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Minor Pulses- The Overlooked Key for Food Security and Sustainable Development

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Abstract

Minor pulses, often overlooked in mainstream agriculture, are the underutilized and lesser-known pulses which could play a vital role in enhancing food security, improving nutrition and promoting sustainable farming practices. These pulses, including horse gram, moth bean, lablab bean, and others, are highly nutritious, climate-resilient, and require minimal inputs, making them an ideal choice for marginal lands. Despite their advantages, the cultivation of minor pulses in India faces several challenges, such as low productivity, biotic and abiotic stresses, limited research and development, inadequate mechanization, and poor market accessibility. By integrating minor pulses into mainstream agricultural systems and promoting their consumption, India can make significant progress toward ensuring food security, reducing malnutrition, and supporting climate-resilient agriculture.

1. Introduction

Pulses are classified as major and minor pulses based on their relevance at the international level in terms of production, consumption and economic significance. While major pulses include chickpea, lentils, pigeon pea, black gram, green gram, peas, kidney bean etc., the minor legumes encompass a variety of cultivated plants, such as the African yam bean, Bambara groundnut, winged bean, yard long bean, tepary bean, rice bean, grass pea, moth bean, horse gram, lima bean, kersting's groundnut, lablab bean etc. Minor pulses are less-known and underutilized, are highly diverse and indigenous to specific regions or continents, possessing significant yield potential. These crops are highly nutritious, naturally climate-resilient and require minimal inputs, making them environmentally sustainable with a lower carbon footprint. Their short life cycles make them ideal as catch crops, thriving effectively in intercropping, mixed cropping, or relay cropping systems. However, despite advancements in high-yielding cultivars, various biotic and abiotic stress factors still pose challenges to maximizing their production

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potential. Minor pulses, such as grass pea (*Lathyrus sativus* L.), moth bean (*Vigna aconitifolia*), horse gram (*Macrotyloma uniflorum*), cowpea (*Vigna unguiculata*), and French bean/kidney bean/rajmash (*Phaseolus vulgaris* L.), contributed approximately 2.73 million hectares (m ha) to 3.15 million hectares (9.4%-11.7%) of total pulses acreage and 1.13 million tons (mt) to 1.65 million tons (6.4%-7.1%) of total pulses production from 2015-16 to 2019-20 (DPD, GoI, 2020). A significant factor behind the increase in pulses production has been the enhanced use of high-quality seeds, driven by strategic interventions from the Government of India and the National Agricultural Research System (NARS) over the past decade, leading to a higher seed replacement rate (Chauhan et al., 2016).

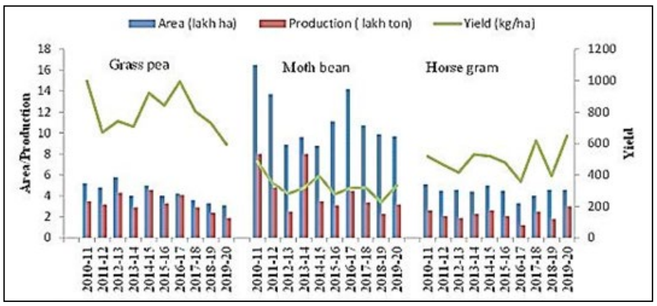

Figure 1: Area, production and yield of grass pea, moth bean and horse gram during 2010-11 to 2019-20 (Source: DPD, GoI)

The nutritional value of pulses and their diverse methods of utilization can play a significant role in combating global malnutrition. Recognizing their importance, the United Nations declared 2016 as the "International Year of Pulses." Pulses contribute both directly and indirectly to achieving the following sustainable development goals:

• **SDG 2**: Zero Hunger – Pulses are an affordable, nutrient-rich food source that helps in combating malnutrition and improve global food security.

• **SDG 3:** Good Health and Well-being – Rich in essential Macro and micronutrients, pulses reduce the risk of chronic diseases like diabetes, heart disease, and obesity.

• **SDG 12**: Responsible Consumption and Production – Pulses require fewer natural resources (such as water and synthetic fertilizers), making them a sustainable food choice with a lower environmental footprint.

• **SDG 13**: Climate Action – As nitrogen-fixing crops, pulses enhance soil fertility, reduce greenhouse gas emissions, and promote climate-resilient agriculture.

• **SDG 15:** Life on Land – Growing pulses supports sustainable farming practices, enhances biodiversity, and prevents soil degradation.

2. Description of Some Minor Pulses

2.1. Horse gram (Macrotyloma uniflorum)

Horse gram (*Macrotyloma uniflorum* Lam. Verdc.) is a leguminous crop primarily cultivated under rain-fed conditions in India. It is considered a functional food with well-documented medicinal properties, known for its ability to cure various diseases (Prasad and Singh, 2015). Horse gram plays a vital role in meeting the nutritional needs of both humans and livestock. Its nutrient composition includes protein (18-29%), carbohydrates (57.2%), crude fiber (5.3%), and essential minerals such as calcium (287 mg 100 g^{-1}), phosphorus (311 mg 100 g^{-1}), and iron (8.4 mg 100 g^{-1}) (Gopalan et al., 2014). Often confused with *Dolichos biflorus* or *Dolichos uniflorus*, horse gram is a twining annual or perennial legume. The cultivated variety, Var. uniflorum, is typically grown as an annual crop. Native to India, horse gram is now widely cultivated across Asia, Africa, the West Indies, and the southern United States, where it serves both as a pulse and a fodder crop. In India, it is predominantly grown in dryland areas of the northern hills and in several central and southern states. It is either cultivated as a monocrop or intercropped with cereals, groundnut, pigeon pea, and sesame.

Horse gram is grown during both the *kharif* and *rabi* seasons, with significant production in Uttarakhand, Karnataka, Andhra Pradesh, Tamil Nadu, and Chhattisgarh. It is also grown to a lesser extent in Odisha, Maharashtra, Rajasthan, Gujarat, and the Jammu and Kashmir Union Territory. This crop is highly adaptable to various soil types, thriving in granitic sands, latosols, and heavy clays, and it is tolerant of salinity, with optimal growth in soils having a pH range of 6.0 to 7.5. Several improved varieties, such as CO1, Paiyur 1, and Paiyur 2, have been developed for cultivation, with the ideal sowing season being November (winter season). For proper establishment, horse gram performs best in a well-prepared seedbed, though it can also establish with minimal soil disturbance. Seeds can be sown by drilling or broadcasting, with a recommended seed rate of 20 kg per hectare for a pure crop. The crop requires 30 × 10 cm spacing and minimal fertilization, typically 12.5–25.0 kg of nitrogen and phosphorus per hectare, with no potassium application needed. Horse gram is primarily rainfed and drought-tolerant, efficiently utilizing residual soil moisture for growth. Weed control involves a single weeding and hoeing during the crop cycle. Often grown as a cover crop after the main crop, it helps in soil conservation and nutrient replenishment. The harvest occurs once the entire plant dries and the leaves fall off. Due to its resilience and nutritional value, horse gram remains an important pulse crop in marginal agricultural regions.

2.2. Grass pea (Lathyrus sativus)

Grass pea, or khesari, thrives in drought-prone, poor soils where lentil and chickpea may not yield reliably. It is primarily cultivated as a paira crop in standing paddy fields, where it is broadcasted. Additionally, grass pea is grown as a sole crop in rice fallows, where other oilseed, cereal, or pulse crops cannot be grown, and is also mixed with linseed or chickpea during the *rabi* season. In paira cropping systems, farmers focus more on its use as fodder, with grain yield seen as an added benefit. It is predominantly grown in Madhya Pradesh, Chhattisgarh, Bihar, West Bengal, Odisha, Maharashtra, and Uttar Pradesh. Improved varieties such as Prateek, Ratan, and Mahateora are available, with seed weights ranging from 40–60 mg. The recommended seed rate varies between 40–50 kg per hectare, depending on the variety and soil conditions. Grass pea requires minimal fertilizers but responds well to 10–20 kg of nitrogen, 40–50 kg of phosphorus, and 20 kg of potassium per hectare. Since it is a nitrogen-fixing crop, excessive nitrogen application is unnecessary. The crop is highly tolerant to drought and waterlogging, requiring only one or two irrigations during flowering and pod-setting stages in non-rainfed conditions. Weed management is typically done through early weeding and intercultural operations to reduce competition and improve yield.

The crop matures in 100–130 days, and harvesting is done when the pods turn brown and dry. Grass pea is rich in protein (28–30%) and serves as an important food and fodder crop (Lambein et al., 2019). However, excessive consumption of raw seeds over a prolonged period can lead to neurolathyrism, caused by the presence of β-ODAP (β-N-Oxalyl-L-α, β-diamino propionic acid). Proper processing, such as soaking and boiling, reduces toxin levels, making it a valuable and safe dietary component. Given its resilience and ability to grow in harsh environments, grass pea is an essential pulse for ensuring food security, livestock nutrition, and sustainable agriculture in India.

2.3. Cowpea (Vigna unguiculata)

Cowpea is a key component of farming systems in resource-constrained agriculture in India, grown as a sole crop, intercrop, mixed crop, or in agro-forestry combinations. It is expected to cover about 50.0% of the 13.0 lakh hectares of area dedicated to cowpea in Asian countries (Tiwari and Shivhare, 2016). In India, it is primarily cultivated in the arid and semi-arid regions of Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, and in certain pockets of Punjab, Haryana, and Western Uttar Pradesh. Cowpea is grown during the kharif (summer) season in northern India and throughout the year in peninsular India. This highly adaptable leguminous crop is cultivated in the Kharif (June–July), *rabi* (October–November), and summer (March–April) seasons. It is grown under both rainfed and irrigated conditions, with improved varieties such as Pusa Komal, V 240, and CO 5 offering better yields. The seed weight ranges from 120–250 mg, with a recommended seed rate of 15–25 kg per hectare, depending on the variety and intended use (grain or fodder). Recommended spacing for optimal plant growth and pod development is 45×15 cm or 60×30 cm.

Cowpea has moderate nutrient requirements, with 20–30 kg of nitrogen, 40–60 kg of phosphorus, and 20 kg of potassium per hectare applied during land preparation. In rainfed conditions, organic matter application helps retain soil moisture and improve soil fertility. Irrigation is critical at the flowering and pod-setting stages to enhance yield. Weed control follows standard pulse crop practices, involving pre-emergence herbicides and inter-row cultivation for effective weed suppression. Cowpea can be harvested 50–90 days after sowing, depending on the variety and cropping season. It is a multi-purpose crop, utilized as a grain legume, green vegetable, fodder, and cover crop for soil improvement. Its high drought tolerance and nitrogen-fixing ability make it a valuable crop for sustainable agricultural systems, particularly in arid and semi-arid regions.

2.4. French bean (Phaseolus vulgaris)

French bean, kidney bean, common bean, or rajmash is primarily grown in Maharashtra, Himachal Pradesh, Uttar Pradesh, the northeastern states, and the Jammu & Kashmir Union Territory, covering approximately 0.8–0.85 lakh hectares. It is also gaining popularity in the north Indian plains (Tiwari and Shivhare, 2016). In hilly regions, it is cultivated during the *kharif* season, in the spring in lower hills/tarai, and in the rabi season in the northeastern plains and hilly tracts of Maharashtra. In the hills, it is commonly intercropped with maize or early potatoes. Rajmash is an important pulse crop grown in both the rabi (October–November) and summer (March–April) seasons under irrigated and rainfed conditions. High-yielding varieties such as VL Rajmash 125, PDR 14, and Arka Komal are popular, with seed weights ranging from 300–500 mg. The recommended seed rate is 80–100 kg per hectare, depending on row spacing and variety, with spacing configurations of 30 ×10 cm or 45×15 cm adjusted based on soil fertility and growth habits. French beans are rich in water, proteins, vitamins, minerals, and dietary fiber, making them a highly nutritious addition to any diet. They are cholesterol-free, low in sodium and fat, and beneficial for heart health. Due to their low glycaemic index, French beans are particularly advantageous for low-carbohydrate diets and for individuals with diabetes.

For optimal growth, rajmash requires 20–40 kg of nitrogen, 50–60 kg of phosphorus, and 30 kg of potassium per hectare. Since it is a leguminous crop, excess nitrogen application should be avoided. Irrigation is crucial during flowering and pod development stages, ensuring proper seed filling and higher productivity. Weed management includes early-stage manual weeding or pre-emergence herbicides to minimize competition and improve crop vigor. Rajmash takes 90–120 days to mature, and harvesting is done when pods are fully dry and seeds have hardened. The crop is widely consumed due to its high protein content (22–25%) and rich fiber content, making it a staple in vegetarian diets. With proper management, rajmash serves as a profitable and sustainable crop, contributing to improved soil health and food security.

2.5. Faba bean (*Vicia faba*)

Faba bean (*Vicia faba*) is a cool-season leguminous crop primarily grown in temperate and subtropical regions, with planting occurring mainly between October and November. Faba bean seeds, both fresh and dry, are highly nutritious and are used for human consumption. They have a high protein content (up to 35% in dry seeds) and are also a rich source of essential nutrients such as potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), and zinc (Zn). Additionally, faba bean seeds contain bioactive compounds, including polyphenols, carotenoids, and carbohydrates (Landry et al., 2016). Due to their high protein content (25–30%), faba beans are considered an excellent component of sustainable food and fodder systems. In India, its cultivation is concentrated in states such as Uttar Pradesh, Bihar, Madhya Pradesh, Himachal Pradesh, Uttarakhand, and West Bengal, where cooler winter temperatures favor its growth. Faba bean is increasingly gaining significance in India's pulse production system due to its adaptability to cool climates and high nutritional value. Several improved varieties of faba beans are available, such as VLF 1, Vikrant, and HFB 1, with seed weights ranging from 800 to 1,200 mg. The seed rate typically varies between 80–120 kg per hectare, depending on the variety and soil conditions. Recommended spacing configurations for optimal growth are 30×10 cm or 45×15 cm, which ensure adequate plant population and better yield.

Faba bean cultivation has specific nutrient requirements based on soil fertility and cropping systems. On average, it is recommended to apply 20–40 kg of nitrogen, 50–60 kg of phosphorus, and 20–30 kg of potassium per hectare. However, as a nitrogen-fixing legume, faba beans require minimal nitrogen application. Irrigation at the flowering and pod development stages is crucial to maximizing yield, while weed management follows standard pulse crop practices, with the use of pre-emergence herbicides and manual weeding aiding in better crop establishment. Faba bean plants also benefit from stalk support and proper canopy management to improve air circulation and reduce the incidence of diseases. The crop is generally ready for harvest 120–150 days after sowing, depending on the variety and growing conditions.

2.6. Moth bean (*Vigna aconitifolia*)

Moth bean is a drought-tolerant leguminous crop primarily cultivated in the arid and semi-arid regions of India, including Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Haryana, and Uttar Pradesh, where it thrives in hot, dry climates with minimal water availability (Tiwari and Shivhare, 2016). It serves as an affordable and valuable source of protein in cereal-based vegetarian diets, particularly in developing nations. The protein content in moth bean seeds ranges from 20 to 24% (Longvah et al., 2017), and it is also rich in essential amino acids, such as lysine (6.63 g 100 g^{-1} protein) and leucine (7.85 g 100 g^{-1}), which are often deficient in cereals. The crop is typically sown during the Kharif season (June–July) and harvested in September–October, though it can also be grown as a summer crop in some regions. Improved varieties such as RMO 40, RMO 225, Maru Moth 2, and Jadia are available, with seed weights ranging from 25 to 40 mg. The recommended seed rate varies between

8–12 kg per hectare, depending on soil type and row spacing. Suggested spacing configurations include 30 × 10 cm or 45×15 cm, ensuring optimal plant density and growth. Moth bean has low nutrient requirements due to its adaptability to poor soils, but 10–20 kg of nitrogen, 20–30 kg of phosphorus, and 10–15 kg of potassium per hectare can enhance productivity. As a nitrogen-fixing crop, excessive nitrogen application is unnecessary. The crop is highly drought-resistant, requiring little to no irrigation, though one or two irrigations at flowering and pod-setting stages can improve yields. Weed management is crucial in the early stages, and inter-row cultivation helps suppress weed growth effectively.

Moth bean matures in 75–90 days, and harvesting is done when the pods dry and turn brown. The seeds are rich in protein (22–24%) and are widely used in traditional Indian cuisine, especially in Rajasthan and Gujarat. Apart from human consumption, moth bean serves as excellent livestock fodder due to its high forage value. Given its drought resistance, low input requirements, and high nutritional value, moth bean is an important crop for ensuring food security and sustainable farming in dryland regions.

3. Challenges in Cultivation of Minor Pulses in India

• **Low Productivity** – Lack of available high-yielding and disease-resistant cultivars pose as significant challenge.

Minor Pulses, their common names, and ICAR-recommended varieties

Pulse Crop	Common Name	ICAR-Recommended Varieties
Horse Gram (*Macrotyloma uniflorum*)	Kulthi	CRIDA Horsegram 1, CRHG 4, PHG 9, Dapoli 1, KBH 1
Grass Pea (*Lathyrus sativus*)	Khesari Dal	Prateek, Ratan, Mahateora, Nirmal, WBK 1
Cowpea (*Vigna unguiculata*)	Lobiya, Chawli	Pusa Komal, V 240, CO 5, KBC 9, Pant Lobia 3
French Bean (*Phaseolus vulgaris*)	Rajmash, Snap Bean	VL Rajmash 125, Arka Komal, PDR 14, Arka Bold
Faba Bean (*Vicia faba*)	Bakla	VLF 1, Vikrant, HFB 1, Pusa Uday
Moth Bean (*Vigna aconitifolia*)	Moth	RMO 40, RMO 225, Maru Moth 2, Jadia

• **Biotic and Abiotic Stresses** – The pulses are vulnerable to pests, diseases, drought, salinity, and extreme temperatures. Different biotic and abiotic stress reduces the crop productivity.

• **Marginal Cultivation Areas** – Minor pulses are predominantly grown in marginal lands with poor soil fertility and limited resources, which significantly reduces their yield potential.

• **Limited Research and Development** – These underutilized pulses have received less attention in breeding programs, agronomic advancements, and technological innovations, hindering their productivity and large-scale adoption.

• **Lack of Mechanization** – The cultivation of minor pulses largely relies on traditional, labour-intensive farming methods due to the unavailability of specialized machinery. This results in higher production costs, lower efficiency, and reduced scalability.

• **Inadequate Extension Services** – There has been limited farmer awareness and guidance on improved practices of these lesser- known pulses.

• **Post-Harvest Losses** – Poor storage infrastructure in the country causes damage and spoilage at post-harvest stages.

• **Market Accessibility Issues** – Price fluctuations and lack of support policies discourage cultivation of minor pulses.

To overcome these challenges, there is a need for focused research, creation of awareness, better seed availability, improved agronomic practices, and stronger market support.

4. Conclusion

Minor pulses play a crucial role in ensuring food security, improving nutrition, and promoting sustainable agriculture. Despite their immense potential, these underutilized crops face significant challenges, including low productivity, biotic and abiotic stresses, limited research focus, and market accessibility issues. However, their adaptability to marginal lands, resilience to climate variability, and rich nutritional value make them a valuable component of sustainable farming systems. To enhance the cultivation and utilization of minor pulses, a multi-pronged approach is required, including investment in research and development, the introduction of high-yielding and stress-resistant varieties, better mechanization, and improved post-harvest management. Strengthening market linkages, increasing farmer awareness through extension services, and incorporating minor pulses into national food security programs will further boost their production and consumption. By recognizing the overlooked potential of minor pulses and integrating them into mainstream agriculture, India can take significant strides toward achieving food and nutritional security, promoting climate-resilient farming, and advancing sustainable development.

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