GREEN AUDIT

REPORT
2024-25

GURU NANAK COLLEGE
DHANBAD

GURU NANAK COLLEGE, DHANBAD

BINOD BIHARI MAHTO KOYLANCHAL UNIVERSITY, DHANBAD, JHARKHAND

Prepared By :

VANASHAKTI

vanashakti

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CERTIFICATE

vanashakti

GREEN AUDIT CERTIFICATE

GURU NANAK COLLEGE DHANBAD

(A SIKH MINORITY DEGREE COLLEGE)
NAAC ACCREDITED GRADE 'B'
AFFILIATED TO B B M K UNIVERSITY, DHANBAD, JHARKHAND

Has been assessed by Vanashakti for the comprehensive study of environmental Impacts on institutional working framework to fulfill the requirement of

GREEN AUDIT

The green initiatives carried out by the Campus have been verified on the report submitted and was found to be satisfactory.

The efforts taken by the management and the faculty towards environment and sustainability are appreciated and noteworthy.

31.01.2025
DATE OF ISSUE

31.01.2025-30.01.2030
VALID UPTO

Uma Shanker Singh, IFS, D.Sc
DIRECTOR, VANASHAKTI, AUDITOR IN CHIEF

Shiv kant Bajpai
DEPUTY DIRECTOR, VANASHAKTI, CO-AUDITOR

Ashutosh Mishra
DEPUTY DIRECTOR, VANASHAKTI, CO-AUDITOR

VANASHAKTI, B 3/263 MANSAROVAR YOJANA, OPP. JALWAYU VIHAR, PHASE- 2, IN FRONT OF GATE NO. 2, SECTOR-O, KANPUR ROAD, LUCKNOW.

ACKNOWLEDGEMENT

Vanashakti would like to thank the management of Guru Nanak College for assigning this important work of Green Audit. We appreciate the co-operation to the teams for the completion of assessment. We would also like to thank Prof. Dipak Kumar, coordinator, IQAC, for his continuous support and guidance, without which the completion of the project was not be possible. We are also thankful to Sri Sujeet Mahto and Sri Suraj Hadi who were actively involved while collecting the data and conducting field measurements. We are also thankful to:

Dr. Sanjay Prasad	-	Principal and ex-officio chairman IQAC
Sardar RS Chahal	-	President Governing council (Management Representative)
Sardar DS Grewal	-	Secretary Governing council (Management Representative)
Prof. P. Shekhar	-	Academician (Member)
Prof. Amarjit Singh	-	Head of the Department English
Prof. Ranjana Das	-	Head of the Department History
Prof. Mina Malkhandi	-	Head of the Department Political Science
Prof. Santosh Kumar	-	Head of the Department Commerce
Prof. Sanjay Kumar Sinha	-	Teacher Representative (TR)
Dr. Varsha Singh	-	Assistant Professor
Sri Amresh Sahay	-	Society Representative
Sri Amresh Choudhary	-	Alumni
Sri Sadhan Kumar Mishra	-	Technical Staff
Prof. Dipak Kumar	-	Coordinator IQAC
Sri Sanjay Kumar Singh	-	PTI
Sri Shreya Pandey	-	Student Representative
Sri Anurag Singh	-	Student Representative

Last but not the least, we would like to thank Dr Sanjay Prasad, Principal Guru Nanak College for giving us an opportunity to evaluate the environmental performance of the campus. Let us put on record that he was the main architect of our endeavour and without him it was not possible to carry out the green audit of this college. He always looked into finer details of the work and gave valuable suggestions.

DISCLAIMER

Vanashakti Audit Team has prepared this report for Guru Nanak College based on input data submitted by the representatives of the College complemented with the best judgment capacity of the expert team. While all sensible care has been taken in its preparation, details contained in this report have been compiled in good faith based on the information gathered. It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report. If you wish to distribute copies of this report external to your organization, then all pages must be included. Vanashakti, and its staff shall keep confidential all information relating to your organization and shall not disclose any such information to any third party, except that in the public domain or required by law or relevant accreditation bodies. Vanashakti staff and accreditation bodies have signed individual confidentiality undertakings and will only receive confidential information on a 'need to know' basis.

CONCEPT AND CONTEXT

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2019–20 onwards that all Higher Educational Colleges should submit an annual Green, Environment, and Energy Audit Report. Green Audit is assigned to Criteria 7 of NAAC, National Assessment and Accreditation Council which is a self-governing organization of India that declares the colleges as Grade A, Grade B, or Grade C according to the scores assigned at the time of accreditation. Moreover, it is part of the Corporate Social Responsibility of the Higher Educational Colleges to ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures. In view of the NAAC circular regarding Green auditing, the College management decided to conduct an external environment assessment study by a competent external professional auditor. The green audit aims to examine environmental practices within and outside the College campus, which impact directly or indirectly on the atmosphere. Green audit can be defined as the systematic identification, quantification, recording, reporting, and analysis of components of college environment. It was initiated with the intention of reviewing the efforts within the colleges whose exercises can cause risk to the health of inhabitants and the environment. Through the green audit, a direction as to how to improve the structure of the environment and the inclusion of several factors that can protect the environment can be commenced. This audit focuses on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint, etc. being implemented by the college. The concepts, structure, objectives, methodology, tools of analysis, and objectives of the audit are discussed below.

INTRODUCTION

Now a days, the educational colleges are becoming more thoughtful towards the environmental aspects and as a result new and innovative concepts are being introduced to make them sustainable and eco-friendly. To preserve the environment within the college, a number of viewpoints are applied by the several educational colleges to solve their environmental problems such as promotion of saving energy, waste recycle, water consumption reduction, water harvesting, and many more. The activities carried out by the college can also create adverse environmental impacts. Green audit is defined as an official inspection of the effects a College has on the environment. Green Audit is conducted to evaluate the actual scenario at the college campus. Green audit can be a useful tool for a college to determine how and where they are using the most of the energy or water or resources; the College can then decide how to implement changes and make savings. It can also be used to determine the nature and volume of waste, which can be used for a recycling project or to improve waste minimization plan. Green auditing and the application of mitigation measures is a win-win situation for all the colleges, the learners and the mother earth. It can also result in health awareness and can promote environmental awareness, values and beliefs. It provides a better understanding to staff and students about the Green impact on college. Green auditing also upholds financial savings through reduction of resource usage. It gives an opportunity to the students and teachers for the development of ownership of the personal and social responsibility. The audit process involves primary data collection, site walk through with the team of college including the assessment of policies, activities, documents and records.

OVERVIEWOFTHECOLLEGE

The main campus of the College is situated at Bhuda, Barmasia, Dhanbad sprawling over three acres with its maximum open area as lush green lawn.Guru Nanak College, Dhanbad (A Sikh Minority Degree College) was established by the Gurudwara Prabandhak Committee in 1970 to mark the fifth Birth Centenary of the great Guru after whom this college is named. The college is managed by a Governing Council nominated by the Gurudwara Prabandhak Committee, Dhanbad, and draws its inspiration from the teachings of the faith propounded by Guru Nanak Dev ji. Initially, the college got affiliated to the Ranchi University, Ranchi since 1970, the year it was stared. With the passage of time, Binod Bihari MahtoKoylanchal University, Dhanbad came into existence and the affiliation of the college got transferred to this new University in 2017. Presently, the college has got permanent affiliation with Binod Bihari MahtoKoylanchal University, Dhanbad in the faculties of Humanities, Social Sciences, and commerce. Besides, AICTE has approved vocational courses in Bachelor of Computer Applications and Bachelor of Business Administration. The college has got "Deficit Grant College Status" by the government of Jharkhand. The college is registered u/s 2F and 12B of the UGC Act. The main aim and objective behind sponsoring this college was to impart value-based teaching to the young men and women of Dhanbad. The college attaches great importance to moral teaching. The college does not merely offer teaching in such subjects as would enable young students to earn their bread and butter, but it also emphasizes grooming them into worthy (morally sound) citizens.

MISSION

THE STATED MISSION OF THE COLLEGE

- To inculcate in students a sense of moral and ethical integrity based on an age-old value system
- To offer students opportunities to appreciate, stretch, and realise their own potential
- To foster the development of generic skills for life-long and life-wide learning, particularly critical thinking
- To help students acquire high proficiency in communication skills and transaction it as a medium.
- To assist students to adopt a multi-cultural and international perspective in life, and to network the college with overseas educational colleges
- To build up students' leadership strengths such as stamina, confidence, commitment, and problem-solving skills
- To develop students' appreciation of their cultural heritage and national identity
- To nurture students to become caring, responsible, and open-minded citizens in order to serve society, their country, and the world
- To boost students' social and life skills, independence, and self-discipline through programs such as enriched cultural programs
- To unleash the creative potential of students to enhance their aesthetic development and nurture enquiring minds
- To train students for physical fitness and help instill in them a good sense of sportsmanship
- To adopt an interactive and student-centered approach in teaching with favorable teacher-student ratios

THE STATED MISSION OF THE COLLEGE

- To encourage teachers' professional growth and collaboration so as to maximize effective teaching and vocational satisfaction
- To become partners with parents, the alumni of the College, and the community at large to foster mutual understanding, care and collaborators
- The College also caters to the academic needs of the students with a priority to those belonging to economically and socially weaker segments of the families. The college puts an extra emphasis on women education and their empowerment.
- The college also aims at personality development with a view to preparing them as responsible citizens with an in-depth faith in the oneness of God and the Universal Brotherhood.
- The College also provides Vocational Courses, which help students develop their entrepreneurial skills and become employment-friendly.
- The College emphasizes on sensitizing the students on socio-economic, gender, and environmental issues with emphasis on gender and human rights as well as on environmental issues through extension activities.
- The college aims at making use of ICT-aided teaching so that the students can be given exposure to the latest advancements in technology.
- To offer students a modern, all-round, and liberal education through a diverse and flexible curriculum

EXECUTIVESUMMARY

Green auditing is an essential step to identify and determine whether the colleges practices are sustainable and ecological. Traditionally, Indians were upright and efficient users of natural resources. But over the period of time, excessive usage of resources like water, electricity, petrol, etc. have become mainstay for everyone especially, in urban and semi-urban areas. Green audit standardizes all such practices and provides an efficient way to use natural resources. In the time of climate change and resource exhaustion, it is necessary to re-check the processes and convert it in to green and sustainable. Green audit provides an approach for it. It also increases overall awareness among the folks working in college toward the eco-friendly environment. This is the first attempt to conduct green audit of this College campus for the fulfilment of NAAC criteria. This audit was mainly focused on greening indicators like consumption of energy in terms of electricity and fossil fuel, quality of soil, water usage, vegetation, waste management practices and carbon foot print of the campus. Initially a questionnaire was shared to know about the existing resources of the campus and the resource consumption pattern of the students and staffs in the College and accordingly, an assessment was done.

AUDIT PARTICIPANTS

On behalf of College

Dr Sanjay Prasad –	-	Principal and ex-officio chairman IQAC
Sardar RS Chahal-	-	President Governing council (Management Representative)
Sardar DS Grewal-	-	Secretary Governing council (Management Representative)
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Sri Shreya Pandey-	-	Student Representative
Sri Anurag Singh-	-	Student Representative

GREENAUDIT- ANALYSIS

1. GENERALINFORMATION

A. Was any Green Audit conducted earlier?

No, this is the first external audit carried out by a third-party

B. What is the total strength (people count) of the College?

a) Students

Male: 1356, Female: 2035, Total: 3391

b) Teachers (including guest faculty)

Male: 13, Female: 25, Total: 38

c) Non-Teaching Staff

Male: 20, Female: 7, Total: 27

d) Total Strength

Male: 33, Female: 32, Total: 65

C. What is the total number of working days of your campus in a year?

220

D. Where is the campus located? (Includes GPS location like Longitude and Latitude)

Shitala Colony Rd, Bhuda Colony, Dhanbad, Jharkhand 828124, India

Lat 23.782759° Long 86.448522°.

E. Which of the following are our college?

Garden area Available	Available
Playground Available	Available
Kitchen Available	Available

Toilets Available for Teachers (Male and Female) separately	Available
Toilets Available for Boys Girls separately	Available
Garbage or Waste Store Yard Available	Available
Laboratory Available	Available
Canteen Available	Available
Hostel Facility Available	No
Guest House Available	No

F. Which of the following are found near your college?

Municipal dump yard	No
Garbage heap	No garbage heap
Public convenience	Public convenience available
Sewer line	Sewer line available
Open drainage	No
Industry – (Mention the type)	No
Bus, Railway station connectivity	Well connected by Railway, Bus
Market, Shopping complex Available	Available

2. WASTE MINIMIZATION AND RECYCLING

A. Does your college generate any waste? If so, what are they?

Yes, natural waste and stationery item waste

B. What is the approximate amount of waste generated per day? (In kg approx.)

- Biodegradable waste -100
- Non-biodegradablewaste- 25
- Hazardous Waste - 0
- Others-0

C. How is the waste managed in the college? By Composting, Recycling, Reusing, Others(specify)

- Is Composting done for horticulture waste management? – Yes
- Is the Hydroponics technique used to recycle the grey water from college mess? - No
- Is Aerobic Composting done for bio-degradable waste management? – No
- Are Diluted solutions used instead of concentrated solutions in laboratories? - No
- Is side printed Paper re-used for internal communication? - Yes
- Is Solid waste taken by the Municipal Corporation after collecting the BMW separately? – Yes
- Is Single-use plastic banned in campus? – Yes
- Is Paper recycling plant installed in the campus? – No

D. Does college use recycle paper in college?

No

E. How would you spread the message of recycling to others in the community?

Followings are the ways through which college is spreading awareness about recycling

- Poster competition activities – Yes
- Campaigns – Yes
- Rally – Yes
- Webinars and seminars - Yes

F. Can you achieve zero garbage in your college? If yes, how?

Yes, by reducing, reusing and recycling 100% of the garbage.

3. GREENING THE CAMPUS

A. Is there a garden in your college?

Yes, 1.25 acres

B. Do students spend time in the garden?

Yes, on an average 2 hours per day

C. Does the College campus having any Horticulture Department?

No

D. How many Tree Plantation Drives organized by the college per annum?

On an average 5 plantation drives are carried out every planting season with the help of NSS, Rotaract Club and NCC

E. Is there any Plant Distribution Program for Students and Community?

Yes, College undertakes seedling distribution programs every year on the eve of World Plantation Day

F. Is there any Plant Ownership Program?

Yes.

4. WATER AND WASTE WATER MANAGEMENT

A. List uses of water in your college

Basic use of water in campus:

- Drinking 18 KL/month
- Gardening 52 Kl/month
- Kitchen and Toilets 15 KL/month
- Others 0 KL/month
- Hostel 0 KL/Month

Total= 85 KL/Month

B. How does College store water? Is there any water saving technique followed by the college?

SL. NO	STORAGE TYPE	CAPACITY	QUANTITY	TOTAL (IN LITRES)
1	Over Head Tank	4000litres	1	4000
2	Under Ground Tank (Fire Tank)	12000 litres	1	12000
Total Storage Capacity				**16000**

C. Water Saving Techniques

Rain Water Harvesting is installed and it is functioning properly

D. Locate the point of entry of water and point of exit of waste water in your college.

- **Entry**- Water comes from the bore-wells.
- **Exit**- Water from the toilets and kitchen is disposed through the covered drainage system which is in turn connected to the sewage system of the town.

E. Write down ways that could reduce the amount of water used in your college Basic ways:

BY recycling the waste water

5. ANIMAL WELFAREACTIVITIESUNDERTAKENINPAST

A. List the animals (wild and domestic) found on the campus (dogs, cats, squirrels, birds, insects, etc.) Species of Birds 3 (crow, pigeon, parrot)

We discovered presence of 5 different classes of fauna and also that includes reptile, amphibian, mammal, avian, insects and some molluscs also. Reptiles and amphibians are mainly found during rainy season and distributed near the

water bodies but some reptiles are found near, and in the, vegetative areas also. The species such as Gecko, Snakes, Lizards, Common Asian toad, Common Indian toad and Indian valley toad found in open vegetative areas of garden and pond. More than 25 bird's species were located during study. Bird species are spread all over area and includes terrestrial birds Crow, Cuckoo, Myna, Loving dove, Greater cowcal, whistling bulbul, Indian courser and as well as aquatic birds Red napped ibis, oriental white ibis, Tufted duck, Brahmany starling, Indian pond Heron, Indian courser, Pied kingfisher, Common kingfisher. Vast number of insects found during the observation, more the 10 species of butterflies 5 species of Catopsillia, Ditch jewel, Common evening brown, Great egg fly, some other rare species of insects includes Centipede, Millipede, Wasp, Honey bee, Beetle and 4 species of Dragonfly. Mammals were also observed during our survey.

B. Does your college have a Biodiversity Program or any Eco-Club or Environment Club etc.?

Yes, Nature's Club is actively functional in the College.

6. CARBON FOOTPRINT-EMISSION&SEQUESTRATION

A. **Thermal power consumption by the college 25,714 units per year.**

Total CO2 emission by electricity = Total Unit (KWH) ×0.93 kg per unit

Total CO2 emission by electricity = 25714 ×0.93

Total CO2 emission by electricity = 23914.02 kg

Total CO2 emission by electricity = 23.91MT CO2 per year

B. Carbon Emission by Diesel consumption which is 360 litres per year.

Total CO2 emission by diesel= Diesel used per year in litres ×2.68kg per litre.

Total CO2 emission by diesel= 360 ×2.68 kg

Total CO2 emission by diesel= 0.96 MT CO2 per year

C. **Carbon Emission by Water consumption, which is 1020 cubic meter per year.**

Where, Carbon emission from 1 cubic meter water consumption = 10.6 kg

Total CO2 emission from water consumption = 1020×10.6 kg

Total CO2 emission from water consumption = 10.8 metric ton per year

D. **Carbon mitigation by solar energy which is 14000KWH per year.**

Total Carbon mitigated by solar energy= Total Unite (KWH)×0.7kg per unit

Total Carbon mitigated by solar energy=14000× 0.715kg

Total Carbon mitigated by solar energy= 10.01 MT CO2 per year

E. **Transportation per year (car) CO2-emission from transportation (Bus and Car)**

College does not own any Bus or Car

Total carbon footprints = Total CO2 emission per year cumulative by electricity usage + Emission from diesel usage per year +Emission from water consumption per year – Carbon mitigated by Solar energy consumption per year= (23.91 + 0.96+10.8– 10.01= 25.66MT CO2 per year).

7. CARBON SEQUESTRATIONBY FLORA IN THE CAMPUS

A. There are 162 full-grown trees on the campus spread over 1.25 acres. Therefore, Carbon sequestration capacity of 162 full-grown trees 1974.95kg CO2 per Year =1.97MT of CO2 per Year.

TABLE 1: CARBON SEQUESTRATION BY THE TREES

SR. NO.	NAME OF TREE	BOTANICAL NAME	NO. OF TREE IN DEFFRENTDIAMETER CLASS (CM)								TOTAL CARBON (IN KG)	TOTAL CARBON PER YEAR (IN KG)
			(0-10)	(10-20)	(20-30)	(30-40)	(40-50)	(50-60)	(60-70)	(70-80)		

1	Aam	Mangiferaindica	9	2	2						266.57	17.77
SR. NO.	**NAME OF TREE**	**BOTANICAL NAME**	**NO. OF TREE IN DEFFRENTDIAMETER CLASS (CM)**								**TOTAL CARBON (IN KG)**	**TOTAL CARBON PER YEAR (IN KG)**
			(0-10)	**(10-20)**	**(20-30)**	**(30-40)**	**(40-50)**	**(50-60)**	**(60-70)**	**(70-80)**		
2	Amla	Phyllanthus emblica		1	3						223.95	14.93
3	Amrud	Psidium guajava	4	2	1						368.00	24.53
4	Ashok	Saracaindica	18	10		1					2536.96	169.13
5	Bel	Aegle marmelos		3	1						325.60	21.71
6	Chakresia	Chukrasiatabularis	2	2							99.80	6.65
7	Chitwan	Alstoniascholaris	1	4	5	1					580.59	38.71
8	Doka tree	Isoberlinia doka						1			1463.93	97.60
9	Ficus	Ficusbenjamina	3								35.83	2.39
10	Gulmohar	Delonix regia	4	8	5	1					2434.93	162.33
11	Gumhar	Gmelina arborea	2	3	2						330.59	22.04
12	Jamun	Syzygiumcumini	3	1							41.07	2.74
13	Kanji	Pongamia pinnata		1		2			1		3419.39	227.96
14	Kathal	Artocarpusheterophyllus		1							62.83	4.19
15	Mithineem	Azadirachtaindica	3	1							10.00	0.67
16	Pipal	Ficusreligiosa								1	1612.11	107.47
17	Safed chandan	Santalum album	2	2							231.09	15.41
18	Sagawan	Tectonagrandis		4	14	7	7	3			14128.54	941.90

SR. NO.	NAME OF TREE	BOTANICAL NAME	NO. OF TREE IN DEFFRENTDIAMETER CLASS (CM)								TOTAL CARBON (IN KG)	TOTAL CARBON PER YEAR (IN KG)
			(0-10)	(10-20)	(20-30)	(30-40)	(40-50)	(50-60)	(60-70)	(70-80)		
19	Shisham	Dalbergia sissoo	1	1	2	3					1405.61	93.71
20	Terminallia	Terminalia neotaliala		1							46.82	3.12
TOTAL			**52**	**47**	**35**	**15**	**7**	**4**	**1**	**1**	**29624.205**	**1974.95**
TOTAL (IN MT)											**29.6**	**1.97**

B. Carbon in tree root: Globally, belowground biomass (BGB) accounts for 20–26% of total biomass, and as such it is an important carbon (C) pool for many vegetation types. However, large uncertainty exists for belowground biomass C compared to aboveground stocks but we have taken 26% as the root carbon present in the roots in the trees in question.

TABLE 2: CARBON SEQUESTRATION BY GIRTH CLASSES IN THE TREES

SR. NO.	NAME OF TREE	BOTANICAL NAME	NO. OF TREE IN DEFFRENTDIAMETER CLASS (CM)								TOTAL CARBON (IN KG)	TOTAL CARBON PER YEAR (IN KG)
			(0-10)	(10-20)	(20-30)	(30-40)	(40-50)	(50-60)	(60-70)	(70-80)		
1	Aam	Mangiferaindica	9	2	2						53.60	3.57
2	Amla	Phyllanthus emblica		1	3						35.23	2.35
3	Amrud	Psidium guajava	4	2	1						59.61	3.97
4	Ashok	Saracaindica	18	10		1					321.29	21.42
5	Bel	Aegle marmelos		3	1						63.18	4.21
6	Chakresia	Chukrasiatabularis	2	2							33.69	2.25
7	Chitwan	Alstoniascholaris	1	4	5	1					126.00	8.40
8	Doka tree	Isoberlinia doka						1			230.26	15.35
9	Ficus	Ficusbenjamina	3								6.58	0.44

10	Gulmohar	Delonix regia	4	8	5	1					382.99	25.53
11	Gumhar	Gmelina arborea	2	3	2						66.17	4.41
12	Jamun	Syzygiumcumini	3	1							8.26	0.55
13	Kanji	Pongamia pinnata		1		2			1		593.49	39.57
14	Kathal	Artocarpus heterophyllus		1							11.67	0.78
15	Mithineem	Azadirachtaindica	3	1							2.17	0.14
16	Pipal	Ficusreligiosa								1	299.39	19.96
17	Safed chandan	Santalum album	2	2							36.35	2.42
18	Sagawan	Tectonagrandis		4	14	7	7	3			2275.97	151.73
19	Shisham	Dalbergia sissoo	1	1	2	3					218.97	14.60
20	Terminallia	Terminalia neotaliala		1							7.58	0.51
TOTAL			**52**	**47**	**35**	**15**	**7**	**4**	**1**	**1**	**4832.46**	**322.16**
TOTAL (IN MT)											**4.83**	**0.32**

C. There are approximately 967 Shrubs and semi-grown trees of various species being raised in the gardens and grown in the areas where no buildings are built Carbon sequestration of bush plants varies widely with their species, on the campus spread over 1.25 acres. Therefore, Carbon sequestration capacity of 967 Shrubs and semi-grown trees1209.8 kg CO2 per Year =1.20 MT of CO2 per Year.

TABLE 3: CARBON SEQUESTRATION BY THE SHRUBS AND SEMI-GROWN TREES

CARBON CONTAIN IN SHRUB					
SR. NO.	**VERNACULAR NAME**	**BOTANICAL NAME**	**NUMBER OF PLANTS**	**CARBON FACTOR PER SHRUB (IN KG)**	**TOTAL CARBON (IN KG)**
1	Gulab	Rosa rubiginosa	14	0.2	2.8
2	Morpankhi	Platycladusorientalis	13	0.2	2.6

3	Sadabahar	Catharanthusroseus	12	0.2	2.4
4	Genda	Tageteserecta	60	0.2	12
5	Mini Crotan	Codiaeumvariegatum	2	0.2	0.4
6	Crotan	Codiaeumvariegatum	8	0.2	1.6
7	Kari Patta	Bergerakoenigii	6	0.2	1.2
8	Chinese evergreens	Aglaonema	8	0.2	1.6
9	Aloe vera	Aloe barbadensis miller	3	0.2	0.6
10	Tulsi	Ocimumtenuiflorum	2	0.2	0.4
11	Mini Chandni	Tabernaemontanadivaricata	1	0.2	0.2
12	Aerohed	Syngoniumpodophyllum	3	0.2	0.6
13	Jashmin	Jasminum	3	0.2	0.6
14	Araucaria	Araucaria	1	0.2	0.2
15	Pinki	Catharanthus roseus	7	0.2	1.4
16	La Llave	Casimiroa edulis La Llave	1	0.2	0.2
17	GlodenDuranta	Durantarepens	600	0.2	120
18	Gudhal	Hibiscus rosa-sinensis Linn	18	0.2	3.6
19	Mogra	Jasminum sambac	2	0.2	0.4
20	Gudluck	Dracaena sanderiana	1	0.2	0.2
21	Lal Axsora	Ixora coccinea	1	0.2	0.2
22	Dalena Grass	Paspalumdilatatum	1	0.2	0.2
23	Bonsai Ficus	Ficusmicrocarpa	1	0.2	0.2
24	BassiaScoparia	Bassiascoparia f.trichophylla	3	0.2	0.6
25	Aralia	Polysciasfruticosa	3	0.2	0.6
26	Chinese hibiscus	Hibiscus × rosa-sinensis L.	1	0.2	0.2
27	Poinsetia	Euphorbia pulcherrima	1	0.2	0.2
28	Lucolia	Luculia gratissima	1	0.2	0.2
29	Hybrid Alocasia	Alocasiamacrorrhizos	1	0.2	0.2
30	Moringa	Moringa oleifera Lam.	1	0.2	0.2
31	Chinese privet	Ligustrum Lyudem	1	0.2	0.2
32	Safed Sapote	Casimiroa edulis	1	0.2	0.2
33	Gandhraj	Gardenia jasminoides	6	0.2	1.2
34	Gulmohar small	Delonix regia	9	0.2	1.8
35	Nagfani	Opuntia ficus-indica	1	0.2	0.2
36	Arbi	Colocasia esculenta	7	0.2	1.4
37	Sleeping hibiscus	Malvaviscusarboreus	5	0.2	1
38	Crape Jasmin	Tabernaemontanadivaricata	4	0.2	0.8
TOTAL			**813**		**162.6**

CARBON CONTAIN IN SEMI-GROWN TREE					
SR. NO.	VERNACULAR NAME	BOTANICAL NAME	NUMBER OF PLANTS	CARBON FACTOR PER SEMI-GROWN TREE (IN KG)	TOTAL CARBON (IN KG)
1	Supari Palm	Areca catechu	9	6.8	61.2
2	Areca Palm	Dypsislutescens	54	6.8	367.2
3	Falsa Fruit	Grewiaasiatica	1	6.8	6.8
4	Babul	Acacia nilotica	1	6.8	6.8
6	Royal palm	Roystonea regia	1	6.8	6.8
7	Champa	Magnolia champaca	2	6.8	13.6
8	Kaner	Nerium oleander	8	6.8	54.4
9	Bougainvillea	Bougainvillea glabra	9	6.8	61.2
10	Foxtail palm	Wodyetiabifurcata	9	6.8	61.2
11	Ficus	Ficusbenjamina	3	6.8	20.4
12	Litchi	Litchi chinensis	4	6.8	27.2
13	Salifa	Annona squamosa	2	6.8	13.6
14	Jamun	Syzygiumcumini	2	6.8	13.6
15	Guava	Psidium guajava	10	6.8	68
16	Kathal	Artocarpusheterophyllus	2	6.8	13.6
17	Aam	Mangiferaindica	8	6.8	54.4
18	Gulamohar	Delonix regia	2	6.8	13.6
19	Neem	Azadirachtaindica	4	6.8	27.2
20	Silk Oak	Grevillea robusta	3	6.8	20.4
21	Harsingar	Nyctanthesarbor-tristis	1	6.8	6.8
22	Nimbu	Citrus ×limon	1	6.8	6.8
23	Putrajeevak Plant	Putranjivaroxburghii	9	6.8	61.2
24	Kela	Musa paradisiaca	9	6.8	61.2
TOTAL			154		1047.2
GRAND TOTAL (IN KG)			**967**		**1209.8**
GRAND TOTAL (IN MT)					**1.2098**

D. The lawns on the campus have Bermuda grass and Motha grass species and cover a total area of 3940 sq. m. Carbon sequestration capacity of 3940 sq. m area of lawn is 0.976 gram per day per sq.m Therefore, carbon sequestration by lawn area 3940 x 365 x 0.976 g CO2 per year per sq.m (on an average) = 1.40MT CO2 per year.

TABLE 4: CARBON SEQUESTRATION BY THE GRASSES

CARBON CONTAIN IN GRASS						
SR.NO	**SAMPLE PLOTS**	**VERNACULAR NAME**	**BOTANICAL NAME**	**NO. OF QUADRATE (IN SQ.M)**	**CARBON CONTAINED IN PER QUADRATE (IN KG)**	**TOTAL CARBON PER YEAR (IN KG)**
1	A	Bermuda grass	Cynodondactylon	26	0.0008611	8.171964
2	B	Bermuda grass	Cynodondactylon	231	0.0008611	72.60476
3	C	Bermuda grass	Cynodondactylon	290	0.0008611	91.14883
		Motha grass	Cyperusrotundus			
4	D	Bermuda grass	Cynodondactylon	2050	0.0010764	805.4099
		Motha grass	Cyperusrotundus			
5	E	Bermuda grass	Cynodondactylon	189	0.0008611	59.40389
6	F	Bermuda grass	Cynodondactylon	383	0.0008611	120.3793
		Motha grass	Cyperusrotundus			
7	G	Bermuda grass	Cynodondactylon	278	0.0008611	87.37716
		Motha grass	Cyperusrotundus			
8	H	Bermuda grass	Cynodondactylon	61	0.0010764	23.96586
		Motha grass	Cyperusrotundus			
9	I	Bermuda grass	Cynodondactylon	55	0.0008611	17.28685
		Motha grass	Cyperusrotundus			
10	J	Bermuda grass	Cynodondactylon	320	0.0008611	100.578
11	O	Bermuda grass	Cynodondactylon	57	0.0008611	17.91546
TOTAL				**3940**		**1404.242**
TOTAL (IN MT)						**1.4**

E. The carbon sequestration in soil by lawn area 4171 x 5.44kg CO2 (on an average) = 22.7MT CO2.

TABLE 5: CARBON SEQUESTRATION BY THE SOIL

CARBON CONTAIN IN SOIL				
SR.NO	**SAMPLE PLOTS**	**NO OF QUADRATE(SQ.M)**	**CARBON FACTOR PER QUADRATE (IN KG)**	**TOTAL CARBON (IN KG)**
1	A	26	6.18	160.68
2	B	231	6.18	1427.58
3	C	290	6.18	1792.2
4	D	2050	5.3	10865
5	E	189	5.3	1001.7
6	F	383	5.3	2029.9
7	G	278	5.74	1595.72
8	H	61	5.3	323.3
9	I	55	5.3	291.5
10	J	320	5.3	1696
11	K	29	5.3	153.7
12	L	32	5.3	169.6
13	M	29	5.3	153.7
14	N	141	5.3	747.3
15	O	57	5.3	302.1
TOTAL		**4171**		**22709.98**
TOTAL (IN MT)				**22.7**

F. Total of carbon sequestrationin the campus

TABLE 6: TOTAL CARBON STOCK IN THE ECO-SYSTEM

CARBON ABOVE GROUND						CARBON BELOW GROUND	
SR. NO	**SPECIES**	**CARBON IN TREE**	**CARBON IN SHRUB**	**CARBON IN SEMI GROWN TREE**	**CARBON IN GRASS**	**CARBON IN ROOT**	**CARBON IN SOIL**
1	Aam	266.57	162.60	1047.20	1404.24	53.60	22709.98
2	Amla	223.95				35.23	
3	Amrud	368.00				59.61	
4	Ashok	2536.96				321.29	
5	Bel	325.60				63.18	
6	Chakresia	99.80				33.69	
7	Chitwan	580.59				126.00	
8	Doka tree	1463.93				230.26	
9	Ficus	35.83				6.58	
10	Gulmohar	2434.93				382.99	

11	Gumhar	330.59				66.17	
12	Jamun	41.07				8.26	
13	Kanji	3419.39				593.49	
14	Kathal	62.83				11.67	
15	Mithineem	10.00				2.17	
16	Pipal	1612.11				299.39	
17	Safed chandan	231.09				36.35	
18	Sagawan	14128.54				2275.97	
19	Shisham	1405.61				218.97	
20	Terminallia	46.82				7.58	
TOTAL CARBON (IN KG)		**29624.21**	**162.60**	**1047.20**	**1404.24**	**4832.46**	**22709.98**
TOTAL CARBON (IN MT)		**29.6**	**0.16**	**1.05**	**1.40**	**4.8**	**22.7**

The total carbon sequestrationby the plants in the campus is 59.7MT CO2.

GREENINITIATIVESBY CAMPUS

RENEWABLE ENERGY

The dense greenery of the College Campus significantly reduces Air Pollution. Waste management is done by composting and college administration has put a complete ban on single-use plastic and plastic crockery in the campus. Plantation drives have been carried out every year on environment day, Forestry day and Van Mahotsav and their survival rate is also found to be extremely high. The existing nature clubs conduct poster and essay writing competitions regularly on pre-designated environmental and related international days. Many seminars have been organized by the college on forestry and climate change in order to make the students aware of the contemporary issues related with environmental problems. In July 2024, the nature club organized 'Tie a Rakhi' event on the occasion of Vanmahotsav in which the students vowed to protect trees by tying handmade, eco-friendly Rakhis to them. This followed a seminar on 'The importance of climate change in India and its challenges' in the month of September 2024 to highlight the different shades of this problem. This was a well-attended seminar where most of the students, research scholars and other teachers participated with full enthusiasm and zeal.

RECOMMENDATIONS

- Environmental parameters should be included in purchase policy to achieve a cradle-to-grave approach for sustainability.
- College should go for water balancing audit for monitoring the use and wastage of water.
- Water Meter should be installed at every building of college for monitoring of water consumption per capita.
- College should start drip irrigation to save water in campus.
- College should increase the use of Sprinklers gardening purpose.
- Flow rate of taps should be checked, it should not be more than 2.5 litres/ minute. Increase plantation drives in nearby villages, local bodies, NGO and Municipal Corporation.
- Arrange training programs on environmental management system and nature conservation for college s and local people.
- Establishment of an E-waste collection centre in campus is highly desirable.
- Green building guide lines for future expansion projects of the campus may be looked into.
- Personal Vehicles (Students) should not be allowed in the campus and this is also recommended that college should pursue air quality monitoring by NABL approved laboratories.

CONCLUSION

This audit involves considerable team discussions and meetings with key staff members on a variety of environmental-related topics. The eco club of College promotes the conservation of resources. Overall 40% of College campus is constructed and landscaped and the rest 60% is under green cover. The College makes a significant effort to act in an environmentally responsible manner and considers the environmental effects of the majority of its activities. The recommendations in this report suggests some more ways in which the College can work to improve its practices and develop into a more sustainable college, despite the fact that it performs rather well overall. It's important to begin a few things, such drip irrigation and checking the water flow from the taps. Additionally, we strongly advise installing water metres at each building/block and water balancing report.

AND SOMETHING MORE ABOUT TREES PRESNT IN THE COLLEGE CAMPUS:

1. **TEAK(**Tectonagrandis)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotylodonae
Order	**:** Lamiales
Family	**:** Lamiaceae
Genus	**:** Tectona
Species	**:** Tectonagrandis

BOTANICALDESCRIPTION: (*Tectonagrandis*), large deciduous tree of the family Verbenaceae, or its wood, one of the most valuable timbers. Teak has been widely used in India for more than 2,000 years. The name *teak* is from the Malayalam word *tēkka*. The tree has a straight but often buttressed stem (i.e., thickened at the base), a spreading crown, and four-sided branchlets with large quadrangular pith. The leaves are opposite or sometimes whorled in young specimens, about 0.5 metre (1.5 feet) long and 23 cm (9 inches) wide. In shape they resemble those of the tobacco plant, but their substance is hard and the surface rough. The branches terminate in many small white flowers in large, erect, cross-branched panicles. The fruit is a drupe (fleshy, with a stony seed) 1.7 cm (two-thirds of an inch) in diameter. The bark of the stem is about 1.3 cm (half an inch) thick, grey or brownish grey, the sapwood white; the unseasoned heartwood has a pleasant and strong aromatic fragrance and a beautiful golden yellow colour, which on seasoning darkens into brown, mottled with darker streaks. The timber retains its aromatic fragrance to a great age. Native to India, Myanmar (Burma), and Thailand, the tree grows as far north as about the 25th parallel in most of this area but to the 32nd parallel in the Punjab. The tree is not found near the coast; the most valuable forests are on low hills up to about 900 metres (3,000 feet). Stands are also found in the Philippines and in Java and elsewhere in the Malay Archipelago. Teak is also planted in Africa, Central America, and South America. During the dry season the tree is

leafless; in hot localities, the leaves fall in January, but in moist places, the tree remains green until March. At the end of the dry season, when the first monsoon rains fall, the new foliage emerges. Although the tree flowers freely, few seeds are produced because many of the flowers are sterile. The forest fires of the dry season, which in India usually occur in March and April after the seeds have ripened and have partly fallen, impede the spread of the tree by self-sown seed. In Burmese plantations, teak trees on good soil have attained an average height of 18 metres (59 feet) in 15 years, with a girth, breast high, of 0.5 metre (1.5 feet). In the natural forests of Myanmar and India, teak timber with a girth of about 2 metres (6.5 feet) and a diameter of 0.6 metre (2 feet) is never less than 100 and often more than 200 years old. Mature trees are usually not more than 46 metres (150 feet) high. Teak timber is valued in warm countries principally for its extraordinary durability. In India and Myanmar, beams of the wood in good preservation are often found in buildings many centuries old, and teak beams have lasted in palaces and temples more than 1,000 years. The timber is practically imperishable under cover. Teakwood is used for shipbuilding, fine furniture, door and window frames, wharves, bridges, cooling-tower louvers, flooring, panelling, railway cars, and Venetian blinds. An important property of teak is its extremely good dimensional stability. It is strong, of medium weight, and of average hardness. Termites eat the sapwood but rarely attack the heartwood; it is not, however, completely resistant to marine borers. Myanmar produces most of the world's supply, with Indonesia, India, and Thailand ranking next in production. Since the mid-1980s, numerous countries have restricted teak logging to control deforestation.

2. **GUMHAR**(Gmelina arborea)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Lamiales
Family	**:** Lamiaceae
Genus	**:** Gmelina
Species	**:** Gmelina arborea

ORIGIN: It originated from greater parts of India, Sri Lanka and Myanmar. Best growth in eastern sub-Himalayan tract, moist areas of Himalayan tract in Bengal and Assam and also in drier areas of central India.

CLIMATE: Gamhar survives up to a maximum temperature of 38℃ to 48℃ and in a minimum temperature of 30℉ to over 60℉ and needs a rainfall range of 750 mm to 4500 mm.

SOIL: Gamhar tree prefers moist fertile valleys and also grows on dry sandy or poor soils.

SILVICULTURAL CHARACTERS: A light demander and doesn't stand bed drainage, moderately frost hardy and has good power of recovering and doesn't stand excessive drought. It coppices very well and root suckers not observed.

METHOD OF PLANTING: Six-month-old seedlings are planted out with the ball of earth round the root portion of the seedlings and planting with root and shoot cutting has also been very successful. Weeding necessary in the first year only and stripping of leaves and branches in first cold weather seems helpful.

PLANT PROTECTION: Squirrels pick up and eat seeds after sowing. In first two years browsing and girdling by deer is prevented by fencing.

USES: Wood is yellowish or greyish white, even-grained, soft-light and strong, seasons well without warping and cracking and is very useful in panellings,

carriages, furniture, boxes and carpentry of all kinds. It has been pronounced very good even for match manufacture and also for plywood.

3. **JAMUN**(Syzygiumcumini)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	: Angiosperms
Class	: Magnoliopsida
Order	: Myrtales
Family	: Myrtaceae
Genus	:Syzygium
Species	**:** Syzygiumcumini

BOTANICAL DESCRIPTION: Jamun is a popular indigenous fruit Of India. It has got very valuable place in Auyurvedic medicines. It is believed to be a boon for diabetic patients. But in India, its organised orcharding is still lacking mainly because of lack of proper information on cultivation practices and non-availability of dwarf and high yielding varieties. In this booklet all the information on jamun cultivation has been collected and presented in a simple and interesting form.

The jamun is an important indigenous minor fruit of commercial value. It is also known as black plum, Indian black cherry, Ram jamun etc. in different parts of India. The tree is tall and handsome, evergreen, generally grown for shade and windbreak on roads and avenues. The original home of jamun is India or the East Indies. It is also found in Thailand, Philippines, Madagascar and some other countries. The jamun has successfully been introduced into many other subtropical regions including Florida, California, Algeria, Israel, etc. In India, the maximum number of jamun trees are found scattered throughout the tropical and subtropical regions. It also occurs in the lower range of the Himalayas up to an elevation of 1,300 meters and in the Kumaon hills up to 1,600 meters. It is widely grown in the larger parts of India from the Indo-Gangetic plains in the North to Tamil Nadu in the South. The data about its total acreage in India are not available.

SOIL: The jamun tree can be grown on a wide range of soils. However, for high yield potential and good plant growth, deep loam and a well-drained soil are

needed. Such soils also retain sufficient soil moisture which is beneficial for optimum growth and good fruiting. Jamun can grow well under salinity and waterlogged conditions too. However, it is not economical to grow jamun on very heavy or light sandy soils.

CLIMATE:Jarnun prefers to grow under tropical and subtropical climate. It is also found growing in lower ranges of the Himalayas up to an altitude of 1300 meters. The jamun requires dry weather at the time off towering and fruit setting. In subtropical areas, early rain is considered to be beneficial for ripening of fruits and proper development of its size, colour and taste.

SPECIES AND VARIETIES: The genus Eugenia comprises of 1,000 species of evergreen trees and shrubs, most of them being tropical in origin. Some of the old-world *Eugenia* species are now placed in the genus *Syzygium*. It belongs to the family *Myrtaceae*. Many of these species yield edible fruits and some of these are of ornamental and medicinal value. A wild species *S.frniticosum* with small edible fruits is grown as windbreaks. The large evergreen tree has small dark purple fruits with prominent elongated seeds. The fruit is an astringent (causing contraction of body tissue) even when ripe. A popular fruit is the rose apple or gulab-jamun (S.jambos). It is found in South India and West Bengal. The tree is very ornamental. The fruit is yellow in colour, generally insipid in taste and has high pectin CONTAIN. *S. zeylanica*, small tree with edible fruits, is found on the Western Ghats and S. *malaccensis* (Malay rose apple) found in South India. Another related fruit found in South India is Surinam cherry (*S. uniflora*). It is a small tree with blight red aromatic fruits. *S. javanicum* (water apple) is also found in South India and West Bengal. *S.densiflora* is used as rootstock in jamun (*S. cumini*) and is resistant to the attack of termites.

VARIETIES: There are no standard varieties of this fruit under cultivation. The common variety grown under North Indian conditions is "Ram Jarnun". It produces big sized, oblong fruits, deep purple or bluish-black in colour at full ripe stage. The pulp of the ripe fruit is purple pink and the fruit is juicy and sweet. The stone is small in size. The variety ripens in the month of June- July and it is very

common both in rural as well as in urban markets. Another late maturing variety bears small sized, slightly round fruits, deep purple or blackish in colour at full ripe stage. The colour of the pulp is purple, less juicy, the weight and sweetness of pulp is also less in comparison to that of 'Ram *J arnun'*. The stone present in this variety is comparatively large in size. Fruits ripen in the month of August. At present, there are a number of seedling strains of jarnun in India which provide a good scope for selection of better varieties.

PROPAGATION: The jamun is propagated both by seed and vegetative methods. Due to existence of polyembryony, it comes true to parent through seed. Though vegetative methods followed in most cases have attained some success, seed propagation is still preferred. However, seed propagation is not advisable as it results in late bearing. The seeds have no dormancy. Fresh seeds can be sown. Germination takes place in about 10 to 15 days. Seedlings are ready for transplanting for the use as rootstock in the following spring (February to March) or monsoon i.e. August to September. Propagation of jarnun is economical and convenient. Budding is practiced on one-year-old seedling stocks, having 10 to 14 mm thickness. The best time for budding is July to August in low rainfall areas. In the areas where rains start easily and are heavy, budding operations are attempted early in May-June. Jamun can also be propagated by inarching but it is not adopted commercially. In this method one-year old seedlings raised in pots are inarched with mother jamun trees with the help of wooden stands during June-July. About 60% air layers are obtained with 500 ppm IBA in lanolin paste, provided air layering is done in spring and not in the rainy season. Better rooting through cutting is obtained in Jamun under intermittent mist. Semi-hardwood cuttings of both *S. jambos* and *S.javanica*, 20-25 cm long, taken from the spring flush and planted in July treated with 2000 ppm IBA (indole butyric acid) give better results.

PLANTING: Jamun is an evergreen tree and can be planted both in spring i.e. February -March and the monsoon season i.e. July-August. The latter season is considered better as the trees planted in February- March have to pass through

a very hot and dry period in May and June soon after planting and generally suffer from mortalities from the unfavourable weather conditions. Prior to planting, the field is properly cleared and ploughed. Pits of 1 x 1 x 1 m size are dug at the distance of 10m both ways. Usually, work of digging of pits is completed before the onset of monsoon. The pit is filled with mixture of 75% top soil and 25% well rotten farmyard manure or compost. Another common way of growing jamun trees is to plant them as shade trees near the farm dwellings and wells. Here they provide a welcome shadow besides fruit.

FLOWERING AND FRUITING: Flowers are borne in the axils of leaves on branchlets. In North Indian conditions, flowering starts in the first week of March and continues up to the end of April. The pollen fertility is higher in the beginning of the season. The maximum receptivity of stigma is one day after anthesis. The jamun is a cross-pollinated and the pollination is done by honey bees, houseflies and wind. The maximum fruit set can be obtained by hand pollination when it is done after one day of anthesis. Thereafter, a sharp decline is observed in fruit set. There is heavy drop of flowers and fruits within 3 to 4 weeks after blooming. Later natural fruit drop can be reduced with two sprays of GA3 60 ppm, one at full bloom and another 15 days after initial setting of fruits. The pattern of growth and fruit development of jamun can be divided into three phases: the first phase from 15-52 days after fruit set having slow growth of fruit, the second phase from 52 to 58 days after fruit set having fast growth and the third and last phase from 58 to 60 days after fruit set having slow growth and very little addition in fruit weight.

4. **NEEM** (Azadirachta Indica)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Eudicots
Order	**:** Sapindales
Family	**:** Meliaceae
Genus	**:** Azadirachta
Species	**:** Azadirachtaindica

BOTANICAL DESCRIPTION: Azadirachtaindica, commonly known as neem, is a versatile tree species that is native to the Indian subcontinent. It is highly valued for its medicinal properties and has been used in traditional medicine for centuries. Neem is an evergreen or semi-evergreen tree with continuous growth throughout the year. It typically flowers and produces fruit twice a year, although flowering and fruiting can occur year-round in favorable conditions. Flowering usually occurs from March to May, while fruiting occurs from June to August in many regions. Leaves are shed throughout the year but are more abundant during the dry season. It is a fast-growing evergreen tree. It can reach a height of up to 20 meters and has a spreading crown. The leaves are compound, alternate, and pinnate, with 20-31 leaflets. The flowers are small, white, and fragrant, arranged in clusters. The fruit is a drupe, green when young and turning yellow as it matures.

DISTRIBUTION: Azadirachtaindica is native to the Indian subcontinent, primarily found in India, Pakistan, Bangladesh, and Sri Lanka. It has been cultivated for thousands of years and has a long history of traditional use in Ayurvedic medicine. Neem trees have been introduced to many tropical and subtropical regions around the world due to their valuable properties. They can be found in parts of Africa, the Middle East, Southeast Asia, and even in some parts of the Americas. In these introduced regions, Neem is often grown for its medicinal, pesticidal, and timber value.

ECOLOGY: Neem trees are well adapted to arid and semi-arid environments, and they can grow in a wide range of soil types. They are drought-tolerant and can thrive in areas with limited water availability. Neem is often used in agroforestry systems and provides various ecosystem services, such as soil improvement, shade, and habitat for birds and insects. The tree has a reputation for pest resistance and is used in organic farming and pest control.

PROPAGATION THROUGH SEEDS: Mature seeds are collected from the neem tree and soaked in water for 24 hours to enhance germination. The seeds are then sown in well-draining soil with an ideal temperature of around 25-30℃ for optimal germination to take place. Soil is kept moist but waterlogging should not be allowed to be in the germination plan at any point of time. Germination usually occurs within 2-3 weeks and the seedlings should be understood ready for transplantation into any individual pot or desired planting location once they have developed a few true leaves. After seed treatment, the seeds are ready for sowing. It is important to ensure proper soil preparation and planting techniques to maximize the success of seed treatment efforts. Seed treatment for Azadirachta Indica offers several benefits, including improved germination rates, enhanced seedling vigor, protection against pests and diseases, and increased overall plant health and productivity. Seed treatment plays a crucial role in the successful cultivation of Azadirachta Indica. By following appropriate pre-treatment, scarification, stratification, priming, and coating techniques, growers can optimize seed germination, seedling establishment, and plant growth, leading to healthier and more productive neem trees.

5. **CHUKRASIA**(Chukrasiatabularis)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Eudicots
Order	**:** Sapindales
Family	**:** Meliaceae
Genus	**:** Chukrasia
Species	**:** Chukrasiatabularis

BOTANICAL DESCRIPTION: Chukrasiatabularis is an evergreen or deciduous, monoecious, medium sized, sometimes fairly large tree up to 30 (max. 40) m tall; bole branchless for up to 18 (max. 32) m, with a diameter of up to 110 (max. 175) cm, without buttresses; bark surface rusty brown or deep brown, deeply fissured or cracked, with lenticels, inner bark reddish. Leaves paripinnate, 30-50 cm long, with 4-6 pairs of opposite or alternate, entire, asymmetrical and acuminate leaflets (imparipinnate and lobed or incised when juvenile) with dentate margins, glabrous or with simple hairs.

Flowers unisexual, small, in axillary (sometimes appearing terminal) thyrses, tetramerous or pentamerous, up to 16 mm long; calyx lobed; petals free, contorted, reflexed in open flowers, white, in 10-30 cm long panicles.

Fruit an erect woody ovoid or ellipsoid capsule 2.5-5.0 cm long, opening by 3-5 valves from the apex; valves separating to a woody outer and inner layer, apex of those in the inner layer deeply bifid; locules appearing as 1 locule due to the breaking of the septae; columella with sharp ridges. Seeds 60-100 per locule, flat, with terminal wings arranged in layers on the central columella. Seed about 1.2 cm long, flat and with a brown membranous wing twice the length of the remaining portion of the seed. Cotyledons thin, radicle facing the wing; endosperm absent.

BIOLOGY:C. tabularis is monoecious, flowers are unisexual. Flowering normally begins when the tree is 8-9 years and, in some places, there is a masting period

every 2-3 years. It flowers and fruits annually; in Southeast Asia, the tree is leafless from December to March. Flowering starts in April and continues until June/July and the fruits ripen in January-March. The winged fruits are disseminated by wind.

ECOLOGY:C. tabularis is usually found scattered in lowland evergreen forest or deciduous forest. It is a dominant tree, occurring in top canopy in natural forests. In peninsular Malaysia, it occasionally occurs as a colonizer of bare land, including road cuttings. In Sarawak, it is notably found on limestone. C. tabularis usually avoids heavy and wet soils. It is regarded as a pioneer species and common in former shifting cultivation areas. It thrives in areas with uni- as well as bimodal rainfall regimes.

6. **CHHITWAN**(Alstoniascholaris)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledon
Order	**:** Gentianales
Family	**:** Apocynaceae
Genus	**:** Alstonia
Species	**:** Alstoniascholaris

BOTANICAL DESCRIPTION: The species can be grown in a variety of climatic conditions in India, ranging from dry tropical to sub-temperate. However, it thrives well in areas where annual rainfall is about 100–150 cm, as it prefers a fairly moist habitat. The species grows well in the red alluvial soil having proper aeration. It can thrive in black cotton soils as well, but the growth is slow due to prevailing moist soil conditions during rainy season. Alstonia is a bitter tonic, febrifuge, diuretic, anthelmintic, stimulant, carminative, stomachic, aphrodisiac, galactagogue, and haemostatic. It is used as a substitute for cinchona and quinine for the treatment of intermittent periodic fever. An infusion of bark is given in fever, dyspepsia, skin diseases, liver complaints, chronic diarrhoea, and dysentery.

MORPHOLOGICAL CHARACTERISTICS: Saptaparna is a medium-sized evergreen tree, usually 12–18 m high, sometimes up to 27 m high, with close-set canopy. Bark is rough, greyish white, yellowish inside, and exudes bitter latex when injured. Leaves are four to seven in a whorl, and are thick, oblong, with a blunt tip. They are dark green on the top, and pale and covered with brownish pubescence on the dorsal surface.

FLORAL CHARACTERISTICS: Flowers are fragrant, greenish-white or greyish-yellow in umbrella-shaped cymes. Follicles (fruits) are narrowly cylindrical, 30 cm × 3 cm, fascicled, with seeds possessing brown hair. Flowering and fruiting occur from March to July, extending to August in subtropical climate.

ECOLOGY: The species can be grown in a variety of climatic conditions in India, ranging from dry tropical to sub-temperate. However, it thrives well in areas where annual rainfall is about 100–150 cm, as it prefers a fairly moist habitat. The species grows well in the red alluvial soil having proper aeration. It can thrive in black cotton soils as well, but the growth is slow due to prevailing moist soil conditions during rainy season.

PROPAGATION MATERIAL: Alstoniascholaris Seeds are the best planting material for raising the crop. No pretreatment is generally required. Fruits may be collected during summer before splitting of thin and wiry pods. Seeds are feathery but unable to disperse easily and automatically.

7. **KATHAL**(Artocarpusheterophyllus)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Rosales
Family	**:** Moraceae
Genus	**:** Artocarpus
Species	**:** Artocarpusheterophyllus

BOTANICAL DESCRIPTION: Jackfruit (Artocarpusheterophyllus Lam.) perhaps the most widely distributed tree species in the genus Artocarpus, enjoys a dominant place in tropical agroforestry primarily on account of its multiple uses and amenability to integrate with other crop forms. The ever-green thick foliage, round crowned tree stands out for its aesthetic elegance. Jackfruit tree is easily distinguishable from other trees on account of its unique fruit which is largest among the cultivated plants. Jackfruit often forms part of regular diet in many places. For instance, it is the national fruit of Bangladesh and it is consumed by all classes of rural people. Jackfruit is rich in vitamin A and C, contains moderate amounts of minerals and high quantities of protein, calcium, thiamin, riboflavin and carotene. Apart from the delicious jackfruit, it is chiefly cultivated for timber and fodder. Jack trees yield excellent timber with good durability and structural properties. It yields fuelwood with high calorific values (22.5 kJ g-1 dry weight). Jackfruit is assumed to have its origin in the Malayan rain forests and Western Ghats of India. Over the times, it has naturalized and enjoying a wider distribution in many humid tropics such as Indonesia, Thailand, China, Myanmar, Philippines, Sri Lanka and parts of Africa, Brazil, Costa Rica, Suriname, the Caribbean islands, Florida, and Australia.

GROWTH HA BIT AND SILVICULTURAL CHARACTERS: Heterophyllus is a medium-size evergreen tree typically reaching 8-25 m in height and 30- 80 cm diameter within a period of 20-25 years. It grows in tropical, near tropical and

subtropical regions. Compared to the other members of the genera it extends into much drier and cooler climates. It can also withstand lower temperatures and frost; it bears fruit at latitudes up to 30º on either s ide of the equator with good yields at 25º north and south. The tree is less tolerant to drought or flooding, and shows optimum production in warm, humid climate with evenly distributed rainfall. Jackfruit enjoys biophysical limits suitable for typical humid tropical climate with mean annual rainfall ranging from 1000-2400 mm and mean annual temperature from 16ºC to 22ºC. In general Jackfruit prefers lower altitudes, however, thrives well over an altitudinal range of 0-1600 m. It prefers well drained deep alluvial soil with moderate fertility and with slightly acidic to neutral pH. It tolerates a wide range of soil texture and grows even in the poorest soils, including gravelly or lateritic soils and sandy or stony soils. However, it exhibits moderate tolerance to saline soils.

8. **SHISHAM**(Dalbergia sissoo)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Eudicots
Order	**:** Fabales
Family	**:** Fabaceae
Genus	**:** Dalbergia
Species	**:** Dalbergia sissoo

BOTANICAL DESCRIPTION: Dalbergia sissoo is best known internationally as a premier timber species of the rosewood genus. However, sissoo is also an important fuelwood, shade, shelter and fodder tree. With its multiple products, tolerance of light frosts and long dry seasons, this species deserves greater consideration for agroforestry applications.

BOTANY: *Dalbergia sissoo* Roxb. (Leguminosae, subfamily Papilionoideae) is a medium to a large deciduous tree with a light crown. It can grow to 30 m in height and 80 cm in diameter but is usually smaller. Trunks are often crooked when grown in the open. Leaves are alternate, pinnately compound and about 15 cm long. Flowers are whitish to pink, 1 cm long and in dense clusters 5-10 cm in length. Pods are oblong, flat, thin, 3-7 cm long, 10-12 mm wide, and light brown. They contain 1-5 flat bean-shaped seeds 7-9 mm long. Sissoo and shisham are common names for *Dalbergia sissoo* (in this article we will be using sissoo).

ECOLOGY: Sissoo is native to the foothills of the Himalayas of India, Pakistan, and Nepal. It is primarily found growing along riverbanks below 900 m elevations, but can ranges naturally up to 1500 m. The temperature in its native range averages 12-22oC but varies from just below freezing to nearly 50oC. An average annual rainfall of 500 to 2000 mm is distributed in a monsoonal pattern with droughts of 3-4 months. Soils range from pure sand and gravel to rich

alluvium of riverbanks; sissoo can grow in slightly saline soils. Seedlings are intolerant of shade.

TIMBER: Sissoo is among the finest cabinet, furniture and veneer timbers. The heartwood is golden to dark brown, and sapwood white to pale brownish white. The heartwood is extremely durable (Specific Gravity = 0.7- 0.8), and is very resistant to dry-wood termites; but the sapwood is readily attacked by fungi and borers.

FUELWOOD: The calorific value of the sapwood and heartwood of excellent fuelwood is reported to be 4908 kcal/kg and 5181 kcal/kg, respectively. As a fuelwood, it is grown on a 10 to the 15-year rotation. The tree has an excellent coppicing ability, although a loss of vigour after two or three rotations has been reported in Nigeria. Sissoo wood makes excellent charcoal for heating and cooking.

FODDER: Leaves and young shoots of sissoo are an important winter fodder in some areas and an emergency fodder in others. They are eaten readily by many animals, including monkeys. On a dry weight basis, leaves contain 12.6-24.1% crude protein, with young leaves having the higher values, and 123-26.1% crude fibre. Dry matter digestibility is about 56%. The trees are deciduous, dropping leaves in the winter. Young leaves appear about the end of February and leafing is complete by early April making April to May the best time of the year for the production of high-quality fodder. Although the material has no known told compounds, feeding green leaves sometimes causes digestive disorders which can be prevented by making silage. Sissoo silage contained 14% crude protein and 30% crude fibre.

BIOMASS PRODUCTION: A study of 40 natural riverine sites showed that growth for 20, 30 and 50-year-old stands were 5, 7 and 7 m3/ha/year. A 10-year-old irrigated plantation in Peshawar, Pakistan, spaced at 2 x 2, 3 x 3 and 4 x 4 m produced a total wet weight biomass (main stem, branches, leaves, and roots) of 510, 231 and 244, tones/ha, respectively. In Nepal, a 9.5-year-old stand thinned to 867 trees/ha at 6.5 years produced an annual increment of 18.1 M3. A

permanent water table 7 m below the surface made the site very favourable. Species trials have indicated that total biomass yields for sissoo are usually lower than that of other species. Sissoo should, therefore, be used in areas where a high-value timber market is available, or on sites unfavourable for other species.

SEED TREATMENT: Seeds (50,000/kg) remain viable for only a few months when exposed to air, but can be stored for up to 4 years in sealed containers. It is not necessary to extract seeds from pods, which can be broken into one-seeded segments and sown. Seeds should be soaked in water for 48 hours before sowing, and 60-80% germination can be expected in 1-3 weeks.

PLANTATION: Stump cuttings are commonly used for the establishment. Plants are grown for 6 months to 1 year in beds, pulled up carefully and cut to leave 5-10 cm of stem and 20-25 cm of the root. Stumps thicker than 2.5 cm and thinner than 1.5 cm in diameter are rejected in Pakistan, although in Nepal stumps average 1 cm in diameter at the root collar.

Container-grown seedlings also are used, but out planting survival averages only 50%. Regular root pruning is necessary for the nursery, as seedlings develop strong taproots. Direct seeding has been a common practice in taungya plantings in India. Rows are planted 3 m apart and saplings are thinned to 1 m spacing within rows after one year. It is also possible to raise plants from stem cuttings. The age of the tree and time of planting are very important. Rooting success of hardwood cuttings from 1-year-old and 4-year-old trees ranged from 34-73% and 18-38%, respectively. Wood cuttings planted in May and June failed completely, while those planted in August achieved up to 20% success; May and June are hot and dry and monsoons occur in August in the study area.

SILVICULTURE: At a spacing of 4 x 4 m, 3 x 3 m and 2 x 2 m, height and diameter after 6 years were 8.4 m and 11.3 cm, 8.7 m and 10.1 cm, and 8.7 m and 8.6 cm, respectively. Differences were not significant, but the 2 x 2 m spacing produced trees with fewer branches and more fuelwood. After 9 years, height and DBH for the three spacing were 15.1 m and 18.9 cm, 13.4 and 15.6

cm, and 13.9 m and 14.2 cm.Thorough weeding is important during the first 2-3 years. In a trial at Adabhar, Nepal, mean height at 18 months was 3.8 m in fully cultivated plots and 1.3 m when weeding was confined to a 50 cm diameter circle around the plants. Protection against browsing animals and fire also is essential if the plant is to become a tree. Irrigation is very important for the establishment of sissoo in and even semiarid areas; it is through canal irrigation that the species has spread throughout much of the Indus valley. Sissoo should be able to tap sub-soil water within a couple of years if irrigated properly. Shallow and frequent irrigation or constant flooding induces superficial root formation. Fertilization with various combinations and amounts of NPK did not show significant effects on DBH or height over 5-6 years on a rich soil . Phosphate would normally be expected to promote early growth on poor soils.

PROVENANCES: Selections for fast growth and tree form have been made in Pakistan and India and experimental seed orchards established. In a trial at Adabhar, Nepal relatively small differences in height growth in two years were observed for seven Nepal provenances, but two Pakistan provenances showed inferior growth to the Nepalese provenances.

OTHER USES: Sissoo is a desirable shade tree in tropical and subtropical regions. Many medicinal uses for its fresh leaves, dried bark, and wood raspings are reported from its native region. Sissoo is reported to be a stimulant used in folk medicine and remedies. Its habit of developing root suckers and runners make it useful for erosion control in gullies.

PESTS AND DISEASES: *Plecopterareflexa*, a leaf defoliator, *Dichmeriaeridantis*, a leaf roller, *Stromartiumbarbatum*, a woodborer, and *Sinoxylon anale* and *Lyctus africanus*, powder post beetles, have been reported as having caused considerable damage. The fungus, *Ganoderma lucidum*, which causes root and butt rot, is common. *Fusarium solani* and *Polyporusgilvus* cause similar diseases. Sissoo suffers minor damage from two foliage rusts and a powdery. Shisham dieback is the most common disease in Pakistan and vicinity regions.

9. **GULMOHAR**(Delonix regia)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledons
Order	**:** Fabales
Family	**:** Fabaceae
Genus	**:** Delonix
Species	**:** Delonix regia

LOCAL NAMES: Amharic (dire dawazaf), Arabic (goldmore), Bengali (chura,radha), Burmese (seinban), Creole (poinciana royal), English (flamboyant,goldmohur,flame of the forest,julutree,peacockflower,flametree,flamboyant flame tree,gulmohr,royal poinciana), French

BOTANICAL DESCRIPTION: The generic name, 'Delonix', is derived from a Greek delos (visible), and onyx (claw), in allusion to the conspicuously clawed petals. The specific name, 'regia', is from the Latin word 'regis' (royal, regal, magnificent). Most of its common names are derived from its large, flame-red flowers.Delonix regia is a tree 10-15 (max. 18) m high, attaining a girth of up to 2 m; trunk large, buttressed and angled towards the base; bark smooth, greyish-brown, sometimes slightly cracked and with many dots (lenticels); inner bark light brown; crown umbrella shaped, spreading with the long, nearly horizontal branches forming a diameter that is wider than the tree's height; twigs stout, greenish, finely hairy when young, becoming brown. Roots are shallow. Leaves are bi- paripinnate, alternate, light green, feathery, 20-60 cm long; 10-25 pairs of pinnae, 5-12 cm long, each bearing 12-40 pairs of small oblong-obtuse leaflets that are about 0.5-2 cm long and 0.3 cm wide; petiole stout. The numerous leaflets are stalkless, rounded at the base and apex, entire thin, very minutely hairy on both sides, green on the upper surface. At the base of the leaf stalk, there are 2 compressed stipules that have long, narrow, comblike teeth.

Corymbs 15-30 cm long, borne laterally near the end of the twig, each with loosely arranged, slightly fragrant flowers; flowers 5-13 cm across, with 5 equal petals, on slender stalks 5-7.6 cm long. Petals 5-6.5 cm long, 2-3 cm wide, orbicular, broadly spoon shaped, rounded but broader than long, slightly wavy-margined or crisp, tapering into claws about 2.5 cm long, widely extended and bending backwards before falling. Petals 4, orange-red, almost scarlet, 1 longer and narrower than the others, whitish inside with red spots and streaks; stalk very long, slender and hairy. Sepals 5, thick, green outside and reddish with yellow border within, reflexed when the flowers open, pointed, finely hairy, about 2.5 cm long. Stamens 5 with 10 red filaments; pistil has a hairy 1-celled ovary about 1.3 cm long and slender style about 3 cm long.

FRUIT:green and flaccid when young, turning to dark brown, hard, woody pods, 30-75 cm long, 3.8 cm thick, 5-7.6 cm broad, ending in a short beak when mature, with many horizontally partitioned seed chambers inside, indehiscent, finally splitting into 2 parts. The conspicuous pods hang down and remain attached most of the year even when the trees are leafless. Seeds 30-45, hard, greyish, glossy, to 2 cm long, oblong and shaped very much like date seeds, transversely mottled with a bony testa. They are arranged at right angles to the length of the pod.

ECOLOGY:D. regia originates from Madagascar, where it is now almost extinct. It is now widespread in most tropical and subtropical areas of the world. Trees can grow at higher altitudes than recommended, but flowering becomes erratic. The tree demands light and grows weakly and sparsely under shade. It grows in areas with both high and scanty rainfall. D. regia has a superficial root system and competes successfully with the neighbouring shrubs and flowering plants, rendering bare the ground under its canopy. It should therefore be planted away from other plants in the gardens. Trees are deciduous only where the dry season is long and pronounced.

TREE MANAGEMENT:D. regia can be planted in areas where rainfall is less than the recommended amount, as long as irrigation is practised. It is fast

growing, and pollarding is a suitable practice. Careful pruning will achieve good crown form. The trees have shallow root systems and the wood is weak; they are therefore liable to being uprooted during strong storms and broken by strong winds. After the leaves are shed, the trees are less attractive, with their conspicuous pods remaining on the bare branches and with prominent tunnels and nests of termites that commonly attacks this species. Another objectionable feature is the surface root system, which sometimes breaks sidewalks and walls. Because of these undesirable characteristics, some authorities classify flamboyant as a tree that should not be planted. Seeds can be stored for a long time if insect attack is avoided, which can be done by adding ash to the seeds. Seed storage behaviour is orthodox and a germination rate of 47% has been recorded after 9 years of storage at room temperature; no loss in viability following 4 years of storage. Viability is maintained following 3 years of hermetic storage at room temperature with 13-12% mc, and for at least 5 years in hermetic storage at room temperature. Average moisture of seeds is 10.45%, and there are about 2000-3245 seeds/kg. D. regia originates from Madagascar, where it is now almost extinct. It is now widespread in most tropical and subtropical areas of the world. Trees can grow at higher altitudes than recommended, but flowering becomes erratic. The tree demands light and grows weakly and sparsely under shade. It grows in areas with both high and scanty rainfall. D. regia has a superficial root system and competes successfully with the neighbouring shrubs and flowering plants, rendering bare the ground under its canopy. It should therefore be planted away from other plants in the gardens. Trees are deciduous only where the dry season is long and pronounced. D. regia is easily propagated from seeds that have a hard, woody testa and take a long time to germinate. They may lie for 2-3 years in the soil without germinating and usually take 12-349 days to germinate. To break this dormancy, pre-treatment is practised; a small portion of the seed coat is clipped, or seeds are boiled in hot water, then allowed to soak for 24 hours. After seeds are sown in unshaded nursery beds, they germinate within 5-10 days, with a germination rate of up to 90%; subsequent growth in the nursery is quite fast. Alternatively, the seeds can

be directly sown in polythene bags, 4-5 seeds/bag. Seedlings watered and weeded regularly are planted out in the rainy season, with total time required in the nursery being 3-5 months. Keeping the plants for more than 9 months is not desirable, as they become too tall to handle, but seedlings can be transplanted even when 20-25 cm high. Trees can also be propagated from branch cuttings. Natural regeneration is common. Young plants are not fire resistant and should be protected from grazing.

10. WEEPING FIG(Ficusbenjamina)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotylodonae
Order	**:** Rosales
Family	**:** Moraceae
Genus	**:** Ficus
Species	**:** Ficusbenjamina

BOTANICAL DESCRIPTION: The weeping fig is a member of the Moraceae (fig) family. A broadleaf evergreen, it is native to southeastern Asia and Australia, with its range extending into the southwestern Pacific. The tree may reach a height of 40 to 50 feet and a spread of 25 to 30 feet. As a houseplant, however, it is usually kept in the range of 2 to 10 feet tall.This ficus performs best in bright indirect sunny locations but will also survive in shade. It is very sensitive to light, so if the plant is moved, it may drop leaves and produce new ones that are accustomed to the new light conditions. It grows well in a soil-based potting mix. Water just often enough to keep the soil from completely drying out. It is intolerant to cold and should be kept away from drafts. Light pruning for shape and size is best done in late autumn or winter. Flowers and fruit will appear on both new and old growth. It may benefit from light fertilization after new shoots form and at the end of summer.The weeping fig is a very popular houseplant because of its attractive appearance, low maintenance, and tolerance of poor growing conditions, and its stems may be intertwined for an interesting effect. Indoors it is usually grown in large containers, thus dwarf forms may be better suited in this setting. Miniature cultivars like ‘Too Little' are popular for bonsai. This tree may be grown as a specimen plant or a focal point in a tropical garden. It tolerates shearing so is often seen pruned into a hedge or a rounded shrub, though this heavy pruning decreases the longevity of the plant. Lenticels tending to be in horizontal lines. Twigs and branches weeping but not as conspicuously as Weeping Willow (Salix babylonica). Dead bark yellowish brown when cut.

DISTRIBUTION AND ECOLOGY: Altitudinal range varies from near sea level to 250 m. Grows in monsoon forest and drier, more seasonal rain forest. Also occurs in SE Asia and Malesia. This species is widely cultivated in Queensland but it is not at all certain that the cultivated form originated in Australia.

LEAVES: Petioles and twigs produce a milky exudate. Leaf blades about 3-12 x 1.5-6 cm. Stipules smooth about 1-2 cm long. Oil dots visible with a lens on both the upper and lower surfaces.

FLOWERS: Male flowers dispersed throughout the fig. Stigma globose and hairy. Bracts at the base of the fig, three. Lateral bracts not present on the outside of the fig body.

FRUIT: Figs sessile, globular, about 10-12 x 10-12 mm. Orifice +/- closed by interlocking apical and internal bracts.

SEEDLINGS: Cotyledons small, almost orbicular, about 2-3 mm long. Oil dots very small, difficult to see with a lens. At the tenth leaf stage: leaf blade lanceolate, glabrous, veins about 12-20 each side of the midrib, intramarginal vein distinct; oil dots small, visible with a lens; stipules narrowly triangular, sheathing the terminal bud and falling early soon after the shoot expands. Seed germination time 13 to 34 days.

11. **PEEPAL**(Ficusreligiosa)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Rosales
Family	**:** Moraceae
Genus	**:** Ficus
Species	**:** Ficusreligiosa

BOTANICAL DESCRIPTION: The tree often starts life as an epiphyte in the branch of a tree; as it grows older it sends down aerial roots which, when they reach the ground quickly form roots and become much thicker and more vigorous. They supply nutrients to the fig, allowing it to grow faster than the host tree. The aerial roots gradually encircle the host tree, preventing its main trunk from expanding, whilst at the same time the foliage smothers the foliage of the host. Eventually the host dies, leaving the fig to carry on growing without competition. The tree is harvested from the wild for local use as a food, medicine and source of materials. It is cultivated in the tropical regions of the world, mainly as ornamental tree with various uses. This is the species under which the Buddha sat when he achieved Realisation. As such it is a holy tree for Buddhists and has been introduced into several other places predominately Buddhist countries, such as Myanmar, Malaysia, Thailand, Vietnam and S China, from its original home of India

DISTRIBUTION: E. Asia - Bangladesh; India; Nepal; Pakistan, Myanmar.

HABITAT: Sub montane forest

CULTIVATION DETAILS: Succeeds in tropical and subtropical areas at elevations up to 1,520 metres. It grows best in areas where the mean annual temperatures are within the range 16 - 35℃, and the mean annual rainfall is in the range 500 - 5,000mm.Prefers a position in full sun but also succeeds in partial shade Succeeds in a good, moist but well-drained soil. It grows on a wide

variety of soils but prefer deep, alluvial sandy loam with good drainage. It is also found onshallow soils including rock crevices. Fig trees have a unique form of fertilization, each species relying on a single, highly specialized species of wasp that is itself totally dependent upon that fig species in order to breed. The trees produce three types of flower; male, a long-styled female and a short-styled female flower, often called the gall flower. All three types of flower are contained within the structure we usually think of as the fruit. The female fig wasp enters a fig and lays its eggs on the short styled female flowers while pollinating the long styled female flowers. Wingless male fig wasps emerge first, inseminate the emerging females and then bore exit tunnels out of the fig for the winged females. Females emerge, collect pollen from the male flowers and fly off in search of figs whose female flowers are receptive. In order to support a population of its pollinator, individuals of a Ficus spp. Must flower asynchronously. A population must exceed a critical minimum size to ensure that at any time of the year at least some plants have overlap of emission and reception of fig wasps. Without this temporal overlap the short-lived pollinator wasps will go locally extinct

MEDICINAL: The leaves and twigs are alterative, antidote, aphrodisiac, astringent, anti-gonorrhoeal and laxative It is used as an antidote against bites of venomous animals, and for the treatment of haemoptysis and fistula Fresh sap from the leaves is used to cure diarrhoea, cholera and for wound healing. An infusion of the bark is drunk as an antidiabetic. A decoction of the bark is used as skin wash to treat scabies, ulcers and skin diseases. The aerial roots are diuretic they are used in the treatment of ascites and are chewed by women to promote fertility. The bark contains tannins and is used as a dye for cloth.

12. **DOKAPED**(Isoberliniadoka)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledonae
Order	**:** Fabales
Family	**:** Fabaceae
Genus	**:** Isoberlinia
Species	**:** Isoberliniadoka

BOTANICAL DESCRIPTION: Small to medium-sized tree up to 25 m tall; bole branchless for up to 12 m but more often only for 4–6 m, straight and cylindrical or twisted, up to 75 cm in diameter, sometimes more; bark surface smooth in young trees, later flaking off in large scales, inner bark red; crown fairly narrow and open; twigs grey-brown hairy, becoming glabrous. Leaves alternate, paripinnate compound with (2–)3(–4) pairs of leaflets; stipules c. 2.5 cm × 2 cm, more or less fused at base, usually caducous; petiole 6–12 cm long, rachis 10–25 cm long, ovate-elliptical, slightly asymmetrical, 6–25 cm × 3–13 cm, base usually rounded, apex obtuse to short-acuminate, leathery, glabrous, pinnately veined with 6–17 pairs of lateral veins. Inflorescence a terminal or axillary panicle 10–18 cm long, soon glabrous, many-flowered. Flowers bisexual, nearly regular, 5-merous, whitish; pedicel up to 2 mm long, with 2 thick bracteoles c. 1 cm long, finely hairy on both sides; sepals narrowly triangular, 6–7 mm long; petals nearly equal but one slightly broader, oblong, 7–13 mm long; stamens 10, free, c. 2 cm long; ovary superior, hairy, with stipe, 1-celled, style slender, longer than stamens. Fruit an oblong pod 15–30 cm × 5–8 cm, brown, with fine transverse streaks, initially short-hairy but becoming glabrous, dehiscent with 2 woody valves, c. 4-seeded. Seeds rounded, flat

DISTRIBUTION: Isoberliniadoka occurs in a wide, more or less continuous belt from Mali and Guinea eastward to northern DR Congo, Sudan and Uganda; its

range does not extend south of the equator. Isoberliniadoka woodlands are estimated to cover close to 20 million ha in West Africa.

ECOLOGY:*Isoberliniadoka* grows in a zone receiving on average 900–1500 mm annual rainfall, at altitudes of 100–1200 m. It is a gregarious pioneer species that occurs in clumps or in large groups, in pure stands or mixed with other leguminous trees; it never occurs dispersed. Isoberliniadoka woodlands are the northern equivalent of the miombo woodlands of the Zambezian region in southern Africa.Intact woodlands of this type have unfortunately become increasingly rare as a result of clearing for agriculture. Isoberliniadoka is a hardy, undemanding species colonizing all types of soil, except hard pans, crusted soils, rocky outcrops and areas subject to flooding. The roots have difficulty in penetrating hardened ferruginous horizons, which leads to superficial rooting, but the roots can penetrate compact gravelly horizons. Isoberliniadoka may grow in very poor sites and may survive fires, land clearing and erosion due to abundant suckering. In the Central African Republic, it prefers well-drained, red or ochre, ferralitic soils, whereas it is replaced by Monoteskerstingii on rocky soils. In northern Côte d'Ivoire and Nigeria, it has been reported that seeds germinate readily in well-drained loamy soils, but not in shallow sandy soils on clay where Terminalia avicennioidesGuill. &Perr. Grows, which may explain the strict segregation of the two species. Isoberliniadoka is associated with several species of ectomycorrhizae, including Scleroderma spp

USES: The wood of *Isoberliniadoka*, called 'abogo' or 'sau' in trade, is used for joinery, furniture and cabinet work. Traditionally, it is also used for posts, poles, handicrafts and agricultural implements. It is suitable for light construction, flooring, panelling, moulding, ship building, railway sleepers, boxes, crates, veneer and pulpwood. As there are no physical differences between the heartwood and the very wide sapwood, the latter can be used just like the heartwood after treatment with preservatives. The wood is widely used for fuel or made into charcoal. Wood ash is used in soap making.

13. AAM(Mangiferaindica)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledonae
Order	**:** Sapindales
Family	**:** Anacardiaceae
Genus	**:** Mangifera
Species	**:** Mangiferaindica

BOTANICAL DESCRIPTION: Mangiferaindica is a large evergreen tree to 20 m tall with a dark green, umbrella-shaped crown. Trunk stout, 90 cm in diameter; bark brown, smoothest, with many thin fissures; thick, becoming darker, rough and scaly or furrowed; branchlets rather stout, pale green and hairless. Inner bark light brown and bitter. A whitish latex exudes from cut twigs and a resin from cuts in the trunk.

LEAVES: Leaves are alternate, simple, leathery, oblong-lanceolate, 16-30 x 3-7 cm, on flowering branches, up to 50 cm on sterile branches, curved upward from the midrib and sometimes with edges a little wavy. Young leaves red, aging to shiny dark green above, lighter below, with yellow or white venation; petioles 4.5 cm long, striate and swollen at the base. Inflorescence 16 cm or more in length, a much-branched panicle bearing many very small (4 mm) greenish-white or pinkish flowers.

INFLORESCENCE: Inflorescence is 16 cm or more in length, a much-branched panicle bearing many very small (4 mm) greenish-white or pinkish flowers.

FLOWERS: Flowers are radially symmetrical, usually have 5 spreading petals, 3-5 mm long, 1-1.5 mm broad, streaked with red, imbricate, with the median petal prolonged like a crest at the base, finely hairy and fragrant, partly male and partly bisexual; stalk short; 5 stamens, 1 fertile, the other 4 shorter and sterile, borne in a disc. The flower has a conspicuous 5-lobed disc between the petals and stamens. Calyx yellow-green, very short, deeply 5-lobed; 5 sepals, each 2- 2.5

mm long x 1-1.5 mm broad, green with whitish margin, or yellowish green, hairy outside.

FRUIT: Fruit is an irregularly egg-shaped and slightly compressed fleshy drupe, 8-12 (max. 30) cm long, attached at the broadest end on a pendulous stalk. The skin smooth, greenish-yellow, sometimes tinged with red. The underlying yellow-orange flesh varies in quality from soft, sweet, juicy and fibre-free in high-quality selected (clonal) varieties to turpentine flavoured and fibrous in wild seedlings. The single, compressed-ovoid seed is encased in the white fibrous inner layer of the fruit. The generic name is derived from 'mango', the Indian name for the fruit, and the Latin 'fero' ('I bear').

BIOLOGY: Individual trees often flower irregularly; some trees do not flower for periods of 10-20 years, sometimes even longer. Flowering starts at the beginning of the rainy season and fruits ripen at the end of the rainy season. Bisexual and male flowers appear on the same cluster, in proportions that vary from 1:4 to 2:1. Evidence from various countries shows that some cultivars develop fruit without fertilization but that others need cross-pollination; the determining factors are not yet well understood. Pollinators are nectarivorous bats and insects such as flies, ants and possibly thrips, but bees are the most effective. Rain and high humidity at blossoming reduce pollination and fruit setting. Usually only small proportions of the flowers develop into fruit. Hermaphrodite flowers are predominantly outcrossing and exhibit protogynous dychogamy, but trees are generally self-compatible, and self-fertilization by pollen from the same flower is possible. It has been shown that 65-85% of hermaphrodite flowers remain unpollinated and that only 0.1-0.25% of them reach the harvesting stage, with fruit drop occurring at all stages. The time of development after fertilization to maturity of fruit is 2-5 months, depending on the cultivar and temperature. Fruiting is often biennial; some cultivars, in addition to the main fruiting seasons, set a few fruits throughout the year. The fruits are eaten and dispersed by bats, hornbills, porcupines, monkeys, elephants and humans

ECOLOGY: The mango thrives in both the subtropics and the tropics. In the subtropics, the cold months ensure excellent floral induction, but late frosts are a major risk; tender parts of the tree are killed by frost. In the tropics, the mango grows anywhere up to 1200 m elevation, but for fruit production a prominent dry season lasting more than 3 months is necessary. A flowering flush is produced during the dry season, but—contrary to the subtropics—flowering is erratic and a yield-limiting factor. At elevations above 600 m in the tropics, the climate becomes too cool for the commercial cultivars, the optimum temperature being about 24-27 deg. C. The trees are drought tolerant but do not seem to suffer from occasional flooding. Frequently found in coastal areas. Trees shade out grasses because of their thick crowns.

BIOPHYSICAL LIMITS: Altitude: 0-1200 m, mean annual temperature: 19-35 deg. C, mean annual rainfall: 300-2 500 mm Soil type: Mango trees thrive in well-drained soils with pH ranging from 5.5 to 7.5 and are fairly tolerant of alkalinity. For good growth, they need a deep soil to accommodate the extensive root system.

14. **EMBLICA OFFICIANALIS**(Phyllanthus emblica)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledons
Order	**:** Malpighiales
Family	**:** Phyllanthaceae
Genus	**:** Phyllanthus
Species	**:** Phyllanthus emblica

BOTANICAL DESCRIPTION: Embelica officinalis is a graceful ornamental tree, normally reaching a height of 18 m and, in rare instances, 30 m. It's fairly smooth bark is a pale greyish-brown and peels off in thin flakes like that of the guava. While actually deciduous, shedding its branchlets as well as its leaves, it is seldom entirely bare and is therefore often cited as an evergreen. The miniature, oblong leaves, only 3 mm wide and 1.25-2 cm long, distichously disposed on very slender branchlets, give a misleading impression of finely pinnate foliage. Small, inconspicuous, greenish-yellow flowers are borne in compact clusters in the axils of the lower leaves. Usually, male flowers occur at the lower end of a growing branchlet, with the female flowers above them, but occasional trees are dioecious. The nearly stemless fruit is round or oblate, indented at the base, and smooth, though 6 to 8 pale lines, sometimes faintly evident as ridges, extending from the base to the apex, giving it the appearance of being divided into segments or lobes. Light green at first, the fruit becomes whitish or a dull, greenish-yellow, or, more rarely, brick red as it matures. It is hard and unyielding to the touch. The skin is thin, translucent and adherent to the very crisp, juicy, concolorous flesh. Tightly embedded in the centre of the flesh is a slightly hexagonal stone containing 6 small seeds. Fruits collected in South Florida vary in the range 2.5-3.2 cm in diameter but choice types in India approach 5 cm in width. Ripe fruits are astringent, extremely acid, and some are distinctly bitter.

BIOLOGY: Cross-pollination is desirable. Honeybees work the flowers in the morning and late evening. It is now known that lack of pollination is the cause of up to 70% shedding of flowers in the first 3 weeks after onset of blooming. The emblic is sensitive to day-length. In northern India, flowering takes place from March to May. In Madras, the tree blooms in June-July and again in February-March, the second flowering producing only a small crop. In Florida flowering occurs during the summer months, the main crop maturing during the winter and early spring. A few fruits developed from late blooms are found in summer and fall.

ECOLOGY: The emblic is subtropical rather than strictly tropical. It survives the unusually cold winter weather in its natural habitat and often shows a remarkable ability to recover from cold injury. On the other hand, it is intolerant of excessive heat. In India, mature trees can stand temperatures up to 46º C in the summer but young plants must be shaded.

BIOPHYSICAL LIMITS: Altitude: 0- 1 800 m Mean annual temperature: Up to 46º C.

SOIL TYPE: The emblic seems to grow equally well under both dry and humid conditions. It is noted for being able to thrive in regions too dry and soil too poor for most other fruit crops. For maximum productivity, the tree requires deep soil ranging from sandy loam to clay, light or heavy, slightly acidic to slightly alkaline. At high pH (as much as 8.0), nutritional deficiencies are evident. Limestone is considered unsuitable but the large, old trees in southern Florida are all in oolitic limestone. Good drainage is essential. A low degree of salinity seems to be fairly well tolerated.

15. **KARANJ**(Pongamiapinnata)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Fabales
Family	**:** Fabaceae
Genus	**:** Pongamia
Species	**:** Pongamiapinnata

BOTANICAL DESCRIPTION:Pongamiapinnata (L.) (Millettiapinnata) has also been called *Derris indica* (Lam.) and *Pongamiaglabra* , all of these three names are still commonly found in literature. According to Lewis (1988), this species may eventually be transferred to genus *Millettia. Pongamiapinnata* is one of the few nitrogen fixing trees (NFTS) to produce seeds containing 30-40% oil. Millettia. Pongamiapinnata is one of the few nitrogen fixing trees (NFTS) to produce seeds containing 30-40% oil. It is often planted as an ornamental and shade tree. This species is commonly called pongam, karanga, or a derivation of these names.Pongamia (Legununosae, subfamily Papilionoideae) is a medium sized tree that generally attains a height of about 8 m and a trunk diameter of more than 50 cm. However, Troup(GOI 1983) reports trees attaining heights of 18 m. The trunk is generally short with thick branches spreading into a dense hemispherical crown of dark green leaves. The bark is thin gray to grayish-brown, and yellow on the inside. The taproot is thick and long; lateral roots are numerous and well developed. The alternate, compound pinnate leaves consist of 5 or 7 leaflets which are arranged in 2 or 3 pairs, and a single terminal leaflet. Leaflets are 5-10 cm long, 4-6 cm wide, and pointed at the tip. Flowers, borne on racemes, are pink, light purple, or white. Pods are elliptical, 3-6 cm long and 2-3 cm wide, thick walled, and usually contain a single seed. Seeds are 10-20 cm long, fig oblong, and light brown in colour.

ECOLOGY: Native to humid and subtropical environments, Pongamia thrives in areas having an annual rainfall ranging from 500 to 2500 mm. in its natural habitat, the maximum temperature ranges from 27 to 38-degree C and the minimum 1 to16 degree C. Mature trees can withstand waterlogging and slight frost. This species grows to elevations of 1200 m, but in the Himalayan foothills is not found above 600 m (GOI 1983). Pongamia can grow on most soil types ranging from stony to sandy to clayey, including Verticals. It does not do well on dry sands. It is highly tolerant of salinity. It is common along waterways or seashores, with its roots in fresh or salt water. Highest growth rates are observed on well drained soils with assured moisture. Natural reproduction is profuse by seed and common by root suckers

DISTRIBUTION: The natural distribution of pongamia is along coasts and river banks in India and Burma. Native to the Asian subcontinent, this species has been introduced to humid tropical lowlands in the Philippines, Malaysia, Australia, the Seychelles, the United States (Little undated), and Indonesia.

USES: Wood. With a calorific value of 4600 kcal per kg, pongamia is commonly used as fuelwood. Its wood is beautifully grained and medium to coarse textured. However, it is not durable, is susceptible to insect attack, and tends to split when sawn. Thus, the wood is not considered a quality timber. The wood is used for cabinet making, cart wheels, posts (NAS 1980), agricultural implements, tool handles and combs (GOI 1983).

OIL: A thick yellow-orange to brown oil is extracted from seeds. Yields of 25% of volume are possible using a mechanical expeller. However, village crushers average a yield of 20% (ICFRE, undated). The oil has a bitter taste and a disagreeable aroma; thus, it is not considered edible. In India, the oil is used as a fuel for cooking and lamps. The oil is also used as a lubricant, water-paint binder, pesticide, and in soap making and tanning industries. The oil is known to have value in folk medicine for the treatment of rheumatism, as well as human and animal skin diseases. It is effective in enhancing the pigmentation of skin affected bvleucoderma or scabies (ICFRE undated). Fodder and feed. Opinions vary on

the usefulness of this species as a fodder. Troup (GOI 1983) reports that the leaves are eaten by cattle and readily consumed by goats. However, in many areas it is not commonly eaten by farm animals. Its fodder value is greatest in arid regions. According to Singh (1982) the leaves contain 43% dry matter, 18% crude protein, 62% neutral detergent fibre, 40% acid detergent fiber, and in vitro dry matter digestibility of 50%. The press cake, remaining when oil is extracted from the seeds, is used as a poultry feed.

OTHER USES: Incorporation of leaves and the press cake into soils improves fertility. Dried leaves are used as an insect repellent in stored grains. The press cake, when applied to the soil, has pesticidal value, particularly against nematodes. String and rope can be made from the bark fibre. Pongamia is often planted in homesteads as a shade or ornamental tree and in avenue plantings along roadsides and canals. When planted as a shade or ornamental tree, branch pruning may be necessary to obtain a trunk of appropriate height. It is a preferred species for controlling soil erosion and binding sand dunes because of its dense network of lateral roots. Its root, bark, leaf, sap, and flower also have medicinal properties.

SILVICULTURE: Pongamia is easily established by direct seeding or by planting nursery-raised seedlings or stump cuttings of 1-2 cm root-collar diameter. Propagation by branch cuttings and root suckers is also possible. In peninsular India, the seeding season is April to June, and the seed yield per tree ranges from about 10 kg to more than 50 kg. There are 1500-1700 seeds per kg. Seeds, which require no treatment before sowing, remain viable for about a year when stored in air-tight containers. Seed germinates within two weeks of sowing. Seedlings attain a height of 25-30 cm in their first growing season. Transplanting to the field should occur at the beginning of the next rainy season when seedlings are 60 cm in height (GOI 1983). Seedlings have large root systems. Soil should be retained around the roots during transplanting. Seedling survival and growth benefit from annual weed control for the first three years after transplanting. The spacing adopted in avenue plantings is about 8 m between plants. In block

plantings, the spacing can range from 2 x 2 to 5 x 5 m. Pongamia seedlings withstand shade very well and can be interplanted in existing tree stands. This species can be regenerated by coppice management. Information on management practices to maximize seed or biomass production is not available and should be investigated. Because it tolerates moderate levels of salinity, pongamia is an ideal candidate for saline soil reclamation.

LIMITATIONS: Pongamia attracts many pests and diseases. Some of the important pests are Parnaramathias, Gracillaria sp., Indarbelaquadrinotata, Mylloceruscurvicornis, and Acrocercops sp. Attacks by these insects cause whitish streaks and the formation of galls on affected leaves. The lateral spread of roots of this species, about 9 m in 18 years, is greater than most other tree species. Moreover, it produces root suckers profusely. Because of these characteristics, pongam is unsuitable for agroforestry and has the potential to become a weed if not managed carefully.

16. ASHOK(Saracaindica)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Fabales
Family	**:** Fabaceae
Genus	**:** Saraca
Species	**:** Saracaindica

BOTANICAL DESCRIPTION: It is a tree, up to 24 m tall. The trunk can reach up to 34 cm in diameter. Leaves are compound and paripinnate. Each leaf has (1–) 2 – 4 (– 7) pairs of leaflets. Leaflet is elliptic-ovate to lanceolate, measuring (5–) 15 – 20 (– 30) long and (1.5–) 3.5 – 6 (– 11) cm wide. The leaflet tip is sharply pointed (acute) to obtuse while the base is rounded, cordate or wedged shaped. The pair of leaflets closed to the leaf stalk is usually smaller than the rest of the leaflets. Young leaves flush white, pink or purple and hang pendulously like a tassel. They gradually turn green as they mature.

FLOWERS: Inflorescence is branched (corymb), measuring 3 – 15 (– 20) cm wide, and usually comprises of a blend of various colors simultaneously. The flower's color is variable, ranging from orange-yellow, deep orange, purple and red, and may have a darker eye in the center. Each flower is accompanied by a slightly upright and spreading bracteole (0.3 – 0.8 cm long) which can persist or fall off during flower maturity. The flower stalk spans about (0.4 –) 1.2 – 2 (– 3.5) cm long. Each flower has (5 –) 6 – 8 (– 10) stamens. The filament, especially the basal parts, is often covered with fine hairs. The flowers may have a subtle fragrance. The tree is observed to bloom several times a year in Singapore.

17. SANDALWOOD(Santalum album)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledonae
Order	**:** Santalales
Family	**:** Santalaceae
Genus	**:** Santalum
Species	**:** Santalum album

BOTANICAL DESCRIPTION: Santalum album is a small evergreen tree that grows to 4 m in Australia, but in India it is much larger and can grow to a height of 20 m; girth of up to 2.4 m, with slender drooping branchlets. Bark is tight, dark brown, reddish, dark grey or nearly black, smooth in young trees, rough with deep vertical cracks in older trees, red inside. Leaves thin, usually opposite, ovate or ovate elliptical, 3-8 x 3-5 cm, glabrous and shining green above, glaucous and slightly paler beneath; tip rounded or pointed; stalk grooved, 5-15 cm long; venation noticeably reticulate. Flowers purplish-brown, small, straw coloured, reddish, green or violet, about 4-6 mm long, up to 6 in small terminal or axillary clusters, unscented in axillary or terminal, paniculate cymes. Fruit a globose, fleshy drupe; red, purple to black when ripe, about 1 cm in diameter, with hard ribbed endocarp and crowned with a scar, almost stalkless, smooth, single seeded. The generic name is derived from the Greek ‘santalon’ meaning ‘sandalwood’, and the species name from the Latin ‘albus’ meaning ‘white’, in allusion to the bark.

BIOLOGY: Flower panicles appear from March to April in India, and fruits ripen in the cold season; in Australia flowers appear in December to January and also June to August, and mature fruit is available from June to September. The species is spread rapidly through seed dispersal by birds, which feed on the outer fleshy pericarp. Viable seed production occurs when the tree is 5 years old.

ECOLOGY: S. album is indigenous to the tropical belt of the Indian peninsula, eastern Indonesia and northern Australia. There is still debate as to whether S. album is endemic to Australia or was introduced by fishermen or birds from eastern Indonesia centuries ago. The main distribution is in the drier tropical regions of India and the Indonesian islands of Timor and Sumba. The principal sandal tracts are most parts of Karnataka and adjoining districts of Maharashtra, Tamil Nadu and Andhra Pradesh in India. The species is mostly found in dry deciduous and scrub forests in this region. The vegetation type is a typical monsoon vine thicket growing on pure sand. It has been recorded on coastal sand dunes immediately above the normal high-water mark and close to the mangroves. It also grows on low lateritic cliffs above the beach. It is a partial parasite that attaches to the roots of other trees, it needs 'nurse' species in the area of planting out. Host plants that fix nitrogen and provide light shade are preferred. Senna siamea is good for this, and a most probable natural host is Drypeteslasiogyna, observed to be the most prolific species in the vicinity of S. album. It does not tolerate frost or waterlogging, but is drought-hardy and is a light demander in sapling and later stages. Prolonged drought and fire kills trees.

BIOPHYSICAL LIMITS:Altitude: 600-1 200 m, mean annual temperature: 2-38 deg. C, mean annual rainfall: 450-3 000 mm

SOIL TYPE: S. album grows in a wide range of soils but is most common in sandy or rocky red soil zones. The species is not found on black soil but luxuriant growth is noticeable in moist soils such as garden loam and well-drained deep alluvium. It also grows on ferruginous loam overlying metamorphic rocks, chiefly gneiss is considered the best and trees avoid calcareous situations. On shallow stony and gravely soils, growth is poor. It is not exacting to soil depth. On Timor it grows on very stony, grey clay and red loam soils derived from coral parent material, well-drained and having a pH of 8- 9. In India it usually grows on free draining red loams with a pH of 6-6.5, and occasionally on sandy soils associated with laterites.

18. **TERMINALIA**(Terminalia neotaliala)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledonae
Order	**:** Myrtales
Family	**:** Combretaceae
Genus	**:** Terminalia
Species	**:** Terminalia neotaliala

BOTANICAL DESCRIPTION: Terminalia neotaliala is native to Madagascar. Like other Terminalia species, it is used in traditional medicine in Africa to treat skin and oral infections, and diseases such as diabetes. Terminalia neotaliala was introduced to China for horticultural purposes in the 1990s. It is widely used for landscaping in parks, campuses, streets, as well as in coastal areas due to its high tolerance to salinity. However, its natural populations are in decline due to agricultural expansion, logging and fire. Terminalia neotaliala is now listed as a 'Vulnerable'species in the IUCN Red List.

19. **GUAVA**(Psidium guajava)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Magnoliopsida
Order	**:** Myrtales
Family	**:** Myrtaceae
Genus	**:** Psidium
Species	**:** Psidium guajava

BOTANICAL DESCRIPTION: Psidium guajava is a large dicotyledonous shrub, or small evergreen tree, generally 3-10 m high, many branches; stems crooked, bark light to reddish brown, thin, smooth, continuously flaking; root system generally superficial and very extensive, frequently extending well beyond the canopy, there are some deep roots but no distinct taproot. Leaves opposite, simple; stipules absent, petiole short, 3-10 mm long; blade oblong to elliptic, 5-15 x 4-6 cm, apex obtuse to bluntly acuminate, base rounded to sub-cuneate, margins entire, somewhat thick and leathery, dull grey to yellow-green above, slightly downy below, veins prominent, gland dotted. Inflorescence, axillary, 1- to 3-flowered, pedicles about 2 cm long, bracts 2, linear. Calyx splitting irregularly into 2-4 lobes, whitish and sparsely hairy within; petals 4-5, white, linear-ovate c. 2 cm long, delicate; stamens numerous, filaments pale white, about 12 mm long, erect or spreading, anther straw coloured; ovary inferior, ovules numerous, style about 10 cm long, stigma green, capitate. Fruit an ovoid or pear-shaped berry, 4-12 cm long, weighing up to 500 g; skin yellow when ripe, sometimes flushed with red; pulp juicy, creamy white or creamy-yellow to pink or red; mesocarp thick, edible, the soft pulp enveloping numerous, cream to brown, kidney-shaped or flattened seeds. The exterior of the fruit is fleshy, and the centre consists of a seedy pulp.

BIOLOGY: The pollen is viable for up to 42 hours and the stigmas are receptive for about 2 days. Bees are the principal pollinators. There is some self- and

cross-incompatibility but several cultivars have set fair crops of seedless or few-seeded fruit. Levels of 60-75% selfing have been found in natural populations; this has been used to produce homozygotic varieties that can be propagated from seed. It is not known to what extent erratic flowering through the year affects pollination intensity. One of the most critical botanical characteristics of guava is that flowers are borne on newly emerging lateral shoots, irrespective of the time of year. The floral structure, which makes emasculation difficult and with a juvenile period of 3-5 years limit conventional breeding. Seedlings may flower within 2 years; clonally propagated trees often begin to bear during the first year after planting. Trees reach full bearing after 5- 8 years, depending on growing conditions and spacing. The guava is not a long-lived tree (about 40 years), but the plants may bear heavily for 15-25 years. Bats are the main fruit dispersal agents.

ECOLOGY: P. guajava appears to have evolved in relatively open areas, such as savannah/shrub transitional zones, or in frequently disturbed areas where it is a strong competitor in early secondary growth. In some areas it is found in large thickets with as many as 100 plants in an area of less than half a hectare, although it is more often found in densities of 1-5 plants/ha. P. guajava is considered a noxious weed in many tropical pasture lands (when chemical control is not available, guava proliferation may result in the abandonment of a pasture). The guava is a hardy tree that adapts to a wide range of growing conditions. It can stand a wide range of temperatures; the highest yields are recorded at mean temperatures of 23-28 deg. C. In the subtropics quiescent trees withstand light frost and 3.5-6 months (depending on the cultivar) of mean temperatures above 16 deg. C suffice for flowering and fruiting. It fruits at altitudes up to 1 500 m and survives up to 2 000 m. Guava is more drought-resistant than most tropical fruit crops. For maximum production in the tropics, however it requires rainfall distributed over the year. If fruit ripens during a very wet period it loses flavour and may split.

BIOPHYSICAL LIMITS: Altitude: 0-2 000 m, mean annual temperature: 15-45 deg. C, Mean annual rainfall: 1 000-2 000 mm

SOIL TYPE: Soils vary widely, including slightly to strongly acid. As expected from a secondary colonizer, it grows well on poor soils with reasonably good drainage, however growth and production are better on rich clay loams.

20. BEL(Aegle marmelos)

BOTANICAL CLASSIFICATION

Kingdom	**:** Plantae
Phylum	**:** Angiosperms
Class	**:** Dicotyledonae
Order	**:** Sapindales
Family	**:** Myrtaceae
Genus	**:** Aegle
Species	**:** Aegle marmelos

BOTANICAL DESCRIPTION: Aegle marmelos is a slow-growing, medium sized tree, up to 12-15 m tall with short trunk, thick, soft, flaking bark, and spreading, sometimes spiny branches, the lower ones drooping. Young suckers bear many stiff, straight spines. A clear, gummy sap, resembling gum arabic, exudes from wounded branches and hangs down in long strands, becoming gradually solid. It is sweet at first taste and then irritating to the throat. The deciduous, alternate leaves, borne singly or in 2's or 3's, are composed of 3 to 5 oval, pointed, shallowly toothed leaflets, 4-10 cm long, 2-5 cm wide, the terminal one with a long petiole. New foliage is glossy and pinkish-maroon. Mature leaves emit a disagreeable odour when bruised. Fragrant flowers, in clusters of 4 to 7 along the young branchlets, have 4 recurved, fleshy petals, green outside, yellowish inside, and 50 or more greenish-yellow stamens. The fruit, round, pyriform, oval, or oblong, 5-20 cm in diameter, may have a thin, hard, woody shell or a more or less soft rind, gray-green until the fruit is fully ripe, when it turns yellowish. It is dotted with aromatic, minute oil glands. Inside, there is a hard-central core and 8 to 20 faintly defined triangular segments, with thin, dark-orange walls, filled with aromatic, pale orange, pasty, sweet, resinous, more or less astringent, pulp. Embedded in the pulp are 10 to 15 seeds, flattened-oblong, about 1 cm long, bearing woolly hairs and each enclosed in a sac of adhesive, transparent mucilage that solidifies on drying.

BIOLOGY: In India flowering occurs in April and May soon after the new leaves appear and the fruit ripens in 10 to 11 months from bloom–March to June of the following year. Agroforestry Database 4.0 (Orwa et al.2009) Page 1 of 5 Aegle marmelosRutaceae (L.) Correa

ECOLOGY: The tree grows wild in dry forests on hills and plains of central and southern India and Burma, Pakistan and Bangladesh, also in mixed deciduous and dry dipterocarp forests. A. marmelos is a subtropical species. In the Punjab, it grows up to an altitude of 1,200 m where the temperature rises to 48.89º C in the shade in summer and descends to -6.67º C in the winter, and prolonged droughts occur. It will not fruit where there is no long, dry season, as in southern Malaysia.

BIOPHYSICAL LIMITS: Altitude: 0-1200 m Mean annual temperature: -6- 48 deg C. Mean annual rainfall: 570-2000 mm

SOIL TYPE: A. marmelos is said to do best on rich, well-drained soil, but it has grown well and fruited on the oolitic limestone of southern Florida. It also grows well in swampy, alkaline or stony soils having pH range from 5 to 8. In India it has the reputation of thriving where other fruit trees cannot survive

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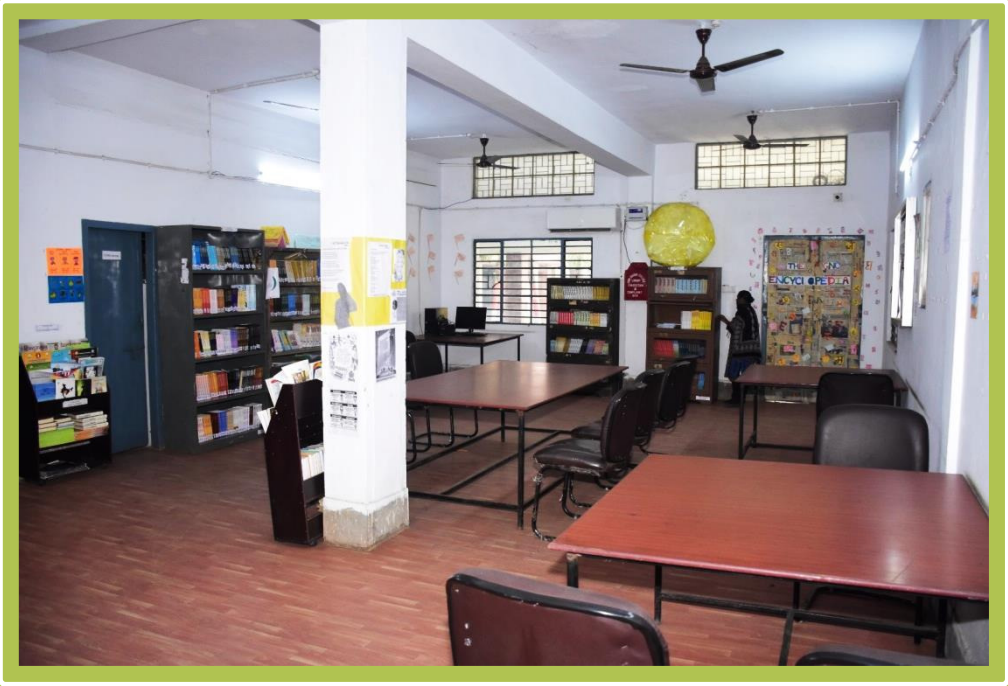
PHOTOGRAPHSOF CAMPUS

MAIN GATE OF CAMPUS

MAIN CAMPUS



LIBRARY OF THE CAMPUS

FACULTY STAFF OF CAMPUS

CLASSROOM OF CAMPUS

ENTRY PATH

OPEN CANTEEN AREA

EXIT PATH

PLAYGROUND OF CAMPUS

STUDENTS SPEND TIME IN THE GARDEN

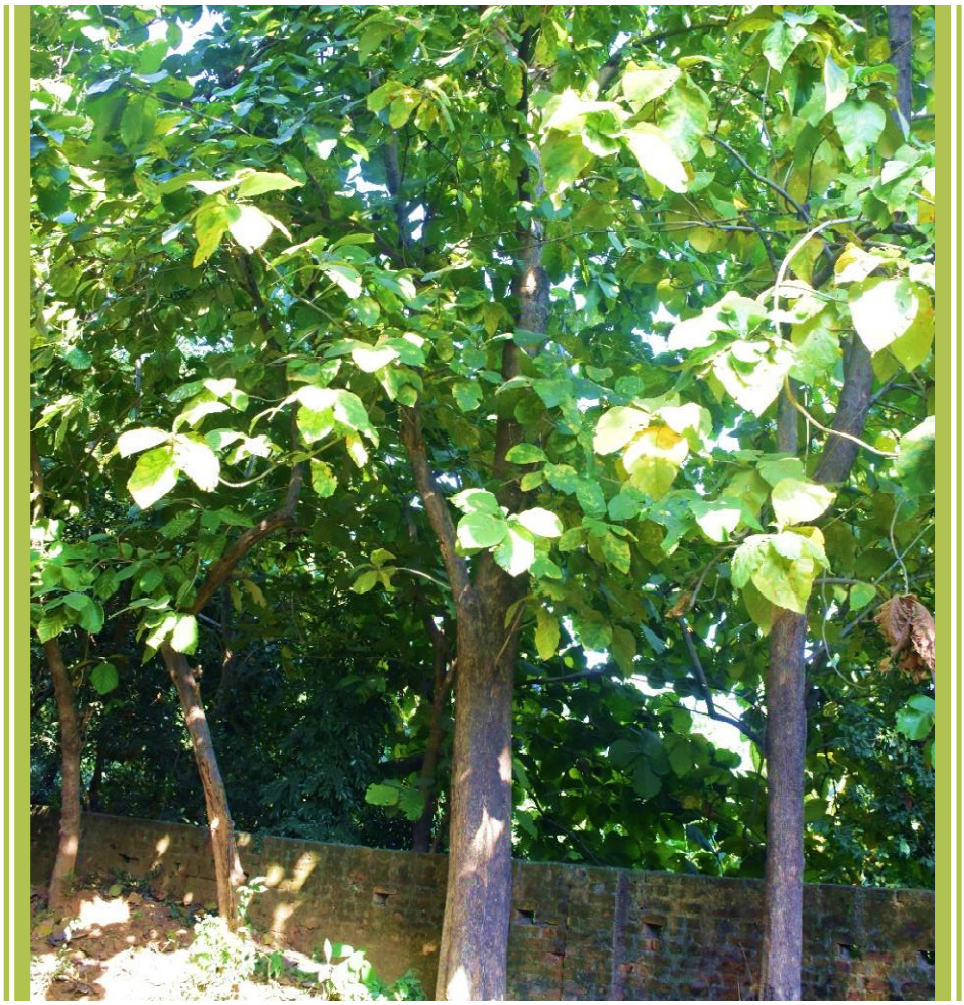
SHRUB

HEDGE PLANT

LONGEST ARECA PALM

OLDEST PEEPAL TREE

ROYAL PALM



********** END OF THE REPORT **********

TEAK TREE