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A glimpse of indigenous and minor vegetables of India

Indigenous (traditional) vegetables are best defined as species that are locally important for the sustainability of economies, human nutrition and health, and social systems but which have yet to attain global recognition to the same extent as major vegetable commodities such as tomato or cabbage. Indigenous vegetables - plant species consumed in specific locations as part of traditional diets - have the potential to diversify cropping systems, increase farm income, and add a range of vital micronutrients to diets. Given the hundreds of indigenous vegetables consumed worldwide, their accumulated value for mankind is considerable. These species deserve much greater recognition and investment in agricultural research and development than they have received presently.

INDIGENOUS vegetables are primary candidates for greater use of crop biodiversity in horticulture as they are already consumed and enjoyed locally and can be produced profitably in both rural and urban environments. Yet many such species have received little scientific attention to date. More effort in research and development would likely produce rewarding results, as productivity increase in these neglected crops are much easier to realize than for intensively researched staple cereals. Questions therefore are: 1) How can we rescue, conserve and utilize the genetic diversity of cultivated and wild forms of indigenous vegetables under threat of genetic erosion with reference to India?; 2) How can the lack of quality seed of these neglected but important vegetable crops can be overcome?; 3) Given the increased levels of biotic and abiotic stresses driven by climate change, as well as existing rural-urban migration trends, how can these indigenous vegetables help produce sufficient quantities of quality food?; and 4) Can greater consumption of such diverse and nutritious indigenous vegetables of India be encouraged, knowing that changing dietary habits is a difficult exercise? This article addresses some of these issues in Indian context.

Indigenous vegetables

Precise definition and explanation of the term 'Indigenous Vegetables' is required in the beginning itself to avoid any confusion and to make the reader comfortable while dealing with indigenous vegetables. Indigenous vegetables are traditional vegetables which are locally important for local food dishes, are rich in nutritional contents, and are part of the social systems but have remained neglected in terms of concerted efforts towards research and development and have yet not received global recognition. This is illustrated from the fact that global public spending on agricultural research and development reached USD 31.7 billion in 2008 and has increased at average annual rate of 2.4% since 2000, mostly driven by China, India and United States. Although, data are not disaggregated by crop, it would be safer to say that very little of this money has been spent on fruits and vegetables and virtually none of it goes into the improvement of indigenous vegetables. The term indigenous is altogether different from another obscure but seemingly related term that is 'landraces'. Although, the term landrace was first used in 1890, it was not in common use until the twentieth century. Early user of the term landrace defined it as a variety that had been grown in a certain locality for a long time and which had become adapted to local growing conditions through natural selection, usually with no intentional selection by farmers. Thus the term landrace reflected seed management in pre-industrial Europe as commonly practiced in wheat and barley. Landraces at this time were often named after a farm or a locality. Some authors used the term 'folk variety' as a substitute for landrace. Folk variety is usually defined as a 'farmers' variety' that is selected and maintained for one or more distinctive properties. They consist of mixture of genotypes all of which are reasonably adapted to the region in which they evolved but which differ in details as to specific adaptations to particular conditions within the environment. They differ in reaction to diseases and pests, some lines being resistant or tolerant to certain races of pathogens and some to other races, but not all and no particular race of pathogen is likely to build up to epiphytotic proportions because there are always resistant plants in the populations. Landraces tend to be rather low yielding but dependable. They are adapted to rather crude land preparation, seeding, weeding, and harvesting procedures

Amaranthus

Brinjal in nursery

Cluster bean

Elephant foot yam

Brinjal

of traditional agriculture. They are also adapted to low soil fertility, they are not very demanding, partly because they do not produce very much. Farmer bred varieties are better termed as folk varieties. This, the term landrace/folk variety is in relation to the term 'modern variety' which is understood as a variety that is improved by a formal breeding programme. The use of the term modern variety vs. landrace/folk variety/farmer's variety depends upon whether the product has been derived through formal breeding or has been derived through informal breeding under natural selection or through limited intervention by the farmers and these landraces/folk varieties/farmers' varieties survive alongside of modern varieties if they are characterized by distinctive traits that make them relevant in the farming system or demanded in the market. Thus, if an indigenous vegetable is subjected to modern breeding, the resulting cultivar will certainly be a modern variety and not the landrace/folk variety/farmer's variety. Another way of understanding indigenous vegetable crops is that these crops are not global but are essentially local and traditional types.

Indigenous vegetables and their importance in global context

Indigenous vegetables do not show substantial biodiversity, are adapted to local niche characterized by marginal soils and climatic conditions, and are often grown without much of external agro-inputs. Increasing use of indigenous vegetables will lead to diversification in agricultural production system; will increase crop heterogeneity which ultimately will result into better crop resilience against biotic and abiotic stresses. There are examples of successful pest and disease suppression and buffering against climate variability triggered by looming climate change in more diverse agro-ecosystems where indigenous vegetables are likely to play greater role than what is happening now. These crops are of great relevance to rural, poor, small-holder farmers with limited land resources and agronomic inputs. Relatively nutrient-dense indigenous vegetables have potential to play significant role in improving human nutrition. For example, bitter gourd (*Momordica charantia*) and tropical pumpkin (*Cucurbita moschata*) which are important indigenous vegetables in tropics possess good nutrient density. Bitter gourd fruits are rich sources of β carotene, vitamin C, folic acid, magnesium, phosphorus and potassium. Many indigenous vegetable species such as moringa (*Moringa oleifera*), amaranth (*Amaranthus* spp.), sweet potato (*Ipomea batatas*) leaves and spider plant (*Cleome gynandra*) also have high levels of anti-inflammatory phyto-chemicals, namely, flavonoids and other antioxidants that are of vital importance to human health and wellness.

Conservation and utilization of genetic diversity of cultivated and wild forms of indigenous vegetables

Indigenous vegetables have not got due attention by researchers, policy makers and funding agencies. Because of these neglects, these vegetables are threatened with extinction which may lead to reduction in biodiversity. These crops have not been fully integrated into the main agricultural production system, are grown generally on small scale using traditional technologies/indigenous technical knowhow (ITKs). *Moringa* is well known, very versatile, high nutrient density vegetable crop and commonly grown in home gardens and is not popular as a crop to be grown on large scale on commercial farms. Work on *Moringa* breeding has made good progress in southern part of India where several clonal selections have been commercialized and are popular among the farmers. These varieties from public sector research institutions include KM-1, PKM-1 (Bhagya), PKM-2, GKVK 1, 2, 3, Dhanraj, Bhagya, Konkan, Ruchira, Anupama, and Rohit 1. ICAR-Indian Institute of Vegetable Research, Varanasi has made some beginning in north India by block planting of annual and perennial *Moringa* as field gene bank and characterization, hybridization and documentation has been initiated using these types to put a full-fledged breeding programme in place. Germplasm collection of 257 accessions of *Moringa* including wild types are being maintained at NBPGR, New Delhi/its regional stations. The World Vegetable Centre, Shanhua, Taiwan's Eastern and Southern Africa seed repository conserves about 2,500 accessions of 20 indigenous crops plus some older traditional varieties of global crops. Wealth of information in genetic resources of Indian snapmelon landraces for resistance to fungal and viral diseases, nematodes and insects, tolerance to drought and salinity, genes for unique flavours, and status of genetic diversity of snapmelon in different parts of India are reported from various researchers. Snapmelon, commonly called 'phut' which means split, is native to India which is considered the centre of domestication of melon by some researchers with the earliest melons remains at the Indus valley site Harappa dated between 2300 and 1600

Flowering and fruiting in Cowpea

Fruiting in King Chilli

Jack bean

Pointed gourd-Bower system

BC. Immature fruits are cooked or eaten raw. Global breeding programmes have transferred many of these qualities into open-pollinated and hybrid cultivars of sweet melons. Snapmelon is a source of high fruit acidity, a trait that has been utilized to breed uniquely flavoured melon cultivars. Resistance genes to combat pathogens and pests and to strengthen crop resilience against climate change have been identified in snapmelon collections from various parts of India. More effort is needed to collect, characterize, evaluate, and preserve Indian snapmelon diversity in gene banks. There is urgent need on part of national gene banks to fully characterize their collections of local indigenous vegetable germplasm. The complex taxonomy of many of these species and need for accurate identification are areas where capacity building is needed.

Quality seed issues in indigenous vegetables

Quality seed supply in the required quantity of the indigenous vegetables is the major bottle neck in the development of these crops. Since research itself on these crops is meager or non-existent, the formal seed production and supply naturally remains almost non-existent. Public sector seed producing organizations are pre-occupied with seed production and distribution of major food crops where bulk seed handling is involved. Private seed companies too are not very enthusiastic to take up these crops in their formal seed business because the seed demand for these crops is scattered and that too in low volumes where seed business does not work. Accordingly, more than 75% of seed of these crops is supplied through informal sources involving farmers saved own seed, recycled seeds, gifts or exchange with other farmers. Small farmers face the problem of scientific seed production methods. For development of a more effective seed supply system, all sectors, including individual farmers, farmer groups, public seed enterprises, research and development organizations and local and multinational seed company will have to play a key role in harmony with each other to improve quality seed production and distribution of indigenous vegetables so that their impact in terms of nutritional security could be fully realized. In India, indigenous vegetable seed is sold by small private seed companies that produce and package local landraces of crops such as Malabar spinach (*Basella* spp.), kangkong (*Ipomea aquatica*) and amaranth.

Indigenous vegetables in India

The Indian subcontinent represents one of the richest diverse genetic resources. Of the estimated 2,50,000 species of flowering plants at global level, about 3,000 are regarded as food source, in which only 200 species have been domesticated. Global diversity in vegetable crops is estimated at about 400 species, with about 80 species of major and minor vegetables reported to have originated in India. However, with the advent of cut-and-burn agriculture and green revolution/ commercialized agriculture, the development project areas and related activities of these diverse resources are declining at a fast pace. Overgrazing, deforestation, and over exploitation of native resources under changed situations have eroded the biodiversity from this unique ecosystem. Moreover, traditional knowledge about these important indigenous plant species has also decreased in the younger generation influenced by urbanization. Indigenous plant species provide a variety of products like food, medicines and raw materials. They are also an important source of renewable energy. The Indian subcontinent has been one of the rich emporia of 2,500 plant species used in indigenous treatment and food sources.

Brief botanical description, distribution/diversity and uses, etc. of individual indigenous vegetable crops commonly grown in India are discussed below.

Kulfa (Purslane, *Portulaca oleracea*)

It is highly popular all over the world. It is found growing as weed in the waste land. The plant is used as vegetable, spice and for medicinal purposes. It is annual succulent plant spreading over the surface of the land. In India, it is commonly available in summer season. It has prostrate stem with reddish yellow green colour due to presence of betalain alkaloid pigment and beta xanthins. Its stem contains white milky juice. It is succulent spongy plant and contains gum like substances. Leave are small and clustered at the end of the stem. It bears yellow colour 4-5 flowers which contain hundreds of black coloured tiny seeds in ovoid capsule shape structures. It is broadly distributed throughout the world. It is successfully grown in America, India, Malaysia and Australia. It is usually self-pollinated but substantial cross-pollination also occurs. It belongs to family Portulaceae. It is rich source of omega-3- fatty acid, vitamins (A, B and C) and minerals (calcium, magnesium, iron). Stems, leaves, flower buds, all are edible. It is consumed as fresh salad, stir-fried or cooked as spinach. Having mucilaginous quality, it is used in soups also.

Shiranti (Joy weed, *Alternanthera sessilis*)

Joy weed/dwarf copper leaf belonging to family

Promising variety of Cucumber

Seedling production in polybag

Multivitamin vegetable

Variation in Lai saag leaf

Amaranthaceae is locally known as *Shiranti* in Bihar and *Sanchi* in West Bengal. This is tropical weed of shady, damp soils in cultivated and barren waste areas. In general, it is available on road sides, waste lands, irrigation canals, dykes, and fallow land. It is typically found in wetland areas having deep water up to 1 m in India, it is found as weed throughout warmer parts of country to an altitude of 1,200 m in the Himalayas. Fresh and immature shoots and leaves are eaten as cooked vegetable or in soups in many countries. It is perennial herb/weed with having 0.2 to 1 m height and strong tap roots. The stems are generally prostrate, creeping, often rooting at nodes, cylindrical with straight branches. The leaves are simple fleshy, short, petiolate, broadly lanceolate, 0.6 to 5 cm long, and 0.3 to 1 cm wide. The apex is rounded and the base cuneate. The flowers are inconspicuous, white, borne in small axillary heads; bracts are ovate, 1 mm long. The inflorescence is dense, silvery white clusters of compressed spikes on axils of leaves. Bracts are ovate, shorter, persistent, sub-equal, 1 to 1.5 mm long. Sepals are 2-3 mm long, white or purplish glabrous with hairs and strong mid-rib. Fruits are indehiscent, small, flattened, ovate, 2-2.5 mm long. Seeds are dark brown to black, hairy, shining with 1 mm diameter. Average number of seed per plant is up to 2,000. It is present throughout old world tropics, tropical Africa, southern and eastern Asia and Australia with China and south-eastern Asia as probable native places. It is propagated by seeds which fall down on the soil and germinate on onset of monsoon. The plant is rich in vitamin, C, riboflavin, calcium, iron and sugars. It is primarily consumed as cooked vegetable. In tribal belt of Jharkhand, its juice is used as medicine.

Jangali chaulai (Wild amaranth, *Amaranthus spinosus*)

Amaranth, commonly known as *Chaulai*, belonging to family Amaranthaceae in India comes under leafy vegetables. Few wild species are edible and are found growing in wild in most parts of India. The cultivated types are grown for nutritious grains and foliage. Its two species, *A. spinosus* and *A. viridis* are edible. They are annuals. It is easily available from June to November. Plants are tolerant to height and drought but cannot tolerate temperature below 8°C. Wild amaranth gets best vegetative growth in temperature range of 25 to 35°C. It has about 60 species, all annual with small seeds (approximately 0.07 g/100 seeds). In India, cultivated and wild, both species are found. *A. spinosus*, commonly known as spiny amaranth, prickly amaranth or spiny pig weed is noxious weed in rice fields. *A. viridis*, known as slender amaranth or green amaranth is commonly found in northern part of India. In rural India, it is used as vegetable on large scale in Uttar Pradesh, Bihar, Jharkhand, and West Bengal. Tribal belts of Jharkhand and Odisha use this species as best source of minerals. Grain amaranth species (*A. hypochondriacus, A. caudatus, A. cruentus*) have several health benefits. They are effectively gluten free, have a variety of medically active compounds. Amaranth oil is the best plant based source of squalene, which is a strong anti-oxidant, protecting the skin from pre-mature aging by preventing cell damage. Grain amaranth has particularly favourable composition in essential amino acids and its protein quality is much higher than conventional food sources such as wheat, barley and corn. The sum of essential amino acids in grain amaranth has been reported to range from 31.22 to 44.88 g/100 g protein, making amaranth a good source of high quality protein and nutritive substitute for some cereals in functional foods. It has C_4 photosynthetic pathway also. Wild amaranth is widely spread in India, Mexico, Guatemala, Peru, China and Nepal. Wild types do not have released cultivars. Propagation is through seed. These are highly adapted to stress conditions.

Keu (Crepe ginger, *Cheilocostus speciosus*)

Crepe ginger (family Cotaceae) is native to India. It is considered a potential invasive plant in Fiji and Hawaii. It is tall and ornamental plant used in landscaping. It can grow up to 10 feet in forest areas but typically it is a potted plant. In India, it has medicinal uses. It is a tall plant with large leaves (up to 18 cm long), dark green leaves arranged in spiral on the stalk. Flowers appear in late summer and they are remarkable in look. They form on glossy red cone-shaped bracts which stay red till flowers are finished. From each cone, 3-4 pure white crinkle flowers appear, one at a time. The attractive red-cone shaped bracts remain even after the flowers are gone. The fruits are red capsule and they contain black seeds with white fleshy aril. This is propagated by division of clumps, stem cuttings or pieces of rhizomes that are similar in appearance to thick fleshy ginger roots. It is a rich source of carbohydrates and proteins. Its rhizomes and new stems are used as vegetables in the tribal areas of Chhattisgarh, Madhya Pradesh, and Jharkhand. Rhizomes are boiled with water and the same are used as vegetables. The plant has many historical uses in Ayurveda.

Bichho grass (Nettle leaf, *Urtica dioica*)

Nettle leaf (family Urticaceae) is herbaceous perennial plant grown in hilly areas of Uttarakhand, Himachal

Pradesh, Sikkim, Meghalaya and Mizoram. The plant bears spines on the stem. The spines contain acetylcholine, histamine, 5 HT or formic acid which is responsible for itching and rashes on skin. It prefers rocks for its growth. It is found in autumn season from February to March. It is dioecious perennial plant (3.5 – 6 feet height). Soft green leaves are borne on erect stem. The plant bears brownish colour, many flowers on axillary inflorescences. Leaves and stem are hairy. The hairs on the leaves secrete chemicals during touch and cause sensation. Flowering starts in May and is completed by October. Seeds remain viable for a long time. Insects with long proboscis are pollinating agents. It is propagated via seeds and stolon. In India, it is available in hilly areas and forests and not cultivated commercially. Fresh green leaves contain proteins, vitamins (A and C), iron, calcium, potassium, manganese, fat and carbohydrates. Mature leaves contain about 40% alpha linolenic acid and omega -3-fatty acid. Spring shoots (leaf tips) are consumed like spinach. Younger tender shoots may be eaten as such or made into juice. In Uttarakhand, the plant is boiled, converted into fine pulp, cooked slowly and garnished with butter. Leaf juice mixed with water and sugar can be taken as a drink also.

Sahjan (Drumstick, *Moringa oleifera*)

Drumstick (family Moringaceae) is widely grown but on limited scale all over India except western part states like Rajasthan, Punjab and western UP, etc. In India, its young seeded pods and leaves are consumed as vegetables. It thrives well in semi-arid tropical and sub-tropical areas. *Moringa* is sun and heat loving plant and does not tolerate frost. It is dry-region crop and can be grown without expensive irrigation facilities. Flowering begins within the first six months after planting. In cool reasons, flowering occurs only once a year between February and March. In southern parts of India, few cultivars flower round the year. It is a fast growing deciduous tree which obtains 11-13 m height and trunk diameter of about 40-50 cm. Flowers are hermaphrodite with yellowish-white petals. The flowers are about 1-1.5 cm long and 2.0 cm broad. The flowers are hairy and the pods are green with hairy surface in the beginning but later on, pods get ridges with rough surface. Pods are 25-30 cm in length and contain winged seeds. Pods are drooping in nature. It is a fast growing tree, native to the southern foothills of the Himalayas in north western India and widely grown in tropical and sub-tropical areas. Leading *Moringa* growing states in India are Andhra Pradesh, Karnataka and Tamil Nadu. It is self-pollinated and propagated by seed and cuttings. Best germination of seed occurs in June-July. Cuttings of 1 m length and diameter of 4 cm are used in propagation. One third of cutting must be buried in the soil, preferably from June to August. Plants raised from cuttings, produce fruits within six months. Leaves are the most nutritious part of the plant being rich source of vitamins A, B, C and K along with manganese and protein. Leaves are cooked and used like spinach. Additionally, leaves are dried and crushed into a powder which is used in soups and sauces. Seed-pods are also a rich source of vitamin C, dietary fiber, and minerals like potassium, magnesium and manganese. Seeds sometimes removed from mature pods are eaten like peas and roasted like nuts and provide high levels of vitamin C and dietary minerals.

Sanai (Sunnhemp, *Crotalaria juncea*)

Sunnhemp is a multi-purpose tropical and sub-tropical legume grown in many parts of India. It is mainly known for fibre and fodder but flowers are used as vegetables also. Another species, *Crotalaria tetragona,* also locally knows as 'Tum Thang' has been collected from Mizoram, North-east hill region of India. It is also known as eastern rattle pod. Flowers are sold by tribal communities in local markets. Buds and flowers are cooked as vegetables and used in garnishing of local food preparations especially in non-vegetarian recipes. It is basically rainy season crop. It belongs to family Fabaceae. The plant is branched, erect, herbaceous, shrubby annual growing 3-9 feet high with bright green simple elliptical leaves. Leaves are simple, oblong (15-20 cm × 1-2 cm), carried on about 4 mm long stalks. Flowers are borne in racemes at branch ends or leaf-opposed. The flower is typical papilionaceous, as in peas, etc. It originated in India and is now widely cultivated in Brazil, Bangladesh and other Asian countries. In India, it is found in Mizoram, Meghalaya, Uttarakhand, Uttar Pradesh, Bihar, West Bengal and Assam. The other species, *tetragona* is found in Himalayas from Kumaon to Bhutan, south-east Asia and China. It is generally reported to be self-incompatible and cross-pollination is extensive. It is propagated by seed. Flowers are rich in dietary fibre, and calcium and iron. Pods and seeds have been reported to contain some toxic alkaloids but the same have not been reported in flowers. Vegetables from buds and flowers are commonly consumed in Uttar Pradesh, Bihar and West Bengal.

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Flowers always make people better, happier, and more helpful; they are sunshine, food and medicine for the soul.

– Luther Burbank