CHAPTER V
CROP COMBINATIONS AND CROP DIVERSIFICATION

Introduction:

Cultivated crops are generally grown in combinational association (Weaver, 1954). Crop combinations or associations are now recognised as important typological characteristics of agriculture (Pande and Saxena, 1972). Due to physical and cultural diversity of land, the farmers of a region grow many crops rather than a single crop. Thus the distributional pattern of crops gives rise spatial predominance of certain crops or combination of certain crops resulting in the emergence of crop regions.

A study of crop combinations forms an integral part of agricultural geography, and such a study is greatly helpful in regional agricultural planning, especially to optimise a crop farming.

Crop concentration or diversification is the result of diversity in agro-climatic, topographical,
edaphic and socio-economic conditions as well as intensity of irrigation, technological level and institutional factors. The objectives considered in the present chapter are:

(i) Identification of the important crop combinations on the basis of Doi's method.

(ii) Measurement of the levels of diversification of the cropping pattern by applying the Gibbs-Martin statistical method.

**Crop combination Technique:**

A number of quantitative and non-quantitative methods are developed for the determination of crop combinations and delimitation of crop regions. In non-quantitative methods, crops are arranged or ranked in hierarchial order and crop combinations are determined intuitively. The ease of these methods is their simplicity in calculation.

Quantitative techniques are more accurate, clearly defined, scientific and objective. In identifying crop combinations and to study the distribution of crop regions, they are very useful. The minimum deviation method developed by Weaver (1959) was perhaps the
first attempt for the delineation of agricultural
regions of the Middle West in the United States.
Weaver computed the percentage of total harvested
cropland occupied by each crop that held as much as
one per cent of the total cultivated land in each of
the 1081 counties covered in his work.

In order to rectify the shortcomings of
Weaver's method, certain modifications have been
developed by some geographers. Thomas (1963) modified
Weaver's method by including all the crops with zero
per cent theoretical values in each step of the method,
in the crop combination studies carried out in Wales.
But it did not yield results much different from the
results obtained by Weaver's method. Coppock (1964)
modified the Thomas method and applied in demarcating
crop and livestock combinations, and combinations of
enterprises in England and Wales. Here an attempt is
made to integrate all crop and livestock in to appropriate
agricultural enterprise combinations on the
basis of mandays. Rafiullah (1965) attempted to modify
Weaver's method and introduced a new deviation called "Maximum positive deviation". But it has no theoretical
basis and to that extent it is conceptually unsound.
Weaver's method as modified by Doi (1959) when applied by Siddiqui in the deficiency disease combinations in U.P., 1972, gave more realistic results which can be obtained with the help of a table of critical values in a short time.

Doi (1959) followed Weaver's method, but avoided too much of time consuming calculations by excluding \(N\) from the formula and by introducing pre-calculated critical values. By making use of the table, the crop combinations in any region, can be readily and easily determined. This method is more meritorious than the others, in the sense that it is simple, elegant and involves practically no calculations, while at the same time it yields a realistic crop combinations. Further, this method can be applied to any type of region and the results obtained are comparable.

Methodology:

Here, Mandal is taken as the basic unit to analyse the crop combinations in the district. The crop data for the year 1987-88 has been considered for this purpose. To examine temporal changes in the crop combinations, crop data for the year 1974-75 and
## DOI'S TABLE

(An abridged part of the deviation analysis table, Rank of element)

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</tr>
</tbody>
</table>

1984-85 on talukwise basis are considered because of the fact that the mandals were formed only after 1985. Doi's method is employed to analyse the crop combinations in the district.

An endeavour is made to measure the degree of diversification of crop combinations by employing Gibbs - Martin Index of diversification.

**Crop combinations (1987-88):**

The crop combinations in the district are identified by employing Doi's method for the whole year. Broadly speaking, the following crops namely paddy, jowar, bajra, groundnut, fruits, tobacco, ragi, pulses, vegetables, spices and condiments, sesame, sugarcane crops found at least in one of the crop combinations and hence these crops are considered for discussion. The distributional pattern of the combinations revealed eight major crop combinations. In all, the above 12 crops are involved in these combinations. Both in area and number, a mono-crop combination, namely 'paddy' is more prevalent in the district.
TABLE 5.1: Distribution of major crop combinations 1987-88

<table>
<thead>
<tr>
<th>Crop combination</th>
<th>No. of Mandals</th>
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</thead>
<tbody>
<tr>
<td>One crop combination</td>
<td>20</td>
</tr>
<tr>
<td>Two crop combination</td>
<td>9</td>
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<tr>
<td>Three crop combination</td>
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<td>Four crop combination</td>
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<td>Five crop combination</td>
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<tr>
<td>Six crop combination</td>
<td>2</td>
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<tr>
<td>Seven crop combination</td>
<td>-</td>
</tr>
<tr>
<td>Eight crop combination</td>
<td>2</td>
</tr>
</tbody>
</table>

Monoculture (or) One crop combination:

Monoculture is found in 43 per cent of Mandals of the district (Fig. 5.1) (Table 5.1). Paddy is in monopolistic position of monoculture. All the coastal mandals are confined to this combination.

Two-crop combination:

This is the second largest combination in the district and account 19 per cent of the mandals. In all
the two crop combinations paddy is cultivated as first crop in combination with groundnut only. The two crop combinations are found in Kota, Ozile, Tada, Vakadu, Naidupet, Dakkili, Pellakur, Venkatagiri and Balayapalli mandals which are generally confined to the southern part of this district.

Three crop combination:

Only 13 per cent of mandals in the district exhibit three crop combinations. Of the total three crop combinations, paddy, fruits and groundnut combination is found in Sydapuram and Gudur mandals. Paddy, groundnut and tobacco combination is observed in A.S. Peta mandal. Paddy, jowar and tobacco combination noticed in Atmakur mandal, jowar groundnut and Ragi combination is seen in Varikuntapadu mandal and the other combination i.e. groundnut, bajra and paddy is found in Seetharampuram mandal. These are confined to North-west and Central part of the district.

Four crop combination:

About 13 per cent of mandals fall in four crop combination category. Jowar, paddy, fruits and pulses combination is observed in Podalakur and Kaluvoya mandals. Jowar, paddy, pulses and fruit combination is seen in Chegerla mandal only. Paddy,
groundnut, jowar and fruits combination is found in Rapur mandal. Paddy, jowar, tobacco and spices and condiments' combination is noticed in Kondapuram mandal, and groundnut, ragi, paddy, and bajra combination is found in Udayagiri mandal. These areas are found in the Western part of the district especially on the southern bank of the river Pennar.

**Five-crop combination**:

Only 2 per cent of mandals exhibit five crop combination. The only mandal that exhibit five crop combination is Ananthasagaram where the combination is paddy, jowar, bajra, groundnut and tobacco.

**Six crop combination**:

Nearly 4 per cent of mandals in the district have this type of combination. Tobacco, jowar, groundnut, paddy, ragi and bajra and jowar, paddy, groundnut, bajra, ragi and tobacco combinations are observed in Marripadu and Vinjamur mandals respectively.

**Seven crop combination**:

It may be stated that seven crop combination is absent in this district.
Eight crop combination:

In this district about 4 per cent of mandals exhibit eight crop combination. They are Duttalur and Kaligiri mandals. The eight crop combination observed is like jowar, bajra, ragi, groundnut, tobacco, spices and condiments, sesamum, pulses; paddy, tobacco, jowar, spices and condiments, bajra, ragi, vegetables, pulses respectively.

Changing crop combinations, 1974-75 to 1984-85:

During the year 1974-75, it is observed that there are six crop combinations, whereas as in 1984-85, it came down to five crop combinations. The following are the different types of combinations noticed in the district during the study period.

### TABLE 5.2: Crop combinations - 1974-75 to 1984-85

<table>
<thead>
<tr>
<th>Crop combinations</th>
<th>No. of Taluks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1974-75</td>
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<tr>
<td>One crop combination</td>
<td>3</td>
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<tr>
<td>Two crop combination</td>
<td>2</td>
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<tr>
<td>Three crop combination</td>
<td>1</td>
</tr>
<tr>
<td>Four crop combination</td>
<td>2</td>
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<tr>
<td>Five crop combination</td>
<td>-</td>
</tr>
<tr>
<td>Six crop combination</td>
<td>1</td>
</tr>
</tbody>
</table>
NELLORE DISTRICT
CROP COMBINATION

1974-75

1984-85

LEGEND

MONO CROP

TWO CROP

THREE CROP

FOUR CROP

FIVE CROP

SIX CROP

P - PADDY, J - JOWAR, B - BAJRA, R - RAGI, G - GROUNDNUT, S - SUGARCANE, T - TOBACCO, Tp - PULSES, Tm - MINOR MILLETS
TV - VEGETABLES
TF - FRUITS

FIG - 5.2
Monoculture (or) one crop combination:

During the year 1974-75, 3 taluks are under monoculture with paddy. They are Nellore, Kovur and Sullurpet taluks. And in 1984-85, one crop combination of paddy is found in Nellore and Kovur taluks. There is a decrease in number of taluks in one crop combinations from 3 taluks during 1974-75 to 2 taluks during 1984-85 (Fig 5.2, Table 5.2).

Two crop combination:

During the year 1974-75 two types of two crops combinations are found in Gudur (Paddy + jowar) and Venkatagiri (paddy + bajra) taluks. Where as during the year 1984-85 only one type of two crop combination (paddy + groundnut) is seen in both Gudur and Sullurpet taluks. Here the number of taluks in two crop combination is neither decreased nor increased.

Three crop combination:

In the number of taluks in three crop combination, there is no change during the years 1974-75 and 1984-85. The only change is in crops of combination. During the year 1974-75, three crop combination is found in Kavali taluk with crops like paddy, jowar and tobacco,
The same combination is observed in the some mandal during the year 1984-85 also. As far as three crop combination there is neither change in the crop nor over space.

Four crop combination:

It may be stated that two different types of combinations are acknowledged both in 1974-75 and 1984-85. Jowar, groundnut, paddy and pulses combination in Rapur taluk and paddy, jowar, tobacco and groundnut combination in Atmakur taluk has been observed in the year 1974-75. Whereas, in 1984-85, four crop combination is found in 3 taluks, with different crops. Paddy, sasamum, groundnut and bajra combination in Venkatagiri taluk; paddy, jowar, tobacco and bajra combination in Udayagiri taluk and jowar, paddy, vegetables and fruits combination in Rapur taluk. So, as far as four crop combination, there is a change both in crops and space (Fig. 5.2).

Five crop combination:

This combination is absent during the year 1974-75. But five crop combination is emerged in Atmakur taluk during the year 1984-85 with the following crops, i.e., jowar, paddy, tobacco, pulses and vegetables. This
is a new combination in the year 1984-85 comparing to 1974-75.

**Six crop combination:**

Under this combination, jowar, bajra, ragi, paddy, pulses and minor millets are the crops found in Udayagiri taluk during the year 1974-75. This type of combination is absent in 1984-85. So, there is a decrease in area under six crop combination.

**Crop diversification:**

The term 'crop specialisation' indicates cultivation of fewer number of crops and 'crop diversification' implies raising a variety of crops from the soil. "The keener the competition, the higher the magnitude of diversification, and lesser the competition, the greater will be the trend towards specialisation or monocultural farming where emphasis is on one or two crops" (Jashir Singh, 1976, p. 317). "In fact it is obvious that greater the number of crops in a combination, the greater will be the degree of diversification" (Ayyar, N.P., 1969, p. 18). The study of crop diversification is needed to know the competition that exists among crops in a region.
Methodology:

Bhatia (1965) developed a simple formula to measure the degree of crop diversification. The index of diversification is obtained by dividing the sum total of percentages of cultivated area under a crop occupying more than 5 per cent of the sown area with the number of such crops. Here the lower is the value of the index, the higher will be the diversification and vice versa. Ayyar (1969) modified Bhatia's (1965) method and took into account only those crops which occupy at least 1 per cent of the gross cropped area. Jasbir Singh (1976) adopted the crop diversification technique of Bhatia in a modified form by taking into account the gross harvested area of the crops which occupy more than 5 per cent of the harvested area.

The Gibbs Martin Index of Diversification (1962) provides an useful alternative index for measuring the degree of diversification in the cropping pattern in an area and the formula developed for calculating the index is as follows:

\[ \text{Index of Diversification} = 1 - \frac{\sum x^2}{(\sum x)^2} \]

Where 'x' is the percentage of the total cropped area occupied by each crop or hectarage under individual crop.
If the total cultivated area in a region is devoted wholly to one crop showing specialisation, the index value will be zero, and if it is evenly distributed among many crops showing maximum diversification, the index value approaches one. This method has an advantage over the other methods in that here

(i) the statistics of the crops need not be reduced into percentages, and

(ii) the indices indicate the magnitude of diversification in direct proportion.

Hence, the Gibbs-Martin method (1962) is employed in the present study to measure crop diversification. For selecting the major crops the procedure followed in this method is as follows. Divide 100 by 'N', number of crops grown in an areal unit. Then consider only those crops as important if they cover an area larger than \( \frac{100}{N} \). For instance, in Nellore district 20 crops are considered for the purpose of calculation. Here only those crops are considered as major crops, if they are cultivated in more than \( \frac{100}{20} \) th percentage of the total cropped land in the district. The rest of the crops which are grown in an area less than \( \frac{100}{N} \) are ignored.
Later the index of diversification is calculated by using the formula.

\[ 1 - \frac{\sum x^2}{(\bar{x})^2} \]

The degree of crop diversification in Nellore district is 0.42. It shows that the agricultural pattern in the district is less diversified. The cropping pattern is almost specialized in the coastal lowland region and more diversified in the western part of the district (Fig. 5.3). The degree of diversification ranging between 0 and 0.9. The highest degree of crop diversification is 0.9 in Duttalur mandal, followed by Vinjamur 0.82.

Very high (>0.80) to high (0.61 - 0.80) diversification is observed in 32 per cent of mandals in the district. Medium (0.41 - 0.60) diversification found in 20 per cent of mandals. And low (0.21 - 0.40) to very low (0.01 - 0.21) diversifications in 30 per cent of the mandals (Table 5.3).

In 18 per cent of mandals there is only specialisation and no diversification. It is found that the specialisation of crops is mostly confined to the deltaic area of the district, i.e., in Kodavalur, Allur,
<table>
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<tr>
<th>Crop diversification (Range in index values)</th>
<th>No. of mandals</th>
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<td>Very high &gt; 0.80</td>
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<tr>
<td>High 0.61 - 0.8</td>
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<td>Medium 0.41 - 0.6</td>
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<td>Low 0.21 - 0.4</td>
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<tr>
<td>Very low 0.01 - 0.2</td>
<td>6</td>
</tr>
<tr>
<td>Nil</td>
<td>8</td>
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</table>
NELLORE DISTRICT
CROP DIVERSIFICATION
1987-88

LEGEND
INDEX VALUES
- > 0.8
- 0.6-0.8
- 0.4-0.6
- 0.2-0.4
- < 0.2
- NIL

FIG - 5.3
Vidavalur, Dagadarthi, Nellore, Muthukur, Venkatachalam and Manubolu mandals. This is confined by the fact that their diversification index is zero.

It is clear from the preceding discussion that cultivation is more intensive, stable and highly productive in the crop-specialisation and low diversification areas, where irrigated farming is common.

Change in crop Diversification, 1974-75 to 1984-85:

The index value of the crop diversification in the district is slightly increased from 0.56 to 0.57 during this decade. Except in Kovur taluk, which registers high specialization in cropping pattern, in other taluks the diversification of crops has shown a marginal increase. The highest increase observed in Sullurpet taluk is from 0.20 in 1974-75 to 0.39 in 1984-85 (Table 5.4). The lowest increase is noticed in Nellore and Udayagiri taluks (0.004) during this period. No change occurred in Kavali taluk. The emergence of cash crops like oil seeds, chillies and fruits have effected diversification of cropping in the district (The percentage cash crops area to the gross cropped area increased from 1974-75 to 1984-85).
<table>
<thead>
<tr>
<th>S.No.</th>
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<th>1984-85</th>
<th>Change</th>
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</thead>
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<td>0.12</td>
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<td>2</td>
<td>Gudur</td>
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<td>0.55</td>
<td>+ 0.05</td>
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<td>Sullurpet</td>
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<td>0.39</td>
<td>+ 0.19</td>
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<td>Venkatagiri</td>
<td>0.59</td>
<td>0.72</td>
<td>+ 0.13</td>
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<td>5</td>
<td>Rapur</td>
<td>0.62</td>
<td>0.72</td>
<td>+ 0.10</td>
</tr>
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<td>Atmakur</td>
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<td>0.84</td>
<td>+ 0.04</td>
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<td>0.56</td>
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<td>Kovur</td>
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<tr>
<td></td>
<td>District</td>
<td>0.56</td>
<td>0.57</td>
<td>+ 0.01</td>
</tr>
</tbody>
</table>
NELLORE DISTRICT

VOLUME OF CHANGE - CROP DIVERSIFICATION
1974-75 TO 1984-85

LEGEND

INCREASE  DECREASE

0.05  
0.06-0.1  
0.11-0.15  
0.15  

0  25
KM

FIG - 5-4
Conclusion:

Crop combinations with a fewer crops i.e., one crop and two crop combinations are more significant than multiple crop combinations. Nearly about 60 per cent of mandals fall in these two combinations only.

Crop combinations with a lesser number of crops are found in coastal low lands. Three-fourths area in this region is highly specialized in paddy cultivation. In contrast more diversification and the combinations with more number of crops are mostly prevalent in the Western part of the district.