



Diversified Cropping Pattern In Indian Agriculture: An Analysis Of Recent Trends

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Abstract: The paper has examined trends and patterns of crop diversification scenarios in India and at the Regional level from 2001-2023. The share area, Compound annual growth rates and Simpson Index of Diversification (SID) are used to assess the extent and speed of diversification among food crops, commercial crops and high-value crops. The study reveals that in India there is a gradual shift in the cropping pattern from foodgrains towards commercial crops and high-value crops. A similar trend is seen in most of the States barring a few of them. However, the transformation from foodgrains to high-value crops is not uniform among the States under reference which is reflected in SID. SID varies from 0.47 in Assam to 0.96 in Maharashtra. The Central and Southern states are relatively highly diversified in comparison with Northwestern and East & Northeastern states. CAGR for foodgrains was significantly low as compared to high-value crops and Commercial crops during the study period. The results indicate the movement of Indian Agriculture towards a more economical and ecologically sustainable agriculture without compromising the food security of the Nation.

IndexTerms: Crop diversification, Simpson Index of Diversification.

1.1 Introduction

For the Indian economy to thrive and develop sustainably, the agriculture and allied sectors will always remain paramount. Apart from fulfilling the dietary and nutritional needs of the 1.4 billion Indians, it also makes a substantial contribution to employment, production, and demand creation through backward and forward linkages leading to a multiplier effect on the gross domestic product of the economy. One cannot undervalue the contribution of the agriculture sector to reducing poverty and guaranteeing the economy's sustainable growth. Traditional to high-value agriculture has been the focus of recent changes in Indian agriculture. The economy's rapid growth and a change in consumption patterns from traditional cereals to a more complete and nutrient-dense diet that includes fruits, vegetables, dairy products, and poultry items have been observed in the economy. India's agriculture has so begun to diversify and move toward high-value crops. (1992, Petit and Barghouti). There is a strong belief among many scholars that agricultural diversity can be utilized as a tool to improve farm income, create jobs, reduce poverty, and preserve natural resources (Birthal et al., 2005; Rayan and Spencer, 2001; Pingali and Rosegrant, 1995; Von Braun, 1995). Crop diversification has enormous potential to stimulate the economy in the agricultural sector and could be crucial for addressing the issues that arose in the aftermath of the Green Revolution. But the Farmers are finding it difficult to add or replace other high-value crops in the cropping system due to the shrinking operational holdings of agricultural land, as a result of the high population growth rate, urban area expansion, and changing dietary preferences of consumers (Singh, 2011).

Recent trends in crop diversification reflect a growing recognition of the need for sustainable agricultural practices. These trends highlight a shift in area allocation towards a more varied and balanced approach to farming, driven by both economic incentives and environmental concerns. There has been a significant increase in the cultivation area of fruits and vegetables. These high-value crops offer better returns to farmers compared to traditional staples like Wheat and Rice. Government programs and policies are promoting horticulture to enhance income, nutrition, and export potential. Pulses and Oilseeds are gaining importance due to their high nutritional value and soil-enriching properties. The area under Pulses has expanded, supported by Government initiatives like the TMOP. Oilseeds like Mustard, Soybean, and Sunflower are increasingly being cultivated to reduce the dependency on imported edible oils and improve farm profitability. Millets and Sorghum, known for their drought-resistant qualities, are seeing renewed interest. These crops are suitable for dryland farming and contribute to food security in arid regions. The declaration of 2023 as the International Year of Millets by the United Nations has further boosted their cultivation, emphasizing their role in sustainable agriculture. Integrating trees and Shrubs into crop and livestock systems (agroforestry) is gaining traction. This practice improves soil fertility, provides shade and windbreaks, and diversifies farmers' income sources. Trees like Moringa, Neem, and fruit-bearing varieties are commonly incorporated into farms, enhancing biodiversity and sustainability. Against this backdrop, the paper has assessed the recent trends and patterns of diversification scenarios of crops at the National level and looked into the status and trends of crop diversification across different states and regions of India.

1.2 An overview of the progression of crop diversification in India:

The Green Revolution phase(1960s-1980s) marked a significant transformation in Indian agriculture, focusing on the production of high-variety seeds (HYVs) of wheat and rice. While this led to a substantial increase in food grain production and ensured food security, it also resulted in reduced crop diversity, particularly in regions like Punjab and Haryana. Recognising the limitations and negative impacts of the Green Revolution, such as soil degradation, depletion of water resources, and reduced biodiversity, Government initiatives were taken to promote diversification for sustainable agriculture during the post green revolution phase(1980s-1990s). During this phase, there was a gradual shift towards crops like pulses, oilseeds, and coarse cereals with the introduction of programs like the National Oilseeds Development Project (NODP) and the Technology Mission on Oilseeds and Pulses (TMOP). The Liberalization and Economic Reforms Phase (1990s - 2000s) marked the opening up of markets. There was a shift towards market-driven agriculture and an increasing focus on high-value crops. Increased cultivation of horticultural crops, including fruits, vegetables, floriculture and growth in commercial crops like cotton, sugarcane, and plantation crops (tea, coffee, rubber) was witnessed. The Sustainable Agriculture and Climate Change Phase (2000s - Present) brought awareness of climate change impacts and the need for sustainable agricultural practices. Emphasis is on organic farming, conservation of agriculture, agroecological approaches, and increased adoption of climate-resilient crops and varieties. Policy support for diversification through schemes like the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), National Food Security Mission (NFSM), greater focus on nutritional security and the promotion of nutri-cereals (millets), the National Mission on Sustainable Agriculture (NMSA) and Rashtriya Krishi Vikas Yojana (RKVY) aimed to encourage farmers to diversify their crops. Current trends and future directions are on Technological advancements in precision farming, biotechnology, and digital agriculture.

2. Data and Methodology

The present study is conducted by undertaking an analysis of crop diversification from 2000 -01 to 2020-21 at the National level and across 15 states of India spread over diverse agro-climatic zones based on Secondary data collected from Agriculture Statistics At a Glance, Department of Agriculture & farmers welfare, Government of India, Directorate of Economics and Statistics and Directorate of Horticulture, Government of India, Handbook of Statistics on Indian States 2022-23, Reserve Bank of India.

The trends and patterns of crop diversification are examined by looking into the temporal changes in the share area of crops. To estimate the speed of diversification average compound growth rates of the area under foodgrains, commercial crops and horticulture crops are examined. The selected crops under the foodgrains include, Cereals and total pulses. A total of all nine oilseeds, Cotton and Sugarcane are included under the commercial crops and horticulture includes fruits, vegetables, plantations, and spices & condiments (high-value crops).

The **compound average growth rate (CAGR)** of different crops and crop groups, at the National and State level has been estimated by exponential method.

The **variability index** is calculated with **Cuddy della Valle instability index** given by

$$CDVI = CV \cdot \sqrt{1 - AR^2} \dots (1)$$

where, CV is the Coefficient of variation, $CV = \text{Standard deviation} / \text{Mean} \cdot 100$

To analyse the nature and extent of diversification, the Simpson Index of Diversification is used and the index is calculated as follows:

$$\text{Simpson Index Diversification: } SID = 1 - \left\{ \sum (P_i / \sum P_i)^2 \right\}, i=1, \dots, n \dots (2)$$

where P_i is the proportionate area of the i -th crop in the gross cropped area. If SID is near zero, it indicates that the region is near to the specialization in growing a particular crop and if it is close to one, then the state is fully diversified in terms of crops.

The SID is measured for the Foodgrains, Non-foodgrains, and total crop sector at the National level and in 15 major states of India for three periods viz, 2004-05, 2015-16, and 2022-23. The study has covered fifteen major Indian states, viz. Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. These states contribute nearly 80 percent to the gross cropped area of the agriculture sector.

3. Objectives:

1. To study the trends and patterns of crop diversification in India.
2. To study the trends and patterns of crop diversification at the State level.

4. Results and Discussion

After 1990, the cropping pattern of Indian Agriculture has been undergoing a significant transformation, especially the diversification towards non-food crops such as oilseeds, Spices, Cash crops, vegetables, and horticulture crops from the traditional foodgrain crops. Post economic reforms and the WTO regime the Indian economy has experienced a spurt in the economic growth rate and per capita level of incomes in the last two decades. Additionally, there has been an increasing trend towards urbanization. These factors have changed the consumption pattern of the population which is moving towards HVCs from staple foods such as rice, wheat, and coarse cereals (Joshi et al., 2003, Joshi et al., 2004). In the present context, the pace and pattern of diversification are looked at through the changing compositions of crops in terms of cropping pattern, growth in the area, and the diversification index.

A Cropping pattern is defined as the proportion of area used for the production of different crops at a particular period. A change in the cropping pattern means a change in the proportion of area under different crops. The cropping pattern in any area depends widely on agroclimatic, technical, socioeconomic, and institutional factors.

Table:1 Trends in the share area under different crops at the National level (in percentage)

	2001-02 2010-11	CDVI	2011-12 2020-21	CDVI	2001-02 2020-21	CDVI
Rice	22.7	2.5	22.0	3.1	22.4	3.2
Wheat	14.3	2.3	15.3	3.1	14.8	4.6
Jowar	4.5	3.6	2.7	7.8	3.6	5.0
Maize	4.0	1.8	4.6	3.4	4.3	4.5
Coarse cereals	13.6	5.7	12.3	3.3	13.0	7.9
Total pulses	12.1	4.1	13.3	6.6	12.7	5.4
Total food grains	64.1	1.3	63.0	3.1	63.6	2.7
Total oilseeds	13.5	5.3	13.2	5.2	13.4	6.2
Sugarcane	2.3	10.6	2.4	7.1	2.4	10.3
Cotton	4.8	7.6	6.2	6.0	5.5	8.5
Total fruits	2.8	2.9	3.4	26.4	3.0	26.1
Total vegetables	3.8	3.0	4.9	30.6	4.3	25.9
Spices and condiments	1.6	23.9	1.8	15.2	1.7	29.1
Plantation	1.7	2.4	1.9	31.7	1.8	22.9

Source: Various issues of Agriculture statistics at a Glance, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India

4.1 Trends in the cropping pattern at the National level:

The shares of the various crops in the gross cropped area and their instability for the period 2001-02 to 2020-21 is presented in **Table: 1** Though rice and wheat are the major food grains and had doubled in the area post-green revolution (Deshpande 2007) a slightly declining trend can be observed during the study period. The Area under jowar and other coarse cereals is on a decline continuously. Coarse cereals have always been on a decline and have been substituted by Rice and Wheat and sometimes by Oilseeds and Pulses in most parts of India. On the whole, the total area under the food grains is falling. The area under commercial crops is making a sway and also the area under high-value crops like fruits and vegetables, spices and condiments, and plantation crops are fairing better in terms of area allocation. The growth rate of the share area of food grains is very meagre and often negative. The fall in the area of food grains was 10.2 per cent in 2013-14. However, there was a rise of 3.3 per cent in 2016-17 but again dwindled to a negative rate of 3.1 per cent. Considering sugarcane, OilSeeds, and cotton as commercial crops it is observed that there is an average growth rate of the share area by 0.7 per cent. The growth was maximum with 11.5 per cent in 2012-13. lot of variation is observed in the shared area of the commercial crops. The area under OilSeeds had increased during the introduction of the Technology Mission on Oilseeds in 1986 but the effect of the policy seemed to fade since the liberalization in the 1990s. Pulses also saw a huge increase in area during the Technology mission but the area under pulses is always varying. Fruits and vegetables share area grew on an average of 3.0 percent and 4.2 percent correspondingly during the study period. The area share of plantations and spices is positive and continuously rising. The positive trend towards commercial crops and fruits, vegetables, spices, and plantations clearly shows the diversification taking place in India towards non-food grains and high-value crops. It is observed that the area under food grains is being diverted to high-value crops mainly because of the changing demand structure and urban lifestyle. Although the non-food grain sub-sector is growing, the growth is sluggish. The food grain sector still dominates the crop sector although the total area under the food grains is declining. Therefore, it can be inferred that the farmers prefer cultivating high-value crops. There seems to be a competitive relationship between foodgrain crops and high-value crops for acreage.

The food grain and the commercial crops have a variability index of less than 15 percent and fall under the low variability category. Among the food grains variability index is relatively higher for Jowar and Pulses whereas Rice, Wheat, Maize, and Coarse Cereals show a low variability index. Amongst the commercial crops Sugarcane shows a relatively high variability index than OilSeeds and Cotton. But under the horticulture crop group, we find a moderate variability for Spices & Condiments and Total fruits with greater than 15 percent and less than 30 percent. Plantation and Total vegetables with a variability index greater than 30 344percent come under the high variability index category.

Table 2: State/Region-wise trends in the share Area. (in percentage)

Year	Rice	Wheat	Coarse cereals	Pulses	Total food grains	Oilseeds	Cotton	Sugarcane	Fruits	Vegetables
Eastern & North-Eastern Region (Assam + West Bengal + Bihar + Odisha)										
2000-01	56.58	8.09	3.23	5.59	73.36	4.90	0.14	0.57	NA	NA
2010-11	58.74	8.49	3.81	7.49	78.53	5.29	0.45	1.14	3.93	9.78
2020-21	60.20	8.18	4.33	7.64	78.72	5.44	0.89	1.04	4.80	10.68
North-Western region (Haryana +Uttar Pradesh + Punjab)										
2000-01	24.49	39.31	8.32	4.67	76.79	4.52	5.02	3.84	NA	NA
2010-11	25.71	40.27	7.30	4.18	77.47	4.33	7.14	3.50	0.96	3.59
2020-21	26.18	40.15	6.10	3.51	75.94	5.04	4.83	3.56	1.42	4.53
Central Region (Gujarat + Madhya Pradesh + Maharashtra + Rajasthan)										
2000-01	6.74	11.06	21.71	14.93	54.21	22.77	7.59	1.07	NA	NA
2010-11	5.64	12.99	16.97	17.96	53.56	24.82	9.14	1.27	2.18	1.99
2020-21	5.49	12.72	11.89	16.75	46.86	23.30	8.14	1.35	1.85	3.37
Southern Region (Andhra Pradesh + Karnataka + Kerala + Tamil Nadu)										
2000-01	21.9	1.1	13.8	10.5	46.8	12.2	3.7	2.5	NA	NA
2010-11	18.0	0.7	11.7	11.8	45.5	9.1	4.8	2.5	6.1	4.6
2020-21	20.4	0.7	11.6	12.7	45.1	7.1	3.9	1.5	7.5	3.9

Based on the author's calculations Source: A hand book of Statistics, 2022 RBI

4.2 State/Region-wise trends in the cropping pattern.

A study of State/region-wise shares of various crops in GCA for the year 2000-01 to 2020-21 is presented in **Table 2**: A region-wise analysis shows that the area under foodgrains is increasing in the Eastern and Northeastern regions. However, there is an increasing area under coarse cereals and pulses amongst the foodgrains and also the area under oilseeds, cotton, and sugarcane is marginally increasing in the traditional rice growing regions. Also, there is an upward trend for the area under vegetables. The share of food crops was highest in Bihar with 87.33percent in 2020-21 followed by Odisha. The area under rice and wheat is on a decline whereas coarse cereals is gaining in West Bengal. The share of Fruits and vegetables (HVC) was highest in West Bengal with 17.58percent followed by Bihar and Odisha. The falling area under rice in Assam and Bihar is being occupied by pulses. In Bihar, the area under wheat is on the rise and pulses is declining. Bihar is diversifying more towards fruits and vegetables. Odisha has specialized with 83.80 percent of the GCA under rice and is mostly diversifying towards fruits and vegetables. The enhanced area under oilseeds pulses and high value crops is due to their profitability. The cropping pattern in Northwestern region is dominated by both rice and wheat and 75 percent of the GCA is under foodgrains. In Punjab, there is a significant increase in rice and wheat and a decline in the Coarse cereals and Pulses. Expansion in market infrastructure, irrigation facilities, and assured minimum support prices could be the possible reason for the increased acreage under fine cereals against coarse cereals. Oilseeds, fruits, and vegetables occupy a small share but there is an increasing trend. The area under oilseeds, cotton, and vegetables depicts an upward trend in Haryana with still retaining 70 percent of the GCA under food grains. The area under food grains sharply declines in Uttar Pradesh and is substituted for cotton and vegetables. A significant decline in the foodgrains can be observed in the Central region. Maharashtra and Madhya Pradesh depict falling share area under rice. The area under food grains has declined by 19.01percent from 2010-11 to 2020-21 in Maharashtra and the area is diversified more towards OilSeeds, cotton, and horticulture crops. The area under food grains has significantly fallen in Madhya Pradesh by 13.95percent from 2010-11 to 2020-21. Whereas the area under OilSeeds has shown a rising trend since 1990 albeit there is a fall in 2020-21. On the other hand, the share of Commercial crops was highest in Maharashtra at 41.79percent followed by Gujarat, Madhya Pradesh, and Rajasthan. Gujarat has diversified the increase in wheat and rice and reduced coarse cereals and pulses which it was traditionally growing and has also increased the area under cotton, fruits, and vegetables. Even Rajasthan has brought more area under rice and wheat at the cost of coarse cereals and pulses. Amongst the commercial crops, OilSeeds and cotton have gained an increase in area. A similar trend for areas under food grains is seen in the Southern region. Andhra Pradesh is diversified more towards fruits, Kerala has diversified in Plantation, fruits, vegetables, spices, and condiments rather than food grains. Even in case of Karnataka, the area under food grains is declining but sugarcane and vegetables in on an uptrend. It may thus be concluded that commercial and Horticulture crops are capturing the area of foodgrain crops in the Central and Southern states and regions.

4.3 Growth in the area under different crops in India

The Quinquennial compound Average growth rate (CAGR) of the selected crops under crop sub-sectors for the period 2000-01 to 2022-23 is presented as five periods in **Table 3**. A perusal of the table reveals that the growth rate was highest for Horticulture crops (fruits +Vegetables+ Spices & condiments + Plantation) with 13.03percent followed by Commercial crops (Oilseeds + Sugarcane + Cotton) with 7.67 percent and Foodgrains (Rice+ Wheat+ Jowar+ Coarse cereals + Maize+ Pulses) with a Negative growth rate of - 5.54percent for the period 2016-2020. Amongst the foodgrains Wheat and Maize have persistently shown a growing trend. The area under cotton has depicted a sharp growth rate in Period II and Period IV. The growth rate of fruits was quite high at 8.90 percent in Period I but gradually the growth rate diminished in the subsequent periods. Spices and Plantations are gaining area mainly because of high export prices post-liberalization. This implies that food grains are now viewed as less profitable and farmers are shifting resources away from traditional crops to High-value crops.

Table:3 Trends in the growth of area under different crops in India.

Compound annual growth rate (percent)					
Crops	Period I 2001-05	Period II 2006-10	Period III 2011-15	Period IV 2016-20	Period V 2021-23
Rice	-0.38	-0.90	0.08	0.46	1.39
Wheat	0.57	0.91	0.85	1.09	1.14
Jowar	-2.64	-2.68	-0.63	-5.86	2.60
Coarse cereals	0.42	-0.54	-1.42	-0.85	3.68
Maize	4.06	1.79	0.65	0.67	3.44
Pulses	1.40	2.47	0.49	-1.05	-1.25
Oilseeds	6.85	0.25	-0.50	2.96	1.88
Sugarcane	-3.04	-2.97	-0.30	0.26	3.77
Cotton	0.35	4.99	0.86	4.45	1.20
Fruits	8.90	3.62	-2.53	2.06	NA
Vegetables	4.30	2.51	2.61	1.45	NA
Spices	-6.29	3.19	2.34	5.33	NA
Plantation	2.47	0.84	0.30	4.19	NA

Source: Agriculture statistics at a Glance, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

4.4 Growth in Area under different crops. A State/ Regional analysis.

Decadal growth trends in the area under different crops for the States/Region for the period 2000-01 to 2020-23 are shown in **Table 4**. An observation of the table shows that the Eastern and Northeastern regions are increasingly allocating more area under coarse cereals, fruits and vegetable cultivation. Except for Bihar, almost all the states are portraying a protagonistic trend in the area growth of Fruits and vegetables. This could be because of the special impetus given to the production of Millets during the year 2023 and the growing health consciousness among the urban population regarding the nutritionally rich millets. It is also found in some of the studies that farmers in backward regions lacking irrigational and other infrastructural facilities resort to crop diversification as the only means to protect their income and consumption requirements. This is in line with the studies of (Sumana Mukherji,2021). The Northwestern region exhibits a substantial growth rate for high-value crops and in 2020-23 there is a growth rate of 11.22 per cent and 12.12 per cent for Pulses and oilseeds. Another noticeable trend is that Punjab has recorded a 26.49 per cent growth rate in Oilseeds. Rice has a positive but low growth rate in the states of Punjab and Haryana. It can be observed that the growth of the area in wheat is higher in Maharashtra and Madhya Pradesh as compared to North Western states that are traditionally Wheat growing. The coarse cereals which occupied a substantial share of the area in states like Gujarat and Rajasthan in the earlier period have had a negative growth rate in recent years. The area growth of oilseeds in the central region has improved during the period 2020-23. This is a result of concerted efforts by the TMOP. Tamil Nadu has increased the area under cotton by 20.33 per cent and Karnataka has allocated more area under Sugarcane with a growth rate of 25.16 per cent in 2020-23. The North Western states of Haryana, Uttar Pradesh, and Central states of Madhya Pradesh and Rajasthan are diversifying the area more towards Fruits and Vegetables as compared to the Southern states. This reaffirms the fact that since traditional crops have become less profitable as compared to commercial and high-value crops the farmers have preferred to shift the resources, although it is moving at a low pace.

Table 4. State/ Region-wise growth in area under different crops.

Compound annual growth rate (percent)

Year	Rice	Wheat	Coarse cereals	Pulses	Total food grains	Oilseeds	Cotton	Sugarcane	Fruits	Vegetables
Eastern & North-Eastern Region (Assam + West Bengal + Bihar + Odisha)										
2000-10	-0.5	-3.1	-1.0	-0.8	-0.3	0.0	3.1	-1.1	3.6	1.3
2010-20	-0.3	-13.8	3.4	2.6	-0.3	-1.3	1.8	-2.0	1.2	0.6
2020-23	-1.8	10.7	2.6	-1.9	-1.3	0.1	1.5	-0.2	1.5	0.8
North-Western region (Haryana +Uttar Pradesh + Punjab)										
2000-10	0.82	0.57	-1.46	-4.36	0.35	-1.66	-0.77	-4.61	8.27	5.02
2010-20	1.00	0.02	-2.16	-3.51	0.03	-0.25	-2.13	1.50	4.85	4.69
2020-23	3.25	-1.72	-3.13	11.22	0.08	12.12	1.02	2.02	6.21	6.82
Central Region (Gujarat + Madhya Pradesh + Maharashtra + Rajasthan)										
2000-10	0.07	6.10	-1.07	2.13	1.28	4.01	1.59	1.72	14.66	4.38
2010-20	2.70	1.46	-2.66	2.18	-0.12	0.04	1.78	0.75	2.44	4.54
2020-23	8.51	4.47	-0.91	1.37	2.59	3.14	0.89	-3.82	2.94	4.54
Southern Region (Andra Pradesh + Karnataka + Kerala + Tamil Nadu)										
2000-10	-0.4	-0.8	-3.1	-0.5	-1.1	-2.5	-3.8	-1.4	6.8	5.0
2010-20	-1.6	-5.4	-2.7	0.0	-0.8	-7.6	0.4	-7.6	-0.1	-5.2
2020-23	-1.6	-10.7	-9.9	-6.3	-2.1	-12.7	11.3	5.7	1.3	1.1

Source: Based on the author's calculations, A handbook of Statistics on Indian economy RBI, 2022-23

4.5 Diversification index at the National level and State level:

Crop diversification is studied with the Simpson index of diversification for three groups of crops namely foodgrain crops, non-food grain crops (Commercial crops and Horticulture crops are taken together), and for total crop sector. The estimates are presented in **Table 5**. At the all-India level, the SID is high as 0.89 but there is no significant change in the diversification index during the reference period. Also, a perusal of data for states shows that most of the states have diversified in favour of commercial crops or Horticulture crops (HVC) and have a high SID for nonfood crops. Simpson diversification index varies from the lowest of 0.47 in the state of Assam to the highest of 0.96 in the state of Maharashtra in 2022-23. Almost all the states in the East and North Eastern region have improved their diversification index indicating a movement away from foodgrain crops towards non-food crops. Among the Northwestern states Uttar Pradesh and Haryana have high SID for foodgrain crops but Punjab has low SID which shows the concentration of wheat and rice and a similar trend can be seen for the total crop group. The states of the Central region and Southern region exhibit high SID for the foodgrain group which indicates a more even cropping pattern and the SID for the total crop group is increasing indicating area under non-food crops is increasing. By constructing the SDI the study cross-checks the state-wise crop diversification pattern and draws an inference about horizontal diversification away from foodgrains. The deviation in the area from total food crops to total non-food crops reflects a change from traditional subsistence cropping to commercial cropping, mainly influenced by the existing price in the market and the profitability per hectare. The change in the consumption pattern of the economy towards high-value commodities has also attracted the farmers to increase the production area under the fruits and vegetables making agriculture more sustainable.

Table 5: Simpson Index of Diversification for India and State/Region wise.

	Foodgrain Crops			Non-foodgrain crops			Total crop sector		
	2004-05	2015-16	2022-23	2004-05	2015-16	2022-23	2004-05	2015-16	2022-23
East & North-Eastern Region (Assam + West Bengal + Bihar + Odisha)									
ASSAM	0.43	0.49	0.49	0.99	0.98	0.98	0.42	0.47	0.47
WEST BENGAL	0.54	0.61	0.67	0.97	0.97	0.96	0.77	0.82	0.86
BIHAR	0.76	0.76	0.77	0.99	0.99	0.99	0.74	0.75	0.75
ODISHA	0.53	0.57	0.60	0.99	0.99	0.98	0.51	0.56	0.58
Average	0.57	0.61	0.63	0.99	0.98	0.98	0.61	0.65	0.67
North-Western Region (Haryana +Uttar Pradesh+ Punjab)									
HARYANA	0.80	0.77	0.78	0.97	0.98	0.97	0.77	0.75	0.78
UTTAR PRADESH	0.78	0.78	0.80	0.99	0.99	0.98	0.78	0.76	0.78
PUNJAB	0.63	0.62	0.62	0.99	0.99	0.99	0.63	0.61	0.62
Average	0.74	0.72	0.73	0.98	0.99	0.98	0.73	0.71	0.73
Central Region (Gujarat + Madhya Pradesh + Maharashtra + Rajasthan)									
GUJARAT	0.95	0.97	0.96	0.85	0.84	0.84	0.81	0.82	0.81
MADHYA PRADESH	0.88	0.87	0.88	0.91	0.91	0.92	0.78	0.78	0.80
MAHARASHTRA	0.86	0.98	0.98	0.95	0.98	0.98	0.81	0.96	0.96
RAJASTHAN	0.82	0.83	0.84	0.92	0.94	0.92	0.73	0.76	0.76
Average	0.88	0.91	0.92	0.91	0.92	0.92	0.78	0.83	0.83
Southern Region (Andra Pradesh + Karnataka + Kerala + Tamil Nadu)									
ANDRA PRADESH	0.95	0.94	0.94	0.97	0.99	0.98	0.92	0.92	0.92
KARNATAKA	0.84	0.83	0.84	0.94	0.97	0.98	0.78	0.81	0.81
TAMIL NADU	0.80	0.79	0.78	0.97	0.98	0.98	0.77	0.77	0.76
KERALA	0.75	0.89	0.89	0.88	0.77	0.72	0.63	0.66	0.62
Average	0.84	0.86	0.86	0.94	0.93	0.92	0.78	0.79	0.78
AI INDIA	0.90	0.89	0.90	0.98	0.97	0.97	0.89	0.88	0.89

Based on the author's calculations

5. Conclusion

The cropping pattern in India is changing from food crops to Commercial and Horticulture crops. Among the foodgrains, the area under rice is showing a downward trend, and also concerning Jowar (Sorghum) and coarse cereals the area is showing a negative growth rate. A gradual shift in crop diversification patterns in all the states under reference is not uniform. The Eastern and Northeastern Regions having more than 75 percent of the GCA under food crops are slowly diversifying towards coarse cereals among food crops and also towards fruits and vegetables. The North Western Region also has more than 70 percent of the GCA under food crops but moving towards oilseeds, fruits, and vegetables, which is however very meager. In the Central region area allocation is increasing towards oilseeds and Cotton. Sugarcane, Cotton, fruits, and vegetables are occupying an increasing area in the Southern region which indicates diversification away from foodgrains and towards commercial and horticulture crops. The changing cropping pattern is due to the changing consumption pattern which is driven more towards the nutritional value of the crops viz coarse cereals (millets), Pulses, fruits, and vegetables. Also, Government initiatives like the Technology Mission on Oilseeds and Oil Palm to reduce their imports, the Technology Mission on Pulses, and the National Horticulture Mission, have promoted the cultivation of these crops. Urbanization, increased per capita income and increased export prices for high-value crops, have induced the farmers to take up agriculture in a more sustainable way without compromising the food security.

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