

Growth and instability in area, production and productivity of turmeric in selected states in india

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ABSTRACT: India is popularly known as the “Spice Bowl of the World” for production of variety of spices with superior quality. Turmeric is called as Indian saffron and it is one among the important commercial crop grown in India. India is the largest producer and consumer of turmeric in the world. India contributes about 78 per cent of the world production and a major supplier of turmeric to the world with more than 60 per cent share in turmeric trade. In the last three decades Indian agriculture witnessed so many policy and technological changes. In this context an attempt is made in this study to examine the growth and instability in turmeric production in terms of area, production and yield in selected states of India. The components of change in average production and change in variance of production were also computed and analyzed with the help of decomposition analysis. The growth and instability in turmeric production in India have been examined using secondary data for the period of 32 years, from 1979-80 to 2010-11. This study is confined to five major turmeric producing states in India viz., Andhra Pradesh, Tamil Nadu, Orissa, Karnataka and Kerala. These five states contributed 72 percent of area under turmeric and 82 per of total turmeric production of the country. It is found that all the selected states registered significant growth in area, production and yield of Turmeric, except in the case of area in Andhra Pradesh and Orissa, production in Andhra Pradesh, Karnataka and Orissa and yield in Andhra Pradesh, Karnataka, Orissa and Kerala. It is also found from the analysis that the instability in area was reduced in Andhra Pradesh, production instability was reduced in Andhra Pradesh and Tamil Nadu, yield instability was reduced in Tamil Nadu and Karnataka. It can be concluded from the above analysis that liberalization measures introduced in 1991 is a mixed bag and its impact on agriculture sector, particularly on Turmeric Cultivation would vary from state to state.

Keywords: Compound Growth Rate; Instability; and Decomposition

1 INTRODUCTION

India is popularly known as the “Spice Bowl of the World” for production of variety of spices with superior quality. Turmeric is called as Indian saffron and it is one among the important commercial crop grown in India. India is the largest producer and consumer of turmeric in the world. India contributes about 78 per cent of the world production and a major supplier of turmeric to the world with more than 60 per cent share in turmeric trade. Turmeric had been grown throughout the country in 18 states. The total area under turmeric is 2,32,500 ha with a total production of 12,71,300 tonnes during 2010-11. In the last three decades Indian agriculture witnessed so many policy and technological changes. In this context an attempt is made in this study to examine the growth and instability in turmeric production in terms of area, production and yield in selected states of India. The components of change in average production and change in variance of production were also computed and analyzed with the help of decomposition analysis.

2 OBJECTIVES AND METHODOLOGY

2.1 Objectives

The present paper is based on the following objectives:

1. To analyze the growth performance of turmeric production in India,
2. To examine the instability in turmeric production in India,
3. To know the sources of change in average production of turmeric, and
4. To know the sources of change in variance of turmeric production.

2.2 Period of Study and Sources of Data

The growth and instability in turmeric production in India have been examined using secondary data for the period of 32 years, from 1979-80 to 2010-11. The whole period was split up into two sub-periods viz., pre-liberalization (Period I) and post-liberalization (Period II), treating the year 1990-91 as the cut-off year. The necessary data were obtained from the Spice Board. This study is confined to five major turmeric producing states in India viz., Andhra Pradesh, Tamil Nadu, Orissa, Karnataka and Kerala. These five states contributed 72 percent of area under turmeric and 82 per cent of total turmeric production of the country.

2.3 Methodology

2.3.1 Compound Growth Rate

To study the growth pattern of area, production and yield of turmeric in India, the following semi log transformation model was used:

$$y = \beta_0(1 + g)^t e^u \quad \dots (1)$$

Where,

- y = Area (or) Production (or) Yield of turmeric,
- t = Time period (years)
- β_0 = a parameter,
- g = a parameter that is the compound rate of the growth of y
- u = the disturbance term

If we now take the logs of both sides of (1), we have

$$\text{Log } y = \text{log } \beta_0 + t \text{ log } (1+g) + u$$

$$\text{If we let } y^* = \text{log } y$$

$$\beta_0^* = \text{log } \beta_0$$

$$\beta_1^* = \text{log } (1+g)$$

$$\text{we obtain } y^* = \beta_0^* + \beta_1^* t + u_t$$

This tells us that a compound rate of growth implies a linear relationship, not between y and t, but rather between log y and t.

$$\text{CGR} = [\text{Antilog } \beta_1^* - 1] \times 100$$

2.3.2 Instability

To measure the instability in area, yield and production of turmeric, the coefficient of variations (CV) was worked out.

$$\text{CV which is defined as } CV = \frac{SD}{AM} \times 100$$

SD = Standard Deviation

AM = Arithmetic Mean

2.3.3 Decomposition Model

Turmeric production in India witnessed commendable changes in terms production, area and yield. In order to find out the sources of growth and variability in turmeric production, Hazell's decomposition model was employed. The procedure followed to compute the extent of variability and its decomposition into different components has been described below. Hazell (1982) suggested the linearly detrended data for his entire decomposition analysis. Because the long-term trend in each variable needs to be removed in order to separate it from the short-term stochastic variation. The area and yield data for turmeric production in India were detrended using linear relations of the form

$$Z_t = a + b_t + e_t \quad \dots (2)$$

Where Z_t denotes the dependent variable (area or yield), t is time and e_t is a random residual with zero mean and variance σ^2 . Separate regressions are run for each of the two time periods to ensure that $\sum_t e_t = 0$ for each period. Linear relations are used here because they do not assume a deterministic part to any relation between the variance of Z and time t .

After detrending the residuals are centered on the mean areas or yields for each period, $Z_t - \bar{Z}$, resulting in detrended time-series data of the form

$$\dot{Z}_t = e_t + \bar{Z} \quad \dots (3)$$

These detrended data are used as the basic data for decomposition of changes in average production and changes in variance of turmeric production. Hazell decomposed the sources of change in mean production and change in production variance into four and ten components. The Hazell's decomposition procedure is given below.

Let P denote production, A denote the area sown under a particular crop and Y is the yield per hectare. Then for each crop total output in the state is $P = A * Y$. The variance of production, $V(P)$ can be expressed as

$V(P) = \bar{A}^2 V(Y) + \bar{Y}^2 V(A) + 2\bar{A}\bar{Y} \text{cov}(A, Y) - \text{cov}(A, Y)^2 + R \dots (4)$ Where \bar{A} and \bar{Y} denote mean area and mean yield respectively. R denote the residual term which is expected to be small. Clearly, a change in any one of these components will lead to a change in $V(P)$ between two periods in time. Similarly, average production, $E(P)$ can be expressed as:

$$E(P) = \bar{A}\bar{Y} + \text{cov}(AY) \quad \dots (5)$$

It is affected by changes in the covariance between area and yield and by changes in mean area and mean yield. The objective of the decomposition analysis is to partition the changes in $V(P)$ and $E(P)$ between the first and the second periods into constituent parts, which can be attributed separately to changes in the means, variances and covariances of area and yield.

2.3.3.1 Method of Decomposition of Average Production

Using Eq. (5), average production in the first period is

$$E(P_1) = \bar{A}_1 \bar{Y}_1 + \text{cov}(A_1 Y_1) \quad \dots (6)$$

and in the second period is

$$E(P_2) = \bar{A}_2 \bar{Y}_2 + \text{cov}(A_2 Y_2) \quad \dots (7)$$

Each variable in the second period can be expressed as its counterpart in the first period plus the change in the variable between the two periods. For example,

$$\bar{A}_2 = \bar{A}_1 + \Delta\bar{A}$$

$$\bar{Y}_2 = \bar{Y}_1 + \Delta\bar{Y}$$

$$\text{Cov}(A_2, Y_2) = \text{Cov}(A_1, Y_1) + \Delta\text{Cov}(A_1, Y_1)$$

Eq. (4.7) can, therefore be rewritten as:

$$\begin{aligned} E(P_2) &= (\bar{A}_1 + \Delta\bar{A})(\bar{Y}_1 + \Delta\bar{Y}) + \text{cov}(A_1 Y_1) + \Delta\text{cov}(A, Y) \\ &= \bar{A}_1 \bar{Y}_1 + \bar{A}_1 \Delta\bar{Y} + \bar{Y}_1 \Delta\bar{A} + \Delta\bar{A} \Delta\bar{Y} + \text{cov}(A_1 Y_1) + \Delta\text{cov}(A, Y) \quad \dots (8) \end{aligned}$$

The change in average production, $\Delta E(P)$ is then obtained by subtracting Eq. (6) from Eq. (8). Thus,

$$\begin{aligned} \Delta E(P) &= E(P_2) - E(P_1) \\ &= \bar{A}_1 \Delta\bar{Y} + \bar{Y}_1 \Delta\bar{A} + \Delta\bar{A} \Delta\bar{Y} + \Delta\text{cov}(AY) \quad \dots (9) \end{aligned}$$

Hence there are four sources of change in average production resulted from this equation (9) which can be arranged as in Table 1. The first two terms, change in the mean yield and change in mean area are called as „pure effects“ which arise even if there were no other source of change. The third term is an interaction effect, which arise from the simultaneous occurrence of changes in mean yield and mean area. The fourth term in the equation represents interaction between area and yield covariance.

Table 1: Components of Change in Average Production

Sources of Change	Symbol	Components of Change
Change in mean yield	$\Delta\bar{Y}$	$\bar{A}_1 \Delta\bar{Y}$
Change in mean area	$\Delta\bar{A}$	$\bar{Y}_1 \Delta\bar{A}$
Interaction between changes in mean yield and mean area	$\Delta\bar{A} \Delta\bar{Y}$	$\Delta\bar{A} \Delta\bar{Y}$
Change in area–yield covariance	$\Delta\text{cov}(AY)$	$\Delta\text{cov}(AY)$

2.3.3.2 Methods of Decomposition of the Changes in Variance of Production

In this section, we will construct a method to partition the changes in variance of production ($V(P)$) between the first and the second periods into its constituent parts.

As shown in Eq. (4), the variance of production, $V(P)$ can be expressed as,

$$V(A_2 Y_2) = \bar{A}_2^2 V(Y_2) + \bar{Y}_2^2 V(A_2) + 2\bar{A}_2 \bar{Y}_2 \text{cov}(A_2, Y_2) - \text{cov}(A_2, Y_2)^2 + R$$

Using Eq. (4), variance of production in the first period is

$$V(P_1) = \bar{A}_1^2 V(Y_1) + \bar{Y}_1^2 V(A_1) + 2\bar{A}_1 \bar{Y}_1 \text{cov}(A_1, Y_1) - \text{cov}(A_1, Y_1)^2 + R \quad \dots (10)$$

and in the second period is

$$V(P_2) = \bar{A}_2^2 V(Y_2) + \bar{Y}_2^2 V(A_2) + 2\bar{A}_2 \bar{Y}_2 \text{cov}(A_2, Y_2) - \text{cov}(A_2, Y_2)^2 + R \quad \dots (11)$$

each variable in the second period can be expressed as its counterpart in the first period plus the change in the variable between the two periods, i.e.,

$$\bar{A}_2 = \bar{A}_1 + \Delta\bar{A}$$

$$\bar{Y}_2 = \bar{Y}_1 + \Delta\bar{Y}$$

$$V(A_2) = V(A_1) + \Delta V(A)$$

$$V(Y_2) = V(Y_1) + \Delta V(Y)$$

$$\text{Cov}(A_2, Y_2) = \text{Cov}(A_1, Y_1) + \Delta\text{Cov}(A_1, Y_1)$$

Eq. (4.11) can, therefore, be rewritten as

$$V(P_2) = \{A_1 + \Delta A_1\}^2 \{V(Y_1) + \Delta V(Y)\} + \{Y_1 + \Delta Y\}^2 \{V(A_1) + \Delta V(A)\} + 2\{\bar{A}_1 + \Delta \bar{A}_1\} \{\bar{Y}_1 + \Delta \bar{Y}_1\} \{\text{cov}(A_1, Y_1) + \Delta \text{cov}(A, Y)\} - \{\text{cov}(A_1, Y_1) + \Delta \text{cov}(A, Y)\}^2 + \{R_1 + \Delta R\} \dots(12)$$

which can be expressed as

$$V(P) = A_1^2 V(Y) + \Delta A_1^2 V(Y) + 2A_1 \Delta A_1 V(Y) + A_1^2 \Delta V(Y) + \Delta A_1^2 \Delta V(Y) + 2A_1 \Delta A_1 \Delta V(Y) + Y_1^2 V(A) + \Delta Y^2 V(A) + 2Y_1 \Delta Y V(A) + Y_1^2 \Delta V(A) + \Delta Y^2 \Delta V(A) + 2Y_1 \Delta Y \Delta V(A) + 2A_1 Y_1 \text{cov}(A_1, Y_1) + 2\bar{A}_1 \bar{Y}_1 \text{cov}(A_1, Y_1) + 2\Delta \bar{A}_1 \Delta \bar{Y}_1 \text{cov}(A_1, Y_1) + 2A_1 Y_1 \Delta \text{cov}(A, Y) + 2A_1 \Delta Y \Delta \text{cov}(A, Y) + 2Y_1 \Delta A_1 \Delta \text{cov}(A, Y) + 2\Delta A_1 \Delta Y \Delta \text{cov}(A, Y) - \{\text{cov}(A_1, Y_1)\}^2 - \{\Delta \text{cov}(A, Y)\}^2 - 2 \text{cov}(A_1, Y_1) \Delta \text{cov}(A, Y) + R_1 + \Delta R \dots(13)$$

The change in variance of production, Δ V(P) is then obtained by subtracting Eq. (10) from Eq. (13). Thus

$$\Delta V(P) = V(P_2) - V(P_1) = \Delta A_1^2 V(Y) + 2A_1 \Delta A_1 V(Y) + A_1^2 \Delta V(Y) + \Delta A_1^2 \Delta V(Y) + 2A_1 \Delta A_1 \Delta V(Y) + \Delta Y^2 V(A) + 2Y_1 \Delta Y V(A) + Y_1^2 \Delta V(A) + \Delta Y^2 \Delta V(A) + 2Y_1 \Delta Y \Delta V(A) + 2A_1 Y_1 \text{cov}(A_1, Y_1) + 2\bar{A}_1 \bar{Y}_1 \text{cov}(A_1, Y_1) + 2\Delta \bar{A}_1 \Delta \bar{Y}_1 \text{cov}(A_1, Y_1) + 2A_1 Y_1 \Delta \text{cov}(A, Y) + 2A_1 \Delta Y \Delta \text{cov}(A, Y) + 2Y_1 \Delta A_1 \Delta \text{cov}(A, Y) + 2\Delta A_1 \Delta Y \Delta \text{cov}(A, Y) - \{\Delta \text{cov}(A, Y)\}^2 - 2 \text{cov}(A_1, Y_1) \Delta \text{cov}(A, Y) + \Delta R \dots(14)$$

which can be arranged as in Table 2.

Table 2: Components of Change in the Variance of Production

Sources of Change	Symbol	Components of Change
Change in mean yield	ΔY	2A ₁ ΔY cov(A ₁ , Y ₁) + {2Y ₁ ΔY + (ΔY) ² } V(A ₁)
Change in mean area	ΔA	2Y ₁ ΔA cov(A ₁ , Y ₁) + {2A ₁ ΔA + (ΔA) ² } V(Y)
Change in yield variance	ΔV(Y)	A ₁ ² ΔV(Y)
Change in area variance	ΔV(A)	Y ₁ ² ΔV(A)
Interaction between changes in mean yield and mean area	ΔA ΔY	2ΔA ΔY cov(A ₁ , Y ₁)
Change in area–yield Covariance	Δcov(A, Y)	{2A ₁ Y ₁ - 2cov(A ₁ , Y ₁)} Δcov(A, Y) - {Δcov(A, Y)} ²
Interaction between changes in mean area and yield variance	ΔA ΔV(Y)	{2A ₁ ΔA + (ΔA) ² } ΔV(Y)

Interaction between changes in yields and area variance	$\Delta Y \Delta V (A)$	$\{2\bar{Y} \Delta Y + (\Delta Y)^2\} \Delta V (A)$
Interaction between changes in mean area and yield and changes in area–yield covariance	$\Delta \bar{A} \Delta \bar{Y} \Delta \text{cov}(AY)$	$(2\bar{A}_1 \Delta \bar{Y} + 2\bar{Y}_1 \Delta \bar{A} + 2\Delta \bar{A} \Delta \bar{Y}) \Delta \text{cov}(A, Y)$
Change in residual	ΔR	$\Delta V (AY) - \text{Sum of the other components}$

3 ANALYSIS AND DISCUSSION

3.1 Growth of Area, Production and Yield of Turmeric

The growth rates of area, production, and yield of Turmeric during pre-liberalization and post-liberalization periods and overall period are presented in Table 3.

Table 3: Growth Rates of Area, Production and Yield of Turmeric

	Period I			Period II			Overall Period		
	A	P	Y	A	P	Y	A	P	Y
Andhra Pradesh	5.96	8.76	2.66	1.46	3.83	2.34	3.57	6.55	2.88
Tamil Nadu	-1.91	1.48	3.47	4.90	4.48	-0.40	3.20	3.53	0.31
Karnataka	6.06	22.43	15.44	7.19	3.37	-3.53	5.69	5.44	-0.22
Orissa	0.41	8.24	7.80	-0.28	4.13	4.42	0.20	4.83	4.61
Kerala	-1.62	-1.16	0.59	-1.24	-0.34	0.95	-0.14	0.89	1.01
India	2.49	7.34	4.73	2.37	4.38	1.97	2.56	5.35	2.73

Note: A – Area, P – Production and Y – Yield

3.1.1 Andhra Pradesh

It is evident from table 3 that, in Andhra Pradesh, the growth rate of area, production and yield of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the growth rates were found to be higher in Period I as compared to Period II.

3.1.2 Tamil Nadu

In Tamil Nadu, the growth rate of area under Turmeric was found to be negative in Period I and the same was higher and positive in Period II. The growth rate of production of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the growth rate of Turmeric production in Period II was found to be higher as compared to Period I. The growth rate of yield of Turmeric was found to be positive in Period I and Overall Period. However, the same was negative in Period II.

3.1.3 Karnataka

In the state of Karnataka, the growth rate of area and production of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the growth rate of area was found to be higher in Period II as compared to Period I and the growth rate of production was found to be higher in Period I as compared to Period II. The growth rate of yield of Turmeric was found to be positive and higher in Period I and turned negative in Period II.

3.1.4 Orissa

In Orissa, the growth rate of production and yield of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the growth rate of area was found to be higher in

Period I as compared to Period II. The growth rate of area under Turmeric was found to be positive and meager in Period I and turned negative in Period II.

3.1.5 Kerala

In the state of Kerala, the growth rate of area and production of Turmeric was found to be negative in Period I and Period II. However, the growth rates of area and production in Period II was comparatively better than the Period I. The growth rate of yield of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the same was negative in Period II. However, the growth rate of yield was found to be higher in Period II as compared to Period I.

3.1.6 India

At national level, the growth rate of area, production and yield of Turmeric was found to be positive in Period I, Period II and Overall Period. However, the growth rates were found to be higher in Period I as compared to Period II.

It is also found from Table 3 that, during the Period I, Karnataka ranked first in terms of growth in area, production and yield of Turmeric. While in the period II, Karnataka retained its first position in terms of growth in area, Tamil Nadu ranked first in terms of growth in production and Orissa ranked first in terms of growth in yield of Turmeric.

3.2 Instability in Area, Production and Yield of Turmeric

The instability index of area, production, and yield of Turmeric during pre-liberalization and post-liberalization periods and overall period are presented in Table 4.

Table 4: Instability Index of Area, Production and Yield of Turmeric

	Period I			Period II			Overall Period		
	A	P	Y	A	P	Y	A	P	Y
Andhra Pradesh	28.44	33.78	18.41	12.41	27.82	20.65	31.89	53.89	30.42
Tamil Nadu	30.05	47.89	24.88	38.97	40.53	11.96	44.23	48.33	17.41
Karnataka	28.91	109.41	77.08	61.20	56.49	58.13	73.00	73.23	65.95
Orissa	5.60	40.93	40.90	9.06	60.10	58.73	8.44	69.22	66.63
Kerala	9.84	9.91	3.23	17.16	20.53	9.16	15.22	21.72	11.43
India	11.50	30.79	20.51	16.79	31.01	16.60	25.14	48.76	26.84

Note: A – Area, P – Production and Y – Yield

3.2.1 Andhra Pradesh

Table 4 revealed that in Andhra Pradesh, area, production and yield of turmeric had shown instability of 31.89, 53.89 and 30.42 per cent, respectively, during the overall study period. In the case of sub-periods, the instability in Turmeric cultivated area and production was found to be highest in Period I as compared to Period II. This clearly indicates that during the Period II the instability in area and production of Turmeric was minimized in a considerable manner. However, the instability in Turmeric yield was increased a little bit from 18.41 per cent in period I to 20.65 per cent in period II.

3.2.2 Tamil Nadu

In Tamil Nadu, area, production and yield of turmeric had shown instability of 44.23, 48.33 and 17.41 per cent, respectively, during the overall study period. In the case of sub-periods, the instability in Turmeric production and yield was found to be highest in Period I as compared to Period II. This clearly indicates that during the Period II the instability in production and yield of

Turmeric was minimized. However, the instability in Turmeric cultivated area was increased from 30.05 per cent in Period I to 38.97 per cent in Period II.

3.3.3 Karnataka

In Karnataka, the instability in Turmeric production and yield was found to be highest in Period I as compared to Period II. This clearly indicates that during the Period II the instability in production and yield of Turmeric was minimized. But in the case of Turmeric cultivated area the instability was increased more than two times i.e., from 28.91 per cent in period I to 61.2 per cent in period II. During the overall study period, the instability in Turmeric cultivated area, production and yield in the state of Karnataka was 73.0, 73.23 and 65.95 per cent, respectively.

3.2.4 Orissa

During the overall study period, the instability in Turmeric cultivated area, production and yield in the state of Orissa was 8.44, 69.22 and 66.63 per cent, respectively. In the case of sub-periods, the instability in area, production and yield of Turmeric was found to be highest in Period II as compared to Period I.

3.2.5 Kerala

The considerable variations were witnessed in area, production and yield of Turmeric in the state of Kerala as evident from higher instability index during the overall study period. Like Orissa, Kerala also witnessed the highest instability in area, production and yield of Turmeric during the Period II.

3.2.6 India

At national level, during the overall study period, Turmeric production had shown the highest instability of 48.76 per cent followed by yield (26.84%) and area (25.14%). Comparing the two sub-periods, Period II registered the highest instability in area, production and yield of Turmeric. However, the instability in production remained almost the same in two sub-periods.

3.3 Decomposition Analysis: Sources of Change in Average Production of Turmeric

To estimate the variability in production of Turmeric in India, two periods were considered. The sources of change in average production during the post-liberalization period (1991-92 to 2010-11) over the pre-liberalization period (1979-80 to 1990-91) was analyzed to identify the contribution of different sources to the change in mean production of Turmeric is presented in Table 5.

Table 5: Sources of Change in Average Production of Turmeric

Components	Andhra Pradesh	Tamil Nadu	Karnataka	Orissa	Kerala	India
Change in Mean Yield	30.9	4.9	-8.6	88.5	68.3	40.5
Change in Mean Area	41.5	94.1	119.7	5.1	24.7	38.2
Interaction between Changes in Mean Yield and Mean Area	26.5	3.2	-12.8	5.4	4.7	21.3
Change in Area-Yield Covariance	1.1	-2.2	1.7	1	2.3	0

In case of Andhra Pradesh the variation in average production was due to the changes in mean area (41.5 per cent), whereas the changes in mean yield, interaction between changes in mean yield and mean area and change in area-yield covariance accounted for 30.9 per cent, 26.5 per cent and 1.1 per cent respectively. Hence change in mean area was found to be dominant source of output growth in Andhra Pradesh.

In case of Tamil Nadu, the change in average production was mainly due to change in mean area (94.1%). The change in mean yield and the interaction between changes in mean yield and mean area contributed a meager 4.9 per cent and 3.2 per cent, respectively.

From the Table 5 it is clear that if we see in the state of Karnataka there is an increasing trend in average production of Turmeric mainly because of change in mean area, which accounted for 119.7 per cent, followed by change in area-yield covariance (1.7 per cent). The interaction effect between change in mean area and mean yield was negative (-12.8 per cent) and that of change in mean yield was also negative (-8.6 per cent). The change average production of Turmeric for the state of Orissa was predominantly due to change in mean yield (88.5 per cent) followed by the interaction between changes in mean yield and mean area (5.4 per cent), change in mean area (5.1 per cent) and change in area-yield covariance(1 per cent).

The analysis for the state of Kerala showed that the change in mean yield was positive and the highest among all the components of change in average production of Turmeric. Change in mean area contributed 24.7 per cent of change in average production and the contribution made by the remaining components was very meager.

The change in average production of Turmeric for the country as a whole was predominantly due to change in mean yield (40.5 per cent) followed by change in mean area (38.2 per cent) and the interaction effect between changes in mean yield and mean area (21.3 per cent). On the other hand, the change in covariance between area and yield was zero.

3.4 Sources of Change in Variance of Turmeric Production

The change in variance of production of Turmeric between sub periods was decomposed and the results are presented in Table 6.

Table 6: Sources of Change in Variance of Turmeric Production

Components	Andhra Pradesh	Tamil Nadu	Karnataka	Orissa	Kerala	India
Change in Mean Yield	8.3	16	-0.9	0.6	4.9	9.9
Change in Mean Area	10	250.5	67.8	1	0.4	18.6
Change in Yield Variance	12.5	-67.9	-2.9	77.9	12	15.7
Change in Area Variance	-0.1	217.7	41.1	0.5	37.6	10.9
Interaction between Changes in Mean Yield and Mean Area	-4.3	2.9	-0.9	0	0	2.2
Change in Area-Yield Covariance	12.3	-58.4	1.7	2.2	21.2	-0.2
Interaction between Changes in Mean Area and Yield Variance	30.8	-116.3	-15.1	9.8	1.7	20.8
Interaction between Changes in Mean Yield and Area Variance	-0.1	15	-8.3	1.7	15.6	15.5
Interaction between Changes in Mean Area and Yield and Changes in Area-Yield Covariance	25.2	-42.2	2.3	2.6	5.8	-0.2
Change in Residual	5.3	-117.3	15.2	3.8	0.9	6.9

In Andhra Pradesh, the variance of Turmeric production was predominantly due to the interaction between changes in mean area and yield variance (30.8 per cent). Another 25.2 per cent

in variance of production was due to the interaction between changes in mean area and yield and changes in area-yield covariance.

In Tamil Nadu, the change in variance of Turmeric production was mainly due to the change in mean area (250.5 per cent) and change in area variance (217.7). Another 16 per cent increase in variance of production was due to the change in mean yield. On the other hand, change in residual, interaction between changes in mean area and yield variance, change in yield variance, change in area-yield covariance and interaction between changes in mean area and yield and changes in area-yield covariance were negative and acted to reduce the variability.

Of the ten component parts, which constitute the total increase in the variance of Turmeric production in Karnataka, change in mean area and change in area variance accounted for the majority of the changes in the variance. They accounted for 67.8 per cent and 41.1 per cent of changes respectively. On the other hand, most of the interaction terms were negative and acted to reduce the variability.

The changes in yield variance account for large shares of the changes in the variance of Turmeric production in Orissa. They account for 77.9 per cent of the increase in the variance of Turmeric production. The results further reveals that the interaction and other terms were not important in explaining the changes in the variance of production of Turmeric in Orissa.

In the case of Kerala, the changes in area variance account for large shares of the changes in the variance of production for Turmeric. They account for 37.6 per cent of the increase in the variance of Turmeric production. The changes in area-yield covariance, interaction between changes in mean yield and area variance and change in yield variance accounted for 21.5 per cent, 15.6 per cent and 12 per cent of changes in the variance of production for Turmeric in the state of Kerala.

The change in the variance of Turmeric production at the all India level was the mainly due to the result of Interaction between Changes in Mean Area and Yield Variance (20.8 per cent), followed by Change in Mean Area (18.6 per cent), Change in Yield Variance (15.7 per cent), Interaction between Changes in Mean Yield and Area Variance (15.5 per cent), Change in Area Variance (10.9 per cent), Change in Mean Yield (9.9 per cent) and Change in Residual (6.9 per cent).

4 CONCLUSION

According to the Spices Board of India, about 52 spices are being grown in our country. Turmeric is one of the most important spice crops of India. It is found that all the selected states registered significant growth in area, production and yield of Turmeric, except in the case of area in Andhra Pradesh and Orissa, production in Andhra Pradesh, Karnataka and Orissa and yield in Andhra Pradesh, Karnataka, Orissa and Kerala. It is also found from the analysis that the instability in area was reduced in Andhra Pradesh, production instability was reduced in Andhra Pradesh and Tamil Nadu, yield instability was reduced in Tamil Nadu and Karnataka.

It can be concluded from the above analysis that liberalization measures introduced in 1991 is a mixed bag and its impact on agriculture sector, particularly on Turmeric Cultivation would vary from state to state.

5 REFERENCES

- [1] Angles, S., 2001, "Production and Export of Turmeric in South India – An Economic Analysis", M.Sc., (Agri) Thesis, University of Agricultural Sciences, Dharwad.
- [2] Basha. S. Kareemullah and Hussaina Banu, 2007, "Turmeric Production", **Kisan World**, Vol.34, No. 12, (December), pp.59-62.
- [3] Dhanoji, M. M., 2011, "Effect of Foliar Spray of Micronutrients and Plant Growth Regulators on Growth and Turmeric", **The Asian Journal of Horticulture**, Vol. 6, No. 1, pp: 60-62.
- [4] Hazell, P.B.R., 1982, "Instability in Indian Foodgrain Production", Research Report 30, International Food Policy Research Institute, Washington, D. C., USA.
- [5] Krishnadas, M., 2010, "Production and Export Performance of Major Indian Spices – An Economic Analysis", M.Sc., (Agri) Thesis, University of Agricultural Sciences, Dharwad.
- [6] Mahir, Mohamed Elamin Abd Ellatif and Hag Hamad Abdelaziz, 2011, "Analysis of Agricultural Production Instability in the Gezira Scheme", **Journal of the Saudi Society of Agricultural Science**, Vol. 10, pp: 53–58.
- [7] Meenakshi, R. and J. Gayathri, 2006, "Instability in Cereals Production: An Analysis of Tamil Nadu", **Agricultural Situation in India**, Vol. LXIII, No. 7, pp: 431-434.
- [8] ThamaraiKannan. M. 2008, Growth of Turmeric Trade in India", **Kisan World**, Vol. 35, No. 10, (October), pp. 8-13.
- [9] www.indianspices.com
