Ecosystem services and Biodiversity conservation survey Report

Introduction

Biodiversity is integral to a healthy and stable environment. Diversity of life ensures environmental resilience, provides humans with the life systems on which they rely, and enriches life on earth. Due to human activities, the planet is currently experiencing a biodiversity crisis which is resulting in the loss of species and populations of species and the habitats that support them.

Neoclassical economics uses the concept of total economic value (TEV). TEV can be broken down into several components, which can then be used to describe the value of ecosystems (Figure 1). TEV can be broken down into use and nonuse values. Use values include direct and indirect use and option values:

Direct-use value: The value of all goods and services derived from the direct, or planned use of ecosystems, consumptive use of resources (e.g., food, timber, and parks), or nonconsumptive use of services (e.g., recreation and landscape amenity). They are generally attributed to provisioning and cultural services.

Indirect-use value: They are derived from the functioning of ecosystems underlying direct-use activities. Indirect-use values correspond to supporting processes and regulating services.

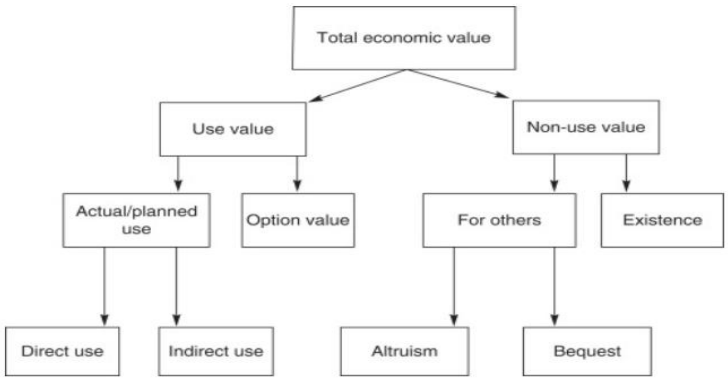
Option value: The value that people place on having the option to use, directly or indirectly, a resource or service in the future, even if not currently in use.

Nonuse value also referred to as ‘passive value,’ is not related to the actual use of ecosystem goods and services, but is derived from the knowledge that ecosystems are maintained. They concern about all types of services. Nonuse value can be further subdivided into three main components

Existence value: It relates to the existence of ecosystem goods and services even if an individual has no actual or planned use for them. Many people are willing to pay for the preservation of species (whales and rainforest insects) even if they know they might never be in contact with them.

Altruistic value: The value individuals attach to the availability of the ecosystem resources or services to others in the current generation.

Bequest value: The value that people place on knowing that ecosystem goods and services will be available for future generations. Bequest value is sometimes regarded as part of existence value.



Pre-audit/survey stage

Based on the Green policy of the SDM College (Autonomous) Ujire. A committee has been formed to conduct the survey of ecosystem services within the campus. To access the contribution of the natural wealth to the sustainable life of the campus; **survey forms**, data collection methods, and **plan of action** have been devised as per the need of the approving agency. The main areas covered under the Biodiversity conservation audit/survey are as follows; Areas covered under plantation, Biodiversity gardens, Flora and faunal diversity, and estimation of carbon sequestration by trees.

Audit stage/survey stage

Under the supervision of the auditing committee, the data has been collected in the appropriate form (Literature reviewed word document, image, google earth images, geotagged photos of areas and facilities), the survey has been conducted using Google Forms application.

Post audit/survey stage

The obtained data has been analyzed and has been used appropriately. The final report has been generated based on the relevant information provided by expert committee members and the auditing agency.

As per the suggested guidelines the report contains data, analysis, and outcome of Provisioning Services.

S.No	Type of Utilitarian/other Services	Link to the details	Remarks
1	List of Plant resources providing food	List of Plant resources providing food:	These plants are located in Botanical Garden, Open classroom area, Arboretum, and Surrounding areas of Hostels
2	List of timber yielding plants	List of timber yielding plants:	These plants are located in Botanical Garden and Arboretum.
3	List of medicinal plants	List of Medicinal Plants:	These plants are located in Botanical Garden and Arboretum.
4	List of ornamental plants	List of Ornamental Plants	These plants are located in the College Front garden area, Pedestrian paths, and as Indoor plants in the College premises including Staff quarters.
5	List of drinking water sources	List of Drinking water sources	These sources include Borewell and Openwells situated within the campus area as well as staff quarters.
6	Regulating services	Regulating services	Carbon sequestration data is included
7	Cultural Services	Cultural Services	Focuses on non-material benefits of the campus ecosystem.
8	Supporting Services	Supporting Services	This section appreciates overall efforts

The campus comprises a lush green arena with high biodiversity. Many types of plants are feeders for the fauna of this area which will directly participate in ecosystem services like pollination, seed dispersal aesthetics of the college. Arboretum, Botanical garden, Front lawn,

List of Plant resources providing food:

This list comprises the plants used as fruits and vegetables, spices & condiments, color yielding, pulses, and oil yielding ones.

S. No	PLANT NAME	FAMILY
1	Grewia serrulata DC.	Malvaceae
2	Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.	Sapotaceae
3	Averrhoa bilimbi L.	Oxalidaceae
4	Averrhoa carambola L.	Oxalidaceae
5	Aglaia elaeagnoidea (A.Juss.) Benth.	Meliaceae
6	Murraya koenigii (L.) Spreng.	Rutaceae
7	Sauropus androgynus (L.) Merr.	Phyllanthaceae
8	Citrus medica L.	Rutaceae
9	Breynia vitis-idaea (Burm.f.) C.E.C.Fisch.	Phyllanthaceae
10	Syzygium jambos (L.) Alston	Myrtaceae
11	Madhuca neriifolia (Moon) H.J.Lam	Sapotaceae
12	Myristica malabarica	Myristicaceae
13	Myristica dactyloides	Myristicaceae
14	Tamarindus indica L.	Leguminosae
15	Syzygium samarangense (Blume) Merr. & L.M.Perry	Myrtaceae
16	Syzygium malaccense (L.) Merr. & L.M.Perry	Myrtaceae
17	Manilkara zapota (L.) P.Royen	Sapotaceae
18	Guazuma ulmifolia Lam.	Malvaceae
19	Phyllanthus acidus (L.) Skeels	Phyllanthaceae
20	Malpighia glabra L.	Malpighiaceae
21	Annona reticulata L.	Annonaceae

22	Citrus reticulata Blanco	Rutaceae
23	Syzygium zeylanicum (L.) DC.	Myrtaceae
24	Cordia dichotoma G.Forst.	Boraginaceae
25	Morus alba L.	Moraceae
26	Artocarpus altilis (Parkinson ex F.A.Zorn) Fosberg	Moraceae
27	Ananas comosus (L.) Merr.	Bromeliaceae
28	Moringa oleifera Lam.	Moringaceae
29	Theobroma cacao L.	Malvaceae
30	Mangifera indica L.	Anacardiaceae
31	Cocos nucifera L.	Arecaceae
32	Solanum torvum Sw.	Solanaceae
33	Abelmoschus esculentus (L.) Moench	Malvaceae
34	Vigna unguiculata (L.) Walp.	Fabaceae
35	Capsicum frutescens L.	Solanaceae
36	Cucumis sativus L.	Cucurbitaceae
37	Musa × paradisiaca L.	Musaceae
38	Plectranthus amboinicus (Lour.) Spreng.	Lamiaceae
39	Psidium guajava	Myrtaceae
40	Solanum melongena L.	Solanaceae
41	Curcuma longa L.	Zingiberaceae
42	Melastoma malabathricum L.	Melastomataceae
43	Garcinia indica (Thouars) Choisy	Clusiaceae
44	Plectranthus rotundifolius (Poir.) Spreng.	Lamiaceae

45	Carica papaya L.	Caricaceae
46	Centella asiatica (L.) Urb.	Apiaceae
47	Benincasa hispida (Thunb.) Cogn.	Cucurbitaceae

List of timber yielding plants:

This list comprises the plants used for agricultural implements, plywood, furniture, roofing, and associated purposes.

S. No	PLANT NAME	FAMILY
1	Adenanthera pavonina L.	Leguminosae
2	Ailanthus triphysa (Dennst.) Alston	Simaroubaceae
3	Albizia lebbeck (L.) Benth.	Leguminosae
4	Albizia odoratissima (L.f.) Benth.	Leguminosae
5	Alstonia scholaris (L.) R. Br.	Apocynaceae
6	Artocarpus gomezianus Wall. ex Trécul	Moraceae
7	Artocarpus hirsutus Lam.	Moraceae
8	Bamboo	Poaceae
9	Bambusa tuldoides Munro	Poaceae
10	Bambusa vulgaris Schrad.	Poaceae
11	Bridelia stipularis (L.) Blume	Phyllanthaceae
12	Calophyllum apetalum Willd.	Clusiaceae
13	Calophyllum inophyllum L.	Clusiaceae
14	Canthium coromandelicum (Burm.f.) Alston	Rubiaceae
15	Careya arborea Roxb.	Lecythidaceae
16	Caryota urens L.	Arecaceae
17	Cassia fistula L.	Leguminosae
18	Cinnamomum verum J.Presl	Lauraceae
19	Cordia dichotoma G.Forst.	Boraginaceae
20	Dalbergia latifolia Roxb.	Leguminosae
21	Diospyros malabarica (Desr.) Kostel.	Ebenaceae

22	Ficus benghalensis L.	Moraceae
23	Ficus racemosa L.	Moraceae
24	Flacourtia montana J.Graham	Salicaceae
25	Garcinia gummi-gutta (L.) Roxb.	Clusiaceae
26	Gmelina arborea Roxb.	Lamiaceae
27	Grevillea robusta A.Cunn. ex R.Br	Proteaceae
28	Haldina cordifolia (Roxb.) Ridsdale	Rubiaceae
29	Holarrhena pubescens Wall. ex G.Don	Apocynaceae
30	Holigarna ferruginea Marchand	Anacardiaceae
31	Holoptelea integrifolia Planch.	Ulmaceae
32	Hopea parviflora Bedd.	Dipterocarpaceae
33	Hopea ponga (Dennst.) Mabb.	Dipterocarpaceae
34	Hydnocarpus pentandrus (Buch.-Ham.) Oken	Achariaceae
35	Ixora coccinea L.	Rubiaceae
36	Lagerstroemia microcarpa	Lythraceae
37	Lannea coromandelica (Houtt.) Merr.	Anacardiaceae
38	Lophopetalum wightianum Arn	Celastraceae
39	Macaranga peltata (Roxb.) Müll.Arg.	Euphorbiaceae
40	Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.	Sapotaceae
41	Mallotus polycarpus (Benth.) Kulju & Welzen	Euphorbiaceae
42	Mammea suriga (Buch.-Ham. ex Roxb.) Kosterm	Calophyllaceae
43	Mesua ferrea L.	Calophyllaceae

44	Mimusops elengi L.	Sapotaceae
45	Persea macrantha (Nees) Kosterm.	Lauraceae
46	Pongamia pinnata (L.) Pierre	Leguminosae
47	Pterocarpus marsupium Roxb.	Leguminosae
48	Strychnos nux-vomica L.	Loganiaceae
49	Syzygium cumini (L.) Skeels	Myrtaceae
50	Tarenna asiatica (L.) Kuntze ex K.Schum.	Rubiaceae
51	Tectona grandis L.f.	Lamiaceae
52	Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae
53	Terminalia bellirica (Gaertn.) Roxb.	Combretaceae
54	Terminalia chebula Retz.	Combretaceae
55	Terminalia paniculata Roth	Combretaceae
56	Vateria indica L.	Dipterocarpaceae
57	Vitex altissima L.f.	Lamiaceae
58	Xylia xylocarpa (Roxb.) Taub.	Leguminosae
59	Zanthoxylum rhetsa DC.	Rutaceae

List of Medicinal Plants:

This list comprises plants associated with curing human and livestock-associated ailments. The decades-long efforts to conserve and widen the collection of medicinal plants include references both from folklore practitioners, codified medicinal systems.

SI NO	PLANT NAME	FAMILY
1	Acacia auriculiformis Benth.	Leguminosae
2	Acacia catechu (L.f.) Willd.	Leguminosae
3	Acalypha wilkesiana Müll.Arg.	Euphorbiaceae
4	Adenanthera pavonina L.	Leguminosae
5	Aegle marmelos (L.) Corrêa	Rutaceae
6	Agave americana L.	Asparagaceae
7	Agave sisalana Perrine	Asparagaceae
8	Aglaia elaeagnoidea (A.Juss.) Benth.	Meliaceae
9	Aglaonema	Araceae
10	Ailanthus triphysa (Dennst.) Alston	Simaroubaceae
11	Alangium salviifolium (L.f.) Wangerin	Cornaceae
12	Alangium salviifolium subsp. hexapetalum (Lam.) Wangerin	Cornaceae
13	Alangium salviifolium subsp. hexapetalum (Lam.) Wangerin	Cornaceae
14	Albizia lebbeck (L.) Benth.	Leguminosae
15	Albizia odoratissima (L.f.) Benth.	Leguminosae
16	Albizia saman (Jacq.) Merr.	Leguminosae
17	Allamanda cathartica L.	Apocynaceae
18	Alpinia calcarata (Haw.) Roscoe	Zingiberaceae
19	Alpinia galanga (L.) Willd.	Zingiberaceae
20	Alstonia	Apocynaceae
21	Alstonia scholaris (L.) R. Br.	Apocynaceae

22	Ananas comosus (L.) Merr.	Bromeliaceae
23	Andrographis macrobotrys Nees	Acanthaceae
24	Angelonia salicariifolia Bonpl.	Plantaginaceae
25	Annona reticulata L.	Annonaceae
26	Antidesma acidum Retz.	Phyllanthaceae
27	Antidesma ghaesembilla Gaertn.	Phyllanthaceae
28	Antidesma montanum Blume	Phyllanthaceae
29	Aporosa cardiosperma (Gaertn.) Merr.	Phyllanthaceae
30	Archdendron	Leguminosae
31	Arisaema tortuosum (Wall.) Schott	Araceae
32	Artocarpus altilis (Parkinson ex F.A.Zorn) Fosberg	Moraceae
33	Artocarpus gomezianus Wall. ex Trécul	Moraceae
34	Artocarpus hirsutus Lam.	Moraceae
35	Asparagus racemosus Willd.	Asparagaceae
36	Asystasia variabilis Trimen	Acanthaceae
37	Averrhoa bilimbi L.	Oxalidaceae
38	Averrhoa carambola L.	Oxalidaceae
39	Azadirachta indica A.Juss.	Meliaceae
40	Baliospermum solanifolium (Burm.) Suresh	Euphorbiaceae
41	Bamboo	Poaceae
42	Bambusa tuldoides Munro	Poaceae
43	Bambusa vulgaris Schrad.	Poaceae
44	Bauhinia	Leguminosae

45	Bignonia sp	Bignoniaceae
46	Billbergia pyramidalis (Sims) Lindl.	Bromeliaceae
47	Bixa orellana L.	Bixaceae
48	Breynia vitis-idaea (Burm.f.) C.E.C.Fisch.	Phyllanthaceae
49	Bridelia stipularis (L.) Blume	Phyllanthaceae
50	Butea monosperma (Lam.) Taub.	Leguminosae
51	Caesalpinia crista L.	Leguminosae
52	Caesalpinia pulcherrima (L.) Sw.	Leguminosae
53	Calamus nagbettai R.R.Fernald & Dey	Arecaceae
54	Calliandra haematocephala Hassk.	Leguminosae
55	Calophyllum apetalum Willd.	Clusiaceae
56	Calophyllum inophyllum L.	Clusiaceae
57	Canarium strictum Roxb.	Burseraceae
58	Canthium coromandelicum (Burm.f.) Alston	Rubiaceae
59	Careya arborea Roxb.	Lecythidaceae
60	Carissa spinarum L.	Apocynaceae
61	Caryota urens L.	Arecaceae
62	Cassia fistula L.	Leguminosae
63	Casuarina equisetifolia L.	Casuarinaceae
64	Catunaregam spinosa (Thunb.) Tirveng.	Rubiaceae
65	Cerbera odollam Gaertn.	Apocynaceae
66	Cheilocostus speciosus (J.Koenig) C.D.Specht	Costaceae
67	Chlorophytum comosum (Thunb.) Jacques	Asparagaceae

68	Chrysophyllum cainito L.	Sapotaceae
69	Chrysopogon zizanioides (L.) Roberty	Poaceae
70	Chukrasia tabularis A.Juss.	Meliaceae
71	Cinnamomum verum J.Presl	Lauraceae
72	Cissus elongata subsp. littoralis (Talbot) B.V.Shetty & Par.Singh	Vitaceae
73	Cissus latifolia Lam.	Vitaceae
74	Cissus repanda (Wight & Arn.) Vahl	Vitaceae
75	Citrus medica L.	Rutaceae
76	Citrus reticulata Blanco	Rutaceae
77	Clerodendrum infortunatum L.	Lamiaceae
78	Cochlospermum religiosum (L.) Alston	Bixaceae
79	Codiaeum variegatum (L.) Rumph. ex A.Juss.	Euphorbiaceae
80	Colebrookea oppositifolia Sm.	Lamiaceae
81	Cordia dichotoma G.Forst.	Boraginaceae
82	Cordyline fruticosa (L.) A.Chev.	Asparagaceae
83	Cosmostigma cordatum (Poir.) M.R.Almeida	Apocynaceae
84	Costus pictus D.Don	Costaceae
85	Couroupita guianensis Aubl.	Lecythidaceae
86	Crescentia cujete L.	Bignoniaceae
87	Cuphea hyssopifolia Kunth	Lythraceae
88	Curculigo orchioides Gaertn.	Hypoxidaceae
89	Cyclea peltata (Lam.) Hook.f. & Thomson	Menispermaceae
90	Cymbopogon citratus (DC.) Stapf	Poaceae

91	Dalbergia horrida (Dennst.) Mabb.	Leguminosae
92	Dalbergia latifolia Roxb.	Leguminosae
93	Dalbergia volubilis Roxb.	Leguminosae
94	Delonix regia (Hook.) Raf.	Leguminosae
95	Dianella revoluta R.Br.	Xanthorrhoeaceae
96	Dichrostachys cinerea (L.) Wight & Arn.	Leguminosae
97	Dieffenbachia seguine (Jacq.) Schott	Araceae
98	Dillenia indica L.	Dilleniaceae
99	Dillenia pentagyna Roxb.	Dilleniaceae
100	Diospyros buxifolia (Blume) Hiern	Ebenaceae
101	Diospyros malabarica (Desr.) Kostel.	Ebenaceae
102	Diploclisia glaucescens (Blume) Diels	Menispermaceae
103	Dracaena	Euphorbiaceae
104	Dracaena braunii Engl.	Asparagaceae
105	Dracaena surculosa Lindl.	Asparagaceae
106	Dregea volubilis (L.f.) Benth. ex Hook.f.	Apocynaceae
107	Duranta erecta L.	Verbenaceae
108	Dypsis lutescens (H.Wendl.) Beentje & J.Dransf.	Arecaceae
109	Eichhornia crassipes (Mart.) Solms	Pontederiaceae
110	Elaeis guineensis Jacq.	Arecaceae
111	Embelia tsjeriam-cottam (Roem. & Schult.) A.DC.	Primulaceae
112	Ensete superbum (Roxb.) Cheesman	Musaceae

113	Erythrina variegata L.	Leguminosae
114	Euphorbia lactea Haw.	Euphorbiaceae
115	Euphorbia tirucalli L.	Euphorbiaceae
116	Excoecaria cochinchinensis Lour.	Apocynaceae
117	Fagraea ceilanica Thunb.	Gentianaceae
118	Feronia elephantum Corrêa	Rutaceae
119	Ficus amplissima Sm.	Moraceae
120	Ficus benghalensis L.	Moraceae
121	Ficus benjamina L.	Moraceae
122	Ficus binnendijkii Miq.	Moraceae
123	Ficus drupacea Thunb.	Moraceae
124	Ficus elastica Roxb. ex Hornem.	Moraceae
125	Ficus exasperata Vahl	Moraceae
126	Ficus hispida L.f.	Moraceae
127	Ficus infectoria Willd.	Moraceae
128	Ficus lyrata Warb.	Moraceae
129	Ficus pumila L.	Moraceae
130	Ficus racemosa L.	Moraceae
131	Ficus religiosa L.	Moraceae
132	Ficus sp	Moraceae
133	Flacourtia montana J.Graham	Salicaceae
134	Flueggea leucopyrus Willd.	Phyllanthaceae
135	Furcraea foetida (L.) Haw.	Asparagaceae

136	Garcinia gummi-gutta (L.) Roxb.	Clusiaceae
137	Garcinia indica (Thouars) Choisy	Clusiaceae
138	Garcinia xanthochymus Hook.f. ex T.Anderson	Clusiaceae
139	Gardenia	Rubiaceae
140	Gardenia jasminoides J.Ellis	Rubiaceae
141	Getonia floribunda Roxb.	Combretaceae
142	Gliricidia sepium (Jacq.) Walp.	Leguminosae
143	Glycosmis pentaphylla (Retz.) DC.	Rutaceae
144	Gmelina arborea Roxb.	Lamiaceae
145	Grevillea robusta A.Cunn. ex R.Br	Proteaceae
146	Grewia serrulata DC.	Malvaceae
147	Guazuma ulmifolia Lam.	Malvaceae
148	Gymnema sylvestre (Retz.) R.Br. ex Sm.	Apocynaceae
149	Haldina cordifolia (Roxb.) Ridsdale	Rubiaceae
150	Heliconia	Heliconiaceae
151	Heliconia rostrata Ruiz & Pav.	Heliconiaceae
152	Helicteres isora L.	Malvaceae
153	Heterocentron elegans (Schltdl.) Kuntze	Melastomataceae
154	Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.	Euphorbiaceae
155	Hibiscus rosa-sinensis L.	Malvaceae
156	Holarrhena pubescens Wall. ex G.Don	Apocynaceae
157	Holigarna ferruginea Marchand	Anacardiaceae
158	Holoptelea integrifolia Planch.	Ulmaceae

159	Hopea parviflora Bedd.	Dipterocarpaceae
160	Hopea ponga (Dennst.) Mabb.	Dipterocarpaceae
161	Hydnocarpus pentandrus (Buch.-Ham.) Oken	Achariaceae
162	Ipomoea cairica (L.) Sweet	Convolvulaceae
163	Ixora brachiata Roxb.	Rubiaceae
164	Ixora coccinea L.	Rubiaceae
165	Ixora polyantha Wight	Rubiaceae
166	Jacaranda acutifolia Bonpl.	Bignoniaceae
167	Jasminum malabaricum Wight	Oleaceae
168	Jasminum multiflorum (Burm.f.) Andrews	Oleaceae
169	Jatropha curcas L.	Euphorbiaceae
170	Jatropha gossypiifolia L.	Euphorbiaceae
171	Justicia gendarussa Burm.f.	Acanthaceae
172	Kaempferia galanga L.	Zingiberaceae
173	Lagerstroemia microcarpa	Lythraceae
174	Lannea coromandelica (Houtt.) Merr.	Anacardiaceae
175	Lawsonia inermis L.	Lythraceae
176	Livistona rotundifolia	Arecaceae
177	Loeseneriella arnottiana (Wight) A.C. Sm.	Celastraceae
178	Lophopetalum wightianum Arn	Celastraceae
179	Macaranga peltata (Roxb.) Müll.Arg.	Euphorbiaceae
180	Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.	Sapotaceae
181	Madhuca neriifolia (Moon) H.J.Lam	Sapotaceae

182	Magnolia champaca (L.) Baill. ex Pierre	Magnoliaceae
183	Mallotus polycarpus (Benth.) Kulju & Welzen	Euphorbiaceae
184	Malpighia glabra L.	Malpighiaceae
185	Mammea suriga (Buch.-Ham. ex Roxb.) Kosterm	Calophyllaceae
186	Manilkara zapota (L.) P.Royen	Sapotaceae
187	Melastoma malabathricum L.	Melastomataceae
188	Melia azedarach L	Meliaceae
189	Melia azedarach L.	Meliaceae
190	Melicope lunu-ankenda (Gaertn.) T.G. Hartley	Rutaceae
191	Memecylon angustifolium Wight	Melastomataceae
192	Memecylon edule Roxb.	Melastomataceae
193	Memecylon randerianum S.M.Almeida & M.R.Almeida	Melastomataceae
194	Mesua ferrea L.	Calophyllaceae
195	Mimusops elengi L.	Sapotaceae
196	Morinda citrifolia L.	Rubiaceae
197	Moringa oleifera Lam.	Moringaceae
198	Morus alba L.	Moraceae
199	Mucuna pruriens (L.) DC.	Leguminosae
200	Murraya koenigii (L.) Spreng.	Rutaceae
201	Mussaenda frondosa L.	Rubiaceae
202	Myristica dactyloides	Myristicaceae
203	Myristica malabarica	Myristicaceae
204	Naringi crenulata (Roxb.) Nicolson	Rutaceae

205	Neonauclea purpurea (Roxb.) Merr.	Rubiaceae
206	Nyctanthes arbor-tristis L.	Oleaceae
207	Ochlandra	Poaceae
208	Ocimum basilicum L.	Lamiaceae
209	Ocimum gratissimum L.	Lamiaceae
210	Olea dioica Roxb.	Oleaceae
211	Paederia foetida L.	Rubiaceae
212	Pandanus dubius Spreng.	Pandanaceae
213	Pandanus odorifer (Forssk.) Kuntze	Pandanaceae
214	Passiflora foetida L.	Passifloraceae
215	Peltophorum pterocarpum (DC.) K.Heyne	Leguminosae
216	Pentas lanceolata (Forssk.) Deflers	Rubiaceae
217	Persea macrantha (Nees) Kosterm.	Lauraceae
218	Philodendron	Araceae
219	Philodendron × domesticum G.S.Bunting	Araceae
220	Philodendron erubescens K.Koch & Augustin	Araceae
221	Philodendron undulatum Engl.	Araceae
222	Phoenix sylvestris (L.) Roxb.	Arecaceae
223	Phyllanthus acidus (L.) Skeels	Phyllanthaceae
224	Phyllanthus emblica L.	Phyllanthaceae
225	Pimenta dioica (L.) Merr.	Myrtaceae
226	Piper trioicum Roxb	Piperaceae
227	Plumeria obtusa L.	Apocynaceae

228	Plumeria rubra L.	Apocynaceae
229	Polyalthia longifolia (Sonn.) Thwaites	Annonaceae
230	Polyscias balfouriana (André) L.H.Bailey	Araliaceae
231	Polyscias fruticosa (L.) Harms	Araliaceae
232	Polyscias scutellaria (Burm.f.) Fosberg	Araliaceae
233	Pongamia pinnata (L.) Pierre	Leguminosae
234	Pothos scandens L.	Araceae
235	Pouteria campechiana (Kunth) Baehni	Sapotaceae
236	Premna serratifolia L.	Lamiaceae
237	Psychotria flavida Talbot	Rubiaceae
238	Pteris	Pteridaceae
239	Pterocarpus marsupium Roxb.	Leguminosae
240	Pterocarpus santalinus L.f.	Leguminosae
241	Pterospermum diversifolium Blume	Malvaceae
242	Putranjiva roxburghii Wall.	Putranjivaceae
243	Ravenala madagascariensis Sonn.	Strelitziaceae
244	Rotheca serrata (L.) Steane & Mabb.	Lamiaceae
245	Rourea minor (Gaertn.) Alston	Connaraceae
246	Salacia chinensis L.	Celastraceae
247	Sansevieria trifasciata Prain	Asparagaceae
248	Santalum album L.	Santalaceae
249	Sapindus laurifolius Vahl	Sapindaceae
250	Saraca asoca (Roxb.) Willd.	Leguminosae

251	Sauropus androgynus (L.) Merr.	Phyllanthaceae
252	Schefflera actinophylla (Endl.) Harms	Araliaceae
253	Schefflera venulosa (Wight & Arn.) Harms	Araliaceae
254	Smilax zeylanica L.	Smilacaceae
255	Solanum torvum Sw.	Solanaceae
256	Spathiphyllum	Araceae
257	Spathodea campanulata P.Beauv.	Bignoniaceae
258	Stachytarpheta urticifolia (Salisb.) Sims	Verbenaceae
259	Sterculia foetida L.	Malvaceae
260	Sterculia guttata Roxb. ex G.Don	Malvaceae
261	Stereospermum	Bignoniaceae
262	Strychnos minor	Loganiaceae
263	Strychnos nux-vomica L.	Loganiaceae
264	Swietenia macrophylla King	Meliaceae
265	Syngonium podophyllum Schott	Araceae
266	Syzygium caryophyllatum (L.) Alston	Myrtaceae
267	Syzygium cumini (L.) Skeels	Myrtaceae
268	Syzygium jambos (L.) Alston	Myrtaceae
269	Syzygium malaccense (L.) Merr. & L.M.Perry	Myrtaceae
270	Syzygium samarangense (Blume) Merr. & L.M.Perry	Myrtaceae
271	Syzygium zeylanicum (L.) DC.	Myrtaceae
272	Tabebuia aurea (Silva Manso) Benth. & Hook.f. ex S.Moore	Bignoniaceae

273	Tabernaemontana alternifolia L.	Apocynaceae
274	Tabernaemontana divaricata (L.) R.Br. ex Roem. & Schult.	Apocynaceae
275	Tadehagi triquetrum (L.) H.Ohashi	Leguminosae
276	Tamarindus indica L.	Leguminosae
277	Tarenna asiatica (L.) Kuntze ex K.Schum.	Rubiaceae
278	Tectona grandis L.f.	Lamiaceae
279	Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae
280	Terminalia bellirica (Gaertn.) Roxb.	Combretaceae
281	Terminalia chebula Retz.	Combretaceae
282	Terminalia paniculata Roth	Combretaceae
283	Theobroma cacao L.	Malvaceae
284	Thevetia neriifolia Juss. ex Steud.	Apocynaceae
285	Thunbergia erecta (Benth.) T.Anderson	Acanthaceae
286	Tinospora sinensis (Lour.) Merr.	Menispermaceae
287	Toddalia bilocularis Wight & Arn.	Rutaceae
288	Tylophora indica (Burm. f.) Merr.	Apocynaceae
289	Uvaria narum	Annonaceae
290	Vateria indica L.	Dipterocarpaceae
291	Ventilago maderaspatana Gaertn.	Rhamnaceae
292	Vitex altissima L.f.	Lamiaceae
293	Vitex trifolia L.	Lamiaceae
294	Volkameria inermis L.	Lamiaceae

295	Wendlandia thyrsoidea (Roth) Steud.	Rubiaceae
296	Woodfordia fruticosa (L.) Kurz	Lythraceae
297	Xylia xylocarpa (Roxb.) Taub.	Leguminosae
298	Zamia furfuracea L.f. ex Aiton	Zamiaceae
299	Zanthoxylum rhetsa DC.	Rutaceae
300	Zingiber zerumbet (L.) Roscoe ex Sm.	Zingiberaceae
301	Ziziphus oenopolia (L.) Mill.	Rhamnaceae
302	Ziziphus rugosa Lam.	Rhamnaceae

List of Ornamental Plants

This list provides information on ornamental plants both exotic and indigenous. The beauty created by these plants has a multifacet iconic identity to our campus added with the richness of ecosystem services.

S. No	PLANT NAME	FAMILY
1	Acalypha wilkesiana Müll.Arg.	Euphorbiaceae
2	Allamanda cathartica L.	Apocynaceae
3	Aphelandra squarrosa Nees	Acanthaceae
4	Asclepias incarnata L.	Apocynaceae
5	Beaucarnea recurvata Lem.	Asparagaceae
6	Bougainvillea spectabilis Willd.	Nyctaginaceae
7	Buxus rolfei S.Vidal	Buxaceae
8	Canna indica L.	Cannaceae
9	Chrysothemis pulchella (Donn ex Sims) Decne.	Gesneriaceae
10	Clerodendrum thomsoniae Balf.f.	Lamiaceae
11	Cordyline fruticosa (L.) A.Chev.	Asparagaceae
12	Cuphea hyssopifolia Kunth	Lythraceae
13	Cycas revoluta Thunb.	Cycadaceae
14	Dracaena reflexa Lam.	Asparagaceae
15	Duranta erecta L.	Verbenaceae
16	Euphorbia milii Des Moul.	Euphorbiaceae
17	Ficus benjamina L.	Moraceae
18	Galphimia glauca Cav.	Malpighiaceae
19	Hemerocallis fulva (L.) L.	Asphodelaceae
20	Ipomoea batatas (L.) Lam.	Convolvulaceae
21	Ixora coccinea L.	Rubiaceae
22	Jatropha podagrica Hook.	Euphorbiaceae
23	Lagarosiphon major (Ridl.) Moss	Hydrocharitaceae
24	Lantana camara L.	Verbenaceae
25	Mussaenda philippica A.Rich.	Rubiaceae
26	Nymphaea alba L.	Nymphaeaceae

27	Nymphaea odorata Aiton	Nymphaeaceae
28	Pandanus pygmaeus Thouars	Pandanaceae
29	Phalaris arundinacea L.	Poaceae
30	Phalaris arundinacea L.	Poaceae
31	Monoon longifolium Sonn. B.Xue & R.M.K.Saunders	Annonaceae
32	Polyscius scutellaria (Burm.f.) fosberg	Araliaceae
33	Pritchardia pacifica Seem. & H.Wendl.	Arecaceae
34	Prunus cerasifera Ehrh.	Rosaceae
35	Rauvolfia tetraphylla L.	Apocynaceae
36	Schefflera arboricola (Hayata) Merr.	Araliaceae
37	Syngonium auritum (L.) Schott	Araceae
38	Syngonium podophyllum Schott	Araceae
39	Talinum paniculatum (Jacq.) Gaertn.	Talinaceae
40	Tradescantia pallida (Rose) D.R.Hunt	Commelinaceae
41	Tradescantia spathacea Sw.	Commelinaceae
42	Yucca aloifolia L.	Asparagaceae
43	Yucca gloriosa L.	Asparagaceae

List of Drinking water sources

These sources provide naturally purified potable water to the inmates of this institution. They are situated within the campus and near the staff quarters. They also serve as sources of freshwater for Kitchens, Washrooms, and also for gardening and agricultural activities where recycled water is not connected.

S. No	SOURCE TYPE	LOCATION	SUPPLY AREA
1	BOREWELL	Siddhavana	Staff Quarters
2	BOREWELL	Main Campus	College
3	BOREWELL	Forest compound	Staff Quarters
4	BOREWELL	Keshava sadana	Staff Quarters
5	BOREWELL	Kashibettu	Staff Quarters
6	BOREWELL	PG Center	PG Center
7	BOREWELL	PG Center	Boys Hostel
8	BOREWELL	PG Center	Girls Hostel
9	OPENWELL	Near Poyye	Staff Quarters
10	OPENWELL	Kashibettu	Staff Quarters
11	OPENWELL	Forest compound	Staff Quarters

Regulating services

Besides the utilitarian services, this campus provides regulating services such as Pollination, Decomposition, Water purification, Erosion and flood control, Carbon storage, and Climate regulation.

The carbon sequestration data of the campus is depicted in a detailed manner.

Carbon Sequestration Assessment of Campus Trees

Introduction

Climate change is a major global challenge. To mitigate this, multidimensional approaches are practiced and recommended by the various expert committees. Reducing the production and emission of greenhouse gases are major among them.

Carbon dioxide is the most commonly produced greenhouse gas. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere.

This report of Sri Dharmasthala Manjunatheshwara College (Autonomous) Ujire, accomplishes the collection, analysis, and assessment of carbon sequestration taking place in the entire campus of the institution.

Area covered under the study

The campus flora of Sri Dharmasthala Manjunatheshwara College (Autonomous) Ujire has been considered to collect, analyze and assess the carbon sequestration.

A visual survey of the campus has been conducted to segregate the whole area into different blocks. Area, Density of plantation, Nature of landscape are the key characters considered for identifying the blocks.

Table 1: Details of the blocks considered in the present study.

Block No	Location	Approx Area (sq.ft)	Landscape
1	College Backside	30,854	Tree plantation
2	Botanical Garden	19289	Tree plantation
3	Front lawn	58,676	Lawn & Garden
4	Indraprastha	108,657	Tree Plantation
5	College Quadrangular	48,798	Tree Plantation
6	Polypetalae Block	24,595	Tree Plantation
7	Gamopetalae Block	8,272	Tree Plantation
8	Triphala Vana	18,664	Tree Plantation
9	In situ Forest	25,908	Natural Forest
10	Thematic blocks	85,342	Tree Plantation

Methodology

Collection of data

To collect the data required to calculate carbon sequestration, a group of students was selected, trained to measure the diameter at breast height (DBH) of the trees using appropriate methods, Guided to identify the plant species either with a common name or with its botanical name.

Data has been collected from all the ten designated blocks through a Google form made for this purpose.

The above method was used for all the blocks except for the front lawn area where the sequestration data was collected by measuring the approximate area with the help of Google Earth.

Analysis of Data

The method of analysis has been designed based on the available data on the internet as there is less availability of data on specific standard methods.

The analysis was done by using Google sheets with the help of relevant functions applied based on the below parameters.

1. Determine the total (green) weight of the tree.
2. Determine the dry weight of the tree.
3. Determine the weight of carbon in the tree.
4. Determine the weight of carbon dioxide sequestered in the tree
5. Determine the weight of CO2 sequestered in the tree per year

The approximate age of the plant has been assigned using indirect non-destructive dendrochronological methods.

Determine the total (green) weight of the tree

the algorithm to calculate the weight of a tree used in this study is:

W = Above-ground weight of the tree in kg

D = Diameter of the trunk in inches

H = Height of the tree in feet

For trees with D < 11: W = 0.25D2H

For trees with D >= 11: W = 0.15D2H

Depending on the species, the coefficient (e.g. 0.25) could change, and the variables D^2 and H could be raised to exponents just above or below 1. However, these two equations could be seen as an “average” of all the species’ equations.

The root system weighs about 20% as much as the above-ground weight of the tree. Therefore, to determine the total green weight of the tree, multiply the above-ground weight of the tree by 120%.

Determine the dry weight of the tree

To determine the dry weight of the tree, multiply the weight of the tree by 72.5%. As per recommendation from an extension publication from the University of Nebraska.

Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's total volume.5 Therefore, to determine the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

Determine the weight of carbon dioxide sequestered in the tree

CO_2 is composed of one molecule of Carbon and 2 molecules of Oxygen. The atomic weight of Carbon is 12.001115.

The atomic weight of Oxygen is 15.9994.

The weight of CO2 is C+2*O=43.999915.

The ratio of CO2 to C is 43.999915/12.001115=3.6663.

Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.6663.6

To determine the weight of CO_2 sequestered in the tree per year by dividing the weight of carbon dioxide sequestered in the tree by the age of the tree.

Assessment Results

Total 9.85 acres of the green cover area comprising more than 1450 individual trees were Identified and measured for their DBH and height. The details can be obtained through this link Co2 Sequestring Data (Responses)

Blockwise carbon sequestration contribution has been represented in the form of a graph.

Image 1: Graph showing Carbon sequestration based on location

The College campus has an average density of **276 trees per Acre**. Which are able to sequester **13,553 kg of carbon per year**.

Block No	Location	CO2 Sequestration /Year (KG)	Contribution	Total Plants	Area in Acre	Density
1	College Backside	1681	12%	188	0.708	265.4
2	Botanical Garden	1351	10%	122	0.443	275.5
3	Front lawn	817	6%		1.347	NA
4	College Quadrangular	569	4%	48	2.494	19.2
5	Indraprastha	616	5%	86	1.120	76.8
6	Polypetalae Block	1227	9%	167	0.565	295.8
7	Gamopetalae Block	1020	8%	113	0.190	595.1
8	Triphala Vana	2311	17%	284	0.428	662.8
9	In situ Forest	2061	15%	247	0.595	415.3
10	Thematic blocks	1898	14%	305	1.959	155.7

Conclusion

The above data suggests that the college has maintained very good tree cover in the campus on par with any agroforestry system (276 trees/acre). These trees can take almost 20,000 L of Carbon dioxide from the atmosphere to sequester around 37 kg of Carbon per day. This essentially magnifies that nearly 7.5 lakh L of carbon dioxide gets fixed within the campus.

This is a good contribution to reduce the emission of greenhouse gases into the atmosphere which gets involved in climate change. The tree cover also gives the opportunity to conduct an

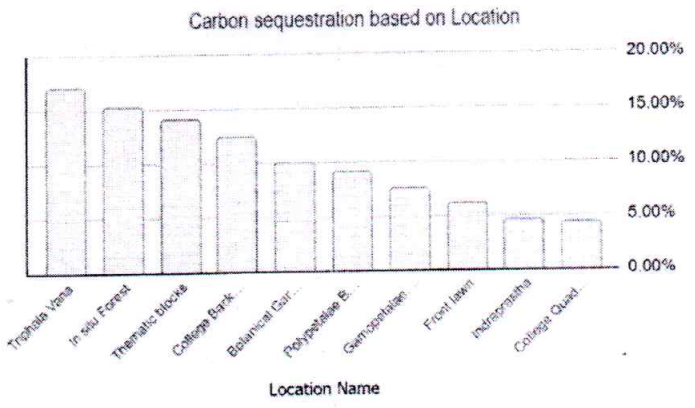
Cultural Services

As we interact and alter nature, the natural world has in turn altered us. It has guided our cultural, intellectual, and social development by being a constant force present in our lives. The importance of ecosystems to the human mind can be traced back to the beginning of mankind with ancient civilizations drawing pictures of animals, plants, and weather patterns on cave walls. A cultural service is a non-material benefit that contributes to the development and cultural advancement of people, including how ecosystems play a role in local, national, and global cultures; the building of knowledge and the spreading of ideas; creativity born from interactions with nature (music, art, architecture); and recreation. These non-material benefits of the campus ecosystem have created a unique identity to this locale.

Supporting Services

The natural world provides so many services, sometimes we overlook the most fundamental. Ecosystems themselves couldn't be sustained without the consistency of underlying natural processes, such as photosynthesis, nutrient cycling, the creation of soils, and the water cycle. These processes allow the Earth to sustain basic life forms, let alone whole ecosystems and people. Without supporting services, provisional, regulating, and cultural services wouldn't exist.

Sri Dharmasthala Manjunatheshwara College (Autonomous) Ujire has consciously developed the campus ecosystem in a more eco-friendly, sustainable, and self-explanatory way to express the ecosystem services to all the stakeholders.



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