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# Multipurpose Trees: A Way to Boost Tree Farming in Semi-Arid Regions of India

The fast-growing multi-purpose trees species are universally recognised as a natural gift and play imperative benefits to environment due to their exultant adaptation and survival capacity in the harsh weather. Water is a highly limiting factor in semi-arid regions. Trees are having special traits or mechanisms to adopt themselves in harsh climatic condition like deep tap rooting, leaf shedding in summer, leaf wax coating, sunken or closed stomata and short and small leaf size etc., in order to minimise the loss of water through transpiration loss. The identified / enlisted multipurpose tree species are the most commonly grown and preferred species for semi-arid agro-ecological regions viz., Neem - *Azadirachta indica*, Karanj (*Pongamia pinnata*), Desibabool (*Acacia nilotica*), Shisham (*Dalbergia sissoo*), Subabul (*Leucaena leucocephala*), Bamboo (*Dendrocalamus strictus*), Anjan (*Hardwickia binnata*), Glyricidia (*Glyricidia sepium*), Senna siamea (*Cassia siamea*), Khejedi (*Prosopis cineraria*), Siris (*Albizia lebbek*), Kachnaar (*Bauhenia racemosa*) White Babul (*Acacia leucopholea*). Few improved and easily adopted agroforestry practices have been identified and it will be useful to small and medium farmers such as silvipasture, alley cropping, wood lot and protein bank and bamboo plantation for livelihood generation and wind-breaks/shelter-belt plantation to protect crop and animals from heavy blowing dusty winds. Also multipurpose perennials shrubs provide green cover/forage during summer season when grasses are almost dried under semi-arid rainfed conditions for balanced utilization of resources to provide other ecosystem benefits too. Multiple trees are ideal

**trees for meeting multiple needs of the farmers/landholders. So, integration of tree species is essential component to be incorporated in landuse farming systems for effective utilization of land on multiple ways.**

### INTRODUCTION

Under this climate changing scenario, semi-arid /rainfed regions may face frequent occurrence of up and down monsoon weather peaks /failures in productivity. In such situations, establishment of climate smart/suitable tree farming system which multiple benefits. So integration of shrubs / tree in association with arable crops can be alternative source of permanent green cover or resilience in farming as it can flexible/survive during drought conditions. Apart from this, a balanced utilization of natural resource like water and nutrient from different level of nutrient niches in the soil layers. Watershed developments by Government of India has initiated and encouraged many ways to emphasizing the low-cost bioengineering with hardy fast growing multipurpose trees and shrubs to improve the soil and water conservation structures. Multipurpose perennials shrubs provide green cover/forage during summer season when grasses are almost dried under semi -arid rainfed conditions for balanced utilization of resources to provide other ecosystem benefits too. Multipurpose trees play the important and most dominant roles in Agroforestry systems. So, integration of tree species is ideal element in land use farming systems for utilization of arable and non-arable land on multiple ways. Agroforestry is a land use system in which trees are grown in association with agricultural crops, shrubs, pastures or livestock. Even, small and marginal land farmers in resource poor regions have been adaptation of growing trees on boundaries for different household purpose like timber, firewood, fodder, fibre and other non-timber forest products. Indigenous MPTs species are universally recognised as a natural souvenir and contributing many tangible and intangible benefits through environmental sustainability because of their exultant survival and high adaptation to harsh local conditions.

Multipurpose trees are defined as all woody perennials that are purposefully grown to provide more than one significant contribution to the production and/or service functions of a land-use system (Burley and Carlowitz, 1984). Apart from direct benefits, MPTs promotes soil and water conservation, improve soil fertility improvement



Figure 1. Suitable MPTs for forestry and agroforestry system development in semi-arid regions in India

through  $N_2$ -fixation, high carbon-biomass production for carbon mitigation. Most of the MPTs can adoptable at higher density per hectare. Likewise, approximately 400 to 600 plants per hectare can be accommodated on block plantation or high density

plantation sometimes on non-arable lands. Regular pruning and lopping will give considerable mulch material of green and dry leaves, green leaf manure and tree fodder for household use and sale. Similarly twigs and small branches are highly useful meeting domestic cooking needs. Neem and Karanj leaves are highly used as botanical pesticides/ bio-pesticides for crop protection. In wind prone areas, MPTs are useful component as Shelterbelts and windbreaks to protect their other farming components like, agricultural crops and livestock. Many times, fast growing Nitrogen Fixing tree species (NFT's) are considered as special group tree species which can be planted in protein bank plantation may helpful to reclamation of wastelands through 'N' fixing ability and provide protein rich foliage which can be used for tree fodder and green manuring.

### SUITABLE MULTI-PURPOSE TREE SPECIES FOR SEMI-ARID REGION

Studies have indicated that the choice of species under agroforestry land use varies significantly from place to place, as it is based on the consideration of economical, silvicultural, ecological and local needs. Accordingly a shortlist prepared and complete silviculture techniques briefed for most suitable MPTs for non-arable land cultivation and rehabilitation. In this system, the multipurpose tree species are raised and managed on farm bunds for their ability to produce not only wood but also leaves and or fruits that are suitable for fodder and food purpose.

#### CRITERIA FOR SELECTION OF MPTs

- Fast growing and yield a maximum volume of wood in a short time;
- High palatable leaves and pods that animals prefer to eat; preferably thorn-less
- Good quality fodder with high nutritional content
- Amenable high lopping, pruning, pollarding, and coppicing;
- fast growing and east establishment, especially in early stages;
- adapt easily to different sites and environments;
- shade and fire tolerant species
- fix nitrogen to enhance soil fertility;
- high tolerance to pests, diseases, and browsing animals;
- Multiple uses and service

- High calorific value
- Wood have a low moisture content or dry relatively quickly;
- Wood produce minimal and nontoxic smoke when burned;

The following MPT species have been identified enlisted the most commonly grown and preferred species for semi-arid agro-ecological regions of India (Figure 1.), those species are *Albizia lebbbeck*, *Azadirachta indica*, *Pongammia pinnata*, *Acacia nilotica*, *Dalbergia sissoo*, *Leucaena leucocephala*, *Acacia spp*, *Bamboos*, *Hardwickia binnata*, *Cassia siamea*, *Prosopis cineraria*, etc.,



Figure 2. Amenable fodder grass species for agroforestry system development in semi-arid regions

### AGROFORESTRY SYSTEMS SUITABLE FOR SEMI-ARID REGIONS

There are choices for adopting several kinds of agroforestry systems in semi-arid regions with different compatible tree-crop combinations. Water is a major constraint input in semi-arid regions. So planning and harvesting rainwater through small to medium sized water harvesting structure might be useful for enhancing plant survival. The choice of our tree species should be drought tolerant and deep rooted mechanisms to overcome the water stress based difficulties during the establishment. Especially trees having leaf shedding in summer, wax coating leaf, sunken and covered stomata, etc., in order avoid transpiration loss of water. The following methods are useful for small and medium sized farmers for development of agro-forestry practices in the semi-arid zone. This could be suitably practiced based on situation, purpose,

availability of input (planting source), sale of output (tree products) and other need of the farmers.

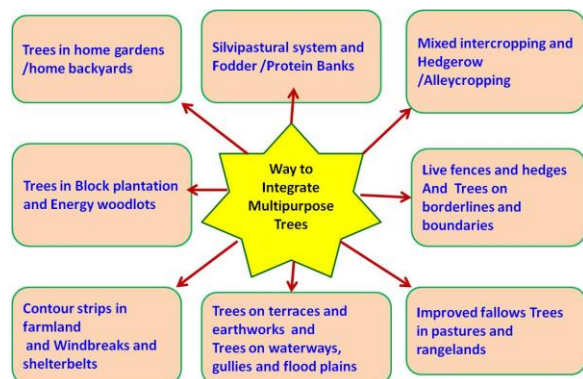


Figure 3. Suitable form / models to MPTs in arable and non-arable lands

**MPTs used in various forms of agroforestry land use systems as:** enlisted the important tree and grass species which highly suitable for semi-arid regions:

#### 1. Agri-silviculture system:

**Alley cropping:** *Azadirachta indica*, *Pongamia pinnata*, *Dalbergia sissoo*, *Prosopis cineraria*, *Zizyphus spp.*, *Leuceana leucocephala*, etc.

**Agricultural crops:** Maize, fodder cowpea, pearl millet, red gram, green gram, finger millet, kodo millet, Chickpea, Seed fenugreek, black gram, coriander, cowpea, sorghum, etc.

**2. Silvopasture system:** *Azadirachta indica*, *Acacia nilotica*, *Acacia leucopholea*, *Albizia lebeck*, *Pogammia pinnata*, *Dalbergia sissoo*, *Ailanthus excelsa*, *Prosopis cineraria*, *Bauhinia racemosa*, *Hardwickia binata*, etc.

**Suitable grass species:** *Cenchrus ciliaris*, *Cenchrus setigerus*, *Panicum maximum*, *Chloris gayana*, *Lasirus indicus*, *Dichanthium annulatum*, *Panicum antidotale* (Figure 2.).

**3. Boundary plantation:** *Tecomella undulata*, *Prosopis cineraria*, *Acacia tortilis*, *Pongamia*, *Eucalyptus camaldulensis*, *Moringa oleifera*, *Dalbergia sissoo*, *Azadirachta indica*, *Eucalyptus camaldulensis*, *Acacia nilotica*, etc.

**4. Protein Bank:** *Moringa oleifera*, *Leuceana leucocephala*, *Azadirachta indica*, *Acacia nilotica*, *Ficus glomera*, *Bamboo spp.*, *Albizia spp.*, etc.

#### 5. Live fence system:

**a) Outer layer:** *Agave spp.*, *Zizyphus mauritiana*, *Cactus spp.*, *Commiphora spp.*, *Zizyphus mauritiana*, *Inga dulce*, *Zizyphus numularia*, *Opuntia sps.*, *Lawsonia spp.*, etc.

**b) Inner layer:** *Lawsonia innermis*, *Cassia auriculata*, *Carissa carundus*, *Muraya coenigi*, *Pithecalobium dulce*, *Parkinsonia aculeata*, *Carissa carandus*, *Leuceana leucocephala*, *Embllica officinalis*.

#### 6. Trees for degraded land Improvement:

**a. Fodder/Green biomass:**, *Bamboo spp.*, *Ficus glomerata*, *Tecomella undulata*, *Dichrostachys cineraria*, *Cassia siamia*, *Acacia nilotica*, *Prosopis cineraria*, *Hardwickia binata*, *Cassia siamea*, *Azadirachta indica*, *Dalbergia sissoo*, *Leucaena leucocephala*, *Albizia amara*, *Albizia lebbeck*, etc.

**b. Energy plantation/Wood Lot in non-arable lands:** *Prosopis juliflora*, *Cassia siamea*, *Acacia tortilis*, *Parkinsonia aculeate*, *Acacia senegal*, *Acacia tortilis*, *Acacia nilotica*, *Pongamia pinnata*, *Eucalyptus spp.*

**c. Rehabilitation of gullies and eroded areas:** *Acacia nilotica*, *Pongamia pinnta*, *Acacia tortilis*, *Acacia senegal*, *Bambusa bamboo*, *Dendrocaluma strictus*, *Cassia aiamea*, etc.

**d. Rehabilitation of Mine-spoil areas:** *Anogeissus pendula*, *Cassia siamea*, *Leuceana leucocephala*, *Acacia nilotica*, *Acaia senegal*, *Acaia tortilis*, etc.

Growth and expansion of agroforestry, social forestry, community forestry, village forestry and farm forestry are highly necessary and compulsory to take-up mainly outside the protected forest areas. Because, Trees Outside Forests (TOFs) are the main source of tree for getting tree based products like fuel, food, fodder, fruits, medicine, fibre, etc. in many ways to might reduce pressure on natural forest areas and similarly enhance national green cover. The quality and quantity of benefits expected from TOFs mainly depends on choice of species,

seedling quality and their field management. Development assured marketing systems, industrial tie-up and value addition industries may persuade farmers' interest to adopt more and more MPTs in their farm lands. Over all, tree farming is pure solution to meet three major benefits viz., i) Economic (tangible benefits like fuel, fodder, fibre, fruits, flosses) ii) Environmental (intangible benefits like natural resource conservation, biodiversity enrichment and climate change mitigation) iii) Social benefits (aesthetic/recreation, employment, livelihood generation)

### CONCLUSION

In the climate changing era, people should have reliable mindset and ready adopt climate resilient farming systems to avoid frequent crop failures, erratic rainfall distribution and localized frequency drought creating considerable threat to farming community in getting economic income from agriculture. So that diversified agriculture farming is an only option which primarily requires integrating MPTs in farming units. Because fast growing MPTs provide notable economic benefits. Further, it also offers variety of environmental services through agroforestry, includes substantial contribution towards carbon sequestration, soil erosion control, reduced risk of leaching, improve the nitrogen balance through legumes which, often associated with tree crops and improved biodiversity. Studies have indicated that the choice of species under agroforestry land use varies significantly from place to place, as it is based on the consideration of economical, silvicultural, ecological and local needs. Fast growing with high photosynthetic ability, multipurpose utility, coppicing ability, adapted to local environment, biodiversity value, easy to regenerate, economically valuable to local people, ecologically well suited local environment. However, fodder tree and grass on community land cultivation with people participation, local industrial tie-ups and value addition like fodder pelleting, fibre extraction, bark powdering through women self-help groups could helpful to provide employment generation and optimum livelihood generation to the local community of the semi-arid regions in India. The people should aware about national agroforestry policies, make own interest, adopt compulsory beneficial techniques like rain water harvesting and integration of multipurpose trees on their farm lands/surroundings land for getting multipurpose functions

and benefits. In this way, increase green cover outside forest area as well as safeguard natural forests cover.