INTERNATIONAL RESEARCH JOURNAL OF HUMANITIES AND INTERDISCIPLINARY STUDIES
(Peer-reviewed, Refereed, Indexed & Open Access Journal)
DOI : 03.2021-11278686 ISSN : 2582-8568 IMPACT FACTOR : 8.031 (SJIF 2025)

Changing Cropping Pattern in India during the Last Forty Years

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DOI No. 03.2021-11278686 **DOI Link ::** https://doi-ds.org/doilink/06.2025-65758859/IRJHIS2506010

Abstract:

The cropping pattern and crop diversification in India have witnessed significant shifts over the past four decades, driven by economic, climatic, technological, and policy-related factors. This paper examines the trends, determinants, and implications of these changes from 1980-81 to 2023-24. It highlights the transition from traditional cereal-dominated agriculture to a more diversified system incorporating horticulture, pulses, oilseeds, and commercial crops. The study also explores the role of government policies, technological advancements, and climate change in shaping these transformations. In India have experienced an increasing trend in crop diversification over the years, 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 irrigated area (PIA), 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 country.

Keywords: *Cropping Pattern, crop diversification, agricultural credit, road density*

1. Introduction:

Agriculture remains a crucial sector of the Indian economy, contributing significantly to GDP and employment. Over the last four decades, cropping patterns have shifted due to various factors such as Green Revolution technologies, liberalization, government policies, climate change, and market demands. In West Bengal, these changes have been more pronounced due to the state's unique agro-climatic conditions and socio-economic factors. Crop diversification is of paramount importance in a developing economy like India in general and the state of West Bengal in particular. Change in the crop-mix over time within the crop growing sector is one of the basic characteristics of a progressive agricultural economy. Diversification within the 'crop sector' has been taking place in India in terms of a shift in area broadly from food-grain crops to non-food grain crops, especially after the mid-sixties (Pandey and Sharma, 1996; Vyas, 1996). During the decade of 1980s, non-food grain crops like potatoes, oilseeds and sugarcane have experienced quite high rate of growth in their

areas (Chand *et al*., 2008). With India achieving self-sufficiency in food grains production by late 1970s, there was a turnaround in policy towards diversification as a result of which the area under cereal crops started declining after 1983-84. From early1990s, diversification towards horticulture received a real boost.

The West Bengal Human Development Report (2004) also reports the increasing trend towards crop diversification in the state since 1985. It must be mentioned here that, following the all-India trend, diversification in favour of horticultural crops is also taking place in West Bengal since early 1990's. During 1990-91 to 2005-06, fruits and vegetables were grown in around 13 percent of cultivated areas in West Bengal, which is next only to Orissa which has a share of 15.37 percent of the same. Both in Orissa and West Bengal, the share of fruits and vegetables in the total value of agricultural output were around 46 percent during the same period (Chand *et al*., 2008).

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

2 Objectives:

i) To examine the nature of cropping pattern change over time in India during last forty years

ii) To prepare Crop-Diversification index of India last Forty years.

iii) To analyze the factors that are responsible for change in cropping pattern in India during the last four decades.

3. Hypotheses:

i) There is significant change in the cropping pattern and Crop-Diversification in India 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) Herfindahl Index (HI) Herfindahl Index (Pattayanayak, 2006) given below is computed by taking sum of squares of acreage proportion of each crop in the total cropped area. Mathematically, the index is given as below.

$$HI = \sum_{i=1}^{N} P_i^2$$

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 industries (Theil, 1967). With the increase in diversification, the Herfindahl Index would decrease. This index takes a value one when there is complete concentration and approaches zero when diversification is perfect. Thus the Herfindahl Index is bounded by Zero and one.

Transformed Herfindahl Index* Or *Crop Diversification Index

Since the Herfindahl Index is a measure of concentration, it was transformed by subtracting it from one,

$$\text{i.e. } (THI = 1 - HI \text{ or } THI = (1 - \sum_{i=1}^{N} P_i^2)$$

The transformed value of HI will avoid confusion to compare it with other indices. The value of transformed Herfindahl Index (1-HI) increases with the increase in diversification and assumes 0 (zero) value in case of perfect concentration i.e. when only one crop is cultivated.

5. Discussion and Result:

5.1 Changing Cropping Pattern in India 1980-81to 2023-24:

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 24.52% in 1980-81 to 21.74% 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. Similarly, wheat cultivation has seen only a marginal increase, from 13.78% in 1980-81 to 14.52% in 2023-24, despite technological advancements and yield improvements. The slow growth in wheat acreage could be linked to the rising profitability of alternative crops, regional unsuitability in certain states, and shifting consumer preferences towards diversified diets. Pulses, a crucial protein source in the Indian diet, have experienced a significant drop in cultivated area—from 14.16% in 1980-81 to 12.68% 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 1980-81 to 14.35% 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. Potato cultivation has seen a dramatic rise, increasing from 0.51% in 1980-81 to 9.78% in 2023-24. 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. Likewise, fruits and vegetables—a highly profitable segment—have experienced a substantial increase in their share, growing from 4.79% in 1990-91 to 8.65% in 2023-24. This surge reflects the growing consumer preference for diversified diets, improved export opportunities, and enhanced supply-chain logistics.

Shifts in Fiber and Plantation Crops:

Tea cultivation, a cornerstone of India's economy, has remained relatively stable, fluctuating between 1.2% and 1.5% over the years. 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

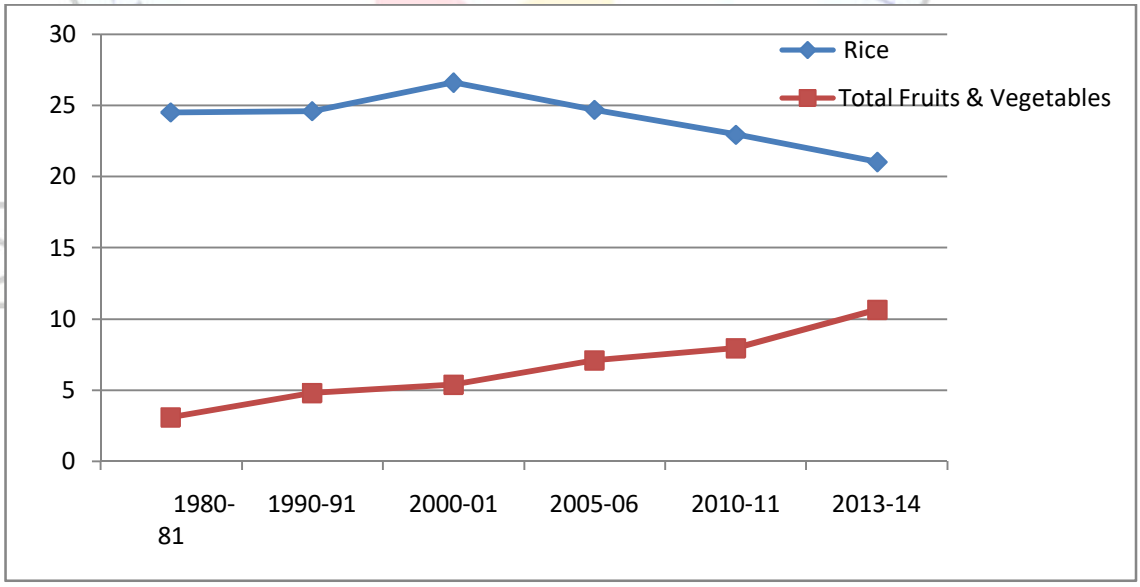
reduced the demand for natural jute fibers. Additionally, other fiber crops such as mesta and cotton have almost disappeared from the cropping system, likely due to similar competitive pressures and shifts in industrial demand.

Table 1 Percentage Share of Gross Cropped Area under Different Crops in India, 1980-81 to 2023-24

Crop	1980-81	1990-91	2000-01	2005-06	2010-11	2023-14
Rice	24.52	24.60	26.61	24.70	22.95	21.74
Total Pulses	14.16	14.21	12.11	12.67	14.15	12.68
Wheat	13.78	13.93	15.32	14.98	15.77	14.52
Total Foodgrains	73.59	73.67	72.02	68.81	67.82	60.45
Total Oilseeds	12.14	13.91	13.55	15.76	13.47	14.35
Total Fibers	0.61	0.58	0.62	0.53	0.49	0.38
Potato	0.51	0.60	0.72	0.79	1.01	9.78
Total Fruits & Vegetables		4.79	5.40	7.11	7.94	8.65

Source: Hand book of Statistics Indian State(RBI)

Figure 1 Trends of the Percentage Share of area under Rice and Fruits & Vegetable in India, 1980-81 to 2023-24



5.2 Crop Diversification of the Whole of India:

Crop diversification is a critical indicator of agricultural development, reflecting shifts in cropping patterns over time. Analyzing the trend in diversification provides insights into the adaptability of agriculture to economic, climatic, and policy-driven changes. This study evaluates the nature of crop diversification in West Bengal vis-à-vis the whole of India by constructing a crop diversification index and assessing the percentage of non-foodgrain area over different time periods. Agricultural diversification in favour of high-value crops and examined the role of small holders in India, Birthal, et al. (2007). West Bengal is gradually diversifying towards high value commodities, namely fruits and vegetables and flowers, Bhattacharyya (2008). 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.

It rose from 0.80 in 1995-96 to 0.82 in 2010-11 and further to 0.84 in 2021-22. 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)

This represents the proportion of total cultivated land that is used for growing non-foodgrain crops (such as oilseeds, fiber crops, sugarcane, and horticultural crops) instead of food grains (like rice, wheat, and pulses). The percentage increased over time, from 29.16% in 1995-96 to 35.75% in 2021-22, indicating a shift towards more diversified agricultural practices.

To further understand these trends, statistical measures such as mean, standard deviation, and coefficient of variation (CV) were analyzed: The average crop diversification index for India was 0.8239 The standard deviation of the index was for India 0.013, A similar statistical comparison of the percentage of area under non-foodgrains revealed: Mean Value of the percentage of non-foodgrain area in India was 31.75%. The CV of India was 0.080, further confirms greater fluctuations in the state's agricultural diversification.

Table 2 Crop Diversification Index and Percentage of Area under Non-foodgrains in India, 1990-91 to 2013-14

Years	Percentage of Area under Non-foodgrains	Crop diversification index
1995-96	29.16	0.8079
1996-97	29.06	0.8076

1997-98	28.59	0.8090
1998-99	28.99	0.8134
1999-00	28.40	0.8107
2000-01	27.95	0.8073
2001-02	28.39	0.8126
2002-03	28.72	0.8141
2003-04	28.13	0.8108
2004-05	31.10	0.8142
2005-06	31.19	0.8134
2006-07	30.92	0.8178
2007-08	31.64	0.8206
2008-09	32.01	0.8195
2009-10	32.32	0.8237
2010-11	32.17	0.8266
2011-12	33.24	0.8328
2012-13	34.20	0.8324
2013-14	33.92	0.8320
2014-15	33.87	0.8368
2015-16	34.54	0.8289
2016-17	34.80	0.8421
2017-18	33.67	0.8377
2018-19	34.45	0.8423
2029-20	34.85	0.8411
2020-21	35.17	0.8443
2021-22	35.75	0.8478
Mean	**31.75**	**0.8239**
SD	**2.59**	**0.013**
CV	**0.080**	**0.0001**

Sources: Statistical Appendix India & Hand book of Statistics Indian State(RBI

Figure 3 Trends of the Crop Diversification Index in India, 1995-96 to 2021-22

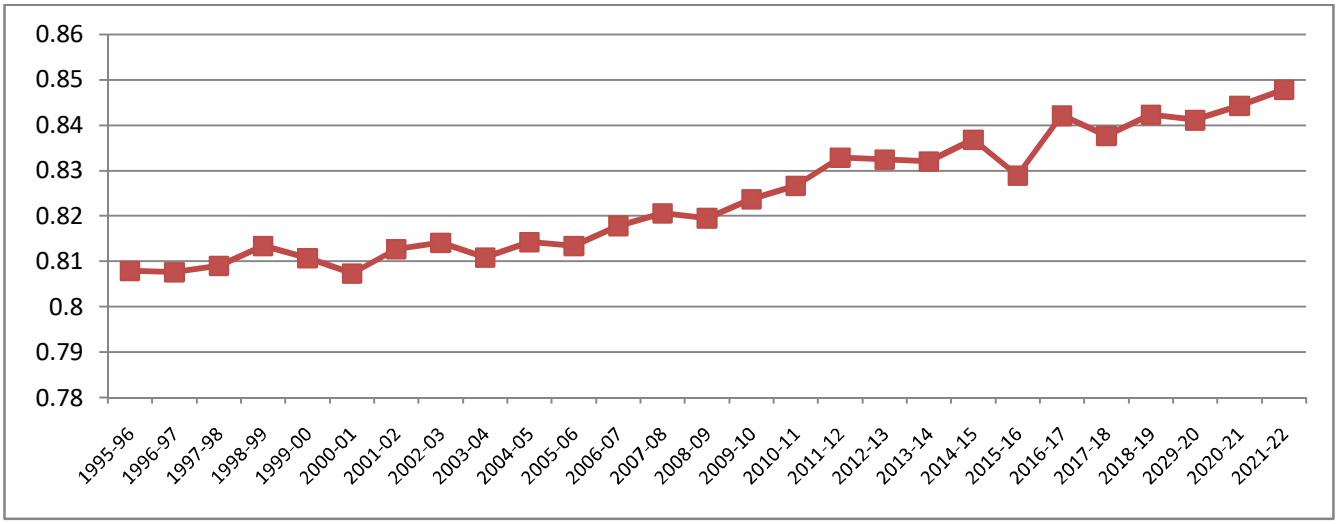
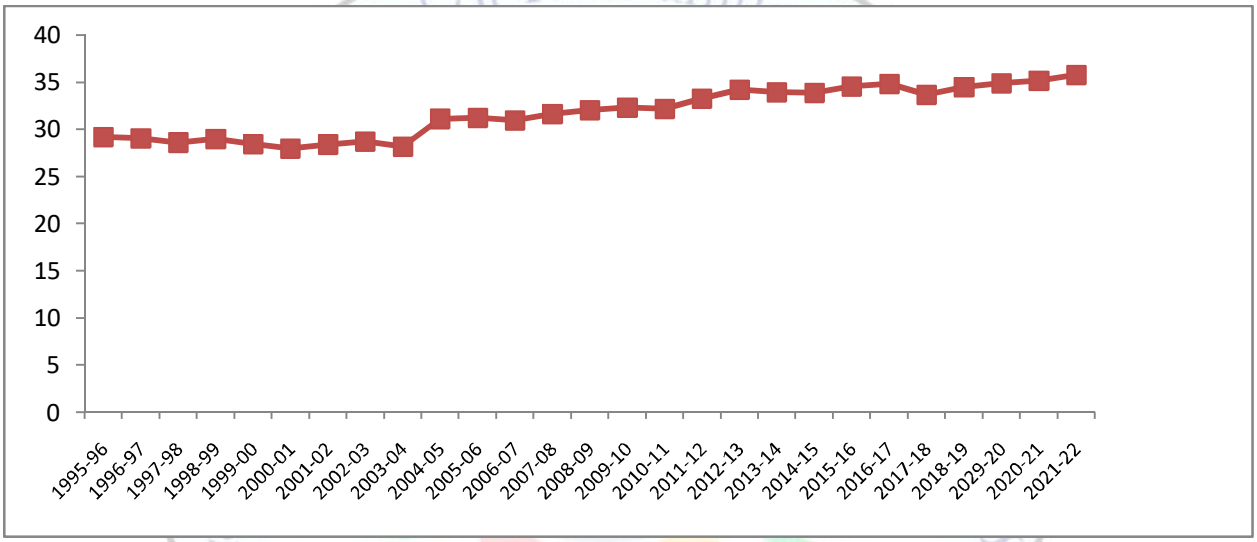


Figure 4 Trends of the Percentage Share of Non-foodgrains Area in India, 1995-96 to 2021-22



The Crop Diversification Index (DI) in India has grown at a CAGR of 0.18%**,** which is significantly higher. The percentage of land under non-foodgrains in India has increased at a CAGR of 0.76 %, outpacing the national growth rate of 0.76%. This indicates a substantial shift away from traditional foodgrain production towards cash crops, horticulture, and other high-value agricultural products.

Table 3 Compound Annual Growth Rate (CAGR) of DI and Percentage of Non-foodgrains area, 1995-96 to 2021-22

State/Country	Variable	CAGR	Level of Significant
India	**Crop diversification index**	0.18	1 per cent
	% of non-foodgrains area	0.76	1 per cent

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)

Infrastructure and Crop Diversification:

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 irrigated area (PIA), 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 and Crop Diversification:

Irrigation is one of the primary determinants of crop diversification in India. 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.

Role of Chemical Fertilizers to changing Cropping Pattern:

The use of chemical fertilizers has played a crucial role in transforming agricultural productivity and diversification over the years. From 1995-96 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 and Agricultural Growth:

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.

Agricultural Credit and Crop Diversification:

The availability of agricultural credit has played a crucial role in promoting crop diversification in India. 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 India. 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.

Over the years, the expansion of agricultural credit in India has been remarkable change. The total agricultural credit disbursed has increased significantly This substantial growth reflects the increasing institutional support for farmers and highlights the role of credit accessibility in transforming the agrarian landscape. With better financial backing, farmers are now able to integrate high-value crops,

This study examines the extent to which fluctuations in the Diversification Index (DI) 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). As presented in Table 5, the results indicate that between 1995-96 and 2023-24, DI variation is primarily driven by FUPH, RD, AC and PGIA, which together account for 71% of the total variation. The coefficient of FUPH is statistically significant at the 10% level, while road density and agricultural

credit exhibit even higher significance at the 1% level. Furthermore, the overall model demonstrates strong explanatory power, with an F-value of 60.23, reinforcing its robustness and reliability.

In addition to analyzing DI, we also investigate the determinants of changes in the percentage of the area under non-foodgrains (PNFA). Specifically, we assess the extent to which PNFA variations can be attributed to road density (RD) and percentage of irrigated area (PIA). As illustrated in Table 6, between 1995-96 and 2023-24, these four factors collectively explain 58% of the variation in PNFA. The coefficient of RD is statistically significant at the 5% level, The coefficient of AC is statistically significant at the 5% level, indicating its notable impact on land-use diversification. Moreover, the overall model is significant at the 5% level, with an F-value of 8.69, highlighting a moderate but meaningful relationship between the explanatory variables and PNFA trends.

These findings underscore the critical role of infrastructure, investment, and mechanization in shaping agricultural diversification and land-use patterns. The strong influence of FUPH and PGIA on DI suggests that technological advancement and financial support play a crucial role in diversifying agricultural activities. Similarly, the impact of RD, AC and PIA on PNFA highlights the importance of infrastructure and cropping patterns and land allocation.

Table 5 Percentage of Irrigated Area, Fertilizer Use Per Hectare, Agricultural Credit and Road Density in Relation to Diversification Index in India 1995-96 to 2023-24

Variables	***Coefficients***	***Standard Error***	***t-Value***	***P-Value***
Intercept	0.6744	0.0217	15.02	0.000***
Percentage of Gross Irrigated area(PGIA)	0.001	0.0004	2.45	0.021**
Fertilizer use per hectare(kg/Ha)(FUPH)	0.0001	0.0002	1.74	0.095**
Road density (km/sq.km)(RD)	0.0184	0.0031	4.23	0.000***
Agricultural Credit (Rs, in billion)(AC)	0.0002	0.0001	2.47	0.008***
Adj R-squared	0.70			
R Square	0.71			
Significant F-Value	60.23	*Number of obs = 29*		

Table 6 Percentage of Irrigated Area, Fertilizer Use Per Hectare, Agricultural Credit and Road Density in Relation to Percentage of non-foodgrains area (NFA) in India 1995-96 to 2023-24

Variables	*Coefficients*	*Standard Error*	*t-Value*	*P-Value*
Intercept	17.624	8.707	2.25	0.035**
Percentage of Gross Irrigated area(PGIA)	0.273	0.152	1.78	0.092*
Fertilizer use per hectare(kg/Ha)(FUPH)	0.045	0.060	0.79	0.444
Road density (km/sq.km)(RD)	2.325	1.196	2.09	0.050**
Agricultural Credit (Rs, in billion)(AC)	0.002	0.077	1.89	0.054*
Adj R-squared	0.53			
R Square	0.58			
Significant F-Value	8.69	Number of obs = 29		

, *** Indicates coefficient significant at 1 percent level ,

** Indicate coefficient significant at 5 percent level, *Indicates coefficient significant at 10 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 Transformed Herfindahl Index to assess shifts over time. Over the past forty years, key crops such as boro rice, potato, and oilseeds—particularly mustard—have gained prominence among farmers. However, in the last decade, some of the earlier cropping trends have re-emerged. 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 transformation of Indian's agricultural sector has been significantly influenced by

infrastructural and technological advancements. The expansion of irrigation, increased use of chemical fertilizers, improved road connectivity, and access to agricultural credit has collectively contributed to greater crop diversification. These factors have enabled farmers to shift towards high-value crops, thereby enhancing rural incomes and overall economic growth. Moving forward, continued investment in rural infrastructure, sustainable agricultural practices, and financial support mechanisms will be critical in ensuring the long-term viability and resilience of the state's agricultural sector.

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