Original Research Article (edited)

Performance of Indian Coffee Sector: An Economic Analysis

ABSTRACT

The study analyses the dynamics in area, production and productivity of coffee in India. It was analyzed using trend analysis, instability analysis and decomposition analysis. The time period chosen for the study was 1961 to 2020. The years were divided into three periods namely thepre-liberalization period (1961-1989), thepost-liberalization period (1990-2020) based on the liberalization of thecoffee market. The results showed that the area under coffee increased from 115000 ha (1961) to 459730 ha (2020). The production increased positively at 3.39 percent and the area at 2.60 percent at one percent level of significance in the post-liberalization period. The stability in area (46.71 %), production (47.57 %) and productivity (41.30 %) increased from thepre-liberalization period to thepost-liberalization period. The decomposition results showed that achange in average production was highly influenced by change in themean area (67.57 %) and change in variance of production was contributed by thechange in area variance (281.74 %) and change inthe mean area (205.89 %). Indian coffee trade performance was analyzed using Herfindahl-Hirschman Index. The results showed that India is less competitive in international coffee market. The study suggests increasing replantation programs for high yielding varieties and disease resistant varieties by replacing the age-old coffee plants in India which would not only increase production but also become competitive in theinternational market.

Key Words: area, export, liberalization, production, productivity

1. INTRODUCTION

India is an agrarian economy with 54.6 percent of the workforce engaged in agriculture and allied sector activities (Neelam and Tanu, 2021). India is the second largest producer of agriculture products in the world. The contribution of agriculture, forestry and fishing to the country's GDP is 16.8 percent as of2021 (World Bank, 2021, data.worldbank.org). With respect to plantation crops, India is the largest producer of plantation crops in the world. The population dependent on plantation crop is around two million of which coffee plantation provides 5.94 lakh workforce directly and indirectly. Coffee contributes to approximately 13 percent of agriculture export in India. It is one of the largest employment providers in Karnataka, Kerala, and Tamil Nadu (Pradeepkumar, 2019).

Coffee is cultivated in India on about 4.60 lakh hectares and is mainly confined to thesouthern states of Karnataka (52.8%), Kerala (18.5%) and Tamil Nadu (7.7%), which form the traditional coffee belt. To a lesser extent, coffee is also grown in non-traditional areas (NTA) of Andhra Pradesh and Odisha (20%) as well as in northeasternregion (NER) (1%)with the primary objective of improving the livelihood of local tribes by providing them with sustainable income generation from coffee and intercrops and

reforestation in the barren hills affected by shifting cultivation (Coffee Board of India, 2021). Indian coffee industry

registered a remarkable growth during the last seven decades during which the area under coffee increased by more than four-fold from 92,523ha to 4,59,730ha between the period 1950-51 and 2019-20 while the production increased from about 18,893 tonnes to 2,98,000 tonnes (Coffee Board of India, 2021) during the same period.

The uniqueness of Indian Coffee is that it is grown under the canopy of native shade trees. Besides, Indian coffee plantations are characterized by intercropping with spices and fruits like black pepper, cardamom, vanilla, orange, banana, arecanut etc. In short, Indian coffee is themost eco-friendly and sustainable production system that helps to preserve the bio-diversity in the ecologically sensitive western and eastern ghats.

Two main types of coffee viz., Arabica (*Coffea arabica L.*) and Robusta (*Coffea canephora*) are commercially cultivated worldwide. India also produces three types of specially processed coffees viz., Robusta Kaapi Royale, Mysore Nuggets Extra Bold and Monsooned Malabar which are very well known in the international market.

Arabica is a mild coffee, but the beans being more aromatic, has higher market value compared to Robusta coffee. On the other hand, Robusta has more strength and is therefore used in making various blends. Arabica is grown at higher altitudes of 1000 to 1500 meters where the weather is mild with temperatures ranging between 15^0C and 25^0C while Robusta is grown at relatively lower altitudes ranging from 500 to 1000 meters in a warm and humid climate with temperatures ranging from 20^0C to 30^0C.

Arabica has an economic life span ranging from 25 to 35 years while Robusta produces economic yields even up to 60 years under proper management. Arabica is highly labor intensive and susceptible to pests and diseases such as white stem borer and leaf rust, while Robusta is a hardy plant and tolerant to pests and diseases. The main harvest season is November-December for Arabica and January-February for Robusta.

India is the seventh largest producer of coffee in the world. The area under Arabica coffee in India from 1985 to 2020 increased by 2.14 percent per annum whereas area under Robusta coffee increased to 2.47 percent per annum. The production of Arabica coffee in India increased slowly at 0.57 percent per annum while the productivity of coffee recorded a negative trend at the rate of -1.53 percent per annum. The production of Robusta coffee in India increased to 3.5 percent per annum while the productivity of coffee recorded a positive and significant growth rate of 1.06 percent per annum (Aruna *et al.* (2021)).Karnataka produces about 69 percent of the country's coffee production while Kerala and Tamil Nadu produce 22 percent and 5.6 percent respectively. The rest is contributed by (NTA) and (NER). Karnataka produces both Arabica and Robusta, while Robusta is predominant crop in Kerala and Arabica in Tamil Nadu, NTA and NER. In terms of productivity, India stands an overall third position in Robusta after Vietnam and Brazil and overall seventh position in Arabica production. The productivity of coffee has increased by four folds from about 200kg per hectare in 1950 to about 790kg per hectare in 2020 (Coffee Board of India, 2021). The average productivity of coffee per hectare is highest in Karnataka with 983 kgs of coffee per hectare in the year 2017-18. Kerala and Tamil Nadu have similar total average productivity of 774 kgs per hectare. The productivity is lowest in North Eastern Region with only 63 kgs per hectare. On

an average the productivity of Robusta variety of coffee per hectare is 1031 kgs and of Arabica is 478 kgs (Vidya and Ravindranath (2018)).

Coffee exports have consistently touched above three lakh tonnes from2017 to 2019 and reached 3.06 lakh tonnes during the2020 year with foreign exchange earnings of about Rs. 5255.37 crores.India is the seventh largest exporter of coffee in the world (Coffee Board of India, 2021). Export performance of Indian coffee over the years (1986 to 2011) show comparative advantage Kumareswaran *et al.* (2019) whileShikha (2016) points out that from 2001 to 2014 India had comparative advantage with an exception in 2009, 2013 and 2014 due to crop failure leading to low production and export. The crop failureis attributed to a long spell of drought after receiving blossom showers, followed by an extremely harsh monsoon in the year 2009 and uncertain rains and pest infestation in Arabica crops in the year 2013 and 2014.

In light of climate change, the ecosystem services of traditionally maintained shaded Arabica coffee farms have become prominent for increasing carbon removal. The most important function of the shade-grown coffee agroforestry system is the reduction of the concentration of carbon in the atmosphere. It is estimated that a one-hectare shade-grown coffee farms with large forest trees can sequester 70-80 tonnes of carbon per hectare, which is more or less equivalent to the carbon stored in an equal area of forest.

Coffee being an export-oriented commodity generates foreign exchange ofmore than Rs.5, 500 crores annually. About 90 percent of the coffee growers are having small holdings. Currently coffee sector in India is reeling under the impact ofa multi-year drop in prices and the changing climate patterns. Further, growers are struggling with the rising input costs and pestsand diseases on account of erratic weather patterns.

The global coffee value chain and the market structure changed dramatically after the deregulation, from monopoly to liberalized markets. It was reported that, since the liberalization of coffee markets, prices paid to coffee growers have increased but have led to very high volatility. The small coffee growers in developing countries are more vulnerable to the upswings and downswings that happen day to day on International Commodity Exchange platforms. The coffee sector has changed since liberalization *viz*,theconcentration of production in fewer origins on the supply side and emergence of new importing markets apparent on demand side.

In this backdrop, the aim of the study is to understand the structural changes in theproduction of coffee in India, theconcentration or competitiveness of Indian coffee exports in the International market.

2. MATERIALS AND METHODS

The study was conducted using secondary time series data of area, production and productivity of coffee in India. The time period chosen for the study of area, production and productivity was 1961 to 2020.The data were split into pre-liberalization (1961-1989), post-liberalization (1990-2020) and the whole period (1961-2020). For this the data was collected from FAOSTAT. For the export data the data was collected from 2002 to 2021 years. The data on India's export to top seven coffee importing countries in the world was collectedfrom Trade Map. The data obtained were subjected to the following analysis:

a) Trend lines of area, production and productivity of coffee*:* The trend lines are fitted for a period of 1961 to 2020 for thearea, production and productivity of coffee in India. This helps to observe the fluctuations across the periods.

b) Instability analysis: Coppocks Instability Index (CII) was used to measure the instability analysis of area, production and productivity. This method shows the average year to year percentage variation adjusted to trend(Kaur and Singhal, 1988).It takes the following form:

$$CII = [Antilog\sqrt{logV} - 1]*100 \text{----------(1)}$$

$$logV = \frac{[\log(Xt+1/Xt) - m]2}{N-1} \text{---------- (2)}$$

where, Xt =Area/Production/Yield in the year "t"
N=number of years
m= mean of the difference between logs of Xt+1, Xt
N= number of
log V = logarithmic variance in the series.

c) Hazell's Decomposition Model

Change in average production and change in the variance of production was assessed using Hazell's decomposition model (1982), which decomposes the sources of change in the average of production and change in production variance into four and ten components as cited by Sadiq *et al*. (2021). For the analysis, the data were classified into two periods 1961 to 1989 (base period) and 1990 to 2020 (terminal period).

i) Changes in average production: the model is shown in eq. (3) and eq. (4) and components of change in the average production are shown in Table 1.

$$E(P)=\bar{A}\bar{Y}+COV(A,Y) \text{..... (3)}$$
$$\Delta E(P)=E(P_2)-E(P_1)=\bar{A}_1\Delta\bar{Y}+\bar{Y}_1\Delta\bar{A}+\Delta\bar{A}\Delta\bar{Y}+\Delta COV(A,Y) \text{ .....(4)}$$

Table 1: Components of change in average production

Sl.No.	Sources of change in average production	Symbol	Components of change
1	Change in mean yield	$\Delta\hat{Y}$	$\Delta\hat{A}_1\ \Delta\hat{Y}$
2	Change in mean area	$\Delta\hat{A}$	$\Delta\hat{Y}_1\ \Delta\hat{A}$
3	Interaction between changes in mean yield and mean area	$\Delta\hat{Y}\ \Delta\hat{A}$	$\Delta\hat{Y}\ \Delta\hat{A}$
4	Change in area–yield covariance	Δcov (AY)	Δcov (A,Y)

Source: Sadiq *et al.* (2021)

ii) Change in variance production: the model is shown in eq. (6) and components of change in the average production are shown in Table 2.

Table 2: Components of change in variance production

Sl. No.	Sources of Change	Symbol	Components of change
1	Change in mean yield	$\Delta\hat{Y}$	$2\hat{A}_1\,\Delta\hat{Y}\,CoV(A_1,Y_1) + [2\,\Delta\hat{Y}_1\,\Delta\hat{Y}+(\Delta\hat{Y})^2]V(A_1)$
2	Change in mean area	$\Delta\hat{A}$	$2\hat{Y}_1\,\Delta\hat{A}\,CoV(A_1,Y_1) + \{2\,\Delta\hat{A}_1\,\Delta\hat{A}+(\Delta\hat{A})^2\}V(Y_1)$
3	Change in yield variance	$\Delta V(Y)$	$\widehat{A_1^2}\,\Delta V(Y)$
4	Change in area variance	$\Delta V(A)$	$\widehat{Y_1^2}\,\Delta V(A)$
5	Interaction between changes in mean yield and mean area	$\Delta\hat{Y}\,\Delta\hat{A}$	$2\,\Delta\hat{Y}\,\Delta\hat{A}\,CoV(Y_1,A_1)$
6	Change in area-yield co-variance	$\Delta CoV\,(A,Y)$	$[2\,\Delta\hat{A}_1\,\Delta\hat{Y}_1\text{-}2CoV(Y_1,A_1)]\,\Delta CoV\text{-}[\Delta CoV(A,Y)]^2$
7	Interaction between changes in mean area and yield variance	$\Delta\hat{A}\,\Delta V(Y)$	$[2\hat{A}_1\,\Delta\hat{A}+(\Delta\hat{A})^2]\,\Delta V(Y)$
8	Interaction between changes in mean yield and area variance	$\Delta\hat{Y}\,\Delta V(A)$	$[2\hat{Y}_1\,\Delta\hat{Y}+(\Delta\hat{Y})^2]\,\Delta V(A)$
9	Interaction between changes in mean area yield and changes in area-yield covariance	$\Delta\hat{A}\,\Delta\hat{Y}\,\Delta CoV\,(AY)$	$[2\hat{Y}_1\,\Delta\hat{A}+2\hat{A}_1\,\Delta\hat{Y}+2\,\Delta\hat{A}\,\Delta\hat{Y}]\,\Delta CoV(A,Y)$
10	Change in residual	ΔR	$\Delta V(A,Y)$ – sum of other components

Source: Sadiq *et al.* (2021)

$$V(P)=\bar{A}^2.V(Y)+\bar{Y}^2.V(A)+2\bar{A}\bar{Y}COV(A,Y)-COV(A,Y)^2+R \quad \text{..... (5)}$$

where, P, A and Yrepresent the production, area and yield respectively.

d) Indian coffee export concentration or diversification: this was assessed using HerfindahlHirschmanIndex (HHI). It is used to measure themarket concentration or diversification. The index helps to find India's coffee exportshare in international market. A market with less than 1500 HHI value indicates a competitive market, an HHI of 1,500 to 2,500 is moderately concentrated, and an HHI of 2,500 or greater is highly concentrated.

$$HHI = \sum_{i=1}^{n} Si^2 \text{ ---------- (6)}$$

where,

i = a firm in a given industry (i varies from 1 to n)
n = a number of firms participating in a given industry
Si = each firm's market share in the considered industry

3. RESULTS AND DISCUSSION

Trend lines of area, production, productivity

The pattern of thearea, production and productivity was observed for the period of 1960 to 2020. Figure 1 shows the trend in thearea and production of coffee in India. Over the years the area under coffee has been increasing steadily. The production ofcoffee has been increasing over the years with slight variations in few years. The productivity as shown in Figure 2 shows an increasing trend till 2001 and from 2002 it has been decreasing due to climatic variations and age old plants of coffee in India that are susceptible to weather parameters and its consequences like increase in disease and pest incidence. Especially from 2017 the productivity had decreased due to floods in coffee growing belts of Karnataka and Kerala which are the major coffee-producing states in India.

Instability analysis

The Coppocks Instability Index in Table 3 infers that in the pre-liberalization period the instability was high in the production followed by productivity whereas with respect to area the instability was less unstable. In the post-liberalization period the instability had decreased in production and productivity compared to the pre-liberalization period. But when compared to the overall period the instability was high in production followed by area and then productivity. The source of instability is explained through the decomposition model.

Hazell's Decomposition Analysis

The factors influencing change in average production of coffee and variance in production of coffee are assessed using thedecomposition model.

Table 4 represents the factors influencing change in average production of coffee. The increase in theproduction of coffee in India was mainly contributed by the factor change in the mean area (67.57 %). The other factors such as theinteraction between change in themean area and mean yield (18.48 %) and change in mean yield (16.92 %) contributed less to the increase in average production of coffee. The change in variance of production as represented in table 5 shows that change in area variance (281.74 %),change inthe mean area (205.89 %) and interaction between changes in mean yield and area variance (175.18 %) were the major contributors towards variance of production whereas change in mean yield (75.55 %) and interaction between changes in themean yield and mean area (31.19 %) contributed less towards variance in the production of coffee. Factors such as change in yield variance, change in area yield covariance, interaction between changes in mean area and yield variance and interaction between changes in mean area and yield and changes in area yield covariance had stabilizing effects on coffee production. It is observable that residual had little or no contribution towards the variance of production in coffee in all the countries.

Indian coffee export concentration or diversification

The coffee market concentration was assessed using theHerfindahl Hirschman Index which included the imports of thetop seven coffee importing countries in the world from 2002 to 2021. Table 6 shows that

thecoffee market of India in the international market was highly concentrated. That is Indian coffee market was less competitive in the international market which is dominated by large exporters in the world. Also because of less value addition of coffee in India, Indian coffee is becoming less competitive. The new exporting markets that do not produce coffee have emerged after liberalization that processes the green coffee and exports the processed coffee which has also influencedthe Indian coffee market to become less competitive.

4. CONCLUSION

In the present study it is found that thearea, production and productivity of coffee in India had been increasing over the years. Compared to the pre-liberalization period the stability inthearea, production and productivity in thepost liberalization period has increased. The change in average production of coffee was mainly influenced by change in mean area whereas achange in variance of production was influenced by thechange inthearea variance, achange in mean area. The Indian coffee trade in the international market had been moderately competitive over the years. Therefore it can be concluded that there is scope for increasing coffee production in India along with increasing coffee trade competitiveness. With the increasing demand for coffee in the world consumption market increasing coffee production in India has positive effects. This can be addressed by replanting programs of high-yielding and disease-resistant varietiesto mitigate climatic effects and improving value addition in coffee. By improving value addition the exports of value added coffee can be increased rather than exporting the raw coffee beans itself. Replanting the demand driven varieties of coffee can increase the exports in the international market which will make Indian coffee market competitive in the international market.

REFERENCES

Anonymous. Annual Report *2021*. Coffee Board of India,124.(Last accessed on 20th August, 2021) Available:https://www.indiacoffee.org/Database/DATABASE3_Jan2022.pdf.

Aruna PS, Sivakumar SD, Murugananthi D, John JA. Trend in Area, Production and Yield of Coffee inIndia. *Asian J of Agrcl Extension, Economics &Sociology.* 2021; 39(11): 310-320

Hazell PBR. Instability in Indian foodgrain production.*Int. Food Policy Research Institute*.1982; 30

Kaur N, Singhal, KC.India's Export Instability. *Margin*.1988; 21: 54-61

Kumareswaran T, Singh HP, Kamalvanshi V, Avdhesh S, Debashish K. Production and export performance of coffee in India. *J of Pharmacognosy and Phytochemistry.* 2019; 8(2): 1619-1623

Mohammed SS, Invinder P, Muhammad MA. Tracking the Performance of Soyabean Production in Nigeria.*Yuzuncu Yil University Journal of Agricultural Science*, 2021;31 (1): 197-215

Neelam P, Tanu S. Rural Women: Key to New India's Agrarian Revolution.*Kurukshetra*, 2021; 26-29

Pradeepkumar S. Paradigm shift in coffee plantation labour and small growers in Tamilnadu. *Int. J. of Research and Analytical Reviews*, 2019; 6(3): 46-49

Sadiq MS, Singh IP, Karunakaran N. Supply response of cereal crop farmers to price and non-price factors in Rajasthan state of Nigeria. *J of Agrcl. Econ. and Rural Dvlpt*,2017; 3(2): 203-210.

Shikha S. Make in India: Evaluating trade competitiveness of indian coffee thorugh revealed comparative advantage analysis. *TMIMT Int J*, 2016;

Vidya K, Ravindranath NK. Area, production and productivity of coffee in India: An enquiry. *J of Emerging Technologies and Innovative Research*, 2018; 5(8): 1217-1220.

http://data.worldbank.org (Last accessed on 20th August, 2021)

Table 3: Instability index of area, production and productivity of green coffee in India

	Pre-liberalization (1961-1989)	**Post-liberalization (1990-2020)**	**Whole period (1961-2020)**
Area	47.07	46.71	56.59
Production	56.24	47.57	67.58
Productivity	46.32	41.30	46.17

Source: Author's calculation

Table 4: Components of change in average production of coffee in India

Sl.No.	**Sources of change in average production**	**Symbol**	**Percentage**
1	Change in mean yield	$\Delta\hat{Y}$	16.92
2	Change in mean area	$\Delta\hat{A}$	67.57
3	Interaction between changes in mean yield and mean area	$\Delta\hat{Y}\ \Delta\hat{A}$	18.48
4	Change in area–yield covariance	Δcov (AY)	-2.98

Source: Author's calculation

Table 5: Components of change in variance of production of coffee in India

Sl. No.	**Sources of Change**	**Symbol**	**Percentage**
1	Change in mean yield	$\Delta\hat{Y}$	75.55
2	Change in mean area	$\Delta\hat{A}$	205.89
3	Change in yield variance	ΔV(Y)	-58.33

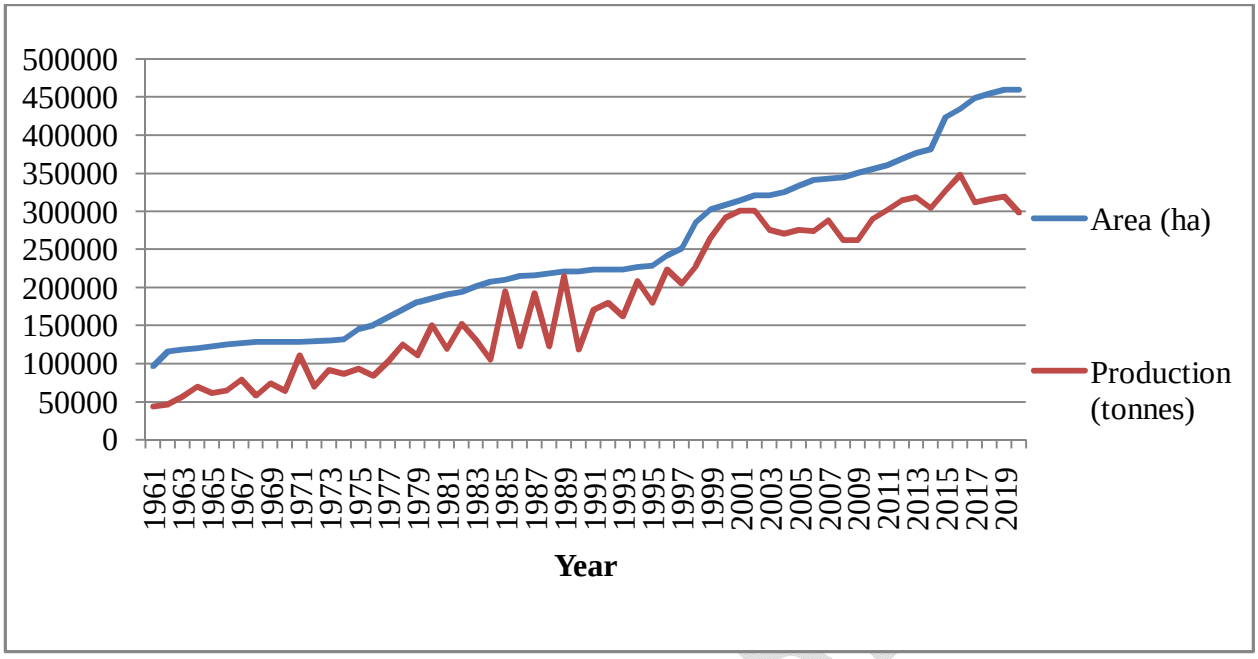
4	Change in area variance	$\Delta V(A)$	281.74
5	Interaction between changes in mean yield and mean area	$\Delta\hat{Y}\ \Delta\hat{A}$	31.19
6	Change in area-yield co-variance	$\Delta CoV(A,Y)$	-154.67
7	Interaction between changes in mean area and yield variance	$\Delta\hat{A}\ \Delta V(Y)$	-197.00
8	Interaction between changes in mean yield and area variance	$\Delta\hat{Y}\ \Delta V(A)$	175.18
9	Interaction between changes in mean area yield and changes in area-yield covariance	$\Delta\hat{A}\ \Delta\hat{Y}\ \Delta CoV(AY)$	-259.55
10	Change in residual	ΔR	0

Source: Author's calculation

Table 6: Concentration of coffee market using Herfindahl-Hirschman Index

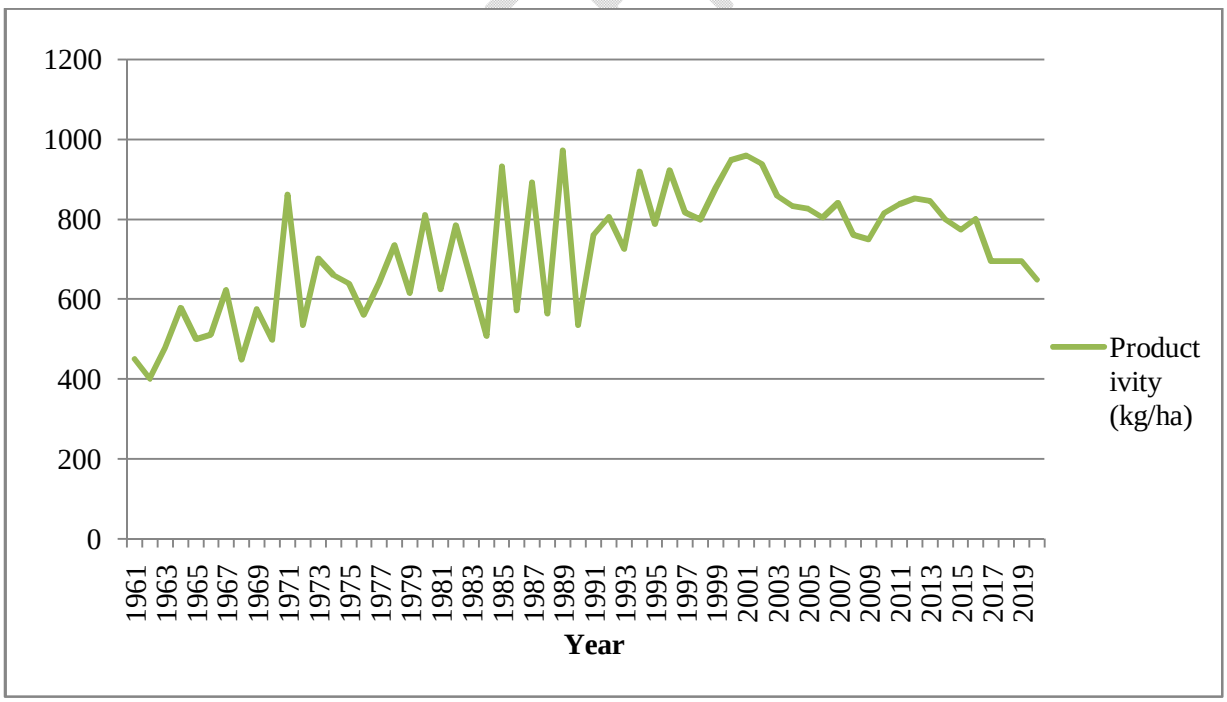
Year	Herfindahl-Hirschman Index
2002	2350.02
2003	2590.51
2004	2324.97
2005	6174.90
2006	8839.67
2007	7308.17
2008	13005.17
2009	6641.93
2010	13628.58
2011	34702.87
2012	33498.66
2013	27916.66
2014	23396.21
2015	24008.57
2016	24465.85
2017	27917.58
2018	19351.42
2019	19315.78
2020	13345.03
2021	21759.40

Source: Author's calculation



Source: Author's calculation

Figure 1: Area and Production of coffee in India



Source: Author's calculation

Figure 2: Productivity of coffee in India