



Research Article

DYNAMICS OF CROPPING PATTERN IN VISVESVARAYA CANAL COMMAND AREA OF KARNATAKA: AN ECONOMIC ANALYSIS

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Abstract: Visvesvaraya Left Bank Canal from the South region of the Karnataka state was selected for the purpose of analysing the changes in cropping pattern. The time series data on cropping pattern in the selected canal command area was collected for a period of 10 years (2009-10 to 2018-19) and analysed using First Order Markov Chain Approach. In Visvesvaraya command area (VC), during *kharif* season, acreage under paddy, black gram and sugarcane was stable during the period. The instability in the area under other crops was mainly because of water scarcity and high cost of cultivation of those crops. During *rabi* season, due to availability of irrigation water the area under sugarcane was stable and when the irrigation water was not available, farmers preferred horse gram crop because water requirement of the horse gram is less and it can be grown on residual moisture also. Therefore, area under sugarcane and horse gram was stable during *rabi* in VC command area. During summer, area under paddy, black gram and sugarcane was stable because of availability of water farmer preferred paddy and sugarcane otherwise farmers preferred black gram. No significant change was observed in the CAGR of area under other crops in VC command area. The projected area in VC command area for paddy, finger millet, maize, horse gram and sesame for the period 2019 to 2021 has shown an increasing trend whereas the projected area under cowpea, field bean, horse gram shown a decreasing trend. In VC command area the area under major crops was found out to be against the cropping patterns suggested by the CADA, thus the higher deviation from the suggested cropping pattern was found in Garden crops (12.18%) followed by Groundnut (9.99%), Niger (9.53%) and Finger millet (7.71%). This study indicated that there was a violation in the cropping pattern from the recommended pattern in VC command area which was mainly due to farmers allocated more area under water intensive crops such as paddy and sugarcane. Hence, there is a need to bring the discipline among the farmers of the study area through proper training and guidance in order to make them not only to strictly follow the recommended cropping pattern but also in the optimum use of water.

Keywords: Markov Chain, CAGR, Command area, Recommended cropping pattern

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Introduction

Cropping Pattern determines the output mix in a particular region. Cropping pattern refers to adoption of particular type of crops by the farmers in a particular region. It has significant bearing on widening the geographical inequalities in income distribution. Introduction of new agriculture technologies has influenced the crop-mix which is more prominent in agriculture developed regions. A dynamic change has been witnessed in agriculture sector in our country, particularly during post-green revolution period. The technological advancement in crop varieties and other yield increasing factors of production influenced the farmers' behaviour which has reflected in the cropping pattern from cultivation of low value crops to high value crops in most of the regions. The long-term changes in the cropping pattern in any region could be due to the development of irrigation infrastructure, whereas the vagaries of nature including rainfall and other institutional factors led to short term fluctuations in the cropped area as well as productivity. These short terms and long-term fluctuations have implications on the economic returns to the farmer as well as on the environment. To assess the extent and gravity of the consequences of such situation, knowledge of the dynamics of cropping pattern is essential. In addition to this Command Area Development Authority (CADA) recommends suitable cropping pattern for the command area on the basis of agro-climatic situation and availability of the water in the command area. This recommended cropping pattern needs to be followed by the farmers to increase crop productivity and also the water productivity.

Nowadays farmers are deviating from the recommended cropping pattern according to the market prices of different crops. Farmers cultivate such crops which fetch high market price irrespective of the recommended crops and agro-climatic conditions. Also lack of inspection by CADA officials, irregularity in water supply, unequal distribution of water in head middle and tail region are some of the major reasons for deviation in the cropping pattern. The present study aims to analyse the dynamics of cropping pattern in VC canal command area with an objective to identify reasons for deviation in cropping pattern and to predict next three years cropping pattern in command area of Karnataka state [1-7].

Materials and methods

The time series data pertaining to cropping pattern in the Visvesvaraya command area was collected for a period of 10 years (2009-10 to 2018-19) from offices of the Command Area Development Authority (CADA), Irrigation department and State Agriculture Departments [1-7].

Tabular analysis

It is used for the presentation of some of the data such as recommended and actual cropping pattern, studied by collecting the data from CADA office. For this, ten years average area in percentage of existing cropping pattern under different crops was compared with the recommended cropping pattern and the deviation in

the cropping pattern from the recommended pattern was worked out and presented in the form of tables.

Compound growth rate analysis

Growth of any variable indicates its past performance. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making policy decisions. The growth in the area of different crops in the Vishveswararaya Command areas of Karnataka and its cropping pattern was estimated using the exponential growth function of the form:

$$Y_t = ab_t u_t \quad (1)$$

Where,

Y_t : Dependent variable for which growth rate was estimated

a: Intercept

b: Regression coefficient

t: Years which takes values, 1, 2, ..., n

U_t : Error term for the year t

The equation was transformed into log linear form for estimation purpose and was estimated using Ordinary Least Square (OLS) technique. The compound growth rate (g) in percentage was then computed from the relationship,

$$g = (\text{Antilog of } \ln b - 1) \times 100.$$

The significance of the regression coefficient was tested using the students 't' test.

Markov Chain Model

The direction of change in cropping pattern was analysed by using First Order Markov Chain Approach. The Lingo Software was used for the purpose. Markov Chain Analysis is the estimation of the transitional probability matrix 'P' whose elements, P_{ij} indicate the probability of shifting area from one crop 'i' to another crop 'j' over time. The diagonal element P_{ii} where $i=j$, measures the probability of a crop retaining its share. The average area shifted to a particular crop was considered to be a random variable which depends only on the area under past crop, which can be denoted algebraically as:

$$E_{jt} = \sum_{i=1}^n [E_{i,t-1}] P_{ij} + e_{jt}$$

Where,

E_{jt} = Area of the crop shifted towards the particular jth crop in the year t

$E_{i,t-1}$ = Area lost by ith crop during the year t-1

P_{ij} = the probability the area lost will shift from ith crop to jth crop

e_{jt} = The error term which is statistically independent of $E_{i,t-1}$

n = the number of crops.

The transitional probabilities P_{ij} , which can be arranged in a (c x n) matrix, have the following properties.

$$\sum_{i=1}^n P_{ij} = 1 \text{ And } 0 \leq P_{ij} \leq 1$$

Based on the results of Markov chain analysis, the Projections of area under different crops for the period (2019-2021) were made for the entire canal Command areas by using:

$$B_t = B_0 \times T \\ B_{(t+1)} = B_{(t+1)} \times T$$

Where

B_0 = Area under the crop in base year;

$B_{(t+1)}$ = Area under the crop in next year (prediction);

T= Transitional probability matrix.

Results and discussion

The Compound Annual Growth Rate (CAGR) of area under different crops in the command area is presented in [Table-1]. No significant change was observed in the CAGR of area under different crops in Visvesvaraya command area. The results of the transition probability matrix for different crops in Visvesvaraya command area (VC) for *kharif* are presented in [Table-2]. The crops considered for the study were paddy, finger millet, maize, horse gram, cowpea, field bean, sesame, sugarcane and others which include sorghum, red gram, black gram, green gram, groundnut, castor and Niger. It is revealed from the table that, in

kharif season, the area under maize, horse gram, field bean, sesame, sugarcane and other crops was unstable. Paddy had retained only 19 percent of its previous year's share of area and lost about 55 percent of its previous years share to finger millet, 5.70 percent to maize, 10 percent to horse gram, 1.30 percent to cowpea, 2.4 percent to field bean and 4.4 percent to other crops. However, it gained about 98 percent of area from maize, 75 percent from field bean, 59 percent from sugarcane 41 percent from finger millet and 29 percent from cowpea. Finger millet retained 32 percent of its previous share and had lost 41 percent area to paddy, 4 percent to cowpea, 19 percent to sugarcane, 0.4 percent to field bean and 0.8 percent to other crops. However, it gained 79 percent area from horse gram and 5 percent area from sugarcane. Maize was unable to retain its previous year acreage and lost about 98 percent area to paddy and 1.80 percent area to field bean. But it has gained about 5.9 percent area from paddy, 4.1 percent from horse gram, 24 percent from field bean, 4.4 percent from sesame and 6.10 percent from sugarcane. Similarly, horse gram was also unable to retain its previous year's acreage and lost about 8.1 percent area to paddy, 79 percent to finger millet, 4.1 percent to maize and 8 percent to field bean; but gained 10 percent area from paddy, 1 percent from cowpea. It was observed that cowpea has retained 43 percent of its previous year's acreage and lost 29 percent to paddy and 1 percent to horse gram, 43 percent to cowpea, 1.5 percent to sesame, 21 percent to sugarcane and about 3 percent to other crops. However, it gained about 1.3 percent area from paddy, 4 percent from finger millet, 43 percent from cowpea and 17 percent from other crops. Field bean also not retained its previous year's acreage but lost about 75 percent area to paddy crop and 24 percent area to maize crop; however, gained 8.8 percent area from sesame crop, 2.4 percent from paddy, 0.04 percent finger millet, 1.8 percent from maize and 8 percent from horse gram. Sesame crop also not retained any area from its previous acreage but lost 86 percent area to sugarcane, 4.4 percent to maize and 8.8 percent to field bean crops. However, sesame gained 1.5 percent area from cowpea and 23 percent from sugarcane. Retention of area from its previous year was also zero in case of sugarcane crop. However, it lost 59 percent area to paddy, 5 percent area to finger millet, 6.1 percent to maize, 23 percent to sesame and 5.1 percent to other crops. However, it gained 19 percent area from finger millet, 21 percent from cowpea, 86 percent from sesame and 75 percent from other crops.

Table-1 Compound growth rates for area under different crops in VC command area of Karnataka

SN	Crops	VC
1	Paddy	-0.95 ^{NS}
2	Finger millet	2.23 ^{NS}
3	Maize	1.39 ^{NS}
4	Green gram	2.85 ^{NS}
5	Horse gram	1.52 ^{NS}
6	Black gram	14.74 ^{NS}
7	Cowpea	7.71 ^{NS}
8	Field bean	0.96 ^{NS}
9	Groundnut	10.30 ^{NS}
10	Sesame	-3.62 ^{NS}
11	Sugarcane	-3.83 ^{NS}
12	Others	-4.89 ^{NS}

Note: ***, **, * denotes significance at 1%, 5% and 10% level respectively; Other crops include Red gram, Caster and Niger.

It is concluded from [Table-2] that, paddy and finger millet are the staple food of the command area and hence area under these crops remained somewhat stable during the period. The instability in the area under other crops may be due to high cost of cultivation of that crop. [Table-3] presents the results of the transitional probability matrix for major crops in VC command during *rabi* season. In *rabi* season major crops grown in VC command were paddy, finger millet, maize, horse gram, black gram, cowpea, field bean, sugarcane and others which include sorghum, red gram, sesame, green gram, groundnut, castor and Niger. The results showed that except horse gram and sugarcane all crops showed instability in their area shares. Horse gram retained about 47 percent of its previous year's area share and sugarcane retained about 27 percent of its previous year's area. Paddy has lost its area share to finger millet (62.70 %), horse gram (34.30 %) and field bean (2.34 %).

Table-2 Transition probability matrix for different crops in VC command during kharif season

Crops	Paddy	Finger millet	Maize	Horse gram	Cowpea	Field bean	Sesame	Sugarcane	Others
Paddy	0.190	0.550	0.057	0.110	0.013	0.024	0.000	0.006	0.044
Finger millet	0.414	0.324	0.000	0.000	0.046	0.004	0.000	0.195	0.008
Maize	0.982	0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000
Horse gram	0.081	0.791	0.041	0.000	0.000	0.083	0.000	0.000	0.000
Cowpea	0.290	0.000	0.000	0.012	0.432	0.000	0.015	0.211	0.030
Field bean	0.750	0.000	0.240	0.000	0.000	0.000	0.000	0.000	0.000
Sesame	0.000	0.000	0.044	0.000	0.000	0.088	0.000	0.860	0.000
Sugarcane	0.599	0.054	0.061	0.000	0.000	0.000	0.234	0.000	0.051
Others	0.000	0.000	0.000	0.000	0.170	0.000	0.000	0.750	0.068

Note: Other crops include sorghum, red gram, black gram, green gram, groundnut, castor and Niger

Table-3 Transition probability matrix for different crops in VC command during rabi season

Crops	Paddy	Finger millet	Maize	Horse gram	Black gram	Cowpea	Field bean	Sugarcane	Others
Paddy	0.000	0.627	0.005	0.343	0.000	0.000	0.023	0.000	0.000
Finger millet	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
Maize	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
Horse gram	0.008	0.256	0.016	0.478	0.000	0.007	0.001	0.232	0.000
Black gram	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
Cowpea	0.000	0.000	0.000	0.989	0.010	0.000	0.000	0.000	0.000
Field bean	0.000	0.914	0.000	0.000	0.000	0.071	0.014	0.000	0.000
Sugarcane	0.000	0.000	0.000	0.729	0.001	0.000	0.000	0.270	0.000
Others	0.000	0.000	0.538	0.000	0.000	0.000	0.000	0.462	0.000

Note: Other crops include sorghum, red gram, sesame, green gram, groundnut, castor and Niger

Table-4 Transition probability matrix for different crops in VC command during summer season

Crops	Paddy	Finger millet	Maize	Black gram	Green gram	Cowpea	Groundnut	Sugarcane	Others
Paddy	0.587	0.122	0.016	0.000	0.000	0.000	0.000	0.273	0.0005
Finger millet	0.737	0.000	0.000	0.000	0.000	0.048	0.000	0.140	0.000
Maize	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
Black gram	0.000	0.000	0.000	0.038	0.020	0.941	0.000	0.000	0.000
Green gram	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cowpea	0.920	0.042	0.000	0.000	0.000	0.000	0.037	0.000	0.000
Groundnut	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
Sugarcane	0.237	0.237	0.057	0.006	0.003	0.036	0.000	0.370	0.000
Others	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000

Note: Other crops include sorghum, horse gram, red gram, field bean, sesame, castor and Niger

Table-5 Projected area under different crops in VC command area (Kharif) (Acres)

Year	Paddy	Finger millet	Maize	Horse gram	Cowpea	Field bean	Sesame	Sugarcane	Others
2019	45402.76 (33.14)	46096.82 (33.65)	4642.54 (3.39)	4979.93 (3.64)	6736.57 (4.92)	2465.69 (1.80)	3449.13 (2.52)	19412.33 (15.59)	3807.16 (2.78)
2020	47735.43 (35.52)	44627.26 (33.21)	4719.81 (3.51)	4607.64 (3.43)	5978.05 (4.45)	2059.54 (1.53)	4565.89 (3.40)	16267.11 (13.32)	3817.51 (2.84)
2021	45241.43 (34.32)	44988.60 (34.13)	4597.31 (3.49)	4833.32 (3.67)	5625.19 (4.27)	2179.53 (1.65)	3831.11 (2.91)	16810.78 (14.03)	3725.93 (2.83)

Note: Other crops include sorghum, red gram, black gram, green gram, groundnut, castor and Niger, Figures in parenthesis indicates percentages

Table-6 Projected area under different crops in VC command area (Rabi) (Acres)

Year	Paddy	Finger millet	Maize	Horse gram	Black gram	Cowpea	Field bean	Sugarcane	Others
2019	203.23 (0.45)	7126.01 (15.89)	416.31 (0.93)	28227.56 (62.95)	11.57 (0.03)	179.29 (0.40)	41.37 (0.09)	8618.75 (21.14)	13.68 (0.03)
2020	211.70 (0.47)	7391.50 (16.52)	431.87 (0.97)	27565.20 (61.60)	11.42 (0.03)	186.41 (0.42)	42.02 (0.09)	8893.74 (21.86)	14.25 (0.03)
2021	206.73 (0.46)	7227.84 (16.18)	422.29 (0.95)	27740.06 (62.11)	11.54 (0.03)	182.15 (0.41)	41.37 (0.09)	8814.43 (21.71)	13.92 (0.03)

Note: Other crops include sorghum, red gram, sesame, green gram, groundnut, castor and Niger, Figures in parenthesis indicates percentages

Table-7 Projected area under different crops in VC Command area (summer) (Acres)

Year	Paddy	Finger millet	Maize	Black gram	Green gram	Cowpea	Groundnut	Sugarcane	Others
2019	1330.44 (51.71)	352.13 (13.69)	66.32 (2.58)	5.49 (0.21)	2.90 (0.11)	54.04 (2.10)	6.48 (0.25)	754.38 (32.25)	0.65 (0.03)
2020	1271.90 (50.80)	343.39 (13.72)	63.75 (2.55)	4.92 (0.20)	2.60 (0.10)	55.71 (2.23)	2.00 (0.08)	758.60 (33.33)	0.72 (0.03)
2021	1233.33 (50.65)	337.32 (13.85)	63.08 (2.59)	4.93 (0.20)	2.60 (0.11)	50.42 (2.07)	2.06 (0.08)	740.46 (33.45)	0.69 (0.03)

Note: Other crops include sorghum, horse gram, red gram, field bean, sesame, castor and Niger, Figures in parenthesis indicates percentages

Finger millet crop lost its 100 percent area share to horse gram and gained 62.70 % area from paddy, 25.60 % area from horse gram and 91.40 percent area from field bean. Maize lost its 100 percent area share to horse gram and gained 0.50

percent area from paddy, 1.60 percent area from horse gram and 53.80 percent area from other crops. Horse gram had retained 47.80 percent of its previous years' share of area and lost about 0.75 percent of its previous years' share to

paddy, 25.60 percent area to finger millet, 1.50 percent area to maize, 0.65 percent to cow pea, 0.13 percent to field bean and 23.20 percent area to sugarcane. Black gram gained about 1 percent area from cow pea. Similarly, cowpea lost 98.90 percent of its previous year area share to horse gram, and 10 percent to black gram. Field bean retained only 1.30 percent of its previous year's area and lost about 91.40 percent of its previous area share to finger millet, 7.1 percent to cowpea, and 1.30 percent to field bean. With respect to sugarcane crop, it is observed that, it had retained 27 percent of its previous years' share of area and lost about 62.7 percent finger millet and 34.3 percent area to horse gram but gained about 25.6 percent from finger millet and 23.20 percent area from horse gram. It is concluded from the table that, due to availability of irrigation water the area under sugarcane is somewhat stable and wherever the irrigation water is not available, farmers prefer horse gram crop because water requirement of the horse gram is very less and it can be grown on residual moisture also. Therefore, area under horse gram was also stable in the command area.

Table-8 Recommended and actual cropping pattern in VC command areas of Karnataka

SN	Crop	Recommended area (%)	Cauvery Command Area	
			Actual Area (%)	Deviation (%)
1	Finger millet	10.00	17.71	7.71
2	Niger	10.00	0.47	-9.53
3	Groundnut	10.00	0.01	-9.99
4	Maize	10.00	3.00	-7.00
5	Sesame	10.00	2.74	-7.26
6	Red gram	10.00	10.64	0.64
7	Paddy	19.00	25.24	6.24
8	Sugarcane	19.00	26.01	7.01
9	Garden crops	2.00	14.18	12.18

[Table-4] presents the results of transitional probability matrix for major crops in VC command during summer season. Paddy, finger millet, maize, black gram, green gram, cowpea, groundnut, sugarcane and other crops such as sorghum, horse gram, red gram, field bean, sesame, castor and Niger were the crops grown in summer season. It is seen from the table that finger millet, maize, green gram cowpea groundnut and other crops could not retain previous years' acreage while paddy, black gram and sugarcane are the most stable crops in VC command during summer season. Paddy retained 58.70 percent of its previous years' share of area and lost about 12.20 percent, 1.56 percent and 27.30 percent area to finger millet, maize and sugarcane, respectively. However, it gained 73.70 percent, 92 percent, and 23.70 percent area from finger millet, cowpea and sugarcane crop, respectively. Finger millet Crop has not retained its previous years' area but lost about 73.70 percent area to paddy, 4.80 percent to cowpea and 14 percent to sugarcane crop and gained 4.24 percent area from cowpea and 23.70 percent area from sugarcane crop. Area under maize crop was also unstable and lost 100 percent area to sugarcane and gained 1.56 percent area from paddy and 5.70 percent area from sugarcane. In case of black gram, 3.77 percent area had retained by that crop from its previous years' area share and lost about 2 percent and 94.10 percent area to green gram and cowpea, respectively. Green gram lost 100 percent area to paddy crop and gained 2 percent area from black gram and 0.33 percent area from sugarcane. With respect to cowpea, it was found that, it had lost 92 percent area to paddy, 4.24 percent to finger millet and 3.70 percent to groundnut, at the same time gained about 4.80 percent area from finger millet, 94.10 percent from black gram, 100 percent from groundnut and 3.60 percent from sugarcane. Groundnut crop had lost 100 percent area to cowpea and gained 3.70 percent from cow pea. The area under sugarcane crop during the 10 years period was somewhat stable but lost about 23.70 percent to paddy, 23.70 percent to finger millet, 5.70 percent to maize, 0.62 percent to green gram, 0.33 percent to green gram and 3.60 percent to cowpea while other crops lost 100 percent area to sugarcane. Area under paddy, black gram and sugarcane was stable because, wherever irrigation water was available farmer preferred paddy and sugarcane and wherever irrigation water was not available farmers' preferred black gram because it fetched good price in the market.

Area projections of different crops in VC command area

The area projections of major crops grown in VC command area of Karnataka was

computed based on the transitional probability matrix and projections were made up to 2021.(Table 5 to 7).The projected area in VC command area for paddy, finger millet, maize, horse gram and sesame has shown an increasing trend whereas the projected area under cowpea, field bean, horse gram shown a decreasing trend. In case of summer crops the projected area under paddy, black gram, cowpea and groundnut shown a decreasing trend whereas finger millet, maize, sugarcane shown an increasing trend.

Recommended and actual cropping pattern in VC command area

The data pertaining to crops grown during last 10 years was collected from CADA office. Ten years average percentage area under different crops was compared with recommended cropping pattern in VC command area to study the deviation of existing cropping pattern from the recommended cropping pattern. The crops suggested in the localised pattern of VC command area was 10 percent each under Finger millet, Niger, Groundnut, Maize, Sesame and Red gram, 19 percent under Paddy and Sugarcane and 2 percent under Garden crops. However, the actual area in percentage of ten years average was 17.71 percent under Finger millet, 0.47 percent under Niger, 0.01 percent under Groundnut, 3 percent under Maize, 2.74 percent under Sesame, 40.64 percent under Red gram, 25.24 percent under paddy, 26.01 percent under Sugarcane and 14.18 percent under Garden crops. The higher deviation was found in Garden crops (12.18%) followed by Groundnut (9.99%), Niger (9.53%) and Finger millet (7.71%).

Conclusion

In VC command area, during *kharif* season, crops such as paddy, black gram and sugarcane were stable. The instability in the area under other crops was due to low market price. During *rabi* season, due to availability of irrigation water the area under sugarcane was stable and wherever the irrigation water was not available, farmers preferred horse gram which requires less water and can be grown on residual moisture. Hence, area under sugarcane and horse gram was stable during *rabi* in VC command area. During summer season, paddy, black gram and sugarcane were stable crops, as irrigation water was available farmer preferred paddy and sugarcane. The projected area in VC command area for paddy, finger millet, maize, horse gram and sesame for the period 2019 to 2021 has shown an increasing trend whereas the projected area under cowpea, field bean, horse gram shown a decreasing trend. In VC command area the area under major crops was found out to be against the cropping patterns suggested by the CADA, thus the higher deviation from the suggested cropping pattern was found in Garden crops, Groundnut, Niger and Finger millet. This study indicated that there was a violation in the cropping pattern from the recommended pattern in VC canal command area which was mainly due to farmers allocating more area under water intensive crops such as paddy and sugarcane. Hence, there is a need to bring the discipline among the farmers of the study area through proper training and guidance in order to make them not only in strictly following the recommended cropping pattern but also in the optimum use of water.

Application of research: The study helps in analyzing the dynamics of cropping pattern in canal command areas of Karnataka. The results can be used for policy regarding, farmers can plan their production and marketing of agricultural crops and non-violation of the recommended cropping pattern in canal command areas of Karnataka.

Research Category: Agriculture Economics.

Abbreviations:

VC: Visvesvaraya Canal

CAGR: Compound Annual Growth Rate

CADA: Command Area Development Authority

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