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Growth and Instability Analysis of Major Cash Crops in India

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Abstract

After the transformation in the economic sector, the agricultural sector of India has been experiencing drastic changes with cash crops which contribute a significant part in the export earnings as well as in rural liberalization in 1991. This paper focuses on the increasing and unstable exportations of large scale cash crops in India. The analysis scores trends in using time-series data area, production, productivity and exports of major crops, that is, cotton, jute, tea, coffee, etc. cashew, spices, and tobacco. In this research, Compound Annual Growth rate (CAGR) is used to measure variability calculates growth performance and the Cuddy Della Valle Instability Index to across three sub-periods: 1991–2001, 2001–2011, and 2011–2022. The outcomes indicate that there is heterogeneous growth of crops and periods. Spices emerge as the most active crop, having always a high growth in production, productivity, and exports. Cotton is very unstable in the aspect of growth trade off, especially a trade off in performance in export. Conversely, habitual foodstuffs like jute and tea have fairly stable trends but low growth prospects. The cashew and coffee show the mid moderate a growth with average variation. The results also show that instability is already top in exports because it has a greater exposure to global price volatility and market in securities in the post-liberalization period.

Keywords: Cash crops, CAGR, Instability index, Cuddy Della Valle, Trade volatility

1. Introduction

The agricultural sector of India is a long term backbone of the economy as it contributed which is of great importance to employment and revenue generation and foreign exchange earnings. A major structural change came after the Indian Economic Liberalization of 1991 that incorporated (Pingali, 2007). During the post-liberalization period, the cash crops include cotton, jute, tea, coffee, cashew, and many others spices, and tobacco have become popular because of their export capabilities and revenue-making capacity. Such crops are very important in encouraging agricultural commercialization enhancing of rural livelihood by means of market-oriented production systems (Acharya & Agarwal, 2019). High value crops have been promoted by the growth of trade internationally, enhancing the Indian market in foreign agricultural markets. As a result, commodities like spices, tea, and cotton have become an influential source of export revenues and commerce competitiveness (Sharma and Kumar, 2020). Climatic variability, factors such as climatic variability, volatility in international prices, and changes in policy are some of the factors that contribute to a high degree of volatility its performance in terms of production and export (Gilbert & Morgan, 2010). Volatility in exportation of agriculture is of serious challenge to farmers and policymakers because this influences income stability, investment determinations, and general economic security. Further enhanced exposure to the world markets has increased the susceptibility to

the export-oriented crops to developing economies such as India (Deb and Hossain, 2019). The principles of instability and growth play the key role in the interpretation of agricultural performance. Although growth is a measure of expansion in the long term on the area, production, productivity, and Instability captures short-term fluctuations which can slow down sustainable development and they are recorded in exports (Hazell, 1982). Empirical studies have indicated a difference in the pattern of different cash crops growth and instability. Export instability has been increased in the past years because of integration of the global market, exchange rates change, and demand dynamic. These external shocks have led to greater insecurities in agricultural trade especially on developing ones countries (World Bank, 2020). Cash crops provide families and countries with a way to equitable growth (Maxwell and Fernando, 1989). Various studies have studied agricultural though few have been conducted most of them are performance based on growth of commodities or a shorter period and export performance periods. It is still necessary to have a pan-time comparative analysis of growth as well as unpredictability among key cash crops in India (Kumari & Kakar, 2023). Access to cash crop financing is shown to enhance the performance in agriculture and make a contribution to sustainable economic growth as this will enable farmers to indulge in productivity enhancing inputs and technology (Asaleye et al., 2020). The cultivation of cash crops is also of larger developmental extent consequences. Moreover, since they provide farmers with income opportunities in the form of the market, integrate the rural households into the commercial value chains, cash crops are commonly selected because it is a feasible method of alleviating poverty in third world countries (Tankari, 2017).

2. Literature Review

With the agricultural export development in the developing economies has been intertwined with reforming of policies and growing globalization. In India, the change started with the aftermath of the transition to market-oriented agriculture was increased in 1991 by Indian Economic Liberalization, enhancing the export role and promoting diversification of crops to high value (Pingali, 2007). There is a significant amount of literature that point out that agricultural expansion is highly correlated to the results of export growth and rural development. Cash crops, in particular, are identified as important sources of farm revenue, creation of employment opportunities as well as structural modernization in the rural countries with the help of commercial orientation (Kumar & Sharma, 2018). The export- growth nexus has also been discussed in term of scholarly work where it has been argued that outward looking strategies will improve efficiency, adoption of technology and competitiveness in. agriculture. This body of research states that export led growth can be a significant source of increasing productivity and growth in the sector in the long run (Kumari & Kakar, 2023). Within thus, against this background, the measurement of agricultural growth has been a hot topic of interest with empirical. Comparing the growth of a portfolio (commonly using metrics like Compound Annual Growth Rate (CAGR)) is usual in studies measured changes in the area, output and yield over time. The fact seems to suggest that, although Indian growth in agriculture has been generally spread out, growth has been disproportionate and institutional limitations lead to commodities and regions being compatible with each other (Tripathi & Prasad, 2009). Also associated with the growth has been instability as an important dimension to assess agricultural performance, in terms of its implication of income uncertainty and food security. Early contributions underlined that the changes in agricultural production have a major significance and should be studied as a system through development trends in order to get real image of the sectoral performance (Hazell, 1982). The later studies have developed a better method of measuring instability using a better method statistical metrics like Cuddy Della Valle Instability Index which accounts for the effect of trends and gives a more realistic estimate of inter-temporal variability. This methodology has gained common ground in empirical studies of fluctuations in agriculture (Dastagiri, 2017). The literature goes ahead to indicate that the external factors are a major contributor to instability in agricultural exports factors, such as movement of the international price, exchange

rate and movement of global demand conditions. The influence has increased during the globalization era exposing agricultural markets to foreign shocks more (Gilbert & Morgan, 2010). These are structural weaknesses that render the agricultural systems in developing countries that is especially sensitive to inner and outside disruptions (Deb and Hossain, 2019). On the same note, studies that have been conducted on plantation and spice crops show that their performance is influenced by the world market situation, leading to a series of boom and recession periods. These variations underscore the weakness of these commodities to international price movements and change in demand (Adarsh et al., 2023). Recent, comparative studies have been taken up perspective, analysis of means of deviations in growth and instability among crops and regions. These analyses reveal the inhomogeneous character of agricultural performance in which some crops perform better grow at a rather stable rate where others show high volatility even though these others are high. Different patterns in cropping are identified as diversified improve the stability of income and resist the shocks in the market and production, thus enhancing more stable agricultural development (Birthal et al., 2015). In addition, research on export competitiveness implies that India has a comparative advantage in even though it has a comparative advantage in export competitiveness a number of agriculture products, the issue of maintaining stability in exports is a challenge because of the intensive nature the competition on the global level and price volatility (Sharma & Kumar, 2020). Goyal, Pandey and Singh (2000) proposed an inquiry into the reasons because of the rise in exports and Indian agricultural volatility. The export of agricultural products declined due to a decrease in agriculture ratio of manufactured products to the overall exports of India increased. Kaundal and Sharma (2006) described that of India agricultural exports under the current economic condition. The agriculture sector has been affected important to the growth of the Indian economy as it has more than two thirds of the population as employees and not only does it contribute to GDP of the country but it also plays a significant role. The study by Goyal and Berg (2012) tested the relationship between the growth rate and volatility of agricultural Indian exports. Samuel et al. (2015) examined the output, growth and competitiveness of India in selling overseas. Dastagiri and Jainuddin (2017) discuss the imports and exports. Export Import Price Elasticity of Oilseeds, identification of the best export import destinations. The research found that multilateral trade would help in the trading of oilseeds source relations with countries where there are large shares of exports and imports. Some of the methods used in other rules of this study are also applied to estimate the Compound Annual Growth rate (CAGR), the Instability. The oilseed export-import price elasticity and the leading export-import destination, index. Meena et al. (2018) has explored the region, production, productivity, and export of the three primary seed spices, coriander and cumin, 1985-2015. Indian agricultural exports were increased the knowledge on long term patterns and the changing patterns of agricultural trade throughout the post liberalization era (Chand, 2014).

3. Research Gap

Existing literature reveals several limitations. First, most studies analyze growth and instability separately, lacking an integrated framework. Second, research is largely commodity-specific, restricting comparative insights. Third, limited studies cover long-term post-liberalization periods. Fourth, there is insufficient focus on sub-period analysis to capture structural changes. This study addresses these gaps by providing a comprehensive, multi-dimensional and long-term analysis**.**

4. Objectives

The study was conducted to observe the production and exports performance of major crops of India. The specific objectives are:

• To examine the growth rate of area, production, productivity and exports over three decades.
• To analyze the instability in area, production, productivity and exports over three decades.

5. Research Design and Methodology

5.1 Research Design

The study adopts a quantitative and analytical research design based on secondary time-series data. A longitudinal approach is used to capture structural changes over time.

5.2 Data Sources

Data were collected from:

- CMIE Economic Outlook
- Ministry of Agriculture
- APEDA
- RBI Handbook of Statistics

5.3 Study Period

1991–92 to 2021–22, divided into:

- Period I: 1991–2001
- Period II: 2001–2011
- Period III: 2011–2022

5.4 Analytical Tools

Growth Measurement

Compound Annual Growth rate (CAGR). Compound Annual Growth Rate (CAGR) is a statistical measure that is widely used to determine the steady percentage of growth of an investment, financial amount or dataset in the course of a period of time. It has a smoothed rate, which the effects of compounding are taken into consideration, with an exception to remove the fluctuations, which can be caused by the temporary volatility or abnormal performance (Brigham and Ehrhardt, 2017).

The mathematical formula for CAGR is expressed as:

The formula to calculate CAGR is:

$$\text{CAGR} = \left(\frac{V_f}{V_i}\right)^{\frac{1}{n}} - 1$$

- V_f = Final value (end value)
- V_i = Initial value (beginning value)
- n = Number of periods (usually in years)

Instability Measurement

The Instability Index basically tracks how much things change or swing around in a set of data as time goes on. Economists and market analysts use it to figure out how unpredictable or shaky things like exports, production, prices, or demand are. A common formula is:

$$\text{Instability Index} = \frac{\sigma}{\bar{X}} \times 100$$

Where:

- σ = Standard deviation of the variable
- $\bar{X}$ = Mean of the variable

In this research, the Instability Index was used to compare stability across different time periods, selection to highlight trends and shifts in performance (Gujarati & Porter, 2009).

6. Results and Discussion

6.1 Growth in Area of Major Cash Crops (Table 1)

The performance of area under major cash crops in terms of growth shows specific trends in terms of performance by crop and time period. Cashew showed the best total growth (2.42) as against spices (1.71) and coffee (1.38) implying that there was a definite transition between low-value and low-value crops in the post-reform years. Cotton also grew positively (1.10%), especially Period II (2.08%), which is indicative of growth due to positive market environment and adoption of technology. Jute on the other hand, recorded a uniform fall in area throughout the periods, with the total growth rate of -1.33 percent, which indicates its loss of economic significance and being replaced by more economically desirable crops. Tobacco also registered unfavorable total growth (-0.37%), although there was a short time growth rise in Period II, which signifies that cultivation choices were unstable. The growth of tea was moderately and steadily one (1.22) implying a fairly developed and stable system of production. In general, the findings suggest that there is a structural change in the current way of cropping with more and more farmers moving to high-value crops like cashew and spices and traditional crops like jute are slowly reducing their share of areas.

Table-1 CAGR of the Area of major cash crops

Crops	Period 1	Period 11	Period 111	Over Period
Cotton *	1.08	2.08	0.15	1.1
Jute**	-0.56	-1.2	-2.25	-1.33
Tea	1.84	0.94	0.93	1.22
Coffee	2.2	1.55	0.42	1.38
Cashew	3.03	2.58	1.75	2.42
Spices	1.62	1.37	2.15	1.71
Tobacco	-4.9	3.48	-1.7	-0.37

Sources: Author's Own Calculation

Table-2 Instability in the Area of major cash crops

Crops	Period1 (1991-01)	Period11 (2001-11)	Period111 (2011-22)	Over Period (1991-2022)
Cotton *	6.84	8.12	6.25	7.14
Jute**	8.95	4.72	6.88	6.91
Tea	4.26	2.98	4.75	3.99
Coffee	5.37	3.84	3.12	4.08
Cashew	6.91	5.42	6.17	6.18
Spices	12.34	10.28	14.66	12.49
Tobacco	15.87	11.63	9.42	12.21

Sources: Author's Own Calculation

6.2 Instability in Area of Major Cash Crops (Table 2)

The analysis of instability of area under cultivation reveals that there is a different level of fluctuation in the crops. The instability was noted to be greatest in spices (12.49% during the whole period), tobacco (12.21%), and meaning that there was a lot of shifting of acreage. This is in accordance to the sensitivity of such crops to price changes and market signals. Cotton and cashew were found to have moderate instability with the overall indices of 7.14 and 6.18 respectively implying that though there was growth in these crops, the crops were characterized by periodical fluctuations. Jute also exhibited moderate instability (6.91%), although it was also declining at the area. Tea and coffee, in turn, were characterized by relatively low levels of instability (3.99% and 4.08% respectively) which means that the data on area allocation is more consistent. This stability could be explained by the perenniality of these crops and the institutional systems of support. In the long run, instability is not a steady trend, but its change, which indicates the impact of the fluctuating market conditions and environment. The instability observed in Period III (14.66) of spices is relatively high, which implies that there is growing uncertainty in recent years.

Table-3 CAGR of the Production of major cash crops

Crops	Period 1	Period 11	Period 111	Over Period
Cotton *	-0.19	12.68	-1.1	3.9
Jute**	0.42	-0.56	-0.86	0.29
Tea	1.16	1.25	1.7	1.37
Coffee	5.28	0.04	0.78	2.14
Cashew	3.97	4.35	0.33	2.87
Spices	4.32	6.54	5.22	5.36
Tobacco	-5.02	3.93	0.77	1.12

Sources: Author's Own Calculation

6.3 Growth in Production of Major Cash Crops (Table 3)

The production trends show a lot of fluctuation both in terms of crop and time. Spices are the crops that showed the best and the most stable growth, with their CAGR of 5.36 in total, which means that the growth rates are high and sustained by the increasing demand on the domestic and international levels. The growth of cashew (2.87%) and coffee (2.14) was also quite high, indicating the growth of commercialization and export

orientation. Cotton had growth that was very volatile, negative growth in Period I (-0.19%), and steep growth in Period II (12.68%) and negative growth in Period III (-1.10), giving a total growth of 3.9%. This implies that the production of cotton is very sensitive to changes in technology and in the market. Tea recorded a consistent and average improvement throughout all the periods with the total CAGR of 1.37 which reflects a reasonably stable production system. On the other hand, jute had recorded the lowest overall growth (0.29) with decreasing performance in later times indicating stagnating production. Tobacco was also a variable that showed negative growth during Period I (-5.02%), and then increased upwards in the later periods, which led to a slight growth overall (1.12%).

6.4 Instability in Production of Major Cash Crops (Table 4)

Production instability varies appreciably across crops. Spices (17.96%), cotton (16.72%), and tobacco (15.61%) recorded the highest instability, indicating strong experience to production shocks. Cotton showed particularly high fluctuation in Period II, aligning with its rapid growth phase. Spices also exhibited rising instability over time, telling increasing uncertainty. Cashew and coffee showed modest instability, while jute remained relatively stable despite low growth. Tea recorded the lowest instability (5.02%), reflecting a more steady production system.

Table-5 CAGR of the Productivity of major cash crops

Crops	Period 1	Period 11	Period 111	Over Period
Cotton *	-1.3	10.4	-1.2	2.2
Jute**	1	0.7	1.4	1.3
Tea	-0.7	0.3	0.7	0.5
Coffee	3	-1.5	0.4	0.7
Cashew	0.9	1.3	-1.4	0.3
Spices	2.7	5.1	3.2	3.2
Tobacco	-0.4	0.4	2.5	1.4

Sources: Author's Own Calculation

6.5 Growth in

Productivity of Major Cash Crops (Table 5)

Crops	Period1 (1991-01)	Period11 (2001-11)	Period111 (2011-22)	Over Period (1991-2022)
Cotton *	13.84	24.67	8.95	16.72
Jute**	10.92	4.38	5.21	7.85
Tea	4.72	3.16	6.88	5.02
Coffee	14.55	5.94	4.96	8.36
Cashew	14.12	8.77	7.63	9.89
Spices	12.68	18.42	20.55	17.96
Tobacco	17.33	16.28	11.47	15.61

Productivity growth shows mixed performance across crops. Spices recorded the highest and most consistent growth (3.2%), indicating steady improvements in yield. Cotton also showed strong but volatile productivity, with a sharp rise in Period II followed by declines, resulting in moderate overall growth (2.2%). Jute maintained stable growth (1.3%), while tobacco showed gradual improvement (1.4%) in later periods. In contrast, tea

(0.5%), coffee (0.7%), and cashew (0.3%) exhibited low productivity growth, reflecting limited technological progress. Overall, spices and cotton dominate productivity gains, while most other crops show weak or stagnant improvement.

Table-6 Instability in the Productivity of major cash crops

Crops	Period1 (1991-01)	Period11 (2001-11)	Period111 (2011-22)	Over Period (1991-2022)
Cotton *	11.82	18.95	14.37	17.93
Jute**	3.74	2.91	3.12	3.31
Tea	5.26	3.88	6.97	6.98
Coffee	10.44	6.72	7.95	8.65
Cashew	7.86	5.94	9.63	8.55
Spices	9.12	8.47	12.88	10.05
Tobacco	6.95	5.63	11.74	10.39

Sources: Author's Own Calculation

6.6 Instability in Productivity of Major Cash Crops (Table 6)

Productivity instability varies widely across crops. Cotton recorded the highest instability (17.93%), indicating strong fluctuations in yield over time. Spices (10.05%) and tobacco (10.39%) also showed relatively high variability, especially in the later period, reflecting sensitivity to climatic and input-related shocks. Coffee (8.65%) and cashew (8.55%) experienced moderate instability, while tea showed comparatively higher variability in the long run (6.98%) despite low growth. Jute remained the most stable crop (3.31%), indicating consistent but low productivity performance.

Crops	Period1 (1991-01)	Period11 (2001-11)	Period111 (2011-22)	Over Period (1991-2022)
Cotton *	102.94	103.99	43.31	104.98
Jute**	16.39	32.99	17.54	41.91
Tea	22.62	28.17	7.80	35.50
Coffee	41.60	39.55	11.36	52.86
Cashew	23.90	18.69	24.89	35.53
Spices	39.10	65.18	18.10	91.88
Tobacco	32.52	61.87	5.52	66.96

Table-7 CAGR of the Exports of major cash crops

Crops	Period 1	Period 11	Period 111	Over Period
Cotton *	-9.99	88.43	-7.57	17.08
Jute**	0.68	8.83	-0.09	4.30
Tea	2.03	8.74	-0.50	3.49
Coffee	11.47	13.24	-0.31	5.78
Cashew	6.86	5.88	-6.58	2.97
Spices	14.18	23.73	4.69	12.90
Tobacco	6.3	21.87	-0.06	7.66

Table-8 Instability in the Exports of major cash crops

Sources: Author's Own Calculation with MS Excel

6.7 Growth in Exports of Major Cash Crops (Table 7)

The performance of exports is not actually consistent at all it varies greatly according to the crop and the time of year. The best and most consistent growth was recorded by spices which reached 12.9. That is an indication that there is consistent demand in the international markets and they are competitive in the export markets. Cotton had an even greater growth, 17.08% on the whole, though the bulk of it was in one large leap in Period II, and, indeed, its work fluctuated about the place in other periods. Moderate gains were experienced on coffee (5.78%), tobacco (7.66%), and jute (4.3%). Probably, this is due to the fact that demand of these crops in the world is increasing and decreasing and hence the numbers mirror the trend. Then tea and cashew here growth was only so 3.49 and 2.97 percent respectively, and both of them actually fell during the latter period. Therefore, it is apparent that export growth is not predictable, and it is high and low. Spices are your best bet in case you want to have a winner as it is obviously the most stable of cash crops.

Sources: Author's Own Calculation with MS Excel

6.8 Instability in Exports of Major Cash Crops (Table 8)

The exports are far more varied than the production or productivity hence the reason why it is quite obvious that these crops are quite vulnerable to these shocks in the international market. Cotton takes the first place in instability, with a shocking 104.98. Spices aren't far behind at 91.88%. Tobacco sits at 66.96%, and coffee at 52.86%. Jute and tea are rather more stable, although still rather wobbly at 41.91% and 35.50%. Cashew is more moderate with a value of 35.53 however; its values vary and fluctuate with time. The spices are something to be proud of they are growing and growing but the instability is off the scale. It is pure volatility, the extreme volatility. So, what does this mean? The international prices, changing demand and exchange rates practically leave the export performance at their mercy. As much as the future of growth may appear optimistic, earnings can be volatile and erratic due to all those messes.

7. Conclusion

The paper excavates the transformation of the cash crop industry in India that has occurred since 1991 when the country liberalized its economy. It has changed in the real sense over the years. The number of high-value, export crops is rising among farmers, but the ups and downs in the amounts of land, production, yield, and export of such crops are still numerous. In the case of area expansion, crops such as cashew and spices are performing extremely well they are acquiring more ground annually. In the meantime, the conventional crops such as jute and tobacco have not increased and in other instances, they are reducing. Tea and coffee are quite stable, and they are growing slowly but steadily since their production systems are already developed. The interesting part is that spices and tobacco swing up and down in regard to the amount of land to be allocated to it whereas tea and coffee are predictable. The same thing happens to production. The actual movers are spices, they are growing up, year after year. Cashew and coffee do not lag much behind, however, cotton production leaps all over the place, often due to the change of technology or a change in the market. Spices, cotton and tobacco are particularly volatile and hence they are prone to externalities during a bad weather or when markets become rocky. All this is supported by productivity the output per unit area. Spices and cotton are gaining, whereas tea, coffee and cashew plod and in smaller measures. Once again, cotton and spices are the most unpredictable in this context as they demonstrate that the crops that are growing the fastest are at the same time the most risky ones. The Indian cash crops are telling a lot about their connection with the world through exports. Spices and cotton are also entering the world markets in a majorly big manner compared to tea and cashew. Export figures can hardly remain constant, particularly in the case of cotton, spices and tobacco. These crops are affected by changes in price, demand as well as global events. Therefore, no, there is actual increase in the cash crop industry of India because the reforms, but it is not stable. The most volatile crops are the ones that are making the highest profit hence exposing the farmers to risk. To correct this situation, the policymakers need to work on risk management, persuade farmers to produce more diverse types of crops, establish smarter export policies, and establish more robust market infrastructure. That is what it requires to enable farmers to gain constant income, continue growing in the sustainable way, and avoid being wiped out by the next big shock.

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