CHAPTER VIII

CROP REGIONALISATION AND CROP COMBINATION TYPES

The quantitative analysis and analytical interpretation of crop combinations and / or associations in geographical investigation of agriculture was originally introduced by Weaver (1954) in his study crop combinations of Mid-Western U.S.A. Such a study helps to understand the important typological characteristics of agriculture. Its usefulness is high in designing the crop planning and advocating various solutions which seek to answer ecological problems and socio-economic implications of the emerging crop associations in the various agro-climatic regions.

In any region crop is seldom grown in isolation even where its proportion is exceptionally high. Cultivated crops are generally grown in combinational association (Weaver, 1954). The environmental determinants, socio-economic and technological milieu profoundly influence the association of the crops cultivated in a
region. Therefore, the concepts of crop combination and crop diversification are dynamic and spatially variable. The new agro-technology adopted in the recent times has resulted in significant changes in the degree of crop diversification and crop combination types. In the extreme agro-climatic conditions, the large number of crops may enter into the crop combination types which normally indicate the high diversified subsistence agriculture. Sometimes lesser number of crops may enter into the crop associations but they denote the specialised market oriented economy. Thus for a comprehensive understanding of complex agricultural mosaic and for a progressive agricultural planning the study of crop combinations are of great significance.

The main objectives of the present study are:

(i) delimitation of the primary crop regions based on ranking of crops,

(ii) identification of the basic crop combination types on the basis of Doi's method, and

(iii) examining the extent of diversification of the cropping pattern in the district on the basis of Gibbs - Martin statistical method.

The Crop Combination Techniques:

The different methods which have been developed for identification of crop combination types can be categorised as quantitative and non-quantitative methods. Non-quantitative methods are irrational, subjective and arbitrary in nature. In such methods,
crops are arranged or ranked in hierarchical order and crop combinations are determined intuitively like the first crop only, the first two crops only or the first three crops etc. The virtue of arbitrary methods is their simplicity in calculation.

Quantitative techniques based on statistical approach are more accurate, reliable, well defined, scientific and objective. These statistical methods are useful both in identifying the crop combination types, delineating the distribution of crops and crop diversification. The minimum deviation method based on standard deviation technique developed by Weaver (1954) was perhaps the first attempt designed to determine the crop combination regions of the Mid-west of the U.S.A.

Weaver's minimum deviation method has been criticised by many researchers and rectified some of the short-comings of this method. Thomas (1963) modified Weaver's method by including all the crops with zero per cent theoretical values in each step of the calculation in deriving the crop combination types in Wales. Thomas method involves too many calculations and at the same time did not yield results and were much different from the results obtained by Weaver's method. Thomas method was modified by Coppock (1964) by deleting 'N' (number of crops) from the formula i.e. the division process of the sum of the squared deviations. His modified method was adopted to study agricultural enterprise (both crop and livestock) combinations in England and Wales. Doi (1959) followed Weaver's method but avoided too much of time consuming calculations by
excluding 'N' from the formula and by introducing precalculated critical values.

Rafiullah (1965) attempted to modify Weaver's method and introduced a new deviation called 'maximum positive deviation' in Weaver's formula. But this method has no sound theoretical basis and to that extent it is conceptually unsound. There are number of other methods to identify the crop combination types which may be referred to in this connection, e.g., Johnson's (1958) method, Pownall's (1953) method which was slightly modified by Nelson (1955), Ayyar's (1969) 'maximum distance' method, Athawale's (1966) 'lower limit' method etc.

After critically reviewing the above techniques, it is opted that Doi's method is suitable than the others in the sense that it is simple, exact and involves practically no calculations while at the same time it yields realistic crop combinations which are comparable.

Methodology:

In the present study, the task of the delimiting the first order crop regions is accomplished taking the first ranking crops. Similarly, the second order crop regions and the third-order crop regions are delimited on the basis of the second ranking crops and third ranking crops respectively. Doi's method is employed to identify the crop combination types in the district for the kharif, rabi and gross sown areas. Gibbs-Martin statistical method is employed
to measure the degree of crop diversification. In this study, the analysis of the spatial distributional aspects of crop regions, crop combinations and crop diversification is made at 'mandal' level for the triennium 1986-89 and the temporal changes are examined at 'taluk' level for the trienniums namely, 1962-65, 1972-75 and 1982-85.

**Crop Regions:**

A study of the crop rankings assumes special significance at it brings out the relative dominance of different crops grown in a region. Such a hierarchical arrangement in the distribution of crops not only gives their importance but also provides a basis for regionalisation of agriculture on an arbitrary scale. The environmental determinants and the socio-economic as well as technological conditions profoundly influence or even condition the primary crop regions.

**First Ranking Crops Or First-order Crop Regions (1986-89):**

The delimitation of the first-order crop regions is accomplished on the basis of first rank crops which accounts for the highest percentage of the total cropped area in each of the component areal unit, but no matter what percentage it occupies in the gross cropped area.

In 1986-89, there were 5 first-order crop regions in the district. The spatial distribution of these first ranking crops throws light on the regional character of these crops. For instance, groundnut cultivation showed spatial dominance in the dry lands and rain-shadow areas of Pulivendula basin of western plains and southern plateau; paddy cultivation is prevalent in the irrigated areas of the K.C. canal region and eastern valley, the cultivation of jowar in the black soil
CUDDAPAH DISTRICT
First-Order Crop Regions 1986-89

INDEX

GROUNDNUT
JOWAR
PADDY
FRUITS
BAJRA

0  30
Km
Table 8.1
Distribution of Different Crop Regions In Cuddapah District

<table>
<thead>
<tr>
<th>Crop</th>
<th>Number of Mandals (1986-89)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First-order crop regions</td>
</tr>
<tr>
<td>Groundnut</td>
<td>28</td>
</tr>
<tr>
<td>Paddy</td>
<td>9</td>
</tr>
<tr>
<td>Jowar</td>
<td>8</td>
</tr>
<tr>
<td>Fruits</td>
<td>4</td>
</tr>
<tr>
<td>Bajra</td>
<td>1</td>
</tr>
<tr>
<td>Spices and condiments</td>
<td>-</td>
</tr>
<tr>
<td>Small millets</td>
<td>-</td>
</tr>
<tr>
<td>Pulses and grams</td>
<td>-</td>
</tr>
<tr>
<td>Ragi</td>
<td>-</td>
</tr>
</tbody>
</table>

region of western plains in the north-western part of the district and fruit farming to the areas of well irrigation in the south-eastern valley of the district.

**Groundnut Region:**

Groundnut is the leading crop in the district as it evident from the fact that groundnut forms the largest crop region by accounting 56 per cent of the total mandals in the district. This largest crop region comprises the red loamy soil cover of southern
plateau and the red clay, red sand, black clay and black loam mixed soil groups of the rain-shadow area of southern and south-western parts of western plains in the district. The study has revealed that the physical conditions especially the soils, the undulating terrain and the climate have determined the spatial extent of groundnut crop region in the district.

Paddy Region:

As a first-order crop, paddy cultivation forms the second largest crop region sprawled over 9 mandals in the district. Although it is a poor second, this region quite commonly confined to irrigated areas namely, central portion of the K.C.canal irrigation project and tank irrigated area of mid-eastern valley area. The fertile soils in the valley areas, assured water facilities especially through tanks and wells, and limited land available for cultivation have prompted the farmers to go for intensive cultivation of paddy and for bumper agriculture production.

Jowar Region:

Jowar region is the third largest region in the district comprising 8 mandals in the rain-shadow area of north-western part of the district. The deep black clay soils with low rainfall and low irrigation facilities in the north-western plains facilitated for spectacular spatial spread of jowar cultivation.
Fruit Farming Region:

Interestingly the cultivation of a variety of fruit crops showed that they are also important in their nature farming in region-forming. Fruit crops formed a significant crop region with 4 mandals in the south-eastern valley of the district. Rich red loamy soils in the valley areas and developed well irrigation, limited agricultural land, improved socio-economic conditions and well developed transport network cumulatively effected for the cultivation of intensive commercial fruit crops in this region.

Bajra Region:

Bajra cultivation as a first-order crop is least important in region-formation in Cuddapah district. It is grown as a first rank crop in only one mandal found in the north-eastern part of the district.

Second Ranking Crops or Second-Order Crop Regions (1986-89):

The second ranking crops which include a good number of crops showed a much diversified distribution. As many as 8 crops are identified as second ranking crops in 1986-89. Among them, the trio, namely, paddy, jowar and groundnut occur as the leading second ranking crops in that order. Next in importance among the second rank crops are spices and condiments and fruit crops. Other second ranking crops which are least in hierarchical order are bajra, small millets and pulses each one by occupying one mandal.
Paddy as a second ranking crop grown in 18 mandals formed the largest second-order crop region in the district. This region comprises of the areas of southern plateau and eastern valley where groundnut and fruit crops were the first rank crops. High rainfall conditions and well developed tank and well irrigations in the areas of eastern valley and canal water from Pincha irrigation project and also the development of well irrigation in the areas of southern plateau are favourable conditions for the cultivation of paddy as an intensive crop in rabi season.

The next important second rank crop is jowar in 15 mandals. This crop is mostly distributed in the black loam soil areas of south-western plains (Pulivendula basin). In this region jowar is an associated crop to groundnut cultivating in the undulating grounds under low rainfall conditions.

Groundnut is the third important second-ranking crop grown in 8 mandals. The crop is mostly distributed in the north-central part and mid-eastern valley areas where paddy is the first rank crop. In paddy fallows, groundnut is cultivated as a rotative crop under irrigation facilities in rabi season.

As a second ranking crop spices and condiments are grown in 4 mandals distributed in the north-western part of the district where jowar is the first ranking crop. Depending on the rainfall and available soil moisture, spices are extensively cultivated in the black soil areas of north-western plains of the district.
It is observed that in the groundnut growing areas of western plains and southern plateau, jowar and paddy are the respective second ranking crops. In the paddy dominated areas of K.C. canal irrigated area and eastern valley, groundnut is the most associated second ranking crop. In the jowar region of the western plains spices and groundnut form the combination. In the fruit forming region south-eastern valley, paddy is the combinational crop. A moderate amount of diversity in the distribution of second-ranking crops are observed.

Third Ranking Crops or Third-order Crop Regions (1986-89):

The diversification in the distribution of third ranking crops is significant and making the crop combinations more complex. There are 9 crops emerged as the third ranking crops in the district among which groundnut, paddy, fruits, bajra, jowar and small millets form the major group. In the areas where paddy, millets and fruits figure the first and second rank crops, groundnut grown as the third rank crop in combination in 10 mandals.

Paddy as a third rank crop found in 9 mandals located in the areas where groundnut and jowar were first and second rank crops. In these areas, paddy is grown as a third crop for subsistence purpose. Wherever paddy and ground form as first two crops, fruits cultivated as third rank crop in combination in 8 mandals located in central and southern parts of the district.

Millet crops like bajra, jowar, ragi and small millets are grown as third rank crops in the areas where paddy, groundnut
and fruits from the first and second rank crops. Bajra is grown as a third rank crop in 6 mandals located in the areas of eastern valley; small millets in 5 mandals confined to western part; jowar in 5 mandals found in western plains and ragi in 2 mandals located in the eastern valley.

Other crops namely, spices and condiments as a third rank crop grown in 3 mandals and pulses in 2 mandals distributed randomly without contiguous third order crop region formation. However, these crops are quite small in their areal extent and to that extent they are insignificant.

The study has revealed that there are 5 first-order crop regions, 8 second-order crop regions and 9 third-order crop regions identified in the district. From the preceding analysis it is observed that both dry and wet crops are involved in crop region formation. This is due to diversified agro-climatic and socio-economic conditions. But overwhelmingly the regional agriculture is characterised by the cultivation of oil seeds especially groundnut and millet crops which together accounted for three-fourths of the cultivated area of the district.

Changing Distribution of Crop Regions (1962-65 to 1982-85):

Crop regions and crop structures are dynamic concepts as they change in space and time. The diffusion of HYV cultivation and the accompanying technology as well as improved socio-economic conditions besides the changes in physical environment have brought out changes in agriculture from subsistence traditional oriented crops
to market oriented commercial crops. As a result, the preferential treatment given to first, second and third ranking crops have also been changing and giving rise to new dimensions to the crop farming in general and crop regions in particular.

Changes in the First-order Crop Regions (1962-65 to 1982-85):

In 1962-65 there were four first-order crop regions formed by paddy, groundnut, jowar and bajra in the district. Among them, paddy and groundnut formed the largest crop regions cultivating as first rank crops in three taluks each. Paddy as a first rank crop grown in Cuddapah, Rajampet and Badvel taluks whereas groundnut is grown as a first rank crop in Rayachoty, Kamalapuram and Pulivendula taluks. Jowar crop formed the second largest crop region comprised Jammalamadugu and Proddatur taluks. Bajra as a first rank crop was confined to Sidhout taluk only.

In 1972-75 there has not been any significant change in the crops involved in formation of first-order crop regions. All the four crops which found in 1962-65 as first rank crops were also found in 1972-75. But in the spatial extent, jowar cultivation has gained from two taluks in 1962-65 to 3 taluks in 1972-75 at the cost of spatial shrinkage in terms of areal units i.e., from 3 taluks in 1962-65 to 2 taluks in 1972-75 in the case of groundnut as a first rank crop. There was no change in the other first-order crop regions in the district between 1962-65 and 1982-85.

In 1982-85, there was a little change in the cultivation of first rank crops. The number of crops involved in the formation
### Table 8.1a

#### Changing Distribution of Crop Regions in Cuddapah District

<table>
<thead>
<tr>
<th>Taluk</th>
<th>First ranking crops or first-order crop regions</th>
<th>Second ranking crops or second-order crop regions</th>
<th>Third ranking crops or third-order crop regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuddapah</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Rayachoty</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Kamalapuram</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Rajampet</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Sidhout</td>
<td>B</td>
<td>B</td>
<td>P</td>
</tr>
<tr>
<td>Badvel</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Jammalamadugu</td>
<td>J</td>
<td>J</td>
<td>J</td>
</tr>
<tr>
<td>Proddatur</td>
<td>J</td>
<td>J</td>
<td>J</td>
</tr>
<tr>
<td>Pulivendula</td>
<td>G</td>
<td>J</td>
<td>J</td>
</tr>
<tr>
<td>District</td>
<td>G</td>
<td>J</td>
<td>G</td>
</tr>
</tbody>
</table>

P - Paddy; J - Jowar; G - Groundnut; M - Small Millet; F - Fruits; R - Ragi; B - Bajra; L - Pulses.
# Table 8.2

**Changing Distribution of First, Second and Third Ranking Crops in Cuddapah District**

<table>
<thead>
<tr>
<th>Crop</th>
<th>First ranking crops</th>
<th>Second ranking crops</th>
<th>Third ranking crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>3 3 4</td>
<td>2 3 1</td>
<td>1 - 1</td>
</tr>
<tr>
<td>Jowar</td>
<td>2 3 3</td>
<td>3 1 1</td>
<td>1 1 1</td>
</tr>
<tr>
<td>Groundnut</td>
<td>2 2 2</td>
<td>- 2 3</td>
<td>3 2 2</td>
</tr>
<tr>
<td>Bajra</td>
<td>1 1 -</td>
<td>2 - 2</td>
<td>- 1 1</td>
</tr>
<tr>
<td>Fruits</td>
<td>- - -</td>
<td>- 1 1</td>
<td>2 - -</td>
</tr>
<tr>
<td>Spices</td>
<td>- - -</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>Small millets</td>
<td>- - -</td>
<td>2 1 -</td>
<td>1 3 4</td>
</tr>
<tr>
<td>Pulses</td>
<td>- - -</td>
<td>- - -</td>
<td>- 1 -</td>
</tr>
<tr>
<td>Ragi</td>
<td>- - -</td>
<td>- 1 1</td>
<td>1 1 -</td>
</tr>
</tbody>
</table>
of crop regions have decreased from four crops in 1962-65 to 3 crops in 1982-85. Paddy, jowar and groundnut were involved in forming the crop regions in 1982-85. Paddy as a first rank crop has increased from 3 taluks in 1962-65 to 4 taluks in 1982-85. In Sidhout taluk, paddy crop has replaced the bajra cultivation as a first ranking crop due to increased irrigation facilities.

**Changes in the Second-Order Crop Regions (1962-65 to 1982-85):**

The crops involved in the formation of second-order crop regions increased from 4 crops in 1962-65 to 6 crops in 1972-75 and 1982-85, thus indicating the diversification in the distribution of second ranking crops in the district. Jowar, paddy, bajra and small millets were the second ranking crops in 1962-65. Among them jowar was found in three taluks while the other crops in two taluks each. In the process of transformation, market oriented crops like groundnut and fruit crops have been emerged in the cropping pattern and occupied as second rank crops in 1982-85 and thus reduced the importance of food oriented crops. In 1982-85 there were six crops namely, groundnut, bajra, paddy, jowar, fruits and ragi formed as second ranking crops. Among them, groundnut formed the largest second-order crop region with three taluks, followed by bajra with two taluks.

**Changes in the Third-Order Crop Regions (1962-65 to 1982-85):**

There are five third ranking crops grown in 1982-85 as against six third ranking crops in 1962-65 indicating the reduction
or elimination of some crops in the combinations. In 1962-65 groundnut in 3 taluks and fruits in 2 taluks were important third ranking crops. But in 1982-85, the cultivation of small millets which was of inferior foodgrain has been reduced to the third ranking crop with 4 taluks and formed as the largest third-order crop region. It was followed by groundnut in 2 taluks.

From the preceding analysis it is observed that both dry crops and irrigated crops have figured to form primary crop regions. Paddy, jowar and groundnut are the important crops to form different hierarchical crop regions. Out of which, groundnut cultivation in one way or other has occupied 7 taluks either as first, second or third rank crops followed by paddy in 6 taluks and jowar in 5 taluks. This shows that the dry crops in general and groundnut in particular has gained significant spatial spread in its cultivation.

**Crop Combinations:**

The crop combinations in the district are identified on the basis of Doi's formula for both kharif and rabi seasons as well as for the whole year. The following crops namely, paddy, jowar, bajra, ragi, small millets, pulses, spices and condiments, groundnut, fruit crops and vegetables, figure at least in one of the crop combinations in different seasons of crop farming.

**Crop Combinations (Kharif) (1986-89):**

If each one of the crop combinations like one-crop combination, two-crop combination, three-crop combination etc., is treated as a crop combination type, then six major crop combination
types are identified in the kharif season. These six major crop combination types include 25 sub-crop combinations based on individual crops and their ranking positions. If the district as a whole is considered as one unit, then two-crop combination type is identified and it consists groundnut and jowar crops.

Monoculture or One-crop Combination:

Single crop dominance or monoculture is found in 17 mandals in the district in 1986-89. Groundnut, paddy, jowar and fruit crops are figured as monoculture crops in the kharif season. Monoculture groundnut is the largest region found in 10 mandals distributed contiguously in the southern plateau area. Fruit farming as a monoculture found in the traditional fruit farming zone of southeastern valley in which it occupied three mandals. Paddy as a monoculture crop has covered two mandals naturally found in the K.C. canal irrigated area. Jowar as a monoculture crop noticed in two mandals in the north-western plain. It is nevertheless to state that groundnut as a monoculture crop is overwhelming in its areal extent.

Two-Crop Combination:

Two-crop combination is extensively found in the rainshadow area of the western belt and it sprawled over 16 mandals. Paddy, groundnut and jowar crops combined in different associations to form two-crop combination. Groundnut with jowar and jowar with groundnut was the single most important two-crop combination covering 12 mandals. Paddy, groundnut and groundnut, paddy are the other sub-
groups of two-crop combination in 4 mandals located in the irrigated areas of central and south-eastern parts of the district.

Three-Crop Combination:

There are 7 sub-groups of three-crop combination found in 7 mandals, indicating that no one sub-group of three crop combination is found in more than one areal unit. Three-crop combination but with varied constituent crops is more prevalent in the paddy and bajra dominated areas of the central portion of eastern valley.

Four-Crop Combination:

About seven sub-groups of four-crop combination are found in 7 mandals. It indicates that no single set of four-crop combination is noticed in more than one mandal. Four-crop combination is more prevalent in the areas of eastern valley. Here, the land under cropping is limited and irrigation facilities are more have created the competition for the cultivation of different crops of both subsistence and commercial. In the eastern valley, paddy and fruits are the major crops to form four-crop combinations with other dry crops like groundnut, jowar, bajra, small millets and spices and condiments.

Five-Crop and Six-crop Combinations:

Five-Crop combination namely, jowar-groundnut-paddy-pulses-bajra is found in Mydukur mandal only. Six crop combination with bajra as a first rank crop is found in Porumamilla and Narasapuram mandals located in the north-eastern valley area. Here
the high rainfall conditions, limited agricultural land and practice of cultivation in the slopy mountainous areas are accounted for diversified cropping pattern.

**Crop Combinations (Rabi) (1986-89):**

As many as 6 major crop combination types are identified in the rabi season involving 7 crops. As large a number as 29 sub-crop combinations are identified. Four crop combination comprises groundnut-spices-paddy-jowar is identified for the district as a whole. It reveals that the crop farming is comparatively diversified in the rabi season.

**Monoculture or One-Crop Combination:**

Monoculture has formed the single largest and contiguous crop region with 15 mandals sprawled over central part of the district. Among the crops figured in the one-crop combination, groundnut is dominant monoculture crop covering 14 mandals out of the total 15 mandals under monoculture. Rabi groundnut is an irrigated crop cultivated in the paddy fallows.

**Two-Crop Combination:**

In terms of areal units, a two-crop combination is the second largest region with 15 mandals, distributed in the areas of southern plateau, western plain and south-eastern valley. There are 7 sub-groups of two-crop combination involving five crops namely, paddy, groundnut, ragi, spices and condiments and pulses. The prominent two-crop combinations are groundnut-paddy found in 5 mandals.
CUDDAPAH DISTRICT
Crop Combinations (Rabi) 1986-89

INDEX
- Mono Crop
- Two Crop
- Three Crop
- Four Crop
- Five Crop

FIG: 85
The second most important two-crop combination regions are groundnut-pulses covered 4 mandals, groundnut-spices 3 mandals and paddy-groundnut 3 mandals. Groundnut as primary crop associated with other crops has formed 4 sub-groups of two-crop combination type. Two-crop combinations are distributed in southern plateau, south-eastern valley and north-western plains of the district.

Three-Crop Combination:

There are 7 sub-groups of three-crop combination found in 8 mandals. Many of the sub-groups of three-crop combination with different crops in combination have scattered distribution in the district. However, paddy-groundnut-ragi combination is more prevalent found in Kodur and Obulavaripalli mandals. Rest of the sub-groups are just confined to one mandal each. Groundnut is the dominant crop to form five different three-crop combinations.

Four-Crop Combination:

Four-crop combination is found in 11 mandals showed the significant diversification of crop farming in the rabi season. The high concentration of four-crop combination is found in northern areas of eastern valley, western part of the western plains and some parts of southern plateau. There are 11 sub-groups of four-crop combination and no single sub-group exists in more than one mandal.

Groundnut as the first rank crop formed six different four-crop combinations distributed in the jowar and groundnut dominated areas of western plains and southern plateau.
Jowar as a first rank crop formed two different four-crop combinations. Ragi as a first rank crop formed one four-crop combination in Porumamilla mandal.

**Six-Crop Combination:**

Six-crop combination is found in only one mandal namely, Ramapuram which consists groundnut-pulses-ragi-fruits-vegetables-jowar combination.

**Crop Combinations (Gross Cropped Area) (1986-89):**

The distributional pattern of the crop combinations shows that there are six major crop combination types identified in the district in 1986-89. As many as 28 sub-sets of major crop combination types are identified by involving 10 crops. For the whole district, three-crop combination consisting groundnut-jowar-paddy is identified. However, in terms of the number of areas units two-crop combination with 16 mandals is more prevalent and it followed by monoculture with 14 mandals.

**Monoculture One-Crop Combination:**

Monoculture is found in 14 mandals. Groundnut is overwhelmingly the leading among the monoculture crops. It has formed the largest contiguous monoculture region sprawled over 10 mandals in the southern plateau area of the district. In this region the presence of red soils, moderate rainfall conditions and undulating terrain conditions have favoured for the dominance of groundnut cultivation.
CUDDAPAH DISTRICT
Crop Combinations (Gross) 1986-89

INDEX
- Mono Crop
- Tow Crop
- Three Crop
- Four Crop
- Five Crop
- Six Crop

FIG: 8-6
Paddy crop formed the second largest monoculture region with three mandals located in the irrigated area of K.C. canal irrigation system. Jowar as a monocrop found in Rajupalem mandal only.

**Two-Crop Combination:**

There are six sub-sets of two-crop combination sprawled over 16 mandals mostly located in the western plains. Among the six sub-sets of two-crop combination, groundnut with jowar is the single most two-crop combination, groundnut with jowar is the single most two-crop combination which covered 10 mandals located in the areas of western plains. The geographical conditions like the distribution of moderate to low rainfall, red and red and black mixed soils, more or less plain topographical conditions and scanty irrigation facilities are facilitated the farmers to opt these two rainfed crops on extensive level to fulfil the both commercial and subsistence purposes. Groundnut-paddy combination is found in two mandals namely, Veeraballi and Sidhout.

Fruits- paddy and paddy-fruits two crop combination are important in the areas of south-eastern valley. Here the development of well irrigation and limited availability of cropland encouraged the farmers to opt for the cultivation of intensive crops in order to get maximum production.

Jowar-spices and jowar-paddy combinations are noticed in Jammalamadugu and Proddatur mandals respectively.
Three-Crop Combination:

There are 8 sub-groups of three-crop combination found in 8 mandals indicating that no single sub-group of three-crop combination comprises more than one areal unit. The concentration of three-crop combination is observed in the south-eastern valley and northern part of western plains.

Groundnut as a first rank crop formed three different three-crop combinations. Paddy as a first rank crop formed two sets of three-crop combination found in the irrigated areas of eastern valley. Fruits-paddy-bajra is another three-crop combination in the valley area under irrigation. Spices-jowar-groundnut and jowar-spices-groundnut are the two different ranking sub-sets of three-crop combination noticed in northern part of western plains depending on rainfall conditions.

Four-Crop Combination:

Four-crop combination is found in 5 mandals distributed in the areas of eastern valley. Four-crop combination consisted four sub-group combinations, out of which, fruits-paddy-bajra-groundnut-combination is significant and found in Rajampet and Kodur mandals in the south-eastern valley. Groundnut as a first rank crop formed two different four-crop combination in Vontimitta and B. Mattam mandals. Paddy as a first rank crop formed four-crop combination in Atloor mandal. Owing to the development of irrigation and scarcity of arable land, there has been a competition among the irrigated
crops, as a result, the diversification in cropping is increased in the irrigated area of eastern valley.

**Five-crop Combination:**

Five-crop combination is found in 3 mandals, but no single combination has occurred in more than one mandal. Paddy as a first rank crop formed two five-crop combinations in Gopavaram and Chapad mandals where as groundnut as a first rank crop in Narasapuram mandal. Both development of irrigation and high rainfall conditions are caused for cultivation of wet and rainfed crops.

**Six-crop Combination:**

There are four sub-sets of six-crop combination assigned in 4 mandals. Out of which, 3 mandals are located in the mountainous area of north-eastern part of the district where substantial irrigation facilities and high rainfall caused for the diversification of cropping pattern with cultivation of both irrigated and unirrigated crops.


**Changing Distributional Pattern of Crop Combination Types (1962-65 to 1982-85):**

Changing conditions in the physico-socio-economic and technological environments have resulted significant changes in the crop associations and crop combination types. It may be noted that
the new agro-technology in the regional agriculture has brought about a substantial change in the crop associations and crop combination types in the last 20 year period. It is evident from the following facts that:

(i) Five-crop combination type (GJPMB) identified for gross cropped area for the district as a whole in 1962-65 has reduced to four crop combination type (GJPM) in 1982-85.

(ii) Within the district the major crop combinations found between the two extreme types namely, three-crop crop combination type and five-crop combination type in 1962-65 have been changed to the range between two-crop combination type and five-crop combination type in 1982-85.

(iii) The number of taluks assigned with two-crop combination types have increased from nil in 1962-65 to 2 taluks in 1982-85. Contrasting to this an increase in the number of taluks having two-crop combination, a decrease in the number of taluks having four-crop combination and five-crop combinations in the last 20 year period. The taluks possessing four-crop combination have decreased from 3 taluks in 1962-65 to 2 taluks in 1982-85. The taluks having five-crop combination have decreased from 2 taluks in 1962-65 to one taluk in 1982-85. This increase in the number of two-crop combinations and decrease of multiple crop combinations shows that the farmers of this region are concentrating on less number of crops and thus they are inclining towards the market oriented agriculture.
Table 8.3

Changing Distribution of Crop Combination Types in Cuddapah District

(Gross Cropped Area)

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Crop Combination Type</th>
<th>1962-65</th>
<th>1972-75</th>
<th>1982-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuddapah</td>
<td>PJG</td>
<td>PGJ</td>
<td>PGJ</td>
<td></td>
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<tr>
<td>Rayachoty</td>
<td>GBPR</td>
<td>GP</td>
<td>GB</td>
<td></td>
</tr>
<tr>
<td>Kamalapuram</td>
<td>GJM</td>
<td>GJM</td>
<td>GJ</td>
<td></td>
</tr>
<tr>
<td>Rajampet</td>
<td>PBF</td>
<td>PFB</td>
<td>PFB</td>
<td></td>
</tr>
<tr>
<td>Sidhout</td>
<td>BPRJF</td>
<td>BPRF</td>
<td>PBGR</td>
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</tr>
<tr>
<td>Badvel</td>
<td>PMJRB</td>
<td>PRMJB</td>
<td>PRMJB</td>
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</tr>
<tr>
<td>Jammalamadugu</td>
<td>JMGL</td>
<td>JMG</td>
<td>JGMS</td>
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<tr>
<td>Proddatur</td>
<td>JPGB</td>
<td>JPG</td>
<td>JPG</td>
<td></td>
</tr>
<tr>
<td>Pulivendula</td>
<td>GJM</td>
<td>JMG</td>
<td>JGM</td>
<td></td>
</tr>
<tr>
<td>District</td>
<td>GJPMB</td>
<td>JGPM</td>
<td>GJPM</td>
<td></td>
</tr>
</tbody>
</table>

P - Paddy; J - Jowar; G - Groundnut; M - Small Millet; B - Bajra;
F - Fruits; R - Ragi; S - Spices; L - Pulses
In 1962-65 there were four crops namely paddy, jowar, groundnut and bajra as the first rank crops to form different crop combinations. While in 1982-85 the number of first rank crops reduced to three crop namely, paddy, jowar and groundnut to form crop combination types. With the development of irrigation in Sidhout taluk, paddy cultivation has reduced the importance of bajra and occupied as a first rank crop to form crop combination in 1982-85.

In the process of transformation of crop farming, significant changes both in combination types and are lative position of the crops in their association are mostly brought out in the areas of rainfed farming. For example in Rayachoty, Kamalapuram, Proddatur, Jammalamadugu and Pulivendula taluks where rainfed farming is more prevalent, some of the inferior foodgrain crops like small millets, ragi and bajra as well as the fibre crop, cotton have gradually lost their importance and in some cases they are eliminated from the crop combinations. Subsequently, the concentration has been given more on the cultivation of more remunerative and more food value oriented crops like groundnut, jowar, paddy and spices in the dry areas.

Changes in the Kharif Crop Combinations (1962-65 to 1982-85):

Significant changes have occurred in the spatio-temporal distribution of kharif crop combination types:

i) Five-crop combination (GHPMB) was identified for the whole district in 1962-65 has been reduced to three-crop combination type (GJP) in 1982-85.

ii) There was no single monoculture region in 1962-65. But monoculture region (G) was found in Rayachoty in 1982-85.
Table 8.4

Changing Distribution of Crop Combination Types in Cuddapah District

(Kharif Season)

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Crop Combination Type</th>
<th>1962-65</th>
<th>1972-75</th>
<th>1982-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuddapah</td>
<td>PJG</td>
<td>PGJ</td>
<td>PGJ</td>
<td></td>
</tr>
<tr>
<td>Rayachoty</td>
<td>GB</td>
<td>GP</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Kamalapuram</td>
<td>GJM</td>
<td>JM</td>
<td>GJ</td>
<td></td>
</tr>
<tr>
<td>Rajampet</td>
<td>PBF</td>
<td>FBP</td>
<td>PFB</td>
<td></td>
</tr>
<tr>
<td>Sidhout</td>
<td>BPF</td>
<td>BP</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Badvel</td>
<td>MPRBG</td>
<td>PMBG</td>
<td>PBMLJ</td>
<td></td>
</tr>
<tr>
<td>Jammalamadugu</td>
<td>JMG</td>
<td>JM</td>
<td>JG</td>
<td></td>
</tr>
<tr>
<td>Proddatur</td>
<td>JPGM</td>
<td>JPM</td>
<td>JPG</td>
<td></td>
</tr>
<tr>
<td>Pulivendula</td>
<td>GJM</td>
<td>JGM</td>
<td>JGM</td>
<td></td>
</tr>
<tr>
<td>District</td>
<td>GJPMB</td>
<td>JGPM</td>
<td>GJP</td>
<td></td>
</tr>
</tbody>
</table>

P - Paddy; J - Jowar; G - Groundnut; F - Fruits; M - Small millet; B - Bajra; L - Pulses; R - Ragi.
iii) The number of areal units with two-crop combination type have increased from one taluk in 1962-65 to three taluks in 1982-85.

iv) There were six taluks assigned with three-crop combination in 1962-65 have decreased to four taluks in 1982-85.

v) Four and Five-crop combination types found in 2 taluks in 1962-65 were decreased to one taluk in 1982-85.

vi) Paddy, jowar, bajra, small millets and groundnut as first rank crops formed the different crop combinations in 1962-65. But they are reduced to 3 crops namely, paddy, jowar and groundnut as first rank crops to form crop combinations in 1982-85. It indicates that the importance has been given to lesser number of crops like groundnut and jowar in dry areas and paddy in irrigated areas.

vii) Spatially, significant changes in the kharif crop combinations both in terms the relative position of the crops in the combination and the combination type have been taken place in the areas where rainfed farming is predominant with the cultivation of groundnut and jowar crops. For example, groundnut-bajra combination in Rayachoty during 1962-65 has been transformed to groundnut monoculture combination. Groundnut-jowar-small millets combination in Kamalapuram and groundnut-jowar-small millets combination in Pulivendula in 1962-65 have been changed to groundnut-jowar and jowar-groundnut-small millets combinations respectively in 1982-85. Here some of the inferior subsistence crops are eliminated from the combination and the relative value of some other crops is reduced.
Changes in the Rabi Crop Combinations (1962-65 to 1982-85):

Crop combination types and association of the crops in the rabi season have also undergone with considerable changes due to the development of irrigation and competition among the crops for both subsistence and market oriented economy.

i) Six-crop combination type (PJRGML) was identified in the rabi season for the district as a whole in 1962-65 has been changed to seven-crop combination type (PRGMJSL) in 1982-85.

ii) Monoculture (Paddy) found in Rayachoty taluk in 1962-65 disappeared in one of the taluks in the district in 1982-85.

iii) Two-crop combination types were identified in two taluks (Kamalapuram and Rayachoty) in 1982-85 in contrast to no such combination type in 1962-65.

iv) Three-crop combination type was found in three taluks in 1962-65 but three-crop combination was not found in any taluk in 1982-85.

v) There were four taluks with four-crop combination type in 1982-85 as against one taluk in 1962-65 indicating an increasing trend in the practice of four-crop combination in more number of areal units.

vi) The number of taluks assigned with five-crop and more than five-crops in combination were decreased from 4 taluks in 1962-65 to 3 taluks in 1982-85.

vii) Four crops namely, jowar, ragi, paddy and groundnut as first rank crops formed different crop combination types in 1962-65. Out of
### Table 8.5

**Changing Distribution of Crop Combination Types in Cuddapah District (Rabi Season)**

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Crop Combination Type</th>
<th>1962-65</th>
<th>1972-75</th>
<th>1982-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuddapah</td>
<td>JPG</td>
<td>JPRG</td>
<td>GPRM</td>
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<tr>
<td>Rayachoty</td>
<td>P</td>
<td>P</td>
<td>PGML</td>
<td></td>
</tr>
<tr>
<td>Kamalapuram</td>
<td>GJR</td>
<td>RLPG</td>
<td>GJ</td>
<td></td>
</tr>
<tr>
<td>Rajampet</td>
<td>PRB</td>
<td>PRJ</td>
<td>PR</td>
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</tr>
<tr>
<td>Sidhout</td>
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<td>RPJLG</td>
<td>RGPMJ</td>
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<td>Badvel</td>
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<td>JRLG</td>
<td>JSLRG</td>
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<td>District</td>
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<td>PJRLG</td>
<td>PRGMJSL</td>
<td></td>
</tr>
</tbody>
</table>

P  Paddy; J  Jowar; G  Groundnut; F  Fruits; M  Small millet; B  Bajra; L  Pulses; R  Ragi.
them, jowar and ragi as first rank crops formed combinations in 3 taluks each, paddy in two taluks and groundnut in one taluk. But in 1982-85 the number of crops as first rank crops to form combination types are increased to six crops namely, groundnut, paddy, jowar, ragi, small millets and spices. Of them, groundnut and paddy are important rabi crops to form combinations in 3 taluks and 2 taluks respectively.

**Crop Specialisation and Diversification:**

The term 'crop specialisation' indicates cultivation of lesser number of crops and 'crop diversification' implies raising a variety of crops from the soil in a particular point of time. "The larger the number and closer the percentage of land occupancy of crops in a regional unit, the higher the degree of crop diversification and vice versa" (Jasbir Singh, 1984, p. 224). Bhatia (1965) explained that "the index of diversification provides a method for generalising the relationship between the relative strength and the number of crops grown." The study of crop diversification is helpful to understand the competition that exists among crops in an areal unit as well as the crop geography in different environmental conditions and ultimately it helps in any further planning of cropping pattern.

The crop specialisation or diversification are based on many factors such as the conditions of soil, the characteristics or rainfall, the extent of irrigation facilities and the topography of the land as well as the amount of arable land. Besides there are other socio-economic factors which influence the cultivator to opt for a variety
of crops in the subsistence agricultural societies especially in the dry tracts of India. The pressure of rural population with high rate of illiteracy, orthodox farm practices and adverse conditions of climate force them to cultivate as many as number of crops to fulfil their domestic requirements from their small size of landholdings. In drought prone areas generally the cropping pattern tended to be diversified because the intensity of droughts or dry spells varied from one crop to another. In the uncertain state of drought occurrences as well as drought intensities, farmers generally go for a variety of dry crops with an intention of getting something from their holdings rather than nothing. Consequently, each crop is bound to occupy only a small portion of the cropland and tend to diversify the cropping pattern.

Methodology:

A study of crop diversification was attempted by many geographers in their study of cropping patterns. For example, Bhatia (1965), Ayyar (1969), Jasbir Singh (1976) etc., have developed and employed simple and arbitrary methods to measure the degree of crop diversification.

The Gibbs-Martin index of diversification (1962) 

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

provides a useful alternative index for measuring the degree of diversification in the cropping in an area. This method has an advantage over the other methods in that (i) it is statistical method, (ii) the statistics of the crops need not be reduced into percentages,
and (iii) the index values ranging between 0 and 1 indicate the magnitude of diversification in direct proportion.

Hence, the Gibbs-Martin method is employed in the present study to measure crop diversification.

**Spatial Pattern of Crop Diversification (Kharif) (1986-89):**

The degree of crop diversification in the kharif season is 0.55. It shows that the kharif cropping pattern is moderately diversified. The highest level of diversification is found in Porumamilla (0.83) mandal followed by B. Kodur (0.78), Narasapuram (0.77) and B. Mattam (0.76).

High (0.61-0.80) and very high (0.80) levels of crop diversification are found in 15 mandals distributed mostly in the eastern valley area and in some parts of western plains. In the eastern valley, the scarcity of agricultural land, high rainfall conditions and moderate irrigation facilities created a great competition among the crops to the cultivated, as a result, the cropping is highly diversified.

Moderate (0.41 - 0.60) degree of crop diversification is found in 17 mandals distributed mostly in south-eastern valley and many parts in western plains. In the areas of western plains the competition has existed among dry crops while in the eastern valley the competition is found between irrigated crops.

Low (0.21 - 0.40) and very low (0.20) crop diversifications are noticed in 18 mandals mostly distributed in the southern plateau and few parts of the western plains where groundnut,
CUDDAPAH DISTRICT
Pattern of Crop Diversification (Rabi)
1986-89

INDEX

\[
\begin{array}{c|c|c|c|c|c}
> & 0.8 \\
0.61 - 0.8 \\
0.41 - 0.6 \\
0.21 - 0.4 \\
< & 0.2 \\
\end{array}
\]
jowar and paddy are monocrops.

Spatial Pattern of Crop Diversification (Rabi) (1986-89):

The degree of crop diversification in the rabi season is high and amounted to 0.73 in the district. The highest level of crop diversification is found in Ramapuram (0.81) mandal.

High (0.61 - 0.80) level of crop diversification is found in 11 mandals located mostly in the northern part of eastern valley and part of southern plateau region. It is not uncommon that the competition among the rabi crops is high due to cultivation of almost all crops under irrigation in a limited spatial extent.

Moderate concentration (0.41 - 0.60) of crop diversification is sprawled over south-eastern valley, southern plateau and some areas of western plains.

Low (0.21 - 0.40) and very low (< 0.20) levels of crop diversification found in 22 mandals. They are distributed in the central part and many areas in the western plains where groundnut and spices are dominant rabi crops.

Spatial Pattern of Crop Diversification (Gross Cropped Area) (1986-89):

The degree of crop diversification for the gross cropped area is moderate i.e. 0.57 in the district. The highest degree of crop diversification is found in Porumamilla (0.81) and Narasapuram (0.81) mandals which are located in the high rainfall zone of north-eastern valley.
High (0.61 - 0.80) and very high (\(\geq 0.80\)) levels of crop diversification are found in 17 mandals. Most of these mandals are distributed in the areas of eastern valley and northern part of western plains. It is observed that high degree of crop diversification is found in irrigated areas and high rainfall areas where both wet and dry crops are preferred for cultivation.

Moderate (0.41 - 0.60) degree of crop diversification is sprawled over the areas of rainfed farming of western plains. There are 16 mandals which exhibited the moderate crop diversification in which dry crops are prevalent.

Low (0.21 - 0.40) and very low (\(< 0.20\)) crop diversifications are found in 17 mandals mostly distributed in the groundnut dominated areas of southern plateau and Pulivendula basin of the western plains.

It is obvious from the preceding discussion that cultivation is more diversified, stable and highly productive in the high rainfall and irrigated farming areas of eastern valley where the cropping pattern is superior with the cultivation of paddy, fruits, groundnut and bajra. In the rain-shadow areas of western plains and rainfed farming areas of southern plateau the cropping pattern is extensive and specialised but the agriculture is characterised by low productivity and uncertainty.

**Changing Pattern of Crop Diversification (Kharif) (1962-65 to 1982-85):**

The index value of the crop diversification in the kharif season has decreased from 0.77 in 1962-65 to 0.71 in 1972-75 and
Table 8.6  
Changing Pattern of Crop Diversification in Cuddapah District (Kharif Season)

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Degree of diversification</th>
<th>Change between</th>
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</thead>
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<td>Cuddapah</td>
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<td>Rajampet</td>
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</tr>
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<td>Sidhout</td>
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</tr>
<tr>
<td>Badvel</td>
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<td>0.72</td>
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<tr>
<td>Jammalamadugu</td>
<td>0.69</td>
<td>0.46</td>
</tr>
<tr>
<td>Proddatur</td>
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<td>0.63</td>
</tr>
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<td>Pulivendula</td>
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<td>0.71</td>
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### Table 8.7

<table>
<thead>
<tr>
<th>Taluk</th>
<th>Degree of Crop diversification</th>
<th>Change between</th>
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</thead>
<tbody>
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<tr>
<td>Rayachoty</td>
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<td>0.41</td>
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<tr>
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</tr>
<tr>
<td>District</td>
<td>0.71</td>
<td>0.72</td>
</tr>
</tbody>
</table>
further decreased to 0.63 in 1982-85 indicating that the cropping system is tending towards the cultivation of less number of crops. It is interesting to mention that the decrease in the degree of crop diversification is found in all taluks of the district.

Changing Pattern of Crop Diversification (Rabi) (1962-65 to 1982-85):

Crop diversification has increased in the rabi season from 0.71 in 1962-65 to 0.72 in 1972-75 and 0.84 in 1982-85. It shows that the rabi cropping under irrigation farming has been tending towards more diversification. It is due to competition exists among various crops in the limited availability of agricultural land.

An increase in the degree of crop diversification is noticed in Cuddapah, Rayachoty, Sidhout and Pulivendula taluks.

Crop diversification has decreased in Kamalapuram, Rajampet, Badvel and Jammalamadugu taluks.

Changing Pattern of Crop Diversification (Gross Cropped Area) (1962-65 to 1982-85):

The degree of crop diversification has decreased from 0.78 in 1962-65 to 0.72 in 1972-75 and 0.70 in 1982-85. It shows that the pattern of crop farming has been gradually tending towards cultivation of less number of crops.

In 1962-65, the degree of crop diversification ranged between a maximum of 0.82 in Sidhout taluk to a minimum of 0.65 in Cuddapah taluk. In 1982-85, the pattern of crop diversification has
<table>
<thead>
<tr>
<th>Taluk</th>
<th>Degree of Crop Diversification</th>
<th>Change between</th>
</tr>
</thead>
<tbody>
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<td>Cuddapah</td>
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<td>Rayachoty</td>
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<tr>
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<td>0.81</td>
</tr>
<tr>
<td>Jammalamadugu</td>
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<td>0.46</td>
</tr>
<tr>
<td>Proddatur</td>
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<td>0.62</td>
</tr>
<tr>
<td>Pulivendula</td>
<td>0.69</td>
<td>0.65</td>
</tr>
<tr>
<td>District</td>
<td>0.78</td>
<td>0.72</td>
</tr>
</tbody>
</table>
been changed and that the maximum diversification value of 0.73 is found in Badvel taluk and a minimum value of 0.38 in Rayachoty taluk. This has revealed that the degree of crop diversification has decreased at all levels i.e., at the average, the highest and the lowest as well as in all taluks of the district.

**Conclusions:**

A study of the crop regions, crop combinations and crop diversification have revealed the following:

1. It is indicated that the primary crop production is accounted both by dry crops and wet crops but dominated by dry crops especially groundnut and jowar.

2. Both rainfed crops and irrigated crops are the predominant in forming the crop regions, either by first-order, second-order or third-order regions. This is due to diversified agro-climatic and socio-economic conditions of the district.

3. The regional agriculture overwhelmingly characterised by an extensive cultivation of dry crops namely, groundnut and millets which together accounted for three-fourths of the cropland.

4. It is found that paddy, jowar and groundnut are the predominant crops to form different hierarchical crop-order regions. Out of which groundnut has gained the spatial extension of its cultivation.

5. The number and spatial extent of each one of the crop
combinations has tended to decrease from 1962-65 to 1982-85 partly due to development of irrigation and modernisation and partly due to the preference of the farmers to cultivate market oriented more remunerative and superior variety of crops.

6. The tendency to specialise rather than diversify the cropping pattern is patently noticeable. For example, groundnut, paddy, fruit crops, jowar and spices have gradually tended to replace minor crops like small millets, ragi, cotton, bajra etc. Some of these crops are getting eliminated from the cropping pattern in the process of crop transformation from subsistensive to market oriented commercial farming.

7. Crop combinations with a fewer crops i.e. one-crop, two-crop and three-crop combinations are far more prevalent than hyper multiple crop combinations.

8. The crop combinations with a lesser number of crops are found in larger number of mandals as well as in areal contiguation. In contrast, the crop combinations with larger number of crops are limited in their spatial spread but contiguous in their areal distribution due to marked geographical conditions of specific localities. The crop combinations with less number of crops as well as specialisation of crops are mostly confined to rain-shadow area of extensive plains, dry upland areas, un-irrigated and scantily irrigated areas of the district. In contrast, high diversification and the crop combinations with more number of crops are mostly prevalent in the high rainfall areas, irrigated areas, river valleys and the regions with limited source of
arable land.

10. In the process of crop transformation due to modernisation of crop farming, significant changes in the structure as well as number of crop combination types are conspicuously exhibited in the areas of rainfed farming.

11. The changing patterns of crop regions, crop combination types and crop diversification vividly revealed that the crop farming has been moving from subsistence farming (millets) to market oriented economy (groundnut, fruits, spices and paddy).

12. As the process of change in the cropping pattern has progressed, a greater degree of uniformity, stability and specialisation are brought in the cropping pattern of the district.

13. It is observed that, kharif cropping is more specialised and mostly rainfed in contrast to rabi cropping which is highly diversified due to irrigated farming in the selected favourable areas.

14. Crop diversification and crop rotation in the rabi season seem to be increasing.

15. It is necessary to achieve high degree of modernisation and intensification of agriculture in the district especially in the areas of eastern valley where the available land is very limited, rainfall is more and scope for further development of irrigation is expected and possible.
16. In the rain-shadow areas of western plains and southern dry uplands there is a great scope for spatial expansion of agriculture as well as diversification of farming in different soil zones rather than intensification of cropping due to limited irrigation facilities.

17. In view of frequent drought occurrences and prolonged dry spells and low development of irrigation facilities in many areas of the district, especially in the western plains, it is essential to opt diversified cropping systems and also it is essential to bring more stability in the cropping pattern with the help of dry farming technology.

18. There is an ample scope for the strengthening of the existing cropping pattern and enhancement of crop production especially oil seeds, spices, fruits, paddy, cotton and millets with the help of irrigation development, modernisation of agriculture and dry farming technology.