Chapter

Invasive Alien Flora in and around an Urban Area of India

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Abstract

Invasive alien species are non-native exotic organisms which can disperse and destroy the biodiversity and change the ecosystem. The present study deals with the comprehensive list of invasive alien plants (IAPs) of Rourkela Steel City, Sundargarh, Odisha, with background information on family, habit, and nativity. A total of 165 invasive alien species under 132 genera and 59 families have been recorded. From the nativity study, among 25 geographic regions, the majority of invasive plants reported from American continent (62%) with 103 species. While in life form analysis, the herbs (114 species) are dominant, followed by trees (23 species), shrubs (22 species), climber (5 species), and undershrub (1 species). *Ageratum conyzoides*, *Blumea lacera*, *Cassia alata*, *Lantana camara*, *Cassia tora*, *Parthenium hysterophorus*, *Xanthium* sp., *Datura* sp., *Cardamine scutata*, *Argemone mexicana*, *Grangea maderaspatana*, *Hyptis suaveolens*, and *Gnaphalium polycaulon* are some noxious species found during the study. *Parthenium hysterophorus* is the highly noxious plant which is grown everywhere after *Ageratum conyzoides* and *Lantana camara*. Most of the invasive species are locally used for medicinal purposes as well as for food, fuel, and fodder purposes. A better planning and reporting of the spread of new plants in the area are needed for early identification and control of the invasive alien plant species in different seasons. Since the flora of Sundargarh districts has not been beneficially explored, this study will help in the compilation of flora of Sundargarh district and Rourkela in particular. Further studies will reveal the allelopathic effects on different agricultural crops as well as the different ethnobotanical values.

Keywords: invasive alien plants, biodiversity, utility, urban area, India

1. Introduction

Human beings depend on plants for his daily needs for which several numbers of plants are used to fulfill their purposes. Sometimes to fulfill human needs, plants are introduced intentionally by humans or accidentally from one region to another new region which is nonnative. These introduced plant species are called alien species or exotic species. The alien species invade the new region after well adapted to the environment. The plants which are introduced by human intentionally or accidentally by migration from its natural habitat to another new habit and their localities are known as alien, introduced, and exotic, originated from foreign or nonnative species [25, 33]. They have the potential to grow in any environmental conditions and are easily invasive to the new environment. Preston and Williams

[22] stated that "Invasive alien plant species (IAPs)" are grown in such a way that they become as more dangerous to sustainable development. As a result, we are facing the great challenge of biodiversity loss all over the globe. These group of plant species act as the main cause for threat to the native biological diversity. They show various effects on the environment and economy of nonnative ecosystems. The exotic or alien plant species not only show negative impacts, but also they have much economic benefits. Now invasion alien species are cultivated to provide food, medicine, fuel, or fodder to local communities [9, 29]. The international trade of the products is helpful for introduction of these invasive alien species. Globally the introduction of IAPs leads to the huge loss of biodiversity and agriculture crops and health problems like respiratory illness [19].

Invasion of plants creates serious problems to the ecosystems by changing the structure, composition, and function of natural ecosystem [15, 17]. The rapid reproduction and growth rate, high dispersal ability, physiological adaptations to new conditions, and ability to survive on various ecosystems are the common characteristics of invasive plants. The IAPs have the ability to associate with human beings very easily. When the invasive plants colonized to grow in new areas, it can change the soil structure and composition of that area. It is reported that the agricultural lands are more threatened by IAPs because they are introduced by the crop seeds, garden plants, and wind breakers [24].

The first and most important step for effective and proper management of IAPs is to collect the baseline data about their invasion status, growth form, and life cycle. Accurately distinguishing between native and alien species is required not only when developing conservation and vegetation management plans but also for improving our understanding of the different components of biodiversity [21]. Rourkela, one of the major steel industrial centers of India and regarded as the industrial capital of Odisha, is situated in the north-eastern part of the state. Rourkela is located in Sundargarh district about 245 km from the shoreline of Bay of Bengal. It is located at 20° 12′ North latitude and 84° 53′ longitude, at the elevation about 219 m above the mean sea level. Due to better communication, abundance of natural mineral resources such as iron ore, limestone, dolomite, water, and other infrastructures in and around Rourkela is the main reason for the starting of industrialization since 1956. Studies on flora of Sundargarh district have not been fully explored. A few reports on flora of Sundargarh district [1, 2, 11, 13, 14] have been published. The study of literatures reveals that survey pertaining to major invasive plant species has not been reported earlier. It is high time to undertake complete survey of the flora of Sundargarh district with special emphasis on IAPs which may not be available in the future due to rapid industrialization. Many species may become endangered in the process of development, and they should be recorded and identified along with their usefulness before their extinction during rapid industrialization. Keeping in view, an attempt has been made in the present study to provide the baseline information on the invasive plant species in and around of Rourkela City of Sundargarh district. It will be helpful in preparation of district flora of Sundargarh.

2. Materials and method

During January 2012 to April 2019, intensive floristic surveys were undertaken in different areas of Rourkela Steel City (**Figure 1**) in such a way that each location could be studied in every season of the year. A comprehensive list of invasive alien plant species (IAPs) and the interaction with local inhabitants were made to collect the information regarding the various uses of IAPs of the area. Periodic collection of IAPs was made from each locality followed by identification using the available

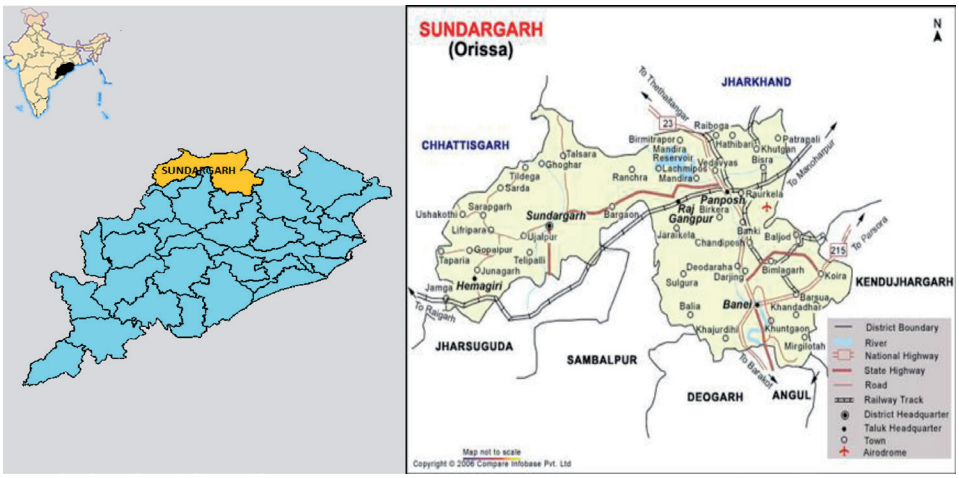

Figure 1.
Location map of Rourkela Steel City of Sundargarh district, Odisha, India.

floras [6, 30]. The nativity, history, diversity, sources, and mode of introduction of these alien invasive plants were noted from the available literatures. The native ranges of the species were recorded from published literatures [3, 4, 5, 10, 12, 15, 16, 18–20, 24–27, 31, 32, 36, 37, 38]. Plants were categorized according to their life forms as herb, undershrub, shrub, climber, and tree as well as their habit-wise as annual, biennial, and perennial. The studied habitats were wasteland, cultivated field, riverbank, pond bank, home garden, forest, roadside, etc. The economic importance of the IAPs was collected from the local inhabitants and surveyed literatures.

3. Results and discussion

A total of 165 taxa of invasive alien plant species belonging to 132 genera and 59 families have been recorded from the Rourkela Steel City of Odisha (**Table 1**). The number of dicotyledonous IAPs found is 149 under 118 genera and 50 families, while 15 species of monocotyledons are found under 14 genera and 8 families. From the study, it was found that 114 species (69%) were herbs followed by trees with 23 species (14%), shrub 22 species (13%), climbers 5 species (3%), and undershrubs 1 species (1%) (**Figure 2**). The life form pattern distribution showed that herbaceous species (114 spp.) were dominant than other life forms (**Table 2**). The herbs can easily grow in any condition of environment and dominate to others. The habit distribution analysis showed that 56% (92 spp.) were annuals and 44% (73 spp.) were perennials. **Table 3** showed the total number of IAPs recorded from the Rourkela Steel City and distributed under different families. From the taxonomic distribution of alien flora, Asteraceae (24 spp.) showed dominant impact among the invasive alien species in this region followed by Caesalpiniaceae (11 spp.), Convolvulaceae (9 spp.), Euphorbiaceae (8 spp.), Amaranthaceae (8 spp.), Poaceae (6 spp.), and Solanaceae (8 spp.), and Fabaceae, Malvaceae, and Verbenaceae represented only 5 spp. each (**Table 4**). These 10 dominant families contributed 89 species (54%) of the total invasive plant species studied (**Figure 3**). The genera *Cassia* and *Ipomoea* showed the highest number (six spp. each) followed by *Cleome*, *Euphorbia*, *Alternanthera*, *Ludwigia*, etc.

The contribution of different geographical regions or the nativity of invasive alien species is shown in **Table 3**. A total of 25 native geographical regions of IAPs were recorded. The major geographical regions or nativities of IAPs were Tropical

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
1	*Abelmoschus esculentus* Moench.	Malvaceae	Shrub	P	Trop. Africa	V, Ft
2	*Acacia auriculiformis* A. Cunn. ex Benth.	Mimosaceae	Tree	P	Australia	M, Ave, Sf
3	*Acanthospermum hispidum* DC.	Asteraceae	Herb	A	Brazil	M
4	*Aerva lanata* (L.) Juss. ex. Schult.	Amaranthaceae	Herb	P	Madagascar	M
5	*Aeschynomene indica* L.	Fabaceae	Herb	A	North America	Fu
6	*Ageratum conyzoides* L.	Asteraceae	Herb	A	Trop. America	Nox
7	*Allium cepa* L.	Liliaceae	Herb	A	Mediterranean	M, V
8	*Aloe barbadensis* Mill.	Liliaceae	Herb	P	Mediterranean	M
9	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	Herb	P	Trop. America	V, M
10	*Alternanthera pungens* Kunth	Amaranthaceae	Herb	P	Trop. America	V
11	*Alternanthera sessilis* (Linn) DC.	Amaranthaceae	Herb	P	Trop. America	V, M
12	*Amaranthus spinosus* L.	Amaranthaceae	Herb	A	Trop. America	V
13	*Antigonon leptopus* Hook. & Arn.	Polygonaceae	Climber	P	Trop. S. America	O
14	*Argemone mexicana* L.	Papaveraceae	Herb	A	S. America (seventeenth cent.)	M, Nox
15	*Bauhinia purpurea* L.	Caesalpiniaceae	Tree	P	West Indies	V
16	*Bidens pilosa* L.	Asteraceae	Herb	A	Trop. America	M, Fo
17	*Blainvillea acmella* (L.) Philipson	Asteraceae	Herb	A	Trop. America (eighteenth)	M
18	*Blumea lacera* (Burm.f.) DC.	Asteraceae	Herb	A	Trop. America	Nox, M
19	*Borassus flabellifer* L.	Arecaceae	Tree	P	Trop. Africa	Ft, Fu
20	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	Shrub	P	Brazil	O
21	*Caesalpinia pulcherrima* (L.) Sw.	Caesalpiniaceae	Shrub	P	Trop. America	O
22	*Calotropis gigantea* R. Br.	Asclepiadaceae	Shrub	P	Trop. Africa	M
23	*Calotropis procera* (Ait.) R. Br.	Asclepiadaceae	Shrub	P	Trop. Africa	M
24	*Cannabis sativa* L.	Cannabinaceae	Undershrub	P	Central Asia	M, Sm, Nar
25	*Capsicum annuum* L.	Solanaceae	Shrub	A	Trop. America	F

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
26	*Cardamine scutata* L.	Brassicaceae	Herb	A	Trop. America	NK, Nox
27	*Cardiospermum halicacabum* L.	Sapindaceae	Herb	A	Trop. America	M
28	*Carica papaya* L.	Caricaceae	Tree	P	Mexico	V
29	*Cassia alata* L.	Caesalpiniaceae	Shrub	P	West Indies	NK, Nox
30	*Cassia fistula* L.	Caesalpiniaceae	Tree	P	Pantropic	O, M, Sf
31	*Cassia obtusifolia* L.	Caesalpiniaceae	Herb	P	Trop. America	M
32	*Cassia occidentalis* L.	Caesalpiniaceae	Herb	P	S. America	M
33	*Cassia siamea* Lamk	Caesalpiniaceae	Tree	P	South East Trop. Asia	Fu, Ave
34	*Cassia tora* L.	Caesalpiniaceae	Herb	A	S. America (1824)	V, M, Nox
35	*Casuarina equisetifolia* Forster & Forster f.	Casuarinaceae	Tree	P	Australia	Fu, Sf
36	*Catharanthus pusillus* (Murr.) G. Don.	Apocynaceae	Herb	A	Trop. America	NK
37	*Catharanthus roseus* (Linn) G.Don	Apocynaceae	Shrub	P	West Indies	M
38	*Celosia argentea* L.	Amaranthaceae	Herb	A	Trop. Africa	V, M
39	*Chenopodium album* L.	Chenopodiaceae	Herb	A	Europe	V
40	*Chloris barbata* Sw.	Poaceae	Herb	P	Trop. America	Fo, Fu
41	*Chromolaena odorata* L.	Asteraceae	Herb	A	Trop. America	M
42	*Chrozophora rottleri* (Geisel.) Juss.	Euphorbiaceae	Herb	A	Trop. Africa	NK
43	*Cleome gynandra* L.	Capparaceae	Herb	A	Trop. America	M
44	*Cleome monophylla* L.	Capparaceae	Herb	A	Trop. Africa	V, M
45	*Cleome rutidosperma* DC	Capparaceae	Herb	A	Trop. America	NK
46	*Cleome viscosa* L.	Capparaceae	Herb	A	Trop. America	V, M
47	*Convolvulus nervosus* Burm.f.	Convolvulaceae	Herb	A	Europe	M
48	*Corchorus aestuans* L.	Tiliaceae	Herb	A	Trop. America	Fu
49	*Crotalaria pallida* Ait	Fabaceae	Herb	A	Trop. America	Fi, Fu
50	*Crotalaria retusa* L.	Fabaceae	Herb	A	Trop. America	Fi, Fu
51	*Croton bonplandianum* Baill.	Euphorbiaceae	Herb	P	S. America	M
52	*Cucumis melo* L.	Cucurbitaceae	Climber	A	Iran and N. West	V

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
53	*Cuscuta reflexa* Roxb.	Cuscutaceae	Herb	A	Mediterranean	M
54	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb	P	Trop. America	M
55	*Cyperus difformis* L.	Cyperaceae	Herb	P	Trop. America	M
56	*Cyperus iria* L.	Cyperaceae	Herb	P	Trop. America	M
57	*Datura innoxia* Mill.	Solanaceae	Shrub	P	Trop. America	M, Nox
58	*Datura metel* L.	Solanaceae	Shrub	P	Trop. America	M, Nox
59	*Delonix regia* (Boj.) Raf.	Caesalpiniaceae	Tree	P	Madagascar	O, Ave, Sf
60	*Duranta repens* L.	Verbenaceae	Shrub	P	America	O
61	*Echinochloa colona* (L.) Link	Poaceae	Herb	A	Trop. S. America	Fo
62	*Echinochloa crus-galli* Beauv.	Poaceae	Herb	A	Trop. S. America	Fo
63	*Eclipta prostrata* L.	Asteraceae	Herb	A	Trop. America (Bf1824)	M
64	*Eichhornia crassipes* (Mart.) Solm.	Pontederiaceae	Herb	P	Trop. America	St
65	*Emilia sonchifolia* (L.) DC.	Asteraceae	Herb	A	Trop. America	V, M
66	*Eucalyptus citriodora* Hook.	Myrtaceae	Tree	P	Australia	M, Fu, Sf
67	*Euphorbia heterophylla* auct. Non L.	Euphorbiaceae	Herb	A	Trop. America	O
68	*Euphorbia hirta* L.	Euphorbiaceae	Herb	A	Trop. America	M
69	*Euphorbia pulcherrima* Willd. ex. Klotz	Euphorbiaceae	Shrub	P	Mexico	O
70	*Euphorbia thymifolia* L.	Euphorbiaceae	Herb	P	Trop. America	NK
71	*Evolvulus nummularius* L.	Convolvulaceae	Herb	P	Trop. America	M
72	*Gnaphalium polycaulon* Pers.	Asteraceae	Herb	A	Trop. America	NK, Nox
73	*Gomphrena celosioides* Mart.	Amaranthaceae	Herb	A	S. America	Fo
74	*Gomphrena globosa* L.	Amaranthaceae	Herb	A	America	O
75	*Grangea maderaspatana* L.	Asteraceae	Herb	A	Trop. S. America	NK, Nox
76	*Grevillea robusta* Cunn. ex R.Br.	Proteaceae	Tree	P	Australia	Fu, Sf
77	*Helianthus annuus* L.	Asteraceae	Herb	A	America	O, Oil

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
78	*Heliotropium indicum* L.	Boraginaceae	Herb	A	S. America	M
79	*Hibiscus rosa-sinensis* L.	Malvaceae	Shrub	P	China	M, O
80	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Herb	A	Trop. America	M, Nox
81	*Impatiens balsamina* L.	Balsaminaceae	Herb	A	Trop. America	O
82	*Indigofera linnaei* Ali	Fabaceae	Herb	A	Trop. Africa	M
83	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	Climber	P	Trop. America	Ft
84	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub	P	Trop. America	Fu
85	*Ipomoea hederifolia* L.	Convolvulaceae	Herb	A	Trop. America	M
86	*Ipomoea obscura* (L.) Ker-Gaw	Convolvulaceae	Herb	P	Trop. Africa	NK
87	*Ipomoea pes-tigridis* L.	Convolvulaceae	Herb	A	Trop. East Africa	M
88	*Ipomoea quamoclit* L.	Convolvulaceae	Herb	P	Trop. America	M
89	*Jatropha gossypifolia* L.	Euphorbiaceae	Shrub	P	Brazil	M
90	*Justicia gendarussa* Burm.f.	Acanthaceae	Shrub	P	China	M
91	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Herb	P	Trop. Africa	O, M
92	*Kigelia pinnata* DC	Bignoniaceae	Tree	P	Africa	O, Ave, Sf
93	*Lagerstroemia indica* L.	Lytharaceae	Shrub	P	China	O
94	*Lantana camara* L.	Verbenaceae	Shrub	P	Trop. America	M, Nox
95	*Leonotis nepetifolia* (L.) R.Br.	Lamiaceae	Herb	A	Trop. Africa	M
96	*Leucaena leucocephala* (Lam.) de Wit.	Mimosaceae	Tree	P	Trop. America	Fu, Sf
97	*Ludwigia adscendens* (L.) Hara	Onagraceae	Herb	A	Trop. America	Sb
98	*Ludwigia octovalvis* (Jacq.) Raven	Onagraceae	Herb	A	Trop. America	M, Sb
99	*Ludwigia perennis* L.	Onagraceae	Herb	A	Trop. America	M, Sb
100	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	Herb	A	Trop. America	M, Fi
101	*Martynia annua* L.	Martyniaceae	Herb	A	Trop. America	M
102	*Mecardonia procumbens* (Mill.) Small	Verbenaceae	Shrub	A	T. N. America	NK
103	*Melochia corchorifolia* L.	Sterculiaceae	Herb	A	Trop. America	NK

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
104	*Merremia vitifolia* (Burm.f.) Hall.f.	Convolvulaceae	Herb	A	Trop. America	NK
105	*Mikania micrantha* L.	Asteraceae	Herb	A	Trop. America	Nox
106	*Mimosa pudica* L.	Mimosaceae	Herb	P	Brazil	M
107	*Mirabilis jalapa* L.	Nyctaginaceae	Herb	P	Peru	O, M
108	*Morus australis* Poir.	Moraceae	Tree	P	China	Ft
109	*Nicotiana tabacum* L.	Solanaceae	Herb	A	S. America	Nar, Sm
110	*Ocimum canum* Sims	Lamiaceae	Herb	A	Trop. America	M
111	*Opuntia stricta* (Haw.) Haw.	Cactaceae	Shrub	P	Trop. America	NK
112	*Oxalis corniculata* L.	Oxalidaceae	Herb	A	Europe	M
113	*Parthenium hysterophorus* L.	Asteraceae	Herb	A	Trop. America	Nox
114	*Passiflora foetida* L.	Passifloraceae	Climber	P	Trop. S. America	O, M
115	*Pedalium murex* L.	Pedaliaceae	Herb	A	Trop. America	M
116	*Peltophorum pterocarpum* (DC.) Backer ex K.Heyne	Caesalpiniaceae	Tree	P	Malaya	Ave, Sf
117	*Peperomia pellucida* (L.) Kunth	Piperaceae	Herb	A	Trop. S. America	M
118	*Peristrophe bicalyculata* (Retz.) Nees.	Acanthaceae	Herb	A	Trop. America	NK
119	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	P	Trop. America	Ft, Fu
120	*Phyla nodiflora* (L.) Greene	Verbenaceae	Herb	A	Trop. America	M
121	*Physalis angulata* L.	Solanaceae	Herb	A	Trop. America	M, Ft
122	*Physalis minima* L.	Solanaceae	Herb	A	Trop. America	M, Ft
123	*Pistia stratiotes* L.	Araceae	Herb	P	Trop. America	M, St
124	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	Tree	P	Mexico	Ft
125	*Plumeria rubra* L.	Apocynaceae	Tree	P	S. America	O
126	*Portulaca oleracea* L.	Portulacaceae	Herb	A	Trop. S. America	M, V
127	*Portulaca quadrifida* L.	Portulacaceae	Herb	A	Trop. America	M, V
128	*Quisqualis indica* L.	Combretaceae	Climber	P	Malaya	O
129	*Rhoeo discolor* Hance.	Commelinaceae	Herb	P	Central America	O
130	*Richardia scabra* L.	Rubiaceae	Herb	A	S. America	NK
131	*Ricinus communis* L.	Euphorbiaceae	Shrub	P	Africa	M

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
132	*Ruellia tuberosa* L.	Acanthaceae	Herb	A	Trop. America	NK
133	*Saccharum spontaneum* L.	Poaceae	Herb	A	T. West Asia	Th, Fu, Fo
134	*Scoparia dulcis* L.	Scrophulariaceae	Herb	A	Trop. America	M
135	*Sida acuta* Burm.f.	Malvaceae	Herb	A	Trop. America	M
136	*Solanum nigrum* L.	Solanaceae	Herb	A	Trop. America	M
137	*Solanum torvum* Sw.	Solanaceae	Shrub	P	West Indies	M
138	*Sonchus asper* (L.) Hill	Asteraceae	Herb	A	Mediterranean	M
139	*Spathodea campanulata* Beauv.	Bignoniaceae	Tree	P	Trop. Africa	Ave, Sf
140	*Spermacoce articularis* L.	Rubiaceae	Herb	A	Trop. America	NK
141	*Sphaeranthus indicus* L.	Asteraceae	Herb	A	Trop. Africa	M
142	*Spilanthes acmella* (L.) L.	Asteraceae	Herb	A	North America	M
143	*Spinacia oleracea* L.	Chenopodiaceae	Herb	A	Europe	V
144	*Stachytarpheta jamaicensis* (L.) Vahl.	Verbenaceae	Herb	A	Trop. America	M
145	*Stylosanthes hamata* L.	Fabaceae	Herb	A	Trop. Africa	Fo
146	*Synedrella nodiflora* (L.) Gaertn.	Asteraceae	Herb	A	West Indies	M
147	*Tagetes erecta* L.	Asteraceae	Herb	A	Mexico	O, M
148	*Tagetes patula* L.	Asteraceae	Herb	A	Mexico	O, M
149	*Tamarindus indica* L.	Caesalpiniaceae	Tree	P	Trop. America	Ft
150	*Tecoma stans* (L.) Juss. ex Kunth	Bignoniaceae	Tree	P	America	O
151	*Thevetia peruviana* (Pers.) Merrill	Apocynaceae	Tree	P	Trop. America	M
152	*Thuja orientalis* L.	Cupressaceae	Tree	P	China	O
153	*Tribulus terrestris* L.	Zygophyllaceae	Herb	A	Trop. America	M
154	*Tridax procumbens* L.	Asteraceae	Herb	P	Mexico	M
155	*Triumfetta pentandra* A.Rich.	Tiliaceae	Herb	A	Trop. America	M
156	*Turnera ulmifolia* L.	Turneraceae	Herb	P	Trop. America	O
157	*Typha angustata* Bory & Chaub.	Typhaceae	Herb	P	Trop. America	Th, Fu, Fo
158	*Urena lobata* L.	Malvaceae	Herb	A	Trop. Africa	Fib, Fu
159	*Vernonia cinerea* L.	Asteraceae	Herb	A	S. America	M
160	*Waltheria indica* L.	Sterculiaceae	Herb	A	Trop. America	M

Sl no.	Plant species	Family	Life form	Habit	Nativity	Use
161	*Xanthium indicum* L.	Asteraceae	Herb	A	Trop. America	M, Nox
162	*Xanthium strumarium* L.	Asteraceae	Herb	A	Trop. America	M, Fu, Nox
163	*Zinnia elegans* Jacq.	Asteraceae	Herb	A	Mexico	O
164	*Zea mays* L.	Poaceae	Herb	A	America	F, Fu, Fo
165	*Ziziphus mauritiana* Lam.	Rhamnaceae	Tree	P	China	Ft

Note: F, food; FT, fruit; O, ornamental; not known; M, medicinal; Fu, fuel; Fib, fiber; V, vegetable; Sp, species; Nox, noxious; Sm, smoking; Co, compost; Sa, sacred plant; Sb, soil binder; Ch, chemical compounds; Ave, avenue; T, thatching; A, annual; P, perennial.

Table 1.
List of invasive alien plant species (IAPs) recorded from Rourkela Steel City, Sundargarh, Odisha.

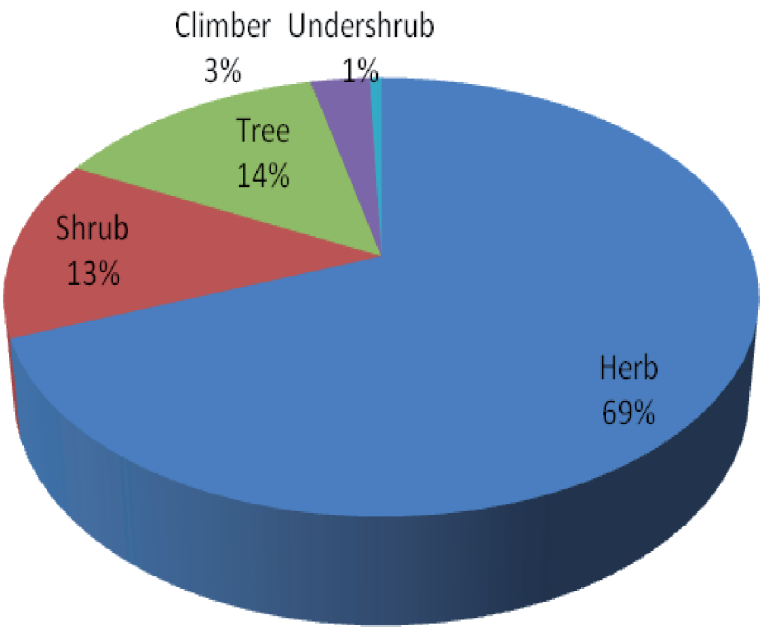

Figure 2.
Habit-wise distribution of invasive alien plant species in Rourkela.

Sl. no.	Habit	No. of species
1	Herb	114
2	Shrub	22
3	Tree	23
4	Climber	5
5	Undershrub	1

Table 2.
Habit of invasive alien plant species in Rourkela Steel City of Odisha.

America 77 species, Tropical South America 7 spp., Central America 1 spp., South America 10 spp., Tropical Africa 15 spp., Mexico 7 spp., and Europe 4 spp. IAPs are having negative impacts on the ecosystem and biodiversity of that region. Besides they are also found to be useful to local inhabitants. From the survey of literatures and interaction with local people about the IAPs, several plant species were used for different purposes like medicine, vegetables, fuels, fodders, etc. The study revealed that 87 spp. are used as medicine, while 18 spp. are used as fuel, 9 spp. used for fodders, and 30 spp. used for ornamental and avenue purposes. A total of 28 spp. were used as edible in the form of fruit, vegetables, oil, etc. Several species like *Argemone mexicana*, *Euphorbia hirta*, *Mimosa pudica*, *Ocimum canum*, *Calotropis* spp., *Croton bonplandianus*, *Catharanthus roseus*, etc. were mostly common medicinal plants used by local people, kabiraj and baidyas, while plants like *Cassia siamea*, *Leucaena leucophloea*, *Kigelia pinnata*, etc. were used for avenue plantation and social forestry. *Cannabis sativa* and *Nicotiana tabacum* were not only used for medicines, but also they are used for smoking as narcotic products. Alien species have been classified into naturalized and noxious species by various

Sl. no.	Nativity	No. of species
1	America	5
2	Central America	1
3	North America	2
4	South America	10
5	Tropical America	77
6	Tropical South America	7
7	Tropical North America	1
8	Africa	2
9	Tropical Africa	15
10	Tropical East Africa	1
11	Brazil	4
12	Australia	4
13	West Indies	5
14	Mexico	7
15	Malaya	2
16	Madagascar	2
17	Europe	4
18	China	6
19	Iran North West	1
20	Pantropic	1
21	Peru	1
22	South East Tropical Asia	1
23	Tropical West Asia	1
24	Central Asia	1
25	Mediterranean	4

Table 3.
Different geographic nativities of the invasive alien plants.

Sl. no.	Family	No. of species
1	Acanthaceae	3
2	Amaranthaceae	8
3	Apocynaceae	4
4	Araceae	1
5	Arecaceae	2
6	Asclepiadaceae	2
7	Asteraceae	24
8	Balsaminaceae	1
9	Bignoniaceae	3
10	Boraginaceae	1
11	Brassicaceae	1
12	Cactaceae	1
13	Caesalpiniaceae	11
14	Cannabinaceae	1
15	Capparaceae	4
16	Caricaceae	1
17	Casuarinaceae	1
18	Chenopodiaceae	2
19	Combretaceae	1
20	Commelinaceae	1
21	Convolvulaceae	9
22	Crassulaceae	1
23	Cucurbitaceae	1
24	Cupressaceae	1
25	Cuscutaceae	1
26	Cyperaceae	2
27	Euphorbiaceae	8
28	Fabaceae	5
29	Lamiaceae	3
30	Liliaceae	2
31	Lytharaceae	1
32	Malvaceae	5
33	Martyniaceae	1
34	Mimosaceae	4
35	Moraceae	1
36	Myrtaceae	1
37	Nyctaginaceae	2
38	Onagraceae	3
39	Oxalidaceae	1
40	Papaveraceae	1
41	Passifloraceae	1

Sl. no.	Family	No. of species
42	Pedaliaceae	1
43	Piperaceae	1
44	Poaceae	6
45	Polygonaceae	1
46	Pontederiaceae	1
47	Portulacaceae	2
48	Proteaceae	1
49	Rhamnaceae	1
50	Rubiaceae	2
51	Sapindaceae	1
52	Scrophulariaceae	1
53	Solanaceae	8
54	Sterculiaceae	2
55	Tiliaceae	2
56	Turneraceae	1
57	Typhaceae	1
58	Verbenaceae	5
59	Zygophyllaceae	1

Table 4.
Total number of IAPs' distributed family-wise species in Rourkela Steel City.

workers [8, 28, 39]. Many reports say different alien species become noxious after naturalized. *Ageratum conyzoides*, *Blumea lacera*, *Cassia alata*, *Lantana camara*, *Cassia tora*, *Parthenium hysterophorus*, *Xanthium* sp., *Datura* sp., *Cardamine scutata*, *Argemone Mexicana*, *Grangea maderaspatana*, *Hyptis suaveolens*, and *Gnaphalium polycaulon* were some noxious species found during the study. *Parthenium hysterophorus* was one of the highly noxious and abundantly grown plant species next to *Ageratum conyzoides* and *Lantana camera*.

From the taxonomical study, Asteraceae was the most dominant invasive family which dominated all other species due to its adaptive nature of seeds in different areas. The plant species have high reproductive potential to produce minute seeds so fast which disperse in new area through wind, air, and water. From the literature study, it was found that Asteraceae was more invasive in other areas of India [5, 7, 8, 23, 31, 32, 34, 35, 37] and also all over the world. Mallick et al. also found Asteraceae as the most dominating group of weeds among all other plant family groups. *Mikania micrantha*, a climber of Asteraceae, can climb trees and walls easily which inhibit the growth of the trees as well as cover the whole area so rapidly. *Parthenium hysterophorus* was another noxious plant of this family which could cause black fever disease. It grows very rapidly as its seeds disperse and grow so fast in new area which become invasive later. Annuals showed dominance over perennials among the invasive species as annuals complete life cycle and produce seeds to disperse in a short period in a year. Habit-wise distribution showed that herbaceous plants become more invasive than shrubs, climbers, and trees. Herbs have more tolerance to harsh condition and have great viability to grow in any condition which helps to become more invasive than others. Kumar et al. [11] found herbs as the more dominant plant group found in Rourkela flora.

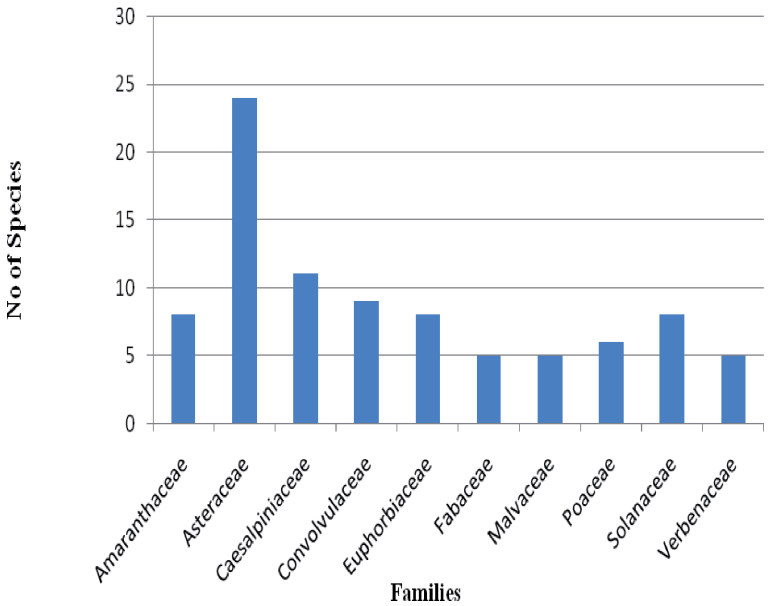

Figure 3.
Family-wise distribution of invasive alien plants in Rourkela Steel City of Odisha.

4. Conclusion

The invasive species are nonnative and exotic which are introduced intentionally for different purposes and sometimes accidentally introduced to a new area. The invasive species are more adapted to new areas by rapidly growing and reproducing more biomass than the native plant biodiversity. As a result, they can change the native ecosystem and become threats to the native ecosystem. IAPs also change the quality of soil, nutrient capacity, as well as the biodiversity present inside the soil. After invasion some invasive plants become narrow and noxious which affects the ecosystem with extinction of species and also affects the human health. Public involvement can be used and needed for early detection and reporting of infestations of the spread of new weeds as invasive species in the area. People should aware about the invasive species and its allelopathic effects on the environment and human health. Invasive species are now becoming more serious causing sustainable use of biodiversity and their impacts on invaded environment. Invasive alien plant species diversity in Rourkela of Sundargarh, Odisha, is a threat for the present flora due to their aggressive growth, colonizing ability, and adaptability. After invasion, their population growth increases rapidly in the new ecosystem; as a result they encroach crop fields, wastelands, and barren lands. The increased rate of invasion by alien species directly affects the agricultural economy and the biodiversity. Hence, eradication of IAPs should be done urgently. So awareness among local people is one of the methods to control IAPs. Besides this, the utilization of hidden medicinal potential can make IAPs beneficial to the people of the region. Moreover, the effect of IAPs in the economy, biodiversity, and human health is yet to be assessed. This study is based on diversity of invasive plant species found in different areas of Rourkela. Since the flora of Sundargarh district has not been beneficially and fully explored, this study will help in the compilation of flora of Sundargarh district and Rourkela in particular. Further studies reveal the allelopathic effects of IAPs on different plants, agricultural crops, and their ethnobotanical values.

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