Assessment of Spatial Variability of Rainfall Pattern in Cuddalore district of Tamil Nadu using GIS techniques

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Abstract: Rainfall is the one of the most important factors among the Climatic elements, and its distribution differs from time to time, season to season and place to place., which determines the Cropping pattern of an area. In India the farmers mainly depend on monsoon season for agricultural practices. southwest monsoon and northeast monsoon together serves maximum rainfall to the nation. The present study deals with the rainfall characteristics of Cuddalore district which includes the spatial distribution of rainfall, rainfall variability and precipitation ratio, these three studies are most important in Rainfall analysis. By rainfall variability study can be identified how rainfall varies from its mean, at the same time the precipitation ratio gives the idea about abnormality of rainfall distribution prevails over a region. For this study 30 consecutive years (1985-2014) monthly rainfall data were collected and analyzed from 14 rain gauge stations. The long-term rainfall analysis reveals the gradual changes of rainfall of the study area. The long term mean annual rainfall of the study area is 1119.63mm, the maximum long-term mean annual rainfall recorded at Annamalai Nagar with 1388.68mm whereas minimum mean annual rainfall has been distributed over Lakkur with 900.74mm. In terms of mean seasonal rainfall of the study area northeast monsoon was received maximum amount of rainfall with 647.71mm followed by southwest monsoon, summer and winter season with rainfall 334.26mm, 95.52mm and 46.14mm respectively. The annual rainfall variability of the region is 40.06%. it varies from 62.40% to 32.17. maximum rainfall variability occurs during winter season and minimum variability experiences during northeast monsoon with 189.29% and 61.40% respectively. The high rainfall abnormality (639.33%) prevails during winter season whereas northeast monsoon season study area under very less (217.03%) abnormality.

IndexTerms. **Rainfall variability, Precipitation Ratio, Spatial Rainfall distribution.**

I. INTRODUCTION

In India more than 75% of people directly or indirectly depend on agricultural sector for their livelihood, one of the significant characteristics of Indian agriculture is that, it depends on monsoon season. Southwest and northeast monsoon together contribute nearly 90% of rainfall. Rainfall is the one of the important climatic factor which deciding the success and failure of the crop in an area and its distribution determines the cropping pattern of a region. The rainfall is not evenly distributed it changes in terms of place and time. The systematic study of long-term rainfall reveals the actual characteristics of the Rainfall distribution in an area, which includes seasonal and annual trends, variability and its abnormality. All this information will help various agronomic activity so, rainfall analysis has much more importance among agrarian countries like India. The present study discuses spatial distribution of rainfall, variability and its abnormality. For this study GIS techniques were used for analysis and the preparation of appropriate maps, interpolation task has been done by Inverse distance weighting (IDW) interpolation meth

II. STUDY AREA

Cuddalore district locates in the Eastern part of the Tamil Nadu State and the geographical location of the study area between 78°38' and 80° East longitude and 5°5'/11°11' and 12°35' North latitude. It is bounded on the north by Villupuram district, on the south by Nagapattinam district, on the west by Perambalur and Villupuram districts and on the east by Bay Bengal the geographical area of the study area is 3,678 sq. km. Geographically the study area is more or less Flat with an average elevation of 6m.

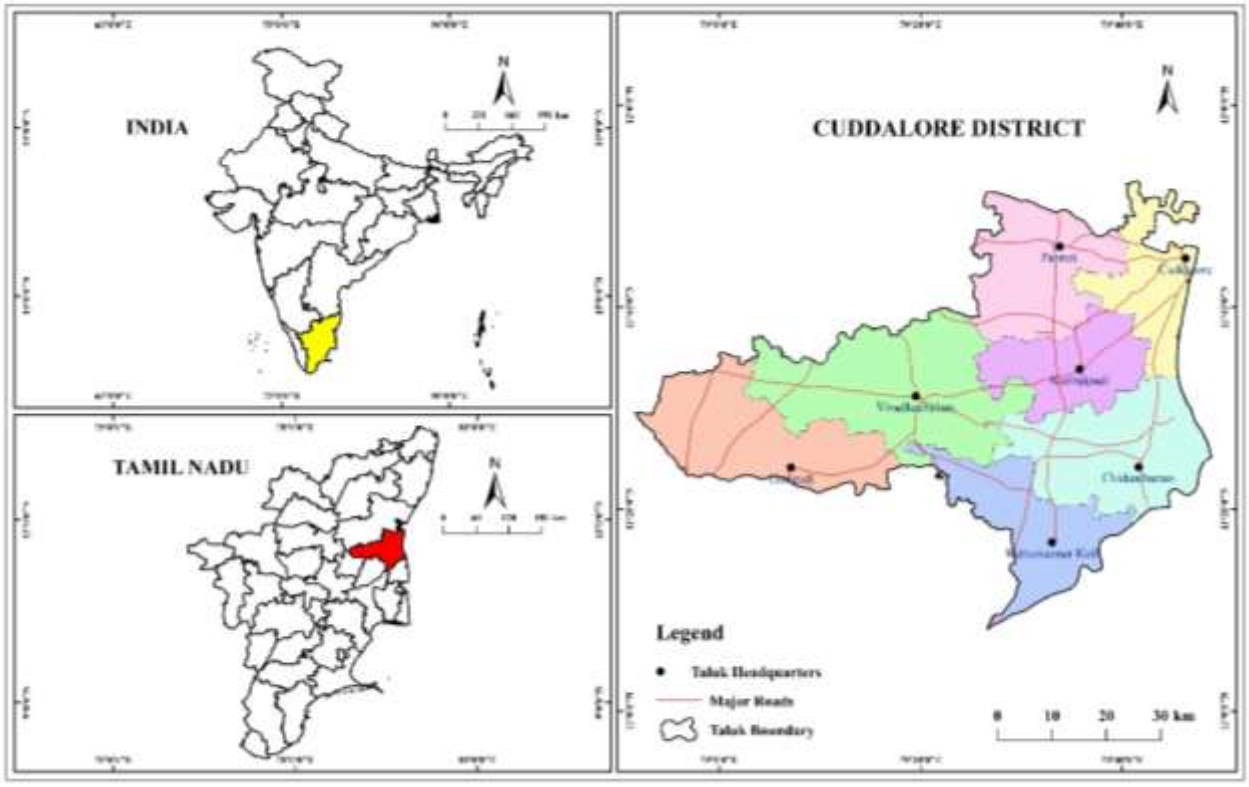

Fig.1 Study Area.

III. METHODOLOGY

Fourteen rainfall Stations were chosen for the Study. Daily Rainfall data for 30 consecutive years have been collected for the years from 1985 to 2014. Rainfall data has been processed in excel and hence seasonal and annual rainfall pattern, co-efficient of variability and Precipitation ratio of the study area has been found out. The collected data have been analysed and represented with appropriate maps using GIS software. Inverse distance weighting (IDW) method has been adopted for the interpolation of rainfall data.

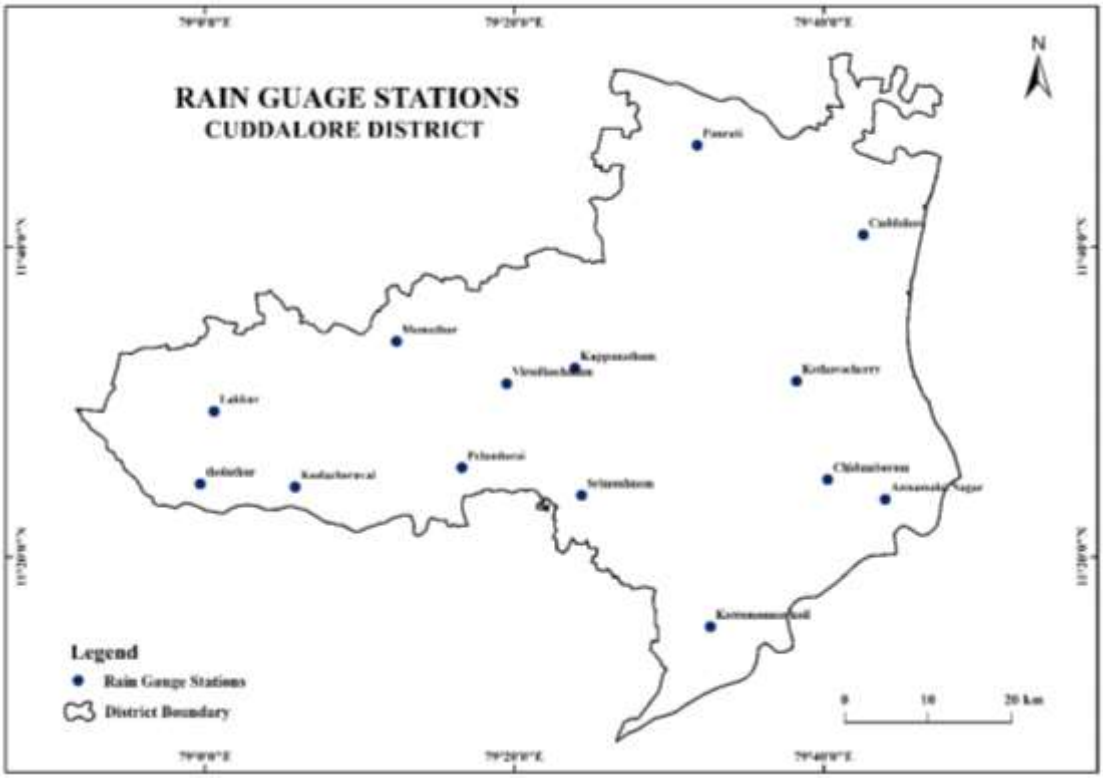

Fig.2 Rain gauge Stations of the study area.

IV. RESULTS AND DISCUSSIONS

Table 1: Mean Annual and Seasonal Rainfall

SI.NO.	Rain Gauge Stations	Winter	Summer	Southwest-Monsoon	North-East-Monsoon	Mean Annual
1	Annamalai Nagar	77.42	105.25	300.49	905.53	1388.68
2	Chidambaram	80.74	98.40	291.61	852.69	1323.44
3	Kattumannarkoil	50.30	107.33	412.81	787.49	1319.21
4	Cuddalore	61.52	75.76	299.30	731.50	1168.08
5	Keelacheruvai	33.50	122.67	420.92	584.84	1161.93
6	Kothavacherry	68.92	82.48	257.33	714.34	1115.08
7	Tholuthur	25.87	126.64	402.32	549.85	1104.67
8	Kuppanantham	36.68	94.49	357.43	580.52	1066.75
9	Virudhachalam	37.32	99.50	355.41	566.44	1058.66
10	Srimushnam	38.34	69.38	308.01	617.79	1033.52
11	Pelandurai	42.13	101.04	340.04	547.14	1030.35
12	Panruti	36.44	71.09	280.70	638.77	1025.83
13	Memathur	30.91	88.90	335.21	523.96	977.99
14	Lakkur	25.93	94.37	318.10	467.05	900.74
Mean		46.14	95.52	334.26	647.71	1119.63

4.1 Mean Annual Rainfall

The geographical location of the study area plays significant role in the distribution of rainfall. Cuddalore district locates in the Eastern part of the Tamil Nadu State which it shares its boundary with Bay of Bengal. Hence the district receives high rainfall during North- East Monsoon period. The long term mean annual rainfall of the district is 1119.63mm, which may vary from 1388.68 mm in Annamalai Nagar to 900.74mm in Lakkur. Topographically the land is completely flat and the Eastern portion of the study area is under the direct influence of Bay of Bengal and hence receives high amount of rainfall during North- East monsoon period. Post monsoon period wind brings high amount of water content from the sea and distributes over the coastal areas. About 57.85% of the

total annual rainfall receives during this season. Except two Stations namely Memathur and Lakkur all other stations receive more than 1000 mm of mean annual rainfall. Very high (>1300mm) rainfall recorded in stations namely Annamalai Nagar (1388.68mm) followed by Chidambaram (1323.44mm) and Kattumannar koil (1319.21mm). Among these stations Annamali Nagar and Chidambaram are located in the South- Eastern part of the study area and Kattumannarkoil is located in the Southern part of the district, which means these three stations are located near to the coast of Bay of Bengal. The moderate rainfall (1100-1200mm) has been seen in four stations named Cuddalore, Kothavacherry, Tholuthur and Keelacheruvai with mean annual rainfall of 1168.08mm, 1115.08mm, 116.93mm and 1104.67mm respectively. Cuddalore station locates in the North- Eastern part of the study area while Kothavacherry locates to the East of the district, Keelacheruvai located in the South- Western part of the study area and Tholuthur located in the Western part of the study area. Most part of the study area were recorded low mean annual rainfall during this 30 consecutive years, this category falls in between 1000 and 1100 mm, this much rainfall recorded in the stations like Panruti (1025.83mm), Kuppanatham (1066.75mm), Virudhachalam (1058.66mm), Srimushnam (1033.52mm) and Pelandurai (1030.35mm). Among these stations Panruti is located in the Northern most part of the study area and stations such as Virudhachalam and Kuppanantham are located in the Central part of the district, while Pelandurai and Srimushnam are located in the Southern part of the study area. Very low mean annual rainfall has been found around Memathur with 977.99mm and Lakkur with 900.74mm rainfall, these two stations located North- West and North respectively. (Fig.3 Shows the Mean Annual Rainfall of the Study Area).

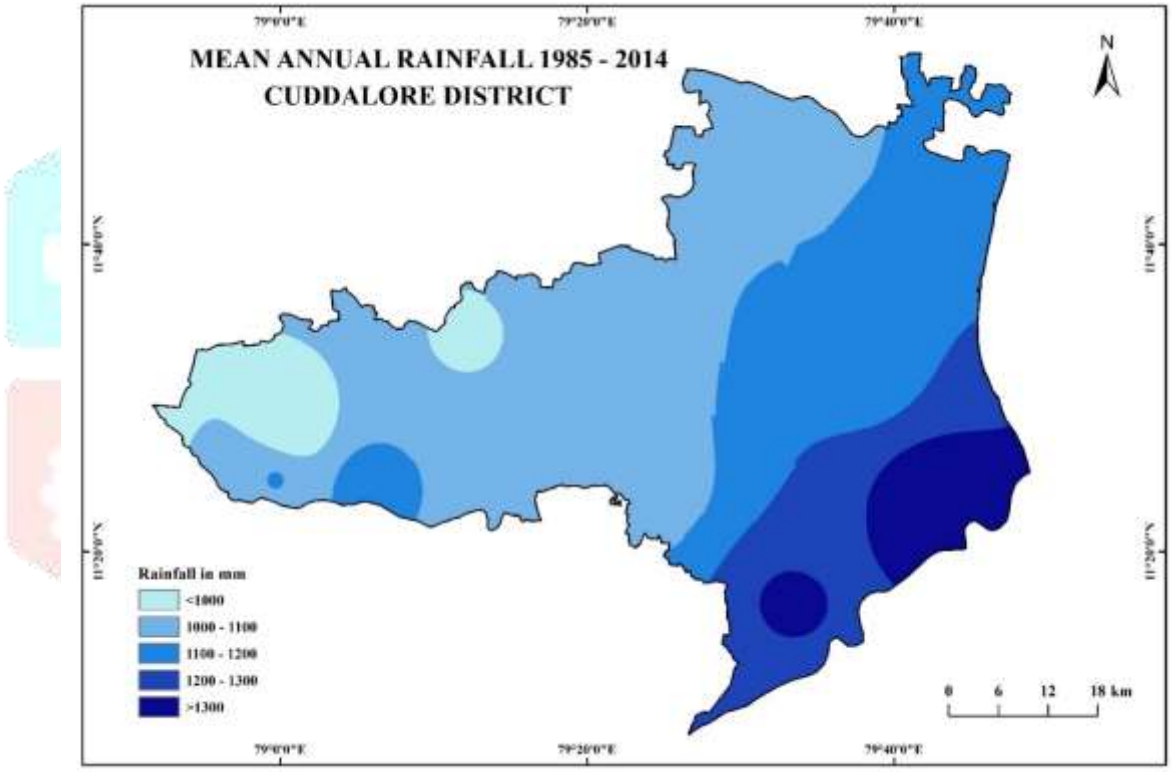

Fig.3 Mean Annual Rainfall

4.2 Mean Seasonal Rainfall

4.2.1 Winter Season

Winter Season starts after the North- East monsoon season i.e., in the last week of December or first week of January and continues up to the end of February. During this period the study area receives only tiny amount of rainfall. The maximum rainfall during this season had recorded at Chidambaram (80.74mm) and the minimum rainfall were recorded at Lakkur (25.93mm). The average rainfall of this season is 46.14mm which contributes only 4.125% to mean annual rainfall. South, South- East, East and North- Eastern part of study area receive comparatively good amount of rainfall during winter season.

4.2.2 Summer season

Summer Season starts March and it's continues up to may, during this season study area experiences hot weather condition. The average rainfall of this season is 95.52mm. it contribute 8.53% of mean annual rainfall. The highest rainfall recorded at Tholuthur

with 126.64mm and lowest rainfall recorded at Srimushanam with 69.38mm. Very high rainfall has been noticed (> 105mm) at three stations namely Kattumannarkoil in the South, Keelacheruvai and Tholuthur in the West, with 107.33mm, 122.67mm and 1126.64mm respectively. High rainfall (95-105mm) has been observed South, Southeast, central, and Western part of the study area. Moderate rainfall (85-95mm) recorded in stations namely Kuppanatham (94.49mm), Memathur (88.90mm) and Lakkur (94.37mm). Kothavacherry and Cuddalore stations have been recorded low rainfall (75-85mm) with 82.48mm and 75.76mm respectively. Very low rainfall (<75) was recorded North and Southern part of the study area, Panruti (71.09mm) in the North and Srimushnam (69.38mm) in the South.

4.2.3 South- East Monsoon

During this period the study area experiences good amount of rainfall as compared to winter season and summer season. This season contributes about 29.85% of the mean annual rainfall (mean: 334.26 mm). Northern and South- Eastern portion of the study area receive less amount of rainfall, while Western, North- Western, Central and Southern part of the district receives comparatively good amount of rainfall. Maximum rainfall has been recorded in Keelacheruvai which is located in the Southern part of the study area and very low rainfall has been recorded at Kothavachery station which lies in the Eastern part of study area with 420.92mm and 257.33mm respectively. Very high rainfall (>410mm) have been recorded in the two different stations namely Keelacheruvai (420.93mm) and Kattumannarkoil (412.81mm), which are located in the Western and Southern parts of the study area respectively. High rainfall (360-410mm) has been observed in Tholuthur with 402.32mm, which lies in the Western part of the study area. Moderate rainfall (310-360mm) has been received by ¾th of the study area especially in some part West, North-West, Central and South-Western parts of the district and the stations namely Memathur (335.21mm), Kuppanantham (357.43mm), Virudhachalam (355.41mm), Lekkur (318.10mm) and Pelandurai (340.04mm) fall in this category. Low rainfall has been found as a single stretch in North, North-East, South-East (Panruti- 280.70mm, Cuddalore-299.30mm, Chidhambaram- 291.61mm and Annamalai Nagar- 300.49mm). Srimushnam also receives much amount of rainfall during this season. Very low rainfall i.e.; below 260 mm has been found over Kothavacherry i.e., 257.33 mm of rainfall.

4.2.4 North- East Monsoon

North-East monsoon of the study area characterized by heavy rain fall and distribute all over the district. The coastal regions receive high amount of rainfall during this period by the influence of Bay of Bengal but the rainfall gradually decreases to Eastern part to Western part of the study area. North, East and South, South- East and North-Eastern part of the study area receive comparatively high amount of rainfall but at the same time Western part of the district except Keelacheruvai receives only less amount of rainfall. During North-West monsoon season, wind picks up maximum water content from Bay of Bengal and distributes over the study area especially in East, North, North-East, South and South-Eastern portions and move towards Western part. By reaching Western part, the water content tends to be decrease and the air begins to become dry. The mean rainfall of this season is 647.71 mm which varies from 905.53mm at Annamalai Nagar and 467.05 at Lakkur. The North-East monsoon is extremely strong during the months of October, November and December. During this season study area receives maximum amount of rainfall and it shares about 57.85% of the mean annual rainfall of the district. Very high rainfall (>630mm) has been recorded in the six different stations Named Panruti (638.77mm), Cuddalore (731.50mm), Kothavacherry (714.34mm), Chidambaram (852.69mm), Annamalai Nagar (905.53mm) and kattumannarkoil (787.49mm). Kuppanantham, Srimushnam and Keelacheruvai have been recorded high rainfall (580-630mm) with 580.52mm, 617.79mm and 584.84mm respectively. Among these three stations, Keelacheruvai locates in the Western part, Srimushnam locates in the Southern part and Kupppanantham lies in the central part of the study area. Moderate rainfall (530-580mm) has been noticed in Virudachalam, Pelandurai and Tholuthur with mean rainfall of 566.44mm, 547.14mm and 549.85mm respectively. Low rainfall (480-530mm) occurs only in one station namely Memathur (523.96mm) and very low (<480mm) rainfall has been identified only in Lakkur with 467.05mm, these two stations are located far away from the coastal area. (Fig.4 Shows the Mean Seasonal Rainfall distribution of Cuddalore district 1985-2014).

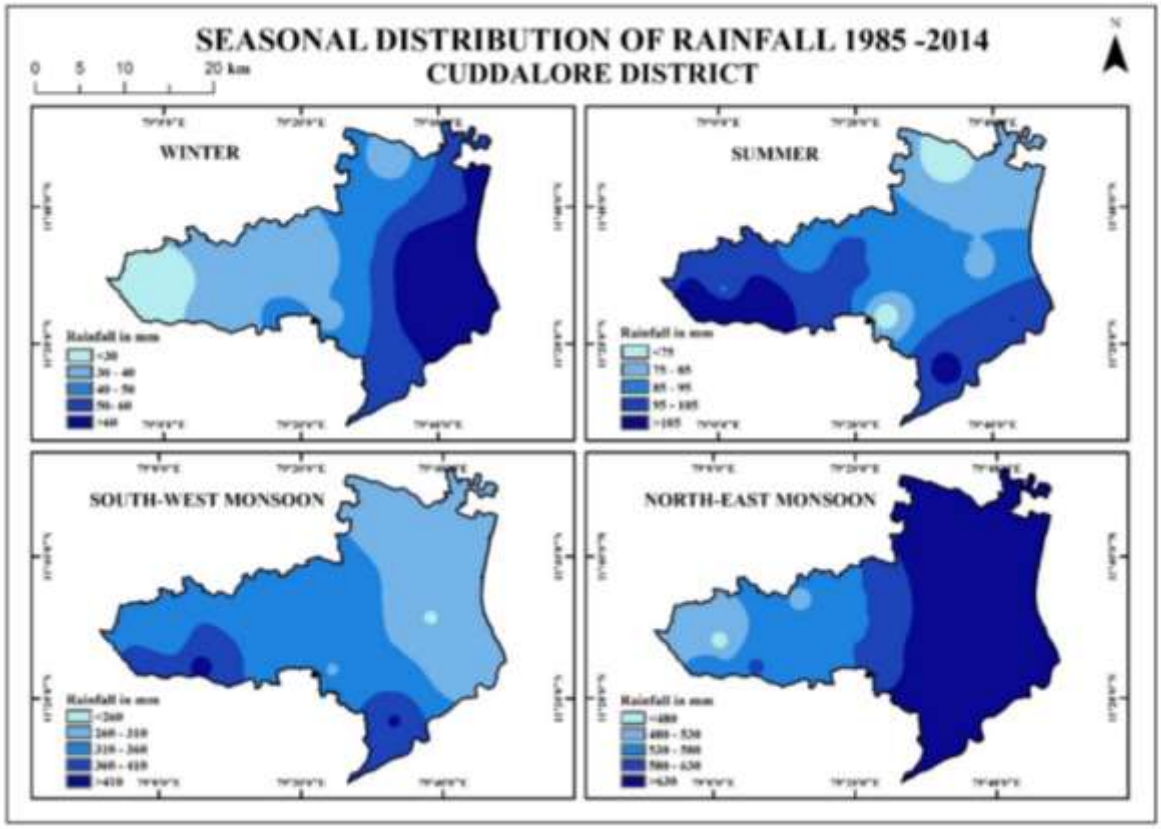

Fig.4 Seasonal distribution of Rainfall of Cuddalore district 1985-2014

Table 2: Seasonal and Annual Rainfall Variability in Percentage

SI. No	Rain Gauge Stations	Winter CV	Summer CV	Southwest CV	Northeast CV	Annual CV
1	Annamalai Nagar	132.55	120.56	45.79	38.53	32.17
2	Chidambaram	146.79	116.25	42.07	40.39	52.89
3	Kattumannarkoil	199.75	114.92	90.87	51.22	47.8
4	Cuddalore	159.16	108.66	52.38	55.33	42.95
5	Keelacheruvai	185.7	82.48	55.69	62.58	46.04
6	Kothavacherry	164.86	115.4	58.57	47.69	37.79
7	Tholuthur	174.82	92.43	58.05	63.5	45.91
8	Kuppanantham	163.54	109.43	48.51	54.56	40.12
9	Virudhachalam	156.16	101.86	44.74	52.55	38.24
10	Srimushnam	223.6	127.35	82.79	68.04	62.4
11	Pelandurai	164.31	81.5	46.63	54.32	37.72
12	Panruti	172.01	153.45	64.48	69.84	55.82
13	Memathur	183.98	84.78	51.47	51.33	39.3
14	Lakkur	189.29	88.76	50.63	61.4	43.06

4.3 Variability of Rainfall

Rainfall variability is the deviation from mean or ratio of the standard deviation to the mean rainfall. In other words, the co-efficient of variation (CV) is defined as the standard deviation divided by the mean value of rainfall. It shows the variability of rainfall in percentage. The higher the variability of percentage the lower is the dependability and vice versa. For the monthly case, less than 100% of CV is dependable, while more than 100% is not dependable rainfall.

CV = (SD/Mean) X 100

4.3.1 Annual rainfall Variability

Annual rainfall Variability of the study area varies from the maximum at Srimushnam (62.40%) to minimum at Annamalai Nagar (32.17%). Both are located in South and South-East portions respectively. More than 55% of rainfall variability has been noticed in two different stations namely Srimushanam (62.40%) and Panruti (55.82%) which are located in Southern and Northern portions respectively. High rainfall variability (50-55%) has been observed in Chidambaram station with the variability of 52.89% in South-Eastern part of the study area. Moderate rainfall variability (45-50%) is found in three different stations such as Kattumannarkoil in the North, Tholuthur and Keelacheruvai in the West with annual rainfall variability of 47.80%, 45.91% and 46.04% respectively. Low annual rainfall variability has been noticed in Cuddalore (42.95%), Kuppanantham (40.12%) and Lakkur (43.06%). Among these Cuddalore is located in the North-Eastern part of the study area, Kuppanantham located in the Central part of the study area and Lakkur is located in the Western part of the study area. The stations of Memathur (39.30%), Virudachalam (38.24%), Pelandurai (37.72%), Kothavacherry (37.79%) and Annamalai Nagar (32.17%) experience very low amount of rainfall variability. (Fig.4 Shows Mean Annual Rainfall of Cuddalore district during 1985-2014).

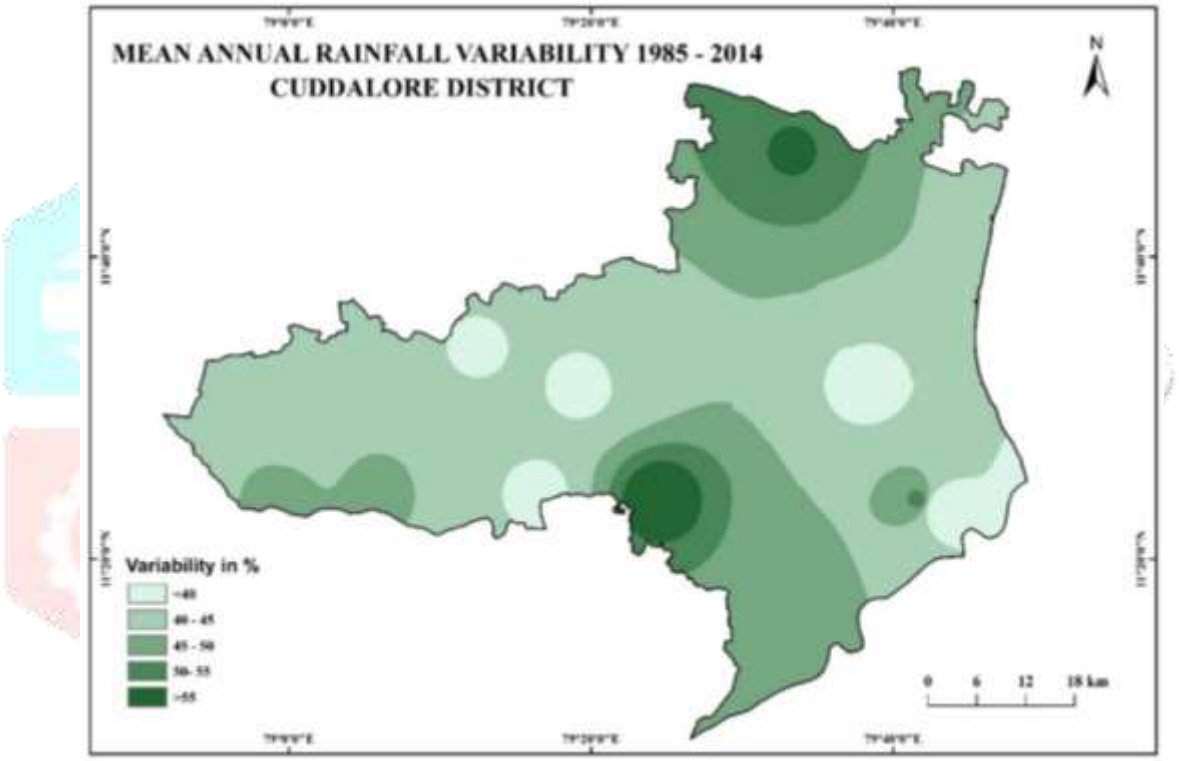

Fig.5 Mean Annual Rainfall Variability of Cuddalore district 1985-2014

4.3.2 Winter Rainfall Variability

Compared to all other seasons, the variability of rainfall is very high in winter season as low rainfall area experiences greater variability. The winter rainfall variability varies from 223.60% at Srimushnam to 132.55% at Annamalai Nagar. More than 170% of variability has been found in North, South, North-West and Western part of the study area, especially in the areas covered by panruti (172.01%), Srimushnam (223.60%), Kattumannarkoil (199.75%), Memathur (183.98%), Lakkur (189.29%), Keelacheruvai (185.70%) and Tholuthur (174.82%). Kothavacherry, Kuppanatham and Pelandurai experience high variability of rainfall with 164.86%, 163.54%, 164.31% respectively. The variability of 150-160% has been recorded in Cuddalore and Virudachalam which are located in the North-Eastern and Central parts respectively. Chidambaram station experiences low variability of rainfall (146.79%), while very low variability of rainfall prevails in Annamali Nagar with 132.55%, which is located in the South-Eastern part of the study area. This fluctuation of rainfall indicates regions under very low rainfall during this particular season. (Fig.6 shows seasonal Rainfall Variability of Cuddalore district 1985-2014).

4.3.3 Summer Rainfall Variability

Summer rainfall variability varies from 153.45% (Panruti) to 81.50% (Pelandurai). Very high rainfall variability (more than 120%) recorded at panruti (153.45%), Srimushnam (127.35%) and Annamalai Nagar (120.56%). High rainfall variability (110-120%) has been noticed in three stations Kothavachery (115.40%), Chidambaram (116.25%) and Kattumannar koil (114.92%), South, Southeast, Eastern part of the study area falls in this category. Three rain gauge stations namely Cuddalore (108.66%), Kuppanatham (109.43%), and Virudhachalam (101.86%) under moderate rainfall variability during summer. Low rainfall variability (90-100%) has been noticed only one station named Tholuthur with 92.43% variability which locates the Western part of the study area. The stations namely Memathur (84.78%), Lakkur (88.76%), and Keelacheruvai (82.48%) recorded very low rainfall variability (<90%). This season subject with less variability compare to winter season by the influence of convectional rainfall.

4.3.4 Southwest Monsoon Rainfall Variability

During this period the study area experiences low rainfall variability compare to winter and summer season very high rainfall variability (>65%) has been recorded Southern part of the study area mainly includes two stations namely Srimushnam and Kattumannarkoil with variability of 82.79% and 90.87% respectively. High rainfall variability (60-65%) has been identified only one station named Panruti with variability 64.48%, this station locates Northern part of the study area. Stations namely Kothavacherry, Tholuthur and Keelacheruvai experiences moderate rainfall variability with 58.57%, 58.05% and 55.69% respectively, among these three stations Tholuthur and Keelacheruvai locate Western part of the study area and Kothavacherry locates Eastern part of the district. Low rainfall variability (50-55%) experience stations like Cuddalore (52.32%), Lakkur (50.63%) and Memathur (51.47%). During this season very, low rainfall variability (<50%) prevail over Chidambaram (42.07%), Annamalai Nagar (45.79%), Kuppanantham (48.51%), Virudachalam (44.74%) and Pelandurai (46.63%).

4.3.5 North-East Monsoon Rainfall Variability

North-East monsoon rainfall variability varies from 69.84% (Panruti) to 38.53% (Annamalai Nagar). North-East monsoon season experiences low rainfall variability compares to all other seasons because during this season study area receives maximum amount of rainfall. Very high rainfall variability has been seen Northern, Western and partially in South and Southwest part of the study area. Stations namely Panruti (69.84%), Cuddalore (55.33%), Sreemushnam (68.04%), Lakkur (61.40%), Tholuthur (63.50%) and Keelacheruvai (62.58%) fall in this category because all these areas receive low rainfall during North-East monsoon period. While Memathur, Kuppanantham, virudhachalam, Kattumannarkoil and Pelandurai experiences high rainfall variability (50-55%) it comes 51.33%, 54.56%, 52.44%, 51.22% and 54.32% respectively. Kothavacherry experience moderate rainfall variability (45-50%) during this season the variability of Kothavacherry is 47.69% which located Eastern part of the study area. Annamalai Nagar (38.53%) and Chidambaram (40.39%) experience very low and low rainfall variability respectively. Mainly Eastern and South-eastern part of the study area receives high amount of rainfall during this season hence low rainfall variability prevails over this region rainfall during this season.

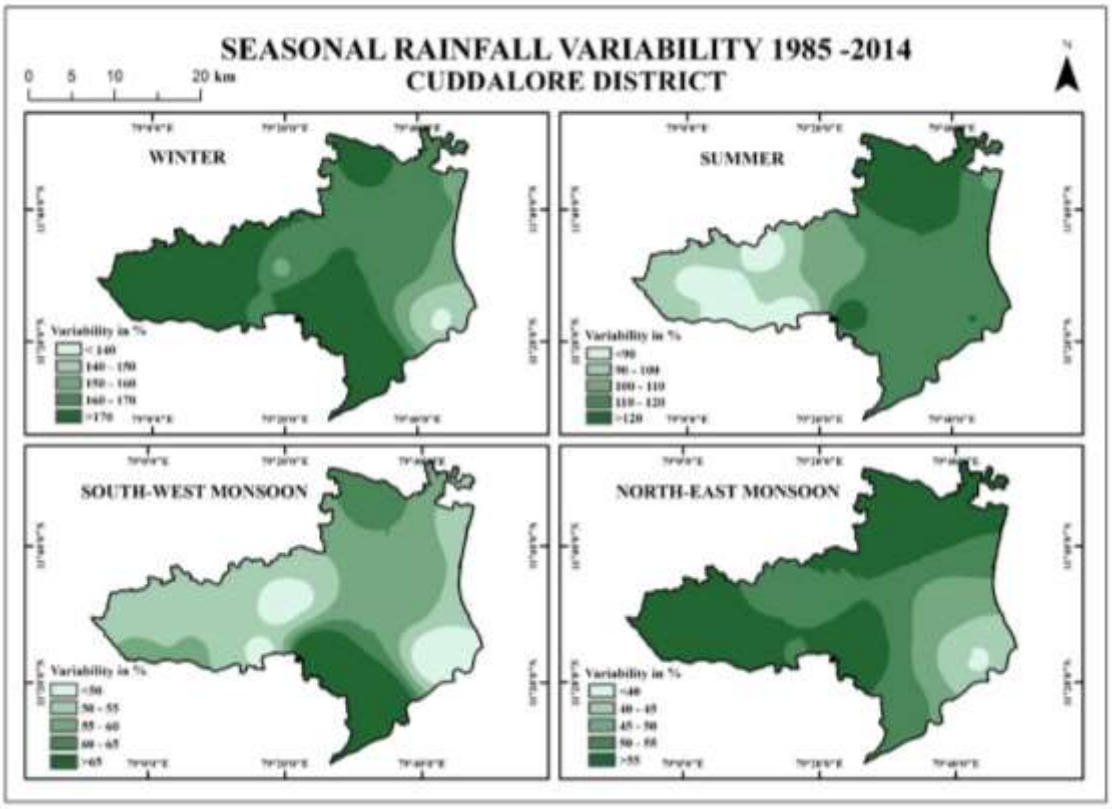

Fig.6 Seasonal Rainfall Variability of Cuddalore district 1985-2014.

Table 3: Precipitation ratio in percentage.

SI.NO	Stations	Winter	Summer	Southwest Monsoon	North-East Monsoon	Annual
1	Annamalai Nagar	532.04	573.31	172.89	157.61	162.50
2	Chidambaram	514.02	511.20	181.99	170.59	219.37
3	Kattumannarkoil	892.59	449.09	500.96	195.43	205.58
4	Cuddalore	643.90	456.32	203.64	186.08	159.35
5	Keelacheruvai	594.03	365.21	199.68	243.83	178.75
6	Kothavacherry	525.98	374.04	217.04	197.81	165.28
7	Tholuthur	602.92	430.36	250.05	296.81	208.60
8	Kuppanantham	548.59	494.44	214.59	199.58	171.76
9	Virudhachalam	567.05	489.66	198.64	214.18	156.27
10	Srimushnam	776.96	477.10	330.51	232.12	232.41
11	Pelandurai	614.73	408.74	189.09	210.55	169.17
12	Panruti	742.25	638.93	237.30	296.48	219.71
13	Memathur	646.39	331.83	199.28	201.54	159.92
14	Lakkur	749.20	407.01	192.86	235.76	192.51
Mean		639.33	457.66	234.89	217.03	185.80

4.4 Precipitation ratio

Precipitation Ratio = Px-Pn/Pm*100

Where Px and Pn represent the maximum and minimum rainfall over a series of years. Precipitation ratio shows the difference between maximum and minimum rainfall over a series of years and it is expressed in the terms of means. In other words, precipitation ratio shows the abnormality of rainfall in an area. Higher the precipitation ratio means higher abnormality in rainfall while less precipitation ratio means less abnormality.

4.4.1 Mean Annual Precipitation ratio

The mean annual precipitation ratio of the study area is 185.80% it varies from 156.27% (Virudachalam) to 232.41% (Srimushanam). Stations namely Chidambaram, Kattumannar Koil, Tholuthur, Srimushnam, Panruti having more than 200% precipitation ratio which means these areas experience higher rainfall variability especially North, South and Western part of the study areas under higher rainfall variability while less rainfall variability found over the North-Eastern, Eastern central and Northwestern part of the study area.

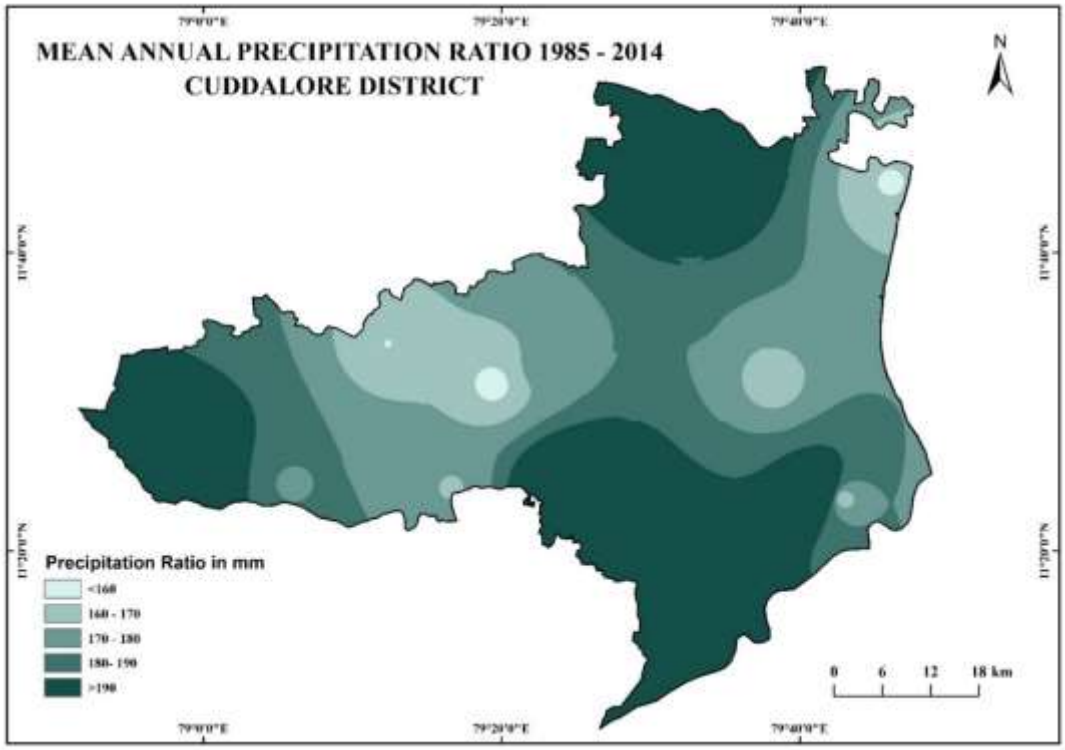

Fig.7 Shows Mean Annual Precipitation Ratio of Cuddalore District 1985-2014

4.4.2 Winter Precipitation ratio

Instability of rainfall is higher during this season compare to other seasons, average precipitation ratio of the study area during winter period is 639.33%. the maximum ratio has been recorded at kattumannar Koil with 892.59% and minimum found at Chidambaram with 514.02%. zones with more than 670% found over Panruti in the North, Lakkur in the West and Kattumannar koil in the South. The regions namely Cuddalore and Memathur were under the ranges between 620-670% of precipitation ratio. The category 570-620% prevails the areas like Pelandurai, tholuthur and Keelacheruvai which located Southwestern and Western portion of the study area. Kuppananthan, Virudachalam, Kothavacherry and Annamalai Nagar recorded ranges between 520% and 570% of precipitation ratio. Very low precipitation ratio less than Chidambaram which locates Southeastern part of the Study area.

4.4.3 Summer Precipitation Ratio

During Summer season rainfall instability less than that of winter. High abnormality prevails over Panruti, Chidambaram and Annamalai Nagar where Panruti locates Northern part of the study area, while Chidambaram and Annamalai Nagar locate Southeastern part of the study area. The following areas show precipitation ratio between 450% and 500% they are Srimushnam, Kuppanatham, Virudachalam and cuddalore. Keelacheruvai and kothavacherry fall under 350-400 category of precipitation ratio. Very low rainfall abnormality found only one station named memathur which located NorthWestern side of the district.

4.4.4 South-West Precipitation Ratio

South-West and North-East monsoon seasons are the two seasons which serves high amount of rainfall to the study area. South-Western monsoon alone contributes about 29.85% of rainfall to the annual rainfall. The annual precipitation ratio of the study area during this season is 234.89% having lesser precipitation ratio as compared to other two seasons (Summer and Winter). Maximum ratio has been noticed over Kattumannar Koil (500.96%) and minimum ratio recorded Annamalai Nanagar (172.89%) which has been indicated by lesser ratio values. Very high category of precipitation i.e., more than 300% percentage are found over Southern part of

the study area especially in Srimushnam and Kattumannar Koil. Category in between 220% and 260% prevails in Tholuthur and Panruti and its influence also experience in the Central part of the study area. Following stations named Lakkur, Keelacheruvai, Memathur, Kuppanantham, virudachalalam, Pelandurai, Cuddalore, Chidambaram and Kothavacherry falls in the category of 180-220%. Very low precipitation ratio (<180%) are found over Annamai Nagar located in the South-Eastern portion of the Study area.

4.4.5 North-East Precipitation Ratio

The study area receives maximum amount of rainfall during North-East monsoon (57.85%) period. Precipitation ratio of the study area during this period is 217.03%, which is less than that of all other seasons. The ratio varies from 296.48% in Panruti to 157.61% in Annamalai Nagar. North and Western part of the study area are characterized by high precipitation ratio which indicates higher abnormality of rainfall in Southern regions. Srimushnam also have the same condition. The stations namely Panruti, Srimushnam, Lakkur, Tholuthur and Keelacheruvai also falls in the same category. The category of 200-200% prevails over Memathur, Virudachalam, and Pelandurai. Cuddalore, Kothavacherry, Kattumannar Koil and Kuppanantham falls in the category of 180-200%. Very low and low precipitation ratio is recorded in the South-Eastern part of the study area. Low precipitation ratio (160-180) has been identified at Chidambaram and very low precipitation ratio <160% has been noticed only in one station namely Annamalai Nagar. The precipitation ratio gradually increases from East to Western part of the study area.

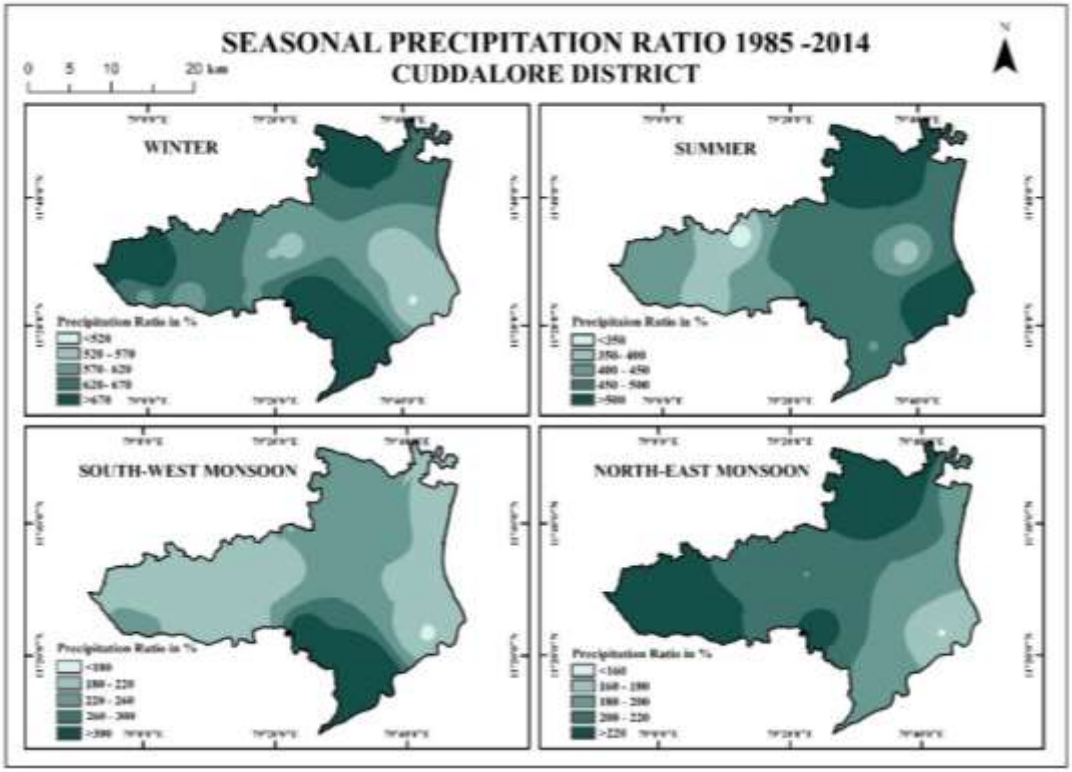

Fig.8 Seasonal Precipitation Ratio of Cuddalore district 1985-2014

4.5 CONCLUSION

Cuddalore district locates eastern part of the Tamil Nadu state. Geographically the area is more or less flat, it bounded on the east by Bay of Bengal thus Eastern portion of the study area is under the direct influence of Bay of Bengal and hence receives high amount of rainfall during North- East monsoon period. The long-term rainfall analysis reveals the rainfall trend of the cuddalore district. The long term mean annual rainfall of the district is 1119.63mm. Maximum rainfall have been recorded at Annamalai Nagar (1388.68mm) and minimum Recorded at Memathur (900.74mm). southwest and northeast monsoon together contribute about 87% of the mean annual rainfall of the study area, Northeast monsoon alone contributes 57.85%. During northeast monsoon span of time north, north-eastern, eastern, south and south-eastern part of the study area receive high amount of rainfall and its distribution gradually decreases from east to western part of the study area. Study area subjects to very less rainfall during winter season. As far the long term-mean rainfall variability concerned maximum rainfall variability prevails over Srimushnam with 62.40% and minimum variability experiences at Annamali Nagar with variability 32.17%. winter season creates high rainfall variability than that of other three seasons by northeast monsoon season, study area enjoys less rainfall variability. North, South

and Western part of the study areas under higher rainfall variability while less rainfall variability found over the North-Eastern, Eastern, central, south eastern and North western part of the study area.

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