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Sustainable Pulse Production in India: Challenges, Innovations and Future Prospects

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INTRODUCTION

Pulses occupy a central position in India's agricultural and nutritional landscape, serving as one of the most important sources of plant-based protein for a predominantly vegetarian population. India is both the largest producer and consumer of pulses in the world, yet paradoxically, it continues to face a persistent gap between demand and supply. Pulses are not only essential for human nutrition but also play a crucial ecological role in maintaining soil fertility through biological nitrogen fixation. In the context of increasing population pressure, climate change, and nutritional insecurity, the sustainable production of pulses has become a national priority. India is the world's largest producer (25%), consumer (27%), and importer (14%) of pulses, with production reaching approximately 25.24 million tonnes (MT) from over 30 million hectares (Mha) of land, achieving an average productivity of around 850-932 kg/ha. Major producing states are Madhya Pradesh, Maharashtra, and Rajasthan, which contribute over 55% of total output (Directorate of Pulses Development (2024-25). This low productivity is one of the major reasons India occasionally depends on imports to meet domestic demand. Despite being the global leader in pulse production, India still struggles with yield instability and regional disparities in production systems. Various agronomic researches have shown that improved cultivation practices, such as seed replacement with improved varieties, raised bed planting method, use of biofertilizers, foliar application of fertilizers at critical stages in rainfed areas, application of secondary and micro-nutrients and adoption of appropriate modules for integrated weed and pest management, etc. have great potential in gearing-up pulses productivity. Thus, there is a great challenge for policy makers, farm scientists and farming community to enhance pulse productivity using improved farm technology to meet out the national and local pulse requirements. (Poonia V *et al*. 2015)

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Current Status and Global Position of India in Pulses

Globally, India holds a dominant position in pulse consumption and production. While countries such as Canada, Myanmar, China, and Brazil also contribute significantly to global pulse output, India remains unmatched in terms of demand due to its large population and dietary patterns. Canada is particularly strong in lentil and pea production, while Myanmar is a key exporter of pigeon peas (tur). However, India's productivity levels lag behind these countries due to limited mechanization, rainfed agriculture dependency, and fragmented landholdings.

India accounts for nearly one-fourth of global pulse production and more than one-fourth of global consumption. Yet, the country's production is highly variable, depending on monsoon performance. States such as Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, and Karnataka contribute significantly to pulse cultivation. Among these, Madhya Pradesh is often referred to as the "pulse bowl of India" due to its large-scale production of gram (chana).

Nutritional and Environmental Importance of Pulses

Pulses are the backbone of Indian agriculture due to their significant role in human and animal nutrition, soil ameliorative properties, environmental sustainability and economic viability. Pulses are often referred to as the "poor man's meat" because of their high protein content, which ranges between 20 to 25 percent. They are also rich in essential micronutrients such as iron, calcium, zinc, potassium, and folate, making them extremely valuable in combating malnutrition, anemia, and protein deficiency, particularly among children and women in rural India. In a country where a large population follows vegetarian diets, pulses serve as the primary and most affordable protein source. Of the total pulse consumption, arhar accounts for 30.9%, followed by gram (23.8%), masoor (13.9%), moong (12.9%), and urd (11.3%). Parihar, A. K., *et al*. (2025)

Beyond nutrition, pulses have significant environmental benefits. They are leguminous crops that fix atmospheric nitrogen into the soil through symbiotic

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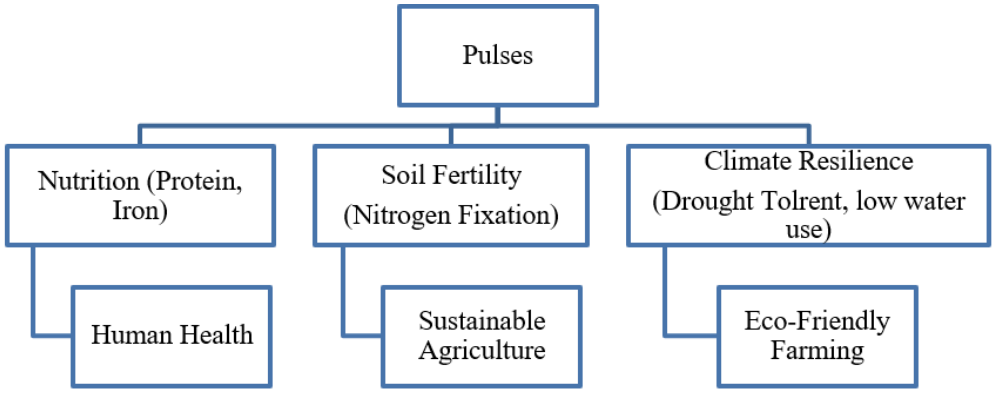
bacteria, thereby reducing the need for chemical fertilizers. This improves soil fertility and contributes to long-term agricultural sustainability. Pulses also require comparatively less water than major cereals like rice and wheat, making them highly suitable for dryland and rainfed farming systems. Their inclusion in crop rotations enhances soil structure and reduces pest and disease cycles, which further supports sustainable agriculture practices.

In this sense, pulses act as a "climate-smart crop" that simultaneously supports human nutrition, soil health, and environmental conservation.

Role of Pulses in Sustainable Agriculture:



Major Challenges in Sustainable Pulse Production

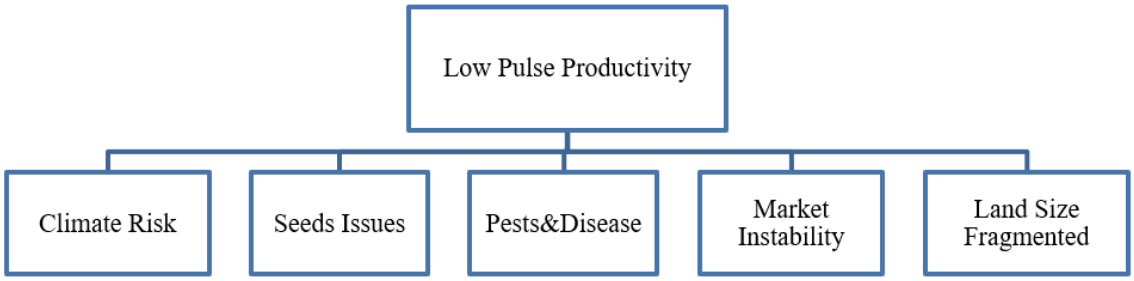
Despite their importance, pulse production in India faces multiple structural and environmental challenges. One of the most critical issues is low productivity caused by limited adoption of improved seed varieties and inadequate extension services. A large yield gap exists between research stations and farmers' fields, indicating inefficiencies in technology transfer.

Another major constraint is the dependence on monsoon rainfall, as nearly 80 percent of pulse cultivation is rainfed. This makes pulse production highly vulnerable to climate variability, including droughts, delayed monsoons, and extreme temperature fluctuations. Such instability leads to fluctuations in output and price volatility in the market.

Pests and diseases also significantly reduce yield. For instance, the pod borer in chickpea and yellow mosaic virus in urad and moong can cause severe crop losses if not properly managed. Additionally, farmers often lack access to timely plant protection measures and resistant seed varieties.

Market-related issues further discourage pulse cultivation. Price instability, weak procurement systems, and competition from imported pulses reduce farmer profitability. Moreover, fragmented landholdings and low mechanization levels make large-scale efficient cultivation difficult.

Constraints in Pulse Production:



Innovations and Government Initiatives

In recent years, India has taken several technological and policy-driven steps to improve pulse production. Agricultural research institutions such as the Indian Council of Agricultural Research (ICAR) have developed high-yielding, drought-resistant, and short-duration varieties of major pulses. These varieties are better suited for Indian climatic conditions and help reduce crop failure risks.

Technological interventions such as micro-irrigation, soil health monitoring, and precision agriculture are increasingly being promoted. The use of bio-fertilizers and integrated pest management systems is also enhancing sustainable production practices. In addition, digital technologies such as drones for pest detection and AI-based advisory systems are gradually entering Indian agriculture.

On the policy front, the Government of India has implemented schemes like the National Food Security Mission (NFSM–Pulses) and minimum support price (MSP) procurement mechanisms. Recently, a long-term mission for achieving self-sufficiency in pulses has been launched with the target of significantly increasing production by 2030–31. These initiatives aim to reduce import dependency and stabilize domestic supply.

Future Prospects of Pulses in India

The future of pulse production in India appears promising due to rising domestic demand, changing dietary patterns, and increasing awareness about protein-rich diets. With population growth and urbanization, the demand for pulses is expected to increase steadily in the coming decades. At the same time, advancements in biotechnology, climate-resilient agriculture, and precision farming are expected to enhance productivity.

There is also significant potential for expanding pulse cultivation into rice fallow areas and dryland regions. The integration of pulses into cropping systems such as intercropping and crop rotation will further improve sustainability and productivity. If properly implemented, India has the potential to achieve self-sufficiency in pulses and even become an exporter in the future.

Pulses Production in Rajasthan: A Regional Perspective

Rajasthan plays a crucial role in India's pulse production due to its extensive arid and semi-arid regions, which are well-suited for drought-resistant crops. The state is particularly known for moth bean (matki), gram, and moong cultivation. Pulses are a vital part of the agricultural economy in Rajasthan, especially in areas where irrigation facilities are limited.

The top pulse-producing districts in Rajasthan include Nagaur, Jodhpur, Jaisalmer, Bikaner, and Barmer. These districts benefit from traditional dryland farming practices and hardy crop varieties adapted to extreme climatic conditions. Among these, Nagaur and Jodhpur are especially important for Mungbean Cultivation and Ajmer and Bhilwara districts for gram production, while western districts like Jaisalmer and Barmer are known for moth bean cultivation.

CONCLUSION

Sustainable pulse production in India is not only an agricultural necessity but also a strategic requirement for ensuring nutritional security, environmental sustainability, and economic stability. Although India faces challenges such as low productivity, climate vulnerability, and market inefficiencies, ongoing innovations in agricultural science and supportive government policies offer a strong pathway forward. Strengthening research, improving irrigation systems, enhancing seed quality, and ensuring stable market mechanisms will be crucial in achieving self-sufficiency in pulses. With coordinated efforts, India can transform its pulse sector into a resilient and sustainable model that supports both farmers and consumers while safeguarding ecological balance.

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