Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

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http://ansinet.com

Asian Journal of Plant Science 2 (9): 719-730, 2003
ISSN 1682-3974

Possibilities of Broadening the Plant Wealth of Horticulture from Existing Flora of Tamilnadu, India an Overview

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Abstract: For roughly a million years, man, by trial and error screened some plant materials for catering his needs. Now in the era of science and technology also, we accept only a handful, mostly of ancient lineage ones as major crops. There has been hardly single food crop domesticated in modern times. This led to less diversity in human diets in turn paved way for malnutrition. It is surprising to see that these nutritional ailments occur in the zones where there plenty of wild edible fruits and leafy greens with rich nutritive potential are available. So frankly speaking, we haven't given a chance for these plants to serve their best to mankind. These underutilized plants apart from their rich nutritive potential, provide variety to our diets, can be best grown in marginal lands, helps in diversification of Agriculture, ultimately leads to diversified income to farmers. Truly speaking, there exists very little basic difference between cultivated plants and weeds except that weeds are unwanted and cultivated plants are wanted. It is in our hands that whether to treat weeds as unwanted ones or crops. If research efforts are diverted to unearth the potential of these plants, one day or other day they will definitely become crop, may supersede today's well-known crops and thereby aids in broadening the horizons of horticulture. Some possible examples from Tamil Nadu, India flora are focused.

Key words: Flora of tramilnadu, plant wealth, crop plant breeding

Introduction

Ever increasing population pressure and fast depletion of bioresources poses threat to agriculturists to feed the same. For roughly a million years, man had lived virtually with the same species of plants that comprise the world's flora today. Perhaps by trial and error, but also by observation and deduction motivated by hunger, cold, pain, fear and superstition, he screened some plant material for catering his needs. Now in the era of science and technology, we accept only a handful, mostly of ancient lineage ones as major crops. This led to less diversity in human diets leading to malnutrition and under-nutrition. In contrast, let us have a look on global and national assessment of number of plant species utilizable by man as quoted by different authors.

Even though the authors' view of considering plants as economical varies, it is a common observation from Table 1 that a vast number of plants remained unexploited and under exploited. They were put into orders, classes, and families, buried in herbaria and often forgotten. We used to boast that we grow the best edible crops in the world. This statement was strongly denied by World's renowned doyen on underutilized crops Noel Viet Meyer that it is rather a myth. According to him, these selected crops are due to ingenuity and brainpower of our Stone Age forebears. There has been hardly single food crop domesticated in modern times i.e., we haven't given a chance for the remaining plants to serve their best to mankind. With today's wealth of scientific knowledge, transport and communication facilities, we can build up much wider and much safer resource base (Viet Meyer, 1990). According to Padulosi, the Head of Department of Neglected and Underutilized Species (NUS), International Plant Genetic Resource Institute (IPGRI), high quality minor crops are a better route to food security than many of today's mass produced varieties, which are very low in vitamins and minerals (Padulosi, 2001).

Coming to the concepts, these underutilized crops are variably called as neglected, new orphan, minor, under exploited, underdeveloped, lost, novel, promising, alternative, local, traditional, niche crops (Padulosi, 2001). The term 'underutilized' is commonly applied to refer the species whose potential has not been fully realized. Underutilized crops are often represented as new crops (Viet Meyer, 1990) for the fact that researchers are only recently working them.

In order to avoid confusion in using the terms, IPGRI defined these into two categories. Neglected crops are those grown primary in their centres of origin or centres of diversity by traditional farmers, where they are still

important for the subsistence of local communities (Eyzaguire *et al.,* 1999). Underutilized crops were once more widely grown but are today falling into disuse due to a variety of agronomic, genetic, economic and cultural factors. Anyway in the interest of readability, the term 'Underutilized' was suggested to refer the plants of this kind (Padulosi, 2001). Advantages of exploiting this underutilized species and the need of this topic is as follows

1: Wild edible plants are usually rich in micronutrients and vitamins there by helps in alleviating malnutrition and undernutrition (Nangju, 1999).
2: Generate diversified income to farmers as well as related sectors of society.
3: Greater use of marginal land can be achieved by growing low input underutilized crops, thereby increases production in those areas
4: These newer resources of diverse edible plant species important component of diversified ecological cropping to combat evolution of pathogen virulence and superrace thereby helps in diversification of Agriculture.
5: They provide variety to out diets, can be cooked in hundreds of ways, thereby ultimately contribute towards a better quality of life (Tsou, 1999).

Need and Opportunities in Tamil Nadu: In Tamil Nadu, about 36 million people have the ability to work, but only 0.25 million people (7.1%) have employed in organized sector such as Government sectors, banks, industries, education etc. The balance of 3.36 corers (92.9%) engaged in unorganized sectors like Agriculture, cattle rearing, trade so on.

In India, nearly 208 million peoples are undernourished. 250 million peoples are considered as poor. That is, it is a home to one fourth of World's hungry and poor people. Citizens of Tamil Nadu also exhibited more or less similar nutritional and health status. MSSRF (2001) revealed the following truths

From the Table 2, it is very clear that anemia is more prevalent in early age group and other problems viz., iodine deficit, stunting, underweight also should be taken into account. Nearly 75% infant mortality in India is attributed to malnutrition due to low nutritional levels of pregnant mothers. Malnutrition is serious is children new borne infants in weaning and post weaning periods in several areas. That is why, Viet Meyer (1990) aptly quoted that Aseveral hundred species of edible leaves hidden away in tropics. They occur in the zones where malnutrition is most severe@. They can best overcome children malnutrition. Moreover there are about 3.7 m ha of waste lands of different kinds are available in Tamil Nadu. These lands can be profitability used for growing low input requiring underutilized crops, which increases family income, enhances employment opportunities etc. Cultivation of wild economic plants generate advantages (Table 3) as stated by Khoshoo (1993).

Coming to the opportunities existing in Tamil Nadu, it is a treasure house for variety of climate, soil type, vegetation, etc. Potential cultivable areas, marginal areas are awaiting their utilization by man. Since it is coming under tropics, we can expect all the wealth expected in tropics from here also. For example, Nilgris, it is treasure for countless species of *Impatiens, Strobilanthes* and *Barleria*. It is possible in these tropics to find a wider variation within the same species, which may be helpful in the further improvement of that species through novel breeding approaches. Many new species are discovered and/or rediscovered from the hills of Tamil Nadu. ex *Paphiopedilum druryi*, is rediscovered in Kalakkad forests. Moreover these activities will provide employment opportunities for this huge human resource. Nowadays, rapidly advancing technologies including those involving molecular genetics, food processing etc. will create new opportunities for maximum exploitation underutilized species in Tamil Nadu.

Plant! Weed!! Crop!!! : Whether Competition? Confusion?? Compliment???: We all well aware of definition for weeds put forth by agronomists i.e, an unwanted plant competing with those we are trying to cultivate. Even though this definition poses a wide void between crop and weed, ecologically, they seem to be akin. There is no doubt that primitive man gathered all kinds of plant food and other produce, wherever he went i.e, as food gatherer. His gathering included definitely weed seeds along with the rest. Then, why some group of weeds alone were domesticated and others not?

Englebrecht (1916) put forward a view that certain primary crops offered themselves to the earliest collecting people by growing near their temporary settlements as 'habitation weeds' favoured high nutritive status of soil. Such plants sought man out as much he sought them out because of their specific manurial requirement. Hawkes (1969) elaborated this in a way that these habitation had already evolved large food reserves because of higher nutritional availability, thereby became favourites to man since no doubt he ate the ones in preference to smaller seeded weeds and wild plants. A similar view was also proposed by Higgs and Jarman (1972) that wild class of plants and animals merge by a continuous series of stages in degree of their intimacy with man. The basic changes that occur in a species on domestication could be due to

Table 1: Global and national assessment of number of plant species utilizable by man

Author	Year	Number of species	Nature of use
Paroda and Mal	1993	80,000	Explored by man since dawn of civilization
Myers	1983	75,000	Edible
Kunkel	1984	12,650	Edible
Uphof	1968	9,500	Economic plants
Zeven and De Wet	1982	2,489	Cultivated species (excluding ornamentals, lower plants timber plants)
Vietmeyer	1990	1,500	
Arora and Pandey	1996	1,000 (India)	Edible (wild)
Paroda and Mal	1992	536 (India)	Economic plants

Table 2: Health status of people of Tamil Nadu

Age group	Stunting (%)	Underweight (%)	Anemia (%)	Vitamin A deficiency (%)	Iodine Deficiency (%)
0-4	62.3	40.6	52.5	5.12	21.21
5-9	50.7	45.1	76.2	1.33	20.00
10-14	47.8	41.0	70.2	5.12	19.23
14-18	40.6	48.2	65.0	2.22	26.66
Mean	50.6	42.9	65.98	3.45	21.28
19-25	N.A	N.A	37.5	3.94	19.48
26-40	N.A	N.A	33.0	2.32	29.00
>40	N.A	N.A	22.0	3.96	22.36
Mean	-	-	30.83	3.41	23.61

N.A. - Not Available, Broadening the plant wealth of horticulture

Table 3: Advantages of cultivation of wild economic plants

Emphasis	Collections from wild	Cultivation
Botanical identity	Chances of misidentification	Definite
Availability of material	Questionable, definitely decrease due to over collection	Definite
Supply	Unpredictable	Definite
Genetic improvement	None	High
Protection from pests and diseases	Only natural	Can be augmented
Harvesting	Not controlled	Can be very good
Agronomy	None	Possible to increase the yield after standardization
Post harvest technology	None or poor	Can be very good
Adulteration	High	Rare if ever
Quality control	None	Large scale multiplication

selective harvesting, resowing as well as specific cultivation packages in man-made habitats. Now man starts resowing the seeds from specific plants in cleared land. This will automatically increase the fitness of these genotypes.

Originally wild ancestors of weed and crop have same degree of ability to colonize. But due to man's intervention, cultivated ones (domesticates) last the ability of their wild ancestors to successfully invade the disturbed habitats without the help of man. On the other hand, weeds are capable of establishing new populations within man-disturbed habitats without further help by man (de Wet and Harlan, 1975). This trait may due to its struggle for existence in nature.

As this domesticates were taken into areas of high altitude or any changing situation, gradually this domesticates (crop) were replaced by weeds since weeds were better adapted to such conditions of harsher climates and poorer soils than crop plants. Hence percentage of weeds increase until finally weed becomes crop since people in those areas select the best out of that environment. This concept was put forth by Vavilov (1951).

From above discussion, it is very clear that there is very little basic difference between cultivated plants and weeds except that weeds are unwanted and cultivated plants are wanted. At any time, domesticates can be weedy and weeds can become crops. Apt example for former category is domesticated ornamentals *Eichhornia crassipes*, *Lantana camara* and fodder crop *Leucaena leucocephala* etc. In contrast the acceptance of *Chenopodium album* as crop is an excellent example of latter category. It is hoped that it is in our hands that whether to treat weeds as unwanted ones or crops. If we care that weeds are also potential economic edible plants, due to our favouritism, one day or other day, they will definitely become crops, which may supersede today's well-known crops. It we start thinking of the same, then these wild plants become compliments to us.

Where we are! How to proceed?: Upon reviewing the literatures regarding new economic plants of national and international importance, following sources may find the best.

Internationally: Bruner, 1989. Useful Plants of Neotropical Origin and their Wild Relatives. Springer Verlag, London.

Table 4: Comparison of nutritive value of underutilized species with commercial as well as accepted fruit crops (CSIR, 1956; Aykroyd 1956; Gopalan *et al.*, 1999)

Nutrient	Wild species	Commercial crop	Known crop
Carbohydrate (%)	*Phoenix sylvestris* (39.3)	Banana(27.4)	Durian (34.1)
	Eleocarpus oblongus (36.2)	Mango (16.9)	Date (33.3)
	Mimusops elengi (35.9)	Apple (13.4)	Bael (31.8)
	Zizyphus rugosa (33.3)		
	Mimusops hexandra (27.7)		
	Diospyros melanoxylon (26.3)		
Protein (%)	*Eleocarpus oblongus* (7.9)	Banana (1.2)	Wood Apple (7.1)
	Pithecellobium dulce (2.7)	Mango (0.6)	Durian (2.8)
	Berberia chitria (2.3)	Apple (0.2)	
	Mimusops elengi (1.8)		
	Cordia dichotoma (1.8)		
Fat (%)	*Spondias pinnata* (3.0)	Apple (0.5)	Avacado (22.8)
	Mimusops hexandra (2.4)	Mango (0.4)	Durian (3.9)
	Flacourtia indica (1.8)	Banana (0.3)	Wood apple (3.7)
	Atrocarpus lacucha (1.1)		
Fibre content (%)	*Catunaregam spinosa* (9.5)	Apple (1.0)	Passion Fruit (9.6)
	Vaccinium leschenaultii	Mango (0.7)	Guava (5.2)
	Rhodomyrtus parviflora (15.6)	Banana (0.4)	Pomegranate (5.1)
	Ziziphus rugosa (4.9)		
	Psidium catteleyanum (4.8)		
	Flacourtia indica (4.7)		
Phosphorous (mg 100^{-1}g *of fresh weight of fruit)*	*Flacourtia indica* (100)	Banana (36)	Wood apple (110)
	Pithecellobium dulce (49)	Mango (16)	Rasp berry (110)
	Cordia dichotoma (30)	Apple (14)	Avocado (80)
	Aglaia domestica (30)		
Ca (mg 100^{-1}g of fresh *weight of fruit)*	*Cordia dichotoma* (212)	Banana (17)	Wood apple (130)
	Flacourtia indica (114)	Mango (14)	Phalsa (129)
	Mimusops hexandra (83)	Apple (10)	Lime (90)
	Diospyres melanoxylon (60)		
Fe (mg 100^{-1}g of fresh weight of fruit)	*Eleocarpus oblongus* (3.11)	Mango (1.3)	Black berry (4.3)
			Phalsa (3.1)
			Rasp berry (2.3)

Table 5: Comparison of nutritive value of underutilized species with commercial as well as accepted vegetable crops (Ayrkord, 1956; Gopalan *et al.*, 1999)

Nutrient	Wild species	Commercial crop	Known crop
Carbohydrate (%)	*Dioscorea hamiltonii* (28.8)	Onion (11.1)	Tapioca (38.1)
	Dioscorea versicolor (24.4)	Tomato (3.6)	Sweet potato (28.2)
	Eleocharis dulcis (23.3)		Potato (22.6)
Protein (%)	*Tribulus terrestris* (6.1)	Brinjal (1.4)	Agathi (8.4)
	Colocasia antiquorum (6.8)	Onion (1.2)	Pea (7.2)
	Acalypha indica (6.7)	Tomato (0.9)	Drumstick (6.7)
	Boerhaavia diffusa (6.1)		
Fat (%)	*Colocasia antiquorum* leaves (2.0)	Brinjal (0.3)	Drumstick (1.7)
	Cleome viscosa (1.8)	Onion (0.3)	Colocasia (1.5)
	Marsilea minuta (1.4)	Tomato (0.2)	Agathi (1.4)
	Acalypha indica (1.4)		
Fibre (%)	*Amaranthus viridis* (6.1)	Brinjal (1.3)	Drumstick(4.8)
	Suaeda maritima (3.8)	Tomato (0.8)	Cluster bean (3.2)
	Acalypha indica (2.3)	Onion (0.6)	Pointed gourd 93)
	Digera muricata (2.2)		
	Malva chinensis (2.1)		
Calcium (mg 100^{-1} g *of fresh weight)*	*Oxalis corniaculata* (5600)	Onion (47.9)	Agathi (1130)
	Tribulus terrestris (1550)	Tomato (48)	Curry leaves (813)
	Cleome icosandra (880)	Brinjal (18)	
	Amaranthus spinosus (800)		
Phosphorous (mg 100^{-1}g *of fresh weight)*	*Eleocharis dulcis* (150)	Onion (50)	Carrot (530)
	Nasturtium officinnale (140)	Brinjal (47)	Parslay (175)
	Colocasia antiquorum (125)	Tomato (20)	
Carotene (Fg 100^{-1}g *of fresh weight)*	*Colocasia antiquorum* (12,000)	Tomato (351)	Amaranthus
	Cassia tora leaves (10,152)		hypochondriacus leaves (14190)
	Rumex vescarius (9440)		*Basella alba* leaves (7440)
	Amaranthus spinosus (3564)		
	Oxalis corniculata (3600)		Amaranth (5520)
Riboflavin (mg 100^{-1}g *of fresh weight)*	*Dioscorea versicolor* (0.47)	Tomato (0.06)	*Amaranth (0.30)*
	Nasturtium officinale (0.38)	Brinjal (0.01)	*Mint (0.26)*
	Colocasia antiquorum (0.45)	Onion (0.01)	

Kunkel, 1984. Plants for Human Consumption. Koelz Scientific Books, Koenigstein, Germany.
Martin *et al.,* 1987. Perennial Edible Fruits of Tropics. Agriculture. Hand Book No. 642. Agricultural Research Service, United States Department of Agriculture, USA
Myers, 1983. A Wealth of Wild Species. West View Press, Boulder, Colorado.
Uphof, 1968. Dictionary of Economic Plants. Hafner Service Agency, New York

Nationally: Well known "Dictionary of Economic Products" 1889-1893 compiled by George Watt is the source book on bringing out the latent potential of wild plants of India. Then comes Council for Scientific and Industrial Research's (CSIR) "Wealth of India" 1948-1992, Indian Council of Agricultural Research's (ICAR) A Dictionary of Broadening the plant wealth of horticulture. Economic Plants in India@ and Wild Edible Plants of India by Arora and Pandey (1996) are notable ones. The attempt by Sundararaj and Balasubramanyan (1959) namely "Guide to the Economic Plants of South India" can cater some aspects of so called underutilized crops.
Little decade back, World people realize the importance of promoting the use of underutilized species. This led to the development of various societies, organizations, workshops etc. In India, also this activity is slowly getting momentum.

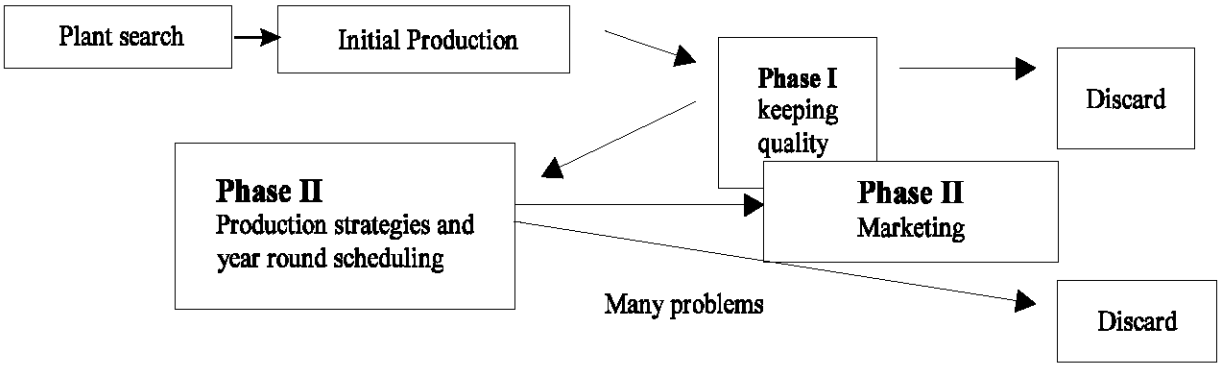
International Level:

1: IPGRI started a new department "Neglected and Underutilized Species". Its strategy for meeting challenges of the promotion of underutilized and neglected species is based on the promise that the broader the deployment of plant genetic diversity in agriculture, the more balanced and sustainable are the patterns of development.
2: ICUC was started by IPGRI in the year. It is the centre devoted wholly to underutilized crops. Its mission statement 'food security, improve nutrition, economic welfare of Human beings raised through sustainable and increase economic production of food and industrial raw material. This is achieved by developing and utilizing biological diversity of underutilized crops. It publishes News Letter (half yearly) and Annual Report. It has tie up with all institutes concerned with conservation and utilization of underutilized species. For further details, please visit http//www.soton.ac.uk
3: A working group on wild tropical and subtropical plants with horticultural potential is started by International Society for Horticultural Sciences (ISHS) in 1982. Its ultimate aim is to promote awareness and interest in research and conservation of species which are of use to man kind (Bedgley and Gardner, 1989).
4: Food and Agricultural Organization of United Nations (FAO) also involved in this aspect by constructing Underutilized Tropical Fruits Asia Network (UTFANET).
5: Global forum on Agricultural Research (GFAR) is interested in enhancing the use of underutilized crops through strengthening of production chain.
6: IPGRI, Purdue University, and FAO organized various proceedings in recent times, specifically to Asia Pacific Oceania (APO) region. An expert consultation on science for sustainable food security, nutritional adequacy and poverty alleviation by M.S. Swaminathan Research Foundation (MSSRF) in collaboration with APO was conducted very recently in Chennai during 25-28 June 2001. It is famously called chennai declaration.

National level: National Bureau of Plant Genetic Resources (NBPGR) has started All India Co-ordinated Research Programme (AICRP) on underutilized crops in 1982. Apart from this, Botanical Survey of India (BSI), National Botanical Research Institute (NBRI), MSSRF and Indian Council of Forestry Research and Education (ICFRE) are also doing some good jobs.
Coming to present status of work, the Plant Kingdom is immense and greater than that believed by applied botanists. Taxonomists are very particular about their biosystematics work. On the other hand, Agriculturalists are very pertinent about so called traditional major crops. Moreover generally, students of applied botany and general botany give less importance to the basic but needed taxonomic studies. In this connection, famous gardeners of last century *viz.,* L.H. Bailey, A.B. Graf, H.F. MacMilllan and Percy Lancaster are still remembered with respect due to their contribution to taxonomy.

How to proceed?: It involves all the aspects promoting the commercial utilization of underutilized crops. IPGRI has get up eight steps for achieving the same.

1: Priority setting
2: Survey, collection, conservation
3: Characterization, evaluation and enhancement
4: Information, documentation and capacity building
5: Policy and legal aspects



6: Marketing and communication
7: Public awareness
8: Partners and partnership

Special need to mention something about conservation, categorization and evaluation.

Conservation: Usually while collecting wild forms, we should be aware of endangered and threatened status of a species or genus. We must be aware of preserving germplasm and not allowing our selections to derive from too narrow a genetic base. So these effects should therefore to be critically analyzed by environmentalists and ecologists. As Kunkel (1984) rightly pointed out "publications of any list of edible plants could be considered dangerous to plants in wild" and this must be fully acknowledged. Biodiversity safeguarding should be in three levels as areas such as diversity of ecosystems, diversity of species, and diversity of gene pool within the species. *In situ* conservation hold diversity of both known and unknown species, which continues to evolve in its prevailing environment. In context of wild plant wealth, a larger percentage of which occur in wild habitats, so more stress needs to be laid on *in situ* conservation. This type of conservation also increases the probability of conserving large range of potentially interested alleles. Moreover, it is especially adapted to species, which can't be established outside natural habitats. For example, Species with highly specialized breeding systems and seeds presenting fugacious germination.
According to survey by MSSRF and BSI in Tamil Nadu, 171 species were reported to endangered (MSSRF, 1994). According to Padulosi (1999) less than 8 accessories on an average per species were presented in *ex situ* gene bank for underutilized species.

Characterization and evaluation: It is done through analysis of nutrient contents, agromorphological traits needed for increasing their use in the agroecosystems and increasing market demands. Theory of climate Analogues by Vavilov (1951) can hold fit for plant introduction into new areas. Meteorological factors such as moisture, relative humidity, and day length are to be taken into account. According to Fritz (1989), prior to introduction of new unknown species to a special area, they have to be tested for their suitability for human nutrition and for any harmful substances. Out knowledge of composition of food plants often is limited to energy, protein and vitamin levels. But tests to determine the suitability of plants, as edible have to include every desired and undesired secondary plant substances, thus give nutritive value. This includes essential oils, acids, flavanoids, alkaloids glycosides etc. So for development of unconventional sources for direct human use nutritive value of protein, their safety functionality, processing methodology as well as acceptability are to be taken in to account.
According to Chen (1999) for evaluating any underutilized species for vegetable purposes, nutritive value, texture (freshness, crispness, tenderness, and succulence), size, shape, flavour, defects etc.
For pot or cut flower crop, Armitage (1986) suggested the need of systematic approach in screening species or cultivars.

Potential wild species as fruits: Tamil Nadu has rich diversity in genetic resources of various fruits of indigenous and exotic origin and serves as a reservoir of a large number of indigenous minor fruits (Table 6). They are multipurpose trees, which could supplement and increase the quality of diets, provide fodder, fuel wood, timber, and medicine for rural populations. Consumption of this fruit species enables particularly rural people to obtain nutrients for balanced diet, supplement family income and increase household food security (Gunasena, 1999). Their wide adoption in marginal lands, income-generating ability, nutritional value contribute towards food security, diversification with other crops, use in agro forestry system and environmental conservation. These fruits are highly suited to localize chemical conditions and

Table 6: Some promising underutilized fruits species

Scientific Name	Common and vernacular name	Location	Particulars	Author
Artocarpus lacucha	Monkey jack *Illagusam*	Western ghats	Ripe fruit is used as a preserve for chutney	Arora and Pandey (1996)
Phoenix sylvestris	Wild Date Palm *Eccham*	Common in drier parts of India	Fruits are consideredrestorative, richest source of minerals.	Parmer and Kaushal (1983).
Morus alba	White mulberry	Srivilliputhur, Nilgris	Fruits are juicy, rich in sugars (10%), Fe (2.3 mg/100g), used in preparation of jam.	Krishnamurthy (1955)
Feijoa sellowiana	-	Coonoor, Nilagiri, Shevaroy and Kodaikanal kills	Fruit juice is utilized for aromating non-alcoholic beverages	Naik (1948)
Phyllanthus acidus	Star gooseberry *Aranelli*	Western Ghats	More ridges on fruits produce a year round crop.	CSIR (1956)
Rhodomyrtus tomentosa var. *parviflora*	Hill guava, Hill gooseberry *Thavattuppalam*	Pulney, Nilgris	Fruits-fleshy, aromatic, available in Oct-Dec, Jam-Jellies	Krishnamurthy (1955)
Psidium cattleyanum	Strawberry Guava *Cheemai koyya*	Nilgris	Eaten fresh or made into excellent tart, jam and jelly.	Ladin (1957)
Annona muricata	*Mullu seetha*	Kanyakumari District	Large fruits on older branches from September onwards; young fruit is cooked used in soups. Pulp of mature fruit is white, fleshy, fibrous rather coolly, acidic and juicy.	CSIR (1948)
Opuntia stricta var. *dillenii*	Prickly pear *Naga thali*	All parts	Introduced, able to thrive in poorer and driest soil, easy to propagated, fruits, mucilaginous, edible, sweet with blend of acid, alcoholic drink also.	CSIR (1956)
Rubus ellipticus	*Mullihannu* (Paduga Language)		One of the tastiest wild fruit in hills, used in jam preparations	Parmer and Kaushal (1983)
Aprorusa lindleyana		Wet Evergreen forest	Fruit edible `	Arora and Pandey (1996)
Capparis decidua	*Khair*	Dry tracts of Tirunelveli District	Fruits generally pickled, Red ripe berries are also eaten	Arora and Pandey (1996)
Capparis zeylanica	Athandai	All Carnatic District of Tamil Nadu	Pulp in red berries eaten, some time used in curries	Arora and Pandey (1996)
Chrysophyllum cainito	Star apple	Nilgris	Green purple fruit apple shaped, pulp B whitish and soft, sweet when mature.	Krishnamurthy (1955)
Cyphomandra betacea	Tree tomato	Nilgris	Pulp is light orange in colour with black seeds fruit sub acid, jam is prepared	Krishnamurthy (1955)
Monstera deliciosa	Cerimon	Nilgris	Soft pulp of fruit is delicate pineapple like odour	Krishnamurthy (1955)
Syzygium malaccensis	Malayan apple		Fruit B good; subacid flavour, propagated by seed or in arching with *S. jambos*	Krishnamurthy (1955)
Chrysobalanus icaco	Coco plum, Spanish nectarine	Nilgris	Small reddish purple, plum like fruit having a large kernel surrounded by white soft sweetish but scanty pulp.	Krishnamurthy (1955)

provide food source for many years but not suited to long distance transportation.

As per MSSRF (1994), Tribes of Tamil Nadu depend on fruits of *Bridelia crenulata*, *Bridelia retusa*, *Clausena heterophylla*, *Cordia obliqua*, *Memecylon edule*, *Premna tomentosa*, *Canthium dicoccum*, *Diospysos ferrea* var. *buxiifolia*, *Ficus racemosa*, *Glycosmis pentaphylla*, *Madhuca longifolia*, *Palaquium ellipticum*, *Polyalthia cerasoides*, *Schleichera oleosa* and *Terminalia bellerica* nutritional value of this wild fruits is one of the most deciding factor as a viable one among people. So their nutritional value and related informations were gathered form various sources and compared with traditional commercial crops and accepted crops having maximum of those particular nutrition (Table 4).

According Arora and Pandey (1996), *Artocarpus lakoocha* and *Spondias pinnata* are rich in Vitamin A, *Hippophae rhamnoides* B Vitamin C, *Rubus fructicosus*, *Spondias pinnata* B Fe; *Rhodomyrtus parviflorus* B K; *Flacourtia indica*, *Ziziphus rugosus* B P, Ca.

As vegetables: A large number of wild plants are consumed as leafy vegetables. Arora and Nayar (1984) have described diversity in less known leafy edible types in India belonging to 52 families, 136 genera and 218 species. In Tamil Nadu much diversity occur in

Table 7: Some promising under utilized vegetables species (Arora and Pandy, 1996)

Scientific Name	Common and vernacular name	Location	Particulars
Oxalis latifolia O.debilis var. corymbosa	-	Nilgris, Pulney	Java, substitute for tamarind
Sagittaria trifolia		Aquatic	Rhizomes B vegetable
Aeschynomene aspera	Solapith plant	Marshy areas	Tender leaves eaten
Amaranthus spinosus	*Mullukkeerai*		Rainy season spiny herb cooked like other *Amaranthus* spp.
Boerhaavia diffusa	Spreading hog weed *Mukkarattai*	All areas	Eaten as vegetable
Rivea hypocrateriformis			Climbing shrub, leaves and young shoots are boiled with salt and chilli, used as vegetable
Sesuvium portulacastrum	Sea purlane	Mangroves, Kanyakumari District and other coastal areas	Succulent herb, leaves and twigs used as spinach
Suaeda maritima		Coastal areas especially in Picchavaram	Fleshy leaves B edible
Tribulus terrestris	*Nerringi*	Dry tracts	Leaves potherb
Typhonium trilobatum T.bulbiferum	*Kattucchempu*		Tubers are eaten after boiling
Hydrocotyle javanica		Western Ghats	Leaf-vegetable by 'Nagas'
Momordica tuberosa		Tirunelveli District	In black cotton soils, trailing plant with herbaceous shoots from tuberous rootstocks. Fruit B dark green, ribbed 2.5 long, edible
Pistia stratiotes		In ditches	Young leaves are cooked and eaten by Chinese
Amaranthus viridis	*Kuppaimeni*	All places	Leaves B edible

agromorphological characteristics of minor leaf vegetables belonging to genera such as *Atriplex*, *Malva*, *Polygonium*, *Tetragonia, Portulaca* etc. The leaves, young shoots being eaten cooked or used in soup like preparations or in salad. Mainly leaf vegetables are excellent sources of Vitamin A, C, minerals, fibres and Protein.

They help to reduce the rich of certain cancers. They are low in calories, Na, fat and Cholesterol (Table 5).

As a thumb rule, almost all-dark green vegetables are more or less similar in their nutritive value and the method of preparation. White or light coloured leaf and sprouts such as Bamboo have low nutrition. Approximately, 80 percent of the most popular dark green leafy vegetables are wild pants and are mainly gathered for home consumption (Table 7).

Tubers of many wild species are very arid and bitter. It was made edible by coursing with ashes and steeping in cold water (Tiwari, 1994). According to MSSRF (1994), trials of Tamil Nadu depends on the leaves of *Dioscorea bulbifera*, *D. oppositifollia*, *D. pentaphylla*, *D. tomentosa*, *Cansjeera rheedii* (locally *Pazhuvi, Teempilikkeerai*), *Allamanda nodiflora*, *Cocculus hirsutus*, *Commelina benghalensis*, *Lycianthes laevis*, *Mukia maderaspatana, Rhapidophora pertusa, Talinum cuneifolium, Trichosanthes nervifolia, Digera muricata* and *Cassia occidentalis*.

Apart from main use of some trees, secondarily, their leaves are edible as evident by leaves of *Bauhinia* sp., *Ficus pseudopalma*, *Premna odorata* etc. (Altoveros, 1999).

New floricultural crops: Strictly speaking all plants bear flower, but only in some species, are they sufficiently showy to be classified as ornamentals. Here colour and attraction of plant (leaves, flowers etc) have the role in their inclusion in garden. The basic of interest in genetic resources of ornamental plants is examined with respect to the relationships between their aesthetic and utilization aspects. They should be resistant to pathogen. As purchasing capacity of the population increases, most of the people look for new plants with strong colour and direct appealing effect suitable for mass production (Klougart, 1987).

Flowry (1983) reported that use of wild flowers in parks; roadsides and golf course reduced maintenance cost and increased beauty.

There are hundreds of wild plants with showy flowers. But it is very difficult to convince all types of people with few selected plants from the whole number. The reason is individuals= likeness on colour, aesthetic views differ

Nilgris and other adjoining hills is the native home for number of *Impatiens* spp (70), *Strobilanthes* spp. (46), *Barleria* spp. (16) (Gamble, 1957). In Viola also 3 species are commonly seen in Nilgris, Anamalai, Pulney and Shevaroy hills viz. *Viola betonicifolia*, *Viola hamiltoniana*, *V. pilosa* etc. Babu *et al.* (1993) narrated the potential horticultural value of *Clerodendron* spp. Some commonly available weed speices of Tamil Nadu with ornamental look are as follows.

1: *Stachyterpheta mutabilis, S. jamaicensis (Ezhuththani pondu), S. utricifolia (Tiruvilai nakku)*
2: *Barleria prionities* for its exquisite yellow flowers
3: *Biophytum sensitivum* - a weed in black cotton soils of South Tamil Nadu. Very ornamental
4: *Ageratum conyzoides* - flowers are ornamental, good source of pollen for bees (CSIR, 1948-1992)

Other potential species from Tamil Nadu are as follows:

***Aystasia travancorica*:** A large ornamental shrub with narrow leaves found in Anamalai hills upto altitude of 900-1000 m. There are several varieties with white, pink, cream, blue coloured flowers. It can be propagated from terminal cuttings or from seeds. (Subramanian and Nair, 1971)

***Anemone rivularis*:** Native of higher elevations *viz,* Nilgris, Anamalai, Pulney hills (CSIR, 1992)

***Paphiopedilum druryi*:** Once considered as extinct B now rediscovered in Kalakkad forest with good ornamental look.

***Hedychium flavescens*:** Found in high ranges adjoining kerala. It grows on hillsides and flowers during April B August. Flowers are creamy yellow with deep yellow centre. Propagated by rhizomatous shoots or suckers. *Hedychium coronarium*, another beautiful species found in hills of 1000 m elevation (Mathew, 1991).

***Gymnostachyum febrifugum* var. *bracteatum*:** Found from Western Ghats, domesticated new leg for its beautiful pink flowers.

Native Genetic resources of Jasmine were mentioned the works of Bhattarcharjee (1980), Khader and Kumar (1993).

Spice, condiment and plantation crops: There are limited plant species available in this category.

1: *Pandanus amaryllifolius* - fragrant leaves add spicy flavour to the cooked area (Arora and Pandey, 1996).
2: *Clausena indica* - aromatic leaves are used for flavouring curries.
3: *Cyperus esculentus* - tubers are ground in powder and used as substitute for coffee and cocoa (Arora and Pandey, 1996).
4: *Decalepis hamiltonii Mahalikizhangu* Climbing shrub in Western Ghats of Tamil Nadu usually present along slopes (400 B 1100 m). Aromatic sarsaparilla like tested roots is used as spice and condiment. Roots are fleshy and pickled with lime or as such (Arora and Pandey, 1996).
5: *Piper schmiditii* - Nilgris pepper Found especially in shola forests of Palani, Nilgris hills above 1500 m. It was reported to be used as spices or condiment among indigenous populations of Nilgris (Krishnamurthi, 1955).
6: *Lepianthes umbellata* Leaves are used as a seasoning material. In Phillipiness, young leaves and flowers are boiled with fish for flavouring (CSIR, 1956).
7: *Piper trichostachyon* - Pouched pepper Found in

Table 8: some of the toxic compounds present in some wild edible plants (Harborne, 1996)

Species	Compounds
Citrullus colocynthis	Cucurbitacin K, colocynthin (in seeds and roots)
Oxalis sp.	Oxalates (decreases the absorption of Ca)
Solanum torvum	SolosodineB It is potentially toxic if several fruits are consumed
Phyllanthus reticulatus	Pyrogallol

Table 9: Future line of work

Problems	Relevant activities
Lack of genetic material	1:Setup local germplasm supply systems among rural communities 2:Initiate participatory programme
Loss of germplasm and traditional knowledge	1:*Ex situ* and on farm conservation 2:Assess distribution of species and genetic erosion threats 3:Collect local knowledge using participatory approach
Lack of knowledge on uses, constraints, opportunities	Participatory survey and survey for gender and other socially significant factors
Limited income generation	1:Value addition through processing, marketing, commercialization etc. 2:Investigate and identify improved agronomic and production procedures
Market commercialization and demand limitation	1:Strengthen operational link in the seed supply system, processing and distribution stakeholders. 2:Develop improved low cost processing technique 3: Analyze and identify market opportunities
Lack of research and development activities and weak national capacities	1:Carry out training courses for researchers 2:Community based participatory courses 3:Characterize crops for agronomic, nutritional and market related traits. 4:Study formal and informal classification system i.e taxonomic studies 5:Investigate methods of maintaining & enhancing nutritional value 6:Investigate new areas of crop growth and
Lack of links across conservation and production to consumption	1:Hold planning work shops for all stake holders 2:Strengthening operational links between stake holders
Inappropriate and/or inadequate policy and legal frame works	1:Identify those in appropriate policy / legal elements. 2:Undertake public awareness actions among policy markers 3:Establish close partnership with extension workers and others involved in agricultural development.

Western Ghats upto 750 m. especially in Sivagiri hills of Tirunelvelli District. It has fragrant spikes and large fruits.

8: *Cleome viscosa* *Manja kadugu* Common wayside weed found in dry riverside or even in poor soil, locally abundant, as a weed of cultivated, in fallow seeds are good substitute for cumin. It grows naturally from seed in rainfed agricultural lands and abandoned fields at attidues ranging from 500 B 1500 m. It provides three times higher yield when maintained by farmers as pure crop compared to yield obtained in mixed cropping conditions (Mainkhuri *et al.*, 2000).

9: *Pinanga dicksonii* A straggling palm found in Nilgiris and Tirunelveli hills at altitude of 300 B 900 m. Fruits are used as substitute for betel nut

Hurdles to Promote Their Utilization and Future Line of Work: The main disadvantage of promotion these wild edible species is the fear on anti-nutritional/toxic factors present in those edible parts (Table 8). According to Kunkel (1984), not all plant parts said to edible are invariably also eaten and the factor of palatableness is best left open to discussion and regional preferences. Most toxic foods are discovered when an attempt was made to use food for nutritional purpose. The people who had limited food resources early recognize the toxicity of their food.

We all know toxic constituents are genetically determined components of plant. As a thumb rule, legumes may have proteinase inhibitors; crucifers contain glucosinolates (Liener, 1980) common anti-nutritional factors and trypsin inhibitors, phytates, tannins, oxalates, goitrogens.

So, for alleviating these hurdle, one should know hot to eat, which part, relative toxicity etc. Normally boiling drastically reduces acridity, astringency, proteinase inhibitors etc. Boiling and cooking is largely practiced in tuber crops because of the presence of calcium oxalate crystals is tuberous forms. Boiling removes acridity and renders tubers edible as vegetables. Many legume leaves have toxin, so Barett (1990) advised boiling and cooking followed by decanting the cooked water. Breeding and biotechnological approach should be concentrated on these particular aspects. Already a success story i.e., elimination of β-Oxalyl Amine Alanine (BOAA) from *Lathyrus sativus* through antisense RNA technology by Chopra and his coworkers in Indian Agricultural Research Institute, New Delhi is a noteworthy example in this context.

Other major problems for research and development work on underutilized species and outputs required for the same and things to be done are in Table 9. This forms future line of work (Modified from Padulosi, 2001).

It is not wrong to believe that in nature's treasure house, there are many botanical jewels just waiting for their turn to serve human being. Unfortunately for mankind, these plants have no advertising agencies to promote a market for a mine of still unknown and hidden compounds. We are not exaggerating that all are promising resources. But if we dedicate or divert a fraction of our Agricultural research efforts and funds to explore these less known species, we are sure that, we can seek out botanical emeralds and rubies i.e., number of substitutes even better many emerge out. We have to stop neglecting these species in our research. To achieve this, a combined effort of botanist, horticulturists, plant breeders and biochemist is needed. This indicates the urgent need for elaborate survey to unearth the potentials of plants in all aspects of human welfare.

In Tamil Nadu, the regions enclosing Western Ghats possess several species rich habitat that are not yet explored. The explored regions are not intensively studied for taxonomic diversity and utility. An untapped potentiality not only exists in forests, but also in grasslands, swamps, riverbanks, deserts etc. The selected diversity out of this assemblage of species and over all variation can be domesticated and further exploited. That is they have to be raised from their present status as plants to the needed status as crops. It is inevitable that opinion will vary on the relative merits of these wild horticultural species. There may be some better species with better horticultural characters than those mentioned by us. Nevertheless we feel, it may pave way for research scientists, conservationists and policy makers who are interested in developing and alternate food sources.

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