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The role of wild edible plants and their medicinal values used by the native people of Dakshin Dinajpur, West Bengal, India– A quantitative study

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Abstract

The main aim of the present study was to gather comprehensive data on the wild edibles found in Dakshin Dinajpur, West Bengal, India, assess their cultural value, and comprehend how they contribute to the local tribes' attainment of food security. We gathered traditional knowledge about edible wild plants by administering a semi-structured questionnaire. Data collection followed standard protocols. To determine which species were most frequently cited and of cultural significance, the gathered data were subjected to specialized statistical analysis using tools such as the Cultural Food Significance Index (CFSI) and Relative Frequency of Citation (RFC). To determine how similar food plants are used in various Balurghat District localities and neighboring areas. A total of 1,603 citations were made by the 96 participants for 63 types of wild edibles spread across 36 families. Among the 63 species, 60 species were angiosperms, three species were pteridophytes. The RFC value was found to be in the range of 0.05-0.07. The most constantly referred species was identified as *Madhuca longifolia* (L.) J. F. Macbr. (RFC= 0,76; FC= 116). A total of 13 wild edible species was identified as the most traditionally valuable species in the locality including *Marsilea vestita* Hook. & Grev., *Colocasia esculenta* (L.) Schott, *Termitomyces heimii* Natarajan, *Enydra fluctuans* Lour etc. For the tribal community of eastern India, using these wild edibles scientifically and sustainably can be a smart move towards achieving multiple health benefits and food security. Furthermore, culturally acceptable species can be a good source for nutraceutical bioprospecting.

Keywords

Cultural food significance index (CFSI); Dakshin Dinajpur; food security; relative frequency of citation (RFC); traditional knowledge; wild edible plants

Introduction

In the world of the twenty-first century, it is estimated that 870 million people do not get enough calories, and another two billion people do not get enough micronutrients (1). This is an unfavorable phenomenon that about ninety percent (~20 species) of our food today comes from a small number of the nearly 20,000 edible plant species that exist. Monotonous diets lacking in food diversity and proper diet planning resulted in malnourished conditions, which is regarded as one of the top 10 risk factors contributing to the burden of chronic health issues worldwide (2). This challenge can be overcome by a food-based strategy incorporating wild edibles into daily diets (3). Wild edible plants are those that commonly grow in the wild or semi-wild areas are not domesticated nor cultivated and are not consumed as a regular food (4). Since the beginning of human civilization, wild edible plants have contributed to humankind's food heritage (5). Apart from the depository of various kinds of essential nutrients (6,7,8) wild edible plants are the crucial source of genetic diversity for breeding and improving today's domesticated crops (9). The World is now witnessing rapid changes in socio-economic and environmental conditions as well as rapid loss of biodiversity globally, which reduces the possibilities for finding new food and crop genetic resources. Scientists from all over the world have begun recording regional food heritage and related biodiversity components after realizing these concerning facts (11,12,13). Many researchers have enlisted several emergency foods consumed during famine, war, pandemic, or prolonged natural disasters (14,15). It is reported from various studies that along with plant groups many wild edible fungi and animal resources are documented in various parts of the world (15,16,17). Over the past 20 years, there has been a surge in research on wild edibles throughout Asia. Several articles have been published from various regions of Southeast Asia (18,19) and South Asia, particularly from China (20), and Pakistan (21,22). India is a land of diversified topography, climate, and ecology, providing a strong foundation for its wide range of phytodiversity. Indians' rural and ethnic lives have historically been greatly impacted by this rich phytodiversity in the areas of religion, culture, social life, and health. To explore such a domain of interrelationship between man and nature across India, scientists have prioritized the documentation of medicinally important plants over the edible ones. But later, realizing the importance of conserving the local food heritage and knowledge associated with the local biodiversity, Indian scholars have also engaged themselves in this domain of food science, and ample numbers of articles on the ethnobotany of wild edible food plants and their nutritional contribution have been reported so far (23).

A review of the literature from the past 20 years in the state of West Bengal reveals the opposite situation, leading to a dearth of research on wild edibles (24,25). West Bengal's laterite region is distinguished by its topography, biodiversity, and ethnicity. This area encompasses five districts: Bankura, Birbhum, Burdwan, Purulia, and Medinipur. There have only been a few studies done in this area thus far, except for the Birbhum district, where no ethnogastronomic research has ever been done (26,27,28). All these works are based on simple enumeration of collected data without any quantitative analysis. The use of quantitative ethnobotanical tools for analyzing collected data is becoming very crucial nowadays to add more objectivity to this field of research (29,30). A perusal of literature reported that a major portion of tribal communities including Santals of the laterite region of the state of West Bengal consume wild edibles as their daily diet(31,32) but still suffer from malnutrition mainly due to lack of optimum amount of food intake and other socio-cultural limitations (33,34). On the other hand, with ongoing anthropogenic activity in the forest, shifting cultivation, reliance on the limited number of high-yielding crop varieties, climate change, and changes in socioeconomic conditions of the ethnic people, the traditional societies are silently losing their traditional food heritage along with the related phyto-resources (15,35).

If this treasure trove of wild edibles is ignored for an extended period, there's a chance that biodiversity will be lost and local knowledge systems won't be able to support them, which could mean that these food sources will soon disappear from society. Thus, it is crucial to record what is still known about the wild edibles that are found in West Bengal's laterite region.

In this context, the current work aims to use quantitative data analysis techniques to identify culturally significant wild edible species, document detailed information on wild edibles available in the Dakshin Dinajpur district of West Bengal, and assess the significance of local flora in achieving the food security of the local tribes.

Materials and Methods

2.1. Description of Study Area

Dakshin Dinajpur situated between latitudes 24°20'N-25° 35'N and longitudes 88°20'E-89°30'E, is a district in the northern part of West Bengal in India. The district covers a vast area of 2162 square kilometers (http://ddinajpur.nic.in) and is bordered on the east by Bangladesh and on the other side by various districts of West Bengal. The district comprises two sub-divisions, viz., Balurghat and Gangarampur, of which Balurghat comprises four community development blocks (Hili, Balurghat, Kumarganj, and Tapan) and Gangarampur comprises three community development blocks (Gangarampur, Banshihari, and Harirampur). It falls under warm and temperate regions having an average annual temperature ranging from 18°C to 29°C, and yearly precipitation of about 1756 mm (Climate-Data.org).

2.2. Field Surveys and Data Collection

For the present study, extensive field surveys were conducted in all blocks of Dakshin Dinajpur district from January 2022 to September 2023. We primarily visited sacred groves across the district, from which 15 well-preserved sacred groves rich in medicinal plants were chosen for the study (Fig. 1). The study's original selections included three sacred groves each from the blocks of Kumarganj, Tapan, and Balurghat; two from Hili and Banshihari; and one each from Gangarampur, Harirampur, and Tapan (Table 1). Because of their abundant and diverse ecological diversity and resources for medicinal plants, these sacred groves were selected. A total of about 96 informants, including men, women, and herbal practitioners from different age groups and literacy stages, were interviewed (Table 2). At first, the snowball sampling method was applied to identify individuals with a particular experience or expertise then a semi-structured

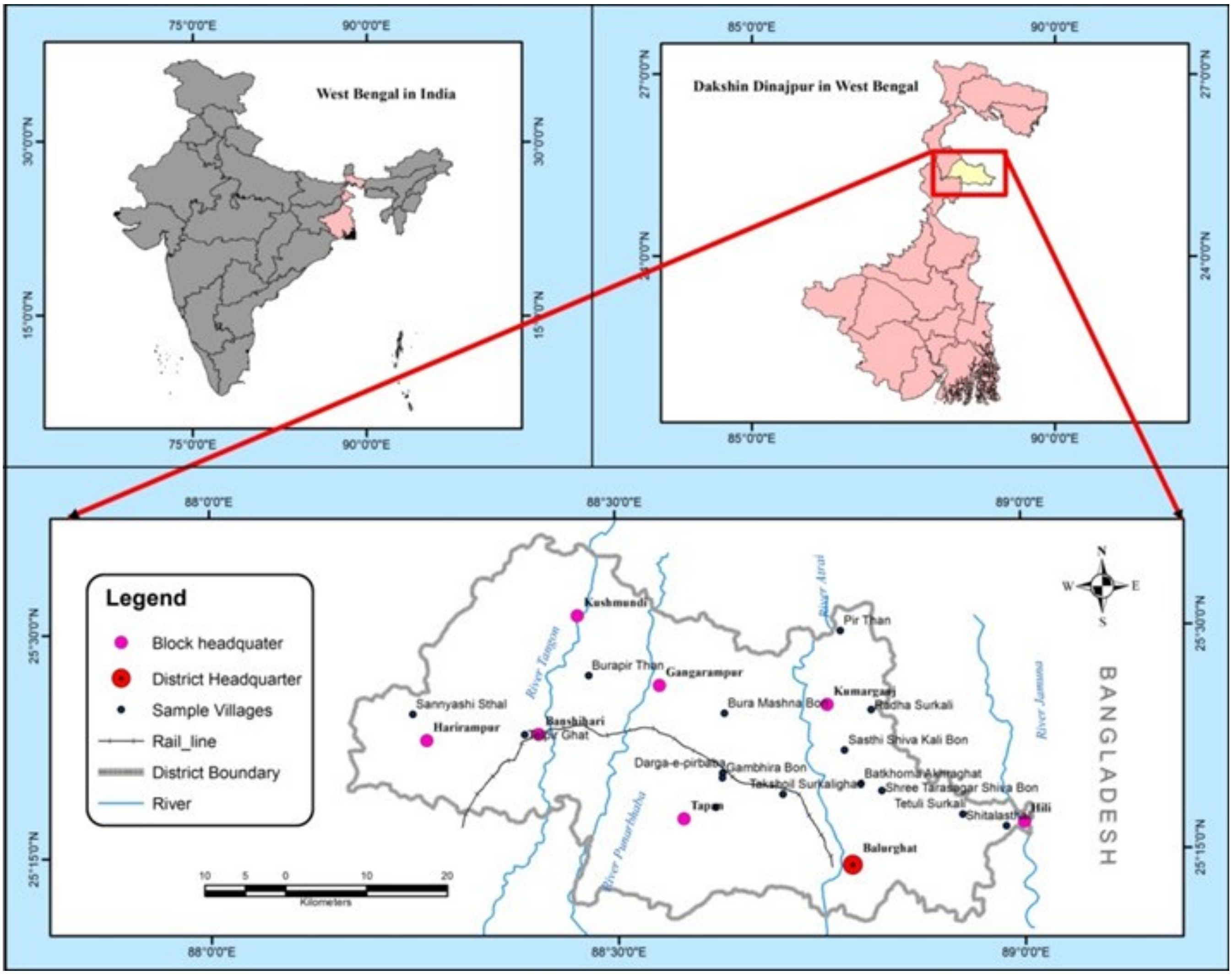

Fig. 1. Map showing the survey area with the location of the market place

Table 1. Detailed location of surveyed Village/Market of Dakshin Dinajpur district, West Bengal, India

Village/Market	GP	Block	Latitude	Longitude
TetuliSurkali	Debra	Hili	25°17.424'N	88°55.465'E
Shitalasthal	Panjole	Hili	25°16.590'N	88°58.684'E
Bura Mashna Bon	Uday	Gangarampur	25°24.383'N	88°37.955'E
Shree Tarasagar Shiva Bon	Nazirpur	Balurghat	25°19.061'N	88°49.513'E
BatkhornaAkhraghat	Nazirpur	Balurghat	25°19.543'N	88°47.973'E
TakshoilbSurkalighati	Bolla	Balurghat	25°18.915'N	88°42.222'E
Pir Than	Raynanda	Kumarganj	88°46.610´E	25°29.839´N
Radha Surkali	Radhakrishnapur	Kumarganj	25°24.508´	88°48.798´E
Sasthi Shiva Kali Bon	Gobindapur	Kumarganj	25°21.825´N	88°46.806´E
Burapir Than	Elahabad	Banshihari	25°27.029'N	88°27.960'E
Telpir Ghat	Buniadpur	Banshihari	25°23.107'N	88°23.185'E
Sannyashi Sthal	Bairatha	Harirampur	25°24.542'N	88°14.939'E
Darga-e-pirbaba	Jagadishbati	Tapan	25°20.378'N	88°37.787'E
Gambhira Bon	Harsura	Tapan	25°20.067'N	88°37.767'E
DaralhatSamshan Bon	Dipukhonda	Tapan	25°18.083'N	88°37.260'E

Table 2. Socio-demographic profile of the participants (n=96).

Variables	Categories	Numbers	Percentage (%)	Nos. of wild edible known	Knowledge holding capacity (%)
Gender	Male	56	58.33	33	53.38
	Female	40	41.66	35	55.55
Ethnic identity	*Santal*	34	35.41	45	71.42
	Munda	23	23.95	20	31.74
	Oraw	19	19.79	13	20.63
	Mahali	20	20.83	12	19.04
Age group (years)	10–30	12	18.95	14	22.23
	31–49	24	25	24	38.09
	50–69	35	36.45	28	44.45
	70–90	25	26.04	30	47.61
Education	Without formal education	22	22.91	34	53.96
	Primary level	18	28.76	20	31.74
	Secondary level	15	8.5	16	25.39
	Higher education (University/ college, Govt. job)	8	4.6	26	41.26
Residence	Rural	36	37.5	54	85.71
	Semi-urban	16	16.66	24	38.09
	Urban	11	11.45	18	28.57
Principal occupation	Daily labourer	20	20.83	14	22.23
	Farmer	12	12.5	18	28.57
	Shepherd	6	6.25	15	23.80
	House wife/household activity	14	14.53	25	39.68
	"*Vaidya*" or traditional herbalist	05	5.20	13	30.63
	Others	06	6.25	11	17.46

Table 3. List of wild edible plants

Family	Wild edible species and voucher specimen numbers	Local name	Habit	Traditional uses	Edible parts and way of eating	(FC*)	(RFC**)	(CFSI***)	Referred work from the laterite zone of WB
Aspleniaceae	*Thelypterisprolifera* (Retz.) C.F.Reed, BKM-1	Dheki shak	Herb	Edible and ethnomedicinal	Young coiled frond (leaf); cooked with garlic and mustard oil; taken with rice	19	0.12	17	(29)
Marsileaceae	*Marsilea vestita* Hook. & Grev.BKM-5	Sushnishak	Herb	Edible	Leaf; fried with garlic and mustard oil; taken with rice	92	0.6	331	(83)
Pteridaceae	*Ceratopteristhalictroides* (L.) Brongn. SKC-2	Panishak	Herb	Edible	Young frond; cooked with garlic and mustard oil; taken with rice	8	0.05	4	(83)
Sapotaceae	*Madhucalongifolia* (L.) J.F.Macbr, BKM-7	Mole dari	Tree	Edible and ethnomedicinal	(i) Flower; fresh fleshy flowers are eaten raw, used to make "*chutney*," and dried flowers are used to make a traditional drink called "*mahua*",(ii) Fruit; unripe fruits are used as an ingredient in vegetable curry; (iii) Seed; seed oil is used as an edible oil in cooking	116	0.76	464	(39,54)
Meliaceae	*Azadirachta indica,* A.Juss.BKM-14	Neem	Tree	Edible and ethnomedicinal	Leaf; young tender leaves are fried with seasonal vegetables like brinjal and/or potato; taken with rice	83	0.54	672	(40)
Araceae	*Colocasia esculenta,* (L.) Schott, SKC-12	Alati kachu/ Anja	Herb	Edible	(i) Leaf; before cooking fresh leaves are boiled in water for some time and then cooked with spices, condiments, and mustard oil; taken with rice, (ii) Petiole; peeled and sliced mature petioles are boiled in water for some time and then cooked with spices, condiments and mustard oil; taken with rice or "roti",(iii) Corm; peeled and sliced thin pieces are boiled in water for few minutes and then cooked with black cumin, condiments, and mustard oil; taken with rice	72	0.47	844	(39)
Asteraceae	*Enydra fluctuans,*Lour. BKM-18	Jal-helencha	Herb	Edible and ethnomedicinal	Shoot; cooked with black cumin, garlic, and mustard oil; taken with rice	58	0.38	835	(55)
Convolvulaceae	*Ipomoea aquatic,* Forssk. BKM-10	Kalmishak	Herb	Edible	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); and taken with rice	51	0.33	826	(39,55)
Acanthaceae	*Hygrophila auriculata* (Schumach.) Heine SKM-105	Kulekhara/ Gokhurajanumara	Herb	Edible and ethnomedicinal	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); and taken with rice	47	0.31	349	(40,54)
Apiaceae	*Centella asiatica* (L.) Urb.	Thankuni	Herb	Edible and ethnomedicinal	Leaf; cooked with black cumin and butter; taken with rice	47	0.31	338	(39,40,54)
Molluginaceae	*Mollugos pergula* (L.) SKC-18	Gime-shak	Herb	Edible	Shoot; tender shoots are first boiled and then mixed with boiled or fried potato; and taken with rice.	47	0.31	571	(40)
Rubiaceae	*Paederia foetida*(L.) BKM-03	Gandhavaduli	Climber	Edible and ethnomedicinal	Leaf; freshly collected leaves are made into paste along with lentils and garlic, mixed with black cumin and salt, fried to cook in mustard oil; taken with rice	47	0.31	165	(39,82)

Apocynaceae	*Carissa spinarum* (L.) BKM-05	Bir karamcha/ Baghjata	Shrub	Edible	Fruit; mature fruits are eaten raw and used as an ingredient of mixed pickle.	48	0.31	23	(29)
Rhamnaceae	*Ziziphus nummularia* (Burm.f.) Wight & Arn. BKM-06	Bhuinkul	Tree	Edible	Fruit; (i) ripe fruits are eaten raw,(ii) mature fruits are used to make sweet pickle	45	0.29	171	(40)
Plantaginaceae	*Bacopa monnieri* (L.) Wettst. BKM-08	Bramhi	Herb	Edible and ethnomedicinal	Shoot; cooked with black cumin garlic, and butter; taken solely or with rice	42	0.275	491	(39,40)
Dioscoreaceae	*Dioscorea bulbifera* (L.) BKM-09	Methe-alu	Climber	Edible and ethnomedicinal	Tuber; peeled and sliced tubers are boiled in water for a few minutes and cooked with mustard oil, onion, and spices; taken with rice	41	0.27	96	(54)
Fabaceae	*Pithecellobium dulce* (Roxb.) Benth.BKM-15	Jilipigachh	Tree	Edible	Fruit; fleshy seed arils are eaten raw	39	0.255	30	(81)
Rhamnaceae	*Ziziphus oenopolia* (L.) Mill. BKM -16	Shia kul	Shrub	Edible	Fruit; ripe fruits are eaten raw	39	0.255	19	(54)
Rubiaceae	*Meyna spinosa* Roxb. ex Link. BKM-19	Bainchikul/ Loto	Shrub	Edible	Fruit; ripe fruit is eaten raw	38	0.25	15	(57)
Amaranthaceae	*Amaranthus viridis* L. BKM-23	Bon-notey-shak	Herb	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; and taken with rice	37	0.24	400	(40)
Malvaceae	*Hibiscus sabdariffa* (L.) BKM-21	Mesta/ takdhanros	Shrub	Edible	Leaf; tender leaves are cooked with black cumin, garlic, ginger flecks, and mustard oil; and taken with rice. Calyx; Fleshy mature calyx is used to prepare chutney	37	0.24	209	(40)
Aizoaceae	*Trianthemaportulacastrum* (L.) BKM--22	Kulpha-shak/ Swet purundi	Herb	Edible	Leaf; cooked with garlic and mustard oil; taken with rice	34	0.22	90	(29)
Amaranthaceae	*Alternanthera sessilis*(L.) R.Br. ex DC. SKC-24	Sanchi-shak	Herb	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; and taken with rice	34	0.22	274	(39)
Rubiaceae	*Randia aculeata* (L.) BKM-25	Maina-kanta	Shrub	Edible	Fruit; ripe fruit is eaten raw and sometimes "*chutney*" is made from it	34	0.22	13	(53)
Araceae	*Typhonium trilobatum* (L.) Schott –BKM-28	Kharkan	Herb	Edible	Leaf; freshly collected leaves are first boiled in water for a few minutes, then a paste is made from the boiled leaves, mixed with lime juice, and "*Pakora*" is made with black cumin, garlic, finely chopped onion, and fried in mustard oil; taken as snacks or with rice.	33	0.22	97	(39)
Amaranthaceae	*Alternanthera philoxeroides* (Mart.) Griseb.SKC-26	Shalunche	Herb	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; and taken with rice	32	0.21	259	(40)
Cucurbitaceae	*Coccinia grandis* (L.) Voigt TM-27	Kundri/ Telakucha	Climber	Edible	Fruit; mature unripe fruits are fried in mustard oil with black cumin and onion; and taken with rice, *chapati,* or *roti*.	31	0.2	92	(39,40)

Amaranthaceae	*Amaranthus spinosus* (L.) BKM-30	Kanta-notey-shak	Herb	Edible and ethnomedicinal	Leaf; tender leaves are cooked with black cumin, garlic, and mustard oil; and taken with rice	29	0.19	235	(39)
Asteraceae	*Centipeda minuta* (G.Forst.) C.B.Clarke BKM-30	Mechetashak	Herb	Edible	Shoot; cooked with garlic and mustard oil; taken with rice	29	0.19	102	(31)
Dioscoreaceae	*Dioscorea pentaphylla* (L.) TM-32	Kanta alu	Climber	Edible	Tuber; after peeling sliced tubers are soaked in water overnight and then used as an ingredient of mixed vegetable curry; taken with rice	29	0.19	147	(59)
Araceae	*Amorphophallus sylvaticus* (Roxb.) Kunth TM-31	Bir Shuran	Herb	Edible	Corm; sliced and boiled in water with salt and a pinch of turmeric till fully cooked; boiled sliced pieces are then smashed and mixed with black mustard seed paste; served with rice	27	0.18	73	(40)
Convolvulaceae	*Riveahypocrateriformis* (Desr.) Choisy BKM-33	Ban pui	Climber	Edible and ethnomedicinal	Shoot; tender shoots are first boiled in water for a few minutes and then fried with black cumin and mustard oil; taken with rice	27	0.18	243	(39)
Rubiaceae	*Neolamarckia cadamba* (Roxb.) Bosser BKM-32	Kadam	Tree	Edible	Fruit; ripe fruits are eaten raw and used to prepare "*chutney.*"	27	0.18	55	(40,54)
Anacardiaceae	*Buchanania lanzan* Spreng.	Piyal	Tree	Edible	Fruit; ripe fruits are eaten raw	26	0.17	15	(54)
Malvaceae	*Grewia asiatica* (L.) BKM-34	Falsa	Tree	Edible	Fruit; ripe fruits are eaten raw; and used to make chutney and pickles.	25	0.16	12	(30,54, 82)
Fabaceae	*Melilotus albus* Medik.TM-35	Ban methi/ Senjishak	Herb	Edible	Shoot; tender shoots are cooked with garlic and butter; and taken with rice	24	0.16	65	(55)
Moraceae	*Artocarpus lacucha* Buch.-Ham.SKC-36	Baral/Deuphal	Tree	Edible	Fruit; mature fruits are used as ingredients of mixed vegetable curry, chutney, and pickle.	24	0.16	122	(54)
Cornaceae	*Alangiumsalviifolium* (L.f.) Wangerin BKM-39	Ankar/Dela	Tree	Edible	Fruit; ripe fruits are eaten raw	23	0.15	11	(54)
Dioscoreaceae	*Dioscorea alata* L. BKM-37	Kham alu/ Chupri alu	Climber	Edible and ethnomedicinal	Tuber; after peeling sliced tubers are soaked in water overnight and then used as an ingredient of mixed vegetable curry; taken with rice	23	0.15	155	(30,54)
Fabaceae	*Trigonella stellata* Forssk.TM-40	Ban paring	Herb	Edible	Leaf; leaves are first made shade dried and then boiled with pulses, garlic, and mustard oil; taken with rice	23	0.15	40	(30)
Arecaceae	*Phoenix acaulis* Roxb. BKM-38	Bir-khejari	Shrub	Edible	Fruit; ripe fruit is eaten raw	23	0.15	2	(54)
Menispermaceae	*Cocculus hirsutus* (L.) W.Theob.TM-43	Aarak-aan-ara	Climber	Edible and ethnomedicinal	Leaf; tender leaves are first made parboiled, shade dried, and then cooked with black cumin and mustard oil; taken with rice. Fat fried leaves are taken with smashed boiled potato.	22	0.144	98	(83)

Polygonaceae	*Polygonum plebeium* R.Br.TM-41	Chimtishak /Tak shak	Herb	Edible	Shoot; tender shoots are fried with black cumin and mustard oil; and taken with rice	21	0.14	33	(39, 54)
Talinaceae	*Talinum portulacifolium* (Forssk.) Asch. ex Schweinf.BKM-42	Tak palang/ Bilatipui	Herb	Edible	Leaf; cooked with garlic and mustard oil; taken with rice	19	0.12	87	(40)
Amaranthaceae	*Ouretlanata* (L.) Kuntze SKC-44	Chhai-shak/ Lupani-ara	Herb	Edible and ethnomedicinal	Shoot; tender shoots are cooked with garlic and "*ghee*" (clarified butter); and taken with rice	18	0.12	225	(73)
Euphorbiaceae	*Euphorbia thymifolia* (L.)	Nanhapushi toa	Herb	Edible and ethnomedicinal	Shoot; cooked with black cumin and mustard oil; taken with rice.	18	0.12	169	(39)
Commelinaceae	*Commelinadiffusa(* Burm.f. TM-46	Bans-kenduri	Herb	Edible	Shoot; tender shoots are cooked with black cumin and mustard oil; and taken with rice	17	0.11	22	(28, 40)
Ebenaceae	*Diospyros ebenum* J.Koenig ex Retz. BKM-45	Kend dari	Tree	Edible	Fruit; mature ripe fruits are eaten raw.	17	0.11	10	(30, 54)
Ulmaceae	*Holoptelea integrifolia* (Roxb.) Planch.TM-48	Pata-badam	Tree	Edible	Seed; seed is eaten raw	17	0.11	7	(54)
Commelinaceae	*Commelina benghalensis* (L.) BKM-47	Kansira	Herb	Edible	Leaf; tender leaves are cooked with garlic and "*ghee*" (clarified butter); and taken with rice	16	0.105	28	(30, 54)
Cucurbitaceae	*Luffa cylindrica* (L.) M.Roem.SKC-49	Dhundul	Climber	Edible	Fruit; (i) used as an ingredient of mixed vegetable curry, (ii) fried to cook with black cumin and onion; taken with rice	16	0.105	43	(30)
Fabaceae	*Cajanus scarabaeoides* (L.) Thouars BKM-52	Birhore	Climber	Edible and ethnomedicinal	Leaf; tender leaves are first made parboiled, shade dried, and then cooked with black cumin and mustard oil; taken with rice	15	0.1	89	(54)
Rubiaceae	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre TM-50	Piralodari	Tree	Edible	Fruit; ripe fruit is eaten raw	14	0.09	1	(40)
Asparagaceae	*Asparagus racemosus* Willd. TM-53	Sadmul	Climber	Edible and ethnomedicinal	Root; mature tuberous roots are eaten raw	14	0.092	16	(54)
Apocynaceae	*Hemidesmus indicus* (L.) R.Br SKC-51	Anantamul	Climber	Edible and ethnomedicinal	Root; dried root powder is used to make recreational tea	13	0.085	23	(54)

Malvaceae	*Pterospermumacerifolium* (L.) Willd. TM-60	Muchkunda	Tree	Edible	Calyx; The fleshy part of the calyx is made into fine paste and mixed thoroughly in water along with black salt, sugar candy, and lemon juice; it is taken as a recreational drink	13	0.085	5	(39)
Nymphaeaceae	*Nymphaea nouchali* Burm.f. BKM -54	Shaluk	Herb	Edible	Petiole; freshly collected petioles are cooked with mustard oil, cumin seed, turmeric, and black mustard seed paste; taken with rice	13	0.085	35	(40,55)
Phyllanthaceae	*Antidesmaghaesembilla* Gaertn. BKM-59	Suramatha	Shrub	Edible	Fruit; ripe fruits are eaten raw	12	0.078	6	(28,34)
Amaranthaceae	*Achyranthes aspera* (L.) SKC-56	Chorchoreshak	Herb	Edible and ethnomedicinal	Leaf; tender leaves are cooked with black cumin and mustard oil; and taken with rice	11	0.07	77	(54)
Dilleniaceae	*Dillenia pentagyna (*Roxb. TM-58	Bon-chalta	Tree	Edible	Fruit; ripe fruits are eaten raw as well as used in preparing "*chutney*"	11	0.072	0.2	(40)
Moraceae	*Ficus racemosa* (L.) SKC-57	Dumur	Tree	Edible	Fruit; a delicious curry is made from immature fruits when cooked with condiment and spices; it is taken with rice, and "*roti.*"	11	0.072	54	(54)
Asteraceae	*Emilia sonchifolia* (L.) DC.BKM-62	Sanchimodi/ Kalai- lutur-ara	Herb	Edible and ethnomedicinal	Shoot; tender shoots are cooked alone with black cumin and mustard oil and sometimes with other seasonal vegetables; taken with rice. It is also used occasionally as a garnishing agent which adds extra aroma to the cooked food.	10	0.065	122	(40,83)
Asteraceae	*Sonchus oleraceus* (L.) SKC-61	Titaleashak	Herb	Edible	Leaf; tender leaves are cooked with black cumin, garlic, and mustard oil; and taken with rice	9	0.06	14	(51,75)
Pandanaceae	*Pandanus amaryllifolius* Roxb. ex Lindl.TM-63	Payesgachh	Herb	Edible	Leaf; leaves are used as flavoring agents in cooking items	9	0.059	1	(39,40)

questionnaire technique was used to gather ethnomedicinal data from the informants (36,37). As the local people are predominantly Bengali speakers, the questionnaire was made in Bengali and later translated into English.

During in-loco interaction and the use of visual stimuli, plants were identified and collected as voucher specimens. The estimated knowledge-holding capacity of each key participant is as follows. Knowledge holding capacity is the number of wild edibles known to the individual total number of wild edibles recorded d×100. The data on the local name of the wild edible species, its traditional uses, cooking methods, season of availability, frequency of use in a week, side effects if any, and market value have been recorded. Free and Prior Informed Consent (FPIC) was requested from each of the participants before starting the interviews as their participation was voluntary. Participating children under the age of 15 years were requested to provide the FPIC of their own and their parents. At the time of the field survey, we strictly followed the best field practice as proposed earlier by the scientists (38), and the Code of Ethics recommended by the International Society of Ethnobiology (2008). The collected data have been compared with the available literature on the ethnobotany of wild edibles from the Laterite region in West Bengal (39,40).

2.3. Plant specimen collection, identification, preparation of herbarium, and nomenclature update

Sample specimens were gathered following national regulations (41) and preserved as herbarium specimens using customary methods (42). For future reference, these specimens are deposited at the Departmental Herbarium of the Department of Botany Krishna Chandra in Hetampur, India. Both expert opinions and consultation with various floras have been taken into consideration for the identification of the collected wild edibles (43,44,45). The standard websites, such as The Word Flora online (http://www.worldfloraonline.org/), and Germplasm Resources Information Network. 2 are followed in using the updated scientific names.

2.4. Data analysis

The most common and widely accepted species in the region have been determined by analyzing the data using specialized statistical indices such as the Cultural Food Significance Index (CFSI) and Relative Frequency of Citation (RFC). A comparative analysis of recent research carried out in and around the surveyed area is done using the Jaccard Similarity Index (JI).

2.4.1. Relative frequency of citation

The frequency of use of individual species was calculated by applying the formula RFC = FC/N, where FC is the total number of participants who reported a specific species as edible in the wild and N is the total number of study participants involved. The value of RFC varies from 0 to 1; a value close to 1 signifies the higher importance or popularity of the plant in the study area (46).

2.4.2. Cultural food significance index

The cultural food significance index was effectively framed to assess the overall acceptability and importance of edible plants in culture (47). It was formulated as-

CFSI= $QI \times AI \times FUI \times PUI \times MFFI \times TSAI \times FMRI \times 10^{-2}$.

The CFSI is the product of seven indices that include frequency of quotation (QI), availability (AI), frequency of use (FUI), plant parts used (PUI), multi-functional food use (MFFI), taste score appreciation (TSAI), and the food-medicinal role (FMRI).

Results and Discussion

3.1. Key informant's socio-demography and knowledge -holding capacity

Among the 96 key participants, ages ranged from 10-90 years which included 40 women, 25 men, 16 girls, and 15 boys from 96 households scattered in the remote rural areas, semi-urban, and urban settlements in Dakshin Dinajpur District (Table 1). Eleven of the participants were traditional healers who were highly regarded for their healing abilities in their respective communities and possessed a broad knowledge of plants. Within the folk culture of eastern India, female informants primarily engaged in household chores and daily labor and were found to possess extensive knowledge of locally available wild edibles. The attachment of female individuals to the local food plants has also been observed in other parts of the world (49). Collectively, participants over 50 years old were able to recognize 77 wild edible species, including their local names and ethnoastronomy applications. The majority of ethnobotanical studies have found that older participants have a greater capacity for knowledge retention (46, 49). Learning that occurs with aging aids in a person's lifelong acquisition of experiences and knowledge. The act of gathering wild edibles is not influenced by the participants' educational or literacy levels, but rather by their socioeconomic circumstances, the type of settlement they live in, their social standing, and their belief in the biodiversity of the area. It's concerning that a small percentage of the young participants have indicated a preference for an urbanized lifestyle and commercially grown fruits and vegetables.

3.2. Taxonomical information of wild edibles

A total of 63 wild edible species (WES) were documented that spread across 36 families. Among the 63 species, 60 species were angiosperms, and 3 species were pteridophytes. Among the reported 36 families, Amaranthaceae was represented by the highest number of WES (6 species) followed by Rubiaceae 5 species, Fabaceae, Araceaeand Asteraceae 4 species. The obtained data was in contrast with the earlier reported data from India where the highest number of edible species belongs to the Family Leguminosae and Compositae (50). Four edible species were represented from each family viz. Asteraceae, Lyophyllaceae, and Malvaceae. Under Dioscoreaceae and Malvaceae three species in each family were recorded. Two species from each family were recorded from six families Rhamnaceae, Convolvulaceae, Moraceae, Apocynaceae, Commelinaceae, and Cucurbitaceae. Only one species represented the rest of the 23 families. The Amaranthaceae family has the greatest number of edible species identified in the present study; this may be because they prefer leafy vegetables, ease of availability in the studied area, and herbaceous nature. The ability of members of the Amaranthaceae family to produce foods with nutritional value has previously been demonstrated (51, 52). So, the diverse nature of this plant family concerning accessibility, palatability, and food value can contribute a lot toward achieving food security.

3.3. Diversity of edible parts

Local inhabitants of the study area collect various edible parts like flowers, calyx, fruit, fruiting bodies, leaves, petioles, young coiled fronds, seeds, stems, shoots, and underground parts like roots, tuber, and corm. Leaves were the mostly collected plant parts (31.74%) that are mainly used as leafy vegetables followed by fruit (28.57%), fruiting body (19.04%), shoot and stem (15.87%), underground parts (9.52%), flower and calyx (6.43%), and seed (3.17%). In the present study most frequently cited leafy vegetables were *Ipomoea aquatica, Azadirachta indica, Enydra fluctuans, Colocasia esculenta, Marsilea vestita, Centella asiatica*, and *Hygrophila auriculata*. These observations are in line with the previous work conducted in eastern India (39,40,53,54). On the other hand, fruits of *Ficus racemosa, Madhuca longifolia, Coccinia grandis, Neolamarckia cadamba, Ziziphus nummularia*, and *Artocarpus lacucha* were considered popular choices for the local people. Both the plant parts (leaves and fruits) were mostly utilized by the local tribes and in agreement with the current study, those edible parts were found as the main source of wild food in other areas of the Asian continent including India (12,22,55,56,57).

3.4. Traditional knowledge of wild edible species, their gathering pattern, postharvest processing, and preservation techniques

A total of 1,603 citations were made by the 96 participants for 63 types of different wild edible species. In the present study, among the 63 WES, 50 species were collected solely for edible purposes. On the other hand, 13 edible species were attached to both ethnomedicine and local food heritage. Local people have a deep understanding and knowledge of the therapeutic properties of those wild edible species. For example- butter fried leaves of *Centella asiatica* and *Bacopa monnieri* are consumed for their brain -boosting properties, *Hygrophila auriculata* is mainly taken for its anti-anemic capacity, soup of *Termitomycesheimii* is taken as a cure for dysentery, the tuber of *Dioscorea alata* is attached with its *Anthelmintic potentialities*, etc. Local people consciously consumed those species as medicinal food despite their low test appreciation scores. It is a fact that those herbs can provide both high nutritional inputs and medicinal effectiveness. Wild edibles that have been documented were primarily collected from late monsoon to mid-winter. April–March and September–November were the months for which maximum collection rates were disclosed. October is when the greatest amount of wild mushrooms are found. The majority of the leafy vegetables were gathered between May and July, according to the participants. Most edible leafy vegetables were gathered from marshy land (e.g., *Alternanthera philoxeroides*), agricultural fields (e.g., *Centipeda minuta*), water bodies (e.g., *Ipomoea aquatica*), fallow lands (e.g., *Ouret lanata*), and road sides (e.g., *Amaranthus viridis*). Herbaceous leafy greens which are easily accessible were mostly collected by women and children. On the contrary, male members of the community harvest edible underground parts and fruits which need extra physical strength and the support of mechanical tools. Some participants pointed out sustainable harvesting practices followed by folk taboos and beliefs attached to ethno-conservation practices (58, 59). For example, during the collection of root vegetables (e.g., *Asparagus* sp.) some parts were left behind which will hopefully help in reviving the plant and sprouting occurs from the remains under favorable conditions. In 17 cases plant parts were eaten raw and mostly they were the ripe fruits. Rest of the cases edible parts were taken in the form of boiled and cooked vegetables, curry, chutney, pakora, pickles, traditional drinks, and recreational tea (Figures 2A –C). Plant like *Pandanus amaryllifolius* is used as flavoring agent only. Despite the potential for wild edibles as food in the future, some people are concerned about their alleged toxicity because of pesticide residues, heavy metals, chemical additives, microorganisms, and/or the synthesis of hazardous chemical compounds (60,61,62). On this matter, the scientific community is very split. One group defends the non-toxic nature of naturally occurring wild foods, while the other warns of the presence of heavy metals, oxalic acids, cyanogenic glycosides, lectins, pyrrolizidine alkaloids, and several other toxic chemicals (63,64,65). Tribes in the studied area have an inherent knowledge of how to treat wild foods after gathering, which aids them in avoiding such harmful dangers. Before consumption in fresh form, washing with clean water is a very common practice that helps in the removal of dirt, putrid residue, or other unwanted things from the surface (66). In a few cases, specialized treatments were given to the edible parts before cooking. In the case of wild edible mushrooms, after thorough washing with water, boiling once or twice in plain water saline water lime water, or tamarind juice was done according to the local tribe's emic perception of the collected mushroom's habit, external features, and palatability (67). It was informed that the cuticle of the pileus and stipe was peeled off in case of species like *Amanita vaginata, Russula emetic, Boletus edulis, Amanita vaginata* var. *alba,* and *Astraeus hygrometricus* to reduce their bitterness and to enhance softness. The best pre-cooking techniques for lowering the amount of soluble oxalate and pyrrolizidine alkaloids in certain wild leafy vegetables and subterranean portions are hot water treatment and boiling (68,69,70,71). Local tribes of eastern India followed this method for processing the leaves and petioles of *Colocasia esculenta*, leaves of *Typhonium trilobatum*, tuber of *Dioscorea* spp., and corm of *Amorphophallus sylvaticus*. The use of organic acids, such as lime or tamarind juice, as part of local custom greatly reduces the concentration of insoluble oxalate crystals in food items. Regular usage of ginger, garlic, and turmeric while cooking may potentially serve as effective detoxifiers (72,73). Most of the wild edibles are seasonal and only harvested during their time of availability. For future use, long-term storage is required without compromising their nutritional quality. Recorded wild edible mushrooms like *Termitomyces heimii, Amanita vaginata* var. *alba, Russula emetic*, and *Termitomyces clypeatus* were first thoroughly cleaned with lukewarm saline water, made sun-dried completely, and then stored in airtight containers for future uses. Local tribes of Himachal Pradesh in India preserved Morchella sp. in the same way (74). Ripe fruits were usually eaten raw, but pickles were better kept in storage. The fruits of *Artocarpus lacucha*, *Grewia asiatica, Carissa spinarum,* and *Ziziphus nummularia* were pickled by the tribes of eastern India studied in this study. Conventional pickling techniques have a long history and are widely used to preserve perishable fruits and vegetables (75). In a few cases, leafy vegetables like *Hibiscus sabdariffa, Trigonella stellata, Cocculus hirsutus, Cajanus scarabaeoides,* and *Sonchus oleraceus* were made shade-dried for long-term use.

3.5 Wild edibles as livelihood support

Many of the recorded wild edibles are gradually finding their place beside the cultivated ones and becoming a source of income generation for the local tribes. The observations were made by the earlier workers also (77,78). Furthermore, a variety of highly nutritious, highly demanding, non-cultivated edible parts are found in vegetable markets in rural, urban, and semi-urban areas. These include medicinal foods like *Hygrophila auriculata, Centella asiatica, Mollugos pergula, and Bacopa monnier, as well as leaves, petioles,* and *corms of Colocasia esculenta*, tubers of *Amorphophallus sylvaticus* and *Dioscorea alata,* petioles of *Nymphaea nouchali*, fruits of *Ficus racemosa*, and *Artocarpus lacucha*. These vegetables are sold for an average of Rs. 100–150/kg. So, there are strong reasons for domesticating some of these economically beneficial wild edibles which can strengthen the arena of food security as well as supply steady nutritional inputs and opens up new avenues for income generation to the local people (79). The sustainable development goals can be accomplished through cooperative efforts from the government, social activists, ecologists, agriculture and food scientists, and local tribes by utilizing a mixed method approach, food sovereignty, or food security strategies (80).

3.6. Enumeration and quantitative analysis of the recorded wild edibles

All the recorded wild edibles with their local names, taxonomic information (updated) habits, availability duration, edible parts, mode of preparation and traditional uses, numbers of quotations (FC), and value of relative frequency of citation (RFC) were presented in Table 2. The RFC value for the recorded species ranged from 0.02 to 0.08. In the present study, *Madhuca longifolia* was identified as mostly cited edible species with a maximum number of food use mentions (FC-77; RFC-0.80). Higher RFC value (i.e., close to 1) indicates greater importance of the species in the locality. Some other wild edibles like *Colocasia esculenta* (FC-72; RFC-0.47), *Azadirachta indica* (FC-44; RFC-0.45), *Marsilea vestita* (FC-45; RFC-0.46), etc. were cited frequently also by the local tribes.The most useful quantitative index, the CFSI, was used to analyze the ethnogastronomical data of 83 WES; the results ranged from 844 to 0.2. For plants with multiple edible parts, such as *Colocasia esculenta*, Hibiscus sabdariffa, and *Madhuca longifolia*, the CFSI is calculated individually for each part before assigning a combined score to the edible species. In Supplementary File S2, all of the wild edibles are listed in descending order based on their CFSI score, along with detailed computations. The enlisted wild edibles are then grouped into six groups (47); species having most highest cultural significance (CFSI ≥ 300), species having high cultural significance (CFSI ranges from 100 to 299), species with moderate significance (CFSI varies from 20 to 99), species with low significance (CFSI ranges from 5 to 19), species with very low significance (CFSI ranges from 1 to 4) and species with negligible cultural significance (CFSI < 1). CFSI values for thirteen wild edibles ranged from 315 to 844. Of these, Colocasia esculenta had the highest estimated value (CFSI = 844), followed by *Enydrafluctuans, Ipomoea aquatica, Mollugospergula, Azadirachta indica, Bacopa monnieri, Madhuca longifolia, Amaranthus viridis, Hygrophila auriculata, Centella asiatica, Marsilea vestita, and Termitomyces heimii.* In this group, most of the plants are wild edible greens that are easily accessible, mostly available, and mainly used as leafy vegetables by the local inhabitants. Both the multi-functional food use score (MFFI) and the plant parts used score (PUI) are high for plants with multiple edible parts. All food plants are classified as "edible" because their edible plant parts are closely associated with regional culinary traditions (81). For this reason, we first calculated the CFSI value separately for each of the edible parts like the corm, petiole, and leaf of *C. esculenta,* and then considering the cultural significance of that plant as a whole we combined the CFSI values of corm, petiole and leaf (corm – 147 + petiole – 308 + leaf – 389 = CFSI value of *C. esculenta* – 844) which make the plant most culturally significant species in the surveyed area with maximum CFSI value. Eighteen WES had low significance as their CFSI value ranged from 5 to 19. Very low significance (CFSI = 1–4) was attached with 5 WES like *Ceratopteris thalictroides, Phoenix acaulis*, *Tripidium bengalens*, *Tamilnadia uliginosa*, and *Pandanus amaryllifolius.* One species *Dillenia pentagyna* was found to have negligible significance (CFSI = 0.2) due to its rare occurrence in the locality and very poor utilization frequency. The wild edibles recorded from Balurghat district are compared with the data published earlier from other districts of the laterite region in West Bengal as well as adjoining states like Jharkhand and Odisha where ethnic composition and biodiversity are very much alike (28,29,53,54,77).

3.7. Some new observations from the Dakhshin Dinajpur District of West Bengal

According to a review of previously published ethnobotanical and ethnogastronomic literature from the laterite region of West Bengal, 29 species—either whole or in edible parts—of the 83 wild edibles in this area are new additions to the existing inventory of wild edibles (39,40,54). Plants like *Alternanthera philoxeroides*, *Antidesmaghae sembilla, Carissa spinarum, Commelina diffusa, Emilia sonchifolia, Hibiscus sabdariffa, Riveahypocra teriformis, Tamilnadi auliginosa, Sonchus oleraceus, Ziziphus nummularia, Tripidiums bengalense,* and *Pandanus amaryllifolius* have been recorded first time as wild edibles from the studied region. Moreover, in a few cases, some plant parts and a few species have been documented here as wild edibles that differ from the previous work of Bouri and Ganguly (2016) (54). In the present study *Polygonum plebeium* is documented instead of *Polygonum barbatum* and *Nymphaea nouchali* is reported as an alternative for *Nymphaea pubescens* (54). Similarly earlier workers have documented the plants *Cajanus scarabaeoides* and *Cordia dichotoma* for their edible fruits but here in both cases, only tender leaves of those plants have been enlisted (54). This observation may have some impact on the local food heritage as it expands the list of wild edibles as well as provides the opportunity to opt for alternative food sources in the absence of one another.

3.8. Interlinking wild edibles with food security

The majority of research found a link between food insecurity and micronutrient insufficiency in consumers (83,84,85). Micronutrient deficit or "hidden hunger" is considerably one bigger problem than hunger, demonstrating the need to integrate food and nutrition security (85). The phrase "food security" generally refers to a circumstance in which members of the population under consideration have access to enough food to meet their nutritional needs and to provide an adequate intake of calories. Dietary variety is one of the sustainable food-based ways to ensure optimal micronutrient consumption and gaining calories. Due to their high micronutrient content, many of the known wild edible fruits, roots, tubers, herbs, and mushrooms may help to address issues like hidden hunger and enhance food security. The current study identified 83 wild edible species, various parts of which are harvested all year long by the local populace. They are mostly enjoyed as an accompaniment to the main dishes that are staple cereal-based meals. The majority of wild edibles that have been identified are nutritious food sources that are high in micronutrients (86). For example- previous researchers have already explored that *Colocasia* sp. leaf is characterized by rich dietary fiber, micronutrients, and proteins, and very low in calories (87). It contains a significant amount of β-carotene, ascorbic acid, folic acid, riboflavin, B vitamins, vitamin A, iron, calcium, potassium, phosphorus, and magnesium. Corms of this culturally most valuable species are also a rich source of carbohydrates, proteins, minerals and vitamins (88). In addition to potatoes and sweet potatoes, it can be used as another tuber vegetable that can help achieve food security. Additionally, it can be processed for use as a food ingredient in the nutraceutical industry. Because of its nutritional value and holiness, the plant *Madhuca longifolia* has long been associated with the tribal cultures of eastern India. It is still regarded as a cultural touchstone. This plant's edible parts were noted to include the flower, unripe fruit, and seeds, with the flower being the most commonly consumed part. Mahua, also known as mahulidaaru, is a traditional beverage made by the ethnic people of eastern India using Madhuca flowers. The madhuca flower has high levels of carotene, calcium, phosphorus, and vitamin C (89). Using this food item regularly—whether it's fresh, dried, or processed—will help prevent malnutrition. Furthermore, 50–61% of the edible oil found in Madhuca seeds has a profitable fatty acid profile that includes oleic, stearic, and palmitic acids. Vegetable oils that are high in oleic acid are preferred by nutritionists because they reduce blood cholesterol, which in turn reduces the risk of coronary heart disease (90). In the rural and semi-urban vegetable markets, the presence of Marsilea vestita or "Sushnishak" is very common which indicates its wider use. The fondness for this edible leafy green is mostly attached to its sleep-boosting and antidepressant activity (91). Additionally, *Marsilea* sp. contains a high amount of essential vitamins like Thiamine (394 mg/100 g), Riboflavin (2.5 mg/100 g), and Vitamin C (240 mg/100 g) which provide the added advantage of gaining the required micronutrients in consumer's daily diets (92). Human beings have been consuming mushrooms as an important food source for centuries due to their attractive and multiple functional attributes (86). Many of these locally growing nutritious wild edibles can be a potent substitute for commercially available costly marketed vegetables and fruits. Earlier workers from different parts of the world have experienced the same (95). A greater proportion of the species that have been documented are herbaceous, meaning that they are easily accessible and can be raised in home gardens at the same time. This will support the local tribe's kitchen by ensuring a steady supply of food. In addition, there are 23 wild edibles with a variety of therapeutic qualities that can offer extra health benefits in addition to food security. Therefore, if the listed species are added to regular meals, there is a good chance that they will provide the necessary food security and micronutrient sufficiency.

3.9. Threats, sustainable harvesting, and conservation practice

Biodiversity loss due to anthropogenic activity, ecological factors, and natural causes is a matter of ongoing discussion worldwide. Threats for wild edible resources are not bereft of it (96). During the group discussion in the present study, a few threats to the local WES were identified. The most significant threat to the wild edibles in West Bengal's laterite region has been determined to be habitat destruction. The region's forest lands are currently being rapidly encroached upon, primarily for development purposes and less so to expand agricultural lands. Second, the informants drew significant attention to an unsustainable competitive harvesting practice for species with high market value, which they identified as the reason behind the local population decline of species such as *Amorphophallus sylvaticus, Asparagus racemosus,* and *Dioscorea alata*. Therefore, maintaining natural habitats and harvesting wild edibles sustainably are essential to the preservation of these valuable wild crop genetic resources.

The rural tribal people's socioeconomic status is changing quickly daily, which has a direct impact on their consumerist mindset and how they preserve the wealth of mother nature. Together, environmentalists, social activists, agriculturists, economists, and other businesspeople can move forward in this direction, abiding by the laws and regulations of the government to preserve the wild edible population and make productive use of them for the benefit of the nearby tribes as they transition to an urbanized culture. This could be the reason for the decline in the use of wild edibles and the traditional knowledge that goes along with them. The best long-term solution for preserving wild edibles in their natural habitat is to increase community awareness. Additionally, the collection of germplasm, raising them in situ or *ex-situ,* and formation of gene banks are also crucial for conserving such a treasure trove of our mother nature. Together, environmentalists, social activists, agriculturists, economists, and other businesspeople can move forward in this direction, abiding by the laws and regulations of the government to preserve the wild edible population and make productive use for the benefit of the nearby tribes.

Conclusion

Phytodiversity, agricultural or harvesting practices, wild food gathering, ethnomedicine, nutrition, and population health are inextricably linked with one another. Plants having food-medicinal values play a key role in it. The formation of an inventory of 63 locally accessible wild edibles (WES) is an important step toward preventing malnutrition and ensuring food security for local inhabitants, especially the marginalized. It can also contribute to the eradication of poverty by generating alternate income sources through gathering and marketing popular wild vegetables and fruits. It also likely contributes to agricultural diversification by keeping some of WES's best qualities, which can be used to create new cross-breeding varieties. The current study found that the Santal community in that area still retains a rudimentary understanding of wild edibles. Maintaining the food heritage through the conservation of both the traditional knowledge and the natural resources associated with it is the most sustainable approach. The first step in achieving this is to increase consumer awareness of the benefits of consuming wild edibles, particularly among the younger members of the tribal community in the studied area. To find out if they can be accepted as food materials, toxicological research is also required. Therefore, it is recommended that recently discovered plants and those with a high CFSI value be chosen for detailed nutritional analysis, chemical profiling, toxicological studies, and bio-assay to begin the development of commercial products and to market them as wholesome foods that can satisfy hidden hunger.

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Authors' contributions

SKC designed, collected the data and prepared the manuscript, MB analyzed the data and improved the manuscript, DB compiled the data and corrected the manuscript , TM checked and edited the language, GD prepared the study area map.

Compliance with ethical standards

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical issues: None.

References

1. Food and Agriculture Organization of the United Nations (FAO), 2009. How to Feed the World in 2050: High-Level Expert Forum. Available at: https://www.jstor.org/stable/25593700
2. Collaborators GB, Ärnlöv J. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020;396(10258):1223-49. https://doi.org/10.1016/S0140-6736(20)30752-2
3. Chadha ML, Oluoch MO. Home-based vegetable gardens and other strategies to overcome micronutrient malnutrition in developing countries. Food Nutrition and Agriculture. 2003;(32):17-23.
4. Tardío J, Pardo-de-Santayana M, Morales R. Ethnobotanical review of wild edible plants in Spain. Botanical Journal of the Linnean society. 2006;152(1):27-71. https://doi.org/10.1111/j.1095-8339.2006.00549.x
5. Flyman MV, Afolayan AJ. The suitability of wild vegetables for alleviating human dietary deficiencies. South African Journal of Botany. 2006;72(4):492-7.https://doi.org/10.1016/j.sajb.2006.02.003
6. Duguma HT. Wild edible plant nutritional contribution and consumer perception in Ethiopia. International Journal of Food Science. 2020;2020.https://doi.org/10.1155/2020/2958623
7. Åhlberg MK. A profound explanation of why eating green (wild) edible plants promote health and longevity. Food Frontiers. 2021;2(3):240-67. https://doi.org/10.1002/fft2.106
8. Mishra A, Swamy SL, Thakur TK, Bhat R, Bijalwan A, Kumar A. Use of wild edible plants: Can they meet the dietary and nutritional needs of indigenous communities in Central India. Foods. 2021;10(7):1453. https://doi.org/10.3390/foods10071453
9. Ulian T, Diazgranados M, Pironon S, Padulosi S, Liu U, Davies L,

Howes MJ, Borrell JS, Ondo I, Pérez-Escobar OA, Sharrock S. Unlocking plant resources to support food security and promote sustainable agriculture. Plants, People, Planet. 2020;2 (5):421-45.https://doi.org/10.1002/ppp3.10145

10. Cruz-Garcia, G. S., and Price, L. L. Ethnobotanical investigation of 'wild'food plants used by rice farmers in Kalasin, Northeast Thailand. J Ethnobiol Ethnomed.2021; 7:1–21.https://doi.org/10.1186/1746-4269-7-33

11. Ahmad, K., and Pieroni, A. Folk knowledge of wild food plants among the tribal communities of Thakht-e-Sulaiman Hills, North-West Pakistan. J Ethnobiol Ethnomed 2016;12: 1–15. https://doi.org/10.1186/s13002-016-0090-2

12. Cheng, Z., Lu, X., Lin, F., Naeem, A., and Long, C. Ethnobotanical study on wild edible plants used by Dulong people in northwestern Yunnan, China. J Ethnobiol Ethnomed. 2022;18:3.https://doi.org/10.1186/s13002-022-00501-3

13. Bhushi, K. Hunger and pandemic: wild edibles as future of food. South Asian Hist Cult. 2021;7:163–168. https://doi.org/10.1177/2393861720977404

14. Reyes-García V, Menendez-Baceta G, Aceituno-Mata L, Acosta-Naranjo R, Calvet-Mir L, Domínguez P, Garnatje T, Gómez-Baggethun E, Molina-Bustamante M, Molina M, Rodríguez-Franco R. From famine foods to delicatessen: Interpreting trends in the use of wild edible plants through cultural ecosystem services. Ecological Economics. 2015;120:303-11. https://doi.org/10.1016/j.ecolecon.2015.11.003

15. Łuczaj Ł, Lamxay V, Tongchan K, Xayphakatsa K, Phimmakong K, Radavanh S, Kanyasone V, Pietras M, Karbarz M. Wild food plants and fungi sold in the markets of Luang Prabang, Lao PDR. Journal of Ethnobiology and Ethnomedicine. 2021;17:1-27. https://doi.org/10.1186/s13002-020-00423-y

16. Łuczaj Ł, Nieroda Z. Collecting and learning to identify edible fungi in southeastern Poland: age and gender differences. Ecology of Food and Nutrition. 2011;50(4):319-36. https://doi.org/10.1080/03670244.2011.586314

17. Guyu DF, Muluneh WT. Wild foods (plants and animals) in the green famine belt of Ethiopia: Do they contribute to household resilience to seasonal food insecurity?. Forest Ecosystems. 2021;1-2. https://doi.org/10.1186/s40663-015-0058-z

18. Ong HG, Kim YD. The role of wild edible plants in household food security among transitioning hunter-gatherers: evidence from the Philippines. Food Security. 2017;9:11-24. https://doi.org/10.1007/s12571-016-0630-6

19. Pawera L, Khomsan A, Zuhud EA, Hunter D, Ickowitz A, Polesny Z. Wild food plants and trends in their use: From knowledge and perceptions to drivers of change in West Sumatra, Indonesia. Foods. 2020;9(9):1240. https://doi.org/10.3390/foods9091240

20. Kang Y, Łuczaj Ł, Kang J, Zhang S. Wild food plants and wild edible fungi in two valleys of the Qinling Mountains (Shaanxi, central China). J Ethnobiol Ethnomed. 2013;9(1):1-20. https://doi.org/10.1186/1746-4269-9-26

21. Shah AA, Shah A, Nadeem M, Rahim S. Evaluation of nutritional potential of wild edible fruits consumed by indigenous communities of central Punjab, Pakistan. Pak J Bot. 2020;52 (5):1715-25.10.30848/PJB2020-5(6)

22. Hussain S, Ullah F, Shah A, Ullah I, Mehmood S, Gul I, Rahim S, Shah IA, Uza NU. Quantitative ethnomedicinal studies of wild edible fruits used by the indigenous people of the Surghar Range, Pakistan. Ethnobotany Research and Applications. 2023;26:1-7.10.32859/era.26.58.1-17

23. Mallick SN, Sahoo T, Naik SK, Panda PC. Ethnobotanical study of wild edible food plants used by the tribal and rural populations of Odisha, India for food and livelihood security. Plant Archives (09725210). 2020;20(1).

24. Singh, A., and Singh, R. K.Cultural significance and diversities of ethnic foods of Northeast India. Indian J Tradit Knowl.2007; 6:79 –94. https://doi.org/10.1080/17441730701270897

25. Majumder S, Mukherjee A. Wild edible plants recorded from Hogalbaria village of Nadia district, West Bengal, India. Indian Journal of Life Sciences. 2015;5(1):63.

26. Chowdhury M, Mukherjee R. Wild edible plants consumed by local communities of Maldah district of West Bengal, India. Indian Journal of Scientific Research. 2012;3(2):163-70.

27. Chatterjee S, Mondal KC, Chatterjee S. Traditional and Ethno-Medicinal Uses of Wild Edible Mushrooms: A Case Study of Santali Tribe of Beliatore Forest, Bankura District, West Bengal, India. Journal of Plant Science Research. 2022;38(1).https://doi.org/10.32381/JPSR.2022.38.01.5

28. Alexiades MN, Sheldon JW. Selected guidelines for ethnobotanical research: a field manual. Advances in economic botany (USA). 1996;10.

29. Bibi T, Ahmad M, Tareen NM, Jabeen R, Sultana S, Zafar M, Zain-ul-Abidin S. The endemic medicinal plants of Northern Balochistan, Pakistan and their uses in traditional medicine. Journal of Ethnopharmacology. 2015;173:1-0.

30. Leonti M, Sticher O, Heinrich M. Medicinal plants of the Popoluca, México: organoleptic properties as indigenous selection criteria. Journal of Ethnopharmacology. 2002;81 (3):307-15. https://doi.org/10.1016/S0378-8741(02)00078-8

31. Rahaman, C. H. "Quantitative ethnobotany: its importance in bioprospecting and conservation of Phytoresources" in Ethnobotany of INDIA - North-East India and Andaman and Nicobar Islands. eds. T. Pullaiah, K. V. Krishnamurthy and B. Bahadur (New York, NY: Apple Academic Press), 2017;269–292.

32. Roy D, Das K, Nandi P, Kundu S, Ghosh B, Sharath A A. Kendu-a promising underutilized forest fruit species for poverty alleviation of tribals. Acta Hortic. 2015;1241:711–716. https://doi.org/10.17660/ActaHortic.2019.1241.103

33. Bandyopadhyay, S., and Mukherjee, S. K. Wild edible plants of Koch Bihar district, West Bengal. Indian J Nat Prod Resour. 2008;8:64–72.

34. Bisai, S. Prevalence of undernutrition among Santal tribal preschool children of Paschim Medinipur district, West Bengal, India. Int J Pediatr. 2014;4;347–354.

35. Chandra A, Chakrabarti S, Mallik S, Bhattacharyya N. Assessment of under nutrition among under 5 tribal children in a rural area in West Bengal. Journal of Family Medicine and Primary Care. 2021;10(10):3935. https://doi.org/10.4103/jfmpc.jfmpc_332_21

36. Downs SM, Ahmed S, Fanzo J, Herforth A. Food environment typology: advancing an expanded definition, framework, and methodological approach for improved characterization of wild, cultivated, and built food environments toward sustainable diets. Foods. 2020;9(4):532. https://doi.org/10.3390/foods9040532

37. Alexiades MN, Sheldon JW. Selected guidelines for ethnobotanical research: a field manual. Advances in economic botany (USA). 1996;10.

38. Chettri D, Chowdhury M. Ethnomedicinal approach against bone fracture among the tea garden workers of Darjeeling Hills. Indian Journal of Traditional Knowledge.2018;17(3):512-517.

39. Heinrich, M., Lardos, A., Leonti, M., Weckerle, C., Willcox, M., Applequist, W.Best practice in research: consensus statement on Ethnopharmacological field studies - ConSEFS. J. Ethnopharmacol. 2018;211:329–339.https://doi.org/10.1016/j.jep.2017.08.015

40. Banerjee, A.Some edible herbaceous Forest resources used by Ethenic Group in Manbazar Subdivision of Purlia District. J Adv Sch Res Allied Educ.2018;15:478–483.

41. Banerjee, A., Mukherjee, A., and Sinhababu, A. Ethanobotanical documentation of some wild edible plants in Bankura district, West Bengal, India. J Ethnobiol Tradit Med. 2013;120:585–590.

42. NMPB (2015). Standard for good field collection practices of medicinal plants. New Delhi: National Medicinal Plants Board, Department of AYUSH, Ministry of Health and Family Welfare, Government of India. Available at: https://www.nmpb.nic.in/sites/default/files/standard_for_gfcp2.pdf

43. Jain, S. K., and Rao, R. R. (1977). A handbook of field and herbarium methods. New Delhi: Today and Tomorrow's Printers and Publishers.

44. Guha Bakshi, D. N. (1984). Flora of Murshidabad District, West Bengal, India. Jodhpur: Scientific Publishers.

45. Bilgrami, K. S., Jamaluddin, S., and Rizrvi, M. A. (1991). Fungi of India. New Delhi, Today and Tomorrorw's Printers and Publishers.

46. Deb, S., Paul, R., Sen, T., and Sen, U. Biodiversity of pteridophytes and their pattern of distribution in Hooghly district. Indian Fern J. 2018;35:255–300.

47. Tardío J, Pardo-de-Santayana M. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany. 2008;62:24-39. https://doi.org/10.1007/s12231-007-9004-5

48. Pieroni AN. Evaluation of the cultural significance of wild food botanicals traditionally consumed in Northwestern Tuscany, Italy. J Ethnobiol. 2001;21(1):89-104.

49. Hamers L. Similarity measures in scientometric research: The Jaccard index versus Salton's cosine formula. Information Processing and Management. 1989;25(3):315-18. https://doi.org/10.1016/0306-4573(89)90048-4

50. Ghanimi R, Ouhammou A, Ahouach A, Cherkaoui M. Ethnobotanical study on wild edible plants traditionally used by Messiwa people, Morocco. J Ethnobiol Ethnomed. 2022;18(1):16.https://doi.org/10.1186/s13002-022-00500-4

51. Ray A, Ray R, Sreevidya EA. How many wild edible plants do we eat—their diversity, use, and implications for sustainable food system: an exploratory analysis in India. Frontiers in Sustainable Food Systems. 2020;4:56.https://doi.org/10.3389/fsufs.2020.00056

52. Ruth ON, Unathi K, Nomali N, Chinsamy M. Underutilization versus nutritional-nutraceutical potential of the Amaranthus food plant: A mini-review. Applied Sciences. 2021;11(15):6879.https://doi.org/10.3390/app11156879

53. Preetha, T. S., Anju, S., Anilkumar, S., and Mini, I. Nutritional analysis of selected species of *Alternanthera Forsskal* (Amaranthaceae). Indian Journal of Experimental Biology.2018; 56: 48–53.

54. Sinha, R., and Lakra, V. Wild tribal food plants of Orissa. Indian Journal of Traditional Knowledge. 2005; 4:246–252.

55. Bouri T, Ganguly S. Documentation of traditional knowledge on edible wild plants of forests in Burdwan district, West Bengal (India). Journal of Medicinal Plants. 2016;4(5):35-8.

56. Bhatia H, Sharma YP, Manhas RK, Kumar K. Traditionally used wild edible plants of district Udhampur, J&K, India. J Ethnobiol Ethnomed. 2018;14(1):1-3.https://doi.org/10.1186/s13002-018-0272-1

57. Amin M, Aziz MA, Pieroni A, Nazir A, Al-Ghamdi AA, Kangal A, Ahmad K, Abbasi AM. Edible wild plant species used by different linguistic groups of Kohistan Upper Khyber Pakhtunkhwa (KP), Pakistan. J Ethnobiol Ethnomed. 2023;19(1):1-23.https://doi.org/10.1186/s13002-023-00577-5

58. Khan MP, Ahmad M, Zafar M, Sultana S, Ali MI, Sun H. Ethnomedicinal uses of edible wild fruits (EWFs) in Swat Valley, Northern Pakistan. Journal of Ethnopharmacology. 2015;173:191-203.https://doi.org/10.1016/j.jep.2015.07.029

59. Rana VS, Sharma S, Rana N, Kumar V, Sharma U, Modgill V, Prasad H. Underutilized fruit crops in North-Western Himalayan region under changing climatic scenario. Genetic Resources and Crop Evolution. 2023;70(1):37-69..

60. Oka, O. N. Cross cultural knowledge, ethno-conservation, and sustainability pragmatism. Management of Sustainable Development. 2018;10:61–72. https://doi.org/10.2478/msd-2018-0009

61. Xu XL, Shang Y, Jiang JG. Plant species forbidden in health food and their toxic constituents, toxicology and detoxification. Food and function. 2016;7(2):643-64.https://doi.org/10.1039/C5FO00995B

62. Urugo MM, Tringo TT. Naturally Occurring Plant Food Toxicants and the Role of Food Processing Methods in Their Detoxification. International Journal of Food Science. 2023;2023.https://doi.org/10.1155/2023/9947841

63. Sai Latha S, Naveen S, Pradeep CK, Sivaraj C, Dinesh MG, Anilakumar KR. Toxicity assessment of wild mushrooms from the Western Ghats, India: An *in-vitro* and sub-acute in vivo study. Frontiers in Pharmacology. 2018;9:90.https://doi.org/10.3389/fphar.2018.00090

64. Saha S, Saha S, Mandal SK, Rahaman CH. Unconventional but valuable phytoresources: exploring the nutritional benefits of 18 wild edible Asteraceae from West Bengal, India. Genetic Resources and Crop Evolution. 2023;1-32.https://doi.org/10.1007/s10722-023-01621-9

65. Liu B, Huang Q, Cai H, Guo X, Wang T, Gui M. Study of heavy metal concentrations in wild edible mushrooms in Yunnan Province, China. Food Chemistry. 2015;188:294-300. https://doi.org/10.1016/j.foodchem.2015.05.010

66. Buenavista DP, Dinopol NM, Mollee E, McDonald M. From poison to food: On the molecular identity and indigenous peoples' utilisation of poisonous "Lab-o"(Wild Yam, Dioscoreaceae) in Bukidnon, Philippines. Cogent Food and Agriculture. 2021;7(1):1870306. https://doi.org/10.1080/23311932.2020.1870306

67. Ruan-Soto, F., Ordaz-Velázquez, M., García-Santiago, W., and Pérez-Ovando, E. C. Traditional processing and preservation of wild edible mushrooms in Mexico. Ann Food Process Preserv.2017; 2:1013.

68. Sharma K. Mushroom: Cultivation and processing. Int. J. of Food Processing Technology. 2018;5(2):9-12. https://doi.org/10.15379/2408-9826.2018.05.02.02

69. Savage GP, Dubois M. The effect of soaking and cooking on the oxalate content of taro leaves. International journal of Food Sciences and Nutrition. 2006;57(5-6):376-81. https://doi.org/10.1080/09637480600855239

70. Chai W, Liebman M. Effect of different cooking methods on vegetable oxalate content. Journal Of Agricultural and Food Chemistry. 2005;53(8):3027-30. https://doi.org/10.1021/jf048128d

71. Takenaka M, Miyake N, Kimura T, Todoriki S, Urushiyama T. Reduction of pyrrolizidine alkaloids by cooking pre-treatment for the petioles and the young spikes of *Petasites japonicus*. Food Science and Technology Research. 2022;28(3):245-55. https://doi.org/10.3136/fstr.FSTR-D-21-00245

72. Hajšlová J, Schulzová V, Botek P, Lojza J. Natural toxins in food crops and their changes during processing. Czech. J Food Sci. 2018;22:29-34. https://doi.org/10.17221/10606-CJFS

73. El-Barbary MI. Detoxification and antioxidant effects of garlic and curcumin in *Oreochromis niloticus* injected with aflatoxin B 1 with reference to gene expression of glutathione peroxidase (GPx) by RT-PCR. Fish Physiology and Biochemistry. 2016;42:617-29. https://doi.org/10.1007/s10695-015-0164-4

74. Ajanaku CO, Ademosun OT, Atohengbe PO, Ajayi SO, Obafemi YD, Owolabi OA, Akinduti PA, Ajanaku KO. Functional bioactive compounds in ginger, turmeric, and garlic. Frontiers in Nutrition. 2022;9:1012023. https://doi.org/10.3389/fnut.2022.1012023

75. Kumari B, Kamal S, Singh R, Sharma VP, Sanspal V, Chand G. Traditional knowledge of the wild edible mushrooms of Himachal Pradesh. Studies in Fungi. 2022;7(1):1-5. https://doi.org/10.48130/SIF-2022-0015

76. Behera SS, El Sheikha AF, Hammami R, Kumar A. Traditionally fermented pickles: How the microbial diversity associated with their nutritional and health benefits?. Journal of Functional Foods. 2020;70:103971. https://doi.org/10.1016/j.jff.2020.103971

77. Pradhan P, Banerjee S, Roy A, Acharya K. Role of wild edible mushrooms in the Santal livelihood in lateritic region of West Bengal. Journal of Botanical Society of Bengal. 2010;64(1):61-5.

78. Singha K, Sahoo S, Roy A, Banerjee A, Mondal KC, Pati BR, Mohapatra PD. Contributions of wild mushrooms in livelihood management of ethnic tribes in Gurguripal, West Bengal, India. Int J Phar Sci Res 2020;11(7):3160-71.https://doi.org/10.13040/IJPSR.0975-8232.11(7).3160-71

79. Pradhan P, Banerjee S, Roy A, Acharya K. Role of wild edible mushrooms in the Santal livelihood in lateritic region of West Bengal. Journal of Botanical Society of Bengal. 2010;64(1):61-5.

80. N'Danikou S, Tchokponhoue DA. Plant domestication for enhanced food security. Zero Hunger. 2020:644-54.

81. Charoenratana S, Anukul C, Rosset PM. Food Sovereignty and Food Security: Livelihood Strategies Pursued by Farmers during the Maize Monoculture Boom in Northern Thailand. Sustainability. 2021;13(17):9821. https://doi.org/10.3390/su13179821

82. Sujarwo W, Caneva G. Ethnobotanical study of cultivated plants in home gardens of traditional villages in Bali (Indonesia). Human Ecology. 2015;43:769-78. https://doi.org/10.1007/s10745-015-9775-8

83. Bhattacharyya K, Mandal S. Characterisation of the dicotyledonous wild edible plants of the district of Bardhaman, West Bengal. Journal of Innovations in Pharmaceuticals and Biological sciences. 2015;2(3):337-45.

84. Chowdhury T, Roy SC, De Sarker, D. (2014). Wild edible plants of Uttar Dinajpur district, West Bengal. Life Science Leaflets.2014;47:20–36.

85. Kirkpatrick SI, Tarasuk V. Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. The Journal of Nutrition. 2008;138(3):604-12. https://doi.org/10.1093/jn/138.3.604

86. Shetty P. Incorporating nutritional considerations when addressing food insecurity. Food Security. 2009;431-40. https://doi.org/10.1007/s12571-009-0039-6

87. Ghosh-Jerath S, Singh A, Magsumbol MS, Kamboj P, Goldberg G. Exploring the potential of indigenous foods to address hidden hunger: nutritive value of indigenous foods of Santhal tribal community of Jharkhand, India. Journal of Hunger & Environmental Nutrition. 2016;11(4):548-68. https://doi.org/10.1080/19320248.2016.1157545

88. Mitharwal S, Kumar A, Chauhan K, Taneja NK. Nutritional, phytochemical composition and potential health benefits of taro (*Colocasia esculenta* L.) leaves: A review. Food Chemistry. 2022;383:132406. https://doi.org/10.1016/j.foodchem.2022.132406

89. Rashmi DR, Raghu N, Gopenath TS, Palanisamy P, Bakthavatchalam P, Karthikeyan M, Gnanasekaran A, Ranjith MS, Chandrashekrappa GK, Basalingappa KM. Taro (*Colocasia esculenta*): an overview. Journal of Medicinal Plants Studies. 2018;6(4):156-61.

90. Pinakin DJ, Kumar V, Kumar A, Gat Y, Suri S, Sharma K. Mahua: A boon for pharmacy and food industry. Current Research in Nutrition and Food Science Journal. 2018;6(2):371-81. https://doi.org/10.12944/CRNFSJ.6.2.12

91. Ramadan MF, Mohdaly AA, Assiri AM, Tadros M, Niemeyer B. Functional characteristics, nutritional value and industrial applications of *Madhuca longifolia* seeds: an overview. Journal of food science and technology. 2016;53:2149-57. https://doi.org/10.1007/s13197-015-2095-6

92. Bhattamisra SK, Khanna VK, Agrawal AK, Singh PN, Singh SK. Antidepressant activity of standardised extract of *Marsilea minuta* Linn. Journal of Ethnopharmacology. 2008;117(1):51-7. https://doi.org/10.1016/j.jep.2008.01.012

93. Jadhao KD, Wadekar MP. Comparative Study of Vitamins Nutrient from *Marsilea quadrifolia* Linn. Asian Journal of Chemistry. 2010;22(3):2483.

94. Das SK, Mandal A, Datta AK, Das D, Paul R, Saha A, Sengupta S, Gupta S, Halder S. Identification of wild edible mushrooms from tropical dry deciduous forest of Eastern Chota Nagpur Plateau, West Bengal, India. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. 2015;85:219-32. https://doi.org/10.1007/s40011-014-0330-y

95. Dutta AK, Acharya KR. Traditional and ethno-medicinal knowledge of mushrooms in West Bengal, India. Asian J Pharm Clin Res. 2014;7(4):36-41.

96. Paloi S, Acharya K. Evaluation of antioxidative activity and chemical composition of ethanolic extract from *Amanita vaginata* (Bull.) Lam.: An in vitro study. Asian J Pharm Clin Res. 2014;7(2):88-92.

97. Roy A, Prasad P, Gupta N. Volvariellavolvacea: A macrofungus having nutritional and health potential. Asian Journal of Pharmacy and Technology. 2014;4(2):110-3.

98. Bvenura C, Sivakumar D. The role of wild fruits and vegetables in delivering a balanced and healthy diet. Food Research International. 2017 ;99:15-30. https://doi.org/10.1016/j.foodres.2017.06.046

99. Oluoch WA, Whitney C, Termote C, Borgemeister C, Schmitt CB.