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A preliminary report on the use of leafy vegetables by the native of Bargarh district, Western Odisha, India

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Abstract
The study was conducted on four dominant tribal communities namely Sahara, Binjhal, Kondh and Gond of Bargarh district, Western Odisha, to assess the diversity of plant species consumed as 'leafy vegetables'. A total of 39 plant species, belonging to 31 genus and 26 families were recorded in the interviews and enquiries. The dominant families were Amaranthaceae and Brassicaceae contributing five species each. The Cucurbitaceae family contributed three species and the families Chenopodiaceae, Convolvulaceae and Fabaceae contributed two species each respectively. Rest of the 20 families contributed one species each. The leafy vegetables consumed by these four tribes include 29 nos. of herbs (74%), 05 nos. of trees (13%), 04 nos. of climbers (10%) and one shrub (3%). Species like *Amaranthus oleraceous*, *Amaranthus viridis* L., *Basella alba* L., *Chenopodium album* L., *Cucurbita maxima* Duchesne., *Coriandrum sativum* L., *Glinus oppositifolius* (L.) A.DC., *Ipomoea aquatica* Forssk., *Marsilea minuta* L., *Moringa oleifera* Lam. and *Spinacia oleracea* L., were used most extensively. Most of the tribal people depend on wild leafy vegetables than the cultivated ones. Many wild leafy vegetables were used for medicinal purposes as well, e.g. *Alternanthera sessilis* L.R. Br., *Glinus oppositifolius* (L.) A.DC. *Ipomoea aquatica* Forssk., *Azadirachta indica* A. Juss., *Enhydra fluctuans* Lour., *Hygrophila auriculata* Schum. (Heine.), *Murraya koenigii* L. Spreng and *Oxalis corniculata* L. Domestication of these reported species will not only improve the economic condition of the people but will also aid in conservation of biodiversity, sustainability and food security.

Keywords: Bargarh district, Odisha, traditional knowledge, wild leafy vegetables

Introduction
Wild vegetables are an important component of traditional food system around the world (Turner *et al*, 2011) [22]. More than 53 millions tribal people in India depend on plant resources for their food purposes (Bharucha and Pretty, 2010) [4]. Although, the life style of Indians is rapidly changing into an urbanized way of life, the tradition of consuming wild plants as food has not been completely erased. Besides, growing a few crops, people frequently collect wild edible plants to meet their subsistence needs. In many developing countries, human diet is dominated by a single staple food and has only minor amount of other food items, resulting in high risk of inadequate intake of both macro and micronutrients. In India, the staple diet is rice/wheat-based. Parboiled, polished rice is the staple food and other food items such as vegetables, fish, pulses, fruits and animal products only constitutes a minor part of the diet. Vegetables, especially leafy vegetables, are good source of nutrition, being rich in carbohydrates, proteins, oils and are important in the diet as they contain b-carotene, folic acid, ascorbic acid, antioxidant phenols and minerals such as Ca, Fe, P, K, Na and Zn (Aberoumand, 2009; Aberoumand and Deokule, 2009; Misra and Misra, 2013) [1, 2]. The flavenoids is an important compound found in vegetables which possesses a remarkable spectrum of biochemical and pharmacological actions, affecting cellular functions such as growth, differentiation and apoptosis (Carlo *et al*. 1999) [5]. The World Health Organization (WHO) recommends a daily intake of more than 400 g of fruit and vegetables per person, to protect against diet related chronic diseases (WHO, 2013) [23]. In the last two decades, the traditional leafy vegetables are being gradually replaced by incorporating high yielding varieties, thereby threatening the existence of many invaluable traits present in rural areas of India. Moreover, there is a rapid decline of traditional knowledge about wild edible leafy vegetables and increased reliance on processed food.

Thus, documentation and evaluation of the traditional knowledge related to the diversity, usage, and status of leafy vegetables is extremely crucial for sustainability and preservation of the wild leafy vegetables. In this regard, a great deal of work has already been done and ethnobotanical information on wild edible leafy vegetable plants in different parts of India has been reported by Jain and Tiwari, 2012 [7]; Chauhan *et al*, 2014 [6]. The same ethnobotanical information on wild edible leafy vegetable has been reported in Odisha by Behera *et al*, 2008 [3]; Sahu and Sahu 2019 [19]; Parida and Mahalik, 2020 [15]; Sahu *et al*. 2021 [18]. However, any comprehensive and elite study on these aspects is yet to be done in the Odisha state so far (Misra and Misra, 2013). In this context, reports from Bargarh district of western Odisha is negligible, even though the poor rural and tribal people of the district largely depend on a wide variety of wild leafy vegetables for their livelihood. Therefore, present investigation has been carried out in the interior pockets of Bargarh district of Odisha, India with the objectives to collect oral traditions on the diversity of leafy vegetables and to conserve it through documentation not only for the potential economic values, but also for its cultural importance.

Materials and Methods

Study site

Bargarh district, one of the ten districts of Western Orissa lies between 20° 43' to 20° 41' North latitude and 82° 39' to 83° 58' East latitude and having 5, 737 Sq Km of geographical area. The major rivers in the district are tributaries of Mahanadi River, Ong (Ang), Jira and Jhaun rivers. Agriculture is the main source of income of the tribal people. They also depend on forest and forest based products for their regular use. Many different tribes of people live and exist in Bargarh district. Among them the Sahara, Binjhal, Kondh and Gond are the major tribes. Although, modern system of medicine has influenced the people, these tribals continue to earn their livelihood from the forest and depend on forest for traditional medicines for the treatment of various ailments.

Data collection

In order to document the utilization of indigenous leafy vegetable plants, a survey of literature was carried out in the study area before starting field work (Sahu *et al*. 2010 [16]; Sahu *et al*. 2013 [17]; Sahu and Sahu 2019 [19]; Sahu *et al*. 2021 [18]; Saxena and Brahman 1990, 1994-96) [20]. The study area was visited frequently and close interaction was made mostly with the elder tribal people practicing herbal medicines. Plant specimens were collected and identified with local flora (Saxena and Brahman 1994-96) [21]. Some of the elderly people practicing such medicines did not easily reveal the identification of the plants. A common belief, that revealing the identity might render the medicine ineffective. As tradition has it, the knowledge is kept as a secret and carefully passed on from one generation to other. Therefore, questionnaires were designed as an indirect approach to collect the information. The identified plant species were photographed and voucher specimens was deposited in the herbarium of Botany Department, Vikash Degree College, Bargarh. The collected leafy vegetable plants were placed on a table having botanical name, followed by local name, its family and mode of use for food/ medicinal purpose for proper identification.

Results

A total of 39 plant species belonging to 31 genus and 26 families were recorded in the interviews and enquiries (Table 1, Fig 1). The dominant families were Amaranthaceae and Brassicaceae contributing five species each. The Cucurbitaceae family contributed three species and the families Chenopodiaceae, Convolvulaceae and Fabaceae contributed two species each respectively. Rest of the 20 families contributed one species each (Table 1, Fig 2). The leafy vegetables consumed by these four tribes include 29 nos. of herbs (74%), 05 nos. of trees (13%), 04 nos. of climbers (10%) and one shrub (3%), (Fig 3). Species like *Amaranthus oleraceous*, *Amaranthus viridis* L., *Basella alba* L., *Chenopodium album* L., *Cucurbita maxima* Duchesne., *Coriandrum sativum* L., *Glinus oppositifolius* (L.) A.DC., *Ipomoea aquatica* Forssk., *Marsilea minuta* L., *Moringa oleifera* Lam., *Portulaca oleracea* L. and *Spinacia oleracea* L. were used most extensively. Most of the tribal people depend on wild leafy vegetables than the cultivated ones. Many wild leafy vegetables were used for medicinal purposes as well. They are mostly picked during their visits to various places such as, home gardens, grazing lands, forest, crop fields and watercourses for grazing the animals, collecting fuel and fodder, tending the crop fields or collecting water etc. Plants are usually collected in vegetative stage, when the leaves are young and fresh. The cited species are available throughout the year. Most of the leafy vegetables were collected for sale in local markets. Personal interaction was made with at least two of the well-known local vendors selling these leafy vegetables at road side of each of the 12 blocks of Bargarh district i.e. Ambabhona. Attabira, Bargarh, Barpali, Bhatli, Bheden, Bijepur, Gaisilet, Jharbandh, Padampur, Paikmal and Sohela respectively. Among these 24 vendors, 18 were men and 06 were women, varying between the age group of 30 and 50 years. These vendors came from the villages nearby. They reported that the different types of wild leafy vegetable they sold included: *Amaranthus gangeticus* L. *Amaranthus oleraceous*, *Amaranthus viridis* L., *Basella alba* L., *Chenopodium album* L., *Cucurbita maxima* Duchesne., *Coriandrum sativum* L., *Glinus oppositifolius* (L.) A.DC., *Ipomoea aquatica* Forssk., *Lagenaria siceraria* (Molina) Standley, *Marsilea minuta* L., *Moringa oleifera* Lam., *Spinacia oleracea* L., *Raphanus sativus* L. and *Trigonella foenum-graecum* L. Out of these species *Amaranthus oleraceous* and *Amaranthus viridis* were sold in greater quantity followed by *Basella alba* and *Spinacia oleracea*.

Table 1: List of plant species used as leafy vegetables by the four dominant tribes of Bargarh district of Odisha, western Odisha, India

Botanical name	Local name	Family	Mode of use
Allium cepa L.	Uel	Amaryllidaceae	Young leaves and shoots are collected, roasted then eaten.
Alternanthera sessilis L.R. Br.	Madaranga	Amaranthaceae	Leaves and young shoot are roasted with mustard oil and then eaten.
Amaranthus oleraceous L.	Kosila	Amaranthaceae	Leaves and young shoots are cut into small pieces, cooked with salt and chilly and then eaten.
Amaranthus spinosus L.	Kanta Leutia saga	Amaranthaceae	Leaves are cooked with mustard oil, chilly, salt with potato and then

			consumed.
Amaranthus tricolor L.	Lal khada	Amaranthaceae	Leaves and young shoots are cut into small pieces, cooked with salt and chilly and then eaten.
Amaranthus viridis L.	Leutia saga	Amaranthaceae	Leaves and young shoots along with other vegetables are cooked and used as curry.
Azadirachta indica A. Juss.	Lim	Meliaceae	Fresh tender leaf along with flower is fried with mustard oil.
Bacopa monnieri (L.)Pennell.	Brahmi	Scrophulariaceae	Young shoots are cooked then eaten by tribal people.
Basella alba L.	Poi	Basillaceae	Leaves are cooked with mustard oil, chilly, garlic, salt and then eaten.
Bauhinia purpura L.	Kuelar	Caesalpiniaceae	Young leaves are collected, mixed with brinjal, onion, oil, salt and cooked as curry and taken.
Boerhavia diffusa L.	Gadhapurni	Nyctaginaceae	Tender leaves are cooked with mustard oil, chilly, salt and then eaten.
Brassica napus L. var. *glauca* (Roxb.) Schulz	Surso	Brassicaceae	Leaves are roasted with mustard oil and then adding brinjal is cooked and then consumed.
Brassica oleracea var. *botrytis* L.	Phula-kobi	Brassicaceae	Leaves are fried or made into curry and consumed.
Brassica oleracea var. *capitata* L.	Bandha Kobi	Brassicaceae	Leaves are fried or made into curry and consumed. Leaves also used to prepare Manchurian.
Brassica oleracea L. var. *gongylodes* L.	Goint kobi	Brassicaceae	Leaves are fried or made into curry and consumed.
Chenopodium album L.	Bathua saga	Chenopodiaceae	Leaves and young shoots are cooked along with dal and other vegetable adding salt and chilly to it.
Cinnamomum tamala Nees.	Tejpatra	Lauraceae	Leaves are used as spice in making curry.
Colocasia esculenta (L.) Schott	Saru	Araceae	Young tender leaves and leafy shoots are collected, cut into small piece, cooked with salt and chilly then eaten.
Corchorus capsularis L.	Nalita	Tiliaceae	Leaves are cooked with mustard oil, chilly, salt with potato and consumed as food.
Coriandrum sativum L.	Dhania	Apiaceae	Tender leaves are collected, curry is prepared and eaten.
Cucurbita maxima Duchesne.	Makhan	Cucurbitaceae	Leaves and young stems are collected, roasted then eaten.
Enydra fluctuans Lour.	Hidimicha	Asteraceae	Leaves are cooked with mustard oil, chilly, salt and eaten especially by poor peoples.
Glinus oppositifolius (L.) A.DC.	Pitasaga	Molluginaceae	Leaves are cooked in mustard oil using oil, chilly, salt and garlic along with brinjal.
Ipomoea aquatica Forssk.	Kalamasaga	Convolvulaceae	Leaves and young stems are cooked with mustard oil and garlic then consumed with rice.
Ipomoea batatas (L.) Lam.	Kanda	Convolvulaceae	Leaves and young stems are cooked with mustard or ground nut oil and garlic then consumed with rice.
Lagenaria siceraria (Molina) Standley	Laoo	Cucurbitaceae	Leaves and young stems are cooked with other vegetables.
Marsilea minuta L.	Sunsunia	Marsileaceae	Leaves are cooked with mustard oil, and garlic paste.
Mentha spicata (L.) *emend*.Nathh.	Podina	Lamiaceae	Young leaves paste adding salt chilly is used as chantey.
Momordica charantia L.	Karla	Cucurbitaceae	Leaves are eaten after frying or roasting.
Moringa oleifera Lam.	Munga	Moraginaceae	Leaves are cooked dried and also with mung dal and vegetables used as curry.
Murraya koenigii L. Spreng.	Lesinga	Rutaceae	Leaves are used as spice in curry and give it a specific scent. Roasted leaf pieces are used in various food materials for batter taste.
Olax scandens Roxb.	Bhadbhadalia	Oleaceae	Leaves are collected, roasted then eaten.
Oxalis corniculata L.	Amlitisaga	Oxalidaceae	Leaves are cooked with mustard oil, chilly, salt with potato as delicious curry to eat.
Polygonum plebeium R.Br.	Muthisaga	Polygonaceae	Leaves and young shoot are roasted with mustard oil and then adding brinjal is cooked and then consumed.
Portulaca oleracea L.	Chanti sag	Portulaceae	Leaves and young stems are collected, roasted then eaten.
Raphanus sativus L.	Mula	Brassicaceae	Leaves are fried along with other vegetables.
Spinacia oleracea L.	Palanga	Chenopodiaceae	Leaves are fried with vegetables and also cooked with dal and potato to make dalma curry.
Trigonella corniculata L.	Phiringi	Fabaceae	Leaves are fried along with other vegetables.
Trigonella foenum-graecum L.	Methi	Fabaceae	Leaves are cooked with mustard oil, and garlic dried and adding vegetables also taken as food.

Fig 1: Photographs of representative leafy vegetables namely *Amaranthus spinosus* L. (a), *Amaranthus viridis* L. (b), *Azadirachta indica* A. Juss. (c), *Bacopa monnieri* (L.) Pennell. (d), *Basella alba* L. (e), *Bauhinia purpura* L. (f), *Boerhavia diffusa* L.(g), *Brassica napus* L. var. *glauca* (Roxb.) Schulz (h), *Brassica oleracea* var. *botrytis* L. (i), *Brassica oleracea* L. var. *gongylodes* L. (j), *Cinnamomum tamala* Nees. (k), *Colocasia esculenta* (L.) Schott (l), *Corchorus capsularis* L. (m), *Coriandrum sativum* L. (n), *Cucurbita maxima* Duchesne. (o), *Enydra fluctuans* Lour. (p), *Ipomoea aquatica* Forssk. (q), *Marsilea minuta* L. (r), *Mentha spicata* (L.) *emend*.Nathh. (s), *Momordica charantia* L. (t), *Moringa oleifera* Lam. (u), *Murraya koenigii* L. Spreng. (v), *Portulaca oleracea* L. (w), *Spinacia oleracea* L. (x), and *Trigonella foenum-graecum* L. (y)

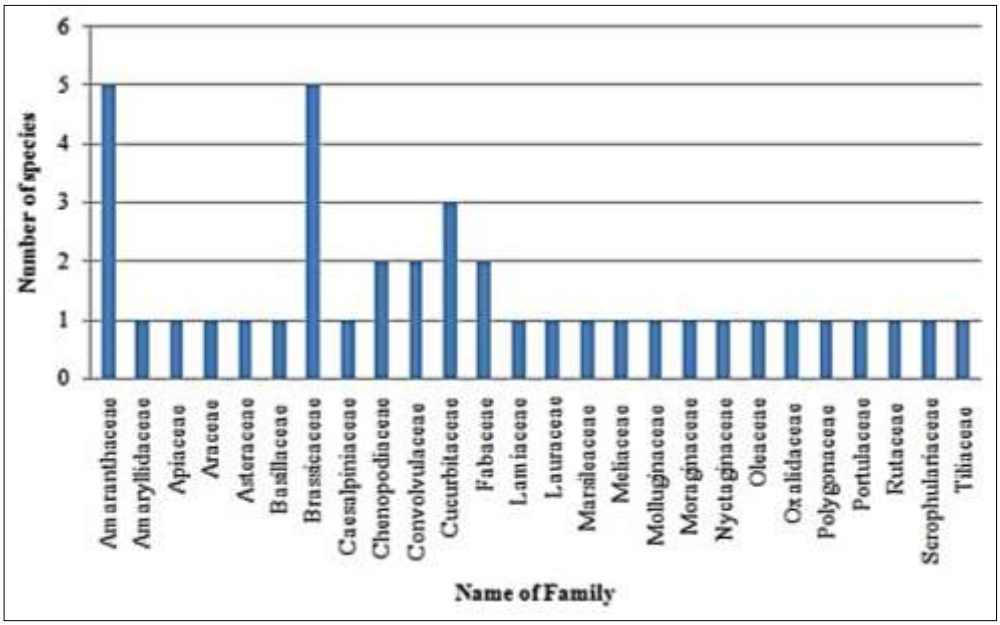

Fig 2: Family-wise distribution of leafy vegetable species used by the native of Bargarh district, Odisha

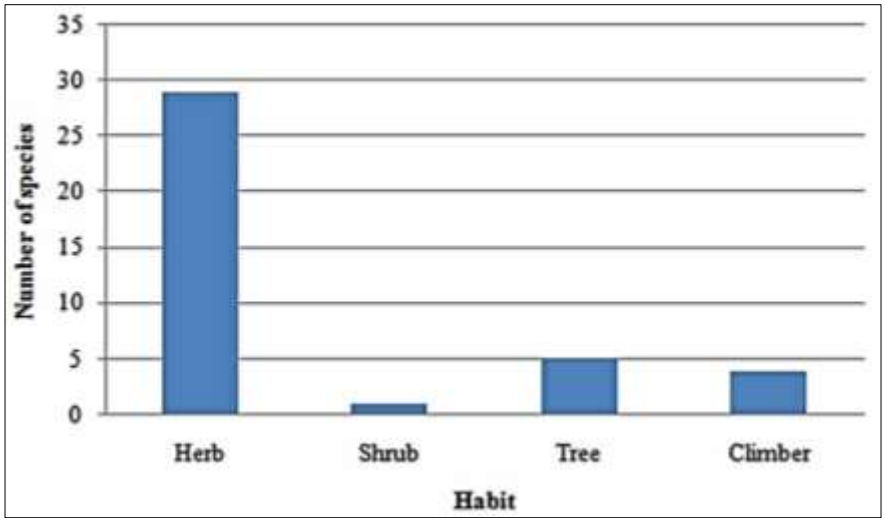

Fig 3: Diversity of plant species by habit

Discussion

The value of wild edible vegetables in food security has not been given sufficient attention in Bargarh district of Odisha, India. The role of wild leafy vegetables in food security has the potential to provide important information for development of policies on sustainable utilization of natural resources for human sustenance. The present study provides empirical evidence about traditional knowledge and diversity of various useful leafy vegetable plants in the studied area. Several studies have been made on plants under a multitude of ethnobotanical grounds. According to a recent study conducted by the Ministry of Environment and Forest (MoEF, 2010) [10], Govt. of India, New Delhi, under the "All India Coordinated Research Project on Ethnobiology", the ethnic communities in India use over 10, 000 wild plant species for meeting their primary health care, food and material requirements. Among them nearly about 3, 900 wild plant species were used as food. During the present investigation some of the female informants claimed that people prefer wild leafy vegetables to cultivated/imported vegetables because they taste better and/or because they have medicinal properties. Majority of the people (mostly men) have informed that the wild leafy vegetables are good for health in general. There were also few claims of stomach ache or diarrhoea on consumption of these wild leafy vegetables. A few others have reported that these wild leafy vegetables are used if and when other vegetables are unavailable. Comparative analysis on the availability of leafy vegetables at different sites revealed that the highest diversity of wild leafy vegetables were harvested from the traditional agro-systems.

Rural, poor households and tribals are mostly reliant on leafy vegetables for their livelihood. Some species like *Alternanthera sessilis* L.R. Br., *Amaranthus spinosus* L., *Glinus oppositifolius* (L.) A. DC., *Ipomoea aquatica* Forssk., *Marsilea minuta* L., *Moringa oleifera* Lam., *Oxalis corniculata* L., *Polygonum plebeium* R.Br. were used more extensively in comparision. Households with financial earnings have also reported consuming the wild edible herbs. The local demand and the productivity of the reported species demonstrate that all have a good economic potential for the region. Therefore, consuming leafy vegetables can play a major role in meeting dietary requirement of the rural poor and tribal population in remote areas as well as economically well to dos. Use of wild leafy plants can substantiate vitamin and protein contents in the human diet. The present study reveals, that in addition to the dietary uses, many leafy vegetables were used for various medicinal purposes in traditional medicine. It is very difficult to categorize these plants into food and medicine respectively. Because species like, *Alternanthera sessilis* L. R. Br., *Glinus oppositifolius* (L.) A. DC. and *Ipomoea aquatica* Forssk. serve both as medicine and food. *Alternanthera sessilis* is used to increases the flow of bile in the intestine, also to stimulate lactation in nourishing mother and in the treatment of leucorrhoea, anemia and diabetes (Panda *et al*, 2012; Panda *et al*, 2013) [12, 13], *Azadirachta indica* is used in curing skin diseases (Sahu *et al*. 2010; Panda, 2012) [12, 16], *Coriandum sativum* is administered to control blood sugar (Panda, 2010) [14]. Several of the leafy vegetable species reported by informants were used for their medicinal purposes. *Basella alba* L., *Chenopodium album* L., *Enydra fluctuans* Lour., *Hygrophila auriculata* Schum. (Heine.), *Murraya koenigii* L. Spreng., *Oxalis corniculata* L., *Trigonella foenum-graecum* L. were extensively used as food as well as medicinal purposes. Other researchers have also documented the dominance of leafy vegetables for dietary caloric value, nutrients and pharmacological importance (Maikhuri *et al*, 2000; Nautiyal *et al*, 2003) [8]. Most of the informants stated that sufficient herbs were available for harvesting throughout the year. However, when asked to compare the current availability with the past decade, majority agreed about the unavailability of these plants in terms of quantity. The main reasons were realities of the modern life: loss of natural habitats due to population explosion and consequent human developmental activities like construction of roads, housing, industrialization of traditional farming methods, conversion of agricultural lands and wetlands to homestead etc.

Conclusion

The present investigation indicates that a wide range of uncultivated leafy vegetable species significantly contributed to the dietary requirements of rural households at Bargarh district, Odisha, India. This study further reveals that the traditional knowledge and usage of leafy vegetables is still an important part of village life and culture. These multi potential resources were in constant threat by various anthropogenic and natural causes like land use change, destruction of habitat, unscientific harvesting methods, over-

grazing and invasive species. Domestication of the reported species will not only improve the economic condition of the people but will also help in conservation of biodiversity and food security. Moreover, the traditional agro-ecosystems are an important source of wild leafy vegetables as observed in this study and deserves priority for conservation. Therefore, wider survey, interactions with the inhabitants and collection of data are essential for proper preservation of this popular traditional knowledge and to enhance the relationship between human society and nature.

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