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Research Article

COMPUTATION OF STATISTICAL DIVERSITY INDICES FOR ACCESSING THE EXTENT OF SHIFT IN CROPPING PATTERN IN KARNATAKA

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Abstract: Present study was carried out across different Agro-climatic zones of Karnataka to assess the extent of agricultural diversification in the state. the study spans over a period of 20 years from 1992 to 2012 was divided into two phases (1992 to 2002 and 2002 to 2012) to assess the impact of agricultural policy on Karnataka agriculture as a whole and cropping pattern in particular, Studies indicated complete decadal shift in cropping pattern in North Eastern Transition Zone (0.1514 & 0.1274), North Eastern Dry Zone (0.1588 & 0.1464), Central Dry Zone (0.1666 & 0.1593), Southern Dry Zone (0.1748 & 0.1770), Southern Transition Zone (0.1754 & 0.1649) and Northern Transition Zone (0.1542 & 0.1254). Whereas the extent of diversification was more during first decade in the above-mentioned zones, Hilly Zone and Coastal Zone (0.6733 & 0.6973) indicated crop specialization. Eastern Dry Zone (0.3758 & 0.3680) revealed moderate diversification in cropping pattern for both the decades.

Keywords: Diversity index, Crop Diversification. Cropping pattern, Cropping shift, Agro-climatic zones

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Introduction

Diversification in Agriculture is defined as diversion of a sizable acreage from the existing crop system to some alternative crops or cropping systems or farm enterprises. It is a strategy of shifting from less profitable to more profitable crops. Changing of varieties and cropping system, increasing exports and competitiveness in both domestic and international markets, protecting the environment and making conditions favourable for combining different enterprises. In India diversification has occurred both across and within the crop, livestock, fishery, and forestry sectors. Shift in Cropping Pattern is measured by sing diversity indices; the crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The major determinants are Infrastructure, Markets, Transportation facility.

Materials and Methods

Study comprised of area allocated to seventeen agricultural crops like rice, ragi, bajra, wheat, jowar, maize, bengal gram, horse gram, green gram, black gram, red gram, sesame, sunflower, groundnut, sugarcane, and cotton under different agro climatic zones of Karnataka for two decades such as 1992-2002 and 2002-2012 (20 years) and the entire analytical frame work is carried out for both the periods separately.

The specific reason for choosing this study period is to know the impact of agriculture policy on Karnataka agricultural cropping pattern using concentration indices such as Herfindhal Index, Simpson Index and Entropy Index, to access the extent of cropping shift.

1. Herfindhal Index (HI): It is the sum of square of the proportion of individual activities in a portfolio.

$$\text{Herfindhal index (HI)} = \Sigma P_i^2$$

Where, $P_i = A_i / \Sigma 1A_i$, is the proportion of the i^{th} activity in acreage

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

Table-1 Agro climatic zones of Karnataka

N	Name	Abbreviation	No. of Taluks
Zone 1	North Eastern Transition Zone	NETZ	7
Zone 2	North Eastern Dry Zone	NEDZ	11
Zone 3	Northern Dry Zone	NDZ	35
Zone 4	Central Dry Zone	CDZ	17
Zone 5	Eastern Dry Zone	EDZ	24
Zone 6	Southern Dry Zone	SDZ	19
Zone 7	Southern Transition Zone	STZ	13
Zone 8	Northern Transition Zone	NTZ	14
Zone 9	Hilly Zone	HZ	22
Zone 10	Coastal Zone	CZ	13

2. Simpson Index (SI): it considered as the most suitable index for measuring dispersion of enterprises in a particular geographical region.

$$\text{Simpson Index of Diversification (SI)} = 1 - \Sigma P_i^2$$

Where, $P_i = A_i / \Sigma 1A_i$ is the proportion of the i^{th} activity in acreage.

The SI ranges from zero to one. If the estimated SI is near to zero indicates crop specialisation. It is close to one then crop diversification.

3. Entropy Index (EI): Entropy indices discussed below constitute a positive measure of diversification. It is a feasible direct measure of diversification having a logarithmic character. The EI lies between zero (complete specializations) to one (perfect diversification).

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

Where, $P_i = A_i / \Sigma 1A_i$ is the proportion of the i^{th} activity in acreage.

4. Ogive index (OI): is 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).

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

$$OI = N \sum \{ [Pi-1/N\}^2$$

Where N is the total number of crops cultivated in the region. The index is quite useful because it measures deviations from equal distribution among existing activities *i.e*., the number of crops only.

5. Index of maximum proportion (IMP):

Index of maximum proportion = Max Pi.

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.

Result and Discussion

Result and discussion broadly the numerical results of the analysis, forbetter understanding, range of index values was again broadly classified. According to Herfindal Index and Index of Maximum Proportion (IMP), the obtained value ranged between 0and 0.33 considered to be complete diversification. The value lies between 0.34 to 0.66 it indicated moderate diversification and between 0.67 and 1.0 as crop specialization. According to Simpson, Entropy and Ogive index, values ranged from 0 to 0.33 then, it considered as crop specialization; 0.34 to 0.66 as moderate diversification and value between 0.67 and 1.0 as complete diversification. To analyze the diversification pattern in agriculture across different agro climatic zones of the state, above mentioned indices have been used. All the five indices were calculated for all the zones separately for two periods 1992-2002 and2002-2012.

Table-2 Herfindhal Index and Simpson Index

Agro-Climatic Zones	Herfindhal Index		Simpson Index	
	1992-2002	2002-2012	1992-2002	2002-2012
NETZ	0.1257**	0.1189**	0.8742**	0.8810**
NEDZ	0.1588**	0.1464**	0.8411**	0.8535**
NDZ	0.1514**	0.1274**	0.8485**	0.8725**
CDZ	0.1666**	0.1593**	0.8333**	0.8460**
EDZ	0.3758*	0.3680*	0.6251*	0.6319*
SDZ	0.1748**	0.1770**	0.8251**	0.8350**
STZ	0.1754**	0.1649**	0.8245**	0.8350**
NTZ	0.1542**	0.1254**	0.8457**	0.8745**
HZ	0.6733	0.6973	0.3266	0.3026
CZ	0.7545	0.7765	0.2454	0.2234

*Indicates moderate shift in cropping pattern. **Indicates considerable shift in cropping pattern.

Herfindhal Index in NETZ are 0.1257 and 0.1189 for the period 1992-2002and 2002-2012 respectively showed considerable extent in cropping shift. Further, NDZ (0.1514 & 0.1274), NEDZ (0.1588 & 0.1464), CDZ (0.1666 & 0.1593), SDZ (0.1748 & 0.1770), STZ (0.1754 & 0.1649), and NTZ (0.1542 & 0.1254) zones have obtained the values nearer to zero for both the decades showing considerable cropping shift in both period [Table-2]. However, the extent of cropping shift is more in the period 2002-2012, when compared to the period 1992-2002. Because these zones have lower index values during the period of *viz*, 2002-2012 (More nearer to zero) when compared to the index values during the period of *viz*, 1992-2002. Coastal zone (CZ) has obtained values 0.7545 and 0.7765 for the period 1992-2002 and 2002-2012 respectively, which are highest among all the zones. If the calculated value is nearer to one then it indicates there is crop specialization. The calculated value of CZ and HZ (0.6733 & 0.6973) for both the period is nearer to one, it is evident that these zones have Crop Specialization for both period of study. EDZ has obtained values 0.3758 and 0.3680 for the period 1992-2002 and 2002-2012 respectively, showing little deviation, from zero, indicating moderate shift in cropping pattern. The Table 2 revealed Simpson index values of NETZ obtained values 0.8742 and 0.8810 for the period 1992-2002 and 2002-2012 respectively, it is highest for NETZ compared to all other zones. If the calculated value is nearer to one then it indicates that there is crop diversification (Cropping shift). Further NDZ (0.8485 & 0.8725), NEDZ (0.8411 & 0.8535), CDZ (0.8333 & 0.8465), SDZ (0.8251 & 0.8350), STZ (0.8245 & 0.8350), and NTZ (0.8457 & 0.8745), zones have obtained the values Nearer to one for both period of study; this index value shows that for the above zones there is considerable cropping shift in both period of study. But the extent of cropping shift is more in the period 2002-2012 than the previous decade. Because these zones have higher index values during 2002-2012 (More nearer to one) when compared to the index values during the period of 1992-2002.The coastal zone (CZ) has obtained 0.2454 and 0.2234 for the period 1992-2002 and 2002-2012 respectively, which are lowest among all the zones, if the calculated value is nearer to zero then it indicates there is crop specialization. The calculated value of CZ and HZ (0.3266 & 0.3066), for both the period is nearer to zero, it is evident that these zones have Crop Specialization rather than crop diversification. The EDZ has obtained values 0.6251 and 0.6319 for the period 1992-2002 and 2002-2012 respectively. Hence this zone has moderate shift in cropping pattern for both the periods of study.

Table-3 Ogive Index and Index of Maximum Proportion

AGRO-CLIMATIC ZONES	OGIVE INDEX		INDEX OF MAXIMUM PROPORTION	
	1992-2002	2002-2012	1992-2002	2002-2012
NETZ	0.8703**	0.8801**	0.2549**	0.2417**
NEDZ	0.8633**	0.8721**	0.2750**	0.2659**
NDZ	0.8532**	0.8619**	0.2318**	0.2264**
CDZ	0.8599**	0.8678**	0.2080**	0.2062**
EDZ	0.6021*	0.6098*	0.4227*	0.4023*
SDZ	0.8432**	0.8516**	0.2074**	0.2022**
STZ	0.8512**	0.8602**	0.2886**	0.2759**
NTZ	0.8655**	0.8741**	0.2709**	0.2119**
HZ	0.3121	0.3015	0.7090	0.7519
CZ	0.2113	0.2065	0.8668	0.8783

*Indicates moderate shift in cropping pattern. **Indicates considerable shift in cropping pattern.

Table explains ogive index calculated for all the zones separately for two periods (1992-2002 and 2002-2012). It can be noted that for NETZ obtained the values 0.8703 and 0.8801 for the period 1992-2002 and 2002-2012 respectively, Ogive index was highest for NETZ compared to all other zones. Revealing the calculated value is nearer to one then it indicates that there is Cropping shift. NDZ, NEDZ, CDZ, SDZ, STZ, NTZ, all these zones also obtained the values Nearer to one for both period of study, this index value shows that there is considerable cropping shift in both periods of study. However, the extent of cropping shift is more in the period 2002-2012, when compared to the period 1992-2002. Because these zones have higher index values during the period of *viz*, 2002-2012(More nearer to one) when compared to the index values during the periods of *viz*, 1992-2002.The coastal zone has obtained the values 0.2113 and 0.2031 for the period 1992-2002 and 2002-2012 respectively, which are lowest among all the zones. If the calculated value is nearer to zero then it indicates there is crop specialization. The calculated value of CZ and HZ, for both the period is nearer to zero, so that these zones have Crop Specialization rather than crop diversification. The EDZ has obtained values 0.6021 and 0.6098 for the period 1992-2002 and 2002-2012 respectively. Hence, this zone has moderate shift in cropping pattern for both the periods of study. [Table-2] also depicts the calculated vales for Index of maximum proportion for all the zones separately for two periods (1992-2002 and 2002-2012). The result shows that for NETZ obtained the values 0.2549 and 0.2417 for the period 1992-2002 and 2002-2012 respectively, which has obtained the lowest value among all the zones under the study.

Hence if the calculated value is nearer to zero then it indicates that there is Cropping shift. Further NDZ, NEDZ, CDZ, SDZ, STZ, and NTZ, Zones also obtained the values nearer to zero for both period of study, indicating that there is considerable cropping shift in both periods of study. The coastal zone has obtained 0.8668 and 0.8783 for the period 1992-2002 and 2002-2012 respectively, Index of Maximum Proportion was highest for CZ compared to all other zones. If the calculated value is nearer to one then it indicates there is crop specialization. Since the calculated values of CZ, and HZ, for both the period were nearer to one, it is evident that these zones have Crop Specialization rather than crop diversification. The EDZ has obtained values 0.4227 and 0.4023 for the period 1992-2002 and 2002-2012 respectively. Hence this zone has moderate shift in cropping pattern for both the periods of study.

Table-4 *Entropy index*

AGRO-CLIMATIC ZONES	ENTROPY INDEX	
	1992-2002	2002-2012
NETZ	0.9900**	0.9995**
NEDZ	0.9055**	0.9247**
NDZ	0.9607**	0.9993**
CDZ	0.9265**	0.9359**
EDZ	0.6466*	0.6552*
SDZ	0.8915**	0.8944**
STZ	0.8580**	0.8602**
NTZ	0.9552**	0.9899**
HZ	0.3516	0.3499
CZ	0.2651	0.2401

*Indicates moderate shift in cropping pattern. **Indicates considerable shift in cropping pattern.

[Table-4] indicates that the calculated value for entropy index for all the zones separately for two period's 1992-2002 and then from 2002-2012, which can be seen in [Table-3]. The result shows that for NETZ obtained the values 0.9900 and 0.9995 for the periods 1992-2002 and 2002-2012 respectively, Entropy index was highest for NETZ compared to all other zones. Revealing the calculated value is nearer to one then it indicates that there is Cropping shift. Further NDZ, NEDZ, CDZ, SDZ, STZ, and NTZ Zones also obtained the values nearer to one for both period of study; this index value shows that there is considerable cropping shift in both periods of study. CZ and HZ shows Crop Specialization while EDZ (0.6466 and 0.6552 for 1992-2002 and 2002-2012 experienced moderate shift in cropping pattern.

Conclusion

The various diversity indices were computed to assess the degree of shift in cropping patterns and there is no variation in the result of these indices. all indices are showing similar result and depicts that there is complete shift in cropping pattern in North Eastern Transition Zone, North Eastern Dry Zone, Central Dry Zone, Southern Dry Zone, Southern Transition Zone and Northern Transition Zone. Whereas the extent of diversification was more during first decade in the above-mentioned zones, Hilly Zone and Coastal Zone indicated crop specialization. Eastern Dry Zone revealed moderate shift in cropping pattern for both the decades

Table-5 Classification of zones based on index value

Result	Agro-Climatic Zones	Diversification pattern	Comparison
Crop Diversification	NEDZ,NETZ,NTZ, NDZ, CDZ, SDZ, STZ,	Crop diversification is occurred in both periods	Extent of shift is more in the period 2002-2012 compared to1992-2002.
Moderate Diversification	EDZ	Moderate crop diversification is occurred in both the periods	Extent of moderate shift is more in the period 2002-2012, compared to1992-2002.
Crop Specialization	HZ, CZ	Crop Specialization in both the periods	Extent of crop specialization is more in the period 2002-2012 compared to1992-2002.

Application of research: The analysis of magnitude of shift in cropping patterns help to assess the crop diversification over the period, which make easy to identify the crops and varieties prevailing in that area, based on that government can go for plan and policy work for that area.

Research Category: Agricultural Statistics

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