



A STUDY OF HISTORICAL TREND AND PATTERN OF CROP DIVERSIFICATION IN MAJOR AGRICULTURAL STATES OF INDIA DURING THE LAST DECADE

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RESEARCH ARTICLE



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Abstract

Crop diversification has emerged as an essential strategy within India's agricultural sector towards enhancing farm productivity, mitigating production risks, and promoting long-term sustainability. This study examines the extent, pattern, and stability of crop diversification across ten major agricultural states in India over the period 2012–2022. By utilizing secondary data from official government sources and employing the Herfindahl-Hirschman Index (HHI) and Simpson's Index of Diversification (SID), the analysis reveals significant inter-state variation. States such as Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, and West Bengal exhibit higher levels of diversification, whereas Bihar, Haryana, Punjab, and Uttar Pradesh remain predominantly less diversified. The findings also suggest a likely correlation between diversification and variability in the area under cultivation, particularly in states transitioning from food crops to cash crops. The state of Tamil Nadu demonstrates a remarkable increase in diversification over the period of study, indicating the potential efficacy of targeted policy interventions and adaptive farming practices. The study concludes that crop diversification is not merely an economic adjustment but a comprehensive strategy essential for ecological resilience, food and nutritional security, and the sustainable transformation of Indian agriculture.

Keywords: *Crop Diversification, major agricultural states, trend, pattern, stability, food crops, cash crops*

Introduction

Crop diversification in India is a significant and evolving aspect of the country's agricultural landscape. It refers to the practice of growing a variety of crops on a farm rather than relying on a single crop, aiming to enhance productivity, reduce risk, and ensure sustainable agricultural development. Crop diversification may also be defined as the process of switching from a crop or cropping system that traditionally produces less profitable crops to one that produces more profitable crops (Feliciano, 2019). Historically, Indian agriculture has been predominantly dependent on traditional food grains like rice and wheat. However, over the decades, changing market demands, environmental concerns, and the need for improved farm incomes have driven a shift toward diversified cropping systems. Crop diversification in India now encompasses a broader spectrum of cereals, pulses, oilseeds, fruits, vegetables, spices, floriculture, and even medicinal plants. Diversification helps to increase nitrogen in the soil and thus improve the soil fertility (Ali et al., 2012). This shift not only helps in maintaining soil fertility and ecological balance but also provides multiple avenues for farmers to earn income throughout the year, thereby reducing their dependency on a single crop and mitigating the risk of crop failure due to adverse climatic or market conditions.

Agricultural diversification as a neo-liberal strategy to shift the dynamics of crop pattern and crop-orientation seems to have gained significance since early 1990s. The sharp rise in the consumption of high-value food items in India indicates the great demand potential for high-value crops (Kumar et al., 2003). Fruit and vegetable exports from developing to developed nations have increased rapidly as a result of the globalization process (Diaz-Bonilla and Recca, 2000). Indian agriculture is progressively shifting toward high-value crops in order to satisfy the country's expanding local demand and benefit from globalization (Joshi et al., 2003).

Need for Crop Diversification

One of the key drivers of crop diversification in India has been the limitations of the Green Revolution. While the Green Revolution brought about significant increases in agricultural productivity in the 1960s and 1970s, it also led to mono cropping practices, particularly in regions like Punjab, Haryana, and western Uttar Pradesh. These practices eventually resulted in soil degradation, depletion of groundwater resources, and a decline in biodiversity. Consequently, policymakers, agricultural scientists, and farmers have increasingly recognized the importance of diversifying cropping patterns to restore soil health, conserve water, and promote long-term sustainability. Moreover, climate change has further underscored the need for diversification, as erratic rainfall patterns, temperature fluctuations, and extreme weather events pose a growing threat to monoculture farming systems.

Another compelling reason for crop diversification in India is the rising consumer demand for a varied and nutritious diet. With increasing urbanization, rising incomes, and growing health consciousness, there is a significant market for fruits, vegetables, pulses, and organic produce. This shift in consumer preferences has encouraged farmers to move away from traditional cereal crops and explore high-value crops that can fetch better prices in local and international markets (Joshi et al., 2003). In states like Maharashtra, Karnataka, and Tamil Nadu, farmers are increasingly turning to horticulture, floriculture, and spice cultivation as profitable alternatives. Additionally, government schemes and incentives, such as subsidies, minimum support prices for select crops, crop insurance programs, and infrastructure development for cold storage and supply chains, have provided crucial support for farmers willing to diversify their crops.

Furthermore, crop diversification plays a vital role in enhancing food and nutritional security. By integrating a wider range of crops into farming systems, India can better address the malnutrition challenges that still persist, especially in rural areas. The regions with greater crop diversification towards non-food grain crops have achieved more security in the access to food (Paul et al., 2011). Diversified farming systems are more resilient, offering not just better returns but also ecological benefits such as pest and disease management, improved pollination, and reduced reliance on chemical inputs. In this context, diversification is not merely an economic strategy but a holistic approach toward sustainable agriculture and rural development.

Literature Review

Diversifying agriculture toward high-value crops is essential for raising farm income, generating jobs, lowering poverty, and conserving resources (Kumar et al., 2012). Their research in eastern India reveals a gradual transitions to high-value crops, with infrastructure, education, and technology all playing important roles. In addition to agro-climatic factors, the paper's regression results have highlighted the significance of technology, contemporary tools, education, and road connection as key predictors of agricultural diversification towards high-value crops.

In their 2014 study, Dasgupta and Bhaumik examined the effects of crop sector diversification on the rise of agricultural output in West Bengal, India, from 1980–1981 to 2009–2010. According to the study, from 1995–96, West Bengal's agriculture accelerated post-globalization by moving away from traditional food grain crops like aus, aman, and pulses and toward boro rice, oilseeds, and potatoes. The development of agricultural output has benefited from this diversification, with yield growth accounting for the majority of the effect. In order to reduce risks, small and marginal farmers have been instrumental in promoting diversification and keeping a varied crop portfolio. This approach, which has enabled yield development in both food and non-food grain crops, has been made possible by the expansion of irrigation and the greater usage of fertilizer.

In their work *Crop Diversification in West Bengal: A District Level Analysis For The Period 1980-81 To 2011-12*, Mukherjee and Chattopadhyay (2017) investigated the dynamics of crop diversification in West Bengal, India, both before and after liberalization. The nature, extent, and determinants of agricultural diversification in a small farm-dominated economy such as West Bengal were the topics of the paper. The beneficial effects of cropping intensity and operational area on the level of crop diversification were demonstrated by the researchers' analysis. On the other hand, crop diversity in a given area is negatively impacted by elements such as the availability of irrigation infrastructure, the level of electrification, fertilizer use, and output price. The study also made the point that a district's high degree of diversification is not always correlated with its traditional resource base or large endowment of contemporary inputs. Additionally, the study discovered that the level of crop diversity throughout the studied time varied significantly between districts. It implies that a low-yielding basket of crops may be the result of need-induced diversification in resource-constrained settings.

The study by Rajendran and Thenmoli (2020) examined the trends and stability in agricultural production in India, particularly the food grains and non-food grains, over the past three decades since the economic reforms. The key findings are first, the area under food grains cultivation has decreased over the period, while the area under non-food grains cultivation has increased significantly, especially in the last decade. Second, the production of food grains has increased continuously, with the yield of major crops like rice, wheat, and coarse cereals showing an increasing trend. However, the stability in production has varied across different food grain crops. Third, the production of non-food grains like oilseeds, cotton, and sugarcane has also increased, but the stability in their production has been lower compared to food grains. Fourth, the study suggests the need to bring more stability in both the food grains and non-food grains sectors through measures like expanding irrigation, promoting agricultural research, and addressing the challenges posed by climate change.

Crop diversity is essential for Indian agriculture to solve food and nutritional security, poverty reduction, and sustainable growth, as stated explicitly in Prajapat and Kaswan's (2022) study. Crop diversification depends on a number of factors, including those related to resources, technology, households, prices, and institutions and infrastructure. Few crops are taking up significant production space and are being farmed year after year, according to the experts. As a result, biotic and abiotic restrictions at various field levels have emerged, and the overall advantages of farming have decreased. As a result, in order to gain from farming, crop diversification must be implemented immediately.

Dalal and Shankar's (2022) study highlights the significance of agricultural diversification in India. The study claims that crop diversification can help small and marginal farmers by offering year-round job and income options. By switching from low-profit to high-profit agricultural systems, diversification enables farmers to increase their output, quality, and profits. The article describes several methods of crop diversification, including crop substitution, horizontal diversification, and including livestock, horticulture, and agroforestry. The study highlights crop diversification's increasing significance and promise in Indian agriculture while pointing out certain obstacles, such as inadequate infrastructure, limited access to inputs, and low farmer awareness.

In his research, Sanjeev Kumar (2022) examined the new crop diversification trends and patterns in the Indian state of Uttar Pradesh between 2000–01 and 2019–20. At the crop group and regional levels in Uttar Pradesh, the author examined the compound annual growth rates (CAGR) of several agricultural indicators, including area, production, and yield. According to the study, high-value crops are replacing conventional food grain crops in Uttar Pradesh, however the distribution of this change varies by region of the state. The regions with the greatest degree of agricultural variety include Western Uttar Pradesh, Central Uttar Pradesh, Bundelkhand, and Eastern Uttar Pradesh. According to this study, in order to encourage crop diversification and raise farmers' incomes throughout Uttar Pradesh, policy support in the form of improved rural infrastructure and suitable technologies is required.

In their article, Malik and Singh (2022) examined agricultural diversification in the state of Haryana at the district level. The researchers examined the degree of crop diversification in various Haryana districts between 1980–1981 and 1996–1997 using two metrics: the Crop Diversification Index (CDI) and the Entropy Index (EI). According to the study, districts in Ambala and Mohindergarh had declining CDI between 1990 and 1991, which suggested a shift toward specialization. However, this trend eventually reversed. Additionally, the CDI increased in Kurukshetra, Sonapat, Rohtak, Gurgaon, Faridabad, and Bhiwani districts, indicating a shift towards more lucrative crops. The findings of the Entropy Index revealed a similar trend, with districts in Ambala and Mohindergarh first displaying less variety and then subsequently showing more. Whereas, districts like Kaithal, Karnal, Panipat, Rewari, Jind, Hisar, and Sirsa saw a drop in Entropy Index, a sign of less diversification. According to the data, some districts had a higher level of agricultural diversity than others because of their closeness to Delhi, the availability of marketplaces, and the rising demand for high-value commodities like fruits, vegetables, and flowers.

Objectives

1. To find out the extent of crop diversification in Major Agricultural States of India.
2. To understand the trend, pattern and stability of area under cultivation for food crops and cash crops in Major Agricultural States of India.

Methodology

The research will be conducted with the help of secondary data from various Government sources and reports such as Agriculture Statistics at a Glance 2022 and database of Directorate of Economics and Statistics, Government of India. Tabular analysis was carried out to depict the magnitude of diversification in India. In order to study the extent or magnitude of diversification, diversification index was used which is coherent and easily comprehensible. For finding the magnitude of diversification within crops two statistical tools namely the Herfindahl Index and Simpson's Index was applied in this study. Two different indexes were tested for establishing consistency in the study. The calculation for both these indexes was rendered using spreadsheet. In order to find the trend and stability of area under cultivation for two categories of crop (food crops and cash crops), mean and coefficient of variation have been utilized.

Crop Diversification in Major Agricultural States

For measuring the magnitude of crop diversification among the major agricultural states of India we have used two methods namely the Herfindahl-Hirschman's Index (HHI) and the Simpson's Index of Diversification (SID), henceforth HHI and SID respectively. The HHI index is defined as a sum of squares of all 'n' proportions (Saha, 2013). Since the value of the Index lies from '0' to '1', values nearer to '0' means more diversification and values away from, '0' means lesser diversification. The HHI index was calculated using equation (1).

$$HHI = \sum_{i=1}^n p_i^2 \quad (1)$$

Where, $P_i = \frac{x_i}{\sum x_i}$

Here,

p_i denotes the proportion of the i^{th} crop/crop sector in the gross cropped area. The diversification index ranges between 0 and 1, with lower values indicating a high degree of diversification and vice-versa.

A measure of diversity or concentration within a dataset is the Simpson's Index of Diversification (SID), sometimes known as the Simpson's Diversity Index or just Simpson's Index. Simpson's Index of Diversification is formulated from the Herfindahl-Hirschman's Index. The formula for Simpson's Index of diversification is given below in equation (2).

$$SID = 1 - \sum_{i=1}^n p_i^2 \quad (2)$$

Where, $P_i = \frac{x_i}{\sum x_i}$

Here,

p_i denotes the proportion of the i^{th} crop/crop sector in the gross cropped area. A numerical value between 0 and 1 is provided by the index; higher values denote greater diversity and vice-versa which is completely opposite of Herfindahl-Hirschman's Index.

Table 1: Herfindahl-Hirschman's Index (HHI) Depicting Crop Diversification for Major Agricultural States of India

Year	Major Agricultural States									
	Andhra Pradesh	Bihar	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Tamil Nadu	Uttar Pradesh	West Bengal
2012-13	0.1569	0.5141	0.2859	0.0897	0.1778	0.1316	0.4136	0.3264	0.2410	0.1986
2013-14	0.1738	0.5142	0.2846	0.0851	0.1860	0.1296	0.4173	0.2396	0.2440	0.1908
2014-15	0.1677	0.5245	0.2947	0.0848	0.1706	0.1308	0.4214	0.2276	0.2430	0.1897
2015-16	0.1443	0.5218	0.2942	0.0887	0.1628	0.1332	0.4285	0.2458	0.2479	0.1793
2016-17	0.1491	0.4843	0.2882	0.0880	0.1533	0.1274	0.4351	0.2280	0.2411	0.1792
2017-18	0.1486	0.5008	0.2584	0.0878	0.1430	0.1290	0.4348	0.1200	0.2447	0.1818
2018-19	0.1460	0.5065	0.2580	0.0953	0.1770	0.1365	0.4388	0.1248	0.2438	0.1817
2019-20	0.1561	0.5150	0.2579	0.0942	0.2089	0.1345	0.4408	0.1191	0.2420	0.1671
2020-21	0.2112	0.5264	0.2567	0.0974	0.2030	0.1336	0.4454	0.1229	0.2355	0.1685
2021-22	0.2062	0.5257	0.2478	0.0996	0.1892	0.1337	0.4428	0.1217	0.2256	0.1697

Source: Authors' own calculation using data collected from Directorate of Economics and Statistics, GoI

Table 2: Simpson's Index of Diversification (SID) depicting Crop Diversification for Major Agricultural States of India

Year	Major Agricultural States									
	Andhra Pradesh	Bihar	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Tamil Nadu	Uttar Pradesh	West Bengal
2012-13	0.8431	0.4859	0.7141	0.9103	0.8222	0.8684	0.5864	0.6736	0.7590	0.8014
2013-14	0.8262	0.4858	0.7154	0.9149	0.8140	0.8704	0.5827	0.7604	0.7560	0.8092
2014-15	0.8323	0.4755	0.7053	0.9152	0.8294	0.8692	0.5786	0.7724	0.7570	0.8103
2015-16	0.8557	0.4782	0.7058	0.9113	0.8372	0.8668	0.5715	0.7542	0.7521	0.8207
2016-17	0.8509	0.5157	0.7118	0.9120	0.8467	0.8726	0.5649	0.7720	0.7589	0.8208
2017-18	0.8514	0.4992	0.7416	0.9122	0.8570	0.8710	0.5652	0.8800	0.7553	0.8182

2018-19	0.8540	0.4935	0.7420	0.9047	0.8230	0.8635	0.5612	0.8752	0.7562	0.8183
2019-20	0.8439	0.4850	0.7421	0.9058	0.7911	0.8655	0.5592	0.8809	0.7580	0.8329
2020-21	0.7888	0.4736	0.7433	0.9026	0.7970	0.8664	0.5546	0.8771	0.7645	0.8315
2021-22	0.7938	0.4743	0.7522	0.9004	0.8108	0.8663	0.5572	0.8783	0.7744	0.8303

Source: Authors' own calculation using data collected from Directorate of Economics and Statistics, GoI

From the above two tables we get the extent or magnitude of crop diversification in the major agricultural states of India. The HHI values are nearer to '0' for states like Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and West Bengal which indicates more diverse crop cultivation. However, for Bihar, Uttar Pradesh, Haryana and Punjab the diversification is less compared to the former states. The SID values corroborates the results of HHI where Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and West Bengal showing higher diversification of crops. Whereas, the SID values for Bihar, Haryana, Punjab and Uttar Pradesh indicates lesser diversification. For the state of Tamil Nadu the pattern is unique as the crop diversification increased significantly during the period of study. Initially in 2012-13 the HHI and SID values are 0.33 and 0.67 respectively. However, in 2021-22 the HHI changed to 0.12 and SID increased to 0.88 which indicates higher diversification.

Trend, Pattern and Stability of Area under Cultivation in Major Agricultural States

In this section, the trend and stability of the area under cultivation for the two categories of crops (food crops and cash crops) is analysed using simple statistical methods such as mean and coefficient of variation. Table 3 below furnishes the mean and standard deviation and coefficient of variation of food crops and cash crops of the ten major agricultural states. Figure 1 depicts the mean area cultivated under food crops for all major agricultural states. Figure 2 depicts the mean area cultivated under cash crops for the ten major agricultural states of India. The mean area under food crops during the period of study (2012-13 to 2021-22) is higher than the mean area under cash crops in most of these states except Maharashtra and West Bengal. One can infer that most of the major agricultural states concentrate on the cultivation of traditional crops such as wheat, rice, maize and pulses rather than cash crops such sugarcane, potato, oilseeds, etc. However, Maharashtra and West Bengal contradict the other states as their mean area under food crops is lower than mean area under cash crops. The mean area under food crops for Maharashtra and West Bengal is 7.63 million hectares and 0.66 million hectares respectively. Whereas, the mean area under cash crops is 8.56 million hectares for the former and 1.53 million hectares for the latter. The coefficient of variation for the area under food crops is comparatively higher for Madhya Pradesh, Tamil Nadu and West Bengal. This would mean that there existed some kind of instability in the area cultivated under food crops among these three states during the period 2012-13 to 2021-22. Moreover, if we refer to table 1 or 2, it can be seen that diversification is higher in these three states. So one of the factors for higher instability or inconsistency in the area cultivated under food crops could be that instead of concentrating only in food crops the farmers of these three states diversified their cultivation towards cash crops. The coefficient of variation for area under cash crops is high for Andhra Pradesh, Bihar, Haryana and Punjab. So it can be said that there is inconsistency in the cultivation of cash crops among these states where coefficient of variation was high during the period of study. By referring to earlier table 1 and 2, it is observed that except for Andhra Pradesh the diversification of cultivation is low in Bihar, Haryana and Punjab. Thus, the instability of area under cultivation for cash crops may be explained by the factor that instead of diversifying towards cash crops the farmers of these three states emphasized on the cultivation of traditional food crops like wheat, maize, barley, pulses, etc.

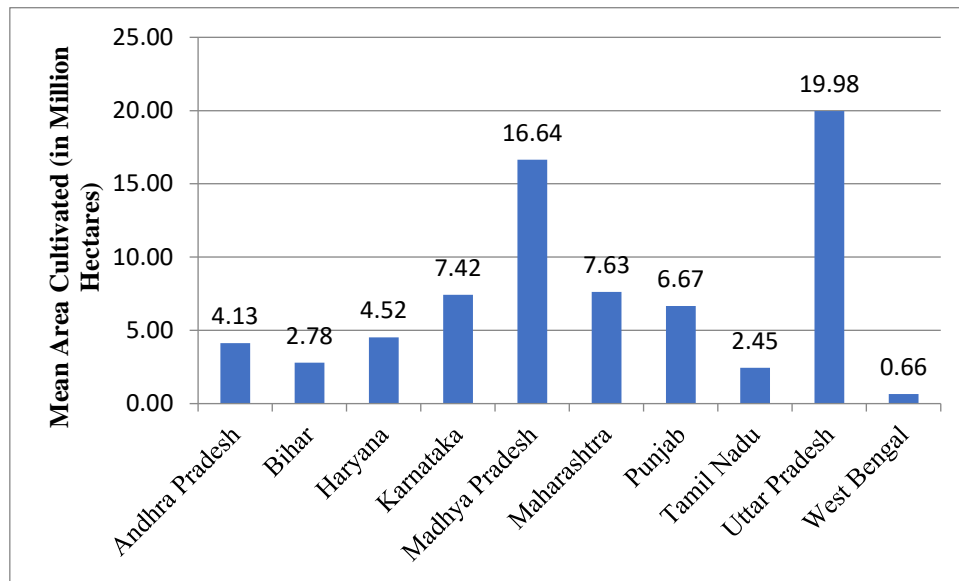
Table 3: Trend, Pattern and Stability of Area under food crops and cash crops cultivation for major agricultural states from 2012-13 to 2021-22

Sl. No.	State	Total Food Crops			Total Cash Crops		
		Mean (Million Hectares)	Standard Deviation (Million Hectares)	Coefficient of Variation	Mean (Million Hectares)	Standard Deviation (Million Hectares)	Coefficient of Variation
1	Andhra Pradesh	4.13	0.12	2.88	1.91	0.46	24.23
2	Bihar	2.78	0.05	1.77	0.27	0.03	10.80
3	Haryana	4.52	0.11	2.48	1.31	0.19	14.54
4	Karnataka	7.42	0.34	4.62	2.04	0.16	7.93
5	Madhya Pradesh	16.64	2.33	14.00	7.66	0.62	8.04
6	Maharashtra	7.63	0.54	7.10	8.56	0.43	5.01
7	Punjab	6.67	0.12	1.73	0.40	0.09	22.67
8	Tamil Nadu	2.45	0.77	31.67	0.59	0.05	8.95
9	Uttar Pradesh	19.98	0.47	2.35	4.21	0.32	7.49

10	West Bengal	0.66	0.07	10.95	1.53	0.06	4.23
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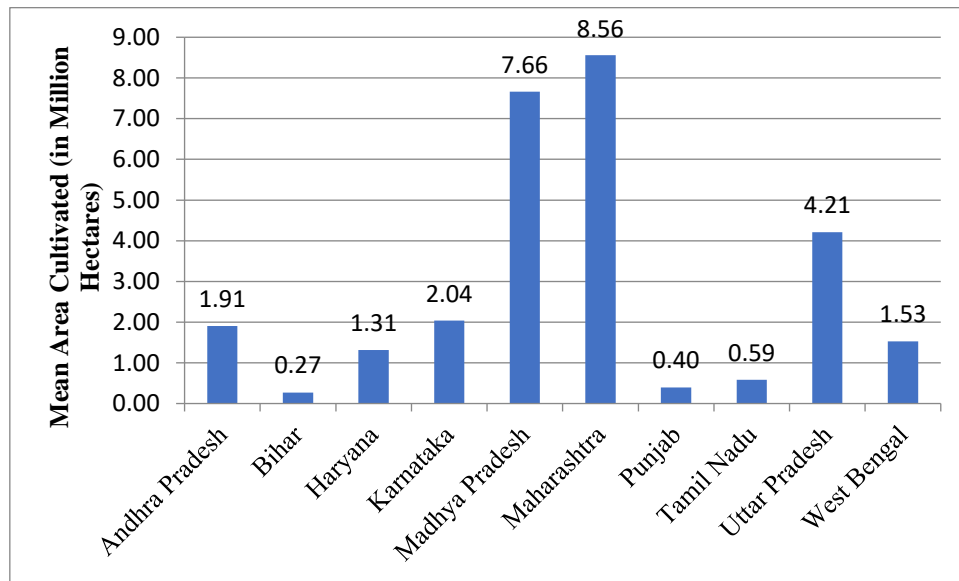
Source: Author's own calculation using data collected from Directorate of Economics and Statistics, GoI

Figure 1: Mean Area Cultivated under Food Crops in major Agricultural States of India



Source: Computed from Table 3

Figure 2: Mean Area Cultivated under Cash Crops in Major Agricultural States of India



Source: Computed from Table 3

Conclusion

Crop diversification in India has emerged as a key strategy for ensuring sustainable agricultural growth, enhancing farmer incomes, addressing ecological and nutritional challenges. There has been a shift from mono-cropping cultivation of traditional food grains to the inclusion of high-value crops such as fruits, vegetables, spices, and floriculture which reflects a response to change in both market demands and environmental necessities. Empirical evidence from this research during the period 2012 to 2022 for major agricultural states, supported by Herfindahl-Hirschman's Index and Simpson's Index of Diversification, indicates that states like Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, and West Bengal have embraced diversification more effectively, whereas states such as Bihar, Haryana, Punjab, and Uttar Pradesh remain relatively less diversified. Additionally, the data indicates a relationship between diversification and instability in the cultivated area, indicating that the shift from food crops to cash crops may be a contributing factor to the instability, especially in states with

greater levels of diversification. Conversely, states with less diversification exhibit instability in area under cash crop cultivation, pointing to inconsistent efforts in expanding beyond traditional staple food crops. The notable increase in crop diversification in Tamil Nadu over the research period highlights the possible advantages of focused policy changes and flexible agricultural methods. In India, crop diversity is ultimately a vital step towards ecological sustainability, climate resilience, and increased food security in addition to being a vehicle for economic advancement. Continued support through policy incentives, infrastructure development, and awareness programs will be essential to broaden and stabilize this transition across all states.

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