A Classification Study of Rain Fall Oscillation in Tamil Nadu with Effect of Agricultural Product Import

Abstract

Trends in Indian rainfall records have been extensively studied but the subject remains complicated by the high spatiotemporal variability of rainfall arising from complex atmospheric dynamics this research article is aimed to study about rainfall design and classification to evaluate the district wise data in Tamilnadu the result in various seasons to understand the climate change. The dataset relates to monthly rainfall from various districts of Tamilnadu in the period of January to December from the Indian Meteorological Department database. The time frame of the data to the present study is 2007-2013. This study we have applied, K-means clustering and correspondence analysis are applied and the rain fall partner districts are grouped year wise. The cluster groups further compared with Agricultural product import during 2007 – 2013.We have identified the classification partner of Agricultural product import with rain fall variation.

Key Words: K- Means Clustering, Correspondence Analysis, SPSS, MAT Lab

1 Introduction

Climate plays an important role in determine the agricultural, industrial and economic growth of any region. Climate includes the parameters like Temperature, Rainfall, Pressure, Wind, Humidity, Precipitation etc. Temperature and Rainfall are the most important aspects which directly affect the climate condition of any region. There is a slow and steady increase in the temperature which has a direct impact on rainfall. Due to industrialization, urbanization, deforestation, and depletion of ozone there is a constant increase in temperature which has led to Global warming. This has a direct impact on the melting of snow, increase in mean sea level, excess of rainfall/ deficit of rainfall, increase on temperature etc. Rain is the primary source of fresh water, providing suitable conditions for diverse ecosystems, as well as water for hydroelectric power plants and crop irrigation. Rainfall is measured through the use of rain gauges. Rainfall amounts are estimated actively by weather radar and passively by weather satellites. The urban heat island effect leads to increased rainfall, both in amounts and intensity, downwind of cities. Global warming is also causing changes in the precipitation pattern globally including wetter conditions across eastern North America and drier conditions in the tropics. Precipitation is a major component of the water cycle, and is

responsible for depositing most of the fresh water on the planet. The globally averaged annual precipitation is 990 millimetres (39in). Climate classification systems such as the Köppen climate classification system use average annual rainfall to help differentiate between differing climate regimes. Antarctica is the Earth's driest continent. Rain is also known or suspected on other worlds, composed of methane iron, neon, and sulphuric acid rather than water. Rain and Temperature are the basic climate parameters essential for the development of agriculture and human settlement. Depending on the rainfall, temperature the growth of trees and yield of crops is dependent. The present study deals about prevailing condition of Temperature and Rainfall in Tamil Nadu during the period of 2007 to 2013.

2 Review of Literature

Rainfall is key factor determining the sustainability and conservation of living species on the earth. Where rainfall is the sources of water for crops, changes in both quantity and distribution of rainfall during the year could affect the economy of an area M.C.Ramos, (2001). Many researchers have applied MPL (Multi variables Polynomial regression) to implement the precipitation forecast model over Myanmar. The model output result in station wide monthly and annual rainfall amount during summer monsoon season. It is observed that MPR method achieves closer agreement between actual and estimated rainfall. In this paper attempts have been made to study pattern in annual and classification of rainfall over Tamilnadu from 2007 to 2013. Long term trends of Indian monsoon rainfall for the country as well as for smaller subdivisions were studied by Pramanik and Jagannathan (1954), Parthasarathy and Dhar (1978), Parthasarathy (1984), Mooley and Parthasarathy (1983), Parthasarathy *et al.* (1993). Rao and Jagannathan (1963), Thapliyal and Kulshrestha (1991) and Srivatsava *et al*. (1992) also reported that All-India southwest monsoon/annual rainfall observed no significant trend. Long term trend in small spatial scale was reported by Koteswaram and Alvi (1969), Jagannathan and Bhalme (1973), Naidu *et al*. (1999) and Singh and Sontakke (1999). Rupa Kumar *et al* (1992) have found significant increasing trend in monsoon rainfall along the West Coast, north Andhra Pradesh and northwest India while significant decreasing trends over Madhya Pradesh and adjoining area, northeast India and parts of Gujarat and Kerala. All these studies reveal that there is no similarity in rainfall trends at the regional level. The main objective of the present study is identifying the pattern and classification of all the season of rainfall data in Tamil Nadu and also we identifying the import export of the Agricultural products in India.

3 Objective

1. To identify the final cluster centres and classification of rainfall data using K- Mean clustering techniques.

2. To identify the pattern of rainfall data in the study period using Correspondence Analysis.

3. To identify the classification Map based on Discriminant analysis.

Quick Cluster

	Year-2007			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	1.20	7.09	8.88	.764
February	5.90	17.08	13.57	.936
March	.80	53.74	31.00	.604
April	122.70	45.14	117.49	.001
May	41.70	135.77	79.21	.276
June	22.50	68.92	31.72	.189
July	121.00	76.34	53.46	.521
August	60.30	98.33	71.76	.525
September	121.00	128.78	105.64	.738
October	938.70	246.76	274.16	.000
November	603.70	121.01	381.80	.000
December	442.10	77.19	129.12	.003

In the year 2007 there are three clusters meaning fully formed and also we identified that during October, November and December there is significant different in rain fall.

Number of Cases in each Cluster[a]		
Cluster	High	1.000
	Low	15.000
	Moderate	14.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Low Level** rain fall in Tamil Nadu during the year 2007. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2008.00

	Year-2008			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	14.32	8.68	26.42	.146
February	12.18	5.23	2.34	.363
March	77.86	18.50	37.30	.232
April	55.49	58.24	42.36	.829
May	60.61	126.84	27.36	.007
June	36.23	67.62	45.80	.085
July	33.63	139.13	53.12	.008
August	63.61	96.49	88.16	.278
September	92.83	174.54	100.74	.002
October	227.31	265.73	493.76	.000
November	187.03	152.22	424.90	.000
December	41.98	104.68	122.94	.177

In the year 2007 there are three clusters meaning fully formed and also we identified that during September, October and November there is significant different in rain fall.

	Number of Cases in each Cluster[a]	
Cluster	Low	16.000
	Moderate	9.000
	High	5.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Low Level** rain fall in Tamil Nadu during the year 2008. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2009.00

	Year-2009			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	1.20	2.21	11.82	.099
February	5.90	6.10	7.24	.966
March	.80	12.55	52.61	.058
April	122.70	53.79	57.74	.618
May	41.70	34.29	112.09	.050
June	22.50	48.15	50.73	.808
July	121.00	82.93	59.32	.460

August	60.30	131.52	66.71	.034
September	121.00	86.89	145.69	.112
October	938.70	200.55	246.67	.000
November	603.70	80.67	285.80	.000
December	442.10	202.92	56.21	.000

In the year 2009 there are three clusters meaning fully formed and also we identified that during October and November and December there is significant different in rain fall.

Number of Cases in each Cluster[a]		
Cluster	High	1.000
	Low	15.000
	Moderate	14.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Moderate Level** rain fall in Tamil Nadu during the year 2009. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2010.00

	Year-2010			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	2.73	41.35	5.59	.000
February	12.30	30.38	8.50	.012
March	6.50	198.68	69.23	.003
April	34.13	24.88	54.06	.224
May	140.83	24.82	104.49	.147
June	27.10	42.98	54.79	.537
July	55.37	47.37	75.48	.446
August	137.90	87.53	99.20	.399
September	210.10	97.45	100.50	.050
October	542.40	291.88	235.04	.000
November	299.77	544.87	154.71	.000
December	308.73	115.85	70.17	.003

In the year 2010 there are three clusters meaning fully formed and also we identified that during October and November and December there is significant different in rain fall.

Number of Cases in each Cluster[a]		
Cluster	High	3.000
	Moderate	6.000
	High	21.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Very High Level** rain fall in Tamil Nadu during the year 2010. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2011.00

	Year-2011			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	8.37	6.05	13.20	.783
February	3.87	2.35	7.66	.601
March	41.14	14.10	53.16	.698
April	46.04	5.30	33.98	.545
May	92.28	176.75	35.20	.069
June	43.80	30.40	20.14	.394
July	61.79	69.50	41.62	.800
August	91.14	105.20	105.40	.851
September	129.09	185.20	108.88	.526
October	207.31	643.05	137.16	.000
November	190.06	318.20	634.68	.000
December	72.37	43.95	223.44	.003

In the year 2011 there are three clusters meaning fully formed and also we identified that during October and November and December there is significant different in rain fall.

Number of Cases in each Cluster[a]		
Cluster	Low	23.000
	High	2.000
	Moderate	5.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Very Low Level** rain fall in Tamil Nadu during the year 2011. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2012.00

	Year-2012			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	2.70	7.82	64.10	.000
February	6.16	5.73	12.40	.879
March	1.28	41.98	328.60	.000
April	30.42	51.34	8.20	.444
May	93.04	99.55	33.70	.703
June	143.76	40.48	33.70	.001
July	165.08	56.38	19.30	.000
August	219.06	79.10	66.00	.000
September	142.44	99.34	56.80	.136
October	211.60	229.51	259.30	.854
November	151.46	268.38	786.50	.000
December	243.74	74.52	188.40	.001

In the year 2012 there are three clusters meaning fully formed and also we identified that during November and December there is significant different in rain fall.

	Number of Cases in each Cluster[a]	
Cluster	Moderate	5.000
	Low	24.000
	High	1.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Very Low Level** rain fall in Tamil Nadu during the year 2012. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Year = 2013.00

	Year-2013			
Month	Cluster 1	Cluster 2	Cluster 3	Sig
January	5.42	10.46	11.38	.462
February	5.40	1.85	6.84	.393
March	33.03	4.90	47.60	.035

April	44.02	53.37	96.16	.216
May	51.61	238.13	52.96	.000
June	45.98	83.73	25.64	.216
July	53.68	74.43	55.56	.523
August	98.22	48.09	79.36	.177
September	77.07	231.93	95.50	.000
October	206.46	255.32	284.22	.290
November	130.55	165.43	546.68	.000
December	89.03	5.13	128.32	.004

In the year 2013 there are three clusters meaning fully formed and also we identified that during November and December there is significant different in rain fall.

Number of Cases in each Cluster		
Cluster	Low	13.000
	Moderate	12.000
	High	5.000

From the above table we identify the Grouping Clusters that indicates that majority of the States having **Moderate Level** rain fall in Tamil Nadu during the year 2013. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Discriminant

% of Variance	Predicted Group Membership			Total
	2007			
	1	2	3	
64.0	100.0	.0	.0	100.0
	.0	93.3	6.7	100.0
	.0	.0	100.0	100.0
68.9	**2008**			
	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0

		2009		
72.2	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0
		2010		
74.4	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0
		2011		
66.1	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0
		2012		
74.3	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0
75.1		**2013**		
	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0

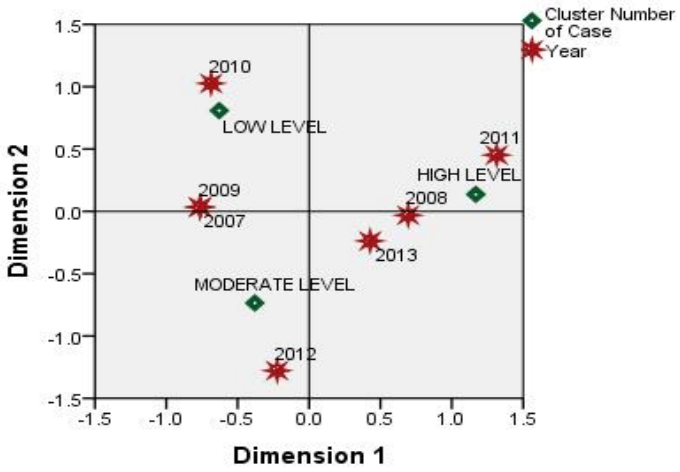
This section is to explore the possibility of identifying the rail fall among 30 districts in Tamil Nadu during the period of 2007 to 2013. An attempt is made to analyse the severity of rain fall at the three clusters. The present analysis shows that only three groups could be meaningfully formed for each category. Further the rain fall among districts in Tamil Nadu are classified into Cluster one, Cluster two, Cluster three categories based on the observation scale parameter, on comparing the preferences of these approaches in terms of clustering the Rain fall Level.

Year	CLUSTER 1	CLUSTER 2	CLUSTER 3
2007	2481.60 **(High)**	1076.15 (Low)	1297.84 (Moderate)
2008	903.06 (Low)	1217.92 (Moderate)	1465.20 **(High)**

2009	2481.60 **(High)**	942.56 (Low)	1152.63 (Moderate)
2010	1777.87 **(High)**	1548.05 (Moderate)	1031.75 (Low)
2011	987.27 (Low)	1600.05 **(High)**	1414.52 (Moderate)
2012	1410.74 (Moderate)	1054.12 (Low)	1857.00 **(High)**
2013	840.48 (Low)	1172.78 **(High)**	1430.22 (Moderate)

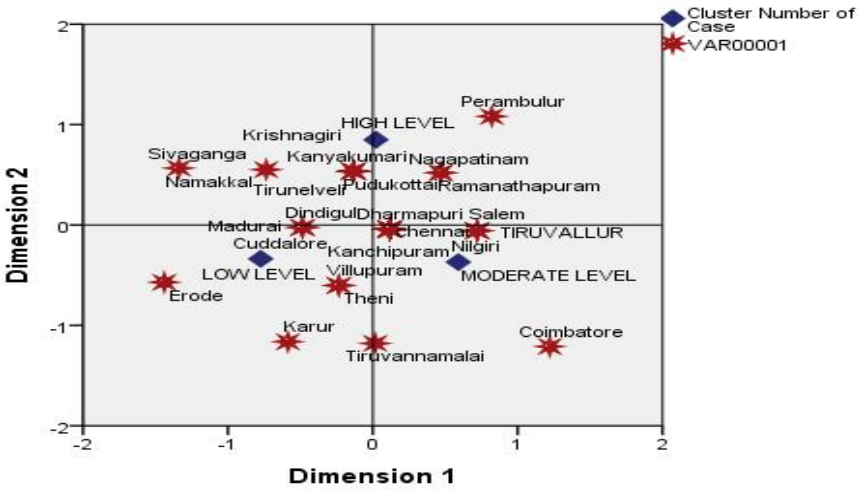
The majority of the States having **Low Level** rain fall in Tamil Nadu during the year 2007. The Grouping Clusters that indicates that majority of the States having **Low Level** rain fall in Tamil Nadu during the year 2008. Grouping Clusters that indicates that majority of the States having **Moderate Level** rain fall in Tamil Nadu during the year 2009, clusters that indicates that majority of the States having **Very High Level** rain fall in Tamil Nadu during the year 2010, grouping Clusters that indicates that majority of the States having **Very Low Level** rain fall in Tamil Nadu during the year 2011, the majority of the States having **Very Low Level** rain fall in Tamil Nadu during the year 2012, Clusters that indicates that majority of the States having **Moderate Level** rain fall in Tamil Nadu during the year 2013.

Correspondence



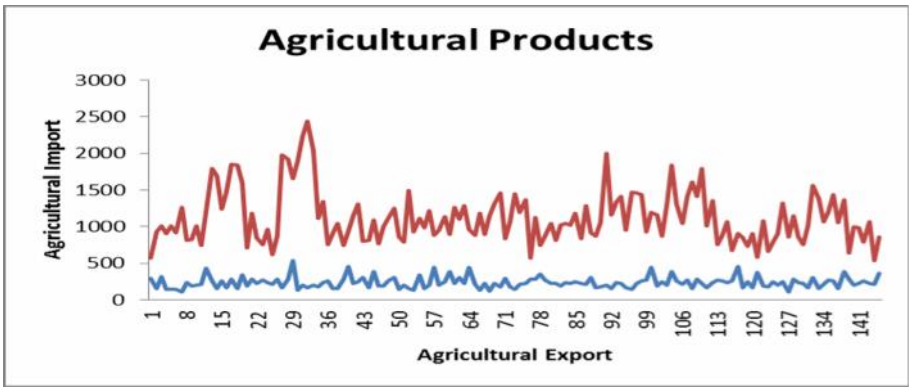
The above Figure represents the rain fall level during 2007 – 2013 at various states of Tamil Nadu. During **2008, 2011** and **2013** we have identified that there were **High level** of Rain fall

level measured. In **2012** we have found that **Moderate level** of Rain fall measured. During **2007, 2009** and **2010** we got **Low level** of rain fall measured because of various climatic changes at atmosphere.



The pictorial diagram represents the rain fall level during 2007 – 2013 at various states of Tamil Nadu. We have identified the correlation between various states with cluster group membership. **Perambur, Krishnagiri, Sivaganga, Kanyakumari, Namakkal, Tirunelveli, Pudukottai, Ramanathapuram, Dindigukal, Dharmapuri** and **Salem** were found **High Level** rain fall during 2007-2013. We have identified in **Chennai, Tiruvallur, Kanchipuram, Coimbatore, Nilgri, Theni, Vilupuram** and **Tiruvannamali** were **Moderare Level** rain fall Measured. We have found that in **Cuddalore , Erode, Karur** and **Madurai** were **Low level** rain fall measured. We have also found that **East** and **South East** region having **High Level** rain fall measured, between **North Region** of Tamil Nadu **Moderate Level** of rain fall have been measured. We found that **North East** region of Tamil Nadu measured very **Low level** of Rain fall was measured.

Year wise Fluctuations			
	Mean Square	F	Sig.
Agri- Export	2152.783	.287	.943
	7492.260		
Agri- Import	412001.578	3.127	.006*



The Agricultural Import of India has been moderately increased during the years 2007-2013. The Anova test shows there is fluctuation between Agricultural import and Export. We have identified there is huge level of Agricultural imports in India during these years because of climatic changes, rain fall fluctuations and Global warming. The sea level is also increased gradually between these years.

Reference:

1. Anderson T W (1984), An Introduction to Multivariate Statistical Analyis, 2/e,John Wiley and Sons, Inc., New York.

2. NeerajBhargava, RituBhargava, Prakash Singh Tanwar, Ankit Sharma (2013): Rainfall Spatial Analysis using GIS, International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 5, May 2013, pp: 2197 – 2200.
3. Khan, Asim (2000): A Spatio – Temporal Analysis of rainfall in the canal command areas of the Indus plains, International Water management Institute, Report No: R-104 pp: 1- 35.
4. Kusre, B. C. (2012): Study of spatial and temporal distribution of rainfall in Nagaland (India), INTERNATIONAL JOURNAL OF GEOMATICS AND GEOSCIENCES, Volume 2, No 3, 2012, pp: 712 – 722
5. Margaret R (1996) spatial modeling and interpolation of monthly temperature using kriging, CLIMATE RESEARCH, Vol. 6, pp: 215- 225.
6. Mohapatra, Mohanty (2006): Spatio-temporal variability of summer monsoon rainfall over Orissa in relation to low pressure systems, J. Earth Syst. Sci. 115, No. 2, pp. 203–218.
7. Odekunle, Orinmoogunje, Ayanlade (2007): Application of GIS to assess rainfall

variability impacts on crop yield in Guinean Savanna part of Nigeria, African Journal of Biotechnology Vol. 6 (18), pp: 2100-2113.

8. Rathod , Aruchamy (2010): Spatial Analysis of Rainfall Variation in Coimbatore District Tamilnadu using GIS, INTERNATIONAL JOURNAL OF GEOMATICS AND GEOSCIENCES Volume 1, No 2, pp: 106 – 118.
9. Jayawardene, Sonnadara, Jayewardene (2005): Trends of Rainfall in Sri Lanka over the Last Century, Sri Lankan Journal of Physics, Vol. 6, pp: 7-17.
10. Xuesong Zhang, Raghavan Srinivasan (2010): GIS-based spatial precipitation estimation usingnext generation radar and raingauge data, Environmental Modelling & Software xxx, pp: 1-8.
11. Sadeghi, Moatamednia, and Behzadfar (2011): Spatial and Temporal Variations in the Rainfall Erosivity Factor in Iran, J. Agr. Sci. Tech. Vol. 13, pp: 451-464.
12. Zengxin Zhang, Chong-Yu Xu, Majduline El-Haj El-Tahir, Jianrong Cao, V. P. Singh (2011): Spatial and temporal variation of precipitation in Sudan and their possible causes during 1948– 2005, Stoch Environ Res Risk Assess, Vol. 26, pp:429–441.