CHAPTER 5
CROPPING PATTERN

5.0 Cropping Pattern
5.1 Ranking of Crops
5.2 Crop Concentration
5.3 Crop Combination
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CHAPTER - 5

5.0 Cropping Pattern:

To meet the demands of food grains for the increasing population, the limited resources of land and water are to be used optimally. The productivity in any area can be substantially raised by growing those crops suitable to the area with scientific devices of cultivation. With the limited resources of irrigation in the district, rainfed crops would continue to dominate in the agriculture of Bellary district. The selection of crops is very important in the light of their adaptability in the agroclimatic conditions of the district under 'study'. The cropping pattern is based on both the time and space sequence of crops. The variety in cropping pattern is the result of physical, economical and social factors. The physical environment provides a wide range of possibilities for growing crops but the social and economical conditions determine as to which crops are to be grown and how much of land is to be devoted to different crops. Moreover social and cultural values strongly influence the cropping pattern.
especially in the countries where agriculture is a way of life. The farming communities have developed their own traits and traditions which affect the growing of crops. These crops are not always being grown where they are best adopted to nor where they can be grown most economically. All correlates of cropping pattern are of a dynamic nature. Except physical elements which take a comparatively longer time to change their determinants belonging to the economic traits change very fast. Technological advancement such as irrigation, soil and water conservation, adoption of high yielding varieties of seeds, use of chemical fertilisers and pesticides, improvement in the means of transportation, marketing and storage facilities, price incentives and above all the change in mental attitude of farmers, the policy makers, the researchers and politicians have brought a tremendous change in cropping pattern. Considering all these factors, the author has viewed the study area and concludes that a similar situation is prevailing in Bellary district. Therefore, in this


subsection, parameters dealing with ranking of crops, crop concentration, crop combinations, intensity of cropping and crop diversification are included.

5.1 Ranking of Crops:

The percentage area under each crop was ascertained simply by ranking them for each taluka in order to have percentage of the total net sown area occupied by each crop. Ranking of crops gives an insight into the geographical reality of the cropping structure. Moreover, ranking of crops helps in knowing the crops which compete with each other to gain more hectarage under cultivation. After assessing the relative strengths of different crops in a geographical unit, the process of planning can be initiated more rationally for the optimal use of the available land for cultivation. A judicious use of land with adequate inputs in fact can help in raising the agricultural production of even the less fertile areas. Thus the study is useful in reducing the inter-regional disparities in the agricultural income and economy. Unless the major crops of the district are studied in their ranking order and the areal strength of each crop is determined, an appropriate association of soil and soil enriching crops for each situation cannot be ascertained.
Ranking Method:

This can be studied by descriptive and quantitative methods to delineate the ranking of individual crops according to their areal importance in each component unit. The crop with the larger percentage share of the net sown area forms the first ranking crop and the crop with the next largest share becomes the second ranking crop. Similarly calculations have been made upto 11th ranking crops (Table-19). The resultant patterns have been plotted in Fig 16 for the year 1975-76 and 1985-86. It is evident from the figures that the distribution pattern of crops in Bellary district is more diversified owing to subsistence type of agriculture. A comparative picture of first, second and upto eleventh ranking crops for the study period of 1975-76 and 1985-86 have been given in the table.

First Ranking Crops:

In the year 1975-76 jowar, groundnut and other cereals were the three crops whereas in 1985-86 four crops, jowar, groundnut, rice and cotton were enlisted as ranking in different talukas of the district. Jowar ranked first in Bellary, Harpanahalli, Hospet, Kudligi and Sirguppa talukas; groundnut
## TALUKA WISE RANKING OF CROPS (AS PER SOWN AREA)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Other Cereals</td>
</tr>
<tr>
<td>2nd</td>
<td>COTTON</td>
</tr>
<tr>
<td>3rd</td>
<td>RICE</td>
</tr>
<tr>
<td>4th</td>
<td>Jo War</td>
</tr>
<tr>
<td>5th</td>
<td>Wheat</td>
</tr>
<tr>
<td>6th</td>
<td>Bajra</td>
</tr>
<tr>
<td>7th</td>
<td>Ragi</td>
</tr>
<tr>
<td>8th</td>
<td>Other Oil</td>
</tr>
<tr>
<td>9th</td>
<td>Pulses</td>
</tr>
<tr>
<td>10th</td>
<td>Groundnut</td>
</tr>
<tr>
<td>11th</td>
<td>Other Seeds</td>
</tr>
</tbody>
</table>

**Fig. 16**

### Legend
- Rice
- Cotton
- Wheat
- Bajra
- Ragi
- Other Oil
- Pulses
- Groundnut
- Other Seeds
- Sugarcane
ranked first in Hadagalli and Hagaribommanahalli talukas and other cereals ranked first only in Sandur taluka. In the existing environmental conditions these crops can be cultivated well to be first ranking in these talukas shown against their names (vide tables 19 and 20). Jowar in Hadagalli, Harpanahalli, Sandur and Sirguppa talukas, groundnut in Hagaribommanahalli and Kudligi talukas, rice in Hospet and cotton in Bellary talukas ranked first. In a span of decade there is a change in the ranking order of the crop. Cotton and rice newly emerged as first ranking crops. The change shows that jowar is replaced by cotton in Bellary taluka and again jowar is replaced by rice in Hospet taluka. In Sandur taluka other cereals were replaced by groundnut. Rice and cotton were more economical and profitable crops rather than jowar and other cereals (subsistence crops), the hectarage was increased under cotton and rice. However, the district ranked first in the cultivation of jowar and groundnut mainly because of semi-arid conditions as well as less percentage of arable land under irrigation.

Second Ranking Crops:

Jowar, other cereals, rice, cotton and groundnut were the five crops ranked second in the year 1975-76 whereas four
### Table- 12

**Bellary District**

**Banking of Crops During 1975-76**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Taluka</th>
<th>Talukawise Percentages of Area Under Crops to the Net Sown Area</th>
<th>Talukawise Ranking of Different Crops (According to their Percentages)</th>
<th>Talukawise Percentages of Area Under Crops to the Net Sown Area</th>
<th>Talukawise Ranking of Different Crops (According to their Percentages)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bellary</td>
<td>15.97 25.13 0.24 4.28 7.84 8.07 2.96 14.57 8.18 11.38 0.28 Bellary</td>
<td>J R G C Os Oc W B J P S R G</td>
<td>J R G C Os Oc W B J P S R G</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Hadagalli</td>
<td>0.17 29.15 0.35 3.04 0.40 2.76 1.39 33.98 4.70 23.75 0.44 Hadagalli</td>
<td>G J C Os B J P S W B G R</td>
<td>G J C Os B J P S W B G R</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Hārpanahalli</td>
<td>1.83 28.29 12.06 0.45 0.55 4.43 9.64 13.37 6.54 22.42 0.42 Hārpanahalli</td>
<td>J C G Rg P Os Oc R W B J S</td>
<td>J C G Rg P Os Oc R W B J S</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Kudligi</td>
<td>1.45 28.06 2.08 6.67 0.43 5.65 5.70 22.92 7.33 18.51 0.20 Kudligi</td>
<td>J G C Os B J P Os Rg. R W S</td>
<td>J G C Os B J P Os Rg. R W S</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Sandur</td>
<td>2.74 20.56 5.92 14.04 0.63 22.12 11.25 5.96 8.04 7.35 0.89 Sandur</td>
<td>Os J B J P Os C Rg G R S W</td>
<td>Os J B J P Os C Rg G R S W</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Sirguppa</td>
<td>9.09 24.36 - 1.80 2.94 20.88 2.85 12.08 5.38 17.53 2.59 Sirguppa</td>
<td>J Os C G R Os W P S B J -</td>
<td>J Os C G R Os W P S B J -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>District Total</td>
<td>6.64 25.57 3.11 4.04 2.59 11.35 5.51 17.08 7.27 15.20 1.65 Total</td>
<td>J G C Os R P B J Rg W S</td>
<td>J G C Os R P B J Rg W S</td>
<td></td>
</tr>
</tbody>
</table>

* Hārpanahalli, J = Jowar, R = Rice, Rg = Bagi, B J = Bajra, W = Wheat, O C = Other Cereals, P = Pulses, G = Groundnut, O S = Other Oil Seeds, C = Cotton and S = Sugarcane.
### Table 20.

**Bellary District**

Ranking of Crops During 1985-86

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the Taluka</th>
<th>Talukwise Percentages of Area Under Different Crops to the Net Sown Area</th>
<th>Talukwise Ranking of Different Crops (According to their Percentages)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>J</td>
</tr>
<tr>
<td>1.</td>
<td>Bellary</td>
<td>8.10</td>
<td>23.46</td>
</tr>
<tr>
<td>2.</td>
<td>Hadagalli</td>
<td>0.11</td>
<td>55.15</td>
</tr>
<tr>
<td>3.</td>
<td>H.B.Halli*</td>
<td>0.55</td>
<td>20.42</td>
</tr>
<tr>
<td>4.</td>
<td>Harpanahalli</td>
<td>1.57</td>
<td>25.48</td>
</tr>
<tr>
<td>5.</td>
<td>Hospet</td>
<td>21.51</td>
<td>12.29</td>
</tr>
<tr>
<td>6.</td>
<td>Kudligi</td>
<td>0.61</td>
<td>17.26</td>
</tr>
<tr>
<td>7.</td>
<td>Sandur</td>
<td>1.53</td>
<td>24.59</td>
</tr>
<tr>
<td>8.</td>
<td>Sirguppa</td>
<td>16.40</td>
<td>26.07</td>
</tr>
<tr>
<td></td>
<td><strong>District Total</strong></td>
<td>6.17</td>
<td>23.41</td>
</tr>
</tbody>
</table>

* Hagaribommanahalli

J = Jowar, R = Rice, Rg = Ragi, Bj = Bajra, W = Wheat, Oc = Other Cereals, P = Pulses, G = Groundnut, Os = Other Oil Seeds, C = Cotton and S = Sugarcane.
crops in the year 1985-86 were in the second rank. Jowar in Hadagalli and Sandur talukas, other cereals in Hagaribommanahalli, Hospet and Sirguppa talukas, rice in Bellary taluka, cotton in Harpanahalli taluka and groundnut in Kudligi taluka were ranked second. In the year 1985-86, jowar in Bellary, Hagaribommanahalli and Kudligi talukas; cotton in Hadagalli and Hospet talukas, ragi in Harpanahalli and Sandur talukas and rice in Sirguppa taluka ranked second.

Change:

Rice is replaced by jowar in Bellary, Jowar is replaced by cotton in Hadagalli, cotton is replaced by ragi in Harpanahalli, other cereals were replaced by jowar in Hagaribommanahalli, by rice in Sirguppa and by cotton in Hospet, groundnut is replaced by jowar in Kudligi and jowar is replaced by ragi in Sandur talukas.

Third Ranking Crop:

There are five crops which rank third in the different talukas of the district in both the years of study. They are groundnut, cotton, jowar, rice and bajra; groundnut in Bellary
and Harpanahalli talukas, cotton in Hadagalli, Kudligi and Sirguppa talukas, jowar in Hagaribommanahalli, rice in Hospet and Bajra in Sandur talukas. In the year 1985-86 though the number of crops remain the same, the names of the crops are not the same. They are jowar, cotton, groundnut, other cereals and other oil seeds. Other cereals in Hagaribommanahalli, Kudligi and Sandur talukas, groundnut in Hadagalli and Sirguppa talukas, other oil seeds in Bellary, cotton in Harpanahalli and jowar in Hospet taluka occupy third rank.

Change:

In Bellary, groundnut is replaced by other oil seeds, in Hadagalli cotton is replaced by groundnut, in Harpanahalli groundnut is replaced by cotton, in Hagaribommanahalli jowar is replaced by other cereals, in Hospet rice is replaced by jowar, in Kudligi cotton is replaced by other cereals, in Sandur bajra is replaced by other cereals and in Sirguppa cotton is replaced by groundnut.

Fourth Ranking Crops:

There are six crops included in this rank in the year 1975-76 and four crops in the year 1985-86.
In the year 1975-76 other oil seeds in Hadagalli, Hagaribommanahalli and Kudligi talukas, cotton in Bellary taluka, Ragi in Harpanahalli taluka, sugarcane in Hospet taluka, pulses in Sandur taluka and groundnut in Sirguppa taluka got the fourth rank.

In 1985-86, other cereals in Bellary, Hospet and Sirguppa talukas, other oil seeds in Hadagalli, Hagaribommanahalli and Sandur talukas, pulses in Harpanahalli, and ragi in Kudligi talukas received the fourth rank.

**Change:**

In Bellary taluka cotton is replaced by other cereals, in Harpanahalli taluka ragi is replaced by pulses, in Hospet taluka sugarcane is replaced by other cereals, in Kudligi taluka other oil seeds replaced by ragi, in Sandur taluka pulses are replaced by other oil seeds and in Sirguppa taluka groundnut is replaced by other cereals, in Hadagalli and Hagaribommanahalli talukas there is no change.
Fifth Ranking Crops:

The number of crops included in this rank are four for both the years of study. In the year 1975-76 other oil seeds in Bellary and Sandur talukas, bajra in Hadagalli and Kudligi talukas, pulses in Harpanahalli, Hagaribommanahalli and Hospet talukas and rice in Sirguppa taluka occupied the fifth rank. In 1985-86 rice in Bellary taluka, pulses in Hadagalli, Hagaribommanahalli, Hospet and Sandur talukas, and other oil seeds in Harpanahalli and Kudligi talukas and cotton in Sirguppa talukas were grown as fifth ranking crops.

Change:

In Bellary taluka rice is replaced by other oil seeds, in Hadagalli taluka bajra is replaced by pulses, in Harpanahalli taluka pulses were replaced by other oil seeds, Hagaribommanahalli and Hospet talukas had no change. In Kudligi taluka bajra was replaced by other oil seeds, in Sandur taluka other oil seeds were replaced by pulses and in Sirguppa taluka rice was replaced by cotton.

Sixth Ranking Crops:

The number of crops included in this rank are four in the year 1975-76 and seven in the year 1985-86. In 1975-76
other cereals in Bellary and Hadagalli talukas, other oil seeds in Harpanahalli and Sirguppa talukas, cotton in Hagaribommanahalli, Hospet and Sandur talukas and pulses in Kudligi taluka occupied the sixth rank. In 1985-86, pulses in Bellary and Kudligi talukas, other cereals in Hadagalli taluka, groundnut in Harpanahalli taluka, cotton in Hagaribommanahalli taluka, sugarcane in Hospet taluka, bajra in Sandur taluka and other oil seeds in Sirguppa taluka ranked sixth.

**Change:**

In Bellary taluka other cereals were replaced by pulses, in Harpanahalli taluka other oil seeds were replaced by groundnut, in Hospet taluka cotton was replaced by sugarcane. In Sandur taluka cotton was replaced by bajra and in Hadagalli, Hagaribommanahalli, Kudligi and Sirguppa talukas had no change.

**Seventh Ranking Crops:**

In this rank there are five crops in the year 1975-76 and four in the year 1985-86.

In 1975-76 wheat in Bellary and Sirguppa talukas, pulses in Hadagalli taluka, other cereals in Harpanahalli and
Kudligi talukas, ragi in Hagaribommanahalli and Sandur talukas and other oil seeds in Hospet taluka occupied the seventh rank.

In the year 1985-86 bajra in Bellary, Sirguppa and Hospet talukas, ragi in Hadagalli and Hagaribommanahalli talukas, other cereals in Harpanahalli taluka and cotton in Kudligi and Sandur talukas were grown as seventh ranked crops.

Change:

In Bellary taluka wheat was replaced by bajra, pulses were replaced by ragi in Hadagalli, other oil seeds were replaced by bajra in Hospet taluka, other cereals were replaced by cotton in Kudligi taluka, ragi was replaced by cotton in Sandur, taluka and wheat was replaced by bajra in Sirguppa. Harpanahalli and Hagaribommanahalli talukas had no change.

Eighth Ranking Crops:

In this rank seven crops were included in the year 1975-76 whereas in the year 1985-86 only five crops were grown.

In the year 1975-76 bajra in Bellary taluka, sugarcane in Hadagalli taluka, rice in Harpanahalli and Hagaribommanahalli
talukas, wheat in Hospet taluka, ragi in Kudligi taluka, 
groundnut in Sandur taluka and pulses in Sirguppa taluka
were grown as eighth ranking crops. In the year 1985-86 ground­
ut in Bellary, Hospet and Sandur talukas, wheat in Hadagalli
taluka, rice in Harpanahalli taluka, bajra in Kudligi and
Hagaribommanahalli talukas and pulses in Sirguppa taluka
were ranked 8th.

Change:

In Bellary taluka bajra was replaced by groundnut,
sugarcane was replaced by wheat in Hadagalli, rice was repla­
ced by bajra in Hagaribommanahalli, wheat was replaced by
groundnut in Hospet, ragi was replaced by bajra in Kudligi,
bajra was replaced by rice in Sirguppa, whereas Harpanahalli
and Sandur talukas had no change.

Ninth Ranking Crops:

There are five crops in this rank in both the years of
study (1975-76 and 1985-86).

In 1975-76 pulses in Bellary taluka, wheat in Hadagalli
and Harpanahalli talukas, bajra in Hagaribommanahalli and
Hospet talukas, rice in Kudligi and Sandur talukas and Sugarcane in Sirguppa were grown as ninth ranking crops. In 1985-86 wheat in Bellary and Harpanahalli talukas, bajra in Hadagalli, rice in Hagaribommanahalli, Kudligi and Sandur talukas, other oil seeds in Hospet taluka and sugarcane in Sirguppa taluka were the ninth ranking crops.

Change:

In Bellary taluka pulses were replaced by wheat, in Hadagalli taluka wheat was replaced by bajra. In Hagaribommanahalli taluka bajra was replaced by rice, in Hospet taluka bajra was replaced by other oil seeds, whereas Harpanahalli, Kudligi, Sandur and Sirguppa talukas had no change.

Tenth Ranking Crops:

Here are also five crops in this rank during both the study periods. In the year 1975-76 sugarcane in Bellary and Sandur talukas, ragi in Hadagalli taluka, bajra in Harpanahalli and Sirguppa talukas, wheat in Hagaribommanahalli and Kudligi talukas and groundnut in Hospet taluka were grown as tenth ranking crops.
In 1985-86 sugarcane in Bellary and Sandur talukas, rice in Hadagalli, Bajra in Harpanahalli, wheat in Hagaribommanahalli, Kudligi and Sirguppa talukas and ragi in Hospet taluka were cultivated as tenth ranking crops.

Change:

Bellary, Hagaribommanahalli, Harpanahalli, Kudligi and Sandur talukas had no change.

Ragi was replaced by rice in Hadagalli, Groundnut was replaced by ragi in Hospet, bajra was replaced by wheat in Sirguppa.

Eleventh Ranking Crops:

There are four crops in this rank in the year 1975-76 but in the year 1985-86 they were reduced to two crops.

In 1975-76 ragi in Bellary and Hospet talukas, rice in Hadagalli, Sugarcane in Harpanahalli, Hagaribommanahalli, Kudligi talukas and wheat in Sandur taluka were cultivated as eleventh ranking crops.
In 1985-86 sugarcane in Harpanahalli and Hagaribommanna-
halli talukas, wheat in Hospet and Sandur talukas were grown as eleventh ranking crops.

Change:

Bellary, Hadagalli and Kudligi talukas were considered and there were no eleventh ranked crops in the year 1985-86. On the other hand, in Sirguppa taluka there were no crops of eleventh rank in both the years of study. Ragi was replaced by wheat in Hospet. There was no change of crops in Harpanahalli, Hagaribommannahalli and Sandur talukas.

The replacement of crops in different talukas of Bellary district was due to various reasons. The increase of area under irrigation had given rise to the cultivation of commercial crops like cotton, sugarcane and oil seeds. In the dry farming talukas usually jowar, bajra and minor millets were grown without much replacement. During some years when rainfall is below the normal average it could also give rise to the replacement of crops. The villages that are close to urban centres can also practise the replacement of crops from
one to another from year to year. The increasing values of certain crops like cotton, sugarcane and groundnut can very often yield better results to the replacement of crops. The spread of technological innovations have also a profound impact on the changing rank position in different talukas. Therefore, our experiences during field work reveal that all the above factors/reasons are responsible in bringing the changing pattern of ranking of crops from 1975-76 to 1985-86.

5.2 Crop Concentration:

The spatial distribution of cropping pattern is a result of multidimensional interactions of its determinants. The pattern of crop distribution reveals the variations in the density of any crop grown in the district at a given point of time. Therefore an attempt is made here to identify the crop concentration pattern at two points of time (1975-76 and 1985-86). Such studies help us in getting a clear picture of the complex agricultural landscape and also help us in making a scientific analysis of the agricultural systems. In this analysis the distributional pattern is shown into high, medium
and low density categories of major crops. The designation of an area into jowar or cotton, for instance, conveys the degree of its density of cultivation.

In order to determine the concentration of cropping pattern in Bellary district the modified location quotient method as applied by Jasbir Singh in his indepth study of crop concentration of Haryana is used. 78

Methodology:

The general concentration of an enterprise can be quantified with the help of location quotient or coefficient of localisation. This technique was primarily used to study industrial location (1948) and was also used by the urban geographers like Powanall (1953), Webb (1959), etc. for determining functional characters of an area. Later on the agricultural geographers Jasbir Singh (1972) used it in a modified way (The location quotient values are to be transferred by percentages).

The modified formula is expressed as follows:

$$\text{C}_i = \frac{\text{Pae}}{\text{Par}} \times 100$$

Where:
- $\text{C}_i$ is the crop concentration index
- $\text{Pae}$ is the percentage of area of 'a' crop in a taluka
- $\text{Par}$ is the percentage of area of 'a' crop in Bellary district.

Higher the index value of a crop concentration indicates that higher is the area under that crop. These would give us an idea of the level of concentration of crops.

On two points of time (1975-76 and 1985-86) talukawise crop concentration indices ($\text{C}_i$) are calculated in Bellary district. Then on the basis of those indices the volume of change is also calculated. The result is plotted on the map so as to get a visual picture of crop concentration strength in the study period. This is a useful technique to measure crop concentration pattern in the district. The studies of crop concentration can also give certain clue to develop the system of agriculture to suggest suitable strategies. The continuous high concentration of a particular crop in a taluka
can also harm the soil structure and related ecology. Therefore crop concentration studies must be used as a better tool of analysis in measuring the different associated parameters of crop cultivation like rainfall, porosity of soil, demand of a particular crop, etc.

Jowar:

In 1975-76 all the talukas in the district had very high concentration of the crop i.e., more than 80 index value of concentration. On the other hand in 1985-86 except Harpanahalli and Hospet talukas all talukas had high concentration of the crop. This replacement is due to the adoption of commercial crops in irrigated portions of Hospet and Harpanahalli talukas. (vide Table 21 for concentration index values).

Volume of Change:

Kudligi followed by Hadagalli and Sandur talukas had low increase and Hadagalli and Sirguppa talukas had very low increase over 1975-76, on the other hand Hospet taluka had low decrease and Bellary and Nagaribommanshali had very low decrease compared to 1975-76.
Cotton:

In the year 1975-76, very high concentration of the crop was found in Hadagalli, Harpanahalli, Kudligi and Sirguppa talukas of the district. Whereas high concentration was in Bellary taluka, medium concentration was in Hospet and Sandur talukas. Hagaribommanahalli taluka had low concentration of the crop. On the other hand, in the year 1985-86, very high concentration of the cotton was in Bellary, Hadagalli, Harpanahalli and Hospet talukas. High concentration was found in Hagaribommanahalli and Sandur talukas of the district.

Volume of Change:

Hospet taluka had very high and Bellary and Hadagalli talukas had very low concentration of cotton. On the other hand, very high decrease was in Sirguppa taluka, medium decrease in Sandur taluka, low decrease in Hadagalli and Harpanahalli talukas and very low decrease in Kudligi taluka.

Groundnut:

In the year 1975-76, very high concentration of the crop was found in Hadagalli, Harpanahalli, Kudligi and Bellary
talukas of the district, high concentration was found in Hagarihommanahalli and Sirguppa talukas, low was found in Sandur taluka and very low was in Hospet taluka of the district. On the other hand in the year 1985-86 very high concentration of the crop was found in Harpanahalli, Kudligi Sirguppa and Hadagalli talukas of the district. Hagarihommanahalli and Hospet talukas had high concentration and Bellary as well as Sirguppa talukas had medium concentration of groundnut.

**Volume of Change:**

Harpanahalli taluka had increased very high, Sirguppa taluka had high increase, Hospet had medium increase and Kudligi taluka had low increase by 1985-86. In the same period, Hadagalli taluka had very high decrease, Bellary taluka had medium decrease and Hagarihommanahalli and Sandur talukas had very low decline of the groundnut.

**Other Cereals:**

In the year 1975-76 Sandur, Sirguppa, Harpanahalli and Hospet talukas had very high concentration of the crop, Bellary taluka had high concentration, Kudligi taluka had medium concentration and Hadagalli and Hagarihommanahalli talukas had low
concentration of the crop. On the other hand, in the year 1985-86, Kudligi, Harpanahalli, Sandur, Sirguppa, Hospet and Bellary talukas had very high concentration of other cereals and Hadagalli taluka had medium concentration.

**Volume of Change:**

Kudligi taluka had very high increase, Hadagalli and Hagaribommanahalli talukas had low increase and Bellary taluka had very low increase in the concentration of other cereals. On the other hand, Hospet and Sirguppa talukas had decreased very high, Kudligi taluka had high decline and Harpanahalli taluka had low decline of other cereals.

**Other Oil Seeds:**

In the year 1975-76 Harpanahalli, Sandur, Bellary Kudligi and Hagaribommanahalli had very high concentration of the other oil seeds. Sirguppa, Hadagalli, and Hospet talukas had high concentration. On the other hand, in 1985-86 Sandur Harpanahalli, Hadagalli, Kudligi and Bellary talukas had very high concentration. Hagaribommanahalli and Sirguppa talukas had high concentration and Hospet taluka had medium concentration.
Volume of Change:

Hadagalli and Sandur talukas had low increase and Hospet, Kudligi and Sirguppa talukas had very low increase. On the other hand, the low decrease was found in Harpanahalli taluka and in Bellary, whereas Hagaribommanahalli had very low decrease during 1985-86.

Ragi:

In the year 1975-76 Hagaribommanahalli, Sandur and Harpanahalli talukas had very high concentration of Ragi. Kudligi taluka was under high concentration. The remaining three talukas were under very low concentration of ragi. On the other hand in 1985-86 the concentration of the crop is very high in Hagaribommanahalli, Kudligi and Sandur talukas, whereas Hadagalli taluka witnessed high concentration, Harpanahalli had medium and Hospet had low concentration. In Bellary and Sirguppa talukas ragi was not cultivated.

Volume of Change:

Sandur, Hadagalli and Kudligi talukas had increased their area under ragi to very high, medium and low respectively
during 1975-76, whereas in the remaining all talukas the crop is reduced. Hagaribommanahalli and Harpanahalli talukas appeared as very high decline whereas Bellary and Harpanahalli had reached very low. In Sirguppa taluka there is no cultivation of crop at all.

Pulses:

In the year 1975-76 Sandur, Hagaribommanahalli, Harpanahalli, Hospet and Kudligi talukas had very high concentration, Bellary and Sirguppa talukas had medium concentration, and Hadagalli taluka had low concentration of pulses. On the other hand, in 1985-86 Sandur, Hospet, Kudligi, Harpanahalli, Hagaribommanahalli and Hadagalli talukas had very high concentration, Bellary taluka had high and Sirguppa taluka had medium concentration.

Volume of Change:

Hadagalli taluka had increased very high, Bellary, Kudligi and Hospet talukas had increased very low. High decline was found in Hadagalli, medium decline was in Sandur and very low decline was in Harpanahalli and Sirguppa talukas.
Rice:

In 1975-76 the concentration of the crop was very high in Bellary, Hospet and Sirguppa talukas. Medium was in Harpanahalli and Sandur talukas, low in Hagaribommanahalli and Kudligi talukas and very low was in Hadagalli taluka. On the other hand in 1985-86 very high was found in Hospet, Sirguppa and Bellary talukas, low was found in Hagaribommanahalli and Sandur and very low was found in Kudligi, Harpanahalli and Hadagalli talukas. The rice being a wet crop, it is naturally very highly concentrated in more irrigated talukas.

Volume of Change:

Sirguppa and Hospet talukas fall under very high concentration of rice whereas Bellary taluka was reduced to a large extent, whereas there was medium reduction in Harpanahalli. In the remaining talukas the reduction was very low (vide Fig.17).

Bajra:

In the year 1975-76 Sandur, Kudligi, Bellary and Hospet talukas had registered very high concentration of bajra, Hadagalli and Harpanahalli talukas had high concentration,
BELLARY DISTRICT
PERCENTAGE CHANGES IN CROP CONCENTRATION
1975-76 to 1985-86

Fig. 17
Sirguppa had medium and Hagaribommanahalli taluka had very low concentration. On the other hand, in 1985-86 Sirguppa, Hospet, Kudligi, Bellary talukas had very high concentration of bajra, Harpanahalli taluka had high whereas in the remaining Hadagalli and Hagaribommanahalli talukas had very low concentration of the crop.

**Volume of Change:**

Hospet and Sirguppa talukas had increased very high whereas Bellary and Harpanahalli talukas had increased very low concentration. On the other hand, Sandur taluka had decreased very high but in Kudligi taluka the decrease was low and in Hagaribommanahalli taluka the decrease was very low by 1985-86.

**Sugarcane:**

In the year 1975-76 abnormal high concentration of sugarcane crop was found in Hospet taluka with the concentration index of 873.33 followed by Sirguppa taluka with 183.72 index value, the remaining six talukas of the district were
meagre producers of sugarcane. In the year 1985-86 the picture of the concentration of the crop had not been changed. Again Hospet taluka stood first with concentration index value of 940.79 and next followed by Sirguppa with 183.72 index value. The remaining six talukas were again meagre producers of sugarcane.

**Volume of Change:**

Hospet and Sirguppa talukas had gained the area under the crop still further. In addition a meagre producer of sugarcane Bellary taluka which is one of the important irrigated talukas of the district also gained hectarage under the crop. In all the remaining dry farming talukas the crop concentration was not only very low but was very unimportant crop.

**Wheat:**

In the year 1975-76 Bellary, Hospet and Sirguppa talukas had very high concentration of the crop, Hagaribommanahalli, Harpanahalli and Sandur talukas had low concentration of the
crop and in Hadagalli and Kudligi talukas the concentration of the crop was very low. On the other hand in 1985-86 Hadagalli Hospet, Hagaribommanahalli, Harpanahalli, Sirguppa and Kudligi talukas had very high concentration of wheat and Sandur had medium concentration.

**Volume of Change:**

Hadagalli and Hagaribommanahalli talukas had increased very high, Harpanahalli and Kudligi had increased high and low increase was in Sandur taluka. On the other hand, very high decrease was in Bellary taluka, low decline in Sirguppa taluka and very low decline in Hospet taluka.

5.3 **Crop Combination.**

A comprehensive understanding of the pattern of agricultural land use of a region needs an analytical description of the combinational association of the crops. Crops are the principal index of the agricultural typology of an area. Therefore, many a time the agricultural regions are known after their dominant crops e.g., Jowar region (belt), Cotton region, so on. Such studies have confined themselves only to the
dominant individual crops rather than the complex agricultural system. This results in over generalisations because the individual crops occur only in rare circumstances of extreme mono-culture (Weaver 1954). The delineation of crop combination regions constitute a significant aspect of agricultural geography as it provides a sound basis for developmental planning in agriculture. The studies which have confined themselves to the description of dominant individual crops usually suffer from over generalisation because the individual crops except in relatively rare circumstances of extreme mono-culture are not grown alone, but characteristically they appear in combinations. The concept of crop combination is a scientific device to study the existing spatial relationships of crops in association with each other in agricultural geography. "A crop is seldom grown in isolation though its proportion may be exceptionally high. Cultivated plants are generally grown in combinational associations. Its delimitation is not an end in itself but only a tool towards a better understanding

of the agricultural situation". Owing to its importance the problem has engaged the attention of geographers and agricultural land use planners in recent years. Since the environmental prerequisites of all crops are basically known, such regionalisation can help to understand how the diverse elements of environment influence the crops in the region. Moreover crop combination regions are used as a basis for planning and they have been accepted as suitable devices for improvements in under developed regions or countries.

An intuitive classification based on objective judgements like wheat belt, rice belt, etc. have no statistical base. All these belts have multiple crops but all of them may not be equally important at every place as some may be very significant while others might be quite inconsequential. It is, therefore essential to adopt a statistical base for identifying the group of significant crops which present the agricultural personality of a region.

A general understanding of the particular combination of the crops and their relative importance of each in an area can be very helpful in interpreting some aspects of social and

Techniques Applied:

A realistic statistical method for the delineation of crop combinations was adopted by Weaver to know the agricultural regions of middle-west in the United States. In this study Weaver has taken into account the percentages of cropped area to the gross cropped area and has calculated deviation of actual areal percentages of crops to that of a theoretical

---

standard for each component areal unit. The theoretical standard is 100.00 per cent to the net sown area in monoculture, 50.00 per cent for two crops combination, 33.33 per cent for three crops combination, 25.00 per cent for 4 crops combination, and so on. For the determination of the minimum deviation for each of the component areal units the standard deviation method was as follows:

\[ \sigma = \sqrt{\frac{\sum d^2}{n}} \]

However, Weaver has pointed out the relative rank of the amount of deviation among the several possible combinations as was desired by him and not the actual magnitude of the deviation, the square root was not extracted in accordance with the standard deviation formula. The specially used variant procedure can, therefore be expressed as follows:

\[ \sigma = \frac{\sum d^2}{n} \]

Where 'd' is the difference between the actual crop percentage and percentage in a theoretical curve and 'n' is the number of crops in a given combination.
A modification over Weaver's method has been put forward by Doi, K. This new method substitutes \( \frac{\sum d^2}{n} \) of Weaver's with sum of squared differences \( \sum d^2 \). The lowest value of \( \sum d^2 \) is the combination of the crops.

The minimum deviation method which was advocated by Weaver tends to include all the crops in the series including very minor crops occupying 1 per cent of the net sown area. This results in an over-generalised combination. In order to overcome this weakness (i.e., over generalisation) Rafiullah (1965) introduced the maximum positive deviation method. Although the formula suffers from laborious calculations, it is quite suitable for delineating sharply the primary crop combinations.

The formula is as follows:

\[
\sigma = \sqrt{\frac{D_p^2 - D_n^2}{N^2}}
\]

Where

- \( \sigma \) = is the deviation
- \( D_p \) = is the positive difference
- \( D_n \) = is the negative difference from medial value of the theoretical curve of the combination.
- \( N \) = is the number of crops in the combination.

Since deviation is relative, the root sign may be ignored to save labourious calculations and hence the formula can be expressed as follows:

$$ \delta = \sqrt{\frac{\sum Dp^2 - \sum Dn^2}{N^2}} $$

In addition to these, this researcher has tested Thomas\(^3\) (1963) least squared method and A.G. Athawale\(^4\) (1966) lower limit method.

Thomas' method is again the modified Weaver's method which includes all the crops upto zero per cent theoretical values also in each step of the comparison and applies the method in deriving crop combinations in Wales. Instead of restricting the crops to the number involved in the combination, Thomas includes all crops in the series under discussion. As this method involves all the crops in each step, there is no need of dividing \( \sum a^2 \) by \( n \). Thus, the formula for the least squared deviation method may be expressed as follows:

$$ \delta^2 = \sum a^2 $$

---


In each step we get some value of $\sigma^2$. The theoretical percentage which gives the minimum value of $\sigma^2$ (least squared deviation) is considered to be matching the reality. Thomas formula however, makes the calculations unnecessarily tedious without having marked differences from the results obtained by Weaver's method.

**Lower Limit Method:**

Athawale, A.G. (1966) has evolved three new methods for crop combinational analysis which are less time consuming and sometimes give lesser number of crops in combination. These three methods are: (1) method of difference, (2) method of summation and (3) lower limit method.

These methods devised by Athawale have been fully described and tried in Andhra Pradesh at the district level to derive the crop combinations. After describing all the three methods in detail he himself opines that the third method is the best because of its simplicity and flexibility and hence, the lower limit method (which itself is modified one) is considered here. In this method Athawale has attempted to
associate the value of $N$ (the number of crops to be included in the combination) to determine the crop combination. To attain the lower limit in terms of acreage of crops he introduced the formula given below.

$$A = \frac{G}{3N}$$

Where $A$ is the lower limit in terms of acreage,

$G$ = Gross Cropped Area

$N$ = Number of crops having acreage more than or equal to $G/100$.

According to this formula all crops having acreages more than $A$ will find place in crop combination.

To illustrate this technique Athawale has given an example which is as follows:

Let $G = 1250$ and the crop acreage be $800, 200, 150, 50, 25, 10, 10$ and $5$

Then $G/100 = 1250/100 = 12.50$

Hence $N = 5$ (since only 5 crops have acreage more than 12.50)

and the lower limit $A = \frac{G}{3N} = \frac{1250}{3 \times 5} = 84$.

There are three crops above 84 and hence combination would be tri-culture i.e., 3 crop combination.
Athawale's Lower Limit Method is very simple as it does not require much calculations and as it also saves the time taken in calculating the percentage of all crops from Gross Cropped Area (GCA) and hence it appears to be a better and suitable method for deriving accurate combination regions within no time and without no defects of labourious calculations like those of other ones. After calculating the data with the above methods it is found that Rafiullah's method is better suited to analyse the crop combinational pattern of Bellary district. Therefore, the foregoing analysis explains the crop combination of the study area only with the help of Rafiullah's method.

**Maximum Positive Deviation Method by Rafiullah:**

In this method, the differences of actual percentage values are calculated from the median theoretical standard value which results in an advantage over Weaver's method as it reduces the number of crops in the combination. Weaver's method considers very wide combinations for the units of high crop specialisation. On the other hand, maximum positive deviation method includes a lesser number of crops and thus avoids
the inclusion of insignificant crops in the combination. Weaver's and Doi's methods have practically failed to delineate a precise combination and include all crops occupying as much as one per cent of the total cropped area. But, the application of Rafiullah method gives such combinations which are true representatives of primary crops. The maximum deviation method devised by Rafiullah gets the ascendancy over Weaver and Doi methods as this method reduces the number of crops in combination. Thus it simplifies the crop association map which can be helpful in the designation of agricultural regions of the area chosen. Thus, the method would give the desired critical combinations. Keeping the merits of the method in view the results of Rafiullah's method are interpreted in detail in the foregoing analysis and are plotted on figure. (vide Fig. 13).

With reference to the above figure and table it is evident that no taluka emerges as monoculture and two crop combination in Bellary district (i.e., 1975-76 and 1985-86).

**Three Crops Combination:**

During 1975-76, Hadagalli and Harpanahalli talukas had three crops combination (JGC). During 1985-86 Bellary(C,J,Os)
ABBREVIATIONS

J = JOWAR
R = RICE
C = COTTON
S = SUGARCANE
G = GROUNDNUT
P = PULSES
W = WHEAT
Oc = OTHER CEREALS
Os = OTHER OIL SEEDS
Bj = BAJRA
Rg = RAGI

NUMBER OF CROPS

1975-76 | INDEX | 1985-86 | NUMBER OF CROPS
--- | --- | --- | ---
G J C | 3a | C J Os | 3
J C G | 3b | J C G |
J G C Os | 4 | J Rg C P |
J R G C Os | 5a | G J Oc Os P |
G Oc J Os P | 5b | R C J Os P |
Oc J Bj P Os | 5c | J Rg Oc Os P |
J Oc C G R | 5d | J R G Oc C |
J Oc R S P C | 6 | G J Oc Rg Os P |

Fig. 18
and Hadagalli (J,C,G) had three crop combination. The Harpanahalli taluka which had three crops combination during 1975-76 falls under four crops (J,Rg,C, and P) combination (vide table- 22).

Four Crops Combination:

During 1975-76 there was only Kudligi taluka with four crops (J,G,C,Os) combination. Similarly during 1985-86 there was only one taluka under four crops (J,Rg,C,P) combination, Harpanahalli which had three crops combination in the previous period, now falls under this category.

Five Crops Combination:

During 1975-76 there were four talukas viz., Bellary, Hagaribommahalli, Sandur and Sirguppa with five crops combination, whereas during 1985-86 Hagaribommahalli, Hospet, Sandur and Sirguppa talukas had five crops combination. Hospet taluka which was under six crop combination had been reduced to five crops combination by 1985-86. Therefore the three talukas (Hagaribommahalli, Sandur and Sirguppa) have remained unchanged in the combination pattern.
Six Crops Combination:

During 1975-76 Hospet taluka had six crops combination whereas the next study period it was reduced to five crops. During 1985-86 Kudligi taluka alone appears with six crops combination whereas in the previous period this taluka was under four crops combination.

Our field observations, discussions with concerned authorities and village case studies reveal that the crop combinations from one taluka to another have changed due to some significant reasons like: The fluctuations of rainfall and the area under irrigation, impact of urban centres, variations in the prices of the crops and above all the percentage of subsistence level in each taluka.

5.4 Cropping Intensity:

The extension of cultivation is not a matter of significance at present except for achieving the local gains. Intensity of cropping, extent of maturity and increasing the yield from the existing cultivated area are of paramount importance in the agricultural economy of a region. These need a serious thought by the planners. Under-utilisation
of a land is no problem in a region, since most of the topographically accessible area for cultivation is already under plough, but the problems of the under use of the net area sown, under productivity and the risk of crop failures are taxing the rural population. It would be a useful gain to overcome these problems in the foreseeable future. Hence it is desirable to investigate the degree of efficiency with which the net area sown is utilised.

Land use efficiency is defined as 'the extent to which the net area sown is resown'. The total cropped area (gross area sown) as a percentage of the net area sown (net cropped area) gives a measure of land use efficiency which really means the intensity of cropping. The intensity of cropping refers to the number of crops raised on a field during an agricultural year; for example, if one crop is grown on a field in one year the index of intensity of cropping is 100 per cent, if two crops in a year are produced, the intensity index will be 200 per cent. Therefore the higher the index of intensity of cropping, the higher is the land use efficiency, and the lower the index, the lower is the land use efficiency.
Intensity of land use in Bellary district is exceedingly complex. In this area, it has been further accentuated by the impact of continued irrigational development and the State intervention in agriculture. The extension of irrigation from the canals and tube wells improved the use of agricultural land and increased the hectare yields adding to agricultural progress.

The following formula is used to delineate the talukas of land use intensity:

\[
I.C. = \frac{\text{Gross Cropped Area}}{\text{Net Sown Area}} \times 100
\]

Where I.C. = Intensity of Cropping

Gross Cropped Area = Net Sown area plus sown more than once in a year (double crop)

Net Sown Area = Area Sown only once in a year.

During 1975-76 the area sown more than once in the district as a whole was 16,701 hectares whereas in the year 1985-86 it was increased to 74,782 hectares. The talukawise intensity of cropping is grouped with the help of mean and standard deviation method. Accordingly the following analysis is made (vide table 23).
### Bellary District

#### Cropping Intensity Regions

<table>
<thead>
<tr>
<th>Intensity Regions</th>
<th>Range of Indices *</th>
<th>No. of Talukas</th>
<th>Names of the Talukas</th>
<th>Intensity Regions</th>
<th>Range of Indices *</th>
<th>No. of Talukas</th>
<th>Name of the Talukas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>&gt; 125.36</td>
<td>1</td>
<td>Hadagalli</td>
<td>Very High</td>
<td>&gt; 127.09</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>High</td>
<td>125.36 to 115.38</td>
<td>-</td>
<td>Hospet and Sirguppa</td>
<td>High</td>
<td>127.09 to 120.09</td>
<td>1</td>
<td>Hospet</td>
</tr>
<tr>
<td>Medium</td>
<td>116.07 to 108.40</td>
<td>2</td>
<td>Hospet and Sirguppa</td>
<td>Medium</td>
<td>120.09 to 113.08</td>
<td>4</td>
<td>Bellary, Hadagalli, Sandur and Sirguppa</td>
</tr>
<tr>
<td>Low</td>
<td>108.39 to 99.92</td>
<td>5</td>
<td>H.B.Halli, Harpanahalli, Sandur, Bellary and Kudligi</td>
<td>Low</td>
<td>113.07 to 106.08</td>
<td>3</td>
<td>H.B.Halli, Harpanahalli, Sandur, Bellary and Kudligi</td>
</tr>
<tr>
<td>Very Low</td>
<td>&lt; 99.92</td>
<td>-</td>
<td>-</td>
<td>Very Low</td>
<td>&lt; 106.08</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* The Ranges of Indices are Calculated on the basis of Mean to Mean + 1 SD and Mean to Mean - 1 SD etc. S.D. means Standard Deviation.

** Hagaribommanahalli.
In the year 1975-76 Hadagalli taluka was found as very high intensity cropping region in the district (vide Fig. 19). On the other hand, Hospet and Sirguppa talukas had medium intensity and Hagaribommanahalli, Harpanahalli, Sandur and Kudligi talukas were under low intensity group, whereas under high and very low intensity of cropping no taluka was found (vide table 23). Among the 8 talukas of the district Hadagalli taluka had got more area under irrigation through wells and tanks than other talukas. This factor is responsible to some extent for the double cropping in the taluka. Besides this, the favourable occurrence of rains also influences the farmers to grow more than one crop. Hence, Hadagalli taluka falls under very high intensity group. Hospet and Sirguppa talukas were included in medium group because these two have canal irrigation. Under this assured water supply the farmers can grow either sugarcane or cotton but both of these two crops take nearly one full year. As a result percentage of land under double cropping can be less than in other talukas. Under low intensity group both irrigated and non-irrigated talukas were included. Bellary taluka ranks first in the district under total percentage of irrigated land. As a result of this
the taluka had more area under single commercial crop i.e., cotton. Therefore, it falls under low intensity group. There are a few more talukas like Hagaribommanahalli, Harpanahalli, Sandur and Kudligi which also fall under low intensity group due to scanty rainfall, infertile soils and more land under waste.

In 1985-86:

The cropping intensity in this year changed (Fig.19) to a considerable extent (vide table 24 and 25). There are no talukas under very high and very low intensity groups, whereas under high intensity group the Hospet taluka had varied chances to grow not only one year crop but also the truck gardening crops like vegetables, etc. As a result Hospet taluka shares more land under double cropping than the rest of the talukas. Medium intensity group Bellary, Hadagalli, Sandur and Sirguppa talukas were included. Though Bellary taluka had canal irrigation, it had not changed its cropping pattern as it has black soils and can cultivate cotton which is a long duration crop, hence it is included in medium group. The remaining other talukas were depending upon rainfall conditions. Low intensity was found in Hagaribommanahalli, Harpanahalli and
Table -24

Bellary District:
Talukwise Intensity of Cropping and the Change from 1975-76 to 1985-86.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Taluka</th>
<th>1975-76 Gross Cropped Area (In Hects.)</th>
<th>1975-76 Net Sown Indices</th>
<th>1985-86 Gross Cropped Area (In Hects.)</th>
<th>1985-86 Net Sown Indices</th>
<th>Change in Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
</tr>
<tr>
<td>1.</td>
<td>Bellary</td>
<td>1,35,790</td>
<td>1,26,477</td>
<td>107.56</td>
<td>1,49,699</td>
<td>1,27,966</td>
</tr>
<tr>
<td>2.</td>
<td>Hadagalli</td>
<td>81,486</td>
<td>72,436</td>
<td>125.30</td>
<td>75,745</td>
<td>64,154</td>
</tr>
<tr>
<td>3.</td>
<td>Hagaribommanahalli</td>
<td>60,641</td>
<td>60,133</td>
<td>100.84</td>
<td>66,790</td>
<td>61,624</td>
</tr>
<tr>
<td>4.</td>
<td>Harpanahalli</td>
<td>94,353</td>
<td>93,211</td>
<td>101.23</td>
<td>1,00,086</td>
<td>99,993</td>
</tr>
<tr>
<td>5.</td>
<td>Hospet</td>
<td>50,268</td>
<td>43,645</td>
<td>115.17</td>
<td>53,074</td>
<td>42,173</td>
</tr>
<tr>
<td>6.</td>
<td>Kudligi</td>
<td>88,575</td>
<td>87,818</td>
<td>100.86</td>
<td>1,02,312</td>
<td>93,572</td>
</tr>
<tr>
<td>7.</td>
<td>Sandur</td>
<td>44,091</td>
<td>42,729</td>
<td>103.19</td>
<td>45,326</td>
<td>40,559</td>
</tr>
<tr>
<td>8.</td>
<td>Sirguppa</td>
<td>89,612</td>
<td>79,810</td>
<td>112.28</td>
<td>92,246</td>
<td>81,234</td>
</tr>
<tr>
<td>District</td>
<td></td>
<td>6,22,951</td>
<td>6,06,250</td>
<td>102.75</td>
<td>6,86,057</td>
<td>6,11,275</td>
</tr>
</tbody>
</table>
## Table 25
Bellary District:

Percentage Changes in Cropping Intensity from 1975-76 to 1985-86.

<table>
<thead>
<tr>
<th>Intensity Regions</th>
<th>Range of Percentage</th>
<th>No. of Talukas</th>
<th>Names of the Talukas</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>$&gt; 12.33$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Medium</td>
<td>12.33 to 8.22</td>
<td>3</td>
<td>Bellary, Hospet and Kudligi</td>
</tr>
<tr>
<td>Low</td>
<td>8.21 to 4.11</td>
<td>2</td>
<td>Hagaribommanahalli and Sandur</td>
</tr>
<tr>
<td>Very Low</td>
<td>$&lt; 4.11$</td>
<td>3</td>
<td>Hadagalli, Harpanahalli and Sirguppa</td>
</tr>
</tbody>
</table>

Total 8
Kudligi talukas because they had to depend exclusively on rainfall conditions. If the rainfall is better their intensity of cropping would also be improved and if it is less then the intensity also is less.

5.5 **Crop Diversification:**

The diversification of cropping pattern means raising of variety of crops in an arable land. The keener the competition of crops, the higher will be the magnitude of diversification. In fact, it is obvious that greater the number of crops in a combination, the larger would be the degree of diversification. The differential and multiplicity of cropping in the areal units is partly the result of the interactions of various agroclimatic phenomena and partly the differential effects of economic and cultural forces. Crop diversity is an important component of the crop geography of a region. It refers to crop variety. "Larger the number of crops grown in

an area during a year with each crop occupying equal proportion of crop land the higher is the crop diversification".  

In a diversified cropping system soil nutrients extracted by some crops are likely to be replenished by others grown in rotation as against a specialised system where a few of them may be taxed heavily.  

Objectives of the Study of Crop Diversification:  

1) The main objective of the study of crop diversification in Bellary district lies in the fact that it enables us to understand the impact of physical and socio-economic conditions on the agricultural mosaic of the district.  

2) It helps us to know the contemporary competition amongst crops, scope for rotation and effect on double cropping, and also productivity.  

3) For complete comprehension of the geography of crops in the district the interpretation of their diversification is essential.  

In view of these objectives an attempt is made to analyse the nature of crop diversification and its spatio-temporal variations in Bellary district.

Measurement of Crop Diversification: A Review of Literature:

Crop diversification has been engaging the attention of geographers since long. However, attempts have been made towards its objective measurements recently. Though the study of crop diversification was attempted by a number of geographers in the cropping pattern, Stress, Konkling, Parr, Shear, Ayyar, Mavi, Gibbs and Martin are noteworthy. Most of them have dealt specially with crop diversification.

Tress, T.C. (1939)\(^88\) Edgar Conkling R. (1963)\(^89\) Shear, James A. (1975)\(^90\) and Parr, John B. (1965)\(^91\) have used Lorenz curve for measuring diversification. But the method suffers from the following defects:


1) It leads to tedious calculations,
2) It is not so precise and accurate,
3) It gives only the broad idea of diversification, and
4) The planimetric, graphic or mathematical measurement of an area between the diagonal and the curve is quite laborious.

S.S. Bhatia (1965) has evolved a single formula by taking into account the total cropped area to make an objective measurement of crop diversification. He took the ratio between the area under all those crops which cover up to five per cent of the crop land and the 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 weaknesses.

1) Instead of using five per cent and more than five as it is arbitrary limit the actual number of crops should have been considered for every unit separately.

2) Some crops which are left out just because of less than 5 per cent of the net sown area may be of great importance.

3) It is supersensitive because of fixing more than 5 per cent value, and

4) The index is too insensitive towards the highest value of diversification, for example, if, no value is more than 10 per cent, the index acquires indeterminate form.

Mavi (1963) rectified this drawback by taking the ratio between the mean of the differences in percentage of crops under each of which is more than 5 per cent of the total cropped area. This method is also not accepted because of the following weaknesses:

1) The method is not a better representative of the number of factors (number of crops), and

2) It gives only a broad idea of diversification of crops.

N.F. Ayyar (1969) has modified Bhatia's method taking into account only those crops which occupy at least 1.0 percent of the gross cropped area. For each unit the standard of evenness is chosen differently according to the actual number of crops. This method also fails to identify clearly the critical values produced by the ideal distribution and hence it is proved to be supersensitive.

Method Adopted in the Study:

The quantitative technique proposed by Gibbs and Martin for measuring crop diversification provides a useful alternative index for measuring the degree of diversification in the cropping pattern of an area. The formula developed for calculating the index was as under:

\[
\text{Index of Diversification} = 1 - \frac{\sum_{i=1}^{n} x_i^2}{n} \times 100
\]

Where \(X = \) Percentage occupied by each crop or hectarage under individual crop to the total cropped area


If the total cultivated area in a region is 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 has overcome the defects which occur in other methods:

i) It has taken into consideration both the evenness of factor (creative strength of crops) and number of factors (number of crops) perfectly to form the basis of proper measurement of diversity.

ii) The method is neither insensitive nor supersensitive like Bhatia's method and is devoid of critical values.

iii) The figures can be adjusted into hundreds, thousands, millions, etc. which will not alter the results.

iv) The indices are directly related to diversification whereas, they are inversely related to diversification in other methods, and

v) The indices are not only relative but also are precise in calculation.
In view of these advantages the Gibbs and Martin Index of diversification has proved to be suitable in measuring the diversification of crops in Bellary district, and is adopted to study at two points of time i.e., 1975-76 and 1985-86. The results are plotted in Fig. 20.

Spatio-Temporal Analysis:

The preceding tables and figures indicate that the indices have been worked out for spatial distribution of crop diversification at the taluka and district levels. The district level index decreases from 91 to 86 which means the diversity is declining in the study period (vide tables 26 and 27). This, of course, is marginal (-5). This may be due to the higher cost of cultivation and lesser prices for agricultural produce in the market. As a result of this, the farmers are more attracted to growing better remunerative crops like cotton, groundnut, other oil seeds and pulses. These crops are competing with and are replacing foodgrains like jowar, bajra, wheat, and other cereals. Sugarcane is replaced by cotton and paddy (Rice). Though jowar shows a declining tendency it still occupies the highest hectarage in the spatial
CHANGE IN CROP DIVERSIFICATION
1975-76 to 1985-86

BELLA B D I S T R I C T
CROP DIVERSIFICATION
1975-76

Fig. 20
TABLE 26
Bellery District
Crop Diversification - 1975-76
(Gibbs and Martin 'et al. :)
Area in hectares

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Rice</th>
<th>Jowar</th>
<th>Ragi</th>
<th>Bajra</th>
<th>'Sheat</th>
<th>Other Cereals</th>
<th>Pulses</th>
<th>Groundnut</th>
<th>Other Oil Seeds</th>
<th>Sugar-cane</th>
<th>Cotton</th>
<th>Index of Diversification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
<td>(11)</td>
<td>(12)</td>
<td>(13)</td>
</tr>
<tr>
<td>1. Bellary</td>
<td>20,194</td>
<td>33,045</td>
<td>300</td>
<td>5,410</td>
<td>9,920</td>
<td>10,202</td>
<td>3,747</td>
<td>18,558</td>
<td>10,541</td>
<td>364</td>
<td>14,396</td>
<td>0.85</td>
</tr>
<tr>
<td>2. Dadgall</td>
<td>125</td>
<td>21,112</td>
<td>250</td>
<td>2,200</td>
<td>292</td>
<td>2,000</td>
<td>1,009</td>
<td>24,535</td>
<td>3,401</td>
<td>298</td>
<td>17,204</td>
<td>0.74</td>
</tr>
<tr>
<td>3. K.B. Ballyi</td>
<td>1,950</td>
<td>10,910</td>
<td>2,540</td>
<td>1,600</td>
<td>343</td>
<td>12,499</td>
<td>4,500</td>
<td>14,490</td>
<td>7,703</td>
<td>78</td>
<td>3,420</td>
<td>0.84</td>
</tr>
<tr>
<td>4. Largamma</td>
<td>1,702</td>
<td>26,370</td>
<td>11,242</td>
<td>424</td>
<td>510</td>
<td>4,125</td>
<td>8,981</td>
<td>12,613</td>
<td>6,100</td>
<td>394</td>
<td>20,900</td>
<td>0.82</td>
</tr>
<tr>
<td>5. Hospet</td>
<td>5,516</td>
<td>9,372</td>
<td>55</td>
<td>1,558</td>
<td>1,534</td>
<td>8,690</td>
<td>3,041</td>
<td>1,341</td>
<td>2,000</td>
<td>6,289</td>
<td>2,848</td>
<td>0.66</td>
</tr>
<tr>
<td>6. Kutch</td>
<td>1,253</td>
<td>25,522</td>
<td>1,826</td>
<td>5,859</td>
<td>375</td>
<td>4,565</td>
<td>5,010</td>
<td>20,128</td>
<td>6,440</td>
<td>175</td>
<td>15,253</td>
<td>0.81</td>
</tr>
<tr>
<td>7. Sirmur</td>
<td>1,170</td>
<td>8,825</td>
<td>2,528</td>
<td>6,000</td>
<td>268</td>
<td>9,452</td>
<td>4,809</td>
<td>2,375</td>
<td>3,777</td>
<td>382</td>
<td>3,142</td>
<td>0.66</td>
</tr>
<tr>
<td>8. Kuppa</td>
<td>7,251</td>
<td>19,840</td>
<td>-</td>
<td>1,440</td>
<td>2,350</td>
<td>16,556</td>
<td>2,272</td>
<td>9,540</td>
<td>4,292</td>
<td>2,069</td>
<td>13,990</td>
<td>0.84</td>
</tr>
<tr>
<td>District Total</td>
<td>40,272</td>
<td>15,497</td>
<td>13,942</td>
<td>24,491</td>
<td>15,692</td>
<td>68,300</td>
<td>33,959</td>
<td>1,03,530</td>
<td>44,054</td>
<td>10,050</td>
<td>92,153</td>
<td>0.83</td>
</tr>
</tbody>
</table>

\( \frac{\sum X^2}{100} \)
### Table - 27

**Bellar District**

**Crop Diversification - 1965-66**

*(Gibbs and Martin's method)*

<table>
<thead>
<tr>
<th>Name of the Taluka</th>
<th>Rice</th>
<th>Jowar</th>
<th>Bajra</th>
<th>Millet</th>
<th>'heat</th>
<th>Other Cereals</th>
<th>Pulses</th>
<th>Ground-Nut</th>
<th>Other Oil Seeds</th>
<th>Sugar-cane</th>
<th>Cotton</th>
<th>(Σ X)^2</th>
<th>(Σ X)^2</th>
<th>Index of Diversification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bellary</td>
<td>10,358</td>
<td>29,992</td>
<td>-</td>
<td>5,258</td>
<td>405</td>
<td>11,551</td>
<td>6,983</td>
<td>4,345</td>
<td>13,341</td>
<td>300</td>
<td>45,253</td>
<td>1155732502</td>
<td>79349713950</td>
<td>79</td>
</tr>
<tr>
<td>2. Kedgali</td>
<td>80</td>
<td>22,549</td>
<td>3,559</td>
<td>279</td>
<td>737</td>
<td>3,955</td>
<td>5,124</td>
<td>8,514</td>
<td>6,932</td>
<td>-</td>
<td>12,257</td>
<td>840283028</td>
<td>4115733750</td>
<td>80</td>
</tr>
<tr>
<td>3. K.J. Ellli</td>
<td>342</td>
<td>17,595</td>
<td>2,139</td>
<td>1,569</td>
<td>304</td>
<td>10,107</td>
<td>5,557</td>
<td>15,972</td>
<td>8,703</td>
<td>16</td>
<td>4,220</td>
<td>389245033</td>
<td>3059973889</td>
<td>84</td>
</tr>
<tr>
<td>4. Karpamalikli</td>
<td>1,573</td>
<td>25,477</td>
<td>25,057</td>
<td>110</td>
<td>538</td>
<td>6,769</td>
<td>8,244</td>
<td>6,949</td>
<td>7,107</td>
<td>97</td>
<td>17,952</td>
<td>1315357071</td>
<td>999860049</td>
<td>82</td>
</tr>
<tr>
<td>5. Hospet</td>
<td>9,114</td>
<td>5,179</td>
<td>3,128</td>
<td>288</td>
<td>4,235</td>
<td>4,232</td>
<td>3,030</td>
<td>2,429</td>
<td>3,409</td>
<td>5,239</td>
<td>277420583</td>
<td>1904868025</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>6. Vyu Lika</td>
<td>570</td>
<td>17,196</td>
<td>13,035</td>
<td>4,964</td>
<td>528</td>
<td>15,465</td>
<td>8,728</td>
<td>15,758</td>
<td>10,073</td>
<td>-</td>
<td>7,425</td>
<td>1451332850</td>
<td>7718001124</td>
<td>82</td>
</tr>
<tr>
<td>7. Janpur</td>
<td>621</td>
<td>9,999</td>
<td>6,254</td>
<td>3,303</td>
<td>100</td>
<td>5,930</td>
<td>5,277</td>
<td>1,425</td>
<td>5,871</td>
<td>174</td>
<td>1,705</td>
<td>294250111</td>
<td>1929784441</td>
<td>86</td>
</tr>
<tr>
<td>8. Sirjaguppa</td>
<td>14,946</td>
<td>21,179</td>
<td>-</td>
<td>3,810</td>
<td>385</td>
<td>8,608</td>
<td>3,251</td>
<td>13,214</td>
<td>6,292</td>
<td>1,282</td>
<td>8,267</td>
<td>1046037956</td>
<td>6599336100</td>
<td>84</td>
</tr>
</tbody>
</table>

**District Total** | 37,704 | 1,43,113 | 50,934 | 22,521 | 3,145 | 66,641 | 47,506 | 70,117 | 50,748 | 5,278 | 1,03,568 | 51473025225 | 373957125425 | 86 |

*Note: ΣX^2 represents the sum of the squares of the values.*
distribution of the crops in both the years because it is a staple food crop. There is a drastic decline in the area under groundnut because of untimely rains and diseases to the crops. There is an increase from 92,153 hectarage to 1,03,568 hectarare under cotton in a span of ten years in the total crop complex of the district. It is mostly due to greater adoption of high yielding varieties of the seeds and better prices in the market.

Taluka-level Analysis:

The taluka level crop diversification analysis in Bellary district reveals a different picture from that of the district. As per the results of 1975-76 Hadagalli taluka (74 index value) has the lowest diversity whereas Hospet and Sandur talukas have highest index value 86. On the other hand, in the year 1985-86 the lowest diversity index (79) was in Bellary taluka and the highest index (86) was in Sandur taluka.

A marginal variation of crop diversification (-6) is noticed in Bellary taluka due to impact of intensive and extensive irrigation, as a result of which farmers are attracted to growing cash crops like cotton and sugarcane instead of
food crops. Hagaribommanahalli, Harpanahalli, Sandur and Sirguppa talukas have no variation in diversification of crops. The high range of increased diversity of the crops was in Hadagalli taluka with 14 index value. The scanty rainfall and increase of underground water table very often lead the farmers to grow a variety of food crops especially the minor millets, etc., which may take shorter growing periods and have higher degree of crop diversity in Hadagalli taluka.

Changes in Crop Diversification:

The critical analysis of the results of the diversification of crops clearly reveals that all the talukas of Bellary district as a whole have generally high diversity of agricultural crops. The comparison from taluka to taluka indicates that there is a marginal variation which is grouped as follows (vide Fig. 20 and Table 28).

i) Decreased diversification (i.e. -1 to 6 index value)

ii) Increased diversification (i.e. +1 to 14 index value)

iii) No diversification i.e. Nil (no change in index value).
1) Decreased Diversification:

Bellary and Hospet talukas in the (Bellary) district have recorded a decline in the diversification of crops. Fertile soils and adequate amount of irrigation facilities are well suited to grow economically valuable crops e.g., cotton and sugarcane. The area under cotton has risen more than 3 times in Bellary taluka which alone contributes 35.38 per cent to the net sown area of the taluka. In Bellary taluka area under rice reduces more than half and groundnut reduces more than one fourth compared to 1975-76.

Hospet taluka of the district also has shown a marginal decline of (01) index value. This is also one of the highly irrigated talukas of the district and proved to incline towards specialisation. The taluka is covered with red and black soils. The rice grown in red soils is replaced by sugarcane. In the medium irrigated tracts of the district, groundnut can be cultivated profitably. In the black soil area with moderate amount of irrigation hybrid cotton can be cultivated profitably. Therefore the area under these crops had risen by more than double.
ii) Increased Diversification:

This is found in Hadagalli taluka of the district. Agriculture in this taluka exclusively depends upon the courtesy of the rainfall. This naturally leads for more diversification. The index value of diversification shown in the study period is +14 which means there is a clear cut inclination of cultivation of more number of crops in the taluka.

Kudligi taluka records a marginal increase of (+1) diversification. It has very negligible irrigational facilities and hence depends upon rainfall. As a result of this uncertainty of the rainfall the farmers have to inevitably grow cereal crops by which they can harvest some of the food grains and fodder.

No Diversification:

Hagaribommanahalli, Harpanahalli, Sandur and Sirguppa talukas of the district have recorded no diversification of the crops in the study period which indicates a stand still situation in cropping pattern and agricultural land use - leading to the subsistence nature of agriculture.
Table - 28

Bellary District

Talukwise Diversification Indices and Their Changes from 1975-76 to 1985-86

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Taluka</th>
<th>ID 1975-76</th>
<th>ID 1985-86</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bellary</td>
<td>85</td>
<td>79</td>
<td>-06</td>
</tr>
<tr>
<td>2.</td>
<td>Kadagalli</td>
<td>74</td>
<td>80</td>
<td>+14+6</td>
</tr>
<tr>
<td>3.</td>
<td>Hagaribommannahalli</td>
<td>84</td>
<td>84</td>
<td>Nil</td>
</tr>
<tr>
<td>4.</td>
<td>Harpanahalli</td>
<td>82</td>
<td>82</td>
<td>Nil</td>
</tr>
<tr>
<td>5.</td>
<td>Hospet</td>
<td>86</td>
<td>85</td>
<td>-01</td>
</tr>
<tr>
<td>6.</td>
<td>Kudligi</td>
<td>81</td>
<td>82</td>
<td>+01</td>
</tr>
<tr>
<td>7.</td>
<td>Sandur</td>
<td>86</td>
<td>86</td>
<td>Nil</td>
</tr>
<tr>
<td>8.</td>
<td>Sirguppa</td>
<td>84</td>
<td>84</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>District</td>
<td>91</td>
<td>86</td>
<td>-05</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>83</td>
<td>83</td>
<td>Nil</td>
</tr>
</tbody>
</table>
Summary:

There are eleven crops grown in Bellary district during both the study periods. The changing pattern of ranking of crops from one taluka to another and from 1975-76 to 1985-86 indicates the changing importance of crop value and its utility. The crop concentration study helps us to know which are the talukas that can be affected by degradation of the soil ecology and how it can be reduced by changing the range of concentration. High concentration of crops is associated with high intensity of irrigation and vice-versa in case of dry farming. The crop combinational analysis indicates no monoculture in the entire district. As per Rafiullah's method the district exhibits 3 to 6 crops combination. It can be noted that lesser the number of crops (3 crops) combination higher is the taluka irrigated and/or higher is the share of commercial crops. In case of more number of crops (six crops) combination more is the dryness of arable land and more is the combination of food crops at subsistence farming. The cropping intensity indicates the frequency of use of arable land. Higher degree of intensity is created with higher percentage of irrigated land. The low
Intensity is very well noted in dry farming talukas. Similarly the crop diversification is related to quality of soil, amount of rainfall received and percentage of irrigation. Thus the entire chapter gives us certain clues to mark out the regionalisation of agriculture in Bellary district.