



Pulses: The Power Packed Plants for Healthy Life and Sustainable Agriculture

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DOI: 10.31080/ASAG.2024.08.1374

Received: February 12, 2024

Published: May 13, 2024

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Abstract

Pulses are essential food crops that contribute to global food security and climate change, as well as to nutritious diets. Pulses also play an important role in soil biodiversity and soil fertility, which is a key factor in ensuring that people have access to a diverse nutritional diet to fight hidden hunger, and are essential for sustainable agriculture. In this review, we discuss importance of pulses and its impact on climate change, sustainable agriculture, biodiversity and their potential applications in the context of addressing malnutrition in India, where a large portion of the population is vegetarians.

Keywords: Agriculture; Biodiversity; Nutrition; Pulse; Soil Fertility

Introduction

One of the greatest challenges facing our world in present is to ensuring food security and balanced diets for people all over the world. The numbers are staggering: around 800 million people suffer from chronic hunger and 2 billion people suffer from one or more micronutrient deficiencies. In addition, more than half a billion people are clinically suffering from obesity. According to experts, the global population is projected to grow from 7.3 billion in 2023 to around 9.8 billion in 2050 with a surge in food demand up to 59-98% [2]. A sustainable, efficient and safe way of food production will be needed to increase the quantity and quality of food. Climate change, population growth, food insecurity and related risks directly affect the economic systems of developing and underdeveloped countries, where agriculture contributes towards a significant share in the economy. As the world continues to grapple with multiple crises, today's global challenges necessitate a coordinated and effective response. The world is searching for a potential crop that could be a sustainable solution to this challenge. That crop should be affordable, easily accessible, low input, low moisture, care, and management, and high nutritional value. Pulses may be the answer to all these requirements [1]. Pulses are an important crop for farmers. When farmers incorporate pulses

into their various cropping systems, it encourages sustainable farming practices that enrich soil with nutrients, improve growing conditions, reduce synthetic fertilizers, and promote biodiversity.

Pulses are one of the oldest plants on the planet. They've been around for millions of years. Pulses are one of the most versatile crops in the world. They can be grown anywhere in the world in almost any climate such as extreme hot and cold climates. They have a high nutritional value, and can grow in arid areas requiring very little water – concentrated during the early stages of growth. Pulses have a nitrogen-fixation property, which is a natural process that has been and continues to be important for soil enrichment. In other words, pulses carry properties that improve the soil in which they grow and this helps other plants grow as well. For all these reasons, pulses are a powerful weapon against hunger and malnutrition. Pulses are a genuine superfood for the future. Not only are they are good for you, but they're tasty too. World Health Organization recommends 80 g pulses man⁻¹ day⁻¹. The Indian Council of Medical Research (ICMR) recommends 40 g pulses man⁻¹ day⁻¹. However, actual availability ranges from 30 – 35 g pulses man⁻¹ day⁻¹. In 2016, the Food and Agriculture Organization (FAO) brought pulses into the spotlight that has immense potential to address the issues of sustainability.

Pulses and their diversity

Pulses are part of the Fabaceae or Leguminosae family, which is the world’s third largest plant family. Pulses are the dehydrated edible seeds of leguminous plants that produce from 1 to 12 grains of different sizes, shapes and colors within a pod. These seeds can be used as human or animal food. Leguminous plants are not only healthy but also good for the soil. Currently, we are on the verge of self-sufficiency in pulse production, as we are the leading exporter of pulses in terms of production, consumption, and import. By 2050, we are expected to be able to maintain our production and become net exporter of pulses if all goes well. Another unique feature of pulses is that they are a source of livelihood, although they are not yet commercially traded. The main pulses grown in India

are chickpea or Bengal gram (*Cicer arietinum*), pigeon pea or red gram or arhar (*Cajanus cajan*), lentil (*Lens culinaris*), urd bean or black gram (*Vigna mungo*), mung bean or green gram (*Vigna radiata*), lablab bean (*Lablab purpureus*), moth bean (*Vigna aconitifolia*), horse gram (*Dolichos uniflorus*), pea (*Pisum sativum* var. arvense), grass pea or khesari (*Lathyrus sativus*), cowpea (*Vigna unguiculata*), and broad bean or faba bean (*Vicia faba*). In general, pulses are mostly grown in two seasons such as the warmer, rainy season or kharif (June-October) and the cool, dry season or Rabi (October-April). Chickpea, lentil, and dry peas are grown in the Rabi season, while pigeon pea, urd bean, mung bean, and cowpea are grown during kharif season. Among various pulse crops, chickpea dominates with over 40 percent share of total pulse production followed by pigeonpea (18-20%), mungbean (11%), urdbean (10-12%), lentil (8-9%) and other legumes (20%).



Figure 1: Different types of pulses grown in India.

Pulses and their importance in Indian context

The Food and Agriculture Organization (FAO) has stressed the need to diversify diets and ensure nutritional security in South Asia, including India. Pulses are a key component of a balanced diet, as they are rich in protein, minerals and vitamins. This is why pulses are getting more attention in the context of addressing malnutrition in India, where a large portion of the population is vegetarians. This is in line with the increasing need to diversify rice and wheat rotation in the Indus Gangetic plains. Pulses such as pigeon pea, chick pea, and lentil can help conserve resources, diversify diets, and increase climate resilience. In view of the above needs, pulses are the most realistic and possible crops for sustainable intensification in India. Of the possible niches in which pulse crops can be efficiently incorporated, the most relevant is the summer fallow rotation of irrigated cereals–cereals (especially rice–wheat) in Indo-Gangetic plains. In addition to increasing system productivity and dietary diversity, cover crops using pulses during the

summer months could significantly improve soil fertility, provide deep soil carbon storage, and be used as green manure [3].

The ‘power pod’ pulses and why are they important

Pulses are the future’s true superfood. As a category of food, pulses differ greatly in terms of nutrition and flavor, but as a whole, their unique characteristics make them ideal for sustainable agriculture. As we explore this ancient food, we find that pulses are poised to open up new avenues for agricultural and nutritional innovation that were once considered science fiction. The adoption of pulses has been varied, yet consistent, because they all share one commonality: their unarguable practical advantages that any nation or culture can embrace. When the final frontier is crossed and humanity reaches out to the stars, there’s no question that pulses will follow humans wherever they go. Pulses are essential food crops that contribute to global food security and climate change, as well as to nutritious diets [4].



Figure 2: Five ways pulses impact our world.

Despite these advantages, per capita pulses consumption has consistently decreased in developed and emerging countries. This trend reflects changes in dietary habits and consumer preferences, but the primary reason is that domestic production has not kept up with population growth in most countries. Although pulses have a wide range of economic, social and environmental importance, they have not increased in production at the same pace as other commodities such as different cereal crops. In order to address these issues, relevant stakeholders need to promote and implement relevant policies, as well as increase investment in research and development and extension services, with a focus on pulse-based cropping systems.

Role of pulses in improving nutrition and health

Pulses are a plant-based source of protein, providing an average of 2 to 3 times more protein per gram than staple cereals like rice and wheat. The amino acids found in pulses complement those in cereals. Protein is essential for physical and cognitive growth during childhood. They are also a good source of B vitamins like folate, thiamine and niacin. Some pulses have a high B vitamin content, which is beneficial during pregnancy as it helps with the development of the fetus' nerve function. According to experts, consuming pulses 4 or more times a week reduces the risk of heart disease by 22% compared to those who consume pulses less often. This is because of a number of factors, such as higher dosages of potassium and higher fibre content [5]. Potassium helps to lower blood pressure, while fibre helps to reduce LDL cholesterol. Pulses are super rich in fibre. They contain soluble as well as insoluble fibre, and it is well known that soluble fibre helps to lower blood cholesterol and control blood sugar levels. Insoluble fibre helps in digestion and maintains regularity. Pulses are good sources of vitamins such as folate, which is shown to reduce the risk of neural

tube defects (NTDs) like spina bifida in newborn babies. As pulses are gluten-free, they are a desirable food for anyone with gluten allergy or suffering from Celiac disease. Also, Pulses are rich in bioactive compounds such as phytochemicals and antioxidants that may contain anti-cancer properties. Phytoestrogens may also prevent cognitive decline, reduce menopausal symptoms and thereby promote bone health.

Role of pulses in mitigating the climate change

According to scientists around the world, our climate is changing quickly, and it's largely caused by human activities that release carbon dioxide and other greenhouse gases into the atmosphere. Agriculture is both the biggest cause of climate change and its biggest victim. The solution to mitigating, adapting, and reducing climate change comes in the form of the pulse. Pulses need less water to grow than other crops, making them especially suitable for dry, arid land where most poor rural farmers live. Bambara nuts, for example, can grow in areas where farmers cannot cultivate other crops. Some pulses, like pigeon pea, are deep rooted, so they don't compete for water with other crops. They slowdown in their early stages so that nearby crops can take root and grow. Pulses play a vital role in preventing soil erosion and depletion. Pulses don't need nitrogen fertilizer because they self-fertilize – that is, they take nitrogen from the atmosphere and transport it into the soil. This self-sustainability saves the environment from greenhouse gases, which are a by-product of nitrogen fertilizer production and use. Pulses also enhance carbon sequestration in the soil, which means that some of the natural CO₂ emissions are absorbed by the soil [6].

Role of pulses sustainable agriculture as well as biodiversity

One of the key characteristics of pulse crops is that they are able to biological nitrogen fixation, which is a naturally occurring pro-

cess that is still important for soil enrichment. In a symbiotic relationship with certain species of bacteria (Rhizobium or Bradyrhizobium) these plants convert atmospheric nitrogen to nitrogenous compounds that are easily exploitable by plants and improve soil fertility. Through this process, pulses can add from 30 to 40 kg of nitrogen into the soil per hectare. Some varieties of pulses are also able to free soil-bound phosphorous which also plays an important role in plant nutrition. In addition, crop residue from pulses can be fed to livestock to increase nitrogen levels in the diet, improving animal health and development. Pulses also play an important role in soil biodiversity. Pulses are ideal for rural farmers, but can also be a model for agribusiness and organic farming anywhere. Pulses as an important crop in agro ecosystems also help to sustain and boost vital microbial biomass and activity in the soil. High soil biodiversity not only makes ecosystems more resilient and resilient to disturbance and stress, but it also makes them more disease-resistant. All of these characteristics favoring the integration of soil health naturally form the basis of food security and promote both human health and planetary health.

Role of pulses in food security

Pulses can be eaten and sold, improving household food security and economic stability. They are an excellent cover crop for sustainable farming, and can be used for green manure or as forage for livestock. When stored properly, pulses have a longer shelf life, allowing for flexibility to withstand extreme weather. Reduced need for inorganic fertilizers reduces agricultural costs. For many people in developing countries, pulses are the main source of protein when meat, dairy products and fish are costly and out of reach for the local population. Because pulses need less water than most other crops, they can be grown in areas with limited or unpredictable rainfall; areas where other crops may fail or produce poor yields. When grown alongside other crops or as part of a rotation, farmers usually enjoy higher yields of both crops, thus reducing their vulnerability to crop failure [7].

Conclusion

With a projected global population of 10 billion by mid-century, shifting to a healthier global diet to create sustainable food systems is a challenge that has never been faced before. Climate change and anthropogenic factors will exacerbate this situation by triggering land-use change, which is one of the main factors impacting soil sustainability and biodiversity. Pulse crops provide a variety of dietary protein sources that can be produced in a more sustainable manner than animal protein and offer similar storage benefits as fresh produce. Pulses are high-nutrient crops that are beneficial to agricultural systems. These are the best way to increase pulse

production because consumers are looking for healthy foods and meatless options. Pulses can be bio-fortified for high protein and low-nutrient content, which increases marketability. Pulses are also a key factor in ensuring that people have access to a diverse nutritional diet to fight hidden hunger, and are essential for sustainable agriculture. Agriculture should focus on increasing the sustainability and nutritional value of the human diet by diversifying staple crops by adding more pulses.

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