

## INTRODUCTION TO AGROFORESTRY

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### Concept of Agroforestry

Agroforestry is the art and science of growing woody and non-woody plants together on the same unit of land for range of benefits.

Agroforestry is the use of land for a combination of agriculture and forestry. In other words, the practice of growing tree crops or some other fast growing trees along with the main crop. Agroforestry is one of the important sustainable land management techniques, involving a combination of different agricultural, horticultural, forestry, and livestock practices. Sometimes it is closely related to community forestry and homestead forestry.

### Definitions of agroforestry

„Agroforestry refers to those land use practices in which woody perennials (trees, shrubs, woody vines, bamboo, palms) are grown in association with agricultural crops or pastures, sometimes with livestock or other animals (e.g. insects such as bees, fish), and in which there are both ecological and economic interactions between the woody plants and other components”

„Agroforestry land use is the deliberate inter or sequential cropping of woody and non-woody plant components (sometimes with animals) in order to generate multiple products and „services”. There are both ecological and economical interactions between the plant components”

„Agroforestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboo etc.) are deliberately grown on the same land management unit as agricultural crops and/or animals either in spatial mixture or in temporal sequence. There must be significant ecological and economical interactions between the woody and non-woody components”

### Characteristics of Agroforestry

- Multiple plant components, at least one of which must be a woody perennial. Components of the system, either ecological and / or economical.
- A high level of interaction (economic and biophysical) between the woody and non-woody components.
- Usually multiple products, often of different categories (e.g. food, fodder, fuelwood).
- The cycle of an agroforestry system is always more than one year.
- The most simple agroforestry system is more complex, ecological and economically than a mono-cropping system.

## Attributes of agroforestry

There are three attributes which all agroforestry systems possess, these are-

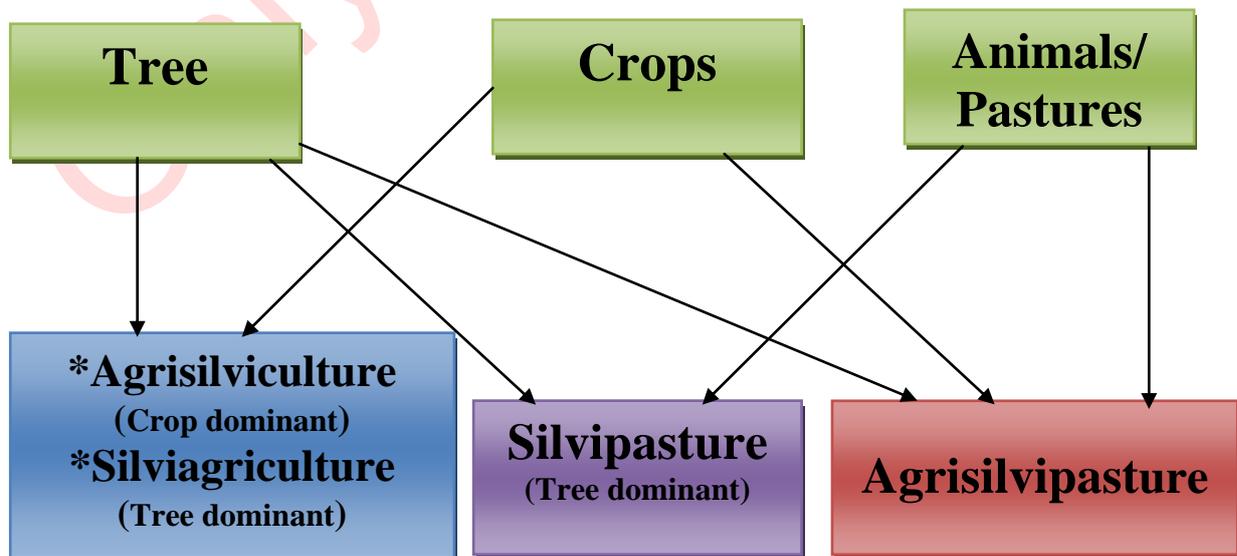
1. Productivity
2. Sustainability
3. Adaptability

- 1. Productivity:** most, if not all, Agroforestry systems aim to maintain or increase production (of preferred commodities) as well as productivity (of the land). Agroforestry can improve productivity in many different ways. These include: increased output of tree products, improved yields of associated crops, reduction of cropping system inputs, and increased labor efficiency.
- 2. Sustainability:** by conserving the production potential of the resource based, mainly through the beneficial effects of woody perennials on soils, Agroforestry can achieve and indefinitely maintain conservation and fertility goals.
- 3. Adoptability:** the word „adopt“ here means „accept“, and it may be distinguished from another commonly-used word adapt, which implies „modify“ or „change“. The fact that Agroforestry is a relatively new word for an old set of practices means that, in some cases, Agroforestry has already been accepted by the farming community. However, the implication here is that improved or new Agroforestry technologies that are introduced into new areas should also conform to local farming practices.

## Components of Agroforestry

There are three major components in agroforestry system. these are:

- Tree or woody perennials
- Crops
- Animals



## Historical development of Agroforestry in Bangladesh

- **Betagi-Pomora Community Forestry Project (1979):** This was the first Agroforestry program started by the Forest Department under the umbrella of social forestry program. Betagi and Pomora are the two villages of Rangunia Thana of Chittagong. These were two denuded (devoid of trees) hills where the Govt. rehabilitated families who encroached forest land with a view to plant trees along with the provision of cultivation of agricultural crops in the allotted land for each family. Initially the program was started in participation of 70 families of Betagi village in 1979, then it was extended in Pomora village on Khas and protected forest land. To start with 70 families so far total 235 families (83 in Betagi and 152 in Pomora) has been rehabilitated in two villages.
- **In the mid 80s** on farm Research Division (OFRD) in BARI was established where Agroforestry as a land use system was evaluated and its potential and necessity in our farming system has been judged.
- **In 1987**, Bangladesh Forest Research Institute (BFRI) conducted Agroforestry research works in Chamoti of Rangunia, Fashiakhali of Dulahazra and Salna of Gazipur with a view to maximize the productivity of the Govt. forest land.
- **In 1988**, the Institute of Forestry of the University of Chittagong introduced the course of Agroforestry in its curricula for the degree of B.Sc (hons) in Forestry.
- **In 1988**, Village and farm Forestry Program (VFFP) was initiated under the guidance of Prof. Abdul Haque (the then Professor of Crop Botany) with financial assistance of Swiss Agency for Development and Cooperation (SDC). This program dealt with the exploration of feasibility of implementing Agroforestry works in different areas of the country. This program actually helped in establishing Agroforestry Department in the Bangladesh Agricultural University.
- **In the 1990s**, the giant NGOs like BRAC, Proshika, SDC and others started Agroforestry works in the country.
- **In the 1990s**, Department of Agroforestry and Environment was established in IPISA, now Bangladesh Sheikh Mujibur Rahman Agricultural University (BSMRAU) to offer MS in Agroforestry.
- **In 1996**, Department of Agroforestry was established by the indefatigable works of Prof. Abdul Haque. With the incorporation of courses of Agroforestry for the undergraduate student of the Faculty of Agriculture, the Agroforestry movement gained momentum. In the newly established department, he (the Prof. Haque) was the founder head.
- **In 1997**, National Agroforestry Working Group (NAWG) was formed by the active initiation of the personnel engaged in the Forestry Division of Bangladesh Agricultural Research Council (BARC).
- **In 1998**, First National Agroforestry Workshop was held at BARC organized by NAWG during 21-25 June.

The history of Agroforestry is intimately associated with the practices of shifting cultivation and Taungya system.

### **Shifting cultivation:**

The term refers to farming of agricultural systems in which land under vegetation is cleared, cropped with agricultural crops for year, and then left unattended while the natural vegetation regenerates. The cultivation phase is usually short (2-3 yrs.), but the regeneration phase is much longer (traditionally 10 -20 yrs.) This is also known as jhum cultivation or jhuming. Jhum is a special kind of comprehensive agricultural practice cultured by the indigenous people for several centuries is also popular known as Sw eden cultivation or cultivation of slash and burn. Jhuming comprises cutting and burning of forest, making holes over the small hill-beds and then sowing a variety of seeds. The life and culture of ethnic people of Chittagong Hill Tracts depends on Jhum cultivation to a great extent.

#### **Criteria of choosing suitable land for jhum cultivation:**

Choice of land for jhum cultivation depends on the following features:

- The high slope
- Well grown trees and bamboo- if trees and bamboo are well grown in a place, the cultivators think that place fertile and good jhuming.
- The hills, which have large trees in the hillside, are not selected for jhum cultivation.
- Enough availability of earth worm in the soil.

**Land processing:** The land is processed by cutting and burning of trees starting from January and is continued to the month of March. Small bushes and bamboo are only cut and burnt in the processing of land. Big trees are not cut down for this purpose.

**Sowing:** Sowing of the jhum covers the whole month of March. By July, the plants become suitable from cutting. But cutting generally begins from August. As the plants come to a maturity it has to be guarded against the depredations of wild pigs, deer, monkeys, parrots and rats. Usually man cuts the jhum for the family. The woman and children are responsible for weeding, tending and harvesting.

**Harvesting:** Harvesting of rice begins from early October and continues to the month of November. Cutting of maize first starts at September which is called „Prenlua“. Maize is cut for the second time in the month of November along with the cutting of rice, which is called „Prenlong“. Cutting of cotton and sesame seed starts at November continues to the month of December.

The following crops are very common in jhuming in the whole of Chittagong Hill Tracts:

- Rice
- Maize
- Sesame
- Turmeric
- Pineapples
- Cotton
- Vegetables etc.

**Taungya system:**

In Burmese, 'Taung' means **hill** and 'ya' means **cultivation** i. e. taungya means hill cultivation. The taungya system consists of growing annual agricultural crops along with the forest species during the early years of establishment of the forestry plantation.

The system was started for the first time in Burma in 1856. In India, the first taungya plantation was raised in North Bengal during 1863 followed by plantations in Chittagong and Sylhet (now Bangladesh) in 1870.

This is a method of establishing forest crops in temporary combination with agricultural crops. Agricultural cropping is confined to the period which ends with the casting of dense lateral shade or closing of the canopy of the forest crops. The farmers tend the forest crops and may also be required to plant it. They usually receive use of the land in return for this labor. This is practiced in Bangladesh.

At the dawn of human civilization these two practices were found suitable to supply the basic needs of human beings. But with the passes of time when population were increasing both the practices were found inadequate to supply the forest products and failed to protect the environment. Sometimes the practices were influencing the rate of deforestation.

**Difference between shifting cultivation and taungya system:**

Shifting cultivation	Taungya system
1. Main objective is to produce crops	1. to grow trees
2. it is sequential system of growing woody species and agricultural crops	2. it is a simultaneous system
3. The length of agricultural cycle last only as long as the soil sustain reasonable crop yield	3. it is primarily dependent on the physical availability of space and light

**Benefits of Agroforestry**

**1. Environmental/ecological benefits:**

- Better protection of crops and lives from environmental hazards such as flood, drought, cyclone etc.
- Conserved biodiversity
- Improved microclimate- such as reduce soil temperature, reduces evaporation of soil moisture.
- Purification of air and water.
- Reduce use and chemical fertilizer
- Reduce pressure on forests.
- Protect lands through reduction of surface run-off and soil erosion.
- Increase soil nutrients through of addition decomposition of litterfall.
- More efficient recycling of nutrients by deep-rooted trees.

- Improve soil structures through the constant addition of organic matter from decomposed litter.

**2. Economic benefits:**

- Diversifies the range outputs a given area
- Increase the value of outputs from a given area of land.
- Reduces incidence of total crop failure, common to single or monocropping systems.
- spread the needs for labour inputs more evenly through the year.
- Provides productive use of underutilized land, labour and capital.
- Increases in levels of farm incomes due to improved and sustained productivity.

**3. Social benefits:**

- Improved in rural living standards from sustained employment higher incomes.
- Improved in nutrition and health due to increased quality and diversity of food outputs
- Stabilization and improvement of upland communities through elimination of the need to shift sites of farm activities.

**4. Biological benefits:**

- Increase crop productivity.
- Sustain crop productivity.
- Produce diversified foods.
- Increase forest productivity.
- Increase fruit supply.
- Decrease weed infection.

Agroforestry systems tend to protect soil from several adverse effects. Most agroforestry systems constitute sustainable land use and improve soils in a number of ways-

- Reduction of loss of soil by reducing surface run-off.
- It adds C through decomposable biomass.
- Enrich the soil through biological nitrogen fixation.
- It improves soil physical conditions by increasing water holding capacity.
- It helps in nutrient recycling that conserve soil.
- It protects the natural flora and fauna within the soil..

## **Limitation of AF**

### ***Environmental aspect***

- Possible competition of trees with food crops for space, sunlight, moisture and nutrients which may reduce food crop yields;
- Damage to food crops during tree harvest operation;
- Potential trees to serve as hosts of insect pests that are harmful to food crops; and
- Rapid regeneration by prolific trees, which may displace food crops and take over entire fields.

### ***Socioeconomic aspects***

- Requirement of more labour inputs, which may cause scarcity at times in other farm activities;
- Competition between tree and food crops, which could cause aggregate yields to be lower than those of a single crop;
- Longer period required for trees to grow to maturity and acquire an economic value;
- Agroforestry is more complex.

## **Ways to overcome the limitations of agroforestry**

- By selecting legume trees that have small or light crowns so that sufficient sunlight will reach the food crops for photosynthesis;
- By selecting tree species that are deep-rooted so that they will absorb moisture and nutrients from the deeper subsoil while the food crops receive their share from the surface layer of the soil; and
- By spacing the trees farther apart to reduce their competitive effects on the food crops.

## Introduction to Bangladesh Forest

**Forest:** is biologically defined as a community of plants and animals generally dominated by trees. Forest is being defined by FAO as-ecological systems with a minimum of 10% crown cover of trees and or bamboos. Generally associated with wild flora, fauna and natural soil conditions and not subject to agricultural practices.

**Forest community:** A group of organisms (like, trees and or bamboo associated with other wild flora and fauna) living together under more or less similar environmental conditions with mutual adjustment and beneficial interactions is called a forest community.

**Forest type:** is a unit forest or tree assemblage whose nature, morpho-physiological characteristics and species arrangement possess similar characteristics and which is easily differentiated from other unit forest.

### Distribution and management of the forest land

Distribution of forest land (managing authority)	Areas of forests (m ha)	% of total land
National forest (Forest Department)	1.46	10.15
Unclassed State Forest (District Council)	0.73	5.06
Village and Homestead Forest (Privately owned)	0.27	1.88
Total	2.46	17.09

### Forest types of Bangladesh on the basis of ecological distribution

1. Tropical moist evergreen forest
2. Tropical moist semi-evergreen forest
3. Tropical moist deciduous forest
4. Mangrove / Tidal forest

#### 1. Tropical moist evergreen forest

##### Characteristics:

- The forest is rich in diversified types of plants.
- The plants of this forest are tall, some of which may attain 46-61 m height.
- The canopy of trees arranged in different layers.
- The average annual rainfall in this forest normally ranges from 3810-5080 mm.
- The forest contains at least 600 species of plants having huge no. of epiphytes, orchids, timber trees, climbers, palms and ferns prevailing at various vertical strata.

**Location:** This forest is situated in the wet and humid areas of the greater districts of Chittagong Hill Tracks, Sylhet, Chittagong and Cox's Bazar.

**Examples:**

□ Teli garjan	: <i>Dipterocarpus turbinatus</i>	□ Dumur	: <i>Ficus spp.</i>
□ Dhulia garjan	: <i>D. Pilosus</i>	□ Gamar	: <i>Gmelina arborea</i>
□ Civit	: <i>Swintonia floribunda</i>	□ Chickrashi	: <i>Chickssia tabularis</i>
□ Champa	: <i>Michelia champaka</i>	□ Boilum	: <i>Anisoptera scaphula</i>
□ Telsur	: <i>Hopea odorata</i>	□ Raktan	: <i>Lophopetalum fimbriatum</i>
□ Dhakijam	: <i>Syzygium grande</i>	□ Chatim	: <i>Alstoma scholaris</i>
□ Chapalish	: <i>Artocarpus chaplasha</i>	□ Jarul	: <i>Lagerstroemia speciosa</i>
□ Sil koro	: <i>Albizia procera</i>		

## 2. Tropical Semi-evergreen forest

**Characteristics:**

- Evergreen species are the dominating trees, there is a mixture of deciduous species which remain leafless during the winter.
- The average height of trees of this forest ranges from 25-27m.
- The climate is similar to that of evergreen forest.

**Location:** This forest is located in the dry and warmer areas of the greater districts of Chittagong Hill Tracks, Chittagong and Sylhet.

**Examples:**

**Evergreen species:**

□ baira garjan	: <i>Dipterocarpus scabber</i>	□ Sheora	: <i>Streblus asper</i>
□ Kanak	: <i>Schima wallichii</i>	□ Menda	: <i>Litsea polyantha</i>
□ Teli garjan	: <i>Dipterocarpus turbinatus</i>	□ Dumar	: <i>Ficas spp</i>
□ Dhula garjan	: <i>D. pilusus</i>	□ Gamar	: <i>Gmelina arborea</i>
□ Civt	: <i>Swintonia floribunda</i>	□ Chickrashi	: <i>Chickrassia tabularis</i>
□ Champa	: <i>Mechelia champaka</i>	□ Boilum	: <i>Anisoptera scaphula</i>
□ Telsur	: <i>Hopea odorata</i>	□ Raktan	: <i>Lophopetalum fimbriatum</i>
□ Dhakijam	: <i>Syzygium grande</i>	□ Chatim	: <i>Alstonia scholaris</i>
□ Chapalish	: <i>Artocarpus chalasha</i>	□ Jarul	: <i>Lagerstroemia speciosa</i>
□ Sil koro	: <i>Albizia procera</i>		

**Deciduous trees:**

<input type="checkbox"/> Simul	: <i>Bombax ceiba</i>	<input type="checkbox"/> Bansimul	: <i>Salmalia insignis</i>
<input type="checkbox"/> Dewa	: <i>Artocarpus lacucha</i>	<input type="checkbox"/> Chapalish	: <i>A. chaplasha</i>
<input type="checkbox"/> Hargoza	: <i>Dillenia pentagyna</i>	<input type="checkbox"/> Bhadi	: <i>Lannea coromandelica</i>
<input type="checkbox"/> Udal	: <i>Sterculia alata</i>	<input type="checkbox"/> Bohera	: <i>Terminalia belerica</i>
<input type="checkbox"/> Amloki	: <i>Embllica officinalis</i>	<input type="checkbox"/> Amra	: <i>Spondias pinnata</i>
<input type="checkbox"/> Haldu	: <i>Adina cordifolia</i>		

**3. Tropical moist deciduous forest or Sal forest**

Characteristics:

- The main species of this forest is Sal (*Shorea robusta*) and 90% area of this forest is covered with the Sal trees.
- The abundance of Sal trees in this forest coined the name Sal forest.
- The Sal tree may attain a height of about 10-25 m and all the Sal trees remain leafless during winter.
- In this forest, there are some raised lands and some low lying areas which are termed as „Chala“ and „Baid“, respectively.
- Average rainfall in this forest normally remains below 2000 mm.

**Location:** There are three major locations of this forest.

a. *Madhupur and Bhawal Range:*

- Major part of this forest
- Located in Mymensingh, Tangail and Dhaka district
- It is about 100 km long in north-south direction and 10-40 km wide.

b. *Slope plain basin of the Garo Hill:*

- 2<sup>nd</sup> height part of this forest
- Located in greater Mymensingh district
- It is about 80 km long in east-west direction and 2-10 km wide

c. The third part of this forest is spread over Rangpur and Dinajpur districts, which is severely degraded and denuded. In the present day, due to encroachment and illegal settlement as well as illegal felling of trees from this forest, it is on the verge of ruination.

**Examples:**

<input type="checkbox"/> Sal	: <i>Shorea robusta</i>	<input type="checkbox"/> Shilkoroi	: <i>Albizia procera</i>
<input type="checkbox"/> Haldu	: <i>Adina cordifolia</i>	<input type="checkbox"/> Simul	: <i>Bombax ceiba</i>
<input type="checkbox"/> Palash	: <i>Butea monosperma</i>	<input type="checkbox"/> Hargoza	: <i>Dillenia pentagyna</i>
<input type="checkbox"/> Kumvi	: <i>Careya arborea</i>	<input type="checkbox"/> Menda	: <i>Litsea polyantha</i>
<input type="checkbox"/> Bohera	: <i>Terminalia belerica</i>	<input type="checkbox"/> Pitraj	: <i>Aphanomixis polystachya</i>
<input type="checkbox"/> Horitoki	: <i>Terminalia chebula</i>	<input type="checkbox"/> Amloki	: <i>Embelica officinalis</i>
<input type="checkbox"/> Sonalu	: <i>Cassia fistula</i>		

Besides these, a large number of Eucalyptus, Akashmoni, Minjiri, Sissoo, Mangium species are planted under social forestry program.

**4. Mangrove or Tidal forest**

**Characteristics:**

- The forest in tidal area is termed as Mangrove forest or tidal forest.
- The main species of this forest is Sunduri (*Heritiera fomes*), due the abundance of this species, this forest is also known as Sundarban.
- Sundarban is the largest Mangrove forest all over the world.
- The soil is highly saline and it remains wet due to inundation of low lying area as 2 times everyday.
- The forest is about 2 m above the sea level.
- Most of the trees have stilt roots and propagated by viviparous germination.
- All the plants growing in the forest are salt tolerant and evergreen.

**Location:** The natural mangrove is located at the southern part of Khulna districts and Chukoria of Chittagong. Plantation mangrove forest has, however, been raised in the newly elevated „Char“ areas in the entire southern coast of the country such as Cox's Bazar, Chittagong, Noakhali, Bhola, Barguna, Patuakhali etc.

**Examples:**

<input type="checkbox"/> Sundari	: <i>Heritiera fomes</i>	<input type="checkbox"/> Bain	: <i>Avicennia alba</i>
<input type="checkbox"/> Geowa	: <i>Exocoecaria agallocha</i>	<input type="checkbox"/> Singhra	: <i>Cynometra ramiflora</i>
<input type="checkbox"/> Kakra	: <i>Bruguiera gynnorrhiza</i>	<input type="checkbox"/> Pasur	: <i>Xylocarpus mekongensis</i>
<input type="checkbox"/> Keora	: <i>Sonneratia apelata</i>	<input type="checkbox"/> Dakur	: <i>Cerbera manghas</i>
<input type="checkbox"/> Hental	: <i>Phoenix paludosa</i>	<input type="checkbox"/> Golpata	: <i>Nypa fruticans</i>

**Types of mangrove forests:** On the basis of salinity, topography, plant characteristics and ecological features, the mangrove forest is divided into the following 5 (five) categories:

1. Fresh water *Heritiera* forest (Sundarban)
2. Moderate water *Heritiera* forest
3. Saline water *Heritiera* forest
4. Tree mangrove forest
5. Low mangrove forest

**Similarities and dissimilarities among forestry, social forestry and agroforestry**

Conventional forestry	Social forestry	Agroforestry
1. It deals with only forest tree species	1. Deals with both forest and fruit trees	1. Deals with combination of trees and agril. crops and/or animals
2. There is no people participation	2. Peoples directly participated and execute the program in community places	2. People do this in their own land
3. Peoples are not direct beneficiary of the produce from this forest	3. Peoples are the direct beneficiary	3. The produce is farmers own property i.e. the question of share benefit does not arise.
4. Activities is limited only to the Govt. forest land	4. It extends throughout the community places including Govt. forest also.	4. Activities limited only to the farmers own land i.e. / in homestead. farm land etc.
5. It provides raw materials of the heavy industries	5. Provide raw materials of small and cottage industries	5. It supplies foods, fuel, fodder, small timber etc. depending on the need of the farmers
6. There is regional limitations in conserving the environment	6. It conserve the environment effectively with certain limitations	6. Balanced and effective environmental conservation is possible

**Scope of Agroforestry in Bangladesh**

Agroforestry is the most effective land use system from sustainable view point and is recognized worldwide as the best productive system from which the rural poor people can meet their requirement of food, fuel, fodder and other necessities. This has long been practiced by the farmers of Bangladesh in haphazard manner. The homestead of rural people is a unique feature of combination of trees, shrubs, vegetable, livestock animals, and duck and poultry birds in association of trees of different multi purpose values. Estimated 16.7 million homestead of the country occupy about 0.3 million hectare of land (which is increasing sharply with the increase of population) in now under traditional agroforestry practices. There is a great scope to manager and develop these homesteads with sound sustainable technologies. Because the homesteads are providing the lion share of bio-fuel requirement as well as fruit, fodder, timber and shelter for rural people. Besides the

homestead, part of our cropper land (net cropper area is 8085 m ha), 0.39 m ha current fallow land, 0.27 m ha culturable waste land, 3.29 m ha land which is not available for cultivation and encroached forest areas in Madhupur Sal forest. CHTs forest along with the denuded hills of greater Chittagong region may bring under agroforestry system. Utilizing appropriate agroforestry technologies in these areas the overall production may be increased many folds.

Only for Students

## Terminology Commonly Used in Agroforestry

**Alley cropping/ farming:** Growing annual crops between rows of trees or shrubs, often leguminous, pruned materials from these is used as mulch around annual crops also as fodder and fuel wood.

**Arid climate:** Climate in regions that lack sufficient moisture for crop production without irrigation in cool regions, annual precipitation is usually less than 25 cm. It may be as high as 50cm in tropical regions. Natural vegetation is a desert shrub.

**Biomass:** The total weight at a given time of living trees or tree parts per unit area.

**Bole:** Bole is the main stem of tree, sometimes; it refers only to the lower part of the stem up to that point where the main branches are given off

- **Clear bole:** A clear bole refers to that part of the bole, which is free from branches.
- **Commercial bole:** A commercial bole refers to the length of the bole that is ordinarily fit for utilization as timber.

**Browse:** The buds, shoots, leaves and flowers of woody plants, which are eaten by livestock or wild animals.

**By-product:** Material produced as wastes in some agricultural, industrial or food preparation process, may be used as feed or for other purpose.

**Canopy:** The upper layer of trees in a forest or a complex of trees.

**Community forestry:**

- A form of social forestry refers to tree planting activities undertaken by a community on common lands the so-called common land.
- Community forestry is the practice of forestry on lands outside the conventional forest area for the benefits of the local population.

**Contour:** An imaginary line connecting point equal elevation on the surface of the soil. A contour ditch is sometimes constructed along the contour to store and conserve water.

**Coppicing:** Cutting trees close to ground level in order to produce new shoots from the stump.

**Cover crop:** A close-growing primarily for purpose of protecting and improving between periods of regular crop production or between trees and vines in orchards and plantations.

**Crop residue:** The portion of a plant or crop that is left in the field after harvest.

**Crop:** All Plants of a farm, which are planted and managed for economic purposes, producing a physical product for farm use or sale. Multipurpose tree species (MPTs): Tree species purposely grown to provide more than one significant product and/ or service.

**Crown:** The canopy or top of a single tree or other woody plant that carries its main branches and leaves at the top of a fairly clean stem.

**Deciduous plant:** A plant that sheds all or most of its leaves every year at a certain season.

**Deforestation:** Disturbance, conversion, or wasteful destruction of forestlands.

**Ecology:** A branch of science concerned with the interrelationship of organisms and their environments.

**Ecosystems:** All the plants and animals in a given area and their physical environments including the interactions within them.

**Environment:** The circumstance by which one is surrounded, that acts upon an organism or an ecological community and ultimately determines its form and survival.

**Evergreen:** Plants, which retain their leaves and remain green through out the year.

**Exotic:** A plant or animal species, which has been introduced outside its natural range. Opposite of indigenous.

**Farm forestry:** Farm forestry is defined as the practice of forestry in all aspects on farm or village lands generally integrated with other operations.

**Fodder:** Parts of plants which are eaten by domestic animals, these may include leaves, stems, fruits, pods, flowers etc.

**Foliage:** The mass of leaves of plants, usually used for trees or bushes.

**Forage:** Vegetative materials in a fresh or dried which is fed to livestock.

**Hedgerow or hedge:** A closely planted line of shrubs or small trees.

**Homegarden:** Traditional cropping practice around the house: usually includes fruit and fuel wood trees, vegetables, root crops, poultry and smaller livestock and sometimes fishponds.

**Humid :** A climate in which rainfall exceeds potential evaporation, during 9 months a year and usually more than 1500 mm annual rainfall.

**Indigenous:** Native to a specific area: not introduced.

**Interface:** The area where there is positive or negative interaction between two entities, such as between a row of trees and a row of crops.

**Legume:** Any plant species from the family leguminous (e.g. beans, peas), many of which have the ability to fix atmospheric nitrogen via bacteria in or on their roots.

**Litter:** The uppermost layer of organic materials on the soil surface, including leaves, twigs, and flowers freshly fallen or slightly decomposed.

**Lopping:** Cutting off one or more branches from a tree, whether standing, felled, or fallen.

**Microclimate:** The temperature, sunlight, humidity and other climatic conditions are a small localized area (e.g. in a stand of trees).

**Mixed intercropping:** Growing two or more crops simultaneously in the same plot with no distinct row arrangement.

**Mulch:** Plant or non-living materials used to cover the soil surface with the object of protecting the soil from the impact of rainfall controlling weeds or moisture loss and in some cases, fertilizing the soil.

**Multiple cropping:** Growing two or more crops on the same field in a year.

**Pasture:** A portion of land covered with grasses or grass-legume mixtures suitable for grazing.

**Phenology:** Phenology refers to the seasonal changes in the development of foliage, flowering, fruiting etc. Species, local climatic conditions, etc. control phenological changes.

**Pollarding:** Cutting back the crown of a tree in order to harvest wood and browse; to produce regrowth beyond the reach of animals and/ or to reduce the shade cast by the crown.

**Pruning:** Cutting away of superfluous growth (including roots) from any plant so as to improve its development, fruitfulness, etc.

**Reforestation:** Replanting of a forest, which has been chopped down or destroyed by fire.

**Relay cropping.** Growing of two or more crops simultaneously in the same field such that one crop is seeded after the other has flowered.

**Row intercropping:** Growing two or more crops simultaneously where one or more crops are planted in rows.

**Sapling:** A young tree, no longer a seedling but not yet a pole, a few meters high and about 2.5 cm in diameter at breast height. (Dbh)

**Seedling:** A young stage of a plant grown from a seed.

**Sequential cropping:** Growing two or more crops in sequence on the same field in a farming year. The succeeding crop is planted after the preceding crop has been harvested. There is no intercrop competition.

**Shelter-belts:** These are belts/blocks consisting of several rows of trees established at right angles to the prevailing wind.

**Shifting cultivation:** A form of agriculture in which soil fertility is maintained by rotating fields rather than crops. New plots are usually cleared by "slash and burn" and cropped until soil exhaustion. The land is then left to regenerate naturally while cultivation is done elsewhere.

**Slope:** The incline or angle of the land surface, which can be measured as a percent or ratio or in degrees or grades.

**Social forestry:**

- State financed and supervised tree-planting programs on common or public land.
- Social forestry is the practice of forestry, which aims at meeting the requirement of rural and urban populations.

**Sole cropping:** Growing one crop alone or in pure stand. Either as a single crop or as a sequence of single crops within the year.

**Stem:** A stem of a plant is the principle axis of it on which buds and shoots are developed.

**Stress:** Any factor that disturbs the normal functioning of an organism.

**Strip intercropping:** Growing two or more crops simultaneously in strips, wide enough to permit independent cultivation but narrow enough for the crops to interact agronomically.

**Taungya:** The intercropping of agricultural crops during the first years of forest plantation establishment.

**Terraces:** Soil and water conservation structures on sloping lands to reduce the run off of soil and water down the slope.

**Topography:** The physical description of land in terms of elevation, slope and orientation.

**Tree:** A woody perennial plant species having a single elongated main stem, generally with few or no branches on its lower part.

**Wind-breaks:** Wind-breaks are strips of trees and/or shrubs planted to protect fields, homes, canals or other areas from wind and blowing soil or sand.

**Yield:** The quantity of a specified product or plant component harvested on a particular area over a specified period of time.



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