



Underutilized Crops and Organic Farming: To Combat Climate Change and Hidden Hunger

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ABSTRACT

Globally there is a concern for diminishing nutritional security and sustainability in agriculture. Presently some of the challenges like climate change, hidden hunger, shrinking food basket due to monocrop culture, declining agricultural land, depriving labour availability, lack of sustainability and indiscriminate use of chemicals, are all alarming for the alternate options for better future of agriculture. In the view of resurgence of interest in alternate agriculture, underutilized crops and organic farming possibly will be the best viable option either individually or in collaboration. These alternatives hold great promise to provide solutions against the above mentioned challenges faced by agricultural community.

Keywords: Climate change, underutilized crops, organic farming, nutritional security

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INTRODUCTION

Earth revolves around sun for whole of the year to keep us alive by providing light in the day for work and dark for rest in the night besides rewarding us with so much resources but man never understand, never learnt to live like man on this livable and loveable planet- The Mother Earth. Nature is a great teacher and we should listen to her and utilize the resources provided by her (such as underutilized crops as well as organic farming) for better survival instead of exploiting artificial sources (pesticides, monocrop culture) that are detrimental to mother earth as well as pose problems to the future generation farmers. The Global Facilitation Unit for Underutilized species (GFU), under Consultative Group on International Agricultural Research (CGIAR) defines Underutilized plants as "species with underexploited potential for food security and nutrition by combating 'hidden hunger' caused by micronutrient deficiencies; they often have medicinal properties and other multiple uses; they provide options for improved income to the poor and for environmental services to the global community" [1]. Underutilized crops show immense nutritional values, ecological compatibility, fitness to ecological niches and above all optimum uses of natural resources like water, energy, space and time [1]. Awareness to such crops, besides enlarging food basket, has come up as a positive development in food and nutrition. These crops are to be encouraged to fit into the changing food habits, life styles and above all climate change. Another option for farmers is organic farming, to avail the same benefits for environment, nutrition and soil health. Soil health care is fundamental to sustainable farming [2]. Organic farming as alternate agriculture is considered as a movement directed towards philosophy of 'Back to Nature'. There are many eco-friendly ways and means to improve the soil health and protect the crop plants from biotic and abiotic stresses, like conservation of biodiversity, use of animal manures and farm wastes and the introduction of legumes in crop rotations. These practices aims at avoiding or largely excluding the use of synthetically produced agricultural inputs like fertilizers, pesticides, growth regulators etc. India's National Agricultural Policy (NAP) 2000 envisaged that agriculture sector should be sustainable technologically, environmentally and economically and there is need to conserve our soil, water and biodiversity. Organic farming is appropriate technology for this purpose [3]. Viewing all these benefits, exploration,

verification, modification and standardization of organic production technologies and its use for cultivation of underutilized vegetable crops has become the need of hour. In the present article an attempt has been made to review how these alternatives help in achieving sustainability and nutrition.

Underutilized Crops

Owing to the biodiversity present, India is considered as the botanical garden of the world and treasure house of biodiversity. The tribal areas are full of biodiversity having natural vegetation which is not harnessed fully. Due to which a wide gap is formed between health and optimal use of natural sources of nutrients, *i.e.*, underutilized crops. The older generations have the knowledge about edible natural foods and they exploit their skills to recognize climatically adapted food sources to supplement their food supplies [4]-[7]. While, the young people either consumers or farmers view them as unfashionable when compared to fast foods [7], [8]. In the same way, the tribal communities are suffering multiple nutrient-deficiency disorders and are severely malnourished due to ignorance about importance of fruits and vegetables in their diets. The main condition and solution we should strive for promotion of underutilized crops is targeted education [9]. So, targeted education in term of their benefits can be considered as a solution for attracting consumers as well as farmers towards underutilized horticultural crops. Underutilized vegetables are a rich source of carbohydrates, fats, proteins, energy, vitamins—A, B1, B2, B3, B6, B9, B12, C, folic acid, and minerals—Ca, P, Fe, and dietary fiber. It is also established fact that seasonal, locally available, and cheap fruits and vegetables can also keep the population healthy and nutritionally secure rather than costly off-season ones. Furthermore, the underutilized crops have the potential to give economic security to tribals by giving employment and by fetching good returns from their sale in raw form as well as value-added products. Unprecedented increase in export of some underutilized crops like Amaranth, Basella, Drumstick, Quinoa, Watercress Celery, Celosia etc., in the last few years can also be brought to knowledge of farmers to encourage them.

Nutritional Value of some underutilized crops

Nutritional qualities of underutilized crops are important for development as a food source for low-income people, and their use as alternative crops in the industrialized world. For example,

Amaranth:

Amaranth as a vegetable is nutritionally more valuable than any of other spring and summer leaf vegetables. It provides 4686 units of vitamin A/ 100 g of edible portion, compared with 600 g of Swiss chard and 280 g for cabbage. The Iron content of amaranth is five times high as that of wheat. Majority of examinations showed that amaranth contains many times more calcium, iron and magnesium than other cereals do [10].

Lettuce:

It is a low calorie food and is a source of vitamin A and folic acid and, is rated fourth behind tomato, citrus and potato in the form of overall contribution to nutrition. Romaine lettuce is the most nutrient dense of all the lettuce varieties and is an excellent source of vitamins A, B1, B2 and C, folic acid, manganese and chromium, while Iceberg lettuce variety provides a good source of choline. It is important to know that the outer leaves may contain 50 times more nutrients than the stem.

Annual Drumstick (*Moringa oleifera* Lam):

Its tender leaves and flowers are used as vegetable [11] and its contains carotene (0.11 mg), protein (2.5g), carbohydrates (3.7 g) and ascorbic acid (120 mg), / 100g of fresh leaves used as edible portion [12].

Ivy gourd:

Young shoots of Ivy gourd are good source of β - carotene and protein [13], [14]. 100 g portion of ivy gourd's young shoot contained more β - carotene (2.47 mg) than Chinese cabbage (1.48 mg) and spineless amaranth (1.43 mg) in comparison [15].

Curry leaf:

It shows richness in Vitamin A and Protein content when compared with commonly grown vegetables [16]. 100g of it contains more protein (6.1 g) than cauliflower (2.6 g), Cabbage (1.8 g), Carrot (0.9 g), Tomato (0.9 g) and Radish (0.6 g). Similarly, its 100g contain more Vitamin A (12600 I.U.) than Carrot (3150 I.U.), Cabbage (2000 I.U.), Tomato (585 I.U.), Dry pea (66 I.U.), Cauliflower (51 I.U.) and Radish (5 I.U.). The leaves are rich source of calcium but due to presence of oxalic acid in high concentration (total oxalate 1.3%), soluble oxalates 1.15%), its nutritional availability is affected [17].

ORGANIC FARMING

International Federation of Organic Agriculture Movements (IFOAM) defined Organic Agriculture as “an agricultural system that promotes environmentally, socially, and economically sound production of food, fiber, timber, etc. In this system, soil fertility is seen as the key to successful production. Working with the natural properties of plants, animals, and the landscape, organic farms aims to optimize quality in all

aspects of agriculture and the environment". The concept of food quality has also changed dramatically in the recent years. It now refers not only to the characteristics of the final product, but also to the way in which it is produced, processed and transported. In view of this fact, promotion of organic farming and utilization of organic wastes has been one of the thrust areas of the Tenth Five Year Plan. For example, Uttaranchal has been declared as the State of Organic Farming. Sikkim, Pondicherry and many North-eastern States have declared their state as 100% organic farming state. But, need of the hour, stresses that all the States of India should be declared as Organic States. What we can do in that context? We need to expose aspiring farmers to organic farming, as the indiscriminate use of chemical pesticides concerns the presence of pesticide residues in our daily life.

Importance and Sources of Organic Farming

Organic agriculture envisages a comprehensive management approach to improve the soil health and underlying productivity of the soil [18]. The potential organic sources of plant nutrients which can be used are Green manure crops, Crop rotation, Crop residues, Organic manures, Farmyard manure, Night soil, Sludge, Oilcakes, Blood meal, Compost, phosphocompost and vermicompost, Biogas Slurry, Agricultural wastes, Pressmud, Biodynamic preparation, Biofertilizers, etc. [19]. Organic production technologies need to be developed with scientific experimentation involving different disciplines to derive complete packages using organic sources.

Underutilized Crops and Organic Farming in Collaboration

How underutilized crops provide mutual support to organic farming?

Underutilized crops bring diversity into crop rotations and provide new possibilities for soil cultivation. Production of underutilized crops helps local communities to be more independent, use the local resources for production and reduce transport expenses. Amaranth provides the farmers with the opportunity to increase diversity of crops available to them for cultivation [20]. Similarly, onion, chillies and cluster bean can be successfully grown as intercrops in annual drumstick. In parts of Tamil Nadu, annual drumstick is cultivated as boarder crop and also as a mixed crop in chilli and brinjal fields [21]. Agri-silvi-cultural models [22] involving drumstick with casuarina or acasia along with maize for obtaining higher yields and income in Tamil Nadu region. The use of underutilized field crops has resulted in product competitiveness, rich nutritional and health value of food, tradition, locality, special quality according to organic production guidelines and even market attraction. Underutilized crops show positive response to Organic environment in terms of production against the inorganic fertilizers. Moringa under the application organic treatment (Poultry manure (500 g/ pit)+ Neem cake (250 g / pit)+ Neem cake (250 g / pit) + Panchagavya (2%)) resulted in early and vigorous growth confirming superiority of Integrated nutrient management to the application of manures and fertilizers [23]. Spine gourd, by virtue of its ease in propagation, adaptability to agro-ecosystems and higher yield, it needs popularization [24], its cultivation will lead to diversification of food and nutritional security. It is a reason why underutilized crops have to play a greater role in organic farming.

How organic environment provide mutual support to underutilized crops?

Three main factors can influence the nutritional composition of vegetables grown organically or conventionally, namely genetics, environment and post-harvest practices [25]. The health and nutritional rich by products, especially if they are produced according to organic farming guidelines, represent a special niche in the market of the developed world. Organically grown vegetables are believed to contain higher vitamins and minerals as well as are of high quality when compared to conventionally grown vegetables. The effects of Arbuscular mycorrhizae on white yam were studied to some extent [26]-[28]. They concluded that white yam responds positively to mycorrhizal application. Mulching and addition of organic matter benefit white yam more than inorganic fertilizer [26]-[28]. Some Scientists claimed that taste and colour of Yam are affected by chemical fertilizer and that its poundability is affected also. The IOF (Instant Organic Fertilizer) treated spinach [29] showed protein content (73.86 mg mL⁻¹), Chlorophyll (32.44 µg mL⁻¹), total phenol (49.84 ± 0.041 mg g⁻¹), 65.56±0.023% (H₂O scavenging activity) and of 65.92±0.22% (DPPH scavenging activity), these results showed the efficiency of the economic, eco-friendly and novel IOF in raising high productive and high nutritive vegetable crops. Application of recommended dose of inorganic fertilizer in Amaranthus during first harvest recorded higher yield while in subsequent cuts and total mean yield of all cuts, organic treatments recorded higher yield, as organics stimulate microbial activity greatly and increased rate of mineralization provides continuous nutrient supply [30], [31]. Slow release activity of three organics applied in combination with biofertilizers increased the leaf yields of amaranthus more or less equally up to 11% [30], similar results were reported in spinach [31], in okra [32]. Besides, amaranthus under organic environment shows high quantity of nutrients as in case of Vitamin A content in organically grown (5620 IU/100g) which is about 400 IU higher and Iron(50mg/100g) about 40mg higher than the conventionally grown [33].

Medicinal benefits of organically grown foods and underutilized crops

Organically grown food and underutilized crops both acts as a good source of medicines as organic food acts as a precautionary measure and underutilized crops can be used for making such medicines. Malnutrition, particularly micronutrient deficiency, is one of the major public health problems in the developing countries, including India [34]. Loss of traditional food systems in societies of some indigenous people was linked to increase in nutrition related diseases [35]. Underutilized crops have the nutritional capacity to prevent and cure various diseases like kwashiorkor, marasmus, night blindness, anemia, diabetes, cancer, hypertension, and hidden hunger. Commonly used underutilized crops in pharmacy and alternative medicine are oil seed pumpkins [36], buckwheat [37]-[39], amaranths [40], [41] etc. Amaranth is incorporated into a range of human food products that are primarily targeted at health-conscious consumers [42]. Lettuce magnesium content has exceptional vitalizing power especially in the muscular tissues, the brain and the nerves. Among the tribal people of Chota Nagpur, especially the Mundas, the powdered seeds of clove bean are a known remedy to cure fever [43]. Similarly, they use Curry leaf as a Snakebite remedy, which also has many other medicinal uses in the Ayurveda form of medicine so popular in India [44]. Further, its green leaves are eaten as raw to cure dysentery [45]. Consumption of organically grown food is often perceived to reduce risk by reducing pesticide residues [46]. [47] reported that organic foods are more nutritious in terms of mineral content than conventional ones. Organically grown carrots and celeriac roots were higher in ascorbic acid and β -carotene contents [48]. When composted manure is used over organic fertilizers, organically grown spinach and lettuce were found to be higher in ascorbic acid compared to those grown conventionally [49]. As reported by [50], kale grown on farms using herbicides was found to contain lower β -carotene compared to organically grown kale. [49] found that inorganic fertilization slightly reduced the β -carotene content in spinach. Similarly, underutilized crops when grown organically can play a role of doctor for individuals sensitive to diets with high-oxalates. Oxalates in higher amount have been linked to an increased risk of kidney stones and other health problems. Use of organics in cultivation of underutilized leafy vegetables like Amaranth had a significant influence on the quality of fresh leaf in terms of oxalate content. Application of recommended dose of inorganic fertilizers recorded significantly higher amount of oxalates [30] as compared to organically grown Amaranthus (application of neem cake @ 2 t ha⁻¹ in combination with PSB + azospirillum @ 5 kg ha⁻¹).

A recent study of 110 urban and sub-urban children found measurable levels of organo-phosphorus pesticide metabolites in the urine of all children sampled, except for one child whose parents reported buying exclusively organic food [51]. Comparing the traces of on organophosphate metabolite in the urine of preschool children in Seattle (USA) eating organic vs. conventional produce showed 9 times higher DMTP averaged values in children eating a conventional diet [52]. The knowledge on different risks connected to the food is ever increasing. In studies conducted by some leafy vegetables (Chinese mustard and swamp cabbage) when grown organically [53] were significantly higher in Vitamin C, β -carotene and riboflavin content. In this study, factors such as environment and post-harvest practices that could influence vitamin content were not controlled.

CONCLUSION

Great potential for a number of currently underutilized crops can play a major role in a more diversified and sustainable food production system. To overcome the constraints in its way, there must be greater investment in long-term research and breeding programs and improved seed supply sources for these crops to ensure they can be competitive in the marketplace. Research and breeding of underutilized fruit and vegetable crops are clearly underfunded compared with the few main staple crops. Substantial initial funding by the international donor community and national state programs is necessary to achieve this goal and to generate interest among private sector breeders once significant market potential is within reach. Organic farming is also needed to improve the food and soil health with minimum use of pesticides to prevent global warming. Although organic farming is strongly opposed and criticized but future cannot be sacrificed for the gratification of present. Thus, once the people resolve to shun chemical fertilizers and pesticides, mono cropping systems, poor nutrient diets and seek to adopt Nature's own technology, new avenues will keep opening up. We have to keep trying to bring it to notice of farmers, breeders as well as private sector organizations until this goal to accomplish the need of the hour will be achieved.

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