

# Growth and instability in area, production and productivity of different crops in Bengaluru division

Nethravathi Ashok Patil\* and R.A. Yeledhalli

Department of Agribusiness Management, University of Agricultural Sciences, Dharwad-580005, Karnataka, India

\*Correspondence author: pnethra5@gmail.com

Paper No. 481

Received: 13-2-2016

Accepted: 15-8-2016

## Abstract

Karnataka State has a typical composition having a large share of its area under highly diversified agricultural crops, higher growth in agriculture assumes great importance and is a matter of concern for policy planners and research scholars in recent times. In view of this the present study was aimed to analyse the growth and instability in area, production and productivity of different crops in Bengaluru Division. The results revealed that Bengaluru urban had the highest CAGR which was 24.26% in productivity in avare was significant at 5% level. In Bengaluru Rural the highest CAGR was 22.26% in productivity of avare (significant at 1%). Production of chrysanthemum had growth of 22.36% was the highest annual growth and 4% (area of tamarind) was found to be lowest instability for selected crops in Chitradurga, In Davanagere the highest CAGR was observed in productivity of tomato (9.12%). In Kolar district, 19.65% instability observed in production of avare & was significant at one %. In Shivamogga district highest CAGR observed in production of sunflower to an extent 29.57%. In Tumkuru area under green chillies was growing at rate of 34.46% per annum.

## Highlights

- Area and production of cereals was observed negative growth but productivity had a positive growth.
- The growth in area, production and productivity of pulses have been increased significantly.

**Keywords:** Compound annual growth rate, instability index, significant, area, production, productivity etc.

Agricultural growth is necessary not only for attaining high overall growth but also for accelerating the poverty reduction in a developing country like India. The annual compound growth rates of the agricultural sector have been quite robust ranging from 2% to 3% after independence. However, the non-agricultural sector has grown faster than the agricultural sector and the divergence between agricultural growth and overall economic growth has widened over time, particularly since 1980s. The India's total GDP growth accelerated from

3.3% per annum in the 1980s to 6.0% in the 1990s, and further to 7.8% during the 2000s. The critics of the Indian agricultural development strategies argue that the growth in agriculture is regionally concentrated, and is confined to a few commodities. The disaggregated analysis of agricultural productivity would decipher these issues and will help in identifying and prioritizing the districts for agricultural development. Karnataka State has a typical composition of having a large share of its area under severe climatic constraints



with a highly diversified agricultural sector. There are Small Farm/Marginal Farm holdings thus the Average size of holding 1.55 ha. The main crops grown here are paddy, ragi, jowar, maize and pulses, besides oilseeds and number of cash crops viz, cashews, coconut, arecanut, cardamom, chillies, cotton, sugarcane and tobacco. (Ramachandra *et al.* 2013). Karnataka is the largest producer of coarse cereals, coffee, raw silk and tomatoes among the states in India. Horticultural crops are grown in an area of 16,300 km<sup>2</sup> and the annual production is about 9.58 million tons. Under these circumstances, growth in agriculture assumes greater importance and is a matter of concern for policy planners and research scholars in recent time frame. In view of this the present study aimed to analyse the growth and instability in area, production and productivity of different crops in Bengaluru Division and contemplates to provide an insignificant into the states of growth of agriculture at large and suggests alternate diversions for growth of agriculture.

## Materials and Methods

Karnataka, one of the major crops growing states in the country, was selected purposively for the

study. All most all types of cereals, pulses, oilseeds, commercial crops, fruits, vegetables, spices and plantation are grown in the state. There are four divisions in Karnataka viz. Bengaluru, Belagavi, Kalaburagi, and Mysuru divisions among which Bengaluru division was selected, this division comprises of Bengaluru Urban, Bengaluru Rural, Chikkaballapur, Chitradurga, Davanagere, Kolar, Ramanagara, Tumkuru and Shivamogga Districts. Chikkaballapur and Ramanagara were excluded from the study because they were recently formed districts and lack 15 years data. This study was based on secondary data on area, production and productivity of the selected crops for a period of ten years i.e from 1998-99 to 2013-14 which were obtained from the Directorate of Horticulture, Bengaluru, Karnataka at Glance, Horticulture at Glance, Directorate of economics and statistics, GoK, Karnataka and various published issues. Based on the highest area under cultivation, three major crops in each category of cereals, pulses, oilseeds, commercial crops, fruits, vegetables, spices and plantation have been considered for the present study were presented in table 1.

**Table 1:** Crops selected for study in districts of Bangalore Urban

Crops/ Districts	Bengaluru Urban	Bengaluru Rural	Chitradurga	Davanagere	Kolar	Shivamogga	Tumakuru
Cereals	Ragi, Paddy Maize	Ragi, Maize, Paddy	Maize, Ragi, Jowar	Maize, Paddy, Jowar	Ragi, Maize, Paddy	Paddy, Maize, Ragi	Ragi, Paddy, Maize
Pulses	Avare, Horsegram, Tur	Horsegram, Avare, Tur	Bengalgram, Tur, Horsegram	Tur, Bengal gram, Horsegram	Avare, Tur, Horsegram	Greengram, Tur, Horsegram	Horsegram, Tur, Greengram,
Oilseeds	Mustard, Niger, Castor oil	Seasamum, Groundnut, Castor oil	Groundnut, Sunflower, Seasamum,	Groundnut, Sunflower, Seasamum,	Groundnut, Sunflower, Mustard	Sunflower, Groundnut, Seasamum,	Groundnut, Castor oil,
Commercial	Sugarcane	Sugarcane	Cotton, Sugarcane	Cotton, Sugarcane, Tabacco	Sugarcane	Cotton, Sugarcane, Tabacco	Sugarcane, Cotton,
Flowers	Marigold, Rose, Jasmine	Rose, Jasmine, Marigold,	Chrysanthamum Aster, Crossandra	Marigold, Aster, Chrysanthamum	Marigold, Rose, Crossandra	Aster, Rose, Jasmine	Jasmine, Chrysanthamum, Aster
Spices	Tamarind, Dry chillies	Tamarind, Dry chillies, Ginger	Tamarind, Dry chillies, Pepper	Dry chillies, Tamarind, Turmeric	Tamarind, Coriander, Dry chillies,	Ginger, Pepper, Cardamom	Tamarind, Dry chillies, Coriander,
Fruits	Mango, Banana, Guava	Mango, Banana, Sopata	Banana, Pomegranate, Mango,	Banana, Mango, Sapota	Mango, Banana, Grapes,	Banana, Mango, Pineapple	Mango, Banana, Pineapple
Vegetables	Tomato, Potato, Green chillies	Tomato , Potato, Green chillies	Tomato, Onion, Green chillies	Tomato, Onion, Green chillies	Tomato, Potato, Beans	Green chillies, Tomato, Brinjal	Green chillies, Onion, Tomato
Plantation	Coconut, Arecanut, Cocoa	Arecanut, Coconut, Betelvine	Coconut, Arecanut, Betelvine	Arecanut, Coconut, Betelvine	Coconut, Cashew, Arecanut	Arecanut, Coconut, Cashew	Coconut, Arecanut, Betelvine

They were analysed using the Compound Growth rate analysis and Instability analysis to draw meaningful interpretation and inferences.

### Compound Growth rate analysis

For computing compound growth rate of area, production and productivity of selected crops in district, the exponential function of the following form was used.

$$Y = a b^t e^{U_t} \quad (1)$$

Where,

$Y =$  Area / Yield / Production,  $a =$  Intercept,  $b =$  Regression coefficient (' $a$ ' and ' $b$ ' are the parameters to be estimated)

$U_t =$  Disturbance term in year ' $t$ '

The equation (1) was transformed into log linear form and written as;

$$\log Y = \log a + t \log b + U_t \quad (2)$$

Equation (2) was estimated by using Ordinary Least Squares (OLS) technique.

Compound growth rate ( $g$ ) was then computed

$$g = (b - 1) 100 \quad (3)$$

Where,

$g$ : Compound growth rate in per cent per annum

$b$ : Antilog of log  $b$

The standard error of the growth rate was estimated and tested for its significance with ' $t$ ' statistic.

### Instability analysis

The coefficient of variation was used as measure to study the variability in area, production and productivity of selected crops in Bengaluru region. The coefficient of variation or index of instability was computed by using the following formula

$$CV = \frac{\text{Standard Deviation } (\sigma)}{\text{Mean } (\bar{X})} \times 100$$

Linear trend were fitted to the original data of area, production, productivity of selected Crops, for the period of 15 years. The trend coefficients were tested for their significance. Whenever the trend of

series found to be significant; the variation around the trend rather than the variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend. That is Coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of multiple determinations ( $r^2$ ) in the cases where  $r^2$  was significant to obtain the Instability Index.

Standard Deviation ( $\sigma$ )

$$\text{Instability index} = \frac{\text{Standard Deviation } (\sigma)}{\text{Mean } (\bar{X})} \times 100 \times \sqrt{1-r^2}$$

### Results and Discussion

The compound growth rates and instability indices for area, production and productivity of different crops in Bengaluru urban for the period from 1998-99 to 2013-14 are depicted in table 1. The pulses like Avare, horsegram, and turn witnessed a negative growth rate in area and production expect for productivity of avare and production of avare which showed highest growth rate at extent of 24.26% and 24.26% indicating higher instability index of 67.49 followed by 62.04. Even though area, production and productivity of oilseeds showed a negative growth productivity of castoroil witnessed a lowest instability followed by production of mustard with 1.90. even though sugarcane was selected under commercial crops it witnessed negative growth in its area production and productivity. It may be attributed due to promoted for shift in cropping pattern and rapid urbanisation in this district.

In table 3 depicted that in Bengaluru rural ragi being an important crop with an average area of about 116726.67 ha showed negative growth rate of and its productivity showed highest instability indices measuring 185.15.09 however area of paddy showed 0.41 which was lowest instability index. Maize being second important crop showed a positive growth in its area, production and with growth rate at 8.78, 15.04 and 5.75% respectively. Avare productivity was the highest growth rate observed in Bengaluru rural with 22.26% it was significant at one %. In this area flowers like rose jasmine and marigold was significantly growing positive. Area of rose was growing at rate of 7.45%

**Table 2:** Compound growth rates and instability in area, production and productivity of different crops in Bengaluru Urban

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Ragi	35376.80	-5.22***	26.13	-4.25	50.82	1.02	28.99
2 Paddy	3423.20	-10.66***	11.51	-8.63***	24.09	2.27	28.72
3 Maize	1019.80	-4.87**	22.46	-1.74	37.59	3.29	41.27
<b>Pulses</b>							
1 Avare	2821.47	-7.38***	13.82	15.09**	67.49	24.26***	62.04
2 Horsegram	2032.17	-12.35***	36.39	-15.31	37.91	-3.38*	24.35
3 Tur	837.20	-2.34	28.67	-2.7	38.52	-0.37*	38.38
<b>Oilseeds</b>							
1 Mustard	325.67	-4.93**	1.9	-6.56***	2.86	-1.71	5.67
2 Niger	305.00	-3.75	29.64	-4.76**	23.99	-1.04	10.65
3 Castor oil	217.33	-7.88***	16.76	-8.99***	17.96	-1.23	1.37
<b>Commercial</b>							
1 Sugarcane	42.72	-4.72	34.52	-5.74**	43.89	-1.26*	10.54
<b>Flowers</b>							
1 Marigold	174.50	-0.64	20.09	-6.10**	33.83	-5.50***	15.49
2 Rose	151.50	-7.13**	30.63	-11.62**	50.13	-4.83	31.13
3 Jasmine	135.50	-2.87	28.54	-6.30**	40.28	-3.53***	18.96
<b>Spices</b>							
1 Tamarind	102.50	-12.97***	3.06	-11.66***	3.73	1.51	12.41
2 Chillies	100.50	-12.05***	12.77	-8.28**	58.05	4.30**	55.14
3 Pepper	82.16	0.04	37.52	-1.52	52.72	-1.63	33.91
<b>Fruits</b>							
1 Mango	1467.33	-0.58	10.00	-6.19***	20.06	-4.95	19.5
2 Banana	904.08	-3.63**	21.18	-7.23**	37.09	-3.74**	22.75
3 Guava	652.67	-3.87***	5.27	-2.8	32.6	1.11	30.78
<b>Vegetables</b>							
1 Tomato	460.50	-11.13***	21.2	-16.99***	25.45	-6.59**	40.71
2 Potato	360.50	-7.57***	19.59	-8.97	43.45	-1.52	32.86
3 Green chilies	250.50	-2.66	29.19	0.39	39.16	3.14	50.48
<b>Plantation</b>							
1 Coconut (lakh nuts)	2110.50	-7.74**	36.51	-6.98**	31.97	0.83	20.93
2 Arecanut	173.50	-2.38	26.18	-2.38	31.79	-0.6	15.85
3 Cocoa	129.00	-2.16	22.36	1.6	31.03	3.84	22.09

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

**Table 3:** Compound growth rates and instability in area, production and productivity of different crops in Bengaluru Rural

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Ragi	116726.67	-1.60**	0.41	-3.70	185.15	-2.13	190.3
2 Maize	13977.00	8.78***	16.13	15.04***	29.31	5.75**	33.79
3 Paddy	9066.33	-5.26**	37.38	-4.54**	41.32	0.76	25.28
<b>Pulses</b>							
1 Horsegram	9472.00	-1.40**	11.18	-0.31	21.44	1.10	19.87
2 Avare	6773.00	-6.16***	23.5	14.74**	54.49	22.26***	53.58
3 Tur	4873.33	-1.32	20.22	16.21*	37.19	17.76*	52.85
<b>Oilseeds</b>							
1 Sesamum	4591.33	7.21	71.8	5.95	46.6	-1.17	40.84
2 Groundnut	4553.00	-11.25***	2.29	-12.42**	3.68	-1.31	6.26
3 Castor oil	1554.67	-5.09**	13.45	-4.77**	16.21	1.20	28.4
<b>Commercial</b>							
1 Sugarcane	899.89	-4.58	44.90	-4.59	47.31	3.47**	30.6
<b>Flowers</b>							
1 Rose	578.00	7.45***	22.83	16.58***	49.78	8.50**	35.72
2 Jasmine	526.50	5.62**	42.32	0.85	55.93	-4.51**	15.04
3 Marigold	267.50	2.49	21.82	4.50**	23.86	1.96	18.91
<b>Spices</b>							
1 Tamarind	734.17	-2.61	12.31	-9.04**	7.74	-6.59**	10.06
2 Chillies	212.67	-13.18***	13.39	-20.90***	43.53	-8.89**	58.4
3 Ginger	192.33	5.57**	29.77	5.29**	43.88	-0.26	33.71
<b>Fruits</b>							
1 Mango	28575.50	2.92**	16.45	2.43	21.7	-0.48	9.91
2 Banana	5702.00	1.86	18.34	1.24	26.48	-0.61	14.12
3 Sapota	941.50	-4.13**	19.73	-4.41**	25.17	-0.28	9.31
<b>Vegetables</b>							
1 Tomato	2830.33	-4.20*	25.17	-2.15	34.61	2.14*	18.65
2 Potato	1795.17	-4.33**	13.67	-5.11**	35.12	-0.81	24.59
3 Green chilies	693.50	-2.54	34.24	-5.01**	34.89	-2.52**	22.01
<b>Plantation</b>							
1 Arecanut	3966.50	5.95***	34.82	-6.04	63.49	-11.31**	64.08
2 Coconut (lakh nuts)	3338.00	-16.11***	18.66	-15.2***	38.51	1.09*	8.42
3 Betelvine (lakh leaves)	473.50	-2.37	15.04	9.36	66.06	20.33**	63.37

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

**Table 4:** Compound growth rates and instability in area, production and productivity of different crops in Chitradurga

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Maize	250450.00	8.53**	43.34	-1.74	37.59	-9.46**	47.15**
2 Ragi	50382.00	-1.66**	12.09	-1.12	22.33	0.55	27.85
3 Jowar	20694.50	-6.03***	21.02	-4.71	18.8	1.41	27.29
<b>Pulses</b>							
1 Bengal gram	23694.00	16.80***	23.75	-4.08	87.17	-17.88*	34.07*
2 Tur	9988.67	-0.09	25.02	4.38	41.94	4.48	37.02
3 Horse gram	8836.67	-5.20***	30.31	-6.40**	36.17	-1.26	26.46
<b>Oilseeds</b>							
1 Groundnut	107790.33	-3.30**	23.96	-7.43**	7.96	-4.27	22.29
2 Sunflower	8773.33	-8.60**	9.41	-9.16**	15.4	-0.62	27.56
3 Sesamum	2932.33	-3.24	32.31	2.61	24.64	6.05	57.12
<b>Commercial</b>							
1 Cotton	17397.00	-1.39	44.54	2.77	36.27	2.62	24.86
2 Tobacco	463.22	-3.42	45.35	-1.95	47.00	1.50	25.55
<b>Flowers</b>							
1 Chrysanthamum	446.00	15.60**	11.47	22.06***	35.31	5.59**	25.32
2 Aster	360.50	-7.57***	19.59	-8.97**	43.45	-1.52	32.86
3 Crossandra	351.50	2.79**	17.18	1.59	24.64	-1.16	37.34
<b>Spices</b>							
1 Tamarind	1218.00	-9.71***	4.00	-24.87***	5.11	-16.79**	9.76
2 Chillies	584.00	-4.55***	13.25	1.19	73.88	6.02***	39.77
3 Pepper	206.00	-11.10***	11.33	-11.28**	35.35	-0.20	34.11
<b>Fruits</b>							
1 Banana	5247.50	5.57***	9.38	3.22***	12.34	-2.22**	15.18
2 Pomegranate	4088.50	15.50***	64.21	14.23**	96.84	-1.1	21.3
3 Mango	3131.50	0.20	11.13	4.46**	15.32	4.25**	20.15
<b>Vegetables</b>							
1 Tomato	1898.00	9.96***	9.32	10.59***	25.36	0.57	18.89
2 Onion	17049.50	0.39	13.97	3.36	33.67	2.96	35.28
3 Green chilies	1564.50	-4.68	115.81	-7.21	175.77	-2.66	39.16
<b>Plantation</b>							
1 Coconut (lakh nuts)	54891.00	0.73**	4.68	0.91	14.11	0.18	11.9
2 Arecanut	19335.00	0.01	7.86	0.01	25.27	-1.88	19.66
3 Betelvine (lakh leaves)	359.00	-4.50***	27.66	-4.70*	36.01	-0.21	19.66

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

and its production and productivity had about 16.58% and 8.50% respectively these were significant one %. Area and production of mango and banana had a positive growth ranges from 2.92% to 1.24% and these instability was also low indicates that fruits are going exponentially because of shift in cultivation. Even though Betelvine has a less area under cultivation its productivity was growing at rate of 20.33% and significant at five % it was because high yielding variety of Betelvine.

As shown in table 4 Among crops grown in Chitradurga the area of maize of was growing at rate 8.53% with 43.34 instability but its production and productivity showed negative growth. About 22.06% was the highest growth rate observed in production of chrysanthamum with one % significant even its area showed 15.60% growth its productivity was growing at rate of 5.59%. Tomato with 1898 ha had an area with 1898 ha and its area growing at rate of 9.96% with instability of 9.32 where as its productivity was growing at the rate of 10.59% and significant at one %. Green chilli possessed negative growth and its production was very high instable of 175.77. Coconut being covered with 54891 ha had a very low growth rate in its area, production and productivity of 0.73%, 0.91% and 0.18% respectively.

Growth rates and instability indices of various crops in Davangere districts are been depicted in table 5 according to this table Cereals constitute of highest area under this area but their growth was slow, production of maize was growing at rate of 4.56% and significant at one %. Production of horsegram was the one pulse which had a positive growth of 2.73% and significant at one %. Area and production of oilseeds had a negative growth but instability in productivity of groundnut and productivity of sunflower had lower instability indices but productivity of sunflower had a growth rate of 3.12% and productivity of seasamum was growing at rate of 6.93% it may be increased in high yielding variety. Cotton is one of the commercial crop growing positively here productivity of cotton showed a growth rate of 12.96%, production was 7.18% and area was 5.34%. attributing to introduction of Bt-cotton (Nithya 2007). Chrysantahamum was one among flower

whose area and production was growing at rate of 7.29% and 10.29% per annum with 28.02 and 19.28 instability indices, which was the highest CAGR in this district. Arecanut was one in whose area had 6.46% and its production was growing at rate of 8.63%. This was mainly due to emphasis of National horticulture Mission horticulture crops like fruits and flowers were having positive growth.

Growth and instability indices of different crops in Kolar district was observed in table 6. Maize being second highest among cereals its production and area was growing at rate of 13.91% and 11.33% had a instability of 33.49 and 12.10. Production of Avare had a highest growth rate of 19.65% but instability was more i.e, 55.47, its productivity was growing at rate of 18.03% and significant at one %, area of horsegram was highly instable with 99.95. Productivity of sunflower was growing at rate of 6.06% it was significant at five % with instability of 36.18. Area, production and productivity of flowers had positive growth, production of rose had a markable growth of 13.59% with instability of 20.62 it was significant at one % but area of rose was growing at rate of 12.71% had low stability of 11.48, production of crossandra had growth rate of 10.27% and area of crossandra was growing at rate of 7.62%. In kolar most are shifting from sericulture to flower cultivation under Hi-tech polyhouse and exporting those. Area of banana had a growth rate of 15.39% with 20.36 instable, production was growing at rate of 13.24%, mango being important crop in these area with widely exporting from this place (Dhakre and Bhattacharya 2013) area of mango was growing at rate of 4.09% with lowest instability of 3.23 . Area of grapes was growing at rate of 8.36% and instability was 26.09%. Tomato was prominently grown in the kolar its area, production and productivity was growing at rate of 2.56%, 7.59% and 4.91% respectively, it also had lower instability.

As shown in table 7 indicates the growth rates and instability indices of different crops in Shivamogga District. Here maize been cultivated in 55125 ha its area was growing at rate of 7.19% and instability was 36.65 where as its productivity was growing at rate of 17.56% which was highest and it was significant at one %. Instability index was highest in case of area of tur with 58.16% which had a

**Table: 5** Compound growth rates and instability in area, production and productivity of different crops in Davanagere

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Maize	134907.67	0.04***	9.20	4.56***	64.08	0.01	41.95
2 Paddy	12899.33	0.02	20.79	1.32	26.08	0.05	18.49
3 Jowar	19252.00	-8.29***	8.88	0.84**	29.78	0.01	27.87
<b>Pulses</b>							
1 Tur	7425.00	-0.41	19.36	5.87	42.54	0.03	39.2
2 Bengal gram	2469.00	2.52	54.42	-2.98	52.5	-0.03	45.87
3 Horsegram	2436.00	-9.31	39.81	2.73***	47.15	0.06	27.38
<b>Oilseeds</b>							
1 Groundnut	19506.33	-4.02**	9.89	-3.64	1.64	0.40	15.37
2 Sunflower	6305.67	-10.24	22.15	-7.44	0.72	3.12**	47.94
3 Sesamum	709.33	-6.80**	23.03	-0.34	32.79	6.93**	37.7
<b>Commercial</b>							
1 Cotton	22868.78	5.34	63.1	12.96**	68.42	7.18	24.76
2 Sugarcane	4920.11	-10.70**	59.65	-6.15	70.99	5.09***	18.35
3 Tabacco	1116.00	-7.12**	45.60	-5.12	62.99	2.18	21.63
<b>Flowers</b>							
1 Marigold	523.00	2.23	57.68	-0.12	22.64	-2.30	26.18
2 Aster	360.50	-7.57***	19.59	-8.97**	43.45	-1.52	32.86
3 Chrysanthamum	328.12	10.47**	41.63	14.33**	103.69	-0.23	24.74
<b>Spices</b>							
1 Chillies	791.33	-6.65**	38.92	-37.83***	72.27	-33.40***	84.69
2 Tamarind	83.40	-9.97**	59.39	-7.16**	108.4	3.12	39.15
3 Turmeric	49.47	-17.99**	127	-27.35***	116.77	-11.41**	35.07
<b>Fruits</b>							
1 Banana	3801.66	4.82**	36.09	4.97**	23.12	0.15	16.42
2 Mango	3429.65	1.90	24.38	1.35	32.03	-0.54	27.17
3 Sapota	860.66	7.29**	27.53	10.29**	28.02	2.79**	19.28
<b>Vegetables</b>							
1 Tomato	4970.75	-0.88	12.35	8.16***	19.18	9.12***	22.36
2 Onion	3762.32	7.36***	34.63	13.17***	27.04	5.41**	31.98
3 Green chilies	1081.50	-5.29**	62.14	-4.33**	30.6	1.02	21.7
<b>Plantation</b>							
1 Arecanut	32676.62	6.46***	4.96	8.63**	39.32	2.04	62.73
2 Coconut (lakh nuts)	13382.07	-1.12**	9.76	-1.12	14.16	1.74**	14.22
3 Betelvine (lakh leaves)	1014.85	0.23	8.83	-8.66**	46.68	-8.88**	44.54

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

Table: 6 Compound growth rates and instability in area, production and productivity of different crops in Kolar

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Ragi	98227.00	-0.16	17.36	-0.53	26.56	-0.39	43.34
2 Maize	47231.33	11.33***	12.10	13.91***	33.49	2.32	27.57
3 Paddy	12420.00	-3.53	46.34	-1.80	54.78	1.79	57.89
<b>Pulses</b>							
1 Avare	12218.33	1.37	27.36	19.65***	55.47	18.03***	42.51
2 Tur	10015.00	2.36	30.27	4.92	54.48	2.49	47.73
3 Horsegram	9030.33	-2.27	99.95	-0.73	48.71	1.57	42.10
<b>Oilseeds</b>							
1 Groundnut	40205.33	-4.86**	11.24	-2.92	20.42	2.07	13.89
2 Sunflower	1625.00	-1.76	4.71	1.95	11.61	6.06**	36.18
3 Mustard	878.67	-4.19**	22.65	-4.61**	16.15	-0.42	7.30
<b>Commercial</b>							
1 Sugarcane	398.00	-16.29***	55.38	-19.11**	86.58	5.32***	31.46
<b>Flowers</b>							
1 Marigold	1096.90	7.29***	13.96	8.64***	11.11	1.26**	5.95
2 Rose	681.50	12.71***	11.48	13.59***	20.62	0.78	16.41
3 Crossandra	546.00	7.62**	23.46	10.27**	29.17	2.46	19.16
<b>Spices</b>							
1 Tamarind	5340.50	-1.72	17.24	-6.50***	24.55	-4.86**	27.81
2 Coriander	377.50	0.42	24.29	-2.81	36.68	-3.22**	20.20
3 Chillies	308.33	-14.69***	30.96	-20.62***	55.16	-6.95**	41.66
<b>Fruits</b>							
1 Mango	58620.30	4.09***	3.23	1.42	17.48	-2.56**	18.85
2 Banana	5829.50	15.39***	20.36	13.23**	25.33	-1.87**	12.61
3 Grapes	2914.10	8.36***	26.09	7.56**	31.03	-0.74	14.58
<b>Vegetables</b>							
1 Tomato	10332.57	2.56**	9.05	7.59***	15.88	4.91***	10.95
2 Potato	8295.50	-0.50	25.45	-0.44	51.07	-0.06	30.33
3 Beans	3981.93	0.59	18.32	0.83	34.18	0.24	30.65
<b>Plantation</b>							
1 Coconut (lakh nuts)	11481.00	-1.55***	5.46	-2.32**	11.59	-0.59	9.38
2 Cashew	4899.30	6.40***	11.47	4.45***	12.55	-1.59**	11.43
3 Arecanut	138.08	-1.20	8.29	-1.05	19.67	0.16	5.40

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

**Table: 7** Compound growth rates and instability in area, production and productivity of different crops in Shivamogga

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Paddy	125122.00	-2.37***	9.59	0.45	18.43	2.88**	17.88
2 Maize	55125.00	7.19**	36.65	17.56***	30.73	9.67**	44.91
3 Ragi	1324.33	-18.65***	27.33	-13.24***	13.76	6.65***	17.47
<b>Pulses</b>							
1 Green gram	1242.33	-7.96***	29.37	-6.09**	56.81	2.04	40.49
2 Tur	343.33	-9.21**	58.16	-1.05	40.22	8.98**	42.33
3 Horsegram	121.00	-21.93***	30.47	-18.64***	47.48	4.21**	44.76
<b>Oilseeds</b>							
1 Sunflower	1359.67	15.60**	36.25	29.57***	8.97	12.08***	53.96
2 Groundnut	662.33	-17.85***	1.33	-15.84***	3.96	2.45	24.7
3 Sesamum	35.67	-20.99**	2.32	-16.77**	3.08	5.33**	146.8
<b>Commercial</b>							
1 Cotton	4903.00	-7.71***	45.52	-8.37***	44.97	-1.50	276.59
2 Sugarcane	1613.00	-15.88***	15.50	-9.85**	35.36	11.89**	23.07
3 Tabacco	45.67	-17.73***	23.81	-15.80***	32.96	2.37**	21.23
<b>Flowers</b>							
1 Aster	860.50	-0.81	21.34	-8.97**	43.45	-1.52	32.86
2 Rose	73.00	-1.80	24.05	1.83	17.53	1.59**	11.61
3 Jasmine	72.00	-8.47	91.59	-0.02	74.72	4.96**	27.53
<b>Spices</b>							
1 Ginger	1010.50	-1.39	24.65	-9.04**	74.73	-6.59**	50.61
2 Pepper	4658.00	-13.18***	5.7	-20.90***	17.53	-8.89**	24.05
3 Cardamom	316.50	5.57**	9.25	5.29**	25.41	-0.26	28.93
<b>Fruits</b>							
1 Banana	6803.00	2.88**	19.95	6.07**	22.37	3.10***	9.67
2 Mango	3482.50	0.31	24.31	2.54	36.26	2.23**	19.00
3 Pineapple	1590.50	3.56**	17.73	3.56**	29.52	7.85***	12.73
<b>Vegetables</b>							
1 Green chilies	172.00	-6.80	67.56	-0.48	61.76	6.78**	28.34
2 Tomato	131.00	-11.30***	65.14	-8.44**	59.76	3.23**	15.82
3 Brinjal	26.50	-20.63***	73.98	-17.28***	74.78	4.23***	13.32
<b>Plantation</b>							
1 Arecanut	44686.00	7.80***	11.27	7.58***	8.14	-0.20	7.54
2 Coconut (lakh nuts)	6712.50	-0.69**	4.93	-0.69	12.07	1.07	9.49
3 Cashew	1345.50	-2.36**	19.49	-2.36***	7.55	-2.43	15.12

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%

**Table 8:** Compound growth rates and instability in area, production and productivity of different crops in Tumakuru

Crops	Average area (Ha)	Area		Production		Productivity	
		CAGR	Instability index	CAGR	Instability index	CAGR	Instability index
<b>Cereals</b>							
1 Ragi	157405.00	-0.93	10.3	1.39	29.16	2.35	31.27
2 Paddy	25866.67	-0.08	42.69	-1.23	32.39	-1.15	86.53
3 Maize	22291.00	12.44***	15.35	10.98***	27.69	-1.30	40.36
<b>Pulses</b>							
1 Horsegram	13654.67	-3.80**	22.71	-0.26	11.65	3.68**	18.1
2 Tur	20946.67	1.19	21.86	10.60**	44.82	9.29	54.2
3 Green gram	8557.00	8.71	40.52	5.33	40.39	-3.11	57.75
<b>Oilseeds</b>							
1 Groundnut	99868.33	-1.39**	15.67	-8.21**	6.98	-5.08	26.88
2 Castor oil	3958.00	-0.77	15.53	-3.66	13.52	-2.91**	18.91
3 Sunflower	3327.67	-1.39	15.24	2.23	10.99	3.67**	1.28
<b>Commercial</b>							
1 Sugarcane	1838.56	3.22	43.59	2.28	45.66	-0.96	307.97
2 Cotton	1824.67	5.34**	54.69	16.94**	222.09	15.91**	13.84
<b>Flowers</b>							
1 Jasmine	991.00	5.09***	19.80	2.04	19.86	-2.90***	11.72
2 Chrysanthamum	852.50	11.31***	15.99	16.95***	20.54	5.07**	21.49
3 Aster	469.17	-2.05	34.83	-1.85	36.00	0.21	7.63
<b>Spices</b>							
1 Tamarind	2764.00	5.70***	5.10	14.10***	23.03	7.95**	21.50
2 Chillies	1743.00	-5.18**	21.54	0.17	179.93	5.64	140.80
3 Coriander	53.00	-1.10	58.94	11.18	129.42	12.42**	68.72
<b>Fruits</b>							
1 Mango	14090.50	5.20***	2.85	6.92***	21.3	1.64	22.67
2 Banana	5401.50	6.52***	8.35	8.66***	21.14	2.23	19.04
3 Pineapple	1589.00	12.32***	33.61	13.48***	39.23	1.03	16.62
<b>Vegetables</b>							
1 Green chillies	1283.50	31.10***	19.78	34.46***	66.53	2.65	104.40
2 Onion	1034.75	5.32**	25.86	13.39***	37.81	7.66***	14.89
3 Tomato	435.50	9.11**	38.98	16.80**	47.56	7.05**	39.89
<b>Plantation</b>							
1 Coconut (lakh nuts)	142077.00	4.11***	5.55	4.86***	14.18	0.64	16.18
2 Arecanut	27928.50	9.03***	10.55	13.38***	21.54	1.35	26.74
3 Betelvine (lakh leaves)	760.50	-0.04	4.81	1.70	16.29	1.74**	10.96

Note: \*\*\* significant @ 1% \*\* significant @ 5%, \* significant @10%



significant negative growth and its productivity had 8.98% growth with five per cent significant. Highest CAGR was observed in production of sunflower i.e, 29.57% per annum with low instability index of 8.97, its area and production also grown at rate of 15.60% and 12.08% respectively indicating a sunflower is growing tremendously and gaining more importance. Commercial crops was having a negative growth rate even in case of productivity of cotton had a highest instability of 274.59, even productivity of sugarcane had a growth rate of 11.89% per which was significant at 5%. Among spices cardamom area and production was growing at rate of 5.57% and 5.29% with insignificant level of 9.25 and 25.1 respectively but its productivity had a negative growth of -0.21%. It was amazed that area, production and productivity was growing positively among selected fruit crops, here productivity of pineapple was growing at rate of 7.85% it was due to varieties grown are Giant Kew and Queen which are High demand in the domestic and exports market for fresh and processed products.

Compound growth rate and instability indices of various crops of Tumkuru was depicted in table 8 where we can see that area of maize was growing at rate of 12.44%, productivity was growing at rate of 10.98% these are significant at one % here instability was 15.35%. Tur had a positive growth in its area, production and productivity with 1.19%, 10.60% and 9.29% respectively. Cotton area, production and productivity was growing at rate of 5.34, 16.94 and 15.91% respectively these were significant at 5% but here highest instability was seen in 222.09. in this place productivity of chrysanthamum possessed 16.95% growth and its area was growing at rate of 11.31% with significance level of one % with 15.99 instability which is low. the district flowers cultivation have been exponentially growing because of shift in cropping pattern and demand for flowers . Area of tamarind was growing at rate of 5.70% with 5.10 instability which was lowest in district. About 34.66% growth was observed in production of green chilli and this was highest among all crops of Tumkuru district, instability was high in productivity of green chillies. In plantation highest CAGR in plantation was 13.38% with one % significance but 26.74% was highest instability was observed in productivity of arecanut. There is greater potential to improve the yield of major crops

through techniques like biotechnology and genetic engineering. This will go a long way in improving the crop production, farmers' income, nutrition and thus, reduce rural poverty (Ramachandra *et al.* 2013).

## Conclusion

The above results indicated the fact that the growth in area, production and productivity for various crops in the Bangalore division registered both positive and negative growth and few were found statistically significant. Compound growth rate in case of productivity of fruits witnessed highest positive growth trend. The instability indices for most the area of crops were found lowest, thereby indicating the low risk for cultivation in the district.

Policies need to be focused to increase the yields of these crops. Scientific methods of cultivation of different crops and Sustainable agriculture need to be carried out to increase the productivity. Research institutes need to be established in the major crops producing in this division The latter factors are important in making agriculture profitable through efficient marketing, access to and adoption of new technologies and providing incentives for making on-farm investment.

## Acknowledgments

The first author wishes to express his deep sense of reverence to Dr. R. A. Yeledhalli, Professor, Department of Agribusiness Management, University of Agricultural Sciences, Dharwad and UGC, New Delhi for providing RGNF Scholarship in the form of financial support during the study period.

## References

- Anjani, K. and Rajni, J. 2013. Growth and Instability in Agricultural Productivity: A District Level Analysis, *Agricultural Economics Research Review* **26** : 31-42.
- Dhakre, D. S. and Bhattacharya, D. 2013. Growth and Instability Analysis of Vegetables in West Bengal, India, *International Journal of Bio-resource and Stress Management* **4(3)**: 456-459.
- Dinesha, M.V. and Sriramappa, K.E. 2015. Growth in Area, Production and Productivity of Vegetables and Fruits in India with Special Reference to Karnataka, *International Journal of Applied Research* **1(8)**: 288-293.
- Elumalai, K. and Sujata, S. 2013. Analysis of Trends in India's Agricultural Growth, The Institute for Social and Economic Change, Bangalore, *Working Paper* **276**: 6-12.



- Krishan, B. and Amar, C. 2014. Agricultural Growth and Instability in Western Himalayan Region: An Analysis of Himachal Pradesh, India, *Journal of Agriculture and Life Sciences* **1(1)**: 21-27.
- Kumawat, R.C. and Meena, P. C. 2005. Growth and instability in area, production and yield of major spice crops in Rajasthan vis-a-vis India, *Journal of Spices and Aromatic Crops* **14(2)**: 102–111.
- Narendra, S., Dikshit, A.K., Reddy, B.S. and Kuthe, S.B. 2014. Instability in Rice Production in Gujarat: A Decomposition Analysis, *Asian Journal of Economics and Empirical Research* **1(1)**: 6-9.
- Nithyashree, M.L. and Suresh, P. 2013. Regional Pattern of Agricultural Growth and Rural Employment in India: Have Small Farmers Benefitted?, *Agricultural Economics Research Review* **26**: 1-11.
- Nithya, V.G. 2007. Bt cotton in Karnataka-An econometric analysis. *M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore, Karnataka (India)*.
- Ramachandra, V.A., Basanayak, Rajashekhar T., Salunke, Renuka and Ravusaheb, Munji, 2013. Growth in area, production and productivity of major crops in Karnataka. *International Research Journal of Agricultural Economics and Statistics* **4(2)**: 117-123.
- Ramesh, C. and Raju, S.S. 2008. Instability in Andhra Pradesh Agriculture — A Disaggregate Analysis, *Agricultural Economics Research Review* **21**: 283-288.
- Saraswathi, P. A., Basavaraj, H., Kunnal, L.B., Mahajanashetti, S.B. and Bhat, A.R.S. 2012. Growth in area, production and productivity of major crops in Karnataka. *Karnataka Journal of Agricultural Sciences* **25(4)**: 431-436.
- Satishkumar, M., Harishkumar H.V., Ramesh and Rangegowda, R. 2016. Growth, Export Performance and Competitiveness of Basmati and Non-Basmati Rice of India-an Markov Chain Approach, *International Journal of Agriculture, Environment and Biotechnology* **9(2)**: 305-311.

