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CROP DIVERSIFICATION IN INDIA: A STATE LEVEL ANALYSIS

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ABSTRACT
India has witnessed a significant transformation in its cropping pattern over the past few decades. This has inevitably led to intensified cropping practices and a notable shift from traditional food crops towards more commercially viable alternatives. The data clearly illustrates a structural transformation within Indian's agriculture. The historical dominance of foodgrains has waned, giving way to an increased cultivation of high-value crops such as oilseeds, potatoes, and fruits & vegetable. Thus we observe that a few states, namely Bihar, Andhra Pradesh, Jammu &Kashmir, Gujarat, Sikkim, Tamin Nadu, Karnataka, Rajasthan Uttarakhand, Uttar Pradesh, WB, Madhya Pradesh, Nagaland and Mizoram moved from crop specialization to the moderate diversification or high diversification. Side by side some states, namely Assam, Chhattisgarh, Kerala, Odisha, Punjab, Tripura and Goa moved from crop diversification to the crop specialization due to their unfertile land, inadequate facilities of irrigation, infrastructural facilities and lack of awareness in respect of government policy and program.
KEYWORDS: *Cropping Pattern, Crop Diversification, Agricultural Credit, Road Density*

1.INTRODUCTION

The diversification of agriculture, characterized by a shift from traditional cereal and low-value crops to high-value cash crops that align with the comparative advantage of a region, has been widely recognized as a viable strategy to enhance agricultural sustainability and economic growth. This transition is suggested as a means to stabilize and increase farm incomes, create employment opportunities—particularly for small and marginal farmers—boost agricultural exports, and contribute to the conservation of natural resources and ecosystems (Pingali & Rosegrant, 1995; Chand, 1996; Vyas, 1996; Barghouti et al., 2004; Joshi et al., 2004; Sharma, 2005; Rao, Birthal & Joshi, 2006; Joshi et al., 2007; Birthal et al., 2015; Rao, Birthal & Joshi, 2016; Birthal, Hazrana & Negi, 2020).

High-value crops (HVCs), such as fruits, vegetables, spices, and medicinal plants, are significantly more remunerative than staple cereals (Joshi et al., 2004; Birthal et al., 2015). These crops not only yield higher returns per unit of land but also require intensive labor, making them particularly beneficial for farm households with a higher labor-to-land ratio (Birthal, Hazrana & Negi, 2020). Moreover, compared to cereal cultivation, horticulture offers substantial economic benefits, as it enhances land productivity and generates greater employment opportunities, both within agriculture and in associated sectors such as processing, packaging, and marketing (Joshi et al., 2004; World Bank, 2007).

The paper also examines the relationship among factors and crop diversification. At the state level, instrumental variable regression results show that crop diversification has a positive and statistically significant effect on agricultural output controlling for effects of other variables such as gross terms of trade, irrigation, cropping intensity, public capital expenditure, fertiliser use and agricultural credit. The study results have policy implications for promoting crop diversification that holds the key to sustain agricultural growth in the long run.

India has witnessed a significant transformation in its cropping pattern over the past few decades. Despite a largely constant net cultivated area, the escalating demand for food, fueled by a burgeoning population and rapid urbanization, has exerted considerable pressure on agricultural land. This has inevitably led to intensified cropping practices and a notable shift from traditional food crops towards more commercially viable alternatives. The data clearly illustrates a structural transformation within Indian's agriculture. The historical dominance of foodgrains has waned, giving way to an increased cultivation of high-value crops such as oilseeds, potatoes, and fruits & vegetable

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2. OBJECTIVES

To prepare Crop-Diversification index of various state in India from 1990-91 to 2023-24.
To analyze the factors that are responsible for change in cropping pattern in India during this period.

3. HYPOTHESES

i)There is significant change in the cropping pattern and Crop-Diversification across states over years.
ii) Economic, Institutional and Social factors explain significantly the change in cropping pattern in India during last four decades.

4. DATABASE AND METHODOLOGY

The primary objective of this study is to analyze the cropping pattern and crop diversification in India. To achieve this, we conduct a comparative analysis at both levels using secondary data. This study relies entirely on secondary data, which has been collected, examined, and analyzed to derive meaningful results and conclusions.
The secondary data on cropping patterns has been sourced from various government publications, including the *Statistical Abstract*, Hand book of statistics of Indian State, *National Horticultural Board*, and reports from the Ministry of Agriculture, Government of India, as well as the *Census of India*.

i) **Correlation and Regression**:- To analyze the relationships between factors, both correlation and regression analyses are employed as needed. A correlation matrix, based on the Pearson correlation coefficient, is constructed to examine the interrelationships among variables. Regression analysis, however, is the most crucial method for accurately estimating the relationship between dependent and independent variables. .

ii) **Crop Diversification Index (CDI)**

a) Entropy Index (EI) Entropy Index is regarded as an inverse measure of concentration having logarithmic character. This index has been widely used by many research workers to measure diversification (e.g., Hackbart and Anderson, 1975; Singh etal., 1985; Gupta and Tewari. 1985). Mathematically the Entropy Index is given as below.

$$EI = \sum_{i=1}^{N} P_i \log(p_i)$$

Where N is the total number of crops and Pi represents area proportion of the i-th crop in total cropped area. The index was first used to measure the regional concentration of. This index takes a value zero when there is complete concentration and approaches one when diversification is „perfect". Thus the Entropy Index is bounded by Zero and one. The upper bound of the index is log N. However, the upper limit of Entropy Index is determined by the base chosen for taking logarithms and the number of crops. The upper value of the index can exceed one, when the number of total crops is higher than the value of the logarithm's base, and it can be less than one when the number of crops is lower than the base of logarithm.

5. DISCUSSION AND RESULT

5.1 Changing Cropping Pattern in Indian States

India's agricultural landscape has undergone a profound transformation in its cropping pattern over the past few decades. Despite the net cultivated area remaining relatively constant, escalating food demand—driven by a rapidly growing population and urbanization—has placed immense pressure on agricultural land. This has necessitated intensified cropping practices and a shift from traditional food crops to more commercially viable alternatives. The data clearly illustrates a structural transition within Indian agriculture, reflecting evolving market dynamics, improved irrigation infrastructure, and targeted policy interventions aimed at fostering diversification.

Decline of Traditional Crops

Historically, Indian agriculture was dominated by food grains, but recent trends indicate a gradual decline in their cultivation. Notably, the area under rice cultivation, comprising the Aus, Aman, and Boro varieties, has contracted from 22.98% in 1980-81 to 21.81% in 2023-24. This decline can be attributed to the crop's vulnerability to monsoon variability, stagnating yields, and the expansion of more profitable alternatives.

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Percentage of area under paddy in all the states decreased except Andhra Pradesh, Haryana, Odisha, Punjab, Uttar Pradesh and Tamil Nadu. Mizoram, Nagaland, West Bengal and Goa states where percentage of area under Paddy rapidly declined during 1990-91 to 2023-24.(Table 1) During this period out of 28 states, 6 states, namely Andhra Pradesh, Haryana, Odisha, Punjab, Uttar Pradesh and Tamil Nadu showed a tendency to increasing specialization. Those states only depend on foodgrains cultivation. High level of rice concentration was noticed in Odisha(45.90% in 1990-91 to 81.06% in 2023-24) and Chhattisgarh(67.38% in 2023-24). Percentage of area under pulses in all the states decreased except Arunachal Pradesh, Assam Jharkhand, Meghalaya and Nagaland. The percentage of area under pulses witnessed robust increase in Jharkhand during 1990-91 to 2023-24

Pulses, a crucial protein source in the Indian diet, have experienced a significant drop in cultivated area—from 20.06 % in 1990-91 to 13% in 2023-24—despite recent policy measures aimed at increasing production. The decline suggests that pulses remain less remunerative for farmers compared to cash crops, necessitating sustained government interventions such as Minimum Support Prices (MSPs) and yield-enhancing research.

Rise of High-Value and Commercial Crops

In contrast to the decline in traditional food crops, high-value and commercial crops have gained significant traction. Oilseed cultivation has witnessed remarkable expansion, rising from 12.14% in 1990-91 to 14 % in 2023-24. This growth can be attributed to increasing domestic demand for edible oils, favorable price incentives, and the development of higher-yielding varieties. The government's focus on oilseed self-sufficiency, including initiatives like the National Mission on Edible Oils, has further supported this trend. The percentage of area under oilseeds witnessed robust increase in Madhya Pradesh, Maharashtra, Manipur, Haryana, Rajasthan and West Bengal during 1990-91 to 2023-24. Andhra Pradesh, Bihar, Jammu & Kashmir, Karnataka, Mizoram, Tamil Nadu and Sikkim states, where the percentage of areas under oil seeds, rapidly declined during this period.

Shifts in Fruits and Vegetable

Tea cultivation, a cornerstone of India's economy, has remained relatively stable, fluctuating between 1.2% and 1.5% over the years. Fruits & vegetables cultivation has seen a dramatic rise in various states like Andhra Pradesh (6% in 1990-91 to 15% in 2023-24) Bihar(10% to 18%) Jharkhand (10% to 24%) during the study period. This expansion has been facilitated by improvements in cold storage infrastructure, better market linkages, and increasing consumer demand, particularly from urban and processed food industries. Fruits and vegetables are highly profitable cultivation in India.

However, the once-dominant jute crop has witnessed a sharp decline, with its share falling from 0.61% in 1980-81 to 0.38% in 2023-24. This trend is largely due to the increasing availability and affordability of synthetic alternatives, which have significantly reduced the demand for natural jute fibers. Additionally, other fiber crops such as mesta and cotton have almost disappeared from the cropping system, likely due to similar competitive pressures and shifts in industrial demand.

Table 1 Percentage of Gross Cropped Area under Major Crops in States, 1990-91 to 2023-24

States	Paddy		Oilseeds		Pulses		Fruits & Vegetable	
	1990-91	2022-23	1990-91	2023-24	1990-91	2022-23	2001-02	2022-23
Andhra Pradesh	30.59	31.57	23.64	10.66	21.18	15.30	6.26	14.85
Arunachal Pradesh	49.31	40.00	8.58	10.70	2.23	4.02	25.16	9.53
Assam	65.41	57.46	8.38	7.96	2.98	3.57	8.74	11.62
Bihar	51.42	39.39	2.32	1.56	19.94	5.97	10.78	17.77
Chhattisgarh	-	67.38	00	2.34	0.00	11.18	2.12	12.82
Goa	35.20	21.88	0.46	0.07	0.00	2.50	4.17	7.64
Gujarat	5.02	6.77	25.66	22.92	11.78	9.37	3.55	8.71
Haryana	11.17	22.86	8.22	11.84	13.03	1.63	2.88	6.19
Himachal Pradesh	8.63	7.59	1.83	1.22	6.97	3.25	26.95	37.22
Jammu & Kashmir	24.99	24.21	6.38	4.03	7.05	1.60	17.45	37.69
Jharkhand	0.00	49.58	0	17.48	0.00	29.22	10.35	24.30
Karnataka	9.98	8.96	21.69	8.48	20.08	19.07	5.27	5.45

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Kerala	18.52	7.62	0.79	0.02	1.61	0.06	11.66	16.23
Madhya Pradesh	21.43	11.34	16.65	25.72	29.78	18.67	0.96	5.41
Maharashtra	7.23	6.77	13.02	20.70	21.72	19.68	4.69	7.43
Manipur	78.31	48.80	1.29	10.21	0.00	8.43	16.99	21.31
Meghalaya	43.21	32.67	3.75	4.36	1.33	2.58	21.47	27.42
Mizoram	60.35	16.55	7.06	2.18	4.71	1.80	28.35	52.62
Nagaland	60.38	44.82	7.11	7.71	6.45	6.99	13.57	16.45
Odisha	45.90	81.06	11.88	2.94	36.76	17.24	9.87	21.36
Punjab	26.98	37.27	1.53	0.71	2.91	0.39	2.17	5.13
Rajasthan	0.62	0.83	15.89	22.81	28.73	19.52	0.58	0.98
Sikkim	12.48	5.90	9.06	3.74	16.24	3.74	21.54	29.06
Tamil Nadu	27.98	33.63	17.31	6.46	22.53	12.32	7.09	10.84
Tripura	59.18	49.86	3.11	2.74	3.69	4.29	21.29	24.91
Uttar Pradesh	22.04	20.89	6.63	5.71	17.02	9.76	4.19	6.87
Uttarakhand	0.00	26.72	--	3.28	0.00	6.65	23.86	16.86
West Bengal	67.10	50.78	5.92	10.05	6.86	4.58	13.16	19.09
ALL INDIA	22.98	21.81	12.14	13.79	20.06	13.18	5.41	8.36

Source: Hand book of Statistics Indian State(RBI)

5.2 Crop Diversification Index

The crop diversification index for India consistent increased over the years. It rose from 0.57 in 1990-91 to 0.69 in 2023-24. Crop diversification in South Asia agricultural diversification in favour of high-value commodities took place on account of rising per capita income, changing food consumption pattern, increasing urbanization and development of infrastructure, including roads, the speed of agricultural diversification was however slow in most of South Asian countries, Joshi, et al. (2003)

Andhra Pradesh, Gujarat, Jammu & Kashmir, Haryana, Karnataka, Maharashtra, Nagaland Sikkim, Tamil Nadu and Uttar Pradesh states recorded higher value of crop-diversification index (above 0.60) than other states in 1990-91. This value for states like Arunachal Pradesh, Bihar, Himachal Pradesh, Madhya Pradesh ,Meghalaya, Mizoram, Rajasthan, Uttarakhand,and West Bengal was above 0.50 in 1990-91. Assam, Chhattisgarh.Goa, Jharkhand, Kerala.Manipur, Odisha, Punjab and Tripura states registered lowest the DI (<0.50) in 1990-91. Diversification index of all the states except Tripura and Goa increased during 1990-91 to 2023-24. Over time, more states have moved from low and moderate diversification towards high and very high diversification, indicating a growing diversification of economic activities across states. The number of states with low diversification has significantly decreased from 1990-91 to 2023-24. The very high diversification category expanded from zero states (1990-91) to 14 states (2023-24), showing a significant improvement in sectoral diversity. Five states, namely Andhra Pradesh, Maharashtra, Sikkim, Rajasthan and Tamil Nadu belonged to the very high category of diversification in 2000-01 and in 2023-24 they retained their position.(Table 2)

Thus we observe that a few states, namely Bihar, Andhra Pradesh, Jammu &Kashmir, Gujarat, Sikkim, Tamin Nadu, Karnataka, Rajasthan Uttarakhand, Uttar Pradesh, WB, Madhya Pradesh, Nagaland and Mizoram moved from crop specialization to the moderate diversification or high diversification. Side by side some states, namely Assam, Chhattisgarh, Kerala, Odisha, Punjab, Tripura and Goa moved from crop diversification to the crop specialization due to their unfertile land, inadequate facilities of irrigation, infrastructural facilities and lack of awareness in respect of government policy and program.

During 1990-91 to 2023-24 Bihar, Andhra Pradesh, Jammu &Kashmir, Gujarat, Sikkim, Tamil Nadu, Karnataka, Rajasthan and Uttarakhand states changed their position in respect of crop diversification. These states got converted and belonged to the moderate diversification group. In 2000-01 five states, namely Andhra Pradesh, Maharashtra, Sikkim, Rajasthan,Tamil Nadu belonged to the high diversification group. But in 2023-24 fourteen states, belonged to this group. The increasing number of states with high and very high diversification suggests that India's economic landscape has become more diversified over the past three decades, with states reducing their reliance on specific crops or industries and expanding into multiple sectors.

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Table 2 Crop Diversification Index (Entropy Index) in states,1990-91 to 2023-24

States	1990-91	2000-01	2005-06	2010-11	2015-16	2023-24
Arunachal Pradesh	0.60	0.64	0.65	0.67	0.65	0.63
Assam	0.39	0.45	0.42	0.48	0.51	0.53
Andhra Pradesh	0.66	0.74	0.76	0.75	0.80	0.81
Bihar	0.56	0.65	0.67	0.69	0.69	0.71
Chhattisgarh	0.35	0.42	0.47	0.52	0.54	0.56
Gujarat	0.61	0.70	0.80	0.82	0.85	0.87
Goa	0.38	0.43	0.45	0.48	0.44	0.44
Jharkhand	0.39	0.43	0.53	0.66	0.65	0.66
Jammu &Kashmir	0.62	0.68	0.64	0.65	0.71	0.75
Haryana	0.63	0.66	0.72	0.71	0.69	0.69
Himachal Pradesh	0.58	0.64	0.63	0.66	0.67	0.68
Kerala	0.50	0.57	0.54	0.56	0.58	0.61
Karnataka	0.63	0.75	0.74	0.79	0.77	0.80
Manipur	0.41	0.47	0.48	0.63	0.65	0.70
Maharashtra	0.63	0.72	0.78	0.80	0.80	0.82
Madhya Pradesh	0.59	0.69	0.71	0.66	0.70	0.74
Meghalaya	0.57	0.64	0.66	0.62	0.65	0.68
Mizoram	0.60	0.62	0.65	0.70	0.68	0.72
Nagaland	0.62	0.66	0.63	0.67	0.69	0.73
Odisha	0.43	0.49	0.52	0.54	0.54	0.58
Punjab	0.45	0.52	0.50	0.49	0.48	0.53
Rajasthan	0.56	0.64	0.62	0.63	0.68	0.71
Sikkim	0.68	0.74	0.74	0.76	0.71	0.72
Tamil Nadu	0.70	0.71	0.73	0.75	0.74	0.77
Tripura	0.36	0.42	0.40	0.39	0.48	0.49
Uttarakhand	0.60	0.65	0.72	0.74	0.76	0.79
Uttar Pradesh	0.66	0.68	0.69	0.66	0.72	0.72
West Bengal	0.55	0.56	0.57	0.60	0.67	0.71
India	0.57	0.62	0.63	0.66	0.67	0.69

Source: Hand book of Statistics Indian State(RBI)

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Table 03 Distribution of States by Crop-Diversification index, 1990-91 to 2023-24

Diversification Index Categories	Range of Diversification Index	1990-91 (States)	2000-01	2010-11	2023-24
Low	Less than 0.50	Assam, Chhattisgarh Goa, Jharkhand, Kerala Manipur, Odisha, Punjab, Tripura (Total = 09)	Assam, Chhattisgarh Goa, Jharkhand, Manipur, Odisha, , Tripura (Total = 07)	Tripura, Goa, Punjab, Assam, (Total = 04)	Tripura, Goa, (Total = 02)
Moderate	0.51 – 0.60	Arunachal Pra, Bihar, Himachal Pra.,Madhya Pra,Meghalaya,Mizoram, Rajasthan, Uttarakhand, West Bengal (Total= 09)	Kerala, Punjab, , West Bengal (Total = 03)	Odisha, Chhattisgarh, Kerala, West Bengal (Total = 04)	Assam, Chhattisgarh, Kerala, Odisha, Punjab (Total = 05)
High	0.61 – 0.70	AndhraPradesh, Gujarat Jammu&Kashmir, Haryana, Karnataka, Maharashtra, Nagaland Sikkim, Tamil Nadu, Uttar Pradesh (Total = 10)	Gujarat Arunachal Pra. Bihar, Jammu &Kashmir, Haryana, Himachal Pra Karnataka, , Madhya Pra, Nagaland Mizoram, Meghalaya, UttarPradesh, Uttarakhand (Total = 13)	Arunachal Pra. Bihar, Jammu &Kashmir, Jharkhand, Manipur, Himachal Pra, Madhya Pra, Nagaland, Mizoram, Meghalaya, Rajasthan UttarPradesh, (Total = 12)	Arunachal Pra. Jharkhand, Haryana, Kerala, Manipur, Meghalaya, Himachal Pra (Total = 07)
Very High	0.71 and above	Total = 0	Andhra Pra, Maharashtra, Sikkim, Rajasthan,Tamil Nadu (Total = 05)	Haryana, Andhra Pra Gujarat, Karnataka, Maharashtra, Sikkim,Tamil Nadu, Uttarakhand (Total = 08)	Bihar, Andhra Pra, Jammu &Kashmir, Gujarat, Sikkim, TN Karnataka, Rajasthan Uttarakhand, Uttar Pradesh, WB, Madhya Pra, Nagaland, Mizoram (Total =14)

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Figure 1 Crop Diversification Index in states, 1990-91

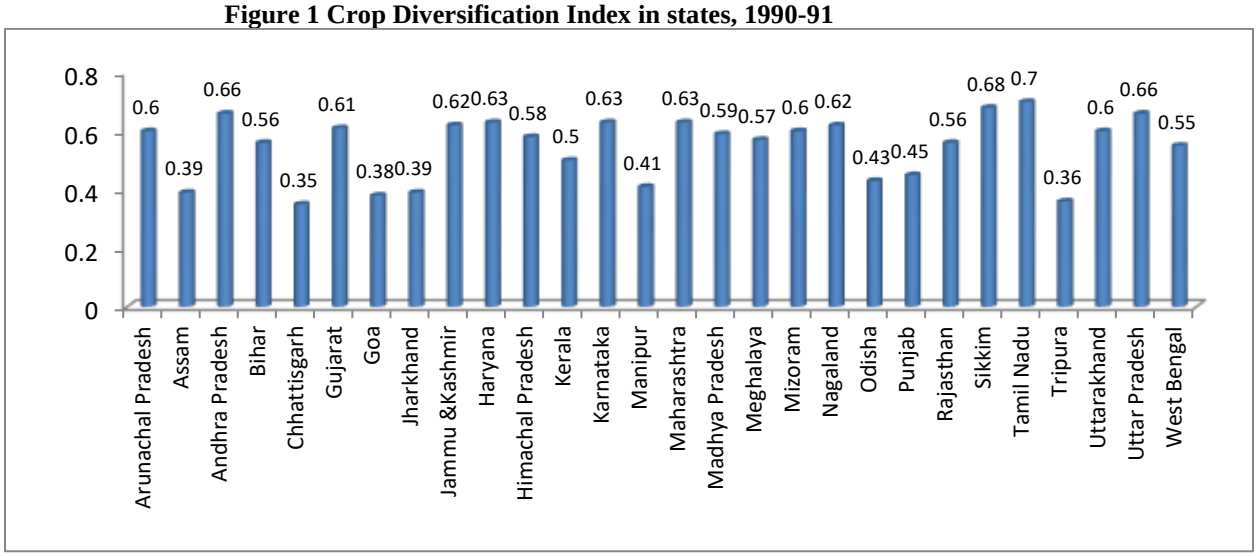
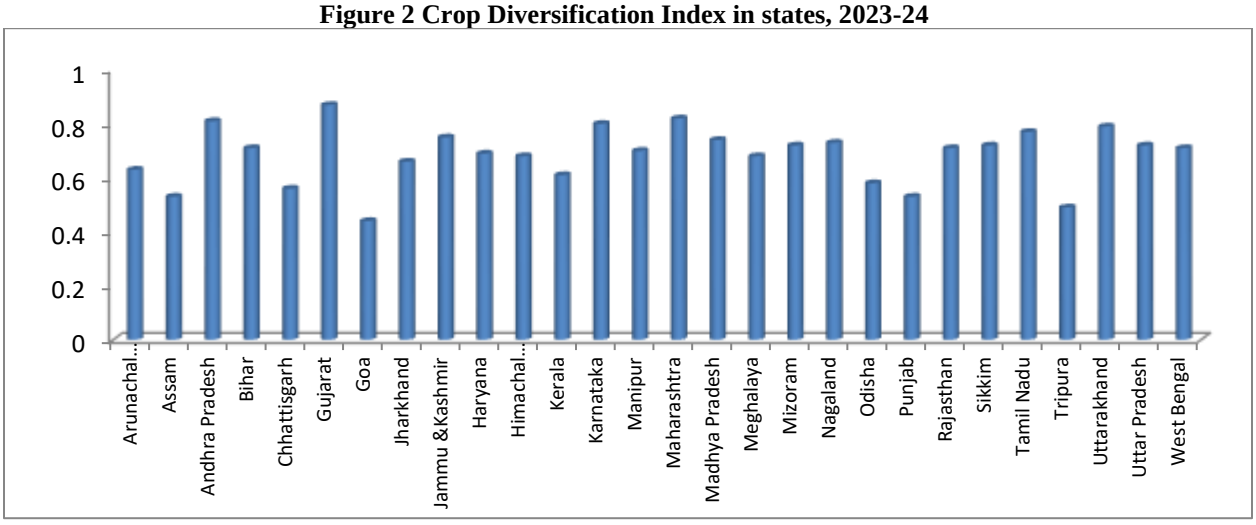


Figure 2 Crop Diversification Index in states, 2023-24



5.3 Factors Influencing Crop Diversification

It is noted that the basic infrastructure is required for the development of agriculture in India across space and time. Irrigation is one of the prime factors for the improvement of agricultural productivity. To examine the forces which influence the diversification in favour of high valued crops in the country a number of explanatory variables are studied. Large-scale irrigation comes from various canals constructed over the years and that helps farmers diversifying their cultivation towards more remunerative crops like potato, oilseeds and to adopt cultivation of summer paddy which is totally irrigation-intensive. the Simpson index and concentration of non-food crops, on several possible factors such as income, land distribution, irrigation intensity, institutional credit, road density, urbanization and market penetration, Jha, et al. (2009)

The development of agriculture in India has been fundamentally dependent on the availability and improvement of basic infrastructure over space and time. Among the various infrastructural elements, irrigation stands out as a crucial factor in enhancing agricultural productivity. The availability of large-scale irrigation, primarily through an extensive network of canals constructed over the years, has played a pivotal role in transforming the agricultural landscape. This has enabled farmers to diversify their cultivation towards high-value and more remunerative crops such as potatoes and oilseeds, as well as to adopt summer paddy cultivation, which is entirely dependent on irrigation. To understand the key drivers influencing crop diversification in India, several explanatory variables have been examined. These

include infrastructural factors such as the percentage of gross irrigated area (PGIA), road density (RD), and agricultural credit (AC), along with technological factors such as fertilizer use per hectare (FUPH). Each of these factors has played a significant role in shaping the cropping patterns in the state.

Irrigation is one of the primary determinants of crop diversification in states. The expansion of irrigation facilities has facilitated the transition from traditional cereal-based farming to more profitable crop choices. The availability of water through canals and other irrigation sources has allowed farmers to shift towards high-value crops, thereby improving overall farm income and productivity.

The use of chemical fertilizers has played a crucial role in transforming agricultural productivity and diversification over the years. From 1990-91 to 2023-24, the per-hectare fertilizer application has witnessed a significant rise, increasing from 102 kg to 175 kg. This substantial growth has led to improved soil fertility and higher crop yields, enabling farmers to transition toward nutrient-intensive and high-value crops. Chemical fertilizers supply essential nutrients like nitrogen (N), phosphorus (P), and potassium (K), which accelerate plant growth and enhance resistance to pests and diseases. As a result, farmers have been able to optimize their land use, expand crop varieties, and meet the growing demand for food, fiber, and biofuels. Additionally, the widespread adoption of fertilizers has contributed to global food security by ensuring stable and increased agricultural outputs.

Road density (RD) is another crucial factor influencing the cropping pattern in India. Defined as the total road length per unit of geographical area, road density plays a vital role in improving market access, reducing transportation costs, and facilitating the movement of agricultural inputs and outputs. The correlation between road density and crop diversification is evident, as better connectivity encourages farmers to cultivate perishable, high-value crops that require efficient supply chain management. Over the years, road density in India has seen remarkable growth, this expansion has significantly contributed to agricultural transformation by improving access to markets, enabling timely delivery of agricultural inputs, and promoting commercialization of farming.

The availability of agricultural credit has played a crucial role in promoting crop diversification in Indian states. Access to credit empowers farmers by providing them with the financial resources needed to invest in modern agricultural practices, high-yield crop varieties, mechanization, and improved irrigation techniques. Institutional credit, in particular, reduces financial constraints, enabling farmers to adopt innovative and diversified cropping patterns that enhance productivity and profitability. A strong positive correlation exists between agricultural credit and the diversification index in Indian states. When farmers have access to reliable credit, they are more willing to take calculated risks, moving away from a heavy dependence on traditional staple crops and exploring more lucrative and resilient alternatives. This shift not only improves farm incomes but also strengthens the overall agricultural sector by mitigating the risks associated with mono-cropping and climate variability.

This study examines the extent to which fluctuations in the Diversification Index (DI) of states can be explained by variations in key economic and infrastructural factors, specifically the share of Fertilizer use per hectare (FUPH), road density (RD), and Percentage of Gross Irrigated area (PGIA) and Agricultural Credit (AC). As presented in Table 4 & 5, the results indicate that between 1990-91 and 2023-24, DI variation is primarily driven by FUPH, RD, AC and PGIA, which together account for 58% of the total variation. The coefficient of PGIA is statistically significant at the 10% level, while road density and agricultural credit exhibit even higher significance at the 5% level. Furthermore, the overall model demonstrates strong explanatory power, with an F-value of 7.67 in 1990-91.(Table-4)

In 2023-24, there are DI variation is primarily driven by FUPH, RD, AC and PGIA, which together account for 61% of the total variation. The coefficient of PGIA is statistically significant at the 10% level, while road density and agricultural credit exhibit even higher significance at the 5% level. Furthermore, the overall model demonstrates strong explanatory power, with an F-value of 8.45 (Table-5)

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Table 4 Percentage of Irrigated Area, Fertilizer Use Per Hectare, Agricultural Credit and Road Density in Relation to DI in Indian states 1990-91

Variables	*Coefficients*	*Standard Error*	*t-Value*	*P-Value*
Intercept	12.620	3.707	2.21	0.032**
Percentage of Gross Irrigated area(PGIA)	0.277	0.155	1.72	0.092*
Fertilizer use per hectare(kg/Ha)(FUPH)	0.048	0.061	0.79	0.445
Road density (km/sq.km)(RD)	2.323	1.194	2.12	0.050**
Agricultural Credit (Rs, in billion)(AC)	0.005	0.079	1.87	0.054*
Adj R-squared	0.56			
R Square	0.58			
Significant F-Value	7.67	Number of obs =	28	

, *** Indicates coefficient significant at 1 percent level ,
** Indicate coefficient significant at 5 percent level, *Indicates coefficient significant at10 percent level.

Table 5 Percentage of Irrigated Area, Fertilizer Use Per Hectare, Agricultural Credit and Road Density in Relation to DI in Indian states, 2023-24

Variables	*Coefficients*	*Standard Error*	*t-Value*	*P-Value*
Intercept	11.435	8.707	2.32	0.029**
Percentage of Gross Irrigated area(PGIA)	0.213	0.158	1.79	0.082*
Fertilizer use per hectare(kg/Ha)(FUPH)	0.045	0.060	0.79	0.465
Road density (km/sq.km)(RD)	2.325	1.196	2.09	0.050**
Agricultural Credit (Rs, in billion)(AC)	0.002	0.077	1.99	0.050**
Adj R-squared	0.59			
R Square	0.61			
Significant F-Value	8.45	Number of obs =	28	

, *** Indicates coefficient significant at 1 percent level ,
** Indicate coefficient significant at 5 percent level, *Indicates coefficient significant at10 percent level.

6. CONCLUSION

In summary, this paper examines changes in the cropping pattern within the agricultural landscape of India. The study analyzes crop diversification using the Entropy Index (EI) to assess shifts over time. The data highlights a structural transformation in India's agriculture, with a decline in foodgrain dominance and an increase in high-value crops like oilseeds, potatoes, and fruit & Vegetable**.** The shift towards Boro rice, increased oilseed production, and diversification into horticulture indicates a response to changing market dynamics, irrigation improvements, and policy interventions. However, the decline in wheat, pulses, and fibre crops suggests areas where further research and support may be needed to ensure balanced agricultural growth. This index measures the extent of crop diversification in agricultural land use. A higher value suggests a greater variety of crops being cultivated rather than focusing on a few dominant ones. The crop diversification index for India exhibited a consistent increase over the years.

The development of agriculture in India has been fundamentally dependent on the availability and improvement of basic infrastructure over space and time. Among the various infrastructural elements, irrigation stands out as a crucial factor in enhancing agricultural productivity. The availability of large-scale irrigation, primarily through an extensive network of canals constructed over the years, has played a pivotal role in transforming the agricultural landscape. This has enabled farmers to diversify their cultivation towards high-value and more remunerative crops such as potatoes and oilseeds, as well as to adopt summer paddy cultivation, which is entirely dependent on irrigation. To understand the key drivers influencing crop diversification in India, several explanatory variables have been examined. These include infrastructural factors such as the percentage of gross irrigated area (PGIA), road density (RD), and agricultural credit (AC), along with technological factors such as fertilizer use per hectare (FUPH). Each of these factors has played a significant role in shaping the cropping patterns in the state.

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