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Analysis of Crop Combination in Vizianagaram District of Andhra Pradesh: Using Geospatial Techniques

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Abstract

In this paper an attempt has been made to analyse the agricultural land use pattern at micro-level in Vizianagaram district. This study is based on secondary data collected from secondary records. Physiography, temperature, rainfall, soil and drainage influence on crop combinations in this district. An endeavor is made here to study crop combination regions in Vizianagaram district for year 2009-2010. The crop data has been computed with the help of Weaver's and Doi technique of crop combination. There are different methods applied in the delineation of crop combination regions. The first method for the demarcation of crop combination regions is arbitrary choice method, e.g., the first crop only, the first two crops only, the first three crops etc. This method being based on statistical approach is more accurate, reliable and scientific as it gives better objective grouping of crops of a region. The statistical techniques about crop combination have been modified suitably by the geographers from time to time. It is observed that paddy ranking first in 26 mandals is the leading crop in Vizianagaram district. Such type of study represents real situation of crop combination pattern in Vizianagaram district and helps to planners, agricultural scientists and research scholars.

Keywords:

Crop combination,
Crop Rankings,
GIS,
Cropping Pattern.

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1. Introduction

The study of crop combination regions constitutes an important aspect of agricultural geography as it provides a good basis for agricultural regionalization. The crops are generally grown in combinations and it is rarely that a particular crop occupies a position of total isolation. The distribution maps of individual crops are interesting and useful for planners, but it is even more important to view the integrated assemblage of the various crops grown in an areal unit. The study of crop combinations is helpful for regional agricultural planning (Balasaheb.D Ghodke, 2009). For a comprehensive and clear understanding of the agricultural mosaic of an agroclimatic region and for planning and development of its agriculture, a systematic study of crop combinations is of great significance. In recent years the concept of crop combination has drawn the attention of geographers and agricultural land use planners. The physical factors determine the shape of the areas of crops, while the socio-economic relationships determine their extent. The government policies can decide to select the crops to grow. With the development of better

irrigation facilities, new varieties of crops can be introduced in the place of traditional and unprofitable agricultural system (Pralhad Y. Vyaliji, 2009). Thirteen crops have been considered for crop ranking and combination (Todkari, G.U. 2010). The study of crop combinations will be helpful for the development of sustainable agriculture and useful for the rotation of crop and the increase in per hectare yield (Sangita and Sonwane 2011).

Crop combinations are now recognized as an important topological characteristic of agricultural activities (Panda and Saxena 1992). Study of crop combinations helps to understand the crop ecosystem of the region. For future crop planning and optimum development of agricultural resources of different regions, the study of crop combinations is essential. Cultivated crops are generally growing in combinational associations due to physical diversity of land and social conditions. Thus, the distributional pattern of crops exhibits a predominance of certain crops resulting in the emergence of crop regions. The exact crop combination indices will provide grounds for understanding the contemporary crop combinations practiced by the farmers. Besides, crops are grown in association, either because they are supplementary each other owing to different growth requirements. Combination analysis is one of the vital methods of studying agricultural patterns and valuable in providing a comprehensive basis for regional planning for rural areas.

2. Study Area

The district is a part of the Northern Coastal plains of Andhra Pradesh and lies between 17o-151 and 190-151 of the Northern Latitudes and 830-00 to 830- 451 of the Eastern Longitudes (Fig.1). It is bounded on the north by the Orrisa state, on the West and South by Visakhapatnam district, on the East by the Srikakulam district, South-East by Bay of Bengal. For administrative convenience, the district is divided into 2 Revenue Divisions viz., Vizianagaram and Parvathipuram and 34 Revenue mandals.

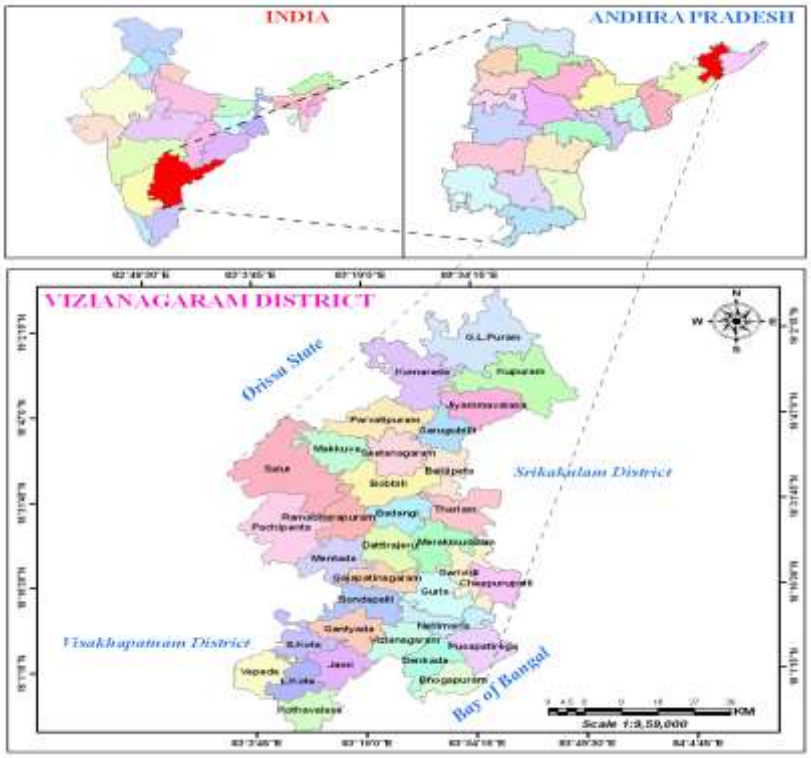

Fig.1: Location map of the study area

3. Objectives

The major objective of this paper is to assess the crop ranking and crop combination regions in Vizianagaram district of Andhra Pradesh.

4. Research Method

Present study mostly relies on the secondary data collected through agriculture department and district statistical Department of Vizianagaram. For the present investigation, district is selected as in general and mandals in particular. Simple stastical method was used to compute crop ranking and Weavers and Doi crop combination technique in the present study.

5. Results and Analysis

First rank Crop only: In this method, the first ranking crop, i.e. the crop occupying the highest percentage of the total cropped area in each of the mandal could be chosen. With the help of this method, the first ranking crops of the mandals have been computed. Crops occupying less than one percent of the gross cultivated area have not been included as they occupy in significant area. The first or first two or first three crops, occupying the major area of the gross cropped area are selected on the basis of their areal strength. The mandals occupied by the first ranking crops are shown in (Fig 2). It may be observed that Paddy ranking first in 26 mandals is the leading crop in Vizianagaram district followed by Groundnut in 3 mandals of the district, Mesta in two mandals Sugarcane in one mandals, Maize in one mandal and Groundnut in one mandal (Fig 2) & (Table 1).

First two crops: On the basis of first and second ranking crops, eight crop combinations are recognized in Vizianagaram district. The mandals occupied by these different crops are shown (table 2). It is observed that Paddy and Mesta enter into two crop combinations in many mandals, followed by Paddy and Groundnut in 6 mandals. Paddy and Sesamum are significant combinations in most of the mandals.

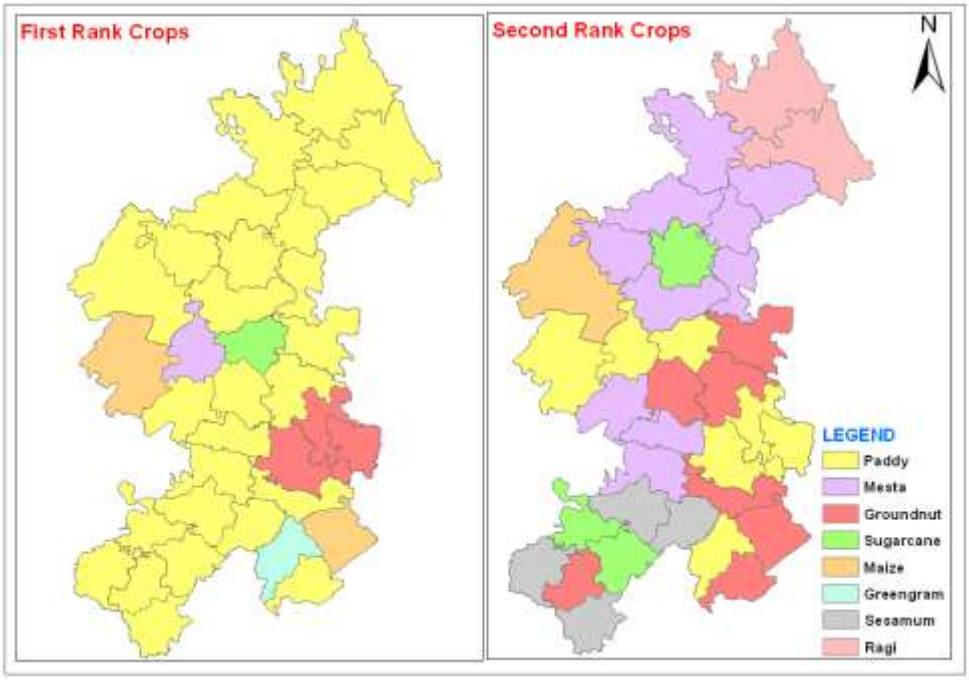

Fig. 2: First & Second Ranking Crops in Vizianagaram district

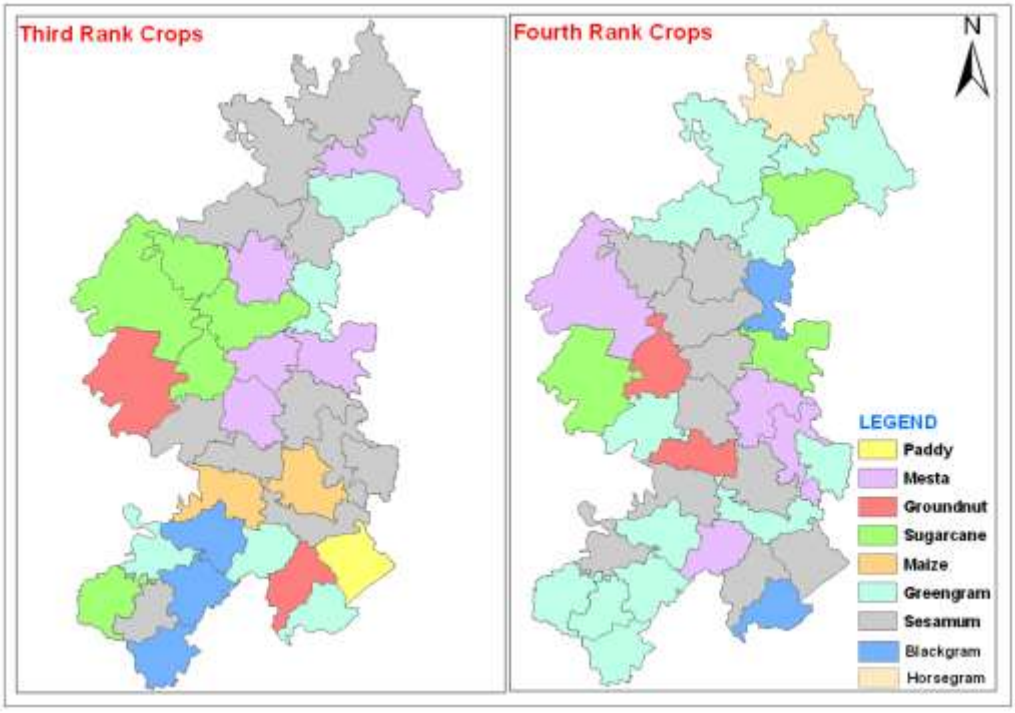

Fig.3: Third & Fourth Ranking Crops in Vizianagaram district

of the district. Greengram, Blackgram, Ragi, Sugarcane and Maize are the other crops that constitute the crop combinations.

First Three Crops: When the first three crops were taken into consideration, there are number of crop combination regions in which Paddy, Groundnut and Mesta are dominant crops. Other crops entering the combinations are Greengram, Blackgram, Sesamum Sugarcane and Maize. The method of first three crops is also unscientific & irrational, as by doing so the rest of the crops are excluded without any consideration of their areal strength. It is necessary to apply some standard statistical technique for a more objective grouping of crops (Table 3)

Statistical Regional analysis

For the determination of crop combinations and to determine the crop regions a number of quantitive and non-quantitive methods and techniques have been developed. In the field of agricultural geography Weaver (1954) was the first to use statistical technique to establish the crop combinations of the Middle West (USA). In his work Weaver calculated deviation of the real percentages of crops (occupying over 1 percent of the total cropped area) for all the possible combinations in the component areal units against a theoretical standard.

According to Weaver, the theoretical percentage of crop distribution is uniform such as:

Monoculture = 100 percent of the total harvested crop in one crop
2- Crop combinations = 50 percent in each of two crops
3- Crop combinations = 33.3 percent in each of three crops
4- Crop combinations = 25 percent in each of four crops
5- Crop combinations = 20 percent in each of five crops
6- Crop combinations = 16.6 percent in each of six crops
7- Crop combinations = 14.28 percent in each of seven crops
8- Crop combinations = 12.50 percent in each of eight crops

For determining the crop combination, the percentage value of each crop is obtained and the percentage of the crop is arranged in descending order of their magnitude and then with the help of following formula, deviation value of crop combinations is found out.

$$S.D = \sqrt{\frac{\sum d^2}{n}}$$

Where d = the difference between the actual crop percentage in an areal unit and the appropriate theoretical percentage

n = the number of crops in a given combination

Table 1: First ranking crops in the district

Crop	No.of.units (Mandals)	Mandals
Paddy	26	Komarada, G.L.Puram, Kurupam, Jiyyammavalasa, Garugubilli, Parvathipuram, Makkuva, Seethanagaram, Baljipeta, Bobbili, Saluru, Therlam, Merakamudidam, Dattirajeru, Mentada, Gajapathinagaram, Bondapalli, Nellimarla, Bhogapuram, Vizianagaram, Gantyada, S.Kota, Vepada, L.Kota, Jami, Kothavalasa
Groundnut	03	Gurla, Garividi, Cheepurupalli
Maize	02	Pachipenta, Pusapatirega
Mesta	01	R.B.Puram
Sugarcane	01	Badangi
Greengram	01	Denkada

Table 2: First two crops in the district

Crops	No. of. Mandals	Mandals
Paddy - Mesta	10	Komarada, Jiyyammavalasa, Garugubilli, Parvathipuram, Makkuva, Baljipeta, Bobbili, Mentada, Gajapathinagaram, Bondapalli
Paddy - Groundnut	06	Therlam, Merakamudidam, Dattirajeru, Nellimarla, Bhogapuram, L.Kota
Paddy - Sesamum	04	Vizianagaram, Vepada, Kothavalasa, Gantyada
Paddy - Sugarcane	03	Seethanagaram, S.Kota, Jami
Groundnut – Paddy	03	Gurla, Garividi, Cheepurupalli
Paddy - Ragi	02	G.L.Puram, Kurupam
Paddy – Maize	01	Saluru
Mesta – Paddy	01	R.B.Puram
Maize – Paddy	01	Pachipenta
Sugarcane – Paddy	01	Badangi
Greengram – Paddy	01	Denkada
Maize - Groundnut	01	Pusapatirega

Table 3: First three crops in the district

Crops	**No. of. Mandals**	**Mandals**
Paddy – Mesta - Sesamum	05	Komarada, Garugubilli, Parvathipuram, Mentada, Gajapathinagaram
Paddy – Groundnut – Sesamum	03	Merakamudidam, Nellimarla, L.Kota

Paddy – Mesta –Sugarcane	02	Makkuva, Bobbili
Paddy – Groundnut – Mesta	02	Therlam, Dattirajeru
Groundnut – Paddy – Sesamum	02	Garividi, Cheepurupalli
Paddy – Mesta – Greengram	02	Jiyyammavalasa, Baljipeta
Paddy – Sesamum – Blackgram	01	Gantyada, Kothavalasa
Paddy –Ragi –Sesamum	01	G.L.Puram
Maize – Ragi – Mesta	01	Kurupam
Paddy – Sugarcane – Maize	01	Seethanagaram
Paddy – Maize – Sugarcane	01	Saluru
Maize – Paddy –Groundnut	01	Pachipenta
Mesta – Paddy – Sugarcane	01	R.B.Puram
Sugarcane – Paddy – Mesta	01	Badangi
Paddy – Mesta – Maize	01	Bondapalli
Groundnut – Paddy – Maize	01	Gurla
Maize – Groundnut – Paddy	01	Pusapatirega
Paddy–Groundnut – Greengram	01	Bhogapuram
Greengram–Paddy – Groundnut	01	Denkada
Paddy – Sesamum – Greengram	01	Vizianagaram
Paddy– Sugarcane – Greengram	01	S.Kota
Paddy – Sesamum – Sugarcane	01	Vepada
Paddy– Sugarcane – Blackgram	01	Jami

For ascertaining crop combination, percentage of each crop is found out and is arranged in descending order and thereafter the difference between the actual crop percentages and the theoretical percentage. This difference is then squared and all these squares are added together and divided by number of crops. Crop combination with minimum deviation is considered the ideal combination in the given unit area. This can be explained by following example.

To explain Weaver's technique an illustration is given from the study area in which the percentage share of crops in the cropped area in a year is as follows: Paddy 38 percent, Mesta 22 percent, Sugarcane 18 percent, Sesamum 7 percent, Greengram 6 percent, Blackgram 6 percent and Horsegram 3 percent. According to Weaver

Monoculture = $\frac{(100-38)^2}{1} = 3844$

Two Crop combination = $\frac{(50-38)^2 + (50-22)^2}{2} = 464$

Three Crop combination = $\frac{(33.3-38)^2 + (33.3-22)^2 + (33.3-18)^2}{} = 127$

$$\text{Four Crop combination} = \frac{(25-38)^2 + (25-22)^2 + (25-18)^2 + (25-7)^2}{4} = 147$$

Similarly five crop combination, six crop combination and seven crop combination values will be 139, 134 and 136 respectively.

The deviation of the actual percentages from the theoretical value is seen to be the lowest for a 3 crop combination (127). Therefore, the crop combination of that unit area (Bobbili mandal of Vizianagaram district) will be Paddy – Mesta – Sugarcane.

Out of many approaches to combinational study, Weaver's method used in crop combination has been applied by many geographers. Weaver's method has admirably been accepted and applied for the demarcation of crop combination and agricultural regionalization as its application results into suitable and accurate grouping of crops.

Doi's Technique

The Weaver's technique was subsequently modified by Doi (1959). Doi's technique used to be considered to be the easiest for combination analysis prior to the application of computer programming facilities. Doi's formula may be expressed as – (∑d2). The combination having the lowest (∑d2) will be the crop combination. Out of many approaches to crop combinational study and agricultural regionalization, Weaver's method has been applied by many agricultural scientists. Hence, in the present study, crop combinations were studied using Weaver's method. Based on this formula, crop combinations have been worked out for 34 mandals of Vizianagaram district. The computed actual percentages of cropped areas show that Paddy, Mesta and Groundnut are predominant crops. Number of crop combinations in the district is shown in Table 4. Out of 34 mandals of the district, about 11 mandals show seven crop combinations. Then six crop combination systems prevail in 8 mandals and eight crop combination in 7 mandals of the district. Five mandals exhibit five crop combinations, 2 mandals with four crop combination and one mandal with two crop combination. It can be concluded that agriculture is more diversified in the district.

Table 4: No. of Crop Combinations in the district

Type	Number of mandals
Two crop combination	1
Four crops combination	2
Five crop combination	5
Six crop combination	8
Seven crop combination	11
Eight crop combination	7

Crop Combination in the Study Area

Mandal wise crop combinations are presented in Fig 4 and Table 5.

Two - Crop combinations: Two crop combinations are observed in only one mandal Parvathipuram (Fig.4). The predominant crops are Paddy and Mesta.

Three - Crop combinations: There is no 3 crop combination in the district.

Four - Crop Combinations: This combination is observed in two mandals, Kothavalasa (Fig.4) and G.L.Puram where the crop combination is Paddy, Sesamum, Blackgram and Greengram.

Five - Crop combinations: This combination is found in 4 mandals, Kurupam, Baljipeta, Denkada and Gantyada. The combination of Paddy, Ragi, Mesta, Greengram and Sesamum prevails in Kurupam and Paddy, Sesamum, Blackgram, Greengram and Sugarcane is observed in Gantyada and Desnkada mandals. Combination of Groundnut is observed in Baljipeta.

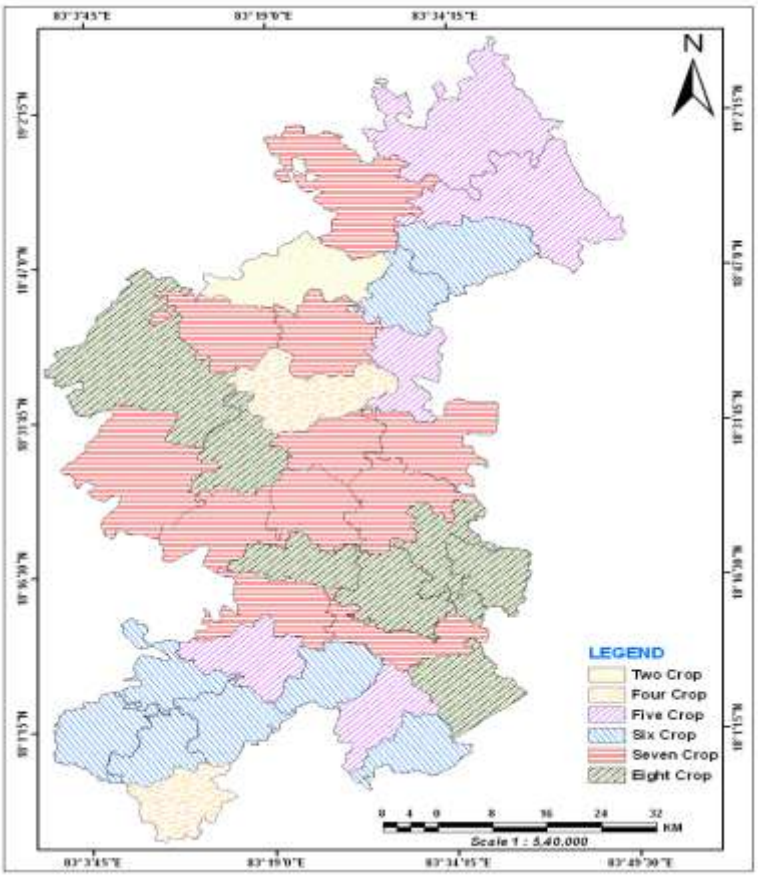

Fig.4: Vizianagaram district - Crop Combinations

Six - crop combinations: It is observed in 10 mandals of the district, six mandals in the north and six mandals in southern part of the district. The crop combinations include Paddy, Mesta, Sesamum Sugarcane, Greengram and Blackgram. Ragi and Maize are added to the crops mentioned in the above combination.

Seven - Crop Combinations: This combination is found in 11 mandals. Crops are same as above but in different associations and proportions.

Eight Crop Combinations: It is observed in 7 mandals such as Saluru, Ramabhadrapuram, Gajapathinagaram, Gurla, Garividi and Pusapatirega where the agriculture is more diversified.

Table 5: Vizianagaram district - Crop combinations

sS.N	Mandals	Crop combinations
1	Komarada	P+ M+ Se+ GG + S+ G + BG
2	G.L.puram	P+ R + Se + HG + RG
3	Kurupam	P + R+ M + GG + Se
4	Jiyyammavalasa	P + M + GG + S + BG + Se
5	Garugubilli	P + M+ Se + GG + Su + B
6	Parvathipuram	P + M
7	Makkuva	P + M+ S + Se + MZ + GG + B
8	Seethanagaram	P+ S + M + Se + MZ + BG + GG

9	Baljipeta	P + M + GG + BG + Se
10	Bobbili	P + M+ S + Se
11	Saluru	P+ MZ+ S + M+ G + R+ GG + BG
12	Pachipenta	MZ+ P+ G + S + R+ GG + BG
13	R.B.Puram	M + P + S+ G + GG + BG+ Se + MZ
14	Badangi	S + P+ M+ Se + GG + BG + GG
15	Therlam	P+ G+ M + S + Se + BG + GG
16	Merakamudidam	P+ G + Se + M + GG + BG + S
17	Dattirajeru	P+ G + M + Se + GG + BG + S
18	Mentada	P + M + Se + GG + BG + S + MZ
19	Gajapathinagaram	P + M + Se + G + GG+ S + BG+ MZ
20	Bondapalli	P + M+ MZ + Se + GG + BG+ G
21	Gurla	G+P+ MZ + Se + GG + BG + M+ R
22	Garividi	G +P + Se+ M + GG + BG + R+ S
23	Cheepurupalli	G +P+ Se + GG + BG + S+ M + MZ
24	Nellimarla	P+ G+ Se + GG + MZ+ M + BG
25	Pusapatirega	MZ + G +P + Se + S+ GG + BG+ R
26	Bhogapuram	P+ G + GG + BG+ Se + R
27	Denkada	GG+ P + G + Se + BG
28	Vizianagaram	P+ Se+ GG + M + BG + G
29	Gantyada	P+ Se+ BG+ GG + S
30	S.Kota	P+ S+ GG + Se + G + BG
31	Vepada	P+ Se+ S+ GG + BG+ G
32	L.Kota	P+ G + Se+ GG+ B G+ S
33	Jami	P + S+ BG + GG+ Se+ G
34	kothavalasa	P+ Se+ BG+ GG

Note: P= Paddy, M= Mesta, G= Groundnut, S= Sugarcane, Se= Sesamum, MZ=Maize, GG= Greengram, BG= Blackgram, HG= Horsegram, RG= Redgram

It is observed that irrespective of the combinations, land occupancy under Paddy, Mesta and Groundnut is relatively is very high. Hence three crops are considered as primary or ranked crops whereas others are regarded as grouped or associated crops.

Conclusions

Different crop combinations prevailed in the district were studied. Study of crop combinations helps to understand the crop ecosystem of the region. The exact crop combination indices will provide basis for understanding the contemporary crop combinations practiced by the farmers. In the present study crop combinations were studied using Weaver's method and it was observed that Paddy, Mesta and Groundnut are predominant crops. Out of 34 mandals of the district, about 11 mandals show seven crop combinations, 8 mandals with six crop combinations and 7 mandals with eight crop combinations. Five mandals exhibit five crop combinations and 2 mandals four crop combinations. Weaver's method has identified eight crop combinations in study region. The crop-combination region in Vizianagaram district reveals that there is no

monoculture anywhere. It reveals that there is a dominating influence of geographical environment on the distribution of area under different crops. This indication more diversification. In case of ranking of crops first ranking crops in Vizianagaram district is Paddy. In second ranking crop Mesta, Groundnut and Sesamum major crops.

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