Utilization of Traditional Plant Diversity for Poverty Eradication in India

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The rich biodiversity of India comprises more than 46,214 plant species of all groups of plant kingdom and multitude of religions, casts, creeds and about 573 tribal communities. Owing to its richness in vegetation wealth and extreme diversity in floristic compositions, Indian sub-continent is designated as one of the twelve mega-centres of biodiversity in the world, representing two of the eighteen hotspots of biological diversity namely Western Ghats and North- Eastern Himalaya. Plant diversity is the basis of life for all living creature, it has great economic and environmental importance. The forests have been the lifeline for forest dwelling communities since time immemorial. Living in close association with nature and natural resources these indigenous tribes have managed and conserved the biodiversity of their localities and established a direct relationship between plants and people since prehistoric and historic periods they have developed their own cultures, customs, taboos, folk-tales, food, medicines and large number of other plants for multifarious uses. The rural and tribal women and men in these regions are repositories of vast knowledge of this biological diversity on its ecology, environment, medicinal use and cultivation techniques.

Farmers and rural communities including tribal have also discovered and maintained many local landraces of different crops which are adapted to specific local environment. Some of the indigenous cultivars conserved by these ethnic people are used in agricultural cultivars improvement programmes to increase productivity and incorporate traits for increasing resistance against different pests and diseases. The cereals, vegetables and root crops that we cultivate today as source of food, fiber and oil for our subsistence, are all gift of tribal to our modern civilized society. The dependence of tribal and marginalised population to take out their livelihoods based on the income drawn from these and other related plants is more pronounced. In the recent past these biologically rich areas are threatened of extinction due to their poor economic potential to support their livelihood in the changing socio-economic condition.

Plant diversity in traditional human food

Cereals, millets, grains, pseudocereals, pulses

Coix lachryma-jobi, Dactyloctenium aegyptium, Dinochloa scandens, Echinochloa colonum, Echinochloa crus-galli, Eleusine coracana, Oryza rufipogon, Panicum miliare, Avena fatua, Aegilops tauschii, Digitaria sanguinalis, Panicum paludosum, Oryza rufipogon, Panicum psilopodium, Paspalum scrobiculatum, Paspalum distichum, Pennisetum alopecuroides, Paspalidium flavidum, Setaria glauca, Setaria italica and *Sorghum halepanse*. These have excellent nutritive value with high protein content and are known as the "poor man's protein".

Seeds

Ripe seeds of several wild plants are very nutritious and rich in protein value. Somae of them are also planted with other crops specially to improve nitrogen content in the soil through root nodules. These seeds are eaten raw or cooked.

i. ***Eaten raw:*** *Buchanania lanzan, Euryale ferox, Nelumbo nucifera, Trapa bispinosa*, etc.

ii. ***Eaten cooked:*** *Artocarpus heterophyllus, Bauhinia purpurea, Bauhinia variegata, Bauhinia vahlii, Cicer soongaricum, Cicer microphyllum, Moghania vestita, Moghania bracteata, Mucuna capitata, Trigonella emodi, Mucuna prurita, Vigna capensis, Atylosia barbata, Atylosia scarabaeoides, Atylosia villosa, Atylosia mollisma, Atylosia platycarpa, Atylosia albicans, Atylosia candollei, Trigonella corniculata, Trigonella polycerata, Nymphaea nauchali, Nymphaea stellata, Vigna corymbosa,Vigna radiata var, sublobata, Vigna umbellata, Vigna pillosa, Vigna vexillata, Vigna aconitifolia, Vigna trilobata, Vigna pilosa.*

iii. ***Eaten after made into coarse flour:*** *Polygonum glabrum, Fagopyrum esculentum, Fagopyrum tataricum.*

Plants as traditional fruits and nuts

Fruits are the most delicious, naturally sweet and nutritive plant food eaten raw or cooked in various ways by local people and tribal communities throughout the India for sweet drinks, pickles, seasoning material, jellies and jams, brewing local beer, and chutneys are:

Aporusa dioica, Baccaurea courtallensis, Eriobotrya angustifolia, Mangifera sylvestica, Musa acuminata, M. balbisiana, M. manni, M. nagensium, M. sikkimensis, M. superba, M. Velutina, Myrica esculenta, Ensete superba, Mikosops elengii, Crataegus oxycantha, Feronia limonia, Myrica esculenta, Docynia hookeriana, Elaegnus latifolia, Elaegnus angustifolia, Emblica officinalis, Euodia fraxinifolia, Ficus plamata, Fragaria indica, Prunus sp., *Ribes graciale, R. Nigrum, Rubus ellipticus, Zizphus vulgaris, Morus spp., Myrica esculenta, Pyrus pashia, Dillenia aurea, Dillenia indica, Hovenia dulcis, Madhuca latifolia, Olax nana, Syzygium jambos, Eiobotrya japonica, Pinanga dicksonii, Rubus niveus, Phoenix sylvestris, Borssus flabellifer, Zizyphus jujube, Zizyphus xylopyrus, Zizyphus oenoplea* etc.

Plants as traditional vegetables

Vegetables are the source of vitamins and minerals, necessary for good health and growth. Even before their intrinsic value was realized, Stone Age men were using several leaves, flowers, fruits, bulbs, roots, tubers, rhizomes, corms as vegetableswhich are cultivated today.

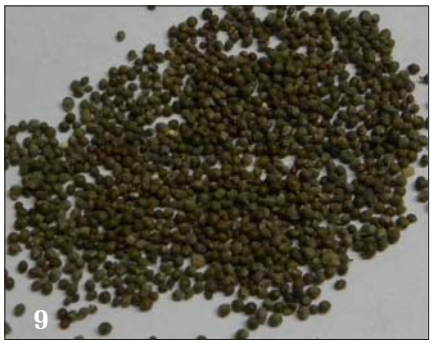
i. Aerial parts used as vegetable:

The aerial parts of the number of wild plants are being used by various tribal communities and other people in the forests, rural and urban areas of the country which may be exploited for better and larger uses.

Young foliar buds of *Ficus infectoria, Cassia tora*; young foliages with tender stems of *Amaranthus blitum, Basella alba, Ipomoea aquatica, Celosia argentea, Chenopodium album, Chenopodium murale, Digera muricata, Fagopyrum esculanta, Lathyrus sativa, Lathyrus sphaericus, Lathyrus aphaca, Moghania macrophylla, Ophioglossum reticulatum, Tetrastigma lanceolarium, Vicia sativa, Vicia hirsuta* etc.; fruits and seeds of *Madhuca indica, Ipomoea alba, Artocarpus heterophylla, Artocarpus lakoocha, Abelmoschus manihot* (tetraphyllus forms), *Cucumis hardwickii, Cucumis trigonus, Luffa graveolens, Solanum incanum, Solanum indicum, Trichosanthes multiloba, Trichosanthes himalensis, Neoluffa sikkimensis Cordia dichotoma, Xeromphis spinosa, Xeromphis uliginosa; flowral buds of Bauhinia variegate, Bauhinia purpurea, Crotalaria juncea, Luffa cylindrica, Luffa acutangula*, etc.

ii. Underground Parts used as vegetable:

Underground parts of a large number of plant species are known for vegetable of which roots, tubers, bulbs and rhizomes are used in various ways and they may be eaten raw or cooked. The tubers of *Aponogeton natans, Aponogeton crispum, Potamogeton natams, Scirpus grossus, Scirpus tuberosus;* Rhizomes of *Nymphaea pubescens, Nelumbo nucifera* and roots of *Phaseolus adenanthus* and *Pueraria tuberosa* are eaten after boiling. The giant taros and Manihot esculenta are eaten raw or cooked after repeated washing to get rid of the bitterness and pungency.



1. Broom - inflorescence stalk of *Veteria zizamioides*; 2. Fibre plant - *Pennisetum hohenackeri*; 3. Handbag made by fibre of *Pennisetum hohenackeri;* 4 & 5. Thatching plant - *Phragmites karka*; *Arundo donax*; 6 &7. Fruit plant - *Averrhoara carambola and Spondias pinnata*; 8-11. Millete 8. *Eleusine coracana*; 9. Grain of *Eleusine coracana*; 10. *Sorghum vulgare*; 11. Grain of *Sorgham vulgare.*

1. Vegetable plant- *Lathyrus hirsutus*; 2. *Nelumbo nucifera*; 3. *Dioscorea bulbidera*; 4. *Luffa echinata*; 5 -6 . Malnutritioned grand mother and child sharing experiences with scientist; 7-8, Med icine plant : 7. *Tylophora indica*; 8. *Gymnema sylvestre*; 9-10. Sacred plant: 9. *Calotropis gigantia*; 10. *Calotropis procera*.

Tuberous roots and aerial bulbils of *Dioscorea alata, Dioscorea bulbifera, Dioscorea esculenta, Dioscorea hispida, Dioscorea aculeate, Dioscorea pentaphylla, Dioscorea versicolor*, etc., are eaten cooked. The fusiform roots of *Phoenix acaulis* and *Borassus flabellifer* are consumed raw or cooked. Likewise, hundred of plants are still left uncared in the forests of which underground parts are consumed by wild animals. They may be exploited for human use.

Plants used as spices and condiments

Spices are defined as "a strongly flavored or aromatic substance of vegetable origin, obtained from tropical plants, commonly used as a condiment". In ancient times, spices were as precious as gold; and as significant as medicines, preservatives and perfumes. India - the land of spices plays a significant role in the global spices market. No country in the world produces as many kinds of spices as India with quality spices come from Kerala, an Indian state. Almost all spices are grown in this country. In almost all of the 28 states and seven union territories of India, at least one spice is grown in abundance.

Spices are aromatic flavourings made from different parts of the variety of plants. Archaeologists estimate that by 50,000 B.C., primitive man had discovered certain aromatic plants, which help him to make their food in better taste. With few exceptions, the spices and condiments known today were used early in human history. Fragrant leaves of *Allium hooker, Allium wallichii, Ocimum basilicum*, wild coriander, *Trachuspermum roxburghianum, Mentha piperata* and Eryngium foetidum; ripe fruits and seeds of *Garcinia cambogia, Zanthoxylum rhetsa, Piper scmidtii* and *Piper mullesua*; roots of *Allium stracheyi* barks of cinnamon. Vanilla, the essence of which is drawn in ice cream, chocolates and cakes, comes from an orchid. The rhizomes of *Alpinia galanga* and flowers of, *Zinziber gerumbet* and *Acacia farnesiana* are used as spice for flavouring food. Other plants are *Allium rubellum, A. schoenoprasum, A. tuberosum, Carum bulbocastinum, Amomum subulatum, Curcuma zedoaria, Alpina speciosa, Amomum aromaticum, Curcuma amada, Piper peepuloides, Myrisica beddomei, M. malabarica, Piper nigrum, P. Schmidtii, Zingiber casumunar, Curcuma angustifolia, C. Aromatica*. The leaves of *Eyngium foetidum, Murraya koenigii* and *Premna latifolia* are provide flavour to curries.

Plants for non-alcoholic beverages and alcoholic drinks

Non-alcoholic beverages

Tea from Asia, coffee from Africa and cocoa from South America are the world's favourite beverages. They all contain caffeine, a stimulant. Tea is the world's most popular beverage after water. China was the main source of tea, whose cultivation spread through trade to other parts of the world. Camellia assamica, a wild tea plant, growing in Assam, was later discovered by Brtishers. Tribal communities inhabiting in forest areas use the leaves of Cymbopogon citratus and Basella alba for preparation of tea like dink. Cooling drink is made from hairy seeds of Lepidagathis bandraensis and Ocimum basilicum. The fruits and plant of Tricopus zeylanicus is used by Kani tribes of Agasthyar Hill as "ginseng" for evergreen health and vitality (Pushpangadan, et.al. 1988). The juice of various fruits, vegetables and the clear water of the tender coconut are used as naturally sweet and refreshing drinks. Toddy or palm liquor obtained from Borassus flabellifer, Caryota urens, Phoenix dactylifer and Phoenix sylvestris is commonly used in India.

Alcoholic drinks

Tribal uses the fleshy petals of *Madhuca latifolia*, rhizomes of *Imperata cylindrica*, fruits of *Phoenix sylvestris, Syzygium cumini* and rhizome of *Cissampelos pareira* in the fermentation of rice beer. The flowers of Madhuca latifolia are also used to prepare country liquor by all tribes.

Diverse plants for traditional Cosmetics

Diverse plant species have been used for ages showing excellent results as cosmetics for men and women. More and more, plants are becoming part of cosmetics partly due to the increasing stigma of using animal products for beauty purposes. The truth is

that botanicals have been used for millions of years by all cultures for cosmetic treatments. There are a countless number of plants that hold an infinite amount of beneficial and cosmetic properties for the body. Some of the diverse species are listed us under:

Achillea millefolium, Acorus calamos, Artemisia absinthium, Allium cepa, Calendula officinalis, Avena sativa, Asplenium scolopendrium, Aloe vera, Camellia japonica, Camellica sinensis, Centaurea cyanus, Chondrus cripus, Cirtus limon (fruits), *Cirtus limon* (peel), *Citrus sinensis* (fresh flowers), *Citrus sinensis* (fruits), *Citrus sinensis* (fresh peel), *Commiphora myrrha, Cupressus sempervirens, Capparis spinosa, Carthamnus tinctorius, Centella asiatica, Cucumis sativus, Cucurbita maxima, Daucus carota, Euonymus tingens, Euonymus lucidus, Euonymus crenulatus, Foeniculum vulgare, Gentiana lutea, Glycine soja, Galium triflorum, Gynostemma pentaphyllum, Hibiscus rosa-sinensis, Hippophae rhamnoides, Hippophae tibetana, Iris germanica, Iris germanica florentina, Iris pallida, Larix occidentalis, Linum usitatssimum, Lupinus supinus, Lycopersicon esculentum, Lycopodium clavatum, Lythrum salicaria, Lilium candidum, Medicago sativa, Melaleuca alternifolia, Melaleuca leucadendron, Melaleuca viridiflora, Melilotus officinalis, Mimosa tenuiflora, Myristica fragans, Mirabilis jalapa, Nasturtium officinale, Olea europaea, Olea europaea, Oenothera biennis, Prunus dulcis, Passiflora incarnata, Plantago* spp, *Pterocaprus santalinus, Rosa centifolia, Ribes nigrum, Ribes rubrum, Sambucus nigra, Solanum tuberosum, Sorbus aucuparia, Salix* spp., *Sambucus nigra, Saponaria officinalis, Silybum marianum, Syzygium aromaticum, Symplocarpus foetidus, Trigonella foenum-graecum, Tragopogon pratensis, Taraxacum officinale, Taraxacum officinale, Terminalia sericea, Tropaeolum majus, Tussilago fárfara, Usnea* spp., *Viscum album, Vitis vinifera*.

Agricultural diversity: direct impact on development

Of all the efforts for survival and livelihood, food has remained central to many civilizations. Biodiversity provides food for humans. Although about 80 percent of our food supply comes from just 20 kinds of plants. Many people around the world depend on these species for their food. There is untapped potential for increasing the range of food products suitable for human consumption, provided that the high present extinction rate can be stopped.

The economic value of the reservoir of genetic traits present in wild varieties and traditionally grown landraces is extremely important in improving crop performance by harnessing the genetic diversity present in wild and domestic crop plants. Inter-breeding crops strains with different beneficial traits has resulted in more than doubling crop production. High biodiversity also controls the spread of certain diseases as pathogens will need to adapt to infect different species.

In agriculture and animal husbandry, green revolution popularized the use of conventional hybridization to increase yield by creating "high-yielding varieties". Often handful of hybridized breeds originated in developed countries and was further hybridized with local varieties in the rest of the developing world to create high yield strains resistant to local climate and diseases.

Hybridization has resulted in several of the indigenous breeds becoming extinct or threatened. Disuse because of unprofitability and uncontrolled intentional and unintentional cross-pollination and crossbreeding (genetic pollution), formerly huge gene pools of various wild and indigenous breeds have collapsed causing widespread genetic erosion and genetic pollution. This has resulted in loss of genetic diversity and biodiversity as a whole.

The conservation has to be looked in terms of gene bank from where potential gene flow is possible for ecological restoration and sustainable management of biological diversity. The emphasis is to be given for *in-situ* and *ex-situ* conservation, because in the ethnic and indigenous society their culture is vanishing and depleting very fast as these people have been in influence of modern culture due to rapid industrialization and urbansitation. Ethnobiologist thus has to salvage the valuable legacies before tribals culture disappear and gives birth to another culture.

The floristic diversity available in the wild relatives and related types of cultivated plants in India

is estimated to about 320 species, of which about 60 are endemic taxa. The diversity in wild relatives is largely distributed in the warm humid tropical, sub-tropical regions, western Himalayas and the north-eastern region. The range of species strength in different genera of wild relatives of crop plants and related taxa such as Cicer (1), *Sesamum* (3), and *Mangifera* (3) with very small number, others like *Vigna* (10) and *Atylosia* (15) *Solanum* (32) and *Piper* (50) are well represented. *Oryza nivara* (annual; source of rice tungro virus resistance). The wild forms of Job's tears (Coix lacryma-jobi) occur predomintaly in northeastern region, and in the peninsular tract. *Saccharum, Erianthus. Vigna radiata-* (sublobata type) provides sources of resistance to yellow-vein-mosaic virus. Wild forms of *pigeonpea* (arhar) and bushy species of *Atylosia* (*A. sericea*, and *A.lineata*) are reported to be resistant to wilt. Another important wild relative of pigeonpea are *Atylosia cajanifolia*, *Vigna umbellata, Cicer microphyllum* and *Sesamum prostratum*. Vegetables include wild okra, *Abelmoschus tuberculatus* (related to the cultivated okra, *Abelmoschus esculentus*. The wild forms of bringal are *Solanum incanum* and *S. melongena* var. *insanum*. Other wild germplasm includes species of *Momordica, Trichosanthes* and *Cucumis* (wild cucumber) and *Cucumis*, wild ginger and turmeric (*Zingiber, Hedychium, Curcuma*), wild yams (*Dioscorea*) and Taros (*Alocasia, Colocasia*).

Linkages : biodiversity and development

Agroforestry model

Agroforestry combines agriculture and forestry technologies to create integrated, diverse, productive, profitable, healthy and sustainable land-use systems, with the purpose of sustainable development. Practices are focused on meeting the economic, environmental and social needs of people on their private lands. Agroforestry practices are intentional combinations of trees with crops and/or livestock that involve intensive management of the interactions between the components as an integrated agro-ecosystem. These key characteristics are the essence of agroforestry and are what distinguish it from other farming or forestry practices. To be called agroforestry, a land-use practice must satisfy all of these criteria. Combinations of trees, crops and/or animals are intentionally designed and managed as a whole unit, rather than as individual elements that may occur in close proximity but are controlled separately. Integrated cropping models have been developed at TFRI for central Indian condition. These include: Babul-paddy (*Acasia nilotica - Oryza sativa*) model, Teak-safed musli (*Tectona grandis-Chlorophyton tuberosum*) model, Bach-paddy (*Acorus calamus-Oryza sativa*) model, *Silvi-olericulture* model.

Vegetables like bhindi, carrot, radish, spinach, cowpea and tomato can be integrated with multipurpose tree species like *Dalbergia sissoo* (sissu), *Albizzia procera* (safed siris) and *Acacia nilotica* (babul) resulting in additional perennial yield of vegetables and thus early income to the growers/ farmers.

Mushroom cultivation

Mushrooms are saprophytic fungi that convert decaying matter into their own food. The major commercial use of mushrooms is for food. However, many species are inedible or poisonous, so the ability to identify these fungi is critical to harvesting and cultivation. Mushrooms are also cultivated for other uses, such as bio-pulping processes, to reduce some of the toxic materials in municipal dumps and as dyes for textiles. There are several species of forest mushrooms, which are used for such commercial purposes. TFRI has developed technology for cultivation of two common edible mushrooms with the objectives of introducing them to the rural masses to enhance their income.

Two crops of white button mushroom and year-round cultivation of oyster mushroom can be undertaken. Cultivation of Agaricus bisporus (25 trays; 1 m x 1/2 m x 0.20 m) can give profit of Rs. 2650 per winter season. Cultivation of oyster mushroom (500 bags; 30 x 35 cm) can give profit of Rs. 5530 per month.

Ganoderma lucidum naturally occurs in the sal forest of India. It is also a parasite on several multipurpose trees like *Albizia procera*, Leucaena *leucocepha*l and *Pongamia pinnata*, etc. TFRI has worked on standardization of technology for the

commercial cultivation of this mushroom and to promote its cultivation by developing simple methodology, which can be adopted by the rural poor:

Agro-biodiversity

Agro-biodiversity plays a vital role in food security, poverty reduction and management of natural resources. Changing socio-economic conditions leads to both loss of biodiversity and the ecosystem services they render. It is pertinent to mention that of the 7000 edible species only 30 are widely used in agriculture for fulfilling human needs. Even among the thirty, only three species - rice, wheat and maize fulfill 90% of the global food needs. Therefore, there is an urgent need for widening the food basket to ensure sustainable development.

Millets are raised under inter cropping, multiple cropping, mixed cropping and crop rotation with a range of cereals, pulses and vegetables. Such cultivation practices involves combination of crops having different food value, maturity period, input period and capacity to withstand calamities, and helps in minimizing the risks, stabilizing household food supply, maintain soil health through recycling crop residue and meets.

Conclusion

The rich bio-diversity of India has been conserved by indigenous people since the dawn of civilization. Conservation of diversity, sustainable management, propagation of such valued flora and their in-situ as well as *ex-situ* conservation are the need of this century. Therefore various disciplines like Genetics, Ecology, Botany, Eco -restoration, Taxonomy, Ethno-botany, Phytochemistry, should work at one platform and linkages have to be established.

Localities dominated by ethnic people needs to be surveyed for identification of plants associated with various ethno-botanical uses and ethnic group should be encouraged for commercial cultivation of locally available plant species. This will provide great help in income generation to tribal peoples and reduction in migration rate from rural to urban areas.

Curtailing population growth, effective implementation of land reforms, augmenting further the access to education and health, improving the agriculture infrastructure, creating better and income yielding employment avenues during agriculture lean season, etc could help the government in reducing the poverty levels.

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