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Underutilized Crops: A Pathway to Climate-Resilient Agriculture

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Underutilized crops, often referred to as neglected, minor, or orphan crops, represent a valuable but overlooked resource for building sustainable and climate-resilient agricultural systems. These crops including pseudocereals, minor millets, legumes, vegetables, oilseeds, and fruits have been cultivated for centuries in traditional farming systems but received little attention in modern research, policy and markets. Despite their marginalization, they are naturally adapted to diverse and harsh environments, showing tolerance to drought, poor soils, salinity and pests. Rich in essential nutrients, bioactive compounds and cultural value, they hold immense potential for improving food and nutritional security, diversifying diets and supporting livelihoods. Their incorporation into climate-smart agriculture strategies can reduce dependency on a narrow set of staple crops, enhance biodiversity, improve soil health and provide resilience against climate shocks. By unlocking the potential of underutilized crops through research, development and promotion, these species can serve as pathways to more sustainable farming practices, income diversification and poverty reduction, while contributing significantly to global food security in the face of climate change.

Introduction

Underutilized crops are mostly wild or semi-domesticated species adapted to local environment and also called neglected, minor, orphan, promising, or little-used. Underutilized crop species are ancient indigenous crop species that are still used at some level within the local, national or even international communities but have the potential to contribute to food security, nutrition, dietary, culinary diversification, health and income generation. The underutilized crops include cereals, pseudo-cereals, legumes, vegetables, oilseeds, roots crops, tubers, fruits, nuts, aromatic and medicinal plants etc. They are less known plant species in terms of marketing and research but well adapted to marginal biotic and abiotic stress conditions. These crops were used as traditional foods for centuries but became increasingly neglected when more productive crops became available in farming systems. Climate change refers to long-term changes in temperature, precipitation, and other atmospheric conditions on Earth. While natural factors can influence the climate. The term "climate change" is commonly used to refer to changes largely caused by human activities, particularly the release of greenhouse gases into the atmosphere. The primary contributors to human-induced climate change include the burning of fossil fuels (such as coal, oil, and natural gas), deforestation and industrial processes.

What are the alternative ways/crops?

Climate change poses significant challenges to agriculture, affecting crop yields, ecosystem, water availability, and overall food security etc. To mitigate these impacts, various alternative approaches and strategies can be employed such as Climate-Smart agriculture. Key components and practices associated with climate-smart agriculture it includes crop

diversification is the one of key strategy. Crop diversification refers to the practice of cultivating a variety of different crops within a specific area, either on a single farm or across a region. Planting a variety of Underutilized crops, development and promotion of underutilized crop species is a key strategy to adapt to a changing climate with more diversified agricultural system and also help farmers adapt to changing conditions and reduce vulnerability to pests or diseases.

Classification of underutilized crops

A. Pseudocereals: Grain Amaranth (Amaranthus sp. L.), Buckwheat (Fagopyrum sp. L.), Quinoa (Chenopodium quinoa L.), Chia (Salvia hispanica L.)
B. Minor millets: Foxtail millet (Setaria italica), Kodomillet (Paspalum scrobiculatum), Little Millett (Panicum sumatrense), Proso Millet (Panicum miliaceum), Barnyard millet (Echinochloa colona), Teff grass (Eragrostis teff L.)
C. Food legumes: Rice Bean (Vigna umbellate L.), Faba Bean (Vicia faba L.), Winged Bean (Psophocarpus tetragonolobus L.)
D. Vegetables: Kankoda (Momordica dioica roxb.), Broccoli (brassica oleracea var.italica)
E. Oil Seed Crops: Perilla (Perilla frutescens (L.)), Simarouba (Simarouba glauca), Tumba (Leucas aspera)
F. Minor Fruits: Custard apple (Annona squamosa L.), Wood apple (Limonia acidissima), Rose apple (Syzygium jambos), Indian goose bery (Phyllanthus emblica), Jamoon (Syzygium cumini), Carambola (Averrhoa carambola)

Significant role of underutilized crops

Underutilized crops play a significant role in agriculture, biodiversity conservation, and food security. These are crops that are not widely grown or commercialized compared to major staple crops, but they often possess unique qualities and can contribute to sustainable and resilient food systems. Here are some of the significant roles of underutilized crops:
Crop diversification: Underutilized crops often have genetic diversity that may not be present in widely cultivated crops. Preserving and cultivating these crops contribute to the conservation of genetic resources, helping maintain biodiversity in agriculture.
Adaptation to Climate Change: Some underutilized crops are well-adapted to specific environmental conditions, such as poor soils or water scarcity. These crops can be crucial in the face of climate change, as they may have traits like drought tolerance, heat resistance, or pest resilience.
Global food security: Underutilized food crops have high nutritional value, but their role in achieving nutrition security is still unexplored. Neglected or underutilized crops have the potential to play a number of roles in the improvement of food security in India.
Diversification in diet: Many underutilized crops have important nutritional qualities. They are therefore a significant complement to the 'major' cereals and serve to prevent various deficiencies. They have been used as food since time immemorial. Nutritionally they are valuable health food, which is low in calories, rich in carbohydrates, proteins, essential amino acids, fibre, important vitamins (water and fat soluble), minerals and many important bioactive components. Their consumption can make a valuable addition to the unbalanced diets of people in developing countries.
Resilience to Pests and Diseases: The genetic diversity of underutilized crops can provide natural resistance to pests and diseases. Introducing these crops into farming systems can contribute to integrated pest management and reduce reliance on chemical inputs.
Cultural and Culinary Diversity: Many underutilized crops have cultural significance and unique flavors. Promoting the cultivation and consumption of these crops helps preserve traditional culinary practices and supports local food cultures.
Sustainable Agriculture: Some underutilized crops are well-suited to agroecological and sustainable farming practices. They may require fewer inputs, such as synthetic fertilizers and pesticides, making them environmentally friendly options for sustainable agriculture.

Erosion Control and Soil Improvement: Certain underutilized crops have deep root systems that can help prevent soil erosion and improve soil structure. Integrating these crops into farming systems can contribute to soil health and conservation.

Research and Development Opportunities: Studying and promoting underutilized crops offer opportunities for research and development. This includes exploring their genetic potential, improving cultivation practices, and developing new varieties with desirable traits.

Income Diversification: Growing underutilized crops can provide farmers with additional income streams. Since these crops may not be as widely cultivated, they can potentially fetch higher prices in niche markets, contributing to income diversification for farmers.

Poverty reduction: Many underutilized plant crops offer opportunities for the poor village people, who are not capable of investing in other ventures. Multiple uses offer greater opportunities to raise income of local people by diversifying valuable plant products.

Why these are called as underutilized crops

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

❖ 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.

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

❖ Crops are recognized to have indigenous uses in localized areas.

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

Pseudo Cereals

1.Grain amaranth (*Amaranthus spp*. L.)

- Genus: Amaranthus
- Family: Amaranthaceae
- Rediscovered ancient crop known for its nutritional value
- Native to America and is widely distributed in tropical regions
- Grown for green leaf vegetable as well as for grain purpose
- Amaranth has a “C-4” photosynthetic pathway
- The drought tolerant characteristics of amaranth make it a prospective dry land crop for farmers in semi-arid areas
- In USA and it is considered as one of the ‘health care crops
- High in amino acid lysine (essential amino acid)
- Good ratio of unsaturated fat that is beneficial for hypertension and coronary heart disease

2. Buckwheat (*Fagopyrum esculentum*)

- Genus: Fagopyrum
- Family: Polygonaceae
- Short duration crop
- Grows well in low-fertile soils
- In India, buckwheat flour is known as kuttu ka atta and is culturally associated with the Navaratri festival.
- In India it is cultivating in Jammu Kashmir, West Bengal Sikkim, Assam Arunachal Pradesh, Nagaland, Meghalaya, Manipur
- Gluten free crop
- It may be eaten by people with gluten-related disorders

3. Chia (*Salvia hispanica* L.)

- Genus: Salvia
- Family: Lamiaceae
- Origin: Mexico
- Most important emerging "superfood"
- Cultivated for its edible and commonly used as food in several countries of western South America, Western Mexico and South Western United States
- Australia is the leading producer of Chia
- Introduced to India in the year 2015 by Central Food Technological Research Institute (CFTRI), Mysore from Central America
- Chia seeds with omega – 3 fatty acids play a key role in preventing the formation of clots and also protects from heart attack and stroke
- Soluble dietary fiber of chia seeds ranged between 23 to 50%
- Chia is the safest, cheapest, and the most sustainable source, as the intake of 25 to 50 g day-1 is enough to meet the daily demand of PUFAs

4. Quinoa (*Chenopodium quinoa* L.)

- Genus: Chenopodium
- Family: Amaranthacae
- Origin: Peru
- Quinoa is a hardy plant can be grown from sea level up to about 4,000 m and can be grown in poor soils as well
- Temperature range: 8 °C to 38 °C
- Tolerates to saline soils
- Low input crop
- Well established in area unsuitable for other crops
- Highly water efficient plan (100-200mm)
- Quinoa is the only plant food that has all the essential amino acids, trace elements and vitamins and also has the ability to adapt to different ecological environments and climates.
- Quinoa is gluten-free and perfect for people with gluten intolerance.

Minor Millets

- Minor millets are one of the oldest foods known to humans
- Millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops, under marginal conditions of soil fertility and moisture
- For centuries, millets have been a prized crop in India and are staple diet for nearly 1/3 rd of the world's population
- Millets have potentiality of contributing to increase food production, both in developing and developed countries
- Besides their better adaptability to adverse growing conditions they are rich in many minerals

Climate resilient qualities of minor millets

1. Millets are highly tolerant to aberrant weather.
2. High water productivity
3. Short duration
4. High storage life (>2years)
5. Requires a small investment for cultivation
6. Inputs added are mostly organic
7. Easy to cultivate
8. Provide both food and fodder
9. Local importance as a staple food

Food Legumes

1. Ricebean (*Vigna umbellata* L.)

- Genus: Vigna
- Family: fabaceae
- Is a legume with multiple use value.
- It is an important crop for food, fodder and green manure
- Ricebean growing states: himachal pradesh, uttaranchal, assam, manipur, meghalaya, mizoram, nagaland and MP
- The crop would grow on wide range of soils
- Resistant to pests and diseases
- Short duration 60 days
- Tolerant to drought and high temperatures
- Tolerant to some degree of waterlogging
- Best suited for intercropping

2. Faba bean (*Vicia faba* L.)

- Genus: Vicia
- Family: Fabaceae
- Multiple use value (food, fodder and green manure)
- High plant hardiness (withstand harsh and cold climate)
- Grown in high salinity as well clay soils
- Carbohydrate (58%), protein (26%), and fat (2%)
- Rich of minerals, such as manganese, phosphorus, magnesium and iron
- In India, faba beans are eaten in the Northeastern state of Manipur. They are locally known as hawai-amubi

3. Winged bean (*Psophocarpus tetragonolobus* L.)

- Genus: Psophocarpus
- Family: Fabaceae
- Also known as Goa bean, four-angled bean, four-cornered bean, manila bean, dragon bean
- Become a major multi-use food crop in Asia, Africa and Latin America
- Its origin is New Guinea
- Disease resistance crop
- All parts of the plant are edible
- Winged bean is a potential food source for poultry, fish and other livestock

Conclusion

Underutilized crops, once sidelined in the shadow of major staples, are now emerging as vital allies in addressing the dual challenges of climate change and food insecurity. Their resilience to harsh environments, rich nutritional profile, and cultural significance make them powerful tools for diversifying farming systems and strengthening rural livelihoods. Promoting these crops through research, policy support, and awareness can unlock their true potential and reduce overdependence on a few staple crops. By bringing these forgotten foods back to the forefront, agriculture can move towards a more sustainable, climate-resilient, and nutrition-secure future.