



Tiruchirappalli District: Determinants of crop geography

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ARTICLE INFO

Article history:

Received: 25th December 2020

Revision Received: 04th August 2021

Accepted: 21st September 2021

Key words: Soil Productivity, Tractors, Cropped Area, Factor Score

ABSTRACT

Thurstone in 1931 first introduced factor analysis as a statistical technique to reduce the number of variables and to detect structure in the relationship between variables so as to classify variables. Many works have been undertaken based on factor analysis technique. Johnson B.L.C. (1958) has made use of factor analysis in identifying crop association regions in East Pakistan. The study area lies between 10° 15' and 11° 12' North latitudes and 78° 10' and 79° 5' East longitudes (fig.2.1). This area lies along the east coastal plain and form a part of the Deccan plateau, one of the natural divisions of India. The present studies the purpose 34 variables (table 1) are selected factors are rotated in order to maximize the relationship between the variables and some of the crops and subjected to factor analysis using SPSS package. The analysis is based on the maps prepared using ArcGIS software through computer.

1. Introduction

The main contribution of Ritter and Humboldt to explanation in geography was their insistence that cause-and-effect laws could be established to explain the occurrence of geographic distributions. Cause-and effect thus become one of the dominant forms of explanation in geography during the nineteenth century. The problem of applying cause-and effect logic empirical research boils down one of identifying the variables which are causally related and identifying the boundaries of the system within which one may apply cause-and-effect analysis (Harvey D, 1989). The cause and effect explanation may successfully be performed either by using a simple correlation analysis or at an advance level using Factor analysis. In the present investigation it is proposed to test the effect of irrigation on the agro-geography of Tiruchirappalli district, which could successfully be performed using Factor Analysis. The idea of “collapsing” a large set of original variables into a small number of basic dimensions or composite variables underlies a large and expanding area of mathematics termed principal components and factor analysis Gould, P.R. (1967). Many studies of complex geographic phenomena begin with a set of data and notions of hypothesis and theories that are vague at best (Rogerson Peter, A. 2003) Factor analysis comprises a group of related techniques including principal components

analysis, the favored option for geographical analysis (Nigel Walford, 1995). Factor analysis are iterative procedures which produce a new composite factor that explains a little more of the overall variance at each successive iteration or pass through the data. Factor analysis is used to find latent variables of factors among observed variables. Factor analysis is used to reduce the number of variables in a data set. Factor analysis groups variable with similar characteristics together. Factor analysis produces small number of factors from a large number of variables, which is capable of explaining the observed variance in the larger number of variables.

Fruchter, Benjamin (1967) published a book on “Introduction to factor analysis”. Cloud P.R.C. (1967) has interpreted Eigen values in his work “On the Geographical Interpretation of Eigen values”. Berry B.J.L. and Phillip H.Rees (1969) have used factor analysis technique in analyzing the factorial ecology of Calcutta. Yeates M. (1974) in his study “An Introduction to quantitative analysis in Human geography” has stressed the significance of factor analysis in geographical studies. Mather P.M. (1976) has put forward the use of multivariate analysis in the study of physical geography. Neinz Nissel (1978) has used factor analysis in the determination of social areas in greater Bombay. Krishnakumari A. (1987) has studied agricultural

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modernization in Nellore district using factor analysis. Onkuno, T (1987) based on numerical regionalization framework has determined Social-Economic Regionality of the Matsumoto basin. Sreenivasa Reddy B and Ramanaiah, Y.V. (1999) analyzed the regional imbalance in the levels of Agricultural development in Andhra Pradesh. Sukumar B., Ahalya Sukumar and Saravana Kumar V. (2003) have identified agricultural regions of Kerala using factor analysis.

2. STUDY AREA

The Tiruchirappalli district is an inland district located in the central segment of the state of Tamil Nadu. The study area lies between 10° 15' and 11° 12' North latitudes and 78° 10' and 79° 5' East longitudes (fig.1). This area lies along the east coastal plain and form a part of the Deccan plateau, one of the natural divisions of India. But except for the presence of Pachamalai hills in the northern part of the district, the entire district is in the Cauvery basin. The river divides into Cauvery and Coleroon and reunites within the district, forming the Sri Rangam Island. The study area experiences semiarid climate. The annual temperature is above 25.5 ° C, the average rainfall accounts to about 645.2mm. The area is formed of crystalline rocks of Archaean age. A total population of 2722290 people is spread over an area of 440412 hectares. The average density of population of the study area accounts to about 604 person

per.sq.km. Around 83.23 percent of the population is classed as literates. There are about 483 villages and 22 urban settlements spread in 14 panchayat unions. The study area has a well-developed transport network. The understanding of the geographical environment of the study area will be helpful in understanding the Spatio-temporal analysis of the demographic characteristics in Tiruchirappalli district.

3. Aim and Objective:

The aims of the present study the purpose 34 variables (table 1) are selected factors are rotated in order to maximize the relationship between the variables and some of the crops. The objective of the study is to correlation matrix is generated for all the variables. To analysis the factors are extracted from the correlation matrix based on the correlation coefficients of the variables.

4. Methods and Methodology:

The study is mainly based on secondary data. Data relating to variables were collected from statistical office at Tiruchirappalli District. In the present study using Techniques is both statistical techniques and cartographic techniques. Follow the simple statistical calculations like percentage have been worked out to study. For this purpose 34 variables (table 1) are selected and subjected to factor analysis using SPSS package. The analysis is based on the maps prepared using ArcGIS software through computer.

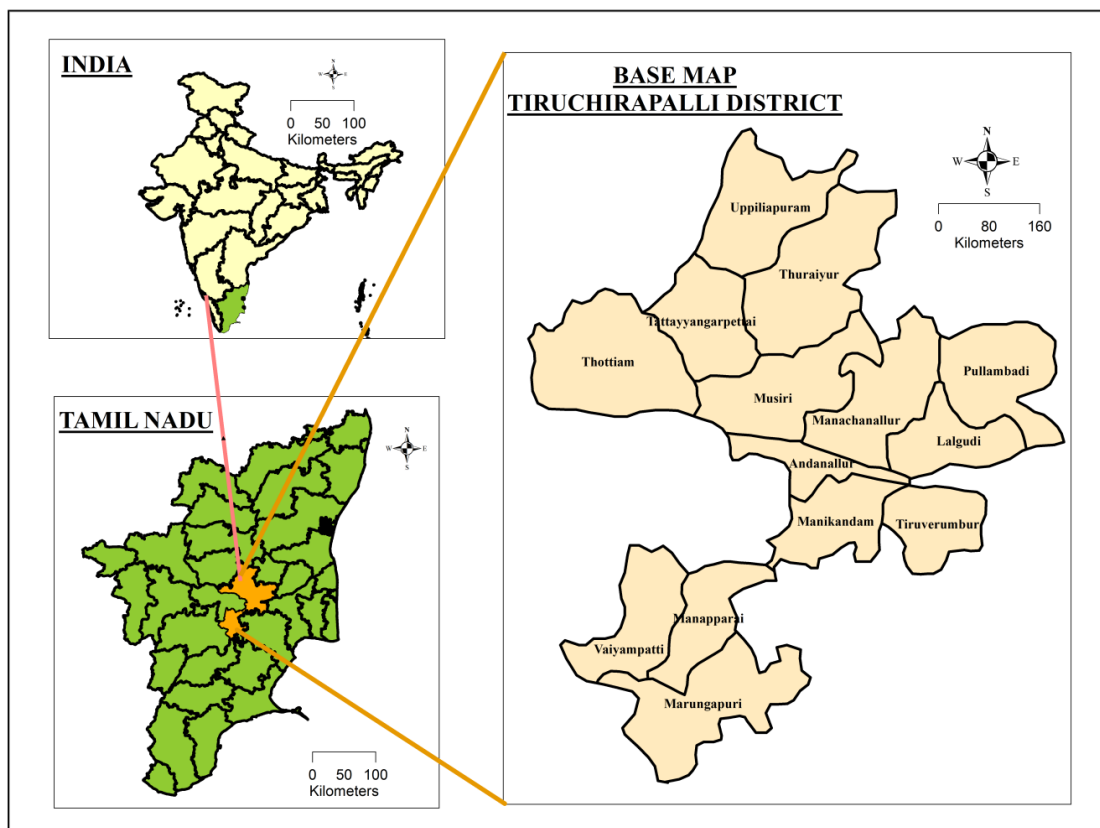


Figure No 1. Base Map

The starting point for carrying out a factor analysis is the complete product moment correlation matrix between all the original variables. The sum of the correlation coefficients for each variable including a value usually 1.0 for its correlation with itself are summed and divided by the square root of the total sum of correlations. The resulting figure known as the factor loading, express the relationship between each input variable and the new factor. The sum of the squared factor loadings provide a statistics called Eigen values, which denotes the amount of the total variance explained by the factor. The Eigen value becomes smaller with each successive factor that is derived since the unexplained part of the total variance becomes progressively smaller. Once the Eigen value falls below 1.0 the new factor does not account for anyone of the total variance than a single input variable. Factor analysis reduces a large number of variables to a smaller group of composite factors.

5. Discussion:

An important output from the procedure is factor scores. This provides a measure of relationship between observations and new factors. The factor scores are useful in geographical investigation since they can be mapped to show the spatial distribution of values or the new factors. In the present investigation it is proposed to perform factor analysis to identify the factors that have determined the crop geography of Tiruchirappalli district. For this purpose 34 variables (table 1) are selected and subjected to factor analysis using SPSS package.

Table 1. Tiruchirappalli District Determinants of Cropping Pattern and Agricultural Productivity

Variable Number	Name of Variable
1	Rainfall (In mm)
2	Soil Productivity Poor (In hectare)
3	Soil Productivity Average (In hectare)
4	Soil Productivity Good (In hectare)
5	Land Capability Moderate (In hectare)
6	Land Capability severe (In hectare)
7	Net sown area (In hectare)
8	Gross sown area (In hectare)
9	Gross irrigated area (In hectare)
10	Net irrigated area (In hectare)
11	Canal irrigated area (In hectare)
12	Tank irrigated area (In hectare)
13	Well irrigated area (In hectare)
14	Area under Marginal and Small Size Land holding (below 1 In hectare)
15	Area under Medium Size Land holding (1-5 In hectare)
16	Area under Large Size Land holding (above 5 In hectare)
17	Tractors (In number)
18	Pump sets (In number)
19	Paddy Cropped area (In hectare)
20	Cholam Cropped area (In hectare)
21	Cumbu Cropped area (In hectare)
22	Pulses Cropped area (In hectare)
23	Groundnut Cropped area (In hectare)
24	Gingelly Cropped area (In hectare)
25	Coconut Cropped area (In hectare)
26	Cotton Cropped area (In hectare)
27	Sugarcane Cropped area (In hectare)
28	Banana Cropped area (In hectare)
29	Chillies Cropped area (In hectare)
30	Agricultural Productivity (weighted ranking co efficient)
31	Cattle (In number)

Land capability classification is essential to understand the inherent capacity of the land to produce. Hence, the extent of land in each of the panchayat union under land capability moderate and land capability with severe limitations are included in the analysis. (In the study area only these two land capability classes are noticed)

The land under cultivation defined as the net sown area determines the extent of land used for cultivation. This represents the land sown once in an agricultural year. The gross sown area includes the net sown area and the area sown more than once. The gross sown area is an indicator of intensity of cultivation.

An analysis on crop geography of an area should give proper emphasis to the irrigation characteristics. Irrigation is an indicator of the efficiency of the cultivated land to produce. Hence, in the present analysis gross irrigated area that is area receiving irrigation more than once and net irrigated area receiving irrigation for the first crop are included. The area under the three sources of irrigation namely canal, tank and wells are also important. The crop geography of an area is dependent to a certain extent on the different sources of irrigation. Hence canal irrigated area, tank irrigated area and well irrigated area in the panchayat unions of Tiruchirappalli district is included in the present analysis.

The size of land holding is an indicator of the economic status of the cultivator. The larger the size of land holding more is the capacity of the cultivator to invest in agricultural activities. Smaller the size of the land holding limited is the capacity of the cultivator to invest in farming. Further the choice of the crop is also dependent on the size of the land holding. Hence, the extent of the land holding in each of the panchayat union of Tiruchirappalli district under marginal and small size land holding (below 1 hectares), medium size land holding (1-5 hectares) and large size land holding (above 5 hectares) are included in the analysis.

The use of tractors is gaining significance recently in farming. The farmers either own tractors or avail tractors on

tractors on rental basis to plough the land. The efficiency of tractors is very much felt by the cultivators. The use of tractors may play a role in determining agricultural productivity. Hence, the number of tractors in each of the panchayat unions in the study area forms one of the variables.

Irrigation through wells is carried out either by bullocks drawn lift or pump sets operated either by diesel or electricity. However, the number of pump sets in each of the panchayat union is an economic indicator. Hence, it has found a place in the analysis.

In the present analysis the crop geography of the study area is confined to 11 selected crops, as they dominate the agricultural scene of Tiruchirappalli district. The cropped area under these 11 crops in the panchayat unions of the study area are selected for the analysis. The cropped area under paddy, cholam, cumbu, pulses, groundnut, gingelly, coconut, cotton, sugarcane, banana and chillies are included in the present analysis.

Agricultural productivity an index of actual production of an area is calculated using Sapre and Deshpande's method. The cultivator also rear cattle, buffalo, sheep and goat and poultry to yield an additional source of income. Further, cattle, sheep and goat rearing are also preferred as they are fenned in the field as a source of natural manure. This land management practice is followed in the subcontinent even from the earlier periods. A study on the crop geography of an area will be incomplete without the livestock rearing analysis. Hence in the present analysis these 34 variables are selected and subjected to factor analysis using SPSS package through computer. The correlation matrix is presented in table 6.2. The result of factor analysis presented in table 3.

6. Initial factor solution

In factor analysis, Eigen value is a measure of how much variance each successive factor extracts. An Eigen value of more than 1 is statistically valid. In the present analysis 6 factors with an Eigen value of more than 1 are extracted accounting for 86.05 percent of variance (table 3).

Table 3. Factor Solution Matrix

DIMENSION	DIMENSION NAME	EIGEN VALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE OF VARIANCE
I	Association between Land Capability, Good Soil Productivity, Cropping Pattern, Small Size Land holding, Tractor use and Poultry farm	9.35	27.50	27.50
II	Irrigation determining cropping Pattern Productivity and Sheep and goat rearing	5.78	17.01	44.51

III	Net Sown area and Gross Sown area Associated with Gross irrigated area	5.42	15.93	60.45
IV	Irrigation through Wells and Tanks Associated with Rainfall	4.26	12.53	72.97
V	Banana Cropped area limited by Land Capability with Severe Limitation	2.65	7.78	80.75
VI	Cattle Rearing Associated with Poor and Average Soil Productivity	1.80	5.30	86.05

The first dimension has extracted the association between land capability, good soil productivity, cropping pattern, small size land holdings, tractor use and poultry farm with an Eigen value of 9.53 accounting for 27.50 percent of the variance. Thus, it is obvious that in the study area cropping pattern is the result of land capability and soil productivity. Further, the size of land holding tends to be small in areas of moderate land capability and good soil productivity. In spite of small size of land holding use of tractors is widespread. Moreover, poultry farming has found a significant place in the agro geography of the study area.

The second dimension with an Eigen value of 5.78 accounting for 17.01 percent of variance has established the association between irrigation, cropping pattern, productivity and sheep and goat rearing.

Net sown area and Gross sown area determined by Gross irrigated area is explained in the third dimension with an Eigen value of 5.42 accounting for 15.93 percent of variance.

The fourth dimension has established the dependence of irrigation through wells and tanks on rainfall with an Eigen value of 4.26 accounting for 12.53 percent of variance. It is worth observing that the first four dimensions accounting for about 72.97 percent of the total variance have explained the major determinants of cropping pattern and agricultural productivity of Tiruchirappalli district.

The fifth dimension with an Eigen value of 2.65 accounting for 7.78 percent of variance has established the fact that the Banana cropped area being limited by land capability with severe limitations. In other words it could be stated that banana cultivation is restricted in areas wherever land capability has severe limitations.

The sixth dimension has brought to light the practice of cattle rearing in areas with poor soil productivity. This dimension with an Eigen value of 1.80 accounts for 5.30 percent of variance.

In the light of the initial dimension solution matrix it could be concluded that rainfall and irrigation along with land capability and soil productivity have determined the cropping pattern and agricultural productivity in Tiruchirappalli district.

6.1 Dimension-I

Association between Cropping Pattern, Land Capability, Good Soil Productivity, Small Size Land holding, Tractor use and Poultry farm

Table 4. Dimension -I

Name of Variable	Factor loading
Sugarcane Cropped area(In hectare)	0.982
Chillies Cropped area (In hectare)	0.981
Gingelly Cropped area (In hectare)	0.980
Coconut Cropped area (In hectare)	0.979
Cumbu Cropped area (In hectare)	0.967
Cotton Cropped area (In hectare)	0.896
Land Capability Moderate (In hectare)	0.797
Soil Productivity Good (In hectare)	0.791
Tractors (In number)	0.756
Small Land holding (In hectare)	0.688
Poultry (In number)	0.568
Eigen Value	9.35
Percentage of Variance	27.50

In the first dimension eleven variables are grouped (table 4). These variables account for an Eigen value of 9.35 and account for 27.50 percent of variance. Soil is the major determinant of cropping pattern. When the soil productivity is good the cultivator selects the crops to be grown considering the rainfall, irrigation and capital availability. In the study area six out of the eleven crops are grouped in dimension I. The First dimension has established the association of the cropped area of these six crops namely sugarcane, chillies, gingelly, coconut, cumbu and cotton with moderate land capability and good soil productivity.

Sugarcane, an annual crop is a cash crop and brings back an assured profit to the cultivators, as it has a ready market in the sugar mills located at Kattur in Lalgudi panchayat union and Cauvery sugar mills in Andhanallur panchayat union. Sugar mills are also located in Karur and Perambalur districts located adjacent to Tiruchirappalli district. But before the trifurcation of Tiruchirappalli district into Tiruchirappalli, Karur and Perambalur, these mills were within Tiruchirappalli district.

The cultivators were encouraged to cultivate sugarcane by way of financial assistance. So in areas of moderate land capability and good soil productivity sugarcane is preferred as it has the highest factor loading of 0.982. chillies and gingelly also cash crops are preferred in areas of moderate land capability and good soil productivity. Chillies cropped area (0.981) and gingelly cropped area (0.980) have a high factor loading. Recently researches have proved that coconut cultivation is gaining significance in areas of paddy, sugarcane and banana cultivation. The recent attitude of the cultivators is to plan for an off farm income to improve their economic status. Further, coconut crop is a less labor-intensive crop, low water requiring perennial crop, which will yield the farmer a permanent income from the farm for about 30 years. The income from the coconut is invested in the nearby urban settlements in secondary or tertiary activities. The economic motivation of cultivators to stabilize his income has resulted in an increase in coconut cultivation in Tamil Nadu. Tiruchirappalli district is no exception to this. Coconut cropped area with a factor loading of 0.979 is preferred in areas of moderate land capability and good soil productivity. Cumbu with a factor loading 0.967 and cotton with a factor loading of 0.896 are also preferred in areas of moderate land capability and good soil productivity. Cotton with a ready market has found a significant place in the crop geography of Tiruchirappalli district. In Tiruchirappalli district the use of tractors is wide spread. The cultivators either own tractors or avail it on a rental basis. As such cultivators with small size land holding are also using tractors. Further these six crops dominate the agricultural scene wherever the size of land holding is small. Poultry has a steady market as it is much preferred by all people. The cultivators prefer to grow poultry in their houses as it yields a good profit.

Thus the Dimension I has established the association between land capability, good soil productivity and cropped area of sugarcane, chillies, Gingelly and coconut moderate land capability, good soil productivity, number of tractors, small size land holding and poultry farms.

Further, these are the crops, which require less amount of water and except sugarcane and coconut, the other crops are short duration crops. In Tiruchirappalli district due to its location in the Cauvery basin the farmers prefer to grow more than one crop in a year. Hence, short duration crops are much preferred wherever land capability is moderate and soil productivity is good. Thus, the first factor has highlighted the preference crops in the study area.

6.2 Dimension II

Irrigation determining Cropping Pattern, Agricultural Productivity and Sheep and goat rearing

Table 5. Dimension - II

Name of Variable	Factor loading
Paddy Cropped area(In hectare)	-0.914
Net irrigated area(In hectare)	-0.795
Canal irrigated area (In hectare)	-0.784
Groundnut Cropped area(In hectare)	0.758
Cholam Cropped area(In hectare)	0.696
Sheep and Goat (In number)	0.675
Pulses Cropped area(In hectare)	-0.667
Agricultural Productivity	0.569
Eigen Value	5.78
Percentage of Variance	17.01

Dimension II with an Eigen value of 5.78 accounting for about 17.01 percent of variance (table 5) has established the association among eight variables namely paddy cropped area (-0.914), net irrigated area (-0.795), canal irrigated area (-0.784), groundnut cropped area (0.758), cholam cropped area (0.696), sheep and goat rearing (0.675), pulses cropped area (-0.667) and agricultural productivity (0.569).

Dimension II explains the role of irrigation as a determining factor of paddy, groundnut, cholam and pulses cultivation and agricultural productivity. paddy cropped area, net irrigated area and canal irrigated area has displayed a negative factor loading. Tiruchirappalli district is located in the river Cauvery basin. Cauvery river is an interstate river. Agriculture of Tiruchirappalli district is very much determined by the flow of water in Cauvery river which is decided by the Karnataka state government. Wherever water is sufficient the cultivator prefer to grow paddy and when water is not released in Cauvery river under insufficient water conditions the cultivator prefers to cultivate groundnut and cholam as rain fed crops and sometimes using the limited water available. During years of adequate water for irrigation through canals the cultivators prefer to grow paddy as the first crop and pulses as the second crop. When water supply through canals is not adequate, the cultivator leaves the land fallow. In the fallow lands sheep and goats are reared as a source of substitute income to the family. Therefore, the negative factor loading is obtained revealing the association between paddy cropped area, net irrigated area and canal irrigated area.

It is quite obvious that paddy cropped area in Tiruchirappalli district is associated with canal irrigated area. The canal irrigated area determines the Net irrigated area. groundnut and cholam crops find a place in the crop

geography of the study area when irrigated area through canal is decreasing. As the study area is a major paddy growing tract when paddy cropped area decreases agricultural productivity also declines. Further, in areas where the irrigation facilities are inadequate dry crop cultivation along with sheep and goat rearing activities becomes an alternative for the farmers.

Thus the Dimension II has established the effect of canal irrigation in determining cropping pattern and agricultural productivity in the study area. Thus, the dependence of agriculture in Tiruchirappalli district on canal irrigation is clearly established.

6.3 Dimension III

Net Sown area and Gross Sown area, Associated with Gross irrigated area

Table 6. DIMENSION –III

Name of Variable	Factor loading
Net sown area (In hectare)	0.938
Gross irrigated area(In hectare)	0.922
Gross sown area(In hectare)	0.922
<i>Eigen Value</i>	<i>5.42</i>
<i>Percentage of Variance</i>	<i>15.93</i>

The third dimension with an Eigen value of 5.42 accounting for 15.93 percent of variance (table 6) has extracted the association between 3 variables namely net sown area, gross sown area and gross irrigated area with a factor loading of 0.938, 0.922 and 0.922 respectively.

Agriculture in Tiruchirappalli district is dependent on supply of water for irrigation through Cauvery river an interstate river. When there is adequate irrigation the area under cultivation increases. Further, when the supply of water for irrigation is available for the second crop also, cropping intensity increases and the gross sown area also increases. When supply of water for irrigation decreases, net sown area and gross sown area decreases in the study area.

Dimension III has established that when irrigation is not assured paddy cultivation as first crop and pulses cultivation as second crop gets affected and the land is left fallow resulting in a decline in the net sown and gross sown area. This fact is again established by the grouping of three variables in the third dimension.

6.4 Dimension IV

Irrigation through Wells and Tanks Associated with Rainfall

Table 7. DIMENSION –IV

Name of Variable	Factor loading
Well irrigated area(In hectare)	0.906
Pump sets (In number)	0.782
Tank irrigated area(In hectare)	0.756
Land holding large(In hectare)	0.613
Rainfall (In mm)	0.538
<i>Eigen Value</i>	<i>4.26</i>
<i>Percentage of Variance</i>	<i>12.53</i>

Dimension IV with an Eigen value of 4.26 (table 7) accounting for about 12.53 percent of variance has established the association between 5 variables namely well irrigated area, number of pump sets, tank irrigated area, large size land holding of above 5 hectares and rainfall. Well irrigated area with a factor loading of 0.906 and number of pump sets with a factor loading of 0.782 reveals the association between well irrigation and energy source used to lift water from wells for irrigation. Tank irrigated area has a factor loading of 0.756. Rainfall has a factor loading of 0.538. In the light of this observation it is inferred that irrigation through wells and tanks are associated with rainfall. However, in the study area the system tanks (76) receive water from the canal system of the Cauvery river. However, rainfall is also a major determinant of well and tank irrigated area in the study area. Large size land holding of more than 5 hectares has a factor loading of 0.615. It is worth noting that the size of land holding tends to be smaller in the panchayat unions where canal irrigation is predominant. In areas where wells and tanks form the major source of irrigation the land holding tends to be larger. Thus, the fourth dimension has established the association of well and tank irrigation to large size land holding.

6.5 Dimension V

Banana Cropped area Limited by Land Capability with Severe Limitation

Table -8

DIMENSION –V

Name of Variable	Factor loading
Banana Cropped area(In hectare)	-0.746
Land Capability severe(In hectare)	0.720
<i>Eigen Value</i>	<i>2.65</i>
<i>Percentage of Variance</i>	<i>7.78</i>

Dimension V with an Eigen value of 2.65 accounting for 7.78 percent of variance (table 8) has established the association between banana cropped area and land capability with severe limitations. Banana cropped area has a factor loading of -0.746 and land capability with severe

limitation 0.720. It could be inferred that banana a wet crop and a cash crop requires fertile land with good soil productivity. When the land has severe limitations the cultivators prefers to grow crops other than banana. Thus, it could be concluded that banana cultivation is less significant in areas with limitations in land capability.

6.6 Dimension VI

Cattle Rearing Associated with Poor and Average Soil Productivity

Table 9. DIMENSION –VI

Name of Variable	Factor loading
Soil Productivity Poor(In hectare)	0.896
Cattle (In number)	0.715
Soil Productivity Average(In hectare)	-0.641
<i>Eigen Value</i>	<i>1.80</i>
<i>Percentage of Variance</i>	<i>5.30</i>

Dimension VI with an Eigen value of 1.80 accounting for 5.30 percent of variance (table 9) has a grouping of 3 variables establishing the significance of cattle rearing in places of poor soil productivity. The three variables associated in the last dimension are soil productivity poor (0.896), number of cattle (0.715) and soil productivity average (-0.641). A cattle rearing is an activity for the cultivators where the soil productivity is poor. The cultivators in areas of poor soil productivity find it difficult to perform cultivation. For their sustenance they grow cattle as it yields a source of income by way of sale of milk. In areas wherever the soil productivity is average cattle rearing is less significant. In such areas the farmers sow some dry crops for their subsistence.

The analysis of all the six dimensions reveals the dominance of canal irrigation in the agricultural activities of the study area. canal irrigation not only provide water directly in the form of irrigation to the regions it flows through but also is an ample source of ground water recharge of wells and supplier of water to tanks. This canal water which is released from Cauvery river Mettur dam around June 20 that is before the onset of monsoon rains in the study area forms a lifeline for agricultural activities in the study area (Gazetteer of Tamilnadu, Tiruchirappalli district 1998).

Thus the third hypothesis "Irrigation is a major determinant of cropping pattern in Tiruchirappalli district" is statistically proved.

1. Factor Score Analysis

Geographers are more concerned with a spatial analysis. Hence, the factor scores for the six factors of all the panchayat unions are identified, mapped and analyzed (table 6.10).

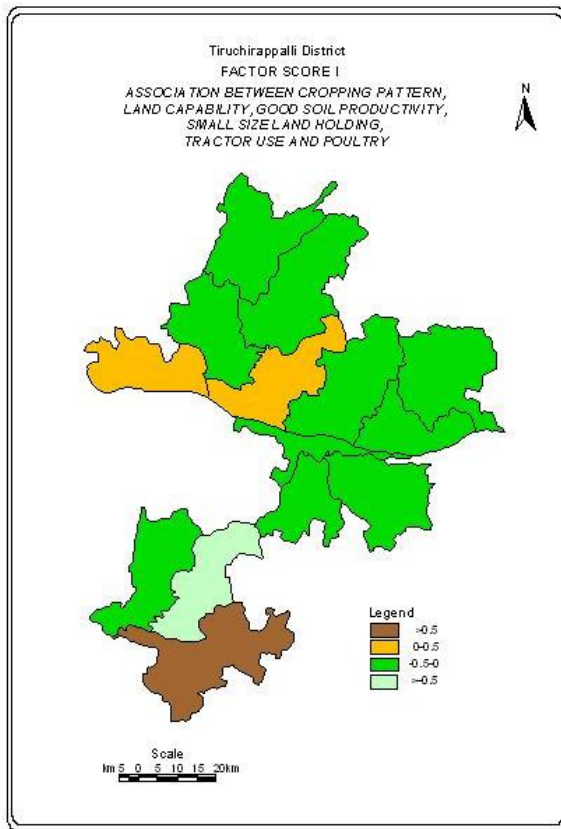
7.1 Factor Score One

The first factor reveals a strong association between cropping pattern, land capability, good soil productivity, small size land holding, tractor use and poultry. The spatial pattern and degree of association among the variables is revealed through the factor scores, which is mapped and analyzed. From figure 2 and table 10, it is inferred that a high positive factor score exists in Marungapuri panchayat union among these variable. A low positive factor score exists in Thottiyam and Musiri panchayat unions.

Table 10. FACTOR SCORES

Panchayat Unions	1	2	3	4	5	6	Composite Factor Score
Uppiliyapuram	-0.494	-0.769	0.325	2.335	-0.374	0.131	1.153
Thuraiyur	-0.390	0.179	0.877	1.673	0.210	-0.163	2.387
Thathiyangarpettai	-0.109	1.034	-0.107	0.036	0.759	-2.047	-0.434
Manachanallur	-0.223	0.152	1.302	-1.222	0.220	1.827	2.056
Musiri	0.065	1.035	0.992	-0.434	-1.174	0.671	1.154
Pullambadi	-0.257	0.077	1.158	-1.023	2.045	-0.975	1.025
Thottiyam	0.064	0.782	0.637	-0.374	-2.091	-0.659	-1.642
Lalgudi	-0.262	-2.447	0.806	-0.324	-0.284	-0.542	-3.054
Andhanallur	-0.148	-0.412	-1.643	-0.841	-1.009	-0.991	-5.043
Thiruverambur	-0.312	-0.825	-0.967	-0.743	-0.189	0.131	-2.906
Manikandam	-0.470	-0.644	-1.207	-0.190	0.597	1.185	-0.730
Vaiyampatti	-0.288	1.340	-0.892	0.195	0.142	0.333	0.830
Manapparai	-0.586	0.710	-1.047	0.566	0.780	0.854	1.276
Marungapuri	3.411	-0.212	-0.234	0.347	0.369	0.246	3.927

Figure No 2. Factor Score 1



The association is negative in the rest of the panchayat unions. Low negative factor score is revealed in Manapparai panchayat union. High negative factor score is revealed in Thuraiyur, Uppiliyapuram, Thathiyangarpettai, Manachanallur, Lalgudi, Pullambadi, Andhanallur, Manikandam, Thiruverambur and Vaiyampatti panchayat unions.

The positive factor score reveals a strong association of preference of crop cultivated on land capability, good soil productivity, small size land holding and goat and sheep rearing activities in Marungapuri panchayat union which comes under the dry tract with no canal irrigation. The other region of positive factor score includes Thottiyam and Musiri, which are partially benefited by canal irrigation.

Negative factor score in the remaining panchayat unions of the study area reveals that in these panchayat unions other social and economic factor may be responsible for the preference of crops cultivated.

7.2 Factor Score Two

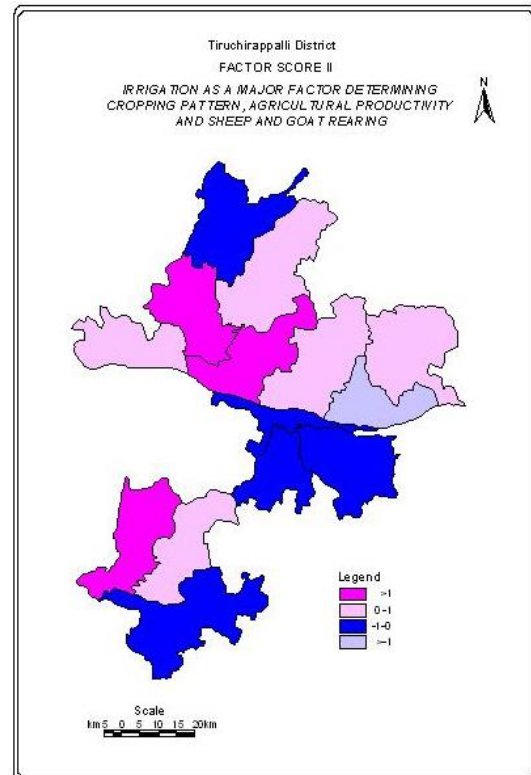
The spatial pattern of distribution of factor score two reveals Irrigation as a major factor determining cropping pattern, agricultural productivity and sheep and goat rearing. It could be inferred from figure 3 that irrigation as determining factor is highly positive in Thathiyangarpettai,

Musiri and Vaiyampatti panchayat unions. It is low positive in Thottiyam, Thuraiyur, Manachanallur, Pullambadi and Manapparai panchayat union.

In Uppiliyapuram, Andhanallur, Thiruverambur, Manikandam and Marungapuri panchayat unions the negative factor score is high. In Lalgudi panchayat union the negative factor score is low indicating the non-dependence of cropping pattern, agricultural productivity and sheep and goat rearing activities on irrigation.

The factor score mapping reveals the significance of irrigation in determining the cropping pattern, productivity and sheep and goat rearing activities in two different scenarios in the study area. The first case where there exist high positive factor score are the northern panchayat unions namely Thathiyangarpetai and Musiri, Thuraiyur, Manachanallur and Pullambadi. These are the canal irrigated areas of the study area where agricultural activities are determined by irrigation mainly through canal. The second case is that of the panchayat unions located in the southern part namely Vaiyampatti and Manapparai where there exists positive factor score. These panchayat unions being in the dry tract have very less area under canal irrigation paving the way for sheep and goat rearing activities supporting.

Figure No 3. Factor Score Two



7.3 Factor Score Three

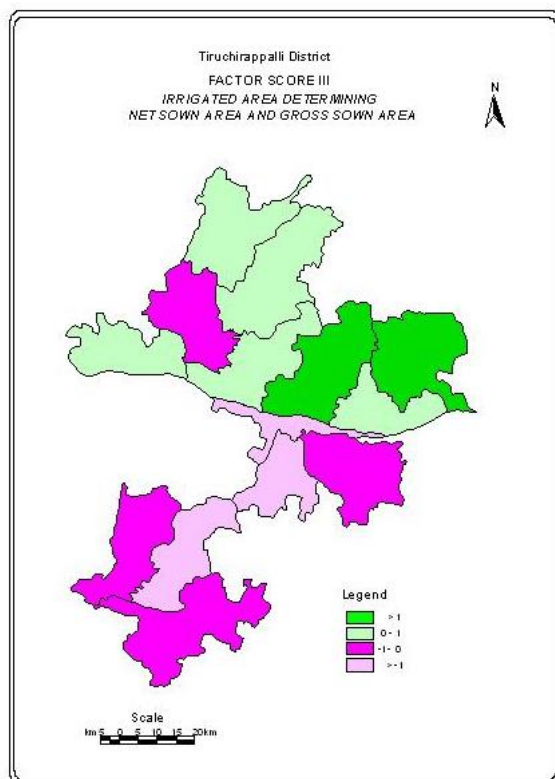
The factor score three reveals irrigated area as a determining factor of net sown and gross sown area. It could

be inferred from figure 4 that in Manachanallur and Pullambadi panchayat unions there exist a high positive factor score revealing irrigated area as a major factor determining net sown area and gross sown area in these panchayat unions. In Thuraiyur, Musiri, Lalgudi, Thottiyam and Uppiliyapuram panchayat union the positive factor score is low.

In Thathiyangarpetti, Thiruverambur, Vaiyampatti and Marungapuri panchayat unions a high negative factor score is noticed. In Manapparai, Andhanallur and Manikandam panchayat unions it is low.

Thus, the third factor score map reveals the significance of irrigated area in determining the extent of net sown area and gross sown area in the panchayat unions located in the northern part of the study area where canal is the major source of irrigation. Contrary to this, panchayat unions located in the southern part where canal irrigation is limited there is a negative factor score indicating that the net sown area and gross sown area are less determined by irrigation.

Figure No 4. Factor Score Three



7.4 Factor Score Four

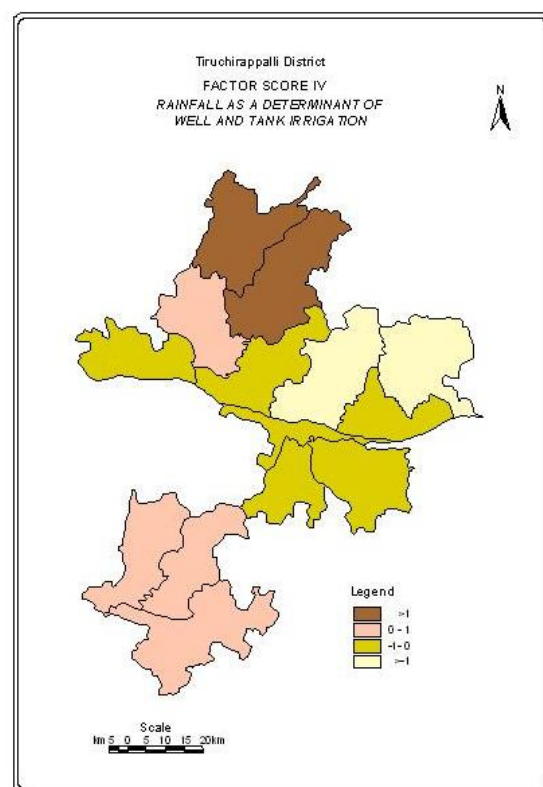
The spatial distribution of factor score four reveals rainfall as a determinant of well and tank Irrigation. As inferred from figure 5 Uppiliyapuram and Thuraiyur panchayat unions exhibit a high degree of positive factor score, indicating a high dependence of well and tank irrigation on rainfall. In Thathiyangarpetai, Manapparai,

Marungapuri and Vaiyampatti panchayat unions it is low.

In the remaining panchayat unions of the study area a negative factor score is observed. A high negative factor score is revealed in Thottiyam, Lalgudi Musiri, Thiruverambur, Andhanallur and Manikandam panchayat unions. In Manachanallur and Pullambadi panchayat unions the negative factor score is low.

It could be noticed from the spatial analysis of the factor score four that in the drier tracts of the study area comprising the panchayat unions of Uppiliyapuram, Thuraiyur, Thathiyangarpetai, Manapparai, Vaiyampatti and Marungapuri positive factor score is revealed. These areas have no canal irrigation or very less area under canal irrigation. The major sources of irrigation in these areas are wells and tanks, which in turn is dependent on the amount of rainfall received in these areas. On the contrary in the remaining panchayat unions the major source of irrigation is canals, which are fed by river Cauvery hence a negative factor score.

Figure No 5. Factor Score Four



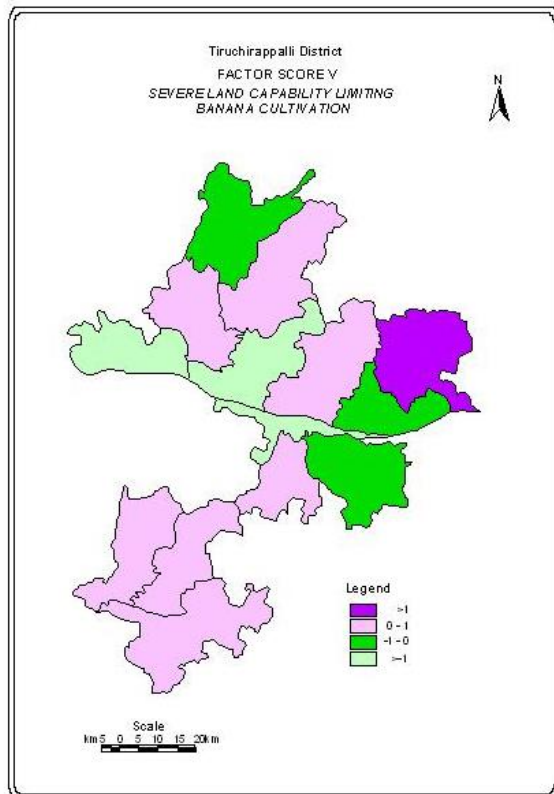
7.5 Factor Score Five

The spatial distribution of factor score five mapped in figure 6 reveals severe land capability limiting Banana cultivation. Pullambadi panchayat union reveals high positive factor score. In, Thathiyangarpetai, Thuraiyur, Manachanallur, Manikandam, Marungapuri, Manapparai and Vaiyampatti panchayat unions it is low positive.

In Uppiliyapuram, Lalgudi and Thiruverambur panchayat unions a high negative factor score is revealed. In Thottiyam, Musiri and Andhanallur panchayat unions it is low.

In the light of the above analysis of the factor score five it can be stated that in the drier tracts of the study area lack of better irrigation facilities and severe land capability limits Banana cultivation, hence positive factor score is established. In the remaining region negative factor score is being established.

Figure No 6. Factor Score Five



7.6 Factor Score Six

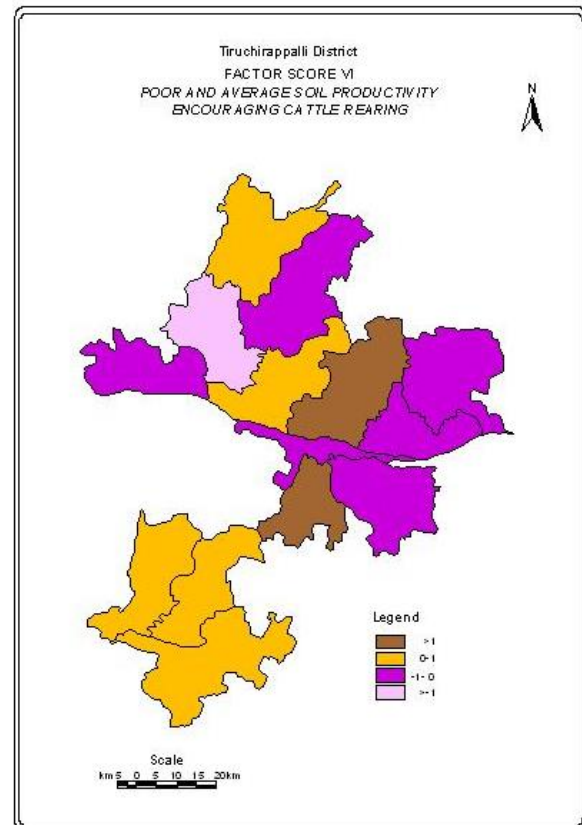
The sixth factor score reveals poor and average soil productivity encouraging cattle rearing activities. It is a common fact that in areas where there exists poor and low productive soils, cattle rearing activities is the main source of subsistence for the farmers.

The spatial pattern of distribution of factor score six is shown in figure 7. As inferred from the figure 6.6 seven panchayat unions exhibit positive factor score. Manachanallur and Manikandam panchayat unions reveal a high positive factor score. In Uppiliyapuram, Musiri, Manapparai, Marungapuri and Vaiyampatti panchayat unions the factor score is low positive.

In the rest of the panchayat unions negative factor score is revealed. A high negative factor score is noticed in Thuraiyur, Thottiyam, Lalgudi, Pullambadi, Andhanallur and Thiruverambur panchayat unions. In Thathiyangarpettai panchayat union a low negative factor score is revealed.

In Uppiliyapuram, Musiri, Manikandam, Manapparai, Vaiyampatti and Marungapuri panchayat unions poor and average soil productivity has encouraged cattle rearing activities. Manapparai, Vaiyampatti, Marungapuri and Uppiliyapuram panchayat unions come under the drier tract where there does not exist canal irrigation or very less canal irrigated area which in turn has resulted in poor and average soil productivity making cattle rearing activities as the alternative source of income.

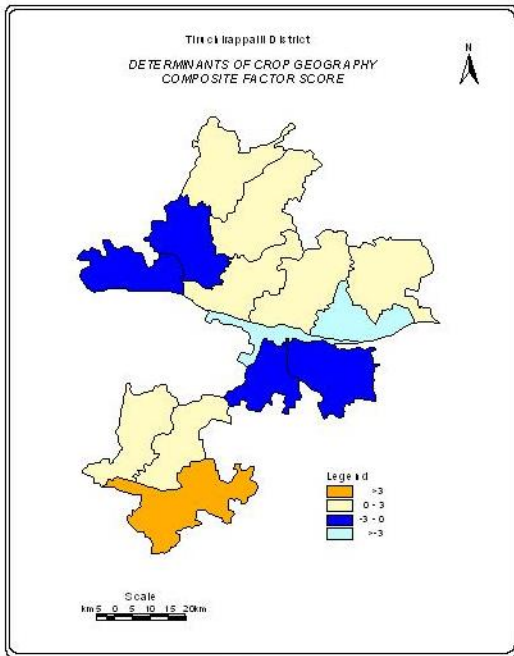
Figure No 7. Factor Score Six



7.7. Composite Factor Score

The composite factor score, i.e. the sum of factor score of all the factors taken together are mapped in figure 8 with an aim to delimit the agricultural regions of Tiruchirappalli district.

Figure No 8. Composite Factor Score



The figure reveals a high positive score in Marungapuri panchayat union. In Thuraiyur, Uppiliyapuram, Manachanallur, Musiri, Pullambadi, Manapparai and Vaiyampatti panchayat unions a low positive score is exhibited.

In Thottiyam, Thathiyangarpetai, Manikandam and Thiruverambur panchayat unions high negative factor score is revealed. In Andhanallur and Lagudi panchayat unions a low negative score is noticed.

The dry tract of the study area where canal irrigation is insufficient positive factor scores can be noticed. These are the areas where rainfall is a determining factor in crop cultivation. The major crop cultivated in this region is cholam, cumbu, groundnut, cotton, pulses and chillies. The regions where negative score is revealed are the regions benefited by canal irrigation. These are the regions where the major crops cultivated are paddy and banana which are wet crops and require good soil.

Thus, it is evident from the analysis of the composite factor score that in the study area in regions where there is adequate supply of irrigation facilities through any means (canal or well or tank) the other factors like land capability, soil productivity etc, do not dominate the choice of crop cultivated by the farmers. Hence, the regions, which are benefited by irrigation, exhibit negative or a low positive factor score.

On the contrary in the regions where irrigation is insufficient drier conditions determine the lands fertility and hence the crop cultivated depends on factors like rainfall, good soil productivity, land capability etc. Thus, high positive scores are revealed by the drier tracts of the study area.

8. Conclusion

Factor analysis was first introduced by Thurstone in 1931 as a statistical technique to reduce the number of variables and to detect structure in the relationship between variables so as to classify variables. In the present investigation factor analysis was performed to identify the factors that have determined the crop geography of Tiruchirappalli district. For this purpose thirty four variables were selected and subjected to Factor Analysis using SPSS package. In the present analysis the crop geography of the study area is confined to eleven selected crops, as they dominate the agricultural scene of Tiruchirappalli district. The cropped area under these eleven crops in the panchayat unions of the study area are selected for the analysis. As geography is concerned with the study of spatial distribution of facts an attempt was made to map and analyze the spatial pattern of Factor Scores of the six factors in the panchayat unions of the study area. The analysis brought to light the following conclusions. On the contrary in regions where irrigation is insufficient, drier conditions determine the lands fertility and hence the crop cultivated depends on factors like rainfall, good soil productivity, land capability etc. Thus, high positive scores are revealed by the drier tracts of the study area.

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