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Mapping and Monitoring Invasive Plant Species in Ranchi's Rural-Urban Gradient: Ecological and Socio-Economic Perspectives

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Keywords

Anthropogenic Disturbance;
Invasive Plant Species;
Biodiversity;
Encroachment;
Urbanisation

Abstract

Invasive plant species (IPS) are considered one of the major drivers of biodiversity loss, altering ecosystem services and socio-economic conditions through different mechanisms. The present study was conducted in Gutwa village, located near Ranchi, where the encroachment of invasive plants was accelerated by infrastructure and other anthropogenic activities. For the enumeration of invasive plant species (IPS), the research site has been classified into three groups: (1) G1 (infrastructure developed area); (2) G2 (developing; infrastructure is going on), and (3) G3 (undeveloped or natural vegetation dominant area). Field data have been collected from 15 quadrats, each measuring 3 m x 3 m. Quantitative analysis has been done with standard methods. Statistically, the variance of all quadrats emphasises the dispersive nature of alien species within the group of all quadrats. The risk of accidental invasion by alien species may increase with rapid urbanisation and globalisation. To this end, the present study aimed to document the harmful and beneficial uses of invasive alien plant species along the rural-urban gradient in Gutwa village. Therefore, it is necessary to consider actions to address the current problems in Gutwa village, Ranchi, caused by invasive species and to mitigate the problem's magnitude in the future. Management prospects can be further strengthened by linking them to geospatial technologies (remote sensing and GIS) to map and monitor the spread of IPS.

1. Introduction

There has been a rise in interest in discussing biodiversity on regional, national, and international scales. Wild plants and animals, microbes, domesticated animals and cultivated plants, and even genetic material like seeds and germplasm are all considered part of the planet's rich biodiversity (Kumari and Choudhary, 2016). Significant losses in economic value, biodiversity, and the health of invaded systems are universally recognised as resulting from biological invasion by non-native or alien species (Hulme, 2007; Wittenberg and Cock, 2001).

Human actions introduce and establish invasive alien species in new geographic regions, where they can multiply and spread. One of the most significant risks to the long-term preservation of ecosystem health and biodiversity is the invasion of alien plants (Westman, 1990; Tyser and Key, 1988), which poses a major threat to indigenous biodiversity. In this way, the importance of biological invasions in the global decline of biological diversity is increasingly recognised (McGeoch et al., 2010; Simberloff et al., 2013). Alien plants have various adverse effects on the environment and the economy; however, many exotic plants are economically beneficial. In general, tribes used to live in close association with nature and maintain a connection between man and the environment (Kumar and Saikia, 2020). Local populations may benefit from cultivating some alien species, which can provide food, medicine, fuel, or fodder. (Rangel-Landa et al., 2016; Linder, 2019) and some of them are responsible for the endangerment and extinction of native species and negatively impact crop production, forest regeneration, livestock grazing, and human health (Shrestha et al., 2019; Nentwig et al., 2016; van der Veer and Nentwig, 2015; Mishra et al., 2024). Based on their actual consequences, it is estimated that up to 50% of invasive species may be classified as ecologically harmful (Richardson et al., 2000). Likewise, Jharkhand, one of India's biodiverse regions, is also invaded by a variety of Invasive alien plants. Without realising the consequences, they have been introduced into Jharkhand knowingly or unknowingly. After announcing Ranchi as a Smart City under the Government of India's 'Smart Cities Mission' (SCM), infrastructure development and rapid horizontal and vertical expansion are at their peak. Gutwa village is just outside the town and is also not untouched by urbanisation. Population growth is one of the major factors driving the city's rapid expansion. The messy and hidden" process of urbanisation compels scholars and policymakers to look for concrete solutions to various problems, such as the invasion of alien species.

Exotic alien species play a significant role in altering the global ecosystem (Panetta and Gooden, 2017; Pysek and Richardson, 2010). The spread of species across biogeographical borders due to anthropogenic introductions of native species to new regions is one of the distinguishing characteristics of the Anthropocene epoch (Lewis and Maslin, 2015; Steffen et al., 2011), where some of them colonise and naturalise (Van Kleunen et al., 2015) by establishing self-sustaining populations (Yang et al., 2021; Bertelsmeier et al., 2018; Ricciardi, 2013) and producing adverse effects on native biota. This shift in population can be seen as a demographic change (Dar et al., 2019). Biological invasions are now a global phenomenon (Liebhold et al., 2017; Catford et al., 2012), and are deemed one of the foremost causes of biodiversity loss (Courchamp et al., 2017). Although they coexist with native species to create "new forests," alien species are also known to repair damaged forest ecosystems (Hanberry et al., 2020; Dar et al., 2019; Martinuzzi et al., 2013). It is even hypothesised that these novel forests might perform ecological functions in a manner comparable to those of natural forests (Martinuzzi et al., 2013). It is thought that about 10% of the world's vascular plants could spread to other ecosystems and have a direct or indirect effect on them (Hulme et al., 2017; Carboni et al., 2021).

There are two possible roles that invasive species might play in the process of environmental change: "drivers" or "passengers"(Pysek et al., 2020; Linders et al., 2019; Waller et al., 2018). If they are drivers, they shape native diversity through their unique traits and mechanisms; if they are passengers, they dominate the region due to anthropogenic factors such as disturbances or habitat degradation. Either way, they affect the native biodiversity (Roy et al., 2019 Young et al., 2017). They are sometimes considered good indicators of land-use change or disturbance in a region (Pyšek et al., 2020; Miserendino et al., 2011). Invasion hotspots are mostly characterised by vegetation with less tree cover (Padalia and Bahuguna, 2017).

Exotic Species that become invasive are considered the main direct drivers of biodiversity loss worldwide (Jaureguiberry et al., 2022). Management of Exotic Alien Species (EAS) Invasions is a major challenge for biodiversity conservation (Mishra et al., 2022). EAS threatens ecosystems, destroys habitats, and harms other native species through invasion. It is believed to be the second-most-important factor contributing to the endangerment and extinction of species. The ecological cost is often the irretrievable loss of native species and ecosystems. It also causes significant economic losses, including reduced crop and livestock production, reduced native biodiversity, increased production costs, and so forth. Exotic Invasive Species (EIS) are species, native to one area or region, that have been introduced into an area outside their normal distribution, either by accident or on purpose, and which have colonised or invaded their new home, threatening biological diversity, ecosystems, and habitats, and human wellbeing (Dyer et al., 2017; Kumari and Choudhary, 2016; Thapa and Maharjan, 2014). Biological invasions worldwide threaten biodiversity, ecosystem dynamics, resource availability, national economies, and human health (Potgieter et al. 2020). The spread of EIS is now recognised as one of the greatest threats to the ecosystem.

The prime objective of the present work was to report the Invasive Species Invasion (ISI) near the roadside of Gutwa village, Ranchi district, threats to vacant land near the residential area, as well as open land and forest land in Jharkhand, India. This study examined the diversity and distributed nature of spared invasive and native species recorded along the rural-urban gradient in the rapidly expanding city, and the benefits and harms of different plant species colonising a rapidly developing environment. The present study aims to determine the status of invasive species in roadside areas in the Gutwa village of Nagri block, Ranchi district, Jharkhand, along with their harmful impacts and beneficial uses.

2. Materials and methods

2.1. Study Area

The study was conducted at Gutwa village, Nagri block of Ranchi district, located on the Ranchi Plateau between latitude 85°14'29.905"E to 85°15'26.861"E and 23°21'28.222"N to 23°21'34.193"N, where altitude varies from 650 to 700 m above mean sea level (msl) **(Figure 1).** The total geographical area of the village is 490.47 hectares.

2.2. Data collection:

2.2.1. Sampling design: A total of 15 quadrats, each of 3 m x 3m in size, were sampled in 15 grids of Gutwa village of Nagri blocks of Ranchi district of Jharkhand from September 2021 to November 2021. All the Shrubs and herbs were sampled using a random sampling method. All sampling sites were classified into three groups: “developed area, dominated by settlements mainly buildings or houses” categories as G1, moderately developed area, with infrastructure work ongoing, called "G2" and natural vegetation growing land without anthropogenic disturbance categories as "Group 3 or G3" (Table 2)

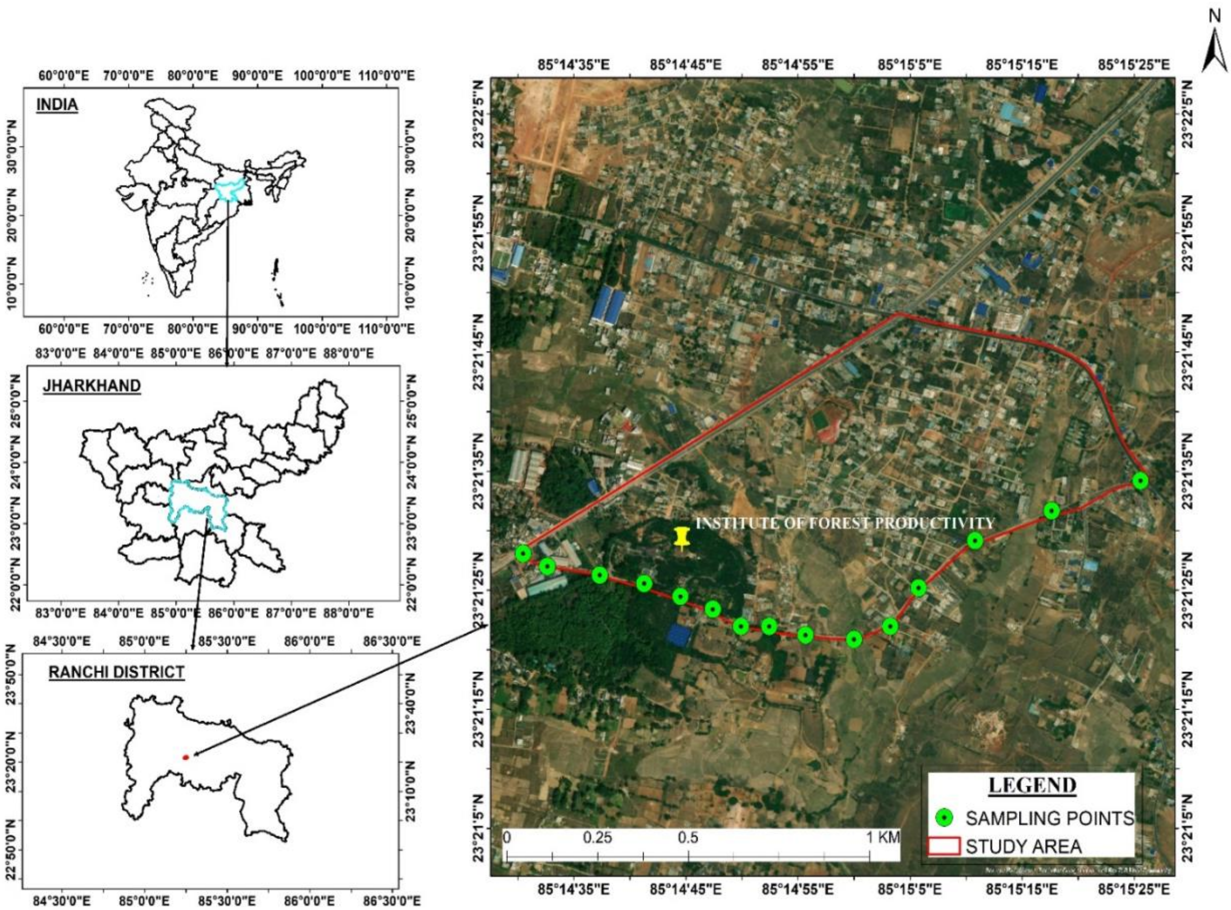

Figure 1: Map of study area showing quadrats location in Gutwa village, Jharkhand

2.2.2. Data Analyses: Vegetational quantitative assessments were conducted according to Misra (1968). Statistical analysis of the data was performed using SPSS (*version* 19), Origin (2019), and Microsoft Excel (2013). Maps were prepared using the open-source software *QGIS* (*version* 3.4). The dispersion of the species across three groups emphasised the need to calculate the variance. In each group, n quadrats (n=5) have been included. Scattered invasive plant species if the value of variance is low or minimum, then it is less scattered from the mean.

$$\text{Variance} = \frac{\sum(xi-x)\,2}{n-1}$$

Where V= sample variance the value of the one observation; x= the mean value of all observations and n= the number of the quadrat in the group

3. Results and Discussion

3.1 Diversity of Species

A total of 1524 individuals of plants of 49 species belonging to 17 families were recorded in 15 studied quadrats. According to habitat assessment, the major vegetation comprised 989 individuals (64.89%) of herbs belonging to 25 species, followed by 535 individuals (35.10%) of shrubs belonging to 24 species. Out of the total plant species, 19 were native (40.81 %) and 30 were exotic (59.18 %) plant species. Among the seven (07) species in the IUCN Red Listed species: least concern version. 3.1 (44 spp.) (Table 1) Of the 17 families, Asteraceae is the most dominant family with 11 species, followed by Poaceae (7), Lamiaceae (5), and Amaranthaceae (4). Three families, namely Caesalpiniaceae, Convolvulaceae, and Malvaceae, represented three species each; however, seven families have only one species.

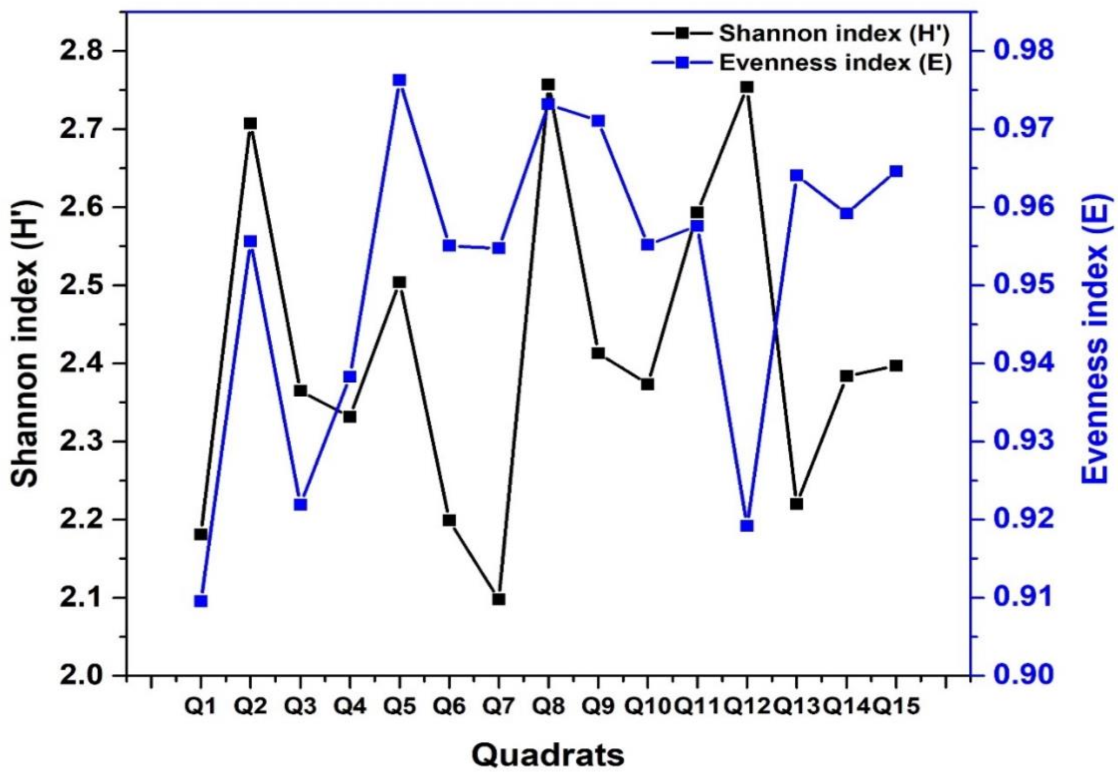

Figure 2: Relationship between Shannon diversity (H') and Eveness index (E) among all quadrats of quadrats location in Gutwa village, Jharhand

3.2. Nature of Alien Species in Gutwa village

All these species recorded during the study were reported as herbs or small shrubs, and many were called "weeds" in other countries or "invasive alien plants" in most regions. Almost 60% of plant species recorded were Invasive alien plant species. Invasive alien species such as *Parthenium hysterophorus* L., *Tridax procumbens* L., and *Lantana camara* L. are aggressive invaders that thrive in disturbed areas and cause significant ecological harm to India's natural areas. Invasive species such as Ageratum conyzoides L. and Parthenium hysterophorus L. hasten the extinction of endangered and endemic species, reduce the carrying capacity of pastures, and increase the cost of maintaining croplands (Dutta and Mukherjee, 2015). Some of these species may have only colonised a small area, but their potential for further spread and destruction is also high. Some species may already have a worldwide distribution and cause cumulative, but less obvious, damage. *Alternanthera philoxeroides, Alysicarpus bupleurifolius* (L.) DC. is encroaching on aquatic and riparian ecosystems, threatening the survival of native species and preventing the area from recovering. The aggressive coloniser plant known as *Parthenium hysterophorus* can be found in cultivated fields, woodlands, overgrazed pastures, waste sites, and gardens (Shiferaw et al., 2018). *Dactyloctenium aegyptium*, often known as crowfoot grass, thrives in disturbed environments including cultivated fields, gardens, and roadside ditches, especially in locations where excess water pools. One of the few types of grass that can survive prolonged periods of drought (Khan and Rao, 2017) as it can quickly grow and seed during the wet season. It is mostly used as food for all ruminant animals (Ahmed et al., 2022). *Pennisetum pedicellatum* is an ornamental-like grass (Suleiman et al., 2020) that spreads quickly and is difficult to control. It is used as a rehabilitation approach to overcome soil degradation caused by overpopulation and unsustainable agricultural methods. This is accomplished through the use of the technique (Smith, 2010), which significantly increases ground cover, thereby reducing runoff and soil loss. Moreover, its enormous root system helps fortify the soil, which in turn enhances water-conservation capacities, and it makes efficient use of deeper nutrients for growth.

3.3. Beneficial Uses of some Native plant species.

Among the many medical benefits of the *Achyranthes aspera* L. plant, native to India, are its antioxidant, hemolytic, anti-inflammatory, antibacterial, and antifungal properties (Lakshmi et al., 2018). The whole plant is used for cough; an infusion of the leaves in alcohol is used for leucoderma; the leaves are also used as an antidote for snakebite (Madan, 2018). *Alternanthera sessilis*, found along the banks of freshwater streams, canals, and ponds, is rich in protein and is eaten raw as a fresh green leafy vegetable in many countries of South Asia (Singh et al., 2009). *Boerhavia diffusa*, which grows wild on the plains up to an altitude of 700 meters, has antidiabetic and diuretic qualities and is also used to treat pain, inflammation, and indigestion (Shrivastava et al., 2017). *Clerodendrum infortunatum, also called "Indian bhat tree" or "Ghetu/Ghato," is observed along river banks and in* wet areas from plains to 1500 m elevation. The leaf and root of the *Clerodendrum infortunatum* plant have been used for a wide variety of medical purposes, including as an antidandruff treatment, a fever reducer, an acaricide, a laxative, a vermifuge, an anticonvulsant, an antidiabetic, a cure for diabetes, and a remedy for a variety of skin conditions and diseases (Duke, 1994; Khadka D, Bhattarai 2019). *Eragrostis tenella* is a weed that grows in crops, waste areas, ancient walls, lawns, roadsides, coastal dikes, and gardens with moist, black, sandier soil *(Chauhan, 2013). E. tenella* is grazed by cattle and water buffaloes in traditional feeding systems. *Ocimum sanctum* Linn, also called tulsi or tulasi, is grown for its aromatic leaves, widely used in Ayurvedic and folk medicine, often as an herbal tea for a variety of ailments. It has been suggested as an effective therapy for a variety of conditions, including bronchitis, malaria, diarrhoea, dysentery, skin illness, arthritis, eye disease, and insect bites (Keshari et al., 2016). *Crotalaria juncea*, or Indian hemp, is a natural fibre that comes from it, which is used to make cordage, fishing nets, and ropes. This natural plant is helpful to farmers because of its resistance to root-knot nematodes and its ability to improve soil quality by fixing nitrogen (Gill et al., 2022). There are almost no known medical benefits of the Crotalaria plant, except that its seeds can help cleanse the blood and the skin. *Calotropis procera* is a well-known plant that has a history of medicinal applications for conditions including skin disease, stomatological illness, sinus fistula, and diarrhoea (Dirir et al., 2017; Aharwal et al., 2014), and jaundice can also be treated using a component of the leaf (Murti et al.,2010).

Table 1: Details of native and invasive plant species recorded during study in Gutwa, Jharkhand

S. No	Name of the Plant	Habitat	Family	Origin Country	IUCN Red-list category
1	*Achyranthes aspera* L.	Shrub	Amaranthaceae	India	Not listed
2	*Alysicarpus bupleurifolius* (L.) DC.	Herb	Fabaceae	India	Least Concern
3	*Alternanthera sessilis* (L.) R. Br	Herb	Amaranthaceae	India	Least Concern
4	*Alternanthera paronychioides* A. St.-Hil	Herb	Amaranthaceae	Tropical America	
5	*Amaranthus viridis* L.	Herb	Amaranthaceae	North America	
6	*Ageratum conyzoides* L.	Shrub	Asteraceae	Mexico	Least Concern
7	*Bidens pilosa* L.	Herb	Asteraceae	Tropical & Subtropical America	
8	*Blumea lacera* (Burm. f.) DC.	Herb	Asteraceae	India	
9	*Boerhavia diffusa* L. nom.cons.	Shrub	Nyctaginaceae	India	
10	*Commelina benghalensis* L.	Shrub	Commeliaceae	India	Least Concern
11	*Senna tora* L. (Roxb.)	Shrub	Caesalpiniaceae	Central America	
12	*Senna sophera* (L.) Roxb	Shrub	Caesalpiniaceae	Tropical America	
13	*Chloris barbata* (L.) Sw.	Herb	Poaceae	Tropical America	
14	*Clerodendrum infortunatum* L.	Shrub	Lamiaceae	India	
15	*Cassia occidentalis* L.	Shrub	Caesalpiniaceae	Tropical America.	Least Concern
16	*Cynodon dactylon* (L.) Pers	Herb	Poaceae	India	
17	*Crotalaria juncea* L.	Herb	Fabaceae	India	
18	*Calotropis procera* (Aiton) W.T.Aiton	Shrub	Apocynaceae	India	
19	*Dactyloctenium aegyptium* (L .)Willd	Herb	Poaceae	Africa	
20	*Emilia sonchifolia (*L.) DC.	Herb	Asteraceae	India	
21	*Eragrostis tenella* (A. Rich.) Hochst. ex Steud.	Herb	Poaceae	India	
22	*Euphorbia hirta* L.	Herb	Euphobriaceae	Tropical & Subtropical America	
23	*Gnaphalium polycaulon* Pers.	Herb	Asteraceae	India	
24	*Hyptis suaveolens* (L.) Poit.	Shrub	Lamiaceae	Tropical America.	
25	*Ipomoea nil* (L.) Roth	Herb	Convolvulaceae	Tropical & Subtropical America	
26	*Ipomoea carnea* Jacq.	Shrub	Convolvulaceae	Mexico to S. Tropical America	
27	*Ipomoea quamoclit* L.	Shrub	Convolvulaceae	Mexico to Central America	
28	*Justicia adhatoda* L.	Shrub	Acanthaceae	India	
29	*Lantana camara* L.	Shrub	Verbenaceae	Tropical America.	
30	*Ludwigia perennis* L.	Shrub	Onagraceae	India	Least Concern
31	*Leonotis nepetiifolia* (L.) R. Br.	Shrub	Lamiaceae	Trop. Africa	
32	*Malvastrum coromandelianum* (L.) Garcke	Herb	Malvaceae	Tropical America.	
33	*Mirabilis jalapa* L.	Shrub	Nyctaginaceae	Mexico to Central America	
34	*Mimosa pudica* L.	Herb	Mimosaceae	Brazil	Least Concern
35	*Ocimum sanctum* L.	Shrub	Lamiaceae	India	
36	*Paspalum scrobiculatum* L.	Herb	Poaceae	India	
37	*Pennisetum pedicilletum* Trin.	Herb	Poaceae	Tropical America.	
38	*Parthenium hysterophorus* L.	Shrub	Asteraceae	Tropical North America	
39	*Ricinus communis* L.	Shrub	Euphobriaceae	Eritrea, Ethiopia, Somalia	
40	*Saccharum spontaneum* L.	Herb	Poaceae	India	
41	*Synedrella nodiflora* (L.) Gaertn	Herb	Asteraceae	Tropical & Subtropical America.	
42	*Acmella oleracea* (L.)R.K.Jansen	Herb	Asteraceae	Brazil	
43	*Sida acuta* Burm. f.	Shrub	Malvaceae	Tropical America.	
44	*Sonchus oleraceus* L.	Herb	Asteraceae	Mediterranean	
45	*Solanum torvum* Sw.	Shrub	Solanaceae	Mexico to N. South America	
46	*Tridax procumbens* L.	Herb	Asteraceae	Tropical Central America	
47	*Urena lobata* L.	Shrub	Malvaceae	Trop. Africa	
48	*Vitex negundo* L.	Shrub	Lamiaceae	Tropical Eastern and Southern Africa and Asia	
49	*Xanthium indicum* Koenig	Herb	Asteraceae	Tropical America.	

3.4. Quantitative Analysis of Alien Species

The biodiversity of any ecosystem can be measured using distinctive tools *i.e*., species richness, and species diversity (Daly *et al*., 2018). Shannon Weiner's diversity (H') was the highest (2.75) recorded for quadrat (Q) 08, while the lowest (2.09) was recorded in Q7. The relationship between H and E among all quadrats is shown in Figure 2.

On the other hand, the Concentration of dominance (CD) and Simpson's index for all quadrats range from 0.06 to 0.15, & 0,85 to 0.94, respectively. Similarly, Dmg and Dmn for 2.29 to 4.47 and 2.43 to 4.25, respectively, while ENS for all quadrats was 8 to 15. Shannon Weiner diversity (H') in forests depicts the number of various species present in a specific area; however, the evenness index depicts how evenly distributed each species is in an environment. Details of community characteristics of the Gutwa village of Ranchi are shown in Table 2.

Interestingly, the species richness was highest, i.e., 66 (sum of species numbers across all five quadrats in G1), recorded at the group one site. Group 1 (G1) site was highly disturbed in terms of infrastructure development and urbanisation, followed by G3 & G2. G3 group quadrats were corporately rich in vegetation and free from infrastructure work. Disturbance has often been found to facilitate the establishment of invading species. At the same time, climate change may affect them positively or negatively through altering abiotic conditions, or indirectly by modifying species interactions (Orbán et al., 2021).

Table 2. Community characteristics of Group 1, Group 2 and Group 3 plant species.

Quadrat Nos.	Group	No of species	Margalef in Biodiversity Richness Index (Dmg)	Palou's evenness index	Concentration of dominance (CD)	Effective no. of species (ENS)	Simpson index (SI)
Q1	G1	11	2.43	0.91	0.15	8.86	0.85
Q2		17	3.44	0.96	0.08	14.99	0.92
Q3		13	2.84	0.92	0.12	10.64	0.88
Q4		12	2.64	0.94	0.11	10.29	0.89
Q5		13	2.98	0.98	0.09	12.23	0.91
Q6	G2	10	2.30	0.96	0.12	9.02	0.88
Q7		9	2.29	0.85	0.13	8.15	0.87
Q8		17	4.25	0.97	0.07	15.76	0.93
Q9		12	2.73	0.97	0.10	11.17	0.90
Q10		12	3.17	0.96	0.11	10.74	0.89
Q11	G3	15	3.56	0.86	0.09	13.37	0.91
Q12		20	4.47	0.92	0.06	15.70	0.94
Q13		10	2.47	0.76	0.12	9.21	0.88
Q14		9	3.00	0.66	0.10	10.84	0.90
Q15		8	3.30	0.36	0.10	10.99	0.90

Compared with the other two sites, the variance for this G1 location was relatively low (4.16), whereas it was 7.60 for G2 and 20.24 for G3. The low variation in G1 reflects the dispersed character of the invasive plant species across the study sites. The natural tendency of plants to disperse increases species richness, helping maintain an equitable distribution of species. In other words, a large number of diverse invasive plant species have been reported in G1, but there are only a small number of individuals per species, which is the primary cause of the high species evenness. Both the number of species and their even distribution are declining, leading to a worldwide loss of biodiversity (Wang et al., 2017).

Changes in land use may influence the dispersion of invasive species and the invisibility of communities by directly or indirectly promoting their spread beyond a threshold level of landscape disruption (Brown and Bestelmeyer, 2012). Jharkhand is famous for its natural beauty and is home to roughly 40 per cent of India's mineral reserves. Despite these natural assets, the state's infrastructure was perhaps the only area that required improvement. However, rapid growth can negatively impact our native vegetation and encourage the introduction of species from other parts of the world. Changes in the landscape are clearly visible in the Google Earth image **(**Figure 3). In addition to this, it has an impact on the several stages of the invasion process (e.g., dispersal vs. population growth) in different, potentially contrasting, ways; interacting with the distribution of invasive species to facilitate spread, e.g., encouraging or modifying relationships between species in ways that make communities less visible to outside observers (e.g., edge effects).

Understanding land-use change driven by development and the spread of invasive species may thus yield new insights and opportunities for managing and restoring landscapes. So it is vital to control the spread of invasive species and minimise the invisibility of communities.

3.5. Invasive plant species (IPS): a global concern

It is fascinating that 5–20% of all alien species cause problems (Lockwood et al., 2013), yet their impacts on ecosystem structure and functions are persistent and large-scale (McGeoch et al., 2016). The adverse effects of invasive species are usually multifaceted and can be anything from quite minor to extremely severe. These include, but are not limited to, the deterioration of natural ecosystems, the eradication of several native species, the eventual disappearance of these species altogether, the effects on human health, and the rising financial expenditures associated with these phenomena. The impact of invasive species on ecosystem function may be both beneficial and detrimental (Pyšek et al. 2020; Liu et al. 2017), and their effects depend heavily on the spatial-temporal environment as perceived by the individuals involved.

The interactions invasive species have with new environments are reason enough to study them. The invaded ecosystems are affected, either immediately or indirectly, by these interactions (Stout and Tiedeken 2017). Changes to the forest's structure brought on by the dominance of invasive trees have an impact on the amount of both above- and belowground carbon pools, as well as the forest's ability to store carbon (Thom et al. 2017), despite the fact that its effects, depending on the species, might be either good or detrimental. As argued by Padalia and Bahuguna (2017), there is a positive relationship between the dominance of non-native invaders and the decline of native plants (Tallamy et al., 2021; Kulmatiski, 2018; Flory et al., 2017). Invasive plant dominance in disturbed or open forests impedes their recovery (Johnson et al., 2016). Bioinvasions often alter community structure, and invasive plants may also affect faunal composition, especially specialists that cause the complete exclusion of their food plants from the invaded region (Renault et al., 2022; Chakraborty, 2019; Dar et al., 2019). Alien species causing disturbances in the water and nitrogen cycles (Eviner et al., 2012; Everard et al., 2010) and transforming non-fire-prone areas into fire-prone areas (He et al., 2019; Vaz et al., 2017; Pausas and Keeley, 2014). They alter soil characteristics by emitting allelochemicals and competing for available nutrients.

However, the beneficial use of IPS has been studied by various researchers (Liu et al., 2017; Jauni et al., 2015). For example, Sandilyan and Klooster (2016) highlighted the potential health benefits of invasive alien plant species. Foreign invaders plant species frequently help local people maintain their standard of living and provide for their families (Rai and Scarborough, 2015; Vaz et al., 2017). They also make a positive contribution to ecosystem function by attracting pollinators and dispersal agents, both of which help increase biodiversity in the surrounding area and region and safeguard soil and coastal sediments. (Vaz et al., 2017), in addition to contributing to the maintenance of various ecosystem services beyond the primary reason they were first planted (such as the provision of fuelwood, horticultural benefits, etc.).

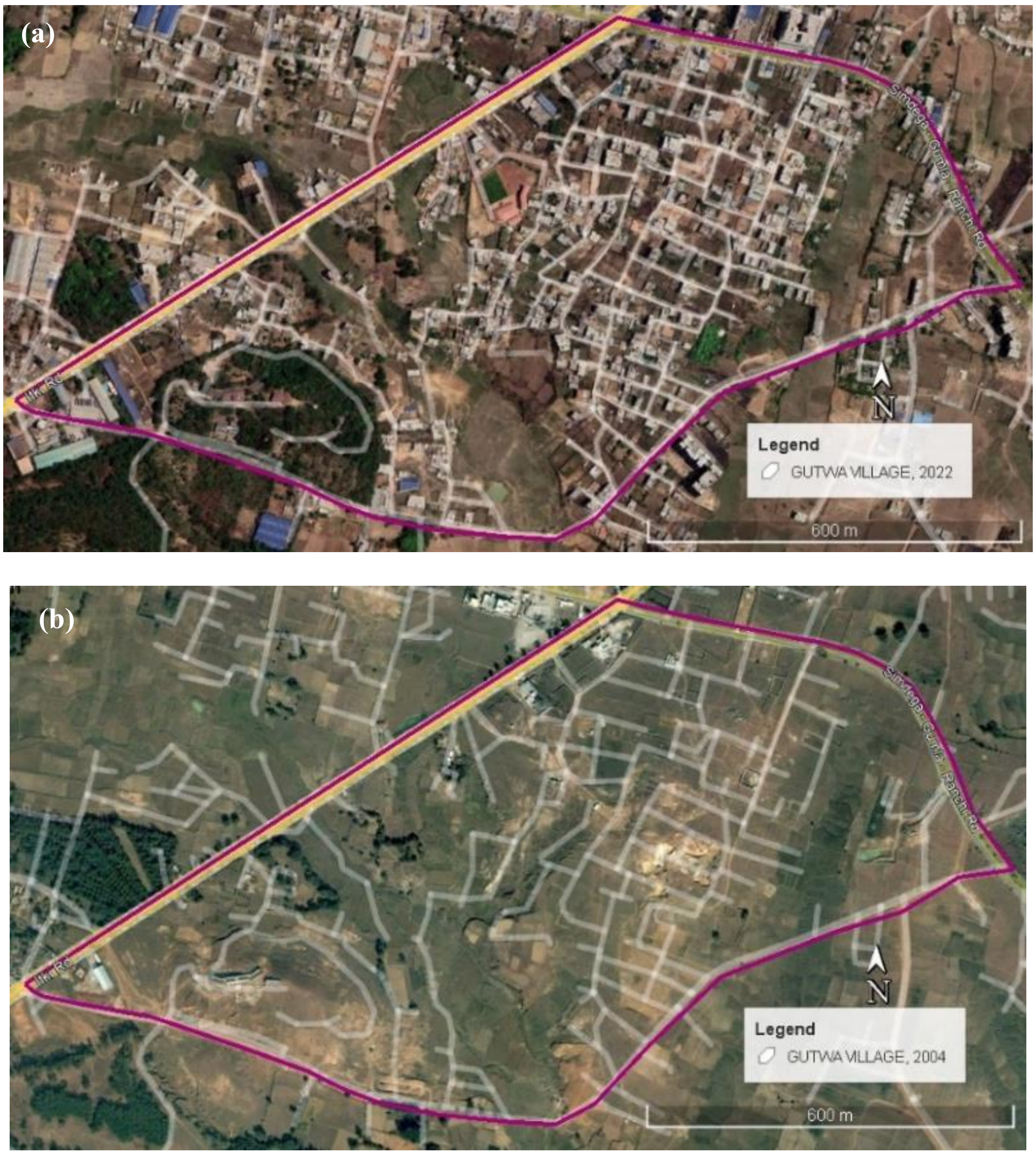

Figure 3**:** Land use change mainly settlement observed between (a) 2004 to (b) 2022, might be major factor for invasion of invasive species in Gutwa village, Ranchi Jharkhand. (Image source- google earth*)*

Invasive non-native species can aid in the rehabilitation of damaged forest areas (Jacobs et al., 2015) and enhance carbon sequestration (Dickie et al., 2014; Vaz et al., 2017). In India, some of the alien species (*L. camara*) are known for their current and potential benefits: soil management, ethnomedicine, insecticide preparation (Uyi et al., 2019; Pathak et al., 2019; Dar et al., 2019), avoiding desertification and ensuring a steady supply of firewood (e.g., Eucalyptus, *Prosopis juliflora*) (Al-Assaf et al., 2019; Dar et al., 2019) and water effluent treatment (e.g., Eichhornia crassipes; Priya and Selvan, 2017. Non-native invasive species can also disrupt terrestrial plant-pollinator mutualisms (Russo et al., 2021; Johnson et al., 2019) and belowground root-mycorrhizal mutualisms of native species (Chen et al., 2022; Duchicela et al., 2020; Mosbah et al., 2018). Therefore, in addition to the fact that primary invasion, the advantages or disadvantages that an alien invader would have had were likely directly tied to its function in the new habitat, site circumstances (or needs), and also the degree to which the plant has been researched and put to use.

4. Conclusion

Rapid urbanisation has heightened the danger posed by invasive plant species. The altered species composition of ecosystems is a direct result of the adverse effects these species have on soil quality and land degradation. Negative effects on rural livelihoods can be seen in the early stages of an invasion caused by accidentally brought invasive plants with high growth rates. People react to factors that threaten their economic well-being and try to adjust to changes in ecosystem dynamics; thus, both negative impacts and the spread of invasive species are likely to diminish over time. The invasion of plant species has prompted natural resource managers around the globe to commit significant money to controlling them. More extensive awareness programmes, management tactics, coordinated control efforts, and effective regulations are needed to prevent the spread of invasive species and safeguard the future security of our food supply, agricultural output, and ecological equilibrium. The control and monitoring of IPS could be: (i) taking measures to limit further harm caused by invading species; and, (ii) converting to the use of commodities invading plant species as valuable resources by means of both innovation and adaptability (iii) Spared awareness and decision-making programmers. To effectively manage and eliminate invasive plant species, it will be necessary to collect and analyse new data over the next several years and to develop a comprehensive, interdisciplinary strategy at the administrative and scientific levels.

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