International Journal of Tropical Agriculture
Volume 42, Numbers (1) • 2024 : pp. 7-16
ISSN: 0254-8755

Statistical Analysis to Know the Extent of Agriculture Diversification in Different Districts of Karnataka

G. Padmapriyadarshini and H.S. Surendra

GKVK, UAS, Bangalore. E-mails: Padmapriya964@gmail.com, hssurendra@rediffmail.com

Abstract: Diversification in agriculture in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. Karnataka is endowed with varied agro-ecological and agro-climatic comprising of 30 districts. The study period was classified as Pre WTO (World Trade Organization) regiem from 1985-1995 and Post WTO regiem from 1995-2005 to analyze the impact of WTO on Diversification in agriculture.

To analyze the extent of diversification in agriculture across different districts of Karnataka various statistical indices such as Simpson index, Herfindal index, Entropy index, Ogive index and Index of maximum proportion were calculated for all the districts for both periods. The result indicated that Bijapur, Bidar, Bellary, Belgaum, Chikkamangaluru, Chitradurga, Dharwad, Gulbaraga, Kolar, Mandya, and Mysore districts showed complete diversification, while Dakshin Kannada and Uttar Kannada showed Crop Specialization, Hasan and Tumkur revealed moderate diversification for both periods. The extent of diversification was more in the first period, compared to second period. Further results obtained indicated no considerable impact of WTO on Diversification in agriculture.

To analyze the factors influencing the diversification in agriculture, eighteen related variables were considered. Multiple linear regression analysis result showed factors influencing the diversification were rainfall, area sown, area irrigated, rural banks and literacy rate were found significant for both the periods.

Keywords: Diversification, cropping pattern, Hirschman's index, Entropy, sustainable farming, ogive index.

INTRODUCTION

India is a country of more than one billion population. More than 70 percent of India's population lives in rural areas where the main Occupation is agriculture sector. Due to existence of diverse Agro-Climatic conditions in the country, a large number of agricultural crops are produced. Broadly these can be classified into two major groups i.e. Food grains crops and Commercial crops. It is presumed that around 60 percent of the total cultivated area focusing under Food grain crops (cereals and pulses). Concurrently, commercial agriculture developed for whatever reasons in the Pre-independent phase also and at most kept flourishing during the post Independent period.

Karnataka state forms the South Western part of the Deccan Peninsula and lies between 11.5°and 18.6° North latitude and 74.0° and 78.4° East longitudes. It is the eighth largest state in the country having an area of 1,91,791 Sq. Kms (6.25% of India's total area of 3,065,027 Sq.Kms,). As per the census of 2011, the State has a total population of 6.12 crores accounting for 5.13 per cent of the country's total population of 121.21 crores. 72 per cent of the total population resides mainly in rural areas, whose main occupation focusing on agriculture and allied activities. Out of the total population, 44.6 per cent concise to working population, of which 69.36 lakhs are cultivators and 62.09 lakhs are

Article History: Received: 21 November 2023; Revised: 13 December 2023; Accepted: 10 January 2024; Published: 25 March 2024

agricultural labourers. One important feature, of agricultural labourers is that the percentage of women (58.19%) overrides the percentage of men (41.81%). The literacy rate of the State found to be 67.04 per cent, while in urban areas it is 81.05 per cent, which is comparatively higher than rural areas (59.68%). The State has totally 30 districts, 176 taluks, 745 hoblies, 29,483 Villages (27,575 inhabited and 1908 uninhabited) and 5692 grama panchayaths (KARNATAKA AGICULTURAL POLICY, (2006) Farmer Centric Agriculture Policy Document, 2010-2011).

REVIEW OF LITERATURE

Balishter *et. al,* (1985) studied on diversification of agriculture in Agra District of Uttar Pradesh and indicated that the diversification of enterprises at farm level based on an enquiry of sample of 42 farmers selected on stratified random sampling basis from the villages of C.D. block Bichuri in Agra District (U.P). The farmers were selected from small, medium, and large farm size groups in proportion to their number in each size group in the three villages. This sample was taken up for the study from the same villages in the year 1961-1962. A similar sample was taken up for study from the same villages in the year 1983-1984. To analyze the extent of diversification they used Herfindhal index, Index of maximum proportion, Simpson index of diversification, entropy index. The results of the study indicated that the average farm size has increased in the case of the small farms while in the case of medium and large farms it has decreased. Introduction of new farm technology, new high yielding varieties, transportation technology, per capita income, regulated markets, are the main influencing factors.

Loren W. Tauer (1990) examined that how Diversified is your State's Agriculture, and observed that the each state's agricultural production diversification was measured for 1984 and 1988. To analyze diversification the techniques used were Herfindhal index and Simpson index. Very little difference existed between the types of index used or the year computed. Linear regressions of the coefficient of variation of receipts on diversification measures implies diversification among states have no impact on variability of components.

Utpal Kumar De (2000) examined that Diversification of Crop in West Bengal: a spacio-temporal Analysis. It is observed that the Agriculture Diversification particularly the changing cropping pattern has been contributing significantly to the rural development in West Bengal. Agricultural diversification was strongly influenced by price policy, infrastructure development, urbanization, technological improvements, and rainfall; etc. which is important Agricultural state of India over a long period of time. This paper examines the spatiotemporal nature of crop diversification in the state in terms of some crop diversification indices, like Herfindhal Index, Ogive Index, Entropy Index, Maximum Entropy index, these index are calculated for the year,1970-73,1977-80,1984-87and 1991-94.

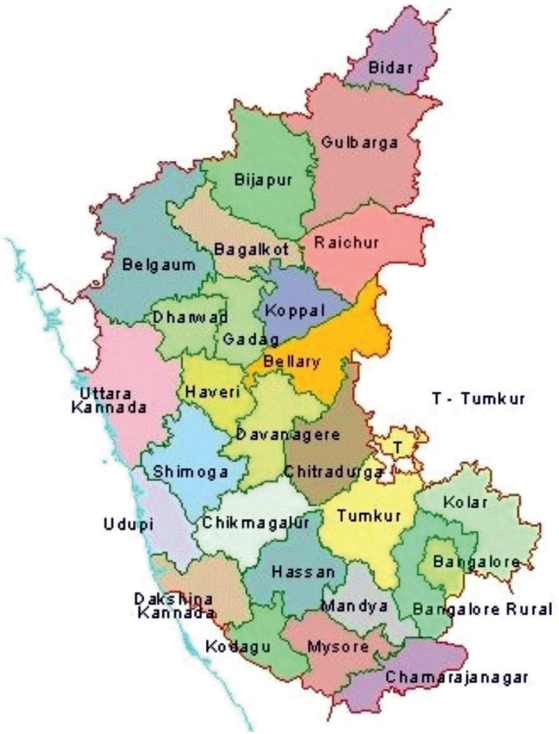
Singh *et al.* (2006) showed that the pattern of diversification across states or crops in India has been schematized and various determinants of diversification have been deciphered. To objectively confer the empirical resonance, values of Simpson index have been estimated. The diversification index (SID) has been found between the range from 0.47 (West Bengal) to 0.90 (Karnataka) in 1990-91 and from 0.40 (Orissa) to 0.92 (Karnataka) in 2000-01. The increase in diversification Index signifies shift towards non-food grain crops. In Karnataka, though the Index has increased, but the similar increases in area under food grains imply shift from course to fine cereals. Agricultural Diversification is influenced by a number of infrastructural and technological factors. The coefficients have indicated that the presence of electricity and road density are negatively associated with the diversification. In the year 2001-02, large share of export earnings has come from non-traditional items, namely rice, fruits, vegetables, livestock and marine products, signifying positive boost to diversification.

METHODOLOGY

Data used for the study were collected from various published sources. Time series aspects of secondary data on the area, production and

productivity of different crops was obtained from various issues of 'Karnataka at a Glance' published by the Directorate of Economics and Statistics, Government of Karnataka. Rainfall data, technological data, and institutional data were obtained from the Drought Monitoring Cell, and the State Department of Agriculture, Government of Karnataka.

Data regarding demographic information collected from the census operation India Bangalore division. The data was collected for area, production, productivity of major agricultural crops for the period 1985-2005. The study period was classified as Pre WTO (World Trade Organization) era from 1985-1995 and Post WTO era from 1995-2005 to agriculture cropping pattern.The Agreement on agriculture was an international treaty of the World Trade Organization. It was negotiated during the Uruguay round of the general agreement on tariffs and trade, and entered into force with the establishment of the WTO on January 1, 1995. First period includes twenty districts and the second period includes twenty seven districts because in first period the districts were only twenty later in second period the twenty districts delimited as twenty seven districts, the seven new districts included in second period are Davangere, Udupi, Chamrajnagar, Gadag, Haveri, Bagalkot and Koppal. The entire analytical frame work was carried out for both the periods indicating separates results for both the periods under study.



Diversification Indices

The present study has used various statistical diversification indices (Balishter *et al.* (1985)):

A. Herfindhal Index.
B. Simpson Index.
C. Entropy Index.
D. Ogive Index.
E. Index of Maximum Proportion.

A. Herfindhal Index (HI): It is the sum of square of the proportion of individual activities in a portfolio. With an increase in diversification, the sum of square of the proportion of activities decreases, so also the indices (HI). This is a measure of concentration, alternately an inverse measure of diversification, the mathematical formulae for calculating the index was as follows,

Herfindhal index (HI) = ΣP_i^2

Where, $P_i = A_i / \Sigma A_i$, was the proportion of the i th activity in acreage or income to the total activities.

The Herfindal index was a measure of concentration and the index which decreases with increase in diversification. Herfindhal index was bound by zero resulting with complete diversification and to one indicating complete specialization.

B. Simpson Index (SI): Simpson Index of diversification(SI) was used and it considered as the most suitable index for measuring dispersion of enterprises in a particular geographical region (Joshi, 2003).The mathematical formulae for calculating the index is as follows,

Simpson Index of Diversification (SI) = 1– ΣP_i^2

Where, $P_i = A_i / \Sigma A_i$ was the proportion of the i th activity in acreage to the total activities

The SID ranges from zero to one. If the estimated SID is near zero, it indicates that the district is near to the specialized in growing of particular crops. If the SID is close to one, the district is fully diversified in the crops that it has grown. The decennial averages were worked out for the SI computed annually for all the districts

to track their average movement towards diversification or specialization.

C. Entropy Index (EI): Entropy indices discussed below constitute a positive measure of diversification. The Entropy index is feasible direct measure of diversification having a logarithmic character.

The Entropy index increases with an increase of diversification. The Entropy index approaches zero when the farm is specialized and takes a maximum value one when there is perfect diversification. The upper limit of the Entropy Index is determined by the base chosen for taking logarithms and the number of crops. The upper value of the index can exceed one, when the number of total crops is higher than the value of the logarithm's base, and it is less than one when the number of crops is lower than the base of logarithm. Thus, a major limitation of the Entropy Index is that it does not give a standard scale for assessing the degree of diversification. The EI lies between zero (complete specializations) to one (perfect diversification).

Entropy index (EI) = $\Sigma i\ P_i * \log (1/P_i)$.

Where, $P_i = A_i / \Sigma A_i$ was the proportion of the i^{th} activity in acreage to the total activities

D. Ogive index (OI): Ogive index was used to compute the index value on the deviation from the ideal or equal distribution of acreage. The range of OI lies between zero (complete specializations) to one (perfect diversification). The mathematical formulae for computing this index is given below:

$$OI = \Sigma \{P_i - (1/N)\}^2/[1/N]$$

Where N was the total number of crops cultivated in the district. The index was quite useful because it measures deviations from equal distribution among existing activities i.e. the number of crops only, and does not incorporate the number of activities in it. This index measures the diversification on the number of crops and the index was not sensitive to change in the number of crops (Shiyani and Pandya, 1998).

E. Index of maximum proportion (IMP) : Index of maximum proportion = Max P_i.

For increasing diversification IMP should decrease and the maximum share held by any activity in total income/cropped area decreases and that of other activities increase with an increase in diversification. This index is however silent about the share of other enterprises on total farm income/cropped area. The IMP is bound by zero resulting with complete diversification and to one indicating complete specialization

RESULTS AND DISCUSSION

Herfindal index

To analyze the diversification in agriculture across the different districts of Karnataka, the above mentioned indices have been used. Herfindhal index was calculated for all the districts separately for two periods 1985-1995 and 1995-2005, and presented in Table-4.1.1. It is observed in Bangalore urban district, the obtained value of 0.5366 and 0.5961 indicating moderate diversification for the first and second period. Herfindal index value obtained for districts *viz.*, Chitradurga, Kolar, Mysore, Mandya, Belgaum, Bijapur, Dharwad, Bellary, Bidar, Chikkmangaluru, Gulbarga and Raichur districts have obtained the values between 0 and 0.33 for both the period of study. Based on these values it can be conclude that there was a complete diversification in cropping pattern during both the periods under study. Herfindhal index value for Bangalore rural district depicts moderate diversification in first period (0.4465) and complete diversification in second period (0.0045). Further index value for added seven districts was also found low suggesting complete diversification except Udupi district (0.8131) which is shown in table 4.1.1. If the calculated value is closer to zero then it is indicative of high diversification in cropping pattern.

However the results indicated lower index values suggesting high crop diversification during the period 1995-2005, when compared to the period 1985-1995.

The Dakshin kannada obtained highest value 0.7932 amongst all districts for first period and Udupi has obtained highest value 0.8131 for the second period. The result obtained was nearer to one it is indicating that there is a crop specialization for both period of the study.

Tumkur district obtained the index value 0.3436 and 0.3459 and Hassan district obtained 0.3855 and 0.3625 for the period 1985-1995 and

Table 1.1: Herfindal index and Simpson index

DISTRICTS	HERFINDAL INDEX		SIMPSON INDEX	
	1985-1995	*1995-2005*	*1985-1995*	*1995-2005*
Bangalore urban	0.5366*	0.5961*	0.4634*	0.4039*
Bangalore rural	0.4465*	0.0045**	0.5535*	0.9955**
Chitradurga	0.1721**	0.2696**	0.8279**	0.7304**
Kolar	0.2538**	0.2162**	0.7462**	0.7838**
Davangere	-	0.2541**	-	0.7459**
Shimoga	0.3126**	0.4205*	0.6874**	0.5795*
Tumkur	0.3436*	0.3459*	0.6564*	0.6541*
Chikmagalur	0.2253**	0.3262**	0.7747**	0.6738**
D kannada	0.7932	0.6738	0.2068	0.3262
Udupi	-	0.8131	-	0.1869
Hassan	0.3855*	0.3628*	0.6145*	0.6372*
Kodagu	0.5199*	0.6862	0.4801*	0.3138
Mandya	0.2997**	0.3233**	0.7003**	0.6767**
Mysore	0.1806**	0.2174**	0.8194**	0.7826**
Chamraj nagar	-	0.1571**	-	0.8429**
Belgaum	0.1579**	0.1466**	0.8421**	0.8534**
Bijapur	0.2552**	0.2818**	0.7448**	0.7182**
Bagalkot	-	0.2376**	-	0.7624**
Dharwad	0.1805**	0.1584**	0.8195**	0.8416**
Gadag	-	0.1949**	-	0.8051**
Haveri	-	0.1668**	-	0.8332**
U kannada	0.6810	0.7057	0.3290	0.2943
Bellary	0.1848**	0.1549**	0.8152**	0.8451**
Bidar	0.2392**	0.2392**	0.7608**	0.7608**
Gulbarga	0.2478**	0.1302**	0.7522**	0.8698**
Raichur	0.2112**	0.2192**	0.7888**	0.7808**
Koppal	-	0.1580**	-	0.8420**

* indicates that there is moderate diversification.
**indicates complete diversification in agriculture.
Values without astrix symbol indicate crop specialization.
'-' Districts are combined

1995-2005 respectively. Suggesting moderate diversification in cropping pattern.

In Kodagu district, moderate diversification (0.5199) was observed in first period and showing crop specialization (0.6862) in second period. Whereas in Shimoga district, complete diversification (0.3126) was observed in first period and moderate diversification in second period (0.4026).

Ogive Index

Ogive Index was calculated for all the districts separately for two periods i.e. 1985-1995 and 1995-2005. It can be noted that for Bangalore urban districts obtained value 0.4669 and 0.4060 for the period 1985-1995 and 1995-2005 respectively, indicating moderate diversification in cropping pattern.

Ogive index for the 12 districts *viz.*, Chitradurga, Kolar, Mysore, Mandya. Belgaum, Bijapur, Dharwad, Bellary, Bidar, Chikkmangaluru, Gulbarga and Raichur districts have obtained values between 0.67 and 1.0 for both the period of study. Revealing there is a complete diversification in cropping pattern. Ogive index value for Bangalore rural district depicts moderate diversification (0.5583) in first period and complete diversification (0.8932) in second period. Further, the index value for the added seven districts was also found high, suggesting complete diversification except Udupi district (0.1929) being crop specialization (Table 4.1.2). If the calculated value of the index nearer to one, it indicative of those districts with more diversification in cropping pattern.

However the extent of crop diversification was more during the period of 1995-2005, when compared to 1985-1995. Dakshin kannada obtained lowest value of 0.2132 among all districts for first period and Udupi obtained lowest value (0.1929) for the second period suggesting crop specialization. The calculated value of Dakshin Kannada and Uttar Kannada, for both the period found nearer to zero which indicative of crop specialization rather than crop diversification for both period of study.

Tumkur (0.6699 and 0.598) and Hassan (0.6192 and 0.6496) districts obtained values for the period of 1985-1995 and 1995-2005 respectively. Hence, these two districts have moderate diversification in cropping pattern for both the period of study.

The Kodagu district shown moderate diversification (0.4872) in first period and shown crop specialization (0.3147) in second period of study. In Shimoga district, complete diversification (0.7004) was observed in first period and moderate diversification in second period (0.5887).

Table 1.2: Ogive index and Index of maximum proportion

DISTRICTS	OGIVE INDEX		INDEX OF MAXIMUM PROPORTION	
	1985-1995	**1995-2005**	**1985-1995**	**1995-2005**
Bangalore urban	0.4669*	0.4060*	0.5903*	0.6557*
Bangalore rural	0.5583*	0.8932**	0.4912*	0.0050**
Chitradurga	0.8425**	0.7410**	0.1893**	0.2966**
Kolar	0.7379**	0.7904**	0.2792**	0.2378**
Davangere	-	0.7917**	-	0.2795**
Shimoga	0.7004**	0.5887*	0.3319**	0.4626*
Tumkur	0.6610*	0.6598*	0.3780*	0.3805*
Chikmagalur	0.7816**	0.6801**	0.2478**	0.3288**
D kannada	0.2130	0.3310	0.8730	0.7410
Udupi	-	0.1930	-	0.894
Hassan	0.6192*	0.6496*	0.4241*	0.3991*
Kodagu	0.4872*	0.315	0.5719*	0.755
Mandya	0.7105**	0.6902**	0.3297**	0.3556*
Mysore	0.8323**	0.7917**	0.1987**	0.2391**
Chamraj nagar	-	0.8526**	-	0.1728**
Belgaum	0.8526**	0.8628**	0.1737**	0.1613**
Bijapur	0.7511**	0.7308**	0.2807**	0.3100**
Bagalkot	-	0.7714**	-	0.2614**
Dharwad	0.8323**	0.8526**	0.1986**	0.1742**
Gadag	-	0.8222**	-	0.2144**
Haveri	-	0.8425**	-	0.1835**
U kannada	0.3160	0.2940	0.7290	0.7760
Bellary	0.8323**	0.8628**	0.2033**	0.1704**
Bidar	0.7714**	0.7714**	0.2631**	0.2631**
Gulbarga	0.7613**	0.8831**	0.2726**	0.1432**
Raichur	0.8019**	0.7917**	0.2323**	0.2411**
Koppal	-	0.8526**	-	0.1738**

* indicates that there is moderate diversification.

**indicates complete diversification in agriculture.

Values without astrix symbol indicate crop specialization.

'-' Districts are combined.

Table 1.3: Entropy index

DISTRICTS	***ENTROPY INDEX***	
	1985-1995	***1995-2005***
Bangalore urban	0.5126*	0.4450*
Bangalore rural	0.5685*	0.9989**
Chitradurga	0.8731**	0.7520**
Kolar	0.7422**	0.7830**
Davangere	-	0.7158**
Shimoga	0.6872**	0.6101*
Tumkur	0.6569*	0.5844*
Chikmagalur	0.7823**	0.6447*
D kannada	0.2410	0.3270
Udupi	-	0.2140
Hassan	0.6325*	0.6311*
Kodagu	0.4489*	0.3220
Mandya	0.6614**	0.6867**
Mysore	0.8587**	0.7941**
Chamraj nagar	-	0.8746**
Belgaum	0.9325**	0.9350**
Bijapur	0.7616**	0.7501**
Bagalkot	-	0.7876**
Dharwad	0.8481**	0.8752**
Gadag	-	0.7763**
Haveri	-	0.8417**
U kannada	0.3130	0.3300
Bellary	0.8653**	0.8949**
Bidar	0.7958**	0.7577**
Gulbarga	0.7427**	0.9062**
Raichur	0.7997**	0.7635**
Koppal	-	0.8816**

* indicates that there is moderate diversification in agriculture.
**indicates complete diversification in agriculture.
Values without astrix symbol indicate crop specialization.
'-' Districts are combined.

Entropy index was calculated for all the districts separately for two periods of 1985-95 and 1995-05 (Table-4.1.3). The result evident for Bangalore urban district the index value found to be 0.5126 and 0.4450 for the period of 1985-1995 and 1995-2005 respectively showing moderate diversification. Entropy index for 12 districts *viz.*, Chitrdurga, Kolar, Mysore, Mandya. Belgaum, Bijapur, Dharwad, Bellary, Bidar, Chikkmangaluru, Gulbarga and Raichur districts obtained values between 0.67 and 1.0 for both the period of study suggesting complete diversification in agriculture. For Bangalore rural district the entropy index computed for the first period (0.3722) and second period (0.9989). Based on obtained value, there is a moderate diversification in first period and complete diversification in second period. Further index value for new added seven districts also found low, suggesting complete diversification except Udupi (0.2141) being crop specialization (Table 4.1.3).

However, the extent of cropping diversification was more during the period of 1995-2005, when compared to the period 1985-1995.

Dakshin kannada district obtained lowest value (0.2068) amongst all the districts for first period and Udupi obtained lowest value (0.2141) for the second period. If the calculated value found nearer to zero is an indicative of crop specialization.

Tumkur (0.6569 and 0.5844) and Hassan (0.6145 and 0.6311) districts have obtained the Entropy index values for the period 1985-1995 and 1995-2005 respectively. Hence, these two districts have moderate diversification in cropping pattern for both the period of study.

The Kodagu district showed moderate diversification (0.4489) in first period and crop specialization (0.3224) in second period of study, where as Shimoga district shown complete diversification (0.6872) in first period and moderate diversification (0.6101) in second period.

Overall Comparison on classification of indices for the study periods

The study period was classified as Pre WTO (World Trade Organization) era from 1985-1995 and Post WTO era from 1995-2005 to know the impact of agreement on agriculture policy on Karnataka agriculture cropping pattern. The Agreement on agriculture policy was an international treaty of the World Trade Organization. It was negotiated during the Uruguay round of the general agreement on tariffs and trade, and entered into force with the establishment of the WTO on January 1, 1995. Based on the results obtained (Table-4.1.4), statistically there was no considerable impact (χ^2=0.880, p>0.05) of Agreement on Agriculture (AOA) policy on Karnataka agriculture as a whole but some districts like Bangalore rural, Kodagu, and Shimoga showed considerable changes in cropping pattern in both periods of study. In the broader scene, it suggested that there was no statistical significant impact of AOA on Karnataka agriculture (Table 1.4).

Classification of Index	No of districts				Chi square value
	(1985-1995) Pre-WTO period		(1985-1995) Post-WTO period		
	N	%	N	%	
Complete diversification	13	65.0	19	70.4	0.880 NS (P = 0.644)
Moderate diversification	5	25.0	4	14.8	
Crop specialization	2	10.0	4	14.8	
Total	20	100.0	27	100.0	

DISCUSSION AND CONCLUSION

The Herfindhal index was calculated for all the districts separately for two period's 1985-1995 and 1995-2005. The Table 4.1.2 Shows that Bijapur, Bidar, Bellary, Belgaum, Chikkamangaluru, Chitradurga, Dharwad, Gulbaraga, Kolar, Mandya, and Mysore have complete diversification in cropping Pattern. When compare the values of indices between two periods in the above mentioned districts showed the diversification in cropping pattern because these districts have index values nearer to zero for both the periods 1985-1995 and 1995-2005. The index values of the period 1995-2005 was lower (nearer to zero) than the index values of the period 1985-1995. Hence, the extent of diversification in cropping pattern observed more for the study period 1995-2005.

The major reasons for complete diversification in cropping patterns in these districts are diversified environmental factors like rainfall, due to considerable uniform distribution of rainfall pattern across these districts. Naturally the farmers will adopt the multi cropping system and also adopt some additional farm enterprises like animal husbandry, hence there will be diversified farm enterprises will arises.

The second was improved Infrastructural facilities like number of regulated markets, if the increase in number of regulated markets in particular region then naturally the farmers will get favorable market facilities, can also get chance to sale the products in particular produce markets. This will enhance the farmers' activity to adopt the high yielding varieties so that naturally there was introduction of well performing improved varieties on particular specific crops.

The commercialization of agriculture does induced by introducing the commercial crops instead of followed traditional crops, so that there was a shift in cropping pattern. Hence, the substitution of agricultural crops by other crops, sometimes horticulture and plantation crops may also introduced. In this region there was marked and considerable rate of increase in rural literacy, with the possibility of the complete diversification in agriculture.

One more predominant variable was net irrigated area, if the net irrigated area was increasing then there was shift of old enterprises to new enterprises will arises in such area, because the farmers will adopting only the monocropping instead of multicropping. Most of the above mentioned districts are have diversified irrigational facilities and sources like pond, lake, rivers, canals, etc. so that most of these districts have good irrigation facilities due to improved irrigation structures, and introduced recent technology. With improved Irrigation facility naturally farmers adopt plantation and horticulture crops, so naturally there was crop specialization (Uttar Kannada, Dakshin Kannada and Udupi districts).

Some of other variables also influencing strongly on shift in cropping pattern, like total livestock population, operational holding, rural literacy, number of IP sets and tractors. Sometimes the farmers will take animal husbandry as main enterprises, in such case fodder oriented crops are majorly growing and other crops are shifted. But in these districts there was more number of farmers were involving in such subsidiary activities. If rural literacy made to increases then the farmers will take economic crops rather than opting for traditional crops, but in these districts it can be viewed that more than average literacy, so that there was an observation of complete diversification. These districts also have better financial institutional facilities like commercial banks, co-operatives, etc.

The result of the study were in conformity with that of Utpal kumar de (2000); Balishter et al, (1985); Joshi et al, (2004).

Table-.1.3. Showed that the Tumkur, Hassan and Bangalore rural district have moderate significant diversification in cropping pattern. The major reasons for this significant shift are due to inappropriate rain fall pattern, because these districts have unequal distributed rainfall across all the district. If the rain fall was well distributed then there was naturally shift will take place. These districts have somewhat moderate irrigation facility, due to moderate improved irrigation structures. The main sources of water are pond, tank, etc. These districts are mainly depends on the monsoon rain, hence most of the crops are rainfed crops.

These Districts have average number of regulated markets when compared to other districts. Which will moderately enhance the farmers' activity to adopt the high yielding and well performing rainfed varieties. The commercialization of agriculture was less in these districts. Apart from the regulated markets, these districts have moderate improved transportation facilities due to not well developed road facilities. These districts also have optimum number of financial institutions like commercial banks, co-operatives, etc. In addition to the above, average rural literacy will also make significant impact on the moderate diversification in cropping pattern. The animal husbandry was also main enterprises, so that naturally there was moderate diversification will exists.

Table-1.4. Showed that Dakshin kannada, Uttar kannada and Udupi do not find any shift in cropping pattern, index showed these Districts noticed with crop specialization. Dakshin kannada, Uttar kannada and Udupi are receiving highest rainfall across all the taluks of the District. Due to this reason the farmers are cultivating the crops which require high water source crops like rice, sugarcane and some horticulture crops. So there was a crop specialization in these districts.

Kodagu districts has shown moderate diversification in first period of study and shown crop specialization in second period of study. In first period there was a practice of paddy cultivation, but due to highest rainfall, climatic condition and resource availability Kodagu district has grown only plantation and spice crops like coffee, tea, rubber, cardamom, zinger, vanilla, arecanut, cocoa, and coconut can be growing. One cannot grow other agriculture crops due to non suitability of weather and soil condition. Because most of these area are hilly and undulated in nature. Hence, in hilly region the farmers preferring only the plantation crops. In coastal region due to high humidity and sandy type of soil the crops like coconut and rice are possible to grow. Hence these districts resulting with crop specialization, instead of the crop diversification.

Bangalore rural district has shown moderate diversification in first period and complete diversification in second period of study where as in Shimoga district, complete diversification was observed in first period and moderate diversification in second period. Due to change in resource availability and climatic condition in general. In Bangalore rural district there was more area under field crops like paddy, ragi, groundnut, millets, wheat etc, but in second period of study it has shown that this district have more cropping area under horticulture and vegetable crops so there was a crop specialization in this district in second period of study.

In Shimoga district, complete diversification was observed in first period and moderate diversification in second period, because in first period of study the area under paddy and ragi was dominated, due to change in rainfall pattern during second period of study farmers inclined to different plantaion and horticulture crops along with field crops leading to major region for change in cropping pattern.

The newly added seven districts like Davangere, Chamaraj nagar, Bagalkot, Gadag, Haveri and koppal have shown complete crop diversification except Udupi which has shown crop specialization. The major reasons for complete diversification in cropping patterns in these districts are diversified environmental factors like rain fall, due to considerable uneven distribution of rainfall pattern across these districts. Naturally the farmers will adopt the multi cropping system and also adopt some additional farm enterprises like animal

husbandry, hence there will be diversified farm enterprises will arises. These districts were divided from the districts of complete diversification area.

The indices worked out showed different values for different districts for two periods of 1985-1995 and 1995-2005. Further, the computed values do found different but these indices establishing the similar result for both the periods under the study. Hence, there was no significant difference in their diversification calculation by different indices under study. The above mentioned finding was in the consonance with the findings of Pradeep Kumar Mehtha (2009); and Sing et al (2006). Based on the above discussion it can be inferred there was no considerable changes in cropping pattern for both the periods, but in some district like Bangalore rural, Shimoga and Kodagu, there was a marked change in cropping pattern for both periods.

Based on the results obtained for study periods as pre and post era of WTO, there was no statistical significant impact of Agreement on Agriculture policy in the cropping pattern of Karnataka as a whole. The probable reason may be due to no proper implication of the policy and also due to rural literacy rate of the state most of the farming communities are illiterate and followed traditional methods of cultivation.

CONCLUSION

The concept of general tendency of shifting less profitable with more profitable crops due to change in varieties and cropping system, on account of increasing exports and competitiveness in both domestic and international markets, protecting the Environment and making conditions favorable for combining different Enterprises. It is very essential and important to understand more clearly and develop tools for acceleration of Agricultural effective growth in the country by promoting food grains production, nutritional security, economic growth, poverty alleviation, employment generation and judicious use of available natural resources, sustainable agricultural development & environmental and ecological improvement aspect.

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