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Dynamics of Major Food Grain Production in Karnataka

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Abstract

This paper investigates the growth performance and instability of cereals, millets and pulses in Karnataka over the period 2001-02 to 2020-21. Data from the Department of Economics and Statistics was analysed using statistical tools such as Compound annual growth rate and Cuddy Della Valle Index to examine growth rates, instability indices, for cereals, including rice, wheat and maize. Results were indicated the robust growth rates for the Period I (2001-02 to 2010-11), followed by varied trends in Period II (2011-12 to 2020-21). Rice and wheat cultivation displayed declines in area and production, while maize showed moderate growth. Overall, cereals demonstrated steady growth in the entire study period. Millets exhibited dynamic trends with Period I showcasing varied growth rates and Period II witnessing mixed trends across different millet crops. Pulses demonstrated significant growth in Period I, with notable increases in Tur, Gram and Moong, while Period II showed positive growth rates across most pulse crops. However, certain pulses, like Urad and Horse-gram, experienced declines. The instability index revealed low to medium instability for cereals and millets, while pulses exhibited varied degrees of instability across different crops and periods. These findings underscore the dynamic nature of agriculture in Karnataka and highlight the need for targeted interventions to ensure the sustainability and resilience of farming systems in the region.

Keywords : Cereals, Millets, Pulses, Trends, Growth rate, Instability

Karnataka stands as a pivotal contributor to India's agricultural landscape, benefiting from its diverse terrains and agricultural practices. Blessed with varied agro-climatic conditions, the state enables its farmers to cultivate multiple crops across different seasons including cereals, pulses, oilseeds, commercial crops and horticultural crops (Acharya *et al.,* 2012). Food crops cover 76.46 per cent of the total cropped area, while non-food crops occupy the remaining 23.54 per cent in Karnataka. The food grains alone constitute 56.9 per cent of the cropped area with total food grain production reaching about 146 lakh tonnes during 2020-21 (Directorate of Economics and Statistics, 2023). The substantial arable land under various crops, the state exhibits the potential for further expansion. The dynamics of food grain production in Karnataka involve a complex interplay of environmental, socio-economic and governmental factors crucial for ensuring food security and rural prosperity. Over the years, Karnataka has emerged as a significant producer of essential food grains like rice, wheat, pulses and millets, owing to its diverse topography ranging from fertile plains to rainfed regions. However, this production was significantly influenced by climatic patterns, including monsoons and droughts, presenting both challenges and opportunities. Socio-economic factors such as landholding patterns, access to credit, market infrastructure profoundly impact agricultural productivity and the cultural significance attached to certain food grains like ragi and jowar further enriches the state's agricultural diversity of farmer livelihoods in Karnataka. This study focused on the dynamics of food grain production in Karnataka to grapples with

issues by informing policymakers, researchers, stakeholders about opportunities and challenges in sustaining agricultural growth to face challenges like climate change and water scarcity, innovative solutions and policy interventions become imperative for ensuring sustainable food production by understanding the dynamics of food grain production in Karnataka not only secures food within the state but also contributes to broader agricultural resilience and sustainability goals on a national scale by analyzing the growth trends in area, production and productivity of major crops over the past two decades by showcasing the state's diverse agro-climatic conditions and dominance of food crops.

METHODOLOGY

Karnataka displays a diverse cropping pattern across its regions, influenced by factors such as rainfall, soil type and climatic conditions. This study evaluated the compound growth rates of major food grains at regular intervals throughout the specified period from 2001 to 2020 relied on secondary data primarily sourced from publications such as Agricultural Statistics at a Glance and the Directorate of Economics and Statistics (DES). Historical data spanning the past two decades from 2001-02 to 2020-21, divided into Period I (2001-02 to 2010-11) and Period II (2011-12 to 2020-21). Assessing the pace of agricultural development involves measuring the growth in area, production and yield of crops cultivated in the region.

Compound Annual Growth Rate

The compound annual growth rates (CAGR) of area, production and yield of food grains were estimated as follows:

$Yt = AB^t e$

$\ln Yt = \ln A + (\ln B)t + \ln e$

Where,

B = (1+r)

Yt = Area/Production/ Yield of major food grains in the i^{th} period,

t = time variable (1, 2, 3……, n),

A and B are parameters to be estimated,

r = compound growth rate and

e = error term

Cuddy and Della Instability Index

To examine the stability in the growth of food grains across state, the coefficient of variation was estimated using following procedure.

$CV = \frac{\sigma}{\mu} \times 100$

Where,

CV = Co-efficient of variation

σ = Standard deviation of the variable

μ = Mean of the variable.

The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend.

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

Where, R^2 = Coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

RESULTS AND DISCUSSION

Trends in Food Grain Production

The trends in cereals, pulses and millets have seen fluctuations in area, production and yield, reflecting the dynamic nature of agricultural practices and external influence. Cereal production generally witnessed increase in both area and yield with intermittent fluctuations (Fig.1). Notably, fluctuations in production and yield often corresponded with variations in area under cultivation, indicating the intricate relationship between agricultural practices, environmental factors and productivity in cereal crops over the years. Millets experienced mixed patterns with fluctuations (Fig.2). The area under millet cultivation fluctuated over the years, with periods of increase followed by declines and vice versa. The production also showed variations with significant increase observed in certain years, such as 2005-06

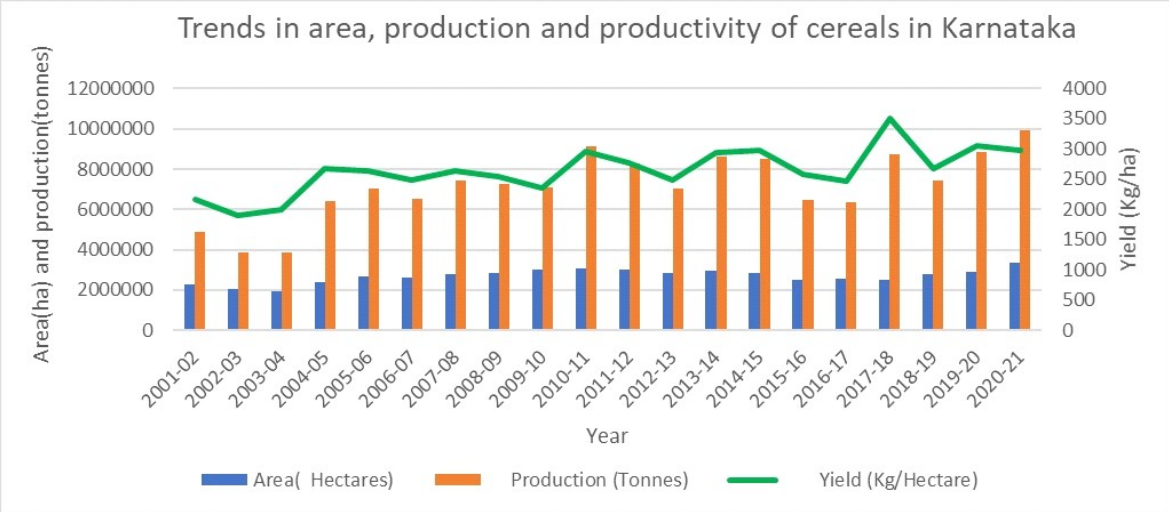

Fig. 1 : Trends in area, production and productivity of cereals in Karnataka

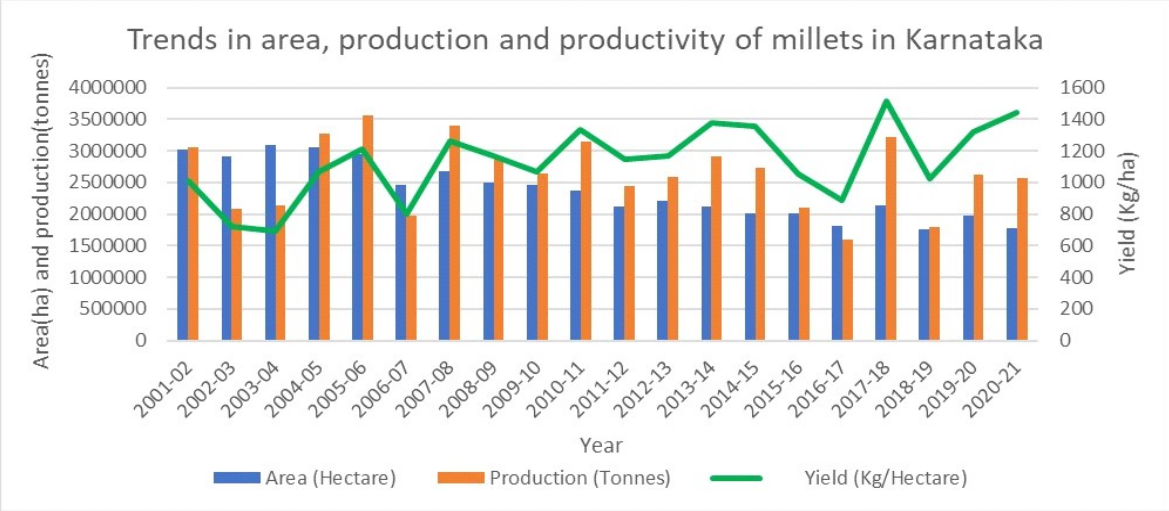

Fig. 2 : Trends in area, production and productivity of millets in Karnataka

and 2017-18 and decline in others. Yield per hectare displayed fluctuations, with peaks in certain years like 2017-18 and 2019-20, while experienced declines in others. Conversely, pulses exhibited varied trends with fluctuations in production and yield (Fig.3). These fluctuations were attributed to various factors such as changes in agricultural practices, weather conditions, market demand and government policies impacting food grain cultivation over the years.

Growth Performance of Cereals

The growth patterns of area, production and productivity of cereals in Karnataka were analyzed over two distinct periods spanning from 2001-02 to 2020-21 (Table 1). Period I encompass the years 2001-02 to 2010-11, while Period II covers 2010-11 to 2020-21. During Period I (2001-02 to 2010-11) rice cultivation in Karnataka experienced a significant

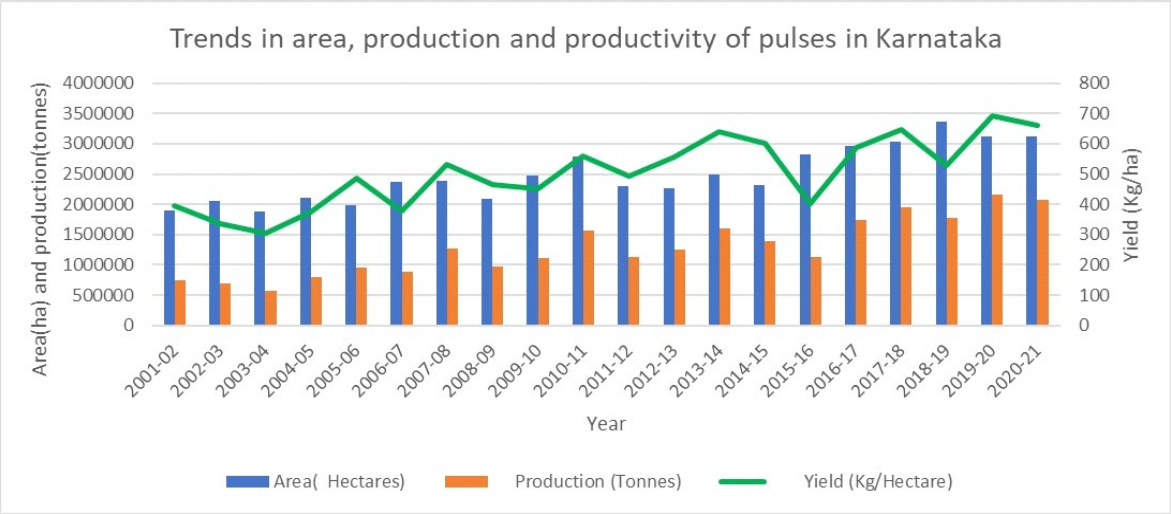

Fig. 3 : Trends in area, production and productivity of pulses in Karnataka

TABLE 1

Growth rates of area, production and productivity of Cereals in Karnataka

	Crop	Years	Area (Lakh ha)	CAGR (%)	Production (Lakh Tonnes)	CAGR (%)	Yield (Kg/ha)	CAGR (%)
	Period I	13.79	2.70 **	35.78	5.37 ***	2577	2.60	**
Rice	Period II	12.34	-1.08	36.13	-0.28	2919	0.81	
	Over all	13.07	-0.64	35.95	0.74	2748	1.39	***
	Period I	2.59	1.19 *	2.20	8.59 **	844	7.31	**
Wheat	Period II	1.91	-2.94 **	1.97	0.57	1036	3.62	*
	Over all	2.25	-2.51 ***	2.09	0.47	940	3.05	***
	Period I	9.30	9.69	25.45	13.23 ***	2667	3.22	*
Maize	Period II	13.92	2.00 **	42.07	3.23	3021	1.2	
	Over all	11.61	4.78	33.76	6.35	2844	1.50	**
Total	Period I	25.68	4.9	63.43	8.40 ***	2434	3.34	**
Cereals	Period II	28.17	0.30 *	80.17	1.58	2844	1.28	
	Over all	26.93	1.4	71.80	3.2	2639	1.78	***

Note : ***significance at 1% level, ** significance at 5% level and * significance at 10%

growth, characterized by a significant increase in both area (2.70%) and production (5.37%), resulting in a substantial rise in yield (2.60%). However, in the Period II (2011-2020) rice cultivation witnessed a slight decline in area (-1.08%) and production (-0.28%), while maintaining a positive growth in yield (0.81%). Overall, rice demonstrated a slight decrease in area (-0.64%) over the entire period but maintained positive growth in production (0.74%) and yield (1.39%), highlighting its resilience amidst changing cultivation dynamics. The growth in rice production in the state primarily contributed from increased rice

productivity rather than expansion in area (Acharya *et al*., 2012). Conversely, wheat cultivation exhibited positive growth rates in Period I, with increase in both area (1.19%) and production (8.59%), leading to a remarkable surge in yield (7.31%). However, in Period II, wheat cultivation experienced notable decrease in both area (-2.94%) and production (0.57%), although yield showed a significant growth (3.62%). Overall, wheat demonstrated a substantial decrease in area (-2.51%) but maintained marginal growth in production (0.47%) and a significant growth in yield (3.05%). Maize cultivation in Karnataka witnessed a significant growth in Period I, with substantial increase in both area (9.69%) and production (13.23%), accompanied by a moderate rise in yield (3.22%). In Period II, maize cultivation saw a modest increase in area (2.00%) but a slight decrease in production (-3.23%), while yield experienced marginal growth (1.20%). Overall, maize demonstrated robust growth in area (4.78%) and production (6.35%), with a modest increase in yield (1.50%) over the entire period, largely attributed to its adaptability and high yield per hectare. The positive growth rate in maize area was facilitated by government interventions such as remunerative support prices and market operations, stimulated maize cultivation expansion (Rani *et al.,* 2022). This rapid expansion was driven by maize's favorable characteristics, including its short duration, adaptability to various soils and climatic conditions and high yield per hectare compared to other cereal crops (Acharya *et al.,* 2012). Total cereals in Karnataka exhibited mixed trends, with Period I marked by a significant growth in area (4.90%), production (8.40%) and yield (3.34%), while Period II saw decline in some cultivation aspects. Overall, total cereals demonstrated moderate growth rates in area (1.40%), production (3.20%) and yield (1.78%), reflecting the dynamic nature of cereal cultivation in the region over the past two decades.

Growth Performance of Millets

The growth rates of area, production and productivity of millets in Karnataka over the periods from 2001-02 to 2020-21 (Table 2). Throughout the entire study period, encompassing two decades, millets exhibited

Table 2

Growth rates of area, production and productivity of Millets in Karnataka

Crop	Years	Area (Lakh ha)	CAGR (%)	Production (Lakh Tonnes)	CAGR (%)	Yield (Kg/ha)	CAGR (%)
Jowar	Period I	15.26	-4.03	13.14	2.32	881	6.62 **
	Period II	10.38	-3.98 ***	10.60	-2.43	1027	1.61
	Over all	12.82	-3.85	11.87	-1.60 *	954	2.33 ***
Bajra	Period I	3.41	1.47	2.18	5.45	629	3.92
	Period II	2.47	-1.39	2.68	0.69	1005	-2.25
	Over all	2.94	-2.33 **	2.43	2.59	817	3.84 ***
Ragi	Period I	8.40	-1.93	12.61	1.47	1490	3.48
	Period II	6.80	0.46	11.14	-0.38	1612	-0.84
	Over all	7.60	-1.73 ***	11.88	-0.84	1551	0.9
Small Millets	Period I	0.48	-11.20 ***	0.25	-12.4	525	-1.35 **
	Period II	0.27	4.36	0.16	11.38 *	575	6.73 *
	Over all	0.37	-4.71 ***	0.21	-3.74 *	551	1.01
Total Millets	Period I	27.49	-3.00 ***	28.16	1.79	1033	4.93 *
	Period II	19.93	-1.90 **	24.59	-0.99	1229	0.93
	Over all	23.71	-2.97	26.37	-0.92	1131	2.12 **

Note : ** *significance at 1% level, ** significance at 5% level and * significance at 10%

dynamic trends in cultivation. Jowar cultivation during Period I, witnessed a notable decline in area (-4.03%). However, production showed a positive growth (2.32%) alongside a significant increase in yield (6.62%) in Karnataka, attributed to the adoption of high yielding varieties, irrigation and fertilizer application (Acharya *et al*., 2012). Conversely in Period II (2011-2020), Jowar cultivation continued to decline and faced challenges such as lack of government support for millets and issues in supply chain management and technology application. Period I for Bajra exhibited moderate growth in area (1.47%) and production (5.45%), with a slight increase in yield (3.92%), while Period II saw decline in both area and production, reflecting challenges such as shifting farmer preferences. Ragi, experienced a decline in area (-1.93%), the reason behind this decline in area in Period I was attributed to the shifting of this crop area to other commercial crops such as sunflower, groundnut, etc. (Divya *et al*., 2013), but maintained positive growth in production (1.47%), although yield increased marginally (3.48%). Growth in productivity of finger millet and pearl millet was due to increased use of manures and fertilizers by the farmers (Amarapurkar and Banakar, 2019), while Period II showed slight fluctuations in area and production. Small millets witnessed a substantial decrease in both area (-11.20%) and production (-12.4%), with a significant decrease in yield (-1.35%) in period I, however in period II, showed substantial increase in area (4.36%) and with a significant increase in both production (11.38%) and yield (6.73%). The Government of Karnataka has introduced a scheme 'Raithasiri' that offers a financial incentive of Rs.10,000 per hectare to boost the cultivation of minor millets in Karnataka. Overall, millets in Karnataka demonstrated moderate decline in area (-2.97%) and production (-0.92%) over the entire study period, with slight significant growth observed in yield (2.12%). Millet growing has declined over the years, probable reasons were crop replacement, better price, better market for the substituted crops, lack of support from government for millets unlike supports provided to rice and wheat in public procurement programmes and no proper supply chain management and lack of modern technology application in supply chain (Kolageri and Israel, 2018). The farmers were shifting from millet cultivation to the cash crops as they give more returns compared to millets (Amarapurkar and Banakar, 2019). The findings underscore the dynamic nature of millet cultivation in Karnataka and highlight the need for strategic interventions to ensure the sustainability and resilience of millet production in the state.

Growth Performance of Pulses

Karnataka holds significance as one of India's key states for pulses cultivation with pulses being cultivated across an area of approximately 24.91 lakh hectares (Table 3). The prominent pulses grown in Karnataka include pigeon pea, chickpea, horse gram, green gram and black gram. Pigeon pea and chickpea crops collectively account for over 60 per cent of the total pulses cultivation area in Karnataka (Sasdhar and Nagaraja, 2018). Tur cultivation displayed promising growth rates during Period I (2001-02 to 2010-11), marked by a significant increase in both area (5.85%) and production (9.52%), alongside notable growth in yield (3.46%). This growth was attributed to favourable market conditions and increased adoption of improved agricultural practices. The Period II (2011-2020) indicated tur cultivation continued to expand at a slightly lower rate with significant growth in area (4.85%) and production (9.90%). Yield also experienced significant growth during this period (4.82%). Overall, tur demonstrated impressive growth over the entire study period with a growth rate of 11.19 per cent in area and 14.22 per cent in production, highlighting its importance in Karnataka's agricultural landscape. Gram cultivation in the region exhibited a consistent growth during Period I with notable increase in both area (5.35%) and production (6.94%), with a modest yield growth (1.51%). The growth in gram production was because of its better prices, wider market and the improved varieties/hybrids introduced by ICRISAT, IIPR and farm Universities of state and resulted in increase in production of red gram and Bengal gram (Kumar *et al*., 2020). However, during Period II, gram cultivation experienced a slowdown

TABLE 3

Growth rates of area, production and productivity of Pulses in Karnataka

Crop	Years	Area (Lakh ha)	CAGR (%)	Production (Lakh Tonnes)	CAGR (%)	Yield (Kg/ha)	CAGR (%)
Tur	Period I	6.06	5.85	3.12	9.52 ***	503	3.46 ***
(Red Gram)	Period II	10.55	4.85 ***	7.65	9.90 **	711	4.82 *
	Over all	8.31	11.19 ***	5.38	14.22 **	607	2.73
Gram	Period I	5.60	5.35 ***	2.97	6.94 ***	527	1.51 *
	Period II	10.16	2.82	6.19	4.45	617	1.58
	Over all	7.88	0.1	4.58	1.59	572	1.48
Urad	Period I	1.38	-3.38 ***	0.35	2.08	248	5.65 ***
(Black Gram)	Period II	0.94	-2.89 *	0.42	-1.79	442	1.13
	Over all	1.16	-1.17	0.38	2.24	345	3.45
Moong	Period I	3.90	0.41	0.69	5.24 ***	177	4.82 ***
(Green Gram)	Period II	3.51	2.17	1.01	5.12	281	2.88
	Over all	3.71	8.12 ***	0.85	13.85 ***	229	5.31
Horse-gram	Period I	2.72	-4.08	1.13	-2.18	425	1.99
	Period II	1.60	-4.92 ***	0.83	-0.46	522	4.70 *
	Over all	2.13	-0.86	0.97	3.16	476	4.05
Other *Rabi*	Period I	0.29	-8.08 ***	0.06	3.15	199	12.22
Pulses	Period II	0.22	-3.9	0.15	10.53 *	678	15.01 ***
	Over all	0.26	6.98	0.11	10.34	450	3.13
Other *Kharif*	Period I	1.28	-7.92 *	0.67	-3.24	541	5.08 ***
Pulses	Period II	0.56	-2.87	0.45	11.18 ***	810	14.47 ***
	Over all	0.90	-7.46 ***	0.55	-9.62 *	682	-2.33
	Period I	22.03	2.76	9.58	6.13	435	3.28 ***
Total Pulses	Period II	27.79	3.63 ***	16.21	8.82 ***	583	5.01 **
	Over all	24.91	4.52 ***	12.89	6.97 ***	518	2.34

Note : ** *significance at 1% level, ** significance at 5% level and * significance at 10%

in growth rates, emphasizing the need for targeted interventions to improve production and yield in the future. Urad cultivation faced challenges during Period I with a significant decline in area (-3.38%) but it maintained modest growth in production and a substantial increase in yield. Urad cultivation in Period II, continued to decline in area (-2.89%) and experienced stagnation in production, indicating the need for strategic interventions to enhance its cultivation and productivity. Moong cultivation demonstrated moderate growth during Period I, with a significant increases in production and yield, showed its potential contribution to the agricultural sector. Its cultivation faced challenges in area expansion but maintained steady production growth, underlining the importance of targeted interventions to support its cultivation in the Period II. Horse-gram cultivation faced challenges but demonstrated marginal growth in yield during Period II, suggesting the need for revitalization efforts. Other *rabi* and *kharif* pulses exhibited mixed trends across the periods, emphasizing the importance of strategic

interventions to boost their cultivation and productivity. The government has included pulses in the National Food Security Mission (NFSM) (along with wheat and rice) since the launch of NFSM in October 2007 and has been significantly increasing the MSP for most pulses (Sasdhar and Nagaraja, 2018). The pulses cultivation in Karnataka displayed mixed trends, highlighting the need for targeted interventions and policy support to enhance productivity and sustainability in the region's agricultural sector.

Instability in Area, production and Productivity of Cereals

The instability index for cereals in Karnataka, as measured by the Cuddy-Della Valle Instability Index (CDVI), indicates the variability in area, production and yield across different periods (Table 4). The results implied that the instability levels remain relatively low for all crops and periods. The rice cultivation for both Period I and II exhibited low instability in area, production and yield with the overall figures falling within the same range. Similarly, wheat cultivation showed consistent low instability across periods, with minor fluctuations in CDVI values. Maize production also demonstrated low instability with slight variations in CDVI values across the periods. The total cereals category, encompassing rice, wheat and maize, maintained low instability levels throughout study periods (Kumar *et al.,* 2023). These findings suggest a certain level of consistency and predictability in cereal cultivation practices in Karnataka, contributing to stable agricultural outputs in terms of area, production and yield.

Instability in Area, Production and Productivity of Millets

The instability index for millets in Karnataka revealed varying levels of instability across different crops and periods (Table 5). Jowar displays consistently low instability in area, production and yield for both the periods, contrasting with Bajra and Ragi, which demonstrated a mixture of low and medium instability. Small millets also exhibited notably a high instability in area and production, particularly in Period II, while yield instability remained comparatively low. Overall, the total millet category showcased low instability in area and yield but slightly higher instability in production, indicating the diverse and fluctuating nature of millet cultivation practices in Karnataka.

TABLE 4

Instability index in area, production and productivity of Cereals in Karnataka

Crop	Years	CDVI		
		Area	Production	Yield
Rice	Period I	8.87	12.42	7.21
	Period II	12.23	16.18	5.52
	Over all	12.45	16.46	6.54
Wheat	Period I	5.35	20.43	18.83
	Period II	10.55	22.52	16.17
	Over all	11.10	25.90	18.16
Maize	Period I	7.32	18.80	14.64
	Period II	8.06	17.77	17.72
	Over all	11.83	19.82	15.67
Total Cereals	Period I	5.42	15.72	15.14
	Period II	8.50	19.07	17.50
	Over all	10.49	19.19	15.78

TABLE 5

Instability index in area, production and productivity of Millets in Karnataka

Crop	Years	CDVI		
		Area	Production	Yield
`	Period I	2.99	18.20	19.15
Jowar	Period II	7.93	17.89	14.99
	Over all	5.84	19.43	17.88
	Period I	24.22	43.91	30.86
Bajra	Period II	20.86	31.62	28.91
	Over all	24.08	35.46	31.21
	Period I	12.84	29.17	21.60
Ragi	Period II	11.00	30.67	23.05
	Over all	12.74	28.75	22.02
	Period I	10.80	11.12	3.80
Small Millets	Period II	34.26	47.78	27.66
	Over all	33.72	45.83	23.68
	Period I	5.17	20.98	18.22
Total Millets	Period II	5.90	21.22	17.43
	Over all	5.92	20.92	17.53

These findings underscore the need for targeted interventions and adaptive strategies to mitigate the impacts of instability and enhance the resilience of millet farming systems in the region.

Instability in Area, Production and Productivity of Pulses

The instability index for pulses in Karnataka illustrates varying degrees of instability in area, production and yield across different pulse crops and periods (Table 6). Tur, Gram, Moong and Horse-gram display a mix of low to medium instability with fluctuations observed in both periods. Tur exhibited relatively low instability in Period I but experienced a significant increase in instability in Period II, particularly in area and production. Gram demonstrated high instability in Period I, particularly in area, but experienced a decrease in instability in Period II, the high instability in Gram due to major production was based on rainfed cultivation (Sahana and Manjunath, 2023). Moong showed moderate instability levels across both periods, Period II experienced slightly lower instability in area and production. Horse-gram presents relatively low instability throughout the study periods with overall instability levels remaining within the low range. Urad, on the other hand, exhibits high instability, especially in production, across both periods. Other *rabi* and *kharif* pulses also showed a mix of medium to high instability with fluctuations observed in area, production and yield across the periods. Overall, the total pulse category demonstrated relatively low instability in area, production and yield across both periods, indicating a certain level of consistency in pulse cultivation practices in Karnataka. However, targeted interventions may be required to address the high instability observed in specific pulse crops such as Urad and Other *rabi* pulses, to enhance the stability and resilience of pulse farming systems in the region. The considerable fluctuations in pulse production, attributed to both biotic and abiotic stresses, coupled with unstable prices due to the absence of an effective government

TABLE 6

Instability index in area, production and productivity of Pulses in Karnataka

Crop	Years	CDVI		
		Area	Production	Yield
`	Period I	10.98	26.16	20.40
Tur	Period II	21.77	35.78	29.70
	Over all	22.43	35.83	25.96
	Period I	39.50	47.16	18.07
Gram	Period II	22.49	28.01	23.21
	Over all	30.11	34.46	20.35
	Period I	13.20	57.28	48.86
Urad	Period II	21.05	34.13	20.94
	Over all	16.62	42.65	32.74
Moong	Period I	25.76	47.22	40.86
(Green Gram)	Period II	16.28	30.55	26.21
	Over all	25.77	41.90	31.79
	Period I	9.95	19.61	19.20
Horse-gram	Period II	12.80	38.11	33.73
	Over all	14.20	28.69	29.05
Other *rabi*	Period I	25.15	41.86	19.18
Pulses	Period II	16.34	26.37	34.67
	Over all	34.19	32.20	34.12
Other *kharif*	Period I	17.85	26.67	21.25
Pulses	Period II	14.27	35.76	32.60
	Over all	19.29	43.61	32.84
	Period I	7.83	16.80	13.70
Total Pulses	Period II	6.34	13.11	14.46
	Over all	8.18	14.83	13.59

price support mechanism, farmers exhibit reluctance to engage in pulse cultivation despite the recent surge in wholesale pulse prices. Instead, they are increasingly drawn towards cultivating cash crops such as Bt cotton, maize and oilseeds, particularly soybean, owing to the prospects of higher returns and lower risk (Sasdhar and Nagaraja, 2018).

The analysis of growth performance and instability indices of cereals, millets and pulses in Karnataka over the past two decades revealed a dynamic trends and varying degrees of stability in agricultural production. The growth rates of cereals during Period I demonstrated significant increases in area, production and yield, while Period II exhibited more modest growth rates with fluctuations across different crops. Despite minor variations cereals maintained relatively a low instability levels throughout the study periods, indicating consistent cultivation practices contributing to stable agricultural outputs. Similarly, millets and pulses exhibited dynamic growth patterns, with millets experiencing moderate declines in area and production

but slight growth in yield over the entire study period. Pulses demonstrated a significant growth in area and production, with fluctuations in yield across different crops and periods. The varying degrees of instability observed in millets and pulses, overall, both categories maintained relatively low instability levels, suggesting resilience in cultivation practices. These findings underscore the importance of strategic interventions to address specific challenges and enhance the stability and resilience of agricultural production systems in Karnataka, ensuring sustainable food security and agricultural development in the region.

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