

6-6-2024

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Available at: <https://journals.tubitak.gov.tr/agriculture/vol48/iss3/10>



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Underutilized edible fruit species of the Indo-Gangetic Plains: A systematic review for food security and land degradation neutrality

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Underutilized edible fruit species of the Indo-Gangetic Plains: a systematic review for food security and land degradation neutrality

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Received: 10.08.2023

Accepted/Published Online: 19.04.2024

Final Version: 06.06.2024

Abstract: Many underutilized edible fruit species (UEFS) are found in the Indo-Gangetic Plains (IGP), which support food security (FS) for both indigenous people and other dependent communities. Unfortunately, there is little study and fragmented information available about these naturally edible products. The UEFS of the IGP was the subject of a systematic review utilizing the PRISMA protocol, which produced implications for FS and land degradation neutrality (LDN). This review aims to survey, summarize, and annotate the published information about the angiosperms native and naturalized UEFS of IGP to identify and make use of this species, particularly for the sustainable development of this region. A systematic review confirmed that 371 species of UEFS, of which 62 species were threatened and near threatened (TNT)-UEFS. Among the TNT-UEFS, 41 species were threatened, while 21 species were NT. The threatened species were further categorized as per the International Union for Conservation of Nature (IUCN) Red List in the IGP as vulnerable (21 species), endangered (16 species), and critically endangered (four species). This systematic review suggests integration of the native and naturalized UEFS in afforestation and reforestation programs to aid in various ecosystem services. *Calamus inermis*, *Corypha taliera*, *Licuala peltata*, and *Saurauia punduana* are examples of multipurpose species that require immediate sustainable conservation and cultivation initiatives to save them from extinction in the near future. Multipurpose species such as *Aegle marmelos*, *Buchanania lanzan*, *Manilkara hexandra*, *Syzygium cuminii*, *Tamarindus indica* are immensely constructive and climate-smart by surviving in harsh agroclimatic conditions and have great potential for establishment on marginal and wastelands throughout the IGP region. These resilient fruit species enhance biodiversity, ecosystems, and landscapes in addition to providing food for humans. It progressively advances India's commitment to LDN, combating climate change, and achieving the UN-SDGs, which call for reducing hunger and raising FS by 2030. As a result, the study will offer baseline data for the next investigations and be helpful to policymakers in creating sustainable and scientific policies for the IGP.

Key words: Native species, underutilized fruits, food security, species conservation, land restoration

1. Introduction

1.1. Salient features of Indo-Gangetic Plains

The Indo-Gangetic Plains (IGP) is situated between the Ghaggar and Teesta rivers and stretch from Delhi to

Kolkata in the states of Bihar, Uttar Pradesh, and West Bengal covering an area of about 0.375 million km² (Wagh, 2017) and supporting a population of over 400 million people (Sinha et al., 2005). The west-east stretched IGP is

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drained by several north-south trending river systems in a varied climatic setting. Even though the entire IGP exhibits geomorphological homogeneity, it is divided into three regions (Table 1), namely Upper Gangetic Plains (GP), Middle GP, and Lower GP based on agroclimatic zones (Khanna, 1989) and the geographic and climatic features of India (Singh, 1971). Generally, the climate of the GP is tropical and subhumid to humid climate receiving 60 mm to 1600 mm of average rainfall. Further, the western and southern part of the GP receives less rainfall in comparison to the eastern and northern parts (Saini, 2008). These soils have good drainage of southeasterly flowing Ganga and its tributaries which are extensively cultivated and habited; however, the land degradation constraints such as flooding, soil salinity, and riverine erosion are dominated in the GP (Saini, 2008). The temperature normally ranges from 5 °C to 25 °C during winter and from 20 °C to 40 °C during summer (Sinha et al., 2005). The soil characteristics are Quaternary alluvia, which is monotonous except for some variations in the peripheral northern and southern parts. Soils are bedded with varying combinations of clay, sand, gravel, and their mixture (Sinha et al., 2005). Information related to the total geographical area, population, forest area, tree cover, the total number of species, southeasterly flowing Ganga, and the number of underutilized edible fruit species (UEFS) in the IGP (present study) were recorded (Table 1).

Though India stands 2nd position in the world as the largest producer of fruits¹, it is still suffering from hunger and malnutrition (Sarkar and Rakshit, 2021). According to The State of Food Security and Nutrition in the World 2020 report, 189.2 million (14%) people are undernourished, and 34% of children under the age of five years in India are stunted (FAO, IFAD, UNICEF, WFP, and WHO, 2020). In the prevalence of stunting, Bihar ranked highest among all the states of the country, followed by Uttar Pradesh while Jharkhand followed by Bihar ranked highest in the prevalence of underweight (Swaminathan et al., 2019). The IGP still fails to address its complete food and nutritional security despite being backboneed by agriculture as in many other regions of the country, and most of the rural community depend on it for their livelihood. This region is always under immense pressure to feed its ever increasing population and suffers from malnutrition, poverty, and hunger. The average operational land holdings in the states of Bihar, Uttar Pradesh, and West Bengal were less than 1 ha, which is less than the national average (Singh, 2014). Approximately 90% of farmers were classified under marginal and small categories, with an average

of half a hectare. This presents serious challenges in mechanization and the use of costly inputs which is economically nonviable. Rainfed agriculture with supplemental irrigation is practiced in most of the GP. Rice-wheat cropping system is more predominant and the important cash crops such as sugarcane, potato, and tobacco, fruit crops such as mango, litchi, and banana, and vegetable crops such as brinjal, onion, and tomato are cultivated. The population density and percentage of the population below the poverty line in the GP were very high while the literacy rate was low (Census of India, 2011). Although the IGP is blessed with the environment and resources for agricultural practices fragmentation of land, green revolution, land degradation, population, urbanization, and other anthropogenic activities result in farmers' reluctance to achieve food and nutritional security (Singh, 2014).

1.2. Importance of UEFS in the IGP

A tiny part of the IGP is still pristine and rich in floral biodiversity, with a high occurrence of UEFS such as *Artocarpus lacucha*, *Baccaurea ramiflora*, *Cordia myxa*, *Diospyros melanoxylon*, *Elaeagnus latifolia*, *Ficus palmata*, *Glycosmis pentaphylla*, and several others (Plates 1–3). These are rare minor wild fruits that are native and unique and mostly eaten by the locals during different seasons (Jeeva, 2009; Singh et al., 2015). These natural fruits benefit poor people by supplying a nutritional diet in rural areas and generate additional income, which are rich sources of macro- and microminerals, vitamins, fibres, antioxidants, and polyphenols (Suresh et al., 2014; Singh et al., 2015). Consumption of these fruits reduces the risk of several diseases such as cancer, diabetes, heart diseases, and neurodegenerative ailments (Singh et al., 2015). Most of these UEFS are easy to grow with fewer cultural and technical inputs, hardy, and generate additional income for the farmers (Suresh et al., 2014). Besides, it depends on various native fauna and components in the farming systems, for large-scale plantations in social forestry, and to support timber and fuel availability in the region (Dwivedi, 1993).

Besides natural threats such as extreme climatic conditions, floods, tectonic movements, and unpredictable monsoons, the IGP is also overburdened due to nonjudicious management of soil, water, and other natural resources (Ingram, 2011). This cultivable land is replaced by industrialization, mining, urbanization, and other human-induced activities. Hence, the IGP is facing twin threats i.e. natural as well as human-induced, any changes in these factors are affecting the pattern of land use and land cover change, food production, human settlement, and other socioeconomic, cultural

¹PIB Delhi (2021). Production of Fruits and Vegetables [online]. Website <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1776584> [accessed 10 March 2023].

Table 1. Total geographical area, population, forest area, tree cover, total number of species and tree species of the IGP.

States	Area (Lakh Sq. km)	Population (million) as per census 2011	Dominant tribes (Top five)	GP region	Area excluded	Forest cover per cent of Geographical area	Angiospermic species reported	UEFS reported (Present study)
Uttar Pradesh	2.40	199.81 m, Urban: 22.27% Rural: 77.73% Tribal: 0.57%	Tharus, Kols, Kharwar, Gond and Bhoxa (Prakash 2011)	Upper GP covers 1.49 Lakh Sq. km and Middle GP covers Eastern UP	Some parts in Central Plateau and Hills Region	6.15% VDF: 1.09% MDF: 1.67% OF: 3.39%	2607 species (Khanna 2017)	149 species
Bihar	0.94	104.10 m, Urban: 11.30% Rural: 88.70% Tribal: 1.28%	Santal, Oraon, Kharwar, Gond, and Munda (Bhatt and Bhargava 2006)	Middle GP covers 1.44 Lakh Sq. km and lower GP covers tahsil of Kishanganj	-	7.84% VDF: 0.35% MDF: 3.49% OF: 4.00%	2963 species, undivided Bihar with Jharkhand (Singh et al., 2001)	219 species
West Bengal	0.89	91.27 m, Urban: 11.29% Rural: 88.71% Tribal: 5.80%	Santal, Oraon, Munda, Bhumijes and Koras (Dey, 2015)	Lower GP covers 0.81 Lakh Sq. km	Purulia and Darjeeling district	18.96% VDF: 3.42% MDF: 4.74% OF: 10.80%	3580 species (Chakravarty et al., 1999)	342 species

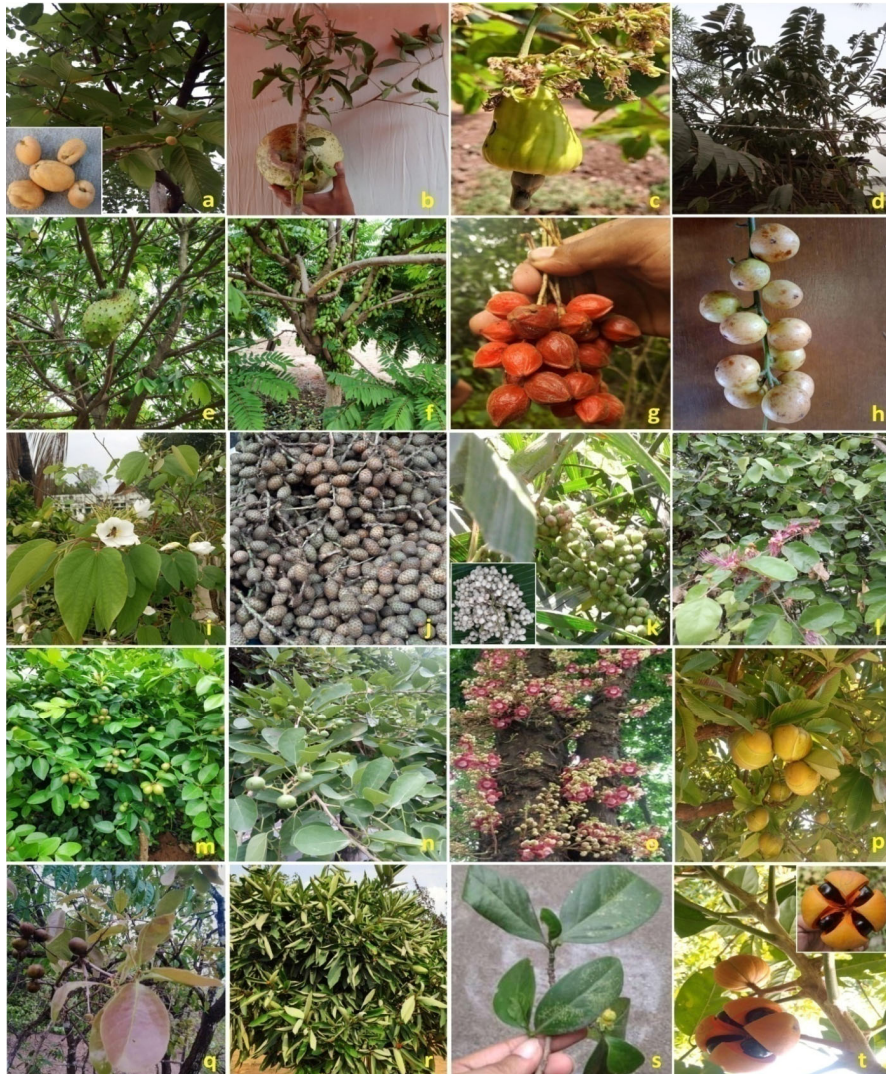


Plate 1. Photograph of some UEFS of the IGP taken during study: a. Monkey Jack (*Artocarpus lacucha*); b. Bael (*Aegle marmelos*); c. Cashew (*Anacardium occidentale*); d. Ramphal (*Annona reticulata*); e. Lakshman phal (*Annona muricata*); f. Bilimbi (*Averrhoa bilimbi*); g. Moottipuli (*Baccaurea courtallensis*); h. Latka (*Baccaurea ramiflora*); i. Dwarf White Bauhinia (*Bauhinia acuminata*); j. Bet (*Calamus Spp.*); k. Rattan (*Calamus viminalis*); l. Caper bush (*Capparis spinosa*); m. Karonda (*Carissa carandus*); n. Assyrian plum (*Cordia myxa*); o. Cannonball tree (*Couroupita guianensis*); p. Elephant Apple (*Dillenia indica*); q. Tendu (*Diospyros melanoxylon*); r. Velvet apple (*Diospyros discolor*); s. Date-plum (*Diospyros lotus*); t. Karakil (*Dysoxylum binectariferum*).

and environmental conditions of the region (Saini, 2008; Sarkar and Rakshit, 2023). Nowadays, land degradation is becoming a global challenge as it poses a high risk to land productivity, food security, and livelihood opportunities (Rakesh et al., 2023). The worst effects of land degradation are malnutrition, disease, forced migration, increased conflicts cultural damage, and poverty. Hence, it is an alarming sign to conserve biodiversity and maintain the ecological balance of the country. Land degradation

neutrality (LDN) is an important concept to restore our mother earth from degradation and prevent further degradation and desertification (Quatrini and Crossman, 2018; Dinesha et al., 2023). Fortunately, tiny sporadic tropical-subtropical forests of the IGP are endowed with many UEFS that have an outstanding potential to improve food and nutritional security among vulnerable groups. Unfortunately, utilization of native UEFS has steadily declined because of lack of awareness, discontinuity in



Plate 2. Photograph of some UEFS of the IGP taken during study: a. Bastard oleaster (*Elaeagnus latifolia*); **b.** Indian olive (*Elaeocarpus floribundus*); **c.** Indian coral (*Erythrina variegata*); **d.** Banyan (*Ficus benghalensis*); **e.** Panjab fig (*Ficus palmata*); **f.** Cluster fig (*Ficus racemosa*); **g.** Hauili (*Ficus septica*); **h.** Fig (*Ficus spp.*); **i.** Mangosteen (*Garcinia kydia*); **j.** Aastani (*Glycosmis pentaphylla*); **k.** Phalsa (*Grewia asiatica*); **l.** Achatta (*Lepisanthes senegalensis*); **m.** Wood apple (*Limonia acidissima*); **n.** Mahua (*Madhuca latifolia*); **o.** Khirni (*Manilkara hexandra*); **p.** Bullet wood (*Mimusops elengi*); **q.** Mulberry (*Morus alba*); **r.** Orange jasmine (*Murraya exotica*); **s.** Lotus (*Nelumbo nucifera*); **t.** Nepal fig opuntia (*Opuntia ficus-indica*).

traditional culture and knowledge, intensive agriculture, limited research done, inadequate policy support, western influence, and urbanization (Tomar et al., 2015; Shankar et al., 2020). Even though they have many advantages, research attention or extension activities are meagre. Hence, the main objective of this review is to survey, summarize, and annotate the published information about the angiosperms native and naturalized UEFS of IGP to

identify and make use of this species, particularly for the sustainable development of this region.

2. Materials and methods

2.1. Protocol for systematic review

This study implements the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol (Moher et al., 2009; Liu et al., 2021) to review the



Plate 3. Photograph of some UEFS of the IGP taken during study: a. Indian trumpet (*Oroxylum indicum*); b. Passion Fruit (*Passiflora edulis*); c. Malay gooseberry (*Phyllanthus acidus*); d. Amla (*Phyllanthus emblica*); e. Jungle Jilebi (*Pithecellobium dulce*); f. Chitki (*Securinega virosa*); g. Marking nut (*Semecarpus kurgii*); h. Sal (*Shorea robusta*); i. Jangli bhata (*Solanum indicum*); j. Black nightshade (*Solanum nigrum*); k. Jangli Badam (*Sterculia foetida*); l. Hirik (*Sterculia guttata*); m. Watery rose apple (*Syzygium aqueum*); n. Mountain Apple (*Syzygium jambos*); o. Jamun spp. (*Syzygium spp.*); p. Jamun (*Syzygium cuminii*); q. Wax apple (*Syzygium samarangense*); r. Black Myrobalan (*Terminalia chebula*); s. Giloy (*Tinospora cordifolia*); t. Tin koli (*Ziziphus rugosa*).

published information pertaining to the angiospermic native and naturalized UEFS of the IGP. The outline map of the study area is presented in Figure 1. A systematic review was executed using the flow diagram (Figure 2, adapted from Moher et al. (2009)). An exact explanation and categorization of major and underutilized (minor) fruits are perhaps difficult as of complexity and it depends on multiple factors such

as availability, awareness, consumption, distribution, exploitation, knowledge, popularity, production, and utilization (Tripathi, 2019). Our definition of UEFS excludes species that falls under widespread to moderate commercial importance category and species which has been widely naturalized, cultivated, and well known in the IGP of Indian subcontinent. For instance, *Tamarindus indica* is well known, widespread, and

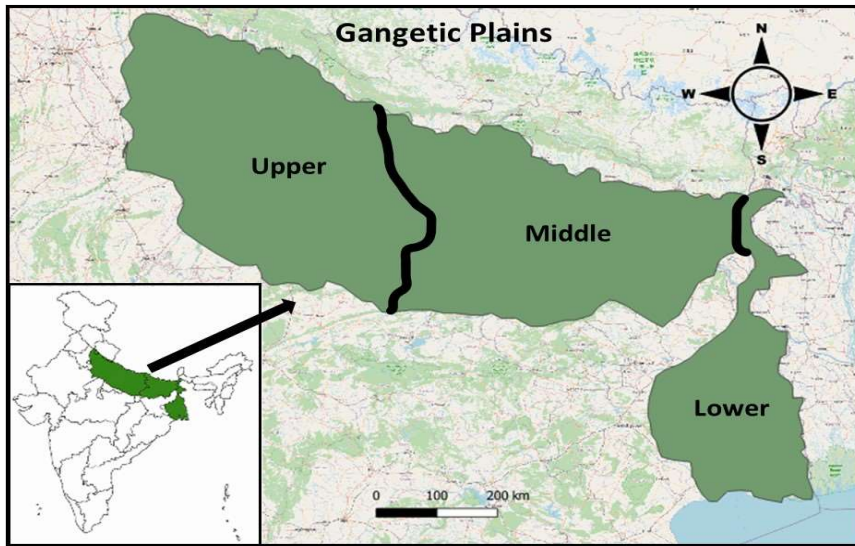


Figure 1. Outline map of the study area.

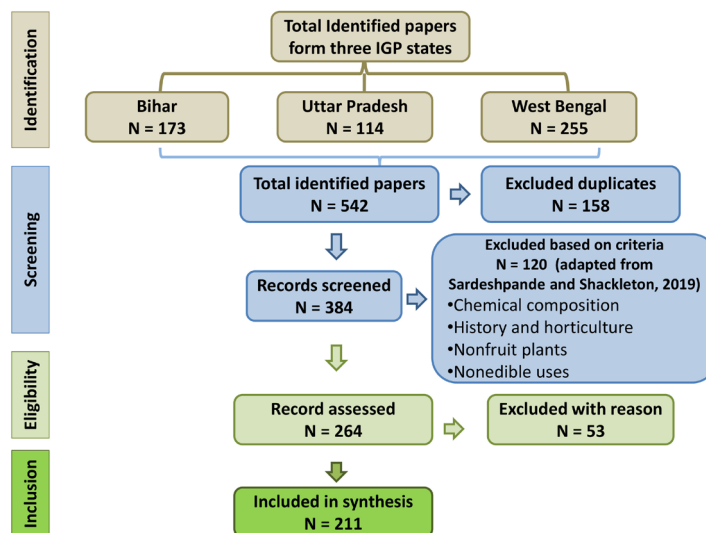


Figure 2. Flow diagram of UEFS of IGP (adapted from Moher et al. (2009)).

widely naturalized in southern India while in other parts of India including GP it still falls under the UEFS category (Mahapatra and Panda, 2009). However, this review includes only a lesser known, lesser distributed, underutilized, undomesticated, and wild edible fruit species from forests, agroforestry systems, gardens, vacant, and other marginal lands (Figure 3).

2.2. Survey and analysis

In this analysis, we examine the literature focused on angiospermic native and naturalized UEFS of the IGP. We reviewed published articles, book chapters, and scientific reports to analyze the ethnomedicinal/traditional/indigenous use, growth pattern, and seasonal availability of UEFS in the IGP. Our

search keywords are forest fruits, wild edible fruits, underutilized fruits, and lesser-known fruits, and we used Google, Google Scholar, J-Gate, Scopus, and Web of Science for our searches. The total of 542 articles which includes the UEFS conservation, documentation, ecology, economics, and ethnobotany in topics of agriculture, botany, environment, forestry and climate change studies, food science, horticulture, medicinal and aromatic plants, social science, and urban studies were considered. Finally, 211 articles were included in the synthesis after the exclusion of duplicates (N = 158), based on criteria (N = 120) and other reasons (N = 53) (Figure 2). Following the guidelines of Sardeshpande and Shackleton (2019), articles concerning the nutritional

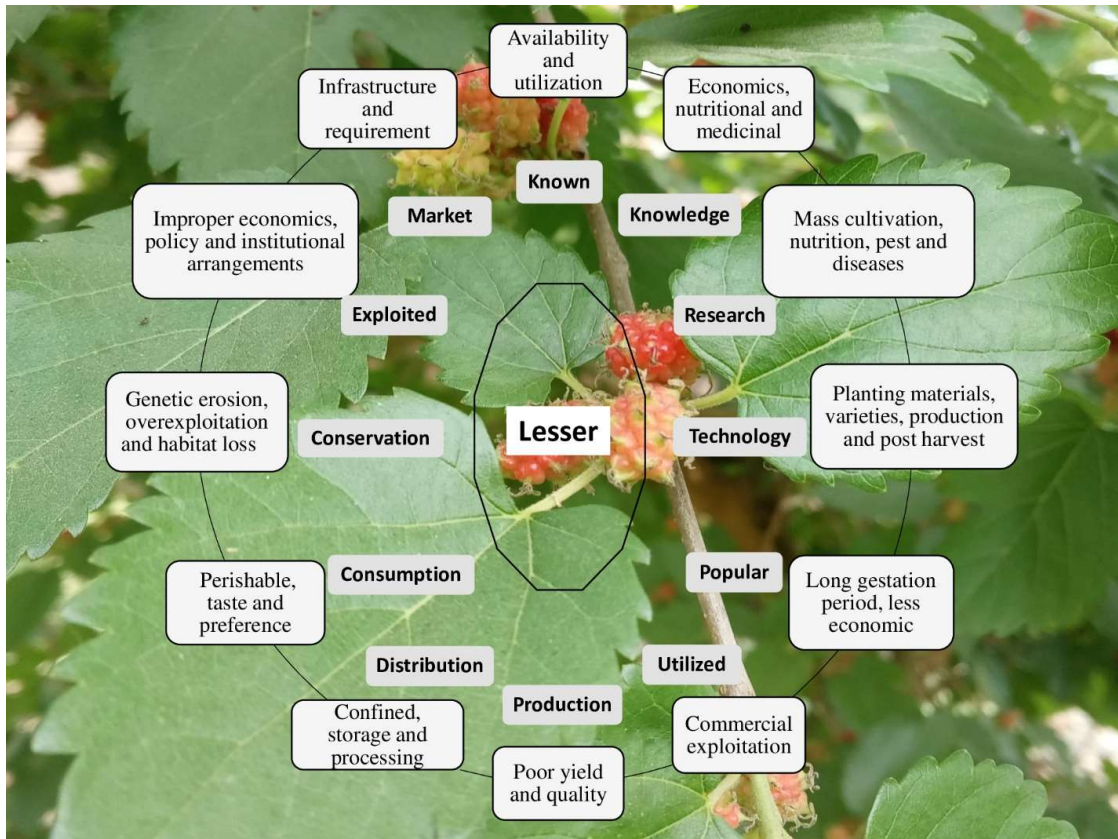


Figure 3. Constraints of UEFS.

value, toxicity, historical and horticultural records, and pharmacology of UEFS were excluded based on certain criteria. From these excluded 331 articles, some related to nutrient composition, evolution, genetics, chemistry, pharmacology, toxicology, immunology, medicine, etc., of UEFS were considered an accessory literature to strengthen our systematic review. The published scientific names of the UEFS were verified from online sources such as Plantlist² and International Plant Names Index³. The recorded species were divided into eight categories as per the IUCN conservation status namely not evaluated (NE), data deficient (DD), least concern (LC), near threatened (NT), vulnerable (VU), endangered (EN), critically endangered (CR) and extinct in the wild (EW) and verified from the IUCN⁴. The information from the literature found from the mentioned sources was used to prepare a comprehensive list of species with scientific names, common names, family, life form, origin, flowering and fruiting time, state-wise distribution, nutritional status, uses, products, other significance, IUCN status and sources (Table 2).

²The Plant List (2013). Version 1.1 [online]. Website <http://www.theplantlist.org/> [accessed 15 March 2023].

³IPNI (2024). International Plant Names Index [online]. Website <http://www.ipni.org>, The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Herbarium [accessed 15 March 2023].

⁴IUCN (2024). The IUCN Red List of Threatened Species. Version 2023-1 [online]. Website <https://www.iucnredlist.org> [accessed 21 April 2023].

3. Results and discussion

3.1. Diversity of the UEFS

The systematic review resulted in a repository of 371 fruit species, belonging to 197 genera in 85 families. Among 85 plant families, at least the top 10 families have been found to be dominant in the IGP which was represented by the maximum number of UEFS (Figure 4). Further, our habit-wise analysis has revealed that around 268 species (72%) were trees, 52 species (14%) were shrubs, 20 species (5%) were herbs, and 32 species (9%) were climbers (Figure 5). Among these fruit species, 341 species (92%) were native and 30 species (8%) were naturalized to the IGP (Table 2). A maximum number of species was recorded in West Bengal (342 species), followed by Bihar (219 species), and a minimum (149 species) in Uttar Pradesh. The recorded 371 species were divided into eight categories (Figure 6) namely NE (115 species), DD (eight species), LC (185 species), NT (21 species), VU (21 species), EN (16 species), CR (four species), and EW (one species). The present study categorized 115 UEFS species under the NE

Table 2. General account on reported UFEFS, significance, IUCN status and references.

Moraceae											
<i>Artocarpus chama</i> Roxb.	Chaplash	T		Native	March–April and May–June	WB	Rich sources of vits A and C	Fruit is eaten raw and seeds eaten roasted form	Medicinal value (Diabetes and anti-arthritis)	NE	Biswas et al. (2018); Abdullah et al. (2020)
<i>Artocarpus hirsutus</i> Lam.	Wild jack	T		Native	December–March	WB	Rich in vitamins and minerals	Eaten raw	Medicinal value	LC	Biswas et al. (2018)
<i>Artocarpus lacucha</i> Buch.-Ham.	Monkey Jack/Barhar	T		Native	March–April and May–June	BR; WB	Rich in minerals and vitamins	Pickle, curries, chutney and dried fruits	PBI; Medicinal and fodder use	LC	Paul (2013); Abdullah et al. (2020)
<i>Ficus benghalensis</i> L.	Banyan	T		Native	January–July	BR; UP; WB	Nutritionally rich	Raw fruits eaten	Medicinal (respiratory and skin disorders)	LC	Bose et al. (2015)
<i>Ficus palmata</i> Forssk.	Panjab fig/Bedu	T		Native	June–July	BR; UP; WB	Fruits eaten	Fruit used in foothills of Himalayas	Medicinal, prevent stress	NE	Tomar et al. (2015)
<i>Ficus racemosa</i> L.	Cluster fig/Red River fig	T		Native	March–May	BR; UP; WB	Ripe and unripe fruits	Vegetable, stir-fries and curries	Medicinal (diarrhoea, dysentery)	LC	Paul (2013); Abdullah et al. (2020)
<i>Ficus septica</i> Burm. F.	Hauili	T		Native	January–June	BR; UP; WB	Nutrient rich fruits	Eaten raw	Folk medicine	LC	Paul (2013)
<i>Morus alba</i> L.	Mulberry	T		Native	February–June	BR; UP; WB	Sweet and sour fruits	Jam, fodder and green leaf manure	Medicinal	LC	Paul (2013)
Rutaceae											
<i>Aegle marmelos</i> L. Corr. Serr.	Bael/Stone apple	T		Native	March–April	BR; UP; WB	Fruit pulp	Pulp eaten, jam, jelly and sharbat	Medicine and Sacred tree	LC	Paul (2013)

Table 2. (Continued.)

<i>Glycosmis pentaphylla</i> (Retz.) DC	Aastani	S	Native	September–April	BR; WB	Rich in nutrients	Ripe berries eaten raw by tribals and villagers	Medicinal, liver problem and hair loss	LC	Mahapatra et al. (2012)
<i>Limonia acidissima</i> L.	Wood apple	T	Native	September–October	BR; UP; WB	Fatty acids, vitamins and minerals	Sweet and sour jams, pickle, Chutney	Religious, medicinal and insecticide use	NT	Paul (2013)
<i>Murraya exotica</i> L.	Orange jasmine	T	Native	May–October	BR; WB	Fruits are rarely used	Culinary uses	Medicinal use for bleeding and pain	NE	Barooah and Ahmed (2014)
Anacardiaceae										
<i>Anacardium occidentale</i> L.	Cashew	T	Naturalized	January–May	BR; UP; WB	Nutrient-dense fruit	Eaten raw or used in culinary and wine making	Medicinal values	LC	Barooah and Ahmed (2014)
Annonaceae										
<i>Annona reticulata</i> L.	Ramphal/ Nag-hawa	T	Native	February–October	BR; UP; WB	High in sugar and vitamins	Eaten raw	Seed used as medicine	LC	Mitra and Mukherjee (2009)
<i>Annona muricata</i> L.	Lakshman phal	T	Native	April–October	BR; UP; WB	Tryptophan, vitamins and mineral rich	Eaten raw	Used as medicine	LC	Mitra and Mukherjee (2009)
Oxalidaceae										
<i>Averrhoa bilimbi</i> L.	Bilimbi	T	Naturalized	January–May	WB	Sour and extremely acidic fruit	Pickle, squash, vegetable	PBI; medicinal	LC	Banarjee et al. (2013)
Euphorbiaceae										

Table 2. (Continued.)

<i>Baccaurea courtallensis</i> (Wight) Muell. Arg.	Moottipuli	T	Native	January–June	WB	Sweet fruits	Eaten raw	Medicinal value	NT	Barooah and Ahmed (2014)
<i>Baccaurea ramiflora</i> Lour.	Latka	T	Native	March–September	WB	Ripe and unripe fruits	Consumed fresh locally	Medicinal (used for constipation)	LC	Rymbai et al. (2016)
Fabaceae										
<i>Bauhinia acuminata</i> L.	Dwarf White Bauhinia	T	Native	April–August	UP; WB	Collected for local use	Culinary use	Folk medicine	LC	Barooah and Ahmed (2014)
<i>Pithecollobium dulce</i> (Roxb.) Benth.	Jungle Jilebi	T	Naturalized	January–March	BR; UP; WB	Rich in nutrients	Eaten raw and used in culinary	Ornamental and leguminous	LC	Dwivedi (1993)
Arecaceae										
<i>Calamus viminalis</i> Willd.	Rattan	T	Native	July–August	BR; WB	Ripe fruits	Ripe fruit occasionally eaten	PBI; Shoot edible, medicinal	LC	Abdullah et al. (2020)
Capparaceae										
<i>Capparis spinosa</i> L.	Caper bush/ Kalavari	S	Native	April–September	BR; WB	Nutritious fruits	Fruits are eaten raw	Medicine	LC	Ahirwar (2015)
Apocynaceae										
<i>Carissa carandus</i> L.	Karonda	T	Native	February–June	BR; UP; WB	Rich in iron and vitamins	Pickled, jam, jelly, syrup and chutney	Used for toxicity and bronchitis	LC	Banarjee et al. (2013)

Table 2. (Continued.)

Boraginaceae										
<i>Cordia myxa</i> L.	Assyrian plum	T	Native	July–August	BR; UP; WB	Rich in minerals and vitamins	Fruits eaten raw and pickled	Paper glue	LC	Paul (2013)
Lecythidaceae										
<i>Couroupita guianensis</i> Aubl.	Cannonball tree	T	Naturalized	November–June	BR; UP; WB	Fruits rarely used	Used locally and used as animal feed	Folk medicine, cultural and religious worth	LC	Barooah and Ahmed (2014)
Dilleniaceae										
<i>Dillenia indica</i> L.	Elephant Apple/Chulta	T	Native	July– August	BR; UP; WB	Ripe and unripe fruits	Chutney and pickle	Medicinal use (abdominal pains)	LC	Abtullah et al. (2020)
<i>Diospyros melanoxylon</i> Roxb.	Tendu	T	Native	During summer	BR; UP; WB	Rich in phenols and fibre	Fruits pulp is used	Folk medicine	NT	Kaur and Fatima (2018)
Ebenaceae										
<i>Diospyros discolor</i> Willd.	Velvet apple/kamagong	T	Native	May–August	BR; UP; WB	Sourish fruit	Pulp is used	Hard and durable wood	VU	Paul (2013)
<i>Diospyros lotus</i> L.	Date-plum	T	Native	April–September	WB	Nutrient-dense fruits used	Fruits used locally	Folk medicine	NE	Sarkar (2021)
Meliaceae										

Table 2. (Continued.)

<i>Dysoxylum binectariferum</i> Hook. f. ex Bedd.	Kempu Devadaru/ Karakil	T	Native	February and December	BR; WB	Pulp rich in sugars, fat, minerals and vit C	Seeds are like chestnuts after roasting.	Ayurveda, folk medicine and immune modulatory	EN	Barooah and Ahmed (2014)
Elaeagnaceae										
<i>Elaeagnus latifolia</i> L.	Bastard oleaster	S	Native	January–April	BR; WB	Several good fatty acids	Eaten raw	Medicinal	LC	Rymbai et al. (2016)
Elaeocarpaceae										
<i>Elaeocarpus floribundus</i> Blume	Jalpai/Indian olive	T	Native	April–May and August to October	WB	Rich in vitamins and minerals	Pickles and chutney prepared	Medicinal	LC	Abtullah et al. (2020)
Papilionaceae										
<i>Erythrina variegata</i> L.	Tiger's claw/ Indian coral	T	Native	September–April	WB	Nutrient-dense fruits	Eaten raw or cooked	Medicinal use	LC	Shivprasad et al. (2016)
Clusiaceae										
<i>Garcinia kydia</i> Roxb.	Mangosteen	T	Native	April to July	WB	Sour fruits are source of vitamins	Dried rind is used for cooking	Folk medicine	NE	Parthasarathy et al. (2011)
Malvaceae										
<i>Grewia asiatica</i> L.	Phalsa/ Falsa	T	Native	April–September	BR; UP; WB	Sweet and sour acidic fruit	Pickles, beverages, sherbet and squash	Used as an astringent and cooling agent	LC	Banarjee et al. (2013); Paul (2013)

Table 2. (Continued.)

Sapindaceae											
<i>Lepisanthès senegalensis</i> (Poir.) Leenh., Blumea	Achatta/ Kaphul	T		Naturalized	November– April	WB	Fruits and seeds	Eaten raw and cooked	Medicinal	NE	Jeeva (2009); Dwivedi (1993)
Sapotaceae											
<i>Madhuca latifolia</i> (Roxb.) Cheval.	Mahua	T		Native	March– August	BR; UP; WB	Source of protein and minerals	Fruits are eaten raw and extract oil, alcoholic beverage.	Medicinal, Used in production of Tasar Silk	CR	Ajesh et al. (2012); Banarjee et al. (2013)
<i>Manilkara hexandra</i> (Roxb.) Dubard	Khirmi	T		Native	November– June.	BR; UP; WB	Minerals, protein and vitamin rich	Sweet fruits eaten raw or after drying, seeds for cooking.	Rootstock for sapota and medicinal use	NE	Tomar et al. (2015); Ahirwar (2015)
<i>Mimusops elengi</i> L.	Molsari/ Bakul/ Bullet wood	T		Native	April–May	BR; UP; WB	Sweet fruit rich calcium content.	Eaten raw or used in pickles and fruit preservatives	Ayurvedic, red color wood is strong and tough	LC	Paul (2013)
Nelumbonaceae											
<i>Nelumbo nucifera</i> Gaertn	Lotus/ Kamal	H		Native	April– September	BR; UP; WB	Fruits collected	Seeds eaten raw or roasted	Medicinal use	DD	Bose et al. (2015)
Cactaceae											
<i>Opuntia ficus-indica</i> (L.) Mill.	Nepal fig opuntia	S		Naturalized	March– December	BR; UP; WB	Nutritious fruits	Fresh fruits eaten raw	Folk medicine	DD	Singh et al. (2020)
Bignoniaceae											

Table 2. (Continued.)

<i>Shorea robusta</i> Roth	Sal	T	Native	January–June	BR; UP; WB	Fruit pulp and oil used	Pulp eaten and oil used in culinary	Medicinal, resin and wood	LC	Barooah and Ahmed (2014)
Sterculiaceae										
<i>Solanum indicum</i> L.	Jangli bhata	S	Native	June–March	BR; UP; WB	Nutrient-dense fruit	Eaten as vegetable	Medicinal use	NE	Barooah and Ahmed (2014)
<i>Solanum nigrum</i> L.	Black nightshade	H	Native	June–December	BR; UP; WB	Nutrient-dense fruits	Jam making or eaten raw	Folk medicine	NE	Bose et al. (2015)
<i>Sterculia foetida</i> L.	Jangli Badam/ Wild Indian Nut	T	Native	April–February	BR; UP; WB	Fruit collected	Eaten as vegetable	Seed oil as medicine and bark for rope.	NE	Paul (2013)
<i>Sterculia guttata</i> Roxb.	Hirik	T	Native	September–March	BR; UP; WB	Fruit and seeds used	The roasted seeds are eaten	Folk medicine and Siddha	NE	Barooah and Ahmed (2014)
Myrtaceae										
<i>Syzygium aqueum</i> (Burm.f.) Alston	Watery rose apple	T	Native	January–October	BR; WB	Nutrient-dense fruit	Eaten raw, salads, pickles	Folk medicine	LC	Singh et al. (2001)
<i>Syzygium jambos</i> (L.) Alston.	Malabar Plum/ Mountain Apple	T	Native	Usually, summer months	BR; WB	Rich in minerals vits B and C	Making preserves, jellies and sweet	Folk medicine, ornamental and charcoal making	LC	Ahirwar (2015)
<i>Syzygium cuminii</i> L. Skeels	Jamun	T	Native	January–May	BR; UP; WB	Fruit rich in Iodine	Fruit and seed	Seed in diabetes and sacred fruits of the	LC	Paul (2013)
<i>Syzygium samarangense</i> (Blume) Merr. & L.M.Perry	Jamrul/ Wax apple	T	Native	January–March and May–September	BR; WB	Rich in Ca, P, K, Mg, vit C	Eaten raw, salads, pickles	Hindu Jambu dweep (India's ancient name) comes from this fruit	LC	Singh et al. (2001); Biswas et al. (2018)

Table 2. (Continued.)

Combretaceae										
<i>Terminalia chebula</i> Retz.	Haritaki/ Black Myrobalan	T	Native	March–April	BR; UP; WB	Edible fruit and seeds	Seeds as snacks, edible oil, sour fruits for salads, fries, black salt	PBI; Ayurvedic medicine (Triphala), dye, calicos	LC	Bose et al. (2015)
Menispermaceae										
<i>Tinospora cordifolia</i> (Willd.) Miers	Guduchi/ Giloy	C	Native	May–October	BR; UP; WB	Rich in nutrients and minerals	Fruit eaten	Nutraceutical and medicinal use	NE	Bose et al. (2015)
Rhamnaceae										
<i>Ziziphus rugosa</i> Lam.	Tin koli	S	Native	April–May	BR; WB	Sweet and acidic taste	Used in culinary	PBI; medicinal use	NE	Mahapatra et al. (2012)

T: tree; S: shrub; H: herb; C: climber; BR: Bihar; UP: Uttar Pradesh; WB: West Bengal; NE: not evaluated; DD: data deficient; LC: least concern; NT: near threatened; VU: vulnerable; EN: endangered; CR: critically endangered; EW: extinct in the wild.

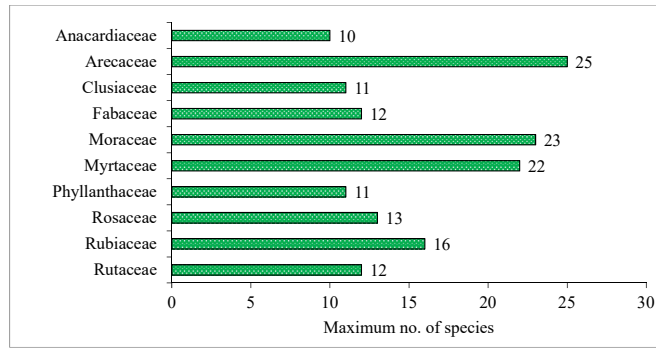


Figure 4. Statistics of top 10 families of UEFS of the IGP which is represented by maximum number of species.

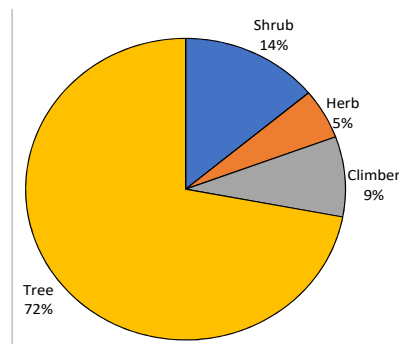


Figure 5. Habit-wise species distribution.

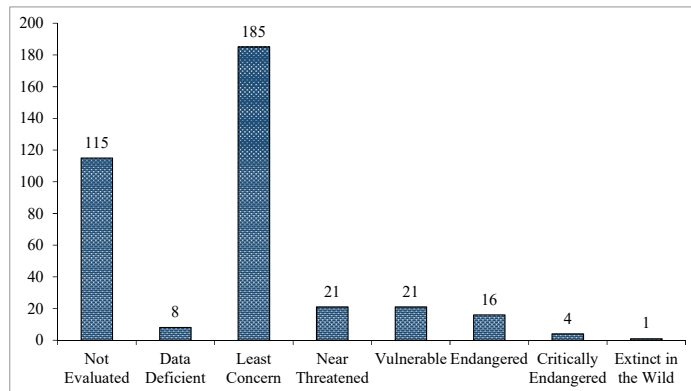


Figure 6. Conservation status of UEFS of IGP as per IUCN categories.

category which needs further extensive survey to enlist under the IUCN conservation list for future conservation, research, and developmental initiatives at the local and regional levels. The literature studies confirmed that, of the total 371 species of UEFS recorded, most of the species reported to have medicinal and economic values but few species were observed to be extremely rare and threatened in their native or naturalized habitat, which needs immediate conservation initiatives for scientific and sustainable conservation, production, and utilization.

Many studies have provided a comprehensive review of UEFS in the context of World, Continent, India, and portion of the GP (Verheij et al., 1991; Mahapatra et al., 2012; Suresh et al., 2014; Singh et al., 2015). Native and naturalized UEFS are primarily organic, nutritious and have huge cultural, medicinal, regulatory, and supporting values. UEFS constitutes the major source of subsidiary nutrients to the tribal, forest dwellers, and marginalized local communities since the cultivar fruits are less familiar and not accessible to them. On the other hand, urban

communities are not familiar with the UEFS which tribal and local communities utilize. Most of the forest dwellers and tribal populations largely depend on forest resources for their livelihood and sustenance. Though they collect a portion of the excessively available fruits from the forest for their sustenance, huge quantities are wasted as uncollected. Documentation of indigenous knowledge on medicinal, therapeutic, and nutritional properties of UEFS through ethnobotanical studies is significant for the sustainable bioprospecting, conservation, and utilization of natural products (Biswas et al., 2018).

3.2. Collection calendar of UEFS

UEFS are mainly collected from forests and other unmanaged landscapes, and they supplement diverse nutrient-dense food and also enhance ecosystem services, livelihoods, and climate resilience (Mahapatra and Panda, 2009; Biswas et al., 2018). The collection calendar includes the flowering and fruiting periods in the months for each species were recorded (Table 2) and the additional details of other species under various families have also been illustrated in Supplementary Table. The extent of the collection of UEFS depends on various factors such as agriculture failure, adverse climatic conditions, erratic rainfall, famine, war, and other lean times (Mahapatra and Panda, 2009). In this study, the most concentrated period of UEFS collection was from April to August, and some species were collected year-round. The year-round availability of UEFS from different species supplements a diverse and nutrient-dense food supply and enhances the livelihoods of the dependent communities (Mahapatra and Panda, 2009). *Madhuca latifolia* was collected from March to August (Ajesh et al., 2012; Banarjee et al., 2013); *Mangifera sylvatica* was collected from April to September (Paul, 2013; Abdullah et al., 2020); *Licuala peltata* was collected from September to May (Mondal, 2019). *Corypha taliera*, a monocarpic species, is presently categorized as extinct in the wild (EW) under the IUCN Red list category and few are present in Kolkata, India. The flowering and fruiting period (October–February) of this species is also important to develop appropriate conservation measures to save this species from the extinction in near future (Johnson, 1998; Paul, 2013; Kour et al., 2018).

3.3. Nutritional status and value-added products of UEFS

UEFS can fulfill the growing need of alternative bionutritional sources for food and nutritional security through bioprospecting of these natural products. Many studies showed the significance of UEFS as an important source of nutrient for rural poor and tribals (Mahapatra and Panda, 2009; Suresh et al., 2014; Tomar et al., 2015). The nutritional values of many UEFS such as *Mimusops elengi* for carbohydrate content, *Ziziphus rugosa* for sugar content, *Bridelia tomentosa* for protein content, *Terminalia citrine* for vitamin C content were found to be at par with

the domesticated popular fruits such as banana, guava, mango, papaya, strawberry, and various other fruits (Mahapatra et al., 2012). Higher total soluble solid (TSS), amino acids, vitamins, minerals, and antioxidants of UEFS are reported globally (Deshmukh and Waghmode, 2011; Mahapatra et al., 2012; Suresh et al., 2014; Biswas et al., 2018). UEFS have been found to improve household food and nutritional security under normal circumstances as well as during food scarcity in both rural and urban contexts (Mahapatra and Panda, 2009; Biswas et al., 2018).

UEFS would facilitate small-scale commercial production of value-added products in rural poor and tribal communities and also help in promoting food security, doubling farmers' income, reducing postharvest losses, and contributing to the sustainable development of the dependent communities. Many studies demonstrated the production of good quality dry fruits, jams, juices, and other drinks using simple procedures that are suitable for small-scale commercial production. Many UEFS are used in pickle preparation by the indigenous tribes and pulp is used for making jam, jelly, wine, and refreshing drinks. Seeds of some UEFS are used for the extraction of crude oil for culinary (e.g., *Carallia brachiata*, *Diploknema butyracea*, *Garcinia xanthochymus*, *Madhuca latifolia* and *Terminalia chebula*), medicinal (e.g., *Atalantia monophylla*, *Gynocardia odorata*, *Hodgsonia macrocarpa*, *Sterculia foetida* and *Terminalia bellirica*) and many other purposes including cosmetics, fuel, and manufactured products. Most of these species are used as an ingredient in the preparation of *Triphala*, *Chavanprash*, and other Ayurvedic formulations such as *Asava* and *Arishta*. Information on the nutritional properties of most of the UEFS lacks details regarding their economic potential, nutrition, utility, and storage capability. These aspects are the least researched and unfamiliar, except for their consumption value and taste (Mahapatra et al., 2012). The present study indicates the scope of using UEFS for dietary supplements since it has valuable ingredients such as Fe, Na, K, Ca, and several others. Physicochemical analysis of UEFS aids in the provision of developing new varieties (Mahapatra et al., 2012).

3.4. Contribution to food security and livelihoods

The contribution of UEFS to food security and livelihoods of the dependent community is well documented even during erratic times such as agriculture failure, adverse climatic conditions, unpredictable rainfall, famine, war, and other lean times (Jeeva, 2009; Mahapatra and Panda, 2009). Most of the UEFS are available around the year and they supply diverse nutrient-dense foods to the dependent communities. Rural and tribal communities in many regions of the world depend on wild resources including UEFS to meet their food and livelihood needs. These UEFS add diversity to family diet and contribute

to household food and nutritional security along with livelihood improvements. Improving the food value can be a commendable step towards ensuring food and nutritional security as it further strengthens the education, employment, and health sectors, small-scale industries, tourism, transportation, and socioeconomical status, women empowerment, etc. Grading, processing, value addition, and packaging are the important practices to fetch better prices in the market. A considerable quantity of UEFS is wasted due to the lack of adequate storage facilities. This waste can be significantly reduced by using advanced and appropriate storage facilities. These UEFS can be processed into various products, including dry fruits, pickles, jams, jellies, juices, wines, and numerous others, through the application of traditional knowledge and advanced techniques. The quality and shelf life of the products could be improved considerably and reduce postharvest losses with the application of modern techniques such as solar drying, electric tray dehydration, pretreatment techniques, and several other methods (Meghwal and Singh, 2016). The application of postharvest value addition technologies may result in the development of small-scale industries which provide livelihoods to the rural masses throughout the year.

3.5. Other significant uses

Apart from the edibility, most of these UEFS are multiuse biological resources that have potential for cosmetic, medicinal, nutraceutical, ornamental, religious, therapeutic, wood, nonwood, and other ancillary purposes (Jeeva, 2009; Mahapatra and Panda, 2009). For example, *Gynocardia odorata*, *Hodgsonia macrocarpa*, and *Terminalia bellirica* are used for medicinal, cosmetics, and manufactured products (Table 2 and Supplementary Table). Species such as *Bridelia tomentosa*, *Carissa carandus*, and *Ziziphus rugosa* are highly recognized for their nutraceutical values and *Aegle marmelos*, *Ficus religiosa*, and *Limonia acidissima* have strong folklore and religious connections. Species such as *Grewia asiatica*, *Morinda angustifolia*, and *Stixis suaveolens* are used for aromatic and beverage purposes (Table 2 and Supplementary Table).

3.5.1. Medicinal and therapeutic potentials of UEFS

UEFS is used in the treatment of a wide range of ailments as they are rich sources of antioxidants, minerals, and vitamins. For instance, some fruits rich in vitamin C are easily assimilated by the human body and have great antioxidant properties. Thus, they can be used to cure insomnia, scurvy, and constipation, and rejuvenate skin cells and hair growth. Phytochemicals of some UEFS possess diuretic, antibacterial, and antifungal properties and nematode toxicity. For instance, a decoction from the root and bark of wild ber is beneficial in the treatment of dysentery, diarrhea, sore throat, and bleeding gums (Kour

et al., 2018). Bael fruits are rich in marmelosin active constituent which acts as an astringent, cardiac depressant, diuretic, laxative, and stomachic and these fruits are also used as a common home remedy for diarrhea, digestive disorders, and dysentery (Mahapatra and Panda, 2009). The kernels of chironji yield light yellow oil, a substitute for olive or almond oils in folk medicine and this seed oil is applied to glandular swellings of neck, itching, and other skin complaints (Mahapatra and Panda, 2009). UEFS such as *Atalantia monophylla*, *Diploknema butyracea*, *Pandanus odorifer*, *Protium serratum*, *Sterculia foetida* and *Terminalia bellirica* are used for numerous therapeutic advantages (Mahapatra and Panda, 2009; Paul, 2013). In addition, these UEFS possess comparatively more nutrients than major fruits; hence, they are used to treat many nutrient deficiencies and other ailments (Meghwal and Singh, 2016).

3.5.2. UEFS association with culture, folklore, and socioeconomy

UEFS has been integrally associated with the culture, socioeconomy, and folklore of indigenous people. Approximately 7000 species of UEFS are documented globally (Grivetti and Ogle, 2000). Out of which, 1000 species were identified in America, 1200 species in Africa, and 800 species in Asia (Verheij et al., 1991). Out of 800 species, approximately 371 species (present study) are prevalent in the IGP. Tribals of various ethnic groups such as Kols, Gonds, Oraons, Mundas, Santals, Tharus, and others are predominant in the various parts of the IGP and follow traditional farm practices (Table 1). Most of the UEFS are used in their diverse and seasonal diets, often shared among each other or sold in local markets. Tribal and rural poor are accustomed to consuming UEFS in a variety of forms, including raw, pickled, boiled or cooked with other dishes (Shankar et al., 2020). In numerous developing nations, wild fruits are often the only fruits consumed by rural poor and tribals as they cannot afford cultivated commercial fruits (Mahapatra et al., 2012). Some UEFS have commercial values while others possess medicinal, religious, or sociocultural values. Hence, there is a need for further research on domestication, as well as ex situ and in situ conservation.

Earlier studies have demonstrated that different tribe communities used various wild fruits for different purposes, showing the diversity of knowledge among the indigenous people from region to region and nation to nation (Grivetti and Ogle, 2000; Deshmukh and Waghmode, 2011). The knowledge and utilization of UEFS depends on availability, habit, habitat, frequency of food shortages, and people's way of life in terms of their social (including age and gender perceptions), cultural, religious (for e.g., sacred groves), and economic domains (Suresh et al., 2014; Kour et al., 2018). In India, some species such as *Aegle marmelos*,

Limonia acidissima, *Ficus* sp., and many other species have strong connections with culture, folklore, and religious beliefs. Nowadays, this traditional culture and knowledge are losing significance due to Western influence, intensive agriculture, and urbanization, resulting in the degradation of harmonious relations among biodiversity, farming, and folklore. Hence, it is imperative to renew, document, and utilize traditional knowledge systems for socioeconomic benefits and environmental balance.

3.5.3. Ecological and environmental implications

UEFS also have numerous socioeconomic and ecological advantages in addition to food, nutrition, medicinal, and therapeutic advantage. Most of these UEFS contribute to the diversity of flora and fauna of the region and offer potential niches to various biotas. UEFS are being exploited continuously and unscientifically from the wild without any conservation efforts to propagate them. Promoting and domesticating these UEFS not only improves nutritional and livelihood security to the local and dependent communities but also helps in situ conservation and well-being of the ecosystem (Singh et al., 2015). These underexploited species, therefore, need to be studied, which could help in selecting promising species for inclusion in various afforestation and reforestation programs that have so far focused only on timber yielding species (Mahapatra et al., 2012). Integration of UEFS not only improves food and nutritional security for humans but also helps in sustaining wild macro- and microfauna such as frugivore, herbivore, and many others. Apart from wood and nonwood products such as timber, dye, fibre, gum, honey, and resins, UEFS are also used for various purposes such as aromatic and beverages (*Grewia asiatica*, *Morinda angustifolia* and *Stixis suaveolens*), birds and bee foraging (*Ehretia acuminata*, *Elaeagnus pyriformis* and *Syzygium cuminii*), fodder (*Artocarpus lacucha*, *Meliosma pinnata*, and *Morus alba*), fuel (*Borassus flaballifer*, *Ficus semicordata*, and *Muntingia calabura*), aesthetic and ornamental purposes (*Phoenix rupicola*, *Prunus cerasoides*, and *Syzygium jambos*). These UEFS have also been acknowledged as critical resources for long-term ecological security as they provide multifarious ecosystem services, grow in varied climatic conditions, and are resistant to biotic and abiotic stresses (Suresh et al., 2014; Mahapatra et al., 2012). Such species are encouraged for commercial production, which plays a significant role in maintaining ecological balance and environmental stability through carbon sequestration, nitrogen fixation, phytoremediation, and soil and moisture conservation.

3.5.4. Potential of further improvement

The narrow altitude difference, coupled with varied tropical to subtropical biogeographic conditions, was found in the IGP. This region is home to variability, variety, and depository of genetic resources of our country, where

many species originated and are reported to occur in the tiny sporadic tropical-subtropical forests of the GP and the foothills of the Himalayas (Shankar et al., 2020). Most of these UEFS thrive well under adverse climatic conditions and are good sources of several desirable, resistant, or tolerant genes for various biotic and abiotic constraints. These genes can be transferred to cultivated species using various intergeneric or interspecific breeding programs. For instance, *Prunus nepalensis*, commonly known as Khasi cherry, is resistant to collar rot and powdery mildew (Pareek et al., 1998). The environment plays a significant role in the biosynthesis of plant bioactive compounds and these compounds in fruits grown in one province may differ from those in the other region. Some fruits like *Diospyros* spp. have an astringent taste, which leads to low consumer preference. This can be improved through natural ripening and genetic improvement. Therefore, further investigations into the nutritional aspects, consumer preference, and genetic improvement of these UEFS are vital concerns.

3.6. Promotion of documentation, cultivation, utilization, and marketing of UEFS

The role of UEFS is now widely recognized, yet unfortunately data available on their documentation, composition, cultivation, marketing, and utilization is scanty and sporadic (Suresh et al., 2014). Hence, further studies are needed to ensure that they become well-known to everyone and, in return, aid in the conservation, development, and production of native and naturalized biodiversity. Nexus among conservation, cultivation, documentation, marketing, and utilization is important to achieve adaptability, productivity, and sustainability of UEFS integrated cultivation practices.

3.6.1. Documentation

The documentation of some UEFS, namely amla, bael, ber, fig, jamun, wood apple, and many others, is found in various ancient literatures, including Charaka Samhita and Vrikshayurveda from the 4th century BC to the present (Mahapatra and Panda, 2009). Keeping records will help in assessment, cultivation, domestication, improvement, and sustainable utilization which can diversify food and enrich the livelihoods of rural poor and tribals (Mahapatra et al., 2012). Also, documentation helps to surmount biodiversity loss and conservation of these valuable bioresources (Laha et al., 2018). There is a need for the scientific collation and validation of traditional knowledge available in Vedas, Grantas, Vrikshayurveda, and numerous other sources.

3.6.2. Cultivation

In ancient Indian times, natural resource-based traditional cultivation was practiced in collaboration with the indigenous knowledge and experience of the practitioners, which safeguards the nation of low population with food security and ecological balance. In recent times, the rapid increase in population, which ancient agriculture

was unable to sustain, and the Green Revolution in India, which emerged in the mid-60s in response to the postindependence demand for food, have come into focus. The overuse of chemical fertilizers, pesticides, and numerous other synthetic substances, with the objective of producing more food from limited land area, has consciously led India to sacrifice its ecological balance and environmental safety. Furthermore, numerous indigenous traditional landraces have been driven to extinction as a consequence of the introduction of hybrids and GM crops. Although the Green Revolution has incurred a significant influence on the agricultural sector, initially boosting crop productivity from the late 1990s onwards, it has begun to lose its efficacy due to stagnation in yield, long-term soil health and environmental deterioration.

Nowadays, people are realizing the potential of UEFS and the demand for quality planting material is increasing. To meet this demand, vegetative propagation techniques such as stem cutting, layering, stooling, and grafting are viable options for commercial multiplication. Various fruit crop-based models can be adopted to diversify farm income, minimize the risk, and enhance productivity. Plantation of UEFS should be done at closer spacing with locally available perennial organic mulches and proper management of the canopy. This approach can double productivity and income, leading to better livelihoods (Singh et al., 2020). Species such as *Eugenia rothii*, *Mimusops elengi*, *Ziziphus oenoplia*, *Ziziphus rugosa*, *Bridelia tomentosa*, and *Carissa carandus* were great sources of minerals and micronutrients. Therefore, they were used as promising species for promoting farming systems suffering from crop loss, food shortage, and chronic malnutrition. Intercropping during the initial years of an orchard of bael, chironji, wood apple, and jamun had no adverse impact on plant growth up to seven years. This can be extended to three more years if the spacing is increased to 10 m × 10 m, which can be expected to increase an income 2–3 times higher (Singh et al., 2020). Generally, the productivity of native and naturalized UEFS of the IGP is very low compared with other major fruit crops grown in India; this might be attributed to the low productivity of soil, species established through natural regeneration, and eventually bearing fruits with inferior quality after a long gestation period. Hence, to solve such major constraints, there is a critical need to develop improved varieties and package of practices, and further demonstrate and expose the established fruit-based farming models to the growers for popularizing the UEFS.

3.6.3. Utilization

UEFS are eaten worldwide as raw, unripe, and cooked forms as it covers the greatest area (FAO, 2011). However, its consumption has gradually decreased due to the introduction of exotic fruits, undervaluation and

utilization of native fruits, overpopulation, urbanization, deforestation, intensive agriculture, and numerous other factors (Deshmukh and Waghmode, 2011). UEFS have been playing a dual role in supplementing the community with food and income and buffering food rescuing lives during food shortages and famines (Grivetti and Ogle, 2000). In a community, their traditional knowledge, demand, availability in terms of duration and distance, tastes, and preferences influence the exploitation of UEFS in a particular area. Poverty and undernourishment are prevalent in the IGP, while the present study hints that the UEFS can help to substantiate the food and nutrition security in this region. Hence, there is a need for a strong linkage between nutritious food security and biodiversity for the formulation of policy support to promote the utilization, value addition, and conservation of UEFS (Grivetti and Ogle, 2000).

3.6.4. Marketing

Improvement in infrastructure and processing technology will be needed for cleaning, grading, drying, cooling, storage, and handling of produce to improve their quality and self-life, reduce losses and cost of transportation, and to increase income and employment opportunities, particularly in rural areas. Promoting UEFS-based small food industries will contribute to sustainable rural development by providing manifold employment opportunities in agro-based industries, packaging, storage, preservation, transportation, marketing, and various other sectors. In addition, a detailed survey is needed for exploring market potential and developing linkages. Furthermore, creating awareness and providing training to various stakeholders through various central and state government schemes helps to gain a proper marketing strategy. There is a need for financial, policy, scientific, and technical support for the effective marketing of UEFS.

3.7. Implications for LDN

Earlier studies show a successful restoration of various degraded and denuded ecosystems such as degraded forests (Babu et al., 2009), mined areas (Ahirwal and Pandey, 2021), and marginal and wastelands (Ghosh et al., 2021). Successful long-term case studies, research collaboration from various disciplines, and integration of practitioner and policy support are important to achieve LDN with the help of restoration science. The degradation and denudation of forest ecosystems mainly through anthropogenic activities is a major driver of biodiversity loss, carbon (C) emission, and uncertainty of food and livelihood for forest-dependent communities. Greenhouse gases such as carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), carbon monoxide (CO), chlorofluorocarbons (CFC), etc., increase the earth's temperature; among them, CO₂ is the key gas playing role in global warming, which leads to climate change (Lal,

2004; Sarkar et al., 2020). These climate-change induced floods, droughts, etc., are degrading soil productivity, crop yields, and environmental quality (Rakesh et al., 2019). Additionally, human-induced intensive agriculture is also degrading the productive soils (Srinivasarao et al., 2021). According to the data published by the Indian Council of Agricultural Research (ICAR) and National Academy of Agricultural Sciences (NAAS) in 2010, there is about 120.72 Mha of land degraded out of 328.73 Mha. Thus, sequestration of atmospheric C would be the possible solution for improving soil quality, yield sustainability, and climate change mitigation (Lal, 2004; Rakesh et al., 2020; 2022a). Planting trees through agroforestry would help in achieving restoration of degraded lands (Rakesh et al., 2022b), and plantation forestry helps in improving the soil C sequestration and nutrient dynamics through continuous litter fall (Dinesha et al., 2020; 2024).

Restoration of ecosystems degraded due to mining is a more challenging task than degraded forests or wastelands because of inadequate hydrological and topographical features and soil physicochemical and biological properties (Ahirwal and Pandey, 2021). Successful afforestation or reforestation measures mainly include assisted natural regeneration, planting or sowing of native seeds or promising naturalized species, improving edaphic and topographic factors, drainage, and hydrological features, and protecting from various biotic and abiotic damages such as fire, flood, grazing, and invasive species (Babu et al., 2009). The most prominent effects on the success of restoration of the planted native and naturalized species depend on the climate, existing natural vegetation, hydrological features, and soil quality. The reclamation, rehabilitation, and restoration of degraded ecosystems such as marginal and wastelands have intensively been studied in India and provided effective methods for the management of degraded marginal and wastelands (Babu et al., 2009; Ghosh et al., 2021). However, region-specific models are vital for effective restoration through vegetation intervention in various geographical regions of India including the IGP. These UEFS like bael, jamun, tamarind, chironji, khirni custard apple, etc., are climate smart, meaning they can survive in harsh climates and can be established on degraded lands (Singh et al., 2020). UEFS have great potential for establishment on marginal and wastelands throughout the GP region. These resilient fruit species apart from feeding humans also augment biodiversity, ecosystem, and landscape. This study suggests the integration of these native and naturalized UEFS for achieving India's national commitment to LDN. Of the 196 countries, 123 countries committed to LDN including India as they participated in the 14th Conference of Parties (COP14) to the United Nations Convention to Combat Desertification (UNCCD) in 2019. India, therefore,

committed to 26 Mha of degraded land to restore land productivity and ecosystem services by adopting a landscape restoration approach. The integration of UEFS to achieve LDN through afforestation or reforestation in various degraded, denuded, and marginalized ecosystems has been illustrated in Figure 7. The study we have conducted is based on data from published literature; further fieldwork is needed for cultivational aspects, in-depth analysis of biochemical characteristics, and a record of indigenous knowledge through ethnobotanical investigations.

3.8. Current status: risks and conservation

The convention on biological diversity recognizes the sovereign right of each country over their biodiversity, and it is therefore necessary to strengthen their scientific and technological capabilities to ensure this sovereignty (Prakash, 2011). Documentation, evaluation, and prioritization of endemic, endangered, and threatened plant species and their conservation for sustainable utilization is a vital concern (Singh et al., 2020). UEFS have remained neglected in many regions of the country, including the GP, and some of the genetic resources of these species are still available in outfields or forests. Apart from this, some are in the hands of tribals and local communities, and they use it solely for their subsistence while also protecting it as part of their folkloric responsibilities. The diversity of some of the UEFS is yet to be explored and there is a discontinuity between the species and regions in terms of scientific research, collection, documentation, and sustainable utilization. There is a need for intensive species-specific surveys and explorations in target variability pockets in diversity-rich areas of the IGP for systematic evaluation, characterization, and conservation of indigenous germplasm. Some of the improved varieties such as bael, jamun, chironji, and tamarind need to be planted on a commercial scale at farmer's field with assured incentives and technical support. There is a need for scientific, technical, financial, and policy provisions for maintaining a large number of diverse germplasms of UEFS of the IGP in the field repository.

3.9. Researchable issues and the way forward

Research work on UEFS should be expanded (Figure 8) in order to maximize output and economy and overcome disease and pest problems. Furthermore, linking policy makers, researchers, and practitioners may build a strong association between India's national policies and ecosystem restoration initiatives. Nutrition surveys need to be carried out at various levels to understand the use of native and naturalized UEFS in food and nutritional security. Awareness and education about nutrition may help to improve the diversity and quality of complementary foods by using locally available native and naturalized food resources. Further studies are needed for the analysis of nutritional, phytochemical, and therapeutic properties that

Land Degradation Neutrality: Concept and principles for integration of Underutilized Native and Naturalized Edible Fruit Species

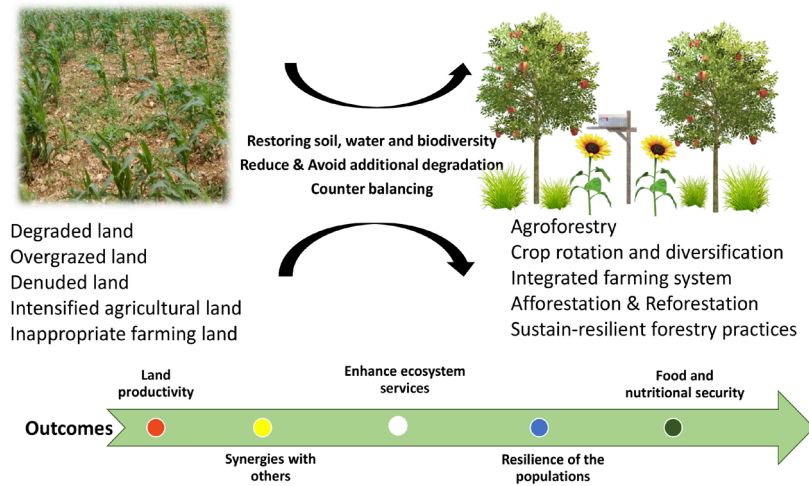


Figure 7. Integration of UEFS to achieve LDN through afforestation or reforestation.



Figure 8. Researchable issues and the way forward.

will benefit society, and additional studies will also help to improve knowledge about these species' habitats according to the climatic zones of the IGP. Development of improved varieties, quality planting materials and seeds, extension services, postharvest management, preservation, marketing, and transport are vital concerns. Studies on exploration, collection, documentation, and utilization of UEFS would be useful in selecting underutilized nutritious fruit species from wild resources of the IGP. Further research is needed on extension services in terms of creating awareness about

new technologies, providing the latest information, and conducting field demonstrations and training programs for the growers. Furthermore, a detailed survey is needed to explore market potential and developing linkage. The intensive species-specific surveys and exploration in target variability pockets in diversity-rich areas of the IGP will be useful for inventory and management purposes. States of the IGP should come up with a clear-cut policy to encourage and promote cultivation, marketing, and utilization of UEFS.

4. Summary and conclusion

UEFS play a vital role in the food and nutrition of the people and have potential nutraceutical properties. Many of these enlisted species were economically potential such as edible, medicinal, ornamental, timber, and many other uses. There is a need for coordinated research efforts for the survey, documentation, evaluation, cultivation, and conservation (ex situ and in situ) of UEFS. The inclusion of UEFS through afforestation or reforestation will be effective for conservation and popularization through awareness and providing suitable standardized cultivation practices and developed technologies through training and demonstrations. In addition, developmental activities like supply of quality planting materials and processing units for gear-up of their value-added products at commercial levels through small-scale industries, self-help groups, and farmer-producer organizations are considered necessary. The government should also actively participate in this regard by providing necessary inputs, technical support, and policy interventions through various schemes for the establishment of commercial orchards of these underutilized fruit trees. These fruits are highly adaptable and show resistance to various insect pests and diseases; hence, pesticide and other chemical requirements are almost negligible. Thus, they can fit well into organic and natural farming, as they require less attention from the cultivars. On the other hand, the government is giving more emphasis on promoting indigenous species through the slogan 'vocal for local' and 'local for global'.

There is a gap between national or state policies and restoration initiatives in India. Replacing natural forests with fast growing nonnative species for timber and other purposes may support economic development but at the cost of losing valuable biodiversity and various ecosystem services. Many studies and projects are already available at the national and state levels. However, we lack region-specific technologies that are accepted by the poor farmers with fragmented land holdings and fewer technological inputs. This must be considered by the government while framing policies for sustainable, environmental, and economic developments, so that we can connect

loose links between researchers, policymakers, and practitioners. This study suggests that the integration of these UEFS in LDN programs through afforestation and reforestation can provide food and nutritional security and health benefits, restore degraded land, and also help in the conservation of indigenous species. India's commitment to LDN by 2030, outlined in the 14th Conference of Parties of the United Nations Convention to Combat Desertification (UNCCD), to restore 26 Mha of degraded area, can also be addressed. Ensuring sustain-resilient production of foods with increasing resource use efficiency and neutralizing land degradation is vital. So that it also contributes to the United Nations Sustainable Development Goals of no poverty, zero hunger, climate action, and good health and well-being in addition to increasing food and nutritional security by 2030.

In conclusion, this systematic review has provided some illumination on all facets of the UEFS and is anticipated to serve as a guide for practitioners integrating the UEFS, a point of reference for researchers interested in delving into its myriad fascinating facets, and a tool for policymakers crafting sustainable and scientifically sound policies in the IGP region.

Contribution of authors

Conceptualization: RS; DS (Dinesha S). Literature search: DS (Dinesha S); RS; DS (Deepranjan Sarkar); PKJ; Shikha. Writing—original draft preparation: DS (Dinesha S); RS; DS (Deepranjan Sarkar). Writing—review and editing: RS; DS (Deepranjan Sarkar); PKJ; RB; Shikha; SKK; VS; AR; RD; SE. Figure: RS; DS (Dinesha S); DS (Deepranjan Sarkar); RB.

Funding

No funding was received to conduct this study.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflict of interest

The authors declare that they have no conflict of interest.

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Supplementary Table. General account on reported UEFs, significance, IUCN status and references.

Sl. No.	Scientific name and family	Common name	Life form	Origin	Flowering-fruiting	State	Nutritional status	Part used and products	Other significance	IUCN Status	References
Acanthaceae											
1	<i>Avicennia marina</i> (Forssk) Vierh.	Grey mangrove/ Peyara ban	T	Native	February–August	WB	Rich in phytochemicals	Eaten raw by the local people	Medicinal, insect repellent, dye, tannins, timber	LC	Mitra and Mukherjee (2009)
Achariaceae											
2	<i>Gynocardia odorata</i> R. Br.	Chaulmogra	T	Native	March–December	WB	Fruit and seeds	Crude oil from seeds	Medicinal	NE	Rymbai et al. (2016)
Actinidiaceae											
3	<i>Actinidia callosa</i> Lindl.	Tekhiphal	S	Native	April–August	UP; WB	Nutritionally rich	Eaten raw	Folk medicine	NE	Jeeva (2009)
4	<i>Saurauia punduana</i> Wall.	Pandua Gogan	T	Native	April–December	WB	Nutritious berry fruit used	Fruits are boiled and pickles are prepared	Firewood and charcoal	CR	Laha et al. (2018)
Adoxaceae											
5	<i>Viburnum foetidum</i> Wall.	Himalayan Viburnum	S	Native	May–September	BR; WB	Sweet fruit	Drupe fruit eaten raw	Medicinal use	LC	Rymbai et al. (2016)
Alangiaceae											
6	<i>Alangium sahyajifolium</i> (L.f.) Kuntze	Ankol	T	Native	February–May	BR; UP; WB	Fruits used	Pulp of fruit is edible	Fruit powder for burning and root bark for diarrhoea	NT	Ahirwar (2015)

Supplementary Table. (Continued.)

Anacardiaceae											
7	<i>Anacardium occidentale</i> L.	Cashew	T	Naturalized	January–May	BR; UP; WB	Nutrient-dense fruit	Eaten raw or used in culinary and wine making	Medicinal values	LC	Barooah and Ahmed (2014)
8	<i>Buchanania lanzan</i> Spreng.	Chironji	T	Native	January–May	BR; UP; WB	Nutritious seed	Sold locally	Fruit is laxative	LC	Shivprasad et al. (2016)
9	<i>Choerospondias axillaris</i> (Roxb.) B.L Burt & A.W.	Hill Hog plum/Bonamra	T	Native	January–June	WB	Sour fruit used	Ripped fruit eaten raw	Medicinal	LC	Khruomo and Deb (2018)
10	<i>Lannea coromandelica</i> (Houtt.) Merr.	Jhingan / Bonamra	T	Native	March–June	WB	Fruits are eaten or cooked	Pickles making	Commercial gum and medicinal use	LC	Dhore et al. (2012)
11	<i>Mangifera blommesteinii</i> Kosterm.	Wild mango	T	Native	January–June	WB	Sour fruit used	Harvested from the wild for local use	Folk medicine	EN	Paul (2013)
12	<i>Mangifera sylvatica</i> Roxb.	Bon Am/Himalayan or Nepal Mango	T	Native	April–September	BR; UP; WB	Unripe and ripe fruits	Jam, pickle	Folk medicine	VU	Abdullah et al (2020)
13	<i>Pegia nitida</i> Colebr	Pegia	S	Native	January–May	WB	Acidic and aromatic fruits	Whole fruit is eaten raw	Medicine use	LC	Singh and Asha (2017)
14	<i>Rhus chinensis</i> Mill.	Nutgall tree/Bhalay	T	Native	December–April	WB	Fruit as a digestive	Eaten raw	Medicinal (Dysentery)	LC	Mitra and Mukherjee (2009)
15	<i>Spondias axillaris</i> Roxb.	Theseli	T	Native	February–December	WB	fruits are rich in vit C	Eaten raw, pickled and processed food	Medicinal	LC	Bhutia et al. (2018)
16	<i>Spondias cythera</i> Sonn	Amra Hog Plum	T	Native	July–August	WB	Ripe fruits eaten raw	Chutney and culinary use	Ayurvedic properties,	LC	Paul (2013)
17	<i>Spondias pinnata</i> (L.f.) Kurz	Hog plum (Means, Pigs feedstuff)	T	Native	April–June and August–September	BR; UP; WB	Sour in taste	eaten raw or as chutney, pickles, jams, jellies, juices	Medicine (dysentery)	LC	Abdullah et al. (2020)

Supplementary Table. (Continued.)

Annonaceae												
18	<i>Annona reticulata</i> L.	Ramphal/ Nag-hawa	T	Native	February- October	BR; UP; WB	High in sugar and vitamins	Eaten raw	Seed used as medicine	LC	Mitra and Mukherjee (2009)	
19	<i>Annona muricata</i> L.	Lakshman phal	T	Native	April- October	BR; UP; WB	Tryptophan, vitamins and mineral rich	Eaten raw	Used as medicine	LC	Mitra and Mukherjee (2009)	
20	<i>Millettia macrocarpa</i> Hook.f.Thomson	-	T	Native	April- November	WB	Nutritious fruits collected	Fruits eaten raw	-	NE	Singh and Asha et al. (2017)	
21	<i>Polyalthia siberosa</i> (Roxb.) Thwaites	Gua koli	T	Native	April- August	BR; WB	Rich in minerals	Fruits edible	Medicinal	NT	Mahapatra et al. (2012)	
22	<i>Uvaria cordata</i> (Dunal) Alston	Maladi/ Cananga	C	Native	June- August	BR; WB	Sweet in taste	Fruits are used	Medicine and fibre use	NE	Singh et al. (2001)	
23	<i>Uvaria lutea</i> Roxb.	Uvaria grape	T	Native	June- August	BR; WB	Sweet and edible	Used locally	Firewood	NE	Laha et al. (2018)	
24	<i>Uvaria tomentosa</i> Roxb.	Dom-Sal/ Hoom	T	Native	April-July	UP	Nutrient-dense fruit	Fruit is eaten	Medicinal use	NE	Prakash (2011)	
25	<i>Uvaria velutina</i> Dunal	Beri	T	Native	February- October	UP	Nutrient-dense fruit	Fruit cooked and used as a vegetable	Folk medicine	LC	Prakash (2011)	
Apocynaceae												
26	<i>Carissa carandus</i> L.	Karonda	T	Native	February- June	BR; UP; WB	Rich in iron and vitamins	Pickled, jam, jelly, syrup and chutney	Used for toxicity and bronchitis	LC	Banarjee et al. (2013)	
27	<i>Carissa opaca</i> Stapf.	Kanod	S	Native	February- June	BR	Rich in minerals	Eaten raw	Folk medicine	LC	Kumar (2016)	

Supplementary Table. (Continued.)

28	<i>Holarrhena pubescens</i> Wall. ex G. Don	Kurchi	T	Native	February-July	WB	Nutritious flowers and seeds	Flowers and seeds were used	Medicinal (Tumor and snake bite)	LC	Prakash (2011)
29	<i>Holostemma adakodien</i> Schult.	Chirvel	C	Native	September-December	BR; UP; WB	Rich in minerals	Fruits are eaten	Medicinal	VU	Singh et al. (2001)
30	<i>Leptadenia pyrotechnica</i> (Forssk.) Decne.	Khimpoli	S	Native	February-March	UP	Pod like fruits are used	Cooked as vegetables	Folk medicine, fodder and fiber for making ropes	LC	Barooah and Ahmed (2014)
31	<i>Willughbeia edulis</i> Roxb.	Aguh Gitan	C	Native	May-August	WB	Acidic pulp	Fruit is eaten by tribals	Latex used as medicine	NE	Barooah and Ahmed (2014)
Areaceae											
32	<i>Borassus flabellifer</i> L.	Doub palm/ tala palm/ ice apple	T	Native	March-April and July- September	BR; UP; WB	Sweet sap from flowers	Fruit and seed eaten raw, pickled and jiggery making	Folk medicine, ornamental, thatching and fuel	LC	Mondal (2019)
33	<i>Calamus flagellum</i> Griff. ex Mart.	Putli bet/ Rab bet	T	Native	June-November	WB	Fruit eaten	Fruit is used	PBI; Medicinal, furniture industry	EN	Mondal (2019)
34	<i>Calamus floribundus</i> Griff.	Lejai/Tenga Bet	T	Native	April-August	WB	Fruit eaten	Fruit pulp is used	PBI; Medicinal, furniture industry	EN	Mondal (2019)
35	<i>Calamus gracilis</i> Roxb.	Chulibet	T	Native	April-February	WB	Fruit eaten	Fruit pulp is used	PBI; Religious use	NT	Mondal (2019)
36	<i>Calamus inermis</i> T. Anderson	-	T	Native	July-August	BR; WB	Fruit eaten	Fruit pulp is used	PBI; High quality and most traded	CR	Rymbat et al. (2016)
37	<i>Calamus pseudotenuis</i> Becc.	Betgara, Oda bet	T	Native	December-May	WB	Fruit eaten	Fruit pulp is used	Fruits for diabetes	EN	Mondal (2019)
38	<i>Calamus tenuis</i> Roxb.	Heiri/Rattans	T	Native	March-April	BR; WB	Highly acidic fruit	Used as digestive	PBI; Medicinal and furniture use	LC	Singh et al. (2015)

Supplementary Table. (Continued.)

39	<i>Calamus viminalis</i> Willd.	Rattan	T	Native	July–August	BR; WB	Ripe fruits	Ripe fruit occasionally eaten	PBI; Shoot edible, medicinal	LC	Abdullah et al. (2020)
40	<i>Daemonorops jenkinsiana</i> (Griff.) Mart.	Golak Bet/ Golla Bet	T	Native	July–May	WB	Fruit eaten	Fruit pulp is used	Fruit eaten by wildlife	NT	Mondal (2019)
41	<i>Caryota mitis</i> Lour	Fishtail Palm	T	Native	January–June	BR; WB	Flower and fruits used	Sap for making wine and sugar	Medicine	LC	Laha et al. (2018)
42	<i>Caryota urens</i> L.	<i>Sugar palm/ Jaggery Palm</i>	T	Native	January–April	BR; UP; WB	Rich in sugar	Making Jaggery and country liquor	Construction and seeds used in place of betel nut	LC	Patiri and Borah (2007)
43	<i>Corypha taliera</i> Roxb. DC.	Tali Palm/ Talipalm	T	Native	October–February	WB	Sweet in taste	Fruit is used	Monocarpic species and few are present in Kolkatta, India	EW	Johnson (1998)
44	<i>Corypha utan</i> Lamk.	Gebang Palm/ Buri Palm	T	Native	November–April	WB	Sweet kernal used	Fruit and seeds used as vegetable	Thatching, fibre and floor mats	LC	Mondal (2019)
45	<i>Corypha umbraculifera</i> L.	Talipot Palm/ Bene Tali	T	Native	November–April	BR; WB	Sweet sap collected	Edible starch and liquor	Thatching, rope and floor mats	DD	Mondal (2019)
46	<i>Licuala peltata</i> Roxb. ex Buch.-Ham.	Chatapat	T	Native	September–May	WB	Flower and fruit used	Edible fruit	Thatching and rope	CR	Mondal (2019)
47	<i>Livistona jenkinsiana</i> Griff.	Tokon/ Talainyom	T	Native	February–December	WB	Sweet in taste	Edible starch and liquor	Thatching, fibre and rain coat	NT	Mondal (2019)
48	<i>Lasia spinosa</i> (L.) Thwaites	Kantakochu	H	Native	July–August	WB	Sweet in taste	Eaten raw	Medicinal value	LC	Mitra and Mukherjee (2009)
49	<i>Nypa fruticans</i> (Thumb.) Wurmb	Golpata Nipa palm	T	Native	November–July	WB	Sap for making wine and sugar	Juice is collected and fruit is eaten like Taal	Medicinal	LC	Paul (2013)
50	<i>Pinanga gracilis</i> Blume	Golden palm	T	Native	April–March	BR; WB	Ripe seeds consumed	Seeds eaten like areca nut	Folk medicine	NE	Singh and Asha (2017)

Supplementary Table. (Continued.)

51	<i>Phoenix acaulis</i> Buch.-Ham. ex Roxb.	Stemless date palm	T	Native	January– April and May–June	WB	Fleshy sweet pulp of fruit is eaten	Eaten raw	Medicinal	NT	Mondal (2019)
52	<i>Phoenix loureiroi</i> Kunth	Dwarf date palm	T	Native	October– December	BR; WB	Rich in sugar	Eaten raw	Medicinal, household brooms	LC	Mondal (2019)
53	<i>Phoenix paludosa</i> (L.) Roxb.	Hetal	T	Native	January– February and May– July	BR; WB	Rich in sugar	Eaten raw	Medicinal	NT	Mondal (2019)
54	<i>Phoenix rupicola</i> (T.) Anderson	Cliff date palm	T	Native	April– August and September– November	WB; BR	Fruit used	Eaten raw	Medicinal, ornamental	NT	Mondal (2019); Hosen et al. (2020)
55	<i>Phoenix sylvestris</i> (L.) Roxb.	Silver date palm/ Indian date	T	Native	May–June	BR; UP; WB	Rich in sugar	Eaten raw	Medicinal, molasses, jaggery, toddy	LC	Banarjee et al. (2013); Paul (2013)
56	<i>Trachycarpus martianus</i> H. Wendl.	Martius' fan palm	T	Native	March– September	WB	Sweet in taste	Fruit and flowers are edible	Thatching	NT	Mondal (2019)
Asclepiadaceae											
57	<i>Cynanchum barbigerum</i> (Scheele) Shinners	Badmashia	C	Naturalized	-	UP	Nutrient-dense fruit	The young fruits are sweet and edible	-	NE	Ahirwar (2015)
58	<i>Pentanura khasiana</i> Kurz	Khasi Swallow- Root	C	Native	May– November	BR; WB	Sweet fruit consumed	Eaten raw	Fodder and Folk medicine	NE	Laha et al. (2018)
Berberidaceae											
59	<i>Berberis aristata</i> DC.	Indian Barberry	S	Native	March–June	BR; UP; WB	Sweet juicy fruits	Fruit eaten raw locally	Country liquor, dye and tannin	LC	Singh et al. (2001)
60	<i>Berberis asiatica</i> Roxb. Ex. DC.	Asian Barberry	S	Native	March–June	BR; UP; WB	Juicy and acid flavor	Fruit used to make the Indian raisins	Traditional medicine	LC	Singh et al. (2001)

Supplementary Table. (Continued.)

Bignoniaceae											
61	<i>Crescentia cujete</i> L.	Ban Bael; calabash tree	T	Naturalized	July–November	WB	Fruit and Shell used	Young fruit is pickled	Medicinal and ornamental use	LC	Biswas et al. (2018)
62	<i>Oroxylum indicum</i> (L.) Kurz	Indian trumpet/ Broken bones	T	Native	January–June	BR; UP; WB	Whole fruit used as vegetable	Eaten raw, Vegetable	PBI; Medicinal, ornamental, wood, and dye	LC	Dwivedi (1993); Lim (2012)
Bombacaceae											
63	<i>Bombax ceiba</i> L.	Cotton tree/ Semul	T	Native	February–June	BR; UP; WB	Flower and fruit used	Eaten raw or cooked as a vegetable	Medicinal	LC	Bose et al. (2015)
64	<i>Durao zabethinus</i> L.	Durian	T	Naturalized	June–August	WB	Fruit used	Pulp and seeds eaten, jam and jelly gives energy	Medicine	VU	Paul (2013)
Boraginaceae											
65	<i>Cordia dichotoma</i> Forst.	Bhokar	T	Native	March–May and June–August	BR; UP; WB	Rich in amino acids and mineral	Vegetable and in preparation of chatnes.			
66	<i>Cordia myxa</i> L.	Assyrian plum	T	Native	July–August	BR; UP; WB	Rich in minerals and vitamins	Pickles, Fruits eaten			
67	<i>Ehretia acuminata</i> (DC.) R. Br.	Koda	T	Native	January–June	BR; UP; WB	Sweet and nutritious fruit	Fruit eaten raw			
68	<i>Ehretia laevis</i> Roxb.	Koss phang	T	Native	January–June	BR; UP; WB	Sweet fruits	Fruit eaten raw or used as medicine			
Burseraceae											

Supplementary Table. (Continued.)

69	<i>Garuga pinnata</i> Roxb.	Jum	T	Native	January– June	WB	Drupe fruit used	Fruit eaten raw		
70	<i>Garuga Floribunda</i> Decne.		T	Native	January– June	WB	Nutritious fruit	Eaten raw		
71	<i>Protium serratum</i> Engl.	Niyar/ Gutgutiya	T	Native	March–July	BR; WB	Antioxidants	Sour fruits used in wine, and pickle		
Cactaceae										
72	<i>Opuntia aciculata</i> Griffiths	Nagphani	S	Naturalized	December– June	UP	Sweet fruits are collected	Eaten fresh fruits		
73	<i>Opuntia dillemii</i> Ker Gowl.	Prickly pear	S	Naturalized	March– December	UP	Sweet in taste	Eaten raw		
74	<i>Opuntia elatior</i> Mill.	Nagaphani	S	Naturalized	June– November	UP	Rich in nutrients	Eaten raw		
75	<i>Opuntia ficus- indica</i> (L.) Mill.	Nepal fig opuntia	S	Naturalized	March– December	BR; UP; WB	Nutritious fruits	Fresh fruits eaten raw		
Caesalpiniciaceae										
76	<i>Cynometra iripa</i> Kostel.	Wrinkle Pod Mangrove	T	Native	November– March	WB	Fruits used	Eaten raw and cooked		
77	<i>Tamarindus indica</i> L.	Imli	T	Naturalized	January– April	BR; UP; WB	Sweet and sour rich in vitamins	Used in sauces, curries, chutneys, boiled or fried kernels eaten		

Supplementary Table. (Continued.)

Cannabaceae										
78	<i>Celtis australis</i> L.	Nettle tree	T	Native	April–July	UP	Ripen fruits used	Eaten raw		
79	<i>Celtis timorensis</i> Span.	Stinkwood	T	Native	May–April	WB	Nutritionally rich	Eaten raw		
Capparaceae										
80	<i>Capparis aphylla</i> Roth	Karira/Karil	S	Native	March–September	UP	Nutrient-dense fruit	Eaten raw or pickled		
81	<i>Capparis spinosa</i> L.	Caper bush/Kalavari	S	Native	April–September	BR; WB	Nutritious fruits	Fruits are eaten raw		
82	<i>Capparis zeylanica</i> L.	Hurhure	S	Native	February–November	BR; UP; WB	Rich in sugars and vitamins	The unripe fruits are used as vegetables		
83	<i>Stixis suaveolens</i> (Roxb.) Pierre	Madhubilata/Madhmalati	C	Native	February–January	BR; UP; WB	Rich in bio-active compounds	Ripe fruit is aromatic and sweetish		
Celastraceae										
84	<i>Celastrus paniculatus</i> Willd.	Mal-kangoni/Climbing staff	C	Native	April–September	BR; UP; WB	Nutritious fruits	Fruits are edible		
85	<i>Gymnosporia senegalensis</i> (Lam.) Loes.	Confetti/Red spike thorn	T	Native	June–October	BR	Flower and fruits	Used as vegetable		
Clusiaceae										

Supplementary Table. (Continued.)

86	<i>Garcinia acuminata</i> Planch. & Triana	Bacuri	T	Native	March–August	WB	Sour fruits	Eaten raw			
87	<i>Garcinia atroviridis</i> Griff.	Asam gelugur	T	Native	April–September	WB	Extremely sourish fruit	Fresh fruits are sliced, sun dried and used in curries			
88	<i>Garcinia brevirostris</i> Scheff.	-	T	Native	April–September	WB	Sourish fruit	Pickled			
89	<i>Garcinia cambogia</i> (Gaertn.) Desr.	Gambooge/ Malabar tamarind	T	Native	March–May and August–November	BR; WB	fruit used in traditional recipes	Used in cooking and seed yields fat a substitute of ghee			
90	<i>Garcinia cowa</i> Roxb. ex DC.	Kaophal	T	Native	March–August	BR; WB	Sourish fruit	Ripe fruits used			
91	<i>Garcinia indica</i> Roxb.	Kokum butter tree	T	Native	August–January	WB	Fruit in used	Used in juice, jelly and Pickle			
92	<i>Garcinia lydia</i> Roxb.	Mangosteen	T	Native	April to July	WB	Sour fruits are source of vitamins	Rind could be dried and stored			
93	<i>Garcinia paniculata</i> Roxb.		T	Native	March–June	WB	Fruit eaten raw	Unripe fruits used to prepare pickles			
94	<i>Garcinia pedunculata</i> Roxb.	<i>Sani</i>	T	Native	March–April	WB	Fruit eaten	Biggest fruit of this genus			
95	<i>Garcinia stipulate</i> T. Anderson	Sanakadan	T	Native	April to July	WB	Sourish fruit	Eaten raw			
96	<i>Garcinia xanthochlymus</i> Hook.f. ex T.Anderson	False Mangosteen/ Mysore Gambooge	T	Native	March–May and August–November	WB	Nutraceutically rich and seeds yield 17% oil	Eaten raw or cooked, used in sherbets, jams, curries, vinegars			
Combretaceae											

Supplementary Table. (Continued.)

97	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	T	Native	June– September	BR; UP; WB	Fruits used	Seeds used			
98	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Bahera	T	Native	March– August	BR; UP; WB	Fruit used	Food for several ethnic groups			
99	<i>Terminalia catappa</i> L.	Desi-Badam	T	Native	February– August	BR; UP; WB	Sweet seed used	Seeds are sweet and substitute for almond			
100	<i>Terminalia chebula</i> Retz.	Haritaki/ Black Myrobalan	T	Native	March– April	BR; UP; WB	Edible fruit and seeds	Seeds as snacks, edible oil, sour fruits for salads, fries,black salt			
101	<i>Terminalia citrina</i> (Gaertn.) Roxb. ex Flem.	Yellow Myrobalan	T	Native	March–June	BR; WB	Raw fruit is used	Fruit is confused with myrobalan			
Connaraceae											
102	<i>Rourea minor</i> Leenh.	(Kalavindhara, Vidhara)	S	Native	April– October	BR; UP; WB	Seed collected	Ripe seeds are edible			
Cucurbitaceae											
103	<i>Cucumis pubescens</i> Willd	Kachariya	H	Native	Year around	UP	Fruits are collected	Ripe fruits are eaten raw			
104	<i>Cucumis callosus</i> (Rottl) Cogn.	Ban kachariya	H	Native	July– October	UP	Nutrient-dense fruit	Ripe fruits are edible and used to make pickle			
105	<i>Coccinia grandis</i> (L.) Voigt.	Ivy gourd/ Telakucha	C	Native	June– August	BR; UP; WB	Nutrients and mineral rich	Vegetable and pickle			
106	<i>Hodgsonia macrocarpa</i> (Bl.) Cogn.	Lard Seed/ Theboulata	C	Native	February– November	WB	Edible oil	Seed roasted and edible oil produced			

Supplementary Table. (Continued.)

107	<i>Momordica dioica</i> Roxb. Ex Willd.	Kakro	H	Native	April– August	BR	Rich in sugar, fat and fiber	Used as vegetable		
Dilleniaceae										
108	<i>Dillenia indica</i> L.	Elephant Apple/Chulta	T	Native	July–August	BR; UP; WB	Unripe and ripe fruits	Chutney and pickle	Medicinal use (abdominal pains)	LC Abdullah et al. (2020)
109	<i>Dillenia pentagyna</i> Roxb.	Agai	T	Native	January– July	BR; UP; WB	Used locally	Fruit fried and used as vegetable	Folk medicine	NE Prakash (2011)
Dipterocarpaceae										
110	<i>Shorea robusta</i> Roth	Sal	T	Native	January– June	BR; UP; WB	Fruit pulp and oil used	Pulp eaten and oil used in culinary	Medicinal, resin and wood	LC Barooah and Ahmed (2014)
Ehretiaceae										
111	<i>Ehretia acuminata</i> Roxb.	Pandayan/ Koda	T	Native	March–May	BR; UP; WB	Sweet fruit	Ripe fruit is eaten, and unripe fruit is pickled	PBI, fast growing, birds and bee foraging	LC Dwivedi (1993)
112	<i>Ehretia laevis</i> Roxb.	Dant-Rang/ Vadhvarni	T	Native	January– April	WB	Fruit used	Fruit is tasteless but is eaten	Ayurvedic and folk medicine use	DD Barooah and Ahmed (2014)
Elaeagnaceae										
113	<i>Elaeagnus conferta</i> Roxb.	Wild olive	S	Native	February– March	BR; WB	Several good fatty acids,	Edible fruit	Medicinal	LC Rymbai et al. (2016)
114	<i>Elaeagnus latifolia</i> L.	Bastard oleaster/ Soh-sang	S	Native	January– April	BR; WB	Several good fatty acids,	Eaten raw	Medicinal	LC Rymbai et al. (2016)

Supplementary Table. (Continued.)

115	<i>Elaeagnus pycnantha</i> L.	Thorny olive	S	Native	November –April	WB	Several good fatty acids,	Fruits are eaten raw or cooked	Medicinal, bee foraging, N fixing	LC	Singh et al. (2015)
116	<i>Elaeagnus umbellata</i> Tumb.	Japanese silvery	S	Native	March–April	BR; WB	Rich in nutrients	Fruit and seed used	Fruit as a digestive	LC	Singh et al. (2015)
Elaeocarpaceae											
117	<i>Elaeocarpus floribundus</i> Blume	Jalpai/ Indian olive	T	Native	April–May and August to October	WB	Rich in vitamins and minerals	Pickles and chutney prepared	Medicinal	LC	Abdullah et al. (2020)
118	<i>Elaeocarpus rugosus</i> Roxb.	-	T	Native	April–October	BR; WB	Nutritious fruits	Eaten raw	Construction and firewood	VU	Laha et al. (2018)
Ephedraceae											
119	<i>Ephedra gerardiana</i> Wallich ex C. A. Meyer	Asmania/ Ephedra	S	Native	April–July	BR; UP; WB	Seeds collected	Seeds are edible	Used as a stimulant and Ayurvedic medicine	VU	Singh et al. (2001)
Ericaceae											
120	<i>Gaultheria fragrantissima</i> Wall.	Eastern Teaberry	S	Naturalized	March–July	BR; WB	Nutritious fruits	Fruits used	Ornamental tree	NE	Singh and Asha (2017)
Erythroxylaceae											
121	<i>Erythroxylum monogynum</i> Roxb.	Bastard Sandal or Red cedar	T	Native	Year around	BR; WB	Small fruits	Eaten raw	Medicinal use	LC	Mallick et al. (2020)
Euphorbiaceae											

Supplementary Table. (Continued.)

122	<i>Baccaurea courtallensis</i> (Wight) Muell. Arg.	Moottipuli	T	Native	January–June	WB	Sweet fruits	Eaten raw	Medicinal value	NT	Barooah and Ahmed (2014)
123	<i>Baccaurea motleyana</i> Muell. Arg.	Rambai	T	Native	April	WB	The pulp is sweet to acid in taste	Eaten raw or cooked or made into jam or wine.	The tree is also used for shade and low-quality wood	LC	Barooah and Ahmed (2014)
124	<i>Baccaurea ramiflora</i> Lour.	Latka	T	Native	March–September	WB	Unripe and ripe fruits used	Consumed fresh locally	Medicinal (used for constipation)	LC	Rymbai et al. (2016)
125	<i>Mallotus roxburghianus</i> Muell. Arg.	Kabaney	T	Native	June–November	BR; WB	Nutritious fruits	Eaten raw	Folk medicine	NE	Singh et al. (2001)
Fabaceae											
126	<i>Acacia leucophloea</i> Willd.	Reonja	T	Native	April–November	BR; WB	Nutritious fruits	Pods used, Gum and pods used	Medicinal	LC	Mitra and Mukherjee (2009)
127	<i>Bauhinia acuminata</i> L.	Dwarf White Bauhinia	T	Native	April–August	UP; WB	Collected for local use	Culinary use	Folk medicine	LC	Barooah and Ahmed (2014)
128	<i>Bauhinia purpurea</i> L.	Kanchan	T	Native	January–June	WB	Tender fruits	Fruit and seeds	Medicinal, ornamental	LC	Barooah and Ahmed (2014)
129	<i>Bauhinia racemosa</i> Lam.	Bidi leaf tree	C	Native	February–May	BR; UP; WB	Tender fruits	Flower bud, fruit & seeds as vegetable and pickled	Medicinal and religious	LC	Dwivedi (1993)
130	<i>Bauhinia variegata</i> L.	Kartair	T	Native	February–May	BR; UP; WB	Fruit and seeds	Used as vegetable and roasted.	Medicinal and religious	LC	Barooah and Ahmed (2014)
131	<i>Butea buteiformis</i> (Voigt) Grierson	Bhujetro	T	Native	April–December	BR	Fruit used	Used as vegetable	-	LC	Singh et al. (2001)
132	<i>Crotalaria spectabilis</i> Roth.	Jhunjhuna	S	Native	November–January	BR; UP	Fruit collected	Dried fruit powder is a source of famine food	Folk medicine	NE	Ahirwar (2015)

Supplementary Table. (Continued.)

133	<i>Dalbergia rimosa</i> Roxb.	Gajai Lota	S	Native	April–December	BR; WB	Seeds collected	Seeds are eaten as pulse by many of the plain tribes	PBI; medicinal use	LC	Dwivedi (1993)
134	<i>Entada rheedei</i> Spreng.	Gila	C	Native	April–July	WB	Seeds collected	Boiled seeds eaten as vegetable	Medicinal	NE	Saha et al. (2013)
135	<i>Paracalyx scariosus</i> (Roxb.) Ali	Ran ghevada	S	Native	January–May	BR	Fruit is acrid and bitter	Improves taste and appetizer	Medicinal use	NE	Singh et al. (2001)
136	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Jungle Jilebi	T	Naturalized	Jan–March	BR; UP; WB	Rich in nutrients	Eaten raw and used in culinary	Ornamental and leguminous	LC	Dwivedi (1993)
137	<i>Rhynchosia bracteata</i> Baker	Jungle sem	C	Native	June–January	BR	Nutritious seeds	Used as a pulse	Medicinal use	NE	Singh et al. (2001)
138	<i>Rhynchosia cana</i> (Willd.) DC.	Snoutbean	C	Native	June–January	BR	Nutritious seeds	Used as a pulse	Medicinal use	NE	Singh et al. (2001)
Fagaceae											
139	<i>Castanopsis armata</i> Roxb.	Chinquapin/chinkapin	T	Native	May–November	WB	Fruit and seeds used	Seeds are roasted or boiled.	Medicinal use	NE	Bhunia et al. (2018)
140	<i>Castanopsis indica</i> (J. Roxb. ex Lindl.) A. DC.	Kathbadam	T	Native	June–November	WB	Nuts are nutritious	Nuts are eaten	PBI; Medicinal use	LC	Saha et al. (2013)
141	<i>Castanopsis hystrix</i> A. DC.	Patlekatus	T	Native	May–June and October–September	BR; UP; WB	Nutritious nuts used	Nuts boiled, perched or roasted	Folk medicine	NE	Bhunia et al. (2018)
Flacourtiaceae											
142	<i>Casearia tomentosa</i> Roxb.	Chilla	T	Native	January–May	BR; UP; WB	Fruits are nutritious	Ripe fruit occasionally eaten	Medicinal use	LC	Abdullah et al. (2020)

Supplementary Table. (Continued.)

143	<i>Flacourtia jangomas</i> (Lour.) Raeusch.	Indian coffee plum/ Panial	T	Native	April–May and August–September	WB	Sweet and tasty	Gently pressed fruits eaten raw and used in jam	Medicinal use (liver problems)	LC	Singh et al. (2015)
144	<i>Flacourtia ramontchii</i> L'Herit.	Kanker/ Katai	T	Native	November–April	UP	Nutrient-dense fruit	Ripe fruits of this plant are edible	Folk medicine	LC	Ahirwar (2015)
Ebenaceae											
145	<i>Diospyros discolor</i> Willd.	Velvet apple/ kamagong	T	Native	May–August	BR; UP; WB	Sourish fruit	Pulp is used	Hard and durable wood	VU	Paul (2013)
146	<i>Diospyros ferrea</i> (Willd.) Bakh	Black ebony	S	Native	April–August	BR; WB	Nutritious fruits	Pulp of ripe fruits	Folk medicine	EN	Barooah and Ahmed (2014)
147	<i>Diospyros kaki</i> Thunb.	Kaki/Asian Persimmon	T	Native	April–August	BR; WB	Sourish fruit	Pulp is eaten locally	Folk medicine	LC	Barooah and Ahmed (2014)
148	<i>Diospyros lanceifolia</i> Roxb.	Malayan Ebony	T	Native	April–February	BR; WB	fragrant flowers and fruits used	Fruits used locally	Hard and durable wood, seeds are ichthyotoxic	LC	Sarkar (2021)
149	<i>Diospyros lotus</i> L.	Date-plum	T	Native	April–September	WB	Nutrient-dense fruits used	Fruits used locally	Folk medicine	NE	Sarkar (2021)
150	<i>Diospyros malabarica</i> (Desr.) Kostel.	Malabar ebony	T	Native	April and June–September	UP; WB	Both ripe and unripe fruits	Raw fruits are used	Uses in Ayurveda, dye and guitar manufacturing	EN	Abdullah et al. (2020)
151	<i>Diospyros melanoxylon</i> Roxb.	Tendu	T	Native	During summer	BR; UP; WB	Rich in phenols and fibre.	Fruits pulp is used	PBI; Folk medicine	NT	Kaur and Fatima (2018)
152	<i>Diospyros montana</i> Roxb.	Mottled ebony	T	Native	April–May and June–August	UP; WB	Nutritious fruits	Eaten fresh, sold in the local market,	Wood used, folk medicine, Bidi making	LC	Kaur and Fatima (2018)
153	<i>Diospyros ramiiflora</i> Roxb.	Uri Gab	T	Native	April–June	BR; WB	Ripe fruits	Ripe fruit rarely eaten.	Medicine	LC	Abdullah et al. (2020)

Supplementary Table. (Continued.)

Hippocrateaceae											
154	<i>Salacia chinensis</i> L.	Lolly berry	S	Native	February–October	WB	Ripe fruit used	Pulp is eaten	Folk medicine	NE	Singh et al. (2001)
Icacinaceae											
155	<i>Nastiatum herpeticum</i> Buch.	Climbing Rough-Leaf	T	Native	December–February	WB	Fruits are used	Eaten raw or cooked with fish	-	NT	Bose et al. (2015)
Lamiaceae											
156	<i>Callicarpa arborea</i> Roxb.	Khunia	T	Native	May–August	WB	Beautyberry fruits used	Eaten raw	PBI; medicinal and livestock feed	LC	Bose et al. (2015)
157	<i>Callicarpa macrophylla</i> Vahl	Beauty Berry/ Perfumed Cherry	T	Native	September–December	UP	Wild fruits are collected for local use	Nutritional fruits used	Medicinal (Tumor and diabetes)	NE	Mall and Tripathi (2017)
158	<i>Gmelina arborea</i> Roxb. Ex Sm.	Gamari	T	Native	February–July	WB	Fruit is used locally	Pulp of the fruit used	PBI; medicinal	LC	Bose et al. (2015)
Lardizabalaceae											
159	<i>Holboellia latifolia</i> Wall.	Broad Leaved Sausage Vine	C	Native	February–October	BR; UP; WB	Nutritious fruit	Fruit eaten raw	Folk medicine	LC	Singh and Asha (2017)
Lauraceae											
160	<i>Beilschmiedia dalzellii</i> (Meisn.) Kosterm.	Umber	T	Native	March–August	BR; WB	Nutritious fruits	Ripe fruit eaten	Medicine	NE	Singh et al. (2001)

Supplementary Table. (Continued.)

Lecythidaceae											
161	<i>Careya arborea</i> Roxb.	Paik	T	Native	March–June	BR; UP; WB	Nutritious fruits	Eaten fresh	PBI; Medicinal	VU	Bose et al. (2015)
162	<i>Couroupita guianensis</i> Aubl.	Cannonball tree	T	Naturalized	November–June	BR; UP; WB	Fruits rarely used	Used locally and used as animal feed	Folk medicine, cultural and religious worth	LC	Barooah and Ahmed (2014)
Linaceae											
163	<i>Hugonia mystax</i> L.	Climbing Flax	C	Native	May–October	BR; UP; WB	Nutritionally rich	Fruits eaten raw	Medicine	VU	Anand and Deborah (2017)
Malpighiaceae											
163	<i>Malpighia punicifolia</i> L.	West Indian Cherry	S	Naturalized	April–November	WB	Rich sources of vit C	Eaten raw	Medicine use	VU	Paul (2013)
Malvaceae											
165	<i>Abelmoschus crinitus</i> Wall.	Ban Bhindi	S	Native	July–December	BR; UP; WB	Nutrient-dense fruits	Fruits are used as a vegetable	Folk medicine	NE	Ahirwar (2015)
166	<i>Grewia abutilifolia</i> W. Vent ex Juss.	Mallow leaved crossberry	T	Native	March–September	BR; UP; WB	Sweet fruits	Consumed by tribals	Used for weight gain, Diarrhea	LC	Deshmukh and Waghmode (2011)
167	<i>Grewia asiatica</i> L.	Phalsa/ Falsa	T	Native	April–September	BR; UP; WB	Sweet and sour acidic fruit	Pickles, beverages, sherbet and squash	Used as an astringent and cooling agent	LC	Banarjee et al. (2013); Paul (2013)
168	<i>Grewia flavescens</i> Juss.	Donkey berry	T	Native	April–September	BR; UP; WB	Rich source of iron	Eaten raw	Medicinal use	LC	Kumar (2016)

Supplementary Table. (Continued.)

169	<i>Grewia tenax</i> (Forssk.) Fiori.	White-crossberry	T	Native	March–September	BR; UP; WB	Sweet fruits	Rich in Iron	Medicinal use	LC	Kumar (2016)
170	<i>Grewia villosa</i> Wild.	Hairy-crossberry	T	Native	March–September	BR; UP; WB	Rich in minerals	Eaten raw	Medicinal use	LC	Kumar (2016)
171	<i>Hibiscus hispidissimus</i> Griff.	Mupparacham	S	Naturalized	September–March	BR; WB	Niacin, vit C, Ca and Fe	Used after cooking	anti inflammatory, anthelmintic and used to treat liver	NE	Ajesh et al. (2012)
172	<i>Malvaviscus arboreus</i> Cav.	Lankajoba	H	Naturalized	April–September	WB	Nutritious fruits	Consumed locally	Folk medicine	LC	Bose et al. (2015)
Melastomataceae											
173	<i>Melastoma malabaricum</i> L.	Malabar melastome	T	Native	February–November	BR; UP; WB	Rich in carbohydrate	Sweet fruits eaten raw, used in festivals	Medicinal (Diarrhea) and phytoremediation	NE	Biswas et al. (2018)
174	<i>Memecylon celastrinum</i> Kurz;	-	T	Native	May–August	WB	Nutritious fruits	Consumed locally	Firewood, Tool handle	NE	Singh et al. (2015)
175	<i>Memecylon edule</i> Roxb.	Delekair/ Miat	T	Native	April–July	BR; UP; WB	Nutritious fruit	Ripe fruit is eaten	Construction and fruits for wildlife feed	EN	Karthigeyan et al. (2016)
176	<i>Memecylon grande</i> Retz.	Palluvirisa	T	Native	April–November	BR; UP; WB	Rich in minerals	Eaten raw	Folk medicine	VU	Karthigeyan et al. (2016)
177	<i>Memecylon lushingtonii</i> Gamble	-	T	Native	May–July	BR; UP; WB	Rich in nutrients	Eaten raw	Medicine	EN	Karthigeyan et al. (2016)
178	<i>Memecylon ovatum</i> Sm.	Bayan	T	Native	March–November	BR; WB	Fruit collected	Fruits eaten	-	LC	Karthigeyan et al. (2016)
179	<i>Memecylon umbellatum</i> Burm.	Ironwood tree	T	Native	April–November	WB	Fruits collected	Eaten raw	Medicine	EN	Karthigeyan et al. (2016)

Supplementary Table. (Continued.)

Meliaceae										
180	<i>Aglaia elaeagnoides</i> (A. Juss.) Benth.	Yerra aduga	T	Native	November-December and June-July	BR; WB	Fruits acidic in taste	Fruits eaten	PBI; Medicinal, making furniture, instruments and ornamental	Mahapatra and Panda (2009)
181	<i>Aglaia edulis</i> (Roxb.) Wall.	Aglaia	T	Native	May-June	WB	Fruits eaten	Fruits are used	PBI; Medicinal, making furniture, instruments and ornamental	Jeeva (2009)
182	<i>Aphanamixis polystachya</i> (wall) Parker	Pithraj	T	Native	March-May	BR; UP; WB	Edible sweet fruits	Fruits eaten raw	PBI; Ayurveda and folk medicine	Singh et al. (2015)
183	<i>Dysoxylum binectariferum</i> Hook. f. ex Bedd.	Kempu Devadaru/ Karakil	T	Native	February and December	BR; WB	Pulp rich in sugars, fat, minerals and vit C	Seeds are like chestnuts after roasting.	Ayurveda, folk medicine and immune modulatory	Barooah and Ahmed (2014)
Menispermaceae										
184	<i>Haematoctarpus validus</i> (Miers.) Bakh. f. ex Forman	Blood fruit/ Raktogota/ Agnigola	C	Native	April-August	WB	Rich in vit C	Ripe fruits eaten raw, coloring agent, culinary use	Medicinal use (anemia)	Abdullah et al. (2020)
185	<i>Tinospora cordifolia</i> (Willd.) Miers	Guduchi/ Giloy	C	Native	May-October	BR; UP; WB	Rich in nutrients and minerals	Fruit eaten	Nutraceutical and medicinal use	Bose et al. (2015)
186	<i>Tinospora sinensis</i> (Lour.) Merr.	Malabar Gulbel	C	Native	May-October	BR; UP; WB	Rich in nutrients	Fruit eaten	Immunomodulatory and medicinal use	Bose et al. (2015)
Moraceae										
187	<i>Artocarpus altilis</i> (Park) Fosb.	Bread fruit	T	Naturalized	March-June	WB	Rich in Ca, beta carotene	Eaten raw	Medicinal	Paul (2013)

Supplementary Table. (Continued.)

188	<i>Artocarpus chama</i> Roxb.	Chapalish/ Cham	T	Native	March– April and May–June	WB	Rich sources of vitamins A and C	Fruit is eaten raw, and seeds eaten roasted form	Medicinal value (Diabetes and anti- arthritis)	NE	Biswas et al. (2018); Abdullah et al. (2020)
189	<i>Artocarpus hirsutus</i> Lam.	Wild jack	T	Native	December– March	WB	Rich in vitamins and minerals	Eaten raw	Medicinal value	LC	Biswas et al. (2018)
190	<i>Artocarpus lacucha</i> Buch.-Ham.	Monkey Jack/ Barhar	T	Native	March– April and May–June	BR; WB	Rich in minerals and vitamins	Pickle, curries, chutney, and dried fruits	PBI; Medicinal and fodder use	LC	Paul (2013); Abdullah et al. (2020)
191	<i>Ficus auriculata</i> Lour.	Elephant ear fig	T	Native	March– April	BR; UP; WB	Fruits used	Green fruits as vegetable and ripen are sweeter	PBI; Diuretic, laxative and digestive	LC	Singh et al. (2015)
192	<i>Ficus benghalensis</i> L.	Banyan	T	Native	January– July	BR; UP; WB	Nutritionally rich	Raw fruits eaten	Medicinal (respiratory and skin disorders)	LC	Bose et al. (2015)
193	<i>Ficus benjamina</i> L.	Bargad	T	Native	December– July	BR; UP; WB	Rich in minerals	Eaten raw or cooked	Folk medicine	LC	Bose et al. (2015)
194	<i>Ficus hirta</i> Vahl	Hairy fig	T	Native	November– April	WB	Ripen sweet fruits	Eaten raw or used as vegetable	A keystone species, medicine, pollination	NE	Anand and Deborah (2017)
195	<i>Ficus hispida</i> L.	Hairy fig/ Kuchuli	T	Native	May– August	BR; UP; WB	Fruit eaten	Culinary use	Medicinal use	LC	Banarjee et al. (2013)
196	<i>Ficus nemoralis</i> Wall. Ex Miquel	Dieng-surme	T	Native	December– February	BR; UP; WB	Sweet fruits eaten	Fruit used	Medicinal use	LC	Anand and Deborah (2017)
197	<i>Ficus palmata</i> Forssk.	Panjab fig/ Bedu	T	Native	June–July	BR; UP; WB	Fruits eaten	Fruit used in foothills of Himalayas	Medicinal, prevent stress	NE	Tomar et al. (2015)
198	<i>Ficus racemosa</i> L.	Cluster fig/ Red river fig	T	Native	March–May	BR; UP; WB	Unripe and ripe fruits	Vegetable, stir-fries, and curries	Medicinal (diarrhea, dysentery)	LC	Paul (2013); Abdullah et al. (2020)
199	<i>Ficus religiosa</i> L.	Aswatha	T	Native	February– June	BR; UP; WB	Rich in nutrients and minerals	Raw fruits eaten	Medicinal (respiratory and skin disorders)	LC	Bose et al. (2015)

Supplementary Table. (Continued.)

200	<i>Ficus semicordata</i> Buch. Ex. Smith	Drooping fig/ Khunia	T	Native	January– December	BR; UP; WB	Rich in nutrients	Raw fruits eaten	Medicinal, food for wildlife, fuelwood	LC	Anand and Deborah (2017)
201	<i>Ficus septica</i> Burm. F.	Hauili	T	Native	January– June	BR; UP; WB	Nutrient rich fruits	Eaten raw	Folk medicine	LC	Paul (2013)
202	<i>Ficus sur</i> L.	Broom cluster fig	T	Native	September– March	WB	Nutrient-dense fruit	Eaten fresh or dried	Folk medicine	LC	Chaudhary et al. (2012)
203	<i>Ficus virence</i> Aiton	Chakkila	T	Native	January– March	BR; UP; WB	Ripe fruits used	Vegetable use	Medicinal	LC	Abdullah et al. (2020)
204	<i>Maclura cochinchinensis</i> (L.) Corner	Dammar	S	Native	April– August	WB	Fruit collected	Ripe fruit	Folk medicine	LC	Singh et al. (2001)
205	<i>Morus alba</i> L.	Mulberry	T	Native	February– June	BR; UP; WB	Sweet and sour fruits	Jam, fodder and green leaf manure	Medicinal	LC	Paul (2013)
206	<i>Morus australis</i> Poir.	Chinese mulberry	T	Naturalized	May– August	BR; WB	Nutrient-dense fruit	Eaten raw, Jam and fodder	Folk medicine	NE	Bose et al. (2015)
207	<i>Morus papyrifera</i> L.	Paper mulberry	T	Native	February– June	BR; UP; WB	Sweet and sour fruits	Jam and fodder	Medicinal	LC	Paul (2013)
208	<i>Morus laevigata</i> Wall.	Himalayan mulberry	T	Native	April–June	BR; UP; WB	Edible sweet and sour fruits	Raw fruits eaten	Medicinal	LC	Bhunia et al. (2018)
209	<i>Streblus asper</i> Lour.	Sheora	T	Native	April–May	WB	Nutrient-dense fruit	Fruits and seeds	Medicinal	LC	Mitra and Mukherjee (2009)
210	<i>Streblus taxoides</i> (Roth) Kurz	Jhumpuri	S	Native	March–May	BR	Nutrient-dense fruit	Fruits as vegetables	Folk medicine	NE	Mahapatra et al. (2012)
Muntingiaceae											

Supplementary Table. (Continued.)

211	<i>Muntingia calabura</i> L.	Singapore cherry	T	Naturalized	June–December	WB	Nutritious juicy fruit	Eaten raw and wildlife feed	Medicinal, timber and fuel use	LC	Anand and Deborah (2017)
Musaceae											
212	<i>Musa balbisiana</i> Colla	Kala	H	Native	April–August	WB	Nutrient-dense fruit	Eaten raw and processed foods	Folk medicine	LC	Bose et al. (2015)
Myricaceae											
213	<i>Myrica esculenta</i> Buch. -Ham.	Box myrtle/ Bayberry	T	Native	May– April	BR; UP	Eaten raw, delicious taste	Used in preparing refreshing drinks, jam, jelly	Medicine	NT	Bose et al. (2015)
Myristicaceae											
214	<i>Horsfieldia kingii</i> (Hook f.) Warburg	Wild nutmeg	T	Native	February– May	WB	Fruit and seed are edible	Used as a substitute for betel nut	Medicinal (Piles) use	EN	Mallick (2020)
215	<i>Semecarpus kurgii</i> Engl.	Marking nut	T	Native	February– March	WB	Accessory fruit is sweet	Ripen edible fruit	Medicinal	NE	Mallick (2020)
Myrsinaceae											
216	<i>Ardisia floribunda</i> Wall.	Coralberry	T	Native	June– February	BR; UP; WB	Nutrient-dense fruit	Eaten raw	Folk medicine	VU	Jeeva (2009)
217	<i>Ardisia pardalina</i> Mez.	Marlberry	T	Native	June– December	BR; UP; WB	Rich in nutrients	Eaten raw	Folk medicine	LC	Jeeva (2009)
218	<i>Embelia undulata</i> (Wall.) Mez	Vidanga	S	Native	June– November	BR; WB	Fruit used	The ripe fruits are eaten	PBI; medicine	NE	Barooah and Ahmed (2014)

Supplementary Table. (Continued.)

Myrtaceae												
219	<i>Eugenia roxburghii</i> DC.	Sagadabatua	T	Native	April–May	BR; WB	Nutritive fruits	Fruit edible	wood	LC	Mahapatra et al. (2012)	
220	<i>Rhodomyrtus tomentosa</i> (Alton) Hassk	Koratta	S	Native	January–June	BR; WB	Nutrient-dense fruit	Eaten raw	Medicinal use	LC	Barooah and Ahmed (2014)	
221	<i>Syzygium aqueum</i> (Burm.f.) Alston	Watery rose apple	T	Native	January–October	BR; WB	Nutrient-dense fruit	Eaten raw, salads, pickles	Folk medicine	LC	Singh et al. (2001)	
222	<i>Syzygium cuminii</i> L. Skeels	Jamun	T	Native	January–May	BR; UP; WB	Fruit rich in Iodine	Fruit and seed	Seed in diabetes and sacred fruits of the Hindus	LC	Paul (2013)	
223	<i>Syzygium claviflorum</i> (Roxb.) Wall.	Harejamun	T	Native	January–March and March–May	WB	Rich in pectin, Ca, K and Mg	Making juice, jellies	Timber, fuel, cattle food, and dye	LC	Chora et al. (2015)	
224	<i>Syzygium balsameum</i> (Wight) Wall. Ex Walp.	-	T	Native	January–May	WB	Nutrient-dense fruit	Fruit is edible	Medicinal use	NE	Chora et al. (2015)	
225	<i>Syzygium caryophyllatum</i> (L.) Alston, Handb.	South Indian Plum	T	Native	February–July	BR; WB	Fruit used	Fruit eaten	Folk medicine for diabetes	EN	Singh et al. (2001)	
226	<i>Syzygium formosum</i> (Wall.) Masam.	Roseapple	T	Native	January–April	WB	Berry fruit and flowers used	Eaten raw or cooked	Folk medicine	LC	Chora et al. (2015)	
227	<i>Syzygium fruticosum</i> DC.	Ban jam	T	Native	January–April	BR; WB	Fruit used	Ripe fruit occasionally eaten.	Medicinal	LC	Abdullah et al. (2020)	
228	<i>Syzygium glaucissimum</i> Rathakr. & N. C. Nair	-	T	Native	January–May	BR	Nutrient-dense fruit	Fruit is edible	Medicinal use	NE	Singh et al. (2001)	
229	<i>Syzygium jambos</i> (L.) Alston.	Malabar Plum/ Mountain Apple	T	Native	Usually, summer months	BR; WB	Rich in minerals vits B and C	Making preserves, jellies and sweet	Folk medicine, ornamental and charcoal making	LC	Ahirwar (2015)	

Supplementary Table. (Continued.)

230	<i>Syzygium kurzii</i> (Duthie) N.P.Balakr.	-	T	Native	March-July	WB	Fruit used	Ripe fruits are eaten	Wood as a fuel	NE	Chora et al. (2015)
231	<i>Syzygium nervosum</i> A.Cunn. Ex DC.	Rai juman	T	Native	March-July	WB	Fruit used	Fruit eaten	Folk medicine for diabetes	LC	Chora et al. (2015)
232	<i>Syzygium oblatum</i> (Roxb.) Wall. Ex Steud.	Bunga Dakwat/ Jambu Hutan	T	Native	March-June	WB	Fruit used	Fruit eaten	Folk medicine	LC	Chora et al. (2015)
233	<i>Syzygium polypetalum</i> (Wall.) Merrill & L.M. Perry	Indian bay leaf	T	Native	March-August	WB	Nutrient-dense fruit	Fruit is edible	Medicinal use	LC	Chora et al. (2015)
234	<i>Syzygium praecox</i> (Roxb.) Rathakr. & N.C.Nair	Malabar plum	T	Native	March-June	WB	Nutritional fruits	Fruit is edible	Medicinal use	NE	Chora et al. (2015)
235	<i>Syzygium ramosii</i> (Blume) N.P.Balakr.	-	T	Native	January-July	WB	Fruit used	Edible fruit	-	EN	Chora et al. (2015)
236	<i>Syzygium salicifolium</i> (Wight) J.Graham	Vellamanchi	T	Native	January-May	BR; UP; WB	Nutritive fruits	Fruit edible	Folk medicine	LC	Singh et al. (2001); Ahirwar (2015)
237	<i>Syzygium samarangense</i> (Blume) Merr. & L.M.Perry	Jamrul/ wax apple/ water apple	T	Native	January-March and May-September	BR; WB	Rich in Ca, P, K, Mg, vit C	Eaten raw, salads, pickles	Jambu dweep (India's ancient name) comes from this fruit.	LC	Singh et al. (2001); Biswas et al. (2018)
238	<i>Syzygium schmidii</i> Rathakr. & N.C. Nair	Jambu	T	Native	March-August	WB	Fruit used	Fruit eaten	Folk medicine	NE	Chora et al. (2015)
239	<i>Syzygium tetragonum</i> (Wight) Wall. ex Walp	-	T	Native	January-June	WB	Fruit used	Edible fruit	-	NE	Chora et al. (2015)
240	<i>Syzygium todaliooides</i> (Wight) Walp.	-	T	Native	January-June	WB	Fruit used	Edible fruit	Medicinal use	NE	Chora et al. (2015)

Supplementary Table. (Continued.)

241	<i>Syzygium venosum</i> DC	-	T	Native	January- July	WB	Fruit used	Edible fruit	-	NE	Chora et al. (2015)
Nelumbonaceae											
242	<i>Nelumbo nucifera</i> Gaertn	Lotus/ Kamal	H	Native	April- September	BR; UP; WB	Fruits collected	Seeds eaten raw or roasted	Medicinal use	DD	Bose et al. (2015)
Nymphaeaceae											
243	<i>Nymphaea nouchali</i> Burm. f.	Blue lotus/ blue water lily	H	Native	August- October	BR; UP; WB	Fruits collected	Seeds eaten raw or roasted	Medicinal use	LC	Prakash (2011)
Oleaceae											
244	<i>Chionanthus ramiflorus</i> Roxb.	Northern olive	T	Native	February- April	BR	Nutrient-dense fruits	Fruit used as a pickle like olives	Folk medicine	DD	Singh et al. (2001)
245	<i>Olea ferruginea</i> Royle	Indian olive	T	Native	January- March	BR; WB	Fruit eaten	Fruit as digestive	Medicinal	NT	Singh et al. (2015)
Opiliaceae											
246	<i>Opilia amantacea</i> Roxb.	Opilia	S	Native	February- April	BR; WB	Fruit eaten	Fruit eaten raw	Medicinal	NE	Mallick et al. (2020)
Oxalidaceae											
247	<i>Averrhoa bilimbi</i> L.	Bilimbi	T	Naturalized	January- May	WB	Sour and extremely acidic fruit	Pickle, squash, vegetable	PBI; medicinal	LC	Banarjee et al. (2013)

Supplementary Table. (Continued.)

248	<i>Averrhoa carambola</i> L.	Kam-ranga	T	Naturalized	January–May	BR; UP; WB	Fruit is sour and acidic	Pickle, squash, souring agent	PBI; medicinal (Used for chickenpox)	LC	Banarjee et al (2013)
Pandanaceae											
249	<i>Pandanus odorifer</i> (Forsk.) Kuntze	Fragrant screw-pine	T	Native	July – September	WB	An oily and nutty seed	Eaten raw or cooked	Medicinal and oil extracted	LC	Barooah and Ahmed (2014)
250	<i>Pandanus andamanensis</i> Kurz	Keora	T	Native	July – September	WB	Fruits are protein rich	Fruits are eaten cooked	Medicine use	LC	Barooah and Ahmed (2014)
251	<i>Pandanus sikkimensis</i> H. St. John.	Sikkim screw-pine	T	Native	June – August	WB	Nutrient-dense fruit	Fruits are eaten cooked	Folk medicine	NE	Barooah and Ahmed (2014)
Papaveraceae											
252	<i>Fumaria indica</i> Pugsley	Bandhania	H	Native	February–April	BR; UP; WB	Nutritive fruits	Eaten raw	Medicinal use	NE	Mitra and Mukherjee (2009)
Papilionaceae											
253	<i>Erythrina variegata</i> L.	Tiger's claw/ Indian coral	T	Native	September–April	WB	Nutrient-dense fruits	Eaten raw or cooked	Medicinal use	LC	Shivprasad et al. (2016)
254	<i>Galactia tenuiflora</i> Wight&Arn.var.	<i>Banakaolata</i>	T	Native	September–October	BR	Fruits used	Unripe legumes used as vegetable	Folk medicine	LC	Bhagat et al. (2016)
Phyllanthaceae											
255	<i>Anidesma acidum</i> Retz.	Sour currant shrub	T	Native	April–August	BR; UP; WB	Edible fruit	Fruit is eaten	Medicinal	NE	Jeeva (2009); Prakash (2011)

Supplementary Table. (Continued.)

256	<i>Antidesma bunius</i> Spreng.	Bignay	T	Native	April– August	UP; WB	Edible fruit	Fruit is eaten by Locals	Medicinal	NE	Jeeva (2009)
257	<i>Antidesma ghaeseumbilla</i> Gaertn.	Khudjam	T	Native	June– December	BR; UP; WB	Nutrient-dense fruit	Eaten raw	Fruit used for headaches and fevers	LC	Mahapatra and Panda 2009
258	<i>Bischofia javanica</i> Blume	Kainjal	T	Native	April– August	BR; UP; WB	Eaten raw	Consumed locally	PBI; Medicinal use	LC	Mitra and Mukherjee (2009)
259	<i>Bridelia retusa</i> (L.) A. Juss	Kasai datum	T	Native	May– August	BR; UP; WB	Nutrient-dense fruit	Eaten locally	PBI; Medicinal use	LC	Kumar (2016)
260	<i>Bridelia scandens</i> (Roxb.) Wild	Asan	T	Native	May– August	BR; WB	Nutritive fruits	Eaten raw	Stem bark paste for skin diseases	LC	Prakash (2011)
261	<i>Bridelia tomentosa</i> Blume	Pop-Gun Seed/ Kenidai	T	Native	April–July	BR; WB	Eaten raw	Rich in protein content	PBI; Medicinal use	NE	Mitra and Mukherjee (2009)
262	<i>Phyllanthus acidus</i> (L.) Skeels	Malay gooseberry	T	Native	February– March	BR; WB	Rich in vit C	It tastes sour and tart, used in pickle	Folklore	LC	Singh et al. (2015)
263	<i>Phyllanthus emblica</i> L.	Amla/ Aonla	T	Native	February– March	BR; WB	Rich in vit C	Used in pickle, culinary	Folk medicine	LC	Paul (2013); Abdullah et al. (2020)
264	<i>Phyllanthus reticulatus</i> Poir.	Sikti	S	Native	September– October	WB	Nutritive fruits	Consumed locally	Folk medicine	LC	Bose et al. (2015)
265	<i>Securinega virosa</i> (Rixb.ex Willd.) Baill.	Chitki	S	Native	March– September	BR; UP; WB	Eaten raw	Fruits consumed as raw in forest areas	PBI; Ayurvedic medicine and feed for wildlife	LC	Deshmukh and Waghmode (2011)
Plastifloraceae											

Supplementary Table. (Continued.)

266	<i>Passiflora edulis</i> Sims	Latabel/ Passion Fruit	C	Naturalized	July- December	WB	Vitamin and iron source	Eaten raw	Folk medicine	NE	Paul (2013)
267	<i>Passiflora foetida</i> L.	Passion fruit	C	Naturalized	July- December	BR; UP; WB	Rich in minerals and fatty acids	Eaten raw fruits and prepare juice, desserts etc	Folk medicine to itching and coughs	NE	Ajesh et al. (2012)
268	<i>Passiflora leschenaultia</i> D.C.	Seemavellari/ nil	C	Naturalized	March-May	BR; WB	Rich in Fibers and vitamins	Eaten raw as well as prepare juice	Medicine	NE	Ajesh et al. (2012)
269	<i>Passiflora ligularis</i> Juss.	Passion fruit/ Sweet grandilla	C	Naturalized	December- May	BR; UP; WB	Rich in Fibers and vitamins	Eaten raw or mixed with yogurts dessert and juice	Medicine and Ayurveda	NE	Ajesh et al. (2012)
Rhamnaceae											
270	<i>Rhamnus pentapomica</i> R. N. Parker	-	T	Native	March- April	BR; UP; WB	Nutritious fruit	Fruit is sweet and eaten	Medicinal use	NE	Singh et al. (2001)
271	<i>Rhamnus napalensis</i> (Wall.) Lawson	Biringa/ Biringuti	T	Native	March-June	BR; UP; WB	Rich in nutrients	Eaten raw	Folk medicine	LC	Singh et al. (2001)
272	<i>Rhamnus procumbens</i>	Creeping Buckthorn	T	Native	March- April	UP	Nutritious fruit	Fruit is sweet and eaten	Medicinal use	LC	Singh et al. (2001)
273	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Wild jujube	S	Native	March- December	BR	Sweet, and acidic	Eaten raw, pickled, dried, or used for confectionery	PBI; Microhabitat builder, control soil erosion	NE	Kumar (2016)
274	<i>Ziziphus oenoplia</i> (L.) Mill.	Kantai koli	S	Native	April-May	BR; WB	Acidic taste	Eaten raw	PBI	LC	Mahapatra et al. (2012); Abdullah et al. (2020)
275	<i>Ziziphus rugosa</i> Lam.	Tin koli	S	Native	April-May	BR; WB	Sweet and acidic taste	Used in culinary	PBI; medicinal use	NE	Mahapatra et al. (2012)
Rhizophoraceae											

Supplementary Table. (Continued.)

276	<i>Aegiceras corniculatum</i> (L.) Blanco	Black mangrove	T	Native	April–August	WB	Sweet red fruits	Eaten raw	Medicinal use	LC	Hosen et al. (2020)
277	<i>Avicennia officinalis</i> L.	Indian mangrove	T	Native	April–May	WB	Rich in nutrients	Eaten raw	Folk medicine	LC	Hosen et al. (2020)
278	<i>Bruguiera gymnorhiza</i> (L.) Lam., Tabl.	Oriental mangrove	T	Native	Year around	WB	Nutritious fruit	Eaten raw	Folk medicine	LC	Hosen et al. (2020)
279	<i>Carallia brachiata</i> (Lour.) Merr.	Daini Jam/Phanashi	T	Native	October–April	WB	Fruit and seeds	The seed oil is substitute for ghee	Ethnomedicinal	VU	Baroah and Ahmed (2014)
280	<i>Certiops decandra</i> (Griff.) Ding Hou	Decandra mangrove	T	Native	Year around	BR; WB	Conical fruits	Eaten as a vegetable	Medicinal use	NT	Hosen et al. (2020)
281	<i>Certiops tagal</i> (Pers.) C.B.Rob.	Spurred mangrove	T	Native	September–February	BR; WB	Fruits are nutritious	Fruit is boiled and cooked	Medicinal	LC	Dwivedi (1993)
282	<i>Rhizophora apiculata</i> Bl.	Garjan	T	Native	April–September	WB	Nutritious fruit	Eaten raw	Folk medicine	LC	Dwivedi (1993)
283	<i>Rhizophora stylosa</i> Griff.	Spotted/ red mangrove	T	Native	May to September	WB	Fruits are nutritious	Fruit eaten	Medicinal	LC	Hosen et al. (2020)
284	<i>Rhizophora mucronata</i> Poir.	Asiatic mangrove	T	Native	April–September	WB	Fruits are used	Fruit is cooked	Folk medicine	LC	Hosen et al. (2020)
285	<i>Xylocarpus mekongensis</i> Pierre	Nyireh batu	T	Native	April–September	WB	Fruits are nutritious	Fruit is cooked	Medicinal	LC	Hosen et al. (2020)
Rosaceae											
286	<i>Docynia indica</i> (Wall.) Decne	Coiled Yam	T	Native	February–November	WB	Fruits collected	Eaten raw	Medicinal	NE	Rymbat et al. (2016)

Supplementary Table. (Continued.)

287	<i>Eriobotrya japonica</i> Lindl.	Loquat Japanese Plum	T	Native	May to September	WB	Fruits are used	Eaten fresh, good taste	Folk medicine	NE	Paul (2013)
288	<i>Fragaria indica</i> Andrews	Wild strawberry	H	Native	March–April	BR; UP; WB	Sweet fruit eaten	Eaten, jam, jelly and gives energy	Eaten by mammals and birds	LC	Singh et al. (2001)
289	<i>Fragaria vesca</i> L.	Pahari rasbhari	H	Native	March–April	BR; UP; WB	Sweet fruit	Ripe fruit is eaten or used as jam	Eaten by mammals	LC	Singh et al. (2001); Singh et al. (2015)
290	<i>Prunus cerasoides</i> D. Don	Himalayan wild cherry	T	Native	April–November	BR; WB	Fruits are nutritious	Fruit eaten	Dye, walking sticks and ornamental tree	LC	Jeeva (2009)
291	<i>Prunus domestica</i> L. Hook.	European plum	T	Native	April–November	WB	Acidic and sweet in taste	Jam, jelly and wine	PBI; medicinal	DD	Singh et al. (2015)
292	<i>Prunus nepalensis</i> Hook.	Khasi cherry/ Sohiong	T	Native	October–September	BR; UP; WB	Rich in vitamins	Wine making and eaten raw	PBI; medicinal	LC	Rymbai et al. (2016)
293	<i>Pyracantha crenulata</i> M. Roem.	Ghingaroo	S	Native	July–September	BR; UP; WB	Red sweetish fruits	Eaten raw by rural community	Medicinal use	NE	Bose et al. (2015)
294	<i>Pyrus pashia</i> Hamilton Ex D. Don	Wild Himalayan pear	T	Native	February–December	BR; UP; WB	Source of natural antioxidants	Fruit eaten	PBI; Fuel, fodder, fencing and control erosion	LC	Rymbai et al. (2016)
295	<i>Rubus birmanicus</i> Hook. f.	Dewberries	S	Native	October–March	WB	Fruits are nutritious	Fruit eaten	Medicine	NE	Laha et al. (2018)
296	<i>Rubus indicus</i> Thunb.	Chemullu	S	Native	October–March	WB	Fruits are nutritious	Fruit eaten	Medicine	NE	Ajesh et al. (2012)
297	<i>Rubus ellipticus</i> Sm.	Yellow Raspberry	S	Native	December–January	WB	Fruits are sweet	Fresh fruit eaten raw	Ornamental and medicinal use	LC	Paul (2013)
298	<i>Machilus edulis</i> King ex Hook. f.	-	T	Native	February–August	WB	Fruits are nutritious	Fruit eaten	Medicine	NE	Bhuria et al. (2008)

Supplementary Table. (Continued.)

Rubiaceae											
299	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Burflower-tree/ Iaran	T	Native	June–October	BR; WB	Ripen fruits used	Fruits are eaten raw	Medicine and Ayurveda	NE	Mallick et al. (2020)
300	<i>Canthium coromandelicum</i> Brum.F.	Coromandal boxwood	H	Native	July–August	BR; WB	Rich in nutrients and minerals	Eaten raw	Medicine	NE	Ajesh et al. (2012)
301	<i>Canthium dicoccum</i> (Gaertn.) Merr.	Ceylon box wood/ Malakafe	S	Native	May–June	BR; WB	Nutrient-dense fruits	Ripe fruits are edible	Folk medicine	VU	Shivprasad et al. (2016)
302	<i>Catunaregam spinosa</i> Thunb. Tirveng.	Gela, Gelpal	T	Native	January–August	BR; WB	Rich in Ca, P, Mg and vitamins	high food energy (126–336 g cal)	Act as astringent used in diarrhea and dysentery	NE	Shivprasad et al. (2016)
303	<i>Gardenia campanulata</i> Roxb.	Bitmora/ Boilem	T	Native	November–December	BR; UP; WB	Fruit eaten	Fruit used as food and medicine	Medicinal, diabetes and skin diseases	NE	Singh et al. (2001); Singh et al. (2015)
304	<i>Gardenia gummifera</i> L. f.	Cumbi-gum	T	Native	January–August	BR; WB	Nutrient-dense fruits	Ripe fruits are edible	Folk medicine	LC	Mallick et al. (2020)
305	<i>Gardenia latifolia</i> Ait.	Papra	T	Native	April–July	BR; WB	Nutrient-dense fruits	Ripe fruits are eaten	PBI; Medicinal	NE	Kumar (2016)
306	<i>Gardenia uliginosa</i> Retz.	Pedar/ Pindar	T	Native	April–August	UP	Fruits collected	Unripe fruit boiled and roasted	Used in Ayurveda medicine	NE	Prakash (2011)
307	<i>Hedyotis scandens</i> Roxb.	Dhup]hora	C	Native	March–December	BR; WB	Nutrient-dense fruit	Eaten raw or cooked	Folk medicine	NE	Saha et al. (2013)
308	<i>Ixora pavetta</i> Andr.	Katagandhal/ Torch tree	T	Native	January–April	BR; UP; WB	Nutrient-dense fruit	Fruits are eaten	PBI; Fuel wood, construction and religious	NE	Singh et al. (2001)
309	<i>Ixora coccinea</i> L.	Chethi/Flame of the woods	S	Native	Throughout the year	BR; UP; WB	Rich in minerals and pigments	Eaten raw	Ayurveda, and in various folk medicines	NE	Ajesh et al. (2012)

Supplementary Table. (Continued.)

310	<i>Meyna spinosa</i> Roxb. Ex Link.	Meyna	T	Native	March–May	BR; UP; WB	Rich in minerals and vitamins	Fruits and seeds used as vegetables	PBI; Biodiesel, Medicinal use	NE	Singh et al. (2015)
311	<i>Morinda angustifolia</i> Roxb.	Haldikath	S	Native	January–August	BR; WB	Nutrient-dense fruit	Fruits are used in beverages	Medicinal	NE	Saha et al. (2013)
312	<i>Morinda pubescens</i> Sm.	Bhurtandi	S	Native	Year around	WB	Rich in nutrients and vitamins	Fruits are edible	Medicinal (cancer and alzheimer's)	NE	Anand and Deborah (2017)
313	<i>Morinda tinctoria</i> Roxb.	Aachhu/ Aal	T	Native	February–October	BR; WB	Rich in vit C	Ripe fruits are edible	Medicinal	NE	Mahapatra et al. (2012)
314	<i>Neonauclea purpurea</i> (Roxb.) Merr.	Purple Neo-Cheeseewood	T	Native	March–September	BR; UP; WB	Nutrient-dense fruit	Fruits cooked occasionally	House posts, firewood and rice stirrer	NE	Laha et al. (2018)
Rutaceae											
315	<i>Aegle marmelos</i> L. Corr. Serr.	Bael/ Stone apple	T	Native	March–April	BR; UP; WB	Fruit pulp	Pulp eaten, jam, jelly and sharbat	Medicine and Sacred tree	LC	Paul (2013)
316	<i>Atalantia monophylla</i> (Roxb.) A. DC.	Narguni/ Katha Naranga	T	Native	October–May	BR; WB	Fruits acidic in taste	Berries are pickled.	PBI; Medicinal (Oil used in paralysis)	NE	Mahapatra and Panda (2009)
317	<i>Citrus grandis</i> (L.) Osbeck	Jambura	T	Native	January–May	BR; UP; WB	Fruits eaten	Ripe fruits edible	Medicinal (fever)	LC	Singh et al. (2015); Abdullah et al. (2020)
318	<i>Citrus hystrix</i> DC.	Kafir lime/ Porcupine orange	T	Native	January–June	BR; UP; WB	Sourish fruit	Unripe fruits are eaten raw	Medicinal	NT	Barooah and Ahmed (2014)
319	<i>Citrus jambhiri</i> Lush.	Tha rock pad/ Jamir	T	Native	January–May	BR; UP; WB	Rich in vitamins	Fruit occasionally eaten	Medicinal	LC	Abdullah et al. (2020)
320	<i>Citrus macroptera</i> Montrouz.	Satkora/ hatkhora	T	Native	September–November	WB	Fruit juice is used	Eaten as a vegetable, pickles. Sun-dried	Perfume, medicine (kidney stone)	NE	Singh et al. (2015); Biswas et al. (2018)

Supplementary Table. (Continued.)

321	<i>Glycosmis mauritiana</i> (Lam.) Tanaka	Gin Berry or Orangeberry	S	Native	October–May	WB	Sweet fruits	Eaten raw	Folk medicine	LC	Prakash (2011)
322	<i>Glycosmis pentaphylla</i> (Retz.) DC	Aastani/Lata kasi	S	Native	September–April	BR; WB	Rich in nutrients	Ripe berries eaten raw by tribals and villagers	Medicinal, liver problem and hair loss	LC	Mahapatra et al. (2012)
323	<i>Limonia acidissima</i> L.	Wood apple	T	Native	September–October	BR; UP; WB	Fatty acids, vitamins and minerals	Sweet and sour jams, pickle, Chutney	Religious, Medicinal and insecticide use	NT	Paul (2013)
324	<i>Murraya exotica</i> L.	Orange jasmine	T	Native	May–October	BR; WB	Fruits are rarely used	Culinary uses	Medicinal use for bleeding and pain	NE	Baroah and Ahmed (2014)
325	<i>Toddalia asiatica</i> (L.) Lam	Junglilebu	C	Native	September–December	BR; WB	Rich in vit C	Edible fruits flavour resembles like orange	PBI; Medicinal, ornamental, Bonsai	NE	Mahapatra et al. (2012)
326	<i>Zanthoxylum acanthopodium</i> DC.	Andaliman	T	Native	May–October	WB	Nutrient-dense fruits	Fruits are used for pickles	Folk medicine	LC	Mahapatra et al. (2012)
327	<i>Zanthoxylum rhetsa</i> DC.	Timbur	T	Native	June–October	WB	Nutrient-dense fruits	Pickles made from fruits	Folk medicine	LC	Mahapatra et al. (2012)
Sabiaceae											
328	<i>Meliosma pinnata</i> (Roxb.) Maxim.	Barbulata	T	Native	May–August	BR; UP; WB	Fruit used	Edible fruits	Fuel, vegetable and fodder	NE	Laha et al. (2018)
Sapindaceae											
329	<i>Cardiospermum halicacabum</i> L.	Latahatkari	H	Native	May–August	WB	Fruits are used	Human and animal feed	Snake bite	LC	Mitra and Mukherjee (2009)
330	<i>Euphoria longan</i> Steud.	Ash phal	T	Native	June–September	WB	Fruit eaten	Relaxation and stomachic from fresh fruit	PBI; Medicinal	NT	Banarjee et al. (2013); Singh et al. (2015)

Supplementary Table. (Continued.)

331	<i>Lepisanthes senegalensis</i> (Poir.) Leenth., <i>Blumea</i>	Achatta/ Kaphul	T	Naturalized	November-April	WB	Fruits and seeds	Eaten raw and cooked	Medicinal	NE	Jeeva (2009); Dwivedi (1993)
332	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenhouts	Ritha	T	Naturalized	October-May	BR; UP; WB	Fruits and seeds	Roasted seeds used	Medicinal	LC	Dwivedi (1993); Prakash (2011)
333	<i>Schleichera oleosa</i> (Lou) Oken	Kusum	T	Native	March-August	BR; UP; WB	Protein, fibre and mineral rich	Fruits used locally	Folk medicine	LC	Tomar et al. (2015)
Sapotaceae											
334	<i>Diploknema butyracea</i> (Roxb.) H.J.Lam	Indian Butter/ Phalwara	T	Native	July-December	BR; WB	Fruit edible and yielding useful oil	Fruits and Seed, Edible oil	Medicinal	LC	Singh et al. (2001)
335	<i>Madhuca latifolia</i> (Roxb.) Cheval.	Mahua	T	Native	March-August	BR; UP; WB	Source of protein and minerals	Fruits are eaten raw and extract oil, alcoholic beverage.	Medicinal, Used in production of Tasar Silk	CR	Ajesh et al. (2012); Banarjee et al. (2013)
336	<i>Manilkara hexandra</i> (Roxb.) Dubard	Khirmi	T	Native	November-June	BR; UP; WB	Minerals, protein and vitamin rich	Sweet fruits eaten raw or after drying, seeds for cooking.	Rootstock for sapota and medicinal use	NE	Tomar et al. (2015); Ahirwar (2015)
337	<i>Mimusops elengi</i> L.	Molsari/ Bakul/ Bullet wood	T	Native	April-May	BR; UP; WB	Sweet fruit rich calcium content.	Eaten raw or used in pickles and fruit preservatives	Ayurvedic, red color wood is strong and tough	LC	Paul (2013)
338	<i>Xantolis tomentosa</i> (Roxb.) Raf.	Hairy xantolis	T	Native	August-February	WB	Nutrient-dense fruits	Unripe fruits are made into pickles	Folk medicine	NE	Mahapatra and Panda (2009)
Smilacaceae											
339	<i>Smilax macrophylla</i> Willd.	Ramdatan	C	Native	April-September	WB	Nutrient-dense fruits	Fruits are used	Folk medicine	NE	Barooah and Ahmed (2014)
340	<i>Smilax zeylanica</i> L.	Kukurdaine	C	Native	April-September	WB	Nutrient-dense fruits	Fruits are used	Folk medicine	VU	Barooah and Ahmed (2014)

Supplementary Table. (Continued.)

Solanaceae											
341	<i>Nicandra physalodes</i> (L.) Gaertner.	Ommathan/Apple of Peru	H	Naturalized	October–February	UP; WB	Rich in carotenoids, vitamins	Fruits are edible after boiling and used to cure fever	Folk medicine, Insecticide	NE	Ajesh et al. (2012)
342	<i>Physalis minima</i> L.	Groundcherry	H	Native	Throughout the year	BR; UP; WB	Sweet fruits	Eaten raw, cooked, jams or jellies.	Medicinal use	LC	Biswas et al. (2018); Prakash (2011)
343	<i>Solanum americanum</i> Mill.	Kalabegun	H	Naturalized	Year around	BR; UP; WB	Nutrient-dense fruits	Fruits are used	Folk medicine	LC	Saha et al. (2013)
344	<i>Solanum betaceum</i> Cav.	Tamarillo	T	Naturalized	September–December	WB	Rich in vitamins and minerals	Pectin as a food additive and gelling agent	PBI; Medicinal	NT	Bandyopadhyay and Mukherjee (2009)
345	<i>Solanum indicum</i> L.	Jangli bhata	S	Native	June–March	BR; UP; WB	Nutrient-dense fruit	Eaten as vegetable	Medicinal use	NE	Barooah and Ahmed (2014)
346	<i>Solanum khasianum</i> C.B. Clarke	Kantikari	H	Native	June–December	BR; UP; WB	Nutrient-dense fruits	Eaten raw	Folk medicine	LC	Bose et al. (2015)
347	<i>Solanum nigrum</i> L.	Black nightshade	H	Native	June–December	BR; UP; WB	Nutrient-dense fruits	Jam making or eaten raw	Folk medicine	NE	Bose et al. (2015)
348	<i>Solanum surattense</i> Burm. f.	Kanta Begun	H	Native	December–September	BR; UP; WB	Nutrient-dense fruits	Eaten raw	Folk medicine	NE	Bose et al. (2015)
349	<i>Solanum torvum</i> Sw.	Turkey berry	S	Naturalized	February–November	BR; WB	Fruits are nutritious	Fruits used to make chutney	Medicinal	NE	Mahapatra et al. (2012)
Sonneratiaceae											
350	<i>Sonneratia apetala</i> Buch-Ham	Mangrove Apple/ Keora	T	Native	April–August	WB	Sour fruit	Used as chutney	Medicinal use	LC	Paul (2013)

Supplementary Table. (Continued.)

351	<i>Sonneratia caseolaris</i> (L.) Engl.	Blatti	T	Native	April–August	WB	Fruits used	Used as chutney	Medicinal use	LC	Hosen et al. (2020)
Sterculiaceae											
352	<i>Firmiana colorata</i> (Roxb.) R. Br.	Bodula/Samari	T	Native	January–June	WB	Nutrient-dense fruit	Eaten raw or roasted	Folk medicine	NE	Barooah and Ahmed (2014)
353	<i>Heritiera fomes</i> Banks	Sunder	T	Native	April–August	WB	Seed	Eaten raw and cooked	Medicinal and Boatbuilding	EN	Mallick et al. (2020)
354	<i>Heritiera littoralis</i> Aiton	Sundari	T	Native	April–August	WB	Seed	Eaten raw and cooked	Folk medicine	LC	Dwivedi (1993)
355	<i>Sterculia foetida</i> L.	Jangli Badam/Wild Indian Nut	T	Native	April–February	BR; UP; WB	Fruit collected	Eaten as vegetable	Seed oil as medicine and bark for rope.	NE	Paul (2013)
356	<i>Sterculia guttata</i> Roxb.	Hirik	T	Native	September–March	BR; UP; WB	Fruit and seeds used	The roasted seeds are eaten	Folk medicine and Siddha	NE	Barooah and Ahmed (2014)
357	<i>Sterculia villosa</i> Roxb.	elephant rope tree/ Udal	T	Native	December–March	BR; UP; WB	Seeds and gum used	Seeds eaten raw or after roasting	Folk medicine	NE	Prakash (2011)
Styracaceae											
358	<i>Bruinsmia polysperma</i> (C. B. Cl.) Steenis	Storax/Snowbell	T	Native	August–December	BR; WB	Fruits are collected	Eaten raw	Construction, firewood and folk medicine	VU	Laha et al. (2018)
Symplocaceae											
359	<i>Symplocos racemosa</i> Roxb.	Lodh tree	T	Native	December–February	BR; WB	Fruits used	Eaten raw	Firewood, dye and medicine	VU	Laha et al. (2018)

Supplementary Table. (Continued.)

Trapaceae											
360	<i>Trapa natans</i> L.	Singhara	H	Native	September- May	BR; UP; WB	Fruits used	Eaten raw, boiled or cooked	Folk medicine, ayurveda	LC	Mall and Tripathi (2017)
Ulmaceae											
361	<i>Holoptelea integrifolia</i> Planch.	Indian elm/ Challa	T	Native	January- April	BR; UP; WB	Nutrient-dense fruits	Eaten raw	Folk medicine	NE	Dwivedi (1993); Ahirwar (2015)
Urticaceae											
362	<i>Debregeasia longifolia</i> (Burm.f.) Wedd.	Sansaru/ Wild rhea	T	Native	July- February	BR; UP; WB	Sweet fruits are eaten	Ripe fruits are eaten fresh	medicinal	LC	Ajesh et al. (2012)
Vacciniaceae											
363	<i>Vaccinium sprengelii</i> (G. Don) Sleum.	Mao khao	S	Native	May- October	BR; WB	Fruits collected	Eaten raw or cooked	Medicinal use in cancer	NE	Singh et al. (2001)
Vitaceae											
364	<i>Ampelocissus barbata</i> (Wall.) Planch.	Gorumara	C	Native	July- October	BR; UP; WB	Fruits are nutritious	Eaten raw	Medicinal use	NE	Bandyopadhyay and Mukherjee (2009)
365	<i>Ampelocissus latifolia</i> (Roxb.) Planch.	Icewar	C	Native	July- October	BR; UP; WB	Fruits are nutritious	Eaten raw	Medicinal use	NE	Bandyopadhyay and Mukherjee (2009)
366	<i>Cissus spectabilis</i> Planch.	Kattumunthiri	C	Native	June- November	WB	Sweet and acidic fruits are eaten	Eaten raw	Medicinal use	EN	Barooah and Ahmed (2014)

Supplementary Table. (Continued.)

367	<i>Leea alata</i> Edgew.	Bon-chalita/ Kukurjihba	T	Native	August- March	BR	Fruits used	Eaten raw	Folk medicine	NE	Singh et al. (2001)
368	<i>Leea indica</i> (Burm. f.) Merr.	Kukur-jhiwa	T	Native	August- March	WB	Fruits used	Eaten raw	Folk medicine	LC	Bose et al. (2015)
369	<i>Tetrasigma allicorne</i> Haines	-	C	Native	November- May	BR; UP; WB	Fruits used	Eaten raw	Ethnomedicinal	NE	Barooah and Ahmed (2014)
370	<i>Tetrasigma bracteolatum</i> (Wall.) Planch.	Nal-tenga	C	Native	August- October	BR; WB	Fruits	Eaten raw	Ethnomedicinal	NE	Barooah and Ahmed (2014)
371	<i>Tetrasigma lancolearium</i> (Roxb.) Planch.	Bherseri	C	Native	February- August	BR; WB	Fruits used	Ripe fruit is eaten or cooked with fish by Mishings	Ethnomedicinal	NE	Mallick et al. (2020)

T: tree; S: shrub; H: herb; C: climber; BR: Bihar; UP: Uttar Pradesh; WB: West Bengal; NE: not evaluated; DD: data deficient; LC: least concern; NT: near threatened; VU: vulnerable; EN: endangered; CR: critically endangered; EW: extinct in the wild.