

Farmers' Varieties as Pillars of Nutritional Security, Ecosystem Resilience, and Sustainable Agricultural Development

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ABSTRACT

The increasing needs for food security, nutritional quality, and sustainable agriculture systems under the increasing challenges of climate change, biodiversity loss, and vulnerability of small farmers have actually amplified. Although the Green Revolution introduced a major increase in the production of food grains using high-yielding varieties (HYVs), it also introduced a cost in the form of genetic quality, ecological vulnerability, and replacing farmers' varieties (FVs) or traditional crop varieties. Farmers' varieties, or landraces and traditional crop varieties, are those crop species whose development over the past few centuries lies in farmers' hands and are characterized by unique attributes such as climate resilience, adaptation specificity, superior nutritional quality, and cultural significance. This review highlights the potential of legislatively protected farmers' varieties in the form of the Protection of Plant Varieties and Farmers Rights (PPV&FR) Act of 2001 and the Geographical Index of the GIs of Goods of 1999, exclusively in the Indian scenario. By critically deliberating on the evidence collected from the field, this review also briefs on the importance of FVs or farmers' varieties in enhancing nutritional security, co-production and

co-construction of biodiversity, climate resilience, and enriched earning capacities based on premium prices and targeted or special markets. By making a comment on the performance of FVs and HYVs on the sustainability of provisioning, regulating, and cultural services, this review also underlines the future mileage of farmers' varieties in formulating genetic stock for future crop improvement and breeding for climate resilience.

INTRODUCTION

Agriculture remains the key to food and nutritional security for a substantial section of the global community, and developing countries like India are no exception (Singh & Agrawal, 2021). The Green Revolution (GR) brought about a sea change in Indian agriculture and helped make the country shift from being a food-deficit country to being a food-surplus country due to the cultivation of high-yielding varieties (HYV) and better irrigation practices (Newton *et al.*, 2010). Along with the contours of success, the challenges of environmental deterioration and greater vulnerability to climate change evolved.

Farmer Varieties (FVs), till now maintained by farm communities in a traditional manner, have lost their niche in the fertile spots, but they can compete effectively in marginal, rain-fed, or stress spots. FVs have adaptational traits, which have made them tolerant to stresses, with low input sustainability and increased nutritional or medicinal uses (Ficiciyan *et al.*, 2018).

There has been a paradigm shift in the sustainable agriculture debate from singularly pursuing high production levels over the past decades to incorporate overall concepts that include nutrition, environmental services, climate issues, and farm livelihood. Farmers' varieties are again gaining significance as key points in this paradigm shift. The recognition of farmers' varieties through intellectual property rights (IPRs) in the form of the PPV&FR Act and the GI Act in India has

reinforced their significance (Singh & Agrawal, 2021).

In this review, findings from evidence on the various roles of farmer varieties in improving nutritional security, and their roles in sustainable agricultural development and improving farmer incomes are compiled and discussed.

1. Farmers' Varieties: Concept, Evolution, and Legal Recognition

1.1 Evolution of Farmers' Varieties

Farmers' varieties are the product of steady selection carried out by farmers over several generations, under certain agro-climatic and socio-cultural conditions (Newton *et al.*, 2010). FVs are specifically adapted, unlike HYVs, which are adapted widely (Dwivedi *et al.*, 2016). They are adapted to drought, saline, or water-logged conditions, floods, pests, or diseases, among others. FVs are also often imbedded in food cultures, traditions, or indigenous knowledge systems (Ficiciyan *et al.*, 2018).

1.2 Legal Protection of Farmers' Varieties in India

A *sui generis* system of plant variety protection has emerged in the Indian scenario through the "Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001". The Act provides protection to breeders' rights and farmers' rights at the same time, and farmers are considered as conservers, breeders, and guardians of plant genetic resources (Singh &

Agrawal, 2021). The PPV&FR Act, 2001, allows the registration and protection of farmers' varieties. At the same time, the Geographical Indications of Goods (Registration and Protection) Act, 1999, safeguards agricultural products with distinctive qualities traceable to their geographical origin (Siddiq *et al.*, 2012). Various farmer varieties, including the ubiquitous "rice," have been registered under the GI category. This allows for premium pricing and differentiation (Singh & Agrawal, 2021).

2. Nutritional, Medicinal, and Adaptive Significance of Farmers' Varieties

2.1 Nutritional Superiority of Farmers' Varieties

There is considerable empirical evidence that traditional varieties, especially traditional rice varieties, have high levels of essential micronutrients like iron, zinc, manganese, and copper, which are higher than in contemporary varieties like HYV (Singh & Agrawal, 2021). This nutritional fact has importance with respect to addressing 'hidden hunger' due to micronutrient malnutrition, which continues to pose severe health problems in India (Dwivedi *et al.*, 2016).

Some varieties also have medicinal and therapeutic uses. For instance, the Navara rice variety has immense use in Ayurvedic medications, whereas the Kalanamak rice variety boasts the finest qualities regarding its fragrance, taste, and medicinal properties (Siddiq *et al.*, 2012). These varieties not only increase the variety of foods, satisfying the requirements of cuisine, but also meet the demands of functional nutrition.

2.2 Adaptive Traits and Climate Resilience

Farmers' varieties are climate-resilient by nature because of their adaptability to

environmental challenges (Newton *et al.*, 2010). Drought tolerance, submergence-tolerant, salinity-resistant, and pest-resistant traits are some characteristics found in FVs (Dwivedi *et al.*, 2016). These traits are important genetic elements used in making climate-resilient varieties because of rising environmental variability (Ficiciyan *et al.*, 2018).

3. Ecosystem Services Provided by Farmers' Varieties

3.1 Provisioning Services

In low-input and marginal environments, crop variabilities are generally lower and more stable when using farmer-developed varieties than when using HYV technology (Newton *et al.*, 2010). While the potential might be lower, input cost savings and stability of output can often make them competitive or superior with respect to returns (Singh & Agrawal, 2021).

3.2 Regulating Services

Farmers' varieties are climate-resilient by nature because of their adaptability to environmental challenges (Ficiciyan *et al.*, 2018). Drought tolerance, submergence-tolerant, salinity-resistant, and pest-resistant traits are some characteristics found in FVs (Dwivedi *et al.*, 2016). These traits are important genetic elements used in making climate-resilient varieties because of rising environmental variability.

3.3 Cultural and Supporting Services

Apart from their agronomic characteristics, farmers' varieties have major cultural and aesthetic values (Newton *et al.*, 2010). They are linked to cuisines and celebration events. Such cultural association is crucial for conservation. The varieties are cultured (Ficiciyan *et al.*, 2018).

4. Role of Farmers' Varieties in Future Crop Improvement

Climate change is a large threat to agricultural productiveness, especially under rainfed conditions. The approach to breeding is undergoing a phase shift towards adaptation rather than wide adaptation (Dwivedi *et al.*, 2016). Farmers' varieties, having vast adaptive gene resources, are considered the best source for developing stress-adapted, high-nutrient content varieties (Newton *et al.*, 2010). Some successful examples that demonstrate such potential are the generation of submergence-tolerant rice using farm-bred genetic material, among others (Singh & Agrawal, 2021). Using FV in breeding can improve genetic diversity and make a crop less vulnerable and more sustainable.

5. Economic Potential and Trade of GI-Protected Farmers' Varieties

Geographical Indications have proved to be useful instruments for improving farmers' remuneration through the association of product quality and geographical position (Siddiq *et al.*, 2012). GI-protected farmers' varieties like Basmati rice, Navara rice, and Pokkali rice fetch high prices in both local and foreign markets (Singh & Agrawal, 2021). There is evidence that GI certification led to an increase in the producer margins, improved consumer trust, and boosted rural development. Despite certain challenges, the knowledge gap, lack of accessibility to markets, and institutional constraints are the main parameters that slow the realization process surrounding the benefits derived by the small farmers regarding the GI certification (Siddiq *et al.*, 2012).

6. Policy and Institutional Interventions

Notwithstanding their value within the seed chain, 'Farmers' varieties still remain largely unconnected to the formal seed systems (Dwivedi *et al.*, 2016). Improving seed

systems using participatory methods, 'Quality declared seeds,' and 'Semi-formal seed certification methods' could be effective in increasing the availability and quality of seeds (Singh & Agrawal, 2021).

Policy interventions should be geared towards:

- Integrating farmers' varieties into public seed programs
- Enabling GI-based value chains
- Encouraging organic and low-input farming of FVs
- Improving awareness and capacity building of the farmers

Such strategies can promote seed system resilience, conserve agrobiodiversity, and enhance farmers' livelihoods.

CONCLUSION

Farmers' varieties are an important and underexploited factor in sustainable agriculture. Their role in food security, biodiversity, and climate change is becoming more and more obvious (Singh & Agrawal, 2021). Providing them protection under PPV&FR and GI laws creates an environment, but it is important that both laws are implemented properly.

Mainstreaming farmers' varieties through improved seed systems, breeding, and market development has been suggested as one possible way to bridge this gap between conservation and use. Under the situation of climate variability/sustainability, farmers' varieties are identified as a possible solution in terms of resilient, inclusive, and nutrition-sensitive agriculture.

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