

Crop Diversification: A Viable Option for Food and Nutritional Security

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There are various factors of traditional farming, which have triggered the need of crop diversification in India. Plenty of old farming methods and principles which were profitable in the past are now failing to produce desired profitability and nutritional security. Importance of crop diversification is often overlooked due to profit motive from cereals-based cropping system having assured market with the provision of minimum support price. Good yield is obtained from these crops by using high fertilizer dose, irrigation water and pesticides. Huge subsidy on fertilizers and free or subsidized electricity for pumping water encourages for cultivation of these crops in large scale leading to promotion of monoculture. However, it is high time to understand the adverse effects of input intensive monoculture. Therefore a urgent need to crop diversification for food and nutritional security in the Country.

Crop diversification

A new crop or cropping system is added to agricultural production with the intention of diversifying it, keeping in mind the various returns from value-added crops and complementing marketing prospects. One of the key technologies for raising farmers' incomes to a particular level, if not double, is crop diversity and the introduction of new kinds. To ensure that farmers are not reliant on a single crop for revenue, crop diversification aims to expand crop portfolios.

Why need crop diversification at present context

Food insecurity can hinder economic development and perpetuate cycles of poverty. When people do not have enough to eat, they are less productive at work, more susceptible to illness, and may face higher healthcare costs, all of which can limit their ability to earn income and contribute to the economy. Food insecurity can also lead to social unrest and political instability. When large segments of the population do not have access to adequate food,

tensions can rise, leading to conflicts over resources. Addressing food security is therefore crucial for maintaining social cohesion and stability within communities and nations. Adequate nutrition is essential for overall health and well-being. A lack of access to nutritious food can lead to malnutrition, which in turn can result in stunted growth, increased susceptibility to diseases, and even death, particularly among children and pregnant women.

Promising solution to tackle the challenges of food and nutritional security

Crop diversification is indeed a viable option to achieve food and nutritional security in India. In this scenario, inclusion of oilseed, legume and millet promotion may be a viable option to adjust as new crops in already adopted cropping systems.

Enhancing Resilience to Climate Change

A farmer's chance of suffering catastrophic crop failures is increased when they monocrop. The soil loses certain minerals that a single crop needs to thrive when it is cultivated constantly. A crop's susceptibility to illnesses and pests increases with time as the soil becomes poor in nutrients and less productive. There could be disastrous yield losses if a single infection spreads swiftly across large monoculture areas. For farmers as well as the security of food worldwide, this crop failure vulnerability might have disastrous consequences. India's food and nutritional security are seriously threatened by climate change, which has an impact on many facets of agriculture, food production, distribution, and consumption patterns. Crop yields and productivity are directly impacted by variations in temperature and precipitation patterns. Extreme weather conditions including floods and droughts, heat waves, and unpredictable rainfall can all drastically lower or completely destroy crop output. This has an impact on pulses, rice, wheat, maize, and other staple crops, which causes price swings and food shortages. Cropping patterns may need to change as a result of

climate change since some crops may become less viable in their traditional locales. It might be necessary for farmers to switch to entirely different crops or accept new crop kinds. Variations in precipitation patterns have the potential to worsen water scarcity, especially in areas where irrigation is reliant on rainfall. Reduced crop production due to water scarcity results in lower agricultural productivity and increased food insecurity. Crop nutritional content can be affected by alterations in climate and environmental factors.

Elevated atmospheric CO₂ levels, for instance, have the potential to lower the protein, iron, and zinc content of staple crops, such as wheat and rice, aggravating malnutrition and micronutrient deficiencies, especially in vulnerable areas. A variety of tactics are used at different levels to increase resilience to climate change, ranging from small-scale individual activities to large-scale global policy initiatives. These methods for crop diversification could be useful tools for developing climate resilience. Crop diversity provides defense against severe and unpredictable weather patterns brought on by climate change. In addition to increasing soil carbon sequestration, it lowers greenhouse gas emissions. In order to maintain current soil organic carbon reserves and replenish them in soils that have lost carbon, crop diversification techniques—like intercropping in cropping systems—are among the most promising sustainable agriculture management solutions. These tactics tackle soil erosion, global warming, and food security all at once.

Reducing Pest and Disease Pressure

When crops are mono-cropped, pests and diseases that target those crops find the ideal environment to thrive. Pests and illnesses can spread quickly over an entire field when a single crop is planted densely and uniformly. In monoculture systems, conventional pest management techniques like crop rotation and natural predators are less effective, which increases the need for chemical pesticides. Sadly, this strategy frequently leads to environmental contamination, insect resistance, and harm to organisms that are not the intended targets. Farmers always have the issue of controlling pests,

which is a crucial ecosystem service. Similar to natural ecosystems, agricultural systems can experience notable changes in plant productivity due to the presence of herbivorous insects. Future climatic changes may impact pest ranges and perhaps introduce new pests into agricultural systems, making pest management more difficult. It is anticipated that range extensions and phenological changes will cause insect pests to typically become more prevalent as temperatures rise. Higher rates of population development, expansion, migration, and overwintering will accompany this abundance. It is improbable that changes in a species' or community's abundance and distribution will happen at the same rates. Pests that migrate are predicted to react to climate change faster than plants do, and they have the capacity to settle in newly accessible areas and crops. However, a number of obstacles exist to prevent range expansions, including biotic factors like parasitism from other species, competition, and predation. Encouraging such obstacles to insect viability and range extension would help prevent agricultural production from being negatively impacted by pest outbreaks right away. Another strategy for controlling plant disease is to increase the diversity of cereal cropping systems by interchanging crops like oilseed, pulse, and pasture crops.



Fig. 1 Diversification with pulse and oilseed in cereals-based cropping system

Crop rotation can break disease cycles by rotating cereal crops with broadleaf crops that are resistant to the same illnesses. Stand densities might be changed to allow for better microclimatic adaptations to disease growth, and reduced tillage could increase soil biodiversity, which would increase disease suppression. These examples demonstrate how farmers can lower disease susceptibility in agricultural systems and decrease the amount of

production loss due to crop diseases by increasing crop diversification.

Improving Soil Health

A common farming technique called agricultural monoculture, or monocropping, involves cultivating a single crop over vast tracts of land each year. Because of this system's ease of use, efficiency in large-scale production, and simplicity, it has become widely used. But despite its seeming advantages, monocropping comes with a lot of hazards and disasters that can have a big impact on the environment and food security. A single crop's continuous cultivation destroys the soil's natural fertility and structural integrity. Crop rotation prevents the soil's nutrient content from becoming unbalanced, which lowers the soil's capacity to sustain healthy plant growth. Consequently, to make up for the depleted soil, farmers turn to extensive chemical fertilizer use, which exacerbates soil deterioration even more. Future agricultural output is seriously threatened by this unsustainable cycle of soil nutrient depletion and reliance on synthetic inputs. Crop rotation and intercropping with oilseed or legume crops, as opposed to monoculture, have greatly enhanced the physical, chemical, and biological properties of soil. Enhancing soil structure and lowering bulk density are achieved by crop rotation and intercropping with legume or oilseed crops. It raises the amount of organic matter in the soil, lowers the EC, and increases the biomass of soil microbes. By improving soil structure, raising the amount of organic matter in the soil, and promoting microbial diversity, diversified systems rather than monocultures have greatly improved soil health. In order to support nutrient cycling, prevent erosion, and hold onto water better, healthy soils are essential to sustainable agriculture.

Enhancing Nutritional Diversity

Understanding the degree of micronutrient deficiencies in soils is crucial to comprehending the link between micronutrient supply and human health. Distributions of micronutrients in soils are frequently not entirely independent of one another. Certain elements have parent material relationships, and these relationships might still exist in soils. The amount of a

soil nutrient that is available to plant roots during a beneficial time, such a growing season, is known as availability.

The entire pool of soil micronutrients is not readily accessible since plant roots directly absorb micronutrients from the soil solution. Exchange phase, chelated with or contained in organic matter, adsorbed or fixed on clays, adsorbed or occluded in or on oxide minerals or carbonates, or be elements of residual primary minerals control the distribution of accessible micronutrients. To demonstrate a connection between soil and available micronutrients and human health, the distribution of available micronutrients, including multiple micronutrient deficits, is crucial. Similar to plants, monoculture—the agricultural technique of growing a single crop across a broad area—can, in fact, result in nutritional inadequacies and dietary monotony for a number of reasons.

Here are some of the nutritional benefits associated with eating a variety of crops:

Nutrient Variety: The proportions of vitamins, minerals, antioxidants, and phytochemicals in various crops differ. You can guarantee that your body gets a wide spectrum of key nutrients—which are crucial for general health and wellbeing—by eating a variety of vegetables.

Micronutrient Intake: The micronutrient composition of each crop varies. For instance, leafy greens high in iron and calcium, as well as vitamins A, C, and K, include spinach and kale. Contrarily, antioxidants like flavonoids and anthocyanins are abundant in vibrant fruits like berries. You may maximize your intake of vital micronutrients by include a range of crops in your diet.

Dietary Fiber: A wide variety of crops are a great source of dietary fiber, including whole grains, legumes, fruits, and vegetables. In addition to encouraging regular bowel movements, preventing constipation, and lowering the risk of chronic illnesses including diabetes, heart disease, and some types of cancer, fiber is essential for digestive health.

Gut Health: A varied diet promotes a healthy gut flora, which is essential for immunological response, nutrition absorption, and digestion. A balanced microbiome is promoted and beneficial bacteria in the

gut are nourished by diverse forms of fiber that are present in different crops and act as prebiotics.

Conclusion

In conclusion, crop diversification holds significant promise for addressing food and nutritional security challenges globally. By embracing

diverse cropping systems, stakeholders can build more resilient, sustainable, and equitable food systems to ensure the well-being of present and future generations. Neglected and underutilized species offer enormous opportunities for fighting poverty, hunger, and malnutrition.

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