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Statistical Analysis to Compute Instability Index and Sustainability Index for Area and Production of Coconut Crop in Districts of Karnataka

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Abstract - In India, Karnataka stands second in area (419 thousand hectare) and third in production (1492 thousand million nuts) of coconut. In Karnataka, Tumkur is the largest producer of coconut with the production of 9945.66 lakh nuts (2010). An attempt is made to study the area, production and productivity of coconut crop in districts of Karnataka. The analysis is based on secondary data taken from Directorate of Economics and Statistics, Karnataka for the period 1982-2009. The results establish an increasing shift of coconut cropped area (130.14%), production (203.65%) and productivity (112.71%) for the period 1982-2009.

Keywords - Instability index, sustainable agriculture, Hirschman's index, crop diversification.

I. Introduction

The coconut is a benevolent crop and a perfect gift to mankind. It has during the span of history represented not only the source of food, beverage, oil seed, fibres, timber and health products but also associated with magic, mystery, medicine and omen in the life of people. The coconut palm tree provides clothing, utensils and dwellings and therefore, remains an important source of earning livelihood to the inhabitants of the coconut producing states in coastal areas. The inhabitants therefore, affectionately eulogized the coconut plant with reverence as "*Kalpavriksha*", because of its manifold virtues. Even today the omen and mystery of coconut symbolism appears in day to day life of people and therefore this nature's most precious gift continue to be explored, scientifically, economically and artistically in the world traditions to adorn coconut (Coconut Development Board).

II. MATERIAL AND METHODS

Instability Index:

Growth is also accompanied by instability, crop growth and instability varies across districts. The growth in crop production is the result of area expansion and growth in production levels. The instability in crop production arises due to instability in area and production of the crop.

The instability in cropped area and production will not only make the vulnerable at the hands of financing agencies but also possess problem for his maintenance and to raise economic finance for the forth coming agricultural season.

The instability in area under a crop is likely to arise when a new crop are introduced, farm crop rotation practices and Variation or changes in the relative profitability of the crop arising out of changes in relative yield levels and or relative prices and contributing weather factors. These factors may bring about the frequent changes in crop composition. Instability in area leads to the result and of instability in production and productivity.

In order to study the variability in Area and Production of coconut crop, an index of instability was used. Data on Area and Production of Coconut crop for the period 1982-1990, 1991-2000, 2001-2009 and overall period of 1982-2009 were calculated. The coefficient of variation (CV %) was calculated using the formula

$$CV (\%) = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

The formula suggested by Cuddy and Delle Vale (1978) was used to compute the index of instability.

$$\text{Instability Index} = CV \times \sqrt{1 - R^2}$$

R^2 : Coefficient of determination of area or production.

The districts were classified considering instability index based on the mean \pm ½ SD as high category, moderate category and low category establishing the area and production of coconut crop separately for all the periods under study.

Instability	Category
Low	< (Mean – ½ SD)
Moderate	Mean – ½ SD to Mean + ½ SD
High	> (Mean + ½ SD)

SUSTAINABILITY INDEX:**a) Singh Sustainability index:**

Singh *et al.* (1990) proposed a sustainability index defined as:

$$SI = \frac{y - s}{y_{max}}$$

Where, y : Average yield of coconut crop

S: Standard deviation

y_{max}: Maximum yield of coconut crop for a period of time.

The result of the sustainability index reveals that higher the value better is the sustainability. The range obtained between 'Zero' and 'One'. Further the sustainability index is further classified as Low, moderate and high as suggested by Vittal K.P.R, Murthy S.G.R, Singh H.P & Samra J.S (2002).

Category	Sustainability index value
High	> 0.67
Moderate	0.50-0.66
Low	< 0.50

Pal Sustainability index:

Pal and Sahu (2007) proposed the following measures of sustainability which do not require any assumption. This is a ideal measure of sustainability using both the measures of central tendency as well as measures of dispersion. The formula for computation is as follows,

$$SI = (si / yi) - (smax)$$

Where,

SI: Sustainability index.

si : Standard deviation of ith area and production over the entire time period.

yi : Average of ith area and production over the entire time period.

smax: Maximum value of the standard deviation of area and production of coconut crop.

According to Pal, positive index value indicates higher Sustainability and negative index value indicates lower sustainability. Higher the value of the index, higher is the sustainability status. The measure can take both positive and negative value. The problem with this index is that, it doesn't have a definite range.

To compute Instability and Sustainability index for area and production

Appropriate statistical indices have been worked out to know the trend of area and production of coconut crop. In the present research study, three indices have been used, viz., Herfindhal-Hirschman's index, Instability index and Sustainability index [Singh (1990), Sahu and Pal (2007)].

The objective of the study is to examine the variations across the different districts of Karnataka. The above mentioned indices have been used. Herfindhal-Hirschman's index was calculated for all the districts separately for study periods considering the total index value of 'one' for the state. According to Herfindhal-Hirschman's, higher index

Table 4.2.1 Hirschman's index of area for the study periods among all the districts of Karnataka

No.	Districts	Hirschman's index of area			
		1982-09	1982-90	1991-00	2001-09
1.	Bagalkote	0.002	-	-	0.002
2.	Banglore-urban	0.011	0.028	0.009	0.006
3.	Banglore-rural	0.048	-	0.059	0.042
4.	Belgaum	0.001	0.000	0.001	0.001
5.	Bellary	0.004	0.004	0.005	0.003
6.	Bidar	0.000	-	-	0.000
7.	Bijapur	0.001	0.001	0.001	0.001
8.	Chamarajnar	0.030	-	-	0.026
9.	Chikmagalur	0.090	0.116	0.101	0.089

10.	Chitradurga	0.113	0.136	0.138	0.109
11.	Dakshina kannada	0.059	0.091	0.077	0.041
12.	Davanagere	0.040	-	-	0.032
13.	Dharwad	0.002	0.004	0.004	0.001
14.	Gadag	0.002	-	-	0.001
15.	Gulbarga	0.002	-	0.003	0.002
16.	Hassan	0.153	0.194	0.168	0.154
17.	Haveri	0.004	-	-	0.003
18.	Kodagu	0.003	0.003	0.003	0.004
19.	Kolar	0.006	0.006	0.008	0.005
20.	Koppal	0.002	-	-	0.002
21.	Mandya	0.048	0.058	0.056	0.046
22.	Mysore	0.048	0.059	0.053	0.048
23.	Raichur	0.001	0.002	0.001	0.001
24.	Shimoga	0.021	0.022	0.032	0.018
25.	Tumkur	0.252	0.250	0.260	0.305
26.	Udupi	0.039	-	-	0.04
27.	Uttara Kannada	0.018	0.026	0.021	0.018
Total		1.000	1.000	1.000	1.000

value among the districts indicate better concentration of the area (crop specialization) lower value considered as diversification.

In table 4.2.1, explains that, among all the districts Tumkur district possess the higher Hirschman's index (0.252) indicating more specialization of the area for the period (1982-2009) followed by Hassan district (0.153) and Chitradurga district (0.113).

Further, for the remaining three periods 1982-90, 1991-2000 and 2001-2009 among the districts Tumkur district establish the higher Herfindhal-Hirschman's index of 0.250, 0.260 and 0.305 followed by Hassan district (0.194, 0.168 and 0.154) and Chitradurga district (0.136, 0.138 and 0.109) respectively.

It is evident from the analysis that, the Hirschman's index showed higher in Tumkur followed by Hassan and Chitradurga district revealing the higher specialization among the districts in the area of coconut crop during the periods of study and remaining districts exhibiting a diversification.

From the table 4.2.2 regarding the production of coconut crop Hassan district possess higher Hirschman's index (0.218) indicating higher specialization of the production followed by Chitradurga (0.168) and Tumkur district (0.081) among the districts for an overall period of 1982-2009.

Further, for the remaining three periods 1982-90, 1991-2000 and 2001-2009, among the districts Hassan district established higher Herfindhal-Hirschman's index of 0.289, 0.214 and 0.087 followed by Chitradurga district (0.214, 0.203 and 0.163) and Tumkur district (0.087, 0.104 and 0.094) respectively.

Instability index of area

It is evident from table 4.2.3, that, the instability index was found to be the least in Tumkur district (6.37), followed by Chitradurga district (9.33) and Hassan district (14.01) the high instability index was noticed in Bangalore urban district (69.63) for the overall period of 1982-2009 regarding the area of coconut crop.

However for the period of 1982-1990, the area of instability index was found to be lower in Tumkur district (1.45) followed by Chitradurga district(2.51), and Hassan district (2.67) as compared to higher instability index was noticed in Bangalore Urban (56.33) among the districts.

For the period of 1991-2000 regarding the area of coconut, the Hassan district (2.94) found least instability index followed by Tumkur district (7.06) and Chitradurga district (8.15) as against Bangalore rural district (45.05) recorded a higher instability index among the districts of Karnataka.

The area of instability index found least in Hassan district (2.57) followed by Tumkur (3.41) and Chitradurga district (3.65) where as higher instability index was noticed in Raichur district (54.57) for the period of 2001-2009.

It can be concluded that, Tumkur district possess least instability index followed by Hassan and Chitradurga district and the higher instability was noticed in Bangalore urban district for the study periods among all the districts of Karnataka regarding the area of coconut crop.

Least Instability index in Tumkur, Hassan and Chitradurga might be due to the area of coconut is more or less same in all the years.

Table 4.2.2 Hirschman's index of production for the study periods among districts of Karnataka

No.	DISTRICT	Hirschman's index of production			
		1982-09	1982-90	1991-00	2001-09
1.	Bagalkote	0.003	-	-	0.003
2.	Banglore-urban	0.015	0.036	0.015	0.008
3.	Banglore-rural	0.053	-	0.064	0.050
4.	Belgaum	0.001	0.001	0.001	0.002
5.	Bellary	0.005	0.005	0.006	0.005
6.	Bidar	0.000	-	-	0.000
7.	Bijapur	0.001	0.001	0.002	0.001
8.	Chamarajnaragar	0.029	-	-	0.027
9.	Chikmagalur	0.064	0.079	0.069	0.070
10.	Chitradurga	0.168	0.214	0.203	0.163
11.	Dakshina kannada	0.072	0.105	0.087	0.061
12.	Davanagere	0.057	-	-	0.049
13.	Dharwad	0.003	0.005	0.004	0.002
14.	Gadag	0.002	-	-	0.002
15.	Gulbarga	0.002	-	0.003	0.003
16.	Hassan	0.218	0.289	0.250	0.215
17.	Haveri	0.005	-	-	0.005
18.	Kodagu	0.004	0.004	0.004	0.006

19.	Kolar	0.007	0.008	0.010	0.006
20.	Koppal	0.003	-	-	0.003
21.	Mandya	0.062	0.075	0.071	0.065
22.	Mysore	0.049	0.055	0.052	0.057
23.	Raichur	0.001	0.002	0.001	0.001
24.	Shimoga	0.021	0.021	0.029	0.020
25.	Tumkur	0.081	0.087	0.104	0.094
26.	Udupi	0.050	-	-	0.056
27.	Uttara Kannada	0.026	0.034	0.027	0.028
Total		1.000	1.000	1.000	1.000

Table 4.2.3 Instability index of area for the study periods among districts of Karnataka

No.	DISTRICT	Instability index of Area			
		1982-09	1982-90	1991-00	2001-09
1.	Bagalkote	48.05	-	-	27.43
2.	Banglore-urban	69.63	56.33	20.33	13.54
3.	Banglore-rural	48.52	-	45.05	42.26
4.	Belgaum	42.23	20.64	15.87	40.17
5.	Bellary	19.44	7.75	12.84	9.78
6.	Bidar	29.70	-	-	6.17
7.	Bijapur	50.78	13.06	37.70	36.57
8.	Chamarajnagar	15.97	-	-	14.82

9.	Chikmagalur	16.21	3.78	14.31	6.31
10.	Chitradurga	9.33	2.51	8.15	3.65
11.	Dakshina kannada	16.21	4.26	19.71	11.28
12.	Davanagere	14.30	-	-	14.29
13.	Dharwad	39.35	10.58	35.15	8.43
14.	Gadag	22.39	-	-	10.89
15.	Gulbarga	14.07	-	11.41	12.49
16.	Hassan	14.01	2.67	2.94	2.57
17.	Haveri	26.43	-	-	26.59
18.	Kodagu	19.80	5.88	8.87	13.58
19.	Kolar	18.13	5.76	11.08	12.72
20.	Koppal	44.69	-	-	45.05
21.	Mandya	16.13	4.04	14.22	7.38
22.	Mysore	16.04	3.70	16.47	15.76
23.	Raichur	40.68	18.43	32.03	54.57
24.	Shimoga	29.56	10.00	19.64	11.58
25.	Tumkur	6.37	1.45	7.06	3.41
26.	Udupi	10.76	-	-	4.22
27.	Uttara Kannada	15.75	3.66	10.42	5.35
	Mean	26.46	10.26	18.07	17.07
	SD	15.94	13.11	11.45	14.48

From the table 4.2.4 the districts were classified considering instability index based on the mean $\pm\frac{1}{2}$ SD as high category, moderate category and low category establishing the area of coconut crop.

The result presented in the table 4.2.4 reveals that, for the period of 1982-1990, 6 districts such as Tumkur, Hassan, Chitradurga, Dakshina Kannada, Mysore and Uttara Kannada falls under the low category, exhibits lower variation in the area of coconut crop. Whereas 3 districts such as Bangalore urban, Belgaum and Raichur falls under high category possess more variation in the area of coconut crop.

For the period of 1991-2000, 7 districts such as Chikmagalur, Chitradurga, Hassan, Kolar, Mandya, Tumkur and Uttara Kannada falls under the low category, indicate lower variation in the area of coconut crop. Whereas 4 districts such as Bangalore rural, Bijapur, Dharwad and Raichur falls under high category possess more variation in the area of coconut crop.

Regarding the period 2001-2009, 12 districts such as Bidar, Chikmagalur, Chitradurga, Dharwad, Dakshina Kannada, Davanagere, Hassan, Mandya, Shimoga, Tumkur, Udupi and Uttara Kannada falls under the low category, exhibits lower variation in the area of coconut crop. On the other hand 7 districts such as Bagalkote, Bangalore rural, Belgaum, Bijapur, Haveri, Koppal and Raichur falls under high category possess more variation in the area of coconut crop.

However, for an overall period of 1982-2009, 9 districts such as Chikmagalur, Chitradurga, Davanagere, Gulbarga, Hassan, Mandya, Tumkur, Udupi and Uttara Kannada falls under the low category, exhibits lower variation in the area of coconut crop. Whereas 10 districts such as Bidar, Bellary, Gadag, Haveri, Dakshina kannada, Chamarajnagar, Kodagu, Kolar, Mysore and Shimoga falls under

Table 4.2.4. Classification of Districts Based On Instability Index Value for Area of Coconut Crop

Year/Period	CLASSIFICATION OF DISTRICTS		
	HIGH	MODERATE	LOW
1982-1990 (Period-I) (17 Districts)	Bangalore urban, Belgaum, Raichur (3 Districts)	Bellary, Bijapur, Chikmagalur, Dharwad, Kodagu, Kolar, Mandya, Shimoga (8 Districts)	Chitradurga, Dakshina kannada, Hassan, Mysore, Tumkur, Uttara Kannada. (6 Districts)
1991-2000 (Period-II)	Banglore-rural, Bijapur,	Bangalore urban, Bellary, Gulbarga, Kodagu, Mysore,	Chikmagalur, Chitradurga, Hassan Kolar,

(19 Districts)	Dharwad, Raichur (4 Districts)	Shimoga, Dakshina kannada, Belgaum (8 Districts)	Mandya, Tumkur, Uttara Kannada (7 Districts)
2001-2009 (Period-III) (27 Districts)	Bagalkote, Bangalore rural, Belgaum, Bijapur, Haveri, Koppal, Raichur. (7 Districts)	Bangalore urban, Bidar, Gadag, Gulbarga, Kodagu, Kolar, Mysore, Bellary. (8 Districts)	Bidar, Chikmagalur, Chitradurga, Dakshina Kannada, Davanagere, Dharwad, Hassan, Mandya, Shimoga, Tumkur, Udupi, Uttara Kannada. (12 Districts)
1982-2009 (Overall) (27 Districts)	Bagalkote, Bangalore Urban Bangalore rural, Belgaum, Raichur, Bijapur, Koppal, Dharwad. (8 Districts)	Bellary, Bidar, Gadag, Haveri, Dakshina Kannada, Chamarajnagar Kodagu, Kolar, Mysore, Shimoga. (10 Districts)	Chikmagalur, Chitradurga, Davanagere, Gulbarga, Hassan, Mandya, Tumkur, Udupi, Uttara Kannada (9 Districts)

moderate category possess moderate variation in the area of coconut crop.

Instability index of production:

The result presented in the table 4.2.5 depicts that regarding the production of coconut crop for the period 1982-2009, the lower instability index was found in Hassan district (4.70) followed by Tumkur district (6.10) and Chitradurga district (6.20).

For the period of 1982-1990, the Tumkur district (1.91) possess least instability index followed by Hassan district (2.63) and Chitradurga district (2.64).

Further, for the period of 1991-2000, the least instability index was found in Chitradurga district (6.10) followed by Tumkur district (6.20) and Hassan district (7.18) in the production of coconut crop among the districts of Karnataka.

However for the period of 2001-2009, Hassan district (2.86) possess lower instability followed by Chitradurga district (5.82) and Tumkur district (6.48) exhibits low variation in the production of coconut crop among all the districts of Karnataka.

It is evident from the analysis that, the instability index showed least in Hassan district followed by Tumkur and Chitradurga district revealed that the instability in production of coconut crop during all the periods under study

The result presented in the table 4.2.6 reveals that, for the period of 1982-1990, 6 districts such as Tumkur, Hassan, Chitradurga, Dakshina Kannada, Uttara Kannada and Mandya falls under the low category, exhibits lower variation in the production of coconut crop.

Whereas, 3 districts such as Banglore urban, Belgaum and Raichur falls under high category possess more variation in the production of coconut crop.

For the period of 1991-2000, 6 districts such as Banglore rural, Chikamagalur, Hassan, Kolar, Mandya and Uttara Kannada falls under the low category exhibits lower variation in the production of coconut crop. Further 6 districts such as Banglore urban, Bijapur, Dharwad, Gulbarga, Tumkur and Raichur falls under high category possess more variation in the production of coconut crop.

The result presented in the table for the period of 2001-2009, 10 districts such as Bellary, Bidar, Chitradurga, Dharwad, Hassan, Mandya, Dakshina Kannada, Tumkur, Udupi, Davanagere falls under the low category, exhibits lower variation in the production of coconut crop. Whereas, 7 districts such as Haveri, Bagalkote, Belgaum, Bijapur, Kolar, Koppal, Raichur falls under high category possess more variation in the area of coconut crop.

However for an overall period of 1982-2009, 11 districts such as Bellary, Chitradurga, Davanagere, Gulbarga, Hassan, Mandya, Tumkur, Udupi, Uttara kannada, Chamarajnagar, Dakshina kannada and Gadag falls under the low category, exhibits lower variation in the production of coconut crop. Whereas 8 districts such as Bagalkote, Banglore urban, Belgaum, Bidar, Bijapur, Koppal, Dharwad, Gulbarga and Tumkur falls under high category possess higher variation in the production of coconut crop.

Table 4.2.7 depicted for the period 1982-1990 that 47.0 per cent of the districts falls under moderate category however 35.3 per cent of the districts classified as low category regarding the area of coconut crop. 42.1 per cent of the districts classified as moderate category and 36.8 percent of the districts classified as low category of instability for the period of 1991-2000. Further 44.5 per cent of the districts classified as low and 29.6 per cent of the district possess moderate category of instability for the period of 2001-2009.

However for the period of 1982-2009, 37.0 per cent of the districts classified as moderate category and 33.4 per cent of the districts as low category based on instability index establishing area of coconut crop for all the study period.

Table 4.2.7 depicted regarding classification of instability for production of coconut crop, 47.0 per cent of the districts falls under moderate category however 35.3 per cent of the districts classified as low category for the period of 1982-1990 regarding the area of coconut crop. Further, 36.8 per cent of the districts classified as moderate category and 31.6 per cent of the districts classified as low category of instability for the period of 1991-2000, 37.0 per cent of the districts classified as low as well as moderate category of instability for the period of 2001-2009.

However for the period of 1982-2009, 29.6 per cent of the districts classified as moderate and high category and 40.8 per cent of the districts as low category of instability index on production of coconut crop for all the study period.

Singh Sustainability index of area

From the table 4.2.8 Singh Sustainability Index of area is calculated for all the periods under study. According to Singh, higher the value of index is better the sustainability. It can be seen that, Tumkur district (0.869) possess highest sustainability followed by Chitradurga district (0.739) and Hassan district (0.620) for the period of 1982-2009 regarding the area of Coconut crop.

Table 4.2.5 Instability index of Production for the study periods among districts of Karnataka

No.	Districts	Instability index of Production			
		1982-09	1982-90	1991-00	2001-09
1.	Bagalkote	54.56	-	-	56.64
2.	Banglore-urban	74.97	58.06	68.74	15.87
3.	Banglore-rural	25.52	-	7.27	18.51
4.	Belgaum	55.14	23.00	19.22	43.89
5.	Bellary	16.80	9.21	15.43	8.84
6.	Bidar	78.59	-	-	7.66
7.	Bijapur	46.93	14.19	35.38	36.17
8.	Chamarajnaragar	19.41	-	-	19.35
9.	Chikmagalur	21.16	4.49	8.56	11.26
10.	Chitradurga	6.20	2.64	6.10	5.82
11.	Dakshina kannada	19.04	8.40	17.54	6.91

12.	Davanagere	14.28	-	-	9.85
13.	Dharwad	42.22	10.81	32.80	5.17
14.	Gadag	20.18	-	-	17.62
15.	Gulbarga	51.64	-	31.95	13.96
16.	Hassan	4.70	2.63	7.18	2.86
17.	Haveri	29.89	-	-	26.70
18.	Kodagu	28.90	6.33	14.61	17.87
19.	Kolar	24.88	6.07	11.27	28.88
20.	Koppal	44.02	-	-	43.03
21.	Mandya	18.40	3.78	12.14	6.91
22.	Mysore	33.21	8.12	15.38	15.34
23.	Raichur	42.38	18.41	39.40	52.21
24.	Shimoga	28.23	11.45	21.74	15.60
25.	Tumkur	6.10	1.91	6.20	6.48
26.	Udupi	12.31	-	-	8.60
27.	Uttara Kannada	12.89	0.76	12.00	13.47
	MEAN	30.84	11.19	20.15	19.09
	SD	19.87	13.48	15.67	14.96

TABLE 4.2.6: Classification of Districts Based On Instability Index Value for Production of Coconut Crop.

Period	Classification of districts		
	High	Moderate	Low
1982-1990 (Period-I) (17 Districts)	Bangalore urban, Belgaum, Raichur (3 Districts)	Bellary, Bijapur, Chikmagalur, Dharwad, Kodagu, Kolar, Mysore, Shimoga (8 Districts)	Chitradurga, Dakshina kannada, Hassan, Mandya, Tumkur, Uttara Kannada (6 districts)
1991-2000 (Period-II) (19 Districts)	Bangalore urban, Bijapur, Dharwad, Gulbarga, Raichur, Tumkur (6 Districts)	Belgaum, Bellary, Chitradurga, Kodagu Dakshina Kannada Mysore, Shimoga (7 Districts)	Bangalore rural Chikmagalur, Hassan, Kolar, Mandya, Uttara Kannada (6 Districts)
2001-2009 (Period-III) (27 Districts)	Bagalkote, Belgaum, Haveri, Bijapur, Kolar, Koppal, Raichur (7 Districts)	Bangalore urban, Banglore rural, Chamarajnagar Chikmagalur, Gadag, Gulbarga, Kodagu, Mysore, Uttara Kannada, Shimoga	Bellary, Bidar, Hassan, Mandya Chitradurga, Dakshina kannada, Davanagere, Tumkur, Udupi, Dharwad, (10 Districts)

		(10 Districts)	
1982-2009 (Overall)	Bagalkote, Bangalore urban, Belgaum, Bidar, Bijapur, Koppal, Gulbarga, Tumkur (8 Districts)	Bangalore rural, Haveri, Kodagu, Dharwad, Kolar, Mysore, Shimoga, Raichur (8 Districts)	Bellary, Hassan, Chamarajnagar, Chikmagalur, Chitradurga, Davanagere, Gadag, Mandya, Udupi, Uttara Kannada, Dakshina Kannada (11 Districts)

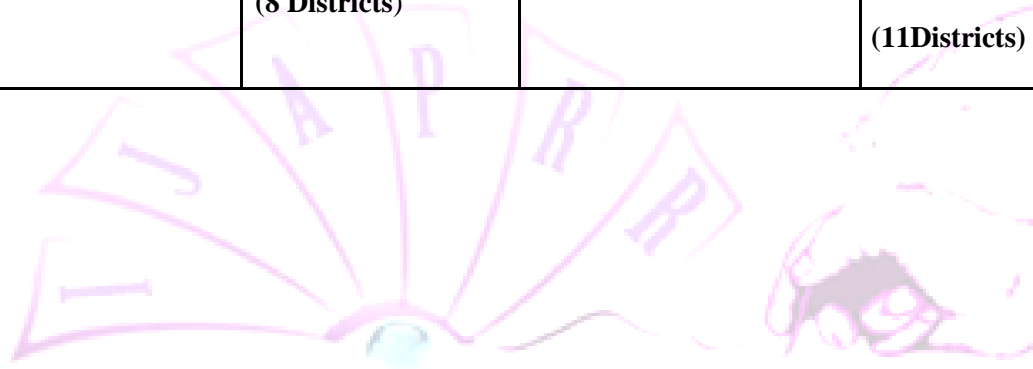


Table 4.2.7: Overall comparison on Classification of Instability index for the Study Periods

Aspect	Instability Classification	Study Period					
		1982-1990 (n=17)		1991-2000 (n=19)		2001-2009 (n=27)	
		N	%	N	%	N	%
Area	HIGH	3	17.7	4	21.1	7	25.9
	MODERATE	8	47.0	8	42.1	8	29.6
	LOW	6	35.3	7	36.8	12	44.5
	MEAN± SD	26.46±15.94		10.26±13.11		18.07±11.45	
Production	HIGH	3	17.7	6	31.6	7	26.0
	MODERATE	8	47.0	7	36.8	10	37.0
	LOW	6	35.3	6	31.6	10	37.0
	MEAN± SD	30.84±19.87		11.19±13.48		20.15±15.67	

Note: Figures in the parenthesis indicate number of districts studied.

For the period of 1982-1990, the Tumkur district (0.965) possess higher sustainability index followed by Hassan district (0.857) and Chitradurga district (0.853).

However, for the period of 1991-2000, the Tumkur district possesses higher sustainability Index (0.953) followed by Chitradurga district (0.889) and Hassan district (0.868).

For the period 2001-09, the Hassan district (0.982) possess higher Sustainability Index followed by Chitradurga district (0.882) and Tumkur district (0.802) regarding the area of Coconut crop.

From the analysis it revealed that, Tumkur district possesses highest Sustainability Index followed by Chitradurga district and Hassan district.

Singh Sustainability index of production

From the table 4.2.9 establishing the production of coconut crop, for the periods of 1982-09 and 1982-1990, Tumkur district (0.663 and 0.865) followed by Hassan district 0.609 and 0.858 and Chitradurga district (0.601 and 0.753) showed higher sustainability for the respective periods.

For the period of 1991-2000 under study, Chitradurga district (0.910) followed by Tumkur (0.905) and Hassan district (0.845) found high sustainability regarding the production of coconut.

However, for the period of 2001-2009, the districts of Hassan (0.865) followed by Chitradurga district (0.863) and Tumkur district (0.802) possess higher sustainability in production.

Table 4.2.8 Singh Sustainability index of area for the study periods among all districts of Karnataka

No.	Districts	Singh Sustainability index of area			
		1982-09	1982-90	1991-00	2001-09
1	Bagalkote	0.219	-	-	0.187
2	Banglore-urban	0.080	0.175	0.341	0.706
3	Banglore-rural	0.168	-	0.162	0.409
4	Belgaum	0.112	0.265	0.789	0.336
5	Bellary	0.533	0.630	0.683	0.727
6	Bidar	0.578	-	-	0.847
7	Bijapur	0.226	0.380	0.404	0.324
8	Chamarajnaragar	0.575	-	-	0.621
9	Chikmagalur	0.598	0.836	0.824	0.799
10	Chitradurga	0.739	0.853	0.889	0.882
11	Dakshina Kannada	0.586	0.841	0.646	0.542

12	Davanagere	0.696	-	-	0.689
13	Dharwad	0.277	0.585	0.435	0.503
14	Gadag	0.595	-	-	0.661
15	Gulbarga	0.601	-	0.780	0.659
16	Hassan	0.620	0.857	0.868	0.982
17	Haveri	0.412	-	-	0.459
18	Kodagu	0.242	0.778	0.641	0.556
19	Kolar	0.647	0.565	0.852	0.801
20	Koppal	0.286	-	-	0.311
21	Mandya	0.516	0.788	0.800	0.728
22	Mysore	0.511	0.851	0.656	0.672
23	Raichur	0.302	0.667	0.449	0.263
24	Shimoga	0.376	0.547	0.555	0.664
25	Tumkur	0.869	0.965	0.953	0.402
26	Udupi	0.492	-	-	0.728
27	Uttara Kannada	0.682	0.756	0.750	0.800

Table 4.2.9 Singh Sustainability index of production for the study periods among all districts of Karnataka.

No.	Districts	Singh Sustainability index of production			
		1982-09	1982-90	1991-00	2001-09
1	Bagalkote	0.240	-	-	0.211
2	Banglore-urban	0.064	0.175	0.067	0.461
3	Banglore-rural	0.555	-	0.834	0.509
4	Belgaum	0.104	0.265	0.643	0.384
5	Bellary	0.532	0.629	0.633	0.761
6	Bidar	0.018	-	-	0.647
7	Bijapur	0.228	0.380	0.343	0.339
8	Chamarajnar	0.249	-	-	0.253
9	Chikmagalur	0.236	0.737	0.820	0.226
10	Chitradurga	0.601	0.753	0.910	0.863
11	Dakshina Kannada	0.476	0.741	0.631	0.400
12	Davanagere	0.535	-	-	0.610
13	Dharwad	0.283	0.585	0.399	0.595
14	Gadag	0.566	-	-	0.631
15	Gulbarga	0.200	-	0.541	0.709
16	Hassan	0.609	0.858	0.845	0.865
17	Haveri	0.418	-	-	0.469
18	Kodagu	0.164	0.776	0.618	0.399

19	Kolar	0.551	0.564	0.829	0.491
20	Koppal	0.301	-	-	0.333
21	Mandya	0.338	0.787	0.759	0.357
22	Mysore	0.120	0.790	0.628	0.102
23	Raichur	0.298	0.666	0.381	0.290
24	Shimoga	0.232	0.548	0.493	0.213
25	Tumkur	0.663	0.865	0.905	0.802
26	Udupi	0.254	-	-	0.422
27	Uttara Kannada	0.408	0.756	0.746	0.481

Overall comparison on Classification of sustainability index for the Study periods.

Table 4.2.8 (a) and 4.2.9(a) Classification of sustainability for area and production for the study periods as high, low and moderate sustainability. For the year of 1982-1990, out of 17 districts, 9 districts (52.94) possess high sustainability area of coconut crop. While, 3 districts (17.64%) possess less sustainability.

For the period of 1991-2000, comprising of 19 districts, 10 districts (52.63%) possess high sustainability and 5 districts (21.05%) exhibit lower sustainability with area of coconut crop.

Contributing to the area of coconut crop for the period of 2001-2009, 12 districts (44.44%) out of 27 districts showed higher sustainability and 8 districts (29.62%) established lower sustainability.

However for an overall period of 1982-2009, 4 districts (14.81%) possess higher sustainability and 12 districts (44.44%) exhibit lower sustainability.

Contributing to the production of coconut crop, for the year of 1982-1990, out of 17 districts, 9 districts (52.94%) possess high sustainability area of coconut crop. While, 3 districts (17.64%) possess less sustainability.

However for the period of 1991-2000, 8 districts (42.10%) classified as higher sustainability and 5 districts (26.31%) as lower sustainability establishing production of coconut crop.

For the period of 2001-2009, regarding the production of coconut crop, 5 districts (18.51%) exhibit higher sustainability and 16 districts

Table 4.2.8(a) and 4.2.9(a): Overall comparison on Classification of sustainability index for the Study periods.

Aspect	Sustainability Classification	Study Period							
		1982-1990 (n=17)		1991-2000 (n=19)		2001-2009 (n=27)		1982-2009 (n=27)	
		N	%	N	%	N	%	N	%
Area	HIGH	9	52.94	10	52.63	12	44.44	4	14.81
	MODERATE	5	29.41	4	26.31	7	25.92	11	40.74
	LOW	3	17.64	5	21.05	8	29.62	12	44.44
Production	HIGH	9	52.94	8	42.10	5	18.51	0	0.00
	MODERATE	5	29.41	6	31.57	6	22.30	8	29.62
	LOW	3	17.64	5	26.31	16	59.25	19	70.37

(59.25%) showed lower sustainability comprising of 27 districts with the production of coconut crop.

During the period of 1982-2009, 19 districts (70.37%) showed lower sustainability and remaining exhibit moderate sustainability with the production of coconut crop.

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