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GUIDEBOOK FOR MAINTENANCE OF PLANTATIONS

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GUIDEBOOK FOR MAINTENANCE OF PLANTATIONS

ABBREVIATIONS

CEC:	Centre for Environment Concerns
DAP:	Di-Ammonium Phosphate
DRDA:	District Rural Development Agency
FYM:	Farm Yard Manure
GIZ:	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GP:	Gram Panchayat
HDPE:	High Density Poly Ethylene
LDPE:	Low Density Poly Ethylene
MGNREGS:	Mahatma Gandhi National Rural Employment Guarantee Scheme
MGNREGA:	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)
MoRD:	Ministry of Rural Development
MSL:	Mean sea level
NE:	North East
NRM:	Natural Resource Management
PMGSY:	Pradhan Mantri Gram Sadak Yojana
PR:	Public relations
SC:	Schedule caste
ST:	Schedule tribe
SW:	South West

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CHAPTER 1.

1.1 BACKGROUND

India has the largest rights-based rural employment guarantee programme in the world involving 7–8 billion US dollars annually and over 80 million rural workers. Known as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), it was unanimously enacted in 2005 by the Indian Parliament.

India has the largest rights-based rural employment guarantee programme in the world involving 7–8 billion US dollars annually and over 80 million rural workers. Known as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), it was unanimously enacted in 2005 by the Indian Parliament.

The Act has pioneering provisions: employment was guaranteed for 100 days per annum to all rural households; wages on par with statutory minimum rural agricultural wages that are linked to the consumer price index; equal wages to men and women; a third of the employment must be for women; employment available on-demand and provided within 15 days; unemployment allowance in case employment is not given on time; workplace facilities such as crèche, drinking water, resting place, and first aid box; community-led social audit, etc.

The investments in MGNREGS are to create durable infrastructure and natural resources such as water conservation, land development, forestry plantations, roads, and civic amenities in rural areas. The gram sabha and gram panchayat (GP) plan the investments and are vested with decision–making, including the empowerment of women and social audit.

1.2 INTRODUCTION

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH has chosen to demonstrate environmental benefits and community participation in the works taken up in MGNREGS in association with the Ministry of Rural Development (MoRD), the Governments of India and Tamil Nadu. In this project, the key focus in Tamil Nadu is on extensive plantations on public land with community participation and the inputs needs of women, with panchayat playing a key role in its planning, operational and oversight functions, etc. GIZ's project

ambition demonstrates improved water resources management through an integrated approach of natural resource management (NRM) for wider national and state adoption of water security and climate adaptation.

For the above, the Centre for Environment Concerns (CECs) has developed a guidebook that is based on GIZ project's field experience in the Tiruvannamalai district of Tamil Nadu. It includes a mapping list of plantations and species, discussions and engagement with stakeholders, plus plantation maintenance and management followed by a practice-based checklist. This is the first guidebook of its kind, and is regarded as bringing the next best practices in water, land, climate change mitigation and natural resources development and management.

The GIZ project opened avenues for the community and the officials to look beyond the immediate and focus on better quality assets with qualitatively rich environmental benefits with the participation of women in decision-making, the community management and vide the GP. We acknowledge and appreciate the cooperation of officials in the Tamil Nadu Department of Rural Development and of Forests.

Apart from assistance in planning, implementing and measuring the ecological impact, our methodology in the development of the guidebook involved a combination of methods. They included secondary data collection and analysis; focus group discussions with various population, occupation and gender segments; personal interviews, casual talk, and observation of body language at the meetings (some team members have done extensive participatory processes of data collection); and visits to worksites and seeing the activity take up and talking with the workers. In all this, our focus was on women. We also interviewed officials and local leaders to get their views and worries.

1.2.1. OBSERVATIONS

In the course of developing the guidebook, we discovered that the community sees itself as the recipient and beneficiary, with a participatory role, with the elected GP having a primary role. The MGNREGS workers are happy as they get continued wage work and investment activities improve their livelihoods. The participation of women is increasing, which leads to their empowerment. In some areas and panchayats,

there is less awareness in the community and a degree of unwillingness of officials who are used to the traditional style of top-down decision-making. Women were articulate at some meetings and hence, capacity building and awareness raising, genuine women leadership can emerge, especially among the scheduled castes (SC) and scheduled tribes (ST) as their women speak while the upper caste women remain indoors and do not want to sit with women of the lower castes. The task is to consolidate this knowledge and benefits of the environment into participation in decision-making bodies, which remains a bigger challenge and hence this practice-based guidebook.

Certain aspects that are being addressed and developed on the ground are also observed. Women said that the panchayat sometimes is not much interested or gives priority to their issues of development and inclusion. The other women's collectives are mostly from SC and ST, while the other progressive and the well–to-do community have been reached out under this plantation activity. The plantation works have a definitive plan on how to bring women and engage with them and show the roadmap. Based on our understanding and a 1-10 scale, we would say that the participation in public relations (PR) is five while in the perceptions on environmental benefits it is seven. In terms of the participation of women (based on articulation), it is placed at six.

The guidebook provides the roadmap and activities to be undertaken with the investment and the resources available in MGNREGS. One observes that environmental benefit dimension of MGNREGS assumes significance as unless addressed it poses serious challenges in pursuing development goals. Thus, the twin objectives of increasing environmental benefits and people's participation in terms of local statutory institutions and especially of women having a clear say in the management and the activities of these institutions make this project and the guidebook timely, relevant, and with the potential to influence the success of the goals of this massive public works programme, and taken up in developing countries as high on social protection, economic development and inclusive growth.

Having worked on worker issues and in asset creation in the MGNREGS, the Centre for Environment Concerns (CEC), thanks to GIZ for the opportunity to assist and develop this predominantly technical guidebook on plantations. It deals with and delivers on multiple dimensions, resulting in benefits on water, soil and other natural resources. The technical design, field demonstration, implementation and maintenance

as given in this book are well-timed as the community and the political leadership begin to understand and address the serious challenges posed by the environmental degradation. It highlights aspects of community and women in decisions and oversight, as well as enhances bio-diversity that fosters maximizing sustainable ecologically benign rural development.

In training and capacity, this guide work must be supplemented with other aspects. In Tamil Nadu, the Government of India and GIZ have developed tools for monitoring environmental and gender impact and in capacity development of the community and officials. Our team of consultants and dedicated experienced local personnel helped prepare the guidebook.

TEAM

K. S. Gopal led the tasks related to planning, developing and validating the guidebook. He has over 40 years of experience and is well versed with participatory approaches and works actively in MGNREGS. Balla Lakshmikantham, who is a retired Deputy Conservator of forests was the Senior Forestry Specialist and S. Madhubabu, former Assistant Director on plantations in MGNREGS served in the team as the Horticulture Specialist. While the first three named resource persons assisted in the technical inputs and the core task, Ajay Jakkoju, having two decades of experience and studies in community participation, provided inputs on gender, worker, excluded communities and GP along with the team leader, K. S. Gopal.

Some words of thanks to GIZ, the Government of Tamil Nadu and the CEC Team.

CHAPTER 2.

2.1 ABOUT THE DISTRICT

Spiritual seekers from all over the world come to Tiruvannamalai, a pilgrimage city, filled with living enlightenment gurus. This ancient town has been built around Arunachala hill (Annamalai hill), a mountain raising 4,000 m from the ground. The city is located 200 km from Chennai, the capital of Tamil Nadu.

The north and west of Tiruvannamalai are covered by the Vellore district and the southwest by the Krishnagiri district. Both Villupuram and Kanchipuram districts are located on the south and eastern sides of the Tiruvannamalai district, respectively.

The district lies between latitudes 11.55° and 13.15° North and longitudes 78.20° and 79.50° East.

Physiographically, the district formed an undulating terrain dotted with clusters of hillocks, particularly in the western and northwestern parts. The Jawadhu Hills are the major hilly regions and other smaller hillocks are scattered in Tiruvannamalai, Chengam Poluru, Arani and kalasapakkam blocks.

The Tiruvannamalai district came into existence on 30th September 1989 after the bifurcation of the erstwhile North Arcot District. The total geographical area of the district is 6,188 square kilometres and comprises the three revenue divisions of Tiruvannamalai, Cheyyar, and Arni.

Tiruvannamalai district has four municipalities, 11 taluks, and 18 blocks, including one tribal block, 10 town panchayats, 860 village panchayats, and 1,067 revenue villages.

The total population of this district is 2,464,875 comprising 1,235,889 men and 1,228,986 women as per the 2011 Census. The urban population is 494,945, constituting 20 per cent of the total population. The remaining 80 per cent, i.e. 1,969,930, live in rural areas. The density of the population is 399 per square kilometres.

2.2 GEOGRAPHICAL FEATURES

Tiruvannamalai is a border district of Tamil Nadu having a large number of small hills and is generally a dry district. Tamil Nadu is divided into seven Agro-climatic zones, based on the climatic conditions. Tiruvannamalai occupies the third zone called the "Northeastern Zone." Tiruvannamalai forms part of the upland plateau region with many hill ranges and undulating plains. Tiruvannamalai district is bordered by the Western Ghats, in the west. A major portion of the district constitutes a plain terrain with a gentle slope towards east and south-east, except for hilly terrain in the west. The general elevation of the area varies from less than 10-1048 m above mean sea level (MSL).

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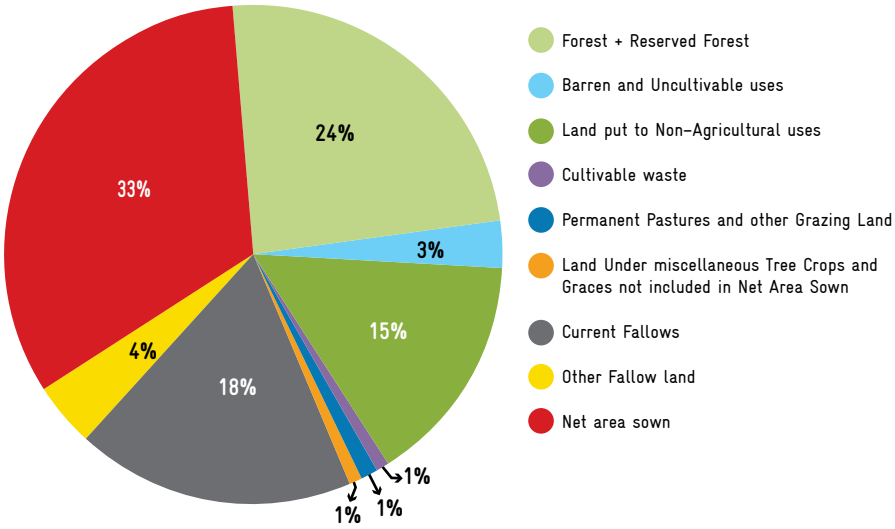
2.3 CLIMATE AND RAINFALL

The climate of the district is tropical. It is very hot from April to June. The average maximum and minimum temperatures at select stations in Tiruvannamalai, district vary between 36.1°C and 20.9°C. The mean temperature is about 36°C. The normal annual rainfall is 1,046 mm. The district receives rainfall from both South West (SW) and North East (NE) monsoons. Approximately, 35 per cent of the total rainfall is received during the SW monsoon, followed by the NE monsoon. November is the wettest month of the year, and there are approximately 75 rainy days in November.

2.4 LAND USE PATTERN OF THE DISTRICT

The total geographical area of Tiruvannamalai district is 631,205 ha. The total gross cropped area of the district is 314,827 and the net area sown was 177,300 ha in 2018.

Figure 1: Pie diagram of Tiruvannamalai's geographical area according to its thematic areas



Source: District Statistics handbook, Tiruvannamalai.

2.5 SOIL

The predominant soil type is red. Red loam was found in all the taluks, with a higher concentration in Polur Taluk. The red sand was also found in all the taluks, but predominantly in Chengam, Tiruvannamalai, and Vandavasi taluks. Different types of soil such as ferruginous loamy and sandy loamy were seen extensively throughout the district and black loam was found in tank and river bed areas of Cheyyar and Vandavasi taluks.

The general climate is tropical. Black loam is found in the tank and riverbed areas of Vandavasi and Cheyyar taluks accounting for about 15 per cent of the total area. One-third of the soil series (24 per cent) are located in the forest area whereas three fourth of the soil series are located in the remaining area (76 per cent).

CHAPTER 3.

3.1 SIGNIFICANCE OF GREENERY UNDER MGNREGS

Improvement of greenery is a meaningful thrust to maintain biodiversity and is essential to combat issues such as climate change, soil erosion, and to ensure the preservation of vegetation and up-gradation of ecological balance, and above all providing fodder, fruit, medicinal herbs, small timber, biomass to the people in rural areas. This strengthens agriculture, livestock, enhances green areas, rural sustainable livelihoods and livestock support by promoting fodder plants.

As per para 7.6.1 of Annual Master Circular of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), 2021, of the MoRD, Government of India, "Afforestation tree plantation and horticulture activities can be taken up under MGNREGA on the following lands."

1. Degraded forest lands.
2. Uplands and hillocks situated near villages.
3. Public and community lands, to take up Silvipasture plantations and massive tree plantations.
4. Avenue plantations along Pradhan Mantri Gram Sadak Yojana (PMGSY) and other roads.
5. Along riverside, canals and embankments.
6. Private land (block plantation, or bund plantation on farm bunds).

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3.2 THE OBJECTIVES OF AFFORESTATION UNDER MGNREGA

Regeneration and eco-development of degraded forests and adjoining areas on a watershed basis:

- Augmentation of the availability of fuelwood, fodder and grasses from the regenerated areas.
- Securing people's participation in planning and regeneration efforts to ensure sustainability and equitable distribution of forest products from the regenerated lands, and to promote the partnership concept in the management and administration of forests and common property resources.
- Promote agroforestry and development of common property resources in upland areas.
- Conservation and improvement of non-timber forest produce such as bamboo, cane and medicinal plants.
- Encourage the production of non-timber products such as wax, honey, fruits and nuts from the regenerated areas.

Raising coastal shelterbelts to mitigate the adverse impacts of cyclonic winds.

Develop water resources through plantation and water harvesting activities:

- Development of high-quality tall seedlings, for use in avenue plantations, sacred groves and massive tree plantation programmes to attain a high success rate and immediate impact.
- Rehabilitation of special problem lands such as saline/alkaline soils, ravines, desert areas, coastal areas and mined areas.
- Employment generation for the disadvantaged sections of society, through MGNREGA, particularly women, SCs/STs and landless rural labourers.

As a continuation of the above short-term benefits, the following sustainable benefits can also be achieved.

Protection and conservation of natural resources through active involvement of the people and GPs, under whose aegis the programme MGNREGA is being implemented.

- Checking land degradation, deforestation and loss of biodiversity.
- Ecological restoration, environmental conservation and eco-development.
- Evolving village level people's organisation which can manage the natural resources in and around villages in a sustainable manner.
- Fulfilment of the broader objectives of productivity, equity, and sustainability for the general good of the people.
- Improve the quality of life and self-sustenance aspect of people living in rural areas.
- Capability endowment and skill enhancement for improving the employability of the rural people.

Keeping the above short-term and long-term benefits in view, the District Rural Development Agency (DRDA), and Tiruvannamalai district have been executing CRW components of works, which aim at enhancement of greenery and conservation and harvesting of rainwater.

CHAPTER 4.

4.1 THE WORKS UNDER MGNREGS

Drought proofing is one of the prime components of MGNREGS, in which the development of vegetation in degraded lands is a priority component.

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Many upland areas or hillocks in the district are devoid of vegetation or left barren due to heavy felling of the age-old trees, which hitherto protected the soil and water bodies in the upland areas. These lands served as common property resources by providing ecological and economic services to the people of the habitations in the vicinity. They used to reap small timber, fodder, green manure, herbal medicines, wild fruits, grasses, and so many products which are useful to lead their lives and keep their livestock happy and healthy. Now there is an urgent need to take operations to improve greenery and rejuvenate the water bodies in these areas, either naturally or artificially.

4.2 GREENING OF HILLOCKS THROUGH NATURAL REGENERATION AND MAINTENANCE

There are a large number of fragmented large and small hillocks in the Tiruvannamalai district, around which habitations are expanded. These hillocks range from 30 ha to 200 ha and have gentle to high slopes. Local people depend on these hilocks or upland areas for their fodder, fuel and other needs. Over a period of time, they were subjected to heavy felling.

Despite felling or exploitation of the trees in these areas, the trees have great potential to rejuvenate and regain the vigour to establish

Despite felling or exploitation of the trees in these areas, the trees have great potential to rejuvenate and regain the vigour to establish themselves, provided favourable conditions are created.

themselves, provided favourable conditions are created. In many upland areas, even after cutting of trees, there exist some hardy species such as *Acacia leucophloea, Acacia nilotica, Albizzia amara, Azadirachta indica, Cassia fistula, Hardwickia binate* (Accha), etc., because of their capacity to withstand the adverse climatic factors. If suitable and favourable conditions are created, the seeds of these species that naturally fall on the ground will germinate. Hence, the following maintenance works can be taken up in order for the existing trees to put on good growth.

Most trees are stunted because of haphazard growth, and the existence of natural creepers hampers the growth of the tree. In such trees, the lower branches can be removed to a one-third height of the tree from the base. The creepers can be removed and the tree freed from the creepers. This operation is called a singling operation.

4.2.1. RETENTION OF MOISTURE AROUND THE TREES

The main reason for these plants to have stunted growth is the lack of moisture in the soil around their root system. Such trees can be provided moisture in the root zone by taking up contour trenching. A contour trench of size 2 m × 0.6 m × 0.5 m on the upstream side of the tree. This trench works like a catch pit for retention of water during the rainy season and percolates down to provide moisture to the root zone of the tree. Alternatively, a semilunar trench of 2 m diameter and depth of 0.3 m can be excavated and deposit the excavated soil on the lower side trench in a semi-circular form. The rainwater flowing from the upstream side will get caught in the trench and keep the moisture regime around the tree. This enhances the growth of the existing trees. Such semi-circular or linear trenches can be dug for each tree to increase the moisture content around the plants.

4.2.2. SINGLING OPERATION

Most trees are stunted because of haphazard growth, and the existence of natural creepers hampers the growth of the tree. In such trees, the lower branches can be removed to a one-third height of the tree from the base. The creepers can be removed and the tree freed from the creepers. This operation is called a singling operation.

4.2.3. REMOVAL OF COPPICE SHOOTS

Some of the tree species have a great capacity to produce coppice shoots from the edges of the stumps of cut trees. The following are some species which produce coppice shoots:

STRONG COPPICERS: *Cleistanthus collinus*, *Albizzia* species, *C. fistula*, *Anogeissus latifolia* and *Emblica officinalis*.

FAIR COPPICERS: *H. binata*, *Terminalia bellerica*, *Terminalia tomentosa*, *Pterocarpus marsupium*, *Chloroxylon swietenia*, etc.

BAD COPPICERS: *A. nilotica*, *Adina cordifolia*, *Madhuca indica*, *Bombax ceiba*.

The coppicing power varies from locality to locality depending on edaphic factors.

If any coppicing species are observed in the location, the slow-growing coppice shoots can be cut, keeping one dominating and well-grown coppice shoot so that a single plant can be obtained.

4.2.4. DIEBACK

The dieback is a phenomenon, in which the shoot portion of the seedling keeps on dying year after year while the root remains alive. This happens in some tropical species and it checks the progress of the seedlings towards the establishment. Every year, the shoot portion diesback to produce new shoots. These are no bigger than the last year's shoots. The dieback occurs even after 20 years in species, such as teak and red sanders. Hence, if continuous favourable conditions, such as the creation of moisture and soil fertility are available the dieback are suppressed and starts growing. Such species also have the potential to rejuvenate the rootstock and grow the trees with vigour. If the moisture regime is increased in the locality through trenching, the rootstock of species such as teak and red sanders will grow vigorously.

If the above operations are carried out and the existing natural growth is protected for at least 5 years, supplemented by planting and seed sowing, the area regains its lost vegetation.

All the above works can be carried out in degraded uplands under MGNREGS. All of the projects are labour intensive and generate employment for the rural people. After the land is regenerated with greenery, the people can manage the area with regulatory systems.

Image 1: Natural Regeneration of Teak Through Rootstock

CHAPTER 5.

5.1 MAINTENANCE OF NURSERIES

Nursery plays an important role in raising plantations, such as greening of hillocks, silvipasture plantations, avenue plantations, community block plantations, high density or mini forest plantations, coastal shelterbelt plantations, etc. In Tiruvannamalai district, these plantation works are being taken up in all the 18 blocks.

Permanent nurseries are also established in many blocks since the implementation of the MGNREGS programme to meet the needs of the planting programme. However, the maintenance of a nursery is as important as the maintenance of plantations. A well-maintained nursery produces all the quality planting stock required to raise good plantations. Hence, the following steps will give the direction to maintain a good nursery.

A well laid out nursery should have separate sectors to raise primary beds, bag plants of different sizes and for the drying and storage of seeds. These sectors should be maintained year after year for the production of primary seedlings and bag plants of different sizes. One should keep in mind that, the nursery is a permanent asset, which gives rise to good plantations. Hence, maintenance of nurseries for the production of quality seedlings is as important as the maintenance of plantations.

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5.2 MAINTENANCE OF FENCING

The fencing is provided to the nursery to protect the seedlings from stray cattle. The fencing is generally erected by using stone monoliths or cement concrete poles. Every year the fencing should be maintained by properly erecting the fencing poles and closing the gaps if any, by repairing the barbed wire.

5.3 MAINTENANCE OF PRIMARY BEDS

The sector earmarked to raise primary beds is repeatedly used year after year, to raise primary seedlings to transplant into the bags. So, the seedlings use the fertility in the soil and hence cause a reduction in fertility. In addition, sometimes, the seed when collected from different sources transfers the diseases into the beds and remains in the soil. Hence, the primary beds are to be maintained by applying manures and applying the insecticides and fungicides, before taking up the formation of new primary beds.

5.4 MAINTENANCE OF SECTORS FOR BAG PLANTS

Generally, the area where the bag plants are kept will be infected by weeds and unwanted species, such as parthenium. Before taking up the new bag plants, the sector should be cleaned properly, and the weeds removed.

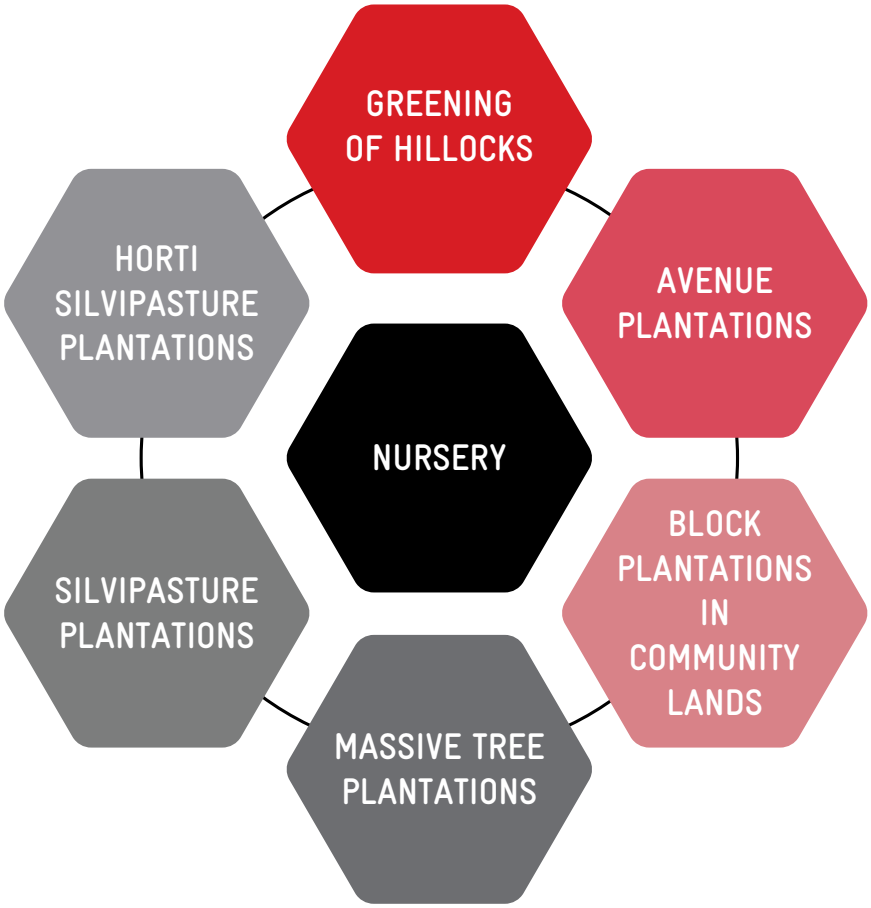
Apart from the above, the overhead tank, the seed shed and the watcher shed are to be maintained properly to serve the purpose for which the assets are created.

5.5 MAINTENANCE OF GREEN/SHADE NET

In most of the nurseries, green nets of different sizes are erected in the district to maintain the humidity and diffused light for bagging plants. The bag plants being raised under the shade/green net put on good growth due to the maintenance of humidity and partial light. Since the green net is exposed to sunlight continuously, the net gets damaged and torn. Hence, every year it should be properly maintained. The holes, if any, are to be closed. Normally, if the shade net is properly maintained, it serves for 5 years. After 5 years, the frame can be kept intact and a new shade net has to be covered. The seedlings were grown in shade nets to attain the plantable size in a short period. But they are very delicate. Hence, after 5 or 6 months,

the bag plants are to be kept in open space to acclimatise to normal field conditions till they are transported to the planting site. This process of acclimatisation is called "hardening." The steps such as shifting, grading and plant protection measures are already explained in the "Manual for raising of nurseries."

Figure 2: **Various Plantations Depending on the Nurseries**



CHAPTER 6.

6.1 MANAGEMENT COMPONENTS

In the Tiruvannamalai district, various types of plantations are being taken up under MGNREGA. So that these plantations can yield sustainable results ecologically and economically, they should be maintained and managed continuously, and keep them as permanent assets.

Once a plantation has been established, the work should not be considered finished. It will be necessary, to protect the plantations against the aberrations of weather, fire, pests, insects and other biotic interferences. A variety of cultural and tending operations also may be required to meet the purpose for which the plantations are raised.

The maintenance can be divided into two parts. They are:

(1) Protection and (2) Cultural. Both these works are to be carried out simultaneously or separately depending on the seasons, i.e. summer, winter and rainy seasons.

In the Tiruvannamalai district, various types of plantations are being taken up under MGNREGA. So that these plantations can yield sustainable results ecologically and economically, they should be maintained and managed continuously, and keep them as permanent assets.

6.2 PROTECTION

Weather phenomena: The occurrence of damaging weather phenomena is normally unpredictable. When taking up plantations on a large scale, little can be done to protect plantations against the damage caused by weather. For example, if the temperature is very high, say more than 44°C, the plants experience moisture stress due to the scorching sun, and casualties occur. Hence, plant species are known for their drought resistance, and those that have resistance against detrimental effects of weather conditions are preferred to be planted. For example, species such as *Sita, Cassia siamea, and Pongamia (Pungam),* which are drought

resistant may be selected for planting. Healthy and sturdy seedlings are resistant to winds. Lean and lanky seedlings get damaged easily. To protect plants against insect and pest attacks, thick barked species, such as *T. tomentosa, A. nilotica and T. bellerica* may be planted. However, the attack by pests is only seasonal, mostly in winter and disappears once the summer sets in. For example, during winter, the tea-mosquito insect attacks the Neem *(Vembu)* plants in the nursery as well as in the plantations, causing top drying during the winter and gets subsided in the summer season. It causes no damage to saplings, but the damage is heavy in the case of smaller seedlings.

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Fire: Damage by fire imposes a serious threat to plantations. Generally, in South India, fire is caused due to the presence of dry grass and inflammable material present at the site. Fire risk should be a major consideration from the early stages of plantation development.

Fires can originate from natural causes, such as lightning, but many fires occur as a result of the activities of human beings. The existence of grasses, such as *Cymbopogon* and *Heteropogon* which are fire climax species spreads fires because of their high inflammability when they dry in summer. Plantation fires can start from fires started on farmland on the edge of the plantation from burning by herdsmen to improve livestock grazing. There have been instances of deliberate burning by local people to show their disapproval of the policies of the government. Hence, the involvement of people in planning and planting avoids such instances.

Clearing Fire Brakes: The grasses along the periphery of the plantation should be cleared to a width of 3 m and the cleared area can be subjected to control burning to clear off the stumps of the grasses. If the plantation area is large it may be divided into sectors by clearing the grasses, in vertical and horizontal stripes. A peripheral trench of 2 m wide and 1.5 m deep, along the edge of the plantation, prevents fire from farmlands or outside the plantation.

Insects and Fungi: Most insects and fungi are selective about their host species. In their natural environment, trees and shrubs attain a state of equilibrium, with indigenous pests. However, when exotic species are

introduced to the plantation, exotic pests also can be introduced. These exotic pests readily adapt themselves to a new environment. Hence, the best precaution is to plant local species which have adapted to the existing locality factors. Before taking up the plantation observe around the site and note down the names of existing tree species, and raise the plants of the same species to plant in the area.

A mix of 90 per cent local species and 10 per cent of exotic species can be planted to avoid the spread of exotic pests in the case of greening of hillock's plantations.

6.3 CULTURAL OPERATIONS

Cultural operations are required to promote conditions that are favourable to the survival and subsequent growth of the plantations, which result finally into successful plantations. The success and establishment of the plantations and thereby plants are dependent on the best cultural practices employed as per requirement and norms. The cultural operations depend on the type of plantation and the species used in plantations. Now, in the Tiruvannamalai district, the following plantations are being taken up under MGNREGA.

1. Greening of Hillocks.
2. Silvipasture plantations.
3. Horti Silvipasture plantations.
4. Block plantations in community lands.
5. Avenue plantation.
6. Massive tree plantation.
7. Canal bank plantations.
8. Coastal shelterbelt plantations.
9. Shelterbelt plantations along the borders of farmlands.

The plantations mentioned above are mostly being taken up or government or community lands, except shelterbelt plantations along farm bunds of farmlands.

Generally, the following cultural operations are required for the promotion of the growth of plants in plantations.

1. Replacement of casualties.
2. Weeding (circular weeding and line/strip weeding).
3. Soil working.
4. Mulching.
5. Providing moisture through watering.

6.4 REPLACEMENT OF CASUALTIES

Generally, in any plantation, the number of plants planted per unit area, or 1 ha, depends on the spacing between the planting points. For example, the number of plants per ha with espacement of 4 m × 4 m is 625. If this number is maintained for a long growing period of the plantation, the plantation has 100 per cent survival. The 100 per cent survival rate depends on the time of planting, quality of seedlings, site conditions and edaphic factors. If planting is done during early rains, the plants will get the benefit of follow-up rains and the survival rate is very high, and there will be the early establishment of the plantation. However, in most of the plantations, survival per cent never can be maintained at 100 per cent, despite taking all precautions against mechanical, physiological, moisture stress, and pest and insect damage. So, for every plantation, a certain percentage is allowed for casualties in the year of raising, the first year, the second year, third year, etc., depending on the number of years of maintenance. In the case of block plantations, the normal percentages allowed are, 10 per cent in the year of planting, 15 per cent in the first year, and 10 per cent in the second year. However, at the end of 5 or 6 years, when the plantation is fully established, and consolidated, even survival of 70-80 per cent is considered a good plantation. Any plantation in its initial stages has a more number of plants, keeping in view the casualties that may happen in the future.

6.5 WEEDING

Weeding is a cultural operation that eliminates or suppresses undesirable vegetation, which if no action were taken, would impact the growth of the plants on the plantation. This undesirable vegetation, such as shrubs and grasses, competes with the desired plants or planted seedlings, for light, water (moisture) and nutrients. Hence, by removing or eliminating this undesirable vegetation, or weeding increases the availability of all or most critical of these elements to the planted seedlings. The primary objective of the weeding is to promote the growth, and development of the plantation while keeping the cost of operation within acceptable limits.

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A main factor affecting the intensity and duration of weeding treatments is the relationship between the plants and the weeds. On some sites where moisture and soil fertility is available, the planted seedlings eventually grow through the weeds and dominate the site and become established. On such sites, the function of weeding is to increase the uniformity of plantations and hasten the establishment and growth. On some other sites, the type or density of the weed growth is such that, in the early stage of the plantation, the weeds may kill the majority of plants. Hence, the main purpose of weeding in such areas is to reduce mortality and maintain an adequate stocking in the plantation.

The method of weeding involves the removal of all weeds and grasses around the base of the plants, and removing them and burning them outside the plantation. If the weeds and grasses are left near the base of the plant, the seed of weed that falls on the ground again germinate in the next monsoon and grows vigorously around the plant.

CIRCULAR WEEDING: Circular weeding involves clearing weeds to a diameter of 1-1.5 m around the base of the plants in a circle shape.

LINE OR STRIP WEEDING: Line/strip weeding is the removal and clearing of the weeds along the rows of plants to a width of 1 m on either side of the plants. This method involves more labour and is costlier when compared with circular weeding. However, it is more effective and beneficial to the plants. Line weeding has the advantage of preventing fires due to the clearance of weeds in strips.

6.6 SOIL WORKING

Normally, from January to May or June, the climate is hot, and the plants in plantations experience a lot of moisture stress. During this period (non-rainy days), watering may be given to see that the plants get minimum moisture and survive till the next onset of monsoon. But some xerophytic (drought-hardy) species, such as *Pongamia* withstand moisture stress and survive. However, watering may not be possible in large-scale plantations, and the cost of watering is far more than the cost of replacement of the mortalities that occur.

In such cases, soil working operation will be useful. Soil working is breaking the soil around the base of the plant to a depth of 15 cm without damaging roots, with a top diameter of 1-1.5 m and leaving the clods around the plant without breaking or trampling. This process will push the subsoil moisture to the root zone of the plants, thus reducing the moisture stress. Furthermore, in small extent plantations where watering is provided, the water directly percolates down into the soil and reaches the root system, which helps the plant to have more moisture.

Though weeding and soil working are separate cultural operations, they can be carried out simultaneously. While carrying out soil work, the soil around the base of the plant is raked up to a depth of 15 cm. In this process, the weeds can also get pulled out. The weeds then can be separated and thrown away from the plantation.

Image 2: **Weeding and Soil Working**

6.7 MULCHING

During summer, the plants experience moisture stress due to loss of moisture through evaporation and extreme heat. The plants at times exhibit the natural physiological phenomenon of shedding their leaves to reduce the leaf area and hence the evapotranspiration. However, soon after weeding and soil working, if the soil is covered with some organic material, then the moisture can be made available to the plants. Mulching helps in retaining moisture around the base of the plant. Any material used to cover the soil moisture is called mulch. For example, organic materials, such as paddy husk, pulverised groundnut husk and coconut fibre, can be used to spread to a diameter of 1 m at the base of the plant and a thickness of 1 inch or 2 inches and covered with soil. This will reduce or prevent evaporation losses and retain moisture. Further, the mulch material after decomposition also helps in adding nutrients to the soil and promotes the growth of young plants. In areas where pebbles or small stones are available, stone mulching can be done. Some mulches, such as dried twigs, and grasses, attract termites that may destroy the plants. Therefore, such type of mulch material may be avoided.

Nowadays plastic sheet is being used as mulch in horticultural plantations. But it is costly and plastic does not decompose.

Images 3: **Mulching material- Rice Husk**

Images 4: Mulching material- Groundnut husk

Manuring is the prime component in raising plantations. Farm Yard Manure (FYM) should be applied in the pit, before planting. The plants get the benefit of manure as the nutrients are available to the root zone. The success of a plantation depends on the availability of moisture and nutrients at the root zone of the plant.

6.8 MANURING

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6.9 WATERING

During non-rainy days, watering may be provided for plantations grown in small areas, say 1-3 ha. However, in plantations, such as the greening of hillocks in upland areas, it is difficult to water the plants and too expensive. In such cases, only moisture retention methods, such as staggered contour trenches can be adopted. For avenue plantations, the watering of plants is required during non-rainy days.

CHAPTER 7.

7.1 MAINTENANCE OF PLANTATIONS

The primary objective of the weeding is to promote the growth, and development of the plantation while keeping the cost of operation within acceptable limits.

Various types of plantations are being taken up in Tiruvannamalai district to improve greenery and vegetation in the district. They are: greening of hillocks, silvipasture plantations, horti silvipasture plantations, avenue plantations, block plantations in community lands, Massive tree plantations, canal bank plantations and shelterbelt plantations along the borders of the farmlands.

The procedures for raising the above plantations, such as selection of site, advance works, (alignment of the planting points, excavation of pits or trenches, and spacing,) and selection of species, are already explained in "Manual for raising of greening of hillocks and Manual for raising of silvipasture plantations and other community plantations."

Now we will discuss the maintenance of each type of plantation till they establish and reach beyond damage due to biotic factors. Once the plantation in an area is successfully established, it has to be protected continuously to obtain ecological or economic services, on a sustainable basis.

7.2 GREENING OF HILLOCKS

Images 5 : **Greening of hillocks**

Images 6: Greening of hillocks

The maintenance starts from raising year. The maintenance should be carried out at least for 5 years. During the raising year, a major portion of the time will be spent on advanced works, such as treating the drainage line and area treatment like the excavation of staggered contour trenches, construction of mechanical structures, rockfill dams, gabions, gully plugs and sunken pits. During the raising year, the following maintenance operations are to be carried out.

RAISING YEAR

Watch and ward right from the day of the start of the plantation at one watcher per 10 ha and to be continued till the end of the 5th year.

1. **Replacement of casualties:** 10 per cent of the total number of plants planted (during November and December).
2. **First weeding and soil working:** during January and February.
3. **Second weeding and soil working:** during April and May (social fencing).
4. **Fire tracing:** In some of the greening of hillocks sites, there exist no grasses that dry during summer. In such cases, there is no necessity for fire tracing. If necessary, the fire tracing can be done during January and February. Almost all the incidents of fire occur because of the local miscreants. People should own the responsibility of protecting the plantations from fire. The shepherds and cattle raring people should be given awareness of the ill effects of fire.

FIRST YEAR:

1. **Replacement of casualties:** 15 per cent.
2. **First weeding and soil working:** during January and February.
3. **Second weeding and soil working:** during April and May.
4. **Fire tracing:** January and February (social fencing).

SECOND YEAR:

1. **Replacement of casualties:** 5 per cent.
2. **First weeding and soil working:** January and February.
3. **Second weeding and soil working:** during April and May.
4. **Fire tracing:** January and February (social fencing).

THIRD YEAR:

No casualty replacements will be allowed. But first and second weeding as well as soil working can be carried out as specified above.

FOURTH YEAR:

The weeding and soil working as specified above.

The plantation should be maintained for 5 years. During this period to protect the plantation it may be closed for grazing. If the area of plantation of the greening of a hillock, is 60 ha. The site may be divided into three parts of 20 ha each and it may be treated in three phases. Deferred grazing may be allowed.

Size of the bag plants to be planted: 5 inches × 9 inches (minimum of 60 cm tall).

Earthwork: staggered trenches depending on the slope. The types of staggered trenches are explained in detail in the manual for the greening of hillocks.

7.3 SILVIPASTURE PLANTATIONS

Silvipasture plantations are those in which the tree species, preferably fodder tree species are planted in an area, with the sowing of grass seed or legume fodder seed in the interspaces of the tree species, after ploughing the area.

ADVANCE WORKS:

Earthwork for pitting: 0.5 m × 0.5 m × 0.5 m. For this, 625 plants per ha. Pits to apply 20 g of Aldrin, 2 kg of FYM and 50 g of superphosphate.

Planting material: fodder tree species in 6 inches × 12 inches bags. Minimum height of 1 m to be fenced. The plantation has to be maintained for 4 years. Watering the plants during non-rainy days.

RAISING YEAR

Watch and ward in case of community pasture plantation. For individual plantations, no watch and ward.

Fencing with brushwood around the plantation.

Replacement of casualties: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May months.

Water the plants at the rate of 10-15 L per plant once a week during February, March, April and May months. The *Stylo hamata* sown as legume pasture should not be cut, till seeding is completed.

FIRST YEAR:

Replacement of casualties: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering the plants at the rate of 10–15 L per plant once in a week from February to May (4 months). The S. *hamata* can be cut during this year. The seed fell on ground during the raising year and start sprouting.

SECOND YEAR:

Replacement of casualties: 5 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering the plants at the rate of 10–15 L per plant, from February to May (4 months).

THIRD YEAR:

By this year, the plants should have attained a height, out of reach of animals.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering may be stopped, as the plants survive with the rainwater.

MANAGEMENT:

The grass or legume fodder may be allowed to be cut and taken. Animals should not be allowed to graze on plantation. After the 5th year, the trees start bearing foliage, and the leaves can be cut and used as fodder during summer.

7.4 HORTI-SILVIPASTURE PLANTATIONS

Horti-silvipasture plantations are the system of plantations wherein the horticultural plants are raised in the main plot at 4 m × 4 m spacing, and fodder trees are planted in the borders at a spacing of 4 m. The interspace in the main plot is sown with *S. hamata* or *Cenchrus ciliaris* or both as pasture.

ADVANCE WORKS:

Pits of size 0.6 m × 0.6 m × 0.6 m pits in the main plot at 4 m × 4 m and 0.5 m × 0.5 m × 0.5 m pits in borders, at 4 m. The pits are to be applied with 20 g of Aldrin, 2 kg of FYM, and 50 g of superphosphate.

Planting of horticultural species, such as mango and guava on mainland.

Planting of fodder tree species in borders. Area to be fenced. The maintenance should be for 4 years. (Raising 1 year + maintenance 3 years.)

RAISING YEAR:

Replacement of casualties: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering the plants during non-rainy days: 10–15 L per plant, once per week.

During the raising year, the pasture should not be cut, and it should be allowed to grow and after seeding on the ground it can be cut. *S. hamata* is a self-tillering plant.

FIRST YEAR:

Casualties' replacement: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering the plants during non-rainy days: 10–15 L of water per plant.

Manuring of horticultural plants: 100 g of DAP per plant. Mulching with pulverised groundnut husk.

The *S. hamata* may be cut during July when the legume is lush green due to moisture in the monsoon. The seed that has fallen on the ground during the raising year starts sprouting.

SECOND YEAR:

Replacement of casualties: 5 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days: 10–15 L per plant per week.

Manuring of horticultural plants: 200 g of DAP and application of tank silt @ 1 cubic ft per plant, for moisture retention. 1 cubic ft of tank silt should be applied to fodder trees for the retention of moisture.

The *S. hamata* may be allowed to cut and stall-feed the animals.

THIRD YEAR:

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days: 15–20 L per plant per week.

Manuring of horticultural plants: 200 g of DAP. If the drip is installed for horticultural plants, the yield and growth will be enhanced.

FOURTH YEAR:

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days: 15–20 L of water per plant both for fodder and horticultural plants.

S. hamata can be cut without allowing animals to graze.

7.5 AVENUE PLANTATIONS

The spacing between plants in Avenue plantations is 5 m. The total number of plants per Km (on both sides) is 400. For this, 2 m tall and sturdy seedlings are to be used for planting.

Advance works: The alignment of planting points should be done on either side of the road. Digging of pits of size.

In April or May, 0.75 m × 0.75 m × 0.75 m at 5 m espacement. Each pit is to be applied with 20 g of Aldrin, 5 kg of FYM and 50 g of superphosphate, soon after pitting.

Images 7: **9 months old neem bag plants**

Images 8: **Tall seedlings used for avenue plantation**

Planting is to be done during pre-monsoon showers or after drenching the pits with rainwater. The species to be planted are given in the "Manual for raising of plantations." Maintenance for 3 years is sufficient (raising year+2 years) as 2 m tall seedlings are being planted.

RAISING YEAR:

Watch and ward soon after planting @one for a stretch of 5 km with one bicycle.

Replacement of casualties: 5 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days: 50 L per plant per time and four times in a month. (From January to May.)

A circular trench around the plant: a circular trench of 2 m diameter and 45 cm width and 45 cm depth may be excavated to harvest the rainwater.

Mulching: mulching should be carried out with pulverised groundnut husk around the base of the plant, and planting should be done at a depth of 1 inch on the mulch.

FIRST YEAR:

Replacement of casualties: 5 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Repair to stake and fencing.

Watering during non-rainy days. (32 waterings as and when required during non-rainy days.)

SECOND YEAR:

Replacement of casualties: Nil (since the plantation was done with tall and sturdy seedlings and watered regularly. The survivals are expected to be 100 per cent).

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

7.6 MASSIVE TREE PLANTATIONS

In most of the vacant community plain areas, massive tree plantations are being taken up by GPs. This component enhances the greenery in the vicinity of villages, and are green assets to the GPs if maintained till they attain a height of about 5-6 m. Such plantations may also be taken up in temple lands, by planting trees of religious importance, such as *Anthocephalus cadamba* (Kadambam), *Aegle marmelos* (Vilva), *Ficus religiosa* (Arasu), *Emblica officinalis* (Nelli) and *Mimusops elangi* (Magizham). Maintenance should be for 4 years (1 raising year+ 3 maintenance years.)

ADVANCE WORKS:

Aligning the planting points with specified spacing, i.e. at 4 m × 4 m. Square trenches of size 1 m × 1 m × 0.3 m are to be excavated at each planting point. At the centre of this trench, a pit of size 0.45 m × 0.45 m × 0.45 m are to be excavated for planting the seedlings. This method provides clear space for catching rainwater. The total number of plants per ha is 625.

RAISING YEAR:

Watch and ward are to be placed from the date of starting planting.

Fencing with thorny brushwood.

Replacement of casualties: 20 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering: Watering during non-rainy days, 4 times in a month (maximum of 24 waterings in a year).

FIRST YEAR:

Replacement of casualties: 15 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering: Watering during non-rainy days, four times a month (maximum of 24 waterings in a month).

SECOND YEAR:

Replacement of casualties: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering: Watering during non-rainy days 4 times a month (maximum of 24 waterings in a year).

THIRD YEAR:

No replacement of casualties.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering: Watering during non-rainy days 4 times a month (maximum of 24 waterings in a year).

7.7 CANAL BANK PLANTATIONS

Irrigation canals have a wide strip of land on both sides which is devoid of any tree growth. The areas along canals and distributaries, are mostly lying waste or infested by thorny and inferior species. Sometimes the soil from the excavation of canals is deposited on either side of the banks. The soil along the canals is sandy or clayey, with large amounts of moisture. The species should be selected depending on soil.

ADVANCE WORKS:

In the case of deposited soils, seed dibbling with *Pongamia* (Pungam), *Cassia siamea* and Seetaphal, can be carried out. On the top of the bund species, such as *Dalbergia sissoo*, *Bauhinia racemosa* (Malai athi), *C. siamea* (manjai konnai), *C. fistula* (Sara konnai), may be planted by scooping the earth.

In the flat blank spaces of canals on either side of canals, pits of size 0.6 m × 0.6 m × 0.6 m pits can be excavated at an espacement of 3 m × 3 m. The pits should be treated with 2 kg of FYM, 20 g of Aldrin and 50 g of superphosphate. Planting more than 1 m tall seedlings of *C. siamea*, *B. racemosa*, *C. fistula*, *Erythrina indica*, *Kalyana murungai*, and Bamboo(Mungil) are to be planted.

RAISING YEAR:

Watch and ward for a 5 km stretch.

Replacement of casualties: 15 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days. Generally, the canal banks have moist soils due to seepage of water. Watering is required only in summer.

FIRST YEAR:

Replacement of casualties: 10 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days.

SECOND YEAR:

Replacement of casualties: 5 per cent.

First weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering during non-rainy days. Normally the soils are moist and watering may be done after observing the moisture in the soil.

In the Tiruvannamalai district, farmers are raising pure plantation crops, such as Casuarina, Red Sanders on their farmlands.

7.8 PLANTATIONS ALONG THE BORDERS OF FARMLANDS

Agrisilvicultural systems include a growing combination of crops and trees on farmland wherein the crops dominate the forestry components. In the Tiruvannamalai district, farmers are raising pure plantation crops, such as Casuarina, red sanders on their farmlands. In addition, they plant teak, bamboo, and red sanders on farm bunds. The trees planted on farm bunds serve as shelterbelts and reduce the speed of desiccating winds, and protecting the crops from strong winds.

ADVANCE WORKS:

Pits of size 0.5 m × 0.5 m × 0.5 m are excavated at a spacing of 2 m along the border of the farmland. The pits are applied with 1 cubic ft of FYM, 20 g of Aldrin powder and 50 g of superphosphate, before planting. Bag plants of teak, red sanders or bamboo are planted.

RAISING YEAR:

First Weeding and soil working: January and February.

Second weeding and soil working: April and May.

Watering @ 10-15 L is required during non-rainy days.

FIRST YEAR:

Weeding and soil working can be carried out two times. Watering should be given during non-rainy days. The plants may be allowed to grow till they attain maturity and good girth. Teak, red sanders and casuarina are of commercial importance.

SECOND YEAR:

Weeding and soil working should be carried out two times in January and April. Watering should be given.

Images 9: **Bund Plantation**

Images 10: **Bund Plantation**

7.9 RECOMMENDATIONS:

The following recommendations are given after interacting with DRDA officials, executive staff, field staff, GP presidents and people, with regard to the work of nurseries and plantation components under MGNREGA in the district.

1. At present, nurseries are established at random, in the blocks. In GPs, nurseries are established wherever land with good water source is available, and in some blocks, the block office compounds are being used to raise the nurseries. Now it is recommended that all the nurseries where shade net, a good source of water, and other infrastructure are available, they may be continued. Now, new block permanent central nurseries may be established after locating a good site of not less than 3 acres in each block.
2. The plantations in some areas are now being carried out using the available bag plants in the nearby nursery centres. In some GPs where bag plants are not available, the bag plants are being purchased from private nurseries and plantations carried out. It is recommended all GPs have the information of the species available nursery wise so that plantations can be raised using the plants from DRDA nurseries.
3. At present, the big and same-sized bags are being used to raise the seedling for all types of plantations in the district. Different sized bag plants are required for different types of plantations. The following sized bag plants may be used for different plantations:
   - **i. Greening of hillocks:** 5 inches × 9 inches.
   - **ii. Massive tree plantations:** 6 inches × 12 inches.
   - **iii. Silvipasture plantations:** 6 inches × 12 inches.
   - **iv. Avenue plantations:** 12 inches × 18 inches bags of tall seedlings.
   - **v. Canal bank plantations:** 6 inches × 12 inches.
   - **vi. High-density plantations:** 4 inches × 7 inches

A central nursery or block nursery should contain all sizes of bag plants as mentioned above.

4. Local traditional species should be raised. Species, such as Pungam, Konnai, Vembu, Korukkapuli, Vembu, Vellangai, and Iluppai, should be raised. The species to be planted for each type of plantation is given in the "Manual for Community plantations" and also in the "Manual for raising of nurseries."
5. Raising nurseries and plantations is a time-bound programme. Hence, they should be taken up as per the calendar of operations specified for plantations and nurseries.
6. The Jawadu hills is a boon for the Tiruvannamalai district. The Jawadu hills have all the southern tropical dry deciduous species. The seed for raising indigenous species can be collected from March to June and the same can be used for raising nurseries in the district.
7. The majority of the plantations raised under MGNREGS are protective in nature and are to be conserved. Benefits to the people are ecological in nature. However, due to increasing pressure on vegetation and a lack of appropriate management strategies, the direct benefits are no longer readily available. To mitigate climate change, improved management of plantations in community lands is essential. Every inch of common land should be put under greenery. But to do so, people must participate in the design, implementation and follow-up of these activities. Hence, the plantations after they attain maturity should conserved permanently and only by-products, such as fruits and fodders, can be collected without harming the growing trees.

Like a river changing its course over a life span,

A change for a better tomorrow has begun.

Water, soil and vegetation are the leaves of the same tree,

The shade of which has made us free.

In this era of technology there is no monopoly in farming,

For better production, farmers monitor their land and crops through GIS and remote sensing.

Food for every hunger, water for every soil,

This is every farmers' wish for their hard toil.

In the palm of every rural household,

livelihood and gender equality are getting mould.

Convergence of mind and passion to conserve water,

is a ray of hope for a better future.

The wind of resilience has started blowing towards the plains, islands and hills of the north, south, east, and west,

Thus, improving the lives of rural India and addressing climate stress.

This is WASCA

(Water Security and Climate Adaptation in Rural India)

-in a quest for a sustainable India-

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