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

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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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. The aim of this work is to study the variation in rainfall pattern and classification of Agricultural products imports in Tamil Nadu. The dataset relates to monthly rainfall from various districts of Tamil Nadu for the period of January to December, from the Indian Meteorological Department we collected. The time frame of the data used in this study is 2007-2013. In this research article, we applied, K-means clustering technique and correspondence method. The cluster group are compared with agricultural product import during the year 2007 – 2013.

Keywords: K- means clustering; correspondence analysis; rainfall classification.

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1. INTRODUCTION

Climate plays an important role in determining 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). The present study deals about prevailing condition of 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. 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 [1], Parthasarathy and Dhar [2], Mooley and Parthasarathy [3], Parthasarathy et al. [4]. Rao and Jagannathan [5], Thapliyal and Kulshrestha [6] and Srivatsava et al. [7] 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 [8], Jagannathan and Bhalme [9], and Singh and Sontakke [10]. Rupa Kumar et al. [11] 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 is observed. All these studies revealed that there is no similarity in rainfall trends at the regional level. The main objective of the present study is to identify the pattern and perform a seasonal rainfall classification over Tamil Nadu as well as to analyse the import and export operation s of the Agricultural products during (2007 – 2013) in India.

3. OBJECTIVES

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.

[K- Mean clustering techniques, Correspondence Analysis, Discriminant analysis. These three Statistical methods were used to analyse the Rainfall pattern in Tamil Nadu].

4. DATA INTERPRETATIONS

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

4.1 Number of Cases Cluster Group Year – 2007

We identified three Grouping Clusters indicating that the majority of the States are observing Low Level rainfall in Tamil Nadu during the year 2007. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

Table 4.1. Cluster group year – 2007

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

We identify the Grouping Clusters indicating that the majority of the States are observing Low Level rainfall in Tamil Nadu during the year 2008. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

During 2008, three clusters are fully formed and a significant difference in rainfall is also noticed during September, October and November.

The Grouping Clusters is showing that majority of the States has a Moderate Level rainfall in Tamil Nadu during the year 2009. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

In the year 2009 there are three clusters meaning fully formed and also we identified that during October, November and December there is a significant difference in rainfall.

The Grouping Clusters that indicates that majority of the States having Very High Level rainfall in Tamil Nadu during the year 2010. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

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 rainfall.

The Grouping Clusters that indicates that majority of the States having Very Low Level rainfall in Tamil Nadu during the year 2011. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

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 rainfall.

We identified the Grouping Clusters that indicates that majority of the States having Very Low Level rainfall in Tamil Nadu during the year 2012. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

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 rainfall.

We identified the Grouping Clusters that indicates that majority of the States having Moderate Level rainfall in Tamil Nadu during the year 2013. The possible reasons were new ecological system changes and new environment conditions with continuous climatic changes.

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 rainfall.

This section is to explore the possibility of identifying the rainfall among 30 districts in Tamil Nadu during the period of 2007 to 2013. An attempt is made to analyse the severity of rainfall at the three clusters. The present analysis shows that only three groups could be meaningfully formed for each category. Further the rainfall 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 Rainfall Level.

Table 4.2. Clusters- 2007

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

Table 4.3. Cluster group year – 2008

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

Table 4.4. Clusters- 2008

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

Table 4.5. Cluster group year – 2009

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

Table 4.6. Clusters- 2009

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

Table 4.7. Cluster group year – 2010

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

Table 4.8 Clusters- 2010

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

Table 4.9. Cluster group year – 2011

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

Table 4.10. Clusters- 2011

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

Table 4.11. Cluster group year – 2012

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

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

Table 4.12. Clusters- 2012

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

Table 4.13. Cluster group year – 2013

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

Table 4.14. Clusters- 2013

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

Fig. 4.1 represents the rainfall level during 2007 – 2013 at various states of Tamil Nadu. During 2008, 2011 and 2013 we have identified that there were High level (cm) of Rainfall level measured. In 2012 we have found that Moderate level (cm) of Rainfall measured. During 2007, 2009 and 2010 we got Low level (cm) of rainfall measured because of various climatic changes at atmosphere.

The pictorial diagram represents the rainfall level during 2007 – 2013, various district 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 we found High Level rainfall during 2007-2013. We have identified in Chennai, Tiruvallur, Kanchipuram, Coimbatore, Nilgri, Theni, Vilupuram and Tiruvannamali where Moderare Level rainfall Measured. We have found that in Cuddalore , Erode, Karur and Madurai were Low level rainfall measured. We have also found that East and South East region having High Level rainfall measured, between North Region of Tamil Nadu Moderate Level of rainfall was measured. We found that North East region of Tamil Nadu has very Low level of Rainfall was measured.

Table 4.15. Discriminant analysis

% 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
		2008		
68.9				
	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
		2013		
75.1				
	100.0	.0	.0	100.0
	.0	100.0	.0	100.0
	.0	.0	100.0	100.0

Table 4.16. Cluster centroids

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(cm))	1600.05 (High)	1414.52 (Moderate)
2012	1410.74 (Moderate(cm))	1054.12 (Low)	1857.00 (High)
2013	840.48 (Low(cm))	1172.78 (High)	1430.22 (Moderate)

Table 4.17. Fluctuation chart

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

The above mention table is not correlation analysis. We are trying to finding out whether any significant effects on rainfall during period, and also we are examining the Agricultural imports during the period. This method gives advanced learning process about effects rainfall. Minor changes are not required in this section

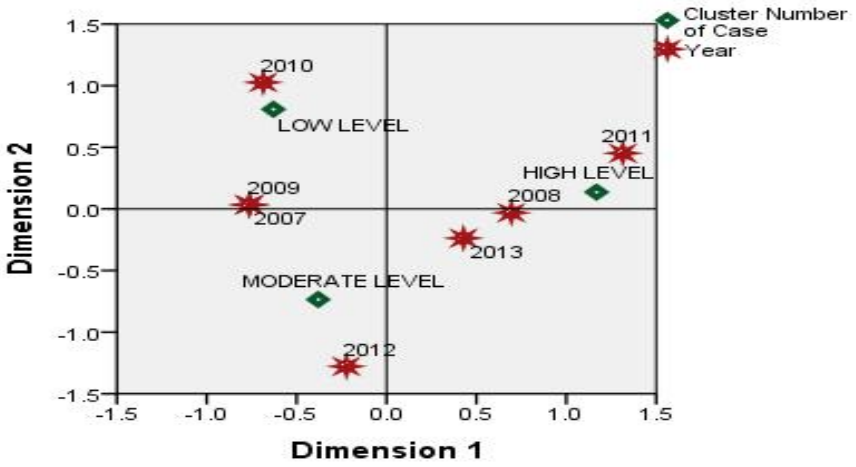

Fig. 4.1. Classification of rainfall during (2007-2013)

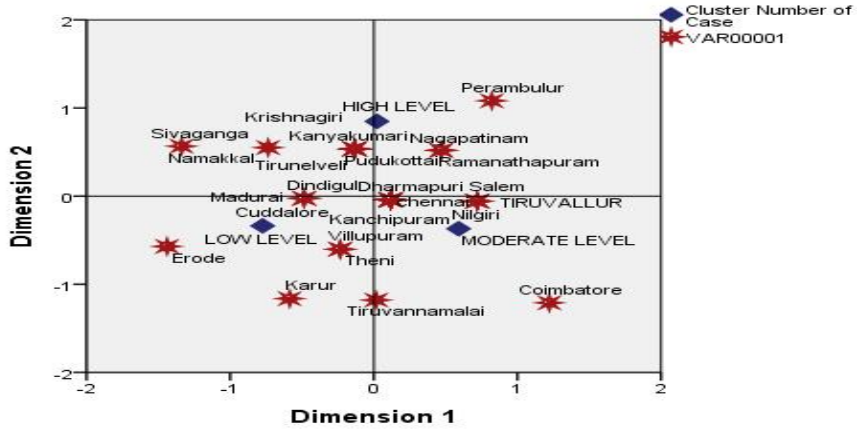

Fig. 4.2. Classification of rainfall among regions

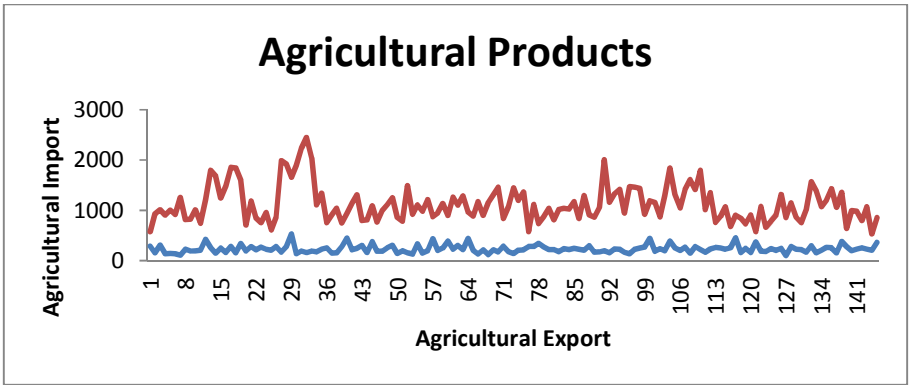

Fig. 4.3. Trend classification

5. CONCLUSION

Tamil Nadu mainly dependent on Agricultural income, people of Tamil Nadu major source of income is Agricultural so our main aim is to analyse how rainfall affect import and export of the Agricultural products during specified period.

Tamil Nadu major sources of income are from Agricultural and rainfall plays very important part in agricultural. In Tamil Nadu during this period we had huge fluctuating in rainfall because of the gobal warming and heavy climatic changes. 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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