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# SPATIO-TEMPORAL ANALYSIS OF CROP DIVERSIFICATION IN HASSAN DISTRICT

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**Abstract:**

The main objective of this paper is studying the crop diversification in Hassan district lie in the fact that it helps us to know the contemporary competition amongst crops. Scope for rotation and effects on double cropping and also productivity. It enables us to understand the impact of physical and socio-economic conditions of the agricultural mosaic of the district. For complete comprehension of the geography of crops in the district. Method Adopted in this paper is the quantitative techniques proposed by Gibb's and Martin's for measuring crops diversification in the cropping pattern of an area. The formula developed for calculating the Index. The crop diversification related to the quality of soil and rainfall, reviewed at percentage of irrigation.

**Keywords:** *Crop Diversification, Agriculture, Contemporary Competition, Quantitative Techniques.*

## Introduction:

The crop diversification technique is applied to compute crop diversification pattern of the district. Its meaning is to raise variety of crops on arable land. It reflects impact of physio-socio-economic variables. Moreover, it shows the contemporary competition cops for an area, scope for rotation, the effect on double cropping (Hassan, 1979). The greater number of crops lead to greater competition. The higher in the magnitude of diversifications. In fact, it is obvious that greater the number of crops in a combination. The larger would be the degree of diversification. Crop diversely in an important component of the crop's geography of a region. It refers to variety of cops, "Larger the number of crops from in an area during a year with each crop employing equal proportion of crop land, the higher is the crop diversification. In a diversification cropping system soil nutrients extracted by some crops are likely to be

replenished by other crops grown in rotation, as against specialized system where a few of them may taxed heavily.

**Study Area:**

Hassan district named after its headquarters city of Hassan is one of the twenty- seven districts of Karnataka state. The district is located in the Southwestern part of the state. The district, situated between 12°31' and 13° 33' North latitude and 75° 38' and 76° 39' east longitude. The greatest length of the district, from north to south, is about 129 kilometers, and its greatest breadth, from east to west is about 110 kilometers, spanning a total geographical area of 6,845 sq. kilometers which ranks second in the area among the twenty-seven districts. The district is surrounded by as many as six districts of Karnataka state.

The district lies partly in the Malnad tract and partly in the southern maidan (plains) tract. Taking into consideration the physical aspects, climate, rainfall, etc., the district may be divided into three regions viz., (1) Southern Malnad, (2) Semi-Malnad and (3) Southern maidan. Three important rivers, viz., the Cauvery, Hemavathy and Yagachi flow through the Hassan district. The soils of Hassan district also show a marked diversity in different parts of the district, depending upon the nature of the parent rock and the climatic conditions of the respective areas. It has forest loams and red laterite, ferruginous and clayey soil of the hill slopes and the Sandy or gravelly soil of the plains. The soils of Hassan district occur in different physiographic units such as hilley region hillocks, undulating to rolling lands, gently sloping pediments, and valleys. In the development of these soils, climate, vegetation and relief have played a dominant role. The district has an agreeable climate. The year may be divided into four seasons according to the climatic conditions. The summer season is from March to the end of May and it is followed by the South-West Monsoon season lasting up to about the end of September, October and November may be termed the post-monsoon or retreating monsoon season. The period from December to February is the dry season with generally clear and bright weather. The district is bounded on the north by Chikmagalur district, on the east by Tumkur and Mandya districts, on the South by Mysore and Coorg districts, and on the west by Dakshina Kannada district. The district has been divided into 8 Taluks for administrative purpose, they are: Alur (40.265 sq km),

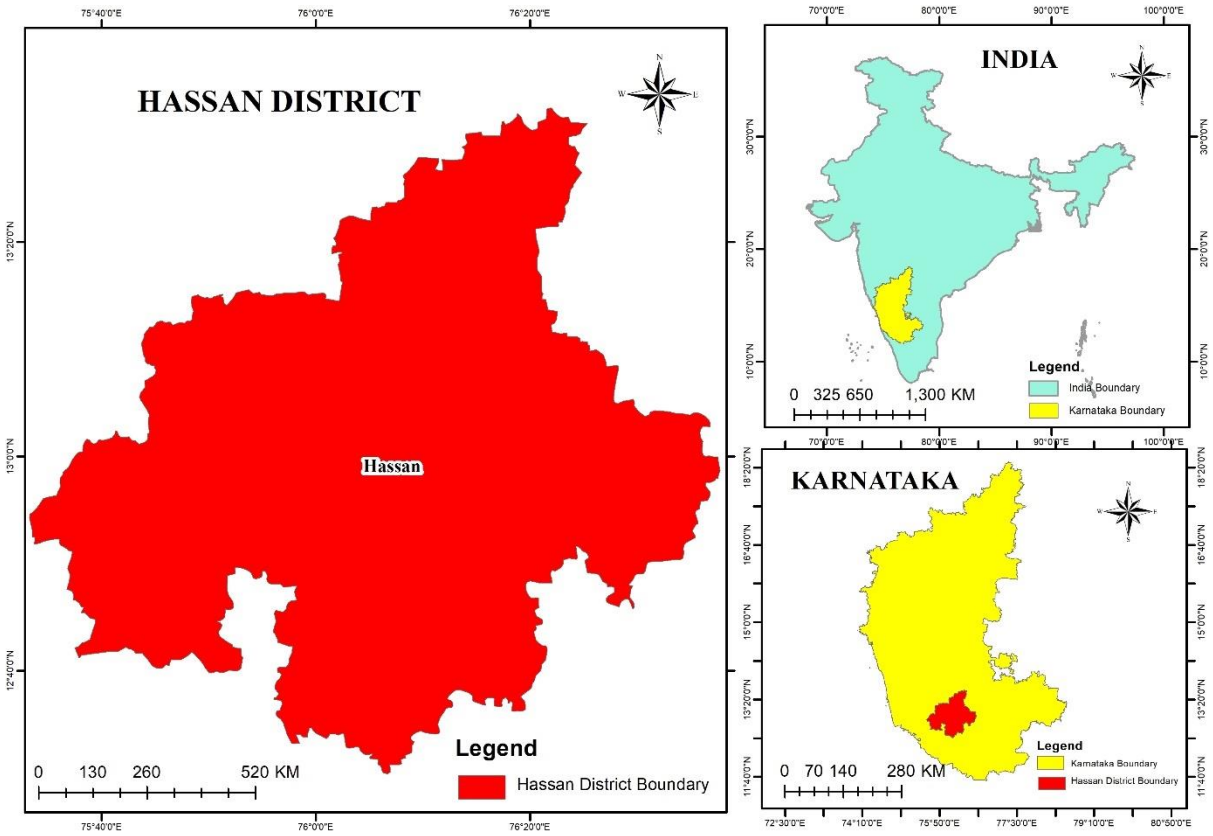


*Figure 1: Location Map of Hassan District.*

Arkalgud (64.450), Arsikere (123.452 sq.km), Belur (76.740 sq.km), Channarayapatna (103,464 sq.km), Hassan (91.818 sq.km), Holenarasipur (59.524 sq.km), Sakleshpur (102.889) sq.km). As per 2004-05, the Hassan district had 10,51,095 population 2,395 villages and 8 towns.

**Objectives of the Study of Crop Diversification:**

1. The study of crop diversification in Hassan district lie in the fact that it helps us to know the contemporary competition amongst crops. Scope for rotation and effects on double cropping and also productivity.
2. It enables us to understand the impact of physical and socio-economic conditions of the agricultural mosaic of the district.
3. For complete comprehension of the geography of crops in the district, the interpretation is essential

In view of these objectives an attempt is made to analyze the natural of crop diversification and its spatio–temporal variation in Hassan district.

**Measurement of Crop Diversification:**

**A Review of Literature:**

Many geographers and economists so far have applied the concept of diversification in variety of sense. This concept, initially was applied in the field of manufacturing to identify the degree of diversification and concentration by Cleann (1930) later on by Tree (1938), Florene (1942) and Rainwald (1949). However, the works of Trees T.C.,Edgar Conkling, R., Parr John, B., Shear James are not worthy and have used Lorenze came for measuring diversification but the methods suffering from one or the other defects viz.,

a. It leads tedious calculation

b. It is not so precise and accurate.

c. It gives only the broad ideas of diversification of an area.

Mani, H.S. (1963) rectified this about back by taking the ratio between the mean of difference in percentage of crops under each of which is more than five percent of the total cropped area. This method is also not accepted because of the following weaknesses:

1. It gives only a broad idea of diversification of crops.
2. This method is not a better representative of the number of factors (number of crops).

N.P. Ayyar (1969) has modified Bhatia's method taking into account only those crops, which occupy at least 1.0% the gross cropped area for each unit the standard of evenness is chosen differently according to the actual numbers of crops. This method also falls to identify clearly the critical values produced by the ideal distribution and hence the is proved

supersensitive. S.S. Bhatia (1963) has evolved a single formula by taking into account the total cropped area to make an objectives measurement of crop diversification. He took the ratio between the area under all these crops which cover up to five percent of the crop land number of crops as an index of diversification. It is not only simple but also an easily workable technique. However, it cannot be accepted here because of the following weakness.

(i) Instead of using five percent and more than five as it is arbitrary limit the actual number of crops should have been considered separately.

(ii) Some crops, which are left out just because of less than 5% of the net sown area may be of great importance.

(iii) It is supersensitive because of fixing more them five percent value, and

(iv) The index is too insensitive towards the highest value of diversification. Example: If no value reaches more than ten percent, than the index acquires determinate form.

**Method Adopted in the Study:**

The quantitative techniques proposed by Gibbs and Martin for measuring crops diversification in the cropping pattern of an area. The formula developed for calculating the Index is as follows.

$$\text{Index for Diversification} = 1 - \frac{\Sigma x^2}{(\Sigma x)^2}$$

Where,

x = The percentage of total cropped area occupied by each crop of hectare under individual crop.

If the total cultivated area in a region in devoted wholly to one crop (i.e., specialization). The index value will be zero and if it is evenly distributed among all crops (i.e., maximum

diversification), the index value approaches one. This method is accepted in the present study as it has the following advantages and had overcome the districts, which occurred in other methods.

1. It takes into consideration both the evenness factors (relative strength of crops) and number of factors (number of crops) perfectly to form the basis of proper measurement of diversity.
2. The method is neither insensitive nor supersensitive like Bhatia's method and is devoid of critical value.
3. The figure can be adjusted into hundreds, thousands, lakhs, million etc., which will not alter the results.
4. The indices are directly related to diversification, whereas, they are inversely related to diversification on other method.
5. The indices are not only relative but also are precise in calculation

**Intensity of Cropping:**

Intensity of cropping of a crop refers to the number of crops raised on field during an agricultural year for example, if one crop is grown on a field in a year the index of intensity of cropping is 100 percent, if two crops in a year are grown intensity index will be 200 percent. Therefore, the higher index of intensity of cropping the higher index of intensity of cropping the higher in the landuse efficiency and lower in the landuse deficiency.

Therefore, keeping the above advantage in view the Gibb's and Martin's Index of diversification has provided the most suitable method in measuringdiversification of crops in Hassan district it is adopted here at two points of time i.e., 1990-91 and 2004-05.

## Results and Discussion:

### Spatio – Temporal Analysis:

The proceeding tables and figures indicate that the induces have been worked out for spatial distribution of crops diversification at the taluks and district lands. Crop diversification index in Hassan district has decreased from 0.38 in 1990, 1 to 0.21 in 2004-05. This decrease of diversification index in the district due to failure of water supply, irrigation, timely rainfall. The crop, which become unprofitable in due course of time with the high yielding variety of seeds and unassumed market through state trading unsupported of price from government.

**Table–1**
**HASSAN DISTRICT**
**Crop Diversification 1990-91 (As per Gibbs and Martin Index of Diversification)**
**(Area in Hects.)**

| Sl. No. | Name of the Taluks | Rice | Ragi | Jowar | Maize | Minor millets | Gram | Tur | Other pulses |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Alur | 6,255 (24.04) | 5,930 (22.79) | - | 357 (1.37) | - | 20 (0.08) | 97 (0.37) | 987 (3.45) |
| 2. | Arkalgud | 11,208 (16.38) | 15,936 (23.29) | 28 (0.04) | 43 (0.06) | - | 250 (0.36) | 280 (0.41) | 15,021 (21.95) |
| 3. | Arsikere | 475 (0.46) | 38,600 (37.79) | 2,550 (2.49) | 135 (0.13) | 5 (0.00) | 400 (0.39) | 1,110 (1.09) | 8,336 (8.16) |
| 4. | Belur | 8,480 (11.96) | 15,727 (22.17) | 1,131 (1.59) | 2,562 (3.61) | - | 69 (0.09) | 946 (1.33) | 5,101 (7.19) |
| 5. | C.R. Pathna | 4,440 (7.03) | 19,150 (30.35) | 1,451 (2.29) | 10 (0.02) | 121 (0.19) | 185 (0.29) | 650 (1.03) | 10,445 (16.55) |
| 6. | Hassan | 4,411 (5.56) | 26,034 (32.84) | 938 (1.18) | 2,122 (2.68) | 4 (0.00) | 553 (0.69) | 663 (0.84) | 9,738 (12.28) |
| 7. | H.N.Pura | 8,855 (14.64) | 16,876 (27.91) | 359 (0.59) | 80 (0.13) | - | 46 (0.08) | 301 (0.49) | 11,551 (19.10) |
| 8. | Sakleshpur | 13,013 (54.02) | 120 (0.49) | - | - | - | - | - | 150 (0.02) |
| | Total | 57,137 (11.56) | 1,38,373 (27.98) | 6,457 (1.31) | 5,309 (1.07) | 130 (0.03) | 1,523 (0.31) | 4,047 (0.81) | 61,239 (12.38) |

Contd. .

| Sl. No. | Name of the Taluks | Groundnut | Sugarcane | Cotton | High yield crops | Total cropped area | $\frac{\Sigma x^2}{(\Sigma x)^2}$ | $1=\frac{\Sigma x^2}{(\Sigma x)^2}$ |
|---|---|---|---|---|---|---|---|---|
| 1. | Alur | 36 (0.14) | 97 (0.37) | 268 (1.03) | 12,058 (46.35) | 26,015 | 220709685 / 676780225 | = 0.32 |
| 2. | Arkalgud | 1,301 (1.90) | 84 (0.12) | 31 (0.05) | 24,246 (35.43) | 68,428 | 1194918468 / 4682391184 | = 0.26 |
| 3. | Arsikere | 1,888 (1.85) | 69 (0.07) | 3,350 (3.28) | 45,210 (44.27) | 1,02,128 | 3626323276 / 10430128384 | = 0.35 |
| 4. | Belur | 894 (1.26) | 1,191 (1.68) | 2,989 (4.21) | 31,840 (44.89) | 70,930 | 1378949250 / 5031064900 | = 0.27 |
| 5. | C.R. Pathna | 695 (1.10) | 2,772 (4.39) | 91 (0.14) | 23,095 (36.59) | 63,105 | 1039665307 / 3982241025 | = 0.26 |
| 6. | Hassan | 618 (0.78) | 273 (0.34) | 242 (0.31) | 33,687 (42.49) | 79,283 | 1933511829 / 6285794089 | = 0.31 |
| 7. | H.N.Pura | 283 (0.47) | 227 (0.37) | 46 (0.07) | 21,845 (36.13) | 60,469 | 974201759 / 3656499961 | = 0.27 |
| 8. | Sakleshpur | 40 (0.17) | 10 (0.04) | - | 10,753 (44.64) | 24,086 | 285003778 / 580135396 | = 0.49 |
| | Total | 5,758 (1.16) | 4,723 (0.96) | 7,017 (1.42) | 20,2734 | 4,94,447 | 67456306325 / 244477835809 | = 0.28 |

## Table–2
## HASSAN DISTRICT
## Crop Diversification 2004-05 (As per Gibbs and Martin Index of Diversification)
## (Area in Hects.)

| Sl. No. | Name of the Taluks | Rice | Ragi | Jowar | Maize | Gram | Tur | Other pulses | Groundnut | Sunflower |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Alur | 4,040 (14.84) | 3,330 (12.23) | 210 (0.77) | 3,965 (14.56) | 5 (0.01) | 35 (0.13) | 588 (2.16) | 10 (0.04) | 4 (0.01) |
| 2. | Arkalgud | 10,050 (16.37) | 17,148 (27.93) | 500 (0.81) | 4,345 (7.08) | 150 (0.24) | 320 (0.52) | 5,975 (9.73) | 105 (0.17) | 8 (0.01) |
| 3. | Arsikere | 210 (0.16) | 34,840 (27.09) | 3,071 (239) | 1,380 (1.07) | 1,575 (1.22) | 480 (0.37) | 11,102 (8.63) | 645 (0.50) | 4,025 (3.13) |
| 4. | Belur | 6,806 (10.76) | 12,162 (19.22) | 73 (0.12) | 5,418 (8.56) | - | 540 (0.85) | 1,632 (2.58) | 58 (0.09) | 1,514 (2.39) |
| 5. | C.R. Patna | 2,100 (2.61) | 20,850 (25.88) | 600 (0.74) | 270 (0.34) | 170 (0.21) | 220 (0.27) | 3,043 (3.78) | 30 (0.04) | 50 (0.06) |
| 6. | Hassan | 830 (0.94) | 41,027 (46.50) | 780 (0.88) | 5,556 (6.29) | 570 (0.65) | 499 (0.57) | 4,100 (4.65) | 75 (0.09) | 165 (0.19) |
| 7. | H.N.Pura | 4,552 (11.74) | 13,116 (33.83) | 571 (1.47) | 986 (2.54) | 88 (0.23) | 111 (0.29) | 5,643 (14.56) | 21 (0.05) | 7 (0.02) |
| 8. | Sakleshpur | 10,945 (13.96) | 65 (0.08) | - | - | - | - | 255 (0.33) | - | - |
| | Total | 39,533 (6.98) | 1,42,538 (25.17) | 5,805 (1.02) | 21,919 (3.87) | 2,558 (0.45) | 2155 | 32,338 (5.71) | 944 (0.16) | 5,773 (1.02) |

Contd. .

| Sl. No. | Name of the Taluks | Oil seeds | Total fruits | Total vegetables | Total spice | Sugarcane | Other non-food crops | Coffee | Yallachi |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Alur | 201 (0.74) | 460 (1.69) | 1,626 (5.97) | 1,108 (4.07) | 10 (0.34) | 5,764 (21.16) | 4,780 (17.55) | 130 (0.48) |
| 2. | Arkalgud | 862 (1.40) | 818 (1.33) | 5,986 (9.76) | 2,750 (4.48) | 50 (0.08) | 8,572 (13.96) | 175 (0.28) | - |
| 3. | Arsikere | 2,980 (2.32) | 2,308 (1.79) | 4,400 (3.42) | 937 (0.73) | 70 (0.05) | 32,710 (25.44) | - | - |
| 4. | Belur | 358 (0.57) | 452 (0.71) | 6,712 (10.61) | 878 (1.39) | 1,172 (1.85) | 13,377 (21.14) | 9,374 (14.82) | 75 (0.12) |
| 5. | C.R. Pathna | 500 (0.62) | 690 (0.86) | 1,523 (1.89) | 580 (0.72) | 4636 (5.75) | 23,223 (28.83) | 4 (0.00) | - |
| 6. | Hassan | 870 (0.99) | 1,213 (1.37) | 20,165 (22.86) | 650 (0.74) | 187 (0.21) | 5794 (6.57) | - | - |
| 7. | H.N.Pura | 1,334 (3.44) | 237 (0.61) | 1,267 (3.27) | 273 (0.70) | 790 (2.04) | 6,413 (16.54) | - | - |
| 8. | Sakleshpur | - | 642 (0.82) | 232 (0.29) | 8,859 (11.30) | - | 24,837 (31.68) | 24,707 (31.52) | 7,284 (9.29) |
| | Total | 7,105 (1.25) | 6,820 (1.20) | 41,911 (7.39) | 16,035 (2.83) | 6,915 (1.22) | 1,20,690 (21.31) | 39,040 (6.89) | 7,489 (1.32) |

Contd. .

| Sl. No. | Name of the Taluks | Banana | Mango | Supari | Coconut | Total | Area sown more than once | $\frac{\Sigma x^2}{(\Sigma x)^2}$ | $1=\frac{\Sigma x^2}{(\Sigma x)^2}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Alur | 118 (0.43) | 130 (0.48) | 110 (0.40) | 607 (2.23) | 27,231 | 3,362 | 104146945 / 741527361 | = 0.14 |
| 2. | Arkalgud | 275 (0.45) | 380 (0.62) | 1,288 (2.09) | 1,642 (2.67) | 61,399 | 12,273 | 572916349 / 3769837201 | = 0.15 |
| 3. | Arsikere | 1,800 (1.39) | 410 (0.32) | 640 (0.49) | 25,000 (19.44) | 1,28,583 | 12,286 | 4324343994 / 16533587889 | = 0.26 |
| 4. | Belur | 163 (0.26) | 125 (0.19) | 478 ).76) | 1,901 (3.00) | 63,268 | 6,260 | 726024635 / 4002839824 | = 0.18 |
| 5. | C.R. Pathna | 370 (0.46) | 155 (0.19) | 125 (1.16) | 21,426 (26.59) | 80,565 | 4,409 | 1472814345 / 6490719225 | = 0.23 |
| 6. | Hassan | 167 (0.19) | 710 (0.80) | 394 (0.45) | 4,474 (5.07) | 88,226 | 23,904 | 2196385216 / 7783827076 | = 0.28 |
| 7. | H.N.Pura | 187 (0.48) | 22 (0.06) | 68 (0.18) | 3,082 (7.95) | 38,768 | 1,183 | 290272307 / 1502957824 | = 0.19 |
| 8. | Sakleshpur | 365 (0.47) | 28 (0.04) | 90 (0.11) | 80 (0.10) | 78,389 | 1,877 | 1479327727 / 6144835321 | = 0.24 |
| | Total | 3,445 (0.61) | 1,960 (0.35) | 3,193 (0.56) | 58,212 (10.28) | 5,66,378 | 65,554 | 45178690852 / 320784038884 | = 0.14 |

**Table –3**
**HASSAN DISTRICT**
**Taluk wise Diversification Indices and their change from 1990-91 to 2004-05**

| Sl. No. | Name of the Taluks | I.D. 1990-91 | I.D. 2004-05 | Change + or - | Increase or Decrease |
|---|---|---|---|---|---|
| 1. | Alur | 0.32 | 0.14 | -0.18 | Decrease |
| 2. | Arkalgud | 0.26 | 0.15 | -0.11 | Decrease |
| 3. | Arasikere | 0.35 | 0.26 | -0.09 | Decrease |
| 4. | Belur | 0.27 | 0.18 | -0.09 | Decrease |
| 5. | C.R.Patna | 0.26 | 0.23 | -0.03 | Decrease |
| 6. | Hassan | 0.31 | 0.28 | -0.03 | Decrease |
| 7. | H.N.Pura | 0.27 | 0.19 | -0.08 | Decrease |
| 8. | Sakaleshpura | 0.49 | 0.24 | 0.25 | Decrease |
| | District Total | 0.28 | 0.14 | -0.14 | Decrease |
| | Mean | 0.38 | 0.21 | | |

**Table–4**
**HASSAN DISTRICT**
**Crop Diversification Categories for 1990-91 to 2004-05**

| Diversification Categories | 1990-91 Range of Crop Diversification | No. of Taluks | Name of Taluks | 2004-05 Range of Crop Diversification | No. of Taluks | Name of Taluks |
|---|---|---|---|---|---|---|
| Very Low | Below 0.30 | 4 | Arkalgud, Belur, C.R.Patna, H.N.Pura | 0.15 | 2 | Alur, Arkalgadu |
| Low | 0.31-0.35 | 3 | Alur, Arsikere, Hassan | 0.16-0.20 | 2 | Belur, H.N.Pura |
| Medium | 0.36-0.40 | Nil | - | 0.21-0.25 | 2 | C.R.Patna, Sakleshpur |
| High | 0.41-0.45 | Nil | - | 0.25-0.30 | 2 | Aersikere, Hassan |
| Very High | 0.46-0.50 | 1 | Sakleshpur | 0.30 above | Nil | |

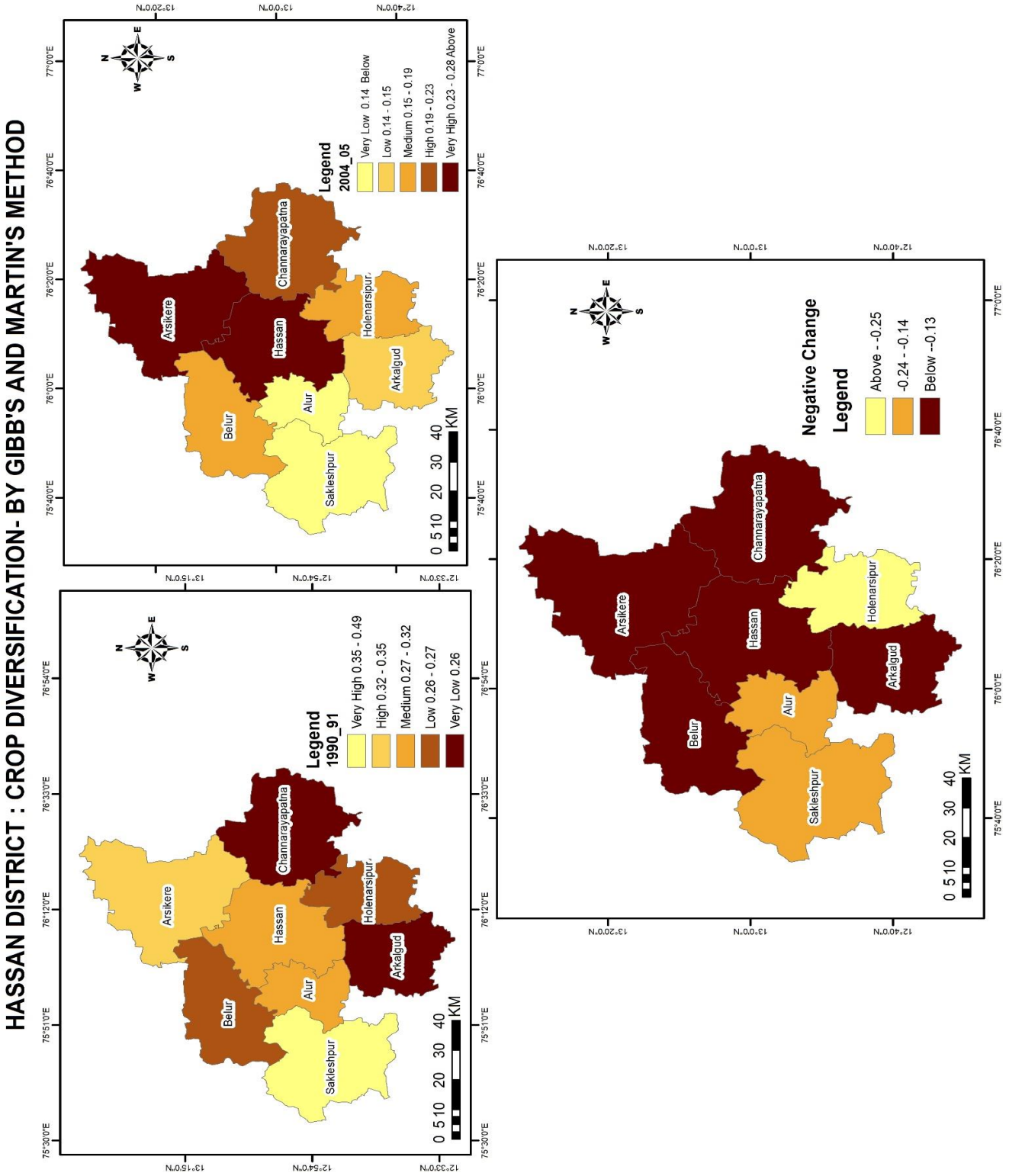


*Figure 2: Crop diversification by Gibb's & Martin's Method of Hassan District.*

**Taluk Level Analysis:**

During 1990-91, Arkalgud, Belur, C.R.Patna and H.N.Pura taluks were in very low diversification. Alur, Arasikere, Hassan taluks fall under low crop diversification. Sakleshpur is the only taluk fall under very high crop diversification. Whereas, the medium and high crop diversification are not noticed in the taluk during 1990-91.

Alur, Arkalgud taluks were under very low crop diversification during 2004-05. Belur and Holenarasipur were under low crop diversification. C.R.Patna and Sakleshpur were under medium crop diversification. Arasikere, Hassan has high crop diversification categories. Whereas very high diversification is not found in any of the taluks in Hassan district.

**Change in Crop Diversification:**

The critical analysis of the result of the diversification of crops clearly reveals that Alur, Arasikere, Hassan has generally high crop diversification, Channarayapatna, Sakleshpur under medium category. Belur and Holenarasipur under low category. Alur, Arkalgud in very low crop diversification during 2004-05. Whereas, Alur, Arasikere, Hassan, Holenarasipur change their categories from low diversification to the medium and high diversification.

**Increase Diversification:**

The Table-3 reveals that (1990-91 to 2004-05) all taluks viz., Alur, Arkalgud, Arasikere, Belur, C.R.Patna, Hassan, H.N.Pura, Sakleshpur have no increased diversification in Hassan district.

**Decreased Diversification:**

Alur, Arkalgud, Arasikere, Belur, C.R.Patna, Hassan, H.N.Pura, Sakaleshpur have decline in the diversification of crops during a span of one and half decade period. Fertile soils and adequate amount of irrigation facilities have suited to grow economically valuable crops like coffee, sugarcane, rice etc.

**Conclusion:**

In thus study period about twenty crops were grown in Hassan district. The crop diversification related to the quality of soil and rainfall, reviewed at percentage of irrigation. Similarly, the cropping intensity indicated the frequency of use of arable land. Higher degree of intensity is higher percentage of irrigated land, whereas low intensity is within noticed in dry forming taluks. Thus, the entire study gives us certain clues to workout reutilization of agriculture in Hassan District.

**References:**


- Vaidya, B.C. (1997), "Agriculture Landuse in India", Manak Publications (P.) Ltd., P.173.
- Ayyar, N.P. (1969), "Crop Regions of Madya Pradesh, Study in Methodology", Geographical Review of India, Pp.1-19.
- Singh Jhusiari (1979), "Spatio- Temporal Analysis of Crop Diversification in Punjab", The Indian Geographical Journal, Vol.14, No.2, Pp.55-71.
- Tress, T.C. (1939), "Unemployment and Diversification of Industry", The Manchester School, Vol.9, No.2, Pp.104-152.
- Conkling Edger, R. (1963), "A Case Study Industrial Diversification", Economic Geography, Vol.39, Pp.258-272.
- Parr John, B. (1965), "Specialization Diversification and Regional Development", The Professional Geographer, Vol. 17, No.6, Pp.21-25.
- Jhear James, A. (1975), "A General Measurement of Diversity", The Profession Geography, Vol.17, No.2, P.15.
- Mani, H.S. (1963), "Crop Diversification in Malava Tract of Punjab", Indian Geographical Journal, Vol. 38, Pp.75-78.
- Ayyar, N.P. (1969), "The Crop Region of Madhya Pradesh A Case Study in Methodology Geographical Review of India", Vol.31, Pp.17-19.
- Bhatia, S.S. (1965), "Pattern of Crop Concentration and Diversification in India", Economic Geography, Vol.41, Pp.39-56.
- Gibbs, J. and Martin, W.C. (1962), "Index of Diversification to Quantitative Ter__ __ in Geography", by Armord, Rand, M.C., Gullah, P.S., Cleareden, Press Oxford, 1977, P.21.