

Evaluation of parameters of crop diversification in Sidlaghatta taluk

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Abstract: Crop diversification is a strategy to deal with risk and uncertainty in climate change. It helps to improve farmer's income stability and recover quickly from difficulties and toughness. In this article an attempt has been made to identify, analyse and evaluate the parameters of Crop diversification. This article reviews critically the literature on crop diversification, its role in sustaining agriculture income and its impact on potential economy of farmers. The magnitude of diversification was evaluated using three diversification indices, Gibb's Martin index, Ogive index and composite entropy index. The Trends and growth in area share of cultivation of crops in Sidlaghatta taluk was analyzed systematically. The transitional probability Matrix shows that over the period of years, toor, Hyacinth bean, fruits and vegetable and other crops retained highest share in the terms of area of cultivation.

Key Words: Cropping pattern, crop diversification, Gibbs Martin index, Ogive index, Composite entropy index, Transitional probability matrix.

1. INTRODUCTION:

Crop diversification gives farmers with wider choice in in the production of variety of crops in a area, so has to expand production and also minimise the possible risk and uncertainty against the climate change. Crop diversification is generally viewed as a shift from a traditionally grown less remunerative single crop to more remunerative to variety of crops. Diversification in agriculture as command as impact on socio-economic in condition and lifting of resource of farming community crop diversification generates income and employment of rural youth and ultimate benefit the farmers in the country(Singh.*et al* 2013). Crop diversification decreases when wage rates increased and with the high literacy rates where is there is a direct proportion of crop diversification with population density (Geethu. *et.al* 2020).

Crop diversification brings about a chain of effects on different aspects of farming and its economy along with certain changes in the social and economic aspects of rural for households (Rahimi.*et.al* 2014)

The specific objective of this study were to analyse and evaluate the parameters of crop diversification at micro taluk level, to study the factors affecting the crop diversification and its impact on agriculture production in the Sidlaghatta Taluk Chikkaballapur district.

2. MATERIALS AND METHODOLOGY:

To analyse and assess the parameters of crop diversification in Sidlaghatta, which is one of the taluks of Chikkaballapur district was selected. The present study based on the time series data pertain to area productivity of different crop-wise area, under irrigation, season-wise crops grown, area under high yielding variety of different crops, net cultivated area, areas sown more than once, gross cropped area were collected from the Directorate of Economics and Statistics Bangalore, Joint director of agriculture office Chikkaballapur, Director office of Horticulture Chikkaballapur and various publish resources during the period 2009-10 to 2018-19 regarding the area under various crops of Sidlaghatta Taluk.

To assess the extent of crop diversification, there are quite a few methods, which explain the magnitude of crop diversification of crops over period of time and space. Each method has a certain limitation and superiority over the other. To evaluate the extent of crop diversification within different crop groups Gibbs-Martin index, Ogive index and composite entropy native were used to assess the crop diversification

Gibbs Martin index

Gibbs Martin index(GMI) of diversification is useful alternative index for measuring the extent of crop diversification in an area. Mathematical formula for calculating the index is given by

$$GMI = 1 - \frac{\sum_{i=1}^N A_i}{(\sum_{i=1}^N A_i)^2}$$

Where A_i represents the area proportion of i^{th} crop in the total crop area, N is the total number of crops. This method as a advantage over the other indices since it is relatively easy to process without reducing to percentiles. If the

index value is 0 indicates the total area in a region is a single crop or specialisation. If the index value approaches to 1 the total cropped area is fully diversified. Besides indices are directly related to the magnitude of diversification. This index of diversification gives a method of generalising the relationship between the relative strength and the number of crops grown.

Ogive index

This index is used to measure the industrial diversity. It measures deviation from the benchmark proportion of each crop. That is if there are N number of crops 1/N is taken to measure the deviation mathematically index is given as below

$$OI = \sum_{i=1}^N \frac{(A_i - 1/N)^2}{1/N}$$

Ogive index(OI) is the measure of degree of diversity, the index approaches to 0 in extreme cases of perfect concentration as well as perfect diversification.

Composite entropy index

Composite entropy index(CEI) is used to compare diversification across different and large group of crops. Since it gives due weightage to the number of crops. The mathematical formula of CEI is given by

$$CEI = - \left(\sum_{i=1}^N A_i \log_N A_i \right) * \left(1 - \frac{1}{N} \right)$$

CEI has two components that is distribution and number of crop. The value of CEI increases with decrease in diversity and rises with number of crops. The value of CEI ranges between 0 and 1

Markov Chain Analysis

To assess the dynamics of area share of crops during 2009-10 to 2018-19, transitional probabilities were calculated using LP Solver IDE software. To estimate the shift in cropping pattern, different crop groups, Ragi, Maize, Hyacinth bean, Oilseeds, Toor, Fruits, Vegetables, Garden plantation, Flowers, Spice and Aromatic and other crops were considered. Markov chain analysis generates a transitional probability matrix, whose elements P_{ij} indicates the probability of crop group switching from the i^{th} crop group to the j^{th} crop group over time. Its diagonal elements retention share of respective crop group in terms of area share of crops.

$$C_{jt} = \sum_{i=1}^N (C_{it} - 1) P_{ij} + e_{jt}$$

Where $i = 1, 2, 3, \dots, N$

C_{jt} = Area under crop to the j^{th} crop group in the year 't'

$C_{i(t-1)}$ = Area under crop to the i^{th} crop group in the year 't-1'

P_{ij} = The probability of shift in area under i^{th} crop group to j^{th} crop group

e_{ij} = error term

N = The number of crop groups.

The transition probabilities P_{ij} arranged in a matrix having the following properties

$$\sum_{i=1}^N P_{ij} = 1 \text{ and } 0 \leq P_{ij} \leq 1, \quad i = 1, 2, 3, \dots, N$$

The transitional probability Matrix P based on linear programming Framework is evaluated by minimization of mean absolute deviation

$$\text{Min OP}^* + 1e$$

$$\text{SP}$$

$$\text{XP}^* + \text{V} = \text{Y}$$

$$\text{GP}^* = 1$$

$$\text{P}^* > 0$$

Where P^* is transition probability matrix is zero matrix '1' is coefficient of 'e' is an appropriate dimensional vector of area and is absolute errors.

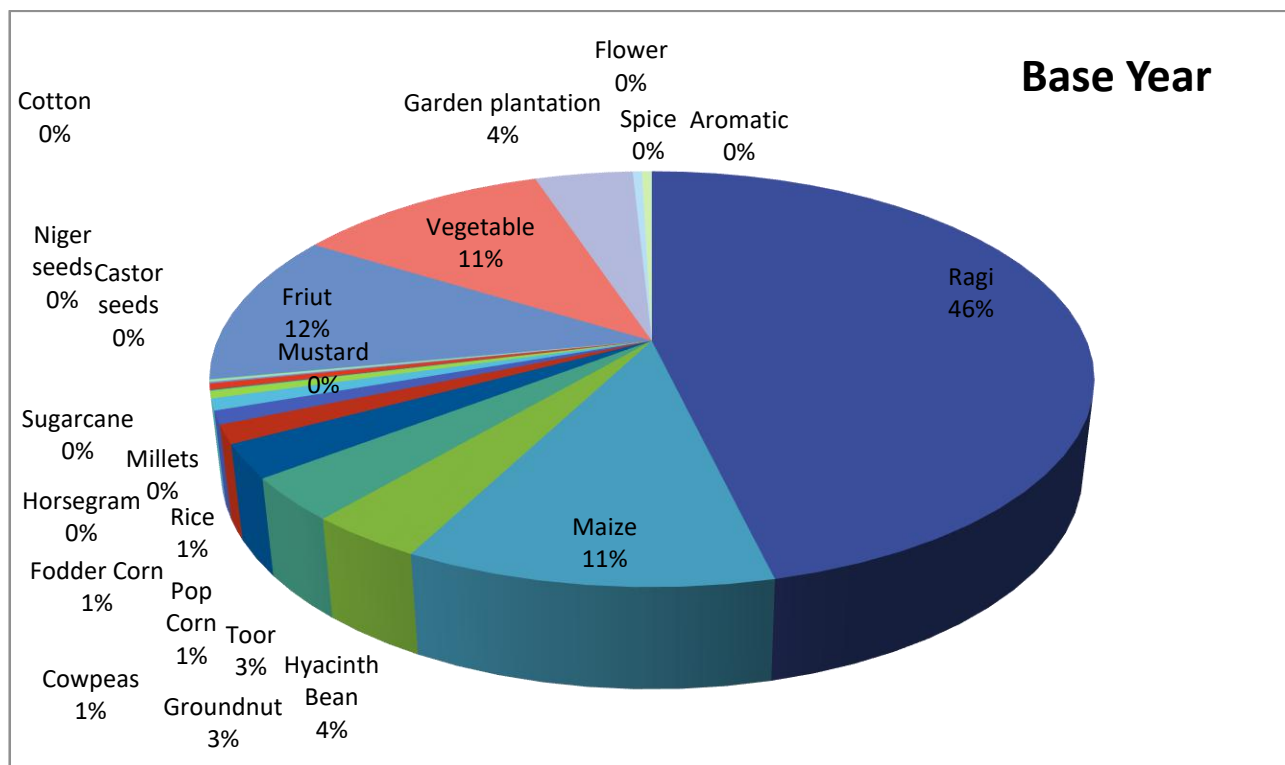
3. RESULTS AND DISCUSSION:

To minimise the effects of annual variations in variables, the average first three years were considered as a base year and those of last three years as the current year. The analytical concepts, absolute change relative change, standard deviation, coefficient of variation, simple and compound growth rates were considered to draw inferences.

Table 1 Fluctuation in area share of crops

Crops	Base year	Curent year	Absolute change	Relative change	Mean	SD	CV(%)
Ragi	31.12	27.86	-3.27	-0.10	29.49	2.31	7.84
Maize	7.66	8.10	0.44	0.06	7.88	0.31	3.99
Hyacinth Bean	2.42	2.55	0.13	0.06	2.48	0.09	3.79
Groundnut	2.26	2.60	0.34	0.15	2.43	0.24	9.99
Toor	1.76	1.84	0.08	0.04	1.80	0.05	2.99
Pop Corn	0.97	1.06	0.08	0.09	1.01	0.06	5.79
Cowpeas	0.70	0.90	0.20	0.29	0.80	0.14	18.01
Rice	0.61	0.05	-0.55	-0.91	0.33	0.39	118.31
Fodder Corn	0.37	0.00	-0.37	-1.00	0.18	0.26	141.42
Horsegram	0.05	0.02	-0.02	-0.51	0.03	0.02	48.55
Millets	0.02	0.04	0.02	1.15	0.03	0.02	51.63
Mustard	0.31	0.12	-0.19	-0.62	0.22	0.14	63.22
Niger seeds	0.07	0.03	-0.04	-0.58	0.05	0.03	57.41
Castor seeds	0.05	0.02	-0.03	-0.65	0.03	0.02	67.64
Cotton	0.06	0.01	-0.05	-0.89	0.03	0.03	113.60
Sugarcane	0.04	0.01	-0.03	-0.87	0.02	0.02	108.53
Friut	7.88	10.75	2.87	0.36	9.32	2.03	21.78
Vegetable	7.48	7.89	0.41	0.06	7.69	0.29	3.80
Garden plantation	2.88	2.61	-0.26	-0.09	2.75	0.19	6.82
Flower	0.27	0.71	0.44	1.67	0.49	0.31	64.38
Spice	0.28	0.33	0.06	0.20	0.30	0.04	13.11
Aromatic	0.02	0.00	-0.02	-1.00	0.01	0.01	141.42

Note: SD – Standard Deviation, CV – Coefficient of variation



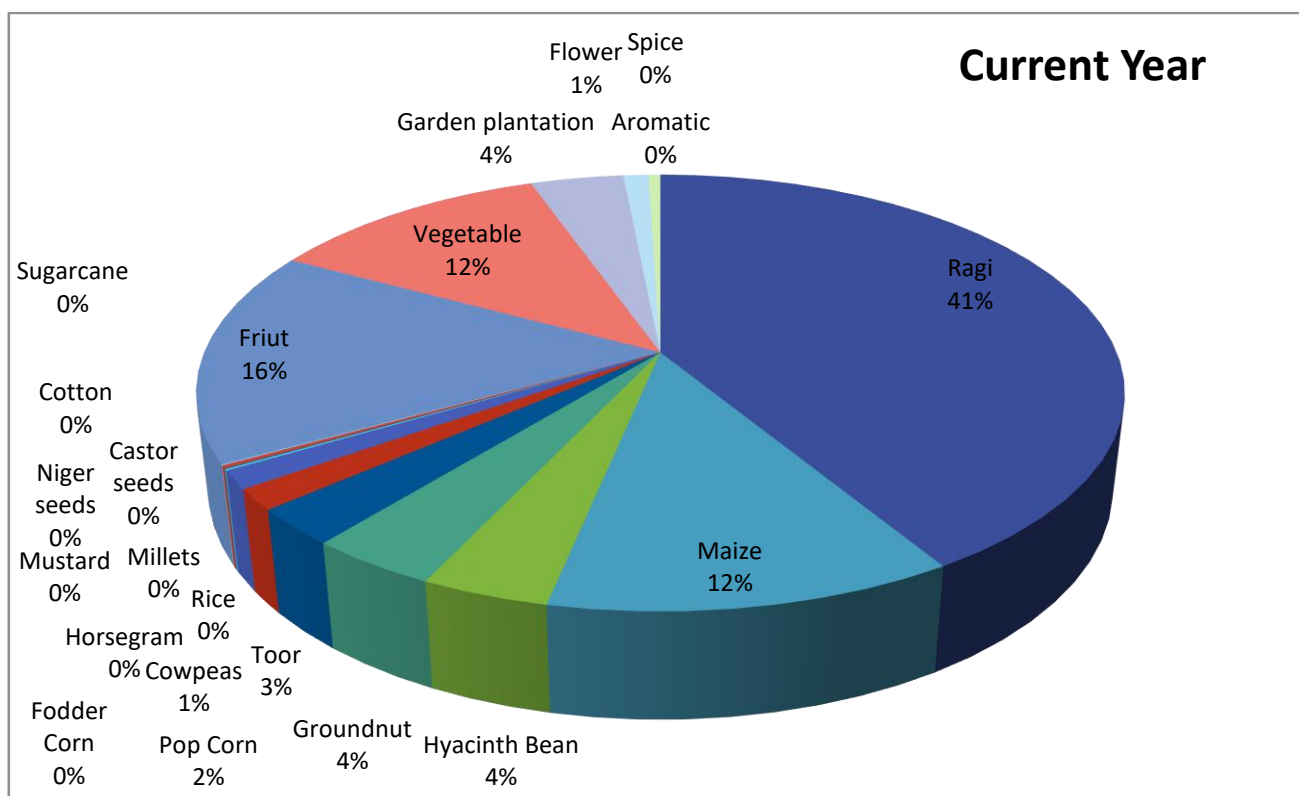


Fig 1

Trends and growth

The trends and growth in an area of major crops, extent of crop diversification and the contributing factors were analysed in the present study

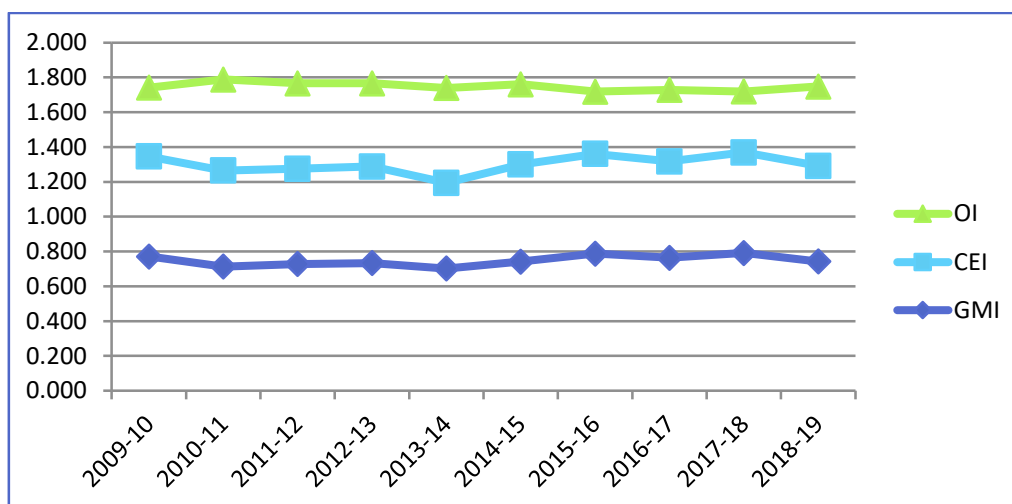
The complete analysis of area of major crops in the taluk level, shows changing scenario in the period. The percentage of share of area crop to the gross cropped area for the base year and the current year after period were analysed and shown in the fig 1. It clearly indicates from the figure that the crop share in the area from the base year for the current year was highest increase in fruits(4%), maize, groundnut, popcorn, flower(1%). The crops that showed a decrease in the percentage share in the area of gross cropped area from the base year for the current year were Ragi(-5%), Rice and Fodder corn(-1%). The Area share of crops were stagnant were Hyacinth bean, Garden plantation and cowpeas in the base year for the current year of the study

The relative changes in the current year at the base year during the period of the study of major crops were analysed in the table 1. The area share under the flowers and the millets were 167 and 115 percent. In the current year to the base year(0.71 thousand ha) as big as compared to the base year(0.27 thousand ha) for the preparation of 64.38 percent and a 51.63 percent respectively during the study period. The area share of crops fruits cowpeas, spice and groundnut also increased by 36, 29, 20 and 15% respectively. In the current year to the base year with the fluctuation of 21.78 percent to 9.99 percent in the study period.

The crops that had shown a decrease in the area of the base year to the current were fodder corn aromatic cotton sugar castor oil mustard and Niger seeds. The highest reduction in the area is noticed in Fodder Corn(-100%) aromatic(-100%), rice(-91%), cotton(-89%) and sugar(-87%).

Table 2 Crop diversification indices in Sidlaghatta taluk in different years

Index	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
GMI	0.771	0.713	0.728	0.733	0.703	0.742	0.788	0.764	0.791	0.743
CEI	0.575	0.552	0.547	0.555	0.492	0.558	0.573	0.554	0.578	0.548
OI	0.395	0.523	0.490	0.478	0.546	0.461	0.358	0.411	0.350	0.457



Crop diversification index

In Table 2, the values of Gibbs-Martin index for the different crop groups in the Sidlaghatta taluk for 10 years for the period 2009-10 to 2018-19 the estimated average values of Gibbs Martin index for the different crop groups work point 0.77, during the year 2017-18 observed. Highest diversification of 0.79 followed by the year 2015-16 and 2016-17 with the diversification index of 0.788 and 0.764 respectively.

Ogive index for different crop group

OI is used to measure the industrial diversity. OI increases with increase in diversification and vice versa. The result clearly shows the Sidlaghatta taluk has a diversification over the years. In 2013-14 diversification OI is 0.5456 followed by 0.523, 0.491, 0.478 respectively in the year 2010-11 2011-12 and 2012-13.

Composite entropy index

The composite entropy Index increases with increasing diversification. The result shown that the values of CEI was maintained study diversification. During the year 2017-18 and has highest diversification followed by 0.575 0.573 and 0.558 during the the year 2009-10, 2015-16 and 2014-15 respectively

Table 3 The transition probability Matrix for the area share of different crop groups in Sidlaghatta

Crop	Ragi	Maize	Hyacinth Bean	Oil seeds	Toor	Fruit	Vegetable	Garden plantation	Flower	Spice & Aromatic	Other crops
Ragi	0.52	0.12	0.20	0.00	0.00	0.10	0.19	0.05	0.00	0.00	0.00
Maize	0.31	0.00	0.03	0.03	0.00	0.23	0.14	0.04	0.00	0.01	0.22
Hyacinth Bean	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
Oil seeds	0.00	0.34	0.00	0.00	0.06	0.00	0.26	0.09	0.02	0.02	0.22
Toor	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fruit	0.34	0.34	0.12	0.02	0.00	0.10	0.03	0.03	0.03	0.00	0.00
Vegetable	0.62	0.00	0.06	0.00	0.12	0.16	0.00	0.03	0.00	0.00	0.00
Garden plantation	0.15	0.00	0.00	0.68	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Flower	0.00	0.00	0.00	0.04	0.00	0.52	0.00	0.00	0.20	0.25	0.00
Spice & Aromatic	0.21	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.14	0.00
Other crops	0.82	0.18	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00

The transition probability Matrix for the area under the different crop groups in Sidlaghatta taluk

Using Markov chain the change in the area under the crops in sugar the taluks was analysed for the period of 10 years from 2019 to 2018 19. Ragi, Hyacinth bean, oilseeds, tour, fruits, vegetables, Garden plantation, flowers, spices and aromatic and other crops were considered for the analysis. The results (Table 3) revealed that among the different crop groups Ragi, flower, Spice, aromatic and fruits retained highest share over the period and other crops gained the meagre shared that over the years.

Farmers are shifting towards Horticulture crop groups Ragi and horticulture crops retained the highest share of crops compared with other crop groups. The analysis indicates that in all shift towards Horticulture crops compared to other crop groups.

In Sindhanur taluk probability of transition had shown a shift towards sunflower, bengalgram, bajra, cereals, pulses and other crops (Satish kumar,*et. al* 2017). The transition probability matrix had shown that the horticultural crops and coconut have retained a higher share in terms of area under crops, retention of area with probability value of zero at Mandya taluk (Satish kumar,*et. al* 2017).

4. CONCLUSION AND POLICY IMPLICATION:

Crop diversification in ensures livelihood security to the farming community, there is a more need to develop markets in the study area. At present, supporting mechanism is not operating for horticulture crops as well stable price act as incentives for growing number of crops. Crop diversification should address the food security and nutritional security to the farmers to grow cereals, pulses in some areas instead of total diversification in favour of high valued crops and horticulture crops. Conducting awareness program initiating more campaigns intensifying the role of service providers, promoting research based education Technologies on the farm. Crop diversification should address and strength the balance between nutritional and food security.

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