Madras Agric. J. 92 (4-6) : 271-278 April-June 2005
https://doi.org/10.29321/MAJ.10.A00047

Instability in area, production and productivity of turmeric in select South Indian states

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Abstract : The instability in turmeric production were examined in terms of area and productivity in important states of South India *viz.* Andhra Pradesh, Tamil Nadu, Karnataka and Kerala. These states contributed around 80 percent of turmeric produced in India. Secondary data was used for the study, considering the period from 1979-80 to 1998-99. Hazell's decomposition model was used for the analysis. The instability in area and productivity of turmeric indicated that the area in the case of Andhra Pradesh and Tamil Nadu showed instability, while Kerala showed stability. But, in the case of yield, except Karnataka all other states showed instability. Decomposition analysis showed that yield instability was the dominant factor affecting production. The future development programmes should envisage stabilisation of yield, which would stabilize production. Evolving location specific varieties, adoption of modern cultural practices and intensive cultivation were some of the suggestions for stabilising productivity of turmeric.

Introduction

India is called as the "Spice Bowl of the World" for production of variety of spices with superior quality. Growing spices for various purposes has been famous since the ancient times. There are records about various spices and its properties in the Vedas as early as 6000 BC. India is well known for the trade, since the period of exploration of sea routes, because of its variety of spices and superior quality, which attracted foreigners to India. This is the key reason because of which India was invaded by the European countries and was imperialized. To such an extent India is famous for the spices. Turmeric is called as Indian saffron. Nowhere in the world one could see such a variety of this spice being grown. Turmeric is an important spice in our daily diet and useful dye with various uses in dying and cosmetic industries.

India is the largest producer and consumer of turmeric in the world. The total area under turmeric is 1,55,800 ha with a total production of 5,98,400 tonnes. Turmeric had been grown throughout the country in 18 states. The important states that produce turmeric are Andhra Pradesh, Tamil Nadu, Orissa and Karnataka. Among the states producing turmeric, Andhra Pradesh has the highest area under turmeric (59500 ha) followed by Orissa (26800 ha) and Tamil Nadu (21700 ha). Andhra Pradesh occupies first position in production also which contributes 51.14 per cent of the total output of the country followed by Tamil Nadu (21.16%), Orissa (10.75%) and Karnataka occupies fourth position which contributes 3.94 per cent of the total turmeric production in India. In the case of yield, Gujarat occupies first position (18,500 kg/ha) followed by Mizoram (9000 kg/ha) and Tamil Nadu (5834 kg/ha), Anonymous (1999). The present study attempts to estimate the instability in area, production and productivity of turmeric in important states of South India.

Table 1. Components of Change in Average Production

S.No.	Source of Change	Nature of effect	Components of change
1.	Change in mean area	Pure effect	$Y_1 \Delta A$
2.	Change in mean yield	Pure effect	$A_1 \Delta Y$
3.	Interaction between changes in mean area and yield	Interaction effect	$\Delta A\ \Delta Y$
4.	Changes in area yield covariance	Effect due to change in variabilities of area and yield and their correlations	$\Delta COV(A, Y)$

Table 2. Components of Change in Variance of Production

S.No.	Source of Change	Nature of effect	Components of change
1.	Change in mean area	A	$2\ Y_1 \Delta\ A\ COV(Y_1, A_1)+[2\ A_1 \Delta\ A+(\Delta A)^2]\ V(Y_1)$
2.	Change in mean yield	ΔY	$2A1\Delta\ YCOV(Y_1, A_1) + [2\ Y_1 \Delta Y+(\Delta Y)^2]\ V(A_1)$
3.	Change in area variance	$\Delta V(A)$	$(Y_1)^2 \Delta V(A)$
4.	Change in yield variance	$\Delta V(Y)$	$(A_1)^2 \Delta V(Y)$
5.	Interaction between changes in mean area and mean yield	$\Delta V, \Delta A$	$2\Delta\ Y\Delta\ A\ COV(Y_1 A_1)$
6.	Change in area-yield covariance	$\Delta COV\ (Y, A)$	$[2\ A_1\ Y_1 - 2COV(Y_1, A_1)]\ \Delta COV(Y,A)-[\Delta COV(Y,A)]^2$
7.	Interaction between changes in mean area and yield variance	$\Delta A, \Delta V(Y)$	$[2\ A1\Delta\ A + (\Delta A)^2]\Delta V(Y)$
8.	Interaction between changes in mean area and yield variance	$\Delta Y, \Delta V(A)$	$[2\ Y_1 \Delta\ Y+(\Delta Y)^2]\ \Delta V(A)]$
9.	Interaction between changes in area & yield and changes in area-yield covariance	$\Delta Y \Delta\ A \Delta COV(Y,A)$	$[2\ Y_1 \Delta\ A+2\ A_1 \Delta\ Y+2\Delta\ A\Delta\ Y]$
10.	Change in residual	ΔR	$\Delta COV(A,Y)$-sum of the other components

Materials and Methods

The study area is confined to the South Indian states namely Andhra Pradesh, Tamil Nadu, Karnataka and Kerala, which contributed 80 per cent of the total turmeric output. To assess the instability in area, production and productivity of turmeric, time series data over the period from 1979-80 to 1998-99 was collected and analysed. The overall period of the study had been divided into two parts i.e. 1979-80 to 1990-91 and 1991-92 to 1998-99 based on pre liberalisation and post liberalisation periods respectively.

Analytical Technique

Instability in area, production, and productivity of turmeric were analyzed using the Hazell's (1982) decomposition technique.

Analysis of Variability in Turmeric Production

In order to estimate variability in production of turmeric, data were detrended linearly and centered around their respective means for both the periods separately. The variance of production was decomposed into its constituent sources *viz.*, area variance, yield variance, area-yield co-variances and higher order interaction between area and yield. The pattern of changes in the sources of instability was examined using Hazell's (1982) decomposition technique. The decomposition procedure was used in the present study in order to isolate the effects of different factors contributing to variability. The method used is discussed below.

Let P, A and Y denote production, area sown and yield of the crop respectively; the relationship between the three variables can be denoted as:

$$P = AY$$

The average production, E(P), can be expressed as:

$$E(P) = \overline{A}\,\overline{Y} + COV(A, Y) \quad \text{..... (1)}$$

Where, A Y and COV (A, Y) are mean area, mean yield and covariance between area and yield, respectively.

To divide the changes in E(P) between the two periods, the average production of each sub periods can be expressed as:

$$E(P_1) = A_1 Y_1 + COV(A_1, Y_1) \quad \text{.......(2)}$$
$$E(P_2) = A_2 Y_2 + COV(A_2, Y_2) \quad \text{......(3)}$$

Taking the first period as base period, each variable in the second period can be expressed in terms of its counter part in the first period as follows.

$$A_2 = A_1 + \Delta A, \quad Y_2 = Y_1 + \Delta Y$$
$$\text{and } COV(A_2, Y_2) = COV(A_1 Y_1) + \Delta COV(A_1, Y_1)$$

$$\text{where, } \Delta A = A_2 - A_1, \quad \Delta Y = Y_2 - Y_1$$
$$\text{and } \Delta COV(A, Y) = COV(A_2, Y_2) - COV(A_1, Y_1)$$

Equation (3) can be written as:

$$E(P_2) = (A_1 + \Delta A)(Y_1 + \Delta Y) + COV(A_1, Y_1) + \Delta COV(A, Y) \quad \text{..... (4)}$$

The change in average production, AE(P) can be derived by subtracting equation (2) from equation (4). This reduces the relationship to :

$$\Delta E(P) = E(P_2) - E(P_1)$$
$$= A_1 \Delta Y + Y_1 \Delta A + \Delta A\, \Delta Y + \Delta COV(A, Y) \quad \text{........ (5)}$$

Change in average production has four components, *viz.*, changes in mean area and mean yield, interaction of changes in mean area and yield and changes in variability of area and yield. Table 1 shows these four components of source of change in average production.

Table 3. Components of Change in Average Turmeric Production in Important States of Southern India

S.No.	Components of change	Andhra Pradesh	Tamil Nadu	Karnataka	Kerala
1.	Change in mean area	98.19 (38.36)	93.44 (44.53)	0.00 (0.00)	-0.55 (-0.54)
2.	Change in mean yield	132.62 (51.81)	80.06 (4.15)	-1.36 (100.00)	126.63 (125.79)
3.	Interaction between mean area and mean yield	5.02 (1.96)	7.90 (4.36)	0.00 (0.00)	-0.26 (-0.26)
4.	Change in co- variance between area and yield	20.14 (7.87)	-0.07 (-0.04)	0.00 (0.00)	-25.16 (-24.99)
5.	Total	255.97 (100.00)	181.33 (100.00)	100.00 (100.00)	100.66 (100.00)

Note: Figures in the parentheses indicate percentages

The first two parts $Y_1 \Delta A$ and $A_1 \Delta Y$ arose from the changes in the mean area and the mean yield. These are pure effects, which arise even if there were no other sources of change. The term $\Delta A\ \Delta Y$ is an interaction effect, which arose from the simultaneous occurrence of changes in mean area and the mean yield. Obviously, this term will be zero if either mean area or the mean yield remains unchanged. The last term, COV(A, Y) arose from changes in the variability of area and yield, since

$$COV(A,Y)- \rho[V(A)V(Y)]^{1/2}$$

Where p is the correlation coefficient. The change in covariance of area and yield arosed from changes in variances of area and yield and from changes in the correlation between area and yield.

In a similar fashion for average production Hazell (1982) derived the variance of production as:

$$V(P) = A^2\ V(Y) + Y^2\ V(A) + 2\ A\ Y\ COV(A,\ Y) - COV\ (A,\ Y)^2 + R.. \quad (6)$$

Where,
A and Y denote the mean area and yield
R is residual term

The variance of production is a function of the variances of yield and area, the mean area and yield, and the covariance between area and yield. Hence, a change in any of these components would bring about a change in variance of production [V(P)J between two periods of time.

The change in variance of production AV(P) was decomposed into ten sources of change.

Table 4. Sources of Change in the Variance of Average Turmeric Production from the Important States of South India 1979-80 to 1998-99

(in per cent)

S.No.	Source of change	Andhra Pradesh	Tamil Nadu	Karnataka	Kerala
1.	Change in mean area	18.75	-45.71	0.00	63.68
2.	Change in mean yield	14.77	-45.48	0.00	-1958.18
3.	Change in yield variance	-2.88	138.37	100.00	-3455.52
4.	Change in area variance	-24.42	20.94	0.00	-102.96
5.	Change in yield-area co-varainces	0.56	-0.08	1.08	-112.24
6.	Change in interaction term	5.28	31.49	0.00	1743.37
7.	Change in residual	87.94	0.47	-1.08	3921.85
8.	Total	100.00	100.00	100.00	100.00

Table 2 indicates the various sources along with the symbols and their components. The negative values indicate stability and positive values indicate instability. In the course of the study, some adjustments were made where it is necessary in which consistency would be maintained in interpreting the data..

Results and Discussion

The components of change in average turmeric production during the post-liberalisation period over the pre-liberalisation period were presented in Table 3. The sources that accounted for the change in the variance of the average turmeric production are presented in Table 4. The statewise analyses are presented as under.

Andhra Pradesh

In the case of Andhra Pradesh, the variation in the average production of the turmeric was due to the change in mean area, mean yield, interaction between mean area and mean yield, covariance between area and yield, which accounted for 51.81 per cent, 38.36 per cent, 1.96 per cent and 7.87 per cent respectively. All the components *viz.*, changes in mean area, mean yield, interaction between mean area and mean yield and covariance between area and yield contributed for instability.

The sources that accounted for the change in the variance of the average turmeric production were, 87.94 per cent by the variability in average turmeric production was attributed by the change in residual. The change in mean area and mean yield contributed 18.75 per cent and 14.77 per cent, respectively for the instability in average turmeric production. The interaction term and yield area covariance contributed 5.28 per cent and 0.56 per cent, respectively to the variance in the turmeric production, whereas, the change in yield variance and area variance contributed 2.88 per cent and 24.42 per cent to the stability in turmeric production in the state. Except the change in area variance and yield variance, all other values were positive, which showed instability in production, which implies high fluctuation in production of turmeric.

The high yielding varieties, organised marketing facilities, and the facilities provided by the Spices Board may be the possible reasons for high instability in the second period over first period.

Tamil Nadu

In the case of Tamil Nadu, the variation in the average production was due to change in mean area, mean yield and interaction between mean yield and mean area, which accounted for 44.53 per cent, 4.15 per cent and 4.36 per cent respectively. The stability of the average production was contributed by the covariance between yield and area, which accounted for 0.04 per cent.

The sources that accounted for the change in the variance of the average turmeric production were, 138.37 per cent was by the change in the yield variance followed by the interaction term, area variance and change in residual value, which accounted for 31.49 per cent, 20.94 per cent and 0.47 per cent, respectively to the variance in the turmeric production whereas, the change in mean area, mean yield and area-yield covariance accounted for 45.71per cent, 45.48 per cent and 0.08 per cent towards the stability in the production of turmeric in the state. The change in mean area and mean yield followed by yield area covariance gave the stability and all other values were positive. This implied that all other variables contributed for instability in production.

The turmeric was grown in and around Erode and Salem districts hence there was no much instability in area and also because of lack of market facilities in other places there was no much variation between the two periods. The pest and disease incidence particularly turmeric scale insect and rhizome rot disease were a greater menace affecting the crop in the state. These may be the possible reasons for the instability in turmeric yield in the second period over first period.

Karnataka

In the case of Karnataka, the variation in average production of the turmeric was due to the variance in the mean yield, which accounted for 100 per cent in the state. All other components were not having any effect on the change in the average production of turmeric.

The sources that accounted for the change in the variance of the average turmeric production were, the 100 per cent of the variability was due to the change in the yield variance followed by yield area co-variance, which attributed for 1.08 per cent. The residual value contributed for 1.08 per cent for the stability of turmeric production in the state. Almost the entire instability was contributed by the change in yield variance and very small effect through yield area covariance. The change in residual contributed very less to the stability of production.

This instability was due to less fluctuation in productivity. The non-availability of assured market facility, middlemen and pre-harvest contractors exploitation, small quantity of output, non-availability of specific varieties and certified seeds may be the reasons for the instability in area and yield of turmeric in the second period over the first period in the state.

Kerala

In the case of Kerala, the variation in the average production of turmeric was mainly contributed by the change in mean yield, which accounted for 125.79 per cent whereas, the stability in the production was due to the change in mean area, interaction between mean yield and mean area and co-variances between yield and area which accounted for 0.54 per cent 0.26 per cent and 24.99 per cent, respectively. Except the change in the mean yield, all other components contributed for the stability in average production of turmeric.

The sources that accounted for the change in the variance of the average turmeric production for the instability was due to the change in the residual value, interaction term and mean area which accounted for 3,921.85 per cent, 1,743.37 per cent and 63.68 per cent respectively whereas, the change in mean yield, yield variance, area variance and area-yield covariance accounted for 1,958.18 per cent, 3455.52 per cent, 102.96 per cent and 112.24 per cent, respectively to the stability of turmeric production in the state. Kerala was unstable in the production of turmeric, which was contributed by the variances of change in mean area, interaction term and change in residual value. The stability was highly contributed by the change in mean area variance and yield area co-variances, which indicated that there was no much variation in the area and yield. Domination of plantation crops and lower labour availability may be the possible reasons for the instability in turmeric production in the first period over the second period in the state.

The yield variability has been an important source of increased instability in turmeric production in all the states except in the case of Karnataka. In the case of turmeric, the yield variability was the main factor. Over the period there was no much variation in area in most of the states. But, because of the technologies such as chemical fertilizers, pesticides and high yielding varieties there was high instability in turmeric yield.

The factors such as climatic change over time, infrastructure, controlled agronomic practices and plant breeding influenced the variability in turmeric yield. Turmeric being a sensitive crop, which was susceptible to pest, disease and climatic factors affected the yield. It was a crop with high input requirements such as FYM, mulches etc. Intensive care was needed for the crop, and the agronomic practices play major role in deciding the yield. The efforts of plant breeders in evolving new and location specific varieties were main reasons for the high productivity. But it was in contradiction with the situation in Karnataka because there were no location specific varieties and seed producing agencies in the state, which lead to lower increase in the yield in the second period, compared to the first period.

The area in the states of Andhra Pradesh and Tamil Nadu showed instability, while Kerala showed stability. In the case of Kerala, there was no effect on the area. But, in the case of yield except Karnataka all other states showed instability. The reason may be due to the new technologies such as fertilizers, pesticides etc. and the new varieties also played an important role in the case of yield. So for the stable growth, the reduction in yield instability is necessary in future. Kumar and Sankaran (1998) reported that the decrease in area instability more than compensated for the marginal increase in yield instability in turmeric during the 1980's, resulting in a reduction in production instability. Hence, evolving the location specific varieties is necessary along with suitable scientific crop production technologies for reducing the fluctuations in turmeric production.

Conclusion and policy implications

The foregoing analysis of the instability in area and productivity of turmeric indicated that the area in the case of Andhra Pradesh and Tamil Nadu showed instability, while Kerala showed stability. But, in the case of yield except Karnataka all other states showed instability. Decomposition analysis showed that yield instability was the dominant factor affecting production. The future development programmes should envisage stabilisation of yield, which would stabilize production. In order to meet the domestic and international demand, the production of turmeric is to be stable. The stability in the productivity could be achieved through investing in the development of cultivars suitable for existing agro-climatic conditions, improved technologies and by solving the problems faced by the farmers such as financial assistance, timely availability of inputs such as seed material, fertilizers etc.