



# Exploring the Value and Potential to Commercialize Underutilized Leafy Vegetables Found in Karbi Anglong District, Assam, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present paper deals with the identification, documentation and exploration of diverse underutilized leafy vegetables consumed by the *Karbi* tribes of Karbi Anglong District, Assam. The NE region of India is the Gateway to India's richest biodiversity zones important for the genetic resources' world over. Genetic diversity of such underutilized leafy vegetables is concentrated or common in Northeast India more particularly in Karbi Anglong Hill District of Assam, which is considered to be one of the hotspots of the biodiversity in the world. The Indigenous and underutilized leafy vegetables are a source of livelihood for the local/ethnic communities of the

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district. In addition to food security these are also a part of culture and tradition for most of the hill tribes. These underutilized leafy vegetables are mostly found in wild forms as non-timber forest products and other natural habitats though some are domesticated and cultivated. The richness of plant diversity is largely due to ecological diversity superimposed with tribal and ethnic diversification, plant usage and religious rituals. The present paper deals with some of the common underutilized leafy vegetables used by the *karbi* communities. From the survey conducted in different local markets/weekly markets altogether 30 species belonging to 23 families were reported from the study area. These plant species were found to be morphologically different from each other and were found to be important in the Karbi Anglong District of Assam because of their medicinal values and provide economic benefit for the rural poor people. Tabulation has been done according to their Scientific name with families, vernacular name(*karbi*), plant parts used, common uses, mode of propagation, ITK's. etc. These plant species are used as vegetables which are having higher nutritional properties than commonly cultivated vegetables. Underutilized leafy vegetables and wild edible plants constitute an essential part in variation of diet and bring nutritional security and act as cheap source of healthcare component among ethnic communities. Therefore, there is a need for conducting systematic studies and research-based information on these plant species so as to establish them as economically viable crop. Domestication and bringing into cultivation is the need of the hour for promotion of these herbs beyond their confined locality. Studies on adaptability of these plant species in different environment are also important for their promotion as commercial crop.

*Keywords: Diversity; Karbi Anglong district; underutilized leafy vegetables; wild edible plants.*

## 1. INTRODUCTION

The use of various wild plant species as food, is a culture and tradition of most of the Hill tribes. These foods are mostly underutilized leafy vegetables, growing as wild in forests and other natural habitats and known among the Hill people as rich source of nutrients as well as for their prophylactic and therapeutic medicinal values. though some are domesticated and cultivated. Many such vegetables have higher nutritional properties than commonly cultivated vegetables [1]. Underutilized leafy vegetables and wild edible plants constitute an essential part in variation of diet and bring nutritional security and act as cheap source of healthcare component among ethnic communities [2,3]. But through the vast over-exploitation of these indigenous wild edible plants has to lead to the over the decline of these plant species [4] Therefore, the survival in their natural habitats is under growing threat and this necessitates the conservation of these plant species for easy availability in the near future.

The north eastern region of India belongs to the Indian Eastern Himalayas – a global biodiversity hot spot which is endowed with a great wealth of plant genetic resources. There is an estimated 3895 species of flowering plants found in Assam alone [5]. In Assam, Karbi Anglong Hill District is known as a rich reservoir of such wild edibles which are used by local people in daily diet as

vegetables or spices and condiments. These are also used for treatment against a number of common ailments. A large number of such plant species are being used by local people as vegetables, for which several other species are yet to be identified or explored. These vegetables are being collected unscrupulously as wild from the nearby forests by the local people and sold in the daily and weekly market. During interaction with the rural women folk as per their observation they cited that daily collection of the indigenous leafy vegetables from the forests by the local people during the season has resulted into a reduction of these products. As per their views the production of such vegetables is declining in recent years. Therefore, such unscrupulous collection of the indigenous vegetables and without any replanting has become a great threat for their extinction from their habitat.

Distribution, seasonality and availability of these vegetables are governed by the agro-ecological factors while, identification, collection and production, part/s used, preference, method of processing and preservation, culinary practices, extent of use, perception about the content of anti-nutritional and medicinal value/s of a given plant species etc are associated with the traditional knowledge and cultural beliefs. Although these forest herbs are in use by local people since long, scientific information on their nutritional and medicinal value is very limited. Underutilized leafy vegetables and other wild

edible plants received little attention in research activities and marketing prospects. Systematic studies and research-based information on these plant species is important to establish them as economically viable crop. Collection, documentation and characterization is always considered as the first and foremost step for a systematic study on any unexplored crop species. Domestication and commercial cultivation is an important method for promotion of these herbs beyond their confined locality as well as conservation and preservation. Studies on adaptability of these plant species in different environment are also important for their promotion as commercial crop. Ethnobotanical information on their diversity, usage, status etc., coupled with nutritional evaluation of these underutilized leafy vegetables can contribute towards food diversity and enhance nutritional security and livelihoods.

Considering the importance of wild vegetables in the daily diet for improving human health and as a supplement of nutrients, the present study was undertaken to gather information about the indigenous beliefs and knowledge of indigenous leafy vegetables used by the local people of Karbi Anglong District, Assam.

## 2. MATERIALS AND METHODS

The present study was carried out during 2021-2022 at different season of the year including both the rainy and dry seasons. Most of the weekly and daily market of Diphu, Manja, Bokajan, Baithalangso and Hawraghat areas of Karbi Anglong District of Assam, India were covered for market survey. This region of India has been identified as one of the 34 hotspots of the global biodiversity. Information regarding their uses, vernacular names, seasonal availability, mode of uses, plant part uses, mode of propagation and associated traditional knowledge were recorded from the correspondent. Information about the indigenous/underutilized leafy vegetables were collected from the village Headman, elderly people, rural women folks, and local vendors through informal personal interview method and discussion. Information on the vernacular names, seasonal availability and types of propagation of the different indigenous leafy vegetables available in the market were collected from the local vendors through personal interview method. Besides, information on the importance of these vegetables, their uses, type of the plant part that is used along with the mode of consumption e.g.

consumed as raw or cooked is also collected from the vegetable vendors, village Headman, elderly people and rural women folk. Live specimens of the underutilized leafy vegetables were collected for identification and photographs were taken for digital records. The plant samples were identified through informal interaction and discussion with local vendors, village headman and by referring relevant literatures and from the internet.

## 3. RESULT AND DISCUSSION

The most important positive aspect of underutilized leafy vegetables is that nearly all of them are known to possess therapeutic properties and are being used by native people as a remedy for a variety of human diseases. From the present study a total number of 30 species were identified which are commonly used as leafy vegetables by the local people especially the Karbi tribes. These 30 numbers of plant species belonging to 23 families namely, *Phyllanthaceae*, *Asteraceae*, *Nyctaginaceae*, *Fabaceae/Leguminosae*, *Costaceae*, *Lamiaceae*, *Verbenaceae*, *Vitaceae*, *Malvaceae*, *Araliaceae*, *Pontedeiaceae*, *Polygonaceae*, *Uritaceae*, *Rubiaceae*, *Gesneriaceae*, *Gnetaceae*, *Solanaceae*, *Rutaceae*, *Menispermaceae*, *Araceae*, *Acanthaceae*, *Rubiaceae*, *Uritaceae*, *Zingibraceae*. The plant species which were collected and identified were categorized according to their vernacular name, botanical names, family, part used, Indigenous Technical Knowledge (ITK's) and arranged in alphabetically order by their Scientific names which is presented in Table 1. The traditional knowledge of the wild edible plants is not only useful for conservation of traditional cultural practices and biodiversity but also play a significant role in community health care system and in the development of new alternative drugs [6].

Some of the plants are consumed as raw, but most of them are eaten as cooked fried or boiled. These plants are considered as rich sources of nutrients, vitamins, minerals and some of them are considered to have medicinal properties [7,8]. The edible plant parts include leaves or tender shoots, petiole, stem, flower, fruit, pod, rhizome and root. Among these, leaves and tender shoot is the most commonly edible part. The nutritional value of these wild vegetables is high in comparison to common cultivated vegetables [9]. The wild vegetables are an important source for the supplementation of

**Table 1. List of indigenous leafy vegetables commonly found in Karbi Anglong district of Assam**

Sl. No	Scientific name	Family	Local name/ Common name	Uses	Part used	Mode of uses	Mode of propagation	Availability	Habitat	ITKs associated
1	<b><i>Antidesma acidium</i></b>	Phyllanthaceae	Ingsum/Sour Currant shrub	vegetables	Leaves and Fruits	Cooked with fish and pork. The fruits are eaten raw.	Seed and vegetatively propagated	April- July	Forest, open space also in semi shade	Treatment of Stomach ache in children, diabetes and digestion related issue
2	<b><i>Blumea lanceolaria</i></b>	Asteraceae	Hanmoiso/Lanceleaf blumea	Vegetables, Medicinal	Leaves	Cooked	Seed and vegetatively propagated	May -June	Forest, riverside, Roadside,	Consumption of this vegetables reduces the backbone ache.
3	<b><i>Boerhavia diffusa</i></b>	Nyctaginaceae	Bituso,Chitu/Tarvine, Punarnava	Vegetables, Herbal Medicine	Leaves along with stalk	Cooked, Raw	Seed	July-Aug	Roadside, field, waste land	Used to cure Diabetes, Pain relief.
4	<b><i>Bauhinia malabarica roxb.</i></b>	Fabaceae/Leguminosae	Kuthor/Mountain ebony	Vegetables	Leaves, Fruit	Cooked	Seed and Cuttings	Throughout the year (leaves), Fruit (Aug-Dec)	Valley of forest	Used to treat dysentery, wound healing
5	<b><i>Cheilocostus speciosus</i></b>	Costaceae	Ai'u po/Crepe ginger, spiral ginger	Vegetables, Medicinal	Tender leaves,	Cooked, Raw	Rhizome	July-October	Shady areas of Forest	The leaves can be eaten raw by chewing for curing urinary incontinence, asthma, dropsy, cough
6	<b><i>Clerodendron colebrookianum</i></b>	Lamiaceae	Pharklum/East Indian glory bower	Vegetables, Medicinal	Leaves, Root	The tender leaves are cooked or boiled with garlic and sometimes cooked with tomatoes along with crush garlic.	Seed, rooted suckers	March-June	Jungles, Kitchen Garden	To cure hypertension, diabetes, rheumatism, cough
7	<b><i>Clerodendron wallichii</i></b>	Verbenaceae	Han ikso/Bridal veil, Wallich's glory bower	Vegetable, Medicinal	Tender Leaves & shoots, Flowers,	Cooked or boiled, chutney	Rooted cuttings, Seed, Cuttings	April-Dec	Semi natural forest, Natural Forest	Used to treat fever, diarrhea, skin infection.
8	<b><i>Cissus adnata</i></b>	Vitaceae	Han phorop/ Entire-leaf Wild grape	Vegetables (Leaves)	Leaves, Tuber	Cooked	Rooted cuttings	Throughout the year	Semi evergreen forest	Leaves are used as vegetables, used in urinary tract

Sl. No	Scientific name	Family	Local name/ Common name	Uses	Part used	Mode of uses	Mode of propagation	Availability	Habitat	ITKs associated
9	<b><i>Gnetum gnemon</i></b>	Gnetaceae	Hanthu/gnetum, two leaf, Melinjo, Belinjo	Leaves (Vegetables), Fruit (roasted/ fried)	Leaves, Fruits	Boiled or cooked with soda	Seed	Throughout the year	Forest	infection, Powdered roots are antiseptic, applied to cuts and wounds. Young leaves and shoots are used as vegetables, The roots are used as an antidote for poison.
10	<b><i>Hibiscus acetosella</i></b>	Malvaceae	Hanserong ke'er/False roselle, Rose Mallow, Craneberry hibiscus	Vegetables, Medicinal	Leaves, Fruit	Cooked, Raw,	Seed	Aril-Sept	Open areas, Jhum areas, Kitchen garden	To cure poisonous insect bites.
11	<b><i>Hibiscus sabdariffa</i></b>	Malvaceae	Hanserong/Roselle, Indian sorrel, Assam Susar	Vegetables, Medicine, Fibre is used to make rope	Leaves, Fruit, Seed	Leaves and tender fruits are cooked with dry fish, Can be cooked along with dal and Fish, Pork	Seed	March-Sept	Open areas, Jhum areas, Kitchen Garden	To cure headache, poisoning. The macerated leaf are applied on insect bite spot.
12	<b><i>Macropanax dispermus</i></b>	Araliaceae	Artisampro/*	Vegetables, Medicinal	Tender leaves	Cooked, Boiled, Roasted in ashes	Cuttings	April-Dec	Forest,	Used to treat inflammation and arthritis.
13	<b><i>Monochoria hastata</i></b>	Pontedeiaceae	Antimi/ Arrow -leaf powdered	Vegetables, Medicinal	Leaves, Tender stalk	Cooked with dal, Fried	Tuberous root, Seed	March-May	Pond, Wet lands, Lakes	The juice of the plant is used for treating tooth ache and asthma.
14	<b><i>Ocimum Americanum</i></b>	Lamiaceae	Lopong birik/Lime basil	Condiments, Medicinal	Leaves	Boiled with Fish, chicken, dried fish, bitter gourd, Kauri Kerela. In all the cases it is used as condiments for enhancing the flavour of the dishes.	Seed	April-Sept	Kitchen garden	Can help to reduce inflammation in the body, lower blood pressure and reduce high blood sugar levels.
15	<b><i>Parabaena sagittate</i></b> Miers	Menispermaceae	Hanrisang*	Vegetables as well as medicine	Leaves	Cooked with other vegetables or	Rooted climbers	Throughout the year	Forest	Used to heal fracture or injury. Also apply on

Sl. No	Scientific name	Family	Local name/ Common name	Uses	Part used	Mode of uses	Mode of propagation	Availability	Habitat	ITKs associated
16	<i>Persicaria nepalensis/Polygonum chinense</i>	Polygonaceae	Delap/Chinese knotweed, Creeping smartweed	Vegetables	Leaves	boiled with soda Cooked	Suckers, Seed	Throughout the year	Wetlands	animals for curing the wound Used for treatment of dysentery, sore throat.
17	<i>Pouzolzia hirta/Gonostegia hirta</i>	Uritaceae	Han thai/ Graceful pouzolz bush	Vegetables, Pickled (tender shoot)	Young Leaves, Bud, Root	Cooked, Raw	Rooted cuttings, cuttings	March-Dec	Riverbanks, wetland, Field	Used to treat boils, dysentery, fevers, urinary problems.
18	<i>Pogostemon benghalensis</i>	Lamiaceae	Han bipo/Bengal shrub mint	Vegetables, Medicinal (Herbal)	Leaves	The leaves are eaten as chutney with dried fish, cooked, boiled	Rooted suckers, Seed	April-Dec	Kitchen garden	To relief body ache, pain of limbs(massage the affected spot with oil and this herb)
19	<i>Paederia foetida</i> L.	Rubiaceae	Rikang nemthu/Stink vine	Leaves (chutney), Climber (rope)	Leaves	The leaves are Eaten as chutney made with dried fish	Runners	Throughout the year	Hillsides in forest, streamsides along forest edge	Used to treat fever, colds, headaches and digestive issues.t
20	<i>Rhynchoechum ellipticum</i>	Gesneriaceae	Mehek/*	Vegetables	Leaves, Fruits	Raw, Cooked	Cuttings	Throughout the year	Forest, Hilly tract	Used to treat diarrhoea, antibacterial,
21	<i>Rhaphidophora hangkongensis</i>	Araceae Juss	Hansangbi/*	Vegetables	Leaves	Eaten as curry (Cooked with soda)	Cuttings	Throughout the year	Forest	Help to cure fevers, fractures, injuries and rheumatism
22	<i>Sauropus androgynus</i>	Phyllanthaceae	Han voti/Sweet leaf	Vegetables, Medicinal	Tender shoots, Leaves	Raw, Cooked	Rooted cuttings, Seed	Throughout the year	Wild	To cure cough and to soothe lung
23	<i>Solanum nigrum</i>	Solanaceae	Hipi sokran/Black night shade	Vegetables	Leaves, Berries	The leaves are cooked as vegetables. Ripe berries are eaten raw	Seed	March-May	Kitchen garden	Used to treat muscle cramp, spasms, paina and for skin infection.
24	<i>Senegalia</i> species	Fabaceae	Hanche	Vegetables, Medicinal	Tender leaves	Cooked with Pork, Fish, dal. can be cooked with vegetables like wild mushroom,	Rooted Suckers	April-Oct	Forest, Kitchen Garden	The boiled leaves water are used to treat cold and cough.
25	<i>Zanthoxylum rhetsa</i>	Rutaceae	Hanjor/Indian prickly ash	Vegetables	Tender Leaves, Seed	Cooked with pork, Seed are powdered and are mixed with	Seed,	Throughout the year	Forest, Domesticated	Remedy for stomach upset, sore throats, skin infection, Stimulate

Sl. No	Scientific name	Family	Local name/ Common name	Uses	Part used	Mode of uses	Mode of propagation	Availability	Habitat	ITKs associated
26	<b><i>Tetrastigma leucostaphylum</i></b>	Vitaceae	Mesoripak/Indian chestnut vine	Vegetables, Rope	Tender leaves, The matured climber	any other vegetables The tender leaves are cooked with pork, mutton, chicken and fish.	Rooted cuttings, Cuttings, Seed	April-Dec	Forest, Riverbanks, Rocky Areas, Terrestrial	saliva flow. Remedy for boils, diarrhea, dysentery, to treat cough.
27	<b><i>Rotheca serrata</i></b>	Lamiaceae	Phelang riho/Blue fountain bush	Vegetable, Msedical	Leaf, Flower	The leaves and flowers are cooked or boiled or eaten as chutney.	Seed, Cutting	Jan-Mar (flower)	Forest,	Boiled water of tender leaves are used to treat dysentery and stomachache. The plant is also used to treat sanke bite. Remedy for treatment of dysentery, diabetes.
28	<b><i>Phlogacanthus thrysiflorus</i></b>	Acanthaceae	Jok'an/	Vegetables, Medicinal	Flowers	The flowers are boiled and mashed with either boiled potato or roasted dry fish	Rooted cuttings, Cuttings	Jan-april	Forest, Hilly tract	Remedy for treatment of dysentery, diabetes.
29	<b><i>Vigna unguiculata</i> Subsp</b>	Fabaceae	Hantharvo/Purple hull pea	Vegetables	Leaves, Pod	The leaves are cooked as vegetables. The immature pod are eaten either as boiled or fried, The mature seed cooked with pork and chicken.	Seed	Jun-Sept (Leaves) Nov-Dec (Pod)	Hillside, Farmland	
30	<b><i>Zingiber chrysanthum</i></b>	Zingiberaceae	Phri Kangnek/Golden flower ginger	Vegetables	Flower	The flowers are cooked with dal, yam, brinjal or with other indigenous leafy vegetables and add a pinch of soda.	Rhizome	Dec-April	Humid, partly shaded	Used for treating fever, Malaria and dysentery.



Jok'an/



Hanthu/gnetum, two leaf,  
Melinjo, Belinjo



Hanrisang



Kurvengso (*Commelina  
communis* L)



Antimi/ Arrow -leaf powdered



Hanserong ke'er/False roselle,  
Rose Mallow, Craneberry  
hibiscus



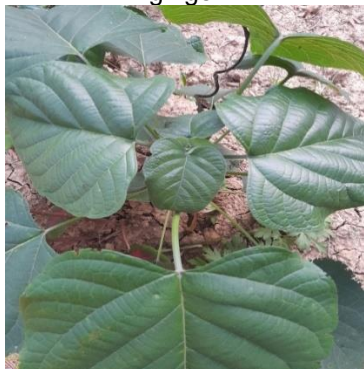
Phri Kangnek/Golden flower  
ginger



Lopong birik/Lime basil



Mehek



Pharklum/East Indian glory  
bower



Han phorop/ Entire- leaf Wild  
grape



Ai'u po/Crepe ginger, spiral  
ginger





Hansangbi



Han voti/Sweet leaf



Hanthai/ Graceful pouzolz bush



Mesoripak/Indian chestnut vine



Hipi sokran/Black night shade



Rikang nemthu/Stink vine



Hanserong ke'er /False roselle,  
Rose Mallow, Crane berry  
hibiscus



Hanche



Daily Market in Diphu





**Fig. 1. Indigenous vegetables available in daily local/weekly markets of Karbi Anglong District**

micronutrients in the vegetarian diets. Though a little proportion of them are considered as domesticated crops, large numbers of the plant species are used in different ways from the traditional point of view since long [10] Two less-known wild food species namely Hanthu (*Gnetum gnemon* L.; family Gnetaceae) and Mehek (*Rhynchosycheum ellipticum* (Dietr.) A. DC.; family Gesneriaceae) are particularly significant to the Karbis. The plants are customarily used in rituals and folklores of these plants touch upon their origin, traditional foodways and religious practices [11]. Certain priest and elderly people of Karbi Tribes usually don't consume Hanjor (*Zanthoxylum rhetsa*) leaves because it's a taboo for them according to a Karbi Tradition before performing certain rituals, the priest would chant this sacred prayer- *Chitu bisi/ Hanjor bisi/ De karlok/ Tur karlok*-which means that the priest had not committed any impurity (by consuming *chitu/ hanjor*) and that his tongue is not impure. However, others can eat the tender leaves of that particular plant species [12].

More than hundreds of such leafy vegetables still have been reported by different scientists. Some of the important plants which are commonly used as leafy vegetables in day to day life are *Antidesma acidium*, *Cissus adnatea*, *Gnetum*

*gnemon*, *Persicaria nepalensis*, *Paederia foetida* L., *Rhynchosycheum ellipticum*, *Rhaphidophora hangkongensis* [13]. Apart from the nutritional value, many underutilized leafy vegetables like *Blumea lanceolaria*, *Boerhavia diffusa*, *Bauhinia malabarica roxb.*, *Cheilocostus speciosus*, *Clerodendron colebrookianum*, *Clerodendron wallichii*, *Hibiscus acetosella*, *Hibiscus sabdariffa*, *Macropana dispermus*, *Monochoria hastata*, *Parabaena sagittate miers*, *Pogostemon benghalensis*, *Sauropus androgymus*, *Senegalia esculentum* etc. are used both as leafy vegetables and some therapeutic value used for medicinal purposes [8,14,15,16] as well as for income generation and poverty alleviation.

Many of these underutilized leafy vegetables are found to be climate resilient and adaptive to adverse climatic condition and can be grown at a minimum management cost even on poor marginal land. These underutilized leafy vegetables are naturally growing plants and thus very little attention is required to grow them. In most cases sowing seeds or planting once provides repeated harvest for long duration. Least maintenance in its natural habitat is also sometimes sufficient for collection in a huge amount. Thus, cultivation of these plants is helpful for small and marginal farmers to gain

good economic returns to the local people of the Eastern India region particularly. Apart from food, these underutilized vegetables can also be used as potential sources of medicines.

#### 4. CONCLUSION

In Karbi Anglong District, a large variety of wild edible underutilized plants are occurring in their natural habitats which are used for various purposes including as dietary supplements by the indigenous people. As they grow naturally, they are more adaptive and can be considered as climate resilient crop in the present context of changing climate scenario. Besides they are inexpensive, locally available and have a great socio-economic significance because of their nutritive and medicinal value. The cultivation and consumption of these crops may be helpful in overcoming the nutritional deficiencies predominant in many rural areas of the country and helpful to boost the socio-economic condition of the society as well. Due to unscrupulous collection of these underutilized vegetables, some of the species has become a threat for extinction. Therefore, promotion and awareness on the importance and scope for commercial cultivation is needed which will not only help in easy availability of these vegetables and generation of income but would also help in the conservation and preservation of such important underutilized vegetables. Now it is the high time for significant efforts to pass on the benefits of these underutilized leafy vegetables and the need of conservation to the peoples at large before there is any extinction of these valuable plants from the rich bio-diversity of our country.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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