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Orphan Crops: A Miracle Crops for Future Farming and Sustainability

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INTRODUCTION

'Orphan crops' as the name indicates this is also called as unnoticed or unfocused crop. They are mainly cultivated in the rural areas of Africa (Somalia, Ethiopia, Nigeria, Sudan, and Eretria) Asia (Mongolia, China, Malaysia, Bhutan, and some parts of India like Andhra Pradesh, Karnataka etc.) South America and in some parts of Europe. These crops are consumed by the local rural people of the region they are found. These crops get very less attention in terms of agricultural research, training and extension even most of the people are not aware of it. Orphan crops are not traded internationally. These crops include Yam, Cassava, Teff, Finger millet, cowpea, Peanut etc. These crops can bring a revolution in the field of agriculture as it can be used for food fortification of next generation and can bring food security for all over the world. These crops can be proved as an alternative source of food. Because they receive little research attention, breeding techniques for orphan crops lag far behind modern technology. This means that the seeds farmers sow are less likely to be resistant to drought, floods or extreme temperatures; low productivity; and are more vulnerable to pests and diseases. Orphan crops are incredibly important in the countries where they are grown. They provide income to the poorest farmers and serve as staples in the local diet. Although backward breeding techniques have affected their resilience, particularly to pests and diseases, they are uniquely adapted to the environment in which they are grown. Tubers like cassava and sweet potato are very important for poor people survival livelihood. They come in endless varieties, many of which are grown in only a few locations, but they may have unique properties that can be used by everyone. We have rich sorghum varieties like zinc, iron-rich pearl millet, and Yellow flesh potato rich in vitamin A. These neglected crops can solve the multiple nutritional problems. One major drawback is the poor yield, that's why they are always neglected and disappearing from the agricultural farming, very few scientific community taking research interest on them.

OVERGROWING POPULATION

As we all know that Earth is the only planet in this universe which is referred as the green planet on which life exist in each and every prospect. Amidst a huge population is sustaining depending on the greenery nature which is existing on the Earth. And the very first thing which we notice to sustain our life is "food" then comes cloth and shelter. As we all are very familiar with the overgrowing population globally on Earth, which is a very big challenge for us. This population needs food, but our land resources are limited, there are some vegetation's which are not noticed yet, which can be a driving pillar in the field of hunger effacement. Today global population is 7.8 billion which is tremendously exceeding, and if we will talk about our India then the total population is around 135.26 crore [1]. As the population is exceeding we need to find the alternatives crops with the required nutritional profile which benefits to our health.

MAJOR GROWING CROPS

The major growing crop all around the world is wheat, rice, potatoes, maize etc. These are the only source for to feed our overgrowing population. And as we know our land resources is limited and with respect to that these crops would not be sufficient for to feed our next generation. We must look towards alternatives of these. We have a broad biodiversity and there are many crops which are yet to be discovered and

noticed and brought it to concern for to increase or add nutritional value in our day to day supplement and add economy to our country GDP. These crops must be noticed because we should think the supplement we are taking today, is this sufficient for our health nutrition. We must look and test those 'orphan crops' which are at the door of vulnerability.

POVERTY LINE

If we talk about the poverty, malnutrition and various other health risks due to absence of required nutrient, then it is at the peak today. The most poverty line seen today in INDIA in the area of Bihar, Rajasthan, Madhya Pradesh etc. If we take the e.g. of Andaman and Nicobar, then we would notice the people of there are living a life of tribal, they don't even have enough food instead, the area is rich with the biodiverse resources.

IMPACT OF NATURAL DISASTERS

Every year, natural disasters such as drought, flooding, storms and earthquake cause considerable damage to animals, plants and nature in general. We all are very familiar with it, every year we get hit by any natural disaster such as flood, drought, earthquake, landslide etc. and the damage we notice is in the agricultural sector. So we must look for more alternatives to escape us from these to some extent. I am not saying that these disasters would not affect "orphan crops", but it may change the situation somewhat, because there are many crops which are tolerant to these disasters, because they are adapted to the adverse weather.

According to the UN food and agriculture organization, the agricultural sector absorbs 22% of the economic impact caused by natural hazard and disasters in the developing world as agriculture contributes up to 30% of the GDP of vulnerable countries [2]. Within agriculture the crops sectors suffers the most. From 78 disaster occurring from the years 2003 to 2013, the highest damage and losses to crops were 42% followed by those to livestock (36%) [2].

EMPLOYMENT GENERATION

India is a land of agriculture, where 60% of its population depends upon it. It is a huge employment generating sector. By introducing orphan crops in research work, we can generate employment as when it get introduced in the market for its commercial cultivation, many farmers or rural people could get job to sustain their life.

ADVANCEMENT IN PLANT BREEDING

This is the very most area where India lacks behind back. We don't have access of laboratories and modern technologies equipment in the field of plant genomic research. The African orphan crops consortium (AOCC) successfully initiated the ambitious genome sequencing project of 101 African orphan crops, trees with 6 genomes sequenced, 6 near completion and 20 currently in progress. AOCC was established in 2011 with an aim to reduce stunting and malnutrition by providing nutritional security through improving locally adapted nutritious, but neglected orphan African food crops [3]. We should also take some initiative step and bring those orphan crops in front of world. These crops would give food security and also reduce some severe health risk. According to research of AOCC, these orphan crops are highly nutritious, rich in vitamins, minerals, and proteins. Orphan crops can be used for to deal with the hunger starvation.

MAJOR ORPHAN CROPS

There are some major orphan crops with their miracle properties, such as cassava, yam, teff, finger millet, pigeon-pea, peanut, and cowpea. Orphan crops may sound familiar to you and me, but they are poised to make a major impact on global food security [4].

CASSAVA

Cassava (Manihot esculenta crantz) a tropical root crop native to South America, is commonly called as Brazilian arrow root, manioc, tropica, or yucca was introduced to Asia in the 1880,s and extensively cultivated in the 20th century in the Philippines, India, Indonesia and later to the rest of Asia (i.e. Malaysia, Thailand, Vietnam and China). Today it is estimated that more than 8 million farmers grow Cassava in Asia covering approximately 4.2 million hectare [5]. It is popular because it is a hardy crop i.e. resistant to drought and does not require much fertilizer, although it is vulnerable to bacterial and viral disease in Tables 1 and 2 [6].

Table 1: Cassava production-2016.

Country	Production (millions of tons)
Nigeria	57.1
Thailand	31.1
Brazil	21.1
Indonesia	20.7
Democratic Republic of the Congo	14.7
World	277.1

Table 2: Nutritional profile of cassava.

Nutritional value per 100 g (3.5 oz)	
Energy	160 kcal (670 kJ)
Carbohydrates	38.1 g
Sugars	1.7 g
Dietary fiber	1.8 g
Fat	0.3 g
Protein	1.4 g
Vitamins	**Quantity % DV†**
Thiamine (B1)	8%
	0.087 mg
Riboflavin (B2)	4%
	0.048 mg
Niacin (B3)	6%
	0.854 mg
Vitamin B6	7%
	0.088 mg
Folate (B9)	7%
	27 µg
Vitamin C	25%
	20.6 mg
Minerals	**Quantity % DV†**
Calcium	2%
	16 mg
Iron	2%
	0.27 mg
Magnesium	6%
	21 mg
Phosphorus	4%
	27 mg
Potassium	6%
	271 mg
Sodium	1%
	14 mg
Zinc	4%
	0.34 mg
Other constituents	**Quantity**
Water	60 g
Full Link to USDA Database entry	
Units	
• µg=micrograms • mg=milligrams, IU=International units	
† Percentages are roughly approximated using US recommendations for adults.	

Raw cassava is 60% water, 38% carbohydrate, 1% protein and has negligible fat [7]. In 100 gm amount, raw cassava provides 160 calories and contain 25% of the daily value (DV) for vitamin C, but otherwise has no micronutrients in significant content (no values above 10% DV, table). Cooked cassava starch has a digestibility of over 75% [8].

Food fortification

Cassava is a rich, affordable source of carbohydrate. It can provide more calories per acre of the crop then other cereals, which makes it a very useful crop in the developing world [6]. Cassava is consumed in different parts of the world, mainly used by the rural people living in village. These contain high value of nutrition and can add extra nutrition in our daily diet. As the days passes we need some extra source of nutrition for to boost our immunity.

Dishes that people can make using cassava include:

• Bread, which can contain cassava flour only, or both cassava and wheat flour.

• French fries.

• Mashed cassava.

• Cassava chips.

• Cassava bread soaked in coconut milk.

• Cassava cake.

• Cassava in coconut sauce.

• Yucca con mojo, a Cuban dish that combines cassava with a sauce comprising citrus juices, garlic, onion, cilantro, cumin and oregano etc [9].

It is very good vehicle for addressing some health related problems and also serve as security food [9]. Scientist may eventually be able to replace high-fructose corn syrup with cassava starch [6]. Overall we can say this, that introducing cassava in our daily diet would be proved as food fortified and also enhance the health and immune system.

Economic importance

As I have already said that India's poverty line is miserable, many peoples don't access to food because they can't afford. Introducing alternative orphan crop and bring this difference between rich and poor down to some extent [10]. It would also support country GDP by introducing it in agriculture. Cassava is one of the most important sources of food in the Tropic regions (local people). The cassava plants give the third highest yield of carbohydrates per cultivated area among crop plants, after sugarcane and sugar beets [10]. Cassava plays a particularly important role in agriculture in developing countries, especially in sub-Saharan Africa, because it does well on poor soils and with low rainfall and because it is a perennial that can be harvested as required. Its wide harvesting windows allows it to act as a famine reserve and is invaluable in managing labor schedules

it offers flexibility to resource poor farmers because it serves as either a subsistence or a cash crop [11]. Worldwide 800 million people depend on cassava as their primary food staple [12]. In today's scenario, Africa is one of the most important continent whose most population depending on orphan crops for their feed, so by introducing it in agriculture we can create a good position in agricultural economy. And India is an agricultural land; here 60% of the populations are agriculture based. Agricultural sector add an important economy In India's GDP. So by introducing it in our agriculture sector, we can ultimately increase our economy.

YAM

Yam (Dioscorea spp.) is a vegetable similar to sweet potato, having high amount of starch present in it. Yams are perennial herbaceous vines cultivated for the consumption of their starchy tubers in many temperate and tropical world regions, especially Latin America, Africa, Asia and Oceania [13]. The tubers themselves are called "yams" and there is a variety owing to numerous cultivars and related species [13]. Some yams are also invasive plants, often considered a "noxious weed", outside cultivated areas. Some 870 species of yams are known, [13] and 95% of these crops are grown in Africa [14]. It's cultivation is labor-intensive, despite the high labor requirements and production costs, consumer demand for yam is high in certain sub-regions of Africa [13], making cultivation of yam is profitable certain farmers to some extent. It has various species varies in color and shape. Its edible part is hard and can be soften by heating it up. Yam crop is also cultivated as intercropping crop with Beetle (Table 3).

Table 3: YAM production-2017.

Country	Production (millions of tons)
Nigeria	47.9
Ghana	8
Ivory Coast	7.1
Benin	3.1
Ethiopia	1.4
Togo	0.8
Cameroon	0.6
World	73

In 2017, worldwide production of yams was 73.0 million tones, led by Nigeria with 66% of the global total. Nigeria farmed yams on 5.9 million hectares, 70% of the world land area of 8.6 million hectares devoted to yam farming [15]. The world average annual yield of yams was 8.8 tonnes per hectare in 2017, with Ethiopia having the most productive farms of 29.2 tons per hectare (Table 4) [15].

Table 4: Nutritional profile.

Nutritional value per 100 g (3.5 oz)	
Energy	**494 kJ (118 kcal)**
Carbohydrates	27.9 g
Sugars	0.5 g
Dietary fiber	4.1 g
Fat	0.17 g
Protein	1.5 g
Vitamins	**Quantity % DV†**
Vitamin A equiv.	1%
	7 µg
Thiamine (B1)	10%
	0.112 mg
Riboflavin (B2)	3%
	0.032 mg
Niacin (B3)	4%
	0.552 mg
Pantothenic acid (B5)	6%
	0.314 mg
Vitamin B6	23%
	0.293 mg
Folate (B9)	6%
	23 µg
Vitamin C	21%
	17.1 mg
Vitamin E	2%
	0.35 mg
Vitamin K	2%
	2.3 µg
Minerals	**Quantity % DV†**
Calcium	2%
	17 mg
Iron	4%
	0.54 mg
Magnesium	6%
	21 mg
Manganese	19%
	0.397 mg
Phosphorus	8%
	55 mg
Potassium	17%
	816 mg
Zinc	3%
	0.24 mg
Units	
µg=micrograms	
mg=milligrams	
IU=International units	
†Percentages are roughly approximated using US recommendations for adults.	
Source: USDA Nutrient Database.	

Raw yam has only moderate nutrient density, with

appreciable content (10% or more of the daily value, DV) limited to potassium, vitamin B6, manganese, thiamin, dietary fiber and vitamin C [16].

Food fortification

Yams are consumed in a variety of preparations such as, flour or whole vegetable pieces across their range of distribution in Asia, Africa, North-America, Central America, the Caribbean, South-America and Oceania [13]. Flours from dried yam slices brought on local market were fortified with soybean and groundnut paste to develop balanced diet. Carrot and egg shell were added as [17] reinforcing sources of micronutrients. The nutritional content and antioxidant properties of the flour blends were then assessed [17]. Results indicate the flour blends satisfy the recommended energy and macronutrients requirements according to set standards. Thus the flour blends can be used for managing protein energy malnutrition [17].

Economic importance

As we have seen, its importance in terms of its nutritional value, nature of food fortification, it may add handsome revenue to our economy. Farmers may get an alternative crop to earn benefits. Efforts made by research to increase agricultural production and productivity are greatly hindered by the lack of a clear understanding of the specific needs of the farmers, their local problems and can conditions under which they grow [18]. Yam tuber like other root crops is essentially a starchy or carbohydrate food. It has a principle nutritional function being a source of supply of calories to the body. Today, the total contribution of yam towards feeding the people of West Africa is less than other staples such as cassava, maize, rice, but the food value of yam is still an important one. The yam crop produces some 18 million tones for the people of the “yam zone” in the tropical regions of West Africa (wilkin, 200 l; keh etal. 2013) more so, in addition to its nutritional relevance, yam plays an important role in social and religious festivals. In yam growing area of West Africa, yam is vital integral part of the cultural heritage for many people. In the agricultural economics/marketing literature its well establishes that production is meant to create utility for consumers and this is done when what is produced gets to the consumers [19].

FINGER MILLET

Finger millet or Eleusine coracana, is a crop of poaceae family and widely grown in different regions of the world. It is a drought tolerant crop. Main cultivation areas are Eastern and Southern African countries (Uganda, Kenya, Zaire, Zimbabwe, Zambia, Sudan, Tanzania, Nigeria and Mozambique) and Southern Asia (mainly India and Nepal) [20]. It is one of important food crops in Sri Lanka. That can be cultivated under adverse soil and climatic conditions mostly as a rain fed crops [21]. Productivity of finger millet has been increased from 0.6 million tones/ hectare in late 1995 to 1.17 million tones/hectare in year 2015 due to newly improved varieties and adoption of improved cultivation practices specially irrigated transplanted method of crop establishment [22].

Nutritional profile

The international crops research institute for the semi-arid tropics (ICRISAT) a member of the CGIAR consortium, partners with farmers, governments, researchers and NGOs to help farmers grow nutritious crops, including finger millet. This helps their communities have more balanced diet and becomes more resilient to pests and drought. Finger millet is very high in calcium, rich in iron and fiber, and has better energy content than other cereals. These characteristics make it ideal for feeding to infants and the elderly [23]. Recent preclinical study with the finger millet whole grain and bran suggested that finger millet could prevent high-fat diet induced obesity and beneficially modifies the gut bacteria (Table 5) [24].

Table 5: Nutritional value of finger millet /100 gm [22].

Nutrition type	Value
Protein	7.6 g
Fat	1.5 g
Carbohydrate	88 g
Calcium	370 mg
Vitamin (A)	0.48 mg
Thiamine (B1)	0.33 mg
Riboflavin (B2)	0.11 mg
Niacin (B3)	1.2 mg
Fiber	3 g

Food fortification

Millets being less expensive compared to cereals and the staple for the poorer section of population could be the choice for fortification with micronutrients such as Zinc. In view of this, finger millet widely grown and commonly consumed in Southern India was explored as a vehicle for fortification with zinc in their investigation. Finger millet flour fortified with either zinc oxide or zinc stearate so as to provide 50 mg zinc per kg flour, was specifically examined for the bio-accessibility of the fortified mineral, as measured by *in vitro* simulated gastrointestinal digestion procedure and storage ability. Moisture and

free fatty acid contents of the stored fortified flours indicated the keeping quality of the same, up to 60 days. The preparation of either roti or dumpling from the fortified flours stored up to 60 days didn't result in any significant compromise in the bio-accessible zinc content [25].

Economic importance

It is a highly productive crop that can thrive under a variety of harsh environment conditions, and is also organic by default. It can be grown on low fertility soils and not dependent on the use of chemical fertilizers, hence is a boon for the vast arid and semi-arid regions. The high fiber content of finger millet helps in preventing constipation, high cholesterol formation, diabetes and intestinal cancer [26]. Thus, the finger millet has various nutritional qualities and is highly tolerant crop, by growing this we can generate alternatives source of nutrition needed for human's health benefits. This can give high economic value, as many marginal and poor people prefer this due to its low cost. This would automatically increase the economy in rural areas.

TEFF

Teff or Eragrostis tef is an un-noticed crop of poaceae family. It is widely distributed in different parts of world as it has quality of nutritional benefits. The reason behind growing this crop is its resistance towards some biotic stresses and is a low risk crop where major cereals could not be grown; it gives better yield and has capacity to deal with starvation and hunger. Teff originated in the Horn of Africa, corresponding to what is, today modern day Ethiopia and Eritrea, where it is one of the most important cereals [27].

Areas of further development include:

1. Improving productivity of teff;

2. Overcoming the lodging malady;

3. Developing climate-smart and appropriate crop and soil management option;

4. Developing tolerance to biotic stresses such as drought and soil acidity;

5. Developing sustainable pre-and post-harvest mechanization technologies suitable for smallholder farmers as well as commercial farms;

6. Food processing and nutrition aspects with special attention to the development of different food recipes and value added products;

7. Developing crop protection measures against diseases, insects, pest and weeds;

8. Improving or strengthening socio-economics and agricultural extension services [28].

Teff is popular because it is allow risk crop [29].

Nutritional profile

It is shown in Table 6.

Table 6: Uncooked teff is 9% water, 73% carbohydrate, 13% protein and 2% fat. The fiber content in teff is also higher than in most other cereals.

Teff, uncooked	Nutritional value per 100 g (3.5 oz)
Energy	1,536 kJ (367 kcal)
Carbohydrates	73.13 g
Dietary fiber	8.0 g
Fat	2.38 g
Protein	13.30 g
Vitamins	**Quantity % DV†**
Thiamine (B1)	34%
	0.390 mg
Riboflavin (B2)	23%
	0.270 mg
Niacin (B3)	22%
	03.363 mg
Vitamin B6	37%
	0.482 mg
Minerals	**Quantity % DV†**
Calcium	18%
	180 mg
Iron	59%
	7.63 mg
Magnesium	52%
	184 mg
Phosphorus	61%
	429 mg
Potassium	9%
	427 mg
Sodium	1%
	12 mg
Zinc	38%
	3.63 mg
Other constituents	**Quantity**
Water	8.82 g
•Units	
•µg=micrograms • mg=milligrams	
•IU=International units	
†Percentages are roughly approximated using US recommendations for adults.	

Food fortification

In Ethiopia teff provides two-thirds of the daily protein intake [30,31]. Due to its high mineral content, teff is also mixed with soybeans, chickpeas or other grains to manufacture baby food [32]. Teff proves good things do come in small packages. “Teff is naturally rich in minerals especially calcium,” says Mckercher. “It also contains health promoting fiber,” she says, which helps digestion and satiety. Each half cup of cooked teff contains 127 calories, 5 grams of protein, 1 gram of fat, 25 grams of carbs and nearly 4 grams of fiber. Teff is high in resistant starch, a type of fiber that may help support insulin sensitivity and increase satiety. Teff has gained attention for being both gluten-free and a complex carbohydrate [33]. Teff is a gluten-free whole grain that’s native to Ethiopia. It has a nutty flavor that pairs well with spicy dishes, and it’s also good with sweet fruit like apple and pears. It’s a staple in Ethiopian dishes and if you like the taste, you can choose to integrate it into your healthy diet [33]. It is also rich in some chemical and anti-oxidant properties used for the treatment of malaria.

Economic importance

Teff has a significant role on Ethiopian agriculture, food, and trade sectors. Major Ethiopian farmers rely on teff production because teff is their daily consumption. Teff is largely produced for market because of its high price and absence of alternative cash crops. Teff is the second most important cash crop after coffee and generating around 500 million USA dollar incomes per year for local farmers. The volume of export has fluctuated and relatively a larger quantity was exported in 1995-1997; 2001 and 2005 but export has declined since 2006; mainly due to high domestic prices and government export ban on unprocessed teff grain. The main reason was to bring domestic inflation price into consumers’ affordable level and meet local food security demand before export. However; the imposed ban averts the Ethiopia government particularly farmers from engaging and benefiting in the raising world trade; which could increase GDP and change the livelihood of producers. However; some report showed that demand is thought to be very high in the USA; Middle East and Europe due to an enormous number of Ethiopian immigrants live there [34]. So, teff is one of the most valuable crops, it has many health benefits, so people prefer this to add in their daily nutritional diet. It also creates job opportunities, which can reduce unemployment to some extent as it is a labor intensive farming practice.

PIGEON PEA

The Pigeon pea (Cajanus Cajan), also known as pigeon pea, red gram or tur, [35,36] is a perennial legume from the family Fabaceae. It is taken as staple diet in many parts of India. The cultivation of the pigeon pea goes back at least 3,500 years. The center of origin is probably peninsular India, where the closest wild relatives (Cajanus cajanifolia) occur in tropical deciduous woodlands [37]. World production of pigeon peas is estimated at 4.49 million tons [38]. About 63% of this production comes from India. Africa is the secondary center of diversity and at present it contributes about 21% of global production with 1.05 million tons. Malawi, Tanzania, Kenya, Mozambique and Uganda are the major producers in Africa. The total number of hectares grown to pigeon peas is estimated at 5.4 million [38].

Nutritional profile

Pigeon peas contain high levels of protein and the important amino acids methionine, lysine, and tryptophan (Table 7) [39].

Table 7: Nutrition profile.

Nutritional value per 100 g (3.5 oz)	
Energy	**569 kJ (136 kcal)**
Carbohydrates	23.88 g
Sugars	3 g
Dietary fiber	5.1 g
Fat	1.64 g
Protein	7.2 g
Vitamins	**Quantity % DV†**
Thiamine (B1)	35%
	0.4 mg
Riboflavin (B2)	14%
	0.17 mg
Niacin (B3)	15%
	2.2 mg
Pantothenic acid (B5)	14%
	0.68 mg
Vitamin B6	5%
	0.068 mg
Folate (B9)	43%
	173 µg
Choline	9%
	45.8 mg
Vitamin C	47%
	39 mg
Vitamin E	3%
	0.39 mg
Vitamin K	23%
	24 µg

Minerals	Quantity % DV†
Calcium	4%
	42 mg
Iron	12%
	1.6 mg
Magnesium	19%
	68 mg
Manganese	27%
	0.574 mg
Phosphorus	18%
	127 mg
Potassium	12%
	552 mg
Sodium	0%
	5 mg
Zinc	11%
	1.04 mg
Values for Choline, Vit. E/K available	
•Units	
•µg=micrograms •mg=milligrams	
•IU=International units	
†Percentages are roughly approximated using US recommendations for adults.	
Source: USDA Nutrient Database.	

Food fortification

Pigeon peas are both a food crop (dried peas, flour, or green vegetable peas) and a forage/cover crop. In combination with cereals, pigeon peas make a well-balanced meal and hence are favored by nutritionists as an essential ingredient for balanced diets. The dried peas may be sprouted briefly, than cooked, for a flavor different from the green or dried peas. Sprouting also enhances the digestibility of dried pigeon peas *via* the reduction of indigestible sugars that would otherwise remain in the cooked dried peas [40].

Economic importance

The present study was based on primary data collected from 100 farmers in Gulbarga district of Karnataka, India, during the agricultural year 2013-2014. Study shows that average land holding size of pigeon pea seed farmers was higher in comparison to grain farmers and district average. The study illustrates a ratio of 32:68 towards fixed and variable costs in pigeon pea certified seed production with a total cost of Rs.39436 and the gross and net returns were Rs.73300 and Rs.33864 per hectare, respectively. The total cost of cultivation, gross return, and net return in pigeon pea seed production were higher by around 23, 32, and 44 percent than grain production, respectively. Hence, production of certified seed has resulted in a win-win situation for the farmers with higher yield and increased returns. The decision of the farmer on adoption of seed production technology was positively influenced by his education, age, land holding, irrigated land, number of crops grown, and extension contacts while family size was influencing negatively. Higher yield and profitability associated with seed production can be effectively popularized among farmers, resulting in increased certified seed production [41,42].

PEANUT

Peanut is widely grown in the tropics and subtropics, being important to both small and large commercial producers. It is classified as both a grain legume [42] and, due to its high oil content, an oil crop [43]. Peanuts are similar in taste and nutritional profile to tree nuts such as walnuts and almonds, and as a culinary nut are often served in similar ways in western cuisines. The botanical definition of a “nut” is a fruit whose ovary wall becomes hard at maturity. Using this criterion, the peanut is not a typical nut [44]. There are many peanut cultivars grown around world. The market classes grown in the United States are Spanish, Runner, Virginia and Valencia [45]. Peanut production in the United States is divided into three major areas: the southeastern United States region which includes Alabama, Georgia and Florida; the southwestern United States region which includes New Mexico, Oklahoma and Texas; and the third region in the general eastern United States which includes Virginia, North Carolina and South Carolina (Table 8) [45].

Table 8: Peanut production.

Peanut production in 2018	
Country	**Production in million tons**
China	17.3
India	6.7
Nigeria	2.9
Sudan	2.9
United States	2.5
World	46
Source: FAOSTAT, United Nations.	

Nutritional profile

Peanut are rich in essential nutrients (right table, USDA nutrient data). In a 100 gm serving, peanuts provide 570 calories and are an excellent source (defined as more than 20% of the daily value, DV) of several B vitamins, vitamin E, several dietary minerals, such as manganese (95% DV), magnesium (52% DV) and phosphorous (48% DV), and dietary fiber (right table). They also contain about 25 g protein per 100 g serving, a higher proportion than in many tree nuts (Table 9) [46].

Table 9: Nutrition profile.

Peanut, Valencia, raw	
Nutritional value per 100 g (3.5 oz)	
Energy	**2,385 kJ (570 kcal)**
Carbohydrates	21 g
Sugars	0.0 g
Dietary fiber	9 g
Fat	48 g
Saturated	7 g
Monounsaturated	24 g
Polyunsaturated	16 g
Protein	25 g
Tryptophan	0.2445 g
Threonine	0.859 g
Isoleucine	0.882 g
Leucine	1.627 g
Lysine	0.901 g
Methionine	0.308 g
Cysteine	0.322 g
Phenylalanine	1.300 g
Tyrosine	1.020 g
Valine	1.052 g
Arginine	3.001 g
Histidine	0.634 g
Alanine	0.997 g
Aspartic acid	3.060 g
Glutamic acid	5.243 g
Glycine	1.512 g
Proline	1.107 g
Serine	1.236 g
Vitamins	**Quantity % DV†**
Thiamine (B1)	52%
	0.6 mg
Riboflavin (B2)	25%
	0.3 mg
Niacin (B3)	86%
	12.9 mg
Pantothenic acid (B5)	36%
	1.8 mg
Vitamin B6	23%
	0.3 mg
Folate (B9)	62%
	246 µg
Vitamin C	0%
	0.0 mg
Vitamin E	44%
	6.6 mg
Minerals	Quantity % DV†
Calcium	6%
	62 mg
Iron	15%
	2 mg
Magnesium	52%
	184 mg
Manganese	95%
	2.0 mg
Phosphorus	48%
	336 mg
Potassium	7%
	332 mg
Zinc	35%
	3.3 mg
Other constituents	**Quantity**
Water	4.26 g
• Units	46
•µg=micrograms •mg=milligrams	
•IU=International units	
† Percentages are roughly approximated using US recommendations for adults	

Food fortification

Peanut has traditionally been used as a source, of oil; however, its worldwide annual protein harvest has reached nearly 4.5 million tons. In recent years, several cereals and legumes-based foods using peanuts as protein supplement have been developed to alleviate protein calories malnutrition problem. Peanut in the form of flour, protein isolates and meal in a mixed product have been found to be very desirable from a sensory quality point of view [47]. Peanut oil is often used in cooking, because it has a mild flavor and a relatively high smoke point. Due to its high monounsaturated content, it is considered more healthful than saturated oils, and is resistant to rancidity [48].

Economic importance

Farmers are the backbone of our country. They spend long days tending to their crops and the land so they can produce safe, abundant and affordable products. Many farmers across America choose to grow peanuts because they are the most sustainable nut [49]. Peanuts are not only a sustainable crop, but they are also a smart addition to healthy, sustainable diets. The U.S peanut industry plays a vital economic role nationally and locally. Peanuts are the seventh most valuable crop in the U.S, with a farm value of more than $1 billion. Aside from their contribution to the economy, peanuts help us fight hunger in communities of need, whether in the U.S or abroad. Peanut-based products like (RUTF) support food security and economic growth in the developing world [49].

COWPEA

Cowpeas thrive in poor dry conditions, growing

well in soils up to 85% sand [50]. This makes them a particularly important crop in arid, semi-desert regions where not many other crops will grow. As well as important source of food for humans in poor, arid regions, the crop can also be used as feed for livestock [51].

Nutritional profile

Cowpea seeds provide a rich source of proteins and calories, as well as minerals and vitamins. Cowpea starch is digested more slowly than the starch from cereals, which is more beneficial to human health [52]. However, it does contain some anti-nutritional elements, notable phytic acid and protease inhibitors, which reduce the nutritional value of the crop in Table 10 [52].

Table 10: Nutrition profile.

Cowpea (raw seeds)	
Nutritional value per 100 g (3.5 oz)	
Energy	**336 kcal (1,410 kJ)**
Carbohydrates	60.03 g
Sugars	6.9 g
Dietary fiber	10.6 g
Fat	1.26 g
Protein	23.52 g
Vitamins	**Quantity % DV†**
Vitamin A equiv.	0%
	3 µg
Thiamine (B1)	74%
	0.853 mg
Riboflavin (B2)	19%
	0.226 mg
Niacin (B3)	14%
	2.075 mg
Vitamin B6	27%
	0.357 mg
Folate (B9)	158%
	633 µg
Vitamin C	2%
	1.5 mg
Vitamin K	5%
	5 µg
Minerals	**Quantity % DV†**
Calcium	11%
	110 mg
Iron	64%
	8.27 mg
Magnesium	52%
	184 mg
Phosphorus	61%
	424 mg
Potassium	24%
	1112 mg
Sodium	1%
	16 mg
Zinc	35%
	3.37 mg
Other constituents	Quantity
Water	11.95 g
•Units	
•µg=micrograms • mg=milligrams	
•IU=International units	
†Percentages are roughly approximated using US recommendations for adults.	
Source: USDA Nutrient Database.	

Food fortification

Cowpeas are grown mostly for their edible beans, although the leaves, green seeds and pods can also be consumed, meaning the cowpea can be used as a food source before the dried peas are harvested [53]. The cowpea has often been referred to as “poor man’s meat” due to the high levels of protein found in the seeds and leaves [54]. The world health organization (WHO) estimated that about 1.62 billion people are affected by anemia and that preschool children are the most affected, with a prevalence of 47.4%. Several countries have stepped up efforts to reduce iron deficiency anemia by supplementing iron, as well as universal fortification of foods with iron and other micronutrients and vitamins. As we have seen cowpea play a vital role in treating iron deficiency, it has high nutritive value and can be added in daily diet supplement with affordable price.

Economic importance

Cowpea is grown across the world on an estimated 14.5 million ha of land planted each year and the total annual production is 6.2 million metric tons. Over the last three decades, global cowpea production grew at an average rate of 5%, with 3.5% annual growth in area and 1.5% growth in yield, and the area expansion accounting for 70% of the total growth during this period. Introducing cowpea in Indian agricultural can be proved as a source for poor farmers to cultivate at minimum price and get a desirable benefits, it would also increase the national economy.

CONCLUSION

Orphan crops can be proved as miracle crop with its enormous potential to feed the overgrowing population. It can bring a new direction in the field of plant breeding, as it can be an important scope for the scientist to work on. It can add an alternative food in our daily diets with quantity of nutrients.

CONFLICT OF INTEREST

None of the Authors have any conflict of Interest.

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