

# Climate Smart Agroforestry in Ethiopia

Technical Information Kit  
with special emphasis on  
*Faidherbia albida*

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## The Purpose of the Technical Information Kit (TIK)

The purpose of this TIK is to establish a common background and knowledge base on how and where Agroforestry systems as the key Climate Smart practice can be promoted and scaled in Ethiopia with special emphasis on *Faidherbia albida*. This TIK is believed to be used by various actors as an extension material to guide, inform and train farmers on the importance of Agroforestry systems and practices and their multiple services and functions taking *Faidherbia albida* as a case and the overall implication for sustainable land management, and climate change adaptation and mitigation.

This TIK will address questions mainly related to:

- ◆ Why Agroforestry is important for Ethiopia?
- ◆ What exactly Agroforestry is?
- ◆ What are the types and forms of Agroforestry along with descriptions on some form or agroforestry systems important for Ethiopia?
- ◆ What type of challenges could be potentially addressed by agroforestry?
- ◆ Which tree is best for Agroforestry?

In addition to these five key issues, the TIK has addressed the details of *Faidherbia albida* including:

- ⇒ Why *F. albida*?
- ⇒ Unique characteristics of *F. albida*
- ⇒ Application of silvicultural practices to *F. albida*

## Acknowledgment

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# Why Agroforestry is important for Ethiopia?

Ethiopia population is growing rapidly, hence demand for food, energy, nutrition, and etc are increasing. This is also the driving factor for the expansion of cropland into the remaining forest and woodlands. The expansion of agricultural

investment and small holder farming remains high and continues to be the most important contributor to the national Green House Gas (GHG) emission levels. As a result, “Agroforestry is a practice that integrates trees with crops, animals or both” (Figure. 1), has gained attention and focus from the Ethiopian government and has been identified as a critical component in the country’s Forestry Strategic Plan, Climate Resilient Green Economy strategy and Sustainable Land Management program.



**Figure 1.** Agroforestry landscape (Photo by Niguse Hagazi/CIFOR-ICRAF)

## What Exactly Agroforestry is?

- It is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops &/or animals,
- It means growing useful trees/shrubs on farms and in rural landscapes, integrated with crops and livestock in the form of either tree-crop, tree-livestock or tree-crop-livestock
- It combines agricultural and forestry to create a profitable, productive, healthy and sustainable land use system
- It benefits humans, animals, plants & entire environment
- It minimize the tradeoff between forestry and agriculture
- It is considered as the future global land use system

## Forms of Agroforestry

- Backyard as multi-storey tree gardens
- Parkland: Trees growing in croplands in dispersed pattern
- Agroforestry for soil and water conservation
- Woodlots for fuel wood & pole production
- Fodder bank as cut and carry fodder production
- Live fences of fodder trees and hedges
- Trees and shrubs on pasture/rangelands
- Shelterbelts and windbreaks
- etc.



**Figure 2.** Backyard and multistorey agroforest system (Photo by Mulugeta Morkia/CIFOR-ICRAF)



**Figure 3.** *Faidherbia albida* dominated pasture/grassland (Photo by Niguse Hagazi/CIFOR-ICRAF)

What type of challenges could be potentially addressed by agroforestry?

## Livelihood oriented challenges

- Poverty, Inequity (rights, gender, negotiation, recognition, access), Malnutrition and human health, Energy scarcity, food security,

## Landscape (environment) oriented challenges

- Land degradation, Climate change, Deforestation and habitat loss, Water scarcity, Biodiversity loss.

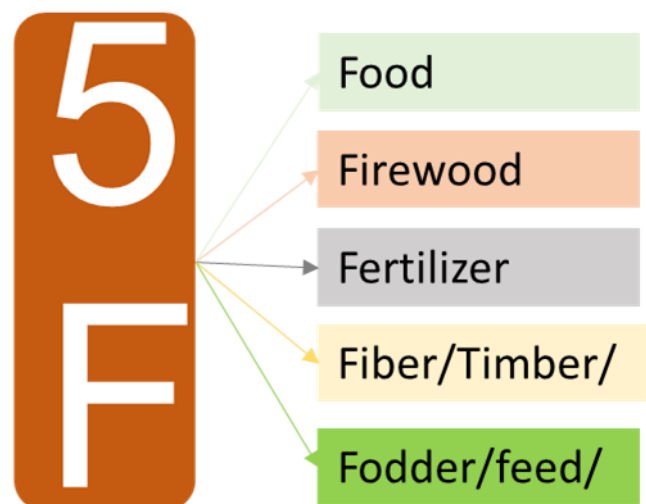


Figure 4. *Faidherbia albida* tree on farm (Photo by Mulugeta Morkia/CIFOR-ICRAF)

## Which tree is best for Agroforestry?

Scaling up of agroforestry system involves accelerated and human-induced evolution to bring tree species into wider cultivation through a farmer determined process. The selection, retention or deliberately planting of agroforestry trees requires to know the function and benefits of a species. Especially toward securing the five functions of trees (“5F”)

(“5F”)



## Major Objective of the TIK

The primary objective of the KIT is to support and promote Agroforestry systems and practices and specifically to *Faidherbia albida* based agroforestry system in Ethiopia and beyond. The specific objective includes: -

- To use as an extension material to guide, inform and train farmers' on the multiservice functions of *Faidherbia albida* centered agroforestry system with its implication for sustainable land management, and climate change adaptation and mitigation
- To promote a country wide adoption of agroforestry to sustain the productive potential of the natural resource base, improve soil fertility, improve incomes, food security and livelihoods of smallholder farmers
- To provide specific production and management requirements and define the pathways for full-scale adoption of increasing coverage of *Faidherbia albida* stands in the country.

## Why *Faidherbia albida*?

*We focused on Faidherbia albida, because it provides the four functions of the best agroforestry trees (Fodder, Fire, Fiber/Timber/, and Fertilizers)*

### [1] Description

The name *Faidherbia albida* was used to call Acacia albida. *Faidherbia albida* is a tree up to 30 m high with light-brown bark and hairy leaves with thorns at the base. Bears leaves only during the dry season. Light-yellow

flowering spikes and crescent shaped or circular light-brown pods. Roots can reach aquifers up to 80 m below the surface. Young trees have inverted cone-shaped crown, old trees with a hemispherical large canopy.

## Unique characteristics of *F. albida*

### [2] Context

Its wider distribution, available local knowledge and information, and multipurpose benefits and services make it one of the best climate smart agroforestry trees. It is also considered as the best agroforestry trees for incorporating with crops as a main entry for *EverGreen Agriculture* that aims to sustain a green cover on the land throughout the year while

increasing food and fodder production to improve the livelihoods of small holder farmers and land productivity (improve soil fertility and create favorable micro-site under/within the canopy). As a result, the national scaling up program on *Faidherbia albida* has been *promoted by* the Ethiopian government.



**Figure 5.** *Faidherbia albida* tree on farm (Photo Niguse Hagazi/CIFOR-ICRAF)



### [3] Applicability: distribution and potential niches

*Faidherbia albida* is widely distributed in Ethiopia. It occurs over a wide range of ecological conditions, mainly on deep, sandy, well-drained soils having water tables that can be easily reached by the roots (2 to 3 m and more). Its natural range extends throughout low to mid-high ranging from 270-2400 m.a.s.l. *F. albida* is adapted to areas characterized by long summer

and dry season with a mean annual temperature ranging from **18°C to 30°C**, and low to medium rainfall (**250–1200 mm yr<sup>-1</sup>**). It grows in a wide range of climates and habitats, mainly as parkland, backyard & rangeland agroforestry systems, woodland, in cultivated and rangeland areas. It develops into large populations and dominantly found in the great rift valley of Ethiopia and many parts of Tigray, Oromiya and Amhara regions.

### [4] Benefits & environmental services as potential drivers to increase or up-scale *F. albida* stands

***F. Albida* can play an important role to create a resilient landscape. Its multifunctional in the view of experts and framers includes:**

- **Agronomist:** a fertilizer tree /fix nitrogen / (enhance soil fertility)
- **Livestock Producer:** fodder and shade tree
- **Beekeeper:** Source of pollen and nectar for bees and wood/bark for beehives construction
- **Watershed Manager:** Improve soil water holding capacity, decrease soil erosion and create favorable microclimate
- **Forester:** fuel wood, farm implement, fencing, and construction
- **Farmer:** a source of income and livelihood improvement
- Etc.

## [5] Description of the technology and steps to cultivate

Establishment and promotion of *F. albida* in Ethiopian farms through planting, assisted natural regeneration or both techniques are the two basic pathways to achieve the intended scaling up programmes of *F. albida*.

### [5.1] Nursery operation starts from getting quality seeds. Seeds can be obtained from local collection and seed supplying organizations.



**Figure 6.** Farming household seed collections (*Hygenia abyssinica* species)  
(Source: Eyob Getahun, CIFOR-ICRAF)

### Seed collection

- **Mother tree selection:** Seeds from more branchy and vigorous trees will most likely produce more branchy and vigorous trees.
- **Seed collection and timing:** The best time for seed collection is when the seed coat is still pale in color and relatively soft and the swollen pods are just beginning to turn brown. The best way of collecting seeds is to harvest the pod when they are ripe but before they open and the seeds dispersed.
- **Seed collection techniques:** Shaking the branches or Beating the tree with a long slender pole, or throwing sticks at the branches, or climbing to the tree.

### Seed preparation

- First pods should dried in the sun until they split open (see Figure 6. above).
- Seed should be stored in dry and cool conditions out of reach of insects, rodents and birds.  
*Note: Before storage the seeds must be properly dried otherwise they will become decaying. Airtight containers, tins or bottles, are good for storage of most seeds, and are essential for storage of seeds that are easily attacked by insects.*
- Seeds should be pre-treated in 3 ways for better germination: 1) *mechanical scarification works best for a seed which have a hard seed coat* or 2) *covering the seed with boiling water then allowing cooling for 24 hours* or 3) *put in cold water for 24 hours and sow immediately.*

### Seedling preparation

- Raise seedlings in Nursery for 6-7 months before planting
- Seedling can be raised by direct sowing to polyethylene tubes or transplant from the bed to polyethylene tube filed with the 2:1:1 forest soil: compost: sand soil composition
- Watering should be done regularly in the early morning and late after noon.





**Figure 7.** *F. albida* seedlings raising using air pruned technique

## [5.2]. In the field through direct seeding

This practice is especially good in relatively moist areas but needs further testing in Dryland areas. Direct seeding of 1-2 seeds to the pits should be under taken early in the rainy season, to allow as much time as possible for the plants to establish before the dry season. A few weeks after the seedlings appear, thin them out leaving one strong and healthy seedling. It is recommended replanting in the furrow/basin where there is no seedling germination. Seeds passes through digestion process of livestock are best preferable for direct sowing. Farmers' in **Tigray Region (Abreha we Atsbeha)** are well experienced in feeding their animals with *F. albida* pods and collect their manure and

spread across their farm lands to get successful establishment of *F. albida* seeds.

The treated *F. albida* seed should be sown to the soil at a depth of two or three times of the seed size (**10-15 mm**). Seedlings raised from direct sown should get water at about five day interval for two or three times or till it get well established.

## Tree care

Fencing/protecting from livestock and human interference is important using locally available materials, like thorny acacia and wooden materials immediately after sowing, then enlarge the fence together with the height of the seedling.



**Figure 8.** Tree care for Agroforestry trees

### 5.3. In the field through Farmer Managed Natural Regeneration (FMNR)

FMNR is a very rapid, low cost, easily replicable and sustainable method of degraded landscape restoration which can be easily managed by the whole family of a given household. It involves selective thinning and

pruning of re-growth from stumps, roots or seeds of *F. albida* coming out from the ground. This practice is easily applicable using locally available materials (sickle, sharp axe, machete, harvesting knife). This method can complement and/or replace in some cases the need to establish trees using seedlings raised in nurseries which is costly and time consuming and often failures during planting out operations.



**Figure 9.** On-field farmers training on FMNR practices and Pruning up to 2/3 of the total length of *F. albida* seedlings grown naturally .



**Figure 10.** *F. albida* managed and grown through FMNR techniques

## [6] Application of silvicultural Practices to *F. albida* trees

### Required management techniques in using *F. albida* in agroforestry system.

#### [6.1.] Pruning

It is the removal of branches from the lower part of the tree crown with the main objectives of reduction of shade for crops near the tree. Early harvest of branch wood for fuel or other use and to reduce competition & enhancing the growth of selected branch.

#### When to prune?

Pruning to develop a single stem can be begin when *F. albida* tree is at sapling stage (~2-years) and an old ones can be pruned starting from the height of the crop under it. Usually the pruning should takes place in dry season when there is enough leaf on the tree.

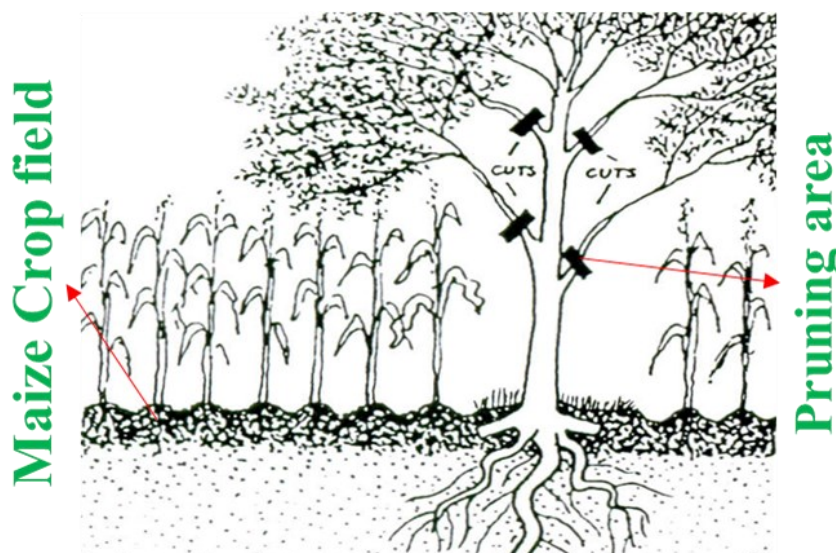


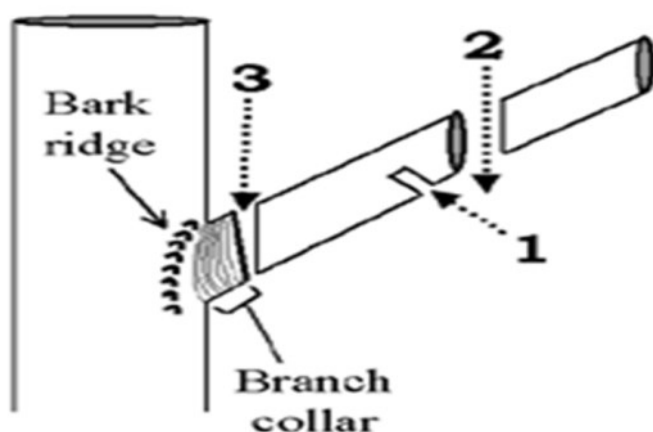
Figure 11. How to prune branches of *F. albida* in crop fields to reduce computation & to use branches for other purposes

#### Regardless of age and size of the tree, generally we can follow three steps to prune *F. albida* trees

[Step 1]: Remove any dead, broken, diseased or dying branch

[Step 2]: Identify the main stem & any branches that will compete with it, & decide how much competing stems should be removed.

[Step 3]: Removal of lower limbs.



There are three steps to prune large limbs that require the use of saw:

[Step 1]: Cut a notch about 1/3 of the diameter of the stem

[Step 2]: Remove most of the branch above the notch

[Step 3]: The final cut is perpendicular to the branch, following the outside edge of the branch collar.

Figure 12. Three steps of large limb pruning of *F. albida*

## [6.2.] Lopping

Lopping is cutting of branches randomly from the leafy crown. Also lopping is not always done starting from the lower part of the tree but can be more

haphazard. If any selection of branches is made, the main criteria are often a good green leafy biomass since the lopping is usually done to obtain branches of fodder. This mostly also common when *F. albida* are grown in rows in farmlands.



**Figure 13.** Lopping practice in row planted *F. albida*

## [6.3.] Pollarding

Pollarding: It is the cut off of all the branches and the top part of the *F. albida* trees with the main objectives of early harvest of wood and fodder production and reduction of shade for crops.



**Figure 14.** Pollarding practices on *F. albida* trees.

## Few descriptions of some form of agroforestry systems important for Ethiopia

### Multistorey backyard or home garden

This is an existing or planted stands of trees or shrubs that are managed as an upper story of woody plants and one to several under multistorey of woody and non-woody plants that are grown for a variety of products. This type of agroforestry system using improves land productivity and crop diversity by

growing mixed but compatible crops of different heights in the same area. The picture below is an example of multistorey agroforestry system which is widely adopted in the southern region of Ethiopia. This story mainly includes trees (*Persea americana*, *Cordia africana*, *Millettia feruginea*, *Albizia gummifera*, *Croton macrostachys* etc..) shrubs (fodder shrubs, coffee, banana, enset etc..) and vegetables/herbs (cabbage, spices, and as well as annual crop line maize).



**Figure 15.** A picture depicting a multistorey agroforestry system

### Parkland

**Parkland:** Trees growing in cultivated lands in dispersed pattern mainly with indigenous tree species. Characterized mainly with diversity of tree species that provides multiple benefits and services including fruits, fodder, firewood, shade, improved soil fertility, provide

favorable micro-climates, windbreaks etc. Parklands are found primarily in the semi-arid and sub-humid and mid-highland zones of Ethiopia. The common species which we need to promote in such systems are mainly include *F. albida*, *Cordia africana*, *Croton macrostachys*, *Ziziphus spina-christi*, *Balanites aegyptica*, *Morniga stenoptella*, *Hagenia abyssinica* etc.



**Figure 16.** Partial view of parkland agroforestry with scattered trees



## Shelterbelts and/or windbreaks

Shelterbelts and/or windbreaks: are barriers of trees and shrubs that protect against damaging wind. They are used to reduce wind velocity, protect growing plants (crops and forage), improve micro-environments to enhance plant growth, delineate field boundaries, and increase carbon storage. They can be in the form of live fences and hedges grow using fodder and construction and firewood trees.



**Figure 17.** A windbreak and Shelterbelts with two or three tree lines planted 1-3 m apart established at the border of cropland

## Spacing

The spacing between windbreak rows could be 20-25 m or vary based on land holding size and landscape form. The row of windbreak can be of a single tree line, of double tree lines or more. depending on wind speed and the scope required protection. Likewise, spacing between tree might also vary depending the type of tree/shrub species plated. Plant density can range from 100 – 200 plants/ha depending on the number of tree lines planted within

a windbreak. The denser the shelterbelts are, the better the wind breaking effect, but the higher the competition with crops for nutrients, light and water. Frequent pruning helps to avoid shade effect on crops and reduce competition while securing household energy demand. When leguminous tree species are used, soil properties can be improved. Species like *Albizia gummifera*, *Leucaena leucocephala*, *Acacia saligna*, *Gravellia*, *Calliandra calostrosis*, etc.

## Woodlots for fuel wood & pole production

Woodlots for fuel wood & pole production is an important form of agroforestry which can be established mainly around homesteads and, river banks. The common species that can adapt to the Ethiopia diverse agro ecologies include *Eucalyptus*, *Gravellia robusta*, *Acacia saligna*, *Acacia decurrense*, *Acacia polyacantha*, *Acacia melanoxylon* etc.



**Figure 18.** Woodlot at the homestead



**Figure 19.** Woodlot at the river side, dominate by *eucalyptus* species

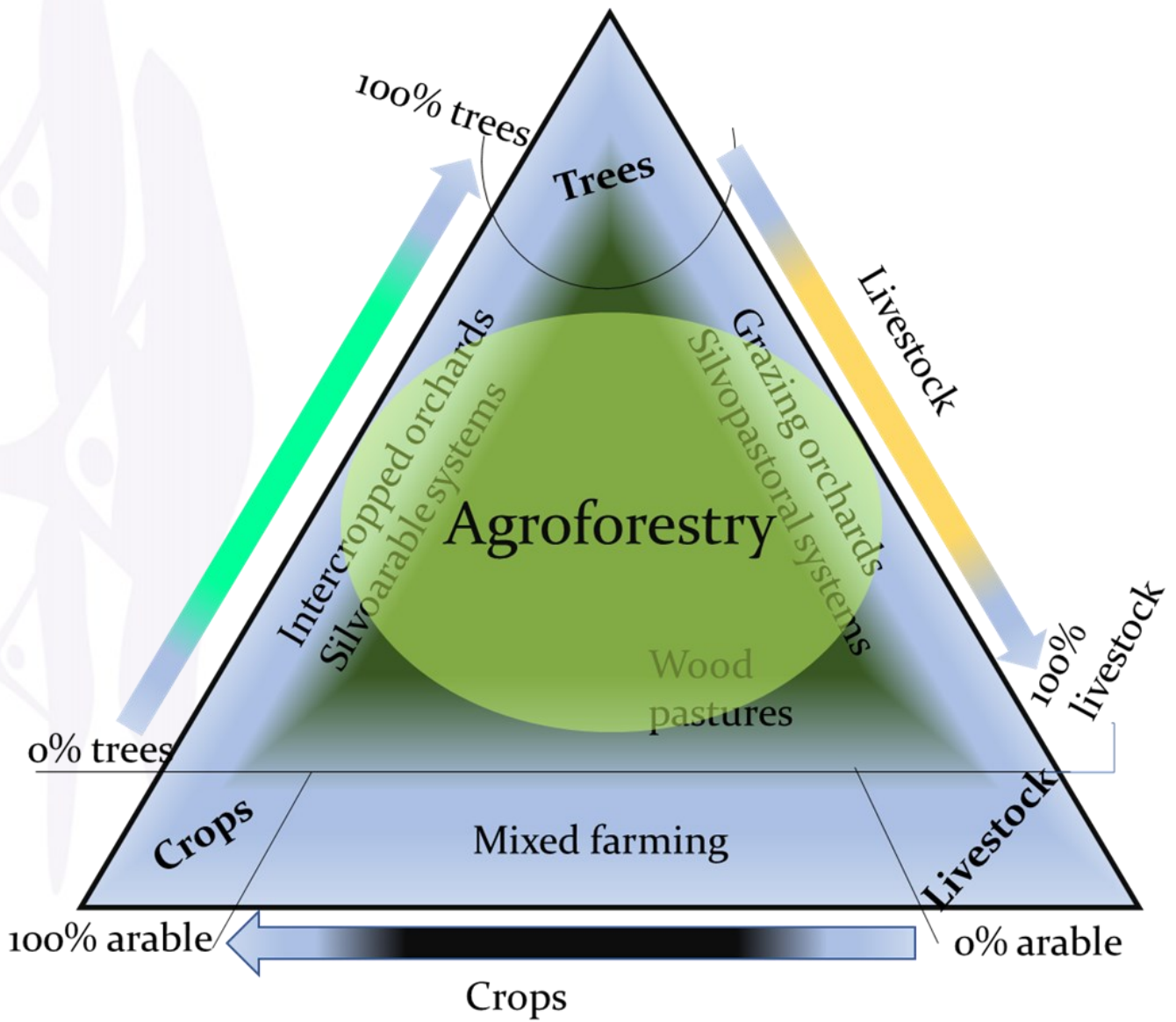
### Fodder bank for cut & carry fodder production

Fodder banks are trees/shrub species primary planted for fodder production. Trees and shrubs with palatable leaves & pods are attractive to farmers as feed supplements for their livestock. This type of tree/shrub species can be planted and grown on boundaries/hedges. They often pollarded to reduce

competition. Managing fodder tree/shrubs requires multiple skills including pruning, pollarding, thinning, trees. The common species important for this type of agroforestry systems include *Leucaena leucocephala*, *Gliricidia sepium*, *Azadirachta indica*, *Moringa oleifera*, *Ziziphus mauritiana*, *Tree lucern*, *callandireia*, *Acacia spp.* *Ficus thonningii*, *Optunia-ficus indica*, *Salt bush* and other grasses species



**Figure 20.** Fodder trees/shrubs — feeding animas using cut -&- carry system





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