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Identification of Droughts in Anantapur District Using DBMS Approach

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ABSTRACT: The agricultural productivity depends upon chiefly the occurrence and distribution of rainfall in a particular region. But due to non-uniform distribution of rainfall and prolonged dry spells during monsoon season and crop period, the dry land agriculture in arid and semi arid regions is becoming difficult. The identification of dry spells and wet spells to find out drought occurring conditions are complex because of the fact that, it requires analyzing the vast hydrological data in a systematic order. Anantapur is one of the drought-affected districts in Andhra Pradesh. Due to prolonged dry spells and ill distributed rainfall the district under went a metamorphosis from drought to desert prone area. Keeping this in view, the present study is carried out to identify the droughts in Anantapur district by analyzing the daily rainfall and evaporation data for a period of 21 years from 1979–2000 by the application of DBMS approach by developing programs using Microsoft Visual FoxPro Software. From the data analysis, dry days, dry spells, wet days, wet spells, monthly, seasonal and annual rainfall, driest and wettest months were obtained. The interpretation of the results yields that it is possible to identify the likely hood of occurrence of dry spells and wet spells. The onset of monsoons was late and consequently the late sowing of crops which results in crop failure. The identification of dry spells is therefore helpful in agricultural planning, reservoir operations, releasing of water to canals for irrigation and for planning Cloud seeding operations.

INTRODUCTION

Meteorology as well as Hydrology are concerned with the atmospheric and land phases of hydrologic cycle with the emphasis on the interrelationship involved. The water resources of a region mainly depends upon the precipitation, which in turn depends upon the meteorology parameters such as temperature, evaporation etc., where as industrialization, deforestation and modern living leading to the phenomenon called global warming. The warming of the earth's surface could cause large scale climatic changes, especially affects rainfall pattern, which greatly alters both agriculture and natural vegetation. World wide decrease in forest area is also affecting the climate, which has direct physical affects on water balance of the earth by altering the temperature, monsoon pattern and thus affecting agricultural production. Water is one of the Nature's wonderful and most precious gift to the earth, the most crucial for sustaining life and is required in almost all the activities of man. All the civilizations have flourished along the water bodies in the world. Water is the fundamental basic need for sustaining human economic activities. Providing water in the desired quantity and quality, and at the right time and place, has been a constant endeavor of all civilizations, and no other natural resource has had such an overwhelming influence on human history and life. As the human population increases, as people express their desire for a better standard of living, and as economic activities continue to expand in scale and diversity, the demand on fresh water resources will continue to grow. However, the water resources in a region are limited considering the future demands. Moreover, the rainfall is confined to the monsoon season and is unevenly distributed both in space and time even during the monsoon season. Hence the conservation and use of water therefore, forms one of the main elements in the development planning.

STUDY AREA

Anantapur District is the study area, which is one of the drought-affected areas of Andhra Pradesh, located in the middle of the peninsular India, which renders it the driest part of the state. Being far away from the East coast, it does not enjoy the full benefits of South West monsoon. Being cut off by the high Western Ghats, the North East monsoon is also prevented from penetrating and quenching the thirst of these perched soils. It is therefore seen that, the entire area of Anantapur district is deprived of both the monsoons and is subjected to frequent droughts. The predominant causes for drought are undependable and ill distributed

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rainfall with prolonged dry spells between successive rains during the crop period, intensive wet spells of short duration causing soil erosion, and no significant perennial water resources in the district. These causes have resulted the district to undergo a metamorphosis from a drought to desert prone area. The district falls between the Northern latitudes of 13° 04′ and 15° 15′ and Eastern longitudes of 76° 50′ and 78° 30′. The normal annual rainfall in the district is 520 mm where as the normal rainfall of Andhra Pradesh as a whole is 925 mm. The number of rainy days on an average in a year is only 36. The normal rainfall during the South-West monsoon (June to September) is 296 mm which forms about 57% of the total rainfall for the year. The rainfall during North-East monsoon (October–December) is 140 mm which forms 27% of the rainfall for the year. Some times, intense storms occur even in the drier regions because of severe cyclonic activity in the Bay of Bengal. The gross cultivated area is only 55% of the total geographical area (19163 Km^2), while the average area cultivated more than once is only 6% of the total area. The percentage of the gross irrigated area both from surface and ground water to the culturable area works out to be only 11.7%, which is very low. Ground nut and Sunflower are the major crops grown in dry land agriculture in Anantapur district. Owing to prolonged dry spells, the yield of the crop is greatly reduced, resulting in the weak economic position of the cultivators in this area.

NECESSITY OF THE STUDY

The identification of dry spells and wettest months is helpful in crop planning, pre and post agricultural activities in Semi-arid areas such as Anantapur District. After the estimation of the likely hood of occurrence of prolonged dry spells, it is possible to select the type of crops that are to be raised in a particular area, which can with stand the moisture stress. Sufficient moisture is necessarily required for the crop, during the critical periods. The critical periods may vary from one crop to other. Unless the required water is not supplied, the crop starts wilting. If the prolonged dry spells occur during the critical stages of crop, then the crop will not be able to survive and results in decrease in the yield, even after sufficient rainfall occur after reaching the ultimate wilting point of the crop. This is because of the greater moisture stress to the plant. In such situations, the knowledge of likely hood of occurrence of dry spells will greatly help to protect the crop from wilting, by supplying the minimum moisture required for the survival of the crop. This can be achieved by following various methods even in dry land agriculture, such as construction of farm ponds and utilizing the stored water using modern methods of application of water to the crops. The identification of wet spells is very much helpful in reservoir operation and planning and for releasing water to the canals for irrigating crops and for planning and carrying out cloud seeding operations.

OBJECTIVES OF THE STUDY

The Various Objectives of the study are:

1. Identification of Droughts in Anantapur district by analyzing the daily rainfall and evaporation data for a period of 21 years.
2. Analysing data by the application of DBMS approach using Microsoft Visual FoxPro software and obtaining Dry spells, Wet spells, Driest months and Wettest months and classify Dry spells.

LITERATURE REVIEW

Rainfall pattern can be represented in two ways namely trend and cycles. Cycles refer to the natural variation while trend refers to man induced pattern such as increasing or decreasing. Topography plays an important role on Indian rainfall. The Western Ghats and North Eastern mountain ranges are monumental examples. Colaba rainguage station and Santacruz rainguage station within Mumbai show an increasing trend in rainfall with Santacruz rainfall higher than Colaba rainfall by about 300 mm, which may be due to cutting of hillocks in wind ward direction of S-W monsoon on the Eastern and North Eastern side of Santhacruz observatory on the runway (Jeevananda, 2000). The geographical position of Anantapur District in Andhra Pradesh is in the middle of the peninsular India, located in the rain shadow region and the leeward side of Western Ghats, renders it the driest part of the state with a normal annual rainfall as low as 520 mm, the second lowest in India after Jaisalmair of Rajastan (K.V.M. Rao, 2002). Crop production under rain fed conditions in the arid and semiarid regions is often affected by droughts during the monsoon season because of prolonged dry spells associated with break monsoon conditions. Some times, heavy rainfall occurs even in the drier regions because of severe cyclonic activity in the Bay of Bengal. In Anantapur, the maximum amount of rainfall received during a wetspell was more than 100 mm even during the years with seasonal rainfall of about 250 mm, although it was less than 100 mm in most cases during the years with seasonal rainfall of up to 450 mm. During the years with seasonal rainfall exceeding 450 mm a single wet spell can contribute more than 150 mm to seasonal

rainfall. Rainfall of more than 250 mm during a wet spell was observed in the early part of the season (July–August) during the years with seasonal rainfall exceeding 600 mm (Singh J.B *et al*,). Though the crop loss due to unfavourable rainfall cannot be avoided fully, it can be minimized with the accurate and timely weather forecasting. Medium range (3–10 days) forecasts are greatly helpful to the agriculture for taking decisions and implementing the same. (Krishna Murthy S.K. *et al.*, 1949). Out of 14 famine occurrences, Anantapur district experienced as many as 11 times. The trend of famine in the district evidently indicate that the southwestern part of the district is recurrently subjected to famine compared to Northern and Eastern parts of the District. Ananthapur area is one among the south-western parts of India subjected to famine 10 times (Baburao *et al.*, 1999). Dry spell and Wet spell water availability index is calculated using threshold values of weekly rain fall and probability of dry spells over three weeks and Agro climatic classification was carried out for assessment of the crop potential of Karnataka state in India (Khambate, 1992).

DATA BASE MANAGEMENT SYSTEMS (DBMS)

A Database Management System (DBMS) is a software designed to assist in maintaining and utilizing large collections of data. Data Base Management System consists of a collection of interrelated data and efficiently to use in retrieving and storing information for the manipulation. A DBMS provide users with an abstract view of the large data. A database is a collection of data, typically describing the activities of one or more related events. For example the hydrological database might contain information about the following:

1. Entities such as rainfall, evaporation, humidity, temperature, wind, velocity.
2. Relationships between entities such as rainfall, evaporation and humidity.

A DBMS allows a user to define the data to be stored in terms of data model, which is a collection of high level data description constructs that hide many low level storage details. A database system provides two different types of languages one to specify the database schema and the other to express database queries and updates. The relational data model is based on a collection of tables. The user of the data base system may query these tables, insert new tables, delete tables and update (modify) tables. The overall design of the database is specified by a set of definitions that are expressed by a Data-Definition Language (DDL). A Data-Manipulation Language (DML) is a language that enables users to access or manipulate data. There are several languages for expressing these operations numerous relational—data base products are now commercially available. Data base products for personal computers include MS Access, D-base and Microsoft Visual FoxPro.

METHODOLOGY

General

In the present study, daily rainfall and evaporation data for Anantapur District for a period of 21 years from 1979 to 2000 was obtained and analysed using Microsoft Visual FoxPro software employing personal computer.

CALCULATION OF DRY SPELLS AND WET SPELLS

Dry Day and Dry Spell

In order to calculate the dry days the daily rainfall and evaporation amount in mm were taken in to consideration. The condition for a dry day in that if

Rainfall (mm) $\leq$ evaporation (mm)

If there are more than three dry days occurred successively, then the entire period is considered as dry spell. The dry days (d.d. count) and the dry spells were calculated between 1st March (as starting date) of a particular year and 28th of February (as ending date) of the next year as the Rabi season end with February normally. In leap year 29th of February is considered as ending date.

Wet Day and Wet Spell

The condition for a wet day is that if

Rain fall (mm) > Evaporation (mm)

If there are one or more wet days occurred successively, then the entire period during which the above condition is satisfied was considered as wet spell. The wet days (w.d. count) and the wet spells were calculated between the starting date (1st January) and the end (31st December) of a particular year.

APPLICATION OF MICROSOFT VISUAL FOX PRO SOFTWARE

Analysis of daily rainfall and evaporation data for a period of 21 years from 1979 to 2000 can be done by application of data base management system approach by developing programs using Microsoft Visual FoxPro

Software. Programs are written in Visual FoxPro to display main menu, data entry screen, dry days and wet days, identification of dry spells, wet spells and displaying Answer table. Various FoxPro display Screens are shown in Figures 1 to 4.

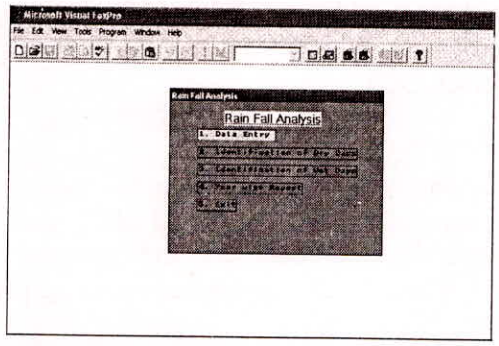

Fig. 1: Microsoft Visual FoxPro Main Menu Screen

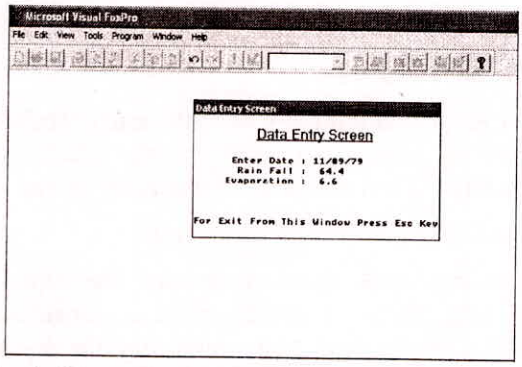

Fig. 2: Microsoft Visual FoxPro Data Entry Screen

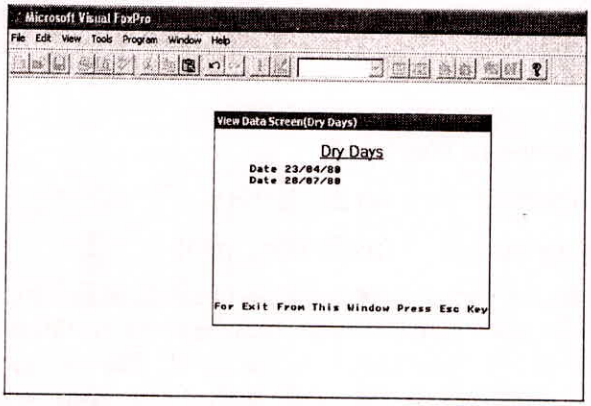

Fig. 3: Microsoft Visual FoxPro View Data Screen for Dry Days

ANALYSIS OF DATA

Dry Days and Dry Spells Analysis

Dry days and Dry spells were computed by analyzing the data with Microsoft Visual FoxPro Software. The dry days and dry spells greater than 3 days duration were computed. It was indicated that, on an average about 14 days spells were occurred per year. The minimum number of dry spells were 10 during 1994–95 and the minimum number of drys spells were 18 during 1983–84. It was also observed that, the dry spell having maximum duration i.e 122 days was occurred during Rabi Season in 1995–96. Mostly the dry spells having greater than 60 dry days were occurred during Rabi Season in almost all the 21 years period of study. During monsoon season i.e from July to November, the maximum dry spell having 65 days duration was occurred in 1989–90. During hot weather season, the maximum dry spells with more than 90 days duration were occurred in 1984, 1986, 1990, 1991, 1992, 1993.

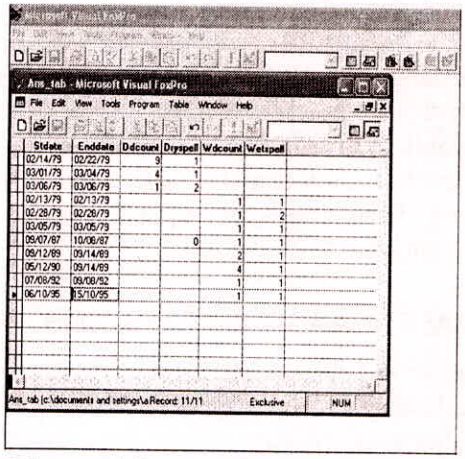

Fig. 4: Microsoft Visual FoxPro Answer Table Screen

Wet Days and Wet Spells Analysis

Wet days and Wet spells were computed by analyzing the data with Microsoft Visual FoxPro Software. It was observed from the above results of wet days and wet spells that mostly one day duration wet spells were occurred in all the 21 years period of study. The wet spell having maximum duration i.e 7 days was occurred during the August Month in 1988. The number of wet spells was varying from minimum of 10 in 1980–81 to maximum of 23 in 1996–97. The number of wet days per year were varying from 15 to 35 and on an average, the number of wet days were 23 per year. The average number of wet spells per year was worked out to be 18. The number of wet days were minimum of 15 in 1980–81 and maximum of 35 in 1988–89.

Monthly Dry Days and Wet Days Analysis

The monthly dry days and monthly wet days during South West and North East monsoon seasons starting from July to November for the period of 21 years from 1979–2000 were obtained from the analysis. It is

indicated that, September and October were the wettest months. This indicates that the maximum number of wet days were occurred in September and the minimum number of wet days were occurred in June.

Monthly and Seasonal Rainfall Computation and Analysis

The monthly and seasonal rainfall were calculated from the daily rainfall data for a period of 21 years from 1979 to 2000.The careful observation of the data reveals that, most of the rainfall events in Anantapur district occurred during monsoon season from July to November. In the 21 years rainfall data, the highest was 937.0 during 1998 and the lowest was 223.0 in 1980. The average annual rainfall at Anantapur district was worked out to be 547.5 mm. The average monthly rainfall over a period of 21 years indicated that the highest rainfall of 127.6 mm occurred in September.

Computation and Analysis of Year Wise Dry Days, Wet Days and Total Rainfall

The yearly Dry days, Wet days and the Total rainfall were calculated. The results indicates that, when the number of wet days are less than 22, the amount of rainfall is also less than the average annual rainfall (547.5 mm) except in one or two cases over the 21 years period of study. When the number of rainy days are greater than or equal to 30, the annual rainfall amount was greater than or equal to the average annual rainfall and the rainfall was distributed in all the monsoon months. During such periods the agriculture yield was not much affected.

Dry Spells Classification

The number of dry spells of different duration's during monsoon period over the 21 years period of study and the total number of dry spells greater than 10 days duration was obtained.

The dry spell duration was classified into five categories such as, Cat. 1:10 to 20 days, Cat. 2: 21 to 30 days, Cat. 3: 31 to 40 days, Cat. 4: 41 to 50 days and Cat. 5: greater than 50 days.

The maximum number of dry spells (> 10 days) were maximum i.e 8 in 1982–83, 85–86 and 92–93 and the corresponding rainfall was 604.3, 404.4 and 433.8 respectively. The number of dry spells (> 10 days) were minimum i.e 3 in 1979–80 and in 1988–89 and the corresponding rainfall was 610 and 927.6 mm respectively.

COMPUTATION AND ANALYSIS OF DRIEST AND WETTEST MONTHS DURING 1979–2000

The interpretation of the results from the above tables, the months with maximum number of rainy days and maximum number of dry days were calculated and tabulated in the Table 1. It can be noted from the above table that in 15 years out of 21 years, September was seen to be the wettest month and the next was October. The driest months were June and July in 15 years out of 21 years. From the statistics of the rainfall data and from the interpretation of the results, it was observed that the onset of monsoons were late in almost all the years over the period of study, due to which the sowing of crops was not done with in the correct time, resulting in reduction of yield. It was also observed that the annual rainfall was even less than the normal annual rainfall in most of the years and once in four years, the annual rainfall exceeded the normal annual rainfall, resulting in drought conditions prevailing in Anantapur district. Because of the number of rainy days which are also non uniformly distributed during the S-W and N-E monsoon period, and the prolonged dry spells during monsoons, the yield of crops were affected and this has resulted in frequent droughts in Anantapur district.

CONCLUSIONS

It was observed that the onset of monsoons were late in almost all the years during the period of study and consequently the late sowing of crops which results in decrease in yield. It can be concluded that, the annual rainfall was even less than normal annual rainfall in most of the years and once in four years, the annual rainfall exceeded the normal annual rainfall over the 21 years period of study, which results in drought conditions prevailing in Anantapur district. It was also concluded from the analysis that when ever in a particular year, the annual rainfall is less than the normal annual rainfall, wet days are less than 23, dry spells are more than 5 during monsoon season and the dry spells with more than 30 days duration occurs during June, July and August, then it can be identified as drought year.

The average numbers of rainy days were less than 30 days and which are also non-uniformly distributed during the S-W and N-E monsoon resulting in prolonged dry spells to occur in Anantapur district. The knowledge of likely hood of occurrence of dry spells will greatly help in protection of crop from wilting by supplying minimum quantity of stored water from farm ponds, check dams etc., using modern

Table 1: Driest and Wettest Months during 1979–2000

Year	Total Rainfall (mm)	No. of Rainy Days (Wet days)	No. of Dry Spells > 10 Days Duration	Max Wet Days Months	Maximum Dry Days Months
1979–80	610	23	3	Sept., Nov.	June, July, Aug.
80–81	223	15	6	Sept, Nov.	June, July, Aug.
81–82	526.7	32	5	Sept, Nov.	June, July, Aug.
82–83	604.3	28	8	Sept, Nov.	Aug.
83–84	665.5	30	6	Aug., Sept.	July, Nov.
84–85	273.2	18	5	July, Oct.	June, Aug., Nov.
85–86	404.4	28	8	July, Sept., Oct.	July, Aug., Nov.
86–87	423.5	19	5	Sept., Oct.	July, Nov.
87–88	505.5	19	6	Aug., Oct.	July, Sept.
88–89	927.6	35	3	July, Sept.	June, Nov.
89–90	826.0	25	7	July, Sept.	Aug., Oct., Nov.
90–91	539.6	26	5	Aug., Oct.	July
91–92	433.8	19	6	June, Oct., Nov.	July, Aug.
92–93	498.7	25	8	Sept., Oct., Nov.	June, Aug.
93–94	699.6	32	7	Aug., Sept., Oct.	June, July
94–95	395.1	19	4	Oct., Nov.	July, Aug., Sept.
95–96	762.5	24	6	Aug., Oct.	June, July
96–97	853.9	32	4	June, Sept., Oct.	Aug, Nov.
97–98	502.4	17	5	Sept.	July, Oct., Nov.
98–99	937.0	25	5	Sept, Oct.	June
1999–2000	472.6	21	7	Aug, Sept.	June, July

methods of application of water. The identification of dry spells and wettest months will be helpful in crop planning and in pre and post agricultural operations. The identification of dry spells is therefore helpful in agricultural planning, reservoir operations, releasing of water to canals for irrigation and for planning Cloud seeding operations.

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