Original Research Article

A District Level Assessment of Instability in Crop Productivity in Karnataka State

Abstract

The study has examined the instability of crop Productivity of principal crops for 20 years in two phases by taking first period as 1998-99 to 2008-09 and second period as 2009-10 to 2018-19 at the district level in Karnataka state.. Five instability categories were used i.e Very low < 19, Low 19-26 , Average 26-38, High 38-58 and Very high instability range above 58 . A low value index indicates the high stability in crop productivity. Through Cudde Della Valle index it was observed that , instability has been low and declined over the time in Rice, Maize, Sugarcane , While medium instability noticed in Ragi, and cotton .The trend of instability is high in Arhar, Gram, Groundnut, Jowar. .Instability in Pulses and oil seeds is high because area under these crops have been shifted towards Rice , maize which are giving high remunerative prices and assured profit.

Key words: Instability, Crop Productivity, Phases, District, Karnataka

1. Introduction

Indian agriculture is known for fluctuations and instability in its performance. The instability in productivity has a cascading effect on the farm economy and has serious implications for food security. The instability may occurs due to its topography, rainfall, climate, socio economic parameters of farmers , government policies. Karnataka is a semi arid state which experiences large variation in climate and recorded as second most drought state after Rajasthan. Despite of its climate adversity , it stood fifth in contribution nominal agricultural GDP with ₹16.29 lakh crore in India (MOSPI,2021) .The principal crops grown in state are Rice, Ragi, Jowar, maize, Tur, Gram ,Groundnut ,sunflower cotton, sugarcane which nearly contributes more than 60 percent in agricultural productivity in State. The state has 10 agro climatic zones with 29 districts in which some districts cultivate more number of crops and other districts have less cultivation despite of its well suited climatic condition.

The variation in cultivation leads to variations in productivity across districts which will leads to regional disparities and it also recorded as the majority of districts in Karnataka have very low productivity when compared to Tamil Nadu and Kerala (Ramesh Chand,2011). Instability in agriculture can be shown for area, Production or Productivity .But this study try to analyse the instability of Productivity at district level in Karnataka. Analyse the instability across districts will give reasons and solution for strategies which need to be implement in

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region level to stabilise and reduce the variations in agricultural Productivity. Increasing ,declining and medium trend of instability of crops across the districts were analysed by comparing the number of districts registering in each category (very low, low, average, high, very low) during first period and shifting of the districts in the second period and finding the possible reasons for crop diversifications.

2. Materials and Methods

The instability of crops in Karnataka was estimated using the Cuddy- Della Valle index 1978. It is a better measure than coefficient of co-variation because it is adjusted for trend, which is common in time series results. Eleven Principal Crops like Rice, Maize, Jowar,Ragi,Redgram,Bengal gram, Sunflower, Groundnut Cotton, Sugarcane were chosen for the study and the necessary secondary data collected for a period of 20 years 1998-99 (first period) to 2018-19 (second period) and analysed at district level**.** The analysis has compared the situation before 2009 and after 2009 .Information about crop yield was collected from various abstract issues of agriculture crops, Directorate of Economics and statistics, Government of Karnataka

$$CD = C.V\sqrt{(1 - R^2}$$

Where, CD = Cuddy-Della Valle index

CV = Coefficient of variation

R2 = ESS/TSS i.e. ratio of explained variation to total variation.

ESS = Variation explained by explanatory variable.

TSS = Total Variation.

The range of Instability are as follows:

Five instability categories were used i.e Very low < 19, Low 19-26 , Average 26-38, High 38-58 and Very high instability range above 58 . A low value index indicates the high stability in crop productivity

3. Results and Discussion

3.1Productivity Instability of Cereals in Karnataka

As shown in (Table:1), Rice is one of the major crop cultivated in Karnataka. It cultivates both in Kharif and Rabi season by providing irrigation**.** The instability in the productivity of Rice is declining during the second phase .Haveri, Belagum and Dharwad showed highest instability during the first period (Fig 1.1a), while during second period ,Belagum and Haveri has reported declining trend in instability (Fig 1.1b) but Dharwad has

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showed increasing trend due to its rainfed condition. .Majority of the districts showed declining trend and falls in the category of very low, low and average instability categories.

Maize was showing decreasing trend in the state during study period (Table 1.b). No districts have recorded in very high or high instability categories. All the districts have been registered in very low, low, average instability categories during both first and second periods (Fig 1.2.a &1.2.b). The use of high yield varieties , drought resistant are reason for its stable productivity and government assured policy of procurement of produce from maize farmers also encouraged them to increase area under its cultivation by replacing Jowar and Bajra crops.

: **Table: 1 Productivity Instability of Rice and Maize in Karnataka**

Table 1.a) Rice				**Table 1.b) Maize**			
1998-99 to 2008-09		**2009-10 to 2018-2019**		**1998-99 to 2008-09**		**2009-10 to 2018-2019**	
Very Low<19%		**Very Low<19%**		**Very Low<19%**		**Very Low<19%**	
Tumkur	5.87	Bellary	3.9	Udipi	8.03	Bagalkot	11.12
Mysore	6.38	DakshinKannada	4.38	Kodagu	9.04	Chikmagulur	12.41
Davangere	6.97	Udipi	5	Bangalore rural	12.93	Udipi	13.8
Mandya	7.46	Mysore	5.68	Benguluru urban	12.94	Dharwad	15.5
Udipi	7.52	Chikmagulur	6	Bellary	14.56	Bellary	16.26
Kodagu	8.12	Davangere	6.51	Ramanagar	15.39	Shimoga	17.1
Bellary	8.46	Tumkur	6.55	Bagalkot	15.63	Kolar	19.93
Koppal	9.07	Bijapur	7.31	Shimoga	16.62	**Average 26-38%**	
Bagalkot	9.18	Kodagu	7.49	Chamarajanagar	17.18	Belagum	20.32
Raichur	9.21	Bagalkot	7.55	Bijapur	17.56	Tumkur	21.27
Chamarajanagar	9.42	Bangalore	8.04	Mysore	17.95	Bijapur	22.2
Dakshin Kannada	9.88	Chitradurga	9.28	**Average 26-38%**		Mysore	22.62
Chikmagulur	9.92	Bangalore Rural	9.57	Raichur	19.91	Benguluru	23.03
Benguluru urban	12.87	Shimoga	9.81	Hassan	19.92	Uttar Kannada	24.03
Shimoga	13.74	Mandya	10.45	Belagum	21.28	Davangere	24.38
Chitradurga	13.97	Uttar Kannada	11.23	Koppal	22.29	**Average 26-38%**	
Hassan	14.63	Koppal	11.43	Kolar	23.74	Haveri	26.65

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Uttar Kannada	17.41	Raichur	11.54	Bidar	24.54	Kodagu	27.52
Low 19-26%		Gadag	12.3	Yadgiri	24.92	Chamarajnagar	28.67
Bangalore Rura	21.36	Chikballapur	13.8	**Average 26-38%**		Gadag	30.38
Bijapur	19.77	Ramanagara	14.41	Tumkur	26.97	Bangalore rural	32.05
Gulbarga	21.06	Chamarajanagar	15.73	Gulbarga	27.59	Gulbarga	32.13
Kolar	25.56	Hassan	16.6	Davangere	27.9	Chikballapur	33.21
Haveri	19.99	Kolar	22.93	Chikmagulur	27.93	Chitradurga	35.63
Bidar	26.58	Gulbarga	26.25	Haveri	32.1	Raichur	35.98
Average 26-38%		**Average 26-38%**		Chitradurga	33.35	Koppal	36.30
Gadag	32.88	Belagum	34.28	Dakshin Kannada	33.65	Hassan	36.97
High 38-58%		Bidar	34.78	Mandya	34.96	Mandya	37.63
Haveri	48.98	Haveri	35.31	Dharwad	36.92	Bidar	38.16
Very high >58%		**High 38-58%**		Gadag	37.21		
Belagum	38.22	Dharwad	41.08				
Dharwad	60.18						

Source :Authors calculation based on data available from aps.dac.gov.in

As shown in (Table 2.a) Ragi has showed medium trend in instability as many districts falls in the low and average instability category during study period. No district has recorded (Fig 1.3 a & 1.3 b) in the category of very high instability category. Bengulru , Shimoga shown declining trend in first period and in the second period, in addition to these districts Mandya, Uttarkannada, .Haveri is one of the district which is continuously showing increasing trend in instability production. It is also noticed that , the Ragi cultivation has been not noticed in Northern eastern Transition Zone of Karnataka. Ragi shares a large area under cultivation but its productivity instability is very high in majority of districts. There is a need of intervention of improved cultural practices, varietal improvement, irrigation methods to stabilise the crop.

Table:2 Productivity Instability of Ragi and Jowar in Karnataka

Table 2.a) Ragi		**Table 2.b) Jowar**	
1998-99 to 2008-09	**2009-10 to 2018-2019**	**1998-99 to 2008-09**	**2009-10 to 2018-2019**
Very Low<19%	**Very Low<19%**	**Very Low<19%**	**Very Low<19%**

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Bengaluru Rural	10.27	Mandya	13.95	Gulbarga	11.59	Mandya	9.86
Shimoga	13.91	Shimoga	14.61	Shimoga	18.73	Davangere	10.31
Low 19-26%		Belagum	15.75	**Low 19-26%**		Bellary	14.05
Kodagu	21.89	Uttar Kannada	17.87	Bidar	20.53	Shimoga	14.32
Mysore	22.05	**Low 19-26%**		Bellary	20.78	Uttar Kannada	16.24
Chamarajanagar	22.6	Bengaluru Rural	19.28	Bijapur	20.91	**Low 19-26%**	
Mandya	23.06	Davangere	21.83	Chitradurga	21.01	Chikmagulur	21.73
Chikmagulur	24.04	Tumkur	22.75	Raichur	21.98	Belagum	22.59
Chitradurga	24.33	Bellary	22.86	Davangere	21.99	Yadgiri	24.19
Kolar	25.59	Mysore	24.92	**Average 26-38%**		**Average 26-38%**	
Hassan	26.01	**Average 26-38%**		Belagum	26.48	Raichur	26.07
Average 26-38%		Ramanagar	26.96	Chamrajanagar	27.12	Bidar	26.18
Chikballapur	27.76	Chikmagulur	26.99	Chikmagulur	28	Gulbarga	26.68
Dharwad	28.58	Chamarajanagar	29.41	Chitradurga	31.01	Bijapur	26.78
Haveri	28.84	Benguluru Urban	30.33	Uttar Kannada	32.41	Haveri	28.86
Tumkur	29.15	Chitradurga	32.74	Hassan	32.61	Gadag	31.67
Uttar Kannada	29.5	Gadag	33.88	Dharwad	36.61	**High 38-58%**	
Davangere	30.79	**High 38-58%**		Haveri	37.8	Dharwad	39.06
Benguluru Urban	30.97	Hassan	43.36	Tumkur	38.58	Tumkur	39.11
Dharwad	31.96	Kolar	44.18	**High 38-58%**		Koppal	42.96
Bellary	32.32			Bagalkot	40.03	Mysore	45.42
Gadag	34.73			Gadag	41.33	Hassan	64.98
High 38-58%				Mysore	42.04		
Belagum	42.49			Koppal	47.94		
Haveri	46.06			Chamrajanagar	51.22		
				Mandya	52.94		

Source :Authors calculation based on data available from aps.dac.gov.in

Instability in case of Jowar (Table 2. b) has following the same constant trend in instability during two phases (Fig 1.4 a & 1.4b)of study period as majority of districts fall under average and high instability category Farmers have lost interest in Jowar cultivation and is evidently seen in Gulbarga, Bidar, raichur and other northern transition districts. The area under Jowar is replaced by maize due to its market demand and assured prices.

3.2 Productivity Instability of Pulses (Arhar & Gram) in Karnataka

As shown in (Table 3a) the trends rate of instability in the productivity of Arhar is increasing through out the study period. Bellary,Benguluru,Chitradurga,Chikmaguluru, Haveri, Mandya, Shimoga, Uttar Kannada had low instability during the first period (Fig 1.5a) and in the next period except Bellary all other districts had medium instability.

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Table 3: Productivity Instability of Pulses in Karnataka

Table 3.a) Arhar				Table 3.b) Gram			
1998-99 to 2008-09		**2009-10 to 2018-2019**		**1998-99 to 2008-09**		**2009-10 to 2018-2019**	
Very Low<19%		**Low 19-26%**		**Very Low<19%**		**Very Low<19%**	
Bidar	18.72	Tumkur	20.2	Gulbarga	13.3	Uttar Kannada	17.42
Low 19-26%		Bellary	24.11	Bidar	15.74	**Low 19-26%**	
Bellary	19.31	Koppal	27.45	Uttar Kannada	18.41	Bangalore Rural	25.79
Haveri	21.5	**Average 26-38%**		**Low 19-26%**		**Average 26-38%**	
Uttar Kannada	21.96	Mysore	30.19	Raichur	21.14	Belagum	26.48
Chikmagulur	22.04	Ramanagar	31.82	Mandya	21.51	Chiballapur	27.57
Mandya	22.07	Shimoga	32.14	Bangalore Rural	23.62	Gulbarga	26.43
Benguluru	22.1	Benguluru	32.28	Shimoga	25.03	Haveri	29.99
Shimoga	22.15	Chikmagulur	32.28	**Average 26-38%**		Shimoga	28.40
Chitradurga	24.94	Chitradurga	32.86	Bellary	26.35	Bellary	33.04
Average 26-38%		Davangere	33.29	Hassan	26.63	Benguluru	36.36
Gulbarga	26.94	Raichur	34.3	Chitradurga	27.76	Bidar	37.18
Hassan	27.45	Kolar	34.5	Yadgiri	28.59	Bijapur	35.22
Belagum	29.4	Uttar Kannada	34.61	Belagum	29.57	Chikmaguluru	37.41
Bangalore Rural	29.41	Mandya	35.72	Tumkur	34.75	Koppal	35.25
Mysore	29.56	Belagum	36.09	Chikmaguluru	34.82	Mysore	33.68
Tumkur	30.22	Gulbarga	37.54	Haveri	34.96	Raichur	35.49
Bijapur	31.08	**High 38-58%**		Chmarajanagar	35.61	Tumkur	37.70
Kolar	31.61	Bagalkot	39.6	Bijapur	35.98	Bagalkot	27.66
Yadgiri	33.9	Gadag	40.73	Bagalkot	36.51	**High 38-58%**	
Davangere	34.62	Bijapur	41.44	**High 38-58%**		Chmarajanagar	46.32
Chamarajanagar	35.5	Chikballapur	43.48	Dharwad	42.36	Chitradurga	42.40
Gadag	37.55	Dharwad	46.26	Benguluru	43.06	Davangere	46.02
High 38-58%		Bangalore	48.83	Mysore	44.88	Dharwad	48.50
Raichur	42.66	Bidar	49.07	Gadag	47.54	Gadag	53.52
Haveri	45.03	**Very high >58%**		Davangere	52.95	Hassan	41.96
Koppal	46.73	Hassan	62.85	**Very high >58%**		Mandya	41.89
Very high >58%				Koppal	72.46		
Dharwad	56.11						
Bagalkot	59.56						

Source :Authors calculation based on data available from aps.dac.gov.in

Tumkur which has been in medium instability in first period had registered as low instability in second period. Hassan has recorded highest instability during study both first and second period (Fig1.5b). 20 districts has recorded in low, medium and average trend of instability and other districts falls in the category of medium , high and very high instability in productivity of Arhar. Gram is showing increasing trend in instability during the study period (Table 3.b).During first period Bidar,Gulbarga,Uttar kannada, Mandya ,Raichur, Shimoga, Benguluru, has showed declining trend during (Fig 1.6 a) first period. However , only two districts Uttar Kannada ,Bangalore only showed declining trend in second period (Fig 1.6 b) and all other districts showed increasing trend. Majority of the districts had registered in medium instability category. Koppal has showed highest instability during first

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period and improved its stability and reported in medium stability category during second period. The instability of gram improved in some district but it was still high in all the districts. The Pulses and oilseeds have registered stable productivity in few districts during second period is due to TMOP mission.

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3.3 Productivity Instability of Oilseeds (Sunflower & Groundnut) in Karnataka

As shown in (Table 4.a) The instability in the productivity of Sunflower is increasing during the study period. During the first period , (Fig 1.7a) only three districts showed increasing trend but during second period seven districts showed increasing trend .During first period, Benguluru ,Belagum,bellary,Bidar, Chitradurga, Davangere, Gulbarga showed declining trend but during second period(Fig 1.7 b) except Davangere all other districts showed increasing trend. The area under sunflower is decreasing over the years due to its less remunerative prices, attack of pest and diseases, poor seed quality and less investment of private companies in seed companies .

Groundnut is one of the major cash crop grown in Karnataka but biotic, technological .institutional, socio economic constraints inhibit the yield potential in groundnut crop. The rising input prices also showed greater negative impact (Ramesh G.B) on groundnut cultivation. Groundnut registered increasing trend in instability at all Karnataka level during study period. Majority of the districts showed declining trend during first period (Table 4.b) and the same districts showed increasing trend during second period. Bagalkot, ,Bidar,Davangere, Gulbarag,Raichur, Ramanagara,Shimoga,Udipi,Belagum registered as very low instability districts during first period (Fig 1.8 a) but among these 9 districts only Bagalkot, Udipi, Uttar Kannada,belagum ,Hassan showed declining trend and all other showed increasing trend during (Fig 1.8 b) second perio

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Table 4: Productivity Instability of Oilseeds in Karnataka

Table 4.a) Sunflower				**Table 4.b) Groundnut**			
1998-99 to 2008-09		**2009-10 to 2018-2019**		**1998-99 to 2008-09**		**2009-10 to 2018-2019**	
Very Low<19%		**Very Low<19%**		**Very Low<19%**		**Very Low<19%**	
Benguluru	7.81	Tumkur	14.03	Uttar Kannada	7.52	Uttar Kannada	8.85
Bidar	11.55	Shimoga	16.07	Raichur	8.31	Hassan	12.61
Bellary	11.8	Davangere	17.01	Bidar	14.89	Udipi	14.05
Benguluru	14.18	**Low 19-26%**		Davangere	15.06	Bagalkot	18.59
Chitradurga	15.55	Raichur	22	Gulbarga	15.79	Belagum	18.87
Belagum	16.69	Haveri	22.01	shimoga	16.75	**Low 19-26%**	
Gulbarga	18.73	**Average 26-38%**		Belagum	16.87	Davangere	19.89
Low 19-26%		Benguluru (R)	26.42	Ramanagara	18.65	Raichur	21.47
Uttar Kannada	21.09	Bellary	28.78	Bagalkot	19.37	Bellary	21.96
Haveri	22.4	Bagalkot	29.27	**Low 19-26%**		Gadag	22.5
Bagalkot	22.82	Chikballapur	30.42	Mysore	19.85	Bijapur	22.84

Mysore	23.17	Belagum	31.44	Koppal	24.73	Chikmangulur	24.29
Bijapur	23.71	Gadag	32.23	Bangalore	25	Kodagu	24.49
Raichur	24.09	Chitradurga	32.24	Bijapur	25.99	Benguluru	24.65
Average 26-38%		Uttar Kannada	32.41	**Average 26-38%**		shimoga	25.89
Koppal	26.45	Mandya	33.28	Hassan	26.89	**Average 26-38%**	
Mandya	28.88	Chikmagulur	34.02	Yadgiri	27.82	Koppal	26.73
Dharwad	28.96	Bidar	35.23	Chamrajanagar	27.89	Gulbarga	27.4
Shimoga	29.84	Hassan	35.73	Benguluru urban	28.38	Haveri	29.39
Ramanagar	31.96	Benguluru (U)	37.18	Bellary	28.56	Dharwad	29.83
Tumkur	34.04	**High 38-58%**		Chikmangulur	28.65	Tumkur	31.97
Gadag	34.41	Koppal	38.15	Mandya	31.78	Mysore	32.62
Hassan	37.19	Bijapur	38.27	Haveri	32.29	Bidar	36.82
High 38-58%		Chamarajanagar	40.17	Gadag	32.6	**High 38-58%**	
Chamarajanagar	38.53	Gulbarga	42.93	Kodagu	33.83	Chamrajanagar	40.39
Chikmagulur	40.69	Yadgiri	46.44	**High 38-58%**		Chitradurga	40.85
Kolar	51.66	Mysore	47.09	Chitradurga	39.94	Bangalore (R)	40.99
		Dharwad	49.98	Dharwad	46.72	Mandya	41.83
				Kolar	48.22	Chikballapur	46.33
				Tumkur	58.82	Kolar	48.56

Source :Authors calculation based on data available from aps.dac.gov.in

Majority of the districts registered in low and average instability category. Chitradurga,Kolar,Tumkur,Dharwad showed increasing trend and registered as highest instability districts but additional to these districts Chamaranjanar, Chikballapur,Mandya, Bangalore also registered as highest instability districts

3.4 Productivity Instability of Commercial crops (Cotton & Sugarcane) in Karnataka

Cotton registered as medium trend in instability in state during the study period.Bagalkot,Bellary, Bidar, Shimoga were four districts which showed declining trend during first period. Except Bellary, all other 3 districts have showed increasing trend and registered in medium instability category (Table 5.a). During first period (Fig 1.9 a) Gadag has registered as highest instability district but during second period (Fig 1.9b) Gadag improved while Tumkur which showed lowest instability during first period has registered as highest instability district during second period. Majority of the districts falls in the category of very low, low and average instability categories.

Table 5 :Productivity Instability of Commercial crops in Karnataka

Table 5.a) Cotton				**Table 5.b)Sugarcane**			
1998-99 to 2008-09		**2009-10 to 2018-2019**		**1998-99 to 2008-09**		**2009-10 to 2018-2019**	
Very Low<19%		**Very Low<19%**		**Very Low<19%**		**Very Low<19%**	
Shimoga	16.84	Bellary	14.71	Gadag	8.39	Bangalore rural	8.64
Bellary	17.31	Bijapur	19	Udipi	8.4	Mandya	8.93
Bagalkot	17.75	**Low 19-26%**		Mandya	9.09	Davangere	9.07
Gulbarga	20.89	Dharwad	20.18	Raichur	9.16	Udipi	9.67

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Low 19-26%		Belagum	21.3	Chamarajanagar	9.26	Tumkur	9.99
Bidar	22.32	Chitradurga	21.84	Davangere	9.61	Shimoga	10.12
Raichur	24.6	Chikballapur	22.45	Koppal	9.7	Mysore	11.72
Tumkur	24.64	Haveri	23.88	Yadgiri	9.76	Chitradurga	12.4
Bijapur	25.31	Davangere	26.43	Dakshin Kannada	9.95	Dharwad	12.59
Chikmagulur	25.32	**Average 26-38%**		Chitradurga	10.41	Belagum	13.86
Chitradurga	25.37	Bidar	29.6	Hassan	10.47	Bagalkot	14.68
Average 26-38%		Uttar Kannada	30.31	Bangalore rural	10.81	Gadag	16
Raichur	26.78	Bagalkot	30.78	Uttar Kannada	11.56	Ramanagara	16.94
Belagum	27.08	Koppal	35.26	Bidar	11.63	Koppal	18.11
Mandya	29.95	Shimoga	35.72	Tumkur	11.87	DakshinKannada	18.45
Haveri	30.31	Gulbarga	36.93	Chikmagulur	12.11	Bellary	18.95
Davangere	32.25	Hassan	37.73	Bagalkot	12.39	**Low 19-26%**	
Dharwad	32.37	**High 38-58%**		Shimoga	12.41	Chamarajanagar	19.81
Mysore	36.08	Gadag	38.8	Mysore	13.67	Chikmagulur	19.95
High 38-58%		Chikmagulur	42.31	Kolar	13.89	Bidar	20.07
Hassan	40.26	Mysore	43.81	Belagum	14.69	Haveri	20.31
Uttar Kannada	40.99	Yadgiri	52.75	Bijapur	17.02	Bijapur	21.37
Koppal	45.9	**Very high >58%**		Bellary	18.48	Uttar Kannada	23.7
Chamarajanagar	49.79	Chamarajanagar	62.35	**Average 26-38%**		Hassan	24.29
Very high >58%		Tumkur	121.06	Haveri	29.99	**Average 26-38%**	
Gadag	60.31					Gulbarga	29.35

Source :Authors calculation based on data available from aps.dac.gov.in

The trends rate of instability in the productivity of sugarcane is declining during the study period (Table 5.b). It registered low instability in all districts of Karnataka and declining continuously in all times. During first period (Fig 1.10 a) among 24 sugarcane growing districts, 23 districts showed declined trend which falls in the very low instability category. However, during second period 7 districts has registered in low stability category with slight increasing trend of instability (Fig 10.b). Haveri has showed increasing trend during first period but slowly it declined in second period while the increasing trend in Gulbarag district was noticied in second period. It was observed that no districts has registered in high and very high instability category. Sugarcane has stable trend in growth of productivity during both periods..

Figure 1.Productivity Instability of Major Crops in Karnataka

Fig 1.1 a) **Fig 1.1b)**

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Comment [APB11]: Use ISI up to 70 on the "y" axis for all figures. This allows for better visualization of differences.

Specify What the ISI parameter on the "y" axis means.

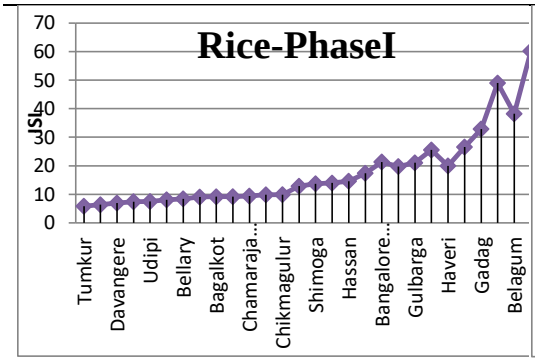
Use "period" instead of "phase".

Adjust the ISI that overlap the "y" axis values. Adjust the size of the figure so that all information appears correctly.

Explain in the material and methods why the use of the ISI parameter and what it is for!

Explain in the material and methods why the use of the ISI parameter and what it is for!

Explain properly why on the "x" axis of the figures there are not all the cities in the state!



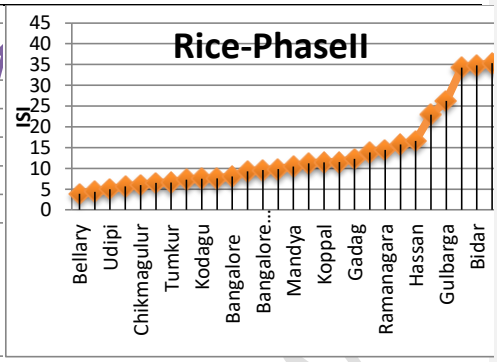


Fig 1.2 a)

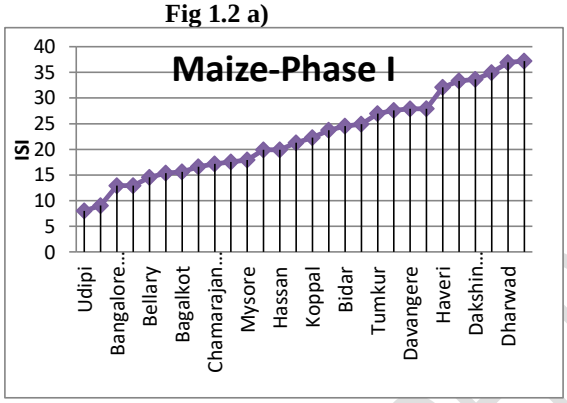
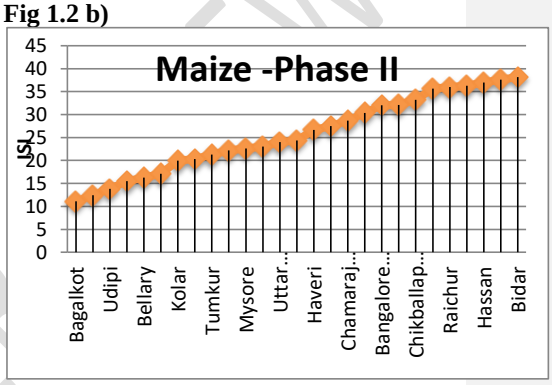


Fig 1.2 b)



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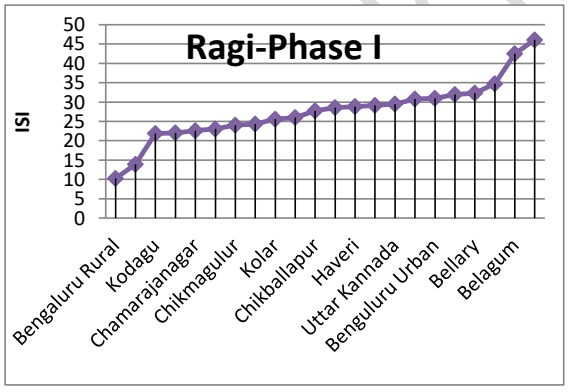
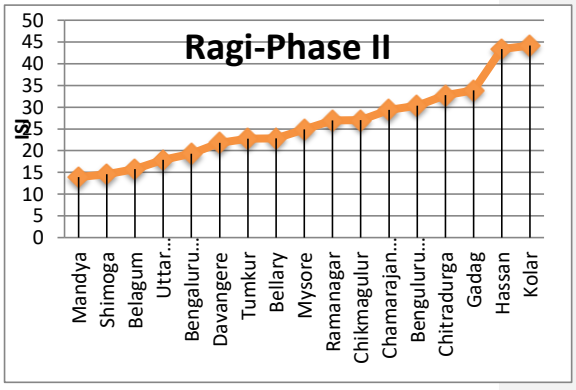


Fig 1.3b)



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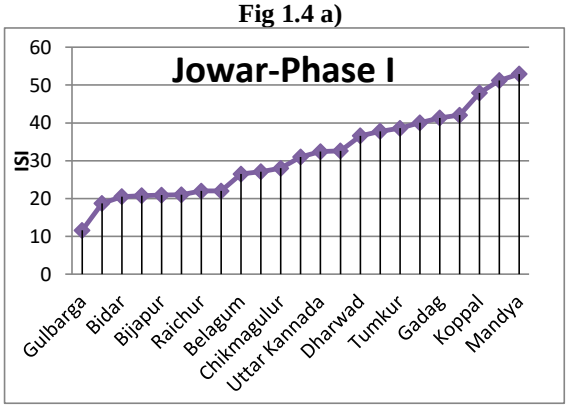

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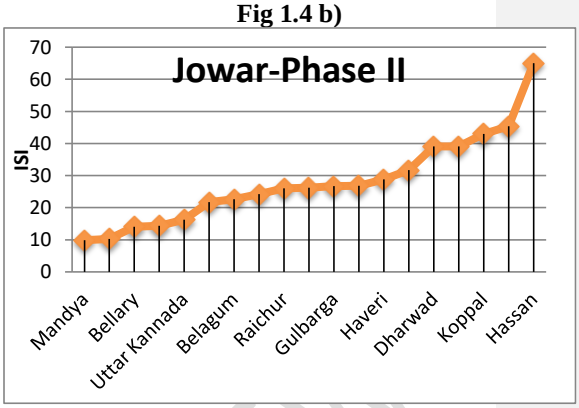

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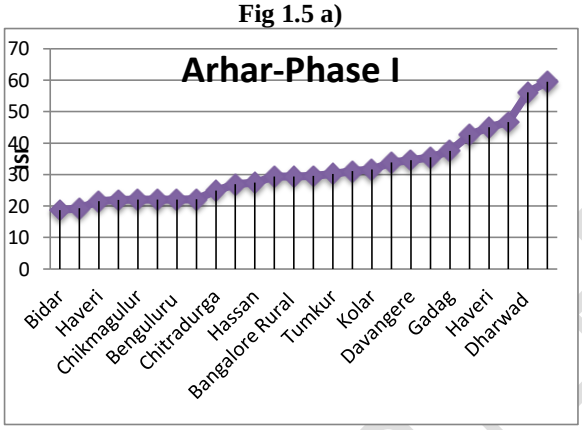

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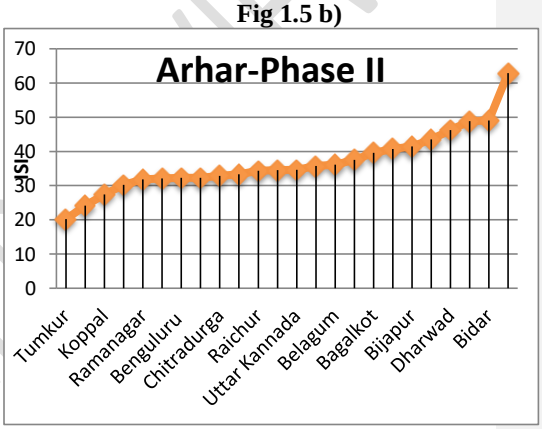

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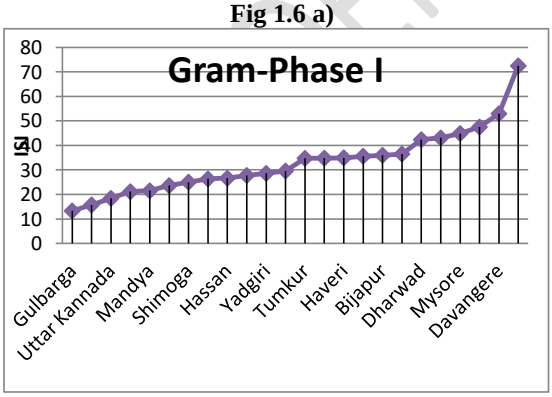
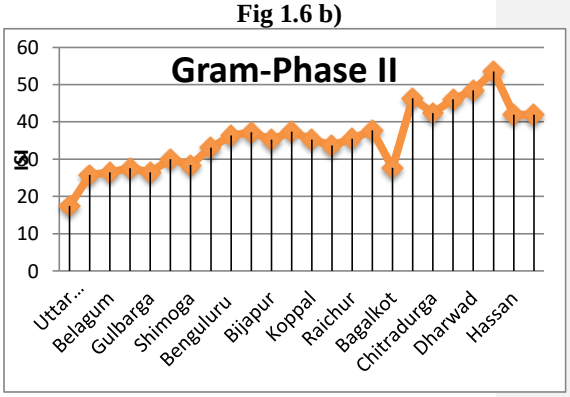


Fig 1.6 b)



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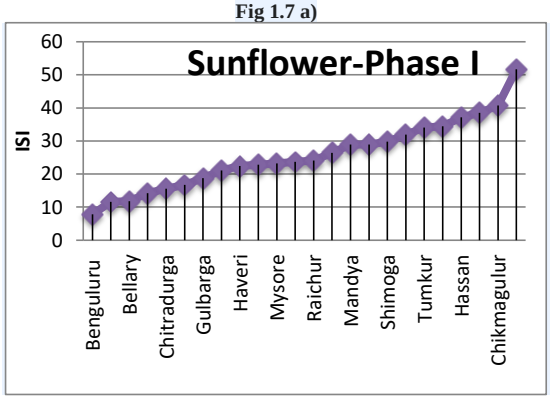
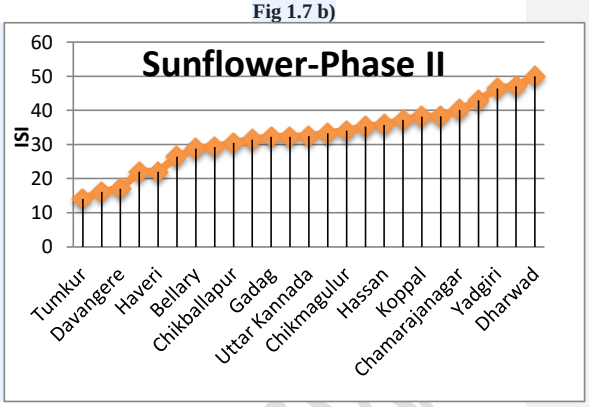


Fig 1.7 b)



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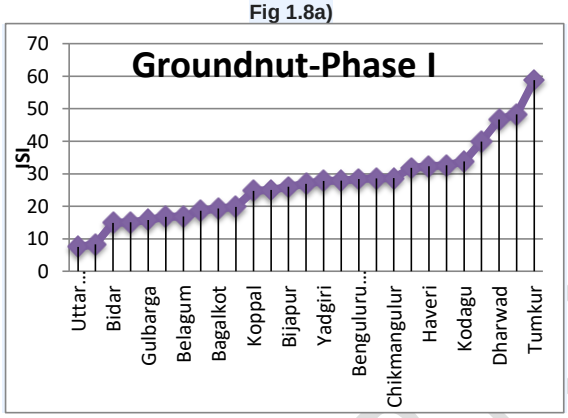

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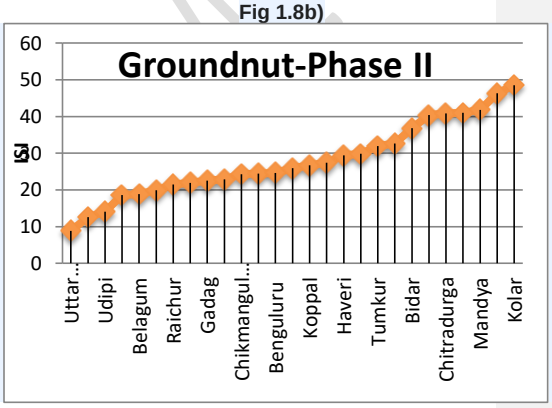

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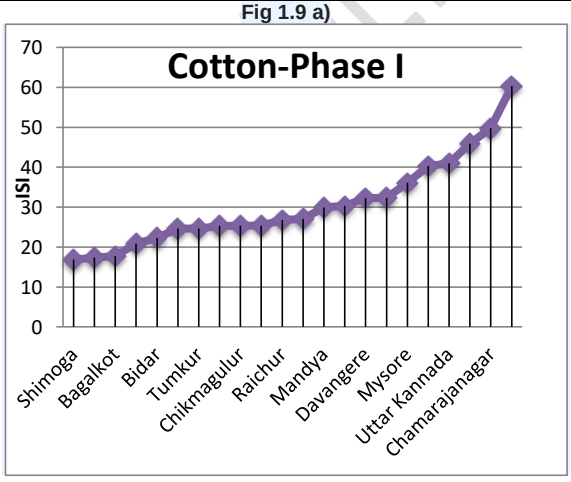
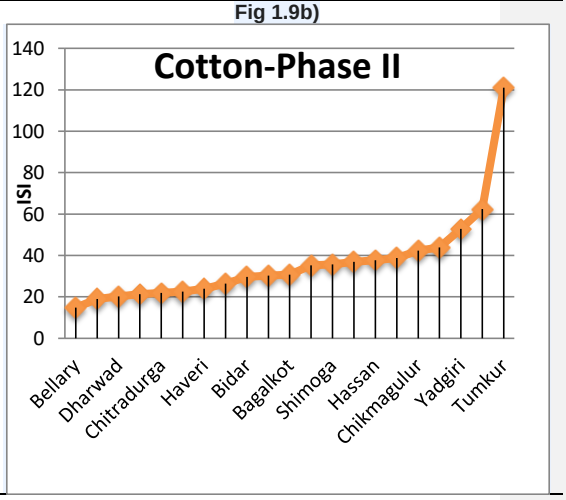


Fig 1.9b)



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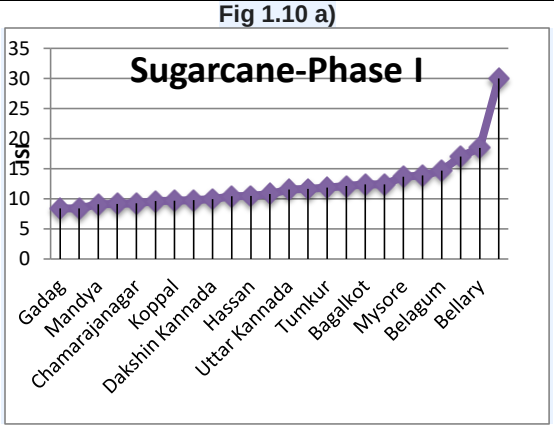

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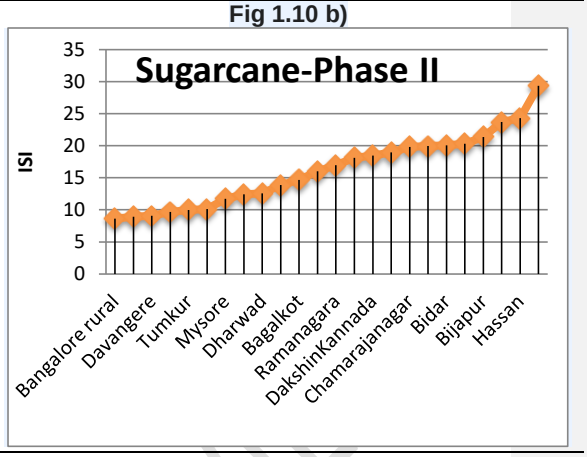

Conclusion

Over the years, the instability and fluctuations in productivity are low in Rice, Maize .The crops like Jowar and Bajra are showing increasing in its instability as area was being diversified towards Maize and Rice The crop like Ragi and Cotton has showed medium instability which indicates as a profitable crop for farmers with high returns. The Pulses and Oil seeds recorded high instability in major districts of the state. Among the commercial crops, Sugarcane is recorded as well suitable and stable crop in state as it showed low instability in majority of districts. The reasons of stable productivity of rice, maize and sugarcane may be due to market demand, government procurement policies and reasonable market prices respectively. Even though , there is a positive progress in Pulses and Oil seeds production in second phase due to TMOP mission but still targeted results in high productivity yet to be achieved and also there is a need to enhance the productivity of these crops with varietal improvement and cultural practices

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Comment [APB12]: Authors may expand the reference list by including references to manuscripts preferably published within the last 10 years.

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