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Diversity of Plant Species in The Steel City of Odisha, India: Ethnobotany and Implications for Conservation of Urban Bio-Resources

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ABSTRACT

The vegetation of the Steel City (Rourkela) of Odisha, India has high ethnobotanical values by virtue of its rich floral diversity. People in the urban area are highly dependent on the plants available in and around the city for their primary needs. The present study highlights the use of local flora, explore, identification, ethnobotany and conservation of wild and cultivated plant species in the city of Rourkela, Odisha, India. It also pays heed to the proper utilization of urban flora as a way of highlighting its ethnopharmacological importance. A field survey was conducted to collect information about floral diversity in and around the city. Data on the use of plants was collected with a semi-structured questionnaire and from the peer-reviewed literature. A total of 154 plant species, belonging to 128 genera and 55 families, were identified, along with their botanical name, vernacular name, family and habitat. Of these plant species, 53 are medicinal, 43 are ornamental, and 33 are edible, while 23 are weeds. Paderia foetida and Saraca asoka fall into the RET (rare, endangered and threatened) group and are very effective against various diseases. Traditional uses of local plants in an urban area like Rourkela are very interesting. This shows that, not only rural and tribal areas are rich in useful bio-resources but so are urban or semi-urban areas. The documentation of all useful flora with ethnomedicinal potential is helpful in conserving plant biodiversity as well as in environmental studies along with potential applications in drug discovery and oriental medicine.

Key words: conservation; ethnobotany; ethnopharmacology; floral diversity

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INTRODUCTION

Human beings cannot survive on this planet without floral diversity which provides resources for life in the form of food, shelter, clothing and, more essentially, atmospheric oxygen for breathing [1]. Floral diversity provides food, medicine, and fodder and has paramount economic and socio-cultural worth throughout the world [2]. Floral diversity is the prime component of biological diversity, represented by medicinal, edible, economic, and socio-cultural plants as well as by diverse other floras that are beneficial to humans and the environment [3,4]. These plants are either wild or cultivated [5]. Of all these plants, edible and medicinal plants in particular play an important role in human life [6]. They provide primary food and medicine to local communities [7,8]. Even in the modern era, most rural and tribal communities who live close to the forest depend on plants for their daily food and healthcare needs [9,10]. The medicinal uses of plants and plant parts are ancient practices [11,12]. Ancient Indian literature indicates that therapeutic uses of plants have been practiced since as long ago as 5000-4000 B.C. [13].

Floral diversity is directly proportional to chemical diversity (bioactive compounds), as reflected in the traditional knowledge of the aboriginal peoples and this area of science is known as "ethnobotany," or sometimes ethnopharmacology [14, 15]. Ethno-medicinal studies offer immense scope and opportunities for biodiversity conservation and sustainable development of local communities around the world [16]. Wild plants are used in the form of fruits, tubers, flowers, leafy vegetables etc. for food and medical purposes [17]. The World Health Organization (WHO) has estimated that as much as 80% of the world's population depends on traditional medicine for their primary healthcare requirements [18]. Traditional medicine is a combination of both knowledge and practices, whether explainable or not; it is used in disease diagnosis and treatment, prevention and elimination of physical, mental, or social imbalance, and relies exclusively on practical experience and observations that are transferred from generation to generation by individuals [19]. Today, there is an increasing desire to reveal the role of ethno-botanical knowledge by capturing centuries-old traditional folk knowledge from elderly people as well as by searching for new plants species of medicinal and economic importance [20].

The medicinal potential of plant species and parts that are used for the preparation and administration of various drugs vary with climate and environmental conditions [21]. However, the knowledge of herbal medicine is gradually dying out, although some traditional herbal healers around the world continue to practice the art of herbal healing effectively [22]. Floral diversity is not only rich in or near the forest or rural areas, but it is also rich in small patches of urban areas, mainly campuses of educational institutions and other government bureaus. These areas play a vital role in balancing pollution and other environmental factors in urban environments. Keeping this in mind, an attempt has therefore been made to document the useful flora in and around the Steel City (Rourkela) of Odisha State in India and its ethnobotanical potential.

MATERIALS AND METHODS

Study area

Rourkela is known as the Steel City of Odisha State in India. It is unique in floral diversity in an urban environment. It is situated between 22°14' 57" N and 82° 54' 58" E (Plate 1). In recent years, the natural wild flora of the city has been adversely affected by the spread of concrete forests and other anthropogenic activities like mining industries and factory construction.

The average height of the study area is about 219 m above mean sea level. Geographically, it is a land mass of red and laterite soils and quite rich in minerals, particularly iron ore (Plate 1). The study area is very close to Vedvyas, where the Koel and Sankha rivers meet and form a single river named Brahmani. The city enjoys a tropical climate and receives high rainfall during the Southeast monsoon and the retreating Northeast monsoon. Average annual rainfall is about 160 to 200 cm. It has semi-evergreen or tropical dry deciduous forest [23-26].

Enumeration of plant species and their ethnobotany

Field studies were carried out in different seasons of the year of 2014-2015 with the aim of enumerating the floral wealth in the city area of Rourkela by means of the Bentham & Hooker system followed by Christian and Brigitte [27]. Seasonal variations and the frequency of occurrence of plants were noted during the field study. During field visits, surveys were undertaken in different locations, namely, waste land, bare land, play grounds, road sides, grass land, gardens, and plant species were recorded. Common and ethnobotanical uses of different plant species were recorded from people inhabiting the city and surrounding areas through a set of questionnaires in the form of a passport data form. Plant species were identified by the first author on the basis of flora books [28,29] and published articles [30]. Each species was tabulated together with its botanical name, local/common name, habit, nature and type of the plant species.

RESULTS

The field survey showed that the city of Rourkela, Odisha, India is blessed with a large number of beneficial plants with medicinal importance. During the present study, 154 plant species in 128 genera and 55 families were recorded (Fig. 1). Survey results demonstrated the wide diversity of plant species in the city. Taxa included monocotyledonous and diocotyledons. Asteraceae contributed the largest number with 12 species, followed by apocynaceae and caselpinaceae with 9 species, euphorbiaceae contributed 7 species, and fabaceae and malvaceae contributed 6 species each. Of the identified species, most were trees (45) and herbs (49); shrubs were also common (28). Climbers were rare (20) and grasses were the least common (5) (Fig. 2). The most common usage classifications of taxa were medicinal (53) (Table 1), ornamental (43) (Table 3), edible (33) (Table 2), common weed (23), timber (14), and cultural (2) (Fig. 3). The study indicates that the largest number of medicinal plants belong to tree group (Fig. 2, 3 and 4).

The most common medicinal plants are *Triumfetta pentandra* (Plate 2.9), *Leonotis nepetifolia* (Plate 2.5), *Passiflora foetida* (Plate 2.3, Plate 2.8), *Borehivia diffusa, Terminalia bellarica* (Plate 2.4), *Paderia foetida, Saraca asoka* and *Abutilon indicum;* edible plants are *Dioscorea bulbifera, Amaranthus spinosus, Annona reticulate* (Plate 2.2), *Annona squamosa, Artocarpus heterophyllus, Commelina benghalensis, Dillenia indica, Dioscorea alata, Emblica officinalis,* and *Mitragyana parviflora;* common weeds are *Pelicetum penicellatum, Ipomea carnea, Tridex procumbens,* and *Xanthium strumarium;* common cultivated plants are *Peltophorum pterocarpum, Allamanda cathartica, Bauhinia acuminate,* and *Canna indica.* There are some plant found in this region which are categorized as RET (Plate 3). The medicinal and ethnobotanical values of the different collected plant species are provided in Table 1-3 and Fig. 1-4.

Table 1: List of medicinal plants in the City of Rourkela, Odisha, India

Botanical names	Local name(s)/ Common name(s)	Family	Habit at	Group(s)	Common uses / other character(s)	Source(s)
Abrus precatorius L.	Kaincho	Fabaceae	Climber	Medicinal	Seeds are used for avoiding conception during menstruation	[30]
Abutilon indicum L.	Pedi-pedika	Malvaceae	Shrub	Medicinal	Root and bark is used as nervine tonic	[31]
Aerva lanata (L.) Juss. ex. Schultes	Paunsia	Amaranthaceae	Herb	Medicinal	Whole plant is used for cholera	[30]
Aloe vera (L.) Burn.f.	Ghee-kumari	Liliaceae	Herb	Medicinal	Leaf juice is used to treat bowel	[30]
Alternanthera sessils (L.) R.Br. ex DC.	Kolamsago	Amaranthaceae	Herb	Medicinal	Leaves are used for treatment of snakebite in Tamil Nadu	[32]
Andrographis paniculata (Burm.f.)	Bhuinimbo	Acanthaceae	Herb	Medicinal	Leaves are used to treat diabetes	Present study
Azadirachta indica Ajuss.	Limba	Meliaceae	Tree	Medicinal	Fresh leaf juice is used to treat different types of skin infections	[30]
Biophytum sensitivum (L.) DC.	Lokachanna	Oxalidaceae	Herb	Medicinal	Whole plant is used to reduce inflammation pain	[30]
Boerhavia diffusa L.	Parani sago	Nyctaginaceae	Herb	Medicinal	Roots are used as diuretic	[30]
Calotropis gigantea R. Br.	Arko	Asclepiadaceae	Shrub	Medicinal	Root powder is used against eczema	[30]
Cassia fistula L.	Sonari	Caesalpinaceae	Tree	Medicinal	Leaves are used against skin infections	Present study
Cassia occidentalis L.	Kasinda	Caselpinaceae	Shrub	Medicinal	Leaf paste externally applied to wounds	Present study
Cissampelos pareira L.	Paru	Menispermaceae	Climber	Medicinal	Leaves are used for asthma	[30]
Clitoria ternatea L.	Aparajita	Fabaceae	Climber	Medicinal	Flowers are toxic and used against skin infections	Present study
Cocculus hirsutus L.	Musakani	Menispermaceae	Climber	Medicinal	Leaves posses aphrodisiac property	Present study
Datura metel L.	Duddura	Solanaceae	Shrub	Medicinal	Leaves are used for skin infections	Present study
Desmodium gangeticum (L.) DC.	Saloporni	Fabaceae	Shrub	Medicinal	Aqueous leaf extract is toxic against E.coli	[33]
Eclipta prostrate L.	Bhrungaraj	Asteraceae	Herb	Medicinal	Leaf extracts show good antibacterial activity	[34]
Elephantopus scaber	Tutamuli	Asteraceae	Herb	Medicinal	Whole plant is used	[35]

L.					to eliminate bladder stones	
Emilia sonchifolia (L.) DC	Sarkara	Asteraceae	Herb	Medicinal	Whole plant is used to treat internal heat among pregnant women.	[36]
Euphorbia hirta L.	Chitakuli	Euphorbiaceae	Herb	Medicinal	Whole plant is used for asthma	[37]
Evolvulus nummularius L.	Bichamadia	Convolvulaceae	Herb	Medicinal	Whole plant is used for asthma	[38]
Ficus hispida L.f.	Baidimri	Moraceae	Tree	Medicinal	Leaves are used against diarrhea	[39]
Guazuma ulmifolia Lam.	West Indian elm	Sterculiaceae	Tree	Medicinal	Leaves are used to control hair loss	[40]
Heliotropium indicum L.	Hatisundha	Boraginaceae	Herb	Medicinal	Decoction of root with honey is taken as vitamin for iron deficiency by woman during pregnancy	Present study
Hemidesmus indicus (L.) R. Br.	Anant mula	Periplocaceae (ascalpidaceae)	Climber	Medicinal	Roots are used in kidney problems	[30]
Hyptis suaveolens (L.) Poit	Gangatulsi	Lamiaceae	Shrub	Medicinal	Leaves are used to cure diarrhea	Present study
Ichnocarpus frutescens (L.) R. Br.	Madhavi	Apocynaceae	Climber	Medicinal	Root juice is good against diabetes	Present study
Leonotis nepetifolia (L.) R. Br.	Kanta Sidha	Lamiaceae	Shrub	Medicinal	Leaf paste is used against inflammation	Present study
Mimosa pudica L.	Lajakuli	Mimosaceae	Herb	Medicinal	Whole plant is used to treat bleeding in piles	Present study
Mitracarpus verticillates L.	Gridlepod	Rubiaceae	Herb	Medicinal	Leaves are used against different types of bacterial infections in Nigeria	[41]
Mollugo pentaphylla L.	Pitagohun	Molluginaceae	Herb	Medicinal	Whole plant is used as diuretic agent	[30]
Ocimum canum Sims.	Ban tulsi	Lamiaceae	Herb	Medicinal	Leaves used in cough	Present study
Paederia foetida L.	Prasaruni	Rubiaceae	Climber	Medicinal	Whole plant is used against diarrhea and dysentery	Present study
Passiflora foetida L.	Bisripi	Passifloraceae	Climber	Medicinal	Leaves are used to reduce sleeping problems	[30]
Pergularia daemia (Forssk.)	Hunturi	Apocynaceae	Climber	Medicinal	Leaves are useful in diarrhea	Present study
Pongamia pinnata (L.) Pierre	Karanjo	Fabaceae	Tree	Medicinal	Seed oil is used against skin infections	[30]
Pterospermum acerifolium (L.) Willd.	Muchukund	Sterculiaceae	Tree	Medicinal	Flower paste is used in headache	[42]

Ricinus communis L.	Joda	Euphorbiaceae	Shrub	Medicinal	Seed oil is used to cure skin infections	Present study
Rungia pectinata L.	Sankh sago	Acanthaceae	Shrub	Medicinal	Leaves are used to reduce swelling and pain	[43]
Saraca asoca (Roxb.) de Wilde.	Oshoko	Caesalpinaceae	Tree	Medicinal	Flowers are used in painful menses	Present study
Sida acuta Burm. f.	Bajarmuli	Malvaceae	Herb	Medicinal	Whole plant is used against dandruff	[30]
Sida cordifolia L.	Bisiripi	Malvaceae	Herb	Medicinal	Leaves are used in nasal congestion aching	[30]
Terminalia arjuna (Roxb. ex DC.)	Arjuna	Combretaceae	Tree	Medicinal	Bark paste is used in skin related problems	[44]
Terminalia bellirica (Gaertn.) Roxb.	Bahada	Combretaceae	Tree	Medicinal	Bark is useful in leucoderma	[44]
Terminalia catappa L.	Desibadam	Combretaceae	Tree	Medicinal	Fruits are edible	[44]
Terminalia tomentosa Roxb. Ex DC	Sahaja/sahada	Combretaceae	Tree	Medicinal	Bark is useful in ulcer	[45]
Tribulus terrestris L.	Gokhuru	Zygophyllaceae	Herb	Medicinal	Whole plant is used as tonic	Present study
Triumfetta pentandra A. Rich.	Fivestamen burbark	Tilaceae	Shrub	Medicinal	Roots are used as a cooling agent	[8]
Veronia cinerea (L.) Less.	Badi poksunga	Asteraceae	Herb	Medicinal	Whole plant is used in asthma	[30]
Wattakaka volubilis L.	Dudhika	Asclepidaceae	Climber	Medicinal	Leaves used in inflammation	[46]
Wedelia chinensis (Osbeck) Merr.	Bhimraj	Asteraceae	Herb	Medicinal	Leaves are good against fever	[47]
Wrightia tinctoria (Roxb.) R. Br.	Pita karuna	Apocynaceae	Tree	Medicinal	Leaves are used in tooth ache	[48]

Table 2: Edible plants and their common uses in the City of Rourkela, Odisha, India

Botanical names	**Local name(s)/ Common name(s)**	**Family**	**Habitat**	**Group(s)**	**Common uses / other character(s)**	**Source(s)**
Aegle marmelos L.	Belo	Rutaceae	Tree	Edible	Fruits are used as a cooling agent	Present study
Allium cepa L.	Piaja	Amaryllidaceae	Herb	Edible	Bulbs are edible as vegetables	Present study
Amaranthus spinosus L.	Kanta sago	Amaranthaceae	Herb	Edible	Leaves are used as leafy vegetables	[30]
Amaranthus viridis L.	Khoda sago	Amaranthaceae	Herb	Edible	Leaves are used as leafy vegetables	[30]
Annona reticulate L.	Ramphala	Annonaceae	Tree	Edible	Fruits are edible	Present study
Annona squamosa L.	Ata	Annonaceae	Tree	Edible	Fruits are edible	Present study
Artocarpus heterophyllus Lam.	Panasa	Moraceae	Tree	Edible	Fruits are edible	Present study
Basella alba L.	Poi	Basellaceae	Climber	Edible	Leaves are used as leafy vegetables	Present study

Borassus flabellifer L.	Tala	Arecaceae	Palm	Edible	Jelly seeds are edible	[49]
Capsicum annum L.	Lonka	Solanaceae	Herb	Edible	Fruits are used as spices	Present study
Carica papaya L.	Bhanda	Caricaceae	Shrub/tree	Edible	Fruits are edible	Present study
Caryota urens L.	Salapo	Arecacea	Palm	Edible	Stem juice is used as a cooling agents	Present study
Commelina benghalensis L.	Khet papra	Commelinaceae	Herb	Edible	Leaves are used as leafy vegetables	Present study
Dillenia indica L.	Oao	Dilleniaceae	Tree	Edible	Fruits are edible	[50]
Dioscorea alata L.	Khambo āalu	Dioscoreaceae	Climber	Edible	Tubers are edible	Present study
Dioscorea bulbifera L.	Pita āalu	Dioscoreaceae	Climber	Edible	Tubers are edible after successive boiling	Present study
Dioscorea hamiltonii Hook.f.	Suta āalu	Dioscoreaceae	Climber	Edible	Tubers are edible	Present study
Dioscorea oppositifolia L.	Pani aalu	Dioscoreaceae	Climber	Edible	Tubers are edible	Present study
Emblica officinalis Gaertn.	Amla	Euphorbiaceae	Tree	Edible	Fruits are edible	[51]
Luffa aegyptica Mill.	Bān Jani	Cucurbitacea	Climber	Edible	Fruits are used as vegetables	Present study
Madhuca indica Gmel.	Mahula	Sapotaceae	Tree	Edible	Flowers are used in making country liquor	Present study
Mangifera indica L.	Amba	Anacardiaceae	Tree	Edible	Fruits are used in making pickles	Present study
Moringa oleifera Lam	Sajana	Moringaceae	Tree	Edible	Fruits, flowers and leaves are edible as vegetables	Present study
Murraya koenigii (L.) Spreng	Bansango	Rutaceae	Herb	Edible	Leaves are used as curry leaf	Present study
Pithecellobium dulce (Roxb.) Benth.	Simakonia, Jalabi	Mimosaceae	Tree	Edible	Fruits are edible for monkeys	Present study
Psidium gaujava L.	Pijuli	Myrtaceae	Tree	Edible	Fruits are edible	Present study
Sesamum indicum L.	Bān Rasi	Pedaliaceae	Herb	Edible	Seed oil is edible	Present study
Solanum melongena L.	Kantra	Solanaceae	Herb	Edible	Fruits are edible as vegetables	Present study
Solanum nigrum L.	Nunununia	Solanaceae	Herb	Edible	Fruits are edible as vegetables	Present study
Syzgium cumini (L.) Skeels	Jamu	Myrtaceae	Tree	Edible	Fruits are edible	Present study
Tamarindus indica L.	Tentuli	Caesalpinaceae	Tree	Edible	Fruits are edible	Present study
Zea mays L.	Mokka	Poaceae	Grass	Edible	Seeds are edible	Present study
Ziziphus mauritiana Lam.	Jhar koli	Rhamnaceae	Shrub	Edible	Fruits are edible	[8]

Table 3: List of socio-cultural, economic, and ornamental plants and common weeds in the City of Rourkela, Odisha, India

Botanical names	Local name(s)/ Common name(s)	Family	Habitat	Group(s)	Common uses / other character(s)	Source(s)
Allamanda cathartica L.	Golden trumpet	Apocynaceae	Shrub	Ornamental	Flowers are used as ornament	Present study
Alstonia scholaris (L.) R.Br.	Chatiana	Apocynaceae	Tree	Ornamental	Planted on roadside to reduce pollution	Present study
Bambusa vulgaris Schrad.	Sundrogai	Poaceae	Grass	Ornamental	Planted for ornamental purposes	[52]
Bauhinia acuminate L.	Kanchanar	Caesalpinaceae	Shrub/ moderate size tree	Ornamental	Planted for ornamental purposes	Present study
Bauhinia purpurea L.	Kuliari	Caesalpinaceae	Tree	Ornamental	Planted for ornamental purposes	[53]
Callistemon citrinus stapf.	Bottlebrush	Myrtaceae	Large shrub	Ornamental	Planted for ornamental purposes	Present study
Calophyllum inophyllum L.	Polang	Cluslaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Canna indica L.	Sarbajaya	Marantaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Cassia siamea Lam.	Seemia	Caesalpinaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Casurina aquisetifolia L.		Casuarinaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Catharanthus roseus (L.) G. Don.	Sadabahari	Apocynaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Ceiba pentandra (L.) gacrtn. Fruct.	Kapok	Malvaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Celosia argentea L.	Sirali	Amaranthaceae	Grass	Weeds	Very attractive white flowers make it an ornamental weed in grassland	Present study
Cleome monophylla L.	Rango Sorisho	Capparaceae	Herb	Weeds	Weed on waste land	Present study
Clerodendrum unfortunatum auct.non L.	Buhasin	Verbenaceae	Shrub	Weeds	Weeds at roadside with attractive white flowers	Present study
Coccinia grandis (L.) Voigt.	Banakundri	Cucurbitaceae	Climber	Weeds	Fruits are edible for birds	Present study
Corchorus acutangula Lam.	Indian mallow	Tiliaceae	Herb	Weed	Insects are attracted by attractive yellow flowers	Present study

Croton bonplandianus Baill.	Ban mirchi	Euphorbiaceae	Herb	Weeds	Fruits and leaves are edible for *Tectoris* species	Present study
Cycas rumphii Miq.	Rosaimaro	Cycadaceae	Fern	Ornamental	Planted for ornamental purposes	Present study
Cynodon dactylon (L.) Pers.	Dubo	Poaceae	Grass	Ornamental	Planted for ornamental purposes	Present study
Cyperus puneticulatus Vahl.	Nutsedge	Cyperaceae	Sedges	Weed	This is an ornamental weed	[54]
Cyperus rotundus L.	Motha	Cyperaceae	Sedges	Weed	This is an ornamental weed	[54]
Cyperus triceps Endl.	Flatsedge	Cyperaceae	Sedges	Weed	This is an ornamental weed	[54]
Dalbergia sissoo Roxb.	Sissoo	Fabaceae	Tree	Timber	Wood is used as timber	Present study
Delonix regia (Bojex Hook.) Raf.	Gulmohar	Caesalpinaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Desmodium triflorum (L.) DC.	Kuradia	Fabaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Drypetes roxburghii Wall.	Poisundia	Euphorbiaceae	Climber	Ornamental	Planted for ornamental purposes	Present study
Duranta repens L.	Golden dewdrop	Verbenaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Eichhornia crassipes (Mart.) Solms.	Water-Hyacinth	Pontederiaceae	Herb	Weed	Not good for water bodies	Present study
Eucalyptus tereticornis Sm.	Eucalptus	Myrtaceae	Tree	Timber	Wood is used as timber	Present study
Euphorbia milii Des. Moul.	Crown of thorns	Euphorbiaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Ficus elastic Roxb. ex. Hornem.	Rubber tree	Moraceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Hedyotic corymbosa (L.) Lam.	Dimond Flower	Rubiaceae	Herb	Weed	Common weed, everywhere in city	Present study
Heliotropium supinum L.	Dwarf Heliotrope	Boraginaceae	Herb	Weed	Common in shady areas of the city	Present study
Hibiscus rosa-sinensis L.	Mandara	Malvaceae	Shrub	Ornamental	Flowers are used for worship	Present study
Ipomea carnea Jacq.	Omori	Convolvulaceae	Shrub	Weed	Toxic to animals	Present study
Ipomea hastate Haines	Irit- Irit	Convolvulaceae	Climber	Weed	Common climber on walls	Present study
Ipomea sepiaria Koeing ex	Bilona	Convolvulaceae	Climber	Weed	Common climber on walls	Present study

Roxb.						
Ixora pavetta Andr.	Patra koria	Rubiaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Lagerstroemia indica L.	Pharas	Lythraceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Lantana camara L.	Naguari	Verbenaceae	Shrub	Weed	Common in city, fruits are edible for birds	Present study
Leucaena leucocephala Lam.	Rajokasundri	Mimosaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Melia azadirachta L.	Chinaberry	Meliaceae	Tree	Timber	Wood is used to make furniture	Present study
Mikania micrantha Kunth.	Mile-a-minute	Asteraceae	Climber	Weed	Common weed on walls of campus	Present study
Mirabilis jalapa L.	Ragani	Nyctaginaceae	Herb	Ornamental	Flowers are used for worship	Present study
Murraya paniculata (L.) Jack.	Ban mallika	Rutaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Parthenium hysterophorus L.	Feverfew	Asteraceae	Herb	Weed	It is a common weed	Present study
Peltophorum pterocarpum (DC.) Backer ex. K. Heyne	Copperpod	Caesalpinaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Phyllanthus amarus Schum & Thonn.	Bhumyamalaki	Euphorbiaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Plumeria alba l.	Devakanchan	Apocynaceae	Shrub	Ornamental	Flowers are used for worship	Present study
Plumeria rubra L.	Katha champa	Apocynaceae	Shrub	Ornamental	Flowers are used for worship	Present study
Polianthes tuberose L.	Rajanigandha	Agavaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Polyalthia longifolia (Sonn.) Thw. Enum.	Debadaru	Annonaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Samanea saman (Jacq.) Merr. J. Wash.	Chakunda	Mimosaceae	Tree	Ornamental	Planted for ornamental purposes	Present study
Sansevieria roxburghiana Schult. & Schult. f.	Murga	Agavaceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Spathodea campanulata P.	African tulip	Bignoniaceae	Tree	Ornamental	Planted for ornamental	Present study

Beauv.					purposes	
Tagetes erecta L.	Gendu	Asteraceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Tagetes patula L.	Genda	Asteraceae	Herb	Ornamental	Planted for ornamental purposes	Present study
Tectona grandis L. f.	Sagwan	Verbenaceae	Tree	Timber	Timbers are used in making furniture	Present study
Thevetia neriifolia Perr. ex. Steud.	Koniyari	Apocynaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Xanthium strumarium L.	Aristha	Asteraceae	Shrub	Weed	Leaves are used in scabies in Unani method	[55]
Zamia furfuracea L. f.	Cardboard palm	Zamiaceae	Shrub	Ornamental	Planted for ornamental purposes	Present study
Zinnia elegans Jacq.	Zinnia	Asteraceae	Herb	Ornamental	Planted for ornamental purposes	Present study

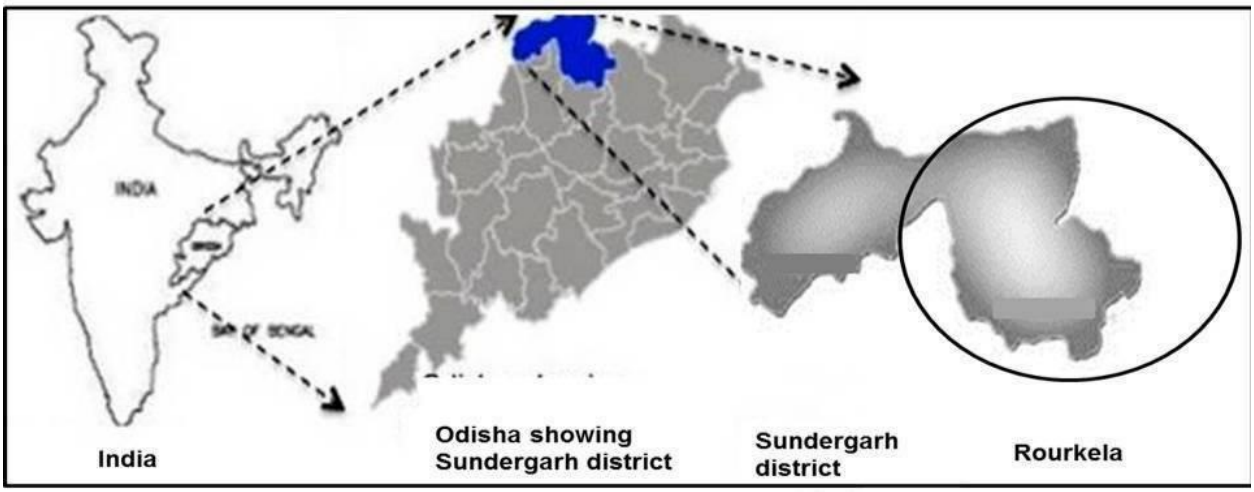

Plate-1: Geographical location of the study area

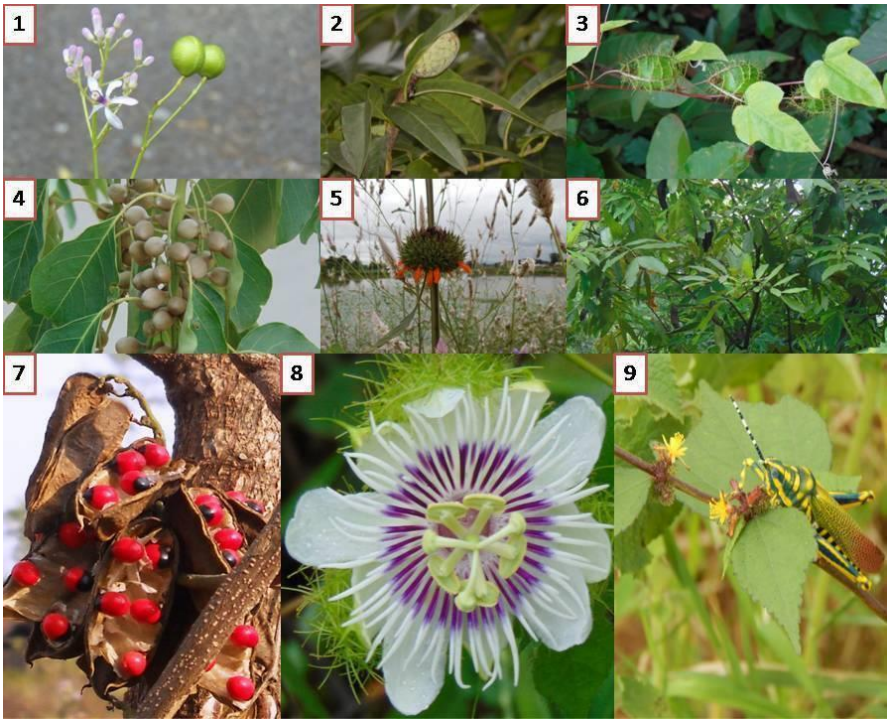

Plate 2: Photos showing selected plant species from Rourkela city, Odisha, India,

1) Flowers and fruits of *Melia azadirachta* L., 2) Fruit of *Annona reticulata* L., 3) Fruits of *Passiflora foetida* L., 4) Fruits of *Terminalia bellirica* (Gaertn.) Roxb., 5) Flowers of *Leonotis nepetifolia* (L.) R.Br., 6) Fruits and leaves of *Saraca asoca* (Roxb.) Willd., 7) Seeds of *Abrus precatorius* L., 8) Flower of *Passiflora foetida* L., 9) *Triumfetta pentandra* A. Rich.

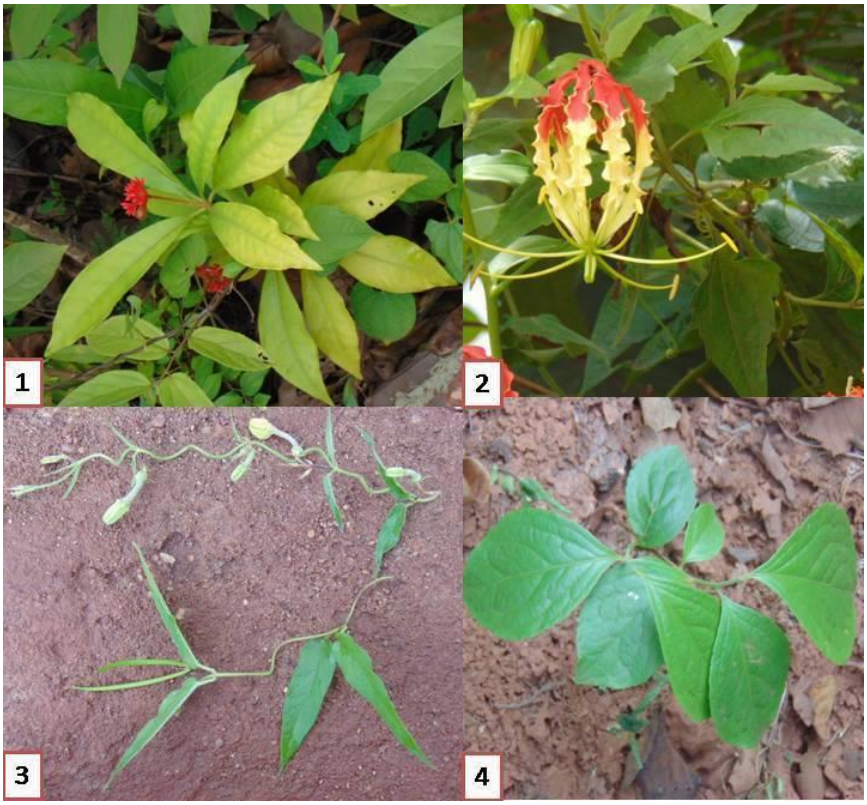

Plate 3: Some RET plant species of the district Sundargarh (Rourkela city is situated in this district), Odisha, India,

1) flowers of *Rauvolfia serpentina*; 2) Flowers of *Gloriosa superba*; 3) Flowers of *Ceropegia hirsuta**;
4) Plantlet of *Celastrus paniculatus.* *Authors found very less population in the state.

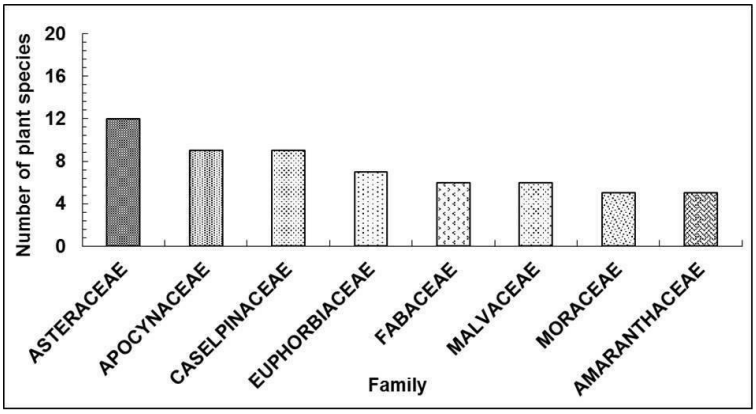

Figure 1. The eight dominant families in city of Rourkela, Odisha, India.

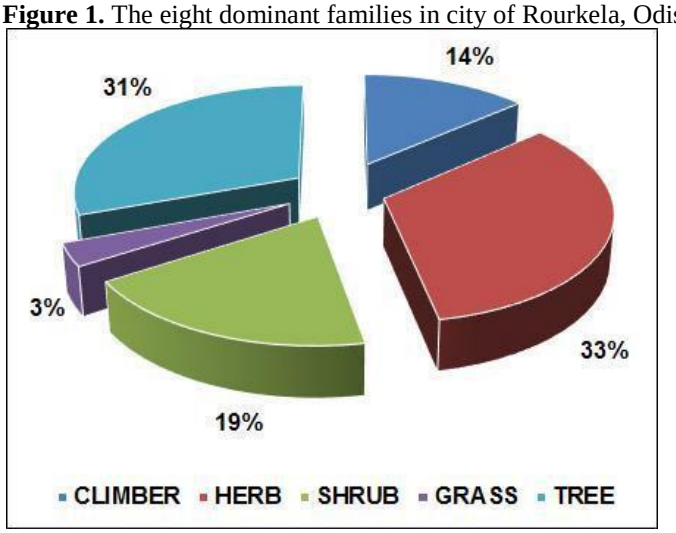

Figure 2: Diversity of plant species by habitat.

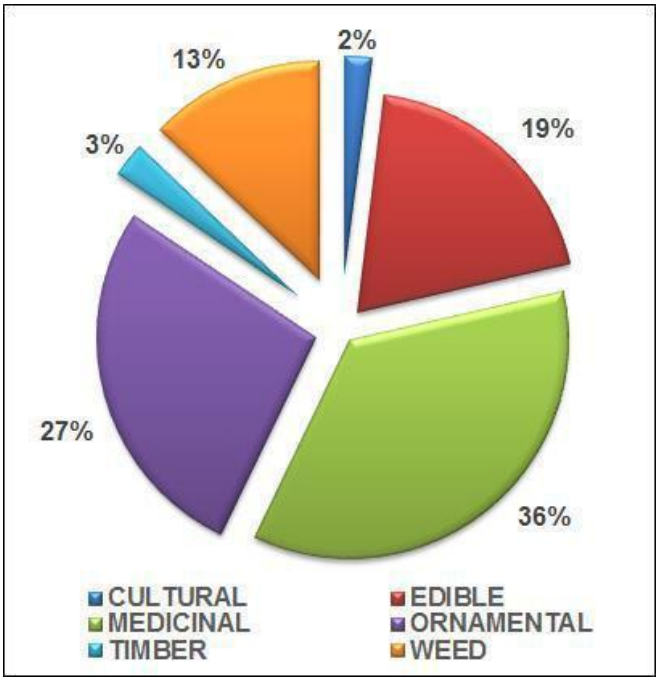

Figure 3: Plants used for different purposes.

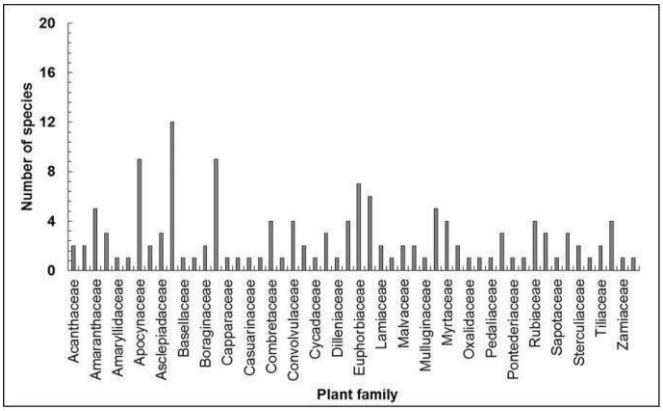

Figure 4: Number of plant species in each family.

DISCUSSION

Traditional knowledge and the use of local plants for primary needs remain important, not only in rural or tribal areas but even in urban and semi-urban areas. The collected information on the useful plants in and around Rourkela city, Odisha, India, includes some that are medicinal, some that are edible, and some that are socio-cultural plants. As therapeutics, the hitherto unknown claims from local people, such as use of the root and bark of *Abutilon indicum* as nervine tonic, of the leaves of *Paderia foetida* against diarrhea were documented (Table 1), of the flowers of *Saraca asoka* (Plate 2.6) in painful menses, and of the leaves of *Datura metel* to cure different types of fungal infections. Of the edible plants, the fruits of *Aegle marnelos* are consumed in summer as a cooling agent (Table 2), the leaves of *Basella alba* are used as leafy vegetables in a delicious local dish, the tubers of *Dioscorea bulbifera* are eaten as vegetables (Table 2) after successive boiling owing to the presence of some unsavory factors such as tannin, the fruit of *Emblica officinalis* is used to make a medicinal pickle, and the leaves of *Murraya koenigii* are used to give aroma to vegetables and other foods of the state, etc. (Present study). Very interesting socio-cultural and economic plants are available in the city, such as the flowers of *Plumeria alba, Hibiscus rosa-sinensis,* and *Mirabilis jalapa* (Table 3) that are used during worship, and the timber of *Tectona grandis*, *Eucalyptus tereticornis,* and *Melia azadirachta* (Plate 2.1) that are used in making furniture etc. (Present study).

Globally, the bio-resources of some urban areas with a view to conservation have been reported by various researchers. Ma and Liu [56] have reported about 455 plants in the urban area of Beijing, China, whereas Grdovic and Stevanovic [57] have documented 58 plant species in the central urban area of Belgrade, Serbia. Thompson and McCarthy [58] have reported 822 vascular plants in the cities of Sheffield and Birmingham, in the United Kingdom. Muratet et al. [59] have documented 626 vascular plants in the urban area of the Hauts-de-Seine district bordering Paris, France, while Yavorska [60] has reported about 114 plant species in the urban area of Kyiv, Ukraine. Pieniak and Chylinski [61] have reported 26 spontaneously-occurring floras in industrial buildings of Warsaw, Poland. Recently, Goraya et al. [62] have reported about 60 plant species with medicinal value in the peri-urban areas of Punjab in Pakistan. Many domestic researchers have likewise reported on urban flora and its ethnomedicinal importance. Singh [63] has reported around 765 medicinal plant species in the urban area of Varanasi, India. Kumar and Satapathy [30] have reported a total of 72 herbaceous plants in the urban area of Bhubaneshwar, India. Singh [64] has reported around 119 vascular plants at Banaras Hindu University, Varanasi, India. Verma et al. [21] have reported about 72

medicinal plants on the campus of Banaras Hindu University, Varanasi, India. Recently, Pasayat et al. [25] have reported about 20 ethno-toxic effects of some common angiosperms found around Rourkela city, India.

The present study revealed that most of the plant species belong to the asteraceae and apocynacea families and showed a rich diversity of useful wild and cultivated species with potential ethnomedicinal value. However, in contrast to the above findings, Mallick et al. [65] have reported that the city enjoys a flora of asteraceae and poaceae and most of the plants are weeds. Though the grasses that belong to the family asteraceae and poaceae are dominant in the urban area, but there are many other plants found in this area which are not weeds, they are wild in nature with prominent medicinal values. Gradually, when these area developed to an urban area, the wild plants available in these areas were later on termed as the urban floras but not as weeds. In 2013, Pasayat et al. [25] reported about 20 ethno-toxic plant species from the present study area. Among these species, they claimed that parts of *Datura metal* L. are toxic, whereas the present study focused on ethnomedicinal properties and found that all plant parts are very much effective against all types of skin infections (Table 1), while the flowers have socio-cultural and economic value and are sold for worship outside Hindu temples around India. In 2014, Mallick et al. [26] documented 30 ethnomedicinal shrubs in the city of Rourkela, India. They reported that the leaves of *Paederia foetida* L. are used against joint pain, gastric problems, and diarrhea, while the present study has found that this is a very important ethno-medicinal plant of the city as it falls in the RET (rare, endangered and threatened) group and the leaves are frequently used in urban communities in the study area against diarrhea (Table 1). The present study supports the claim that seed oil of *Ricinus communis* L. is used to cure skin infections and is also effective against joint pain [26]. Ives et al. [66] reported that cities are the hotspots of RET (rare, endangered and threatened) plant species. The forest patches of the district is rich with many RET plant species (Plate 3). Among them, present study also suggests that the city is home to two RET plants (*Saraca asoka* and *Paederia foetida*) of the state and an ongoing study addresses the sustainable harvesting of these two useful plants of the Steel City of Rourkela, Odisha, India. Many other plant species found in this area are of potential medicinal importance.

CONCLUSION

Urbanization has increased tremendously over the last 60 years around the world, with the result that more than 50 percent of the world population now live in cities. This is especially true for developing countries, and it is expected that developing countries will take the lead in future urban population growth. Increasing urbanization has serious consequences for the environment, as it fragments and changes natural habitats and alters environmental conditions. Therefore, there is a need for more exploration and awareness of research with the aim of conserving urban floras. It is has also emerged quite recently that not only natural and semi-natural landscapes can be highly diverse in terms of flora, but that urban, institutional and industrial areas may also harbor a wide variety of habitats, organisms, and communities. The use of local floras as primary medical resources and traditional practices of plant-based medico-foods are still alive in the modern urban or semi-urban areas such as Steel City (Rourkela) of the State of Odisha, India. The present study illustrates to what extent urban communities may depend on various plants to meet their needs and to cure various diseases and disorders by means of traditional medicines. Appropriate conservation planning is therefore

required to conserve these useful floras and to maintain biodiversity in this urban area, which underpins traditional knowledge.

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