

FINAL REPORT OF COMMITTEE FOR
SPECIFYING STANDARDS FOR PLANTATION /
REPLANTATION OF TREES IN DIFFERENT
LANDSCAPE / LAND USE



दशकूपसमा वापी दशवापीसमो ह्रदः ।
दशह्रदसमः पुत्रो दशपुत्रसमो द्रुमः ॥
(Matsya-purāṇa 154:512)

A pond equals ten wells, a reservoir equals ten ponds.
A son equals ten reservoirs, and a tree equals ten sons!

FINAL REPORT OF COMMITTEE FOR SPECIFYING STANDARDS FOR PLANTATION /
REPLANTATION OF TREES IN DIFFERENT LANDSCAPE / LAND USE



**Technical Committee for Specifying Standards for Plantation / Replantation of
Trees in Different Landscape / Land Use**

The report has been prepared by the committee members as signed below and submitted to the Forest Department

Dr. Pradip Sarmokadam, Member Secretary, GSBB
Chairman of the Committee

Shri. Anand Jadhav, Deputy Conservator of Forests (HQ)
Member Secretary of the Committee

Deputy Director, Department of Agriculture, Goa
Member

Town Planner, Town & Country Planning
Department, Goa
Member

Representative of Head of Department, Botany
Department Goa University
Member

Executive Engineer, Water Resources
Department, Goa
Member

Executive Engineer, Public Works Department,
Goa
Member

Sub Divisional Forest Officer, Mapusa
Member

Representative of Wetland Authority of Goa
Member

Sub Divisional Forest Officer, Quepem
Member

SUMMARY OF REPORT OF COMMITTEE FOR SPECIFYING STANDARDS FOR PLANTATION / REPLANTATION OF TREES IN DIFFERENT LANDSCAPES / USE

Background

- A Committee was constituted vide order no.5-43 (meeting of tree authority) – 2021-22-Vol I – FD /2994 dated 12/10/2021 for Specifying Standards for Holistic Plantation / Replantation of Trees in Different Landscape / Use with clear scope. Further extension was granted till April 2022 to be able to conduct field study in selected locations.

Terms of Reference:

- To specify standards regarding the number of trees which specific locality, type of land and premises shall have and which shall be planted subject to **minimum of five trees** per hectare in the case of rural areas
- To **specify standards for the planting and maintaining** such number of trees as may be considered necessary according to prescribed standards on roads, in public parks and gardens and on the banks of rivers or lakes or seashores

Methodology Adopted

- Compiling **secondary relevant information**, publications and data
- **Consultation with stakeholders** including petitioner within the available time frame.
- The **inputs from member departments and experts** are duly recorded in the report. List of plants from existing programs of forest dept. was also referred.
- **Field study was conducted (placed in Annexure I of the report) based on ground survey** with staff from forest department and biodiversity board.

Recommendations

- **Predominantly native / indigenous** (except when desired, designated forest officer will give permission for non-native) due to certain specific local conditions

• **Report of the committee is a dynamic document** and can be upgraded by the department by including / altering species based on field experience whenever there are such new findings brought forward in the field or by experts or any other authentic sources

REPORT HAS 4 ANNEXURES AND ANNEXURE II ARE THE RECOMMENDATIONS OF THE COMMITTEE

List of 81 Species of Plants with Spacing for various locations

- A RECOMMENDATIONS FOR HIGHWAY & ROADSIDE PLANTATIONS (37 Species)
- B PLANTATION IN URBAN AREAS INCLUDING PUBLIC PARKS AND GARDENS (66 Species)
- C PLANTATION ALONG AND AROUND CANAL, LAKES, EMBANKMENTS AND WETLANDS (28 Species)
- D PLANTATION ALONG AND AROUND RIVER, SEA SHORE & COASTAL AREAS (45 Species)
- E PLANTATION IN PREMISES INCLUDING INSTITUTIONS / SCHOOL / COLLEGES/ UNIVERSITY/ INDUSTRIAL ESTATES. (15 Species)
- F PLANTATIONS FOR AGRO FORESTRY (80 Species)

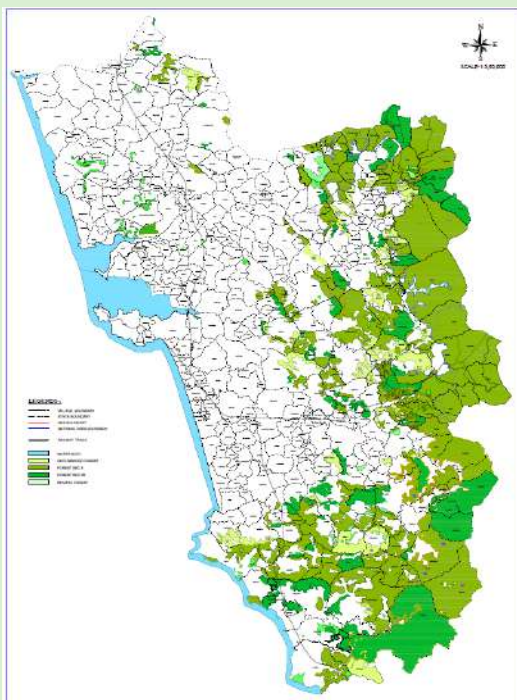
1. Background and Introduction:

A Committee was constituted vide order no.5-43 (meeting of tree authority) – 2021-22-Vol I – FD /2994 dated 12/10/2021 for Specifying Standards for Plantation / Replantation of Trees in Different Landscape / Use with following terms of reference. Further the extension was granted till April 2022 by the tree authority on request of the committee.

1. To specify standards regarding the number and kind of trees which each locality , type of land and premises shall have and which shall be planted subject to a minimum of five trees per hectare in the case of rural areas
2. To specify standards for the planting and maintaining such numbers of trees as may be considered necessary according to the prescribed standards on roads , in public parks and gardens and on the banks of rivers or lakes or seashores.

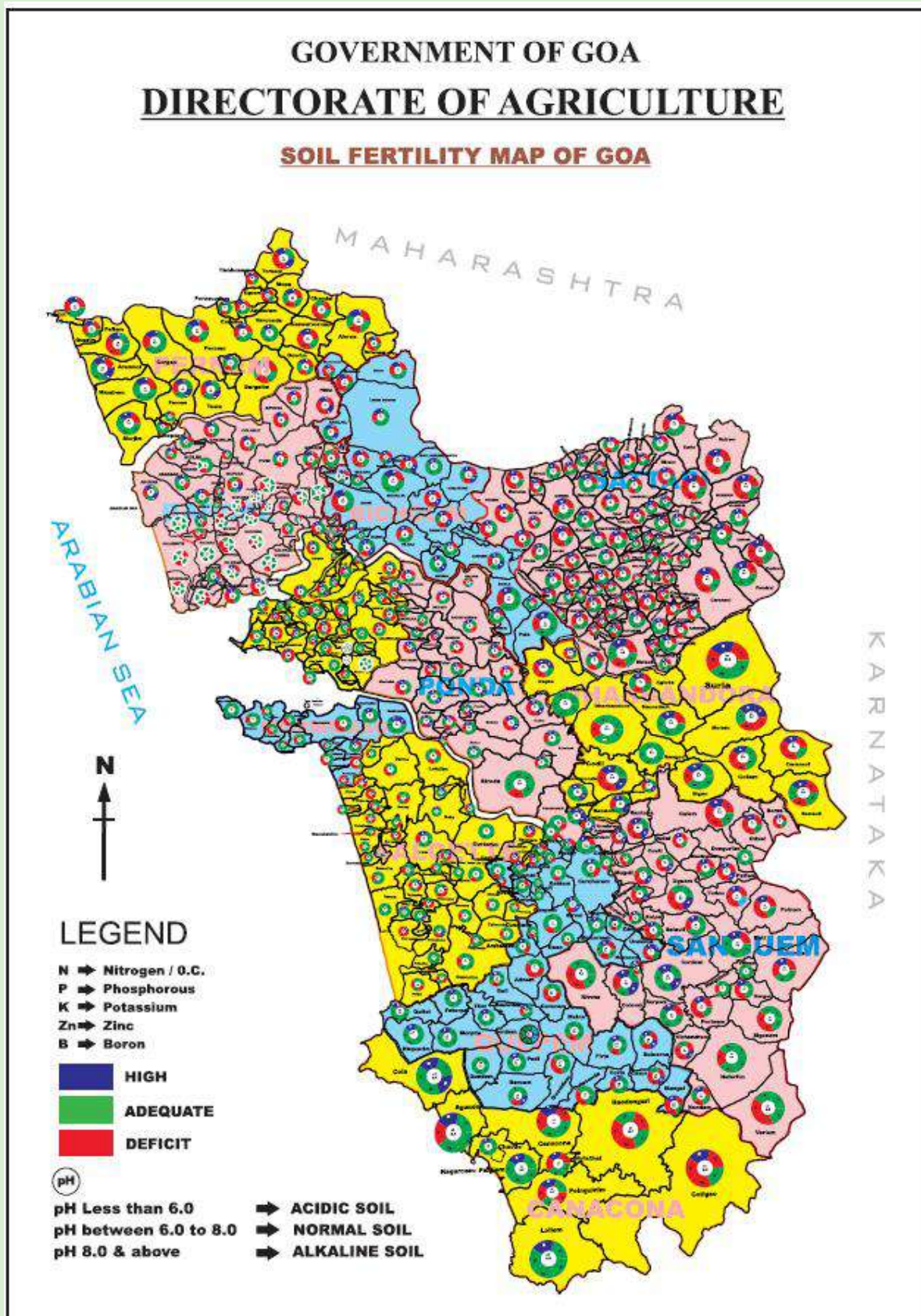
The entrusted task to the committee is first such attempt to recommend standards for plantations in different specific landscapes and users and whatever was possible within short time available was attempted.

Goa is situated along the Konkan coast of India covering ~3072 sq km raising up to the mountains of the Western ghat, receiving an average of ~2900 mm of the rainfall during the monsoon season (June-September). While the rainfall increases as we move from coastal areas towards east i.e. towards western ghats. The general tree cover also is found to get thicker as we move towards uplands. The floral diversity is result of several factors ranging from eco-climatic variations, soil types, topographic variations, rainfall, erosion pressures, surface water dynamics pollination agents and other factors that influence growth and propagation of trees.



The forest map of Goa shown besides has predominantly green cover on the eastern region. The coastal and riverine vegetation is predominantly mangroves and associated species while other locations have diverse tropical & subtropical species from plateaus to forest areas of State. There is increase in fallow land, decrease in crop production and conversion to non-agriculture lands as per the reports including report by NBSS & LUP to Dept. of Agriculture.

Soil is one of the most important components which indicates richness and diversity of plants. Hence below given is the soil fertility map of Goa indicating Nitrogen, Phosphorous, Potassium, Zinc and Boron levels in the State. The map is self-explanatory and covers all Talukas of Goa.

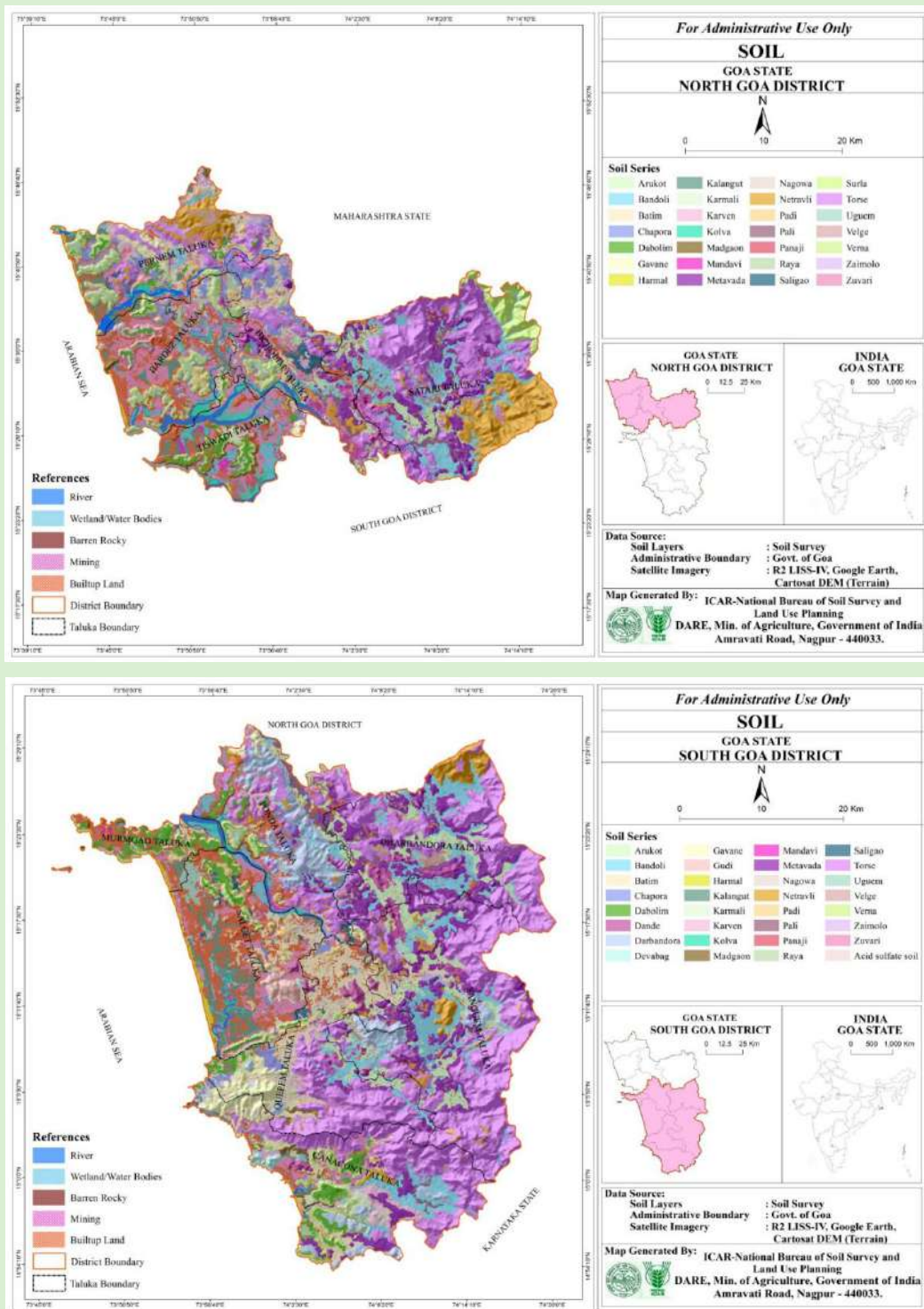


Soil is one of the most susceptible landscape elements, to land-use change. It supports crops, grasslands and forests which will provide food, fiber, wood, fuel and building materials. The general concept and the definition of soil have been subjected to many alterations (Wilde, 1946). According to agronomists “soils are a mixture of sand, clay, lime and humus”. Geologists regard soil as “products of weathered minerals and a composition of dead plant and animal remaining (Fallow, 1862) and biologists consider it as “a lithosphere penetrated by the biosphere” (Stebutt, 1930). In general soil is “a portion of the earth surface which serves as a medium for the sustenance of biosphere; it consists of mineral and organic matter, permeated by varying amounts of water and air, and inhabited by organisms; it exhibits peculiar characteristics impressed by the physical and chemical action of the tree roots and forest debris (Wilde, 1946). Examination of the vertical section of soil gives an idea of underlying forces in soil formation. The vertical section of the soil is called the profile and the individual layer is called as horizon (Figure1). Each horizon has its own peculiarities. The upper layer of soil profile has large amount of organic matter. This is mainly due to decaying organic matter. Variation in color of each horizon is evident as the upper layer has dark color compared to the other underlying layers. The underlying layers which form the subsoil have low organic matter. The uppermost horizon in a typical soil profile is called the O horizon. This horizon is composed mostly of mineral soils. This horizon contains more than 30% of organic matter present in the soil profile. Below the O horizon is the A horizon which is called the fertile top soil. Below the A horizon is the E horizon. The main feature of this horizon is the loss of clay, iron and the aluminum. Mineral horizon with evidence of pedogenesis or illuviation is called the B horizon. Below the B horizon is the un-weathered geologic 5 material commonly called as C horizon. Below the C horizon is the hard bed rock commonly called R horizon (Miller & Donahue, 1990). The quality of the soil varies from horizon to horizon.

Land use changes modify carbon and litter quality of a location and hence the soil quality (Ojima, 1994). Land cover changes associated with different land use are important agents of environmental change and degradation (Wick et al., 2000). Land cover changes are happening very rapidly in recent times due to over-exploitation and lack of integrated approaches in planning. This is coupled with growing demands of increasing human population. During the past several centuries’ humans have modified the environmental systems a lot. Most of the world’s forests have been extensively modified by human use of land (Houghton, 1994). This global change in land use has influenced adversely human well-being as well as the climate.

The soils of Goa are mostly lateritic (81%). They are sandy loam to silt-loam in texture, well drained and highly acidic (5.5 to 6.5 pH). These soils have moderate organic carbon and are poor in potash. About 11% of the soils located along the seacoast and estuaries are sandy-to-sandy loams. They include the Ker lands and beach fronts. The remaining 8% of the soils are alluvial in nature. The Khazans and adjoining areas have alluvial soil with high water tables and are subject to inundation by saline water.

Below are the soil maps of both the districts as studied by ICAR – NBSSLUP



Land Types

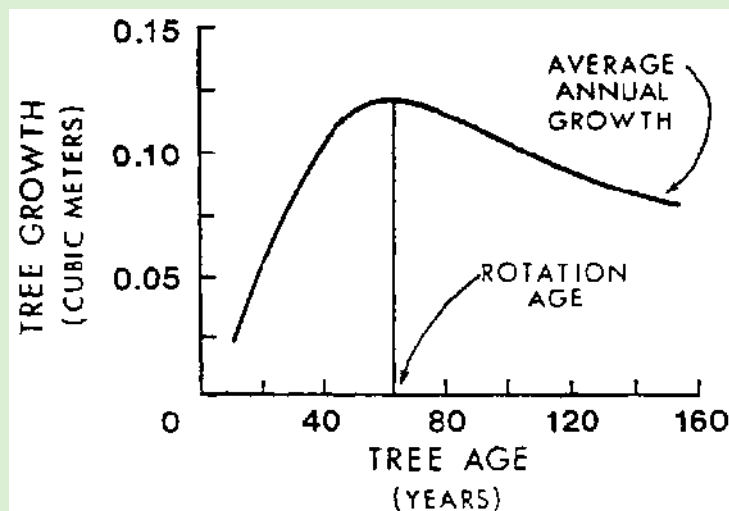
1. Khazan Land: It consists of low-lying areas, of elevation below sea level along the estuaries. This land is used for monsoon paddy crops followed by Rabi Vegetables, in limited areas, pisciculture is also done by regulating and managing the flow of water

2. Ker Land: This is flat land at low elevation above sea level and having a high water table. Sandy-to-sandy loams soils are fit for multiple cropping through irrigation. Rabi paddy vegetables, pulses, etc. are grown in these areas.

3. Morod Land: It refers to upland or terraced field suitable for Horticultural/Plantation crops or single rain fed crop of rice.

(Source: Department of Agriculture, Goa)

The increasing population pressure, unplanned land utilization, mining and other such disorganized activities including unplanned commercial plantations on slopes have aggravated the landslide events in recent decades. Below given graph shows correlation between tree growth with its age. Indicates that growth is not perpetual but has peak after which it will slow down.



Relationship between tree age and tree growth indicating the rotation age
(Source - <https://www.fao.org/3/t0122e/t0122e09.htm>)

2. Methodology

The strategy and approach adopted was by dividing the state of Goa in three eco-climatic zones namely, 1) Coastal zone, 2) Low lying - agricultural lands – midlands – plateaus and 3) Western Ghat foothills and slopy areas for the simplicity but it is necessary to specifically mention that in case of plantations in eco sensitive zones / vulnerable areas / sacred groves identified under any other legal provisions or by statutory or Govt. bodies, there is need to take approval from competent authority – mainly designated officer by tree authority.

Study - The methodology adopted was generating primary data from few surveys as well as information from forest department based on existing plantations. Also compiling secondary relevant information, publications and consultations with stakeholders within the available time frame was ensured. The inputs from member departments and experts are duly recorded in the report. The outcomes of study are placed in Annexure I.

Aspects related to plantation based on outcomes of consultations are given below.

- 1.To select the right species based on the plant growth characteristics.
2. Planning aspects considering the pace of growth and result expected ensuring the balance between the two.
- 3.location in terms of soil type, sun and shade ratios.
- 4.Categorising the landscape as a) Coastal zone, b) Low lying - agricultural lands – midlands – plateaus and c) Western Ghat foothills and slopy areas.
- 5.Kind of substratum, the purpose of planting - like whether it is for intensification of existing plants, aesthetics or shade or for fruits or other commercial purpose, etc.
- 6.Cultural aspect of the locality with regard to planting.
- 7.Considering the availability of water.
- 8.Context based planting and commercial benefits desired may be also considered.

Details about the methodology used to gather information and data from primary field survey and study summary is placed in annexure I.

Locality	Area identified for survey	Locations wherein primary survey conducted or information sourced (Type of Land)	Prescribed standards	Recommended Species
Roads	NHGA and Two Samples + Indicative List + Forest Dept. Social Forestry	NHAI publication	Distance between species and standards	In Annexure II
Public Parks	Forest Dept. Social Forestry from existing parks	Forest Dept. Social Forestry from existing parks	Distance between species and standards	In Annexure II
Gardens	North Goa, South Goa + Forest Dept. Social Forestry	Forest Dept. Social Forestry from existing parks	Distance between species and standards	In Annexure II
Banks of rivers	CSIR-NIO, Chapora and Sal	North Goa - Kalna River bank South Goa - Stretch of Riverbank of Khushawati at Chandor	Distance between species and standards	In Annexure II
Embankments or Banks of lakes	Wetlands from NIO- CSIR - Bondvol data of forest Dept, Nanda and Pilerne	North Goa - Pilerne Sawle Lake South Goa - Nanda Lake Wetland at 2 locations (natural boundary and bund with organized plantation)	Distance between species and standards	In Annexure II
Embankments or Banks of Canals	WRD - N & S	North Goa - Tillari Canal embankment at VP Alorna at Murkungo near Khutwal (unplanned indigenous) and Amthane Dam bank (predominantly organized) South Goa - Canals at Borimol Quepen near Forest Dept. (organized plantation)	Distance between species and standards	In Annexure II
Sea Shores	Morjim and Colva	Source Forest Dept information and information from PBR of Morjim as well as GSBB information during inspections	Distance between species and standards	In Annexure II
Premises	List from Sustainable Architects	Information availed from renowned sustainable architects and fraternity	Distance between species and standards	In Annexure II

3. General recommendation with standards for plantation and replantation in various landscapes

- a) **Type of plant** – It is necessary to plant the same species when planted as replacement or for compensatory purpose. But in case this is not possible then at least from same family or plant or associated species of same family. In case of space constraints or less than five species per hectare or any other reasons beyond control subject to approval by competent authority and if the species under consideration is commonly available, then may be allowed to compensate by vertical garden or terrace garden or any other innovative method of plantation wherein the same amount of canopy shall be grown and sustained for the desired period or perpetuity by ensuring such arrangement. Alternatively, the plant may be selected from the approved list of Forest Dept. In general case the exotic or non-native species shall not be recommended for plantation and monoculture shall be prevented. However, in any such case there is desire to plant exotic or non-native then approval shall be availed from competent authority designated by Tree Authority. The overall intent is to ensure diversity and ecological character of the area wherever the plantation or replantation is proposed.
- b) **Replantation** - In case of replantation, there is need to ensure non-destructive method or technique of plantation wherein the protocol is suitably prepared depending on the girth of plants to be replanted. The species, spacing and pit size should be as per the annexure II guidelines to be adopted. The proven techniques of pre-treatment to loosen the soil around the tree, clearing branches before the transplantation and such pretreatments need to be adopted for roots and other tree parts if any to reduce the shocks of transplantation. The use of suitable mechanical equipment should be used in such a way that minimal damage is caused during transplantation and transportation to desired location and maximum survivability is ensured.
- c) **Time of plantation** – The best time is before onset of monsoons to ensure best natural growth during first few months. But when not possible it is necessary to ensure survivability by creating conducive soil conditions and watering arrangements. It is necessary to ensure at least

5 years initial support for care and survivability of plant including watering, fencing, sufficient soil at the root-zone area and exposure to sunlight as per the species demand.

d) **Scale of plantation or replantation** – Spacing and pit size will be depending on whether the no of plants are less than 10, between 10-50, from 50-100, 100-500, 500-1000 and every thousand trees should be treated as separate block whenever such scale plantations / replantation should be well planned. For plants less than 10 in numbers the space could be less than generally desired for dense plantation but beyond that, there is need to provide sufficient spacing as per the standard and scientifically accepted spacing from commercial or forestry point of view as in both cases productivity is important criteria. For plants beyond 10 nos. the proper plantation plan shall be approved by the competent authority as designated by the Forest Dept.

e) *Type of Plant:* To plant same species or from species of same preferably indigenous/ native spp.

f) *Time of plantation:* Before onset of monsoons

g) *Scale of plantation or replantation:* Spacing and pit size will depend on the number of plants to be planted and same will be will approved by the competent authority designated by Forest department.

h) **Generally exotic or non-native species shall be allowed (Except in such a case that may be approved by competent authority designated by Tree Authority)** to be planted and monoculture shall be prevented. The overall intent is to ensure diversity and ecological character of the area wherever the plantation or replantation is proposed.

i) In case of replantation, there is need to ensure non-destructive method or technique of plantation wherein the protocol is suitably prepared depending on the girth of plants to be replanted. The spacing and pit size should be as per the annexure II.

Why Native Species?

- **Native trees are more appropriate than exotics,**
(1) they are often better adapted to local environmental conditions,

- (2) seeds may be more generally available, and
 - (3) farmers are usually familiar with them and their uses
 - (4) More robust during cyclones or susceptible to high wind speeds
 - (5) Have well defined role in ecosystem and mingles well with other species including dependant fauna.
- Besides, the use of indigenous trees helps preserve genetic diversity and serves as habitat for the local fauna.
 - Limitations / Disadvantages of the use of native species are
- (1) uncertainty regarding growth rates and adaptability to soil conditions; (2) general lack of guidelines for management; (3) large variability in performance and lack of genetic improvement; (4) seeds of native tree species are often not commercially available and have to be collected.

1. General Specifications for Plantation in various landscapes

NORMALLY FIRST ROW PLANTATION	
Distance from embankment	Minimum 0.5 m away from the toe of the embankment and close to the edge of the right of way
Spacing between plant to plant	4 m to 6 m
Spacing between rows	3 m minimum
Size of pits	60x60x60x cms . In waterlogged areas , mound with height varying depending on water level
No. of plants per Km	167 to 250 on one side preferably
Height of sapling at the time of planting	1.2 to 2 m
Survival percentage of plantation	90% at any time
SECOND ROW PLANTATION	
Distance from preceding row	3.0 minimum
Spacing between plant to plant	8 m to 12 m (6 mts if mortality expected)
Spacing between rows	3 m minimum
Size of pits	60x60x60x cms . In waterlogged areas , mound with height varying depending on water level
No. of plants per Km	84 to 125 (127 at 6m spacing) on one side
Height of sapling at the time of planting	2 m and above
Survival percentage of plantation	90% after replacement of casualties in first two years and 80% afterwards

While above general recommendations will serve as guiding, detailed specific guidelines are given in annexure II

Consultations by Committee – Meetings & consultations were held by committee as per the details in Annexure III and photos are given below.



Meeting Dated 26/10/2021



Meeting Dated 11/11/2021



MEETING FOR CONSULTATIONS WITH STAKEHOLDERS & PETIONER DATED 23/11/2021

4 General Recommendations -

- i. The plant species selected for plantation or replantation should be indigenous and suitable to the local ecosystem set up which can be identified based on locally available plants / trees in that specific area as mentioned in Annexure II of this report and further validated locally as per the Peoples Biodiversity Register of the concerned local body or may be selected from the list of species that may be issued by Forest Dept. from time to time based on their field experience. In a situation wherein the desired plant species is non-native or non-indigenous, approval is necessary from the competent authority designated by Tree Authority. This will ensure that the list remains dynamic and is subjected to revision with broader strategy that it should be native to the area.
- ii. While selecting species the due consideration shall be given to local conditions and situation such as nearness to structure or any other heritage structure that may result in damage to the structure then in such case plant with shallow / adventitious root system or suitable attributes. In private areas the owner may decide the species based on desired results, suitability of soil, water availability and other factors and may be selected from species list as per Annexure II
- iii. The methods and techniques for plantation and replantation should be to ensure full-fledged growth of the selected species and allow for the growth of root zone.
- iv. It is recommended by this committee that there is need to keep this report further enriched by forest officials based on field experience and findings shared by stakeholders after proper validation.
- v. It is important to further encourage ecosystem specific research based scientific methods for creating ecosystem-wise data, alteration to spacing between each species and other attributes identified in Annexure based on methods such as “Miyawaki” or any other proven methods / techniques for intensification of green cover to support local biodiversity.
- vi. A wrong tree at wrong place can trigger events such as landslide, erosion, monoculture and in long run may neither provide ecological nor economic benefits to people or biodiversity. Hence a dynamic strategy that will be updated from time to time based on research findings and ground level validations is essential.

ANNEXURE- I

Existing predominant flora & recommended list of species for Goa

Source: PPT from College of Forestry, Sirsi

In a prominent study of western ghat task force wherein one of the expert members was Dr. R. Vasudevan from the College of Forestry, Sirsi. They provided the information that team had conducted grid base sampling in the biggest, robust and uniform sampling spread over 3000 km area. The grid was divided into 6.25 km X 6.25 km grids. A transect of 1km X 5m was taken for plant enumeration.

Based on the study top 20 species had been selected. The species are enlisted below:

1. *Tectona grandis*
2. *Terminalia paniculata*
3. *Memecylon umbellatum*
4. *Syzygium cumini* (Jamun)
5. *Terminalia tomentosa*
6. *Mangifera indica* (mango)
7. *Olea dioica*
8. *Xylia xylocarpa*
9. *Careya arborea*
10. *Acacia nilotica*
11. *Azadirachta indica*
12. *Lagerstroemia lanceolata*
13. *Acacia auriculiformis*
14. *Aporosa lindleyana*
15. *Macaranga peltata*
16. *Anacardium occidentale* (Cashew)
17. *Cocos nucifera* (coconut)
18. *Grevillea robusta* (silver oak)
19. *Terminalia elliptica*
20. *Areca catechu*

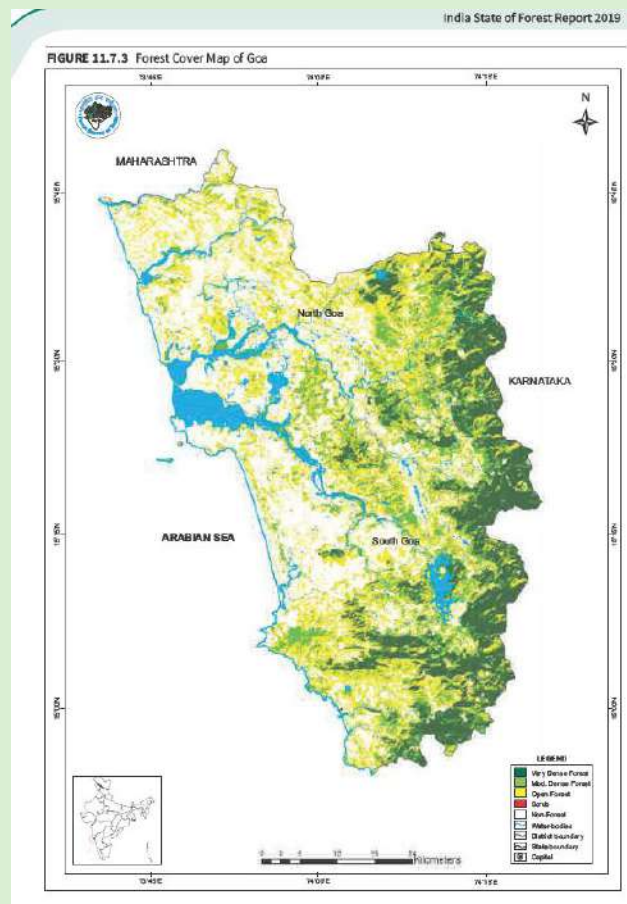
Source: Indian State Forest Report 2019

Recorded Forest Area (RFA) in the State is 1,225 sq km of which 253 sq km is Reserved Forest and 972 sq km is Unclassed Forests. In Goa, during the period from 1st January 2015 to 5th February 2019, a total of 42.75 hectares of forest land was diverted for non-forestry purposes under the Forest Conservation Act, 1980 (MoEF&CC, 2019). As per the information received from the State 140 ha of plantations have been raised in the State in the last two years. Based on the study top 20 species had been selected. Hence these can be included in the plantation.

Table 1. Major invasive species in the State inside the RFA/Green Wash in Goa

Sl. No.	Species	Estimated Extent
1	<i>Chromolaena odorata</i>	60
2	<i>Cassia tora</i>	13
3	<i>Ageratina Adenophora</i>	3
4	<i>Triumfetta rhomboidei</i>	1
5	<i>Acacia farnesiana</i>	1

Source: Joshi VC and Janarthanam MK (2004)



Appendix 1 Life-form, habitat and phenology of the endemics in the Goa region of the Western Ghats, India.

Species	Family	Habit	Habitat	Flowering months
<i>Burleria strigosa</i> Willd. var. <i>terminalis</i> (Nees) Clarke*, †	Acanthaceae	Shrub	B, C	November–February
<i>Gymnostachyum glabrum</i> (Dalz.) T. Ander.*	Acanthaceae	Shrub	B, C	December–February
<i>Haplanthodes neilgherryensis</i> (Wight) Majumdar	Acanthaceae	Herb	A, G	January–April
<i>Justicia wynaadensis</i> (Nees) Wall. ex T. Anders.	Acanthaceae	Herb	A, B, C	November–March
<i>Mackenzia integrifolia</i> (Dalz.) Bremek	Acanthaceae	Shrub	B	December–January
<i>Neuracanthus sphaerostachyus</i> (Nees) Dalz. †	Acanthaceae	Under shrub	B, F	August–December
<i>Nilgiranthus barbatus</i> (Nees) Bremek. ‡	Acanthaceae	Shrub	D (Myristica swamp)	January–February
<i>Thelepaepale ixiocephala</i> (Benth.) Bremek.	Acanthaceae	Shrub	B, C	October–January
<i>Wiesneria triandra</i> (Dalz.) Micheli†	Alismataceae	Herb	A (water pools)	July–October
<i>Holigarna arnotiana</i> Hook. f.	Anacardiaceae	Tree	A, B	February–April
<i>Holigarna ferruginea</i>	Anacardiaceae	Tree	A, B	February–April
<i>Holigarna grahamii</i> (Wight) Kurz.	Anacardiaceae	Tree	C, D	January–June
<i>Ancistrocladus heyneanus</i> Wall. Ex Graham ‡, §	Ancistrocladaceae	Climbing shrub	C, F	March–May
<i>Sagenea laurina</i> Dalz.	Annonaceae	Tree	B, C	December–February
<i>Amorphophallus commutatus</i> (Schott) Engl.	Araceae	Herb	A, B	May–October
<i>Amorphophallus konkanensis</i> Hettterscheid, Yadav & Patil*, †	Araceae	Herb	A	June–July
<i>Arisaema sivadasanii</i> Yadav, Patil & Janarthanam*, †, ‡	Araceae	Herb	B	July–October
<i>Cryptocoryne cognata</i> Schott†	Araceae	Herb	G (streams)	September–November
<i>Arenga wightii</i> Griff. ‡	Arecaceae	Tree	D	November–January
<i>Calamus thwaitesii</i> Becc. & Hook. f.	Arecaceae	Climber	C, D	February–March
<i>Hyphaene dichotoma</i> (Wight) Furtado	Arecaceae	Tree	H	January–April
<i>Brachystelma mahwanense</i> Yadav & Singh*, †, ‡	Asclepiadaceae	Herb	G	March
<i>Ceropegia attenuata</i> Hook. †	Asclepiadaceae	Herb	A	August–October
<i>Ceropegia fantastica</i> Sedgw. †	Asclepiadaceae	Climber	A, B	August–September
<i>Heterostemma dalzellii</i> Hook. f., †	Asclepiadaceae	Climber	B, G	August–September
<i>Tylophora dalzellii</i> Hook. f.	Asclepiadaceae	Climber	A, G	August–November
<i>Phyllocephalum ritchiei</i> (Hook. f.) Narayana ‡	Asteraceae	Herb	B, C	September–October
<i>Phyllocephalum tenue</i> (Clarke) Narayana	Asteraceae	Herb	B, C	August–November
<i>Senecio belgaumensis</i> (Wight) Clarke	Asteraceae	Herb	A, B, C	October–December
<i>Impatiens kleiniformis</i> Sedgw.	Balsaminaceae	Herb	B, C	October–November
<i>Impatiens pulcherrima</i> Dalz.	Balsaminaceae	Herb	C	November–December
<i>Begonia crenata</i> Dryand.	Begoniaceae	Herb	A (marshy areas), B	July–October
<i>Adelocaryum coelestinum</i> (Lindl.) Brand	Boraginaceae	Herb	B, C	September–November
<i>Moullava spicata</i> (Dalz.) Nicolson	Caesalpiniaceae	Climber	A, B	November–January
<i>Capparis theedii</i> DC.	Capparidaceae	Shrub	C	March–May
<i>Calophyllum calaba</i> L.	Clusiaceae	Tree	C	October–March
<i>Garcinia indica</i> (Dupetit – Thouars) Choiss.	Clusiaceae	Tree	A, B	November–August
<i>Garcinia talbotii</i> Raiz. ex Santapau	Clusiaceae	Tree	D	December–May
<i>Murdannia versicolor</i> (Dalz.) Brueckner	Commelinaceae	Herb	A, G	August–October
<i>Fimbristylis dauciformis</i> Govind. †	Cyperaceae	Herb	A (marshy areas), E	July–December
<i>Fimbristylis lawiana</i> (Boeck.) Kern†	Cyperaceae	Herb	A, G	July–August
<i>Hopea ponga</i> (Dennst.) Mabberley	Dipterocarpaceae	Tree	C (along stream)	February–April
<i>Diospyros angustifolia</i> (Miq.) Kosterman	Ebenaceae	Tree	B, C, D (along streams)	March–May
<i>Diospyros paniculata</i> Dalz.	Ebenaceae	Tree	C, D	March–April
<i>Diospyros pruriens</i> Dalz.	Ebenaceae	Tree	C, D	April–May
<i>Diospyros sakkamhae</i> Kosterman	Ebenaceae	Tree	C, F	March–May
<i>Eriocaulon cuspidatum</i> Dalz.	Eriocaulaceae	Herb	A	August–November
<i>Eriocaulon dalzellii</i> Koern. ‡	Eriocaulaceae	Herb	A (Water pools), F	August–November
<i>Eriocaulon aerypeplon</i> Koern. ‡	Eriocaulaceae	Herb	A (water puddles)	July–September
<i>Eriocaulon fysonii</i> Ansari & Balakr. †	Eriocaulaceae	Herb	A (water puddles)	August–November
<i>Eriocaulon lanceolatum</i> Miq. ex Koernick ‡	Eriocaulaceae	Herb	A (water puddles)	July–February

Appendix 1 continued

Species	Family	Habit	Habitat	Flowering months
<i>Eriocaulon radactum</i> Rhuland†	Eriocaulaceae	Herb	A (water puddles)	July–September
<i>Eriocaulon stellulatum</i> Koern.	Eriocaulaceae	Herb	C (wet open areas)	November–December
<i>Briocanelia indica</i> Dennst. ex Kostel	Euphorbiaceae	Shrub	B, C	October–March
<i>Dimorphocalyx glabellus</i> Thw. var. <i>lawianus</i> (Hook. f.) T. Chakrab. & Balakr	Euphorbiaceae	Shrub	C	January–April
<i>Drypetes venusta</i> (Wight) Pax & Hoffm.†	Euphorbiaceae	Tree	C, D	November–February
<i>Euphorbia notoptera</i> Boiss.†	Euphorbiaceae	Herb	A	September–November
<i>Phyllanthus talbotii</i> Sedgwick	Euphorbiaceae	Shrub	F	August–October
<i>Crotalaria filipes</i> Benth.	Fabaceae	Herb	A	September–November
<i>Crotalaria lutescens</i> Dalz.	Fabaceae	Herb	A	September–November
<i>Derris hoyaana</i> (Wight & Arn.) Benth.	Fabaceae	Climber	B	March–April
<i>Geissaspis tenella</i> Benth.	Fabaceae	Herb	A	July–November
<i>Indigofera dalzellii</i> Cooke	Fabaceae	Herb	A	July–October
<i>Spatholobus purpureus</i> Benth. ex Baker†	Fabaceae	Climber	D	November–January
<i>Hydnocarpus pentandra</i> (Buch. – Ham.) Oken	Flacourtiaceae	Tree	B	November–March
<i>Trithuria konkaniensis</i> Yadav & Janarthanam†,‡	Hydathyllaceae	Herb	A	August–September
<i>Eusteralis tomentosa</i> (Dalz.) Panig.	Lamiaceae	Herb	E	November–March
<i>Cryptocarya lawsonii</i> Gamble†	Lauraceae	Tree	D	November–March
<i>Litsea coriacea</i> (Heyne ex Meisner) Hook. f	Lauraceae	Shrub	C	October–February
<i>Litsea ghatica</i> Saldanha†	Lauraceae	Shrub	C	October–November
<i>Utricularia lazulina</i> Taylor†	Lentibulariaceae	Herb	A	July–September
<i>Utricularia malabarica</i> Janathanam & Henry†	Lentibulariaceae	Herb	A	August–November
<i>Utricularia praeterita</i> Taylor	Lentibulariaceae	Herb	A	August–October
<i>Lagerstroemia microcarpa</i> Wight	Lythraceae	Tree	B	November–April
<i>Rotala macrandra</i> Koehne†	Lythraceae	Herb	E, F	November–January
<i>Rotala malampuzhensis</i> Nair†	Lythraceae	Herb	E, F	July–October
<i>Dacachiria trilobata</i> Wight	Malvaceae	Herb	B, C	October–November
<i>Meneocylon alborianum</i> Brandis	Melastomataceae	Tree	C	March–May
<i>Sonerila rheaultii</i> Wight & Arn.†	Melastomataceae	Herb	B	September–October
<i>Artocarpus hirsutus</i> Lam.	Moraceae	Tree	A, B	January–February
<i>Gymnacantha farquhariana</i> (Hook. & Thom.) Warburg	Myristicaceae	Tree	D	April–November
<i>Knema attenuata</i> (Wall. ex Hook. f., & Thoms.) Warb.,	Myristicaceae	Tree	C, D	November–December
<i>Eugenia macrocephala</i> Duthie	Myrtaceae	Tree	C, D	February–March
<i>Aerides dalzelliana</i> (Sant.) Garay†	Orchidaceae	Herb	C, D	May–June
<i>Dendrobium ovatum</i> (Willd.) Krnzl.‡	Orchidaceae	Herb	B, G	December
<i>Eria dalzellii</i> (Hook. ex Dalz.) Lindl.†	Orchidaceae	Herb	B, C	August
<i>Oberonia brachyphylla</i> Blatter & McCann†	Orchidaceae	Herb	C, D	March–April
<i>Porpax jerdoniana</i> (Wight) Rolfe†	Orchidaceae	Herb	C, D	July–September
<i>Artifragaria lanceolata</i> (Roxb.) Hochst var. <i>marboldii</i> (Stapf.) Welzen†	Poaceae	Herb	B, G	November–December
<i>Arundinella metzii</i> Hochst. ex Miq.	Poaceae	Herb	B	October–December
<i>Dimeria woodrowii</i> Stapf†,‡	Poaceae	Herb	A	August–November
<i>Glyphochloa acuminata</i> (Hack.) Clayton var. <i>woodrowii</i> (Bor) Clayton	Poaceae	Herb	A	August–October
<i>Glyphochloa goensis</i> (Rao & Hemadri) Clayton†	Poaceae	Herb	A	July–October
<i>Glyphochloa talbotii</i> (Hook. f.) Clayton†	Poaceae	Herb	A	September–November
<i>Ischaemum dalzellii</i> Stapf ex Bor†	Poaceae	Herb	B	July–August
<i>Ischaemum jayachandranii</i> Ansari et al.†	Poaceae	Herb	E	December–January
<i>Ischaemum travancorense</i> Stapf ex C. E. C. Fischer†	Poaceae	Herb	A	October–January
<i>Ophiuros bombaiensis</i> Bor†	Poaceae	Herb	E	September–October
<i>Panicum patanum</i> Nair & Patankar var. <i>patanum</i> †,‡	Poaceae	Herb	G	August–September
<i>Paspalum canarae</i> (Steud.) Veldk. var. <i>fimbriatum</i> (Bor.) Veldk.	Poaceae	Herb	B	November–December
<i>Griffithella hookeriana</i> (Tulasne) Warming	Podostemaceae	Herb	F	October–November

Appendix 1 *continued*

Species	Family	Habit	Habitat	Flowering months
<i>Verilago bombaiensis</i> Dalz.	Rhamnaceae	Shrub	C, D	December–February
<i>Hedyotis maheshwarū</i> (Sant & Merch.) Rao & Hemadri	Rubiaceae	Herb	G	July–September
<i>Ixora brachiata</i> Roxb. ex DC	Rubiaceae	Shrub	B, C	October–January
<i>Mussaenda laxa</i> Hutchin. ex Gamble	Rubiaceae	Shrub	A, B	August–November
<i>Neanotis foetida</i> (Dalz.) Lewis	Rubiaceae	Herb	A	September–October
<i>Neanotis rhodei</i> (Wall. ex Wight & Arn.) W. H. Lewis	Rubiaceae	Herb	B	August–October
<i>Psychotria dalzellii</i> Hook. f.	Rubiaceae	Shrub	B, C	April–September
<i>Tricalysia phaeocarpa</i> (Dalz.) Gamble†	Rubiaceae	Tree	D	October–November
<i>Lindernia staminodosa</i> (Blatt & Halfl.) Mukherjee‡	Scrophulariaceae	Herb	F, G	June–October
<i>Lindernia mantalana</i> Sivarajan‡	Scrophulariaceae	Herb	A	July–October
<i>Torenia bicolor</i> Dalz.	Scrophulariaceae	Herb	E, F	August–November
<i>Zingiber neesatum</i> (Graham) Ramamoorthy	Zingiberaceae	Herb	C	July–October

*Species added to the endemic plant list of Western Ghats; †restricted to Northern Western Ghats; ‡endemic species of Western Ghats which were not collected by earlier worker from Goa; §Mentioned by Rao (1985–86), but not collected in the study area.

Habitats: A, plateaus; B, moist deciduous; C, semi evergreen; D, evergreen; E, fields; F, streams; lakes and river; G, open areas other than plateaus; H, beach.

Reference- Joshi VC and Janarthanam MK (2004) *The diversity of life-form type, habitat preference and phenology of the endemics in the Goa region of the Western Ghats, India. J. Biogeogr*, 31: 1227-1237

Note – Above species are suitable for western ghat areas whenever plantations are planned.

Study report based on field study in selected locations

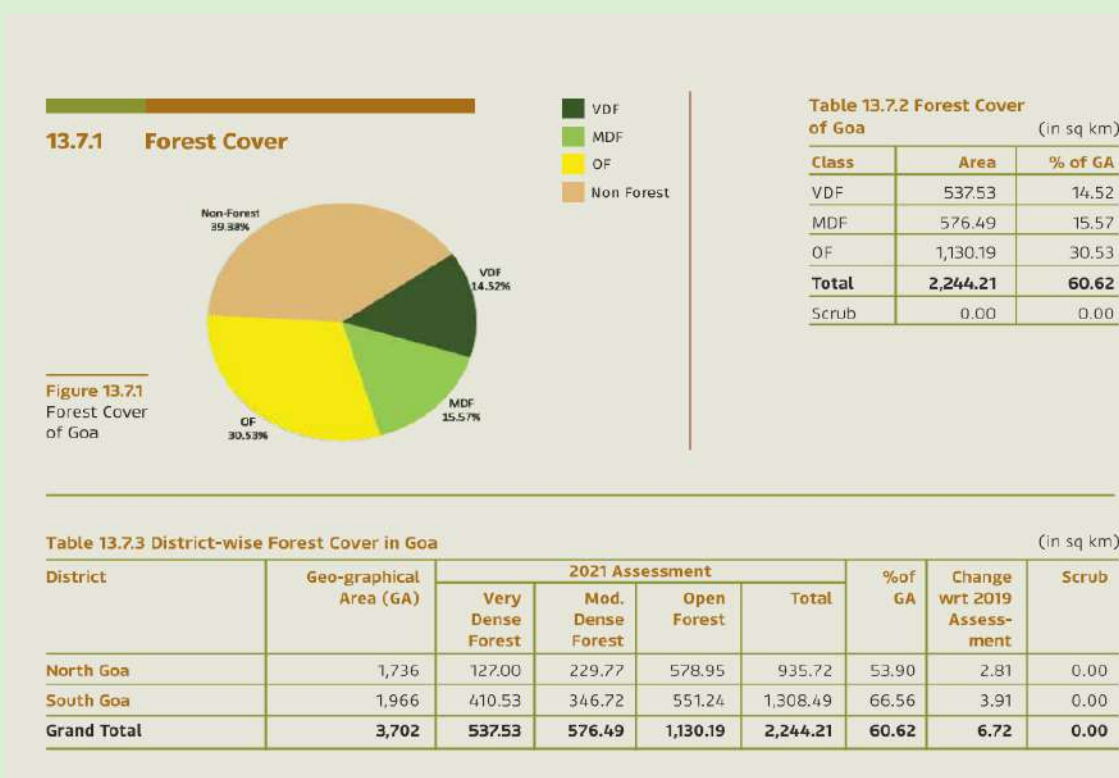
Global scenario - Forests absorb around one third of the carbon dioxide released globally from burning fossil fuels every year but we are also losing this voracious carbon sink at the rate of an area equivalent to the size of 27 football pitches every minute. (State of India’s Environment Report 2022 by CSE) Global Forest watch further reports that the world lost roughly 25.9 million hectares of tree cover to deforestation in 2020 – most of it in the tropics.

Indian scenario – IUCN reveals that the country has a total of 2608 tree species of which 651 are endemic. Total of 413 species are threatened with extinction and two endemic species (*Hopea shingkeng* and *Sterculia Khasiana*) are already extinct, while *Corypha taliera* is extinct in the wild. The rest fall in the IUCN categories of ‘critically endangered’ (55 species), ‘endangered’ (136 species), ‘vulnerable’ (113 species), ‘near threatened’ (49 species), ‘least concern’ (736 species), ‘data deficient’ (57 species) and ‘not evaluated’ (1459 species). Only 55 threatened

species are found in ex-situ collections for conservation outside their natural habitat and around 57 in protected area networks like parks and reserves.

Even BGCI's Global Tree Assessment, ongoing since 2015, highlights that India is rapidly losing tree species vital for livelihoods and ecological services. The key threats to these species include deforestation, habitat loss, exploitation for timber and non-timber products, agricultural activities and the spread of alien pest and disease

tatus of Forest and Tree cover in Goa (from *State of Forest Report, 2021* by Forest Survey of India)-



13.7.1.1 Forest Cover Inside and Outside Recorded Forest Area (or Green Wash)

The Forest Cover inside and outside Recorded Forest Area (RFA) has been analysed in different categories and presented in Table given below.

Forest Cover Inside the Recorded Forest Area (or Green Wash)				Forest Cover Outside the Recorded Forest Area (or Green Wash)			
VDF	MDF	OF	Total	VDF	MDF	OF	Total
516	329	375	1,220	22	247	755	1,024
42.30%	26.97%	30.73%		2.15%	24.12%	73.73%	

*in case of Goa, RFA boundaries have been used.

Table 13.7.8 Area statistics of the Forest Types found in Goa

(in sq km)

Sl. No.	Forest Type	Area	% of the total mapped area*
1.	1A/C4 West Coast tropical evergreen forest	506.33	22.63
2.	2A/C2 West Coast semi-evergreen forest	483.38	21.60
3.	3B/C2 Southern moist mixed deciduous forest	906.80	40.53
4.	4B/TS2 Mangrove forest	26.00	1.16
5.	5/E7 Laterite thorn forest	0.50	0.02
Sub Total		1,923.01	85.94
6.	TOF/Plantation	314.48	14.06
Total (Forest Cover & Scrub)		2,237.49	100.00

*Forest Types have been assigned to the natural forest formations under forest cover and scrub categories shown in forest cover mapping (ISFR, 2019). The total mapped area, therefore, is sum of forest cover and scrub.

Dominant tree species in Trees Outside Forests (TOF)

Top five species in numbers in Trees Outside Forests in Goa in rural and urban areas are given in the Table 13.7.14 and Table 13.7.15 respectively.

Table 13.7.14 Top five tree species in TOF (Rural) in Goa

Sl. No.	Species	Relative Abundance (%)
1.	<i>Areca triandra</i>	26.63
2.	<i>Cocos nucifera</i>	17.41
3.	<i>Anacardium occidentale</i>	10.68
4.	<i>Acacia auriculiformis</i>	6.53
5.	<i>Terminalia paniculata</i>	3.49

Table 13.7.15 Top five tree species in TOF (Urban) in Goa

Sl. No.	Species	Relative Abundance (%)
1.	<i>Cocos nucifera</i>	39.4
2.	<i>Mangifera indica</i>	9.62
3.	<i>Tectona grandis</i>	3.99
4.	<i>Artocarpus heterophyllus</i>	3.75
5.	<i>Areca triandra</i>	3.34

13.7.8 Carbon Stock in Forest

The total Carbon stock of forests in the State including the TOF patches which are more than 1 ha in size 25.24 million tonnes (92.55 million tonnes of CO₂ equivalent) which is 0.35 % of total forest carbon of the country. Pool wise forest carbon in Goa is given in the following table.

Table 13.7.16 Forest Carbon in Goa in different pools (in '000 tonnes)

Sl. No.	Carbon Pools	Forest Carbon
1.	AGB	8,863
2.	BGB	2,606
3.	Dead wood	232
4.	Litter	448
5.	SOC	13,095
Total		25,244

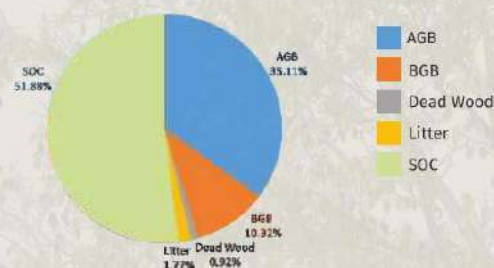


Figure 13.7.5 Forest Carbon in Goa

Photo Plate 1 - North Goa

Location: Pilerne Lake; Wetland, Bardez



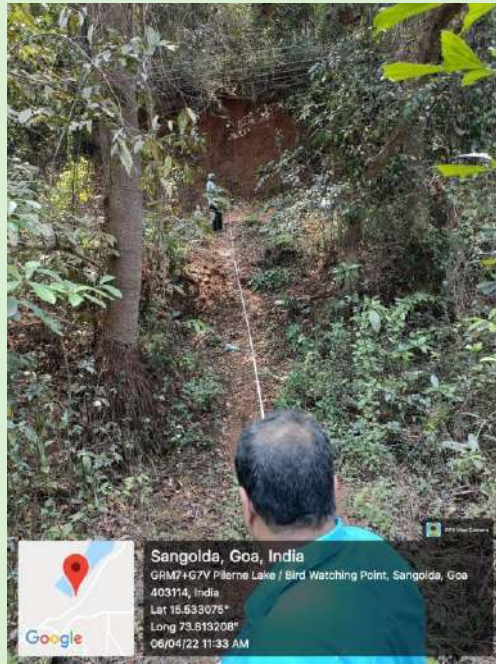
Fig 1: Tree survey trough transect walk



Fig 2: Measuring girth of the tree



Fig 3: Measuring distance between two trees



Location: Banks of Kalna River, Alorna, Pernem



Fig 4: Tree survey trough transect walk



Fig 5: Measurement of road



Alorna, Goa, India
PV7X+Q76, Alorna, Goa 403512, India
Lat 15.713798°
Long 73.866914°
07/04/22 08:32 AM

Location: Amthane Dam, Bicholim



Dumacem, Goa, India
MWC4+8V4, Amthane, Dumacem, Goa 403503, India
Lat 15.669102°
Long 73.908028°
07/04/22 10:53 AM



Photo Plate 2 South Goa

Location: Nanda Lake, wetland, Cacora, Quepem – Goa.



Fig 6: Tree Survey at Nanda Lake, Quepem



Location: Banks of Kushavati River, Quepem – Goa



Fig 7: Tree Survey at Kushavati River, Quepem



Location: Borimol canal, Quepem – Goa



The field survey was conducted to understand the native as well as organized species plantations along / around various locations and the location wise details are placed below. Graphs depict predominant species.

Table- Pilerne Lake Data Group 1			
Sr.No	Local Name (A To B)	Scientific Name	Number of Trees
1	Chandado	<i>Macaranga peltata</i>	1
2	Bhilloh Maad	<i>Careya urens</i>	46
3	Mango tree	<i>Mangifera indica</i>	5
4	Savar tree	<i>Bombax ceiba</i>	1
5	Bokul(ovla)	<i>Mimusops elengi</i>	10
6	Kharvat tree	<i>Ficus exasperata</i>	3
7	Bhedas	<i>Syzygium caryophyllatum</i>	1
8	Coconut tree	<i>Cocus nucifera</i>	1
9	Shiris tree	<i>Albizia lebbeck</i>	2
10	Bibo tree	<i>Semecarpus anacardium</i>	4
13	Tirphala tree	<i>Zanthoxylum rhetsa</i>	3
14	Moi tree	<i>Lannea coromandelica</i>	10
15	Kaatekavach tree	<i>Bridelia retusa</i>	1
16	Jackfruit tree	<i>Artocarpus heterophyllus</i>	1
18	Chara	<i>Buchanania lanzan</i>	2
20	Jambul tree	<i>Syzygium cumini</i>	1
21	Cashew tree	<i>Anacardium occidentale</i>	1
22	Kumyo tree	<i>Careya arborea</i>	1
23	Kinal tree	<i>Terminalia paniculata</i>	1

Pilerne Lake Data Group 1

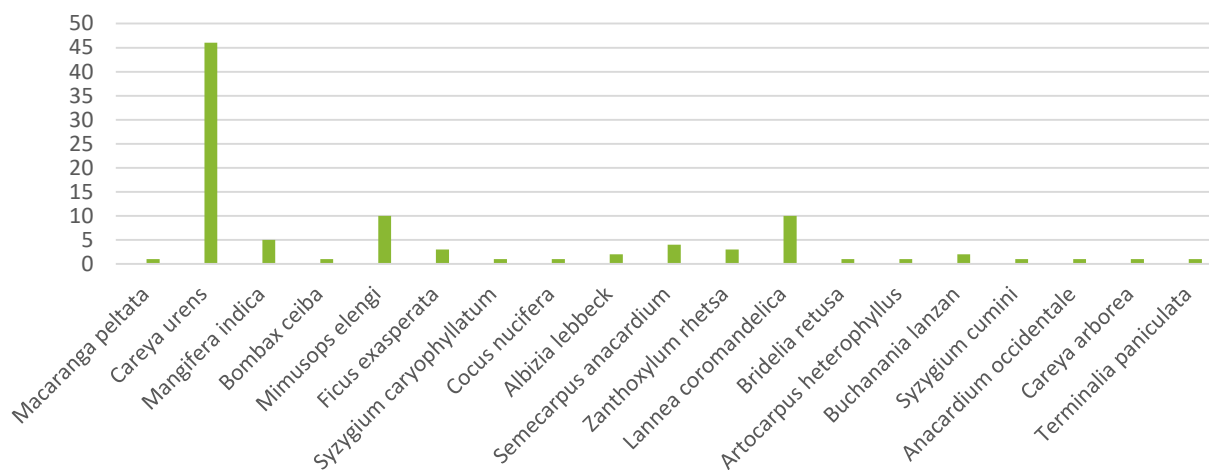


Table- Pilerne Lake Data Group 2

Sr. No.	Local Name (C To B)	Scientific Name	Number of Trees	Height (M)	Girth (Cm)
1	Mango	<i>Mangifera indica</i>	7	20	201
2	Bibo	<i>Semecarpus anacardium</i>	2	10	75
3	Bhillo Maad	<i>Careya urens</i>	19	7	95
4	Arjun	<i>Sterculia urens</i>	8	5	70
5	Moi	<i>Lannea coromandelica</i>	5	7	75
6	Karmal	<i>Dillenia pentagyna</i>	1	7	70
7	Cashew	<i>Anacardium occidentale</i>	18	8	82
8	Sailo	<i>Tectona grandis</i>	14	8	45
9	Dhaman	<i>Grewia tilifolia</i>	2	5	30
10	Tefla	<i>Zanthoxylum rhetsa</i>	3	7	70
11	Savar	<i>Bombax ceiba</i>	1	8	100.5
12	Matti	<i>Terminalia eliptica</i>	2	8	95
13	Coconut	<i>Cocus nucifera</i>	30	6	78
14	Drumstick	<i>Moringa oleifera</i>	1	3	45
15	Chikoo	<i>Manilkara zapota</i>	1	3	45
16	Jack Fruit	<i>Artocarpus heterophyllus</i>	3	9	92
17	Kandla	<i>Rhizophora mucronata</i>	7	12	100.1
18	Ghotting	<i>Terminalia bellirica</i>	1	15	100.6
19	Ovla	<i>Mimusops elengi</i>	1	6	85
20	Jamun	<i>Syzygium cumini</i>	2	12	200.9
21	Mirvo	<i>Polyalthia fragrans</i>	4		
22	Chandado	<i>Macaranga peltata</i>	1	12	100.1
23	Shankar	<i>Caesalpinia pulcherrima</i>	1	10	100.3

Pilerne Lake Group 2

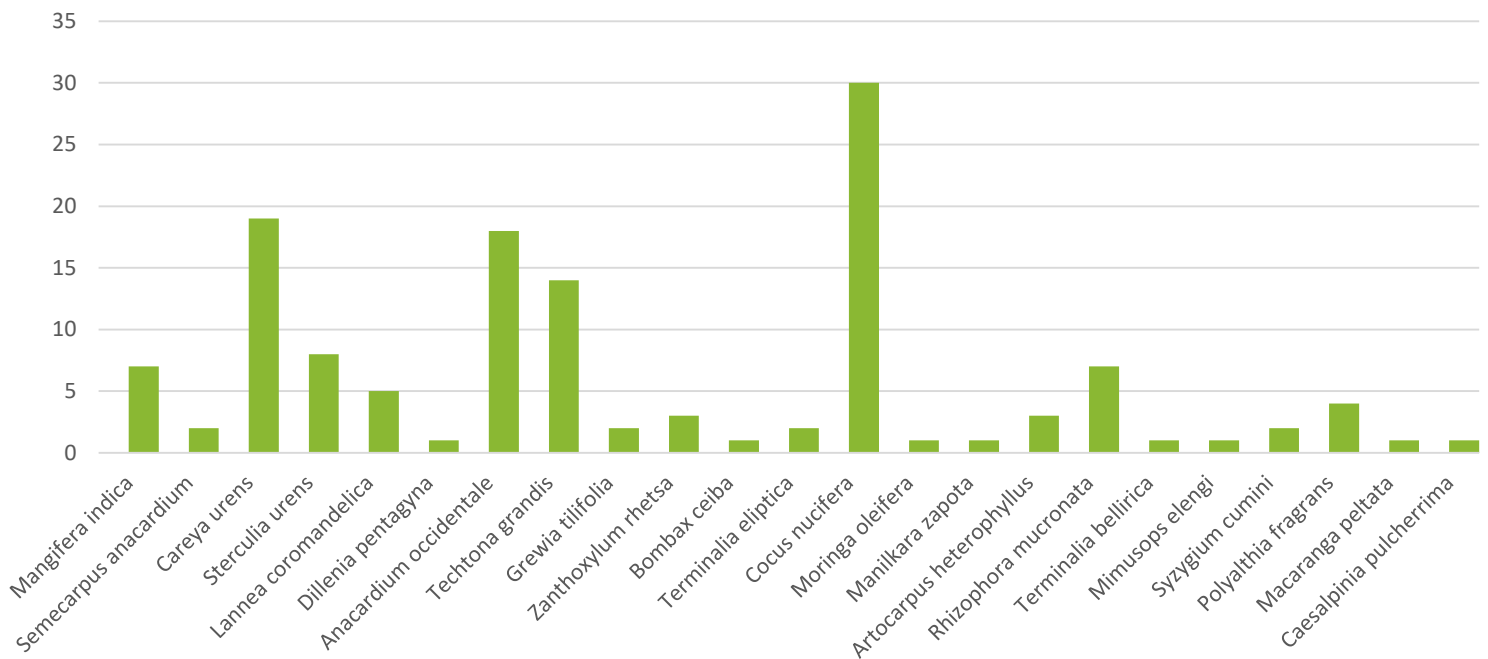


Table- Khutwal Lake Data

Sr.No.	Local Name	Scientific Name	Number of Trees
1	Jackfruit tree	<i>Artocarpus heterophyllus</i>	9
2	Mango tree	<i>Mangifera indica</i>	3
3	Chandado tree	<i>Macaranga peltata</i>	4
4	Bhendi tree	<i>Hibiscus tiliaceus</i>	1
5	Bhillo Maad	<i>Caryota urens</i>	8
6	Sailo tree	<i>Tectona grandis</i>	25
7	Katekawach tree	<i>Bridelia retusa</i>	2
8	Jambul tree	<i>Syzygium cumini</i>	14
11	Satvin tree	<i>Alstonia scholaris</i>	1
12	Tefla tree	<i>Zanthoxylum rhetsa</i>	1
13	Rumad (Black Rumad/Bokardo)	<i>Ficus racemosa</i>	1
14	Murud Sheg tree	<i>Helicteres isora</i>	1
17	Bhirand tree	<i>Garcinia indica</i>	1
18	Kumio tree	<i>Careya arborea</i>	1
20	Mirvo tree	<i>Polyalthia fragrans</i>	1
21	Coconut tree	<i>Cocus nucifera</i>	43
25	Cashew tree	<i>Anacardium occidentale</i>	4

28	Avla tree(Indian gooseberry)	<i>Phyllanthus emblica</i>	1
29	Shivan(yellow flowers)	<i>Gmelina arborea</i>	1
30	Bhirand tree	<i>Garcinia indica</i>	1

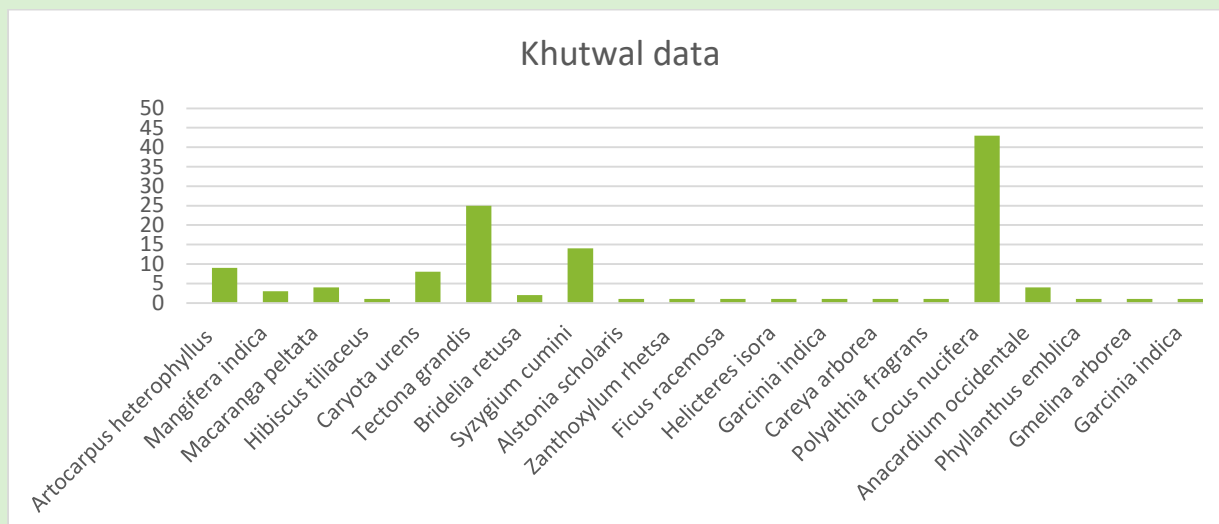
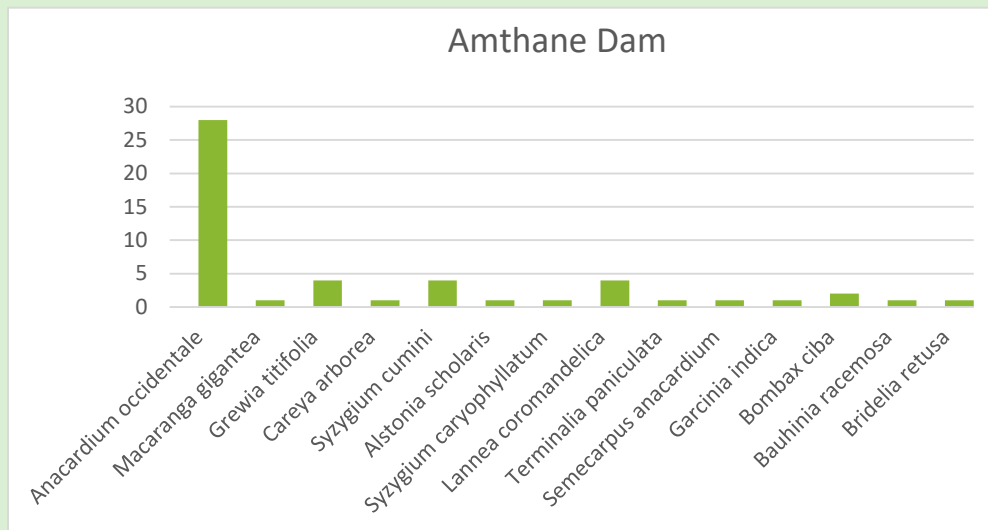


Table- Amthane Dam			
Sr. No.	Local Name	Scientific Name	Number of Trees
1	Cashew tree	<i>Anacardium occidentale</i>	28
2	Amti tree	<i>Macaranga gigantea</i>	1
3	Dhaman tree	<i>Grewia titifolia</i>	4
4	Kumiyo tree	<i>Careya arborea</i>	1
5	Jambal tree	<i>Syzygium cumini</i>	4
6	Satvin tree	<i>Alstonia scholaris</i>	1
7	Bhedas tree	<i>Syzygium caryophyllatum</i>	1
8	Moi tree	<i>Lannea coromandelica</i>	4
9	Kinal tree	<i>Terminalia paniculata</i>	1
10	Bibo tree	<i>Semecarpus anacardium</i>	1
11	Bhirand tree	<i>Garcinia indica</i>	1
12	Kate Savar tree	<i>Bombax ciba</i>	2
13	Aapto tree	<i>Bauhinia racemosa</i>	1
14	Katekawach tree	<i>Bridelia retusa</i>	1



Observations as outcome of the study

1. The interrelation between flora and fauna is visible considering predominant species around the water bodies or lakes are those which are propagated by civet cats, reptiles or birds etc. The distance between these trees in natural condition is very close as they are not organized plantations whereas organized plantations along canals are sparsely placed with fairly equal spacing.
2. The riverside indigenous species hold the soil and protect river banks. Hence, predominantly fresh water and saline water mangroves and associated species. Also, *Ficus* and other native species are found along riverside in addition to mangroves and associated species.
3. Some of the species seen on plateau are also those found in forest and on peripheral forests but their growth on plateau is slow and short due to limiting conditions.
4. Hence when it comes to number of plants to be recommended in particular locality, it is best to consider organized plantations or if the owner is private and decides to adopt intensive plantation using methods like Miyawaki or other traditionally proven techniques then the same may be considered for relatively small areas as felt appropriate by the deciding forest official.

ANNEXURE II

RECOMMENDATIONS OF THE COMMITTEE ON

- 1. SPECIFYING STANDARDS REGARDING NUMBER AND KIND OF TREES WHICH EAH LOCALITY, TYPE OF LAND AND PREMISES.**
- 2. STANDARDS FOR PLANTING AND MAINTAINING OF TREES ON ROADS, IN PUBLIC PARKS AND GARDENS AND ON THE BANKS OF RIVERS OR LAKES OR SEASHORES**

SPECIFYING STANDARDS REGARDING NUMBER AND KIND OF TREES FOR EACH LOCALITY, TYPE OF LAND AND PREMISES.

The committee deliberated on specifying standards regarding number and kind of trees which each locality , type of land and premises shall have . It was concluded that it cannot be suggested to have standards on the number of trees for each locality , type of land and premises , since the choice and type of tree to be planted should be kept for discretion of the owner / management to choose of their choice , based on available land , location etc

The owner / management of land shall hold the prerogative of type and species of plants, number of plants to be planted in their land , as per availability of land , and their preferred choice , it will be difficult to fix any such fixed criteria on specific number of plants to be planted species wise in each type of land use, as per provisions of Section & sub section c of Goa Preservation of Tree Act, 1984 , wherein it is mandated to plant minimum five trees per hectare in rural areas .

The Committee has also recommended exhaustive list of trees along with spacing and planting pit dimensions to be considered in different landscapes, premises and type of land , so that people at large can take up plantations at free choice and the number of trees to be planted can be decided based on available land and other edaphic factors.

STANDARDS FOR PLANTING AND MAINTAINING OF TREES ON ROADS, IN PUBLIC PARKS AND GARDENS AND ON THE BANKS OF RIVERS OR LAKES OR SEASHORES

ANNEXURE II A

LIST OF TREES PROPOSED FOR PLANTATION IN GOA STATE

(APPROVED BY FOREST DEPARTMENT, GOA STATE) WITH RECOMMENDED SPACING BETWEEN SAPLINGS OF

PROMINENT SPECIES:

Table I

Sr. No.	Local Name	Botanical Name	Uses **	Space between two saplings (m – meter, ft – feet)	Pit Size for planting
1.	Arjun	<i>Terminalia arjuna</i>	<i>Terminalia arjuna</i> Bark is used in different forms like bark juice, powder, decoction etc. Bark is mainly used for heart diseases and as a heart tonic.	6m x 6m	60cm x 60cm x 60cm
2.	Awala	<i>Emblica officinalis</i>	Emblica exhibits strong antioxidant activity. It is one of the most important plants in the traditional Ayurvedic medical system as well as in other traditional health systems for immunomodulatory, anti-inflammatory, antiulcer, hepatoprotective, and anticancer actions.	4.5 m x 4.5 m	1 m x 1 m x 1m
3.	Badam	<i>Terminallia catappa</i>	Various parts of the tree, such as the leaves and fruit, contain tannins and are astringent. The fluid from the bark is used to treat diabetes and as a tonic. The tree's vast root system binds together both sands and poor soils.	6m x 6 m	1 m x 1 m x 1m
4.	Balo	<i>Cassia fistula</i>	The ripe pods and seeds are widely used in both traditional and conventional medicine as a laxative. The pods are used as a remedy for malaria, blood poisoning, anthrax, diabetes and dysentery	2m x 2m	1 m x 1 m x 1m
5.	Bel	<i>Aegle marmelos</i>	The fruits, leaves, twigs and root of the bel tree are used medicinally. The ripe fruit is also laxative and demulcent. It eases stomach pain and supports healthy function of the stomach.	6 m x 6 m	1 m x 1 m x 1m

6.	Bhillomaad	<i>Caryota urens</i>	A porridge prepared from the seed flour is prescribed by local physicians to treat gastric ulcers, migraine headaches, snake-bite poisoning and rheumatic swellings. The root is used for treating tooth ailments.	7.5m to 10m	1.2m x 1.2m x 1.2m
7.	Bhirand	<i>Garcinia indica</i>	The root, bark, fruit and the seed oil are used to treat piles, abdominal disorders, mouth diseases and worm infestations. The seed butter is used as a remedy in the treatment of dysentery and mucous diarrhea.	5m to 6m	60cm x 60cm x 60cm
8.	Bimbal, bilimbi	<i>Averrhoa bilimbi</i>	The leaves can be used to cure syphilis when taken internally, either fresh or fermented. Three leaves are put in water and the liquid is drunk daily as a remedy for high blood pressure.	5m x 5m	1 m x 1 m x 1m
9.	Cashew (native – natural selection)	<i>Anacardium occidentale</i>	The fruit is anti-scorbutic, astringent and diuretic. Cashew syrup is a good remedy for coughs and colds.	6m x 6m	1 m x 1 m x 1m
10.	Chafi	<i>Michelia champaka</i>	The bark is used as a febrifuge. The flowers are used to treat leprosy. A decoction of the bark and leaves is given after childbirth.	7 ft x 7 ft	45cm x 45 cm x 45 cm
11.	Chafra	<i>Flacourtia montana</i>	Fruits are pleasantly acrid, eaten raw or made into jelly.	7 ft x 7 ft	45cm x 45 cm x 45 cm
12.	Chandan, sandal wood	<i>Santalum album</i>	sandalwood oil has been widely used in folk medicine for treatment of common colds, bronchitis, skin disorders, heart ailments, general weakness, fever, infection of the urinary tract, inflammation of the mouth and pharynx	10 ft	45cm x 45 cm x 45 cm
13.	Chapha	<i>Magnolia champaca</i>	It has a finely textured, dark brown and olive-colored wood, which is used in furniture making, construction, and cabinetry	7 ft x 7 ft	45cms x 45cms x 45cm
14.	Copperpod tree	<i>Peltophorum pterocarpum</i>	In traditional medicine it is used as an astringent to cure or relieve intestinal disorders after pain at childbirth, sprains, bruises and swelling or as a lotion for eye troubles, muscular pains and sores.	6m x 6m	60cm x 60cm x 60cm
15.	Dhavorukh / Arjun	<i>Stercularia urens</i>	The gum is also used to treat throat infections.	6m x 6m	60cm x 60cm x 60cm
16.	Flame tree	<i>Spathodea campanulata</i>	The seeds, flowers and roots are used as medicine. The unopened flower buds contain a sweet, watery liquid that is considered to be tonic.	6m x 6m	60cm x 60cm x 60cm

17.	Ghoting	<i>Terminalia bellerica</i>	In Indian herbal medicine the ripe fruit is used in cases of diarrhea and indigestion, whilst the unripe fruit is used as a laxative in cases of chronic constipation.	6m x 6m	60cm x 60cm x 60cm
18.	Guava	<i>Psidium guajava</i>	The ripe, fresh fruit is eaten as a cure for constipation. The bark, mixed with the roots of <i>Achyranthes aspera</i> and <i>Urena lobata</i> , is used to treat diarrhea and dysentery.	4m x 4m	1m x 1m x 1m
19.	Harda	<i>Terminalia chebula</i>	Black myrobalan is of central importance to Ayurvedic medicine. It has long been considered a prime remedy for all manner of digestive problems.	6m x 6m	60cm x 60cm x 60cm
20.	Jagma	<i>Flacourtia jangomas</i>	The roots, leaves and bark all contain tannins and are used in the treatment of diarrhea. A decoction of the bark, mixed with mustard seed paste, is used in the treatment of diarrhea and dysentery. The fruit is usually rubbed between the palms of the hands prior to eating it in order to reduce the astringency	5m x 5m	60cm x 60cm x 60cm
21.	Jaiphal	<i>Myristica fragrans</i>	The seed of nutmeg is rich in essential oils. Nutmeg is also said to have stimulant, carminative and aphrodisiac properties. The seed is used in Ayurveda to treat poor digestion, insomnia, urinary incontinence and premature ejaculation.	5m x 5m	60cm x 60cm x 60cm
22.	Jambo	<i>Xylia xylocarpa</i>	The bark contains tannins and is astringent. A decoction is used to rid the body of worms. It is also used in the treatment of leprosy, vomiting, diarrhea, gonorrhoea and ulcers.	6m x 6m	60cm x 60cm x 60cm
23.	Jambul	<i>Syzygium cumini</i>	Both the seeds and the fruit are diuretic and have important carminative and astringent properties. The seeds also reduce blood sugar levels and are useful in the treatment of diabetes. Fruit - raw or made into jams, sherbet, jellies, juice, tarts, puddings etc.	8m x 8m	1m x 1m x 1m
24.	Kachnar	<i>Bauhinia variegata</i>	The bark is alterative, anthelmintic, astringent and tonic. The juice of the bark is used in the treatment of amoebic dysentery, diarrhoea and other stomach disorders.	6m x 6m	60cm x 60cm x 60cm
25.	Kadamb	<i>Anthocephalus cadamba</i>	The dried bark is used to relieve fever and as a tonic. An extract of the leaves serves as a mouth gargle. The plant is considered to be astringent, digestive, expectorant and febrifuge. It is used in the treatment of conditions such as	6m x 6 m	1m x 1m x 1m

			ulcers, digestive problems, fevers and vomiting.		
26.	Karanjei	<i>Millettia pinnata</i>	The seed oil is given as a stomachic and cholagogue in the treatment of dyspepsia and cases of sluggish liver.	5m x 5m	45cm x 45cm x 45cm
27.	Karmal	<i>Averrhoa carambola</i>	The powdered seed is given as an expectorant in the treatment of bronchitis and whooping cough, and is also prescribed as a febrifuge and tonic.	6m x 6m	1m x 1m x 1m
28.	Karo	<i>Strychnos nux-vomica</i>	The root bark is ground up into a fine paste with lime juice and made into pills which are said to be an effective treatment for cholera.	6m x 6m	60cm x 60cm x 60cm
29.	Karvill, kadipatta	<i>Murraya koenigii</i>	Curry leaf contains several medically active constituents including a glycoside called koenigine, an essential oil and tannins. The leaves, roots and bark can all be used internally in the treatment of digestive problems.	2m to 4m	30cm x 30cm x 30cm
30.	Kindal	<i>Terminalia paniculate</i>	The fruits are a source of tannins and can be used as a dye. The wood is very useful for ship building and is used as substitute for teak.	6m x 6m	60cm x 60cm x 60cm
31.	Kumyo	<i>Careya arborea</i>	The fibrous bark has been applied medicinally for relieving body swellings. The juice of the bark, and the calices of the flowers, is astringent and mucilaginous.	4m x 4m	60cm x 60cm x 60cm
32.	Lavang	<i>Syzygium aromaticum</i>	Cloves, and the essential oil contained in them, are often used medicinally. A spicy, warming, stimulant herb, it is strongly antiseptic, relieves pain, controls nausea and vomiting, improves digestion, protects against intestinal parasites, and causes uterine contractions.	5m x 5m	75cm x 75cm x 75cm
33.	Mad	<i>Cocos nucifera</i>	A very versatile food, being eaten raw and used in a wide range of cooked dishes. The seed is often dried then shredded to be used as a flavoring in cakes, curries etc.	7.5m to 10m	1.2m x 1.2m x 1.2m
34.	Madat	<i>Terminalia elliptica</i>	The bark, and especially the fruit, yield pyrogallol and catechol. Pyrogallol has antiseptic properties, whilst catechol is an antioxidant. The bark is astringent. It is used in the treatment of diarrhoea	6m x 6m	60cm x 60cm x 60cm
35.	Mango	<i>Mangifera indica</i>	The leaves are astringent and odontalgic. An infusion is drunk to reduce blood pressure and as a treatment for conditions	8m x 8m	1 m x 1m x 1m

			such as angina, asthma, coughs and diabetes.			
36.	Mashing	<i>Moringa oleifera</i>	Moringa is used for asthma, diabetes, obesity, symptoms of menopause	6m x 6m	50cm 50cm 50cm	x x x
37.	Moi	<i>Lannea coromandelica</i>	The bark and the leaves are used as medicine. The powdered bark is used as a flavouring.	5m x 5m	45cm 45cm 45cm	x x x
38.	Nano	<i>Lagerstroemia lanceolate</i>	The heartwood is red or reddish-brown. The wood is moderately hard, not durable in the open, liable to split. It is used for construction, ship building, coffee cases, furniture.	5m x 5m	45cm 45cm 45cm	x x x
39.	Narkya, Ghaneri	<i>Nothaphodytes nimmoniana</i>	This species has gained a considerable importance in recent times, for its alkaloid camptothecin, 9-hydroxy Camptothecin and Mappicin which are quite effective against a variety of cancers.	2m x 2m	45cm 45cm 45cm	x x x
40.	Neem	<i>Azadirachta indica</i>	Use of Neem has been recommended by Ayurveda for a wide range of diseases. It is suggested to be an antibacterial, anthelmintic, antiviral, anticancer and more importantly Immunomodulatory agent.	5m x 5m	25cm 25cm 25cm	x x x
41.	Neem Chameli	<i>Milingtonia hortensis</i>	The tree is considered ornamental and the pleasant fragrance of the flowers renders it ideal as a garden tree. The wood is also used as timber and the bark is used as an inferior substitute for cork.	5m x 5m	45cm 45cm 45cm	x x x
42.	Nirpanas	<i>Artocarpus altilis</i>	Breadfruit is a staple food in many tropical regions. Most breadfruit varieties produce fruit throughout the year. Both ripe and unripe fruit have culinary uses; unripe breadfruit is cooked before consumption.	10m to 12m	60cm 60cm 60cm	x x x
43.	Ovala	<i>Mimusops elengi</i>	The bark is astringent, bitter and tonic. It is used in the treatment of diarrhoea and dysentery. The leaves are used to treat headache, toothache, wounds and sore eyes, and are smoked to cure infections of the nose and mouth.	5m x 5m	45cm 45cm 45cm	x x x
44.	Palas	<i>Butea monosperma</i>	The seeds, ground into a paste with honey, are used for their anthelmintic, antifungal, antibacterial and purgative properties.	5m x 5m	45cm 45cm 45cm	x x x
45.	Palpanas	<i>Annona muricata</i>	The fruit is used as natural medicine for arthritic pain, neuralgia, arthritis, diarrhea, dysentery, fever, malaria, parasites, rheumatism, skin rashes and	4m x 4m	50cm 50cm 50cm	x x x

			worms, and it is also eaten to elevate a mother's milk after childbirth.		
46.	Parijat	<i>Nyctanthes arbor-tristis</i>	A saffron-yellow dye obtained from the flowers is used for coloring food. The bitter leaves are useful as a cholagogue, laxative, diaphoretic and diuretic	5m x 5m	45cm x 45cm x 45cm
47.	Peepal	<i>Ficus religiosa</i>	Fresh sap from the leaves is used to cure diarrhea, cholera and for wound healing.	8m to 10m	45cm x 45cm x 45cm
48.	Phanas	<i>Artocarpus heterocarpus</i>	Fruit - raw or cooked in a variety of ways. The ashes of leaves, with or without oil, are used to treat ulcers, diarrhoea, boils, stomach-ache and wounds. The pulp and seeds of the fruit are regarded as a cooling tonic.	6m x 6m	1m x 1m x 1 m
49.	Putranjiva	<i>Putranjiva roxburghii</i>	A decoction of leaves and fruit is taken for the treatment of liver complaints, colds, fevers and rheumatism.	5m x 5m	45cm x 45cm x 45cm
50.	Ranawara	<i>Senna auriculate</i>	The plant has a long tradition of use in local medicine, with the leaves, flowers, seeds, roots, and bark all being utilized. A decoction of the flowers and the seeds is recommended for diabetes.	5m x 5m	45cm x 45cm x 45cm
51.	Ritho	<i>Sapindus laurifolius/ mukorossi</i>	The fruit is rich in saponins. It is used as a substitute for soap in washing clothes, particularly delicate and natural fabrics.	5m x 5m	45cm x 45cm x 45cm
52.	Rumad	<i>Ficus glomerata/racemose</i>	The leaves are used in the treatment of diarrhea. The bark is astringent. It is used in the treatment of hematuria, menorrhagia, and hemoptysis.	8m to 10m	45cm x 45cm x 45cm
53.	Sal	<i>Tectona grandis</i>	A wood tar paste is made from the powdered wood by putting it into hot water. It is vermifuge; promotes digestion; is effective in relieving bilious headaches and tooth aches; reduces inflammations or eruptions of the skin.	6m x 6m	1m x 1m x 1 m
54.	Santvin	<i>Alstonia scholaris</i>	The bark is a bitter, astringent, alterative herb that lowers fevers, relaxes spasms, stimulates lactation and expels intestinal worms.	6m x 6m	45cm x 45cm x 45cm
55.	Savar	<i>Bombax ceiba</i>	The flowers are astringent and refrigerant. The young roots are diuretic and tonic. They are used in the treatment of cholera, tubercular fistula, coughs, urinary complaints, nocturnal pollution, abdominal pain due to dysentery, and impotency.	6m x 6m	45cm x 45cm x 45cm
56.	Shivan	<i>Gmelina arborea</i>	Both fruit and bark have medicinal properties against bilious fever. The leaf sap is used as a demulcent to treat	5m x 5m	45cm x 45cm x 45cm

			gonorrhoea and cough, and is also applied to wounds and ulcers.		
57.	Shirish (Siris)	<i>Albizia lebbek</i>	The leaves and seeds are used in the treatment of eye problems such as ophthalmia. The bark is astringent. It is taken internally to treat diarrhoea, dysentery and piles. The bark is used externally to treat boils	5m x 5m	45cm x 45cm x 45cm
58.	Sita Ashok	<i>Saraca asoca</i>	Ashoka is a very popular medicinal herb in Ayurveda, where it is said to be particularly useful for treating a range of conditions related to the female reproductive system.	5m x 5m	45cm x 45cm x 45cm
59.	Sitaphal	<i>Annona squamosa</i>	The sweet and creamy fruits are highly regarded as a dessert fruit. Leaves, shoots, bark and roots have been reported to have medicinal properties.	5m x 5m	45cm x 45cm x 45cm
60.	Supari	<i>Areca catechu</i>	Betel palm is an astringent, stimulant herb that relieves hunger, abdominal discomfort and weariness. It kills intestinal parasites and other pathogens, and also has diuretic and laxative effects.	2.7m x 2.7m	90cm x 90cm x 90cm
61.	Suranga	<i>Mammea suriga</i>	It is a medium sized plant bearing fragrant white flowers. It is cultivated in Western Ghats for its flowers.	5m x 5m	45cm x 45cm x 45cm
62.	Taman	<i>Lagerstroemia reginae</i>	The tree has a dense and wide spreading root system, which has made it useful in plantings for erosion control. A preparation from dried leaves, known as banaba, is widely used in the Philippines to treat diabetes and urinary problem	5m x 5m	45cm x 45cm x 45cm
63.	Taman	<i>Lagerstroemia speciose</i>	The tree has a dense and wide spreading root system, which has made it useful in plantings for erosion control.	5m x 5m	45cm x 45cm x 45cm
64.	Tefla	<i>Zanthoxylum rhetsa</i>	The peel of the fruits, the seeds, the bark of the stems and roots as well as the oil (mullillam-oil), extracted from the fruits, are used for medicinal purposes.	5m x 5m	45cm x 45cm x 45cm
65.	Tikhi	<i>Cinnamomum zeylanicum</i>	The stem bark is used as a flavoring. A very well-known flavoring, it is used in curries and a wide range of sweet dishes. Essential oils, obtained from the leaves and the bark, are used as food flavorings in a range of foods including sauces and pickles, baked goods, confectionery and cola-type drinks Cinnamon bark oil is employed in a range of dental and pharmaceutical preparations	3m x 3m	50cm x 50cm x 50cm

66.	Vad tree	<i>Ficus bengalensis</i>	The leaves are used to remedy dysentery and diarrhea. The milky latex in the plant is applied topically to treat toothache, bruises, painful areas, rheumatic joints and lumbago. The bark is tonic and diuretic. An infusion is antidiabetic and a decoction is used as an astringent in the treatment of leucorrhea.	10 m to 20 m	60cm 60cm 60cm	x x
67.	Zam	<i>Syzygium aqueum</i>	Fruits usually eaten raw. Various parts of the tree are used in traditional medicine, and some have in fact been shown to possess antibiotic activity.	5m x 5m	45cm 45cm 45cm	x x
68.	Dhoop	<i>Vateria indica</i>	Gum used in incense sticks	10mx10 m	60cm 60cm 60cm	x x
69.	Ebony	<i>Diospyros montana</i>	Timber especially canoe making	10mx10 m	60cm 60cm 60cm	x x
70.	Ebony	<i>Diospyros paniculata</i>	Timber	10mx10 m	60cm 60cm 60cm	x x
71.	Egg fruit	<i>Pouteria campechiana</i>	Edible fruit	8m x 8m	60cm 60cm 60cm	x x
72.	Limbu	<i>Citrus limon</i>	Edible fruit	5mx5m	45cm 45cm 45cm	x x
73.	Mahua	<i>Madhuca Indica</i>	Timber and apiculture	10mx10 m	60cm 60cm 60cm	x x
74.	Mohogony	<i>Swietenia mahagoni</i>	Timber	10mx10 m	60cm 60cm 60cm	x x
75.	Malabar tamarind	<i>Garcinia gummigutta</i>	Edible fruits	10mx10 m	60cm 60cm 60cm	x x
76.	Nagkeshar	<i>Mesua ferrea</i>	Essential oils, apiculture, musical instruments making	10mx10 m	60cm 60cm 60cm	x x
77.	Ramphal	<i>Annona reticulate</i>	Edible and leaves as insecticide	8mx8m	45cm 45cm 45cm	x x
78.	Shisam	<i>Dalbergia sisso</i>	Timber	10mx10 m	60cm 60cm 60cm	x x
79.	Raktachandan (Red sanders)	<i>Pterocarpus santalinus</i>	Expensive wood used for pooja & timber	10m x 10m	60cm 60cm 60cm	x x

80.	Chaul Mogra	<i>Hydnocarpus laurifolia</i>	Flowers, essential oils	4m x 4m	45cm 45cm 45cm	x x x
81.	Chafa (Kavthi)	<i>Magnolia lilifera</i>	Flowers, essential oils	8m x 8m	45cm 45cm 45cm	x x x

** <http://tropical.theferns.info>: useful tropical plants and traditional knowledge

Note – *If the name of species selected does not reflect in above table then the same should be requested for approval from designated competent authority approved by Tree authority.*

Note- *If the distance for a specific species of tree is not given in the annexure, then minimum distance of 3 m to be followed and for fruit bearing trees minimum distance 7-8 m to be followed.*

ANNEXURE II B

A. SPECIES RECOMMENDED FOR HIGHWAY & ROADSIDE PLANTATIONS

- It is not possible to lay down rigid and uniform standards for tree plantation along roads, as the plantation scheme to be adopted may vary from place to place depending upon the topography, climate and other environmental conditions / features
- This report lays down broad general guidelines subject to such modifications as may be governed by local site conditions
- It would be productive and useful, if the road agencies consult with the departments dealing with Forest and Agriculture for seeking their advice as to the selection of species and methods of plantation especially for large scale plantation programs exceeding 25 nos.
- Ornamental and flowering species of plants should be selected for plantation along the road, near the entry of village and also near the junctions from the main roads.
- Species with aroma which do not attract cattle should normally be proposed along the roadside
- A combination of ornamental, shade and screening trees have been recommended
- Roads margins available NH, SH, MDR's and village road throughout the state can be used for plantation without causing hindrance to preexisting rights and privileges of existing dwellers
- Road medians to be planted with herbaceous shrubs (Flowering & Non Flowering)

1. NEED BASED SPECIES OF PLANTS RECOMMENDED

- SHADE PURPOSE:
 - *Azardirecta indica, Albezzia lebbeck, Dalbergia sissio, Ficus, T. Belerica, Termanalia arjuna, Callophyllum oenophyllum, Fagara budrunga, Mohagany, Vateria , mango and other suitable local species*
- FLOWERING TREES
 - *Bauhinia sps , Cassia fistula ,Cassia nodusa ,Jacaranda mimosaeifolia, Peltophorum ferrugineum*
- FRUITING TREES
 - Mango, Tamarind, Jamun, *Mimosops elengi*

*** Other Suitable local species shall be personally decided by concerned Deputy Conservator of Forests, after proper assessment with regards to the site, climatic and other local conditions.**

Strategy – shade or flowering plants with greenery and canopy are preferred in first line near the road. Second and subsequent rows, if possible, based on available space, then the suitable fruit bearing species may be selected. But it is necessary to ensure systematic harvesting of fruits by entrusting responsibility without creating any hindrance to the traffic or safety. Above are indicative species. For exhaustive list of species kindly refer below

A. INDICATIVE LIST OF PLANTS ALONG HIGHWAY & ROADSIDE

Table 2

SR. NO	LOCAL NAME	BOTANICAL NAME
1	Sita Ashok	<i>Saraca indica</i>
2	Mango	<i>Mangifera indica</i>
3	Cashew	<i>Anacardium occidentale</i>
4	Rosewood	<i>Dalbergia latifolia</i>
5	Mahogoni	<i>Sweitenia mahogoni</i>
6	Mahogoni sp.	<i>Sweitenia macrophylla</i>
7	Trumpet Tree	<i>Tabubia spectabilis</i>
8	Trumpet Tree	<i>Tabubea rosea</i>
9	Casurina	<i>Casuarina equisetifolia</i>
10	Shankar	<i>Caesalpinia Pulcherrima</i>
11	Bhendi	<i>Thespesia Populnea</i>
12	Kapoor	<i>Cinamomum camphora</i>
13	Palms	
14	Kanakchampa, Bayur or Karnikara	<i>Pterospermum acerifolium</i>
15	Neem Chameli	<i>Millingtonia Hortensis</i>
16	Devils Tree	<i>Alstonia Scholaris</i>
17	Jacaranda	<i>Jacaranda Mimosifolia</i>
18	Vavlo	<i>Holoptelia Integrifolia</i>
19	Kino	<i>Pterocarpus Marsupium</i>

Note – Above list is extracted and enhanced based on Indian Roads Congress List and It is possible to include more plants from agrobiodiversity list or any other list from Annexure I or II based on desired attributes but without leading to monoculture

ANNEXURE II C

B. SPECIES RECOMMENDED FOR PLANTATION IN URBAN AREAS INCLUDING PUBLIC PARKS AND GARDENS

- Vacant areas, gardens, Parks & and the roadside spaces in urban areas subject to availability should be taken for plantation
- Care has to be taken to avoid electricity line and telephone lines during alignment
- Species recommended: Mahogany, Kadamba, Mango, Tabubia, Spathodia , Bahuania , Butea monosperma, madhuca latifolia, Neem , Michelia champaca, Suranga , Lagerstroemia speciosa etc.
- Strategy – Above are indicative species. For exhaustive list of species kindly refer below

INDICATIVE LIST OF PLANTS FOR URBAN AREAS INCLUDING PUBLIC PARKS AND GARDENS

Table 3

Mahogany, Kadamba, Mango, Tabubia, Spathodia , Bahuania , Butea monosperma, madhuca latifolia, Neem, Michelia champaca, Suranga , Lagerstroemia speciosa etc.		
Sr. No.	Local Name	Botanical Name
1.	Arjun	<i>Terminalia arjuna</i>
2.	Awala	<i>Emblica officinalis</i>
3.	Badam	<i>Terminallia catappa</i>
4.	Balo	<i>Cassia fistula</i>
5.	Bamboo	<i>Bambusa vulgaris</i>
6.	Bel	<i>Aegle marmelos</i>
7.	Bhendi	<i>Thespesia populnea</i>
8.	Bhillomaad	<i>Caryota urens</i>
9.	Bottle Brush	<i>Callistemon citrinus</i>
10.	Casuarina / Suru	<i>Casuarina equistifolia</i>
11.	Chafi	<i>Michelia champaka</i>
12.	Chandan, sandal wood	<i>Santalum album</i>
13.	Chapha	<i>Magnolia champaca</i>

14.	Charoli	<i>Buchanania lanzan</i>
15.	Copperpod tree	<i>Peltophorum pterocarpum</i>
16.	Dhavorukh / Arjun	<i>Stercularia urens</i>
17.	Dhoop	<i>Vataria indica</i>
18.	Flame tree	<i>Spathodea campanulate</i>
19.	Ghoting	<i>Terminalia bellerica</i>
20.	Guava	<i>Psidium guajava</i>
21.	Gulmohar	<i>Delonix regia</i>
22.	Harda	<i>Terminalia chebula</i>
23.	Jacaranda	<i>Jacaranda mimosifolia</i>
24.	Jagma	<i>Flacourtia jangomas</i>
25.	Jambo	<i>Xylia xylocarpa</i>
26.	Jambul	<i>Syzygium cumini</i>
27.	Kachnar	<i>Bauhinia variegata</i>
28.	Kadamb	<i>Anthocephalus cadamba</i>
29.	Karanjei	<i>Millettia pinnata</i>
30.	Karmal	<i>Averrhoa carambola</i>
31.	Karvill, kadipatta	<i>Murraya koenigii</i>
32.	Kindal	<i>Terminalia paniculate</i>
33.	Kumyo	<i>Careya arborea</i>
34.	Lemon	<i>Citrus limon</i>
35.	Mad	<i>Cocos nucifera</i>
36.	Madat	<i>Terminalia elliptica</i>
37.	Malabar Tamarind	<i>Garcinia gummigutta</i>
38.	Mango	<i>Mangifera indica</i>
39.	Nagkesar	<i>Mesua ferrea</i>
40.	Nano	<i>Lagerstroemia lanceolate</i>
41.	Neem	<i>Azadirachta indica</i>
42.	Neem Chameli	<i>Milingtonia hortensis</i>
43.	Ovala	<i>Mimusops elengi</i>
44.	Palas	<i>Butea monosperma</i>
45.	Parijat	<i>Nyctanthes arbor-tristis</i>
46.	Peepal	<i>Ficus religiosa</i>
47.	Putranjiva	<i>Putranjiva roxburghii</i>

48.	Rain tree	<i>Samanea saman</i>
49.	Ranawara	<i>Senna auriculate</i>
50.	Ritho	<i>Sapindus laurifolius/ mukorossi</i>
51.	Rumad	<i>Ficus glomerata/racemose</i>
52.	Sal	<i>Tectona grandis</i>
53.	Santvin	<i>Alstonia scholaris</i>
54.	Savar	<i>Bombax ceiba</i>
55.	Shankar	<i>Caesalpinia pulcherrima</i>
56.	Shirish (Siris)	<i>Albizia lebbeck</i>
57.	Shivan	<i>Gmelina arborea</i>
58.	Sita Ashok	<i>Saraca asoca</i>
59.	Suranga	<i>Mammea suriga</i>
60.	Taman	<i>Lagerstroemia reginae</i>
61.	Taman	<i>Lagerstroemia speciose</i>
62.	Tamarind	<i>Tamarindus indica</i>
63.	Tefla	<i>Zanthoxylum rhetsa</i>
64.	Tikhi	<i>Cinnamomum zeylanicum</i>
65.	Vad tree	<i>Ficus bengalensis</i>
66.	Zam	<i>Syzygium aqueum</i>

Note – Other plants could be selected from any of the tables in this annexure based on the theme or area of park or intended visitors or any other purpose keeping in mind the ecosystem approach

ANNEXURE II D

C. SPECIES RECOMMENDED FOR PLANTATION ALONG AND AROUND CANAL, LAKES, EMBANKMENTS AND WETLANDS

- Preferably adventitious root systems or as given below subject to space availability
- Due to availability of water, Fruit Trees & NTFP can be selected for plantation
- Species recommended: **Mango , Neem, Pongamia pinnata, Vateria indica, , Syzygium cumini, Madhuca latifolia, Emblica officinalis and any other suitable local species**
- Vacant areas, gardens, Parks & and the roadside spaces in urban areas subject to availability should be taken for plantation
- Care has to be taken to avoid electricity line and telephone lines during alignment

Species recommended: **Mahogany, Kadamba, Mango, Tabubia, Spathodia , Bahuania , Butea monosperma, madhuca latifolia, Neem , Michelia champaca, Suranga , Lagestromia speciosa etc.**

- Strategy – The faunal biodiversity like birds and reptiles and other associated fauna play important role in propagation of suitable species around wetlands and lakes that re in natural conditions but in those wetlands around agricultural lands, farmer decides based on experience and livelihood. Example coconut and mango species. It is necessary to ensure plants that will attract more native species and give livelihood opportunities to the nearby communities while ensuring erosion control. systematic harvesting of fruits by entrusting responsibility without creating any hindrance to the traffic or safety. Above are indicative species. For exhaustive list of species kindly refer below

Table 4 INDICATIVE LIST OF PLANTS FOR PLANTATION ALONG AND AROUND CANAL, LAKES, EMBANKMENTS AND WETLANDS

SR. NO	LOCAL NAME	BOTANICAL NAME
1.	Bhillomad	<i>Cariota Urens</i>
2.	Ovala	<i>Mimusops elengi</i>
3.	Moi	<i>Lamnea Coromandelica</i>
4.	Mango	<i>Mangifera indica</i>
5.	Bibo	<i>Semicarpus Anacardium</i>
6.	Tefla	<i>Zanthoxylum Rhetsa</i>
7.	Bhedas	<i>Syzygium Cariophylletum</i>
8.	Bhirand	<i>Garcinia indica</i>
9.	Katekavach	<i>Bridelia Retusa</i>
10.	Chafra	<i>Flacourtia montana</i>
11.	Chara / Chaaroli	<i>Buchanania Lanzas</i>
12.	Guava	<i>Psidium guajava</i>
13.	Jagma	<i>Flacourtia jangomas</i>
14.	Jambul	<i>Syzygiumcumini</i>
15.	Karmal	<i>Averrhoa carambola</i>
16.	Mad	<i>Cocos nucifera</i>
17.	Malabar tamarind	<i>Garcinia gummigutta</i>
18.	Awala	<i>Emblica officinalis</i>
19.	Mashing	<i>Moringa oleifera</i>
20.	Palpanas	<i>Annona murigata</i>
21.	Phanas	<i>Artocarpus heterocarpus</i>
22.	Dhavrukh	<i>Sterculia Urens</i>
23.	Sitaphal	<i>Annona squamosa</i>
24.	Tamarind	<i>Tamarindus indica</i>
25.	Bel	<i>Aegle marmelos</i>
26.	Bimbal, bilimbi	<i>Averrhoa bilimbi</i>
27.	Kumyo	<i>Careya Arborea</i>
28.	Fresh water mangroves	<i>Barringtonia actangulata</i>

Note – The species suitable for birds and other wetland fauna could be planted

ANNEXURE II E

D. SPECIES RECOMMENDED FOR PLANTATION ALONG AND AROUND RIVER, SEA SHORE & COASTAL AREAS

- In Mangrove area: Core mangrove Species recommended from those documented by forest Dept.
- Coastal sand dune belts : Plantation as shelter belt cum vegetative barrier is effective in halting sand erosion
- Species recommended : *Spinifix littorate* , *Ipomea spp*, *Pandanus spp*, *Morinda citrifolia* , *Thespesia populnea* , *Callophyllum inophyllum*, *Anacardium occidentale* , *Casurina equisitfolia*
- *Planting and spacing varies with type of plant from 2x2 mts to 4x4 mts*
- **Strategy** – It is necessary to ensure that plants susceptible to high winds and those capable of holding soil for prevention of soil/sand erosion are preferred. While, *Cocos nusifera* is predominant in groves around coasts it is important to note that saline and fresh water mangrove and associated species are also found on sea banks and shores. Though the *Casurina* sps. are seen to be standing tall besides sand dunes, there are instances wherein they are uprooted during high winds and hence more adaptable existing local species are indicated in exhaustive list of species as given below

INDICATIVE LIST OF PLANTS FOR PLANTATION ALONG AND AROUND
RIVER, SEA SHORE & COASTAL AREAS

Table 5 – 4 lists made at representative locations that could be adopted

List I

SR. NO	LOCAL NAME	BOTANICAL NAME
1	Jackfruit tree	<i>Artocarpus heterophyllus</i>
2	Mango tree	<i>Mangifera indica</i>
3	Chandado tree	<i>Macaranga peltate</i>
4	Bhendi tree	<i>Hibiscus tiliaceus</i>
5	Bhillo Maad	<i>Caryota urens</i>
6	Sailo tree	<i>Tectona grandis</i>
7	Katekawach tree	<i>Bridelia retusa</i>
8	Jambul tree	<i>Syzygium cumini</i>
11	Satvin tree	<i>Alstonia scholaris</i>
12	Tefla tree	<i>Zanthoxylum rhetsa</i>
13	Rumad(Black Rumad/Bokardo)	<i>Ficus racemose</i>
14	Murud Sheg tree	<i>Helicteres isora</i>
17	Bhirand tree	<i>Garcinia indica</i>
18	Kumio tree	<i>Careya arborea</i>
20	Mirvo tree	<i>Polyalthia fragrans</i>
21	Coconut tree	<i>Cocus nucifera</i>
25	Cashew tree	<i>Anacardium occidentale</i>
28	Avla tree (Indian gooseberry)	<i>Phyllanthus emblica</i>
29	Shivan (yellow flowers)	<i>Gmelina arborea</i>
30	Bhirand tree	<i>Garcinia indica</i>

List II

SR. NO	LOCAL NAME	BOTANICAL NAME
1	Cashew tree	<i>Anacardium occidentale</i>
2	Amti tree	<i>Macaranga gigantea</i>
3	Dhaman tree	<i>Grewia titifolia</i>
4	Kumiyo tree	<i>Careya arborea</i>
5	Jambal tree	<i>Syzygium cumini</i>
6	Satvin tree	<i>Alstonia scholaris</i>
7	Bhedas tree	<i>Syzygium caryophyllatum</i>
8	Moi tree	<i>Lannea coromandelica</i>
9	Kinal tree	<i>Terminalia paniculata</i>
10	Bibo tree	<i>Semecarpus anacardium</i>
11	Bhirand tree	<i>Garcinia indica</i>
12	Kate Savar tree	<i>Bombax ciba</i>
13	Aapto tree	<i>Bauhinia racemose</i>
14	Katekawach tree	<i>Bridelia retusa</i>

List III

Sr. No.	Local Name	Botanical Name
1	Owlla	<i>Mimusops elengi</i>
2	Jackfruit	<i>Artocarpus heterophyllus</i>
3	Tirfala	<i>Zanthoxylum rhetsa</i>
4	Bibo	<i>Semecarpus anacardium</i>
5	Salai	<i>Boswellia serrata</i>
6	Cashew	<i>Anacardium occidentale</i>
7	Sarang	<i>Gliricidia sepium</i>
8	Matti	<i>Terminalia elliptica</i>
9	Mango	<i>Mangifera indica</i>
10	Bamboo	<i>Bambusa</i>
11	Tamarind	<i>Tamarindus indica</i>
12	Rumad	<i>Ficus racemosa</i>
13	Bora	<i>Ziziphus mauritiana</i>
14	Shivam	<i>Gmelina arborea</i>
15	Coconut	<i>Cocos nucifera</i>
16	Taman	<i>Lagerstroemia speciosa</i>
17	Bhirand	<i>Garcinia indica</i>
18	Satvin	<i>Alstonia scholaris</i>
19	Rumad	<i>Ficus hispida</i>
20	Bhillamad	<i>Caryota urens</i>
21	Akash	<i>Acacia auriculiformis</i>
22	Karanj	<i>Millettia pinnata</i>
23	Bodgini / Kevada	<i>Pandanus Utilis</i>
24	Charcoal Tree	<i>Trema orientale</i>

List IV – MANGROVES ALONG THE RIVERS

Sr. No.	Local Name	Botanical Name
<u>1</u>	Chipa	<i>Sonneratia alba</i>
<u>2</u>	Chipa	<i>Sonneratia caseolaris</i>
<u>3</u>	Ipali / Mangroves	<i>Rhizophora mucronate</i>
<u>4</u>	Ipali / Mangroves	<i>Rhizophora apiculate</i>
<u>5</u>	Ipali / Mangroves	<i>Bruguiera gymnorrhiza</i>
<u>6</u>	Ipali / Mangroves	<i>Bruguiera clindrica</i>
<u>7</u>	Ipali / Mangroves	<i>Cariops tagal</i>
<u>8</u>	Ipali / Mangroves	<i>Kandelia candal</i>
<u>9</u>	Ipali / Mangroves	<i>Aviccenia officinalis</i>
<u>10</u>	Ipali / Mangroves	<i>Aviccenia marina</i>
<u>11</u>	Ipali / Mangroves	<i>Aegiciras corniculatum</i>
<u>12</u>	Ipali / Mangroves	<i>Excoecaria agallocha</i>
<u>13</u>	Ipali / Mangroves	<i>Lumnitzera racemose</i>
<u>14</u>	Ipali / Mangroves (fishpoison tree) / Samudrafal	<i>Barringtonia asiatica</i>
<u>15</u>	Ipali / Mangroves / Fresh water / Samudrafal	<i>Barringtonia acutangular</i>
<p>Note - Associated mangrove trees can be also planted as per ecosystem findings during more surveys in pristine areas. Such as <i>Thespesia populnea</i> – bhendi, <i>pandanus</i>, <i>bhedsa</i> etc. The plants indicated along wetlands can also be grown n this zone. Along the coastline, it is also found that palm species could be grown is native species are not practically possible.</p>		

ANNEXURE II F

E. SPECIES RECOMMENDED FOR PLANTATION IN PREMISES INCLUDING INSTITUTIONS / SCHOOL / COLLEGES / UNIVERSITY/ INDUSTRIAL ESTATES.

- Vacant land and boundaries of Institutions, Government Offices, Schools , Colleges & universities can be considered for planting
- Species recommended: **Ficus Spp, Tamarind, Guava, Mango, Cashew, *Mimosops elengi*, Jamun, Awala, Bael, Garcinia spp, *Flocourtia jangomas* , *Termanalia bellerica* , Kadamba, *Lagestroemia lanceolatus*, Jackfruit, and any other local species including wild fruits**

Strategy – It is necessary to ensure that plantation should be based on which ecosystem existed before the premises. However due to possibility of proper soil, water and care, many types of plants suitable to weather conditions could be planted.

Strategy is not encourage plantation of *Acacia Longifolia* (Australian acacia) or species that would deter other plants with aggressive growth and pressure on ecosystem

ANNEXURE II G

F. SPECIES RECOMMENDED FOR AGRO FORESTRY

- Goa forest department has exempted commercial tree plantation from the proviso of GPTA, 1984
- For facilitating voluntary tree planting by people outside the forest areas
- Tree felling and transportation rules have been made farmers friendly to facilitate farm forestry on large scale
- Species proposed: **Teak (*Tectona grandis*)** , **Sissum (*Dalbergia latifolia*)**, **Sandal Wood (*Santalum alba*)** , **Khair (*Acacia catechu*)** , **Kindal (*T. paniculata*)** and **Madat (*T. tomentosa*)**
- **Strategy – This area is cross cutting and a farmer would focus more on benefits derived from plantation but at the same time it is necessary to ensure long term sustainability of stable income and also ecosystem compatibility. Refer to below list for further details.**

INDICATIVE LIST OF PLANTS RECOMMENDED FOR AGRO FORESTRY IN ADDITION TO ABOVE

Table V

SR. NO	LOCAL NAME	BOTANICAL NAME
1.	Arjun	<i>Terminalia arjuna</i>
2.	Awala	<i>Emblica officinalis</i>
3.	Badam	<i>Terminallia catappa</i>
4.	Balo	<i>Cassia fistula</i>
5.	Bel	<i>Aegle marmelos</i>
6.	Bhillomaad	<i>Caryota urens</i>
7.	Bhirand	<i>Garcinia indica</i>
8.	Bimbal, bilimbi	<i>Averrhoa bilimbi</i>
9.	Cashew	<i>Anacardium occidentale</i>
10.	Chafi	<i>Michelia champaka</i>
11.	Chafra	<i>Flacourtia montana</i>
12.	Chandan, sandal wood	<i>Santalum album</i>

13.	Chapha (Kavti)	<i>Magnolia lilifera</i>
14.	Chaul mogra	<i>Hydnocarpus laurifolia</i>
15.	Copperpod tree	<i>Peltophorum pterocarpum</i>
16.	Dhavorukh / Arjun	<i>Stercularia urens</i>
17.	Dhoop	<i>Vateria indica</i>
18.	Ebony	<i>Diospyros Montana</i>
19.	Ebony	<i>Diospyros paniculata</i>
20.	Egg fruit	<i>Pouteria campechiana</i>
21.	Flame tree	<i>Spathodea campanulate</i>
22.	Ghoting	<i>Terminalia bellerica</i>
23.	Guava	<i>Psidium guajava</i>
24.	Harda	<i>Terminalia chebula</i>
25.	Jagma	<i>Flacourtia jangomas</i>
26.	Jaiphal	<i>Myristica fragrans</i>
27.	Jambo	<i>Xylia xylocarpa</i>
28.	Jambul	<i>Syzygiumcumini</i>
29.	Kachnar	<i>Bauhinia variegata</i>
30.	Kadamb	<i>Anthocephalus cadamba</i>
31.	Karanjei	<i>Millettia pinnata</i>
32.	Karmal	<i>Averrhoa carambola</i>
33.	Karo	<i>Strycnosnux-vomica</i>
34.	Karvill, kadipatta	<i>Murraya koenigii</i>
35.	Kindal	<i>Terminalia paniculate</i>
36.	Kumyo	<i>Careya arborea</i>
37.	Lavang	<i>Sygzigium aromaticum</i>
38.	Limbu	<i>Citrus limon</i>
39.	Mad	<i>Cocos nucifera</i>
40.	Madat	<i>Terminalia elliptica</i>
41.	Mahua	<i>Madhuca indica</i>
42.	Malabar tamarind	<i>Garcinia gummigutta</i>
43.	Mango	<i>Mangifera indica</i>
44.	Mashing	<i>Moringa oleifera</i>
45.	Mohogony	<i>Swietenia mahagoni</i>
46.	Moi	<i>Lannea coromandelica</i>
47.	Nagkesar	<i>Mesua ferrea</i>
48.	Nano	<i>Lagerstroemia lanceolata</i>
49.	Narkya, Ghaneri	<i>Nothaphodytes nimmoniana</i>
50.	Neem	<i>Azadirachta indica</i>
51.	Neem Chameli	<i>Milingtonia hortensis</i>
52.	Nirpanas	<i>Artocarpus altilis</i>

53.	Ovala	<i>Mimusops elengi</i>
54.	Palas	<i>Butea monosperma</i>
55.	Palpanas	<i>Annona murigata</i>
56.	Parijat	<i>Nyctanthes arbor-tristis</i>
57.	Peepal	<i>Ficus religiosa</i>
58.	Phanas	<i>Artocarpus heterocarpus</i>
59.	Putranjiva	<i>Putranjiva roxburghii</i>
60.	Raktchandani (Red Sanders)	<i>Pterocarpus santalinus</i> **
61.	Ramphal	<i>Annona reticulata</i>
62.	Ranawara	<i>Senna auriculata</i>
63.	Ritho	<i>Sapindus laurifolius/ mukorossi</i>
64.	Rumad	<i>Ficus glomerata/racemose</i>
65.	Sal	<i>Tectona grandis</i>
66.	Santvin	<i>Alstonia scholaris</i>
67.	Savar	<i>Bombax ceiba</i>
68.	Shisam	<i>Dalbergia sisso</i>
69.	Shivan	<i>Gmelina arborea</i>
70.	Siris	<i>Albizia lebbbeck</i>
71.	Sita Ashok	<i>Saraca asoca</i>
72.	Sitaphal	<i>Annona squamosa</i>
73.	Suranga	<i>Mammea suriga</i>
74.	Taman	<i>Lagerstroemia reginae</i>
75.	Taman	<i>Lagerstroemia speciosa</i>
76.	Tamarind	<i>Tamarindus indica</i>
77.	Tefla	<i>Zanthoxylum rhetsa</i>
78.	Tikhi	<i>Cinnamomum zeylanicum</i>
79.	Toring (Pomelo)	<i>Citrus maxima</i>
80.	Vad tree	<i>Ficus bengalensis</i>

NOTE: Mad- Cocos nucifera & Supari- Areca catechu may be also considered in this list

** : *Milingtonia hortensis* – *Neem chameli/ Indian cork tree* is not to be planted in first row to prevent accidental fall of tree or branches on road .

ANNEXURE-III

CHRONOLOGY OF COMMITTEE PROCEEDINGS		
(12-10-2021 TO 22.12.2021)		
Sr. No.	Date	Particulars
1	8 th July 2021	Judgement in PIL Writ Petition No. 8 of 2021 in the High Court of Bombay at Goa, Living Heritage Foundation V/s 1. State of Goa Through its Principal Secretary (Forests), 2. Tree Authority North Goa through Member Secretary, O/o DCF (North Goa Division) Ponda, Goa & 3. Tree Authority South Goa through Member Secretary, O/o DCF (South Goa Division) Aquem, Margao, Goa. State Government directed to submit compliance report on or before 31.12.2021
2	12 th October 2021	Technical Committee of ten members, constituted vide order dated 12-10-2021 received from Dy. Conservator of Forests, Planning & Statistics, to provide holistic approach for planting of trees in different landscape/use, to specify standards for planting & replanting.
3	26 th October 2021	First meeting of the committee, decided to co-opt more stakeholder members
4	11 th November 2021	Second meeting of the committee
5	23 rd November 2021	Third meeting of the committee, attended by Petitioner and stakeholders including members of GCCI & CREDAI
6	17/01/2022	Fourth meeting of the Committee to discuss about INTERIM REPORT and field study of various locations in Goa
7	07/03/2022	Fifth meeting of the Committee to discuss about Tree Authority held its meeting on 01/03/2022, observed the recommendations given by Committee are generic in nature; so to furnish specific recommendations specifying standards regarding number and kind of trees to each locality and submit final report by 30 th April, 2022
8	11/04/2022	FINAL REPORT SUMMITTED

MINUTES OF THE 1ST MEETING OF THE TECHNICAL COMMITTEE (Technical Committee appointed vide order dated 12-10-2021 from Dy. Conservator of Forests, Planning & Statistics).

DATE: 26th October, 2021;

TIME: From 3:00 pm onwards

VENUE: Conference Hall, Van Bhavan, Altinho, Panaji, Goa.

The Meeting was chaired by Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairperson, Tree Plantation Committee

The following members attended the meeting:

1. Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee
2. Shri . Anand Jadhav, Deputy Conservator of Forests, Headquarters, Member Secretary, Tree Plantation Committee
3. Shri. Atmaram Gawade, EE WD VII NH, PWD
4. Shri. Deepak G Pednekar, SDFO, Mapusa
5. Shri. Mahesh S Patankar, Goa State Wetland Authority, Expert Member
6. Shri. Sanjeev A Mayekar, DDA, Agriculture Department.

At the onset Member Secretary, GSBB, Chairman, Tree Plantation Committee, welcomed the members & Member Secretary, Tree Plantation Committee briefly explained the purpose and mandate of the Committee - Which was to comply on Or before 31st December 2021 to order dated 8th July 2021 from Hon'ble High Court of Bombay at Goa, in Public Interest Litigation, Writ Petition No. 8 of 2021, which in turn specifies compliance to directives of the Goa Daman and Diu Preservation of Trees Act 1984.

A round of introductions followed wherein all the members present, introduced themselves and briefly presented their understanding of the mandate of the Committee and also explained how they and their department/Institution could help in the drafting of the guidelines for tree plantation across Goa.

Some of the discussed points and inputs were as follows:

- It was resolved that henceforth all the meetings were to be attended by the same deputed person from each Department so as to maintain continuity.
- All the appointed members were to ensure attendance for the meetings convened henceforth as it is short term of the Committee.
- The draft or the Minutes of the meeting are to be shared with Departments & Members of the Committee only till the entire mandated work of the committee is completed.
- As required vide the Hon'ble High Court Order dated 8th of July 2021, the eleven directives are to be followed, the Standard Operating Procedures/ methodologies are to be defined for tree plantation, transplantation, these should identify the type of trees as per specification and location of plantation with proper minimum standard procedures to be followed to be defined.
- Each member present shared his opinion regarding earlier strategies followed, their success & failures.
- It was opined that further scope of the Committee should be defined.
- Mandate of the Committee to also include ecosystem specifications.
- Members to give their inputs for chalking out broader guidelines from the perspective of each of the departments point of view and as per purpose for which plantation is taken up. Examples discussed were: Trees to be planted along Western bypass-
- Monotonous plantations to be avoided, specifications to consider the aerodynamics, Rules for plantations along Highways, etc.
- Trees for replacing agriculture lands considering the socio-economic needs, other benefits, financial needs, etc.
- Plantations as per Ecosystem needs, different species for wetlands, other water inundated areas, Mangroves, to facilitate migratory visitors (birds, butterflies) etc.,
Planned plantations
Indigenous land races (including some exotics which have adapted)
- Tree census to be done first and then build the project around the existing trees.
- The Act for which the guidelines are to be prepared by the Committee is basically to grant permission or otherwise for major projects, so accordingly the standards are to be laid down.

- It was decided to co-opt some more members in the Committee preferably with presence of full quorum, at the next meeting which was resolved to be held on 11th November 2021.
- As part of consultations - Two members each from Biodiversity Management Committees from North and South, Prominent NGO Member, two farmers one each from North & South Goa to be added to Committee.
- It was resolved to do audio visual recording of the meetings.
- WhatsApp group of the Committee members to be created and important relevant studies to be shared. The Goa Daman & Diu Preservation of Trees Act 1984 and the order of the High Court to be shared for better understanding of the mandate of the Committee.

The meeting ended with vote of thanks by Chairman, Tree Plantation Committee.

Sd/-

Dr. Pradip Sarmokadam

Member Secretary,

Goa State Biodiversity Board,

Chairman, Tree Plantation Committee

**MINUTES OF THE 2ND MEETING OF THE TECHNICAL COMMITTEE
(Technical Committee appointed vide order dated 12-10-2021 from Dy. Conservator of
Forests, Planning & Statistics.)**

DATE: 11th November, 2021;

TIME: From 3:30 pm onwards

VENUE: Conference Hall, Van Bhavan, Altinho, Panaji, Goa.

The Meeting was chaired by Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairperson, Tree Plantation Committee

The following members attended the meeting:

1. Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee
2. Shri. Anand Jadhav, Deputy Conservator of Forests, Headquarters, Member Secretary, Tree Plantation Committee
3. Shri. Atmaram Gawade, EE WD VII NH, PWD
4. Smt. Vertika Dagur, Town & Country Planning Department, Goa
5. Shri. Anant Hoble, DDA, Agriculture Department.
6. Shri Deepak G. Pednekar, Sub Divisional Forest Officer- Mapusa
7. Shri. Vishal V. Surve, Sub- Divisional Officer-Quepem.
8. Shri. Mahesh S. Patankar, Goa State Wetland Authority, Expert Member

At the onset Member Secretary, GSBB, Chairman, Tree Plantation Committee, welcomed the members & Member Secretary, Tree Plantation Committee briefly explained the purpose and mandate of the Committee - Which was to comply on or before 31st December 2021 to order dated 8th July 2021 from Hon'ble. High Court of Bombay at Goa, in Public Interest Litigation, Writ Petition No. 8 of 2021, which in turn specifies compliance to directives of the Goa Daman and Diu Preservation of Trees Act 1984.

Dr Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee read out the Minutes of Meeting of 1st Tree Plantation Committee.

Some of the discussed points and inputs were as follows:

- As required vide the Hon'ble High Court Order dated 8th of July 2021, the eleven directives are to be followed, the Standard Operating Procedures/ methodologies are to be defined for tree plantation.
- Tree Authority Committee constituted Tree plantation Committee vide order dated 12th October 2021.
- Committee should identify the type of trees peculiar to the location of plantation with proper minimum standard procedures to be followed.
- It was discussed that to formulate the guidelines for tree plantation there is need to base it on the Primary Data. It was identified by the committee that sources of primary data can be Biodiversity Register prepared under Biological Diversity Act 2002 and Biological Diversity Rules 2004 and Soil Map of Goa prepared by the Department of Agriculture and data from the Forestry College of Sirsi.
- It was opined that plant species which are alien and invasive in nature, which will disturb the ecology of the area should be avoided and adhere to the indigenous plant species of Goa.
- Members agreed to classify area based upon ecosystem type instead of administrative jurisdictions.
- Committee opined that in Urban spaces preference should be given to those species of trees which are beneficial as well as not a nuisance to the residents and the ecosystem.
- Committee decided to prepare an indicative list of species of plants reviewed by the Forest Department also to prepare a negative list.
- Committee agreed to take the opinions of stakeholders like farmers, landscape and sustainable architects, representatives of CREDAI and Chief Architect.
- Committee decided to meet for next Tree plantation committee for stakeholder consultation on 22nd November at 3.00 pm onwards also to invite litigants to consider their apprehensions.

The meeting ended with vote of thanks by Chairman, Tree Plantation Committee.

Sd/-

Dr. Pradip Sarmokadam

Member Secretary,

Goa State Biodiversity Board,

Chairman, Tree Plantation Committee

MINUTES OF THE 3rd MEETING OF THE TECHNICAL COMMITTEE (Technical Committee appointed vide order dated 12-10-2021 from Dy. Conservator of Forests, Planning & Statistics.)

DATE: 23rd November, 2021;

TIME: From 3:00 pm onwards

VENUE: Conference Hall, Van Bhavan, Altinho, Panaji, Goa.

The Meeting was chaired by Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairperson, Tree Plantation Committee

The following members attended the meeting:

1. Dr Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee
2. Shri. Anand Jadhav, Deputy Conservator of Forests, Headquarters, Member Secretary, Tree Plantation Committee
3. Shri. S. A. Mayekar, DDA, Agriculture Department
4. Smt. Vertika Dagur, Town & Country Planning Department, Goa
5. Shri. M. K. Janarthanam, Representative of Head of Botany Department, Goa University.
6. Shri Deepak G. Pednekar, Sub Divisional Forest Officer- Mapusa
7. Shri Prem Kumar, DCF, South Goa
8. Shri. Santosh Fadte, DCF, North Goa.
9. Smt. Ambika Kamat Dhakankar, Goa Chamber of Commerce & Industry.
10. Shri. Nilesh Salkar, CREDAI
11. Shri. Manguesh R. Prabhugaonkar, Landscape Archirect.
12. Shri. Rajesh S. Sheth, CREDAI.
13. Shri. Mohan Kumar, Litigant, Living Heritage Foundation.

At the onset Member Secretary, GSBB, Chairman, Tree Plantation Committee, he welcomed the members & briefly explained the purpose and mandate of the Committee to comply to the order from Hon'ble. High Court of Bombay at Goa, in Public Interest Litigation, Writ Petition No. 8 of 2021, which in turn specifies compliance to directives of the Goa Daman and Diu

Preservation of Trees Act 1984. Minutes Of Meeting of 2nd Tree Plantation Committee were circulated.

The litigant was represented by Shri Mohan Kumar, was of opinion that preference could be given to indigenous species of trees. He also added that he does not possess the necessary scientific expertise to provide inputs on this issue. He informed the committee that he would submit the inputs through email after consultation with his organization. The same was accepted by the committee.

Representatives of the 'Confederation of Real Estate Developers' Associations of India' (CREDAI) Shri Rajesh Sheth and Shri Nilesh Salkar were of the opinion that the guidelines to be formed by this committee should not create additional hurdles in the development of the real estate projects in the State of Goa.

Smt. Ambika Kamat Dhakankar, rep. of Goa Chamber of Commerce & Industry put forth the opinion that fruit bearing trees should be planted wherever possible as it will be beneficial to the local people and biodiversity at large. The committee assured that the inputs would be duly considered.

Some of the discussed points and inputs were as follows:

- Committee invited inputs from stakeholders about the guidelines for formation of Tree Plantation.
- It was discussed that to formulate the guidelines for tree plantation it is important to consider various perimeters as listed below:
 1. To understand the physical plant growth characteristics.
 2. Proper planning required considering the pace of growth and result expected ensuring the balance between the two.
 3. Location in terms of sun and shade ratios.
 4. Categorising the landscape as coastal sea facing salinity-based belts, mid plains and the high lands that is western ghats.
 5. Kind of substratum.
 6. The purpose of planting that is whether it is for aesthetics or shade or for commercial planting etc.
 7. Cultural aspect of the locality with regard to planting.

8. Planting considering the availability of water.
 9. Context based planting.
 10. Plants with commercial benefits could be considered.
 11. Considering that the species which are not menace example Kokum.
- Members agreed that these guidelines should not be procedural hurdles in commercial development of landscape.

The meeting ended with vote of thanks by Chairman, Tree Plantation Committee.

Dr. Pradip Sarmokadam
Member Secretary, GSBB
Goa State Biodiversity Board,
Chairman, Tree Plantation Committee

**MINUTES OF THE 4th MEETING OF THE TREE PLANTATION COMMITTEE
(Technical Committee appointed vide order dated 12-10-2021 from Dy. Conservator of
Forests, Planning & Statistics.)**

**DATE: 18th January, 20 , TIME: From 3:00 pm onwards,
VENUE: 'Conference Hall, Van Bhavan, Altinho, Panaji, Goa.**

The Meeting was chaired by Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairperson, Tree Plantation Committee

The following members attended the meeting:

1. Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee
2. Shri. Anand Jadhav, Deputy Conservator of Forests, Headquarters, Member Secretary, Tree Plantation Committee
3. Shri. S. A. Mayekar, DDA, Agriculture Department
4. Smt. Vertika Dagur, Town & Country Planning Department, Goa
5. Shri. M. K. Janarthanam, Representative of Head of Botany Department, Goa University.
6. Shri Deepak G. Pednekar, Sub Divisional Forest Officer- Mapusa
7. Shri Prem Kumar, DCF, South Goa
8. Shri. Santosh Fadte, DCF, North Goa.

In the beginning Member Secretary, GSBB, Chairman, Tree Plantation Committee, welcomed the members & briefly explained that the interim report was discussed with Member Secretary of Tree Authority, who had opined that the interim report submitted by this committee was more general in nature and hence specific recommendation may be given as per local study and survey . It was also apprised that to undertake such study and field inspections more time is required and cannot be completed in the given time to the committee .

Chairman proposed below given locations to conduct the field study by involving staff from Forest Dept, GSBB and few research scholars.

Locations and scope were proposed as per the table given below.

Locality	Area identified for survey	Locations wherein primary survey conducted or information sourced (Type of Land)	Prescribed standards
Roads	NHGA and Two Samples + Indicative List + Forest Dept. Social Forestry	NHAI publication	Distance between species and standards
Public Parks	Forest Dept. Social Forestry from existing parks	Forest Dept. Social Forestry from existing parks	Distance between species and standards
Gardens	North Goa, South Goa + Forest Dept. Social Forestry	Forest Dept. Social Forestry from existing parks	Distance between species and standards
Banks of rivers	CSIR-NIO, Chapora and Sal	North Goa - Kalna River bank South Goa - Stretch of Riverbank of Khushawati at Chandor	Distance between species and standards
Embankments or Banks of lakes	Wetlands from NIO- CSIR - Bondvol data of forest Dept, Nanda and Pilerne	North Goa - Pilerne Sawle Lake South Goa - Nanda Lake Wetland at 2 locations (natural boundary and bund with organized plantation)	Distance between species and standards
Embankments or Banks of Canals	WRD - N & S	North Goa - Tillari Canal embankment at VP Alorna at Murkungo near Khutwal (unplanned indigenous) and Amthane Dam bank (predominantly organized) South Goa - Canals at Borimol Quepen near Forest Dept. (organized plantation)	Distance between species and standards
Sea Shores	Morjim and Colva	Source Forest Dept information and information from PBR of Morjim as well as GSBB information during inspections	Distance between species and standards
Premises	List from Sustainable Architects	Information availed from renowned sustainable architects and fraternity	Distance between species and standards

Above locations were discussed and approved by the committee.

Member secretary of the committee mentioned that if we could not complete the field study in allocated time , then we will submit interim report and will also seek time from Tree Authority for submission of Final report with filed study .

The plan of action was approved and the meeting ended with vote of thanks by Chairman, Tree Plantation Committee.

Dr. Pradip Sarmokadam

Member Secretary, GSBB

Goa State Biodiversity Board,

Chairman, Tree Plantation Committee

MINUTES OF THE 5th MEETING OF THE TECHNICAL COMMITTEE (Technical Committee appointed vide order dated 12-10-2021 from Dy. Conservator of Forests, Planning & Statistics.)

DATE: 07th March , 2022;

TIME: From 3:00 pm onwards

VENUE: Conference Hall, Van Bhavan, Altinho, Panaji, Goa.

The Meeting was chaired by Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairperson, Tree Plantation Committee

The following members attended the meeting:

1. Dr. Pradip Sarmokadam, Member Secretary, Goa State Biodiversity Board, Chairman, Tree Plantation Committee
2. Shri. Anand Jadhav, Deputy Conservator of Forests, Headquarters, Member Secretary, Tree Plantation Committee
3. Shri. S. A. Mayekar, DDA, Agriculture Department
4. Smt. Vertika Dagur, Town & Country Planning Department, Goa
5. Shri. M. K. Janarthanam, Representative of Head of Botany Department, Goa University.
6. Shri Deepak G. Pednekar, Sub Divisional Forest Officer- Mapusa
7. Shri Minguel Fernandes , SDFO ,Quepem

At the onset Member Secretary, GSBB, Chairman, Tree Plantation Committee, he welcomed the members & briefly explained the purpose and mandate of the Committee to comply to the order from Hon'ble. High Court of Bombay at Goa, in Public Interest Litigation, Writ Petition No. 8 of 2021, which in turn specifies compliance to directives of the Tree Authority , Minutes Of Meeting held on 01/03/2021 were circulated.

The Chairman apprised all the members about the interim report submitted by the Committee to the Tree Authority followed by discussion and presentation done on the report by the Chairman. He also mentioned that the Tree Authority observed the recommendations given by Committee are generic in nature and directed the Committee so to furnish specific recommendations specifying standards regarding number and kind of trees to each locality in

adherence to High Court order in WP 8/2021 and to submit final report by 30th April ,2022. The Chairman assured that the inputs would be duly considered.

Some of the discussed points and inputs were as follows:

- Committee invited inputs from members about the filed visits and study to recommend specific standards about planting , maintenance and species as per location, type of land etc
- It was discussed that to formulate the guidelines for tree plantation it is important to consider various perimeters as listed below: as decided in earlier consultation held with stakeholders
 1. To understand the physical plant growth characteristics.
 2. Proper planning required considering the pace of growth and result expected ensuring the balance between the two.
 3. Location in terms of sun and shade ratios.
 4. Categorising the landscape as coastal sea facing salinity-based belts, mid plains and the high lands that is western ghats.
 5. Kind of substratum.
 6. The purpose of planting that is whether it is for aesthetics or shade or for commercial planting etc.
 7. Cultural aspect of the locality with regard to planting.
 8. Planting considering the availability of water.
 9. Context based planting.
 10. Plants with commercial benefits could be considered.
 11. Considering that the species which are not menace example Kokum.
- Members agreed that these guidelines should not be procedural hurdles in commercial development of landscape.

The meeting ended with vote of thanks by Chairman, Tree Plantation Committee.

Dr. Pradip Sarmokadam
Member Secretary, GSBB
Goa State Biodiversity Board,
Chairman, Tree Plantation Committee

Annexure IV
List of References

List of References
Information received from Deptt of Forest, Agriculture, Town & Country Planning Dept., Public Works Dept. etc as well as Inputs from committee members and stakeholders
Plantation forestry in India (book) by RK Luna
Joshi VC and Janarthanam MK (2004) The diversity of life-form type, habitat preference and phenology of the endemics in the Goa region of the Western Ghats, India. J. Biogeogr, 31: 1227-1237
https://blog.practicalsanskrit.com/
Presentation contents shared by Dr. R. Vasudevan, Professor, Professor (Forest Biology) and University HOD, Department of Forest Biology University of Agricultural Sciences, Dharwad, College of Forestry, SIRSI Campus Karnataka,