



Advances and Future Prospects in Potential or Minor or Underutilized Crops

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The world is faced with the challenges of climate change, terrorism, and poverty, among other factors, which hinder food production, food availability, as well as food and nutritional security. Agriculture is under increasing pressure to produce greater quantities of food, feed and biofuel on limited land resources for the projected nine billion people on the planet by 2050 (Godfray *et al.*, 2010). It is envisioned that agricultural production has to increase by 70% by 2050 to cope with an estimated 40% increase in world population (Bruinsma *et al.*, 2009). In India, over-reliance on a few staple crops is a leading cause of low dietary diversity and persistent malnutrition. Promising neglected and underutilized species (NUS) or minor crops that are nutrient dense, climate resilient, economically viable, and locally available or adaptable have been prioritized as Future Smart Food (FSF) and have a central role to play in the fight against hunger and malnutrition. Modern agricultural systems that promote cultivation of a very limited number of crop species have relegated indigenous crops to the status of neglected and underutilised crop species (NUCS). Current research efforts have identified NUCS as having potential to reduce food and nutrition insecurity, particularly for resource poor households in India. This is because of their adaptability to low input agricultural systems and nutritional composition. However, what is required to promote NUCS is scientific research including agronomy, breeding, post-harvest handling and value addition, and linking farmers to markets.

Among the essential knowledge base is reliable information about water utilisation by NUCS with potential for commercialisation. This commentary identifies and characterises NUCS with agronomic potential in India, especially in the semi-arid areas taking into consideration inter alia: (i) what can grow under water-scarce conditions, (ii) water requirements, and (iii) water productivity. Several representative leafy vegetables, tuber crops, cereal crops and grain legumes were identified as fitting the NUCS category. Agro-biodiversity remains essential for sustainable agriculture. 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. The most cost-effective and easily disseminated changes that can be made to a crop are changes to the genetics, as these are contained within the seed itself and, for many species, the seed is a pure breeding, self-replicating, resource. Biodiversity is fundamental for ecosystem functioning, sustainable agricultural production (Jacobsen *et al.*, 2013) and the attainment of food and nutritional security (Toledo *et al.*, 2016), yet only a few crop species are utilised for food production throughout the world (Padulosi *et al.*, 2001). The term underutilized has been used among other several descriptions including “orphan”, “minor”, “new crops”, and “neglected” to

represent crops species that have potential but fallen to disuse due to various reasons (Padulosi ,*et al.*2004).

The productivity of crops like maize, wheat, rice and other dominant food crops of today resulted in replacement of numerous other crops. Today, our food security is depended on less than ten crops. The impact of narrowing down of species base at food security level is likely to be felt most by the rural and hill people as they have restricted livelihood opportunities. The underutilized crops of today were the major crops in the past.

Main crops face huge obstacle in the upcoming future and a diversification away from over-dependency on staples will be significance as part of the progress towards the goal of acquiring security of food production. Potential or neglected crops or minor species are often indigenous old crop species which are still part at some level within the local, national or even international communities, but have the ability to contribute further to the mix of food sources than they currently do. The most cost-effective and readily disseminated changes that can be made to a crop are changes to the genetics, as these are have within the seed itself and, for many species, the seed is a convention plant breeding, self-replicating, resource. Promising neglected and underutilized species (NUS) or minor crops that are nutrient dense, climate resilient, economically viable, and locally available or adaptable have been prioritized as Future Smart Food (FSF) and have a key role to play in the fight against hunger and malnutrition.

What aAre Miscellaneous, Neglected and Underutilized Crops

Globally, neglected and underutilized species (NUS) are often identified based on their local usefulness, localized domestication, adaptation coupled with general abandonment by mainstream agricultural researchers, extension services, plant breeders, donors, technology providers, policy- and decision-makers, as well as consumers.

1. Local importance in consumption and production systems
2. Adaptation to agroecological niches/marginal areas
3. Representation by ecotypes/landraces
4. Cultivation and utilization based only on indigenous knowledge
5. Rare representation in ex situ collections
6. Uncoordinated attention from national agricultural and biodiversity conservation policies, research, and development
7. Neglect by mainstream market system

General Background Information: All Underutilized and Neglected Crop Species

Table 1: Important underutilized and neglected crop species

Crop group	Crop name
Pulses	Sword bean (<i>Canavalia</i> spp.) hyacinth bean (<i>Lablab purpureus</i>), grass pea (<i>Lathyrus sativus</i>), horse gram (<i>Macrotyloma uniflorum</i>); velvet bean (<i>Mucuna</i> spp.), winged bean (<i>Psophocarpus tetragonolobus</i>), faba bean (<i>Vicia faba</i>), moth bean (<i>Vigna aconitifolia</i>), adzuki bean (<i>Vigna angularis</i>), rice bean (<i>Vigna umbellata</i>)
Root and tuber	Elephant foot yam (<i>Amorphophallus paeoniifolius</i>), taro (<i>Colocasia esculenta</i>), yams (<i>Dioscorea</i> spp.), <i>Vigna vexellata</i>
Vegetables	Cucubitaceae (<i>Benincasa</i> , <i>Luffa momordica</i> <i>Trichosanthes</i> spp.) aibika (<i>Abelmoschus manihot</i>), leafy amaranth (<i>Amaranthus</i> spp.), Brassica spp., Kangkong (<i>Ipomoea aquatic</i>)
Fruits and nuts	Jack fruit (<i>Artocarpus heterophyllus</i>), bread fruit (<i>A. allitis</i>), carambola (<i>Averrhoa carambola</i>), longan (<i>Dimocarpus longan</i>), pillinut (<i>Canarium ovatum</i>), durio (<i>Durian zibethinus</i>), Indian gooseberry (<i>Emblica</i>

	<i>officinalis</i>), mangosteen (<i>Garcinia mangostena</i>), duku (<i>Lansium domesticum</i>), Litchi (<i>Litchi chinensis</i>), Manilkara spp., rambuttan (<i>Nephelium lappaceum</i>),
Cereal and pseudocereal	Finger millets (<i>Eleusine coracana</i>), Buckwheat (<i>Fagopyrum esculentum</i>), <i>Amaranthus spp.</i> , Proso millet (<i>Panicum miliaceum</i>), <i>Panicum miliare</i> , <i>Triticale</i> , Foxtail millet (<i>Setaria italica</i>), <i>Chenopodium quinoa</i> , <i>Echinochloa frumentacea/ utilis</i> , <i>Paspalum scrobiculatum</i>

Advantages of UUC's

- They have potential to eliminate the poverty elimination through employment generation and income generation and also through improved efficiency and profitability of farm household labour use in both rural and urban environments.
- With the use of underutilized or minor or orphan crops, there is a way to reduce the risk of over-reliance on very limited number of major crops.
- Role in food security to contribute to sustainable livelihoods as they can widen the food edibility options.
- These underutilized crops add nutrients to the diet and are food for low income urban people. They are adapted to fragile environments and can contribute to the stability of agro ecosystems, particularly in the arid, semi-arid lands, mountains, steppes and tropical forests.
- They provide a opportunity of a broad spectrum of crops to improve productivity and global food security and to meet new market demands. They assist development of rural community.

Potentiality and Nutritional Importance of Underutilized Crops

As it is well accepted that climate change is not a hoax but reality hence, there lies the importance of diversification. Wider crop diversification both temporally and spatially will lead to better adaptability towards various stresses. Several pieces of research have been shown that wider diversification and mixed agro-ecosystem have shown better resistance and suppression ability against pests and diseases. Several strategic measures may lead to the adaptation of a diversified cropping system. These include: (1) promoting intra-specific genetic monoculture, (2) alternating individual field with the cultivation of legumes and broadleaf crops, (3) promoting mix farming, (4) integrating agriculture, horticulture, animal husbandry, fisheries, forestry, etc. Other nutritionally rich crops like potato, sorghum, mung bean, maize, etc., are left behind. These crops have tremendous potential for economic, social and ecological prospects, which can lead to promoting sustainable agriculture. Incorporating inherent perennial trees, grasses, fodder crops in the cropping pattern has several benefits like: (1) acting a source of biomass, (2) enriching the carbon sink of the soil and (3) reduce nitrogen emission from the irrigated system into the atmosphere. Gene modification and biotechnological interventions of the crop wild relatives have resulted in developing modern high-yielding crop cultivars, developing tolerance to various stresses, etc.

Table 2: List of potential crops of the tropical and subtropical environment

Sr.No.	Common name	Scientific name
1	Foxtail millet	<i>Setaria italica</i>
2	Proso millet	<i>Panicum miliaceum</i>
3	Finger millet	<i>Eleusine coracana</i>
4	Buckwheat	<i>Fagopyrum esculentum</i>
5	Amaranth (leaf and grain)	<i>Amaranthus species</i>
6	Drumstick	<i>Moringa oleifera</i>

7	Bitter gourd	<i>Momordica charantia</i>
8	Fenugreek	<i>Trigonella foenum-graecum</i>
9	Rosella	<i>Hibiscus sabdariffa</i>
10	Snake guard	<i>Trichosanthes cucumerina</i>
11	Bambara groundnut	<i>Vigna subterranea</i>
12	Mung bean	<i>Vigna radiata</i>
13	Rice bean	<i>Vigna umbellata</i>
14	Lentil	<i>Lens culinaris</i>
15	Horse gram	<i>Macrotyloma uniflorum</i>
16	Taro	<i>Colocasia esculenta</i>
17	Elephant foot yam	<i>Amorphophallus paeoniifolius</i>
18	Sweet potato	<i>Ipomoea batatas</i>
19	Yams	<i>Dioscorea species</i>
20	Jackfruit	<i>Artocarpus heterophyllus</i>
21	Jamun	<i>Syzygium cumini</i>
22	Custard apple	<i>Annona species</i>
23	Tamarind	<i>Tamarindus indica</i>
24	Ber	<i>Ziziphus mourtiana</i>
25	Pickle mango	<i>Mangifera indica</i>
26	Kokum butter tree	<i>Garcinia indica</i>
27	Rambutan	<i>Nephelium lappaceum</i>



Examples of Underutilized Vegetables and Legume Crops With Potential

Not all traditional and underutilized crops can simply and easily be turned into commercial success stories. Significant research, breeding and development efforts are needed to convert existing local landraces of carefully selected, promising crops into varieties with wide adaptation and commercial potential (Stamp *et al.*, 2012 and Ochatt and Jain 2007). An overview of breeding efforts and application of biotechnology tools such as

micropropagation, molecular marker studies and genetic transformation for the improvement of underutilized crops has recently been provided by Ochatt and Jain and Jain and Gupta. Access to genetic diversity of selected crops, either in situ or ex situ, is a pre-condition for success. Two underutilized traditional vegetable crops—amaranth and drumstick tree—and the underutilized legume crop mungbean are highlighted and briefly described. As indicated in section four, the term—underutilized used here refers to as yet low global production and market value. All three crops have the potential to assume a more important role globally in the sustainable supply of diverse and nutritious food if given appropriate attention by plant breeders.

Diversification for Food Security: The Role of Underutilized Crops

Human livelihood like any other living beings requires three basic fundamental compositions for sustainable development, i.e. carbohydrate, protein and fat. The majority of the population highly relies on three principal cereal crops, namely rice, wheat and maize for fulfilling the daily carbohydrate requirements. For protein source, we mainly rely on animal components and by-products, such as fish, meat, milk, etc. The ever-increasing population globally has compelled researchers to modify the existing cropping system by introducing transgenic and conventional breeding techniques. Interestingly, despite focusing merely on increasing global productivity by technological interventions to meet the food requirement, food insecurity and nutritional requirement cannot be fulfilled. These interventions also make the cereal crop more prone to several biotic and abiotic stresses. Under such circumstances, the small and marginal farmers are compelled to undergo or rather diversify cropping practices. It is well established that crop diversification often leads to climate-resilient agriculture for the agrarian community. It is also one of the most economically feasible, rational way out for mitigating climate risks. Only diversifying crop species also helps in achieving higher price by reducing marketing risks.

The Underutilized Crop Community: Creative Tension?

Pragmatic approach to increasing food security through decreasing yield gaps, increasing efficiency of resource use, changing diets, and reducing waste. We would argue (and they mention) that underutilized crops can play an essential part of this process, particularly in terms of the resilience of food production systems and matching crops to their above- and below-ground environments. Our brief overview of the process of domestication and the history of increases in yields of staple crops argues that there are underutilized crops which could become new minor or even major crops under the new agricultural regime of low inputs which we will have to adapt to in the future. This is not to denigrate the importance of local and niche crops, which can also improve environmental and economic resilience and provide important food and income sources. Our understanding of agricultural systems and the tools that are now available have never been greater. The focused application of these can help to diversify cropping systems, for food and nutritional security.

Conclusion

- To meet the food and nutritional security of nine billion people by the year 2050, agricultural productivity has to be increased by 70%. While 90% of the increased demand can be achieved through the improvement of agricultural productivity.
- The remaining demand can be achieved by adding unutilized land for crop production. Besides these, the cultivation of neglected and underutilized species (NUFCs) along with modern crop varieties may be an innovative strategy for managing future agricultural production under the changing environmental conditions.
- The NUFCs are generally well-known as ‘**minor crops**’ in terms of global production and market value.

- Wider use of today's NUFCS provides more options to build temporal and spatial heterogeneity into uniform cropping systems and will enhance resilience to both biotic and abiotic stress.
- Underutilized crops are 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.
- However many underutilized crops were once more widely grown but are today falling into disuse for a number of problems with respect of agronomic, genetic, economic and cultural factors.
- Farmers and consumers are using these crops less due to they have not competition with other crop species in the same agricultural environment.
- The underutilized crops have good option for region is one of the richest reservoirs of genetic variability and diversity of different horticultural crops, within which exist in plant types, morphological and physiological variations, reactions to diseases and pests, adaptability and distribution.
- As underutilized crops have a great potential to alleviate hunger directly through increasing food production in the challenging environments where major food crops are severely limited day by day.

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