Crop Diversification and Intensification Alternative to Rice-wheat Cropping System

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OPEN ACCESS

Keywords

Crop diversification, Crop intensification, Rice-wheat, Sustainability

How to cite this article:

Sudarshan, S. and Niveditha, M. P. 2024. Crop Diversification and Intensification Alternative to Rice-wheat Cropping System. *Vigyan Varta* 5(9): 175-178.

ABSTRACT

India's diverse agroecological conditions allow for the cultivation of a wide range of crops, including oilseeds, pulses, vegetables, fodder and medicinal plants. Integrating these crops into the rice-wheat cropping system (RWCS) can boost resilience and productivity. In areas like Punjab and Haryana, where groundwater levels are declining, replacing water-intensive rice with crops like soybean and early pigeon pea can help conserve water. Pulses, which are adaptable to harsh climates and beneficial for soil health, show great potential for diversification. Crop diversification enhances food and nutritional security, generates income, creates employment, and supports ecological management. Sustainable diversification and intensification of the RWCS are crucial for improving productivity, soil health, and livelihoods in the Indo-Gangetic Plains. However, these strategies must be tailored to the specific socioeconomic and agro-climatic conditions of each region. Farmers should choose diversification options that best suit their local circumstances. Promoting diversified and intensified cropping systems within the RWCS is essential for addressing sustainability challenges and improving the well-being of farmers in the Indo-Gangetic Plains.

INTRODUCTION

The rice-wheat cropping system (RWCS) is crucial for India's food security, but its prolonged practice leads to declining productivity, groundwater depletion, and soil degradation. Diversification offers a solution. Crop diversification involves shifting from unsustainable to profitable systems through spatial and temporal modifications (Barman *et al.*, 2022). Horizontal diversification broadens the cropping base by adding more crops, utilizing techniques like multiple cropping. Vertical diversification involves processing crops into value-added products like canned fruits. Both approaches enhance sustainability and profitability, mitigating the RWCS's challenges.

Problems in rice-wheat cropping system

Evidence is now emerging that continued intensification of input use since the adoption of green revolution technologies is providing lower marginal returns. At the same time, it is known that inappropriate use of applied inputs and overexploitation of natural resource base, principally land and water, is in many situations leading to emergence of several problems, such as declining soil organic matter, emerging multi-nutrient deficiency, decline in factor productivity, reduction in biodiversity, lowering of ground water table and build-up of pests including weeds, diseases and insects in traditional rice-wheat cropping system (Dhanda *et al*., 2022).

Fig. 1: Problems in Rice-wheat Cropping System

Major driving forces for diversification of rice-wheat cropping system

Crop diversification on small farm holdings offers several advantages. It helps increase income for small farmers and mitigates the adverse effects of unpredictable weather (Vernooy, 2022). Diversification ensures food and nutritional security and improves fodder availability for livestock. It also conserves natural resources such as soil and water while minimizing environmental pollution. Additionally, it reduces the risks associated with farming and decreases problems related to insect pests, diseases and weeds.

Principles of crop diversification

The core idea of crop diversification involves transitioning from low-value to high-value crops and from water-intensive to water-saving crops. It aims to replace soil-depleting crops with those that restore soil health. The focus shifts from traditional cropping systems to comprehensive farming systems moving from single crops to multiple or mixed crops. Diversification integrates crops with livestock, fish, and apiculture, emphasizing not just production but also processing and value addition. It encourages a shift from household consumption to market-oriented production and expands the focus from national to international markets.

Approaches of crop diversification

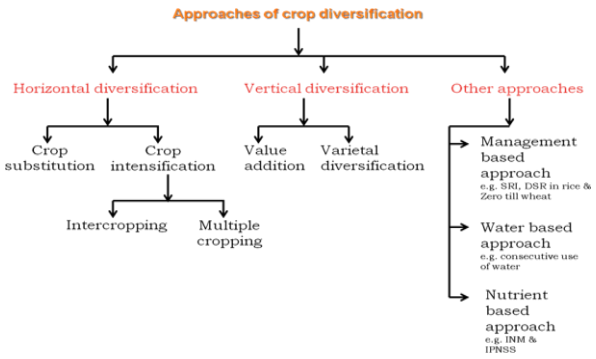
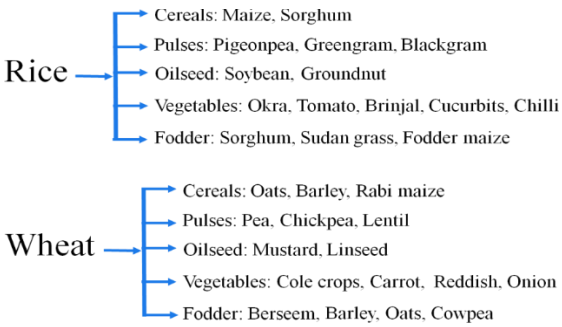


Fig. 2: Approaches of crop diversification

Diversification of RWCS by crop substitution



Considering the importance of rice and wheat in the national food security, complete substitution of these crops is neither feasible nor recommended. But some of the areas of these traditional crops can be diverted to other crops on rotation basis; it will help in restoring soil health and improving livelihood of the farmers.

Management based diversification

Diversifying the management practices of traditional rice-wheat cropping system (RWCS) is offers immense potential for increasing the productivity and sustainability of the system.

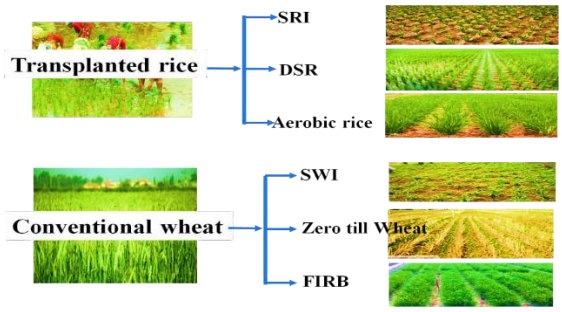


Fig. 4: Substitution of crop establishment methods

Driving forces for crop diversification

Crop diversification helps farmers withstand price fluctuations and balance or diversify food demand. It increases income on small farm holdings and addresses national issues like nutritional and food security. By improving resource use efficiency and conserving natural resources it promotes sustainability. Diversification also reduces reliance on off-farm inputs and decreases problems with insect pests, diseases and weeds leading to healthier crops (Kumar *et al*., 2022).

Benefits of crop diversification

In the long term, crop diversification offers numerous benefits. It ensures better utilization of natural resources contributing to ecological sustainability. Planting alternate crops can enhance profitability and stabilize farm income and productivity. Diversification also improves human nutrition and health by providing a variety of crops. It reduces pest incidence including diseases, insects and weeds leading to healthier crops. Furthermore, it creates more employment opportunities in agriculture. Diversification also mitigates the risks of crop failure, especially in dry lands providing a more reliable and resilient agricultural system.

Constrains in diversification of rice-wheat system

Crop diversification faces numerous challenges including a shortage of high-quality seeds and poor basic infrastructure such as rural roads power and communication. The agro-based industry is weak and there is a lack of post-harvest technologies and infrastructure. Connections between research, extension services and farmers are weak and many farmers are inadequately trained and face high levels of illiteracy. Investment in agriculture has declined over the years and over 63% of the cropped area relies entirely on rainfall making it vulnerable to weather fluctuations.

Promotion of crop diversification by government

The Government of India supports state efforts to diversify crop production through programs like the National Food Security Mission (NFSM) for pulses, cereals, cotton and oilseeds and the Mission for Integrated

Development of Horticulture (MIDH) for fruits and vegetables. States have flexibility under the Rashtriya Krishi Vikas Yojana (RKVY) to address local needs with approval from the State Level Sanctioning Committee. The Crop Diversification Programme (CDP) part of RKVY has been encouraging farmers in Haryana, Punjab and Western Uttar Pradesh to shift from water-intensive paddy to alternative crops since 2013-14. Since 2015-16 it also targets reducing tobacco cultivation in 10 states. CDP provides support for crop demonstrations, farm mechanization, value addition and capacity building, covering 6.32 lakh hectares from 2013-14 to 2020-21.

CONCLUSION

The RWCS in India has helped feed many people but has also caused sustainability issues. To improve land and water productivity, soil health and the environment, sustainable diversification and intensification are needed. Diversifying with high-value crops can boost farm profits through exports. Including certain crops in rotation or intercropping can reduce the need for nutrients and water. Vertical diversification such as switching to basmati rice and durum wheat can also help. The government and policymakers must encourage farmers to diversify beyond rice and wheat monoculture. Diversification should be tailored to local socioeconomic and agro-climatic conditions.

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