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# AN EMPIRICAL ANALYSIS OF GROWTH AND INSTABILITY IN MAJOR SPICES IN INDIA

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**Abstract-** This study has examined trend in growth and instability of major spices in India for the last 39 years from 1974-75 to 2012-13, which were further divided into three sub-periods. The growth rates were worked out by fitting the exponential growth function and instability analysis was carried out by generating Cuddy Della instability index. The study has observed that almost all the spices have recorded a positive and significant growth rate in all the sub-periods. Sub-period II (1990-91 to 1999-00) is comparatively stable in terms of area, production and productivity in all the spices which also recorded a higher growth rates. Sub-period III (2000-01 to 2012-13) however witnessed fluctuations in growth rate in most of the spices. Variations in weather and price fluctuations were observed as the main factors affecting growth and instability in spices in India. So, plans should be formulated to make spice sector more research oriented to prevent it from vagaries of weather and also plan should be oriented towards creation of efficient markets.

**Keywords-** Spices, Growth rates, Exponential Growth Function, Cuddy Della instability index

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## Introduction

Spices are high value and low volume commodities of commerce in the world market. All over the world, the fast growing food industry depends largely on spices as taste and flavor makers. Health conscious consumers in developed countries prefer natural colors and flavors of plant origin to cheap synthetic ones. Thus, spices are the basic building blocks of flavor in food applications. The estimated growth rate for spices demand in the world is around 3.19%, which is just above the population growth rate. India has been a traditional producer, consumer and exporter of spices. There are about 109 spices listed by International Organization for Standardization and India grows about 63 of these spices which include pepper (King of Spices), cardamom (Queen of Spices), chillies, ginger, turmeric, coriander, cumin, fenugreek and many others. Almost all the states in the country produce one or other spices. During the crop year 2012-13 the country produced about 5801 thousand tons from 3172 thousand hectares of area under spices [1]. India stands first in the production of most of the spices. Still we are not able to exploit the full potential of these spices since these are often subjected to wide price fluctuation in the domestic as well as international markets which results in fluctuations in production and yield too rendering an intense debate on agricultural growth and instability.

While there is an obvious need for growth in agriculture sector, the increased instability in production instills more uncertainty about sustainability of agricultural growth in India. Increased instability in agriculture augments the risks involved in farm production and adversely affects farmers' income and decisions to adopt modern technologies and make investments in farming. Instability in production affects price stability and the consumers, and it increases vulnerability of low-income households to market [2]. Mamatha [3] has estimated the growth rates of production and export of selected spices including turmeric and observed a positive growth rate in respect of production and export of these spices. Kumar and Sankaran [4] have analyzed the instability in turmeric production in India and have concluded that decrease in area instability has been compensated by the marginal increase in the yield instability during 1980s. Rao, et al [5] Larson, et al [6] have concluded that instability has increased in Indian agriculture during post-green revolution period due to adoption of modern technology. The green revolution which was mainly confined to cereals especially, wheat and rice, also neglected the production of other crops like pulses, oilseeds, spices, etc. A number of attempts were made earlier by Hazell and Peter [7], Ray [8], Mahendradev [9] and Pal & Sirohi [10] to measure the extent of instability in area, production and yield of different crops, but most of these studies are mainly related to food grains. Looking upon the importance of spices, the present study was carried out to examine the growth and instability in area, production and yield of major spices grown in India.

## Methodology

The growth and instability analysis was carried out at national level. The study was based on the secondary data obtained from statistical publications of Spices Board and Indiastat.com The required data for the present study was collected for the period 1974-75 to

2012-13 which was further divided into three sub-periods, viz. sub-period I (1974-75 to 1989-90) where the effects of adoption of superior technology and institutional reforms were found to manifest, sub -period II (1990-91 to 1999-00) which was the period of wider dissemination of technology and was characterized by sustained growth in the agriculture sector for over a decade peaking at the year 1996-97and sub- period III (2000-01 to 2012-13) from where the deceleration of growth was started and a clear indication of slumping of the agricultural sector was visible till the year 2005-06. On the basis of highest area and production five major spices namely, pepper, chilli, turmeric, coriander and cumin growing in the country was selected for the study.

### Growth Rate Analysis

In the present study, compound growth rates in area, production and yield of spices in the country as a whole were estimated by using the exponential growth function of the form,

$$Y_t = a\, b^t \quad (1)$$

Where, $Y_t$ = dependent variable for which growth rate is estimated

a = intercept

b = regression coefficient

t= time variable

The growth rate coefficient (b's) will be computed by transforming the equation in log form

$$\text{Log } Yt = \text{Log } a + t \text{ Log } b \quad (2)$$

Thus compound growth rate (g) in % will be computed as

$$g = [(\text{antilog of } b) - 1) * 100] \quad (3)$$

Significance of growth rate was judged by Student's t-test.

### Instability Analysis

Instability is one of the important decision parameter in development dynamics and more so in the context of agricultural production. An analysis of fluctuations in crop output, apart from growth, is of importance for understanding the wide fluctuations in crop output that not only affect prices and bring about sharp fluctuation in them but also results in wide variations in disposable income of the farmers. The magnitude of fluctuations depends on the nature of crop production technology, its sensitivity to weather, economic environment, availability of material inputs and many other factors. High growth in production accompanied by low level of instability for any crop is desired for sustainable development of agriculture. In this study the extent of area, production, and yield instability in major spices were examined. The instability in area, production and yield of major spices is measured in relative terms by the Cuddy-Della Valle index which is used in recent years by a number of researchers as a measure of variability in time series data. The simple coefficient of variation overestimates the level of instability in time-series data characterized by long term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation. The coefficient of variation (CV) can be calculated by using the formula

$$CV = \frac{\sigma}{\overline{X}} \times 100 \quad (4)$$

Where,

σ = Standard deviation of variables concerned i.e. area/ production/ productivity and,

$\overline{X}$ = Mean value of the variable.

The formula suggested by Cuddy & Della [11] will be used to compute the index of instability.

$$\text{Index Instability } (CV^*) = CV * (1 - R^2)^{0.5} \quad (5)$$

Coefficient of variation will be multiplied by the square root of the difference between the unity and coefficient of multiple determination ($R^2$) in the cases where $R^2$ is significant.

### Results and Discussion

### Growth Rates in Area, Production and Yield of Major Spices in India

The compound growth rates (used as growth rates hereafter) of area, production and yield of pepper, chilli, turmeric, coriander and cumin for the period from 1974-75 to 2012-13 were computed. The spice wise result for the country as a whole is presented in [Table-1].

**Table 1-** Growth rates in area (A), production (P) and yield (Y) of spices in India (1974-75 to 2012-13) (Percentage)

| Spices | Sub-Periods I 1974-75 to 1989-90 | | | II 1990-91 to 1999-00 | | | III 2000-01 to 2012-13 | | | Overall 1974-75 to 2012-13 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | P | Y | A | P | Y | A | P | Y | A | P | Y |
| Pepper | 2.64*** | 4.19*** | 1.52** | 1.57 | 3.37** | 1.81 | -1.17** | -3.51** | -2.40** | 2.39*** | 2.88*** | 0.48** |
| Chilli | 0.80** | 3.24*** | 2.42*** | 0.75 | 4.98*** | 4.19*** | -0.45 | 2.72*** | 3.2*** | -0.03 | 3.03*** | 3.06 |
| Turmeric | 3.5*** | 8.5*** | 4.8*** | 2.18** | 6.01** | 3.75** | 2.37*** | 5.77*** | 3.20*** | 2.73*** | 5.66*** | 2.83*** |
| Coriander | 3.1** | 3.53** | 0.42 | 3.6 | 5.32** | 1.56 | 3.8** | 6.06** | 2.17** | 0.85*** | 3.21*** | 2.34*** |
| Cumin | 0.42 | 1.7 | 1.27 | 4.5 | 0.69 | -3.74** | 4.6*** | 9.8*** | 4.94*** | 5.3 | 5.75*** | 0.41 |

### Pepper

The growth rate analysis in pepper revealed that overall sub-period I and II emerged out to be better period for pepper with highest and positive growth in output, however sub-period III (2000-01 to 2012-13), recorded a slow pace of growth in pepper which registered a negative growth in area, production and yield. Similar results in pepper were obtained by Soumya *et al.* [12] and Jayesh [13] who concluded that this was mainly due to decrease in area and productivity of pepper in Kerala state which is the highest pepper producing state in India and due to incidence of phytophthora foot rot and pest attacks in that period.

### Chilli

In case of chilli, the area growth showed a decline of 0.75per cent in sub period II from previous period. But it is interesting to note that despite decline in area growth in sub-period II, there was an increase in output and yield growth, this can be attributed to the adoption of new package of practices and with economic liberaliza-

tion in the period, farmers cultivating chilli gained initially which leads to increase in production despite slight or no change in area. The area further witnessed a negative growth rate of -0.45 per cent in sub-period III. This change in area growth is the effect of change in cropping pattern of the farmers growing chilli, severe influence of pest and diseases and fluctuations in the prices of chilli during the period. The findings of the study were at par with the results obtained by Veena [14] and Rajur et al. [15]. The production and yield growth rate showed a decline in sub-period III. Overall the growth rate in output and yield was much better in sub-period II than other periods.

**Turmeric**

In case of turmeric, [Table-1] reveals that in all the periods, the growth rate of production was higher than that of productivity and area. The lower growth in area in sub-period II might be due to stability in area under turmeric, i.e. no scope to allocate more area under new planting. Turmeric noticed a decline in output and yield growth rate in sub-period III. Report of Karvy Comtrade [16] suggested that this decline is mainly the result of fluctuation in prices of turmeric in the period that reached to its lower level and partly due to the drought condition in Andhra Pradesh which is the major turmeric producing state. Growth recorded in all periods was significant at one per cent level, except in sub-period II, which was significant at 5 per cent level.

**Coriander**

The growth rate in coriander registered an increase in area, production and yield over the periods but it was observed that growth in production is higher and significant than the growth in yield. Coriander recorded highest output growth (6.06%) in sub-period III, almost double than the growth in sub-period I. The increase in production can be attributed to higher productivity of coriander in Rajasthan in that period which is one of the major coriander growing states in India [17]. Yield growth rate also jumped from 0.42 per cent in sub-period I to 2.17 per cent in sub-period III.

**Cumin**

The growth rate in area, production and yield of cumin has shown an increase over the periods recording highest in sub-period III. In sub-period II despite increase in the area growth, the production and yield growth declines sharply reporting 0.69 per cent in production and a negative (-3.74 per cent) growth rate in yield which was significant. However, the growth in output regained its pace in the sub-period III with a significant growth rate of 9.8 per cent. The growth in production was mainly contributed by high productivity which was probably attributed to introduction of high yielding varieties coupled with Integrated Nutrient Management. [12]

Overall analysis of growth in spices reveals that sub-period I (1974-75 to 1989-90) witnessed a positive and significant growth rates with higher production growth for most of spices. Sub-period II (1990-91 to 1999-00) also reveals a positive growth in output and yield of all the spices except cumin which shows a negative growth of 3.74 per cent in yield. It was observed that output growth was primarily on account of growth acceleration in yields that offset the deceleration in area growth. Sub-period III (2000-01 to 2012-13) however, recorded a slow pace of growth in some spices especially pepper which registered a negative growth in area, production and yield.

**Instability in Area, Production and Yield of Some Major Spices in India**

[Table-2] presents the estimates of instability in area, production and yield for major spices in India which are discussed below:

**Table 2-** Instability in area (A), production (P) and yield (Y) of spices in India (1974-75 to 2012-13) (Percentage)

| Spices | Sub-Periods | | | | | | | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I 1974-75 to 1989-90 | | | II 1990-91 to 1999-00 | | | III 2000-01 to 2012-13 | | | 1974-75 to 2012-13 | | |
| | A | P | Y | A | P | Y | A | P | Y | A | P | Y |
| Pepper | 13.81 | 26.63 | 15.07 | 8.5 | 11.77 | 7.47 | 9.57 | 19.05 | 13.38 | 13.83 | 24.91 | 15.24 |
| Chilli | 6.13 | 13.26 | 11.19 | 6.19 | 10.15 | 7.89 | 7.72 | 8.29 | 9.5 | 8.69 | 10.33 | 11.12 |
| Turmeric | 8.76 | 17.97 | 11.37 | 7.15 | 18.06 | 14.5 | 11.48 | 16.14 | 7.39 | 9.11 | 17.67 | 12.39 |
| Coriander | 22.6 | 32.48 | 14.33 | 16.4 | 17.88 | 10.72 | 20.51 | 32.69 | 13.3 | 22.86 | 26.36 | 15.45 |
| Cumin | 34.01 | 41.89 | 18.64 | 29.89 | 33.66 | 12.42 | 19.91 | 17.9 | 14.59 | 30.66 | 39.72 | 20.73 |

**Pepper**

Area under pepper showed a high instability during sub-period I (13.81 per cent) which decreases to 8.5 per cent in the 1990s (sub-period II). It further rose to 9.57 per cent in sub-period III which was the period of negative growth in area, output and yield of pepper. Instability in the yield of pepper was more than the instability in area in sub-period I. Sub-period II recorded a decline in pepper yield instability which almost reduces to half from 15.07 per cent to 7.47 per cent. The instability again increases in sub-period III to 13.38 per cent which may be the result of negative growth rate in yield in the same sub-period. The ups and downs in yield instability of pepper were subjected to favorable and unfavorable climatic conditions [12]. Instability in pepper output showed a decline from 26.63 per cent to 11.77 per cent in the 1990s. However, the variability in pepper production after 2000-01 was considerably higher (19.05 per cent) as compared to sub-period II, but lower than that experienced in sub-period I. Overall analysis suggest that sub-period II was most stable period for pepper which was considered a period of wider dissemination of technology and economic liberalization which had opened its gates for international markets.

**Chilli**

In case of chilli, the instability in area reported not much increase from sub-period I to sub-period II showing instability of 6.13 and 6.19 per cent respectively. The instability increases in sub-period III (7.72 per cent), which may be the result of negative growth rate in area in that sub-period. The instability in chilli yield declined by almost 30 per cent in sub-period II (1990-91 to 1999-00) from sub-

period I (1974-75 to 1989-90). Due to this decline in yield instability the output in 1990's also decline by around 24 per cent. However, this trend in yield does not carry over further in third sub-period (2000-01 to 2012-13) as the instability in yield further increases in this period from the previous period but remained low from sub-period I, while the trend in production remains declining, resulting in 18 per cent decline in chilies output in sub-period III. Overall the instability analysis in chilli reveals stability in production over periods whereas area and yield showed some variations.

**Turmeric**

For turmeric, the area instability first declined to 7.15 per cent in the second sub-period but further increases to 11.48 per cent in the third sub-period. It, however, needs to be notice that the yield instability in turmeric reduces almost to 50 per cent in third sub-period from the previous sub-period. The fluctuations in yield of turmeric were mainly influenced by the rainfall and other climatic factors. Favorable weather conditions prevailing in the major turmeric growing areas in the country (Andhra Pradesh, Tamil Nadu, Orissa, Karnataka and West Bengal) and the important steps taken by the Spices Board, such as providing drying sheets to small and marginal growers of turmeric and other spices for drying under hygienic conditions, providing subsidies for the small and marginal farmers for the construction of concrete drying yards and warehouses, organization of training programmes for growers on improved technologies, have led to increased productivity of turmeric in this period. Besides, release of high-yielding varieties over the years also has made a significant contribution. These Studies are at par with Angles *et al.* [18]. The production instability also follows similar trend, it first increases (18.06 per cent) and then declines in sub-period III (16.14 per cent), but the amplitude of decline was lower than that of yield. These results implied that there was a high instability in sub-period II than sub-period III.

**Coriander**

The instability analysis of coriander witnessed that area, production and yield in sub-period I and sub-period III were almost of the same magnitude, though the area and yield instability declines in the sub-period III but the decline was not much, whereas, sub-period II witnessed a different situation, where area, production and yield instability declined to a higher extent. Area instability declined to about 27 per cent, the production instability declines to 45 per cent and the yield instability declined to 25 per cent. This declining trend in instability in sub-period second is the result of larger spatial expansion under the crop.

**Cumin**

The behavior of cumin is noteworthy. Extent of instability was very high in sub-period I which also witnessed low and insignificant growth rates in area production and yield. Instability in the area under cumin declined from 34 per cent in sub-period I to 30 per cent in sub-period II and the decline continued in the sub-period III also. It however, needs to be appreciated that the production instability in cumin reduces progressively and in sub-period III it was 57 per cent lower than that recorded during the sub-period I. It is the yield instability that largely contributes to variations in output of cumin. Overall analysis reveals that there was continuous decline in output and yield instability over the periods.

**Conclusion and Policy Implications**

The analysis of growth and instability of spices has revealed that almost all the spices have recorded a positive and significant growth rate in all the sub-periods, except pepper which showed a negative but significant growth in area, production and yield in sub-period III. Sub-period II emerges to be the stable period in most of the spices which also recorded a higher growth rate in area, production and yield compared to other sub-periods. This can be attributed to the liberalization policy of government during that period which leads to increase in output and yield of these export oriented commodities. Cumin showed high growth and a low declining instability in sub-period III, but spice like coriander showing fast growth in output is offset by high or increasing instability. The study has shown comparatively instable behavior in most of spices in sub-period III. There are various sources of instability and growth affecting factors in agriculture sector, in case of spices it was observed from the past studies that variation in weather and price fluctuations play a pivotal role. Research and policy support is needed for raising productivity in the rain-fed areas and also for insulating the crop sector from year-to-year variations in rainfall. Agricultural practices would have to involve the use of varieties and species that have the ability to cope with drier conditions, higher temperatures and emerging pests and diseases. This would enhance the capacity of the farmers to allocate their resources effectively and reduce risks. Secondly, the problem of price volatility in spices is also an important factor for low growth. For farmers to feel committed to spice production they foremost need a guaranteed and competitive price for their produce, enabling them to support their families. Government's role as a provider of agricultural extension services would have to be complementary to the creation of efficient markets.

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**References**

[1] Government of India (2013) *Spices Statistics*, Spice Board, Ministry of Commerce, Cochin, Kerala.

[2] Chand R. & Raju S.S. (2009) *Indian Journal of Agricultural Economics*, 64(2), 187-207.

[3] Mamatha B.G. (1995) Export trade of selected spices in India—An economic analysis, *Master of Science Thesis*, University of Agricultural Sciences, Bangalore.

[4] Kumar N.A. & Sankaran P.G. (1998) *Journal of Spices and Aromatic Crops*, 7(1), 19-22.

[5] Rao C.H.H., Ray S.K. & Subbarao K. (1988) *Unstable Agriculture and Droughts: Implications for Policy*, Vikas Publishing House Pvt. Ltd, New Delhi.

[6] Larson D.W., Jones E., Pannu R.S. & Sheokand R.S. (2004) *Food Policy*, 29(3), 257-273.

[7] Hazell P.B. R. (1982) *Instability in Indian Food grain Production, Research Report No. 30*, International Food Policy Research Institute, Washington, DC, U.S.A.

[8] Ray S.K. (1983) *Indian Journal of Agricultural Economics*, 38 (4), 459-474.

[9] Mahendradev S. (1987) *Economic and Political Weekly*., 22 (39), A82-A92.

[10] Pal S. & Sirohi A.S. (1989) *Agricultural Situation in India*, 44,

933-936.

[11]Cuddy J.D.A. & Della Valle P.A. (1978) *Oxford Bulletin of Economics and Statistics*, 40(1), 79-85.

[12]Soumya C., Burark S.S., Sharma L. & Jain H.K. (2014) *International J. Seed Spices,* 4(2), 1-10.

[13]Jayesh T. (2001) *Production and export performance of pepper and cardamom in south India: An economic Analysis*. M.Sc. (Agri.) Thesis, Uni. Agric. Sci., Dharwad.

[14]Veena U.M. (1992) *An economic analysis of Indian coffee exports*, M.Sc.(Ag.) Thesis, Univ. Agric. Sci., Bangalore.

[15]Rajur B.C., Patil B.L. & Basavaraj H. (2008) *Karnataka Journal of Agricultural Sciences,* 21, 312-313.

[16]Karvy Comtrade Limited (2008) *Turmeric Seasonal report*.

[17]Kumawat R.C. & Meena P.C. (2005) *Journal of Spices and Aromatic Crops*, 14(2), 102-111.

[18]Angles S., Sundar A. & Chinnadurai M. (2011) *Agricultural Economics Research Review*, 24, 301-308.