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Opportunities and Difficulties for Sustainable Agriculture in India Under the Vision of Viksit Bharat: Including Peas (Pisum Sativum L.) In Cereal-Based Crop Rotations

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Abstract:

Indian agriculture is dominated by cereal-based farming systems, which are essential to the country's food security. However, ongoing production of crops like wheat and rice has led to environmental degradation, growing reliance on chemical fertilizers, and soil fertility depletion. Including legumes, such as peas (Pisum sativum L.), in cereal-based crop rotations is a viable way to increase soil fertility, boost nitrogen fixation, and support sustainable farming methods. In order to facilitate biological nitrogen fixation and lessen the need for artificial fertilizers, peas, a nitrogen-fixing legume, develop a symbiotic relationship with Rhizobium bacteria. Pea-based rotations also enhance nitrogen cycling, microbial diversity, and soil structure. Legume integration improves crop yield, soil health, and financial returns, according to a number of studies.Despite these advantages, pea-based rotations are still not widely used in India because of things like market restraints, disease susceptibility, and climate restrictions. With a focus on sustainable agriculture and the national goal of Viksit Bharat, this article examines the potential and difficulties of incorporating peas into cereal-based cropping systems in India. The study emphasizes that the sustainability and productivity of Indian agriculture may be improved by encouraging legume diversification, enhancing crop management techniques, and bolstering policy support.

Introduction:

India's economic and social growth is largely dependent on agriculture, which also makes a substantial contribution to rural lives and food security. The country's farming systems are dominated by cereal crops like wheat and rice, especially in the Indo-Gangetic Plains. However, ongoing grain monocropping has resulted in decreased crop output, nutritional imbalance, and deteriorating soil fertility. In order to preserve soil health and guarantee long-term production in Indian farming systems, sustainable agricultural techniques are crucial. It is well known that including legumes into cereal-based rotations is a successful strategy for resolving these issues and enhancing agricultural sustainability (Walia et al., 2025).

Through symbiotic partnerships with nitrogen-fixing bacteria, leguminous crops like peas (*Pisum sativum L.)* have the unusual capacity to fix atmospheric nitrogen. In addition to improving soil fertility, this biological nitrogen fixation lessens reliance on artificial nitrogen fertilizers. Legume-based cropping systems can thereby improve soil structure, increase nutrient availability, and encourage ecologically friendly agricultural methods. Additionally, adding peas to cereal rotations increases system productivity and lowers farmers' output costs (Hu et al., 2018).

A significant cool-season pulse crop, peas are grown around the world, especially in India. It is prized for its agronomic advantages in crop rotation systems in addition to its high protein content. By enhancing soil fertility and boosting

crop diversity in cereal-dominated systems, pea growing supports sustainable agriculture. Thus, including peas into cereal-based rotations is consistent with India's vision of Viksit Bharat, which prioritizes enhanced farmer livelihoods, agricultural resilience, and sustainable development (Singh et al., 2021).

Review of Literature:

Crop rotations based on legumes have been well researched for their potential to increase crop yield and soil fertility. According to research, adding legumes to cropping systems greatly increases the availability of soil nutrients, especially potassium, phosphorus, and nitrogen. In comparison to grain monocropping systems, long-term studies carried out in India showed that legume-based rotations enhanced soil biological health, microbial activity, and nutrient availability (Walia et al., 2025).

Because of its capacity to fix nitrogen, field peas (*Pisum sativum L.*) have been acknowledged as a crucial part of sustainable cropping systems. Research shows that through symbiotic partnerships with Rhizobium bacteria, peas may fix substantial quantities of atmospheric nitrogen, enhancing soil nitrogen levels for crops to come. Because of this, cereals planted after peas frequently have better growth and yield and require less nitrogen fertilizer (Ahlawat et al., 2008).

The complimentary relationships between peas and cereal crops have also been emphasized in research on cereal-legume intercropping systems. For instance, when peas are cultivated alongside wheat or other cereals, the legume depends on biological nitrogen fixing while the cereal crop uses soil nitrogen. In addition to increasing total system production, this complementary nutrient usage lessens competition for nutrients (Springer Agriculture, 2025).

Peas improve soil structure and organic matter concentration in addition to fixing nitrogen. Legumes' root systems boost soil fertility and nitrogen cycling by increasing soil aeration and microbial activity. These advantages are especially significant in areas where intense cereal farming has lowered agricultural production and deteriorated soil quality (Singh et al., 2021).

The beneficial impact of including peas into crop rotations on fertilizer efficiency and nitrogen management is another significant advantage. According to studies, adding peas to cereal rotations can improve nutrient usage efficiency and lower the need for nitrogen fertilizer. Reduced fertilizer inputs and better nutrient cycling also help to minimize greenhouse gas emissions and environmental pollution (Hu et al., 2018). Furthermore, the inclusion of peas in cropping systems can increase overall farm profitability and productivity. Legume-based cropping systems often produce higher rice-equivalent yields and improved economic returns compared with conventional cereal monocropping. These systems also enhance resilience against climate variability by diversifying crop production and improving soil health (Walia et al., 2025).

Peas' Place in Sustainable Agriculture:

Because of its many agronomic and ecological advantages, pea growing is essential to the advancement of sustainable agriculture. Biological nitrogen fixation, which helps sustain soil nitrogen levels without significantly depending on synthetic fertilizers, is one of pea's most important contributions. Reducing fertilizer use avoids environmental contamination from excessive nitrogen application while also lowering production costs (Hu et al., 2018).

Additionally, peas help to improve the physical characteristics of soil, including its

structure, porosity, and ability to store water. Pea plants' root systems promote soil aggregation and microbial activity, which improves soil fertility and cropping systems' long-term viability. Maintaining agricultural output under intensive farming circumstances requires such improvements in soil health (Singh et al., 2021).

Crop rotations based on peas also aid in lowering the prevalence of pests and illnesses in cereal crops. When a crop is continuously grown, pests and diseases can accumulate and reduce productivity. By improving crop health and disrupting pest and disease cycles, rotating cereals with legumes increases system production (Ahlawat et al., 2008).

Possibilities for Including Peas in Cereal-Based Systems:

There are several prospects for sustainable agriculture in India when peas are included into cereal-based cropping systems. First, by recycling nutrients and fixing nitrogen biologically, pea farming increases soil fertility. This improves the sustainability of agricultural production systems and lessens the requirement for artificial fertilizers (Hu et al., 2018).

Second, in areas where cereals predominate, pea integration boosts crop diversity. Cropping systems that are diversified are better able to withstand environmental stress and climate fluctuations. By offering more food and nutritional sources, crop diversification also increases agricultural revenue (Walia et al., 2025).

Third, growing peas improves nutritional security. Peas are a vital part of balanced meals since they are high in protein, vitamins, and minerals. Therefore, encouraging pea production can aid in addressing India's problems with malnutrition and protein deficit. (Singh et al., 2021).

Difficulties with Adoption:

Even though integrating peas into cereal-based systems has several advantages, there are a number of obstacles that prevent it from being widely used in India. The absence of improved pea varieties appropriate for various agroclimatic situations is one significant barrier. Many of the current cultivars are prone to pests and diseases, which lowers crop output and deters farmers from growing peas (Singh et al., 2021).

Farmers' lack of knowledge about the advantages of crop rotations based on legumes presents another difficulty. Due to established market systems and government procurement rules for commodities like wheat and rice, farmers in many places choose monocropping cereals. In farming systems where cereals predominate, this restricts the growth of pea crops (Walia et al., 2025).

Pea growth and production can also be impacted by climate variables as drought, temperature swings, and water availability. Because peas are usually produced as cool-season crops, unfavorable weather might restrict their appropriateness in some parts of India and lower output (Hu et al., 2018).

Prospects for the Future and Policy Repercussions:

Legumes like peas must be encouraged to be included into cereal-based farming systems in order to advance sustainable agriculture in accordance with Viksit Bharat. Crop diversification, research on better pea varieties, and the creation of effective agronomic techniques for pea farming should all be supported by government policy. These actions can improve Indian agriculture's sustainability and production (Walia et al., 2025).

The development of climate-resilient pea varieties and the promotion of integrated nutrient management techniques should be the main

priorities of research organizations and agricultural colleges. Furthermore, extension agencies must to inform farmers about the advantages of sustainable farming methods and crop rotations based on legumes (Singh et al., 2021).

Conclusion:

Including peas *(Pisum sativum* L.) in cereal-based crop rotations provides a long-term answer to many of the problems Indian agriculture faces. Pea farming promotes soil health, boosts crop output, and increases soil fertility through biological nitrogen fixation. Additionally, it enhances nutrient cycling, lessens reliance on fertilizer, and increases farmers' profits. To encourage broader adoption, however, issues including low farmer knowledge, climate limitations, and a dearth of better cultivars must be resolved. Pea integration into cereal-based cropping systems and sustainable agricultural development in India can be facilitated by bolstering research, policy assistance, and farmer education. These programs are in line with Viksit Bharat's goal, which seeks to enhance farmer livelihoods, provide food security, and promote agricultural sustainability.

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