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Changing cropping pattern in Thiruvarur district using GIS

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Abstract
The Traditional bound methods of agriculture cultivation is responsible for the low level production. The population growth has also steep that it has resulted in an imbalance in the supply of agriculture products of food grains. This in turn led to a large scale incidence of property, malnutrition and under nutrition. Cropping pattern means the proportion of area under various crops at particular periods of time. Cropping patterns differs from macro to micro regions both in space and time and covered largely by the physicals, cultural and technological factors. land-use and land-cover results from their direct relationship to many of the planet's fundamental characteristics and processes, including the productivity of the land, the diversity of plant and animal species, and the biochemical and hydrological cycles. Land cover is continually molded and transformed by land-use changes such as, for example, when a forest is converted to pasture or crop land. Land-use change is the proximate cause of land-cover change. The underlying driving forces, however, can be traced to a host of economic, technological, institutional, cultural and demographic factors.

Keywords: landscape, livestock, consideration, cropping pattern

Introduction
Agriculture is by far the most important of the world economic activities. The term Agriculture is derived from the Latin word "Agriculture" which literally means care of soil. The science of art of cultivating crop growing and harvesting of crops, domestication of animals and rising of livestock are known as agriculture. Studies have shown that there remain only few landscapes on the Earth that is still in their natural state. Due to anthropogenic activities, the Earth surface is being significantly altered in some manner and man's presence on the Earth and his use of land has had a profound effect upon the natural environment thus resulting into an observable pattern in the land use/land cover over time. The land use/land cover pattern of a region is an outcome of natural and socio – economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

Land-use and land-cover change
Deforestation can also impact hydrological processes, leading to localized declines in rainfall, and more rapid runoff of precipitation, causing flooding and soil erosion. And finally, scientists have come to a better understanding of the role that forests play in the carbon cycle, and how forest burning in certain parts of the world is important contributors to greenhouse gases that contribute to climate change. Clearly, all of these changes impact society. This dual role of humanity in both contributing to the causes and experiencing the effects of global change processes emphasizes the need for better understanding of the interaction between humans and the terrestrial environment. This need becomes more imperative as changes in land use become more rapid. Understanding the driving forces behind land-use changes and developing models to simulate these changes are essential to predicting the effects of global environmental change (Veldkamp *et al.,* 2001).
This results in varied environments. The land must be utilized on a rational basis so that the available resource of land, water and livestock are developed to the maximum potential and the population is assured a decent living. There exists a state of balance between rainfall, soils, crops, trees, animals and man. The potential may include both qualitative terms as degree of suitability and quantitative terms as crop/cash outputs.

Study Area
Agriculture is an important sector in the economic development of any area. The progressive development of agricultural sector will reflect the condition of economic development and income of any society. Hence Thiruvarur district located in Tamilnadu state is chosen for study. Taluk is selected as the basic unit of study. The district of Thiruvarur was carved out as a separate district by detaching Valangaiman Taluk from Thanjavur District and Thiruvarur, Nannilam, Kudavasal, Needamangalam, Mannargudi, Thirutturaippoondi Taluks from Nagappatinam District on 01.01.1997. It lies between 10º20‘ and 11º 07’ North latitude and 79º 15’ and 79º 45’ East longitude. The total area of the district is 2,377 sq.km (Fig -1).

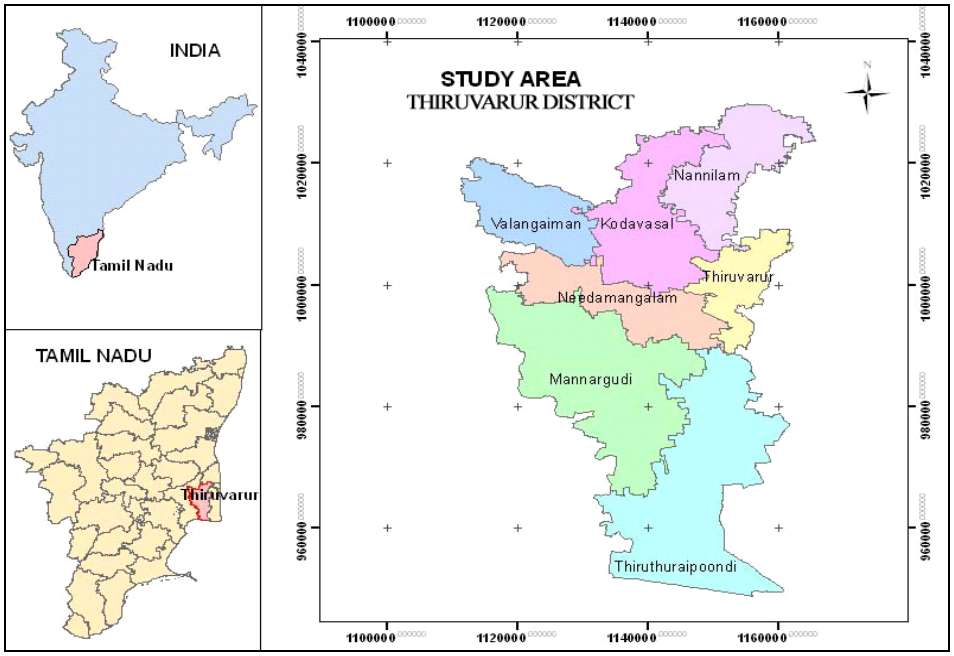

Fig 1

Aims and Objectives

The present investigation aims to analysis the various irrigation sources, and cropping pattern in Thiruvarur district, Tamilnadu. The following objectives of the study with reference to space and time.

- Examine the pattern of sources of irrigation practices of Thiruvarur District and the existing cropping pattern.
- To analyze the changes of cropping pattern between the period 2003-2013
- To analyze the crop concentration for major four crops.

Methodology

In the present study Thiruvarur district has been selected as the unit of study. There are seven Taluk in Thiruvarur district. The following crops are selected for the study Paddy, Oil seeds, Pulses, Sugarcane and Cotton. GIS used to analyze the changes of cropping pattern. Concentration Index is used to analyze the distribution pattern of crops. Socioeconomic Diagram can be drawn with help of GIS software.

Cropping Pattern in Thiruvarur District

The Cauvery River flows through mettur Dam, where water is stored and released to the Grand Anaicut from where the cauvery delta irrigation starts. The water from Anaicut is than released to the cauvery river, Vennar, Odampokki, Vettar, Mudikondan, Nandalar, Nattar, Thirumalairayanar, Koraiyar, Valavaikkadkattar, Pandavaiyar, Arichandranathi, Mullaiyar, Pamaniyar. Well irrigation Thiruvarur district. Net area irrigated 12908 Hec, Gross area irrigated 138483 Hec. Vaduvur lake, Thirumeni lake, Ayyampettai lake, Uthayamarthandapuram lake, Moovanallur lake. These lake are used to irrigation source in Thiruvarur District.

Three important tributaries of river cauvery are flowing Thiruvarur district which substantially benefit the agricultural activity the cauvery and vennar areas are called as old delta whereas the Grand Anaicut Canal area called as the new delta. The taluks benefited by the three important rivers of this district are follows rivers basin cauvery Nannilam part of Valangaiman Kodavasal and Thiruvarur. Vennar river basins Thiruthuraipoondi, Needamangalam and part of Thiruvarur, Kodavasal, Valangaiman and Mannargudi. Grand Anaicut canal is very small extent of Mannargudi and valangaiman. The main source of irrigation found over the region are canals, wells, Tube wells, others canals – 132676 Hec in irrigated area, Tube wells 12345 Hec in irrigated area. Others 92526 Hec in irrigated area in Thiruvarur District.

Changes in Irrigation Practices

In Thiruvarur District the cropping pattern is mainly conditioned by the amount of surface water in the form of river Cauvery distributaries and the grand water resourced two significant changes have taken place during 2003-2013 among the sources of water supply in Thiruvarur District.

Area Irrigated By Canal

Since Thiruvarur District is situated in Cauvery delta, canal irrigation occupies a predominant place. However the number and length of canals are not uniform thought-out the district. More ever no changes in number and length of the canals are observed for the entire district during 2003-2013. About 12 canals, mainly Government canals with a total length of 435km have been measured during 2003-2013. Nannilam, Valangaiman, Kudavasal, Thiruvarur, Tiruthuraipoondi, taluks have a maximum 2 canals maximum canal length 85 km in Mannargudi Taluks. Needamangalam, Mannargudi one canal in this Taluks. A both positive and negative change occurs in terms amount of canal irrigated area in the Thiruvarur District 2012-2013.

Area Irrigated By Well

Ordinary Well

Wells have occupied on important position in the irrigation system of Thiruvarur District. About 1233 private wells have been used for irrigation in this district. More number of ordinary wells are found in Mannargudi (333), Needamangalam (278) Thiruvarur (174), Valangaiman(155) well irrigation is completely absent in Nannilam, Kudavasal and Thiruthuraipoondi taluk during the same period.

Tube Wells

The number of tube wells has steadily increased from 6748in 2013, Valangaiman (2343) Kudavasal (1678), Nannilam (982) Needamangalam (680). A steady increase in number has been in Mannargudi, Thiruvarur Taluk, Tube wells irrigation is not for Tiruthuraipoondi Taluk. (Fig -2)

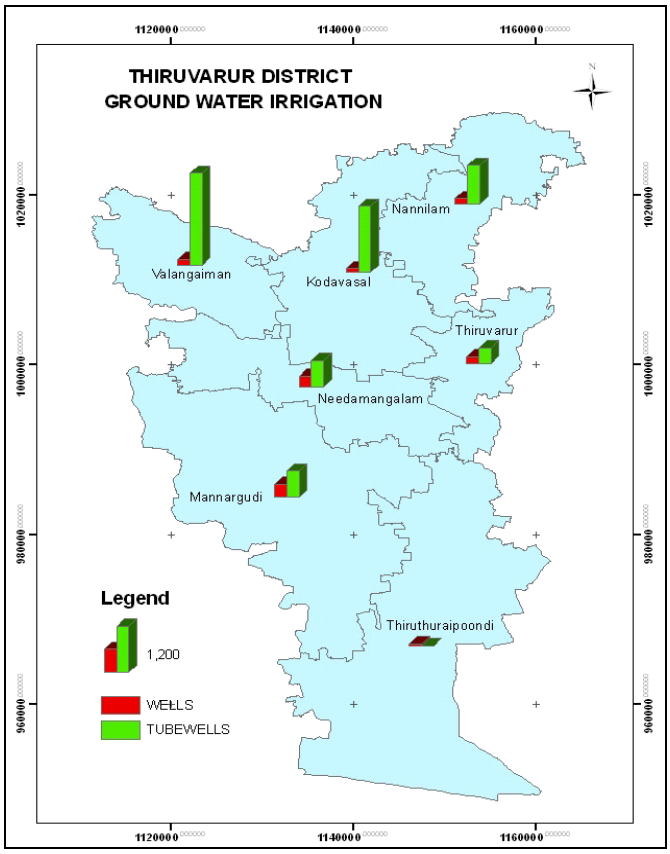

Fig 2

Cropping patterns means the percent contribution of area under different crops at a point of time, whereas change in cropping pattern refers to change in proportion of area under different crops at two different points of time. The cropping pattern of any area generally controlled by physical, cultural, socioeconomic and technological factors. There are more than 24 crops with varying hectare are grown in this district, out of 24 crops only 4 crops based on the properties of land to the total area under cultivate alone has been considered for analysis. Simple percentage is obtained by dividing the total area under crops into area of different crops. Paddy is the dominant crop in this district. Paddy occupies 66per cent of the total area of the district. Paddy, pulses, cotton, oilseeds are considered for analysis. (Fig -3)

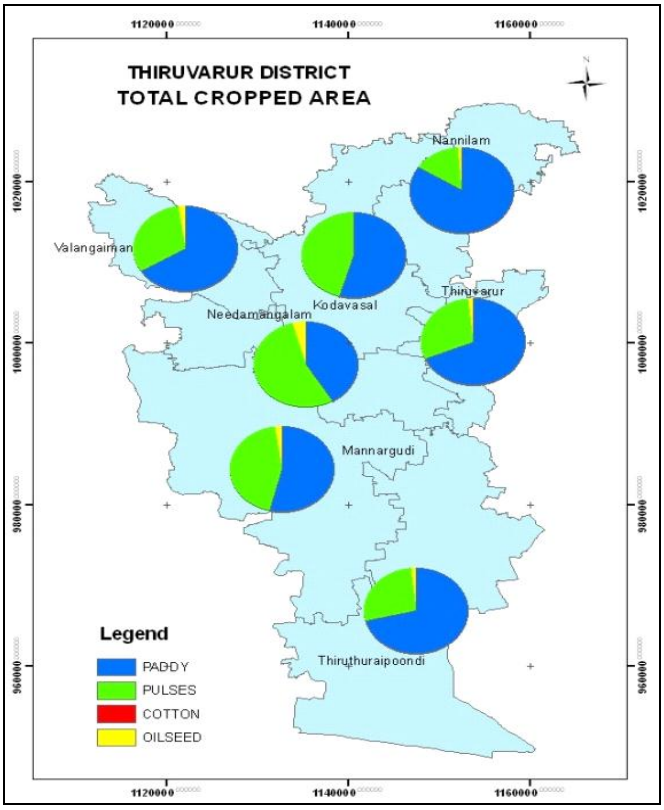

Fig 3

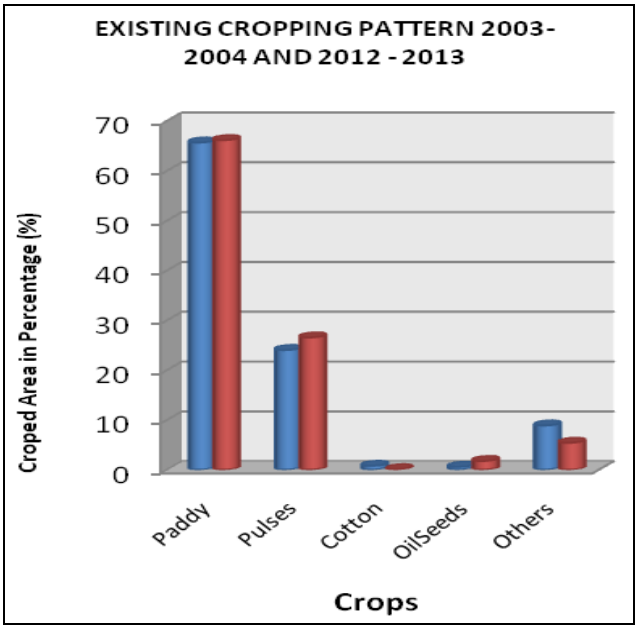

Fig 4

Table 1: Total Cropping Area in Hec (2012-2013)

S.no	Name of taluk	Gross cropped area	Area under paddy	Area under Pulses	Area under Cotton	Area under oil Seeds
1	Nannilam	68511	56030	10139	50	898
2	Valangaiman	40247	26033	12150	55	903
3.	Kudavasal	44195	36022	12930	40	596
4.	Thiruvarur	38863	26021	10999	43	690
5.	Needamangalam	17146	6010	7933	35	685
6.	Mannargudi	31644	16009	12938	64	692
7.	Thiruthuraipoondi	34721	16020	6055	26	404
	Total inHectare	275327	182145	73144	313	4868

Paddy

Figure -4 shows the Thiruvarur taluk the area under paddy cultivation is more than 85per cent Kudavasal and Mannargudi have got more than 70per cent of the paddy of the total cropped area. Valangaiman and Thiruthurapoondi taluks have got more than 20 per cent of the area under paddy cultivation.

Pulses

Pulses are the second ranking crop in order of its area. It occupies an area of 24.04 per cent of the total cropped area in this district. Nannilam taluk has got 33.02 per cent the taluk of Valangaiman and Mannargudi have got more than 25 per cent of its total cropped area. Kudavasal, Needamangalam and Thiruthuraipoondi have got more than 20 per cent of its total cropped area. Thiruvarur taluk has got less than 10 per cent of its total cropped area (Fig -4).

Cotton

Cotton rank in third order of its area which occupies only 0.80 per cent of the total cropped area. The taluk of Valangaiman, Needamangalam and Mannargudi have got more than 1 per cent of the area under cotton. Nannilam, Thiruvarur and Tiruttuaipoondi have got more than 0.5 per cent of the under cotton. Kudavasal taluk has got less than 5 per cent of the area under cotton (Fig-4).

Oilseeds

Oil seeds occupy fourth rank with 0.58 per cent of the total cropped area in the district. Nannilam, Valangaiman, Kudavasal, Needamangalam and Thiruthuraipoondi have got more than 0.5 per cent of area under oil seeds. Thiruvarur, Mannargudi taluk have got more than 0.2 per cent of the area under oil seeds (Fig-4).

Crop Concentration in Thiruvarur District

The relationship between density of individual crop in the taluk and the corresponding density for the district as a whole has been studied crop concentration was determined by the following formula.

Formula

$$\text{Index of concentration} = \frac{\text{Area of crop 'a' in the aerial unit}}{\text{Area of all crops in the aerial unit}}$$

Crop concentration means that there is recognizable degree of concentration of particular crop in the region. Crop concentration pattern is mainly to differentiate the area of high and low density of individual crop in the different part of the region. The following table clearly shows that the area under different crop can be divided into 3 zone of magnitude. We can analysis the concentration of paddy with the help of three zones. This concentration is found in the taluk of Nannilam, Needamangalam, Valangaiman and Thiruthuraipoondi. Medium concentration is found in the taluk Mannargudi and Kudavasl, low concentration is found in the taluk of Thiruvarur. Needamangalam, Mannargudi have high concentration in pulses cultivation. Medium concentration found in Valangaiman, Kudavasal and Thiruvarur. Low concentration is found in the taluk of Thiruthuraipoondi and Nannilam. Cotton cultivation is found to be high in the taluk of Nannilam and Thiruvarur, medium concentration is found in Thiruthuraipoondi, low concentration is found in the taluk of Kudavasal, Valangaiman, Needamangalam, Mannargudi. (Fig -5)

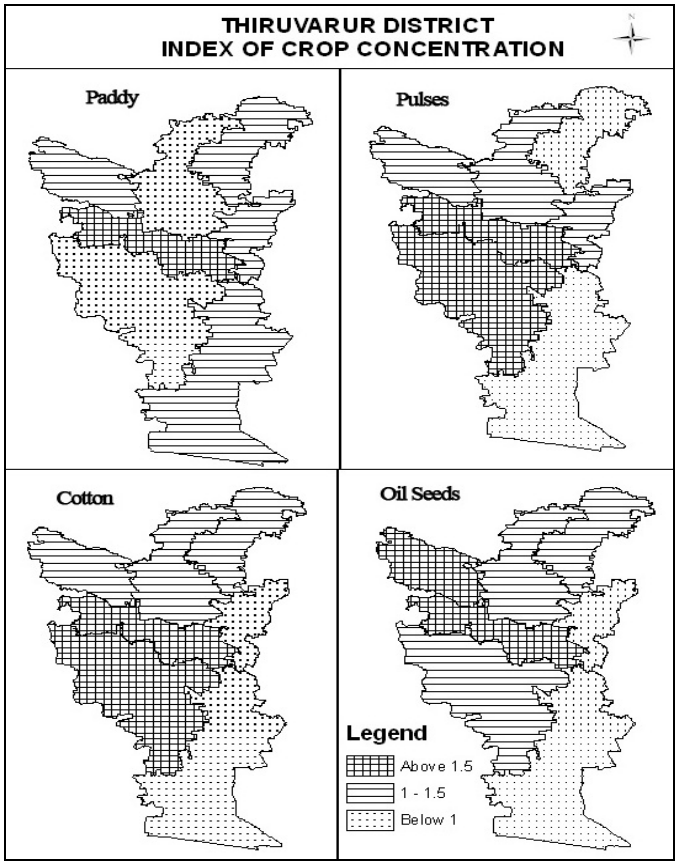

Fig 5

.**Table 2:** Index of Concentration

	Name of crop	Index value	Levels of Concentration	Taluk under zone
1	Paddy	>1.5 1-1.5 <1	A B C	Needamangalam Nannilam, Thiruvarur Thiruthuraipoondi, Valangaiman Kudavasal, Mannargudi
2	Pulses	>1.5 1-1.5 <1	A B C	Needamangalam Mannargudi Valangaiman, Kudavasal Thiruvarur, Nannilam Thiruthuraipoondi

3	Cotton	>1.5 1-1.5 <1.5	A B C	Needamangalam Mannargudi Valangaiman Kudavasal, Nannilam Thiruvarur, Thiruthuraipoondi
4	OilSeeds	>1.5 1-1.5 <1.5	A B C	Needamangalam Valangaiman , Mannargudi Kudavasal, Nannilam Thiruvarur Thiruthuraipoondi

Needamangalam has got high concentration in oilseeds cultivation, medium concentration is found in Valangaiman, Mannargudi. Low concentration is found in the taluk of Nannilam, Kudavasal, Thiruvarur, Thiruthuraipoondi

Changes in Cropping Pattern

In the year 2003-2004 there are 4 important major crops in the district are ranked as paddy, pulses, cotton, oilseeds. During the year of 2012-2013, in the order of crops have changed as paddy, pulses, oilseeds and cotton. 2012-2013, there is some changes in the area of all crops i.e.; paddy has been increased. It may due to the monsoon rainfall.

Paddy crop depends upon the seasonal rainfall and it requires high rainfall, the failure of seasonal rainfall, which affects the paddy crops, tank irrigation is the main source of irrigation and it is used to cultivate. In the Taluk of Thiruvarur, Needamangalam, Mannargudi, Tiruttaraipoondi, areas of paddy have been decreased. It may be due to the changes in the urban land use.

Pulses areas are decreased in the year 2012-2013. It is mainly due to the lack of water facility, recording the area of oilseeds have increased. The farmers in this district have changed their ideas. They have given importance to cultivate the crops as cotton, oilseeds. Since they require less water when compared to other crops.

The above analysis clearly brings out the change in the cropping pattern as well as the area under each crop. The area under paddy have been increased, in some of the taluks and decreased in some other taluks, other crops like pulses. District as the whole almost all the crops area has been decreased.

Changes in the Cropping Pattern in the Thiruvarur District

The area under paddy, well illustrate the relative importance of casual factor in the change of cropping pattern. The cropping pattern of the recent years increased irrigation facilities like tube well, oil engines and related profitability of crops are the two main stimulants for the changes. Ten years data's (2003-2013 to 2012-2013) have been analyzed for this purpose. The study has been lighted by the detailed sample of Thiruvarur district Diagrams regarding the trend of cropping pattern have been drawn for seven taluks in Thiruvarur district

Paddy (2003 to 2013)

The following table-3 and figure - 6 reveals that the major crops such as Paddy, Pulses, Cotton, and oil seeds have registered increase in area during the periods of 2003-2013.

Table 3: Changes in Cropping Pattern (2003 to 2013)

S. No	Name of Taluks	Paddy (in %)		Pulses (in %)		Cotton (in %)		Oilseeds (in %)	
		2003-2004	2012-2013	2003-2004	2012-2013	2003-2004	2012-2013	2003-2004	2012-2013
1	Nannilam	6403	81.78	33	15	0.7	0.1	0.6	1.3
2	Valangaiman	24.9	64.68	31	30	1.2	0.1	1.0	2.3
3	Kudavasal	73.3	81.50	24	29	0.2	0.1	0.8	2.0
4	Thiruvarur	89.3	66.95	8	28	0.7	0.1	0.3	1.8
5	Needamangalam	69.6	35.1	24	46	1.1	0.2	0.8	4.5
6	Mannargudi	70.6	50.6	27	41	1.1	0.2	0.6	2.3
7	Thirutturaipoondi	53	46.1	24	17	0.7	0.1	0.3	0.9

Paddy area is registered sharp increase during the periods of 2003 to 2004. Nannilam Taluks has 79 per cent for the total cropped area under paddy in 2003 – 2004. After the year 2005 there is sharp increase in the paddy area in Nannilam taluk. In the year 2012-2013 it goes up to 82 per cent of the total cropped area of the Taluk. All most all the Taluks except Needamangalam the paddy area is increased in the year 2012-2013. It may due to favorable conditions prevailing in the monsoon periods or due to the raising price of the paddy. In the Valangaiman Taluk in 2003-2004 paddy area is 25 per cent of the total cropped area after that period 2005-2006 area under paddy have been increased. The Taluk of Kodavasal in 2003-2004 paddy area is 65 per cent of the total cropped area on the periods 2005-2006 area under paddy have been increased.

The Taluks of Thiruvarur and Mannargudi in 2003 – 2004 paddy areas are 89 per cent and 71 per cent of the total cropped area on the period 2005-2006 area under paddy have been decreased. The people of this taluk changed to cultivate oilseeds instead of paddy. Thiruthuraipoondi Taluk in 2003-2004 paddy area is 53 per cent of the total cropped areas on the periods 2005-2006 area under paddy have been increased. The reason for the paddy increase in area may due to the factor of availability of water supply through tube wells either by oil engine or by electric motors.

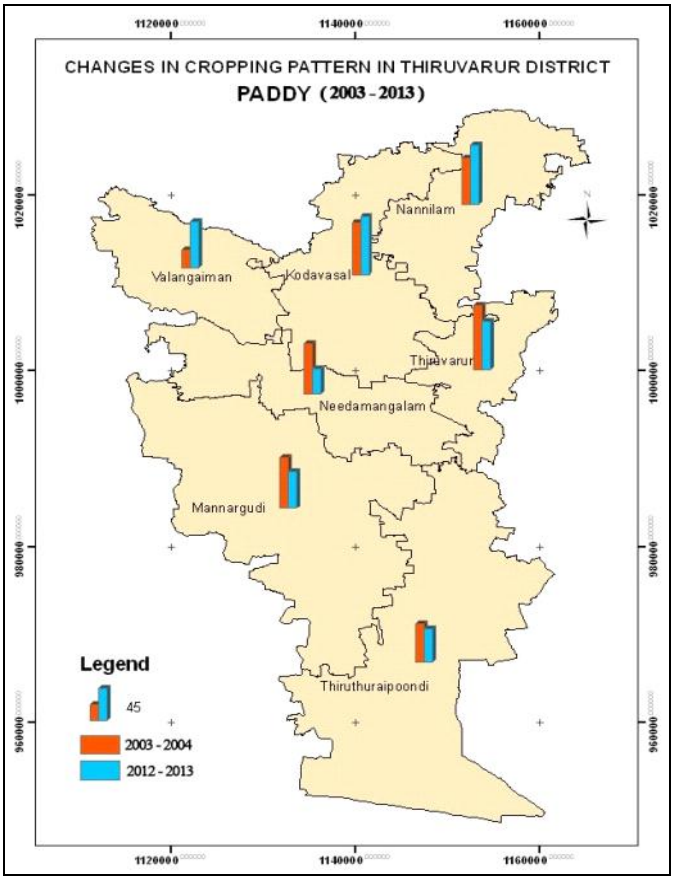

Fig 6

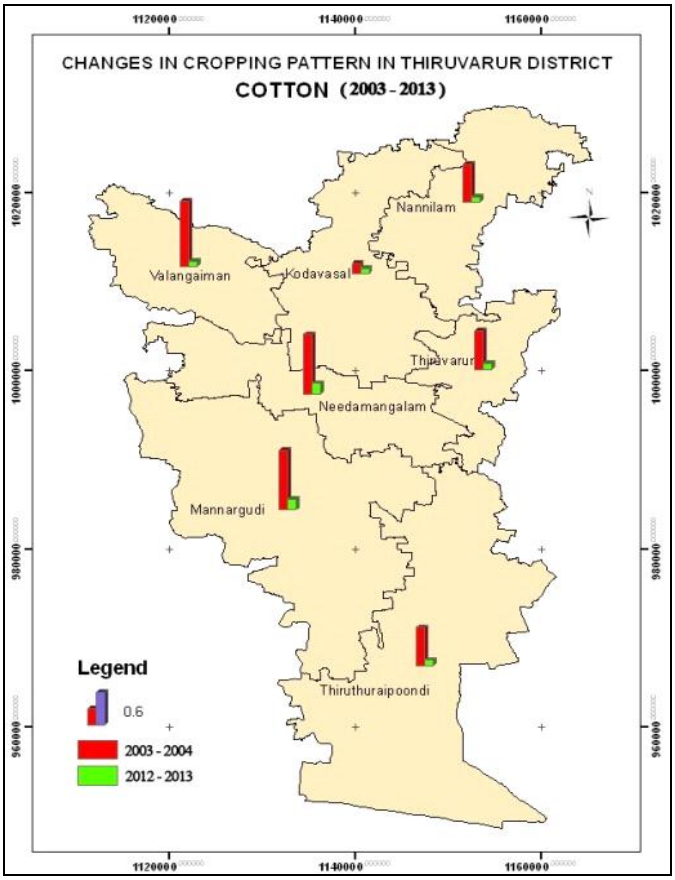

Fig 8

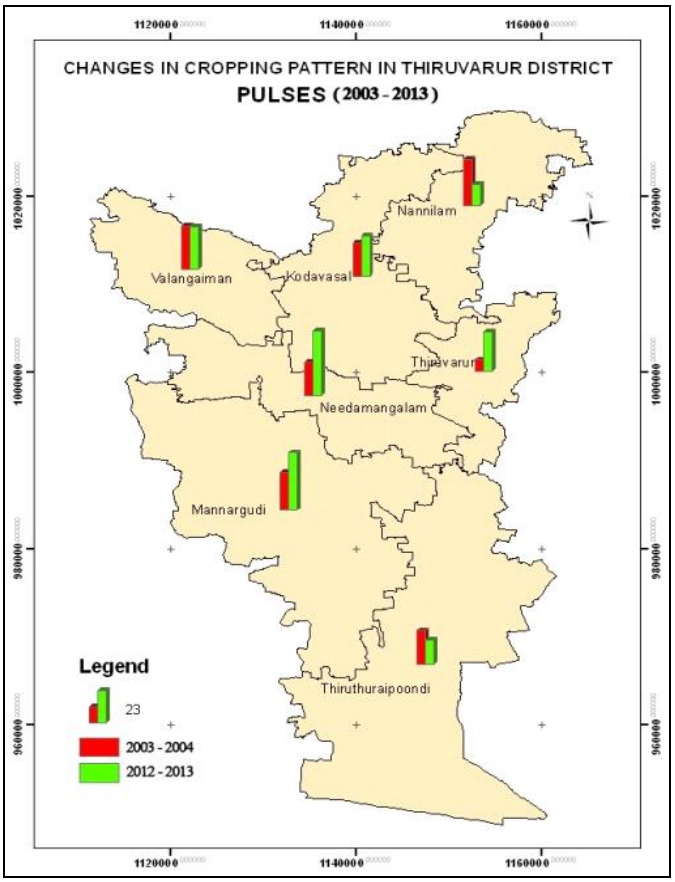

Fig 7

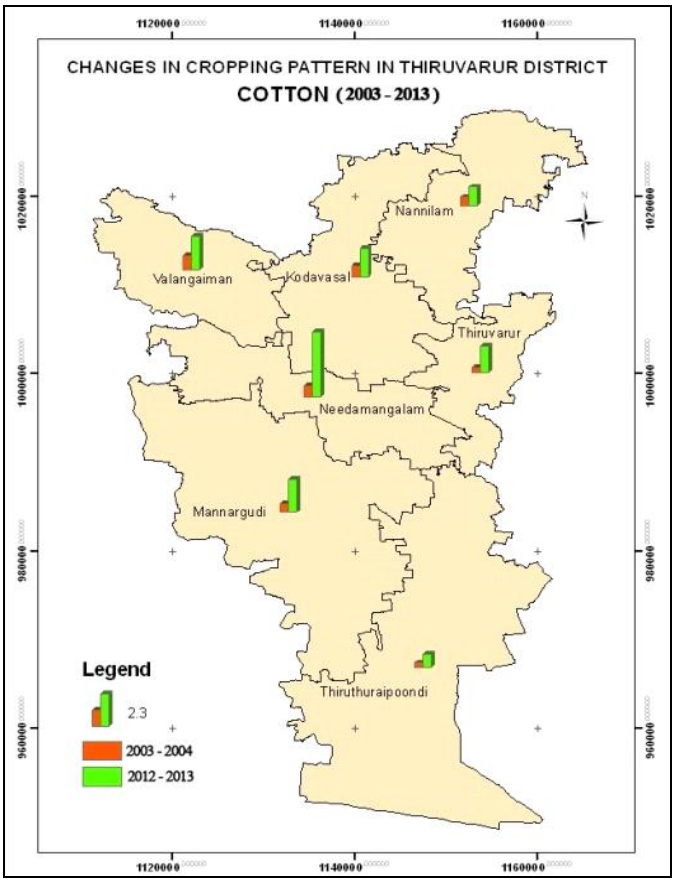

Fig 9

Pulses (2003 to 2013)

Pulses are the second ranking crop in Thiruvarur District. In 2003– 2004 to 2012 -2013 to slow decrease in seen in the district as a whole except Needamangalam and Mannargudi area under pulse in Thiruvarur taluk increase to 89 per cent in the period 2008 – 2009 (Fig-7)

Cotton (2003 to 2013)

Cotton is the third ranking crop in Thiruvarur District. Nannilam taluk in 2003 – 2004 area under cotton accounts 0.7 per cent of the area is increased to 1.3 per cent of the total cropped area. In 2012– 2013 the area is decreased to 0.1 per cent of the total area. (Fig – 8)

Oilseeds (2003 to 2013)

Oilseeds is the fourth ranking crop in Thiruvarur District. Oil seeds area is increased year after year Nannilam, Valangaiman, Kudavasal, Thiruvarur, Needamangalam, mannargudi and Thiruthuraipoondi taluks have increased in the total cropped area. (Fig – 9)

Summary and Conclusion

Etymologically, Agricultural geography deals with the art and science of domestication of plants and animals. "Bernnard" (1915) defines agricultural geography as the study of regional variations in agricultural and the factors responsible for them. The science and art of cultivating soil, growing and harvesting of crops, domestication of animals and raising of livestock is known as agriculture. In its broadest sense the word "agriculture" includes not only the domestication of plants and animals useful to man, but also many of the operations involved in marketing them.

Agriculture occupies an important position in India economy. It contribution to the national income in 2006-2007 was up to 60 per cent which declined to about 54 per cent in 2012-2013. In India nearly 70 per cent of its population is directly or indirectly involved in agriculture. Tamilnadu has significantly progressed in the field of agriculture since the III five year plan, it has accepted, high yielding variety of seeds and increased agricultural production. The important in irritation and uses of fertilizers have also helped to increase agricultural production.

India has achieved a major breakthrough in agriculture production by harnessing scientific inputs and technological innovation in the farm sector. There are several factors that retard the growth of agriculture production in India. The monsoon rainfall is insufficient and unevenly distributed. Sometimes due to heavy rain and result in flood and causes wide spread damage and destruction. Agriculture is by the most important of the world economic activities. It uses one third of the total land surface and employs 40 per cent of working population. Agriculture is the primary source of national income, and a half hundred million people and three and half million livestock population have depended upon. Its several agro based industries of our country depend upon agriculture for raw material. Thiruvarur district is situated in the Eastern part of Tamilnadu. This district stretches latitudinal from 10^0 20' North to 11^0 07' south and longitudinally from 79^0 15' East to 79^0 45' west. The problems of water supply and crop structure have attracted many researchers to work on water essentially one of the vital inputs for agricultural development. A part from Rainfall, Man- made resources are determined the crop structure of the study area. Canals, Wells, Tube wells and others are the available means of water supply in Thiruvarur District.

The number of tube wells has increased in Valangaiman, Kudavasal, Nannilam, Taluks. Well irrigation mainly in Mannarkudi, Needamangalam and Thiruvarur Taluks. There is significant change in the cropping, considered for analysis. Thiruvarur district depends upon irrigation such as tanks, canals, wells, and bore wells and other. In Thiruvarur district paddy is the dominant crop under cultivated area. Next to pulses, cotton, oilseeds are the leading crops. With the consideration of area under cultivation four crops are selected for the analysis. i.e., paddy, pulses, cotton and oilseeds.

Actually several changes are taken place between the periods of 2003 - 2004 to 2012 – 2013. Paddy areas are increased and other crops areas are also increased. In 2003-2004 paddy occupies 65 – 68 per cent of the area under cultivation and during the year of 2012 – 2013 the percentage is increased to 66.15 per cent. i.e. 0.47 per cent of increase is found through this analysis.

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