Calliandra calothyrsus/ houstoniana</i>		<p>Apiary (bee forage) Fodder crop</p> <p>Intercropping with e.g. maize, beans, vegetables, pulses, potatoes</p> <p>Arrangement pattern: Alley cropping boundary tree planting Scattered on farm</p>
Kipkarkariat Cape chestnut	<i>Calodendrum capense</i>		<p>Apiary (bee forage) Apiary (bee forage) Timber crop</p> <p>Intercropping with eg. maize, beans, vegetables, pulses, potatoes</p> <p>Arrangement pattern: Boundary tree planting; Scattered on farm</p>
Tea	<i>Camellia sinensis</i>		Cash crop Soil conservation Buffer against forest encroachment
Casuarina Whispering pine	<i>Casuarina equisetifolia</i>		<p>Firewood, charcoal, furniture, poles (house construction), posts,, tool handles, fodder, shade, ornamental, mulch, nitrogen-fixing, soil conservation, reclamation of degraded areas, windbreak, tannin, dye</p> <p>Arrangement pattern: Boundary tree planting</p>



Common/ local name	Scientific name	Photo		How to use in agroforestry systems
Orange	<i>Citrus Sinensis</i> Washington navel			Fruits Cash crop Apiary (bee forage) Arrangement pattern: Rows
Coffee	<i>Coffea arabica</i>			Cash and food crop Bee forage Arrangement pattern: Boundary tree Rows
Kemeliet Mlama Mgurure	<i>Combretum molle</i>			Bee forage Soil conservation Arrangement pattern: Boundary tree Scattered in field
Kelelwet	<i>Croton dichogamus</i>			Live fences
Tobosuet Tebeswet	<i>Croton macrostachyus</i>			Intercrops Apiary (bee forage) Wood fuel Timber Green manure crop River bank stabilization Arrangement pattern: Intercropping with eg. maize, beans and potatoes, Linear along riversides / banks, Shelter belts, Boundary tree planting, Scattered in fields



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Maruguwet Murugeiywet	<i>Croton megalocarpus</i>		Apiary (bee forage) Timber crop Wood fuel crop Arrangement pattern: Boundary tree planting, Scattered in the fields
Cypress	<i>Cupressus lusitanica</i>		Timber crop Firewood Arrangement pattern: Boundary planting, woodlots
Silibwet	<i>Dombeya torrida</i>		Apiary (bee forage)
Olmorogi (Maasai) Nukiat	<i>Dovyalis abyssinica</i>		Apiary (bee hives use and forage) Riverbank stabilization Fruit tree crop Medicinal plant Intercrops Arrangement pattern: Intercropping (with maize, potatoes, beans etc, Scattered in the fields, linear along river banks
Kayaba Kei Apple	<i>Dovyalis caffra</i>		Fruits rich in vitamin c Live fencing



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Cheptabirbriet Chopinot	<i>Dovyalis macrocalyx</i>		Bee forage
Munyanyuruet Mbunduki Kisw Mundereriet Mutereriet Kip	<i>Ehretia cymosa</i>		<p>Apiary (bee forage) Medicinal plant Intercropping</p> <p>Arrangement pattern: Intercropping with e.g. maize, beans, vegetables, pulses, potatoes, Scattered in the fields, linear along river banks</p>
Ekebergia, Ararwet Arorwet	<i>Ekebergia capensis</i>		<p>Riverbank stabilization Timber crop Medicinal plant Bee forage</p> <p>Arrangement pattern: Boundary planting, Scattered in the fields, linear along river banks</p>
Kakaruet Kipisorwet Mbamba ngoma	<i>Erythrina abyssinica</i> (Photos: old and young)		Apiary (bee forage)



Common/ local name	Scientific name	Photo		How to use in agroforestry systems
Eucalyptus	<i>Eucalyptus grandis</i>			Boundary planting Scattered Apiary (bee forage) Timber Fuelwood Poles woodlots
Mtikafu Murumuyinja	<i>Fagaropsis angolensis</i>			Medicine Timber Poles
Sagawaita	<i>Faurea saligna</i>			Apiary (bee forage) Timber tannin Fuelwood Arrangement pattern: Boundary tree Windbreak Ornamental
Bamboo Teget	Giant bamboo <i>Dendrocalamus giganteous</i> , Mountain bamboo <i>Yushania alpina</i> , and <i>Bambusa vulgaris</i>			Poles Arrangement pattern: woodlot Along rivers / banks



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Gliricidia	<i>Gliricidia sepium</i>		<p>Apiary (bee forage) Soil fertility</p> <p>Arrangement pattern: Intercropping (with maize, beans, veges & pulses potatoes etc Boundary planting</p>
Grevillea Sepesepe	<i>Grevillea robusta</i>		<p>Apiary (bee forage) Timber Fuelwood manure mulch</p> <p>Arrangement pattern: Intercropping with maize, potatoes, vegetables, beans and any other crops</p> <p>Along boundaries scattered in the field</p>
Leucaena	<i>Leucaena leucocephala</i>		<p>Fuelwood</p> <p>Arrangement pattern: Intercropping with maize, potatoes, beans and any other crops</p> <p>Along boundaries scattered in the field</p>
Macadamia nuts	<i>Macadamia integrifolia</i>		<p>Apiary (bee forage) Fruits</p> <p>Arrangement pattern: Intercropping with maize, potatoes, beans and any other crops</p> <p>Along boundaries scattered in the field</p>



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Mango	<i>Mangifera indica</i>		Fruits Leaves for fodder
Mobet Sanandet	<i>Markhamia lutea</i>		Windbreak Shade Mulch Firewood & timber
Mdunga Mdeewe Kugerwet Kigorwet	<i>Maytenus heterophylla</i>		Apiary (bee forage)
Mulberry	<i>Morus indica or alba</i>		Fruits, host for silk worms
Elgon teak Loliondo Murugeiywet	<i>Olea capensis</i>		Apiary (bee forage) Timber medicinal Fuelwood medicinal soil conservation Poles & posts Arrangement pattern: Boundary tree Scattered



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Lngeryoi Emitiot, Oloirien, Olorien	<i>Olea europaea</i> spp. <i>africana</i>		<p>Apiary (bee forage) Timber Fuelwood Soil conservation medicinal</p> <p>Arrangement pattern: Boundary tree River sides/bank Scattered in field</p>
African Locust Bean	<i>Parkia biglobosa</i>		<p>Bee forage nectar, fodder Firewood Timber medicine, alcoholic beverages</p> <p>Arrangement pattern: Intercrop</p>
Avocado (Hass)	<i>Persea americana</i> 'Hass'		<p>Fruit tree crop Firewood</p> <p>Arrangement pattern: Intercrop</p>
Pine Chesarur	<i>Pinus patula</i>		<p>Timber</p> <p>Arrangement pattern: Boundary tree Scattered</p>
Saptete Saptet, Podo Lpiriprinti	<i>Podocarpus falcatus</i>		<p>Apiary (bee forage) Timber Fuelwood medicinal soil conservation Ceremonial shade ornamental</p> <p>Arrangement pattern: Boundary tree Scattered</p>



Common/ local name	Scientific name	Photo		How to use in agroforestry systems
Sitetet Podo	<i>Podocarpus latifolius</i>			Apiary (bee forage) Timber medicinal Fuelwood soil conservation shade ornamental Arrangement pattern: Boundary tree planting Scattered
Tendwet Olkonjuku	<i>Prunus Africana</i> (Mature photo and Young)			Apiary (bee forage) Timber medicinal Fuelwood medicinal soil conservation Arrangement pattern: Boundary tree planting Scattered
Guava	<i>Psidium guajava</i>			Live fences, fruit Bee forage
Olobarat	<i>Psychotria orophila</i>			Shrub Bee forage
Rwandet	<i>Rauvolfia caffra</i>			Apiary (bee forage) Medicinal



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Munjororuet Mishangwe Msigioi Lmisigiyioi Lmisigiei Siriat	<i>Rhus natalensis</i>		Apiary (bee forage) Timber medicinal Fruits Soil conservation Arrangement pattern: Scattered
Marula	<i>Sclerocarya birrea</i>	 	Fruits Alcoholic drinks Arrangement pattern: Boundary tree Scattered in field
Sesbania Koibeyot	<i>Sesbania sesban</i>		Intercropping with maize, pulses, annuals, beans, potatoes etc Scattered Apiary (bee forage) Fuelwood conservation
Lamaywet Lamaiyat Lamayat	<i>Syzygium cordatum</i>		Scattered Apiary (bee forage) Fuelwood medicinal Fruits Arrangement pattern: riversides/ banks conservation
Java plum	<i>Syzygium cuminii</i>		Apiary (bee forage) Medical use Tannin or dyestuff Alcohol



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Tamarind	<i>Tamarindus indica</i>		Timber
Kuriot, Koriot	<i>Teclea nobilis</i>		Fuelwood timber Bee forage Edible fruits Medicinal
White Tephrosia	<i>Tephrosia candida</i>		Apiary (bee forage) Arrangement pattern: Intercropping with maize, potatoes, beans and any other crops
Tephrosia Poison Fish Tree	<i>Tephrosia vogelii</i>		Fuelwood Mole repellent Soil conservation Apiary (bee forage) Arrangement pattern: Intercropping with maize, pulses, vegetables, beans, potatoes etc Scattered



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Yellow oleander	<i>Thevetia peruviana</i>		Live fences
Mugurit Whistling Thorn	<i>Vachellia drepanolobium</i> syn. <i>Acacia drepanolobium</i> ,		<p>Apiary (bee forage) Fencing Tool handles and other implements Shade</p> <p>Arrangement pattern: Boundary tree Scattered in field</p>
Kimolwet	<i>Vangueria apiculata</i>		<p>Apiary (bee hives setting & forage) Along rivers / banks Fruit tree crop Woodfuel Conservation</p> <p>Arrangement pattern: Intercropping (with maize, beans, etc) Boundary tree planting Scattered in the fields</p>
Kimolwet	<i>Vangueria madagascariensis</i>		Apiary (bee forage)



Common/ local name	Scientific name	Photo	How to use in agroforestry systems
Seyniet Sewerweriet	<i>Xymalos monospora</i>		timber fuelwood Conservation Arrangement pattern: Along rivers / banks Boundary tree planting Scattered in the fields
Sogo African satinwood	<i>Zanthoxylum gillettii</i>		Apiary (bee forage)
Desert apple Indian jujube	<i>Ziziphus mauritiana</i>		Fruit tree crop Firewood Arrangement pattern: Boundary tree planting, Scattered in the fields



10 Characteristics of tree species

This section provides an overview of the tree species that are suitable for specific altitude zones in the Upper Mara river basin, their uses and physical needs.

Species	Common/ local name	Tendwet, Pygeum, Olkonjuku	Pine	Cypress	Kuriot, koriot	Mango	African Locust Bean
	Scientific name	<i>Prunus africana</i>	<i>Pinus patula</i>	<i>Cupressus lusitanica</i>	<i>Teclea nobilis</i>	<i>Mangifera indica</i>	<i>Parkia biglobosa</i>
Status	Indigenous	X			X		X
	Exotic		X	X		X	
Currently cultivated		X	X	X			X
Uses	Food crop				X	X	X
	Cash crop		X			X	
	Medicinal	X	X		X	X	X
	Timber/Poles	X	X	X	X	X	X
	Shade	X	X	X	X	X	X
	Fuelwood/charcoal	X	X	X	X	X	X
	Manure /mulch	X			X	X	X
	Melliferous	X			X	X	
	Other products	Bark	Pulp Gum Resin			Dye Latex	
	Forage/Fodder					Leaves Seed kernels	X
	Nitrogen fixing						
	Inter-cropping		2y	X		X	
	Erosion control	X	X	X			
	Maturation time (Y)					5	
	Fruiting season					Feb-Apr	
Input required					Mulch or fertilizer		
Reproduction method	Seed	Seed	Seed	Seed	Grafting		
Needs	Water needs	900-3400mm	1000-2200mm	1000- 1500mm		Drought tolerant. Withstand water-logging	
	Special labour input	Bark removal	Thinning	Weeding Pruning	Coppice, pollard	Pruning seedlings	
	Altitude	1500-3000m	1000-3300m	1000-4000m	900- 2600 m	<1200m	>600m
	Environment	Highlands forests. Sub-Sahara.	Well drained, neutral to acid soils. Light demanding.	Moist climates		Tropics, sub-tropics	Drier lowland elevations
Suitability in upper Mara River Basin		Higher & middle	Higher	Higher	Higher	Lower	Lower
Agroforestry systems spacing							Intercropping scattered in field, along boundaries
Special advantages							
Current product unit sale							
References		i	v	ii	iii	xxiv	xxiv



Species	Common/ local name	Pine	Cape chestnut	Silky oak	Mlama, Mgurure	Mtikafu, Murumuyinja	Sesban	Cypress
	Scientific name	<i>Pinus patula</i>	<i>Calodendrum capense</i>	<i>Grevillea robusta</i>	<i>Combretum molle</i>	<i>Fagaropsis angolensis</i>	<i>Sesbania sesban</i>	<i>Cupressus lusitanica</i>
Status	Indigenous		X		X	X	X	
	Exotic	X		X				X
Currently cultivated		X		X				
Uses	Food crop							
	Cash crop	X						
	Medicinal	X			X	X	X	
	Timber/Poles	X	X	X	X	X		X
	Shade	X	X	X			X	X
	Fuelwood/charcoal	X	X	X	X	X	X	X
	Manure /mulch		X	X	X		X	
	Melliferous		X	X	X			
	Other products	Pulp Gum Resin	Oil	Gum. Poison	Tanin Dye		Poison Pulp Resin	
	Forage/Fodder				X		X	
	Nitrogen fixing			X			X	
	Inter-cropping	2y	X	X			X	X
	Erosion control			X			X	
	Maturation time (Y)							
Fruiting season								
Input required								
Reproduction method	Seed	Seed	Seeds Cuttings	Seed	Seed	Seed Tissue culture	Seed	
Needs	Water needs	1000-2200mm	Drought and frost resistant. 800-1500mm	600-1700mm Drought tolerant	800mm	Moisture	Withstand waterlogging. 500-2000mm	1000- 1500mm
	Special labour input	Thinning	Coppicing Pollarding	Pruning Pollarding Coppicing	Pruning Coppicing	Coppicing	Cutting Coppicing	Weeding Pruning
	Altitude	1000-3300m	0-2200m	0-2300m	0-2300m	1,000- 2,600 m	100-2300m	1000-4000m
	Environment	Well drained, neutral to acid soils. Light demanding	Not restricted to any specific habitat	Riverine rainforest or Vine forests. No waterlogging	Bush and Savannah regions	Dry evergreen forest, sometimes moist/rain-forest, especially edges	Sub-tropic. Along streams, swamp banks & moist bottomland	Moist climates
Suitability in upper Mara River Basin		Middle	Middle & Lower	Middle & lower	Middle & lower	Upper, middle, lower	Middle & lower	Middle & lower
Agroforestry system spacing						Boundary planting		
Special advantages				Sheds leaves in dry seasons		Fast growing	Rapid early growth	
Current product unit sale								
References		i	xiii	ii	iii, i	xxiv	vi	xxv



Species	Common/ local name	Silibwet	Banana	Plantain	Sweet Orange Washington navel	Passion fruit	Avocado (Hass)	Cheperenet	Mapagola, Kababu, Winterthorn
	Scientific name	<i>Dombeya torrida</i>	<i>Musa acaminita</i>	<i>Musa × paradisiaca</i>	<i>Citrus Sinensis</i>	<i>Passiflora edulis</i>	<i>Persea americana 'Hass'</i>	<i>Barleria grandicalyx</i>	<i>Faidherbia albida</i> (<i>Acacia albida</i>)
Status	Indigenous	X				X		X	X
	Exotic		X	X	X		X		
Currently cultivated					X		X		
Uses	Food crop		X	X	X	X	X		X
	Cash crop		X	X	X	X	X		
	Medicinal	X			X	X	X	X	X
	Timber/Poles	x							X
	Shade				X				X
	Fuelwood/charcoal				X		X		X
	Manure /mulch	X	X	X					X
	Melliferous	X	X	X	X		X	X	X
	Other products	Fibres for rope	Fibres	Fibres	Pectin Oil		Oil, poison (unripe fruit)		
	Forage/Fodder						Fruit surplus		X
	Nitrogen fixing								X
	Inter-cropping		x	x	X	X	X		X
	Erosion control								X
	Maturation time (Y)				5-jun	0.7	4-mei		
	Fruiting season		Year round	Year round	Sept-Mar	Jul-August and Dec-Jan	Mar-Sept		
Input required				Irrigation Fertilizer Pest control windbreak	Fertilizer before planting	Mulch or fertilizer			
Reproduction method	Seed	Suckers	Suckers	Seed Grafting	Seed Grafting	Grafting Budding		Seed Grafting	
Needs	Water needs		Regular water, no waterlogging	Regular water, no waterlogging	No waterlogging. 900-2500mm	900-2000mm. Drought resistant.	1000-1200mm		Tolerates water logging 300-1000mm
	Special labour input	Coppicing, poillarding			Pruning. disease and weed control	Construct trellis for support. Twisting and ting shoots. Pruning Weeding	Pruning first 2 Y. Fruit thinning. Weed control. Harvest		Pruning Lopping
	Altitude	1,600 - 3,400 m	0 to 2000m	0 to 2000m	0-2000m	1000-2000m	1000-2000m	>500	250-2000m
	Environment		Susceptible to wind & frost	Susceptible to wind & frost	Sub-tropics. Well drained deep soils. Need windbreak	Deep well drained fertile soils. Wind protection needed.	Depends on hybrid Well drained soils.		River banks. Sandy alluvial soils.
Suitability in upper Mara River Basin		Upper & Middle	Middle & lower	Middle & lower	Middle & lower	Middle & Lower	Middle & Lower	Middle	Middle & Lower
Special advantages									Protects banks of watercourses
Current product unit sale					€2.5/kg		€3/kg		
References		xii			xvii			xi	xv



Species	Common/ local name	Mgunga, Scented thorn	Kotutwo /tugen	Umbrella thorn, Altarara	PaiPai, Papaya	Coffee	Sanandet, Mobet	Mukumari, Mukebu	Kipisorwet, Kipisorwet, mbamba ngoma	Sagawaita	
	Scientific name	<i>Acacia nilotica</i>	<i>Albizia amara</i>	<i>Acacia abyssinica</i>	<i>Carica papaya</i>	<i>Coffea arabica</i>	<i>Markhamia lutea</i>	<i>Cordia africana</i>	<i>Erythrina abyssinica</i>	<i>Faurea saligna</i>	
Status	Indigenous	X	X	X			X	X	X	X	
	Exotic				X	X					
Currently cultivated					X	X					
Uses	Food crop	X		X	X	X					
	Cash crop				X	X					
	Medicinal	X	X	X	X	X	X	X	X	X	
	Timber/Poles	X	X			X	X	X	X	X	
	Shade		X	X			X	X	X		
	Fuelwood/charcoal	X	X	X			X	X	X	X	
	Manure /mulch					X	X	X			
	Melliferous	X		X		X	X		X	X	
	Other products	Tanin Dye Gum Resin				Latex or rubber				X	Tannin
	Forage/Fodder	X	X	X	X	X		X	X		
	Nitrogen fixing	X	X	X					X		
	Inter-cropping	X		X	X	X	X	X	X	X	
	Erosion control	X					X	X	X	X	
	Maturation time (Y)				1	5					
Fruiting season		Oct-Nov		Year round	Nov-April						
Input required				Manure and mulch	Mulch						
Reproduction method	Seed	Seed	Seed	Seed	Seed	Seed	Seed	Seed	Seed Cuttings	Seed wildings	
Needs	Water needs	Drought resistant. 250-1500mm	drought resistant	Drought tolerant	No waterlogging g. 1000-1500mm well distributed.	1500-2000mm	800-2000mm Drought resistant. Can't stand waterlogging	700-2000mm			
	Special labour input			Lopping	Weed control. Fertilizer Pest control	Pruning Harvest	Fast growing coppicing	Pollarding, lopping, coppicing			
	Altitude	0-2000m		900-2000	<2100m	1800-3000m	900-2000m	900-2400m	<2300m	<2400	
	Environment	Plain and flat ground and ravines. Periodic inundation.	intolerant of shade,	Moister highlands. Deep soils	Tropics to temperate latitudes. Warm, sunny sites, sheltered from wind. No frost. Drained soils.	Deep friable soil. No water-logging		Woodland, savannah and bush		open woodland and on stony hillsides, sometimes along river banks	
Suitability in upper Mara River Basin		Middle & lower	Middle	Middle	Middle	Middle & Lower	Middle & Lower	Middle	Middle	Middle & lower	
Special advantages								Excellent shade tree			
Current product unit sale					10-30 \$US/kg	\$458/bag					
Agroforestry spacing						Intercropping, home gardens rows scattered		Intercropping Along boundaries scattered in the field	Scattered in fields, along rivers/ banks Boundary planting		
References		xv	xiv	vii	xxv		xvi	xxv	xxv	xxv	



Species	Common/ local name	Ndunga Ndeewe KugerwetKip	Mulberry	Elgon teak, Loliondo, Murugeiywet	Cactus	Kuresiei Cactus	Leucaena	Macadamia	Mgunga, mkengewa, white thorn, falcon's claw acacia	
	Scientific name	<i>Maytenus heterophylla</i>	<i>Morus indica or alba</i>	<i>Olea capensis</i>	<i>Euphorbia tirucalli</i>	<i>Euphorbia candelabrum</i>	<i>Leucaena Leucocephala</i>	<i>Macadamia integrifolia</i>	<i>Acacia polyacantha</i>	
Status	Indigenous	X		X					X	
	Exotic		X				X	X		
Currently cultivated							X			
Uses	Food crop		X	X			X	X		
	Cash crop							X		
	Medicinal	X		X	X	X	X		X	
	Timber/Poles	X	X	X	X		X		X	
	Shade		X	X			X	X		
	Fuelwood/charcoal			X			X			
	Manure /mulch						X			
	Melliferous	X		X		X	X	X	X	
	Other products		Silk from worms, baskets from branches			Caustic poison Live fence	Live fence beehives poison	Dye. Gum	Dye Oil	
	Forage/Fodder		x					X		
	Nitrogen fixing								X	
	Inter-cropping					X		X	X	
	Erosion control			X	X	X	X		X	
	Maturation time (Y)							6-jul		
Fruiting season							All			
Input required							Mulch			
Reproduction method		Seeds grafting cuttings	Seed direct sown	Cuttings			Direct sowing Cuttings	Seed Grafting	Seed	
Needs	Water needs		600 - 2500 mm		Drought tolerant	Drought tolerant	Drought tolerant 650-3000mm	>1200mm	High ground water table	
	Special labour input				Coppices well,		Pruning Pollarding	Mulching Corrective pruning young trees		
	Altitude	>3000m	>1000 m	800 - 2,600m	>2000m	>2,200m	<1900m	0-1800m	<1800m	
	Environment	forest, forest margins & woodland, sandy and riverine		sunny			Steep slopes. Tropical. Aggressive colonizer	Sub-tropical Well drained soils.	Woody grasslands, wood and bushlands	
Suitability in upper Mara River Basin		Lower, middle, upper	Lower	Lower, middle, upper	Lower	Lower, middle, upper	Lower	Lower	Lower	
Agroforestry uses		scattered in fields	Live fences Rows	Boundary tree Scattered shade	Boundary tree Fence	Boundary tree Fence	nitrogen fixing		Boundary tree Fence	
Special advantages										
Current product unit sale								Variable		
References		v	xxiv	xxiv	xxiii	xxiv	iv	xxiv	iv, v	



Species	Common/ local name	Eucalyptus								
	Scientific name	<i>Eucalyptus urophylla</i>	<i>Eucalyptus grandis</i>	<i>Eucalyptus saligna</i>	<i>Eucalyptus regnans</i>	<i>Eucalyptus citriodora</i>	<i>Eucalyptus camaldulensis</i>	<i>Eucalyptus maculate</i>	<i>Eucalyptus paniculata</i>	<i>Eucalyptus globulus</i>
Status	Indigenous									
	Exotic	X	X	X		X	X	X		X
Currently cultivated			X	X						
Uses	Food crop									
	Cash crop						X			
	Medicinal					X		X		X
	Timber/Poles	X	X	X	X	X	X	X	X	X
	Shade		X	X			X	X		X
	Fuelwood/charcoal	X	X	X			X	X		X
	Manure /mulch									
	Melliferous		X	X		X	X	X		X
	Other products	X		X	Pulp, paper	X	X	X		X
	Forage/Fodder							X		
	Nitrogen fixing									
	Inter-cropping		X	X		X	X			
	Erosion control	X	X	X		X	X	X		X
	Maturation time (Y)									
Fruiting season										
Input required										
Reproduction method	Seed	Seed	Seed	Seed	Seed	Seed	Seed	Seed	Seed	
Needs	Water needs	1000 mm	>900mm	>900mm	650–2000 mm	1000 mm	600 mm	600-900 mm	600-900 mm	1000mm
	Special labour input									
	Altitude	0-1200m	>2200m	>2200m	2000–3200 m	1200-2200m	0-1200m	1200-2200m	1200-2200m	1200-2200m
	Environment									
Suitability in upper Mara River Basin		Lower	Lower	Higher & Middle	Higher & Middle	Higher & Middle	Lower	Lower	Lower	Lower
Special advantages										
Current product unit	sale		Poles & Firewood profitable							
References		xxiii	xix	xxiii	xxiii, xxvi	xxiii	xxiii	xxiii	xxiii	xxiii



Species	Common/ local name	Tea	Lngeriyo, Emityot	White Tephrosia	Cheperenet	Pai pai, Paw Paw Papaya	Bamboo			
	Scientific name	<i>Camellia sinensis</i>	<i>Olea europaea</i> spp. <i>aficana</i>	<i>Tephrosia candida</i>	<i>Barleria grandicalyx</i>	<i>Carica papaya</i>	<i>Bambusa membranaceae</i>	<i>Arudinaria alpina/ Yushania alpina</i>	<i>Dendrocalamus asper</i>	<i>Bambusa vulgaris 'Vittata'</i>
Status	Indigenous		X		X			X		
	Exotic	X		X		X	X		X	X
Currently cultivated		X				X				
Uses	Food crop	X	X			X	X	Young shoots	X	
	Cash crop	X				X		X		
	Medicinal		X		X	X				
	Timber/Poles		X				X	X	X	X
	Shade			X			X	X	X	X
	Fuelwood/charcoal		X	X				X		
	Manure /mulch			X			X	X	X	X
	Melliferous				X					
	Other products			Insecticide		Latex/rubber	X	Multipurpose	X	X
	Forage/Fodder		X	X		X				
	Nitrogen fixing			X						
	Inter-cropping	X		X		X		X		
	Erosion control	X		X			X	X	X	X
	Maturation time (Y)						1		4 years 9-10 full size stems	
Fruiting season	All year					Year round				
Input required	Shade					Manure and mulch				
Reproduction method	Vegetative	Seed cuttings	Seed			Seed		Culms, seed		
Needs	Water needs	1200-1400mm	drought tolerant	No waterlogging. 1400-1800mm		No waterlogging. 1000-1500mm well distributed.	Not waterlogged 950mm	Drought tolerant. 800-2200mm	Not waterlogged 1200-4500mm	Not waterlogged
	Special labour input	Weeding Pruning Picking		Pruning		Weed control. Fertilizer Pest control		Harvest		
	Altitude	1000-1700m		<1650m	>500	<1600m	<1000m	2500-3300m	<155m	<1000m
	Environment	Well drained soils. Volcanic highlands	near water, on stream banks, open woodland, rocks and in mountain ravines	Seasonally dry tropics. Disturbed places, steep slopes		Tropics to temperate latitudes. Warm, sunny sites, sheltered from wind. No frost. Well drained soils.	Tropical mixed forests	Well drained humus-rich soils on gently slopes	Tropical/subtropical Well drained soils	Tropical/subtropical
Suitability in upper Mara River Basin		Lower		Lower	Lower	Lower	Lower	Lower	Higher & Middle Basin	Lower
Agroforestry system									River banks,	
Special advantages							Regulates quantity and quality of water	Regulates quantity and quality of water	Regulates quantity and quality of water	Regulates quantity and quality of water
Current product unit sale		US\$ 2.98/kg				10-30 \$US / kg				
References		xxv	vii, xxv	xxv	viii	xxv	xx	xx	xx	xx



	Common/ local name	Tobosuet, Tebeswet	Kipisorwet	Java Plum	Shiny-leaf buckthorn	Marula	Kayaba Kei apple	Mugavu	Sogo
Species	Scientific name	<i>Croton macrostachyus</i>	<i>Erythrina abyssinica</i>	<i>Syzygium cuminii</i>	<i>Rhamnus prinoides</i>	<i>Sclerocarya birrea</i>	<i>Dovyalis caffra</i>	<i>Albizia coriaria</i>	<i>Zanthoxyllum gillettii</i>
Status	Indigenous	X	X			X	X	X	X
	Exotic			X	X				
Currently cultivated									
Uses	Food crop			X	X	X	X		
	Cash crop			X		X			
	Medicinal	X	X	X	X	X		X	X
	Timber/Poles	X	X		X	X	X		X
	Shade	X	X	X	X	X		X	X
	Fuelwood/ charcoal	X	X	X				X	
	Manure /mulch								
	Melliferous	X	X	X	X		X	X	
	Other products		X	X		Poison, tannin, dye, oil, gum	Poison Live fence		Oil ornamental
	Forage/Fodder	X	X	X	X	X	X	X	
	Nitrogen fixing		X					X	
	Inter-cropping	X	X	X					
	Erosion control	X	X	X	X			X	X
	Live fence						X		
	Maturation time (Y)								
Fruiting season						Sept- Nov			
Input required									
Reproduction method	Seed	Seed Cuttings	Seed	Seed	Seed	Seed	Seed	Seed	
Needs	Water needs	150-1200		Tolerates drought		0-1370mm Drought resistant	salt and drought-tolerant		
	Special labour input					Coppicing		Pollarding, lopping	
	Altitude	<2000	<2300m	<1800m	<2100m	<1500m		850-1,680m	900-2400m
	Environment						open bush wooded grassland	Pioneer, needs light	tropical rainforest
Suitability in upper Mara River Basin		Lower	Lower	Lower	Lower	Lower	Lower. Middle, upper	Middle	Middle, upper
Special advantages						Multi-purpose tree, markets in S. Africa & int.			
Current product unit sale									
References		xxv	xxv	xxv	xxv	xxi	xxv	xv	xxv



11 Tree nurseries

Seedling and seeds can be obtained at the following nurseries:

Nursery	Indigenous tree species	Exotic tree species	Contact person & telephone number
Socofona CFA, Sogoo	Mobet (<i>Markhamia lutea</i>) Soket, Sogoet (<i>Waburgia</i>) Zebra (<i>Microberlinia brazzavillensis</i>) Casuarina (<i>Casuarina equisetifolia</i>)	Avocado Mulberry White bottlebrush Red bottlebrush <i>Cordia africana</i> Leucaena Callidandra Grevillea Eucalyptus	Joesph Waitage 0726685357
Amala WRUA	Tobosuet, tebeswet (<i>Croton macrostachyus</i>) Loquat (<i>Eriobotrya japonica</i>) Kipisorwet (<i>Erythrina abyssinica</i>) Sagawailta (<i>Faurea saligna</i>) Sogo (<i>Zanthozyllum gillettii</i>) Soket, Sogoet (<i>Waburgia</i>) Lamayay (<i>Syzygium cordatum</i>)	Cypress Papaya Grevillea	Joseph Chebusit
Engare Ngito WRUA	Several indigenous species	Avocado Mango Fast growing forage	
Nyangores WRUA	Tendwet (<i>Prunus africana</i>) Tobosuet, Tebeswet (<i>Croton macrostachyus</i>) Silibwet (<i>Dombeya torrida</i>) Kuriot, Kuriot (<i>Teclea nobilis</i>)		Kipigrui 0723279686
Taunet Tree nursery user group	Silibwet (<i>Dombeya torrida</i>) Tendwet (<i>Prunus africana</i>) Tobosuet, tebeswet (<i>Croton macrostachyus</i>) Lamayay (<i>Syzygium cordatum</i>)	Cypress	John Bett 0723173022
Nairotia CFA	Tendwet (<i>Prunus africana</i>) Saptete, Saptet (<i>Podocarpus falcatus</i>) Lamayay (<i>Syzygium cordatum</i>) Different indigenous trees	Tree tomato	Kiplangat Sigei 0729941512
Kipsegow Tree Nursery Group	Mobet (<i>Markhamia lutea</i>) Tobosuet, tebeswet (<i>Croton macrostachyus</i>) Kayaba, Kei Apple (<i>Dovyalis caffra</i> Warb.) Acacia Different indigenous trees	Grevillea Cypress Eucalyptus Casuarina White bottlebrush Red bottlebrush	John Koskei 0721117142
Mara WRUA	<i>Prunus africana</i> (Tendwet) Emitiot, Oloirien, Olorien (<i>Olea</i>)	Grevillea Calliandra Other trees	Richard Chapkouwe 0700431695
Kejingoo Tree Nursery	Tendwet (<i>Prunus africana</i>) Kayaba, Kei Apple (<i>Dovyalis caffra</i>) Acacia	Grevillea Cypress Vinus Avocado Eucalyptus Passion fruits	Joeseeph Ngerechi 0724385514



12 Further information

Please note: contact persons and details can go out of date quickly!

AGROFORESTRY

SNV

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josephhitimana@kabianga.ac.ke <http://kabianga.ac.ke/main/content/mr-joseph-hitimana>

Forest Tree Nurseries Association of Kenya (FOTNAK) and Kenya Forest Growers Association

Waumini house, 1st floor, Westlands, po box 64159 00620, Nairobi
0254 204 450 161/734 887 772/729 210 001/ 770 100 474
Fotnak09@gmail.com info@kefga.co.ke <https://en-gb.facebook.com/kefga/>

World Agroforestry Centre

United Nations Avenue, Gigiri, PO Box 30677, Nairobi, 00100
020 7224000
worldagroforestry@cgiar.org <http://www.worldagroforestry.org>

WATER RESOURCES

Mara Water Resource Users Association (MWRUA)

0720 952482
ppaulronoh@gmail.com

Ministry of Environment and Natural Resources (MEWNR)

NHIF building,12th floor, Ragati road, Upperhill P.O BOX 30126-00100 Nairobi
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Water Resource Management Authority (WRMA)

0722 259506 020 2732291 02729048/9
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BEEKEEPING

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BAMBOO

International Network for Bamboo and Rattan (INBAR)

www.inbar.int

GreenPot Bamboo

The Greenhouse, West Wing, Second Floor, Suite 10, Adams Arcade, Ngong Road, Ground Floor, Oltalet Mall, Narok Town

Nairobi: 0737933955, 0729933955 Narok: 0705933955

info@greenpotenterprises.com www.greenpotenterprises.com

USEFUL WEBSITES

Food Plants International <http://foodplantsinternational.com/plants/>

Guide to Trees in Kenya - James Madison University <http://agroforesttrees.cisat.jmu.edu/>

IAFN / RIFA - International Analog Forestry Network www.analogforestry.org/resources/database

Guide to tree planting in Kenya <http://www.infonet-biovision.org/environmentalhealth/guide-tree-planting-kenya>

Naturally African <http://www.naturallyafricanplatform.org/napData/directory.php?switch=2>

Nature Kenya [http://www.naturekenya.org/sites/default/files/Nairobi Arboretum Indigenous & Exotic Tree List.pdf](http://www.naturekenya.org/sites/default/files/Nairobi%20Arboretum%20Indigenous%20&%20Exotic%20Tree%20List.pdf)

Plant Resources of Tropical Africa <http://www.prota4u.info>

Raintree's Tropical Plant Database www.rain-tree.com/plants.htm

Technical Centre for Agricultural and Rural Cooperation (CTA) www.cta.int

Tropical Species - Tree Database – WUR <http://www.wur.nl/en/Expertise-Services/Chair-groups/Environmental-Sciences/Forest-Ecology-and-Forest-Management-Group/Education/Tree-database/Tropical-species.htm>

World Agroforestry Centre <http://www.worldagroforestry.org/output/agroforestree-database>



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- iv http://www.tropicalforages.info/key/Forages/Media/Html/Leucaena_leucocephala.htm
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- v <http://www.jstor.org.ezproxy.library.wur.nl/stable/pdf/25562585.pdf>
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https://www.researchgate.net/profile/Moses_Imo/publication/226144530_Interactions_amongst_trees_and_crops_in_tungya_systems_of_western_Kenya/links/00463525fcccc3b2a2000000.pdf
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https://www.researchgate.net/profile/Moses_Imo/publication/226144530_Interactions_amongst_trees_and_crops_in_tungya_systems_of_western_Kenya/links/00463525fcccc3b2a2000000.pdf
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- vii <http://www.fao.org/docrep/x5327e/x5327e07.htm>,
<https://www.gbif.org/species/3772787>
- viii <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1475560/pdf/1746-4269-2-22.pdf>
- x http://www.doc-developpement-durable.org/file/Arbres-Fruitiers/FICHES_ARBRES/Sclerocarya%20birrea/sustainable%20management%20of%20indigenous%20fruit%20trees%20in%20the%20drylands.pdf
- xi <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1475560/pdf/1746-4269-2-22.pdf>
- xii <http://tropical.theferns.info/viewtropical.php?id=Dombeya+torrida>
- xiii <https://www.prota4u.org/protav8.asp?h=M4&t=Calodendrum&p=Calodendrum+capense#Synonyms>
- xiv <http://www.fao.org/docrep/x5327e/x5327e07.htm>
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