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Role of wild edible vegetables as a source of supplementary food in a changing climate: A case study in Khagrachari hill district, Bangladesh

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Abstract
Wild edible vegetables are a fundamental source of micronutrients in many developing countries, especially for the forest dependent communities in the world. Present study assessed the diversity and availability of wild edible vegetables in four different upazilla markets (i.e. Khagrachari, Matiranga, Dighinala and Guimara) in Khagrachari hill district, Bangladesh. The study found that communities are directly dependent on wide variety of wild edible vegetables especially during lean period of cash crops, nutrition, healthcare and income generating opportunities. The study recorded and documented 71 wild edible vegetables belonging to 34 families and 48 genera. Distribution of vegetable plants based on growth habit reveals that herb is the dominant type with 40 species (56%), followed by 11 climbers (16%), 7 trees (10%), 6 fungi (8%), 5 shrubs (7%) and 2 ferns (3%). Availability of wild edible vegetables were recorded from April and continue till the end of September. Mid June to August (rainy season) is the peak season for wild edible vegetables (WEVs) because of geographical distribution and the characterization of the hill forests. Bamboo shoots are extensively collected during rainy season to after rainy season (May-Nov) and mushrooms are collected before monsoon (Mar-May). Some of the species of WEPs which were collected for their leaves, tubers and roots, shoots, stems, fronds etc. available for the human consumption round the year. From market survey, it is found that WEVs are sold with cheapest price in the study areas. The dwellers of the study region sell their collected commodities as per kg (i.e. fruits, bamboo shoots, mushrooms, tubers and roots etc.) or per bundle (i.e. leafy vegetables, stems, flowers etc.) and price range exists between BDT 5 to 60. This study represents an important pioneer step in taking a holistic view of the subsistence value of WEVs which might be helpful for policy makers to strengthen food and nutrition security in a changing climate through prioritization, cultivation, utilization and conservation of wild edible plants in a sustainable manner. These wild vegetables can be incorporated in commercial crop plants. This will improve food scarcity, economy in tribal areas and helps in regeneration of barren lands.

Keywords: wild edible vegetables, food security, market survey, hill forests, ethnic communities, sustainable utilization and conservation, commercial plantation

Introduction
For food security, globally three cultivated crops are extensively used as main food i.e. maize, rice and wheat, providing over 50% of the world's daily requirement of proteins and calories (Bisht *et al*. 2017) [8]. Wild and uncultivated or uncared edible plants can contribute a significant part of the diets for most of the rural communities of the world, especially when the supply of agricultural products is unsatisfactory (Bisht *et al*. 2017 [8]; Mukuka and Simoloka 2015; Termote *et al*. 2014) [41]. Bangladesh has 2.53 million ha of land is covered by various types of forest, of which 84% as natural forest and 16% as plantation forest, are including classified and unclassified state lands and homestead forests and tea/rubber (Hossain, 2015) [19]. These forests are good sources of edible wild plants of economic potential, have a superior opportunity to select better one for cultivation (Uddin and Hassan, n.d.). Globally, about 25% of the estimated 0.27 million vascular plant species are edible in which only 3,000 species are regularly used for food (Hossain *et al*., 2017) [20]. It is estimated that about 5,000 species of angiosperm plant species have existed in Bangladesh, of which about 3,611 species are recorded in the encyclopedia of Flora and Fauna of Bangladesh (Ahmed *et al*., 2007, 2008, and 2009) [2, 3, 4]. The basic sources of food are leafy greens, grasses, grains, ferns, roots, bulb and tubers, leaves of trees-flowers-fruits and seeds (Mazhar *et al*., 2007). Food insecurity and malnutrition affect much of the world's population (Godfray *et al*. 2010) [15]. Again, the fulfillment of Sustainable Development Goals (SDGs, an agenda of UN- 2030), Food and Nutrition security is the concern of SDGs (Goal -2: "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture") (Nilson *et al*., 2016). Wild edible plants are a low-input, low-cost option for increasing nutrition and reducing the need to spend limited cash resources (Shackleton and Shackleton 2004 [37], Jama *et al*. 2008) [21]. They provide greater benefits to vulnerable populations i.e. poorer households, women, and children (Grivetti and Ogle, 2000; Fentahun and Hager, 2009) [13], who are often disproportionately affected by climate events (Eriksen and O'brien, 2007). Thus, wild edible plants can play an important role in full filing the goals and targets of SDGs and meet the sustainable income generating opportunity throughout the year. The Chittagong Hill Tracts (CHT) consisting three districts i.e.

Rangamati, Khagrachari and Banderban, are ethnically, culturally and geographically diverse region extending 13,295 sq. km., about 10% of Bangladesh's land area (3,685 sq. km.) (Rasul and Tripura, 2016 [35]; Roy, 2000). About 40% of Bangladesh's forests land lie in the CHT (Roy, 200), are supporting almost 80% of the country's total biodiversity and also contributing a significant portion of the CHT economy (46%) followed by crop and or fruit production (Jannat *et al*. 2020 [22]; Kamruzzaman *et al*. 2018 [22]; Rasul and Tripura, 2016) [35]. The population of the CHT is approximately 1.6 million including 12 ethnic communities (Hossain, 2015) [19] and 90% of ethnic people have practiced traditional farming system of shifting cultivation (Jhum) on hilly forest lands (Nath *et al*. 2005) [30]. The common situation in the CHT region is much worse than in the plain land or districts of the country. The dwellers of the CHT have faced severely faced food security, especially from June to August, known as rainy season (Rasul and Tripura, 2016) [35]. Here, wild edible vegetables can play an important role as a supplementary foods during scarcity of foods (Deshmukh and Waghmode, 2011; Rani *et al*., 2016) [34]. as they are available during times of drought or conflict-driven famine (Gordon and Enfors 2008 [16], Muller and Almedom 2008 [39], Strauch *et al*. 2008) [39].. They tolerate water stress better than their domesticated relatives (Addis *et al*. 2005), possessing an "innate resilience to rapid climate change, which is often lacking in exotic species". Considering the importance of WEPs to household food security, it is essential that the social-ecological systems that make gathering these natural resourcespossible be appropriately protected, managed, and valued to avoid overexploitation and degradation (Feyssa *et al*. 2011) [14]. In spite of recognition that WEPs are an important dietary component for at least one billion people worldwide (Burlingame, 2000), there is a research gap regarding which demographic groups rely on these resources and where they are obtained in times of low food availability and financial stress. Thus, present study aims to explore potential of wild edible vegetables as a source of supplementary food in a diverse geographic location of Bangladesh.

Methods and Materials

Study area

Present study was conducted at four sub-district name as Khagrachari, Matiranga, Dighinala and Guimara in Khagrachari hill istrict (Fig. 1). The district lies between 22º38´ and 23º44´ on the North latitudes and between 91º44´ and 92º11´ on the East longitudes (Wikipedia, 2018). The area of the district is 2,749.11 sq. km in which 2056.73 sq.km is land area, 651.85 sq. km is under forest and 40.53 sq.km is under river area. The annual rainfall is 3031 mm and 80% of which rainfall occurs during rainy season (Jun to August) district varies from maximum 34.6°C to minimum 13°C. The forests of Khagrachari district may be broadly classified into three general classes are: (i) Tropical evergreen forest, (ii) Semi-evergreen forest and (iii) Deciduous forest. The deciduous forest type is always mixed with the evergreen species. (BBS, 2011) [7].

Fig 1: Common market scenarios in the study area (A) Khagracahri, (B) Matiranga, (C) Dighinala and (D) Guimara

Methodology

Before conducting the field or market survey in the study area, literature survey was conducted for preparing wild edible vegetables in Khagrachari hill district. For the study objectives, Khagrachari hill tract was selected first purposively. The study was carried out over a period of 6 months from April to September 2018. There are 9 sub-districts in Khagrachari hill district from where four distinct sub-districts were randomly selected for data collection and observation of local market. In these market, the inhabitants are gathered their daily commodities for selling and buying which are collected from forest or other natural conditions. Four markets from four distinct sub-districts

are selected for market survey i.e. Khagrachari sadar, Matiranga, Guimara and Dighinala (Fig.1).

A Semi-structured questionnaires and open ended interviews were prepared for the collection of data such as local name, time of availability, collecting site, retailing price and curing for the health. Plant species were identified with the help of local people and referring for the relevant scientific literatures (i.e. journals, books, articles, souvenirs), Encyclopedia and in consultation of Taxonomists at Institute of Forestry, University of Chittagong.

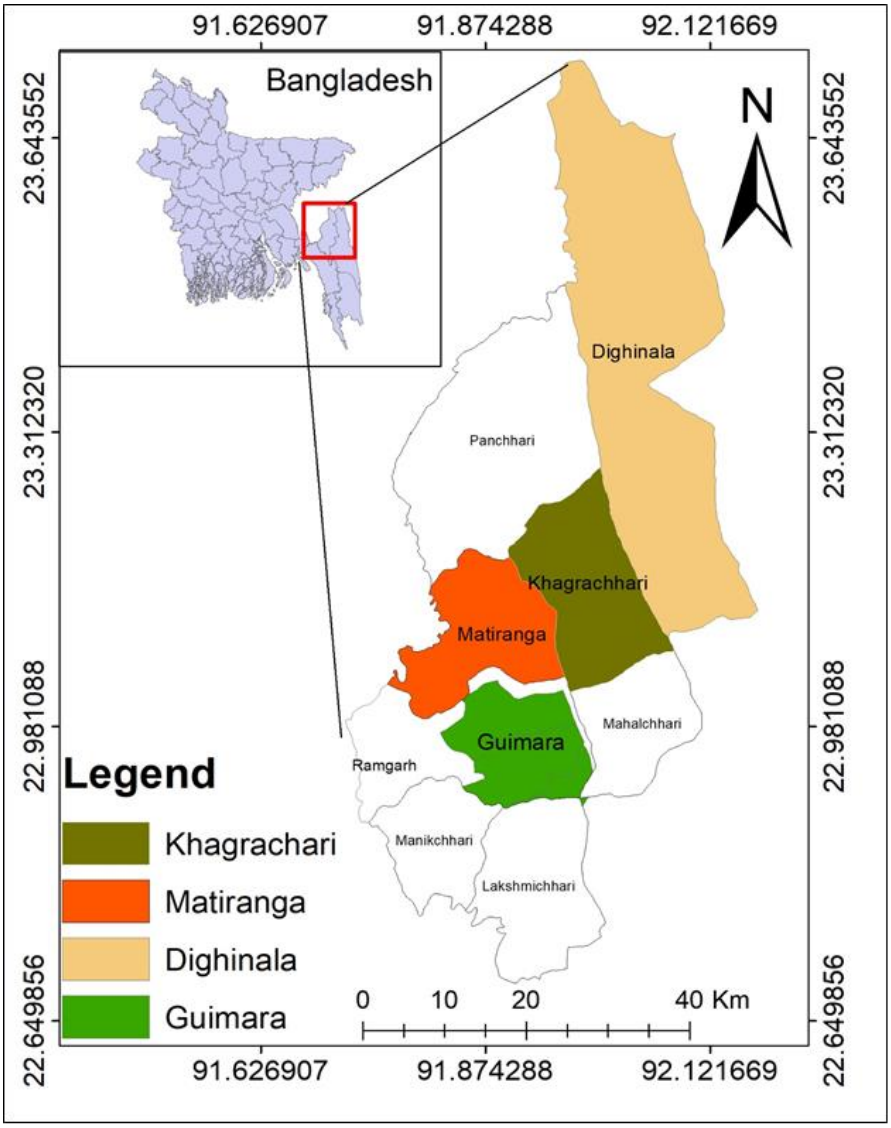

Fig 2: Map of studied areas (four upazilla) in Khagrachari hill district

Result and Discussion

Wild edible vegetables in Khagrachari Hill District

The present market survey in Khagrachari Hill District (KHD), 71 species of wild edible vegetables (WEV) or wild and wild relatives to cultivated vegetables were documented that belongs to 48 genera of 34 families (Table-1) and 5 species are unidentified. Among these, herbs are dominating vegetables in this region containing with 40 species (56%), followed by 11 climbers (16%), 7 trees (10%), 6 fungi (8%), 5 shrubs (7%) and 2 ferns (3%).

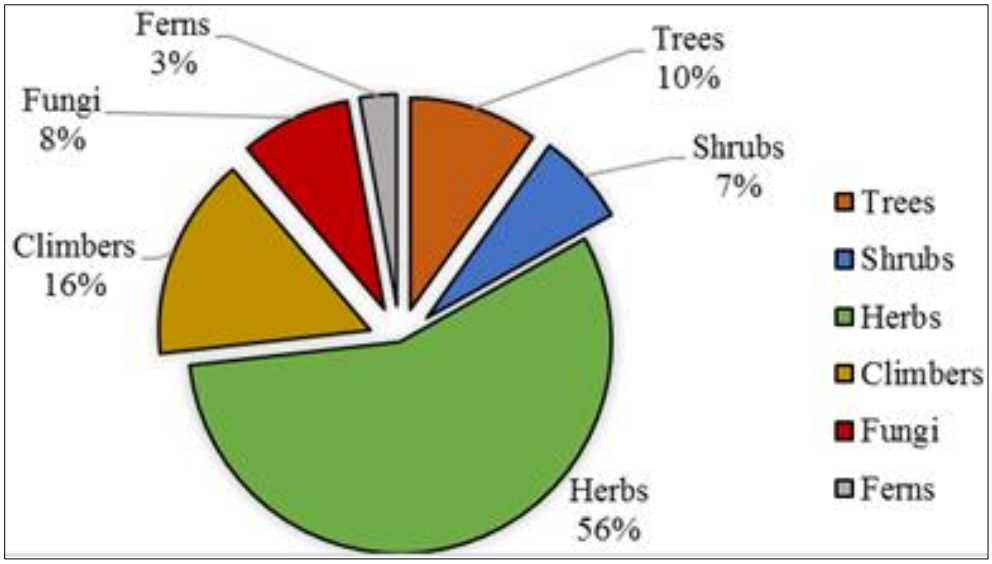

Fig 2: Distribution of vegetable plants based on habit in the study areas

Composition of uses parts: Various parts of WEVs are taken as vegetables i.e. buds or flowers, fruits, frond, leaves, roots and tubers, young or tender shoots and or whole parts of the plants. Out of these wild vegetables, around 20% species was taken as young shoots or tender shoots followed by 19% of leaves, 13% of stems, 11% of buds and flowers, 8% of stems, 8% of tubers and roots, 7% of whole plants, 6% of rhizomes, 3% of inner piths, 2% of fronds and only 1% of young pods (Fig 3).

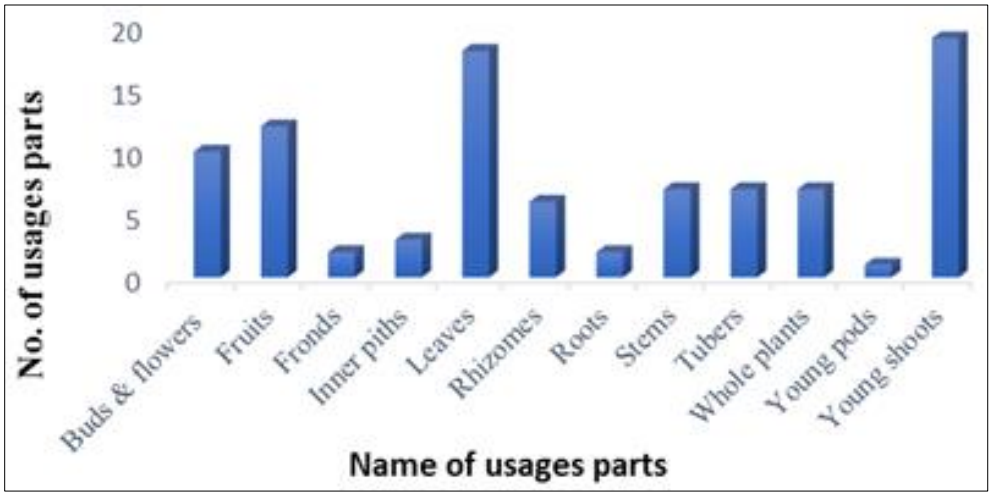

Fig 3: Plant parts used as edible vegetable

Tubers: Tubers contain both bulbs and roots. During market survey, 4 *Dioscorea* species along with single cassava species (*Manihot esculanta*) and 9 aroids or kochu was found where generally bulbs or tubers, roots or rhizomes, leaves and stems are used. Aroids have versatile uses such as leaves, stems, flowers, tubers, roots and also rhizomes (Table-1). Further, *Dioscorea spp.* and aroids species are good sources of energy, carbohydrate, vitamins and minerals.

Root and tuber crops occupy a remarkable position in the food security of the developing countries due to their high caloric value and carbohydrate content (Padhan and Panda, 2016) [32]. The important tuber crops are grown in Bangladesh including potato, sweet potato, aroid (taro or kachu), yam (dioscorea spp.) and cassava (shimul alu) (Banglapedia, 2018).

Mushrooms: Fungi or mushroom is also a popular vegetable in Kagrachari, which is mostly collected from dead trees or bamboos, moist soils or rotten paddy straws. Six mushrooms species belonging to 3 families and 3 genera were found in Khagrachari market (Table-1), which are called "Gacher Ul" by tribal people.

Mushrooms provide a substitute for meat (FAO, 2011) [12]. Eating two to three types of mushrooms per day can deliver the proper amount of essential amino acid, high level of protein, vitamins as well as the minerals potassium, phosphorus, calcium, and magnesium those required by the body (Kamal *et al*, 2009) [25].

In northern and central Siberia, up to 40% of indigenous families engage in mushrooms collection. About 18 species of mushrooms are collected from pine and birch forests across the region (Vladyshevskiy *et al*., 2002) [44], and from a study of Upper Shaba and Zaire, about 30 types of Mushrooms are eaten by the indigenous communities which are contained highly protein about 22% of dry weight (FAO, 2011) [12]. About 20 mushroom species grow wild in Bangladesh, mostly in CHT, of which 5-6 species are poisonous (Banglapedia, 2018). The white button or

bottom mushrooms (Agaricus bisporus) and wood mushrooms (oyster mushrooms) are the most common and favorite in Bangladesh.

Bamboo: Bamboo shoot is another important vegetable to the tribal communities containing high calories, proteins, fibers, vitamins and minerals. They are usually used to eat fresh bamboo shoots. Bamboo shoots are available at the beginning of rainy season and continue up to next 5 to 7 months (May-October) and June to August is the peak season for bamboo shoot production. Khagrachari is suitable for bamboo shoot production because of its geographical location, natural forest distribution and climatic condition. Six bamboo species belonging to 4 genera (Table-1), have been recorded from the study areas. Most of the bamboo shoots are collected from natural forests and some are collected from homestead. Muli bans (*Melocanna bacifera*) is extensively found in KHD.

Bamboo shoots have a long history of being used as a source of both food and medicine in China and Southeast Asia (Bao, 2006) [6]. According to Chongtham (2011) [9], the bamboo shoot is called the "King of Forest Vegetables". It assists in employment and income generation and also in achieving food security in food deficit areas. Medically bamboo shoot is regarded as the "King of health" -keeping food and 'Street cleaner' for intestine (Zashimuddin, 2010). There are 9 Genera and more than 33 native bamboo species are found in Bangladesh (Zashimuddin, 2005) [47]. The major forest bamboo producing areas of Bangladesh are the forests of Sylhet, Chittagong, Cox's Bazar and Chittagong Hill Tracts. Bamboo shoots or bamboo sprouts are the most popular edible shoots of many bamboo species in CHT, are a traditional food of the indigenous Jumma people. The fresh shoots have a high content of carbohydrates, proteins and fiber but are low in fat (Chongtham *et al*., 2011) [9]. They have a good profile of minerals, consisting mostly potassium, calcium, zinc, iron, phosphorus and also good source of thiamine, niacin, vitamin A, vitamin B6 and vitamin E (Visuphaka, 1985) [43].

Ferns: Pteridophytes or ferns, locally known as Dheki shak, are the most common WEVs in the region. The most two common dheki shak, i.e. *Diplazium esculentus* and *Dryopteris filix-mas* are respectively belonging to the family Athyriaceae and Polypodiaceae (Table-1) respectively. *Dryopteris filix-mas*, is now has been tried to cultivate in small scale to the farmer's agro-land in Khagrachari.

Pteridophytes are also important WEPs in many developing countries, growing on moist soil as a neglected group of plants with greater diversity (Sarker and Hossain, 2009) [36]. The young coiled leaves of some pteridophytes are eaten as vegetables in the world including Bangladesh, mostly consumed by ethnic communities in the hilly areas, and day to day, it's famous to the general people (Banglapedia, 2015). It is estimated by Groombridge and Jenkins (2002) [17], around 13,025 species of ferns are distributed in the tropical and sub-tropical countries, but now at present it is recorded that around 12,838 species of ferns exist in the world (Yumkham *et al*., 2017) [46]. In Bangladesh, more than 195 species of pteridophytes (Haque *et al*., 2016) [18]. are found, in which some are used as vegetables, salads, medicinal and ornamental plants and some species are also very poisonous.

Market price of WEVs

From the investigation of market survey, it was found that WEVs were sold with cheapest price in the study areas. The dwellers of the region sold their collected commodities with per kg (i.e. fruits, bamboo shoots, mushrooms, tubers and roots etc.) and per bundle (i.e. leafy vegetables, stems, flowers etc.). Prices of WEVs ranged from BDT 5 to 60 (Table-1).

Seasonal availability of wild edible plants

From the study area, it is found that wild edible vegetables are available from April and continue till the end of September. Mid June to August (rainy season) was prominent as the peak season for wild edible vegetables (WEVs) because of geographical distribution of our country and the characteristics of the tropical hill forests. From the investigation, it is clear that maximum vegetables (about 49 species) are available during June to July. Bamboo shoots are extensively collected during rainy season to after rainy season (May-Nov) and mushrooms are collected before monsoon (Mar-May). Some of the species of WEVs are available for the human consumption round the year, recorded as 12 for vegetables (Table-1).

Table 1: List of wild edible vegetables found in the study area.

SL No.	Scientific name	Local name	Family	Plant form	Habitat	Used parts	Seasonal availability
1	*Alocasia macrorrhiza*	Maan/Fankachu	Araceae	H	B	St, Y	Ayr
2	*Alpinia conchigera*	Ketrang pata	Zingiberaceae	H	B	Y, Rh	Apr-Jun
3	*Alpinia nigra*	Ban ada/tara	Zingiberaceae	H	B	I	Apr-Aug
4	*Alternanthera sessilis*	Haicha	Amaranthaceae	H	F	Y	AYr
5	*Amaranthus viridis*	Note shak	Amaranthaceae	H	F	Y	AYr
6	*Amorphophallus campanulatus*	Oolkachu	Araceae	H	B	St, T	Apr-Aug
7	*Auricularia auricula*	Wood ear	Auriculariaceae	M	F	W	Apr-Jun
8	*Baccaurea ramiflora*	Loatkan/kushumgulo	Euphorbiaceae	T	B	F	Apr-Aug
9	*Bambusa aurandinasea*	Katabans	Poaceae	H	F	Y	May-Aug
10	*B. polymorpha*	Pharua	Poaceae	H	B	Y	Jun-Oct
11	*B. tulda*	Mitinga	Poaceae	H	B	Y	May-Nov
12	*Basella alba*	Lal pui	Basellaceae	Cl	B	L	May-Aug
13	*Calamus guruba*	Jali bet	Arecaceae	Cl	B	St	Jun-Aug
14	*Calamus latifolius*	Korak Bet	Arecaceae	Cl	B	St	Jun-Aug
15	*Canavalia gladiata*	Ban shim	Fabaceae	Cl	B	Yp	July-Sept
16	*Centella asiatica*	Thankuni	Apiaceae	H	B	W	AYr
17	*Chenopodium album*	Bathua shak	Chenopodiaceae	H	C	Y	Feb-Apr
18	*Coccinea cordifolia*	Telekucha	Cucurbitaceae	Cl	B	Y, F	Jun-Sept
19	*Colocasia esculenta*	Mukhi/chara kachu	Araceae	H	C	L, Fl, R, T	Jun-Sept
20	*Colocasia hassanii*	Titakachu	Araceae	H	F	St, Fl	Apr-Sept
21	*Colocasia nymphaeifolia*	Ban kochu	Araceae	H	F	L, F	Apr-Sept
22	*Colocasia spp.*	Panikachu	Araceae	H	C	L, R, Rh	Jun-Sept
23	*Commelina benghalensis*	Vat patti/kanshira	Commelinaceae	H	F	Y	Apr-Aug
24	*Curcuma aromatica*	Ban halud/shoti	Zingiberaceae	H	F	Fl, Rh	AYr
25	*Curcuma longa*	Halud	Zingiberaceae	H	C	Fl, Rh	Mar-Jun
26	*Dendrocalamus hamiltonii*	Pecha	Poaceae	H	B	Y	Jun-Sept
27	*Dillenia indica*	Chalta	Dilleniaceae	T	B	F	Jun-Sept
28	*Dioscorea alata*	Chupri alu	Dioscoreaceae	Cl	B	T	Jan-Apr
29	*D. bulbifera var. sativa*	Moa/Mou alu	Dioscoreaceae	Cl	B	T	Mar-May
30	*D. oppositifolia*	Chinna maitya alu	Dioscoreaceae	Cl	C	T	Feb-Apr
31	*D. pentaphylla*	Jum/pagla alu	Dioscoreaceae	Cl	B	T	Feb-Apr
32	*Diplazium esculentus*	Dheki shak	Athyriaceae	Fr	F	Fr	Apr-Sept
33	*Dryopteris filix-mas*	Dheki shak	Polypodiaceae	Fr	F	Fr	Apr-Sept
34	*Elsholtzia incisa*	Jhum dhoniya	Lamiaceae	H	C	Y	Jun-Aug
35	*Eryngium foetidum*	Bahar pata	Apiaceae	H	C	L	Apr-Sept
36	*Ficus racemosa*	Jaigya Dumur	Moraceae	T	F	F	Jun-Sept
37	*Grifola frondosa*	Hen-of-the-wood	Meripilaceae	M	F	W	Mar-May
38	*Hibiscus sabdariffa*	Chukur/kharagula	Malvaceae	S	C	L, F	Apr-July
39	*Homalomena pendula*	Shionsak	Araceae	H	B	Y	Apr-Aug
40	*Ipomoea aquatica*	Kalmi shak	Convolvulaceae	Cl	B	Y	Jun-Sept
41	*Ipomoea batatas*	Misti alu	Convolvulaceae	Cl	C	L, Rh	Mar-July
42	*Jussiaea repens*	Helencha	Onagraceae	H	F	Y	Ayr
43	*Lasia spinosa*	Hattal dengi	Araceae	H	B	L, St	Apr-July
44	*Nymphaea nouchali*	Shapla/shaluk	Nymphaeaceae	H	B	Fl	Jun-Aug
45	*Manihot esculenta*	Cassava	Euphorbiaceae	S	C	L, T	Mar-May
46	*Marsilea quadrifolia*	Shusni/Amrul shak	Marsileaceae	H	F	L	Jun-Sept
47	*Melocanna baccifera*	Muli Bnash	Poaceae	H	B	Y	May-Nov
48	*Moringa oleifera*	Sajna	Moringaceae	T	C	L, F	Apr-Aug
49	*Murraya koenigii*	Gandri pata	Rutaceae	T	B	L	Ayr
50	*Musa acuminata*	Pahari kola	Musaceae	H	F	B	Ayr
51	*Musa balbisiana*	Bichi kola	Musaceae	H	B	I, F, B	Ayr
52	*Musa oronata*	Ram kola	Musaceae	H	B	B	Ayr
53	*Musa supientum*	Anaji kola	Musaceae	H	C	I, F, B	Ayr
54	*Ocimum americanum*	Sabarang/Ban tulsi	Lamiaceae	H	B	L	Ayr
55	*Oroxylum indicum*	Kanaidinga/Khona	Bignoniaceae	T	C	F	Apr-Aug
56	*Pleurotus citrinopileatus*	Golden top oyster mushroom	Pleurotaceace	M	F	W	Mar-May
57	*Pleurotus ostreatus*	Oyster mushroom	Pleurotaceace	M	F	W	Mar-May
58	*Pleurotus pulmonarius*	Common oyster mushroom	Pleurotaceace	M	F	W	Mar-May
59	*Pleurotus sajor-caju*	Phoenix tail mushroom	Pleurotaceace	M	F	W	Mar-May
60	*Portulaca oleracea*	Nunia shak	Portulacaceae	H	F	Y	Jan-Apr
61	*Premna esculenta*	Lelom pata	Verbenaceae	T	B	L	Apr-Aug

62	*Schizostachyum dullooa*	Dalu	Poaceae	H	B	Y	Jun-Sept
63	*Solanum indicam*	Titagulo	Solanaceae	S	B	F	Mar-Aug
64	*Solanum nigrum*	Tint begun	Solanaceae	S	B	F	Apr-Aug
65	*Spilanthes oleracea*	Ajonshak/Ushundai	Asteraceae	H	F	Y	Apr-Aug
66	*Xanthosoma violaceum*	Dudhkachu/Narikel kchu	Araceae	H	C	L, St	Apr-Aug
67		Baranashak		H	C	L	Apr-July
68		Beol bichi		S	C	F	Jun-Sept
69		Pamurashak		H	C	L	Jun-Sept
70		Miankha/miashak		H	C	Y	Jun-Aug
71		Muichuishak		H	C	L	Jun-Aug

Wild edible vegetables beyond the market

Some wild edible vegetables (Table- 2) are also existed in Khagrachari hill district but still not available in market (Photo 2), having high nutritional values. About 9 wild edible vegetables were collected and recorded from district plant fair, horticulture center, fruit and vegetable orchards (i.e. Bashu's Fruits Valley in Dighinala), Journals, Books and Daily News Papers etc. Most of the rural communities of the district, partially rely on these wild vegetables.

Table 2: A list of wild edible vegetables available beyond the market

No	Scientific name	Local name	Family	Plants Habit	Parts used
1	*Amaranthus spinosus*	Kanta shak	Amaranthaceae	Herb	Young shoots
2	*Bacopa monnieri*	Brahmi shak	Plantaginaceae	Herb	Young shoots
3	*Corchorus aestuans*	Bon pat	Malvaceae	Herb	Young shoots
4	*Crotalaria tetragona*	Jhunjhuni	Fabaceae	Herb	Flowers
5	*Enhydra fluctuans*	Helencha (Bitter)	Asteraceae	Herb	Young shoots
6	*Ficus carica*	Dumur	Moraceae	Tree	Fruits
7	*Ficus hispida*	Dumur	Moraceae	Tree	Fruits
8	*Sesbania grandiflora*	Bak ful	Fabaceae	Tree	Flowers
9	*Xanthium strumarium*	Ghagra	Asteraceae	Herb	Young shoots

Fig 2: Two wild edible vegetables beyond the market

About 220 wild edible vegetables (Pasha, 2018) [33]. have been found in Bangladesh whereas about 71 vegetables species were identified in the present study, which is the sign of elegance of wild edible plant utilization. It was observed that over extraction and utilization of WEVs (i.e. Bamboo shoots, *Dioscorea spp.*, Aroids, Mushrooms etc.) may be affected the local diversity and lower possibilities of availability of those species in their natural habitats. Modern agriculture, slush and burn agricultural system, habitat degradation, encroachment of the forests land etc. are also liable for reducing WEVs from their natural habitation in Khagrachari. Hence, wild edible plants need to be used in a sustainable manner for perpetuity use and can be incorporate immediately under managed cultivation in agro-land and homestead agroforestry system. Here, effective measures can be taken that the heavy dependency of ethnic community on forest resources (Jannat *et al*. 2018) [23], it is need to involve them in forest management and sustainable use of forest resources.

Globally, 1,800 species (110 genera) of aroids are existed, wheres Bangladesh has around 89 species (30 genera). 8 aroids were recorded from hill forest of Lawachara Natonal Park, wheres this

study recorded 6 genera and 9 species of aroids. Globally 880 species of dioscorea (8 genera) are existes in which 18 species in Bangladesh. From Lawachara National Park (Uddin, 2010), 7 Dioscorea spp. was recorded but from the study in Khagrachari, reported 4 Dioscorea species. Bamboo is another important edible vegetable to the community people. 6 bamboo species of four genera were found from study areas among 9 genera and 33 bamboo species in Bangladesh. Mushrooms provide a substitute of meat, contaiming high energy, protein and minerals About 20 mushrooms grow in Bangladesh in which 6 species 3 genera and 3 families were recorded from my studied areas. Pteridophytes or ferns known as 'Dheki shak' are extenxively used as vegetables salads and medicinal purposes. Diplazium esculentus, D. polypodioides and Dryopteris filis-mas are mostly used as vegetables in Bangladesh, only two ferns of Diplazium esculentus and Dryopteris filis-mas were recorded in this investigation.

For the improving and increasing our biodiversity consequently providing native food and nutrient sources of vegetables, wild edible plants or vegetables are play an important role for the local communities.

Wild Edible Plants (WEPs), both fruits and vegetables are a fundamental source of micronutrients in many developing countries, especially for the communities of forest dependency in the world (Sunderland *et al*., 2013) [40]. Approximately 1.2 to 1.5 billion people (20% of the global population) are directly or indirectly depended on forests (Vira *et al*., 2015). These estimates include about 60 million indigenous people who are almost wholly dependent on forests (World Bank, 2002) [42].

In Bhutan, during food scarcity due to drought and infestation by pests and diseases, subsistence farmers rely on wild foods i.e. wild tubers, fruits, vegetables, medicines etc. (Mijatovic *et al*., 2011) [27]. More than 50 million people in India, directly depend on forests for subsistence (FAO, 2011) [12], in Zambia, around 60% of total population are lived in forests area (Mukuka and Simoloka 2015), while in the Lao People's Democratic Republic, wild foods are consumed by 80% of the population daily, and in Senegal over 150 species of WEPs are consumed. In the arid and semi-arid Sahelian belt of Africa, more than 800 different WEPs species have been identified and in Southern Africa, around 126 WEPs species and 100 animals are used as food sources (FAO, 2011) [12].

Conclusion

This study represents an important first step in taking a more holistic view of the important subsistence value of NTFPs such as WEVs. Indigenous fruits play an important role in the nutrition of people and children in rural and tribal communities. These vegetables are containing high amount of energy, carbohydrate, protein, fiber and vitamins.

To enrich these items of plants, horticultural sector and the local people need to be encouraged them to establish and develop to nurseries of these wild edible plants. Here, various research and education center, i.e. BFRI, BARI, BRGB, BCSIR, IFESCU and other Universities, Gene and Seed Bank etc. can play an important role for the conservation and cultivation activities of WEVs in the area. The production and consumption of these vegetables in arid zones provides dietary supplement as well as commercial opportunity and form basis of traditional agroforestry land use system. This will improve food scarcity, economy in tribal areas and helps in regeneration of barren lands.

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