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Agricultural Regionalization Based on Cropping Pattern in Sweta Nadhi Basin, Tamil Nadu

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Abstract:

In the present paper the cropping pattern in Sweta Nadhi Basin is outlined, followed by the discussion on the area under individual crops, Bhatia's method is used for concentration of selected crops, Location Quotient method and for the combination analysis; J.C Weaver's statistical method of crop combination has been followed. The diversification index is calculated with the Gibbs-Martin method, six major crops which occupies more than half of the cropped area is considered for crop concentration study. The cropping pattern of the study area is assessed to understand the proportion of various crops in the study area at a particular point of time, for the year 2009 – 2010, The study is mainly focused on the secondary data collected from the statistical office, the Spatial variation in degree of crop concentration area are found to be the result of the different interaction such as physiographic, climatic, hydrological, socio-economic and technological factors.

Keywords: Cropping Pattern, Crop Concentration, Combinational analysis, Diversification Index and Sweta Nadhi Basin

1. Introduction

Agriculture is the back bone of the Indian Economy. Agricultural development is essential condition for economic growth in India. Agriculture is an essential occupation for income and employment in developing countries, and particularly for the rural poor, and is widely considered to be the major “engine” of economic growth in most of the developing countries. Agriculture is the mainstay of Indian economy as it contributes nearly 14.6 per cent Gross Domestic Product (GDP) and more than two-thirds of the population is directly or indirectly dependent on it. India experienced rapid strides in agriculture growth with the advent of green revolution in 1960s and it has managed to move from food deficient crisis to self food sufficient situation today. However, increase in agricultural productivity has led to several environmental challenges. Land degradation due to over cropping, over irrigation, loss of biodiversity, declining agricultural genetic diversity and climate change are some of the challenges that potentially threatened the future viability of agricultural systems, particularly at regional and local levels (DFID, 2002). Cropping pattern is the proportion of area under various crops at a point of as it changes over space and time.

The cropping patterns of a region are closely influenced by the geo-climatic, socio-economic, historical and political factors (Hussain, M. 1996) patterns of crop land use of a region are manifestation of combined influence of physical and human environment. Differences in attitude towards the rural land in the level of prosperity and technology have produced changes in emphasis. Their effects on both landscape and land use studies are likely to be far reaching (Coppock, 1968). Weather plays a decisive role in determining the existing cropping pattern. Cropping pattern is also depending on terrain, topography, slope, soils and availability of water for irrigation use of pesticides, fertilizers and mechanization.

2. Database and Methodology

Cropping patterns is made with the help of secondary data obtained from the District Statistical Departments of Salem, Namakkal, Perambalur and Tiruchirappalli districts. In order to determine the Village wise concentration of crops Bhatia's method is used for the calculation of the location quotient. The following formula is used to work out the concentration of crop in Sweta Nadhi basin.

$$\text{Index for determining crop concentration} = \frac{\text{area of } x \text{ crop in the component areal unit}}{\text{area of all crops in the component areal unit}} \div \frac{\text{area of } x \text{ crop in the entire country}}{\text{area of all crops in the entire country}}$$

Crop combination is of vital importance to understand cropping pattern and level of diversification (Bhat, 2013). The delineation of crop combination formula devised by J.C. Weavers’ (1954) based on statistical technique was used:

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

Where ‘d’ is the difference between the actual percentage and the appropriate percentage in the theoretical curve, ‘n’ is the number of crops.

$$\text{Index of Diversification} = 1 - \frac{\sum X^2}{(\sum X)^2}$$

Where ‘x’ is the total cropped area of each crop. Result output maps prepared in ArcGIS 9.3. software.

3. Objectives

In the present study, different methods have been adopted to show the cropping pattern and to delineate crop combination regions in the basin.

4. The Study Area

The Sweta Nadhi basin lies in the districts of Namakkal, .salem, trichy and perambalur of Tamil Nadu state. This river originates from northern portion of Kollihills in Namakkal district. It is partly in central part of salem and some area covered by Thiruchirappalli district, then it is partly in the eastern part of perambalur district. It is located between 11° 15’ N and 11° 45’ N latitudes and 78° 15’ E and 78° 00’ E longitudes (as read form the survey of India Topographic sheets 58 I/6,I/7,I/10,I/11,I/14 (Fig.1). This river basin situated in Namakkal distict in East, Salem district in south, Trichirappalli district in north and Perambalur district in west. It is based on study area, major three relief order like hill, upland, and plain. The river originated in the northern portion of Kolli hills, part of Manmalai, adjoining Kollihills and Palakkadu malai with Pachamalai. The area of study area of Sweta Nadhi 1034 Sqkm with in 82 Revenue villages, The 34 revenue villages in Salem district, 27 revenue villages in Namakkal district, 17 revenue villages in Perambalur district and remaining 4 revenue villages in Tiruchirappalli district. The major taluks of basin Gangavalli, Rasipuram and Veppanthattai. The Sweta Nadhi is one of the tributaries of the Vellar Basin The river flows in the west to East direction with length with of 116 km and basin breath is 35 km.. The physiographic feature has controlled by structural hills, denudational and pediplain and fluvial process in the study area.

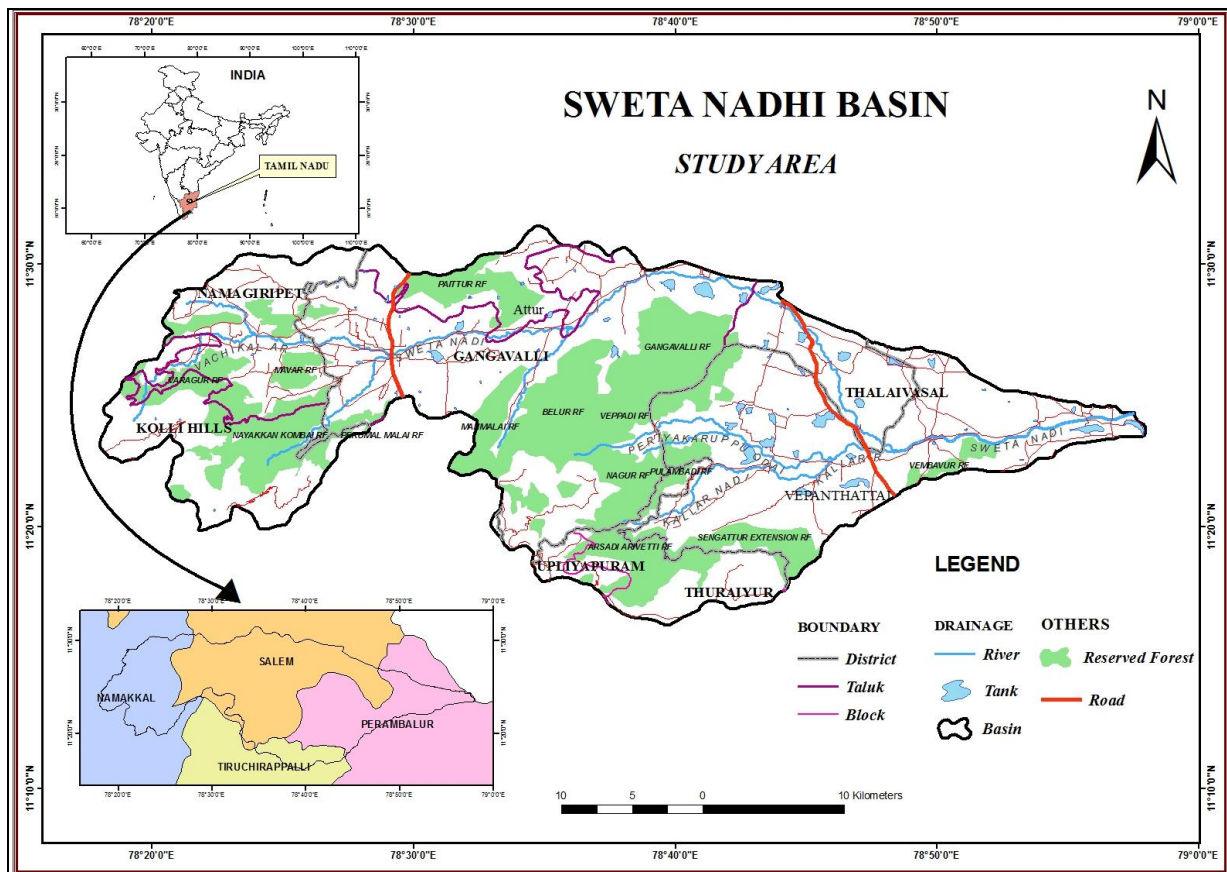


Figure 1: Sweta Nadhi Basin- Study area

5. Discussion

The present study has mainly examined the crop concentration, crop diversification and Weaver's Method in different villages of Sweta Nadhi Basin, it envisages the different levels of diversification at village-level (i.e., High, moderate, low, etc.) in the basin mainly the spatial pattern of crop diversification would be the tools for future planning in case of crop production.

6. Crop concentration

The Relationship between density of individual crop and the corresponding density for the study area as a whole has been studied. Table.1 is showing the village wise crop concentration index in Sweta Nadhi Basin. The pattern of crop concentration in the region is as follows Figure 2.

6.1. Paddy

Paddy is the important crop in the study area because here though the rainfall is enough to meet the requirement, even then area is enjoying fairly good irrigation facilities to facilitate paddy cultivation without risk. The concentrated of paddy ranges from 0.7 to 4.7 and its Higher level of concentration of found in 12 villages mainly sangapatti (4.7), Kottampalayam (1.1) and Kallatbhukombai (1.0) having high degree of crop concentration in the study area remaining 39 and 16 villages having moderate level to low concentration then this crop occupy in the eastern part of the study area figure 2 (a).

Sl. No	Crop Name	Total cropped area of each crop in the GCA (in hect)	Index Value	Level of Concentration	No. of Villages
1	Paddy	10794.763	< 0.2	Low	16
			0.2 - 0.3	Moderate	39
			> 0.3	High	12
2	Maize	11544.205	< 0.2	Low	11
			0.2 - 0.4	Moderate	15
			> 0.4	High	23
3	Tapioca	9457.245	< 0.5	Low	20
			0.5 - 1.0	Moderate	10
			> 1.0	High	15
4	Cholam	8615.061	< 0.1	Low	5
			0.2 - 0.3	Moderate	11
			> 0.3	High	7
5	Turmeric	2722.743	< 0.2	Low	10
			0.2 - 0.3	Moderate	14
			> 0.2	High	9
6	Banana	1004.34	< 0.2	Low	6
			0.2 - 0.4	Moderate	7
			> 0.4	High	4

Table 1: Crop Concentration index of Sweta Nadhi Basin

Source: Compiled by Author based on G – Return data (2009-2010) of District Statistical Office (Salem, Namakkal, Tiruchirappalli, Perambalur)

6.2. Maize

Maize is the another important crop in study area. High concentration of maize is found in 23 villages such as Varagur Kombai (1.1), Thondamandurai (0.3) and Manmalai (0.8) villages having high degree level of concentration remaining 15 villages and 11 villages under the moderate to low level concentration in the middle part of the study area figure 2 (b).

6.3. Tapioca

The concentration of Tapioca ranges from 0.1 to 6.3 found the study area. The high concentration having 15 villages especially Moolakurchi (2.6), Pacchacoundampatti (2.9) and Kolakkamedu (6.3) and 10 and 20 villages having moderate to low concentration of the basin figure 2 (c).

6.4. Cholam

Next to Cholam is found in considerable portion of the cropped area with high concentration areas with index value range from 0.1 to 0.9. Seven villages having high concentration level such as Kolakkamedu (0.9), Vengalam (0.6) and Thiruvandurai, Pulambadi and Pasambalur (0.5) other then 11 and 5 villages having moderate level to low concentration of the study area figure 2 (e).

6.5. Turmeric and Banana

High concentration of Turmeric is found in 9 villages in the study area mainly found in Paithur (1.0), Sangampatti (0.4) and Kolakkamedu(0.6) and rest of the villages 14 and 10 villages having moderate to low level concentration in western part of the study area. Banana cover very small or negligible area of the total cultivated area in the study area but the concentration of banana is high concentration in Mulaikkadu (0.7), Varagur Kombai (0.6) and Moolakuruchi (0.4) in Namakkal District figure 2 (d & f).

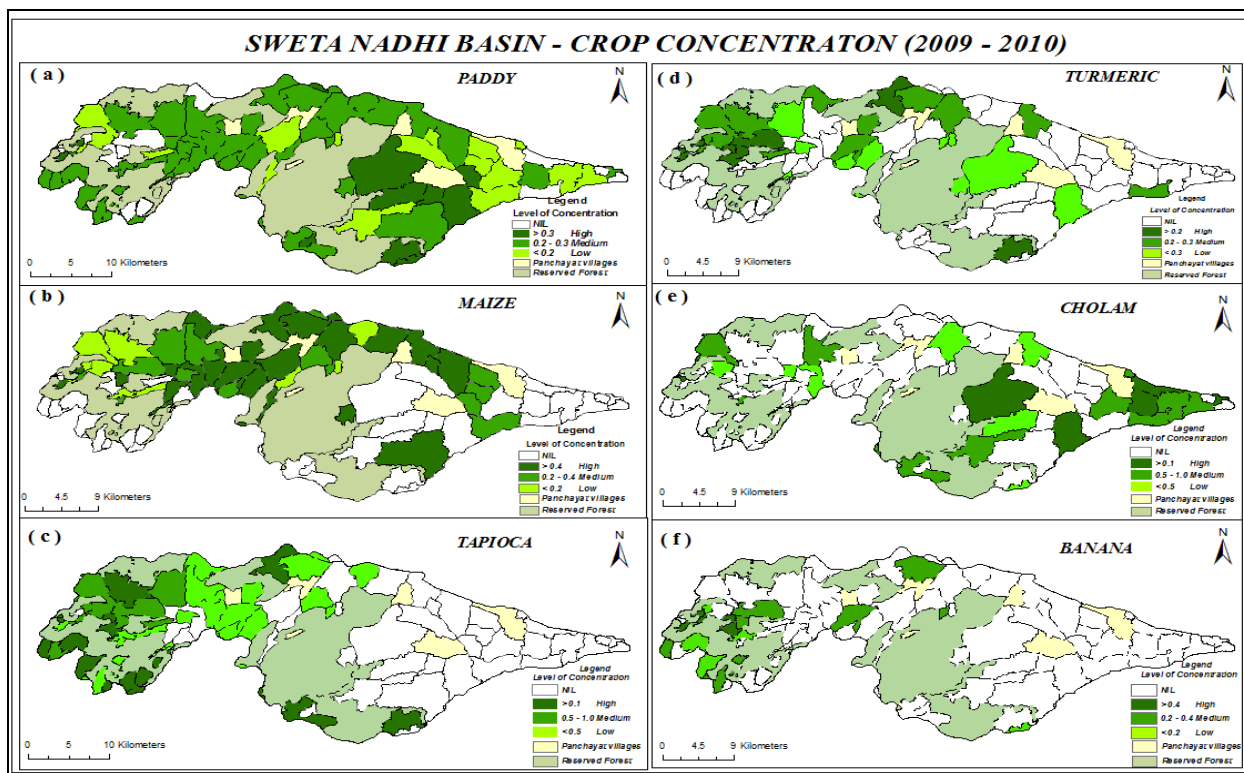


Figure 2: Concentration of major crops in Sweta Nadhi Basin in 2009 – 2010

7. Crop Diversification

Crop diversification means raising different variety of crops in arable land. It is a concept to opposite to crop specialization. The level of diversification largely depends upon the geoclimatic, socioeconomic conditions and technological development in the region (Husain, 1996). Crop diversification give a wider choice in the production of a variety of crops in a given area and also to expand production related activities on various crops and also to lessen risk. In general, higher the level of technological inputs lesser the level of diversification. It enables the planners to know the relative area strength of crops grown in the region and it is the indicator of multiplication of agricultural activities which obviously involves intense competition among various activities for space.

Sl. No.	Name of the Villages	Index of Crop Diversification	Sl. No.	Name of the Villages	Index of Crop Diversification
1	Vazhakombai	0.40	42	Thiruvilandurai	0.64
2	Pacchakoundampatti	0.00	43	Periyakombai	0.64
3	Kallathukombai	0.00	44	Pinanur	0.65
4	Kottappalayam	0.00	45	Periyavadakarai	0.65
5	Alathurnadu	0.22	46	Chinnasekkadi	0.65
6	Kolakkamedu	0.23	47	Mavar	0.66
7	Gangavalli	0.27	48	Sentharappatti	0.66
8	Chithoor Nadu	0.27	49	Pungavadi	0.66
9	Perakkarai Nadu	0.29	50	Pimbalur	0.67
10	Polapadi Nadu	0.33	51	Pandagappadi	0.68
11	Edappulinadu	0.35	52	Oonanthangal	0.68
12	Sengadu	0.40	53	Kondayampalli	0.68
13	Gudamalai	0.40	54	Kai kalathur	0.69
14	Bail Nadu	0.42	55	Paithur	0.69
15	Pulambadi	0.45	56	Gundininadu	0.69

16	Vembavur	0.46	57	Kavarpanai	0.69
17	Arumbavur	0.47	58	Thirupulinadu	0.69
18	Naduvallur	0.47	59	Kadambur	0.70
19	Gundur Nadu	0.47	60	Ulipuram	0.70
20	Thittacheri	0.47	61	Valasai Sikkalpatti	0.71
21	Tenparanadu	0.48	62	Belur	0.71
22	Pasumbalur	0.51	63	Veeraganur	0.71
23	Koneripatti	0.52	64	Malayalapatti	0.72
24	Naraikinaru	0.53	65	Nagiampatty	0.72
25	74 Krishnapuram	0.54	66	Jangamasamudram	0.73
26	Manmalai	0.55	67	Periyasekkadi	0.74
27	Thedavur	0.56	68	Thaluthalai	0.74
28	Mathurutu	0.56	69	Mudakku Patti	0.74
29	V.Kalathur	0.56	70	Varagur Kombai	0.75
30	Karkoodalpatti	0.56	71	Pudupalapatti	0.76
31	E. Rajapalayam	0.57	72	Mulaikkadu	0.76
32	Vengalam	0.58	73	Perappansolai	0.77
33	Moolakuruchi	0.58	74	Keeri Patti	0.77
34	Neikuppai	0.58	75	Udumbium	0.78
35	Thondamandurai	0.59	76	Anayampatty	0.78
36	Agaram	0.59	77	Veppanthattai	0.78
37	Thammampatti	0.60	78	Mullukuruchi	0.81
38	Pillayar Madhi	0.60	79	Kallipatti Seradi	0.81
39	Kariavampatti	0.60	80	Serama Moolai	0.82
40	Lathuvadi	0.61	81	Periyakurichi	0.82
41	Sangampatti	0.64	82	Veppadi	1.12

Table 2: Crop Diversification of Sweta Nadhi Basin
 Source: Compiled by Author based on G – Return data (2009-2010) of District Statistical Office (Salem, Namakkal, Tiruchirappalli, Perambalur)

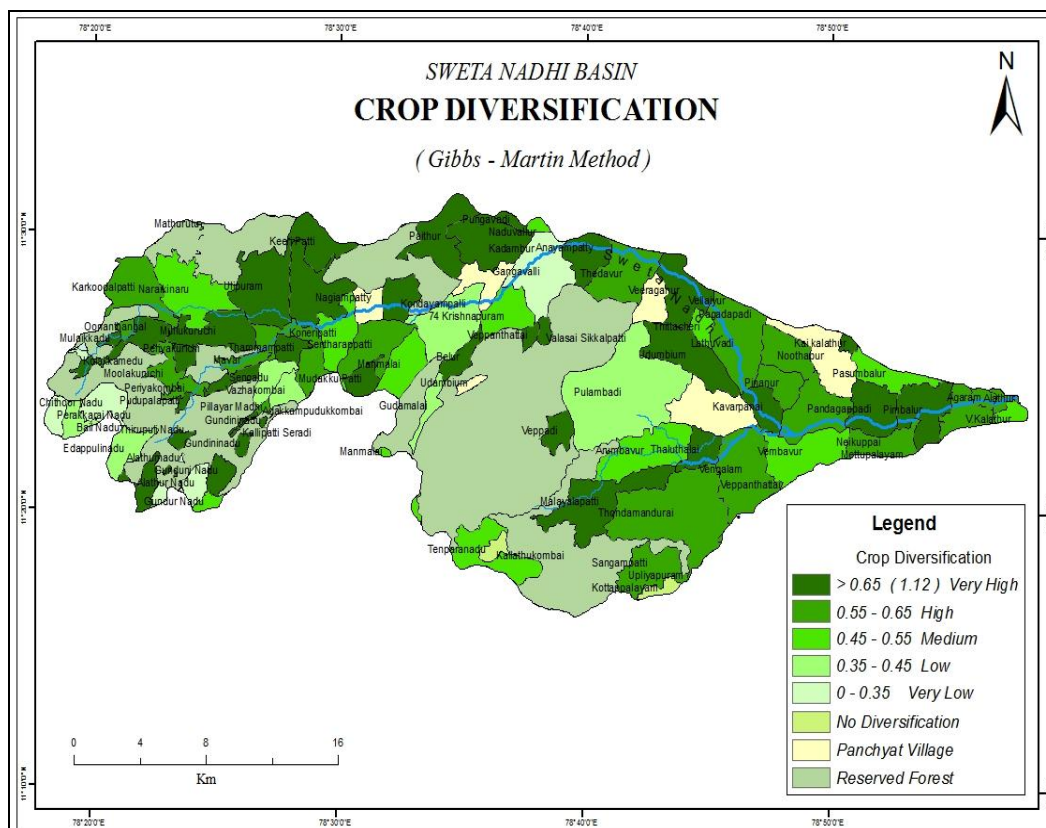


Figure 3: Index of Crop Diversification in Sweta Nadhi Basin in 2009 – 2010

In this study Gibbs-Martin Index of Diversification (1962) has been followed and this method has an advantage over other indices in that it is relatively easy to process since the index value may be calculated without reducing the actual statistics to percentages. According to this method if the total area is devoted to single crop the index value is zero i.e. indicating specialization and when the index value is 0.9 it shows that the area is evenly distributed among the crops i.e., the maximum diversification.

The study of crop concentration and diversification as a measure of the intensity of crops in a region is considered to be a step ahead in determine the regional character of distribution of crops to highlight the importance of one crop over another. The index of crop diversification depends on the conditions of soils, characteristics of rainfall, the extent of irrigation facilities and the site of the arable land is important one. It may be identified that lower the value of the index, higher is the degree of crop diversification and vice versa(Singh and Dhillon, 2004). The diversification of crops is very high and high all over the study area 34 Villages having index varies from 0.6 to 1.12 Table.2 & Figure 3. Relatively less rainfall and varying degree of topography might be the reason for the selection various crop based on the suitability of land and local needs. There twenty two villages having high level of crop diversification of 0.50 to 0.60 and 12 villages having medium diversification remaining 8 villages having low to very low diversification its denotes the cultivation of monocrop like Tapioca and Turmeric that diversity variation the villages have higher cropping intensity.

8. Crop Combinations

The study of crop combination regions constitutes an important aspect of agricultural geography as it provides good basis for agricultural regionalization. The crops are generally grown in combination and it is rarely that a particular crop occupies a position of total isolation other crops in a given area unit, at a given point of time.

Crop Combination	No. of Villages	Area in Hectares	Area in %	Name of the Villages
Monoculture	1	11.48	0.02	Pacchakoundampatti
2-Crop	44	33639.47	64.2	Agaram, Alathurnadu, Arumbavur, Bail Nadu, Chinnasekkadi, Chithoor Nadu, E. Rajapalayam, Edappulinadu, Gudamalai, Gundininadu, Gundur Nadu, Kai kalathur, Kallipatti Seradi, Kavarpanai, Kolakkamedu, Koneripatti, Kottappalayam, Lathuvadi, Malayalapatti, Manmalai, Moolakuruchi, Naraikinaru, Neikuppai, Paithur, Pasumbalur, Perakkarai Nadu, Periyavadakarai, Pinanur, Polapadi, Nadu, Pulambadi, Pungavadi, Sangampatti, Sengadu, Tenparanadu, Thaluthalai, Thammampatti, Thedavur, Thirupulinadu, V. Kalathur, Vembavur, Vengalam, Veppadi, 74 Krishnapuram, Vazhakombai
3-Crop	19	7424.98	14.17	Jangamasamudram, Kadambur, Kallathukombai, Kariavampatti, Kondayampalli, Mathurutu, Mavar, Mulaikkadu, Mullukuruchi, Naduvallur, Oonanthangal, Perappansolai, Periyakombai, Periyasekkadi, Pimbalur, Serama Moolai, Thittacheri, Ulipuram, Veeraganur
4-Crop	10	6266.44	11.96	Belur, Keeri Patti, Mudakku Patti, Nagiampatty, Pudupalapatti, Thondamandurai, Udumbium, Valasai Sikkalpatti, Varagur Kombai, Veppanthattai
5-Crop	4	1902.53	3.63	Anayampatty, Karkoodalpatti, Periyakurichi, Pillayar Madhi
Multi Crop	4	3152.5	6.02	Gangavalli, Pandagappadi, Thiruvilandurai, Sentharappatti
Total	82	52397.405	100	

Table 3: Areas Shared by Crop Combinations (Based on J.C. Weaver's Combination)

Source: Compiled by Author based on G – Return data (2009-2010) of District Statistical Office (Salem, Namakkal, Tiruchirappalli, Perambalur)

The theoretical standard 100% of the gross cropped area is monoculture, 50 % for two crop combinations, 33.3 % for three crop combinations, 25 % for four crop combinations 20 % for five crop combinations and so on. The application of present method gives more than five crop combination regions for the study area Pachacoundampatti village only under monoculture Table 3. Two crop combinations are found in 44 villages 33639.47 hectares in cropped area. Three crop combination regions are seen in 19 villages in the study area, 10 villages occupy four crop combinations. Anayampatty, Karkoodalpatti, Periyakurichi and Pillayar Madhi are under 5-crop combinations, the variance values of other 4 villages decrease for more than five crops and they are categorized as multi crops. Which are shown in Figure 4. There are the villages intercropped by variety of crops. Finally 64.2 % total cropped area occupies the two crop combination 33639.47 hectares in the study area.

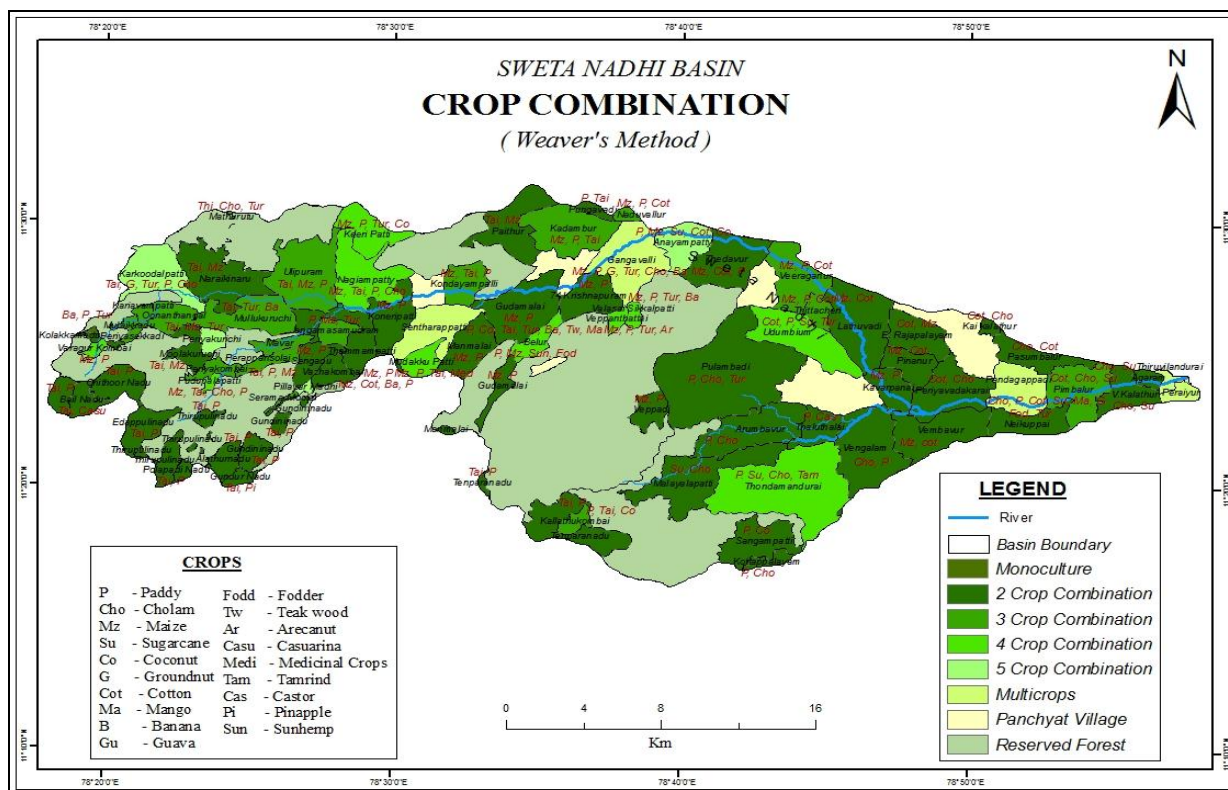


Figure 4: Index of Crop Combination in Sweta Nadhi Basin in 2009 – 2010

9. Agricultural Land use

Agriculture land-use means land under net sown area, fallow land and uncultivable land excluding fallow land. In short Agriculture land-use means a cropping pattern (Todkari.G.U.2010). It is largely influenced by the agro-climatological condition of the study area. It will undergo changes with the introduction of new agricultural technology and efficient high yielding varieties, new cropping pattern may emerge in the place of traditional cropping pattern.

Paddy is the food crops sown in samba season (July – August) accounts for 18.8 percentage of the net sown area. Sugar crops, Food oil crops, Fodder crops, Medicinal Crops and Pulses occupying significant percentage in the total cultivated area. The cropping pattern of study area is such as that Cereal crops holds major share in the net sown area followed by the Maize, Vegetables, Cholam. The proportion of the study area shared by various crops is shown in Table 4.

Sl. No.	Crops	Cropped Area (in Hectares)	Cropped Area in Percentage
1	cereals	14790	25.8
2	Vegetables	11279.2	19.7
3	Paddy	10794.8	18.8
4	Fiber Crops	4519.2	7.9
5	Spices & Condiments	3552.5	6.2
6	Fresh Fruits	3168.4	5.5
7	Sugar Crops	2668	4.7
8	Food oil crops	2593.2	4.5
9	Fodder crops	2134.8	3.7
10	Medicinal Crops	692.7	1.2
11	Pulses	649.5	1.1
12	Flowers	334.5	0.6
13	Non Food Crops	71.2	0.1
14	Nonfood oil crops	41.2	0.1
15	Citrus Fruits	37.9	0.1
16	Manure Crops	30.5	0.1
	Gross Cropped Area	57357.6	100.0

Table 4: Crop Area Details of the Sweta Nadhi Basin (2009 -2010)

Source: Compiled by Author based on G – Return data (2009-2010) of District Statistical Office (Salem, Namakkal, Tiruchirappalli, Perambalur)

10. Conclusion

It is clear from the above analysis that villages having largest proportion of the area are covered by cereal crops otherwise called grain crop, especially Maize, Paddy and vegetables (Tapioca). The patterns of crop concentration identify the six major crops in the study area paddy, cholam, tapioca, maize, turmeric and banana. The Pattern of diversification varies according the Gibbs-Martin technique very low diversity is noticed only in Pacchakoundampatti, Kallathukkombai and Kottapaylam Villages has higher cropping intensity. The study of crop combination region constitutes an important aspect of agricultural geography as it provides a good basic for agricultural regionalization. The crops are generally grown in combination and it is rarely observed that a particular crop occupies a position of total isolation than other crops in a given area at a given time. (Weaver, 1954). Two crop combination are found in 44 villages and 4 villages decrease for more than five crops and they are categorized as multi crops, for example a farming field has atleast 3 or 4 intercrops, in order to understand the obtainable agricultural situations, the land use pattern of the region planning of crops the future, the proposal of crop combination could be utilized.

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