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CONSERVATION, UTILIZATION AND CONSTRAINTS OF UNDERUTILIZED CROP SPECIES—A REVIEW

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ABSTRACT

India is one of the hot spots of world's biodiversity having wealth of different Plant species. The crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized crops. Underutilized crops are lesser-known plant species in terms of marketing and research, but well adapted to marginal and stress conditions. The popularity of these horticultural crops varies from crop to crop and locality to locality, which however, can be enhanced to a greater extent through publicity. Their indigenous potential and ethnobotanical data are well known to people, whereas, commercial importance and market value is unknown to the public. The survey conducted and the indigenous data gathered gave information that, UUC's make Indian economy sounder and in many cases benefit the environment as well, by replacing the depleting resources with the new ones. The Indian government policies and strategies for food security should take into account the diversity of underutilized crops. Although the options for scaling-up neglected crops for large-scale agriculture appear to be increasingly exhausted, many species have the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation. There is need to compile and disseminate that knowledge in order to help maintain cultural traditions and facilitate research into food history and new food sources. Due to unsustainable market pressures and rapid urbanization, majority of these species have come to near extinction. A holistic approach is hence proposed which includes both *in-situ* and *ex-situ* conservation strategies, as well as re-governance of the market chain. Reinforcement of their domestication through standardization of cultivation practices, facilitation for supply of planting material and increasing the demands for the produce by exploring their uses, creation of awareness among consumers and establishing a good distribution network are also crucial for attaining sustainability.

Key words : *Underutilized crops, diversity, conservation strategies, utilization, sustainability*

Global food security and economic growth now depends on a declining number of plant species. In human history, 40- 100,000 plant species have been regularly used for food, fibers, shelter, industrial, cultural and medicinal purposes (Magbagbeola *et al.,* 2010). However, only a small number of plants are widely used. The remaining plant diversity is underutilized (Jaenicke *et al.,* 2006). Agriculture in today's context is one of the most important sources of renewable wealth in the world. There are many plants species still lying unexplored and underexploited. Therefore, there has been focused attention by the researchers on exploiting alternative or underutilized plant species for multifarious use. "Underutilized crops" are plant species that are used traditionally for their food, fiber, fodder, oil or medicinal properties, but have yet to be adopted by large scale agriculturalists.

Kunkel (1984) discussed that once underutilized food crops are properly utilized, they may help to contribute in food security, nutrition, health, income generation and environmental services when properly utilized. The underutilized foods can also be defined as ¯the foods which are less available, less utilized or rarely used or region specific (William and Haq, 2002). According to Dansi *et al.,* (2012) many neglected and underutilized species are nutritionally rich and adapted to low input agriculture. The erosion of these species can have immediate consequences on the nutritional status and food security of the poor. Their enhanced use can bring about better nutrition and fight hidden hunger. For example, many underutilized fruits and vegetables contain more vitamin C and pro-vitamin A than widely available commercial species and varieties. With the increasing population pressure, India is facing serious challenges of food security, unemployment and environment degradation. About 65 per cent of the Indian population is presently living in rural areas and 85per cent of these rural families are dependent on agro-based activities for their livelihood (Williams and Haq, 2002).

Underutilized or neglected crops species are often indigenous ancient crop species which are still used at some level within the local, national or even international communities, but have the potential to contribute further to the mix of food sources than they currently do (Mayes *et al*., 2011). Neglected and underutilized plants are those that could be-and, in many cases, historically have been-used for food and other uses on a larger scale. Global Facilitation Unit (GFU) for Underutilized species also define UUC's as, "those plant species with under-exploited potential for contributing to food security,

Table-1 : Suitable underutilized crops for western Rajasthan.

Scientific name	Common / local name	Family	Distribution
Cordia myxa	Lasora	Boraginaceae	Jodhpur, Barmer, Pali and rangelands of arid and semi-arid ecosystem
Capparis decidua	Kair/ker	Capparaceae	Hot and sandy desert, Jodhpur, Bikaner, Pali, Nagaur
Ziziphus nummularia	Jhar ber	Rhamnaceae	Arid and semi-arid regions of Rajasthan
Prosopis cineraria	Khejri	Mimosaceae	Arid and semi-arid regions of Rajasthan
Salvadora oleoides	Meetha jal	Salvadoraceae	Jodhpur, Barmer, Jalore, Bikaner, Jaisalmer, Churu, Nagaur
Carissa carandas	Karonda	Apocynaceae	Jodhpur, Jaipur, Pali, Sirohi, Udaipur, Chittor, Ajmer, Bhilwara etc.
Aegle marmelos	Bael	Rutaceae	Arid and semi-arid regions of Rajasthan
Ficus carica	Common fig	Moraceae	It is grown in Udaipur, Ajmer and in kitchen garden and garden through out Rajasthan except extreme arid district like Bikaner, Barmer, Jaisalmer etc.
Opuntia ficus-indica	Prickly pear	Cactaceae	Wild species O. elatior found growing at selected places through out Rajasthan, however, the O. ficus-indica is of recently introduced cultivated species which is being tried at Jodhpur, Bikaner and Kutch Bhuj region of Gujarat
Citrus latifolia	Persian lime	Rutaceae	Ajmer, Jodhpur, Jaipur, Pali, etc.

health (nutritional/medicinal), income generation and environmental services". These underutilized crop species have also been described as "minor", "orphan", "promising" and "little-used". UUC's have poor shelf-life, un-recognized nutritional value, poor consumer awareness and reputational problems, therefore, also called as, "poor people's food". As the demand for food changes (re-discovery of nutritional and culinary value, therapeutic value–complete ethnobiology), UUC's can overcome the constraints to the wider production and use by the poor people. As a matter of fact, many formerly neglected crops are now globally significant crops (oilpalm, soybean, kiwi fruit) and have shown the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation (Hammer *et al*., 2001).

In India, there are large areas of marginal and wasteland, which are not suitable for cultivation of staple crops, either due to poor quality soil or lack of water resources. Most of UUC species are tolerant to harsh agro-climatic conditions; they have excellent potential for establishment on marginal and wasteland throughout the tropics (Hegde, 2002). Many underutilized fruit crops such as ber, tamarind, jamun, gooseberry etc. which are in good demand but these crops are not very popular among farmers (Hegde, 2002). Most of these lesser known fruit trees establish through natural regeneration of the seeds grow slowly without any nutrition, start bearing fruits after a long period. Hence, these species are renamed as neglected without any commercial importance. Neglected or underutilized crops have the potential to play a number of roles in the improvement of food security in India that include being :

Part of a focused effort to help the poor for subsistence and income.

A way to reduce the risk of over-dependency on very limited numbers of major staple food crops.

A way to increase sustainability of agriculture through a reduction in inputs.

increase the food quality.

A way to preserve and celebrate cultural and dietary diversity.

A way to use marginal and wastelands for agricultural purposes to meet the ever increasing food demand (Mayes *et al*., 2011). Thus, these UUC's because of their untapped potential shall be very soon explored to combat food security. Unfortunately, the lack of attention and authenticated data claim their potential value as under-exploited, and they are in danger of continued genetic erosion, ultimately leading to disappearance," (ICUC, 2006). Therefore, there has been a concern to diversity the agriculture and explore the possibilities of newer plant resources and promote utilization of underutilized nutritive food crops. Apart from being the store house of nutrients, these crops are evolved with very important genetic pool for resistance to biotic and abiotic stress.

To be considered as an 'underutilized food crop', a plant must have the following features

Crops are recognized to have indigenous uses in localized areas.

May be highly nutritious and/or have therapeutic medicinal or therapeutic properties or other multiple uses.

Crop must have a scientific or ethnobotanical proof of food value.

Crop must have been cultivated, either in the past or only being cultivated in a specific geographical area.

It must be currently cultivated less than other conventional crops.

Crop must have weak or no formal seed supply system.

Received little attention from research, extension services, farmers, policy and decision makers and technology providers.

Some underutilized crops of India

There are many underutilized food crops in India and majority are not well known or well documented. Singh *et al.,* 2012 studied the diversity of underutilized vegetable crops species in North-East India. The ethnobotanical data for all the underutilized species is still to be explored for such species. Some of the underutilized plant species are -

Aonla/Amalaki/Amla (*Emblica officinalis*) : Aonla is a deciduous fruiting plant grown in many states of India. The tree is hardy, prolific bearer and a suitable choice for arid regions of the country (Mitra, (1999). Likewise, (Das, 2013) also reported on the presence and significance of this fruit in hilly regions of India. Amla is the most concentrated form of vitamin C (500-600 mg/100 g) found in the plant kingdom, and when the whole fruit is used rather than an active ingredient, the vitamin C is easily assimilated by the human body and has been found to have great antioxidant properties.

Ber/Indian Jujube (*Zyziphus mauritiana*) : It belongs to the family Rhamnaceae. It is an ideal fruit tree for arid and semi-arid regions in tropical and subtropical climate where most of the fruit crops cannot be grown either due to lack of irrigation facilities or adverse climatic and soil conditions. Fruits are greenish yellow to reddish brown. It has a high amount of vitamin C (85-95 mg per 100 g). More vitamin C was found in the fruit flesh near the seed rather than near the skin of the fruit (Krivencov, 1970). It is also a rich source of vitamin A and B-complex. The fruits can also be used for making several products like chutney, dried ber, murabba, jelly, etc.

Fig (*Ficus carica*) : Fig was an important food crop in ancient civilization. It is a highly nutritious fruit consisting of 84% pulp and 16% skin. Fresh figs are nutritious and used as dessert or for making jam, jelly, pudding, cakes, etc. The fruit is valued for its laxative property. It is applied for boils and other skin infections (Polumin, 1965 and Font, 1973).

Karonda (*Carissa carandas*) : It is a hardy, evergreen, spiny and indigenous shrub which thrives well as rainfed crop. The fruit belongs to the family Apocynaceae. Fruits, sour and astringent in taste, are a very rich in iron contains a good amount of vitamin C. They also contains protein, carbohydrates, fat, fibre and calcium. The ripened fruits may be eaten as dessert or used for the preparation of jelly, sauce, carissa cream or jellied salad. Unripe fruits are used for making pickles, sauces and chutney. The dried fruits may act as a substitute for raisins Cheema (1971). The wine prepared from ripe fruits contains about 14.5 to 15% alcohol and is very much liked by wine fanciers Nalawadi (1975).

Tamarind (*Tamarindus indica*) : It is native to Tropical Africa and belongs to the family Fabaceae. It is the ?Indian date‘ and is one of the most important fruits of India. In Tripura, it is locally called ¯tentul? (Das, 2013). The pulp has low water content and high levels of proteins, carbohydrates and minerals. The pulp is also the principal souring agent for squashes, chutney, beverages, etc. The fruit is used in the Indian medicine as a refrigerant, carminative, antiscorbutic and laxative and is also prescribed for bilious disorders (Roy, 1988). The active constituents present are furunone, phenyl acetaldehyde and tartaric acid. The products of the seeds are used mostly for manufacture of sizing powders (Rao, 1959). Tamarind kernel powder is extensively used for starching of cotton yarns, jute fabrics and woollen materials.

Passion fruit (*Passiflora edulis*) : It is native to tropical America. It produces fruits with unique flavour and aroma for fresh eating and processing as well. Passion fruits are fair to good source of provitamin A, ascorbic acid, riboflavin and niacin and have a high mineral content. The pulp obtained after scooping from the fruits when cut in halves are added to fruit salads, ice-cream or fruit juice. Other processed products include juices, jelly, jam, squash, etc. (Menzel 1985).

There are around 30 plant species in arid zone known for their edible uses either table purpose or as vegetables. Important among these are listed in Table-1.

Strategies of conservation of underutilized crops

In India and its neighbouring countries, various native fruits, such as aonla, bael fruit (*Aegle marmelos*), jackfruit, jamun (*Syzygium cuminii*), karonda (*Carissa congesta*), Kokum (*Garcinia indica*) and phalsa (*Grewia subinaequalis*) are underutilized. Some of these might be important in the near or far future, because of their therapeutic/medicinal and nutritive value as well as their excellent flavor and very attractive appearance. Consumers today are becoming increasingly conscious of the health and nutritional aspects of their food. Underutilized fruits could play an important role in satisfying demand for nutritious, pleasantly flavoured and attractive natural food of high therapeutic value. Encouraging local people to produce these fruits can help to improve their social and economic welfare. In this way, they can also significantly contribute to the preservation of the environment by stopping uncontrolled harvesting from the wild and assisting in the retention of the various species in their native habitats where they perform best.

Conservation is very important, because many species are becoming extinct and many others are threatened and endangered. The diversity of some fruits is well collected, while for other fruits relatively little has been done yet (Arora, 1994). Gaps in collections are found both between species and between regions. This is especially true for both underutilized species and wild crop relatives, where big gaps are noted. Kostermans and Bompard (1993) indicate that *Mangifera blommesteinii*, *M. leschenaultii*, *M. superba* and *M. paludosa* are in real danger of extinction. High genetic erosion has been noted for jackfruit, Citrus sp. and Litchi chinensis in a survey carried out by the International Centre for Underutilized Crops (ICUC) and IPGRI (Haq, 1994). The main components are; Identification and collecting live samples of neglected and underutilized crop species establishment of plant arboretum for neglected and underutilized vegetables, fruits and other crop species and promote studies, research and multiplication for the benefit of future generation, conducting awareness creation and educational workshops on the medicinal and nutritional values of identified underutilized species, conducting field research and studies to identify the most suitable techniques for the growing of these plant species and introduction of identified underutilized vegetables and other crop species to the rural home gardens and facilitate the community contribution for conservation of such crop species.

Indian government strategy

In India, strategy development and appropriate policies are limited to a large extent by a lack of authentic documentation on underutilized crops. The Indian government policies and strategies for food security should take into account the diversity of underutilized cops. For this thing the Ethnobotanical data available on indigenous, neglected Indian crops is more valuable. Indigenous knowledge must be tapped and combined from various localities and merged with scientific solutions to create new opportunities. Recognition of UUC's in India was initiated in 1960's at the Indian Agricultural Research Institute, New Delhi. This research was later extended by, All India Coordinated Research Project (AICRP) on Under-utilized plants (UUP) in 1982, with its headquarters at National Bureau of Plant Genetic Resources (NBPGR), New Delhi, towards, collection, evaluation, utilization and conservation/ maintenance of under utilized crops. Later on, this work was also carried out in various parts of India (Paroda, 1979; Bhag Mal, 1988; Bhag Mal and M Joshi, 1991; Paroda and Bhag Mal, 1989, 1992; Joshi *et al*., 2002; Joshi, 2005). So far, 115 leafy vegetables and 46 other vegetables have been documented as underutilized in India (Anonymous, 2003). Ravi *et al*. (2010) discussed the mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. In India, also a national coordinated project by Ministry of Agriculture has been launched to do research on UUC's. Still the threat has been for the crops as their underutilized potential is continued to be underutilized, ultimately this will lead to disappearance of the same crop.

International Centre for Underutilized Crops (ICUC)

This is a research, development and training organization. It provides expertise and acts as a knowledge hub and supported research on national priorities for germplasm collections, agronomy and post-harvest methodology of underutilized species and associated scientific conferences and training events. In recent years, the focus has expanded to include processing and marketing assessments and entrepreneurship development only. ICUC have several professional networks in twenty one countries in particular as UTFANET (Underutilized Tropical Fruits in Asia Network), UTVAPNET (Underutilized Tropical Vegetables for Asia and the Pacific Network), SEANUC (Southern and East Africa Network for Underutilized Crops and ACUC (Asian Centre for Underutilized Crops) etc.

Global facilitation unit (GFU)

The GFU is a multi-institutional initiative that acts globally to promote a wider use of underutilized plant species through supporting and facilitating the work of other stakeholders. The mission rather to create an enabling environment for stakeholders who are engaged in developing underutilized species.

Convention on biological diversity (CBD)

Became a rallying point and promoted the concept of maintaining local agro-biodiversity. All these various international units which are working on underutilized species have led to a better liaison between relatively isolated groups of workers but there are still major gaps. The Consultative Group on International Agricultural Research (CGIAR) organized a workshop in 1999 at Chennai (India) followed the major FAO Global Plan of Action. One of the outcomes was a recommendation to survey all ongoing activities on underutilized species worldwide.

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Utilization of underutilized crops

The main processed products consumed by people were jam, RTS – fruit drinks, chutneys, candies, pickles, squashes, concentrate etc. (Roy, 2000; Khurdiya, 2001 a and b; Singh *et al.,* 2008). Various processed products like canned jackfruit bulbs in syrup, squash, raw jack pickle, roasted jack seeds, jack seed flour, and candied jackfruit, have been prepared from Jack fruit (Berry and Kalra, 1998; Chadha and Pareek, 1988; Chandra and Prakash, 2009). Various processed products such as nectar, squash, slab, toffee powder, etc. can be made with Bael pulp. Ber can be processed to prepared murrabba, candy, dehydrated ber, pulp, jam, and ready-to serve beverage (Khurdiya, 1980; Pareek, 2001). Jamun fruits can be processed into excellent quality fermented and non-fermented beverages. Besides that, good quality jelly, jam, leather can be prepared. A good quality jelly can also be prepared from its fruits. The seeds can be processed into powder, which is very useful to cure diabetes (Khurdiya, 2001a and b). The main processed product made from Karonda is pickle. Ripe ber fruit is consumed as popular dessert and processed for various value added products such as murabba, candy, sharbat, squash and powdered fruits after drying are also consumed.

Constraints in utilization and marketing of UUC's

Overall, the slow progress and poor popularity in the effective development and utilization of underutilized crops results from a number of constraints which are summarized below :

Lack of information on production, nutritional quality, consumption and utilization of many of the underutilized plant products which are unpopular compared to major fruits.

Lack of awareness on economic benefits and market opportunities.

Lack of technology for value addition through village level food processing.

Lack of improved quality planting material.

Lack of technology to reduce the gestation period and enhance the fruit production.

Lack of interest by researchers, agriculturists and extension workers.

Lack of producer interest.

Low yield.

Post-harvest and transport losses.

Non-existence of marketing network and infrastructure facility for underutilized fruits.

Lack of national policy.

Lack of credit and investment.

Non-availability of scientific resources for testing, valuation and post harvest management of different underutilized fruits.

Disorganized communities.

Future Strategies

Identification of suitable growing areas in respect of each underutilized fruit crop suitable for different soil types of arid region.

Market linked production and shift in attitude from subsistance farming to commercial orcharding.

Location specific farming systems involving underutilized crops need to be developed and popularized to ensure its adoption by the farmers of the region.

Creating awareness among the growers for marketing of produce through cooperative or growers' association so as to fetch better price of the produce for grower's prosperity.

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