

## Structural transition in Karnataka Agriculture during post liberalization era

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### ABSTRACT

*Cropping pattern connotes the crop-mix grown in a particular area in an agricultural year. The transitions in cropping pattern are usually brought by complex gamut of factors. The study on these changes is vital in adjusting research priorities accordingly. Time series met a data on area under various field crops in Karnataka state forms the data base for empirical analysis. Ratios such as location quotient and crop versatility index were used to assess the extent of transition. The results of the study revealed that the specialized crops in particular parts of the state with high magnitude of location quotient. Crop versatility index reflected that most of the traditional staple food crops have become more versatile in terminal period of the study. Based on the degree of versatility of the crop, development of desired infrastructural facilities needs to be taken.*

**Key words:** Cropping pattern, crop versatility index, and location quotient

Karnataka's agriculture has undergone sea changes in past decade due to a complex gamete of factors. One of the vital factors responsible for this change can be attributed to the crop diversification. Crop diversification is an approach, which aimed at maximized use of land, water and other natural resources for the development of agricultural sector in the country. It provides the farmers with practicable and possible options to grow different crops on their land. The diversification in agriculture serves as a coping mechanism against risk and uncertainty arising out of climatic and biological vagaries. 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. A change in cropping pattern implies a change in proportion of area under different crops. It has significant bearing on widening the geographical inequalities in income distribution.

The development and adoption of new agricultural technologies have a significant influence on the crop-mix which is more prominent in agriculturally developed regions. A dynamic change has been witnessed in agricultural sector in the state, particularly during post-green revolution and post liberalisation period. The technological advancement in crop varieties and other yield increasing factors of production are hypothesised to have influence on farmers' behaviour which have been reflected in the changing cropping pattern from cultivation of low value crops to high value crops in most parts of the state.

The true reflection of diversification is the wide variety of crops being grown in different seasons in different parts of Karnataka. The major crops grown are paddy covering 14.16 lakh ha, ragi 8.32 lakh ha, jowar 13.82 lakh ha, bajra 4.32 lakh ha,

maize 11.13 lakh ha, wheat 2.76 lakh ha, minor millets 0.36 lakh ha. Totalling the area under cereal crops was around 54.87 lakh ha. The area under major pulses was about 23.85 lakh ha. Of which the area sown under Bengal gram was about 6.05 lakh ha and red gram about 6.81 lakh ha. The area under major commercial crops such as groundnut, cotton, and sugarcane was about 9.08 lakh ha, 4.03 lakh ha and 3.06 lakh ha respectively (Karnataka State at a Glance, 2008-09). The study of transition in cropping pattern is of immense importance in designing and formulating various policies related to agricultural growth and development.

### MATERIALS AND METHODS

To accomplish the objective, simple ratios and indices which better reflect the changes in spatial distribution of crops along with their relative importance in each district of Karnataka were computed. To have dynamism, the total study period of ten years was divided into two quinquennial sub periods. The first quinquennium was regarded as the base period (1997-2001) and the second quinquennium was regarded as the terminal period (2002-2006). To have uniformity of the data, which is crucial, the districts considered for the base period should be the same as in the terminal period, the two quinquennial periods from 1997 and from 2002 are considered for 27 districts of Karnataka. During the terminal period of analysis, agricultural years of 2002, 2003 and 2004 are regarded as drought periods. The remaining years *i.e.*, 2005 and 2006 of the terminal period are considered as normal years. The hypothesis behind the choice of two periods is to examine the consistency in the performance of agriculture between the two periods.

The Meta data on area under major annual field crops was obtained from the various published reports of Directorate of Economics and Statistics (DES). Only those annual field crops occupying more than 5 per cent of the cultivated area were included in the analysis. The areas of vegetable crops and fruit crops were not included in the analysis due to want of data. The area under plantation crops is not included in the analysis mainly because of their very nature of location specificity and they will not attract similar attention as in the case of annual crops in terms of policies, programmes and institutional arrangements.

**Methodology**

To analyze the performance of the selected field crops, simple measures like percentages, ratios, rank correlations, coefficient of concordance, computation of location quotient, crop versatility index were employed. The details of analytical tools are summarized below, (Ranganatha, 1983)

**Location Quotient**

$$LQ_{ij} = \frac{\text{Percentage area of the } i^{\text{th}} \text{ crop in } j^{\text{th}} \text{ district to the Gross cropped area in the } j^{\text{th}} \text{ district}}{\text{Percentage of area of the } i^{\text{th}} \text{ crop in the state to gross cropped area in the state}}$$

**Crop versatility index**

The versatility index of a crop is inversely proportional to coefficient of variation among the district wise areas of the corresponding crop. Thus, more the coefficient of variation lesser is the versatility of the crop and vice-versa.

A more versatile crop is one which is grown in more number of districts with more or less same

$$CV \text{ of } i^{\text{th}} \text{ crop} = \frac{\text{Standard deviation among the percentages of areas of the } i^{\text{th}} \text{ crop in 27 districts}}{\text{Mean of the district wise percentages of areas of } i^{\text{th}} \text{ crop to the total cropped area in the 27 districts}} \times 100$$

‘i’ ranges from 1 to 15.

**RESULTS AND DISCUSSION**

All the crops are not equally important in all the districts. Knowledge of specialization of crops in each district will facilitate in planning and organizing crop development activities in the districts. In addition, this is not only useful to biological scientists but also for social scientists, policy makers, and others in tackling the various aspects of crop improvement programmes. Location quotient (LQ) was computed to know the relative importance of different crops in the different districts. The magnitude of the quotient reflects the degree of specialization of crops. Crops with LQ more than unity in each of the 27 districts

To assess the relative importance of different crops in the different districts, location quotient was computed. The degree of specialization of the crops in the district is reflected in the magnitude of the quotient. Location quotient of a quotient more than unity is considered as an index of specialization of the particular crop in the district.

Location quotient was worked out using the following formula.

$$LQ_{ij} = \frac{A_{ij}}{A_j} / \frac{A_i}{A}$$

Where,  $LQ_{ij}$  = Location quotient of  $i^{\text{th}}$  crop in  $j^{\text{th}}$  district,  $i = 1,2,\dots,15$  and  $j = 1,2, \dots,27$

$A_{ij}$  = Area of the of  $i^{\text{th}}$  crop in  $j^{\text{th}}$  district,

$A_j$  =Gross cropped area in the  $j^{\text{th}}$  district

$A_i$  = Area of the  $i^{\text{th}}$  crop in the state

$A$  =Gross cropped area in the state,

Thus,

percentage of area in all the districts. The crops have been ranked based on the magnitudes of the coefficient of variation. Over the study period, if the rank of a crop increase it can be inferred that its versatility increased indicating its spread to more number of districts and tending to be of similar importance, in terms of allocation of area, in the different districts of the state.

during different periods of the study are presented in the table1.

The LQ considers the relative position of a crop in a district with that at the state level. In case of the important dry land crop of the southern and eastern Karnataka, namely, ragi, both the acreage as well as LQ are decreased in case of Davangere, Kolar, Chickmagalur, Bengaluru rural and urban, Chitradurga and Hassan (in majority of these districts the cereal based cropping system has paved way for more profitable vegetable based cropping system which enjoys comparative advantage over the other). In case of Tumkur and Mysore district, though the area under ragi has decreased the LQ has shown an

increased trend. The result was contrasting in case of Chamarajnagar wherein the area under ragi has increased but the LQ has shown a declining trend. In case of dry land crop of Northern Karnataka, jowar, both the area and LQ has decreased in major jowar growing districts such as Bijapur, Bagalkot, Gulbarga, Gadag, and Bidar. This result clears the fact of diversification of crops in these districts. The farmers in these districts have eventually reduced their dependence on dry land crops like jowar and shifted to high value crops like grapes, sunflower and pomegranate. The other likely reason is the versatility of this crop in the state, *i.e.*, this crop is being grown even in the non-traditional areas. The trend in case of Haveri and Raichur district was bit different, wherein the area under jowar has decreased while the LQ has shown an increasing trend. In case of paddy both the area and LQ has dropped in major paddy growing districts of the state *i.e.*, Shimoga, Dakshina Kannada, Kodagu, Chickmagalur, Mandya, and Mysore. The area and LQ has shown an increasing trend in case of Davangere, Bellary and Raichur. This clearly indicates the transition in the cropping pattern from paddy crop to less labour and water intensive, relatively remunerative crops like arecanut, maize. In case of Uttara Kannada the area has decreased while the LQ has increased. The contrasting result was observed in Udupi wherein the area has increased while the LQ has dropped. The result was in accordance with the outcome indicating that the area under jowar, bajra, ragi and minor millets are experiencing a substantial annual decrement. The area under rice has recorded a mild annual increment. The growth in area under oilseeds and commercial crops was negative and insignificant (Saraswati *et al.*, 2012)

As regards sugarcane crop, it may be noticed that both the area and LQ has decreased in Chamarajnagar and Shimoga. Both the area and LQ has increased in case of Bidar district. In major cane growing areas such as Mandya, Bagalkot and Bijapur the area under cane has decreased whereas the increase in LQ was observed. Regarding ground nut crop both the area and location quotient has decreased in Kolar, Gadag and Bellary. In case of Chitradurga and Tumkur the area under crop has decreased while the LQ has shown an increasing trend. The area and LQ for the cotton crop was decreased in case of Gadag and Bellary. Whereas contrasting result was observed in Uttara Kannada where both have shown an increasing trend. The area under cotton crop has decreased, while the LQ was positive in case of Dharwad, Mysore and Belgaum. This outcome was aptly supported by the result reflecting the shift in cropping pattern in favour of maize and cotton in Northern transitional zone of Karnataka. Though this was a welcome feature in terms of profitability to

farmers but it is at the cost of making the zone deficient in rice, wheat and jowar the staple food crops of the zone (Aravind, 2010).

Crop versatility can be derived from the information on the cropping pattern prevailing in the state. If a crop is region specific the development of the genetic material, availability of specialists, extension efforts, arranging services and supplies, building market services etc., are to be developed specifically for that crop with special reference to that region. (*i.e.* Location specific and demand driven research and development and extension delivery mechanism has to be adopted ) On the other hand if a crop is more versatile it is necessary to develop infrastructure and other facilities keeping in view the degree of versatility of the crop. This measure is useful in the context of knowing the nature of the crop with regard to its spatial coverage in quantitative terms. The results relating to the crop versatility are presented in Table 2.

Among the food crops, despite of the fact of decline in area under jowar, it became more versatile during terminal period (its capacity to withstand and acclimatize to periodically occurring sporadic droughts and depleting ground water table has increased its spatial coverage even to non-traditional belts). Next to jowar, paddy was regarded as more versatile in both the periods besides being the fact that the area under the crop has declined. It is because of the obvious reason that the paddy is the staple food crop of the state. It was followed by maize crop which is relatively versatile among the remaining cereal food crops despite the fact of increased area under it. The maize crop is gradually replacing specialised crops of various districts because of its relative profitability, adaptability to varying agro-climatic condition, need of less farm management operations and serves as a source of feed and fodder. This outcome was in line with the results indicating that the growth rate of maize crop in terms of area and production has increased significantly and overtaken the traditional crop, and occupies largest share of area and production in the state. In this manner, the state of Karnataka, traditionally known for rice cultivation has slowly switched over to the cultivation of maize crop in the recent years. (Singha and Chakravorty, 2013)

Among the oilseed crops groundnut was found to be more versatile in both the periods. Since, it occupies a prominent place in majority of the cropping systems by virtue of its adoptability to wide soil and agro-climatic situation. With regard to sesamum, it was more versatile during base period, which has shown a tendency of getting specialized in the terminal period. Linseed was found to be more specialized crop as it is confined to the northern

districts of Karnataka and its versatility decreased marginally in the terminal period. Amongst the commercial crops the more versatile crop was found to be the cotton crop in the study period. Whereas the versatility of other commercial crops inter alia sugarcane and tobacco remained less versatile in both the periods. Sugarcane being a location specific crops demands for areas congenial soil and agro-climatic conditions and also the accessibility to processing units and transportation facilities. On the other hand to grow tobacco, special permission from the government is required. *i.e.*, it is considered as controlled crop since area under this crop is predefined. These results are at par with the actuality and theoretical expectations.

However, jowar, paddy, maize and ragi also tended to become more versatile during the terminal period. This transitional process was facilitated by the development of technology (location specific HYV and hybrids). Technologies like aerobic rice, jowar varieties for different conditions helped in breaking location specificity. The factors like productivity of the crop, ease of management, skill and knowledge of farmers, nearness to processing unit, market demand as reflected by prices of the products, own consumption need of the farmers decides allocation of area under the crops. All these factors are considered to have significant influence on versatility of crops.

The results of the study revealed that the paddy and ragi are the crops specialized in Southern and Eastern parts of the state. The crops like Jowar, wheat, Bajra, sesamum, linseed, Bengal gram, Tur and cotton are mainly specialized in Northern parts of the state. Crops like ground nut, sesamum, tobacco, sugarcane are grown in all parts of the state reflected their versatile nature. Knowledge of specialization of crops is a prerequisite for biological and social scientists as well as for the policy makers in planning, organizing and executing various crop improvement programmes. The transitional process in cropping

pattern was observed among the traditional staple food crops like paddy, jowar etc. Technologies like aerobic rice, location specific high yielding varieties and hybrids helped in breaking specialisation. The factors like productivity of the crop, ease of management, skill and knowledge of farmers, nearness to processing unit, market demand as reflected by prices of the products, own consumption need of the farmers have a significant bearing on versatility of the crops. The future line of work is to study the relative impact of these factors on transition in the cropping pattern.

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Table 1: Location quotient

Particlars	Crops specialized only in the base period		Crops specialized only in the terminal period		Crops specialized in both base and terminal period		LQ(+)	LQ(-)
	Area(+)	Area(-)	Area(+)	Area(-)	Area(+)	Area(-)		
Bengaluru Urban						Ragi		Ragi (5.38)
Bengaluru Rural						Ragi		Ragi (4.63)
Chitradurga		Sunflower			Maize, Sesamum	Ragi, Groundnut	Groundnut (4.06), Sesamum (1.45)	Ragi (1.39), Maize (1.25)
Davangere	Tobacco	Sugarcane			Paddy, Maize		Paddy (2.22), Maize (4.21)	
Kolar						Ragi, Groundnut		Ragi(3.26), Groundnut (1.88)
Shimoga		Sugarcane			Maize	Paddy, Sugarcane	Maize (3.81)	Paddy (4.81), Sugarcane (1.44)
Tumkur				Paddy		Ragi, Groundnut	Ragi (6.98), Groundnut (7.74)	
Belgaum			Groundnut, Bajra	Jowar	Maize, Wheat, Bengal gram	Linseed, Sugarcane, Cotton, Tobacco	Maize (5.68), Wheat (11.91), Linseed (5.20), Sugarcane (19.94), Cotton (3.28), Tobacco (9.82)	
Bijapur					Bajra, Wheat, Bengal gram	Wheat, Linseed, Sunflower, Jowar	Sunflower (3.01)	Jowar (1.87), Wheat (2.50), Bengal gram (1.62), Bajra (2.39), Linseed (3.81)
Bagalkot		Bengal gram			Maize	Jowar, Bajra, Wheat, Linseed, Sunflower, Sugarcane	Bajra (2.04), Linseed (6.24), Sugarcane (4.13)	Jowar (2.04), Wheat (1.81), Maize (1.10), Sunflower(2.19)
Dharwad			Groundnut	Jowar	Bengal gram	Wheat, Cotton	Wheat (4.19), Cotton (4.51)	Bengal gram (1.75)
Gadag					Wheat,	Jowar, Maize, Bengal gram, Groundnut, Wheat, cotton Sunflower	Linseed (1.88)	Jowar (1.21), Maize (3.53), Bengal gram (1.52), Groundnut (1.47), Sunflower (1.59), Cotton (2.84)
Haveri	Paddy	Wheat			Maize	Jowar, Cotton	Jowar (1.19), Maize (3.54), Cotton (4.24)	

Table 1. Contd.

District	Area(+)	Area(-)	Area(+)	Area(-)	Area(+)	Area(-)	Area(+)	Area(-)	LQ(+)	LQ(-)
Uttara Kannada					Cotton	Paddy			Paddy (6.26), Cotton (2.02)	Jowar (1.58), Bengal gram (1.72), Sesamum (1.65)
Bidar					Tur, Sugarcane	Jowar, Bengal gram, Sesamum			Tur (3.37), Sugarcane (1.99)	
Bellary					Paddy, Maize, Bajra, Sesamum	Groundnut, Sunflower, Cotton			Paddy (1.51), Maize (1.65), Cotton (1.44), Groundnut Bajra (1.26), Sesamum (1.42)	(1.72), Sunflower (1.65)
Gulbarga		Linseed	Sesamum	Sunflower	Bengal gram, Tur	Jowar, Bajra			Bajra (1.59), Tur (5.53)	Jowar (1.59), Bengal gram (1.77)
Raichur					Paddy, Bengalgram	Jowar, Sesamum, Sunflower, cotton			Paddy (2.49), Jowar (2.09), Bajra, Bajra (4.18), Bengal gram (5.88), Sesamum (1.34), Sunflower (3.96), Cotton (1.47)	
Koppal	Linseed	Paddy, Jowar, Groundnut, Cotton			Bajra, Sesamum	Sunflower			Bajra (5.58), Sesamum (3.25), Sunflower (1.47)	
Chickmagalur									Sesamum. Paddy, Ragi	Sesamum (2.33)
Dakshina Kannada									Paddy	Paddy (1.29)
Udupi					Paddy					Paddy (4.03)
Hassan	Paddy				Tobacco	Ragi, Sesamum			Tobacco (2.30)	Ragi (2.75), Sesamum (1.11)
Kodagu										Paddy (2.15)
Mandya			Sesamum			Paddy, Ragi			Ragi (2.34), Sugarcane (2.91)	Paddy (2.48)
Mysore						Ragi, Paddy, Cotton			Ragi (6.81), Cotton (3.03), Tobacco (15.63), Sesamum (2.64)	Paddy (1.90)
Chamarajnagar		Cotton		Groundnut	Ragi, Maize	Sugarcane			Maize (1.53)	Ragi (1.36), Sugarcane (3.03)

Note: - + Increase, -Decrease, Numerical figures in the parenthesis indicates Location Quotient (LQ) values in the terminal period.

Table 2. Crop versatility during the base and terminal periods

SI No.	Crops	Base period			Terminal period		
		Gross area in the state in thousand ha	Coefficient of variation of the percentage	Rank	Gross area in the state in thousand ha	Coefficient of variation of the percentages	Rank
<b>Food crops</b>							
1	Paddy	1456.71	106	3	1288.28	111	2
2	Ragi	996.60	143	9	1060.74	144	8
3	Jowar	1835.62	108	4	1559.21	102	1
4	Bajra	542.75	175	11.5	379.12	197	12
5	Maize	595.87	131	7	955.20	127	6
6	Wheat	265.52	175	11.5	251.38	184	11
7	Bengal gram	308.22	140	8	638.66	125	5
8	Tur crop	522.08	197	13	575.94	226	14
<b>Oil seed crops</b>							
9	Ground nut	1137.95	105	2	861.28	114	3
10	Linseed	19.29	211	14	13.28	215	13
11	Sesamum	99.78	104	1	98.26	115	4
12	Sunflower	601.68	123	5.5	916.69	147	9
<b>Other crops</b>							
13	Sugar cane	374.30	145	10	237.81	161	10
14	Cotton	567.98	123	5.5	368.35	143	7
15	Tobacco	76.53	329	15	98.74	380	15