

Crop Diversification for Sustainable Agriculture

Frank Notes



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The country has progressed well on agriculture front and harvested record production of 354 million MT of food grains and 367 million MT of horticultural crops. The splendid growth in production of crops has become possible due to evolution of fertiliser responsive varieties of wheat and rice in mid-1960s and subsequently of other crops. However, desirable growth in agricultural production is necessary to meet the growing need of burgeoning population in terms of food and nutritional security.

There has been increase in sowing area under wheat by 79.6% from 18.24 million hectares (Mha) in 1970-71 to 32.76 Mha in 2024-25. Corresponding figures for increase in area under rice and maize have been 36.8% from 37.59 Mha to 51.42 Mha; and 105.5% from 5.85 Mha to 12.02 Mha, respectively. Area under pulses showed an improvement of 22.6% from 22.53 Mha to 27.62 Mha. Area under oilseeds, cotton and sugarcane improved by 81.8%, 47.7% and 104.9%, respectively. Area under horticultural crops has also shown considerable increase. However, there has been deceleration in area under *jowar* and *bajra*. The cropping intensity has improved from 117.7% in 1970-71 to 156.8% in 2023-24. Share of wheat and rice in total production of food grains has now reached to around 75%.

Prevalence of cereal-focused rotations or mono cropping rotations is quite input and energy intensive. Due to adoption of same cropping systems over the years on the same land, challenges witnessed in agriculture are deterioration in soil health; decline in organic carbon (OC) in the soil, natural resources and microbial diversity; emergence of multi-nutrient deficiencies in soil; deepening of water table in tube well irrigated area; salinization and alkalisation in canal irrigated area, etc. There has been inter-crop and inter-cropping system variations in absorption

of nutrients and management practices. Variability in fertility of the soil within the same field is very common. Such spatial heterogeneity can result in uneven crop growth and yield across the field. Improvement in soil health can be possible by enhancing OC in the soil to take care of adverse effect of climate change even. One of the possible strategies is to lay more emphasis on crop diversification.

Crop diversification is a strategic approach aimed at ensuring food and nutritional security, improving farm income thereby reduction in poverty, conserving natural resources, reducing risk to climate and market uncertainties and achieving sustainable growth in agriculture. Diversified crop rotations generally results in higher crop yields compared to mono crop or two crop rotations, commonly known as the rotation effect. The efficacy and efficiency of a crop rotation strategy depend on several factors, including the type, sequencing and frequency of crops, duration of rotation cycle, agricultural history of the land, and soil attributes.

Crop/cropping diversification entails reallocating a portion of the existing crop system to alternative crops, cropping systems, or farming systems. It addresses the fundamental aspects of soil health and the productivity of the agro-ecosystem. In India, most of the highly productive systems are centered on cereal-based cultivation, which demands significant resources. These systems include rice-wheat rotations in the Indo-Gangetic plains, rice-rice cultivation in coastal and high rainfall areas, and coarse cereal-based systems in regions with low rainfall. This has been in vogue for decades.

Among these strategies, grain legumes, particularly pulses, offer inherent advantages such as biological N fixation, enhanced root exudation, and compatibility with cereals and non-legume crops. These characteristics make grain legumes essential for crop diversification. Availability of short-duration (about 60 days) or extra-short-duration (nearly 55 days), green gram cultivars have opened up opportunities for utilizing the summer fallow in irrigated cereal-cereal systems to enhance system intensification in Indo-Gangetic Plain. In specific geographic regions like southern and eastern states, short-duration varieties of black gram and green gram can be successfully cultivated utilizing the residual soil moisture following rice harvests. Similarly, coastal rice-fallow areas of Andhra Pradesh, Karnataka, Tamil Nadu, and Odisha have potential for cultivating these pulses during the *rabi* season. In humid tropical regions, black gram is a better choice for system intensification,

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particularly in cropping systems like rice-potato or rice-mustard which are widely followed in eastern India - West Bengal and Bihar. In eastern Uttar Pradesh and northern Bihar, rice-chickpea system assures economic viability even under limited resources. In fact, alternate year replacement of wheat by chickpea in rice-wheat and maize-wheat rotation can be more effective to achieve higher system productivity while sustaining the soil quality parameters. Short-duration pigeon pea has gained significant attention as a promising alternative to rice in the rice-wheat system.

Over-exploitation of ground water has become a serious problem. Absence of proper rainwater management leads to floods causing huge loss to the people and property during rainy season and water shortage during the rest of the year. There is an urgent need to evolve permanent solution to the problem by conservation and management of available water resources. A national level drive giving special emphasis on conservation, recharge and management of water resources is the need of hour to make visible impact. Area under micro-irrigation has already reached a level of more than 16 Mha with the concerted efforts of central and state governments. Producing more crop per drop of water through micro-irrigation particularly drip-fertigation needs more impetus as it has potential of saving of 50-60% on water, 20-40% on fertiliser N, 50% on labour expenditure, enhancing crop yields by 25-75%, and improving the quality of produce compared to traditional pattern, especially when employed under protected environment. Such systems also help for adoption of sustainable agri-practices and diversifying crops/cropping systems, as per choice of the farmers.

Though agriculture production increased manifold during Green Revolution, it came from the irrigated areas under few crops, namely, rice, wheat and sugarcane. The NABARD-ICRIER study conducted in 2018 reported that these three “water guzzler” crops occupy about 41% of the gross cropped area and consume more than 80% of irrigation water. Sugarcane, occupying only a small portion of Maharashtra’s cropped area, consumes

disproportionately high amount of the state’s irrigation water. Same is the case in Karnataka for rice and sugarcane, fetching considerable amount of water. Farmers need to be incentivized to replace these crops with crops such as millets, oilseeds, fruits and vegetables and adopt integrated farming along with dairy, poultry and fisheries. State-specific and season-specific crop replacements could also lead to annual water-saving which could be diverted to critical and supplementary irrigation for millions of small and marginal farmers, in addition to increase in rural drinking water sources. This will also benefit the population to increase nutritional security with increased consumption of nutri-cereals and pulses.

Accepting the proposal made by India, United Nations (UN) had declared 2023 as the International Year for Millets with aim to create awareness about health benefits accruing from the accelerated use of millets component of staple diets of vast population. To reduce dependence on import of oilseeds, a nationalized and comprehensive scheme is needed to increase domestic production of oilseeds. Horticulture is emerging as one of the most dominant faces of Indian agriculture. Development of adequate cold chain in agriculture will further encourage farmers to switch over to horticultural crops.

The Union Cabinet, Chaired by the Prime Minister, Shri Narendra Modi, on 1 October 2025 has approved the National Pulses Mission, aimed at boosting domestic production and achieving self-sufficiency in pulses. The Mission will be implemented over a six-year period, from 2025-26 to 2030-31, with a financial outlay of Rs. 11,440 crore. India is the world’s largest producer and consumer of pulses. However, domestic production has not kept pace with demand, leading to a 15–20% increase in pulse imports. To reduce this import dependency, the Mission will adopt a comprehensive strategy covering research, seed systems, area expansion, procurement, and price stability.

Conservation agriculture is a set of sustainable farming practices that promote soil health by minimum soil disturbance (like zero-tillage), permanent soil cover (using crop residues or mulch), and crop diversification (such as crop rotations or intercropping), and its adoption needs to be promoted among the farmers. Inclusive research should be given more emphasis to know the effects of continuous cropping system on physical, chemical, and biological properties of the soils, and suggestive cropping systems for agro-climatic zones across the country having better system productivity on sustainable basis, keeping the food security intact. ■