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Invasive and Alien Species of Imphal Valley Districts of Manipur Northeastern India: A Review

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Abstract

A survey work was carried out to study the invasive and alien flora of Imphal Valley districts of Manipur, during the period of February 2021 to December 2024, 54 invasive alien plant species (IAPs) of 20 families were found in Manipur, among them Fabaceae family recorded highest number of Invasive species. so as to investigate the information of the invasive species of herbs, shrubs, vines, etc. These categories are the successful plant species which are grown and effects the plant diversity i.e. natural flora of Valley district and can withstand in the prevailing environment. In the present scenario of the valley districts of Manipur maximum invasive species recorded i.e. *Eupatorium adenophorum* followed by *Ageratum haustonianum*, *Mikania micrantha*, *Lantana camara*, *Chromolaena odorata Achyranthes aspera*, etc. However, some invasive parasites like *Cuscuta reflexa* and *Loranthus scurrula* are also interfered the forest flora. *Mikania micrantha*, *Momordica dioica*, *Dioscorea bulbifera*, *D. alata*, *Thunbergia grandiflora*, *Smilax lanceifolia*, *Entada phaseoloides*, etc. are some of the vines showing green carpeting on the roof of the forest flora is also remarkable. Therefore, necessary steps should be taken up to control the luxuriant growth of the invasive plant species, so, that they do not complete/interfere with the indigenous forest of Manipur.

Keywords: Alien, Invasive flora, Control, Valley District, Manipur.

INTRODUCTION

Invasive alien species (IAS) are one of the major threats to global and local biodiversity. In forest ecosystems, the threats caused by IAS include hybridization, transmission of diseases and species competition. This review sets out to analyse the impact of alien plant species on forest regeneration, which we consider to be one of the key stages in tree ecology for the survival of forest ecosystems in the future. The focus of the study is directly relevant to practitioners, forest managers and the conservation management of forests. With this systematic review, aim to provide an overview of 48 research studies reporting on the impact and/or management of IAS in European temperate forests. A multi-step protocol was followed for compiling the publications for the literature review, with nine search queries producing a total of 3,825 hits. After several reduction rounds, ended up with a grand total of 48 papers. Thereby, identified 53 vascular plant species having a negative influence on forest regeneration in Central European forests. In total, 21 tree species were reported to be impacted by IAS in 24 studies (Early *et al*., 2016). The results of the review synthesis show that five impact mechanisms affect the regeneration success of native tree species: competition for resources, chemical impact on regeneration, physical impact on regeneration, structural impact on regeneration and indirect impact through interaction with other species. By synthesis management measures that have been recommended for application at different stages of biological invasions. The associated costs and required resources of

management measures are under-reported or not accessible by reviewing the scientific literature. Thus, conclude that it is very important to improve the links between science and practical forest management. This review will provide direction for invasive plant species research and management aimed at protecting biodiversity in European temperate forest ecosystems (Early *et al*., 2016).

Globally, invasive alien species have been considered as a grave threat to the biodiversity, ecosystem services and functions, human livelihoods and health and regional economy. Studies, in the recent past, have confirmed that the invasive species also have the potential to significantly alter the regional and global climate for example, several invasive plants accelerate the nitrogen and CO_2 deposition, and thereby increase their levels in earth systems which in turn contribute to "global" warming, which changes the regional and global precipitation patterns (Michunas and Lauenroth1995; Dukes and Mooney, 1999; Asner *et al*., 2006; Field *et al*., 2007). Besides, researchers identified that one-sixth of the global land surface is highly vulnerable to bio-invasion (*Early et al*., 2016). On the other hand, increasing globalization facilitates more alien introductions in several parts of the world. Recent reports highlighted that international trade is a primary source of new introductions of invasive alien spices as stowaways or contaminants in goods and packing materials. Especially, pet animals and ornamental plants trade through online is one of the major sources of exotic plant and animal introductions.

This uncontrolled/unnoticed online trade leads to frequent escape or release of invasive alien species into wild (Early *et al*., 2016). Ironically, most of the countries, especially developing countries, have limited capacity to act against such alien introductions (Early *et al*., 2016). Ecological modelling studies on biological invasions have predicted that, in the coming days, developing countries will face more threats rather than the developed countries. Studies also highlighted that developing countries must prepare for a new suite of invasive species, as climate change disturbs resident ecosystems (Early *et al*., 2016). Besides, it is a fact that most of the countries do not have a comprehensive list of invasive alien species reported in their respective territories.

Considering the large-scale negative impacts of invasive alien species on global biodiversity, Aichi Target 9 states 'By the year 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.' Keeping this in view most of the Convention on Biological Diversity (CBD) signatory countries-initiated steps for identification and prioritization of some aggressive and widespread invasive flora and fauna that are threatening the regional biodiversity, human health and agriculture (Early et al., 2016).

MATERIALS AND METHODS

Study area

Manipur is situated at the Indo-Myanmar border region. The state is surrounded by Nagaland in north, Mizoram in south, Assam in the west, and Myanmar in the east. The geographical feature of Manipur with an area of 22,327 m^2 (Fig.1). The Manipur Valley Area covers only 8% of the total area of the state with 70% of the population. It is an oval-shaped elevated plain with an average altitude of 792.4 m.

The survey work was carried out from February 2021 to December 2024, in the different selected sites of five districts of Manipur. These sites are: 1. Imphal East District, 2. Imphal West District, 3. Bishnupur District, 4. Thoubal District and 5. Kakching District.

The numbers and other characters of the invasive and alien plant species were collected. The survey and data collection on the plants were carried out during all the seasons of the year. Field Books were maintained to record the following information: collection number, date of collection, local name, botanical name family, habit, habitat and impacts.

Mounted herbarium specimens were used for the purpose of identification. Critical morphological studies have been made for the collected plant specimens. The specimens have been studied by making dissection of several flowers both live and preserved. The authentic identification of the plants has been done with the help of the available floristic literature such as Flora of British India vol.1-7 (Hooker, 1872 – 1897); Flora of India, vol. 1 (Sharma *et al*. Edt. 1993); Flora of Assam, vol. 1-4, (Kanjilal *et al*., 1934 – 1940); Forest Flora of Meghalaya, vol. 1 & 2 (Haridasan & Rao,1985 & 1987).

After going through the extensive review of literature on the global invasive species (Mooney and Drake, 1987; Heywood, 1989; Drake *et al*., 1989; Huxel, 1999; Jenkins, 1999; Londsale, 1999; Mooney, 1999; Elton,

2000; Mooney and Hobs, 2000; Almeilla and Freitas, 2001; Cowie, 2001; Mc Neely et al., 2001; Cox, 2004; Cracraft and Francesca, 1999; D' Antonio and Vitousek, 1992) of India and Manipur and spread history origin / nativity (except few) field observation a list of plant species of invasive and aliens plant species were prepared.

The nativity / orign of the species is provided as describe by Mathew, 1969; Maheswari and Paul, 1975; Nayar, 1977; Sharma, 1984; Hajra and Das, 1982; Saxena, 1991; Pandey and Parmar, 1994; Reddy and Raju, 2002; Reddy and Reddy, 2004; Negi and Hajra, 2007. Some of the Herbarium specimens of the collected plants were prepared and submitted to the Herbaria maintained by the Department of Botany, Manipur International University, Ghari, Imphal West, Manipur for future references.

RESULTS AND DISCUSSION

Indian Scenario

In India, many research organizations (government and non-government), state and central universities and colleges have initiated to document invasive alien species and their impacts on different ecosystems. Many studies have also been focusing on alien plants in different ecosystems. Indian researchers adopted numerous methodologies and approaches to study the alien flora during the last two decades. These include floristic and faunistic surveys and documentation, mapping, ethnobiological information and ecological experiments, eco-physiological and genetical studies (Adhikari *et al.*, 2015). However, most of these investigations were conducted at the local scale and are often species specific, and hence of little value for working on a pan-Indian status of invasive alien species (Adhikari et al., 2015). Considering the high taxonomic diversity and large geographical area, number of researchers working on invasive alien species in India is extremely low and far less than the number of researchers working in other much smaller countries having less biodiversity (Adhikari *et al*., 2015). Unfortunately, India does not have a comprehensive list of invasive alien species.

For an effective invasive alien species research, prioritization and management, certain specific data including details of invasive species, pathways of invasion and the information about the sites that are most sensitive and prone for further invasion are essential McGeoch, M.A. et al.2016. Considering the above-mentioned facts, the National Biodiversity Authority (NBA) constituted an 18-member expert committee on invasive alien species under Subsection (2) of Section 13 of the Biological Diversity Act, 2002 read with Rule 11 of Biological Rules, 2004. The objective of the committee is to advise NBA on issues related to the preparation of consolidated list of invasive alien species reported in India. Further, the committee also provides inputs on reports and other materials including brochures, handouts, booklets, research and review articles developed by NBA. Besides, the committee also needs to review the current management and policy-related matters and other aspects of biological invasions.

The first meeting of the expert committee (EC) on invasive alien species was held on 12 January 2017 at the NBA. Members discussed the importance of developing a national list of invasive alien species during deliberation. The chairperson of the NBA mentioned that the Centre for Biodiversity Policy and Law (CEBPOL) NBA has already started compiling the listing of invasive alien species of different ecosystems and assured that it will be placed in the second EC meeting for comments and Kakching) Valley Districts of Manipur

A draft list of invasive alien species in different ecosystems [terrestrial aquatic (inland and marine) and agro ecosystems] was placed in the second EC meeting held on 29 June 2017, at the NBA. During deliberations, members expressed that the proposed draft list of invasive alien species requires minor revisions Chairperson of NBA and chairman of the EC stated that the list would be shared with EC members and subject experts to fine-tune it. After a series of discussions with EC members and different experts through mail, over phone and personal discussion, the draft list of invasive alien species of different ecosystems was prepared and the same was placed in the third meeting of the EC for finalization. The third EC meeting was held from 6 to 7 February 2018 at the NBA, Chennai, under the chairmanship of Dr. C.R. Babu. Apart from the EC members, NBA invited the members/representatives and researchers from various institutions identified by the National Biodiversity Action Plan, viz., SACON, Forest department, DoS, Wetland International, South Asia, WII, CAS in Marine biology, ICRF (forest invasive species cell), CABI South Asia (NBAP 2014). After the series of two-day discussion, the final list of invasive species has been prepared. The details of the deliberation and the participation list are placed in annexure 1. The committee also insisted on NBA for the periodical updating of the list based on the various studies published by the researchers.

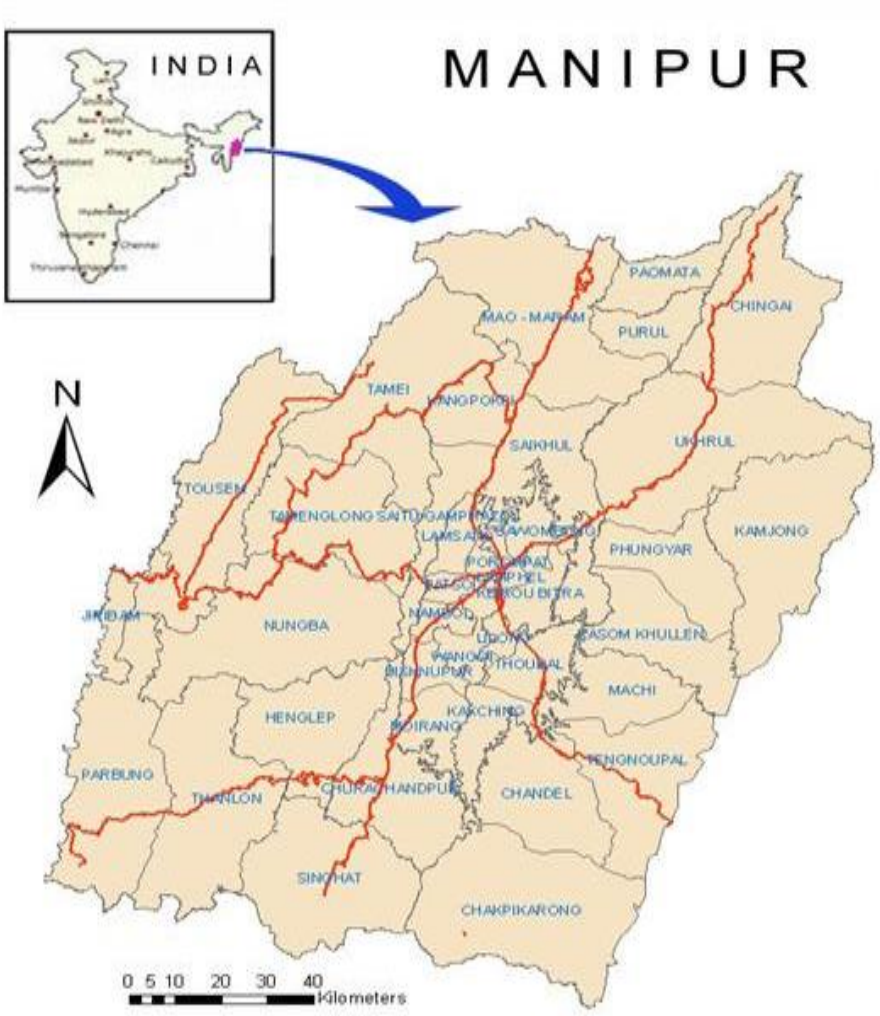
Criteria Adopted for Designating an Alien Species as Invasive

Invasive alien species research is relatively a young discipline in biology and has a shallow root/base with few thousand research papers published during the last 25 years (Richardson *et al.*, 2011). Consequently, there are differences in the usage of terminology and definitions relating to invasive alien species in different countries and from time to time. The use of terms for different taxonomic groups also varies in different ecosystems. Developing a uniform and widely acceptable terminology and definitions are the need of the hour. Researchers also advocated the need for developing regional terminologies and definitions for better understanding of the issue of biological invasions (Richardson *et al.*, 2011). Further, there are no prescribed guidelines available on how to identify and differentiate between naturalized species and invasive alien species present in a country. Obviously, robust criteria need to be developed for designating an alien species as invasive in an ecosystem.

In India, the subject of biological invasions is still in its infancy and did not attract the attention of stakeholders, managers, policy makers, researchers and the common public. For instance, only about 150 studies on invasive alien species were carried out till 2000. After 2000, there has been increase in the number of studies on invasive alien species, as evident from the number of publications. Interestingly, 60% of the studies have been done only after 2000 (Hiremath and Sundaram, 2013). However, a comprehensive list of invasive alien species and uniformly accepted terminology are not available in India so far. Globally, several terminologies and definitions are available on invasive species. Especially

individual researchers and national-level research organizations have evolved their own descriptions; however, in most of the cases the definitions and terminologies failed to reflect the core and led to ambiguity. On the other hand, most of the countries wisely adopted the CBD and IUCN definitions and terminology for documentation and in research studies. As a signatory of CBD, NBA has also adopted the CBD terminology and definitions and the same is followed in the present documentation. The adopted definitions for the current documentation are provided in the box for reference

Fig. 1: Map of Manipur, Study site in the five (Imphal West, Imphal East, Bishnupr, Thoubal



Alien Species

An alien species is a species, subspecies or lower taxon introduced outside its natural past or present distribution, which includes any part, gametes, seeds, eggs or propagules of such species that might survive and subsequently reproduce (CBD, 2002).

Invasive Alien Species

An invasive alien species refers to an alien species whose introduction and/or spread threatens the biological diversity of the region/habitat (CBD, 2002).

Naturalized Species

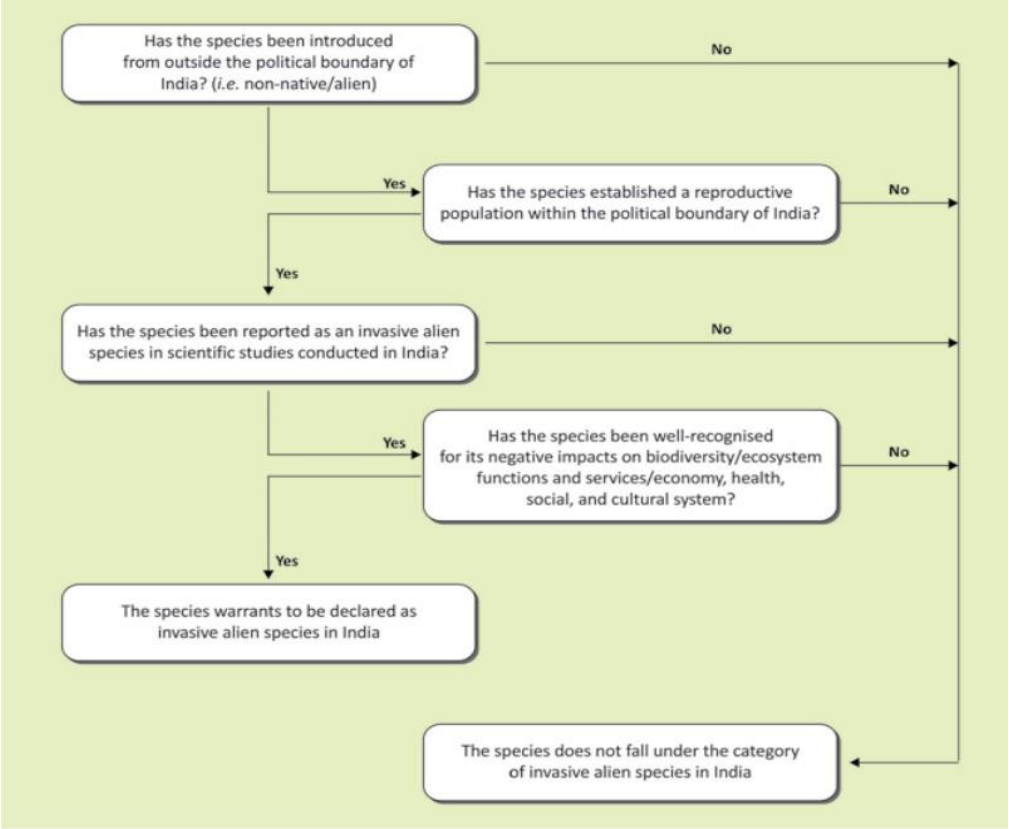
Naturalized species are alien species that sustain self-replacing populations for several life cycles or a given period (10 years is advocated for plants) without direct intervention by people or despite human intervention (Richardson et al. 2011).

Role of CEBPOL and NBA

CEBPOL, NBA collected the readily available ecosystem-wise literature of invasive alien species and thoroughly analysed the reported species. During the consolidation, we found that there were lots of confusions, wrong citations, biased definitions and information in most of the published lists of invasive alien species. For instance, some of the lists declare the naturalized species as invasive, and conversely some lists declare the invasive species as naturalized alien species. Besides, the accepted name and the synonym of a species were simultaneously reported in the same list and mentioned as different species. In a worst-case scenario, the native species has also been reported as invasive alien species. CEBPOL, NBA realized the need for avoiding this kind of ambiguity and at the same time felt the necessity for criteria to be adopted for declaring a species as invasive alien species.

As a first step, we compiled an ecosystem-wise major invasive taxa (terrestrial and aquatic invasive alien plants, inland invasive alien fish species, marine invasive alien species, invasive alien species/strains of microbes in freshwater and brackish water ecosystems, invasive alien species of microbes/strains (other than plants) in agricultural ecosystems, invasive alien insect species in agricultural ecosystems and invasive alien species of major islands). After assorting the ecosystem-wise list, it was primarily screened to confirm the alien status and invasiveness of the species based on a simple methodology developed by CEBPOL (details of the methodology are provided in Figure 2). After the initial filtration/confirmation, the confirmed list was placed in the NBA's invasive species expert committee for scrutiny (held on 29th June 2017 and 6th to 7th February 2018 at NBA).

Figure 2. Flow chart devised to identify whether a given species can be considered as invasive or not.



The committee deliberated on the lists compiled by CEBPOL, NBA and suggested to include the invasive attributes on a graded scale for confirmation of the invasiveness of the species in India. After reviewing the available literature, the committee has suggested to adopt the important invasive attributes viz., invasiveness, impacts, range of extension and others to designate the alien species as invasive in India (Table 1). Besides, the committee also considered the personal experiences of the researchers and their view in declaring a species as invasive if there is non-availability/inadequate literature.

Based on the aforesaid criteria, the committee finalized a list of 169 invasive alien species in different ecosystems (Table 2). The committee also felt the list might further be expanded. For example, when some species are designated as invasive based upon the specific criteria, there may be many more invasive species which may satisfy the above criteria, but due to lack of adequate information of the concerned species it is not included in the present lists Keeping this aspect in view, the committee requested the NBA to host the lists on its website for public access and comments. Once adequate information is available on the new invasive species in Indian provinces, it may be included in the lists in the near future after due consultation with the expert committee.

Table 1. Invasive attributes used to confirm the invasive status of the species reported in Indian ecosystems.

Invasive attributes	
Sl No	INVASIVENESS
1.	IE – Invasive Elsewhere
2.	RMS- Rapid Multiplication and Spread in different ecosystems
3.	MMR – Multiple Modes of Reproduction
4.	MMD – Multiple Modes of Dispersion
5.	IMPACTS
6.	B1 – Affecting ecosystem functions and services
7.	B2 – Biodiversity loss
8.	B3 - Economic loss and health hazards
9.	INVASION AREAS (Continues spread)
10.	RE – Range Extension

Table 2: Showing the checklist of IAS recorded from India as per National Biodiversity Board, India, and Manipur State[Invasiveness: IE – Invasive Elsewhere, RMS- Rapid Multiplication and Spread in different ecosystems, MMR – Multiple Modes of Reproduction, MMD – Multiple Modes of Dispersion, IMPACTS- B1 – Affecting ecosystem functions and services, B2 – Biodiversity loss, B3 - Economic loss and health hazards, RE – Range Extension].

Sl No	Name of taxa	English Name	IE	RMS	MMR	MMD	B1	B2	B3	RE	References
1	*Abutilon crispum* (L,) Brizicky Malvaceae	Bladder Mallow	Y	Y		Y	Y	Y		Y	Inderjit *et al.*, 2018; Sandilyan *et al.*, 2018
2	*Acacia auriculiformis* L. Fabaceae	Northern black wattle	Y	Y	Y	Y	Y	Y		Y	Sandilyan *et al.*, 2018
3	*Acacia dealbata* Link Fabaceae	Silver wattle	Y	Y		Y	Y	Y		Y	Sekar 2012; Sandilyan *et al.*, 2018
4	*Acacia mearsnii* De Willd. Fabaceae	Back wattle	Y	Y		Y	Y	Y	Y	Y	Sankaran et al., 2013; Naithani *et al.*, 2017; Sekar 2012; Reddy *et al.*, 2008.
5	*Ageratina adenophora* (Spreng.) King & H. Rob. Asteraceae	Crofton weed or sticky snakeroot	Y	Y	Y	Y	Y	Y	Y	Y	Muniappan and Viraktamath1993; Sandilyan *et al.*, 2018
6	*Ageratina riparia* (Regel) R. M. King & H. Rob Asteraceae	Creeping croftonweed	Y	Y	Y	Y	Y	Y	Y	Y	Sandilyan *et al.*, 2018
7	*Alternanthera bettzickiana* (Regel) G. Nichols Amaranthaceae	Red Calico plant	Y	Y	Y	Y	Y	Y	Y	Y	Sankaran *et al.*, 2013; Sandilyan *et al.*, 2018
8	*Alternanthera brasiliana* (L.) Kuntze Amaranthaceae	Brazilian joy weed	Y	Y	Y	Y	Y	Y	Y	Y	Sankaran *et al.*, 2013; Sandilyan *et al.*, 2018
9	*Alternanthera ficoidea* P. Beauv. Amaranthaceae	Joseph's coat	Y	Y	Y	Y	Y	Y	Y	Y	Sandilyan *et al.*, 2018
10	*Alternanthera paronychioides* St. Hil. Amaranthaceae	Smooth joy weed	Y	Y	Y	Y	Y	Y	Y	Y	Sekar 2012; Sandilyan *et al.*, 2018
11	*Alternanthera pungens* Kunth. Amaranthaceae	Khaki weed	Y	Y	Y	Y	Y	Y	Y	Y	Naithani *et al.*, 2017; Sekar 2012;
12	*Alternanthera tenella* Colla Amaranthaceae	Calico plant	Y	Y	Y	Y	Y	Y		Y	Naithani *et al.*, 2017; Sekar 2012;
13	*Antigonon leptopus* Hook. & Arn. Polygonaceae	Coral vine	Y	Y	Y		Y	Y		Y	Sekar 2012; Sandilyan *et al.*, 2018
14	*Argemone mexicana* L. Papaveraceae	Mexican poppy	Y	Y			Y	Y		Y	Sankaran *et al.*, 2013; Naithani *et al.*, 2017;
15	*Bidens pilosa* L. Asteraceae	Black jack	Y	Y	Y	Y	Y Y	Y	Y	Y	Muniappan and Viraktamath1993; Sekar,2012;
16	*Cabomba caroliniana* A. Gray Cabombaceae	Carolina fanwort	YY	Y	Y		Y Y	Y		Y	Sandilyan *et al.*, 2018

17	*Cannabis sativa* L. Cannabaceae	Hemp/ Marijuna	Y	Y		Y	Y	Y		Y	Based on field observation by experts
18	*Centrosema molle* Benth. Fabaceae	Butterfly-pea	Y	Y			Y	Y		Y	Sankaran *et al*., 2013; Sandilyan *et al*., 2018
19	*Cestrum aurantiacum* Lindl Solanaceae	Orange cestrum	Y	Y	Y	Y	Y	Y	Y	Y	Sankaran *et al*., 2013; Sandilyan *et al*., 2018
20	*Chromolaena odorata* (L.) King & Robin. Asteraceae	Siam weed	Y	Y Y	Y	Y	Y	Y	Y	Y	Mahajan and Azeez, 2001. Sankaran *et al*., 2013; Naithani *et al* ., 2017
21	*Cirsium arvense* (L.) Scop Asteraceae	Canada thistle	Y	Y	Y	Y	Y Y	Y	Y	Y	Sandilyan *et al*., 2018
22	*Coronopus didymus* Sm. Brassicaceae	Lesser swinecress	Y	Y	Y	Y	Y	Y	Y	Y	Sandilyan *et al*., 2018
23	*Cryptostegia grandiflora* R. Br. Apocynaceae	Rubber vine	Y	Y		Y	Y	Y		Y	Naithani *et al*., 2017; Sekar 2012; Reddy *et al*., 2008;
24	*Cuscuta chinensis* Lam. Convolvulaceae	Dodder	Y	Y		Y	Y	Y		Y	Naithani *et al*., 2017; Sekar 2012;
25	*Cytisus scoparius* (L.) Link Fabaceae	Scotch broom	Y	Y		Y	Y	Y		Y	Naithani *et al*., 2017
26	*Dactylandra welwitschii* Hook. f. Cucurbitaceae	Badi Aankh phootani bel	Y	Y		Y	Y	Y		Y	Sandilyan *et al*., 2018
27	*Dinebra retroflexa* (Vahl) Panz. Poaceae	Viper grass	Y	Y	Y	YY	Y	Y		Y	Naithani *et al*., 2017; Sekar, 2012;
28	*Diplachne fusca* (L.) P.Beauv. Poaceae	Brown flowered swamp grass	Y	Y	Y	YY	Y	Y		Y Y	Sandilyan *et al*., 2018
29	*Dysphania ambrosioides* Mosyakin & Clemants Amaranthaceae	Mexican tea	Y	Y		Y	Y	Y		Y	Sekar, 2012; Sandilyan *et al*., 2018
30	*Erigeron bonariensis* L., Asteraceae	Horseweed/ butterweed	Y	Y	Y	Y	Y	Y		Y	Inderjit *et al*., 2018; Sandilyan *et al*., 2018
31	*Erigeron canadensis* L. Asteraceae	Canadian horseweed	Y	Y		Y	Y	Y		Y	Sandilyan *et al*., 2018
32	*Evolvulus nummularius* (L.) L. Convolvulaceae	Round leaf bindweed	Y	Y		Y	Y	Y		Y	Naithani *et al*., 2017; Sekar 2012;
33	*Hyptis suaveolens* Poit. Lamiaceae	Pig nut	Y	Y	Y	Y	Y	Y		Y	Sankaran *et al*., 2013; Sekar 2012;
34	*Ipomoea eriocarpa* R. Br. Convolvulaceae	Purple morning glory	Y	Y		Y				Y	Naithani *et al*., 2017; Sekar 2012;
35	*Ipomoea fistulosa* Mart. ex Choisy Convolvulaceae	Bush morning cory/shrub Ipomea	Y	Y	Y	Y	Y	Y		Y	Sandilyan *et al*., 2018
36	*Lantana camara* L.	Lantana	Y	Y		Y	Y	Y	Y	Y	Chandrasekaran and Swamy 2001; Love *et al*., 2009; Sundaramand Hiremath 2012.

	Verbenaceae										Sankaran *et al.*, 2013;
37	*Leucaena leucocephala* (Lam.) de Wit Fabaceae	Horse tarmind	Y	Y			Y	Y		Y	Sankaran *et al.*, 2013; Naithani *et al.*, 2017;
38	*Maesopsis eminii* Engl Rhamnaceae	Umbrella tree	Y	Y		Y	Y	Y		Y	Sankaran *et al.*, 2013
39	*Mikania micrantha* Kunth Asteraceae	Mile-a minute	Y	Y	Y	Y	Y	Y		Y	Gogoi 2001; Sankaran and Srinivasan,2001 ; Lahkar *et al.*,2011.
40	*Mimosa diplotricha* C. Wight ex Sauvalle var. Fabaceae	Giant sensitive plant	Y	Y	Y	Y	Y	Y		Y	Sandilyan *et al.*, 2018
41	*Mimosa pigra* L. Fabaceae	Cat claw mimosa	Y	Y	Y	Y	Y	Y		Y	Naithani *et al.*, 2017; Sandilyan *et al.*, 2018
42	*Muntingia calabura* L. Muntinginaceae	Jamaican Cherry	Y	Y	Y	Y	Y	Y	Y	Y	Sandilyan *et al.*, 2018
43	*Opuntia dillenii* Haw. Cactaceae	Prickly pear	Y	Y	Y	Y	Y			Y	Muniappan and Viraktamath1993; Sekar 2012
44	*Opuntia elatior* Miller Cactaceae	Prickly pear	Y	Y	Y	Y	Y			Y	Sekar, 2012; Sandilyan & Bharathianma, 2018
45	*Parthenium hysterophorus* L. Asteraceae	Congress weed	Y	Y	Y	Y	Y	Y	Y	Y	Aneja, 1991; Gunaseelan,1998; Singh and Kaur, 1997; Sankaran *et al.*, 2013;
46	*Pennisetum purpureum* Schumach Poaceae	Elephant grass	Y	Y		Y	Y	Y		Y	Naithani *et al.*, 2017; Sekar2012;
47	*Prosopis juliflora* (Sw.) DC. Fabaceae	Mesquite	Y	Y	Y	Y	Y	Y		Y	Dayal, 2007; Anoop, 2010; Kaur *et al.*,2012.
48	*Pueraria montana var. lobata* (Willd.) Sanjappa & Pradeep Fabaceae	Kudzu	Y	Y		Y				Y	Sandilyan *et al.*, 2018
49	*Senna spectabilis* (DC.) Irwin & Barneby Fabaceae	Calceolaria shower	Y	Y			Y	Y		Y	Sankaran *et al.*, 2013; Sandilyan *et al.*, 2018
50	*Solanum elaeagnifolium* Cavanilles Solanaceae	Silverleaf night shade	Y	Y			Y	Y		Y	Sandilyan *et al.*, 2018
51	*Solanum mauritianum* Scop. Solanaceae	Bug weed	Y	Y			Y	Y		Y	Sandilyan *et al.*, 2018
52	*Sphagneticola trilobata* (L.) Pruski Asteraceae	Singapore daisy	Y	Y			Y			Y	Sankaran *et al.*, 2013; Sandilyan *et al.*, 2018
53	*Typha angustifolia* L. Typhaceae	Lesser bulrush	Y	Y	Y	Y	Y	Y		Y	Sekar 2012; Naithani *et al.*, 2017; Inderjit *et al.*, 2018;

54	*Ulex europeus* L. Fabaceae	Common gorse	Y	Y		Y	Y	Y	Y	Y	Naithani *et al*., 2017; Sandilyan *et al*., 2018

CONCLUSION

According to the available information, 54 invasive alien plant species (IAPs) of 20 families were found in Manipur, among them Fabaceae family recorded highest number of Invasive species. Herb species are more vastly spreading than shrub, climber, grass and tree in this beautiful state. Clearly indicate IAPs are moving upwards in higher elevations than their natural habitat. So as to investigate plants invasion, seasonal species inventories, ground based methods as well as better planning for early detection and link communication between staffs and researcher are very much needed (Singh *et al.*, 2021). This review study concludes that Manipur is having rich and unique biodiversity hotspot but faced severe threats of IAPs due to least investigation.

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