RAINFALL CHARACTERSTICS AND DISTRIBUTION OF MADANAPALLI TALUK ANDHRA PRADESH INDIA

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ABSTRACT

Water is a precious and most commonly used resource. Surface water resources are exploited and may become short of supply or may not be easily available at site. Ground water commonly occurs and is widely distributed. There has been an increase in groundwater development and utilization particularly in developing countries for agriculture, industry and rural water supply schemes. So, after studying the land resource evaluation in the pervious chapter, it is felt necessary to study the water resources (both surface and sub-surface) to justify the 'water resources study' of Madanapalli Taluk.

KeyWords: water resources-Rainfall-seasons- charecterstics-distribution.

INTRODUCTION.

Chittoor District as well as Madanapalli Taluk has been identified by the irrigation commission as a droughtprone area. Since rainfall is a very important parameter in the indication of drought / droughtproneness and is the source of all the water available for agriculture and other purposes, a knowledge of the extent of water resources available in the study area from this source is of vital importance. The major portion of rainfall comes as surface run-off in the form of rivers, streams and rivulets while some part of it percolates into the ground and remains there as underground water. It is therefore necessary to make separate assessment of water resources available in the study area from these two important source that is surface and sub-surface sources of the study area.

Data and Methodology

In the present study an attempt has been made to describe the spatial distribution of the seasonal and annual rainfall, rainfall variability, rainfall intensity and rainfall ratio with an idea of getting a good picture of surface water resources of the study area. To understand the distribution, variability, intensity and abnormalities of rainfall, the respective statistical techniques such as mean, standard deviation (S.D) and co-efficient of variation (C.V), number of rainy days and the rainfall ratio are worked out for the study area taking 100 years of rainfall data (from 1901 to 2000) for 6 rain-gauge stations.

Rainfall pattern and Distribution in study area

Due to the diversity of relief in the district / Taluk and climatic conditions particularly rainfall for crop production differ seasonally and regionally to a great extent. As said earlier the location of Chittoor district in the southeastern fringe of Andhra Pradesh, its varied surface configuration, its somewhat nearness to the Bay of Bengal and the direction of prevailing winds, all

combine to generate a climatic environment with a wide variety of characteristics. To study the characteristics of rainfall in the district the criteria suggested and adopted by the India Meteorological Department (I.M.D), Pune have been used in the present investigation in the following way:a)　　The cold weather season or winter season (January and February)　b) The　　hot weather season or summer season (March to May)c)　The　southwest　monsoon　season　(June　to　September)　d)The　northeast monsoon season (October to December)

The two seasons namely the southwest monsoon and the northeast monsoons are very effective in the District/ Taluk　when compared with the other two.

Existing raingauge stations

The study area has a network of 6 raingauge stations for a geographical area of 1000.56 Km^2 thus the density works out to one for an area of 166.76 km^2. Out of the 6 raingauge stations, two raingauge stations are well maintained by the India Meteorological Department since the pre-independence period. The remaining 4 raingauge stations are maintained by various agencies like Public Works Department (P.W.D), Revenue Department and the like. Some stations have continuous data for10 years and only one station have got the data for 10 years. So, for the purpose of drawing the isohyetes the rainfall data for the neighbouring stations of the Taluk were also considered.

Description of winter rainfall

From the analysis of mean seasonal rainfall in the study area in winter it is evident that it varies from a minimum of 16.42 mm in Kurabalakota in the northern hilly terrain of Madanapalli Taluk to a maximum of 19.46 mm in Nimmanapalli in the eastern part of the Taluk, the normal rainfall being 18.08 mm . The spatial distribution of rainfall in the study area depicts that it is reducing from east to west.

The average number of rainy days ranges from a minimum of 1.32 in Ghattu to a maximum of 1.7 in Nimmanapalli, the normal is 1.4. The intensity of rainfall in the study area reveals that it varies from a minimum of 11.44 mm per a rainyday in Nimmanapalli to a maximum of 14.13 mm per a rainyday in Ghattu, the normal intensity of rainfall in the study area in winter is 12.54 mm per a rainyday. The spatial pattern of intensity in the study area shows that it is more in the western parts of the Taluk, than in the eastern part.

From the study of analysis of co-efficient of variability in the Taluk, it is discernible that it ranges from a minimum of 139.6 per cent in B.Kothakota to a maximum of 192.42 per cent in Kurabalakota, the normal variability of the study area is 164.7 per cent, which shows the erratic nature of rainfall in winter. The spatial distribution of variability in the Taluk shows that in the western part it is less variable (more than 150 per cent) than in the remaining part of the Taluk. The rainfall ratio or the abnormalities in the occurrence of rainfall in the study area is ranging from a minimum of 390 per cent in Kurabalakota to a maximum of 816.39 per cent in

Nimmanapalli, the normal ratio in winter is 654.0 per cent. The spatial pattern of rainfall ratio in the study area shows that the southern part shows more abnormality in rainfall than in the northern part

Particulars of Rainfall in Winter Season

S. No.	Name of the Raingauge Station	Mean seasonal Rainfall (mm)	Average No. of Rainydays	Rainfall Intensity (mm)	Rainfall Variability (%)	Rainfall Ratio (%)
1.	Arogyavaram	19.0	1.46	13.01	189.42	586.6
2.	B.Kothakota	17.32	1.40	12.37	139.6	696.4
3.	Ghattu	18.66	1.32	14.13	156.2	718.6
4.	Kurabalakota	16.42	1.4	11.72	192.42	390.10
5.	Madanapalli	17.63	1.40	12.59	146.3	716.42
6.	Nimmanapalli	19.46	1.7	11.44	164.6	816.39
7.	Madanapalli Taluk	18.08	1.4	12.54	164.7	654.0

Source : Computed from the data collected

Description of summer rainfall

Form the study of mean seasonal rainfall in summer it is found that the rainfall ranges from a minimum of 54.69 mm in Ghattu to a maximum of 116.4 mm in Arogyavaram, the normal rainfall is 90.2 mm (Table 3.2). It is observed that the influence of seasonal rainfall is more in the eastern and southern parts than on the north and western part. The spatial distribution of rainfall shows that the rainfall is more in Arogyavaram, Madanapalli and Nimmanapalli areas than in the other areas.

The average number of rainydays in the study area ranges from a minimum of 4.2 in Ghattu, the border place of drought stricken Anantapur district to a maximum of 7.4 in Arogyavaram, the normal number of rainydays of the Taluk is 5.78. The rainfall intensity in the study area shows that it ranges from a minimum of 13.02 mm per a rainyday in Ghattu to a maximum of 17.23 mm per a rainyday in Madanapalli. The normal is 15.53 mm per a rainy day. The spatial pattern shows that the intensity is more in the southern part of the Taluk and decreasing gradually towards northwestern corner of the Taluk. The rainfall variability in the study area shows that it varies from a minimum of 53.69 per cent in Kurabalakota to a maximum of 82.0 per cent in Arogyavaram. The Taluk average is 59.5 per cent, which shows the erratic nature of rainfall. The spatial distribution of variability

shows that it is low in the Ghattu and Kurabalakota and B.Kothakota area and irregular in the other parts of the Taluk.

Rainfall in Summer Season

S. No.	Name of the Raingauge Station	Mean seasonal Rainfall (mm)	Average No. of Rainydays	Rainfall Intensity (mm)	Rainfall Variability (%)	Rainfall Ratio (%)
1.	Arogyavaram	116.4	7.4	15.72	82.0	365.4
2.	B.Kothakota	79.4	5.2	15.26	55.0	166.4
3.	Ghattu	54.69	4.2	13.02	54.3	151.6
4.	Kurabalakota	74.08	4.3	17.22	53.6	138.4
5.	Madanapalli	112.04	6.5	17.23	56.0	266.46
6.	Nimmanapalli	105	7.1	14.78	56.6	274.00
7.	Madanapalli Taluk	90.2	5.78	15.53	59.5	226.9

Source : Computed from the data collected

The rainfall ratio in the study area ranges from a minimum of 138.4 per cent in Kurabalakota to a maximum of 365.4 per cent in Arogyavaram. The normal being 226.9 per cent. To sum up, the abnormalities in the occurrence of rainfall is increasing from northwest to southeast (Fig.3.4).

Description of rainfall in southwest monsoon season

Both the Southwest monsoon and Northeast monsoons are principal monsoon seasons of the study area. The Southwest monsoon season lasts over the Taluk from June till the end of September. The rainfall is discontinuous and characterized by alterations of moderate to light rain with intervening day spells. It is this variation of the monsoon which is of great agricultural significance, for *kharif* crops in the study area. The rainfall of 311.82 mm which forms 48.07 per cent of the total normal annual rainfall of 656.64 mm in the Taluk is received during the Southwest monsoon season[2].

From the study and analysis of mean seasonal rainfall in Southwest monsoon it is discernible that it ranges from a minimum of 253.6 mm in Kurabalakota in the northern part of the Taluk to a maximum of 347.01 mm in Nimmanapalli, the normal rainfall of the Taluk is 311.82 mm.

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The spatial distribution of rainfall shows that it is more in the eastern and southeastern part of the study area and decreasing towards north. The average number of rainy days ranges from a minimum of 17.97 in Ghattu to a maximum of 24.19 in Madanapalli, the average being 20.55.

Rainfall in Southwest Monsoon Season

S. No.	Name of the Raingauge Station	Mean seasonal Rainfall (mm)	Average No. of Rainydays	Rainfall Intensity (mm)	Rainfall Variability (%)	Rainfall Ratio (%)
1.	Arogyavaram	319.9	20	15.99	35.6	188
2.	B.Kothakota	313.9	19	16.47	35.39	149.95
3.	Ghattu	298.23	17.97	16.59	46.76	103
4.	Kurabalakota	253.6	19.5	13.0	40.7	90
5.	Madanapalli	338.29	24.19	13.98	33.53	164.9
6.	Nimmanapalli	347.01	22.67	15.30	35.58	184.4
7.	Madanapalli Taluk	311.82	20.55	15.22	37.92	146.70

Source : Computed from the data collected.

The intensity of rainfall in this season ranges from a minimum of 13.0 mm per a rainy day in Kurabalakota to a maximum of 16.59 mm per a rainy day in Ghattu, the average being 15.22 mm per a rainy day. The spatial distribution shows that it is more in the western and central parts of the Taluk and decreasing towards north.

The rainfall variability of the study area ranges from a minimum of 33.53 per cent in Madanapalli to a maximum of 46.76 per cent in Ghattu, with the average being 37.92 per cent. The spatial pattern shows that the variability is more in the northern part of the Taluk and gradually decreasing towards the south.

The rainfall ratio in the study area ranges from a minimum of 90 per cent in Kurabalakota to a maximum of 188 per cent in Arogyavaram, the normal being 146.7 per cent. The spatial pattern shows that the abnormality in the distribution of rainfall is more in the eastern part of the Taluk than in the western and northern parts.

Description of rainfall in northeast monsoon season

From the study and analysis of mean seasonal rainfall in the northeast monsoon in the Taluk it is observed that it ranges from a minimum of 203.05 mm in Ghattu in the northern part of the Taluk to a maximum of 265.13 mm in Madanapalli, the southern part of the Taluk, the average being 236.50 mm. The spatial pattern clearly shows that the rainfall is decreasing from south to north. The average number of rainy days ranges from a minimum of 12.2 in Ghattu to a maximum of 15 in Madanapalli, with the average being 13.96

The rainfall intensity of the Taluk ranges from a minimum of 15 mm per a rainy day in Kurabalakota to a maximum of 18 mm per a rainy day in Nimmanapalli, the average being 16.91 mm per a rainy day. The spatial pattern shows that the intensity has been decreasing towards northeast.

The rainfall variability of the study area ranges from a minimum of 32.63 per cent in Ghattu to a maximum of 51.8 per cent in Nimmanapalli, the average being 44.35 per cent. The spatial pattern shows that it is more in the eastern part than in the north and western part of the study area. The rainfall ratio ranges from a minimum of 158.5 per cent in Ghattu to a maximum of 289.6 percent in Nimmanapalli, the average being 222.14 per cent. The spatial pattern shows that the abnormality in the distribution of rainfall is more in the southeastern part than in the north and central part of the study area

Rainfall in Northeast Monsoon Season

S. No.	Name of the Raingauge Station	Mean seasonal Rainfall (mm)	Average No. of Rainydays	Rainfal Intensity (mm)	Rainfall Variability (%)	Rainfall Ratio (%)
1.	Arogyavaram	242.8	14	17.34	49.6	260.0
2.	B.Kothakota	222.95	13.2	16.89	46	213.75
3.	Ghattu	203.05	12.2	16.65	32.63	158.5
4.	Kurabalakota	220.5	14.7	15.0	38.8	159.1
5.	Madanapalli	265.13	15	17.67	47.3	251.9
6.	Nimmanapalli	264.6	14.7	18.0	51.8	289.6

| 7. | Madanapalli Taluk | 236.50 | 13.96 | 16.91 | 44.35 | 222.14 |

Source : Computed from the data collecte

Yearly rainfall particulars

From the study and analysis of the mean annual rainfall in the study area it is discernible that it ranges from a minimum of 564.6 mm in Kurabalakota to a maximum of 736.0 mm in Nimmanapalli, the average rainfall of the Taluk is 656.64 mm. The spatial distribution of rainfall shows that it is decreasing from south to north. The average number of rainy days ranges from a minimum of 35.69 in Ghattu to a maximum of 47.09 in Madanapalli, the normal number of rainy days in the study area are 41.75

The rainfall intensity ranges from a minimum of 13.71 mm per a rainy day in Kurabalakota to a maximum of 16.14 mm per a rainy day in Nimmanapalli. The normal intensity of Taluk is 14.65 mm per a rainy day. The spatial pattern of intensity in the study area shows that it is decreasing from south to northeast. The eastern part shows the intensity more than 15 mm per a rainy day. The rainfall variability in the study area ranges from a minimum of 24.2 per cent in Kurabalakota to a maximum of 33.0 per cent in Arogyavaram which shows the erratic nature of rainfall for dependable agriculture. The normal variability of the Taluk is 27.66 per cent. The spatial pattern of annual rainfall variability in the study area shows that in a major part of the Taluk the variability is in the range of 25 to 30 per cent except a few pockets with variability of more than 30 per cent in the central part of the Taluk. An examination of rainfall reveals that although the normal annual C.V. value is 27.66 per cent, the annual rainfall is varying from a maximum of 1220.65 mm in the year 1925 to a minimum of 325.42 mm in the year 1965. This range is too high for any stable agriculture.

S. No.	Name of the Raingauge Station	Mean seasonal Rainfall (mm)	Average No. of Rainydays	Rainfall Intensity (mm)	Rainfall Variability (%)	Rainfall Ratio (%)
1.	Arogyavaram	698.1	42.86	13.98	33.0	200.0
2.	B.Kothakota	633.5	43.44	14.59	26.57	188.88
3.	Ghattu	574.58	35.69	14.36	24.33	183.75
4.	Kurabalakota	564.6	41.18	13.71	24.2	182.6
5.	Madanapalli	733.09	47.09	15.05	27.4	214.9

6.	Nimmanapalli	736.06	46.17	16.14	28.47	207.37
7.	Madanapalli Taluk	656.64	41.75	14.65	27.66	196.25

Source : Computed from the data collected.

The rainfall ratio or the abnormality in the occurrence of rainfall ranges from a minimum of 182.6 per cent in Kurabalakota to a maximum of 214.9 per cent in Madanapalli, the average being 196.25 per cent. In the northern part of the Taluk the ratio is in the range of 182.6 to 188.88 per cent due to orographic effect

Rainfall availability of study area. These are as detailed below :

Average annual rainfall of the Taluk   :   656.64 mm

Area of the Taluk   :   1000.56 Km^2

Total rainfall received in the Taluk : 656.64 x 1000.56=657.00 Mm^3

Based on the estimation of precipitation potential, the mean annual rainfall of the Taluk and the geographical area of the Taluk, it is estimated that the study area has a potential of 657.00 Mm^3.

However, not the entire quantum of rainfall is available for various human activities as the volume of water is reduced by evaportranspiration and infiltration. The availability of surface water resources determines the land use and agriculture of any region. During the ancient period man did not know the technique of harnessing the surface water resources in a planned way. He has constructed some tanks and lakes for the storage of such water for future use. At that time he suffered a lot from drought during the dry season and flood during the rainy season. Modern man has developed some measures with recent technology to utilize the surplus water during the lean season by constructing a number of control works such as dams and weirs. Therefore any account of surface water resource estimate is incomplete without a discussion on flow details of the streams. As stated already that the Chittoor District in general, and Madanapalli Taluk in particular is a drought prone area due to its peculiar geographical location in the leeward side of the western ghats and cannot derive the full benefits of the two monsoons that is the southwest monsoon and the northeast monsoon. As the topography of the study area is mostly hilly and undulating with exposed rocky mounds and rocky outcrops, it may be one of the Taluks in the District where there is not much scope for large scale development of surface water resources for irrigation as the rivers of the study area are non-perennial with poor catchment area. Most of the prominent rivers of the study area originate in the hilly tracts in the form of rills and gullies and after the formation of a major river due to the union of a number of tributaries, they flow in the other Taluks of Karnataka state, which is the bordering the Study area

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