



Changes in Cropping Pattern in India: Trends, Instability and Decomposition Analysis from 1973-74 to 2022-23

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Abstract: In order to ensure sustainable use of water for irrigation, enhance food security, as well as a consistent increase in farmers' income, India is concentrating on diversification to pulses and oilseeds to reduce import dependency. So the change in cropping pattern in India takes place to overcome several critical issues, notably rice and sugarcane, which are water-intensive crops that consume about 80 per cent or more of the country's fresh water but contribute only less than 25 per cent to agricultural GDP. The drought-resistant crops are now an option as an alternative because climate change leads to irregular monsoon patterns, affecting crop yields and necessitating a shift from one crop to another. In the present context, diversification of agricultural activities is an important matter to address the issue of changing agricultural production and productivity in India. In accordance with the data from 1973-74 to 2022-23, the study examines cropping patterns with the help of data collected from Handbook of Statistics on Indian States published by Reserve Bank of India (RBI) and analyses changes in cropping patterns, focusing on area, gross cropped area elasticity, and instability in area, production, and yield for various crops. The study reveals that there is a modest growth in rice area and significant yield improvements, increasing production by 2.14 per cent. Wheat production growth has been driven by yield improvements (1.92 per cent) and moderate area

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increase (0.91 per cent). Rice and wheat show moderate substitution effects on other crops and moderate instability, while pulses and oilseeds like groundnut, rapeseed, and soyabean exhibited high instability. The analysis suggests the need for extension and development packages, including credit systems and policies like Farmer-Producer Organisations (FPOs), to support Indian farmers.

Keywords: Cereal cropping, Change in productivity, Instability Index, Decomposition analysis

JEL Classification: Q01, Q13, Q17

INTRODUCTION

The majority of the population in India predominantly depends on agriculture to earn their livelihood. The institutional and technological changes in HYV technology of seeds have played an important role in India. Though allocation of acreage is skewed towards cereal food grains, but few non-food grain crops like cotton, sugarcane, oilseeds and vegetables have been considered as popular crops among the Indian farmers in recent years (Ghosh, 2011). This is due to a change in consumption patterns among the households. It is observed that there has been a change in the food consumption pattern of the population in both rural and urban areas across the nation, with a serious decline in the intake of cereals and a rise in some expensive food items (milk products, edible oil and meat products). According to Engel's law, if household income increases beyond a certain level, then the share of food expenditure in total expenditure begins to fall even though absolute expenditure on food may rise (Das, 2021). Engel's law starts to work for a society as well as for an individual as the per capita GDP rises, and this point is seen as the threshold of prosperity. Engel, however, says nothing about how variations in income affect the content of food. According to Bennett's Law, consumers vary their diets and want high-value goods such as processed foods, drinks, livestock products, fruits and vegetables, and proportionally fewer staple foods as per capita earnings rise. They also want more processed and ready-to-eat/ready-to-cook foods, as well as safer and higher-quality items. India's population, specifically in the National Capital Territory (NCT) of Delhi, declined cereal consumption per person per day by 11.6 per cent while consumption of eggs, vegetables and fruits increased. That consumption habit has led to increased cultivation of non-cereal items in accordance with the demand (Firdus, 2016).

There is an impact of non-institutional credit, and expanding non-foodgrain cultivation plays an important role in the case of changes in cropping patterns. The significant impact on employment generation is a positive impact of the change in cropping patterns in the state of West Bengal (Roy, 2007). In order to increase their income more from agriculture, the farmers are changing their cropping pattern with bearing minimum cost of production. The farmers prefer to produce some crops, such as millets and pulses, where less water is required for their production. Those crops also have better nutritional value and can mitigate the issue of hunger. This can also be used to benefit over 195 million undernourished people in the country of India.

In order to increase the farmers' income, the adoption of a diversified cropping pattern is needed. The change in cropping pattern also depends on some environmental factors like water, temperature, etc. The Government of India has started a lot of policies and schemes to protect the loss of farmers, such as Pradhan Mantri Kisan Samman Nidhi (PM-KISAN), Pradhan Mantri Fasal Bima Yojana (PMFBY), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Rashtriya Krishi Vikas Yojana (RKVY), Agricultural Technology Management Agency (ATMA), Kisan Credit Card (KCC), National Food Security Mission (NFSM), etc. In PM-KISAN, farmers are getting support of Rs. 6000 annually in three instalments through direct beneficiary transfers. PM-KISAN has aimed to enhance rural livelihoods and lessen poverty by assisting smallholder farmers in Indian states. Farmers have improved their farming methods, which has increased sustainability and production. PM-KISAN's contribution to rural development has made policy recommendations to increase agricultural assistance in India (Amarjothi, 2024). PMFBY provides a comprehensive insurance cover against failure of the crop and thus helps in stabilising the income of the farmers and encourages them to adopt innovative practices. PMKSY is used to enhance the physical access to water on the farm and expand cultivable area under assured irrigation. It ensures the integrated development of rain-fed areas using the watershed approach towards soil and water conservation, regeneration of groundwater, arresting runoff, and providing livelihood options. The RKVY scheme is used to strengthen the farmers' efforts through the creation of required pre- and post-harvest agro-infrastructure. The Agricultural Technology Management Agency (ATMA) scheme is used to benefit the farmers in overcoming the technological gaps in

the industry. Kishan Credit Card (KCC) provides timely and adequate credit to farmers to meet their production credit needs and expenses related to ancillary activities. The National Food Security Mission was launched to increase the production of rice and productivity at the farm level.

This paper attempts to examine the cropping pattern over the period of 1973-74 to 2022-23 in the country of India. The study period is eventful, because the Green Revolution occurred in the decades of the 1960s and 1970s in a few selected areas of the country, and the adoption of the globalisation policy in the 1990s posed challenges for the agriculture of the country.

LITERATURE REVIEW

Increased agricultural productivity and performance in any nation implies a favourable trade-off connection with the secondary and tertiary sectors, which speeds up that nation's growth. Agricultural development may be deemed as the critical aspect of inclusive growth and proves to be a smooth path for achieving social and economic inclusion (Das, 2021). The change in food consumption patterns, like urban consumption of processed and fast foods, poses a significant challenge to nutrition security in India, where the urban households spend more on processed foods, and the Food Away from Home (FAFH) consumption habit has led to a change in cropping patterns to increased cultivation of non-cereal items (Firdus, 2016). The change in cropping patterns has been impacted by climatic elements like temperature fluctuations and relative humidity, underscoring the necessity of additional infrastructure and agricultural services development to facilitate this transition (Paria *et al.*, 2022). The farmers' income and profitability are driven by market availability, increased demand for product and improved export facilities; these are the indications to shift cropping patterns towards high-value crops (Amirthalingam & Sita Devi, 2022). There is a tool for improving the livelihood and resilience to climate change through the policy implementation under the consideration of agroforestry because climate change indicates an increase in temperature and rainfall affecting cropping patterns in the Himalayan region (Pandey, 2017). There is a change in cropping pattern in the Indian state of Meghalaya, where traditional slash-and-burn rotations called 'Jhum' have been largely replaced by cash-cropping, and this shift has promoted mono-cropping, altered food consumption patterns, and exposed farmers to market risks, impacting both short- and long-term food security

in the respective area (Behera *et al.*, 2016). Das and Bhowmik (2024) have examined the change in productivity of cereal cropping and trade relationships among the BIMSTEC nations. They have observed that India has revealed a comparative advantage (RCA) in the case of rice and millet. Progressive growth of this index over time shows improvement in the competitive position of a good in the world or in a specific region. Climate change has affected crop production and cropping patterns in the Jashore district of Bangladesh, as a decrease in rainfall has reduced Boro rice production, increasing temperature has lowered winter vegetable yields, and increasing rainfall has boosted the production of Aus, Boro, Aman, Wheat, and Jute (Shaibur *et al.*, 2018). Singh *et.al* (2023) have examined the impact of PM-KISAN on the consumption of agri-inputs for the farmers in the Jammu-Kashmir (J&K) region. They have argued that the farmers in the Jammu region have benefited from the Scheme, have changed their consumption habits, as well as the variations in agri-input usage for local paddy production in isolated border outpost of Indo-Pak border villages in India. In the US, where soyabean expansion has occurred, climate change has had a major impact on agricultural acreage expansion, especially for corn and soyabeans, which have accounted for 10–35 per cent of the growth seen over the last 30 years. Significant acreage modifications have been made by farmers in response to climate change, with differing reactions in various geographical areas and farming methods (Cui, 2020).

METHODOLOGY

Data

In the present study, time series data of fifty years from 1973-74 to 2022-23 of India have been used. The data on different variables such as area, production and yield of rice, wheat, coarse cereals, pulses, groundnut, rapeseed, soyabean, sugarcane, tea, coffee, cotton, raw jute and tobacco crops have been taken from Handbook of Statistics on Indian States published by Reserve Bank of India (RBI).

Analysis of Data

The nature of crop diversification is identified with the help of considering the changes in the distribution of land towards the cultivation of various crops grown at different times over the years.

Average annual exponential growth

The average annual exponential growth rates in the case of area, production and yield under the crops like rice, wheat, coarse cereals, pulses, groundnut, rapeseed, soyabean, sugarcane, tea, coffee, cotton, raw jute and tobacco are measured with the help of the following regression equation.

$$\ln(Y) = \alpha + \beta t + \varepsilon \quad (1)$$

In equation (1), the variables are;

Y is considered as area, production and yield, α is an intercept term, β is the slope coefficient and t is time here year from 1973 – 74 to 2022 – 23.

The slope coefficient β measures the instantaneous relative change in Y for a given change in the explanatory variable t (Ikuemonisan *et al.*, 2020).

Elasticity measure

In order to examine the change in the cropping pattern of cereal cropping, the expansionary effect and substitution effect are measured. For a given gross cropped area, the substitution effect is defined as the relative decline in area of some crops and compensating increase in area of other substitutable crops. Whereas the expansionary effect of the cropped area is shown with the change in cropping pattern, it can also be discussed more clearly by dint of "cropped area gross cropped area elasticity (E)" (Venkataraman & Prahladachar, 1980).

$$E = \frac{\% \text{ change in the growth of area of a crop}}{\% \text{ change in gross cropped area}}$$

The positive elasticity of the cropped area shows the expansionary effect, while the negative elasticity shows the contraction effect in the cropped area.

The substitution effect shows the change in substitute cropping due to changes in cropping. The substitution effect is the cross-crop area elasticity, which is informed by the change in the area of one crop with respect to the change in the area of another crop. The substitution effect is shown by using the following formula.

$$\text{Cross Elasticity for Substitute Cropping} = \frac{\% \text{ change in the growth of area of a crop}}{\% \text{ change in the area of contracting crop}}$$

Instability measure

In accordance with Coppock (1962) and Ikuemonisan *et al* (2020), Coppock's instability Index is estimated using the following equations (3)

$$\text{Instability Index}(PCII) = \text{antilog}(\sqrt{V \log} - 1) * 100 \quad (3)$$

$$\text{Where, } V \log = \frac{\Sigma \left(\log \frac{X_{t+1}}{X_t} m \right)^2}{N}$$

In the above instability index, X_t is the time series variable under consideration, here, production, area, and yield for the crops selected in the study during the period of fifty years from 1973-74 to 2022-23; log values of X_t are obtained for each year, and the first differences of logarithmic are then computed; m is the mean value of the first differences of logarithms, and the value of $V \log$ is obtained by substituting the values of first differences. The high instability value is an indication of a high value of PCII (Ikuemonisan *et al.*, 2020).

Decomposition analysis

The equation written below is used to analyse the decomposition in case of change in production as well as yield effect, area effect and interaction effect.

Where, change in production is ΔP , a change in yield is ΔY and change in area is ΔA . The del (Δ) is the difference between the current and base year values. Specifically,

$$\Delta P = \text{Production}_{\text{Current Year}} - \text{Production}_{\text{Base Year}}, \Delta Y = \text{Yield}_{\text{Current Year}} - \text{Yield}_{\text{Base Year}} \text{ and } \Delta A = \text{Area}_{\text{Current Year}} - \text{Area}_{\text{Base Year}}$$

RESULTS AND DISCUSSION

The cropping pattern in the study period reveals that there is no significant change in the area allocation for the crop rice under the principal cereal crops group. The area of wheat is increased to 318 lakh hectares in the year 2022-23 from 186 lakh hectares in the year 1973-74. The area of rice cultivation is relatively stable because of its important role in the agriculture sector, supported by traditional practices and different government initiatives in favour of rice

production, like Minimum Support Price (MSP), High-Yielding Varieties (HYVs). Rice is considered the staple food for a majority of the population, and cultivators are maintaining its supply through HYVs, improved irrigation and proper use of fertilisers in view of meeting the growing demand owing to an increase in population (Mahajan *et al.*, 2017). The production area of wheat has increased to 5 per cent of total gross sown area in the year 2022-23 because of the pivotal role of the green revolution, which introduced high-yielding wheat varieties. This is also due to qualitatively improved agricultural practices leading to a dramatic increase in the area of wheat production. The joint effort of the International Maize and Wheat Improvement Centre (CIMMYT) plays an important role through participatory research for meeting future requirements of wheat in India, the second largest producer of wheat globally (Joshi *et al.*, 2007). Table 1 shows the change in area of different crops cropping patterns in the country India from 1973-74 to 2022-23, and an analysis and overview of the changes in agricultural priorities and land uses over the past five decades. Table 1 shows a significant decline in the share of coarse cereals, including jowar, bajra, millets, etc., in the area during the study period. As a result of which the percentage share of coarse cereals has declined from 27.20 per cent in 1973-74 to 11.17 per cent in 2022-23. There might be a shift to high-yielding crops, and government policies, irrigation facilities, and climate factors are the probable reasons, but with the irrigation and technological improvement in rice production, farmers prefer growing rice and wheat. It has been observed that the per capita cereal consumption in India is declining, with a sharp decrease for coarse cereals and a moderate decline for rice and wheat (Chand & Kumar, 2002). In the case of pulses production, a steady percentage share is maintained with slight fluctuations to 13.77 in 2022-23 from 13.78 in 1973-74. Soyabean, among the category of oilseeds, shows a notable increase in both area and percentage share, which indicates a growing importance of the crop.

The commercial crops sugarcane and cotton have increased in area and percentage, and are showing a trend towards more commercial crop cultivation. The crops like tobacco and raw jute & mesta have shown a declining trend in both area and percentage share. This analysis gives an idea of the changes in agricultural priorities as well as land use in the country over the past five decades.

Table 1: Change in Area of Different Crops cropping pattern in India from 1973-74 to 2022-23 (Lakh hectares)

Category	Crops	1973-74	1983-84	1993-94	2003-04	2013-14	2022-23
Cereals	Rice	383 (22.55)	412 (22.94)	425 (22.78)	426 (22.46)	440 (21.86)	477 (22.57)
	Wheat	186 (10.95)	247 (13.76)	252 (13.51)	266 (14.03)	312 (15.50)	318 (15.05)
	Coarse Cereals	462 (27.20)	417 (23.22)	328 (17.58)	308 (16.24)	257 (12.77)	236 (11.17)
Pulses	Pulses	234 (13.78)	235 (13.09)	223 (11.95)	235 (12.39)	252 (12.52)	291 (13.77)
Oilseeds	Groundnut	70.2 (4.13)	75.4 (4.20)	83.2 (4.46)	59.9 (3.16)	55.1 (2.74)	50.1 (2.37)
	Rapeseed & Mustard	34.6 (2.04)	38.7 (2.16)	62.9 (3.37)	54.3 (2.86)	66.5 (3.30)	88.1 (4.17)
	Soyabean	0.5 (0.03)	8.4 (0.47)	43.7 (2.34)	65.6 (3.46)	117.2 (5.82)	130.7 (6.18)
Major Commercial Crops	Sugarcane	27.5 (1.62)	31.1 (1.73)	34.2 (1.83)	39.3 (2.07)	49.9 (2.48)	58.8 (2.78)
	Tea	3.6 (0.21)	4 (0.22)	4.2 (0.23)	5.2 (0.27)	5.7 (0.28)	6.2 (0.29)
	Coffee	1.6 (0.09)	2.1 (0.12)	2.3 (0.12)	3.3 (0.17)	4.2 (0.21)	4.8 (0.23)
	Cotton (Lint)	75.7 (4.46)	77.2 (4.30)	73.2 (3.92)	76 (4.01)	119.6 (5.94)	130.6 (6.18)
	Raw Jute & Mesta	11.6 (0.68)	10.5 (0.58)	8.9 (0.48)	10 (0.53)	8.4 (0.42)	6.6 (0.31)
	Tobacco	4.6 (0.27)	4.4 (0.25)	3.8 (0.20)	3.7 (0.20)	5 (0.25)	3.9 (0.18)
	Gross Shown Area	1698.7 (100)	1795.6 (100)	1865.8 (100)	1896.6 (100)	2013 (100)	2113.6 (100)

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by the Reserve Bank of India (RBI)

The significant advances in agricultural technology, appropriate policies and market dynamics are important, as they have played crucial roles in the case of varying growth rates of different crops, emphasising the importance of yield improvements and expansion of area in different crop production during the study period.

Table 2 shows the exponential growth rates for the production, area and yield of various crops under different categories like cereals, pulses, oilseeds and major commercial crops in India.

Table 2: Growth Rate of Area, Production and Yield of Different Crops in India from 1973-74 to 2022-23

Category	Crops	Exponential Growth Rates		
		Production	Area	Yield
Cereals	Rice	0.0214* (25.48)	0.0030* (10.56)	0.0183* (29.07)
	Wheat	0.0283* (27.23)	0.0091* (22.88)	0.0192* (23.45)
	Coarse Cereals	0.0114* (10.60)	-0.0144* (-37.21)	0.0258* (27.92)
Pulses	Pulses	0.0159* (11.25)	0.0037* (4.74)	0.0121* (15.08)
Oilseeds	Groundnut	0.0072* (3.58)	-0.0093* (-8.32)	0.0165* (9.87)
	Rapeseed	0.0369* (17.19)	0.0148* (9.87)	0.0221* (19.14)
	Soyabean	0.1047* (16.28)	0.0958* (15.28)	0.0083* (4.91)
Major Commercial Crops	Sugarcane	0.0274* (16.70)	0.0139* (18.36)	0.0085* (14.14)
	Tea	0.0405* (18.87)	0.0129* (33.64)	0.0087* (14.27)
	Coffee	0.0091* (7.19)	0.0254* (39.06)	0.0048* (3.15)
	Cotton	0.0225* (21.50)	0.0125* (12.31)	0.0279* (16.31)
	Jute & Mesta	0.0215* (56.89)	-0.0098* (-9.16)	0.0190* (36.37)
	Tobacco	0.0134* (8.22)	-0.0006 (-0.51)	0.0144* (16.12)

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by the Reserve Bank of India (RBI)

Note: The values in the parentheses are the corresponding t-values, and the symbols ‘*’, ‘**’ and ‘***’ are the indication the level of significance at 1%, 5% and 10%.

The values in parentheses represent the t-values, which indicate the statistical significance of the estimated growth rates. For rice, production growth of 2.14 per cent has been driven mainly by a substantial improvement in yield (1.83 per cent), supported by a modest increase in area (0.30 per cent). In the case of wheat, strong yield growth of 1.92 per cent and a moderate expansion in cultivated area (0.91 per cent) together explain the robust production growth. For coarse cereals, despite a decline of 1.44 per cent in the area under cultivation, productivity improvements of 2.58 per cent have sustained production growth; the negative area growth suggests a shift of land towards more profitable crops such as rice and wheat.

Pulses show a positive trend, with production increasing by 1.58 per cent, supported by both area (0.37 per cent) and yield (1.21 per cent) growth. Groundnut production has shown modest improvement, as yield growth of 1.65 per cent has compensated for the decline in area by 0.93 per cent. Rapeseed, under oilseeds, exhibits strong performance, with production growing at 3.69 per cent, largely driven by increases in both cultivated area (1.48 per cent) and yield (2.21 per cent). Soyabean production has expanded rapidly, with a significant increase in area (9.58 per cent) emerging as the key driver of production growth (10.47 per cent), reflecting higher profitability and market demand.

Among major commercial crops, sugarcane production has grown by 2.74 per cent, supported by improvements in both area and yield (1.39 per cent each). Tea production (0.91 per cent) has increased due to growth in both cultivated area and productivity. For coffee, expansion in cultivation area (2.54 per cent) has contributed to a production increase of 0.91 per cent. Cotton has recorded notable growth, with area increasing by 1.25 per cent and yield by 2.79 per cent, resulting in a production growth of 2.25 per cent. Jute and Mesta show a decline in area (-0.98 per cent), although yield improvements support some production stability. In the case of tobacco, yield growth of 1.44 per cent, despite a slight decline in area (-0.06 per cent), has contributed to production growth of 1.34 per cent.

Table 3 highlights the changing degrees of responsiveness of different crops to changes in the gross cropped area. The crops with elasticity value $E > 1$ show strong responsiveness and have expanded in area because of both substitution and expansion effects, while those crops with elasticity value

$E < 0$ have contracted owing to being substituted by more profitable crops. The elasticity values are important for the policy makers to plan and promote agricultural strategies effectively for the benefit of the farmers as well as ensuring food security for all. Table 3 provides valuable insights regarding the elasticity of different crops in connection to the gross cropped area over the years 1973-74 to 2022-23, where the value of elasticity represents the responsiveness of the area allocated to a particular crop relative to changes in the gross cropped area.

Table 3: Expansionary Effect of Different Crops during 1973-74 to 2022-23

Category	Crops	Elasticity (E)	Elasticity	Increase in Area (in lakh ha)	Substitution / Expansion Effect
Cereals	Rice	$E > 1$	1.0039	94	Expansionary Effect
	Wheat	$E > 1$	2.1146	132	Expansionary Effect
	Coarse Cereals	$E < 0$	-4.8784	-226	Substitution Effect
Pulses	Pulses	$0 < E < 1$	0.9978	57	Both Effect
Oilseeds	Groundnut	$E < 0$	-2.0438	-20.1	Substitution Effect
	Rapeseed & Mustard	$E > 1$	3.0936	53.5	Expansionary Effect
	Soyabean	$E > 1$	5.0748	130.2	Expansionary Effect
Major Commercial Crops	Sugarcane	$E > 1$	2.7117	31.3	Expansionary Effect
	Tea	$E > 1$	2.1363	2.6	Expansionary Effect
	Coffee	$E > 1$	3.3962	3.2	Expansionary Effect
	Cotton (Lint)	$E > 1$	2.1415	54.9	Expansionary Effect
	Raw Jute & Mesta	$E < 0$	-3.8593	-5	Substitution Effect
	Tobacco	$E < 0$	-0.9144	-0.7	Substitution Effect

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by Reserve Bank of India (RBI)

The area of rice production has increased to 94 lakh hectares, and the value of elasticity $E > 1$ indicates an expansion effect, which means the area under rice cultivation has increased slightly more than proportionately with the gross cropped area. The crop during the same study period shows a high elasticity as well as a substantial increase in area, both from substituting other crops and expanding the total cropped area. There is a significant negative elasticity or contraction effect for coarse cereals, groundnut, raw jute and mesta and tobacco, with the value of elasticity $E < 0$. These crops, which are showing contraction, have a substitution effect, and these are substituted by those crops such as rice, wheat, mustard, soyabean, etc., which have an expansionary effect. The elasticity value of crop pulses is very low and has seen $0 < E < 1$, indicating a modest increase in area. The elasticity of groundnut $E < 0$, and the area decreased by 20 lakh hectares because of substitution by other crops. Rapeseed & Mustard area increased by 53.5 lakh hectares due to the substitution and expansion effect with elasticity value $E > 1$. Soyabeans' elasticity $E > 1$ with increased area by 130.2 lakh hectares because of rapid expansion and substitution, which indicates increasing importance and profitability. In case of tea, coffee and cotton, the elasticity $E > 1$ and area increased for the aforesaid crops due to both substitution and expansion effect, indicating growth in these crops' cultivation. Raw Jute & Mesta and Tobacco are showing the elasticity

Table 4: Substitution effect during the year 1973-74 to 2022-23

	Crops	Substitution Effect			
		Coarse Cereals	Groundnut	Raw Jute & Mesta	Tobacco
Expansionary Effect	Rice	-0.21	-0.49	-0.26	-1.10
	Wheat	-0.43	-1.03	-0.55	-2.31
	Pulses	-0.20	-0.49	-0.26	-1.09
	Rapeseed & Mustard	-0.63	-1.51	-0.80	-3.38
	Soyabean	-1.04	-2.48	-1.31	-5.55
	Sugarcane	-0.56	-1.33	-0.70	-2.97
	Tea	-0.44	-1.05	-0.55	-2.34
	Coffee	-0.70	-1.66	-0.88	-3.71
	Cotton (Lint)	-11.25	-1.05	-0.55	-2.34

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by the Reserve Bank of India (RBI)

$E < 0$ due to the substitution effect, reflecting changing market demands and the influence of government policies.

Table 4 shows the substitution effect of four crops, viz. coarse cereals, groundnut, raw, jute & mesta and tobacco, which are facing the contraction effect. The substitution effect is measured by cross elasticity. There is a substitution effect in India that illustrates significant changes in crop cultivation patterns from 1973-74 to 2022-23.

Table 4 shows that the dominance of rice and wheat as preferred crops is due to both policy support and market demand. A higher value of cross elasticity against different crops, which have a better expansionary effect, indicates better substitution. Coarse cereals are substituted by cotton, soyabean, rapeseed, & mustard as the absolute value of cross elasticity is very high. Groundnut can be substituted by soyabean, coffee, rapeseed & mustard, sugarcane. Raw jute is substituted by soyabean. Tobacco has a very high substitution effect, and it is substituted by soyabean, coffee, rapeseed & mustard, sugarcane, cotton, wheat, etc.

Table 5 reveals that the decomposition of production changes into area, yield and interaction effects for different crops considered in the study during the year from 1973-74 to 2022-23.

Table 5: Decomposition of area, yield and interaction towards changes in production from the year 1973-74 to 2022-23

Category	Crops	Area Effect	Yield Effect	Interaction Effect
Cereals	Rice	648419	108194	159142
	Wheat	441006	154704	312972
	Coarse Cereals	784476	-140798	-383748
Pulses	Pulses	120978	24339	29469
Oilseeds	Groundnut	84801.6	-16984.5	-24280.8
	Rapeseed	32039.6	26375.5	49541
	Soyabean	158.5	107935.8	41273.4
Major Commercial Crops	Sugarcane	903100	1601401.9	1027892
	Tea	3268.8	3408.6	2360.8
	Coffee	414.4	1776	828.8
	Cotton	23088.5	7795.8	16744.5
	Raw Jute	16170.4	-5940	-6970
	Tobacco	5138.2	-700.7	-781.9

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by the Reserve Bank of India (RBI)

Table 5 shows that the increase in rice production is primarily driven by a significant expansion in the cultivated area, with substantial contributions from both yield improvements and the interaction effect. Wheat production has benefited significantly from both area expansion and yield improvements. There is a strong negative interaction effect in the case of coarse cereals, which indicates the scope of the cultivation of other goods. With a moderate interaction effect, the increase in pulse production is relatively balanced between area expansion and yield. Groundnut shows a significant area effect but a negative yield effect, indicating decreased productivity per unit area. The interaction effect is positive, but not enough to offset the negative yield effect completely. Rapeseed production has increased mainly due to area expansion, with positive contributions from yield improvements and interaction effects. Soyabean shows a minimal area effect but significant yield improvements and a strong interaction effect. Sugarcane has an enormous yield effect, indicating significant improvements in productivity, with large contributions from area expansion and interaction effects. Tea production has modest contributions from area, yield, and interaction effects, indicating balanced growth. Coffee shows a higher yield effect compared to the area effect, with a moderate interaction effect. Cotton production benefited from both area expansion and yield improvements, with a notable interaction effect. Raw jute production shows significant area effects, with smaller but positive yield and interaction effects. Tobacco production shows a considerable area effect, with positive contributions from yield and interaction effects.

Table 6 shows the changes in cropping with three categories: area instability, production instability and yield instability.

Table 6: Instability for area, yield and production from 1973-74 to 2022-23

<i>Category</i>	<i>Crops</i>	<i>Area Instability</i>	<i>Production Instability</i>	<i>Yield Instability</i>
Cereals	Rice	37.98	41.03	40.06
	Wheat	38.13	39.68	38.9
	Coarse Cereals	38.51	42	40.97
Pulses	Pulses	39.21	42.24	40.62
Oilseeds	Groundnut	40.01	49.39	47.49
	Rapeseed	41.22	44.63	42.26
	Soyabean	42.83	47.83	45.15

<i>Category</i>	<i>Crops</i>	<i>Area Instability</i>	<i>Production Instability</i>	<i>Yield Instability</i>
Major Commercial Crops	Sugarcane	39.86	40.86	38.75
	Tea	37.68	38.45	38.47
	Coffee	38.59	46	46.29
	Cotton	39.4	43.29	42.27
	Raw Jute	40.46	42.03	39.47
	Tobacco	41.83	43.63	40.51

Source: Author's calculation from data of the Handbook of Statistics on Indian States published by the Reserve Bank of India (RBI)

The cereals, namely rice and wheat, show moderate instability, but pulses and oilseeds, more specifically groundnut, rapeseed and soyabeans, show high instability. The high insatiability is an indication of high variability and potential risk in their cultivation. Table 6 also shows that the major commercial crops like sugarcane, tea, coffee, cotton, raw jute and tobacco are showing considerable instability, while coffee and cotton are showing high fluctuations in production and yield.

SUMMARY, POLICY IMPLEMENTATIONS AND RECOMMENDATIONS

The study analysed the overall analysis of the cropping pattern changes in terms of cropped area, gross cropped area elasticity and instability in area, production and yield for different crops. The findings reveal that no significant change in the area allocation for cropping rice under the principal cereal crops group is observed. The growth in area is modest, and a significant improvement in yield has driven the production to increase 2.14 per cent, followed by a yield of 1.83 per cent and an area of 0.30 per cent for rice. The substantial improvements in yield 1.92 per cent, and a moderate increase in cultivation area 0.91 percent and area 0.91 percent growth have supported the wheat production growth in India. The area of rice production has increased to 94 lakh hectares, and the value of elasticity $E > 1$ indicates both substitution and expansion effects, which means the area under rice cultivation has increased more than proportionately with the gross cropped area, influenced by both substituting other crops and expanding the overall cultivated area. The cultivated crop rice has a high substitution effect, which can be substituted by coarse cereals. Soyabean

has a substitution effect which can be substituted by groundnut. Soyabean, Rapeseed is highly substituted by tobacco. Wheat shows a similar pattern to rice but with slightly higher substitution effects, particularly substituted by tobacco. The cereals, namely rice and wheat, show moderate instability, but pulses and oilseeds, more specifically groundnut, rapeseed and soyabeans, show high instability.

The present analysis concludes that the trends of cropping patterns in India urgently require the implementation of an extension and development package, including a credit system from a financial institution. It is also important to implement the most appropriate policy, like Farmer Producer Organisations (FPOs), for the benefit of Indian farmers through aggregation, value addition, market access, input supply and capacity building for the benefit of farmers.

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