



Invasive alien plants from Arjuni/Mor taluka of Gondia district (M.S.) India: Their diversity and use potential

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Abstract

Tribal and rural people of Arjuni/Mor taluka depend on plant products for their primary healthcare and food. Indigenous communities of study area possess ethnomedicinal knowledge about usage of plants and the invasive alien plants are not the exception. A total number of 54 invasive alien species under 47 genera belonging to 26 families have been recorded, of which 38 (70.37%) and 8 (14.81%) species are being used for medicinal and food purposes respectively. Asteraceae was the dominant family with 7 species and in life form category herbs stand dominant with 34 species. Leaf is the most frequently used plant part for both medicinal and food purposes in the study area. 35 (64.81%) of the invasive plants showed a use value of more than 0.50. This indicates the high acceptance of these plants in the primary healthcare and other ethnobotanical usage. Out of the total of 54 species, 23 species were under the naturalised category of degree of invasiveness followed by 16 species introduced, 07 species possibly invasive, 04 species moderately invasive and 04 species highly invasive. The use of invasive alien species as part of management strategy could lead to the native plant diversity conservation and allows the indigenous vegetation to convalesce thereby enhancing the region's biodiversity. However, the information generated through this study will be helpful for future phytochemical and pharmacological studies.

Keywords: healthcare, food, ethnomedicinal, ethnobotanical, invasive alien plants, biodiversity

Introduction

Historically, humans have depended on nature to provide for their fundamental needs, namely food, clothing, medicines, and natural healing remedies. In India about 2500 plant species are used for medicinal purposes by traditional healers (Chandel *et al.*, 1996) [7]. The World Health Organisation (WHO) reported that approximately 80% of the populations of developing countries rely on traditional medicine for primary health care (WHO, 2002). In India almost 95% of medications are plant based formulations from the traditional system of Unani, Ayurveda, Homeopathy and Siddha and their associate material largely depended on wild harvested plants (Satyavati *et al.*, 1987) [40]. Documentation of indigenous medicinal knowledge of plant species has contributed to a number of modern drug formulations for basic healthcare (Cox, 2000; Bibi *et al.*, 2014) [10, 6]. Exploration on the traditional use of medicinal plants has attained significant consideration within the scientific community in recent years; about 25% of the drugs prescribed worldwide come from plants (Rates, 2001; Jabbar *et al.*, 2007) [34, 17]. Aboriginals believed that some of the seasonal wild vegetables are good for health and also provide the immunity during the rains which is supposed to be the most suspicious period to become ill by various disorders (Setiya *et al.*, 2016) [42]. Now the ancient men are thoroughly acquainted with the method of excluding the harmful substances from the wild plants and preparing recipes for their meager meals (Jain & Tiwari, 2012) [18]. India has a tribal population of 42- million, of whom 60-percent live in forest areas and depend on various edible forest products (Jain & Chauhan, 1998) [19]. Plant species that move from one geographical region to the other (either accidentally or intentionally), establish and proliferate there

and compromise native ecosystems, habitats and species are known as invasive alien plants (Richardson *et al.*, 2000) [36]. Invasive alien plants have been rising as the second greatest risk to global biodiversity after habitat destruction and it is expected to soon surpass the damage caused by habitat destruction and fragmentation (De Milliano *et al.*, 2010; Surendra *et al.*, 2013) [13, 46]. Since the 17th century, invasive alien species have contributed to nearly 40% mixed with indigenous flora (Rothe & Dhale, 2016) [38]. Indian flora also has a significant percentage (173 species) of invasive alien plant species (Reddy, 2008) [35]. Over the last many decades various economically vital plants such as crops and ornamentals are introduced to an alien environment. Some invasive plants are introduced accidentally as contaminants of imported food grains or agricultural/horticultural material or in ships ballast water and some of them are introduced intentionally for their role in commercial forestry, agro-forestry and erosion control. These introduced plants initially considered to be valuable have become a nuisance and hard to oversee. Invasive alien plants are noxious and cause negative impact in environment, ecosystems, habitats, native biodiversity, economics and even human health (Khanna, 2009) [23]. They may cause changes in environmental services, such as flood control, water supply/level, water assimilation, nutrient recycling, conservation and regeneration of soils (Armstrong, 1995; MA, 2006) [2]. Invasion brought about a decline of grass land which influenced the already critically endangered bird species known as the Great Indian Bustards (*Ardeotis nigricaps*) (Tiwari, 1999) [48]. Likewise, the tiger population declined in the Ranthambore National park, Rajasthan, India, due to the poor herbivore prey base which

was an immediate consequence of the invasion of *Prosopis julifera* (Dayal, 2007) ^[12].

Several studies (Njoroge *et al.*, 2004; Zhang & Hiziroglu, 2010) ^[28, 53] have shown that invasive alien plants also have positive economical, social and ecological contributions and that these need to be considered when assessing the costs resulting from invasions. Some alien species, often cultivated, may provide food, medicine, fuel and fodder to local communities (Kull *et al.*, 2007; Roder *et al.*, 2007) ^[25, 37]. Many invasive plants are used in agro-forestry services like rapid biomass accumulation, nitrogen fixation and reforestation of degraded land, improved fallows and contour hedgerows (Crooks, 2002) ^[11]. Critical evaluation of the literature reveals that most of invasive plants are used for fuel, fodder, manure, insecticide, furniture, rope making, pollutant remover (Sekar, 2012; Aravindhan & Rajendran, 2014; Kumar & Bihari, 2015) ^[41, 1, 26].

Several studies also show the ethnobotanical importance of invasive plants in traditional medicine system (Kamble *et al.*, 2011; Surender *et al.*, 2014) ^[21]. In India, a number of attempts have been made to identify the invasive species and their impact on ecosystem and biodiversity (Rothe & Dhale, 2016; Rai & Singh, 2020; Wagh & Jain, 2018; Sandilyan & Charlotte, 2016; Aravindhan & Rajendran, 2014; Kumar & Bihari, 2015; Prabakaran *et al.*, 2019) ^[38, 32, 51, 39, 1, 26, 30] but no study especially on Gondia district was so far performed solely on the status and traditional usage of invasive plants for medicinal, food, domestic and agriculture purposes. Therefore, the present study aimed to report the ethnobotanical uses of the invasive alien plants which can possibly lead to commercial benefits and contribute in arresting the further proliferation of invasive alien plants since an increased market demand for a plant can lead to a rapid decline of the species in the wild. This study further explores habitat, use value and degree of invasiveness to study the ethnobotanical importance of the invasive plants in the study area.

Materials and Methods

Study area

This study was conducted in 11 villages in Arjuni/Mor Taluka of Gondia district, Maharashtra state, India. Surban, Bondgaon, Gothangaon, Pratapgad, Navegaon, Dewalgaon, Khairi, Sukadi, Dabhana, Tidka and Kesori are the villages in study area. All these villages are surrounded by dense forest. Gondia district is situated between 20° 39' to 21°38' N and 79° 27' to 80°42' E. The district is located in the north-eastern part of the state and is bordered by the states of Chhattisgarh and Madhya Pradesh from east and north respectively and Bhandara district and Chandrapur district of Maharashtra to the west and south (Fig.1).

Ethnic background of study site

The total area of the Arjuni/Mor Taluka is 988.21 km². The total population of the taluka is 148265 as per the survey of census during 2011 by Indian Government. Out of which

total scheduled tribes are 33201 comprising 22.39% of total population. Most of the village habitants of Arjuni/Mor taluka belong to Gond tribes which is second largest tribe in India (Choubey, 2013) ^[8]. Gondia district was under the privilege of 'Gond Raja'. The whole area was surrounded by the dense forest. About 2833 km² area of Gondia district is under forest which constitutes 50.22% of the total area. Itiyadoh Dam, Navegaon Bandh National Park and Bird Sanctuary, Nagzira National Park and Pratapgarh Temple are the natural attraction for tourist.

Floristic Exploration of study site

The present study was carried out during 2016-2020. This Information on invasive alien plant species is outcome of ethnobotanical field survey and interviews among old tribal peoples, ethnic men's and women's based on the standard procedures suggested by Jain (1989). The field survey covered different seasons. Plant samples were collected and photographed from their natural habitat including forest, wasteland, river bed, roadside, cultivated field and near localities in the study area and identified with the help of floras (Cook, 1958; Ugemuge, 1986; Sharma, 1996; Singh, 2001) ^[9, 49, 7, 43, 44].

Data collection from informants

Ethnobotanical information was collected by using a semistructured questionnaire developed by Jain (1989). The informants generally age old man, medicine man, forest dwellers, farmers and housewives were selected on the basis of their experience regarding sufficient ethnomedicinal knowledge and their popularity of ethnomedicinal practice in the study area. A total of 46 inhabitants have been interviewed, consisting of 39 men and 07 women. The ages of the participants range from 26 to 85 (Table 1). Notes were recorded on local names, useful plant parts and their utilization by showing photographs of some collected specimens to informants and local peoples. The identified plants are arranged alphabetically with family names, local names and parts used (Table 2).

Degree of invasiveness (DI)

Degree of invasiveness of invasive plants was measured through respondent's opinion. Degree of invasiveness were categorised into 5 different categories namely, naturalised, introduced, possibly invasive, moderately invasive and highly invasive on the basis of their availability. Each respondent was provided with list of 54 invasive plant species in the study area and was asked to sort them separately into 5 pre-selected categories. Each category has been given a number (1 to 5) on the basis of the impact of the species in the study area, the higher the number the higher the impact *viz.* naturalised (1), introduced (2), possible invasive (3), moderately invasive (4) and highly invasive (5) (Wagh & Jain, 2018) ^[51]. Thus opinions regarding the degrees of invasiveness for 54 species of invasive plants were taken from 46 respondents

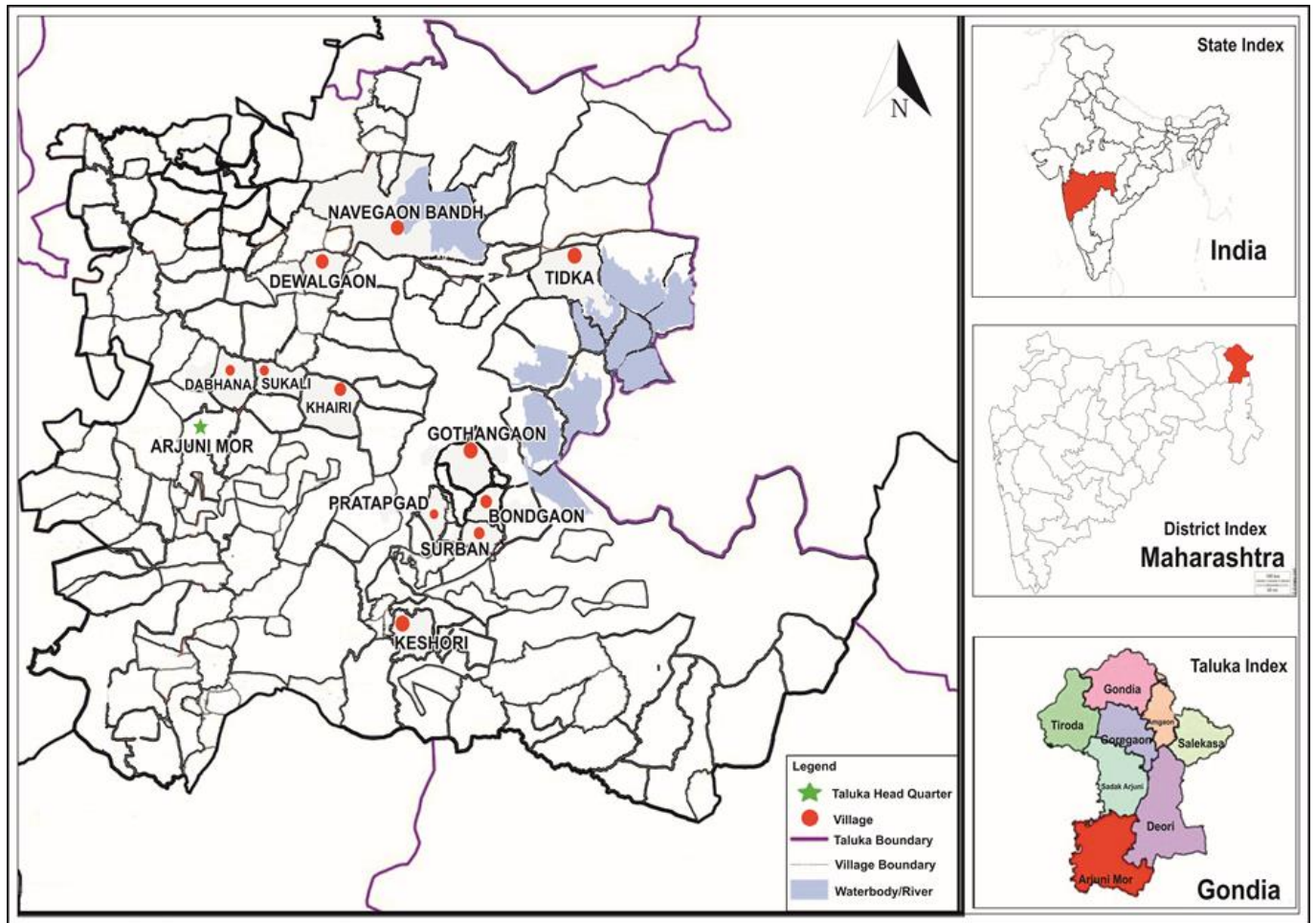


Fig 1: Map of Arjuni/Mor. Taluka of Gondia district, Maharashtra state, India.

Table 1: Characteristics of the study sample, N = 46.

Socio-economic Variables		Number	%
Gender	Female	7	15.21
	Male	39	84.78
Age (years)	26-35	3	6.52
	36-45	12	26.08
	46-55	19	41.3
	56-65	7	15.21
	66-75	4	8.69
	76-85	1	2.17

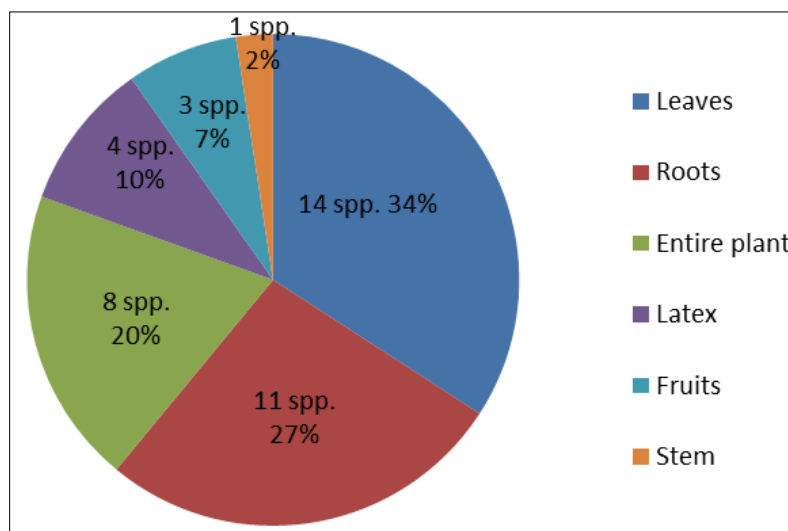


Fig 2: Classification of Ethnomedicinal Invasive plants on the basis of plant parts used

Table 2: List of invasive alien plants used by tribal and local people of study area.

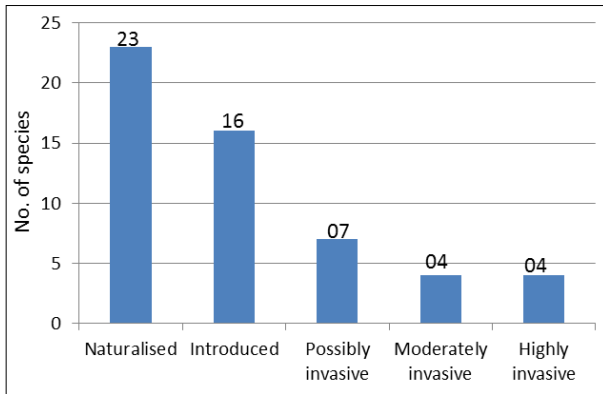
Family and botanical name	Local Name	Habitat	Life form	Nativity	Part used	Ethnobotanical uses	DI	UV
Amaranthaceae								
<i>Alternanthera sessilis</i> (L.) DC.	Jibhkati	River bed	Herb	Tropical America	Leaves	Cooked as vegetable	1	0.65
<i>Amaranthus spinosus</i> L.	Chaulee	Cultivated field	Herb	Tropical America	Leaves	Cooked as vegetable	1	0.86
<i>Celosia argentea</i> L.	Siliyari	Cultivated field	Herb	Tropical Africa	Leaves	Cooked as vegetable	1	0.30
Arecaceae								
<i>Borassus flabellifer</i> L.	Taad	Along roadside	Tree	Tropical Africa	Fruit/Sprouts	Fruits are eaten raw. Whole mature fruit is buried into pit and after successful germination the sprouts are plucked and boiled and eaten.	1	0.32
Asclepiadaceae								
<i>Calotropis gigantea</i> (L.) R. Br.	Rui	Wasteland	Shrub	Tropical Africa	Roots, Latex	Roots are used as anti dysenteric, Latex is used in treatment of Skin diseases	3	0.52
<i>Calotropis procera</i> (Ait.) R. Br	Madar	Wasteland	Shrub	Tropical Africa	Roots	Root powder with cow milk is taken to reduce sperm count by men.	2	0.19
Asteraceae								
<i>Acanthospermum hispidum</i> DC.	Landaga	Wasteland	Herb	Brazil	Entire plant	Used in the treatment of jaundice, malaria, vomiting, snake bite.	1	0.54
<i>Ageratum conyzoides</i> L.	Mukhra	Wasteland	Herb	Tropical America	Entire plant	This plant is used to counter stomach disorders. Also, an extract of the entire plant is taken as a tonic.	5	0.45
<i>Blumea eriantha</i> DC.	Buradi	Wasteland	Herb	Tropical America	Leaves	Used as a diuretic and also for the treatment of cholera, cancer and diarrhea.	1	0.41
<i>Eclipta prostrata</i> (L.) Mant.	Bhrungaraj	Along roadside	Herb	Tropical America	Leaves	Cooked as vegetable	2	0.60
<i>Parthenium hysterophorus</i> L.	Gajar gavat	Wasteland	Herb	North America	Entire plant	Whole plant extract used as insecticide.	5	0.45
<i>Tridax procumbens</i> L.	Kambermodi	Cultivated field	Herb	Central America	Leaves	Leaf juice is applied on wound.	2	0.95
<i>Xanthium strumarium</i> Mill.	Chota gokhru	Along roadside	Herb	Tropical America	Roots	Used in the treatment of Malarial fever, leucorrhoea, cough and asthma	1	0.67
Balsaminaceae								
<i>Impatiens balsamina</i> L.	Terda	Homestead	Herb	Tropical America	Entire plant	Used as Ornamental plant	1	0.67
Cactaceae								
<i>Opuntia elatior</i> Miller	Nagphani	Wasteland	Shrub	South America	Roots	Root bark decoction is given in tuberculosis.	3	0.69
Caesalpiniaceae								
<i>Cassia occidentalis</i> L.	Dewangini tarota	Wasteland	Shrub	South America	Leaves	Leaves are chewed to cure dog bite. Leaf juice is given for regular menstruation.	1	0.65
<i>Cassia absus</i> L.	Kankuti	Wasteland	Herb	Tropical America	Seeds	Seed infusion poured in eye in eye disorders.	1	0.26
<i>Cassia tora</i> L.	Tarota	Wasteland	Herb	South America	Leaves	Cooked as vegetable	4	0.89
Cleomaceae								
<i>Cleome viscosa</i> L.	Pivala tilavan	Wasteland	Herb	Tropical America	Entire plant	Treatment of rheumatic arthritis, hypertension, malaria, neurasthenia, and snakebite	1	0.50
Convolvulaceae								
<i>Evolvulus nummularius</i> (L.)L.	Nimulwel	Wasteland	Herb	Tropical America	Entire plant	Used as fodder	2	0.19
<i>Ipomoea carnea</i> Jacq.	Besharam	Wasteland	Shrub	Tropical America	Latex	Treatment of leucoderma, The latex is used as an antiseptic for treating lesions	2	0.34
<i>Ipomoea hederifolia</i> L.	Lal pungli	Forest	Climber	Tropical America	Leaves	Leaf infusion is given as blood purifier.	2	0.17
<i>Ipomoea nil</i> (L.)Roth.	Kaladana	Wasteland	Climber	North America	Leaves	Leaf paste is useful in piles.	2	0.60
Cuscutaceae								
<i>Cuscuta chinensis</i> Lam.	Amarvel	Parasite	Climber	Mediterranean	Entire plant	Plant decoction is used in jaundice.	3	0.56
<i>Cuscuta reflexa</i> Roxb	Amarvel	Parasite	Climber	Mediterranean	Entire plant	An infusion of this plant is used in the treatment of lice infections, and for the washing of sores.	4	0.10
Euphorbiaceae								
<i>Croton bonplandianum</i> Baill.	Jangli Tulas	Wasteland	Herb	South America	Leaves	Fresh leaf juice is applied topically in wound healing.	1	0.34
<i>Euphorbia hirta</i> L.	Dudhanali	Cultivated field	Herb	Tropical America	Leaves, Latex, Entire plant	Leaves are used in the treatment of urinary disorders, itches, gonorrhoea. Latex of a plant is used in Removing warts. Entire plant extract is used in the treatment of cough, asthma, piles, and semen debility	2	0.71
Fabaceae								
<i>Indigofera tinctoria</i> Ali.	Neel	Forest	Herb	Tropical Africa	Leaves	Leaves Chewed to relieve mouth ulcer.	2	0.58
Lamiaceae								
<i>Hyptis suaveolens</i> (L.) Poit.	Bhut Ganja	Along roadside	Herb	Tropical America	Leaves	Used as anticatarrhal, anticutaneous, parasitic, and an antipyretic	3	0.13
<i>Leonotis nepetifolia</i> (L.)R. Br	Deepmal	Wasteland	Herb	Tropical Africa	Entire plant	Used in burns, breast swelling, ring	3	0.30

						worm, scalds, skin afflictions, malaria and rheumatic pain.		
<i>Ocimum americanum</i> L.	Dev tushi	Wasteland	Herb	Tropical America	Leaves	A paste or extract made from the leaves of this species is applied to the skin in cases of eczema or other epidermal infections.	1	0.78
Malvaceae								
<i>Malachra capitata</i> (L.) L.	Bhur bhendi	Wasteland	Herb	Tropical America	Roots	A root decoction is given in epilepsy.	2	0.58
<i>Malvastrum coromandelianum</i> (L.) Gar.	Chandiri	Wasteland	Herb	Tropical America	Leaves	The leaf decoction is given in jaundice.	1	0.54
<i>Sida acuta</i> Burm.f.	Chikana	Wasteland	Herb	Tropical America	Roots	Root paste is applied on bitten part in snakebite.	2	0.56
<i>Urena lobata</i> L.	Raan kapashi	Wasteland	Shrub	Tropical Africa	Roots	Roots are used as diuretic and used externally for lumbago and rheumatism	1	0.56
Mimosaceae								
<i>Leucaena leucocephala</i> (Lam.) de Wit	Subabul	Along roadside	Tree	Tropical America	Leaves	Used as fodder.	3	0.69
<i>Mimosa pudica</i> L.	Lajurli	Wasteland	Herb	Brazil	Roots	Roots are used as aphrodisiac and strength promotor.	1	0.52
<i>Prosopis juliflora</i> (Sw.) DC.	Vilayati Shami	Wasteland	Shrub	Mexico	Stem	Used as Fuel wood	1	0.73
Oxalidaceae								
<i>Oxalis corniculata</i> L.	Khatti Bhaji/Tipani	Cultivated field	Herb	Europe	Entire plant, Leaves	Entire plant used in Treatment of Piles. Leaves used to cure skin diseases	1	0.67
Papaveraceae								
<i>Argemone mexicana</i> L.	Piwala Dhotra	Wasteland	Herb	South America	Seeds	The powdered seed mixed with coconut oil is used to treat fungal infection.	4	0.58
Poaceae								
<i>Echinochloa crusgalli</i> (L.) P. Beauv.	Khas	Wasteland	Grass	South America	Entire plant	Used as fodder	4	0.84
<i>Saccharum spontaneum</i> L.	Kamis	Wasteland	Grass	Tropical West Asia	Stem	Used for rope Making	2	0.21
Polygonaceae								
<i>Antigonon leptopus</i> Hook. & Arn.	Ice Cream Vel	Along roadside	Climber	Tropical America	Leaves, Seeds	Paste made from fresh leaves is applied externally in skin problems, Seeds are used in diabetes.	3	0.54
Pontederiaceae								
<i>Eichhornia crassipes</i> (Mart.)	Jalkumbhi	Aquatic	Herb	Tropical America	Entire plant	Used as manure	5	0.50
Portulacaceae								
<i>Portulaca oleracea</i> L.	Ghodbhaji	Wasteland	Herb	South America	Entire plant	Cooked as vegetable	2	0.91
Primulaceae								
<i>Anagallis arvensis</i> L.	Ran Draksh	Cultivated field	Herb	Europe	Entire plant	Used as wound healing remedies.	1	0.32
Solanaceae								
<i>Datura metel</i> L.	Dhotra	Wasteland	Shrub	Tropical America	Roots, Leaves, Fruits, Seeds	Roots are used in the treatment of Pimples, Boils. The dried leaves of this species are smoked in the treatment of asthma and bronchitis. The fruit juice is taken as a preventative against dandruff and hair fall. Seeds are astringent, antispasmodic, narcotic and intoxicant	1	0.63
<i>Datura stramonium</i> L.	Dhotra	Wasteland	Shrub	Tropical America	Latex	Plant latex is used in malarial fever.	1	0.28
<i>Physalis minima</i> L.	Phophunda /Chirpoti	Wasteland	Herb	Tropical America	Ripe fruits	Eaten raw.	2	0.76
<i>Solanum nigrum</i> L.	Ranvanga /Kamuni	Cultivated field	Herb	Tropical America	Fruits	Fruits eaten raw and chewed in Toothache.	1	0.71
Tiliaceae								
<i>Corchorus tridens</i> L.	Jangali Tag	Cultivated field	Herb	Tropical Africa	Leaves	Cooked as vegetable.	2	0.21
<i>Triumfetta rhomboidea</i> Jacq.	Jhinjhardi	Wasteland	Herb	Tropical America	Roots	Root infusion is useful in asthma.	2	0.50
Typhaceae								
<i>Typha angustifolia</i> L.	Pan kanis	River bed	Grass	Tropical America	Roots	Root decoction is given as antidote against snakebite.	1	0.30
Verbenaceae								
<i>Lantana camara</i> L.	Ghaneri	Forest	Shrub	Tropical America	Stem, Seeds	Stem is used as tooth brush. Seed powder is applied topically in leucoderma.	5	0.54

Notes: DI (Degree of invasiveness, based on peoples' perception) means that particular species was fallen under this category; "1" is naturalised (species have self-sustaining and spreading capability without human support, but they don't necessarily hamper other plant's growth), "2" is introduced (species are planted and may or may not become naturalised), "3" is possibly invasive (species are locally regenerating but the extent of spread may or may not be limited), "4" is moderately invasive (species are spreading at moderate densities and are considered to have some immediate problem), "5" is highly invasive (species become dominant or co-dominant in the invaded region and are considered a threat to the native flora and ecosystem) (Wagh & Jain., 2018) ^[51]. UV: use value.

Table 3: Diversity of invasive ethnobotanical plants at different habitats in the study areas.

Habitat	Herbs(34)	Shrubs(10)	Climbers(5)	Grasses(3)	Trees(2)	Total(54)
Along road side	3(3.0)	0(0)	1(1.0)	0(0)	2(2.0)	6(6.0)
Cultivated field	8(8.0)	0(0)	0(0)	0(0)	0(0)	8(8.0)
Wasteland	19(19.0)	9(9.0)	1(1.0)	2(2.0)	0(0)	31(31.0)
Aquatic	1(1.0)	0(0)	0(0)	0(0)	0(0)	1(1.0)
River bed	1(1.0)	0(0)	0(0)	1(1.0)	0(0)	2(2.0)
Forest	1(1.0)	1(1.0)	1(1.0)	0(0)	0(0)	3(3.0)
Parasites	0(0)	0(0)	2(2.0)	0(0)	0(0)	2(2.0)
Homestead	1(1.0)	0(0)	0(0)	0(0)	0(0)	1(1.0)

**Fig 3:** DI Categories of invasive alien plants in the study area.**Use value (UV)**

The use-value (UV) for each species was used to calculate the citation of plants during interviews, proposed by Phillips *et al.* (1994) and adapted by Ferreira *et al.* (2009) [14]. It is calculated as follows:

$$UV = \Sigma U/n$$

Where 'U' is the sum of the total number of use citations by all informants for a given species, divided by the total number of informants (n). This method evaluates the relative importance of each plant species based on its relative use among informants and does not depend on the opinion of the researcher (Ferreira *et al.*, 2009) [14].

Results and Discussion

A present survey was undertaken to identify and document the ethnobotanical information of invasive alien plant species in Arjuni/Mor Taluka of Gondia district, Maharashtra state, India. A total number of 54 invasive alien plants from 26 families belonging to 47 genera were recorded for family, botanical name, local name, habitat, life form, nativity, part used, ethnobotanical uses, the degree of invasiveness (DI) and use value (UV). Among the 26 families, the most widely utilized plant species belong to Asteraceae (7), Convolvulaceae (4), Malvaceae (4), Solanaceae (4) followed by Amaranthaceae (3), Caesalpiniaceae (3), Lamiaceae (3), Mimosaceae (3). Asclepiadaceae, Cuscutaceae, Euphorbiaceae, Poaceae, Tiliaceae are with two species each, and the rest of the thirteen families with single species (Table.2). Many researchers also recorded the dominance of Asteraceae among invasive alien species (Aravindhan & Rajendran, 2014; Kumar & Bihari, 2015) [1, 26]. Sekar (2012) [41] in Indian Himalayan region have also recorded that the species under the Asteraceae, Solanaceae, Convolvulaceae, Fabaceae, Amaranthaceae, Poaceae, Caesalpiniaceae, Euphorbiaceae, Mimosaceae and Tiliaceae families are frequently used as medicinal plants.

A total of 46 informants (at age of 26 to 85), having rich knowledge and experience of the use of native as well as invasive medicinal flora were interviewed (Table 1). 46-55 year age group were dominant (41.3%) among the informants. The observations from the study show that the traditional knowledge about medicinal plants and their uses was declining day by day among the younger generation. The same observation was made by Bhatia *et al.*, (2014) [5]. While analyzing the life forms, it was noticed that 34 species were herbs, 10 shrubs, 5 climbers, 3 grasses and the remaining 2 were trees (Table.3). Several researchers also found similar results with this study regarding the dominance of herbaceous plants in the ethnobotanical uses (Bhatia *et al.*, 2014; Rao *et al.*, 2015; Wagh and Jain., 2018) [5, 33, 51]. Among the 54 different invasive alien plants in the study area 38 (70.37%) were used for a medicinal purposes. Inhabitants are using these plants to cure many diseases like Jaundice, Cough, Malaria, Diarrhea, Dysentery, Wound healing, Diabetes, Fever, Vomiting, Skin diseases, Urinogenital disorder, Menstrual disorder, Hypertension, Piles etc. Khonde *et al.*, 2012 [24]; Ghoshal and Saoji., 2013 [15] and Rao *et al.*, 2015 [33] also reported the same ailment categories in different parts of India. Tribal and local peoples in study area uses different preparation methods i.e. decoction, extract, juice, powder, infusion, paste and Oil. The parts of the plants used for medicinal purposes were stem, leaf, root, fruits, seed, whole plant and latex. Among the total plant parts leaves were the most frequently used plant parts (14 spp.) followed by root (11 spp.), Entire plant (8 spp.), latex (4 spp.), fruit (3 spp.) and stem (1 spp.) (Fig. 2., Table 2). Leaves and roots were the most preferred plant parts as they contain a high concentration of the bioactive compounds (Ullah *et al.*, 2013). In India the predominant use of leaves was reported by many researchers (Iqbal *et al.*, 2010; Zingare., 2012; Puranik., 2013; Bhatia *et al.*, 2014; Rao *et al.*, 2015) [16, 54, 31, 33]. From this study, it was confirmed that the aerial part of the plant is the most preferred plant parts (53.65%) than that of the underground and whole plant parts (46.34%). The present study also explored the degree of invasiveness of the plant species. Among 54 species, 23 species were under the naturalised category followed by 16 species introduced, 7 species possibly invasive, 4 species moderately invasive and 4 species highly invasive (Fig. 3). From this study it is clear that, most of the species (42.59%) are naturalised that means these species does not show much negative effect on the native flora. Some of the species such as *Ageratum conyzoides*, *Parthenium hysterophorus*, *Lantana camara*, and *Eichhornia crassipes* are categorised under highly invasive and have negative impact on the native flora. Similar observation was made by many researchers (Wagh & Jain., 2018; Khan *et al.*, 2011) [51, 22].

Habitat wise analysis showed that diversity of invasive plants was highest in the wasteland (31 spp.) followed by the cultivated field (8 spp.), roadside (6 spp.), forest (3 spp.), river bed (2 spp.), parasites (2 spp.), homestead and aquatic (1 spp.), each (Table 3). Result also revealed that the diversity of herbs, shrubs, climbers and grasses was highest in wasteland only. This study result shows coherence with the study conducted by Khan *et al.*, (2011) [22] and Wagh & Jain., (2018) [51] they also recorded the higher diversity of herbs, shrubs, climbers and grasses in wasteland. From this observation, it was concluded that the wastelands are the best habitat for the luxuriant growth of invasive alien plants. The present study also recorded some other important uses of invasive plants other than medicinal uses. In that category, a maximum number of plants are used as edible plants (8 spp.) followed by fodder (3 spp.), ornamental (1 spp.), fibre yielding (1 spp.), manure (1 spp.) and the plant used as an insecticide (1 spp.) (Table 2). *Alternanthera sessilis*, *Amaranthus spinosus*, *Cassia tora*, *Celosia argentea*, *Corchorus tridens*, *Eclipta prostrata*, *Physalis minima* and *Portulaca oleracea* are categorised under edible plants and are easily available in the vicinity of study area. Many rural parts of the world depend on wild edible plants for their food (Sundriyal, 2003) [45]. Edible plants are not only supplement to the food quantity, but also an important option during starvation for survival and thus make significant contribution to the human nutrition throughout the year.

The use value of the plant was appraised to study the importance of invasive alien plants used in the study area. The plants with high use value indicate the frequent use whereas the low use value indicates least prefer. It is observed that about 35 plant species (64.81%) show the use value of more than 0.50 (Table 2). This result shows that tribal and local peoples in study area used these plants frequently for curing various ailments and other purposes. The present study reported *Tridax procumbens* has the highest use value (0.95), followed by *Portulaca oleracea* (0.91), *Cassia tora* (0.89), *Amaranthus spinosus* (0.86) and *Echinochloa crusgalli* (0.84). The lowest use value reported species are *Cuscuta reflexa* (0.10), *Hyptis suaveolens* (0.13) and *Calotropis procera* (0.19). Several researchers have reported the use of *Tridax procumbens* in a different treatments such as toothache, foot cracks, wounds and diabetes (Wagh & Jain., 2018; Bakare, 2014; Thomas *et al.* 2014; Bhagwat *et al.*, 2008) [51, 3, 47, 4]. Several plants are already examined for their pharmacological activity, but further research on many more plant species are needed to test them for phytochemical and pharmacological importance.

Conclusion

This study revealed that most of the tribal and local peoples in and around the study area use invasive plant species for their traditional health care practices due to the unavailability of modern medicinal facilities. Forest resources are the only source for curing the various diseases. Inhabitants of study area were using 54 invasive alien plants belong to 26 different families. This imply that study area have rich diversity of invasive plants and populace had great traditional knowledge regarding the uses of these plants not only in primary health care but also in fodder, food, manure, fuel wood, insecticide, etc.

No such study has been done before to highlight the importance of the invasive alien plants. The use value of 35 plant species is more than 0.50, and this is due to the massive use of these plants for medicinal purposes. Exploitation of the medicinal properties of these plants can minimize the pressure on the native plant species, which are already facing various kinds of threat. Ultimately the commercial utilization of invasive alien plants, especially screening their medicinal potential for the development of new drugs is also the alternative ways for better management or eradication of these weeds. However, findings of this study will be helpful for further phytochemical and pharmacological investigation of new bioactive compounds for the treatment of various ailments.

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