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Review Paper

Crop Diversification in India: A Review

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ABSTRACT

In the 1980s, Indian agriculture understood the importance of shifting away from grains and towards other crops, but this did not expressly target the horticulture sector. Early in the 1990s, while economic reforms and liberalisations were being implemented, diversification in the direction of horticulture became increasingly evident. In recent years, the economy has gradually shifted from producing food crops to non-food crops and the area under non-food crops has increased far more than that of the sector producing food crops. Fruits and vegetables have dominated the diversification in horticulture because to a change in demand brought on by a shift in peoples' consumption patterns. The high rate of return and higher productivity of horticulture than other food crops are additional factors driving diversification in this sector. It also benefits the farmers since it gives the population year-round jobs and income.

HIGHLIGHTS

- Crop diversification increases income because high-value crops, such vegetables and roots, not only make the cropping system more intensive but also produce higher financial returns per unit of land.
- Diversification towards commercial crops alsoassists the small and marginal farmers to uplift their economy through increasing their farm output.

Keywords: Crop diversification, Determinants, Impacts, food security, India

Around 80% of operational holdings in Indian agriculture are tiny, peasant-based economies, and they cultivate 34% of the country's agricultural land (GOI, 1997; Pal and Kar, 2012). Due to their tiny operational holdings, small farmers find it difficult to increase their incomes solely by increasing the yields of their current crops through crop specialisation, mainly grains. They should switch to high-value crops with widely accessible modern farm inputs so that the impoverished peasants might have a secure economic foundation (De and Chattopadhyay, 2010). An alternative strategy which aims to increase the land's productivity also promoting its regeneration and conservation is agricultural diversification. (Dharmasena, P.B. and Jayawardena, S.N. 1996; Sharma, H.R. 2005; Bhattacharyya, B. 2008; De, U.K. and Chattopadhyay, 2010). Globalization-related agricultural diversification brought about at the local level throughout the second decade of the 1990s (Ghosh, 2011). Crop selection must be planned to take advantage of crop synergism in order to make the most use of resources and boost overall productivity (Anderson, 2005). Crop diversification is the process of transitioning from one crop or cropping technique to another that is more lucrative and environmentally friendly (Barman *et al*. 2022). It leads to a movement from low-value agricultural and towards high-value agriculture and enhances agricultural output (Dutta, 2012). One key element in reducing poverty is the switch from lower-value to higher-value crops, which are frequently grown

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for export (Birthal *et al.* 2015; Pingali and Rosegrant 1995; Raju 2005; Von Braun 1995). Agricultural diversification varies from area to region both spatially and temporally, and is mostly controlled by physical, cultural, and technical factors (Giri and Mishra, 1983). Crop diversification away from staples towards high-value crops (HVCs). One strategy that can increase earnings, generate jobs, and reduce poverty is within the agricultural sectoras a result of a sluggish transfer of labour towards non-farm industries (Ali and Abedullah, 2002; Barghouti, Kane, Sorby, and Ali, 2004; Birthal, Joshi, Roy, and Thorat, 2013; Joshi, Gulati, Birthal, and Tewari, 2004; Weinberger and Lumpkin, 2007). High-value crops (HVCs), which include fruits, vegetables, condiments, spices, and plantations, are said to be crucial for guaranteeing agricultural-based livelihoods, fostering growth, and eliminating rural poverty (Bigsten and Tengstam, 2011; Birthal *et al*. 2015; Michler and Josephson, 2017). HVCs are more lucrative than the commonly cultivated cereal crops (Joshi *et al*. 2004; Birthal *et al*. 2015) and also labor-intensive (Joshi *et al*. 2006). As a practical way to stabilise and increase farm income, create more jobs, and preserve and improve natural resources, primarily land and water, it is advised that agriculture diversify towards specific high-value crops like fruits and off-season vegetables, compatible with the region's comparative advantage (Vyas, 1996).

Extent of Crop Diversification

Kumar and Gupta (2015) defined crop diversification to the degree depicted in Fig. 1. The crop subsectors in different Indian states were divided into three categories: food crops, non-food crops, and total crops. The degree of crop diversification was further divided into three classes: Lower SID (Range: 0.00-0.20), Moderate SID (Range: 0.21-0.40), and Higher SID. (Range: 0.41-1.00). Due to the lack of significant crop diversification, Madhya Pradesh, Punjab, Haryana, Rajasthan, Jharkhand, Bihar, and Jammu & Kashmir reported a lower SID under the category of food crops. Himachal Pradesh, Maharashtra, Uttar Pradesh, Karnataka, Odisha, West Bengal, Andhra Pradesh, and Tamil Nadu were all categorised as having a moderate SID because they all displayed a moderate degree of crop diversification. Kerala was the only state to attain a higher SID and a higher level of food crop diversification. Jammu & Kashmir, Odisha, and Madhya Pradesh saw lower amounts of crop diversification in the non-food crops group (lower SID). Crop diversification was portrayed at moderate levels in Rajasthan, Uttar Pradesh, Himachal Pradesh, Punjab, Tamil Nadu, Karnataka, and Andhra Pradesh. High levels of crop diversification were observed in Kerala, Gujarat, Maharashtra, Haryana, Bihar, West Bengal, and Assam, which also had greater SID. Himachal Pradesh, Bihar, Uttar Pradesh, Jammu & Kashmir, and Odisha exhibit low agricultural diversification and low SID in the third category of total crops sub-sector. Haryana, Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, Rajasthan, Kerala, and Gujarat experienced a high level of crop diversification higher SID, while West Bengal, Punjab, Madhya Pradesh, and Assam experienced a middling degree of crop diversification moderate SID.

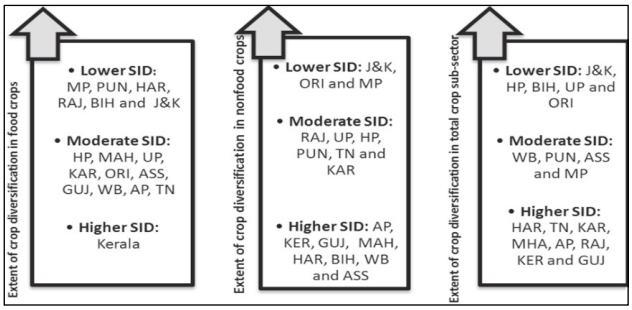

Fig. 1: Extent of crop diversification across 17 major states of India

[AP stands for Andhra Pradesh, ASS for Assam, GUJ for Gujarat, BIH for Bihar, HAR for Haryana, and HP for Himachal Pradesh. Jammu and Kashmir, or J&K KA means Karnataka Kerala is represented by KER, Madhya Pradesh by MP, Maharashtra by MAH, Odisha by ORI, Punjab by PUN, Rajasthan by RAJ, Tamil Nadu by TN, Uttar Pradesh by UP, and West Bengal by WB.]

Determinants of Crop Diversification

The variables influencing agricultural diversification help us identify the dominant forces in a given area that shape agricultural practises. Additionally, it aids in our understanding of current crop rivalry. (Bhalsing, 2009). A particular socio-economic environment may have distinct driving forces behind agricultural diversification than another environment (Jha *et al*. 2009).

Natural Factors

Diversification is also influenced by the agroclimatic

environment in a specific location and the technology accessible for various crops. The fundamental elements affecting the cropping pattern are those that are natural and physical, such as the soil, drainage, slope, rainfall, temperature, and humidity. Only certain types of crops can be grown in certain soils and with certain availability of water (Behera *et al*. 2008). Climate change factors include irregular and infrequent rainfall, the depletion of water supplies, and a decline in the productivity of the current cropping pattern (Guiteras 2007; Joshi *et al.*). Cropping pattern changes also have detrimental effects on the environment, including salinity, water logging, groundwater depletion, and soil fertility loss, all of which can hinder agriculture's productivity and development potential (Kamraju *et al.* 2017).

Resource factors

Crop diversification is impacted by resource variables like rainfall, irrigation capability, and soil fertility condition. In regions where irrigation was installed, it was observed that the cropping pattern grew more diversified, which has primarily resulted to high production as well as multiple cropping (Behera *et al*.,2008).Numerous studies have discovered that irrigation favourably affects agricultural diversification. The study also supported by Kumar *et al.* (2012) that crop diversification in support of high-value commodities was positively and significantly influenced by the irrigation area. (Birthal *et al.* 2006; Kumar *et al*. 2012; Basavaraj *et al.* 2016), while the other studies indicate the opposite, that irrigation inhibits diversification (Joshi *et al*. 2004; Basantaray and Nancharaiah 2017; Mukherjee and Chattopadhya 2017). Cropping intensity and annual rainfall have been found to have a statistically positive and significant impact on crop diversification in a study conducted by Kumar and Gupta (2015). In agreement to the above study, Joshi *et al.* (2004) have also reported that agricultural diversification in support of high-value crops by replacing inferior coarse cereals has benefited rainfed areas more than non-rainfed areas.

Technology-related factors

Crop diversification is accelerated by using high-yielding variety seeds, fertilizers, and infrastructure-related variables like marketing and storage. The producers do not receive the right signals if the market structure is poor due to insufficient transportation or communication infrastructure, as well as a lack of relevant information, which is also true for institutional arrangements (Behera *et al*. 2008). As has been reported by (Joshi *et al*. 2004) that price regulation, the expansion of markets and roads, urbanization, and technical advancements has a strong influence on agricultural diversification. Improved markets and a better road system encouraged diversification in favour of high-value goods because they have lower marketing costs and can be sold quickly and easily. Also, it lessens the possibility of post-harvest losses for perishable goods. Similarly, Neogi and Ghosh (2022) are of the opinion that crop diversification is significantly influenced by road infrastructure by establishing a link between villages and the nearby towns and markets. However, lack of transportation infrastructure raises the price of moving goods from rural to urban markets as well as the price of purchasing inputs, information, and technology. was studied by (Nakro and Khiki, 2006). The proportion of high-yielding varieties and the ratio of gross irrigated area to gross cropped area were found to have a substantial impact on the diversification of commercial crops. Crop diversity depends in part on fertiliser usage. Crop diversification is positively impacted by the use of fertilizers, pesticides, seeds, and farm credits. Another research found that while the use of fertiliser fosters diversity in some states, it has negative effects in eastern India.

Household Size

Since the high-value crops require a lot of labour to develop, households with larger sizes benefit from the availability of more reliable labour resources. Farmers are prompted to diversify their crop rotation in support of high-value crops by the increased availability of family labour (Kumar *et al*. 2012). Kiru *et al*. (2014) have also reported that a farmer's ability to diversify will be improved by expanding their landholding. Due to the perishability of the product and the tiny amount of marketable surplus, larger farmers are frequently better equipped to handle risk from weather, disease, and pests as well as marketing risk (Minot and Roy, 2007). Jha *et al*. (2009) observed that the size of a holding is inversely linked to diversification, suggesting that

small farmers are less willing to take risks than large farmers. Fan and Chang-Kang (2005) also indicating that there is higher productivity on small farms in developing countries. Another study by Mango *et al.* (2018) asserts that households with higher crop diversification intensities are more likely to have a diverse diet.

Rising Income and Urbanization

Undoubtedly, a key factor in shifting spending patterns is an increase in per capita income (Rao *et al*. 2008). Consumer preference for high-value foods like fruits, vegetables, dairy, poultry, meat, and fish products rises with income, moving away from staple foods like rice, wheat, and coarse cereals. Both the wealthy and the poor have changed their diets to prefer non-cereals (Joshi *et al*. 2007; Joshi *et al*. 2004; IFPRI, 2007). Numerous studies have linked diversification indices and income, and they generally found a favourable relationship (Walker *et al*. 1983; Singh *et al*. 1985 and Shiyani R.L. *et al*. 1998). Another significant demand-side element that affects consumption patterns is urbanisation. Urbanization rates in South Asian nations are extremely high, increasing from 23.3 percent in the 1980s to 1990s in 2000 (Joshi *et al.* 2007). Both the way of life and the pattern of consumption vary greatly between rural and urban areas. Urban consumers spend more money and buy more high-value commodities (HVC) than do rural consumers. (Joshi *et al*. 2007; IFPRI, 2007). Kumar *et al*. (2012) observed that urbanisation and per capita income have a negative impact on the diversification of vegetable, spice, and fruit crops, respectively. The amount of land planted with high-yielding varieties and the ratio of gross irrigated area to gross cropped area were found to have a substantial impact on the diversification of commercial crops. Urbanization is the primary factor pushing crop diversification, or the rise of high-value crops in place of traditional crops. Commercial crop cultivation is greatly impacted by the tendency towards urbanisation. There is always a rural-to-urban migration because there are more lucrative job possibilities. Therefore, local demand is still crucial for high-value crops like fruits and vegetable oil because of the improvement in living standards (Neogi and Ghosh, 2022). Per-capita gross state domestic product has a beneficial impact on crop diversification as well. Increased purchasing power increases the demand for high-value products, which in turn encourages farmers to choose to grow them. A greater GSDP is a sign of increased purchasing power. The Indian farming community's capacity for risk-taking has grown (Neogi and Ghosh, 2022).

Government interventions

According to (Neogi and Ghosh, 2022) the government needs to act right away to enforce proper policy implementation, increase funding for R&D, infrastructure improvements,efficient organisations and support services for credit, marketing, packing, and processing agricultural goods. In addition, it must ensure that marginal and small farms participate more effectively in crop diversification. In the era of globalisation, contract or corporate farming may be one way to increase the speed of crop diversification and give these farmers better options to boost their farm revenue and take risks. Government initiatives that either directly or tangentially affect crop diversification include pricing policy, tax and tariff measures, trade measures, public spending initiatives, and agrarian reforms (Behera *et al*. 2008). Chaurasia *et al*. (2021) found that, increased productivity indicates the proper utilisation of inputs like labour and capital, improvements through mechanisation, changing attitude of farmers and positive impact of government initiatives.

Agriculture as Main Occupation

According to Kumar *et al.* (2012) compared to households involved in other activities, those with agriculture as their primary employment would be more diversified and have higher incomes. Farmers who are solely engaged in agriculture can devote more time and make better use of their resources when planting a variety of high-value crops, which will improve their diversification strategies, lower the risk involved in growing a single crop, and assist them in escaping the poverty trap (Deshpande *et al.* 2007) the quantity of crops grown and household income on the farm were found to be positively correlated by Pellegrin and Pellegrin (2014).

Impact of Crop Diversification

Crop diversification significantly affects social and economic situations and increases the available

resources for the people in poverty that depends on agriculture. Additionally, it boosts exports and offers year-round employment and income possibilities to the youth population (Joshi *et al.* 2004; Dalal and Shankar, 2022). Kaur *et al.* (2021) evaluated 50 contract farmers and 50 non-contract farmers were used as a sample to examine the contribution of contract farming to agricultural diversification and the creation of jobs. It was observed that contract farmers were able to diversify their farming through the introduction of novel crops, the expansion of crop production, and the creation of more jobs than farmers who did not use contracts. This encourages crop diversification and creates jobs for field laborers, particularly women. Similarly (Singh, 2000) also reported that stabilising the incomes and employment in the farming sector can be achieved by diversifying the crops produced or the technologies used. It is also supported by Acharya *et al.* (2011) Crop diversification results in better cropping efficiency, higher employment, commercialization of farming, decreased male migration, and participation of women in income-generating activities. Chattre *et al.* (2016) analyzed the effects of growing alternative crops on producers' profitability, using information from four representative districts of Punjab and data from land size,labour and working capital and yield and revenue information was used. It was observed that alternative crops such as onion, cauliflower, capsicum and tomato compared to the current paddy-wheat rotation, have higher net expected returns (116–384%), and also use considerably less water overall (29–50%) than the current paddy–wheat rotation system. Farmers can gain access to domestic and foreign markets by diversifying their crops to grow novel products, foods, and medicinal plants. It also enhances the conditions for food security by allowing farmers to produce surplus goods for market sale and thereby contribute to increased income to meet other needs related to family well-being (Khanam *et al*. 2018). It also promotes economic stability because it makes it easier to withstand fluctuations in the price of different agricultural commodities (Rede, 2022). Rao *et al.* (2019) studied increasing per capita income through the creation of diversified production avenues, employment in the agricultural and non-agricultural sectors, maintenance of the livelihood of small and marginal farmers, production of lucrative crops, provision of wholesome food, and long-term sustainability of broad-based economic growth. Mandal and Bezbaruah (2013) evaluated the impact of cropping diversification in flood-affected agriculture in the plains of Assam using farm-level survey data. It was observed that farmers in areas with frequent flooding had adopted a diverse and intensive cropping plan to maximise the use of their land resources during the dry periods. Crop diversification was found to play a significant role in raising farm income. Also, access to irrigation leads to a higher crop diversification as farmers were able to cultivate in the *rabi* season as well and the access to institutional credit capacitate farmers to practice crop diversification to a greater extent by enabling them to carry on farming operations in a better way through the provision of financial assistance to purchase the necessary inputs at a relatively lower rate of interest. Thus, they have concluded that the greater the level of crop diversification more is the farm income. Likewise, access to irrigation is found to be positively impacting farm income. This is due to the fact that having access to irrigation not only makes it easier to farm during the *rabi* season but also makes it possible to utilise chemical fertilisers and high-yielding seed varieties, both of which boost crop productivity Birthal *et al.* (2015) assessed the impact of crop diversification on farm poverty. It was found that smaller farmers give HVCs a larger portion of their land and that they are also more productively effective. The farmers also use HVCs for domestic consumption, saving money on their purchases. It was also observed that if a farmer grows HVCs, their chance of being impoverished is reduced by 3–7 percent families that grow HVCs had a reduced incidence of poverty, but households that dedicate their entire plot to cereal crops have a 6 percent greater incidence of poverty. Due to its dependence on rain, Indian agriculture is extremely vulnerable to climatic shocks including floods, droughts, and heat stress. Keeping this in view Birthal and Hazrana (2019) carried out a study by using district-level panel data, assess the efficiency of crop diversification in reducing the negative effects of climatic shocks, such as rainfall deficit and heat stress, on agricultural output. The result demonstrates that climate shocks have a negative impact on agricultural productivity, and that these impacts worsen as a function of increasing severity. Crop diversification was found to be an

important adaptation technique for increasing agriculture's resilience to such shocks. Additionally, diversification's adaptation advantages are dynamic and become more clear over time (Makate, 2016). Furthermore, it was stated that crop diversification is a crucial climate-smart strategy because it enables smallholder farmers to withstand the impacts of accelerating climate change and variability.

Crop Diversification and Food Security

Food security and nutrition variables were found to benefit from and be statistically significant affected by crop diversification. This suggests that, crop variety has a direct impact on food availability and nutrition in addition to increasing productivity, production, and income stability. This is primarily due to the fact that crop diversification will increase yields, bring crop yield stability, and also have a crop insurance impact, allowing farmers to rely on the other crop in the event that one fails. This will have a direct impact on the nutrition and food security of smallholder farming system (Njeru, 2013). Crop diversification increases the level of food security and allows farmers to sell excess produce on the market, generating more income to meet other household needs (Rubina *et al*. 2018).

CONCLUSION

According to the studies mentioned above, crop diversification in Indian agriculture—from traditional, less lucrative food crops to more lucrative commercial crops, horticulture crops, and plantation crops has resulted in a considerable change. In India, crop diversification has increased as a result of economic expansion, higher levels of education in rural areas, rising standards of living, better and more innovative market institutions, increased accessibility and use of credit facilities, infrastructure improvement, and contract farming methods. Irrigation facilities, chemical fertiliser use, road length, market density, rainfall, percentage of urban population, percentage of area under high-yielding cereal crops, proportion of small and marginal landholders in total holdings, average size of landholding, mechanisation, and per capita income were the main driving forces behind crop diversification. The development of farmers' incomes across all size categories and agroclimatic zones depends on their ability to diversify their crop production.

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