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Checklist of angiosperm and gymnosperm in Chandbali College Campus, Odisha, India

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ABSTRACT

The assessment of biodiversity plays a crucial role in promoting sustainable development and serves as a valuable tool for decision-making regarding the conservation and management of natural resources. The present study addresses the floristic composition of Chandbali College Campus, Odisha, India. From 2020 to 2022, an extensive field survey was carried out, resulting in the identification of 234 plant species, representing 73 families and 202 genera. Among these, three gymnosperm species from three genera and families were found, while the remaining 231 species were angiosperms, comprising 122 native and 109 non-native species. Based on the APG IV system of classification, the angiosperm taxa were categorized into 34 orders, with Lamiales, Fabales and Malpighiales being the most prominent. Among the angiosperm families, Fabaceae, Euphorbiaceae and Malvaceae exhibited the highest species diversity. Notably, 31 families consisted of a single species, indicating their monospecific nature. Habit analysis revealed that the campus had a predominance of herbs, followed by trees, shrubs and climbers. Additionally, the study noted the progressive invasion and proliferation of certain invasive plant species in the campus. Traditional uses of various plant species, including food, fodder and medicine, were also documented. The documentation of the college's flora holds significance for students, staff, botanists, taxonomists, ecologists and the general public. Furthermore, this study provides vital baseline data for the conservation of natural vegetation and sustainable resource utilization in the region.

Keywords: Biological invasion, Phytodiversity, APG IV classification, Traditional medicine, Ornamental plants

1. INTRODUCTION

Vegetation plays a vital role as an ecosystem component, reflecting the overall impact on the environment. Plants coexist within specific ecosystems, establishing mutual relationships among themselves and with the local environment, leading to the formation of distinct vegetation types across different regions. India, renowned for its abundant biological diversity, has documented approximately 45,500 plant species in its ten biogeographic regions, representing 11% of the world's known plant species (Rao, 1997; Arumugam & Vivek, 2022; Mastan & Reddy, 2023).

Additionally, India is recognized as one of the eight Vavilovian centers of

origin and diversity for crop plants, hosting over 300 wild ancestors and close relatives of cultivated plants that continue to evolve naturally. India boasts a diverse range of ecosystems and habitats, including forests, grasslands, wetlands, deserts and coastal and marine ecosystems, due to varied edaphic, climatic and topographic conditions along with long periods of geological stability. Presently, there are 18,666 recorded species of angiosperms in India (Mao and Dash, 2019). Alarming trends indicate that the world's seed-bearing plants have been disappearing at a rate of nearly three species per year over the past 250 years due to reckless human activities (Ledford, 2019).

Additionally, approximately 50,000 vascular plant species are estimated to be threatened with extinction (Brummitt et al., 2015). Human activities, particularly habitat destruction and fragmentation, population growth, over-exploitation of natural resources, agricultural expansion, livestock grazing, tourism and ongoing developmental activities, pose significant risks to wild plant populations worldwide. These activities result in the creation of small, isolated plant populations, making them highly vulnerable to local extinction. The depletion of phytodiversity and the associated ecosystem services present immense challenges to humanity today (Piccolo, 2017).

Conservation efforts and sustainable practices are crucial to address these challenges and ensure the preservation of plant diversity and the valuable services it provides. The documentation of biodiversity is essential for assessing the overall health of ecosystems and developing appropriate conservation strategies, particularly for ecologically sensitive organisms like plants (Le et al., 2019). The flora of a region plays a crucial role in determining the ecological wealth of the ecosystem. Proper utilization of plant resources at various levels, from countries to villages, has been instrumental in maintaining the availability and richness of flora. While checklists of flora on specific hills, reserve forests or focused on particular plant groups or genera are available, documentation of flora in rural areas remains relatively limited (Parthipan et al., 2016; Bansal et al., 2022).

Additionally, urban areas have undergone significant transformation due to human activities, with cities and towns serving as important ecosystems. Urban societies have created gardens to meet social, cultural and emotional needs, which not only contribute to global biodiversity conservation but also play a vital role in rehabilitating degraded natural habitats (Mashizi and Sharafatmandrad, 2020). Although comprehensive checklists of the flora in the Odisha state have been compiled, focusing on district-level or specific genera in different regions, no studies have been conducted in cities, towns or college campuses (Saxena and Brahmam, 1996; Jena et al., 2018; Kumar et al., 2022).

Therefore, this study aims to document the flora of the Chandbali College Campus, which has been a center for educational activities for over 44 years. The campus retains its natural vegetation and exhibits a high concentration of exotic species. Thus, this study serves as an important contribution to understanding the flora and assessing regional biodiversity. The main objectives of this study are as follows: (i) To create an inventory of the angiosperms and gymnosperms found in the Chandbali College Campus, (ii) to classify the angiosperms according to the APG IV system and (iii) to document the ethnobotanical uses of the plant species if any. To the best of my knowledge, this is the first study conducted on the floristic diversity of the Chandbali College Campus, which will prove invaluable for future students in conducting taxonomical and ecological studies in the field of plant sciences.

2. MATERIALS AND METHODS

Study Area

Odisha, located at the head of the Bay of Bengal in India, is a state comprising 30 districts and a coastal stretch of 481 km. The state is traversed by several perennial rivers, including Mahanadi, Brahmani, Baitarani, Rushikulya, Birupa, Budhabalanga and Subarnarekha, making it susceptible to flooding. Bhadrak, one of the districts in Odisha, is particularly prone to cyclones due to its coastal location. Chandbali (20.7936°N and 86.7408°E), situated in the Bhadrak district, is a block-cum-Tahasil located on the banks of the Baitarani River, covering an area of 528.45 sq (Figure 1).

The block has a total population of 250037 individuals, comprising 126367 males and 123670 females residing in 292 villages. The climate of the study area exhibits coastal monsoonal characteristics and can be divided into three distinct seasons: Rainy season (mid-June to September), winter season (October to February) and summer season (March to mid-June). The annual rainfall in the area is recorded at 1962.1 mm. January is the coldest month, with temperatures averaging around 13°C, while May experiences the highest temperatures, reaching up to 38.3^{0}C in the district (Directorate of Economics and Statistics, 2020).

The primary crops cultivated in the study area are rice and various types of vegetables. Additionally, Chandbali is an important fishing center in Odisha. Over the years, the region has experienced severe flooding, not only due to storm surges from the Bay of Bengal but also as a result of river flooding and heavy precipitation associated with tropical cyclones and monsoon depressions. Chandbali has a rich historical significance as an ancient river port known as 'Ravenshaw Port'. The port played a pivotal role in

facilitating trade and navigation in Odisha. During its heyday, approximately 60% of the trade and commerce between Odisha and Calcutta (now Kolkata) was conducted through Chandbali, making it a thriving port until 1885.

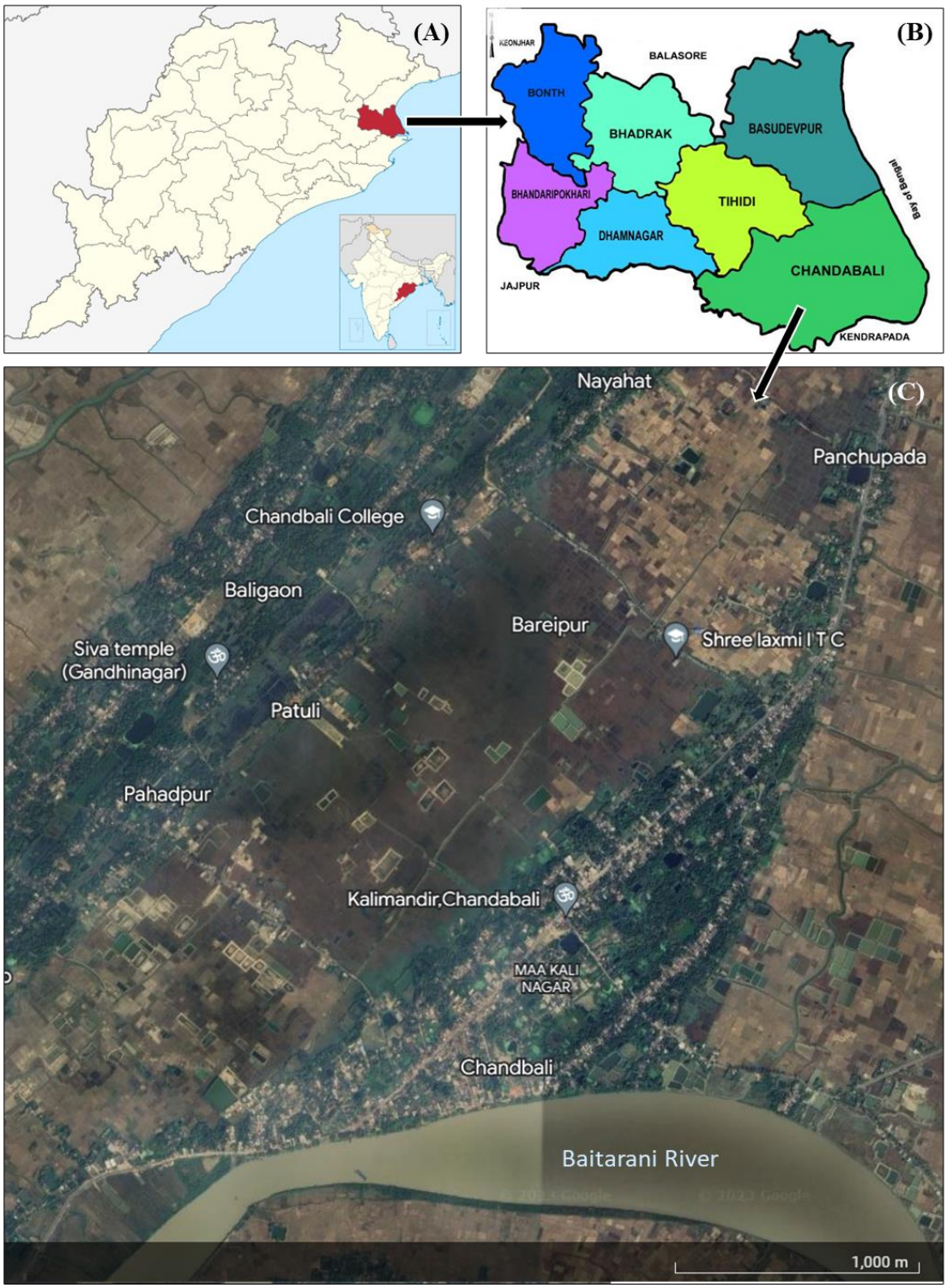

Figure 1 A) Map showing India, Odisha and Bhadrak district; B) Different blocks of Bhadrak district; C) The study area showing Chandbali College

Vessels from Chandbali connected to destinations such as Madras (now Chennai), Bombay (now Mumbai), Burma (now Myanmar) and Ceylon (now Sri Lanka). Salt was a prominent export commodity from Chandbali throughout the 19th century. The port served as a crucial hub for the transportation of consumer goods and cotton to Calcutta, while forest products, oil seeds and rice were brought from Calcutta in return (Bhatta, 1998). However, the port's decline began after it was struck by a devastating

cyclone on September 22, 1885, which resulted in the shallowing of the sea in the region. Despite the decline, Chandbali continued to function as a minor port in Odisha until 1903, aided by the installation of marked buoys and beacons in the rivers' mid-channel to facilitate navigation (Bhatta, 1998).

Data Collection

The present study was undertaken to study the plant diversity in Chandbali College Campus situated 3km away from Chandbali town. The campus spanned an area of 12 acres. To gather data on the flora present, extensive field surveys were conducted from January 2020 to January 2022. Every corner of the campus was thoroughly surveyed to identify plant species. Specimens of the collected plants were carefully collected and identified using relevant flora references (Saxena and Brahmam, 1996).

These plant specimens were then processed to create herbarium specimens, which were deposited in the herbaria of Chandbali College for future reference and study. In addition to documenting the plant species, the study also aimed to gather information on the local names and ethno botanical uses of the plants, if any. This information was collected from the nearby village residents using structured questionnaires, as well as through informal conversations and free interviews, following the methods of Martin, (1995).

The collected data was analyzed based on various parameters, including habit, nativity and any noteworthy species, including exotic species. The plants were systematically categorized according to the APG IV, (2016) classification system. The current nomenclature of each species was determined by referring to reliable databases such as India Biodiversity Portal (https://indiabiodiversity.org/) and Plants of the World online (http://www.plantsoftheworldonline.org).

3. RESULTS

The campus of Chandbali College is an eye-pleasing natural semi-urban area in close proximity to Chandbali town. The data collected from Chandbali College revealed that the entire campus contains 234 plant species of which only 3 species (belonging to 3 genera and 3 families) were represented by gymnosperms while the remaining 231 plant species (122 native and 109 non-natives) were angiosperms (Table 1) (Figure 2 to 7).

Table 1 List of angiosperm taxa recorded from Chandbali College Campus arranged according to the Angiosperm Phylogeny Group Classification IV

Superorder/order	Family and Species	Common Name	Habit	Nativity	Uses
Magnoliids					
Piperales	Piperaceae				
	Peperomia pellucida (L.) Kunth		Herb	AM	Medicinal
Laurales	Lauraceae				
	Cinnamomum tamala (Buch. -Ham.) T.Nees & C.H.Eberm.	Tejpatra	Tree	Native	Medicinal
Magnoliales	Annonaceae				
	Polyalthia longifolia (Sonn.) Thwaites	Debdaru	Tree	SR	Medicinal
Monocots					
Alismatales	Araceae				
	Aglaonema commutatum Schott		Herb	PH	Ornamental
	Caladium bicolor (Aiton) Vent.		Herb	Native	Ornamental
	Colocasia esculenta (L.) Schott	Saru	Herb	Native	Edible
	Dieffenbachia seguine (Jacq.) Schott		Herb	AM	Ornamental
	Epipremnum aureum (Linden & André) G.S.Bunting		Climber	France	Ornamental
	Syngonium podophyllum Schott		Herb	AM	Ornamental
Dioscoreales	Dioscoreaceae				
	Dioscorea alata L.	Khamba-alu	Climber	Native	Edible
Pandanales	Pandanaceae				
	Pandanus fascicularis Lam.	Kia	Shrub	Native	Biofencing

Liliales	Colchicaceae				
	Gloriosa superba L.	Ognisikha	Climber	Native	Medicinal
Asparagales	Amaryillidaceae				
	Crinum asiaticum L.	Arsa	Herb	Native	Medicinal
	Crinum latifolium L.		Herb	Native	Medicinal
	Zephyranthes rosea Lindl.		Herb	Mexico	Medicinal
	Asparagaceae				
	Agave americana L.	Baramasi	Shrub	AM	Ornamental Bio fencing
	Agave angustifolia Haw.		Shrub	Mexico	Ornamental
	Asparagus aethiopicus L.		Herb	Africa	Ornamental
	Asparagus racemosus Willd.	Satabari	Climber	Native	Medicinal
	Beaucarnea recurvata (K.Koch & Fintelm.) Lem.		Tree	Mexico	Ornamental
	Chlorophytum capense (L.) Voss		Herb	Africa	Ornamental
	Cordyline fruticose (L.) A.Chev.		Shrub	New Guinea	Ornamental
	Dracaena reflexa Lam.		Shrub	MD	Ornamental
	Furcraea foetida (L.) Haw		Herb	AM	Ornamental
	Ophiopogon japonicus (Thunb.) Ker Gawl.		Herb	China	Ornamental
	Sansevieria roxburghiana Schult. & Schult.f.	Muruga	Herb	Native	Ornamental
	Xanthorrhoeaceae				
	Aloe vera (L.) Burm. f.	Gheekunwari	Herb	Native	Medicinal
Commelinids					
Arecales	Arecaceae				
	Areca catechu L.	Gua	Tree	Native	Edible
	Borassus flabellifer L.	Tala	Tree	Africa	Medicinal/ Edible
	Caryota urens L.		Tree	Native	Ornamental
	Cocos nucifera L.	Nadia	Tree	Native	Edible
	Dypsis lutescens (H. Wendl.) Beentje & J. Dransf.		Tree	MD	Ornamental
	Hyophorbe lagenicaulis (L.H.Bailey) H.E.Moore		Tree	Mauritius	Ornamental
	Licuala grandis (T.Moore) H.Wendl.		Tree	Vanuatu	Ornamental
	Rhapis excelsa (Thunb.) A. Henry ex Rehder		Shrub	China	Ornamental
	Roystonea regia (Kunth) O. F. Cook		Tree	Mexico	Ornamental
Commelinales	Commelinaceae				
	Commelina benghalensis L.	Kansiri	Herb	Native	Medicinal
	Commelina diffusa Burm. f.		Herb	Native	Medicinal
	Cyanotis axillaris (L.) D.Don ex Sweet		Herb	Native	Fodder
	Murdannia nudiflora (L.) Brenan.	Kanduli	Herb	Native	Fodder
	Murdannia spirata (L.) G. Brückn.		Herb	Native	Fodder
	Tradescantia spathacea Sw.		Herb	Native	Ornamental
Poales	Poaceae				
	Bambusa vulgaris Schrad.	Baunsa	Tree	Native	Bio fencing,

					artifact
	Chloris barbata Sw.		Herb	AM	
	Chrysopogon aciculatus (Retz.) Trin.	Guguchia	Herb	Native	Medicinal
	Cymbopogon flexuosus (Nees ex Steud.) Wats.	Dhanatwari	Herb	Native	Medicinal
	Cynodon dactylon (L.) Pers.	Duba	Herb	Africa	Medicinal, ritual
	Dactyloctenium aegyptium (L.) Willd.		Herb	Native	Fodder
	Digitaria sanguinalis (L) Scop.		Herb	Native	Fodder
	Digitaria ciliaris (Retz.) Koeler		Herb	Native	Fodder
	Echinochloa colona (L.) Link	Swanghas	Herb	AM	Edible
	Echinochloa crusgalli (L.) P. Beauv.	Dhera	Herb	AM	Edible
	Eragrostis gangetica (Roxb.) Steud.		Herb	Native	Fodder
	Eleusine indica (L.) Gaertn.	Anamandia	Herb	Native	Fodder
	Oplismensus burmanii (Retz.) P. Beauv.		Herb	Native	Fodder
	Panicum repens L.		Herb	Native	Fodder
	Cyperaceae				
	Cyperus rotundus L.	Mthaghas	Herb	Europe	Medicine
	Kyllinga nemoralis (J.R. & G. Forst.) Dandy ex Hutch. & Dalziel		Herb	Native	Fodder
Zingiberales	Cannaceae				
	Canna indica L.		Herb	AM	Ornamental
	Costaceae				
	Costus speciosus (J.Koenig) Sm.		Herb	Native	Medicinal
	Marantaceae				
	Calathea virginalis Linden ex Regel		Herb	AM	Ornamental
	Strelitziaceae				
	Ravenala madagascariensis Sonn.		Tree	MD	Ornamental
	Musa paradisiaca L.	Kadali	Herb	Native	Edible
	Zingiberaceae				
	Elettaria cardamomum (L.) Maton	Gujurati	Herb	Native	Medicinal
Eudicots					
Ranunculales	Menispermaceae				
	Cissampelos pareira L.	Akanbindi	Climber	AM	Medicinal
	Papaveraceae				
	Argemone mexicana L.	Kantakusuma	Herb	AM	Medicinal
Rosids					
Vitales	Vitaceae				
	Cayratia trifolia (L.) Domin	Amla lata	Climber	Native	Medicinal
Zygophyllales	Zygophyllaceae				
	Tribulus terrestris L.	Gokhara	Herb	AM	Medicinal
Fabales	Fabaceae				
	Abrus precatorius L.	Kaincha	Climber	Native	Medicinal
	Acacia auriculiformis A.Cunn. ex Benth	Akashi	Tree	AUS	Wood
	Acacia leucophloea (Roxb.) Willd.		Tree	Native	Wood
	Adenanthera pavonina L.	Manda kaincha	Tree	Native	Medicinal
	Albizia lebbeck (L.) Benth.	Sirish	Tree	Native	Medicinal
	Caesalpinia bonduc (L.) Roxb.	Gilo	Climber	Native	Medicinal

	Clitoria ternatea L.	Aparajita	Climber	Native	Medicinal
	Crotalaria spectabilis Roth.	Jhumka	Herb	Native	Fodder
	Desmodium triflorum (L.) DC.		Herb	Native	Medicinal
	Mimosa pudica L.	Lajakuli	Herb	Brazil	Medicinal
	Mucuna pruriens (L.) DC.	Baidanka	Climber	Native	Medicinal
	Peltophorum pterocarpum (DC.) K.Heyne	Radhachuda	Tree	Native	Wood
	Pithecellobium dulce Roxb.	Simakaina	Tree	Native	Medicinal
	Pongamia pinnata (L.) Pierre	Karanj	Tree	Native	Medicinal
	Samanea saman (Jacq.) Merr.	Chakunda	Tree	Native	Wood
	Senna alata (L.) Roxb.		Herb	AM	Medicinal
	Senna auriculata (L.) Roxb.		Tree	Native	Medicinal
	Senna occidentalis (L.) Link	Kalachakunda	Herb	AM	Medicinal
	Senna tora (L.) Roxb.	Chakunda	Herb	AM	Medicinal
	Tephrosia purpurea (L.) Pers.	Banakolathi	Herb	Native	Medicinal
Rosales	Rosaceae				
	Rosa indica L.	Golap	Shrub	Native	Medicinal
	Moraceae				
	Ficus benghalensis L.	Baro	Tree	Native	Medicinal
	Ficus benjamina L.	Pokaha	Tree	Native	Ornamental
	Ficus hipsida L.f.	Dimri	Tree	Native	Medicinal
	Streblus asper Lour.	Sahada	Tree	Native	Medicinal/Edible
	Rhamnaceae				
	Ziziphus mauritiana Lam.	Barakoli	Tree	AUS	Medicinal/ Edible
	Ziziphus oenoplia (L.) Mill.	Kankoli	Shrub	Native	Medicinal/ Edible
Fagales	Casuarinaceae				
	Casuarina equisetifolia L.	Jhaun	Tree	Native	Wood
Cucurbitales	Cucurbitaceae				
	Coccinia indica Wight & Arn.	Kunduri	Climber	Native	Edible
	Cucumis melo L.	Banakakudi	Climber	Native	Edible
	Luffa cylindrica (L.) Roem	Pitataradi	Climber	Native	Medicinal
Com clade					
Oxalidales	Oxalidaceae				
	Oxalis corniculata L.	Ambiliti	Herb	Europe	Medicinal/ Edible
Malpighiales	Euphorbiaceae				
	Acalypha indica L.		Herb	Native	Medicinal
	Acalypha wilkesiana Mull.Arg.		Shrub	Fiji	Ornamental
	Codiaeum variegatum (L.) A. Juss.		Tree	Indonesia	Ornamental
	Croton sparsiflorus Morong	Nandababuli	Herb	AM	Medicinal
	Drypetes roxburghii (Wall.) Hurusawa.	Poichandia	Tree	Native	Medicinal
	Euphorbia hirta L.		Herb	AM	Medicinal
	Euphorbia heterophyla L.		Herb	AM	Not Known
	Euphorbia milii Des Moul.		Shrub	MD	Ornamental
	Euphorbia tithymaloides L.		Shrub	Native	Biofencing
	Jatropha curcas L.	Jara	Shrub	AM	Medicinal
	Jatropha gossypiifolia L.	Baigaba	Shrub	AM	Medicinal

	Jatropha podagrica Hook		Herb	AM	Ornamental
	Micrococca mercurialis (L.) Benth.		Herb	Native	Medicinal
	Ricinus communis L.	Jada	Shrub	Africa	Medicinal
	Synadenium grantii Hook f.		Shrub	AM	Biofencing
	Tragia involucrata L.	Bichhuati	Herb	Native	Medicinal
	Phyllanthaceae				
	Breynia vitis-idaea (Burm. f.) C.E.C. Fisch.	Pohalakuli	Shrub	WI	Biofencing
	Phyllanthus fraternus Webster	Bhuianla	Herb	Native	Medicinal
	Violaceae				
	Hybanthus enneaspermus (L.) F. Muell.		Herb	Native	Medicinal
Rosids					
Myrtales	Myrtaceae				
	Eucalyptus tereticornis Sm.		Tree	AUS	Medicinal
	Melaleuca citrina (Curtis) Dum. Cours		Tree	AUS	Not Known
	Psidium guajava L.	Pijuli	Tree	AM	Medicinal/ Edible
	Syzygium cumini (L.) Skeels	Jamukoli	Tree	Native	Medicinal/ Edible
	Lythraceae				
	Lagerstroemia speciosa (L.) Pers		Tree	Native	Medicinal
	Onagraceae				
	Ludwigia hyssopifolia (G.Don) Exell		Herb	Mexico	Medicinal
Sapindales	Anacardiaceae				
	Anacardium occidentale L.	Saitamba	Tree	AM	Medicinal/ Edible
	Mangifera indica L.	Amba	Tree	Native	Medicinal/ Edible
	Meliaceae				
	Azardiracta indica A. Juss.	Nimba	Tree	Native	Medicinal/ Edible
	Swietenia mahagoni (L.) Jacq.		Tree	AM	Wood
	Rutaceae				
	Aegle marmelos (L.) Correa	Bela	Tree	Native	Medicinal/ Edible
	Murraya koenigii (L.) Spreng.	Bhursunga	Tree	Native	Medicinal/ Edible
	Murraya paniculata (L.) Jack	Kamini	Shrub	Native	Ornamental
	Sapindaceae				
	Cardiospermum halicacabum L.	Kanphuta	Climber	Native	Medicinal
Malvales	Malvaceae				
	Abutilon indicum (L.) Sweet	Pedipedika	Herb	Native	Medicinal
	Ceiba pentandra (L.) Gaertn.		Tree	Mexico	Medicinal
	Corchorus olitorius L.		Herb	Native	Not Known
	Corchorus trilocularis L.		Herb	Africa	Not Known
	Hibiscus rosa-sinensis L.	Mandar	Shrub	China	Medicinal
	Malachra capitata (L.) L.		Shrub	AM	Not Known
	Melochia corchorifolia L.	Telpuri	Shrub	AM	Not Known
	Pavonia zeylanica (L.) Cav.		Herb	Native	Not Known

	Pterospermum acerifolium (L.) Willd.	Muchukund	Tree	Native	Medicinal
	Sida acuta Burm.f.	Sunakhadika	Shrub	AM	Medicinal
	Sida cordata (Burm. f.) Borss. Waalk.	Bisiripi	Herb	Native	Medicinal
	Sida cordifolia L.	Bisiripi	Herb	Native	Medicinal
	Sida rhombifolia L.	Sahabeda	Shrub	AM	Medicinal
	Triumfetta rhomboidea Jacq.		Shrub	Native	Not Known
Brassicales	Brassicaceae				
	Brassica juncea (L.) Czern. & Coss.	Raisorisha	Herb	CAS	Edible
	Caricaceae				
	Carica papaya L.	Amrutabhanda	Tree	AM	Medicinal/ Edible
	Cleomaceae				
	Cleome rutidosperma DC.		Herb	AM	Medicinal
	Cleome viscosa L.	Anasorisho	Herb	AM	Medicinal
	Moringaceae				
	Moringa oleifera Lam.	Sajana	Tree	Native	Medicinal/ Edible
Superasterids					
Santalales	Santalaceae				
	Santalum album L.	Chandan	Tree	Native	Medicinal
Caryophyllales	Aizoaceae				
	Trianthema portulacastrum L.	Purinisaga	Herb	Native	Medicinal
	Amaranthaceae				
	Achyranthes aspera L.	Apamaranga	Herb	Native	Medicinal
	Aerva lanata (L.) Juss. ex Schult.		Herb	Native	Medicinal
	Alternanthera ficoidea (L.) Sm.		Herb	AM	Not Known
	A. sessilis (L.) R. Br. ex DC.	Madranga	Herb	AM	Medicinal/ Edible
	Amaranthus spinosus L.	Kantaneutia	Herb	AM	Medicinal/ Edible
	Gomphrena serrata L.		Herb	AM	Medicinal
	Cactaceae				
	Pilosocereus arrabidae (Lem.) Byles & G.D.Rowley	Deulisiju	Shrub	Native	Biofencing
	Molluginaceae				
	Glinus oppositifolius (L.) A.DC.	Pitasaga	Herb	Native	Medicinal/ Edible
	Nyctaginaceae				
	Boerhavia diffusa L.	Puruni	Herb	AM	Medicinal/ Edible
	Mirabilis jalapa L.	Chandrakanta	Herb	Peru	Medicinal
	Bougainvillea spectabilis Willd.	Kagajaphula	Shrub	Brazil	Ornamental/ Biofencing
	Polygonaceae				
	Antigonon leptopus Hook. & Arn.		Climber	AM	Medicinal
	Portulacaceae				
	Portulaca oleracea L.	Badabalbaula	Herb	AM	Medicinal
	Portulaca quadrifida L.	Balbaula	Herb	AM	Edible
	Portulaca grandiflora Hook.		Herb	Brazil	Ornamental

Asterids					
Ericales	Balsaminaceae				
	Impatiens balsamina L.	Haragoura	Herb	AM	Medicinal
	Sapotaceae				
	Madhuca indica J.F. Gmel.	Mahula	Tree	Native	Medicinal
	Mimusops elengi L.	Baula	Tree	Native	Medicinal
Gentianales	Apocyanaceae				
	Adenium obesum (Forssk.) Roem. & Schult.		Shrub	Native	Ornamental
	Allamanda cathartica L.		Climber	AM	Ornamental
	Calotropis procera (Aiton)W.T. Aiton	Arakha	Shrub	Africa	Medicinal
	Cathranthus roseus (L.) G. Don	Sadabihari	Herb	AM	Medicinal
	Ervatamia divaricata (L.) Burkill	Tagar	Shrub	Native	Medicinal
	Ichnocarpus frutescens (L.) W.T.Aiton		Climber	Native	Medicinal
	Pergularia daemia (Forssk.) Chiov.	Uturudi	Climber	Native	Medicinal
	Plumeria pudica Jacq.		Shrub	Panama	Ornamental
	Rauvolfia tetraphylla L.		Shrub	WI	Medicinal
	Thevetia peruviana (Pers.) K. Schum.	Kaniyara	Tree	AM	Medicinal
	Rubiaceae				
	Ixora coccinea L.		Shrub	Native	Ornamental
	Morinda pubescens Sm.	Acchu	Tree	Native	Medicinal
	Mussaenda frondosa L.		Shrub	Native	Ornamental
	Oldenlandia corymbose L.		Herb	Native	Medicinal
	Spermacoce articularis L.f.		Herb	Native	Medicinal
Boraginales	Boraginaceae				
	Heliotropium indicum L.	Hatisundha	Herb	Native	Medicinal
Solanales	Convolvulaceae				
	Cuscuta reflexa Roxb.	Nirmuli	Climber	MR	Medicinal
	Evolvulus alsinoides (L.) L.	Bichhamalia	Herb	Native	Medicinal
	Evolvulus nummularius (L.) L.		Herb	AM	Not Known
	Ipomoea marginata (Desr.) Verdc.		Climber	Native	Not Known
	Merremia hederacea (Burm.f.) Hallier f.		Climber	Native	Medicinal
	Solanaceae				
	Datura metel L.	Kaladudura	Herb	AM	Medicinal
	Datura stramonium L.	Dudura	Herb	AM	Medicinal
Lamiales	Acanthaceae				
	Andrographis paniculata (Burm.f.) Wall.ex Nees	Bhuinnimba	Herb	Native	Medicinal
	Hygrophila auriculata Heine	Koelekha	Herb	Native	Medicinal
	Justicia gendarussa Burm.f.	Kalabasanga	Herb	Native	Medicinal
	Ruellia prostrata Poir.		Herb	Native	Not Known
	Rungia pectinata (L.) Nees		Herb	Native	Not Known
	Lamiaceae				
	Anisomeles indica (L.) Kuntze		Herb	Native	Medicinal
	Clerodendrum indicum (L.) Kuntze	Nagri	Shrub	Native	Medicinal
	C. viscosum Vent.		Shrub	Native	Medicinal
	Coleus scutellarioides		Herb	Native	Medicinal

	(L.) Benth.				
	Leucas aspera (Willd.) Link	Gaiso	Herb	Native	Medicinal
	Ocimum canum Sims	Kapur kanti	Herb	AM	Medicinal
	O. sanctum L.	Tulasi	Shrub	Native	Medicinal
	Oleaceae				
	Jasminum sambac (L.) Aiton	Malli	Shrub	Native	Ornamental
	Plantaginaceae				
	Scoparia dulcis L.	Chirarita	Herb	AM	Not Known
	Pedaliaceae				
	Pedalium murex L.	Gokara	Herb	AM	Medicinal
	Sesamum indicum L.	Khasa	Herb	Native	Medicinal
	Scrophulariaceae				
	Bacopa monnieri (L.) Pennell	Brahmi	Herb	Native	Medicinal
	Lindernia crustacea (L.) F.Muell.		Herb	Native	Medicinal
	Verbenaceae				
	Duranta repens L.	Bilatikanta	Shrub	AM	Biofencing
	Lantana camara L.	Gandhagauria	Shrub	AM	Medicinal
	Lippia javanica (Burn.f.) Spreng	Naguari	Herb	Native	Medicinal
	Phyla nodiflora (L.) Greene	Gosing	Herb	AM	Fodder
	Stachytarpheta jamaicensis (L.) Vahl	Jatia	Herb	AM	Not Known
Asterales	Asteraceae				
	Ageratum conyzoides L.	Poksunga	Herb	AM	Medicinal
	Eclipta prostrata (L.) L.	Bhrungaraj	Herb	AM	Medicinal
	Gnaphalium polycaulon Pers.		Herb	AM	Not Known
	Helianthus annus L.	Suryamukhi	Herb	AM	Medicinal
	Mikania micrantha Kunth		Climber	AM	Not Known
	Sphagneticola trilobata (L.) Pruski	Bhimraj	Herb	Mexico	Not Known
	Spilanthes 11aniculate Wall ex DC.		Herb	Native	Fodder
	Synedrella nodiflora (L.) Gaertn.		Herb	AM	Not known
	Tagetes erecta L.	Gendu	Herb	Mexico	Medicinal
	Tridax procumbens L.	Bisalyakarani	Herb	AM	Medicinal
	Vernonia cinerea (L.) Less.	Poksunga	Herb	Native	Medicinal
Apiales	Araliaceae				
	Polyscias guilfoylei (W.Bull) L.H.Bailey		Shrub	Malesia	Ornamental
	Apiaceae				
	Centella asiatica (L.) Urb.	Thalkudi	Herb	Native	Medicinal
Gymnosperms					
Cupressales	Araucariaceae				
	Araucaria columnaris (G.Forst.) Hook.		Tree	France	Ornamental
Cycadales	Cycadaceae				
	Cycas revoluta Thunb.		Shrub	China	Ornamental
	Zamiaceae				
	Zamia furfuracea L.f. ex Aiton		Shrub	Mexico	Ornamental

Abbreviations: AM: America, AUS: Australia, CAS: Central Asia, MD: Madagascar, MR: Mediterranean region, PH: Philippines, SR: Sri Lanka, WI: West Indies.

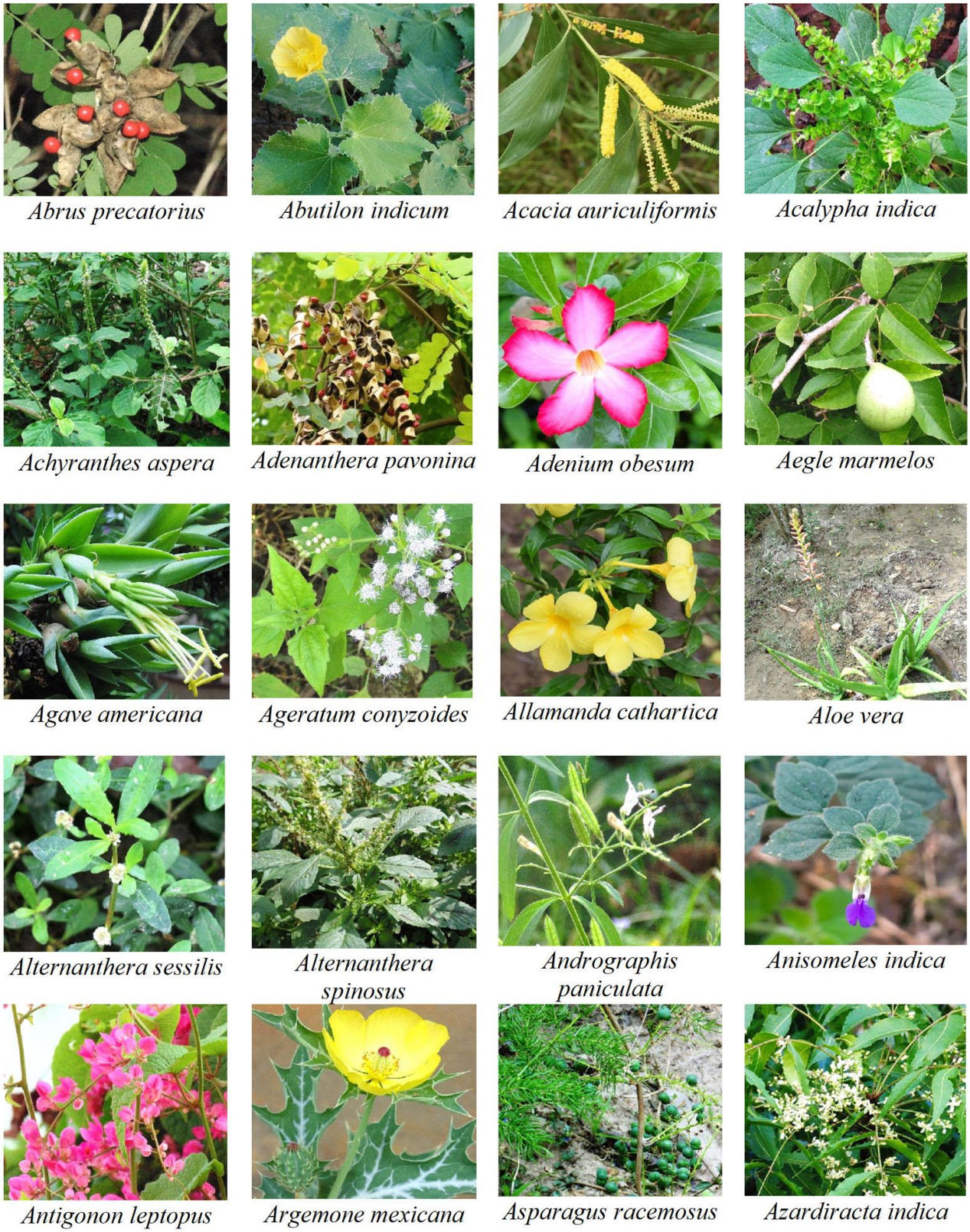

Figure 2 Some of the plants collected from the study site

Figure 3 Some of the plants collected from the study site

Figure 4 Some of the plants collected from the study site

Figure 5 Some of the plants collected from the study site

Figure 6 Some of the plants collected from the study site

The angiosperm taxa were distributed in 199 genera, representing 70 families as per APG IV classification. These taxa are distributed under 34 orders, of which the major contributions in terms of descending species number were from Lamiales 23, Fabales 20, Malpighiales 19, Caryophyllales 16, Poales 16, Asparagales 15, Gentianales 15, Malvales 14, Asterales 11 and Arecales 09 (Figure 8). The ten well-represented families in species quantity were: Fabaceae (20 sp.), Euphorbiaceae (16 sp.), Malvaceae (14 sp.), Poaceae (14 sp.), Asparagaceae (11 sp.), Asteraceae (11 sp.), Apocynaceae (10 sp.), Arecaceae (09 sp.), Lamiaceae (7 sp.) and Araceae (6 sp.) (Figure 9).

Figure 7 Some of the plants collected from the study site

A total of 31 families remained monospecific and were represented by only one species from the study area, such as members from Menispermaceae, Cannaceae, Pandanaceae and Apiaceae. Habit analysis showed that herbs were represented by the highest proportion with 120 species (52.9%), trees by 51 species (21.1%), shrubs by 39 species (16.9%) and climbers by 21 species (9.1%) (Figure 10). Amongst the recorded plants, most of the species were found to have economic importance. These are used as medicine, food, fodder, wood, rituals, bio fencing and ornamental purposes (Figure 11).

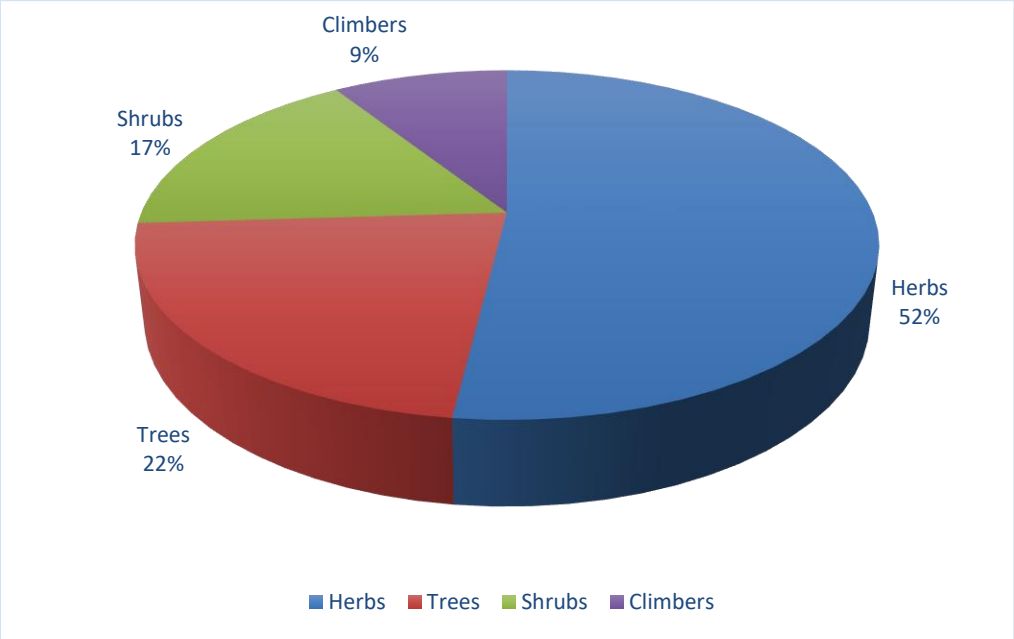

Figure 8 Different life forms of the recorded species

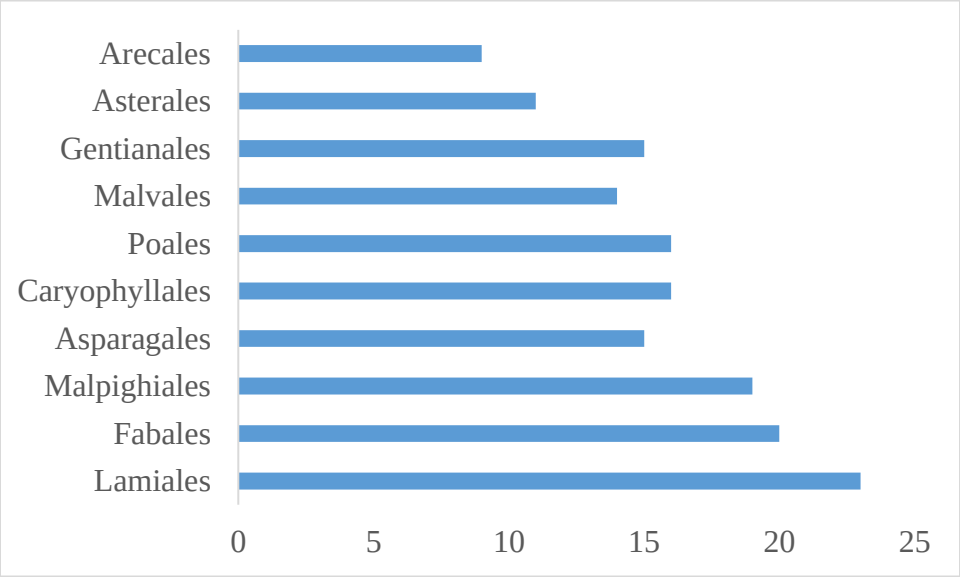

Figure 9 Distribution of species in orders per APG IV

About 49% of the plant species were used for medicinal purposes. Prominent species among them were *Abrus precatorius* L., *Achyranthes aspera* L., *Aegle marmelos* (L.) Correa, *Aloe vera* (L.) Burm. f., *Andrographis paniculata* (Burm. f.) Wall. ex Nees, *Asparagus racemosus* Willd., *Azadirachta indica* A. Juss., *Bacopa monnieri* (L.) Pennell, *Cathranthus roseus* (L.) G. Don, *Centella asiatica* (L.) Urb., *Cinnamomum tamala* Nees., *Cissampelos pareira* L., *Commelina benghalensis* L., *Croton sparsiflorus* Morong, *Cymbopogon flexuosus* (Nees ex Steud.) Wats., *Cyperus rotundus* L., *Datura metel* L., *Desmodium triflorum* (L.) DC., *Eclipta prostrata* (L.) L., *Euphorbia hirta* L., *Jatropha curcas* L., *Gloriosa superba* L., *Heliotropium indicum* L., *Lantana camara* L., *Luffa cylindrica* (L.) Roem, *Madhuca indica* J.F. Gmel., *Mimusops elengi* L., *Moringa oleifera* Lam., *Ocimum sanctum* L., *Phyllanthus fraternus* Webster, *Pongamia pinnata* (L.) Pierre, *Rauvolfia tetraphylla* L., *Santalum album* L., *Sesamum indicum* L., *Syzygium cumini* (L.) Skeels and *Tridax procumbens* L.

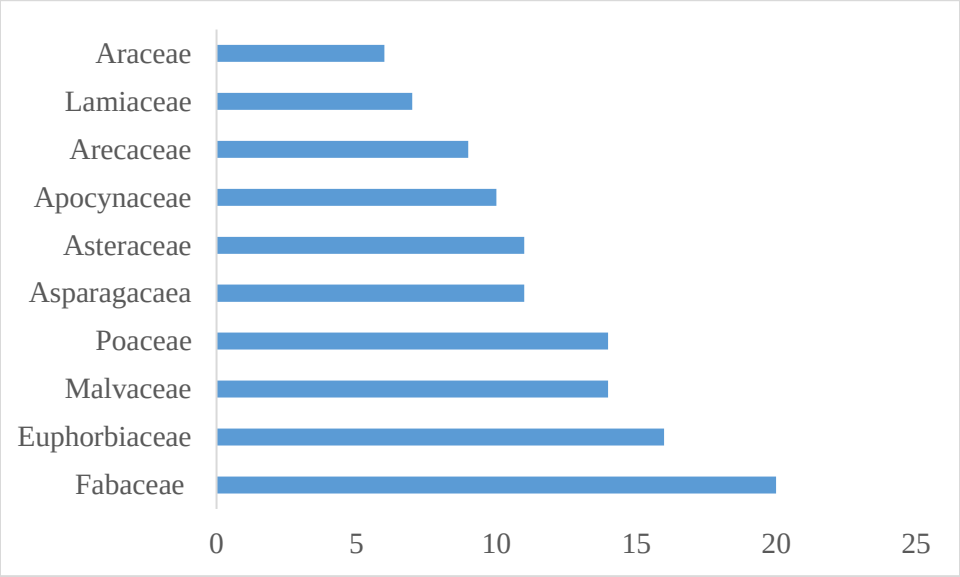

Figure 10 Distribution of species in families per APG IV

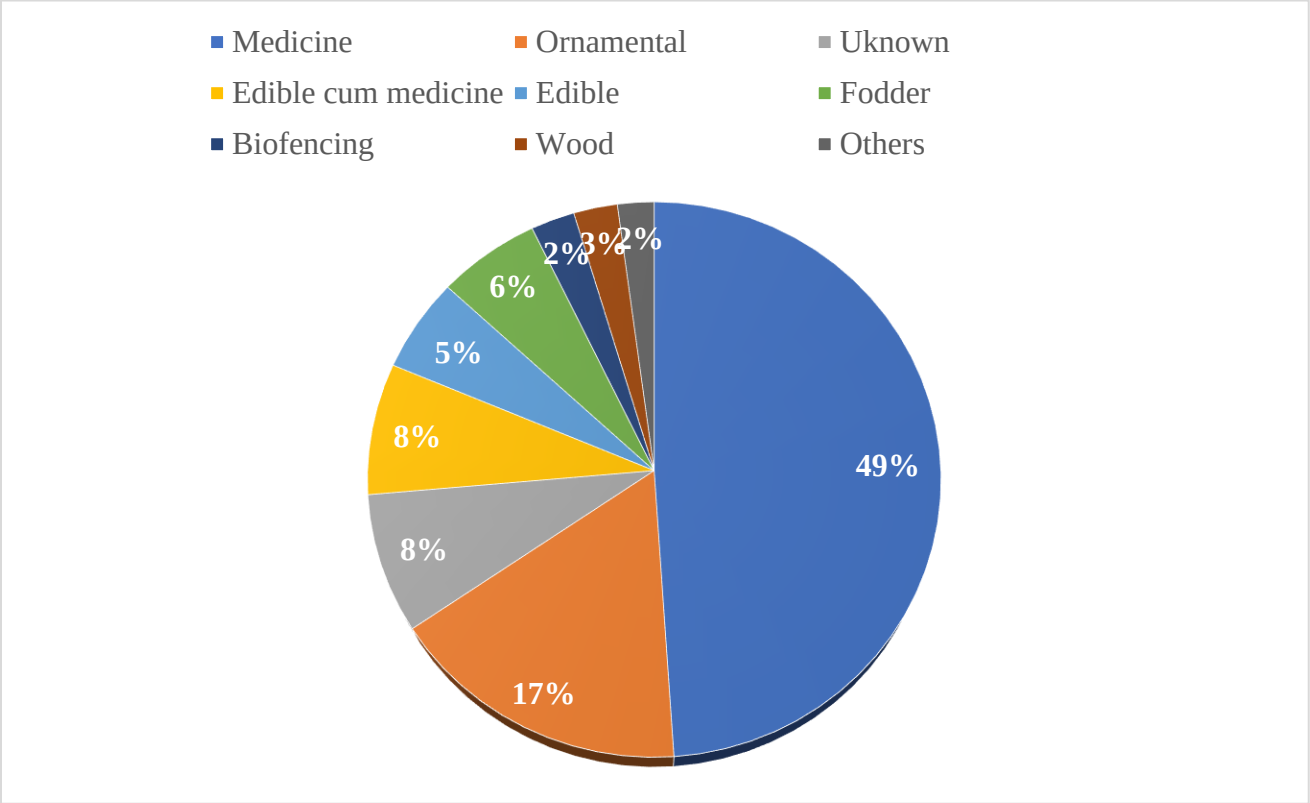

Figure 11 Traditional use of the reported species

The edible species like *Cocos nucifera* L., *Coccinia indica* Wight & Arn., *Colocasia esculenta* (L.) Schott, *Cucumis melo* L., *Dioscorea alata* L., *Musa paradisiaca* L., *Ziziphus mauritiana* Lam., *Ziziphus oenoplia* (L.) Mill. were found in the campus. In the present study, a total of 18 species such as *Alternanthera sessilis* (L.) R. Br. ex DC., *Anacardium occidentale* L., *Azardiracta indica* A. Juss., *Boerhavia diffusa* L., *Carica papaya* L., *Glinus oppositifolius* (L.) A.DC., *Mangifera indica* L., *Moringa oleifera* Lam., *Murraya koenigii* (L.) Spreng., *Oxalis corniculata* L., *Psidium guajava* L., *Streblus asper* Lour. and *Syzygium cumini* (L.) Skeels were consumed both for edible and therapeutic purposes (Table 1).

A sizeable number of ornamental plants (39 sp. from angiosperm and 3 species of gymnosperm) were reported from the campus. Prominent among them include *Adenium obesum, Aglaonema commutatum, Cestrum nocturnum, Codiaeum variegatum,*

Cordyline fruticose, Dieffenbachia seguine, Dypsis lutescens, Epipremnum aureum, Licuala grandis, Mussaenda frondose, Portulaca grandiflora, Ravenala madagascariensis, Sansevieria roxburghiana and *Tradescantia spathacea.*

A large number of exotic flora (109 species) were reported from the campus of Chandbali College which includes *Ageratum conyzoides, Argemone mexicana, Asparagus racemosus, Casuarina equisetifolia, Ceiba pentandra, Croton sparsiflorus, Cynodon dactylon, Cyperus rotundus, Datura metel, Eucalyptus tereticornis, Euphorbia hirta, Gomphrena globosa, Heliotropium indicum, Lantana camara, Mimosa pudica, Oxalis corniculata, Physalis minima, Portulaca oleracea, Senna occidentalis, Tridax procumbens and Ziziphus mauritiana.*

4. DISCUSSION

A diverse flora plays a crucial role in shaping ecosystem functions, including soil improvement, water retention, weather buffering, wildlife habitat, carbon sequestration, climate mitigation and urban landscaping (Pearse and Hipp, 2009). Additionally, it serves as a valuable source of essential needs such as food, fodder, medicine and other products. The floristic survey conducted on Chandbali College Campus revealed the presence of 231 angiosperm taxa from 199 genera and 70 families, categorized into four growth forms: Climbers, trees, shrubs and herbs (Table 1).

This number of plant species can be compared to other regions in India, such as the Travancore Hindu College campus in Kanyakumari, Tamil Nadu (238 plant species; Parthipan et al., 2016); Deccan College Campus in Pune (215 plant species; Naik, 2020); and Rajagiri College Campus in Kalamassery, Kerala (164 plant species; Krishnakumar and Ramesh, 2022). Among the surveyed families, the family Fabaceae stood out as a species-rich family, consistent with findings from other studies (Parthipan et al., 2016).

The herbaceous component represented the largest number of species, mirroring observations from other parts of India (Parthipan et al., 2016). While a considerable number of woody species (51 species) were recorded, a few species, such as *Acacia auriculiformis* A.Cunn. ex Benth, *Azardiracta indica* A. Juss. and *Polyalthia longifolia* (Sonn.) Thw., were observed in the seedling stage, indicating a poor rate of woody species regeneration in the studied area. Notable tree species like *Ficus benghalensis* L. and *Ficus hipsida* L.f. serve as examples of keystone species found on the campus.

Figs (*Ficus* spp.) play a keystone role in tropical and subtropical ecosystems globally, mainly due to providing a copious fruit crop that is consumed by many insectivorous bird species as well as frugivores (Matthews et al., 2017). In the present study, approximately 49% of the recorded plant species were found to have medicinal uses for various ailments. Notably, *Aloe vera* (L.) Burm. f., *Andrographis paniculata* Nees, *Azadirachta indica* A. Juss., *Cissampelos pareira* L., *Lantana camara* L., *Pongamia pinnata* (L.) Pierre and *Tridax procumbens* L. were among the most cited plant species for treating skin disorders.

Similar uses of these plants have been documented in different regions of India (Anand et al., 2022), highlighting the importance of traditional medicine in skin disorder treatments. *Centella asiatica* (L.) Urb. has been reported for its use in treating various ailments such as stomach disorders, irregular menstruation and maternal healthcare (Prakash et al., 2017). In Ayurveda, *Bacopa monnieri* (L.) Penn. is recommended for memory improvement and has been studied for its potential anti-inflammatory, analgesic, antipyretic and sedative properties (Russo and Borrelli, 2005).

Additionally, researchers have investigated the herbal remedies derived from the reported plant species for the treatment of different ailments in India (Bushi et al., 2021; Laldingliani et al., 2022). Wild edible plants are frequently collected by people from diverse cultures and various habitats, playing a significant role in supplementing the global food supply, particularly in rural areas. In India, approximately 53 million tribes from 550 different communities utilize 9,500 wild plant species to meet their food, medicinal, fodder, fiber, fuel, cultural and other needs (Jain and Tiwari-Barua, 2012).

Some of the edible plant species documented in the current study, such as *Coccinia indica* Wight & Arn., *Colocasia esculenta* (L.) Schott, *Dioscorea alata* L., *Musa paradisiaca* L. and *Ziziphus mauritiana* Lam., have been reported in other studies as well (Jhamta et al., 2019). While these plants are commonly used as food, they also have medicinal applications. For example, in the present study, *Glinus oppositifolius* is consumed as food and used for medicinal purposes. Boiled leaves of *Glinus oppositifolius* are eaten to treat skin diseases, increase appetite, cure kapha, piles, leukoderma, provide intestinal tonic, treat urinary infections, fever, cough, liver problems and also due to its antioxidant properties attributed to its potent phytoconstituents (Sheu et al., 2014).

Similarly, *Boerhavia diffusa* is a well-known medicinal plant used in Ayurveda, Unani and other traditional medicines in various parts of the world. Different indigenous groups in India use this plant to facilitate childbirth (Shah et al., 1983) and the whole plant and root are used to treat leucorrhoea in South India (Balamurugan et al., 2017). Some of the fodder plant species documented in this study have also been reported elsewhere (Shaheen et al., 2020). The current study recorded the use of species such as *Agave americana* L., *Bambusa vulgaris* Schrad., *Bougainvillea spectabilis* Willd., *Euphorbia tithymaloides* L., *Pandanus fascicularis* Lam. and *Pilosocereus arrabidae* (Lem.) Byles & G.D.Rowley for biofencing purposes, which aligns with the findings of Panda et al., (2018).

Similarly, *Bambusa vulgaris* has been utilized for handicraft purposes. In the present study, *Cynodon dactylon* (L.) Pers. and the leaves of *Ziziphus mauritiana* are used in various ritual ceremonies such as Durga puja, Laxmi puja, thread ceremonies and marriage ceremonies in Odisha. In today's era of stressful lifestyles and anthropogenic climate change, there is a growing trend of incorporating ornamental plants into various environments. These plants enhance urban and rural landscapes, develop fallow lands, promote afforestation and manage outdoor and indoor spaces. They are commonly found in homes, educational institutions, public spaces and workplaces, adding beauty, amusement and enlightenment to these settings.

The present study revealed a significant number of ornamental plants. However, it is important to note that the introduction of attractive plants that are not well-suited to the local ecosystem can result in significant environmental damage (Cong and Han, 2022). The issue of biological invasions has gained considerable attention due to the potential threats they pose to native species, natural systems, ecosystem processes and functioning, environmental quality and human health. Pysek et al., (2017) have identified 11 alien plant species that are naturalized in one-third or more regions globally and cover at least 35% of the Earth's land surface.

Mikania micrantha Kunth, a fast-growing perennial climber, is spreading rapidly on the campus and causing severe damage to the natural flora due to its aggressive growth. It is recognized as one of the world's top 10 most invasive weeds. The plant forms numerous adventitious roots from stolon internodes, anchoring it firmly in the soil and allowing for efficient uptake of water and nutrients, leading to its rapid expansion (Yue et al., 2019). The vine can climb over surrounding trees and grass, depriving them of adequate sunlight, impeding their growth and eventually causing their demise (Yue et al., 2019).

Similarly, *Lantana camara* L. is spreading rapidly throughout the campus due to its competitive ability and allelopathic effects. Originally introduced to India in 1807 as an ornamental plant at the Acharya Jagadish Chandra Bose Botanical Garden in Kolkata, it quickly escaped into the wild and successfully spread across open areas such as roadsides, railway tracks, crop field edges and open forests throughout the country (Kannan et al., 2013). Currently, the monitoring of invasive species primarily relies on manual inspection, which has limitations in terms of accuracy and efficiency.

5. CONCLUSIONS

College campuses play a vital role as green spaces in urban areas, attracting naturalists and serving as hubs for biodiversity research and education. They offer a unique opportunity to connect people with nature and raise awareness about local flora and fauna. Students and researchers have long been engaged in documenting and protecting the biodiversity on campuses, including plants, birds and insects, for educational purposes.

To ensure the conservation of biodiversity in the face of climate change, two key strategies can be implemented for the future management of Chandbali College Campus: 1. Implementing stringent regulations, raising awareness about conservation and promoting responsible behavior among students, staff and visitors are crucial steps to address and halt any illegal activities that may harm natural resources on the campus. 2. Initiatives to restore and enhance plant biodiversity on the campus. This may involve planting native tree species, creating green spaces and preserving habitats that support a diverse range of flora and fauna.

Special attention can also be given to conserving rare species unique to the region, contributing to the preservation of local ecological diversity. By implementing these strategies, Chandbali College Campus can become a model for an ecologically responsible future, promoting biodiversity conservation and demonstrating sustainable practices in response to the challenges posed by climate change.

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Authors' contributions

TP spearheaded the research design, conducted the comprehensive survey and wrote the manuscript. SR and BKP provided assistance to the primary author (TP) in data collection and expertly interpreted the accompanying photographs. NM made significant contributions to the literature survey. All authors actively engaged in reviewing the manuscript, offering valuable feedback and approving final approval.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Ethical approval

The ethical guidelines for plants & plant materials are followed in the study for sample collection & identification.

Data and materials availability

All data associated with this study are present in the paper.

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