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Study of rainfall pattern in Prakasam district of Andhra Pradesh using long term rainfall data

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Abstract

In Prakasam district of Andhra Pradesh out of 57 mandals 15 mandals were selected under APDMP (Andhra Pradesh Drought Mitigation Project) project in Prakasam district. All the fifteen mandals received highest rainfall during the September and October months. During the month of June and July months, where the farmers will sow most of the rainfed crops, less than 50 mm of rainfall was recorded in some mandals. Uneven distribution of rainfall, affect the agricultural production remarkably. However, prolonged dry periods affect the final crop production. Monsoon is an important season for water supplies, from surface reservoir The daily rainfall data was collected for each mandal of Prakasam district for the period of 30 years (1989-2018) and it was to be summed up on meteorological weekly, monthly, seasonally, annual basis for each mandal of Prakasam district basis for the study of rainfall characterization. The results indicated that the normal annual mean rainfall in selected mandals ranged from 504.1 to 747.7 mm. The mean of annual basis total rainfall was ranged between 504.1 mm in Pedaraveedu and 747.7 mm in Marripudi. The weekly highest rainfall on annual basis was recorded in Ardhaveedu (48.2 mm) in the 40th MW and lowest weekly rainfall was recorded in Giddalur (31.0 mm) in the 42 MW. The seasonal distribution of Prakasam district was obtained in winter season (9.2 mm), in summer (69.3 mm), in monsoon (348.02 mm), in post monsoon (239.3 mm). Here, the results indicated that the onset of monsoon was observed in 23th MW and withdrawal in 43rd MW in Prakasam district. It showed that average rainfall of Prakasam district is 679.8 mm with 39.6 rainy days per year.

Keywords: Monsoon, rainfall characterization, rainy days, statistical analysis and Prakasam district.

Introduction

Rainfall is an important weather factor for living entity especially to human being. About 60 per cent of the total cultivable area of the country is rainfed. Being a tropical country, India mainly depends upon the rainfall for the water resources. However, Economy of the nation significantly depends on the agricultural production. In India 70 per cent population lives in rural areas and two third of this population depends on agricultural production comes from rainfed areas. More than 80% of the annual rainfall occurs during the monsoon periods in Andhra Pradesh. Intensity of monsoon rainfall is uneven and erratic both in space and time (Vennila, 2007) [12]. One of the sources of information on climatic-scale is rain gauge observation, which has advantages and shortcomings. Long-term gauge data of particular region can be important source to understand the nature variation of monsoon. Knowledge and understanding of such variability can lead to improved risk management practices in agriculture and other industries. Thus it is essential to analyse the occurrence of rainfall during various seasons for evolving a system to manage the water resources effectively. Prospects of rainfed crops are determined by the times of onset and end of rains, the temporal March of times of occurrence and quantum of rainfall in the rainy season. Primarily rains comes from South-West monsoon rainfall that accounts for the 70 per cent of the annual rainfall over India as where North-East monsoon, pre monsoon and winter rainfall contribute 20, 7 and 3 per cent respectively. Ishappa (2010) [3] has studied the rainfall characteristics of the Coimbatore District, which include the spatial distribution and variability through different seasons. However detailed study on the occurrence and distribution of rainfall in Prakasam District has not been done.

The study includes rainfall variability, commencement and withdrawal of monsoon, sequence of wet and dry spell, length of growing period and probability of rainfall etc. The study of rainfall and their interaction with soil are useful for the places of various management of farm operations like land preparation, preparation of seed bed, manure application, sowing time, fertilizer application, irrigation, harvesting and threshing etc.

The selection of a crop for the zone is based on the rainfall, soil type and climatic condition i.e. rainfall of locality, the probable information about weather condition in adverse is used for planning suitable management strategy to escape of weather (Maniyar *et al.*, 2007) [7]. The present paper analyses the pattern of rainfall distribution over space and time in Prakasam district of selected mandals.

Material and Methods

The Project work on “Study of mandal-wise Rainfall pattern in Prakasam district Andhra Pradesh” was carried out during the period of 2019-20 the Andhra Pradesh Drought mitigation project (APDMP) at Department of agricultural Research Station, Darsi, Prakasam District. The each mandal wise daily rainfall data for Prakasam district of last 30 years (1989-2018) was downloaded from the website of Dept. of Agriculture, Govt. of Andhra Pradesh (Anonymous 2019) [11] for statistical analysis and the collected data of each mandal was summed up on meteorological weekly, monthly, seasonally and annually basis. The year was partitioned into standard meteorological week (MW) as per meteorological calendar, starting from 1st January of each year and ending on 31st December of the same year. Calendar month wise data was processed and tabulated for further analysis. In methodology describes material and techniques used for carrying out present study to suggest crop planning for sustainable agriculture production in any particular district as block level under rainfed condition. The important aspects like onset and withdrawal of monsoon, distribution of monsoon, break in monsoon of Prakasam district we are analyzed by using suitable statistical techniques.

Collection of data

- 1. Meteorological data:** The historical daily rainfall data of selected 15 mandals of Prakasam district under APDMP project for a period of minimum 31 years i.e from 1971/72/79/86/88 to 2018 is collected from Agromet Databank, AICRP on Agrometeorology, ARS, Ananthapuramu. The data is analysed using Weather Cock 1.5 software developed by AICRP on Agrometeorology, ICAR-CRIDA, Hyderabad.
- 2. Processing of data:** The collected data of each mandal was summed up on meteorological weekly, monthly, seasonal and annual basis. The year was partitioned into standard meteorological week (MW) as per meteorological calendar, starting from 1st January of each year and ending on 31st December of the same year. Calendar month wise data was processed and tabulated for further analysis.
- 3. Statistical analysis:** The data collected for each mandal of Prakasam district (*viz.*, Giddaluru, Racherla, Komarolu, Ardhaveedu, Pedaaraveedu, Dornala, Hanumanthunipadu, Pamur, C.S Puram, Donakonda, Podili, Marrisudi, Konakanamitla, Tarlapadu and Mundlamuru etc.) were subjected to statistical analysis such as mean (A), standard deviation (SD), coefficient of Variation (CV), extreme lowest and highest and rainy days (Panse and Sukhatme, 1967) [8].

Annual, seasonal, monthly, weekly rainfall variability

$$\text{Mean (A)} = \frac{\sum_{i=1}^n x/n}{n}$$

Standard Deviation

$$\delta = \sqrt{\frac{\sum (x - y)^2}{n - 1}}$$

C.V. (%) coefficient variation

$$\text{C.V.(\%)} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Where,

x = Annual/Seasonal/Monthly/Weekly rainfall of ith year,

n = Number of year,

\bar{y} = Mean Annual/Seasonal/Monthly/Weekly rainfall

Results and Discussion

Analysed the mandal wise rainfall data using weather cock software. Worked out the Normal weekly, monthly, seasonal, annual rainfall, rainy days and rainy days (CV and SD). Created a what's app group with the APDMP contact persons of the selected mandals and communicating the agromet advisories pertaining to Prakasam district in the group. The historical daily rainfall data of selected 36 mandals of Ananthapuramu district under APDMP project for a period of minimum 31 years i.e from 1971/72/79/86/88 to 2018 is collected from Agromet Databank, AICRP on Agrometeorology, ARS, Ananthapuramu. The data is analysed using Weather Cock 1.5 software developed by AICRP on Agrometeorology, ICAR-CRIDA, Hyderabad. The mandal wise rainfall data is analysed for Normal weekly, monthly, seasonal, annual rainfall, rainy days, year wise weekly, monthly, seasonal, annual rainfall, rainy days, maximum rainfall events, high rainfall events and the variation in rainfall and rainy days (CV and SD). The results of rainfall analysis were given below.

The normal Annual rainfall of Prakasam district is 679.8 mm, major portion of rainfall is received during South West monsoon (61%, 348.02 mm), followed by North East monsoon (28%, 239.3 mm). Summer receives 69.3 mm (10%) rainfall and 9.2 mm rainfall occurs in winter season. In the district, October is the highest (145.09 mm) rainfall receiving month followed by September (106.7 mm) and August (95.4 mm) and January (4.1 mm) receives lowest rainfall. The farmers usually start land preparation with the pre monsoon rains received during the months of May. The predominant sowing season starts from last week of June/1st week of July month, which receives rainfall of 63.4 and 82.4 mm, respectively. The rainfall activity decreases from the 2nd week of November onwards (88.8 mm) and the normal rainfall during the month of December is 19.2 mm. In the selected mandals under APDMP project, the normal annual rainfall received ranges from 504.1 mm (38 rainy days) in Peddaardhaveedu to 747.7 mm (39 rainy days) in 39 mandal (Table 1). The coefficient of variation in annual rainfall is highest in Dornala (49.9%) mandals and lowest in Podili and Marrisudi (28.3%). Out of 15 mandals under APDMP, One mandal receive annual rainfall of less than 500 mm, 8 mandals receive rainfall between 600-700 mm and 6 mandals receive rainfall in the range of 700-750 mm. The winter rainfall in the APDMP mandals ranges from 3.4 mm in Komarolu to 14.8 mm in Chandrasekharapuram. The pre monsoon (summer) rainfall is in the range of 52.1 mm

(Pamur) to 86.5 mm (Marripudi).The south west monsoon rainfall in APDMP mandals is in the range of 278.4 mm (Pamur) to 405.9 mm (Komarolu). All the 15 mandals are receiving rainfall during NE monsoon period, which ranges from 161.4mm in Peddaraveedu to 306.6 mm in Marripudi mandal (Table 1).

Mandal-wise rainfall characterization of Prakasam district

Annual mean rainfall (mm)

The normal annual mean rainfall in the APDMP project mandals ranged from 504.1 to 747.7 mm. Among the operational area of 15 mandals, Pedda Ardhaveedu mandal is received the lowest annual rainfall (504.1 mm) in 38 rainy days, While Marripudi mandal received the highest annual rainfall (747.7 mm) in 39 rainy days. The SD and CV% result of rainfall ranged from 160.37 to 361.67 and 28.39 to 49.95 per cent respectively. The data was given in table (1) showed the annual mean rainfall (normal) 679.8 mm for Prakasam district, while mandal-wise it was for Giddalur (680.7 mm), Racherla (644.7 mm), Komarolu (740.6 mm), Ardhaveedu (702.7 mm), Peddaraveedu (504.4 mm), Dornala (724.0 mm), Hanumanthuni padu (676.6 mm), Pamur (632.4 mm), Chandrasekhara puram (670.3 mm), Donakonda (668.8 mm), Podili (744.1 mm), Marripudi (747.7 mm), Konakanamitla (681.5 mm), Tarlapadu (637.5 mm) and Mundlamuru (741.4 mm) mandal.

Annual mean for rainy days

The data was given in table (1) showed the annual mean rainy days for Prakasam district (39 RD). While, mandala-wise it was for Giddalur (44 RD), Racherla (41 RD), Komarolu ((47 RD), Ardhaveedu (44 RD), Peddaraveedu (38 RD), Dornala (38 RD), Hanumanthuni padu (39 RD), Pamur (34 RD), Chandrasekhar a puram (39 RD), Donakonda (40 RD), Podili (40 RD), Marripudi (39 RD), Konakanamitla (32 RD), Tarlapadu (38 RD) and Mundlamuru (39 RD) mandala.The lowest normal rainy days were observed in Konakanamitla (32rainy days) and highest in Komarolu (47 RD).

Table 1: Normal annual mean rainfall (mm)

S. NO.	Name of the mandals	Annual rainfall (mm)		SD		CV	
		RF	RD	RF	RD	RF	RD
1	Giddaluru	680.72	44.69	207.19	7.7	30.44	17.24
2	Racherla	644.71	41.32	186.07	8.52	28.86	20.61
3	Komarolu	740.64	47.57	258	8.99	34.83	18.91
4	Ardhaveedu	702.7	44.21	243.73	8.41	34.68	19.03
5	Pedda ardhaveedu	504.1	37.96	160.37	9.91	31.81	26.1
6	Dornala	724.06	38.48	361.67	9.9	49.95	25.74
7	Hanumanthunipadu	676.65	39.27	216.49	9	31.99	22.91
8	Pamur	632.45	34.52	228.28	9.06	36.1	26.24
9	Chandrasekarapuram	670.35	39	209.6	8.97	31.32	23
10	Donakonda	668.84	40.04	190.99	8.56	28.55	21.38
11	Podili	744.19	40.77	211.28	8.84	28.39	21.68
12	Marripudi	747.71	38.87	212.29	8.09	28.39	20.81
13	Konakanamitla	681.51	32.77	252.4	11.5	37.03	35.1
14	Tarlapadu	637.54	37.93	230.8	10.12	36.2	26.69
15	Mundlamuru	741.42	38.9	276.21	10.22	37.25	26.26

Seasonal mean rainfall (mm)

A year has been divided into four seasons namely winter, summer, South West monsoon and North East monsoon. Winter season has two months January and February, summer season starts in March and ends in May, South West monsoon starts in June and runs up to the end of September and North East monsoon starts in October and ends in December. South West monsoon is the longest season with four months and this is the season in which India receives majority of its rainfall followed by North East monsoon. The APDMP mandals was received seasonal rainfall recorded during winter period (Jan-Feb) was 9.29 mm with 0.58 rainy days, Whereas during summer period (Mar-May) was 69.39 mm with 3.92 rainy days. The normal seasonal rainfall was 679.86 mm of rainfall and 39.6 rainy days. The APDMP project mandals received 348.02 mm of rainfall in 23.05 rainy days during South West monsoon (Jun-Sep). While 239.33 mm rainfall received in 12.13 rainy days during North East monsoon (Oct-Dec).

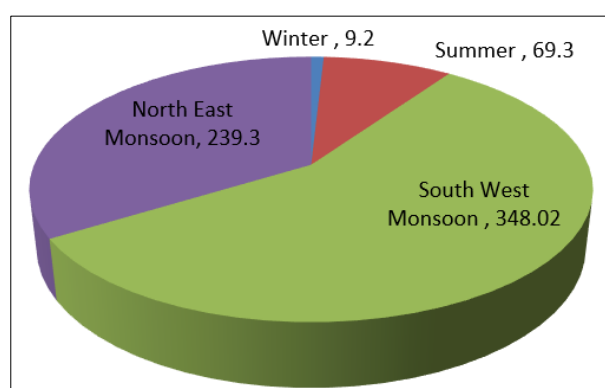


Fig 1: Seasonal rainfall distribution in APDMP mandals

The normal winter seasonal rainfall of the APDMP project mandals ranged from 3.46 mm to 14.88 mm. Among the operational area of 15 mandals, Komarolu received the lowest winter seasonal rainfall (3.46 mm), Whereas Chandrasekharapuram received the highest rainfall (14.88 mm) with same season. The normal summer seasonal rainfall of the APDMP project mandals ranged from 52.61 mm to 86.5 mm. Among the operational area of 15 mandals, Pamur received the lowest summer seasonal rainfall (52.61 mm), Where as Marripudi received the highest rainfall (86.5 mm) with same season.

The normal southwest seasonal rainfall of the APDMP project mandals ranged from 278.44 mm to 405.93 mm. Among the operational area of 15 mandals, Pamur received the lowest southwest seasonal rainfall (278.44 mm), Where as Komarolu received the highest rainfall (405.93 mm) with same season.

The normal northeast seasonal rainfall of the APDMP project mandals ranged from 161.43 mm to 306.62 mm. Among the operational area of 15 mandals, Peddaraveedu received the lowest northeast seasonal rainfall (161.43 mm), Where as Marripudi received the highest rainfall (306.62 mm) with same season.

Table 2: Seasonal mean rainfall distribution in APDMP mandals

Name of the mandals	Winter	Summer	South West Monsoon	North East Monsoon
Giddaluru	5.89	60.34	384.77	229.72
Racherla	6.94	57.09	373.46	207.22
Komarolu	3.46	72.35	405.93	258.9
Ardhaveedu	5.73	61.5	404.76	230.72
Pedda ardhaveedu	5.51	55.57	281.59	161.43
Dornala	7.69	77.71	365.08	273.58
Hanumanthunipadu	7.01	78.73	339.85	251.07
Pamur	11.57	52.61	278.44	289.82
Chandrasekarapuram	14.88	64.85	288.2	302.43
Donakonda	8.57	73.61	378.19	208.48
Podili	12.77	80.09	346.17	305.16
Marripudi	13.71	86.5	340.88	306.62
Konakanamitla	11.44	77.2	324.02	268.85
Tarlapadu	10.24	67.88	314.03	245.38
Mundlamuru	13.95	74.86	395.01	257.61

Monthly mean rainfall

In the present APDMP project report, maximum efforts have been made to update the monthly rainfall data of 15 mandal stations for the period from 1989 to the recent available up to 2018. Monthly normal rainfall in the APDMP project ranged from 4.10 mm to 145.09 mm. Among the operational area of 15 mandals, the total mean monthly normal rainfall received was 679.85 mm with 39 rainy days. The distribution of monthly normal rainfall highest frequency of occurrence was in October (145.09 mm) and percentage distribution of normal months varied from 4.10 to 145.09 mm rainfall shown in below fig (2). The January received the lowest rainfall of 4.10 mm. Monthly normal rainfall between 10-50 mm

available for 6 months January, February, March, April, May, December where as June, July, August, September, October, November months have been receiving rainfall between 51-150 mm. The mandala wise data of monthly mean rainfall for the study period (i.e.1989-2018) of Prakasam district observed data indicated that the lowest and highest monthly mean rainfall amongst all the mandala was observed in January (4.1 mm) in the October month received (145.09 mm). The mean monthly rainfall gradually increased generally from January onward and received peak in October which there after decreased and it was minimum in month of January (Chakraborty and Mandai., 2008.) [2].

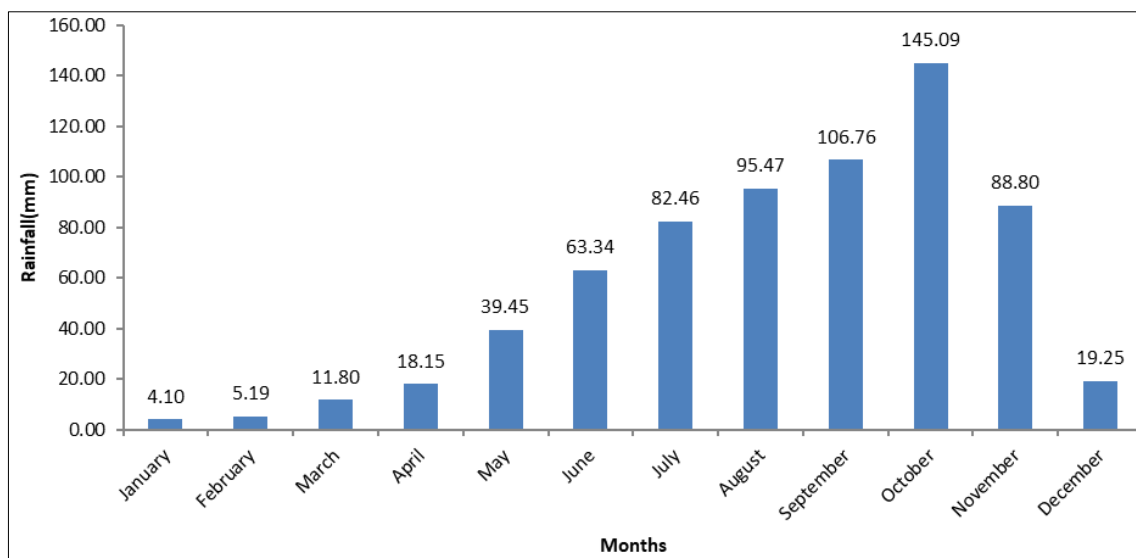


Fig 2: APDMP project mandals monthly rainfall

Normal mean weekly rainfall (mm)

The weekly mean annual basis total rainfall was ranged between 504.1 mm (Peda araveedu) and 744.7 mm (marripudi). The weekly highest rainfall on annual basis was recorded in Ardhaveedu (48.2 mm) in the 40th MW and lowest in Giddaluru (31.0 mm) It was observed that mandal wise highest weekly mean rainfall was 31.0 mm in (42th MW), 42.5 mm (40th MW), 43.2 mm (40th MW), 48.2 mm (40th MW), 41.0 mm (40th MW), 46.0 mm (40th MW), 38.0 mm (42th MW), 47.0 mm (37th MW), 35.0 mm in (40th MW), 38.8 mm (39th MW), 44.3 mm (40th MW), 44.0 mm (40th MW), 42.0 mm (44th MW), 41.0 mm (41th MW), 45.3 mm

(42th MW), in Giddaluru, Racherla, Komarolu, Ardhaveedu, Pedaarveedu, Dornala, Hanumanthunipadu, Pamur, C.S puram, Donakonda, Podili, Marripudi, Konakanamitla, Tarlapadu and Mundlamuru Mandals respectively.

Normal of annual mean rainfall (mm)

The data of mandal-wise annual normal of weather parameter (i.e. rainfall and rainy days) calculated by using last 30 years (1989-2018) rainfall data of Prakasam district (mandal-wise). The normal annual mean rainfall in the APDMP project mandals ranged from 504.1 to 747.7 mm. Among the operational area of 15 mandals, Pedda Ardhaveedu mandal is

received the lowest annual rainfall (504.1 mm) in 38 rainy days, While Mairipudi mandal received the highest annual rainfall (747.7 mm) in 39 rainy days. The SD and CV% result of rainfall ranged from 160.37 to 361.67 and 28.39 to 49.95 per cent respectively. These results are in conformity with Maniyar *et al.* (2007)^[7].

Conclusion

The data of mean seasonal rainfall during 1998-2018 of each mandal in Prakasam district the statistical analysis for seasonal rainfall variability showed that within the year season to season in Prakasam district. it means that Prakasam district received maximum rainfall in monsoon season (i.e. *kharif* season) and thereafter in post- monsoon (i.e. *Rabi* season). Hence, this region comes under assured *kharif* season and also useful to *rabi* season to cultivate the crops. The information on different aspects of rainfall pattern of each mandal of Prakasam district will be helpful for suggesting agricultural cropping plans to the farmers.

The monthly rainfall analysis of the selected 15 mandals of the project reveals that, in all the mandals October is the highest rainfall receiving month. All mandals follow the similar trend as that of the district in case of lowest rainfall receiving months (January/February). The onset of SW monsoon occurs during the 1st week of June in normal years. June month rainfall ranges from 63.3 mm. The thumb rule to take sowing of rainfed crops is 50 mm accumulated rainfall after onset of monsoon. Among the 15 APDMP mandals, some mandals receive 50-75 mm rainfall and remaining mandals receives less than 50mm rainfall, where sowing of rainfed crops is risky as the rainfall is insufficient for sowing. One has to follow the rainfall forecast and normal weekly rainfall, its dependability and start of growing season before taking up sowing. July is the predominant month for sowing of all rainfed crops in Prakasam district. Hence, there is a need to create awareness among farmers, to well utilize the sowing rains received during this month and complete sowing of rainfed crops as quickly as possible by adopting mechanized sowing.

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