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Diversity of angiosperms and their conservation status in Susunia hill and adjacent regions, Bankura District, West Bengal, India

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ABSTRACT

Angiosperms are the most important group among the plant kingdom. An attempt was made to study the angiosperms diversity and their conservation status of Susunia hill and its adjacent region in Bankura district, West Bengal. The plants were collected from the study area and identified. Field survey method was used for the present investigation. The threatened, endangered, not evaluated, least concern and vulnerable status of plant species were confirmed by India biodiversity portal and other standard publications on rare and threatened taxa of the country. A total of 91 species of angiosperms were recorded which were represented by 84 genera belonging to 42 different families. During the survey period 02 species of Pteridophytes under 02 genera belonging to 02 different families were also reported. Fabaceae was recorded as most dominant family from the angiosperms in study site. There were 36 species as least concern, 10 species as not evaluated, 04 species as vulnerable, 01 species as near threatened and 01 species as endangered as per the IUCN threatened categories. Analysis of habits showed that trees were represented by the highest proportion followed by perennial herbs, shrubs, annual herbs and climbers. The present study is the compilation of data on threatened plants of Susunia hill purview over various literatures with an update on their present status. It needs conservation of the biodiversity and their habitat as well as to increase the awareness of the people for the importance of the study site.

Key words: Angiosperms, Conservation status, Susunia hill, Bankura.

Introduction

The biodiversity loss occurs worldwide due to enormous anthropogenic activities such as pollution, global warming, over population, habitat modification, climate changes etc. Loss of biodiversity is a current issue in the field of ecology and it is the subject for many researchers. A large number of parameters have been promoted by researchers to measure for the indication of the status of biodiversity in ecologi-

cal systems, for conservation, planning, management, environmental monitoring and decision making (Borah *et al.*, 2021). The risk of extinction of a species is provided by representing the list of the threatened species which is based on the most recently available ecological data for that species (Jeph and Khan, 2019; Lasushe *et al.*, 2022).

The most important factor is to identify the alarming rate at which the species becomes extinct which will aid to secure that the extant biodiversity

can be preserved, maintained and recovered (Leu *et al.*, 2019; Costante *et al.*, 2022).

Hills are considered as extensive reservoirs of angiosperms as they are least explored and away from human occupation. Despite of richness in floral and faunal diversity it also has great geological and ecological uniqueness and representiveness (Bargali *et al.*, 2022). Angiosperms show variation in diversity at different elevations. Altitude provides changes in the availability of resources like temperature, water etc which are also important ecological factors for habitat diversity (Sankaran *et al.*, 2015). An extensive study of angiosperms in diverse hills of India will aid for identification of new species. Inventorization of angiosperms diversity, addressing depleting ethnobotanical knowledge, moreover detailed account on floristic study of existing angiosperms and ecology of habitats, present trends and status of medicinal and endangered species, in the most structurally complex hilly region containing the biological diverse ecosystem add an exceptional importance in floristic study (Cuong *et al.*, 2020; Bargali *et al.*, 2022).

The IUCN Red List provides the information to the scientists and help to explore the information on their status, trends, and threats. It also provide to catalyze the action for conservation of biodiversity (Leao *et al.*, 2014; Mondal *et al.*, 2015; Betts *et al.*, 2020).

Materials and Methods

Study site

Susunia hill is located between 23.56°N latitude and 86.95°E longitude at Chatna block of Bankura district, West Bengal. The distance of the hill is about 10 Km from Chhatna town and is about 20 Km from Bankura town. Altitude of the hill is about 1800 feet. The hill is wrapped by different kinds of flora, fauna and medicinal plants. It is one of the well-known fossil spots for palaeobotanist. It is also a famous site for freshers, trekkers as well as scientists. Rock climbing and camping are conducted around the hill during winter season.

Fresh and tasteful water is obtained from the waterfalls of the hill. Gandheswari river keeps whispering always down the hill and *Butea monosperma* (palash) dominates the overall hill with its flaming orange hue in seasons. A park and a guest house are also available here for tourists to leisure the time.

Many craftsmen are dependent on the hill for their handicraft. Craftsmen are residing in Netkamla and Bindhyajam villages around the hill (Fig. 1).

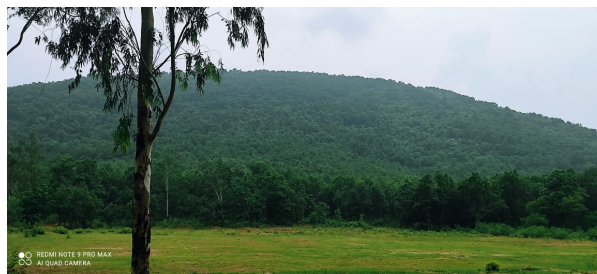


Fig. 1. A view of Susunia hill, Bankura district.

Traditional herbal healers of the neighboring villages of Susunia hill are also dependent on the hill to obtain their raw material for their livelihood (Rahaman and Karmakar, 2015). Some adjoining villages of the Susunia hill are Sheulibona, Hapania, Ramnathpur, Bagdiha, Kushbona, Paharberia, Bharatpur and Biduria. The people belonging from these villages are mainly aboriginal of this district. The tribal communities are Murmu, Hansda, Mandi, Soren, Kishku and Hembram.

Data collection, sample collection and identification

For the present study in Susunia hill and adjoining areas field survey method has been used which was followed by questionnaire. A few field trips has been conducted during the periods of January 2020 to June 2020 and January 2022 to August 2022. Plant specimens has been collected and herbarium sheets has been prepared for preservation in herbarium, S.K.B. University, Purulia. For proper identification adequate literatures has been consulted (Guha Bakshi, 1984; Sanyal, 1994; Sankar *et al.*, 2008; Biswas *et al.*, 2016, 2017; Mandal and Mukherjee, 2016; Hussain *et al.*, 2016; Roy, 2020; Paul, 2021; Chaudhari and Pathak, 2022; Das, 2021, 2022; Kumar *et al.*, 2021; Mandal, 2021; Krishnakumar and Ramesh, 2022; Mandal *et al.*, 2022 a,b; Pawar and Telave, 2022; Prakash *et al.*, 2022; Thao, 2022). Valid names of collected plant specimens has been checked by POWO (2022).

Results and Discussion

A total of 91 species of angiosperms has been recorded which were represented by 84 genera belonging to 42 different families. Out of 93 species

Table 1. An enumeration of different species in Susunia hill, Bankura district.

Sl. No.	Scientific names of the plants	Family	Vernacular/ Common name	Habit	Fl.& Fr.season
1	<i>Acacia auriculiformis</i> A. Cunn.ex Benth.	Fabaceae	Akashmoni	T	July-Sept
2	<i>Acalypha indica</i> L.	Euphorbiaceae	Muktojhuri	PH	Feb-May
3	<i>Achyranthes aspera</i> L.	Amaranthaceae	Apang	PH	TOY
4	<i>Adiantum caudatum</i> L.	Pteridaceae	Walkingfern	PH	NFP
5	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Bel	T	Feb-May
6	<i>Ailanthus altissima</i> (Mill.) Swingle	Simaroubaceae	Mahanimba	T	Nov-Feb
7	<i>Ailanthus excelsa</i> Roxb.	Simaroubaceae	Mahanimba	T	Janu-Mar
8	<i>Alangium salviifolium</i> (L.f.) Wangerin	Cornaceae	Ankura	T	Feb-May
9	<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae	Chhatim	T	Nov-Jan
10	<i>Alternanthera sessilis</i> (L.) R.Br.ex DC.	Amaranthaceae	Shalantisak	PH	TOY
11	<i>Andrographis paniculata</i> (Burm.f.)Nees	Acanthaceae	Kalmegh	PH	Feb-Apr
12	<i>Antidesma venosum</i> E.Mey.exTul.	Phyllanthaceae	Archal	T	July-Sept
13	<i>Antirrhinum majus</i> L.	Plantaginaceae	Snapdragon	AH	Mar-May
14	<i>Argemone mexicana</i> L.	Papaveraceae	Shialkanta	PH	Feb-May
15	<i>Asparagus tenuifolius</i> Lam.	Asparagaceae	Shatamuli	C	Apr-June
16	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Neem	T	Dec-July
17	<i>Bauhinia variegata</i> (L.) Benth.	Fabaceae	Kanchan	T	Jun-Aug
18	<i>Boerhavia repens</i> L.	Nyctaginaceae	Khaprasak	AH	July-Sept
19	<i>Borassus flabellifer</i> L.	Arecaceae	Tal	T	May-July
20	<i>Butea monosperma</i> (Lam.) Kuntze	Fabaceae	Palash	T	Feb-May
21	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Fabaceae	Krishnachura	S	Jun-Aug
22	<i>Cajanus scarabaeoides</i> (L.) Thouars	Fabaceae	Bonkurti	C	July-Sept
23	<i>Catharanthus roseus</i> (L.)G. Don	Apocynaceae	Nayantara	PH	TOY
24	<i>Chromolaena odorata</i> (L.) R.M.King&H.Rob.	Asteraceae	Tonkabean	S	TOY
25	<i>Chrysobalanus icaco</i> L.	Chrysobalanaceae	Cocoplum	T	Feb-Apr
26	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Poaceae	Chorkanta, Jurgunda	PH	July-Sept
27	<i>Chrysopogon zizanioides</i> (L.) Roberty	Poaceae	Bena	PH	Sept-Nov
28	<i>Cissampelos pareira</i> L.	Menispermaceae	Kijri	C	July-Sept
29	<i>Clerodendrum Infortunatum</i> L.	Lamiaceae	Ghentu	S	Feb-Apr
30	<i>Costus spiralis</i> (Jacq.) Roscoe	Costaceae	Ketaki	PH	July-Sept
31	<i>Crassula helmsii</i> (Kirk) Cockayne	Crassulaceae	Crassula	PH	July-Sept
32	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	Bhabari	AH	TOY
33	<i>Cyanthillium cinereum</i> (L.) H.Rob.	Asteraceae	Kakshima	AH	TOY
34	<i>Cyperus compressus</i> L.	Cyperaceae	Mutha	PH	July-Sept
35	<i>Cyperus hermaphrodites</i> (Jacq.) Standl.	Cyperaceae	flatsedge	PH	July-Sept
36	<i>Cystopteris fragilis</i> (L.) Bernh.	Cystopteridaceae	Fragile fern	PH	NFP
37	<i>Dalberia sissoo</i> Roxb.ex DC.	Fabaceae	Shishu	T	Apr-June
38	<i>Digitaria sanguinalis</i> (L.) Scop.	Poaceae	Makur-jali	AH	July-Sept
39	<i>Diospyros kaki</i> L.f.	Ebenaceae	Kendu	T	Feb-May
40	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	Chapra	AH	July-Sept
41	<i>Eranthemum roseum</i> (Vahl) R.Br.ex Roem. & Schult.	Acanthaceae	Dasmuli	S	Feb-Apr
42	<i>Eucalyptus globulus</i> Labill.	Myrtaceae	Akashmoni	T	Feb-Apr
43	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Khirkakali	AH	July-Sept
44	<i>Evolvulus nummularius</i> (L.)L.	Convolvulaceae	Nupurlata	PH	Octo-Jan
45	<i>Festuca ovina</i> L.	Poaceae	Sheep's fescue	PH	July-Sept
46	<i>Ficus benghalensis</i> L.	Moraceae	Bat	T	Nov-Janu
47	<i>Ficus hispida</i> L.f.	Moraceae	Dumur	T	Feb-May
48	<i>Frangula dodonei</i> Ard. Alder Buckthorn	Rhamnaceae	Alder Buckthorn	S	July-Sept
49	<i>Gomphrena celosioides</i> Mart.	Amaranthaceae	Chanchi	PH	TOY
50	<i>Helicteres isora</i> L.	Malvaceae	Atmochra	S	Oct-Jan

Table 1. Continued ...

Sl. No.	Scientific names of the plants	Family	Vernacular/ Common name	Habit	Fl.& Fr.season
51	<i>Heliotropium indicum</i> L.	Boraginaceae	Hatisur	AH	Jun-Aug
52	<i>Hemidesmus indicus</i> (L.) R.Br.	Apocynaceae	Anantamul	C	Oct-Dec
53	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Jaba	S	TOY
54	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Ulmaceae	Chharra	T	Feb-April
55	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	Kulekhara	AH	July-Sept
56	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Berakalmi	S	TOY
57	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Kuchiverra	S	Feb-Apr
58	<i>Lantana camara</i> L.	Verbenaceae	Putus	S	TOY
59	<i>Lawsonia inermis</i> L.	Lythraceae	Mehendi	T	Aug-Oct
60	<i>Leonotis nepetifolia</i> (L.) R.Br.	Lamiaceae	Hejhurchi	S	Oct-Dec
61	<i>Ligustrum lucidum</i> W.T. Aiton	Oleaceae	Glossyprivet	T	Feb-Apr
62	<i>Melia azedarach</i> L.	Meliaceae	Banneem	T	Dec-Jul
63	<i>Muntingia calabura</i> L.	Muntingiaceae	Festival berry	T	Aug-Oct
64	<i>Murraya paniculata</i> (L.) Jack	Rutaceae	Kamini	S	Mar-May
65	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae	Kadam	T	July-Sept
66	<i>Ocimum basilicum</i> L.	Lamiaceae	Bantulsi	AH	July-Sept
67	<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Tulsi	PH	Oct-Jan
68	<i>Ouret lanata</i> (L.) Kuntze	Amaranthaceae	Daykhay	PH	TOY
69	<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	Khejur	T	Jun-Aug
70	<i>Phyllanthus virgatus</i> G. Forst.	Phyllanthaceae	Bhuiamla	AH	July-Sep
71	<i>Psydrax lividus</i> (Hiern) Bridson	Rubiaceae	Paharjhuko	T	Feb-Apr
72	<i>Saccharum spontaneum</i> L.	Poaceae	Kashi	PH	Sept-Nov
73	<i>Scoparia dulcis</i> L.	Plantaginaceae	Bondhone	PH	TOY
74	<i>Sida acuta</i> Burm.f.		Malvaceae	Berela	PH TOY
75	<i>Sida cordifolia</i> L.	Malvaceae	Berela	PH	Jun-Aug
76	<i>Semecarpus anacardium</i> L.	Anacardiaceae	Bhala	T	Aug-Oct
77	<i>Senna occidentalis</i> (L.) Link	Fabaceae	Kalkashunda	S	Jun-Aug
78	<i>Shorea robusta</i> C.F. Gaertn.	Dipterocarpaceae	Shal	T	Apr-June
79	<i>Solanum diphyllum</i> L.	Solanaceae	Twoleaf nightshade	S	July-Sept
80	<i>Solanum sisymbriifolium</i> Lam.	Solanaceae	Sadakantikri	AH	Feb-Apr
81	<i>Sorghum halepense</i> (L.) Pers.	Poaceae	Sor	PH	July-Sept
82	<i>Spondias pinnata</i> (L.f.) Kurz	Anacardiaceae	Amra	T	Apr-June
83	<i>Strychnos nux-vomica</i> L.	Loganiaceae	Kuchila	T	July-Sept
84	<i>Tamarindus indica</i> L.	Fabaceae	Tentul	T	Mar-May
85	<i>Tectona grandis</i> L.f.	Lamiaceae	Segun	T	Jun-Aug
86	<i>Terminalia arjuna</i> (Roxb.ex DC.) Wight & Arn.	Combretaceae	Arjun	T	May-July
87	<i>Tragia involucrata</i> L.	Euphorbiaceae	Bichhati	C	July-Sept
88	<i>Trema micrantha</i> (L.) Blume	Cannabaceae	Jamaican Nettle tree	S	July-Sept
89	<i>Tridax procumbens</i> L.	Asteraceae	Taraful	PH	TOY
90	<i>Urena lobata</i> L.	Malvaceae	Banokra	S	July-Sept
91	<i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb.	Fabaceae	Babla	T	Feb-Apr
92	<i>Vitex negundo</i> L.	Lamiaceae	Nishinda	T	July-Sept
93	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	Kul	T	Dec-Feb

AH-Annual Herb; PH-Perennial Herb; C- Climber; S- Shrub;T-Tree; NFT – Non Flowering Plant; TOY-Throughout the year.

conservation status of 52 species has been described (Table 1 & 2).

Susunia hill is rich in biological diversity as well as ethnic peoples along with ethnobotanical resources. Essentially hill is an abode to a large number of medicinal flora and fauna. From taxonomic analysis of the angiosperms it was revealed that Fabaceae to be the most predominant family with 09 species which was followed by Poaceae with 07 species.

Life form of the species

The life form of different plant species were also concerned. It was observed that only 12 spp. e.g. *Antirrhinum majus*, *Heliotropium indicum*, *Ocimum basilicum* etc. were annual herbs and 25 spp. e.g. *Oureta lanata*, *Costus spiralis*, *Sorghum halepense* etc. were recorded as perennial herbs. Only 16 spp. were shrub, e. g. *Helicteres isora*, *Ipomoea carnea*, *Chromolaena odorata*, *Eranthemum roseum*, *Jatropha gossypifolia*, *Murraya paniculata* etc. 35 spp. e.g. *Diospyros kaki*, *Butea monosperma*, *Ligustrum lucidum*, *Psydrax lividus* etc were found as trees and only 05 spp. e.g. *Asparagus tenuifolius*, *Cajanus scarabaeoides*, *Cissampelos pareira* etc. were reported as climber in the present study.

Flowering and fruiting seasons

Flowering periods of these plant species occurs in different seasons e.g. February to May (pre-monsoon), June to September (monsoon) and October to January (post-monsoon). As many as 21 spp. were seen to flowers in the pre-monsoon season, 33 spp. in monsoon and 07 spp. in the post-monsoon seasons (Fig. 2). While analyzing range of flowering season(s) of the concerned species only 14 spp. were found to flower throughout the year. Only two spp. (e.g. *Azadirachta indica* and *Melia azedarach*) flow-

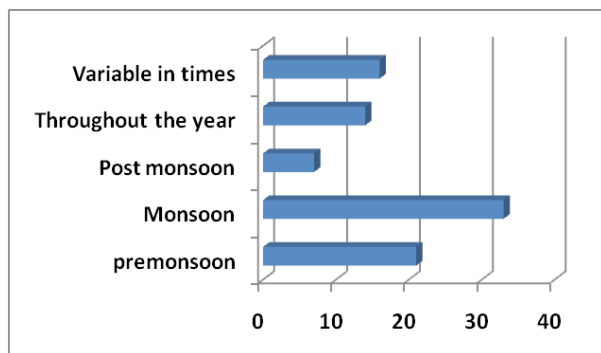


Fig. 2. Flowering and fruiting seasons of angiosperms.

ered in three seasons. Flowering and fruiting seasons of more than 14 spp. were in variable times. The variable responses of these species regarding flowering can be attributed to the timing of vegetative phenology that strongly determines the flowering periods. Variation in flowering time is related to vegetative phenology, especially leafing events is induced by a variety of factors (rain in winter/summer, decreasing or increasing photoperiod, or drought induced leaf fall), results in a number of flowering patterns in tropical trees (Borchert *et al.*, 2004). Several important climatic factors, such as temperature and sunshine period are also respon-

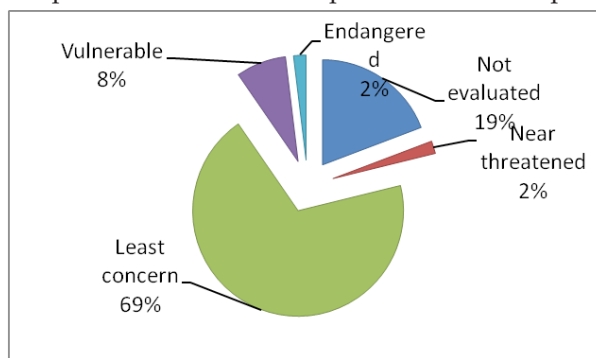


Fig. 3. Conservation status of angiosperms at Susunia hill.

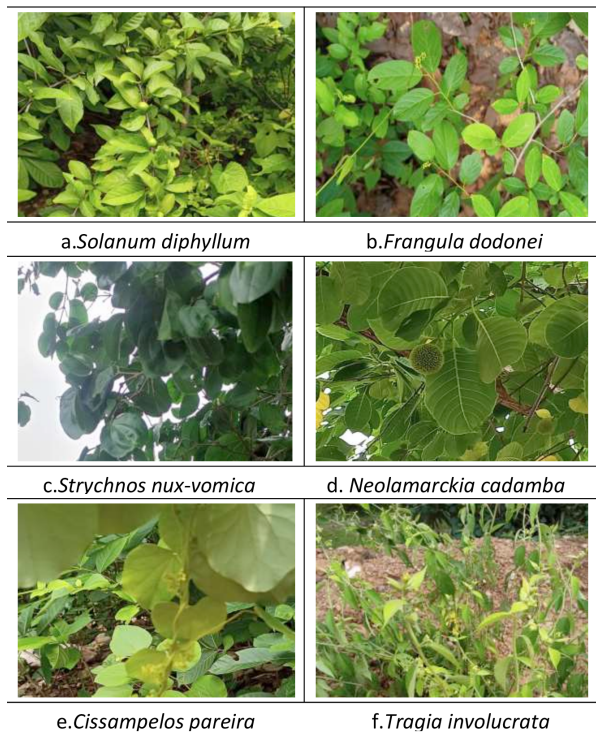


Fig. 4. A few views(a -f) of collected plants from Susunia hill.

Table 2. Conservation status of collected plant species from Susunia hill, Bankura district.

Sl No	Scientific names of the plants	Family	Conservation status
1	<i>Acacia auriculiformis</i> A.Cunn.ex Benth.	Fabaceae	LC
2	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	V
3	<i>Ailanthus excelsa</i> Roxb.	Simaroubaceae	NE
4	<i>Alangium salvifolium</i> (L.f.) Wangerin	Cornaceae	LC
5	<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae	LC
6	<i>Alternanthera sessilis</i> (L.)R.Br.ex DC.	Amaranthaceae	LC
7	<i>Andrographis paniculata</i> (Burm.f.) Nees	Acanthaceae	V
8	<i>Antidesma venosum</i> E. Mey.ex Tul.	Phyllanthaceae	LC
9	<i>Argemone mexicana</i> L.	Papaveraceae	NE
10	<i>Asparagus tenuifolius</i> Lam.	Asparagaceae	LC
11	<i>Azadirachta indica</i> A. Juss.	Meliaceae	LC
12	<i>Bauhinia variegata</i> (L.) Benth.	Fabaceae	LC
13	<i>Borassus flabellifer</i> L.	Arecaceae	EN
14	<i>Butea monosperma</i> (Lam.) Kuntze	Fabaceae	LC
15	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Fabaceae	LC
16	<i>Cajanus scarabaeoides</i> (L.) Thouars	Fabaceae	LC
17	<i>Chrysobalanus icaco</i> L.	Chrysobalanaceae	LC
18	<i>Clerodendrum infortunatum</i> L.	Lamiaceae	LC
19	<i>Cyperus compressus</i> L.	Cyperaceae	LC
20	<i>Digitaria sanguinalis</i> (L.) Scop.	Poaceae	LC
21	<i>Diospyros kaki</i> L.f.	Ebenaceae	LC
22	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	LC
23	<i>Eranthemum roseum</i> (Vahl)R.Br.ex Roem. & Schult.	Acanthaceae	LC
24	<i>Eucalyptus globulus</i> Labill.	Myrtaceae	LC
25	<i>Festuca ovina</i> L.	Poaceae	NT
26	<i>Ficus benghalensis</i> L.	Moraceae	NE
27	<i>Ficus hispida</i> L.f.	Moraceae	LC
28	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	NE
29	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Ulmaceae	NE
30	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	LC
31	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	LC
32	<i>Lantana camara</i> L.	Verbenaceae	NE
33	<i>Lawsonia inermis</i> L.	Lythraceae	LC
34	<i>Ligustrum lucidum</i> W.T. Aiton	Oleaceae	LC
35	<i>Melia azedarach</i> L.	Meliaceae	LC
36	<i>Phoenix sylvestris</i> (L.)Roxb.	Arecaceae	NE
37	<i>Saccharum spontaneum</i> L.	Poaceae	LC
38	<i>Sida acuta</i> Burm.f.	Malvaceae	NE
39	<i>Sida cordifolia</i> L.	Malvaceae	NE
40	<i>Semecarpus anacardium</i> L.	Anacardiaceae	LC
41	<i>Senna occidentalis</i> (L.) Link	Fabaceae	LC
42	<i>Shorea robusta</i> C.F. Gaertn.	Dipterocarpaceae	LC
43	<i>Solanum sisymbriifolium</i> Lam.	Solanaceae	LC
44	<i>Strychnos nux-vomica</i> L.	Loganiaceae	V
45	<i>Tamarindus indica</i> L.	Fabaceae	LC
46	<i>Tectona grandis</i> L.f.	Lamiaceae	NE
47	<i>Terminalia arjuna</i> (Roxb.ex DC.) Wight & Arn.	Combretaceae	V
48	<i>Trema micrantha</i> (L.) Blume	Cannabinaceae	LC
49	<i>Urena lobata</i> L.	Malvaceae	LC
50	<i>Vachellia nilotica</i> (L.)P.J.H. Hurter & Mabb.	Fabaceae	LC
51	<i>Vitex negundo</i> L.	Lamiaceae	LC
52	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	LC

NE-Not Evaluated, NT-Near Threatened;LC-Least Concern; V- Vulnerable; EN-Endangered.

sible for the variation of flowering phenology among species. Various strategies, such as the variations on flowering phenology, fruit type and flower colour have been developed by the plants, to promote their reproductive success (Wang *et al.*, 2020). Phenological shift occurs due to the ecological effects of global climate change. From the literatures it was elucidated that timing of flowering and fruiting seasons in most of the species are advancing in response to warmer temperatures (Sandor *et al.*, 2021).

Conservation status

Overall, the IUCN threatened categories of plant species revealed that the 36 spp. were considered as least concern and 10 spp. as not evaluated. Red lists attract attention of scientists for the conservation of threatened species. As a consequence, for conservation of biodiversity it was determined by the impact of these red lists (Andrade and Freitas, 2021).

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