PROBABLE MAXIMUM PRECIPITATION (PMP) OVER THE KRISHNA RIVER BASIN BY STATISTICAL METHOD

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A Report Submitted to :

Central Water Commission, New Delhi, India

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APRIL, 2005

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1. Background

The work of preparation of generalized Probable Maximum Precipitation (PMP) Atlas over the Krishna river basin has been awarded to the Indian Institute of Tropical Meteorology, Pune by the Hydrology Study Organization (HSO), Central Water Commission (CWC), New Delhi under the Dam Safety and Rehabilitation Project. As per the work plan under this project, the generalized PMP Atlas will be prepared for the entire Krishna basin and its different sub–catchments based on the statistical as well as the physical methods, following hydrometeorological practices as per the guidelines contained in the Manual for Estimation of PMP, WMO Tech. Note No. 332 (1986), as applicable to Indian conditions. The present report highlights the PMP estimates and return periods analyses by Statistical Methods over the entire Krishna basin based on the long period daily rainfall data of 570 stations with varying length of records from 50–102 years (1901–2002) that are well distributed in and around the basin.

2. Introduction

Dams, barrages and other hydraulic structures across the rivers must be designed and built to withstand maximum floods that can occur at a site. Earlier, design floods used to compute by using various empirical formulae. Unavailability of long–term and reliable discharge data at the proposed dam site or water reservoir structure results in more dependency on rainfall data. Considerable amount of input in terms of data, experiences and resources are required to derive PMP values for any hydraulic structure which pose potential hazards to the downstream areas if failed. PMP can be thought of as a reasonable upper limit of the rainfall that could be anticipated and is the key design rainfall input to the calculation of Probable Maximum Floods (PMF). If a spillway is not able to safely release the PMF, breaching of the dam wall due to overtopping can occur and cause heavy loss of lives and damages to property.

The PMP concept is based upon the hypothesis that the rainfall results from the simultaneous occurrence of a storm of higher efficiency together with maximum moisture available (Paulhus and Gilman, 1953; Gibbs, 1958; USWB, 1960; Wiesner, 1970). The term generalized, in the sense of its use here, is to describe a study that covers a broad region involving numerous drainages. The primary advantages of generalized studies are to be found in the consistency when determined over a large area which can be used for one drainage versus another.

The techniques used to estimate PMP depend on the rainfall data available and may vary with catchment size and location, as well as with the meteorological conditions responsible for causing extreme rainfall over the catchments of interest.

A large number of hydrometeorological studies are available on different aspects of Indian rainfall including the estimation of PMP by statistical method over different regions of India and over some of the river basins upto certain dam sites only. However, such PMP studies for all the sub–basins over a major river basin in India are lacking. Statistical method used for estimating PMP at a point station or an area is based upon the assumption that information regarding extreme rainfall is contained in the long rainfall records of that station/area. Statistcal methods are also widely used by many research workers to analyse long period rainfall data in order to arrive at the estimates of maximum rainfall magnitudes for various durations and return periods over a region / river basin.

Keeping in view the above facts, the present report is intended to deal with the preparation of Generalized PMP maps and return periods analyses for the entire Krishna river basin in Peninsular India by statistical method.

3. Physiograhic features of the Krishna basin

The Krishna and its tributaries form an integrated drainage system in the central portion of the Peninsular India (See Fig.1). The Krishna river rises near Mahabaleshwar at 1360 m a.s.l. in the Western Ghats (Rao, 1975). The drainage area of the basin is 2,58,948 km^2 of which 26.8% lies in Maharashtra, 43.8% in Karnataka and 29.4% in Andhra Pradesh.

The basin drains a length of approximately 700 km of the Western Ghats which is the predominant source of water of the river. As the river flows about 135 km from its origin near Mahabaleshwar hills, it is joined by the Koyna river flowing from the western side of the same hill. Further along its course it is joined by tributaries like the Varna, the Panchganga and the Doodhganga draining about 150 km of the Western Ghats. As the river emerges from the eastern slopes of the Western Ghats, it is joined by the Ghataprabha and the Malaprabha from the south at a distance of approximately 500 km from the origin.

After traversing the Deccan Plateau, the east flowing Krishna then enters the alluvial lands and at a distance of about 800 km from the source, just before it enters Andhra Pradesh, a major tributary of it, i.e. the Bhima, draining the Western Ghats, north of Mahabaleshwar joins it from the north. Near Kurnool the river is joined by another major tributary, the Tungabhadra, from the south, draining a major section of the Western Ghats in Karnataka. Within a short distance from this confluence, the river enters the Naliamali Ranges characterised by deep gorges. Tributaries like Dindi, Musi, Palleru and Muneru draining the dry north–eastern parts of the basin join the river between Srisailam dam and Vijayawada but do not add much water. After flowing eastwards from the origin for about 1400 km, it falls into the Bay of Bengal near Masullipatnam. The important tributaries of the Krishna river are the Bhima, the Musi, the Munera, the Koyna, the Varna, the Ghataprabha, the Malaprabha and the Tungabhadra (see Fig.2).

A large number of water resources projects have been constructed in the Krishna basin for impounding huge volumes of water for hydroelectric power generation and for irrigation needs. The major projects over the Krishna river basin are as follows :–

i) Koyna, ii) Malaprabha, iii) Ujjani, iv) Tungabhadra,
v)Almatti, vi) Narayanpur, vii) Srisailam, viii) Nagarjunasagar.

The entire Krishna river basin has been divided into 5 sub–catchments (No. 306 to 310) considering the orography and rainfall climatology of the region (See Fig.2) so that the estimates of PMP and maximum rainfall of different return periods and durations obtained by statistical analyses can be presented properly in this report.

4. Rainfall data used for the analysis

Daily rainfall data of all the available stations in and around the Krishna basin have been procured up to their latest available years from the following sources :–

a) National Data Centre (NDC), India Meteorological Department (IMD), Pune,
b) Rainfall data available with the Hydromet. Group of IITM, Pune,
c) State Rainguage Authorities ,
d) Drought Monitoring Cell, Bangalore,
e) National Climate Data Centre (NCDC), NOAA and
f) Water Resources Division, Maharashtra.

4.1 Quality Control of the Data :

After procurement of daily rainfall data from different sources, they were subjected to extensive quality control tests to remove gross errors, archival errors, reformatting problems, etc. as follows :–

a) Flagging off the data that fall outside of broad error specifications, and
b) Checking of the data against a narrower range of error specifications and those that fall outside this range generate an error alert message.

However, questionable data were not automatically removed. Rather, for each error alert, the suspected data were checked for validity from different reliable sources.

Data quality control procedures adopted in the present report are summarized as follows :–

1. Data procured from various agencies were first arranged in an uniform format and
2. The daily rainfall data have been further subjected to quality check to remove the outliers in the data sets using extreme rainfall series. All the daily extreme rainfall values for individual stations that differ from their corresponding long–term means by more than 5 σ (as extreme rainfall series are + vely skewed) were listed and manually examined. Spatial patterns of Coefficient of Variations (Cvs) were also considered to compare the variability in extreme rainfall of neighbouring stations to determine whether they can be considered

as outliers. Whether such values can be treated as an outliers or not are also determined by examining the synoptic situations of that day. The outliers so identified are flagged off as missing values and appropriate care has been taken for further computations.

On the basis of the above, data set of 570 long period (1901–2002) (with varying lengths) stations uniformly distributed in and around the river basin and having 80% availability of daily rainfall data for a year were considered for this report. Stations with data period more than 30 years have been used for estimating climatological features of rainfall for the basin.

It was seen that there is a good network of rainfall stations in and around the Krishna river basin. Fig.3 shows schematic diagram showing number of stations in and around the Krishna basin whose data has been considered in the present report. The sub–catchmentwise distribution of these stations falling in three states of Maharashtra, Karnataka and Andhra Pradesh is shown in Fig.4. Time series plot of the above 570 stations is shown in Fig.5. It is seen from this figure that the length of records for maximum number of stations was found to be good for the period 1955 to 1995. It is also seen that stations over most of the sub–catchments of the Krishna basin have data records for at least 50 years. On an average, 20 stations in each of these sub–catchments have 90 to 100 years data.

5. Rainfall climatology of the Krishna basin

5.1 Meteorological situations responsible for causing heavy rainfall

The Krishna catchment is bounded on the west by mountains of the Western Ghats which exerts a profound influence on rainfall over the basin. During the southwest monsoon season (June to September), the monsoon winds from the Arabian Sea are intercepted by mountain ranges of the Western Ghats producing very heavy rainfall over the mountainous part of the basin than over the plateau to the east. The heavy rainfall received by the basin during the monsoon months is mostly caused by the following meteorological situations :–

1. Monsoon depressions / cyclonic storms after originating in the head Bay of Bengal and crossing the eastern coast of the country move in west to northwesterly direction. These

disturbances cause heavy to very heavy falls of rain along and near their tracks. Heavy rainfall is generally found to occur in the southwest quadrant of these disturbances,

2. Westward or west–northwestwards movement of low pressure areas and upper air cyclonic circulations particularly between 700 hpa and 500 hpa,
3. Position and strength of the axis of the seasonal monsoon trough, especially when it is south of its normal position, north peninsular region receives heavy to very heavy rainfall and
4. North–south oriented trough in the lower /middle troposphere.

However, the conditions in the interior of the basin are somewhat unfavourable for heavy rainfall except in association with the depressions from the Bay of Bengal.

5.2 Seasonal and annual rainfall

The southwest monsoon normally advances over the Krishna basin and adjoining areas by around the first week of June and establishes firmly over the entire basin by the end of June. It withdraws from this region in the second week of October. As mentioned earlier in Section 5.1, during the four monsoon months of June to September, different low pressure systems like depressions, cyclonic storms, etc. originating in the Bay of Bengal when they cross the Indian coast and move west to northwestly direction, generally cause heavy rainfall over the basin.

On the basis of 570 stations daily rainfall data, it is seen that the mean annual rainfall over the entire Krishna basin is of the order of about 90 cm and 74% of the annual rainfall is contributed by the southwest monsoon season. About 25% of the annual rainfall is received during the month of July. Tables 1 to 6 give the mean monthly, seasonal and annual rainfall over the 5 sub–catchments and the entire Krishna basin. It is seen from these tables that except catchment No.309, other sub–catchments of the Krishna basin receive about 72 to 80% of annual rainfall during monsoon season. The Tungabhadra (Catch. No. 308) and the Upper Krishna (Catch. No.306) sub–catchments were found to receive higher mean annual rainfall. Spatial patterns of mean seasonal (for four seasons) and annual rainfall of the entire Krishna basin are shown in Figs 6 to 10.

5.3 Highest Observed Point Rainfall

Magnitudes of highest rainfall are useful as background material for workers investigating on estimation of Probable Maximum Precipitation (PMP) or extreme rainfall which is possible at a given point for a given duration. The map showing the distribution of one–day highest point rainfall in India was first prepared by Iyer and Zafer (1938) based on 30 years data from 1891 to 1920. Later, Parthsarthy (1959) updated this information upto 1955. Several workers have subsequently carried out studies on highest rainfall over Indian region. Dhar and Mandal (1981) using percentage ratios of observed highest one–day rainfall to the respective mean annual rainfall of about 300 stations over the country, prepared a generalized chart and also catalogued yearly observed highest ever recorded 1–day rainfall over India during 1940–1980. Rakhecha et. al (1990) have prepared homogeneous zones of highest rainfall for 1–day duration over India by considering 300 stations data during 1875 to 1982.

According to Hershfield (1962) the magnitude of point PMP at an individual station should normally not exceed three times the highest observed rainfall from a long period of rainfall data. Dhar et al (1981) have, however, shown that at some of the stations over India, the highest ever recorded 1–day rainfalls were nearly equal to their respective estimates of point PMP. As an example, Bhagamandala station (Karnataka State) recorded the highest 1–day rainfall of 84 cm on 25 July, 1924 and it was found that its estimate of point PMP was near about this magnitude. Similarly, Bhir, a station in Marathawada region of Maharashtra state has recorded 35 cm rainfall on 24 July,1989 which was found to be almost equal to the estimate of physical upper limit of rainfall (i.e. PMP) for this station (Kulkarni et. al,1991).

Of all the synoptic situations mentioned in section 5.1, passage of tropical disturbances such as depressions / cyclonic storms and low pressure areas moving across the basin are found to be the major contributory factor for causing heavy rainfall over the Krishna basin. In view of the importance of highest rainfall for different durations and their usefulness in many types of hydrologic analyses, highest ever observed 1, 2 and 3–day rainfalls for each of the 570 stations were catalogued. These values were then plotted on the base maps of the basin (Scale 1" = 16 miles) and generalized maps of highest ever recorded 1, 2 and 3–day rainfalls have been prepared which are shown in Figs. 11, 12 and 13 respectively. In order to know incidence of such highest ever recorded rainfalls over each of 5 sub–catchments of the Krishna basin, selected representative stations from each of these sub–catchments have been included in Tables 7 to 11 for 1, 2 and 3–day durations. Approximate variations of highest rainfall based upon these selected stations from each sub–catchments are also given at the bottom of the above five tables.

6. Probable Maximum Precipitation (PMP)

Planners and design engineers of water resources would like to have estimates of Probable Maximum Rainfall for the design of spillway capacities of major dams which are to be located upstream of large towns and industrial areas. In the case of such hydraulic structures no risks regarding their failure can be taken as their failure due to inadequate design would result in tremendous loss of life and destruction of valuable property.

PMP is defined as theoretically the greatest depth of precipitation for a given duration that is physically possible for a given size storm area at a particular geographical location at a certain time of the year (WMO,1986). In other words, PMP is that magnitude of rainfall which should not exceed normally over a very long period of time. Another definition of PMP which is of operational nature, states that PMP is that magnitude of rainfall which will yield flood flows of which there is virtually no risk of being exceeded (Myers, 1967).

6.1 Estimation of PMP by Statistical Method

Statistical method used for estimating extreme rainfall (PMP) at a station or over an area is based upon the assumption that information regarding extreme rainfall is contained in the long rainfall records of that station / area. Statistical procedure for estimating PMP is normally used whenever sufficient rainfall data are available and is particularly useful for making quick estimates or where other meteorological data, such as dew point and wind records, are lacking.

Hershfield (1961) for the first time used the statistical method for estimation of PMP for USA. Preliminary appraisal of this technique in USA (Myers, 1967) and in Canada

(Bruce and Clark, 1966) has shown that the PMP estimates obtained by this approach are closely comparable to those obtained by the conventional moisture maximization and storm transposition methods. According to Wiesner (1970) this method has an advantage of taking into account the actual rainfall data, expressing it in terms of statistical parameters and is easy to use.The World Meteorological Organization (WMO) in their various manuals and technical publications (WMO, 1969, 1970, 1976, 1986) have also recommended this method for estimation of extreme rainfall for those river basins whose daily rainfall data are available for a long–period of time.

The procedure described by Hershfield is not the only one, but it has also received the widest acceptance (WMO,1986). It is used mostly for making quick estimates for basins having size up to 10,000 km^2 but has been used for much larger areas also (WMO, 1986). Its convenience lies in that it requires considerably less time to apply than does the meteorological or traditional approach and one does not have to be a meteorologist to use it. A major shortcoming in it is that it yields only point values of PMP and thus requires area–reduction curves for adjusting the point values to various size areas.

As Hershfield's statistical approach (1961,1965) is the widest accepted one, the same has been applied in obtaining PMP estimates over the Krishna basin, as this method is based on the actual observed rainfall data of long–period stations in the study region.

6.2 Hershfield Statistical Technique

The Hershfield statistical technique for estimating point PMP for a station is as follows :

$$X_{PMP} = \overline{X}_n + S_n \cdot K_m \qquad \text{---(1)}$$

where, X_{PMP} = PMP estimate for a station,

$\overline{X}_n$ = mean of the annual maximum series,

S_n = standard deviation of the annual maximum series, and

K_m = frequency factor which depends upon the availability of data period and the return period

According to Hershfield (1961), values of the frequency factor 'K_m' is obtained by using the following equation :

$$K_m = (X_1 - \overline{X}_{n-1}) / S_{n-1} \qquad \text{----(2)}$$

where, X_1 = largest value of the annual maximum series,

$\overline{X}_{n-1}$ = mean of the annual maximum series omitting the largest value from the series, and

S_{n-1} = standard deviation of the annual maximum series omitting the largest value from the series.

Hershfield worked out K_m values for about 2650 stations (10% of stations from various parts of the world and 90% from USA) and found it to be of the order of 15 for 1–day duration (Hershfield, 1961). Later on Hershfield (1965) found that K_m varies inversely with the mean of the annual maximum rainfall series (i.e. $\overline{X}_n$) and used the envelope K_m curve technique for obtaining K_m values for different values of ($\overline{X}_n$). He prepared the envelope K_m curve for obtaining K_m values for different values of $\overline{X}_n$. In this modified approach K_m value does not depend on single highest value of K_m in a region but each station has its own K_m value depending upon its magnitude of ($\overline{X}_n$).

Mazumder and Rangarajan (1966) and Lockwood (1967) questioned the universal applicability of K_m=15 given by Hershfield. However, the value of K_m =15 was found to be high for area of generally heavy rainfall and low for arid areas (WMO, 1973). Dhar and Kamte (1969,1973) have also argued that as each meteorological sub–divisions of India has its own distinct rainfall characteristics, it is reasonable to obtain the K_m values for each of these sub–divisions on the basis of their respective long–period rainfall data of stations in each of these regions. Actually for Indian conditions it was seen that very high values of PMP are obtained if one uses the world envelope value of K_m =15 (Dhar et al,1976).

The modified approach of Hershfield technique (1965) has subsequently been extensively used by different workers. Dhar and Kamte (1973) have used this modified approach for preparing a generalized PMP chart of the Brahmaputra basin in northeast region. Dhar and Kulkarni (1974), Dhar et. al (1975 a&b, 1981, 1982 & 1983) have used this modified technique in their PMP studies over different parts of the country over north Indian region as well as over the peninsular India. Kulkarni (2000) prepared a generalized PMP chart for the Godavari river basin by using this modified approach. The modified technique has also been used in preparing PMP Atlas for different states of Indian Union (IITM, 1989). Kulkarni et. al (2000) have used 1–day rainfall data of about 2016 stations uniformly distributed over the Indian region having data records ranging from 50 to 80 years and prepared a generalized 1–day PMP map for the entire Indian region.

In the present report, for preparation of generalized 1, 2 and 3–day PMP charts of the entire Krishna basin, the modified Hershfield technique has been used to estimate point PMP on the daily rainfall data of 570 stations uniformly distributed in and around the Krishna basin .

From the Eqn. 2 mentioned above, envelope of the frequency factor (K_m) was determined for each of the sub–catchments of the Krishna basin for 1, 2 and 3–day durations separately by considering stations over and near each of the sub–catchments. Using these K_m factors, PMP estimates of individual stations over different sub–catchments are computed by using Eqn.1. The PMP estimates thus obtained for each of the 570 stations for different durations are then plotted on large scale base maps of the Krishna basin and generalized PMP maps were prepared for 1, 2 and 3–day durations.

Coefficient of Variations (CVs) values were estimated for all the 570 stations and the same were plotted on large scale base maps of the Krishna basin to smoothen out the inherently large errors associated with Standard Deviations (Hershfield,1961). For those stations whose C.V. values were adjusted, their Standard Deviations were recalculated on the basis of adjusted C.V. values. Using the revised Standard Deviation values, PMP estimates were re–computed for those stations whose Standard Deviation values were adjusted.

Figs. 14, 15 and 16 show the generalized PMP maps for 1, 2 and 3–day durations over the Krishna river basin. Tables 12 to 16 give the estimates of point PMP for selected representative stations for 1, 2 & 3–day durations over each of the 5 sub–catchments in the Krishna basin with variability ranges. It is seen from these tables that point PMP estimates for stations over the Krishna basin broadly range from about 18 to 79 cm for 1–day, 27 cm to 132 cm for 2–day and 31 to 172 cm for 3–day durations.

7. Return period analysis

The most important factors to be taken into consideration in the designing of engineering structures are safety, economy and efficiency. Thus structures have to be designed to withstand the pressures to which they may be subjected during their estimated economic life which may vary from less than 10 to more than 100 years or so. Thus, design of water control structures focuses on the prediction of runoff during major hydrologic events. This requires estimates of the frequencies of occurrence of rainfall of a given duration and intensity, for analysis of the potential costs and benefits of building adequate controls. These estimates are called return periods. Thus, the Recurrence Interval or Return Period (T) is the frequency which is expected, on an average, a given rainfall event to reoccur.

The standard method of estimating the probability of occurrence of maximum rainfall for hydrologic design is to fit a known probability distribution to the maximum annual rainfall series and estimating its parameters by statistical procedures. Various theoretical and empirical distributions have been proposed by various workers which are generally applicable to the annual maximum rainfall series. A comprehensive study of various distributions was made by Hershfield and Kohlar (1960) who found that the Gumbel (EV1) technique, based on the Fisher–Tippet (Type–I) distribution, was the most suitable distribution (if applied to the data of stations in the homogeneous region). This was also the experience of Reich (1963) while studying the intensity–duration relationship of South African rainfall. Gumbel's method has been increasingly used in estimating the probability of occurrence of maximum rainfall events (Harihar Ayyer and Tripathi,1974; Dhar et al,1980; Rakhech et al, 1991). As such the Gumbel's extreme value distribution (1941, 1954) as modified by Chow (1964) has been used in this report for computations of return period values for 25, 50, 100, 500, 1000and 5000–year periods for durations of 1, 2 & 3–day durations using 570 station's rainfall data in and around the Krishna basin.

7.1 Gumbel's (EV1) Extreme Value Distribution

If χ = annual maximum rainfall series following the Gumbel's (EV1) distribution, then its cumulative distribution function F(x) is given by

$$F(x) = e^{-e^{-\left[\frac{(x-u)}{\alpha}\right]}} \quad \text{...... (1)}$$

where, u and α are statistical parameters of the distributions, estimated from the data.
Inverting the distribution function

$$x = u - \alpha \, ln.ln(1/ \quad F(x)) \quad \text{....... (2)}$$

Return Period T is given by,

$$T = \frac{1}{1 - F(x)} \quad \text{....... (3)}$$

Substituting this in the Eq.(2)

$$K_T = -\ln.\ln \; [T/(T-1)]$$

Thus the return period value for any period can be estimated using the following equation

$$X_T = u + \alpha \; K_T$$

Fitting the above Gumbel extreme value distribution to the annual maximum rainfall data series for 1, 2 & 3–day durations for each of 570 stations in and around the Krishna river basin, return period values were estimated for 25, 50, 100, 500, 1000 and 5000–years. These values were then plotted on base maps of the Krishna basin and generalized maps have been prepared. Figs. 17 to 22 (for 1–day), Figs. 23 to 28 (for 2–day) and Figs. 29 to 34 (for 3–day) show the generalised maps of 25, 50, 100, 500, 1000 and 5000–year return periods over the Krishna river basin. Tables 17 to 21; 22 to 26; 27 to 31 give estimates of maximum rainfall for 1–day, 2–day and 3–day respectively at selected stations over each of the 5 sub–catchmebnts (Nos. 306 to 310) for return periods of 25, 50, 100, 500, 1000 and 5000–years respectively.

Acknowledgements

Authors are grateful to the Hydrology Study Organisation (HSO) of the Central Water Commission (CWC), New Delhi of the Ministry of Water Resources, Govt. of India for sponsoring this project.

Authors are highly thankful to Dr. Rupa Kumar Kolli, Scientist–F and Head of the Climatolgy and Hydrometeorology Division, IITM and Member of the Technical Advisory and Review Committee (TARC) of the present project for his keen interest and encouragement in providing valuable guidance in the project implementation and supporting feed back for the progress of the project work from time to time.

Authors are also highly thankful to all those Organisations from whom daily rainfall data were procured and used in this report specially to the Director General of Observatoies (DGM), IMD for kindly permitting to procure data from the National Data Centre (NDC), IMD, Pune.

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TABLE 1

River Krishna upto its confluence with River Bhima, excluding river Bhima (Sub catchment No. 306)

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as % of annual	Standard Deviation	C.V. (%)
January	0.23	0.2	0.86	314
February	0.17	0.2	0.64	345
March	0.59	0.6	1.33	228
April	2.7	2.6	2.94	113
May	5.59	5.4	5.18	95
June	14.68	14.2	8.45	63
July	30.43	29.5	13.83	57
August	19.71	19.1	10.26	67
September	14.08	13.7	8.84	64
October	10.44	10.1	8.21	78
November	3.52	3.4	4.96	141
December	0.79	0.8	2.07	263
Winter (Jan.–Feb.)	0.39	0.4	1.17	276
Pre–monsoon (Mar.–May)	8.86	8.6	6.1	70
Monsoon (Jun.–Sept.)	79.11	76.8	21.32	31
Post–monsoon (Oct.–Dec.)	14.69	14.3	9.8	66
Annual	103.04	100.0	26.25	28

TABLE 2

River Bhima
(Sub catchment No. 307)

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as % of annual	Standard Deviation	C.V. (%)
January	0.3	0.4	0.95	328
February	0.21	0.3	0.67	365
March	0.38	0.5	0.95	267
April	1.24	1.5	1.85	161
May	2.89	3.5	3.65	132
June	12.49	15.3	7.92	64
July	20.05	24.5	11.06	65
August	15.54	19.0	9.89	77
September	17.23	21.1	10.95	64
October	8.17	10.0	7.46	91
November	2.81	3.4	4.54	161
December	0.57	0.7	1.5	270
Winter (Jan.–Feb.)	0.51	0.6	1.21	253
Pre–monsoon (Mar.–May)	4.46	5.5	4.17	98
Monsoon (Jun.–Sept.)	65.36	79.9	22.26	34
Post–monsoon (Oct.–Dec.)	11.45	14.0	8.68	75
Annual	81.76	100.0	25.02	30

TABLE 3

River Tungabhadra upto dam site
(Sub catchment No. 308)

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as % of annual	Standard Deviation	C.V. (%)
January	0.16	0.1	0.54	389
February	0.15	0.1	0.59	444
March	0.63	0.4	1.37	237
April	3.9	2.7	3.7	100
May	7.92	5.5	6.6	82
June	24.42	17.1	11.96	59
July	44.03	30.8	18.93	50
August	29.02	20.3	13.51	56
September	13.66	9.6	8.52	64
October	13.52	9.5	9.11	68
November	4.53	3.2	6.08	138
December	0.98	0.7	2.39	247
Winter (Jan.–Feb.)	0.3	0.2	0.82	324
Pre–monsoon (Mar.–May)	12.4	8.7	7.85	63
Monsoon (Jun.–Sept.)	111.12	77.8	30.1	31
Post–monsoon (Oct.–Dec.)	19.03	13.3	11.33	60
Annual	142.9	100.0	35.13	27

TABLE 4

River Tungabhadra from the dam site to its confluence with river Krishna and River Vedavati

(Sub catchment No. 309)

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as % of annual	Standard Deviation	C.V. (%)
January	0.17	0.3	0.62	398
February	0.23	0.4	0.82	391
March	0.46	0.8	1.22	282
April	2.25	4.0	2.73	127
May	5.82	10.2	5.09	91
June	5.84	10.3	4.98	88
July	7.36	12.9	5.98	85
August	7.68	13.5	6.49	89
September	12.24	21.5	8.66	71
October	10.81	19.0	8.83	82
November	3.34	5.9	4.45	138
December	0.7	1.2	1.73	261
Winter (Jan.–Feb.)	0.4	0.7	1.1	301
Pre–monsoon (Mar.–May)	8.48	14.9	6.07	74
Monsoon (Jun.–Sept.)	33.24	58.3	14.5	45
Post–monsoon (Oct.–Dec.)	14.89	26.1	10.1	68
Annual	57	100.0	19.38	34

TABLE 5

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungahadra (Sub catchment No. 310)

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as % of annual	Standard Deviation	C.V. (%)
January	0.31	0.4	0.94	329
February	0.6	0.7	1.56	268
March	0.73	0.9	1.69	244
April	1.63	2.0	2.4	154
May	3.78	4.6	5.53	144
June	10.57	12.7	6.56	62
July	17.62	21.2	9.79	56
August	16.38	19.7	9.61	59
September	15.72	18.9	9.93	63
October	11.87	14.3	9.61	85
November	4.05	4.9	5.4	145
December	0.75	0.9	1.87	269
Winter (Jan.–Feb.)	0.86	1.0	1.86	233
Pre–monsoon (Mar.–May)	5.79	7.0	6.28	109
Monsoon (Jun.–Sept.)	60.01	72.3	20.13	33
Post–monsoon (Oct.–Dec.)	16.34	19.7	11.4	73
Annual	82.99	100.0	22.98	27

TABLE 6

Entire Krishna basin

Mean monthly, seasonal and annual rainfall (cm)

Months / Seasons	Mean Rainfall (cm)	Rainfall as a % of annual	Standard Deviation	C.V. (%)
January	0.24	0.3	0.79	326
February	0.29	0.3	0.89	335
March	0.56	0.6	1.32	253
April	2.25	2.5	2.67	133
May	5.05	5.6	5.16	110
June	12.72	14.2	7.63	68
July	22.12	24.7	11.3	64
August	16.74	18.7	9.65	70
September	14.58	16.3	9.41	65
October	10.89	12.2	8.67	81
November	3.62	4.0	5.04	145
December	0.75	0.8	1.88	263
Winter (Jan.–Feb.)	0.51	0.6	1.27	267
Pre–monsoon (Mar.–May)	7.75	8.6	6.03	84
Monsoon (Jun.–Sept.)	66.18	73.9	20.97	35
Post–monsoon (Oct.–Dec.)	15.16	16.9	10.26	69
Annual	89.59	100.0	24.99	29

TABLE 7

River Krishna upto its confluence with River Bhima, excluding river Bhima (Sub catchment No. 306)

Highest 1, 2 and 3-day rainfall (cm)

No.	District	Station Name	1-day rainfall (cm)	Date	2-day rainfall (cm)	Date	3-day rainfall (cm)	Date
1	BELGAUM	ATHANI	14.9	10/10/1952	20.5	24-25/08/1935	20.8	24-26/08/1935
2	BELGAUM	BELGAUM (O)	27.9	05/08/1914	45.7	05-06/08/1914	50.8	27-29/06/1983
3	BELGAUM	CHIKODI	17.3	26/10/1910	18.0	03-04/05/1966	21.5	27-29/06/1983
4	BELGAUM	GOKAK	18.1	09/10/1925	21.3	05-06/08/1914	22.3	04-06/08/1914
5	BELGAUM	KHANAPUR	30.7	05/08/1914	56.4	05-06/08/1914	61.6	05-07/08/1914
6	BELGAUM	RAMDURG	15.1	03/11/1916	17.7	06-07/08/1938	22.5	06-08/08/1938
7	BELGAUM	SAMBRA AERO (O)	17.4	28/06/1983	30.1	27-28/06/1983	38.0	27-29/06/1983
8	BELGAUM	SAUNDATTI	15.0	16/10/1956	20.5	15-16/10/1956	22.7	24-26/09/1907
9	BIJAPUR	BADAMI	16.0	17/07/1916	22.8	03-04/11/1916	27.0	02-04/11/1916
10	BIJAPUR	BAGEWADI	22.6	12/12/1940	22.6	11-12/12/1940	24.6	20-22/09/1949
11	BIJAPUR	BILGI	17.2	25/10/1969	22.5	14-15/09/1931	23.3	14-16/09/1931
12	BIJAPUR	JAMKHANDI	16.0	07/09/1960	17.5	20-21/09/1949	19.7	19-21/09/1968
13	BIJAPUR	MUDDEBIHAL	14.6	22/09/1949	22.3	21-22/09/1949	25.0	20-22/09/1949
14	DHARWAR	DHARWAR	14.7	06/08/1914	25.4	05-06/08/1914	27.3	05-07/08/1914
15	DHARWAR	GADAG (O)	29.3	21/10/1996	40.0	20-21/10/1996	42.7	19-21/10/1996
16	GULBARGA	SHAHPUR	19.5	29/10/1997	23.5	15-16/06/1977	28.7	15-17/06/1977
17	RAICHUR	DEODURGA	23.5	30/09/1964	31.4	29-30/09/1964	31.8	29/09-1/10/1964
18	RAICHUR	LINGASUGUR	14.1	11/08/1946	19.1	21-22/09/1949	22.1	20-22/09/1949
19	KOLHAPUR	AJRA	21.2	30/06/1959	35.3	30/06-1/07/1959	44.8	30/06-1/07/1959
20	KOLHAPUR	CHANDGAD	26.7	13/07/1924	44.7	13-14/07/1924	60.7	12-14/07/1924
21	KOLHAPUR	GADHINGLAJ	18.0	05/08/1914	34.0	05-06/08/1914	40.2	28-30/06/1983
22	KOLHAPUR	GARGOTI	20.1	28/06/1983	37.5	28-29/06/1983	53.3	27-29/06/1983
23	KOLHAPUR	KOLHAPUR (O)	19.0	09/07/1963	30.4	05-06/08/1914	34.2	04-06/08/1914
24	KOLHAPUR	KURUNDWAD	11.8	05/08/1914	19.4	02-03/05/1966	27.5	02-04/05/1966
25	KOLHAPUR	PANHALA	18.4	25/05/1961	25.7	21-22/07/1969	35.5	09-11/07/1961
26	KOLHAPUR	RADHANAGARI	31.2	01/07/1941	48.0	30/6-1/07/1941	68.5	23-25/07/1952
27	KOLHAPUR	SHAHUWADI	22.9	21/07/1965	33.3	21-22/07/1966	39.6	20-22/07/1966
28	SANGLI	ISLAMPUR	21.0	08/09/1984	26.0	07-08/09/1984	26.2	06-09/09/1984
29	SANGLI	MIRAJ (O)	15.1	27/08/1932	17.2	27-28/08/1932	19.2	03-05/05/1966
30	SANGLI	SHIRALA	25.4	11/01/1936	28.5	05-06/08/1914	33.5	03-05/05/1966
31	SANGLI	TASGAON	15.1	05/08/1914	17.3	05-06/08/1914	18.4	13-15/11/1966
32	SATARA	KARAD	15.1	21/07/1950	23.0	05-06/08/1914	24.7	05-07/08/1914
33	SATARA	KOREGAON	16.9	06/06/1976	25.3	06-07/06/1976	28.2	05-07/06/1976
34	SATARA	MAHABALESHWAR (O)	44.0	07/07/1977	76.2	22-23/07/1912	106.2	21-23/07/1912
35	SATARA	MEDHA	20.4	25/08/1938	33.6	17-18/07/1947	46.1	21-23/07/1912
36	SATARA	PANCHGANI	20.0	06/06/1976	34.2	05-06/06/1976	43.8	05-07//06/1976
37	SATARA	PATAN	29.7	11/07/1943	44.1	11-12/07/1943	58.1	11-13/07/1943
38	SATARA	SATARA (O)	21.6	06/06/1976	28.5	06-07/06/1976	33.1	05-07/06/1976
39	SATARA	VADUJ	12.5	14/09/1926	15.7	13-14/09/1926	20.8	26-28/07/1966
40	SATARA	WAI	16.0	10/07/1943	20.8	27-28/07/1967	25.7	27-29/07/1967
		Approx. Range	***(12 – 44)***		***(16 – 76)***		***(18 – 106)***	

TABLE 8

River Bhima

(Sub catchment No. 307)

Highest 1, 2 and 3–day rainfall (cm)

No.	District	Station Name	1–day rainfa		2–day rainfall		3–day rainfall	
			(cm)	Date	(cm)	Date	(cm)	Date
1	HYDERABAD	PARGI	17.8	15/08/1978	22.7	13–14/05/197	23.5	13–15/08/1978
2	HYDERABAD	VIKARABAD	24.9	30/06/1942	27.6	14–15/08/199	32.6	14–16/08/1990
3	BIJAPUR	BIJAPUR (O)	18.1	04/11/1979	20.9	21–22/09/194	24.4	28–30/07/1964
4	BIJAPUR	INDI	17.1	21/06/1906	21.4	21–22/09/194	23.8	21–23/09/1949
5	BIJAPUR	SINDGI	20.3	29/09/1912	20.4	28–29/09/191	24.1	30/9–2/10/1964
6	GULBARGA	AFZALPUR	14.2	15/06/1985	15.3	15–16/06/198	17.3	24–26/09/1971
7	GULBARGA	ALAND	19.0	20/08/1980	21.9	24–25/10/197	25.5	24–26/10/1973
8	GULBARGA	CHINCHOLI	16.0	06/10/1977	20.3	01–02/08/198	23.4	15–17/09/1983
9	GULBARGA	GULBARGA (O)	18.2	06/09/1969	21.7	23–24/08/197	24.3	21–23/08/1976
10	GULBARGA	JEWARGI	21.4	15/08/1978	23.6	14–15/08/197	24.2	13–15/08/1978
11	GULBARGA	SERAM	16.1	29/07/1956	19.5	24–25/10/197	24.2	27–29/07/1956
12	GULBARGA	YADGIR	25.4	15/08/1978	28.2	14–15/08/197	28.5	14–16/08/1978
13	AHMEDNAGAR	AHMEDNAGAR (O)	19.0	18/09/1970	23.6	14–15/09/190	23.6	14–16/09/1902
14	AHMEDNAGAR	JAMKHED	16.8	14/11/1966	30.1	15–16/09/198	32.6	15–17/09/1983
15	AHMEDNAGAR	MIRAJGAON	19.1	19/04/1937	21.0	14–15/06/194	26.5	14–16/06/1942
16	OSMANABAD	OSMANABAD	21.6	04/11/1979	24.7	13–14/09/190	26.8	14–16/09/1926
17	OSMANABAD	TULJAPUR	16.4	04/11/1979	19.3	15–16/09/197	26.0	30/8–1/09/1956
18	POONA	BARAMATI (O)	14.0	07/11/1922	17.6	06–07/11/192	21.7	19–21/09/1981
19	POONA	BHOR	19.3	05/08/1914	26.7	24–25/07/190	34.9	30/7–1/08/1976
20	POONA	DHOND	15.0	22/09/1949	28.1	22–23/09/194	31.0	22–24/09/1949
21	POONA	INDAPUR	16.7	05/11/1946	23.8	17–18/08/198	27.1	16–18/08/1980
22	POONA	JEJURI	20.0	26/07/1979	22.2	26–27/07/197	25.1	06–08/06/1976
23	POONA	JUNNAR	23.0	05/11/1946	32.4	11–12/07/195	38.2	10–12/07/1958
24	POONA	KHANDALA (O)	51.6	19/07/1958	87.3	02–03/08/195	109.6	01–03/08/1956
25	POONA	KHED	14.5	15/09/1979	20.3	22–23/11/194	25.0	24–26/09/1960
26	POONA	LONAVALA (O)	49.3	02/08/1956	88.2	02–03/08/195	110.1	01–03/08/1956
27	POONA	POONA (O)	14.2	17/08/1987	22.8	07–08/06/199	29.8	07–09/06/1991
28	POONA	SIRUR	18.2	26/10/1916	22.1	07–09/09/193	24.9	06–08/09/1933
29	POONA	VADGAON	25.3	17/07/1976	31.2	10–11/07/194	37.1	09–11/07/1943
30	POONA	VELHE	27.3	19/07/1958	49.2	19–20/07/195	61.1	02–04/07/1961
31	SANGLI	JATH	19.9	23/09/1939	24.7	14–15/09/196	27.8	21–23/09/1938
32	SATARA	MHASWAD	20.7	17/09/1902	21.4	17–18/09/190	27.0	17–19/07/1902
33	SATARA	PHALTAN	16.9	26/09/1979	21.0	25–26/09/197	23.0	24–26/09/1979
34	SHOLAPUR	BARSI	15.3	15/09/1902	18.1	25–26/09/197	25.7	15–17/09/1902
35	SHOLAPUR	KARMALA	19.1	11/07/1960	22.7	21–22/09/194	28.6	21–23/09/1948
36	SHOLAPUR	MADHA	21.1	08/09/1950	21.2	08–09/09/195	23.7	25–27/09/1979
37	SHOLAPUR	MALSIRAS	17.2	03/10/1996	24.4	03–04/10/199	26.5	02–04/10/1996
38	SHOLAPUR	PANDHARPUR	19.8	09/10/1984	34.5	22–23/09/198	37.6	22–24/09/1983
39	SHOLAPUR	SHOLAPUR (O)	19.1	12/08/1940	21.8	21–22/09/194	24.5	21–23/09/1948
		Approx. Range	***(14 – 52)***		***(15 – 88)***		***(17 – 110)***	

TABLE 9

River Tungabhadra upto dam site
(Sub catchment No. 308)

Highest 1, 2 and 3–day rainfall (cm)

No.	District	Station Name	1–day rainfall		2–day rainfall		3–day rainfall	
			(cm)	Date	(cm)	Date	(cm)	Date
1	BELLARY	HADAGALLI	14.9	21/05/1943	18.6	04–05/09/1933	22.7	03–05/09/1933
2	BELLARY	HARAPANAHALLI	22.5	02/10/1987	25.9	02–03/11/1983	25.9	02–04/11/1983
3	BELLARY	KUDLIGI	17.8	30/09/1932	22.0	07–08/11/1978	22.0	06–08/11/1978
4	CHICKMAGALUR	HIREBYLE	41.9	03/07/1961	81.4	02–03/07/1961	113.6	01–03/07/1961
5	CHICKMAGALUR	KALASA	36.0	10/07/1997	57.0	07–08/08/1964	84.0	06–08/08/1964
6	CHICKMAGALUR	KOPPA (BALGADI)	31.1	07/08/1923	54.4	24–25/07/1924	61.8	23–25/07/1924
7	CHICKMAGALUR	NARASIMHARAJAPURA	22.5	11/07/1923	40.8	10–11/07/1923	54.9	09–11/07/1923
8	CHICKMAGALUR	SRINGERI	34.0	21/07/1945	49.8	06–07/07/1953	65.7	16–18/07/1924
9	CHICKMAGALUR	TARIKERE	25.2	27/07/1942	26.2	28–29/10/1960	29.3	27–29/10/1960
10	CHITRADURGA	MALEBENNUR	28.5	17/11/1992	32.9	16–17/11/1992	37.2	16–18/11/1992
11	CHITRADURGA	RAMGIRI	17.8	20/05/1955	20.3	20–21/05/1955	21.6	19–21/05/1955
12	DHARWAR	HANGAL	15.8	30/06/1959	24.5	30/6–1/07/1959	34.4	17–19/07/1961
13	DHARWAR	HAVERI	25.6	17/11/1992	31.6	17–18/11/1992	33.2	16–18/11/1992
14	DHARWAR	HIREKERUR	19.3	17/11/1992	24.2	16–17/11/1992	26.0	16–18/11/1992
15	DHARWAR	RANEBENNUR	33.8	17/11/1992	36.8	17–18/11/1992	38.8	16–18/11/1992
16	DHARWAR	SHIGGAON	17.4	17/11/1992	22.0	17–18/11/1992	23.7	17–19/11/1992
17	DHARWAR	SHIRHATTI	18.2	20/10/1978	24.3	17–18/11/1992	30.3	17–19/11/1992
18	KANARA NORTH	SIDDAPUR	40.6	22/06/1975	71.3	21–22/06/1975	91.8	21–23/06/1975
19	RAICHUR	YALBURGA	13.3	31/10/1975	14.8	17–18/11/1992	15.4	17–19/11/1992
20	SHIMOGA	AGUMBE (O)	54.9	04/07/1959	88.4	04–05/07/1959	108.8	04–06/07/1959
21	SHIMOGA	ANANDAPURAM	28.2	02/07/1953	37.3	02–03/07/1953	44.2	22–24/07/1989
22	SHIMOGA	ARASALU	36.2	19/07/1999	43.7	19–20/07/1999	53.1	17–19/07/1999
23	SHIMOGA	HONNALI	26.4	17/11/1992	32.4	16–17/11/1992	34.9	16–18/11/1992
24	SHIMOGA	SAGAR	28.8	20/07/1923	42.4	02–03/08/1982	52.3	01–03/08/1982
25	SHIMOGA	SHIMOGA (O)	16.2	01/09/1939	23.1	05–06/06/1971	26.1	09–11/07/1923
26	SHIMOGA	SHIRALKOPPA	17.1	17/11/1992	21.9	16–17/11/1992	25.0	16–18/11/1992
27	SHIMOGA	SORAB	25.0	10/07/1923	39.0	23–24/07/1951	46.6	23–25/07/1951
28	SHIMOGA	THALAGUPPA	32.3	01/07/1980	56.3	30/6–1/07/1980	70.9	29/06–1/07/1980
29	SHIMOGA	THIRTHAHALLI	34.3	21/06/1924	49.8	11–12/07/1941	71.7	16–18/07/1924
		Approx. Range	***(13 – 55)***		***(15 – 88)***		***(15 – 109)***	

TABLE 10

River Tungabhadra from the dam site to its confluence with river Krishna and River Vedavati

(Sub catchment No. 309)

Highest 1, 2 and 3–day rainfall (cm)

No.	District	Station Name	1–day rainfall		2–day rainfall		3–day rainfall	
			(cm)	Date	(cm)	Date	(cm)	Date
1	ANANTAPUR	KANEKAL	14.9	24/07/1975	16.5	24–25/07/1975	18.3	22–24/07/1975
2	KURNOOL	ADONI	20.7	31/10/1916	23.6	21–22/09/1949	28.0	20–22/09/1949
3	KURNOOL	DHONE	19.2	31/10/1916	27.7	26–27/06/1963	28.2	05–07/06/1963
4	KURNOOL	HELALAGUNDI	15.9	15/08/1959	22.5	24–25/09/1959	33.5	24–26/09/1959
5	KURNOOL	KOSIGI (KESIGI)	16.9	28/09/1959	21.6	21–22/09/1949	29.9	20–22/09/1949
6	KURNOOL	KURNOOL (O)	16.6	23/05/1952	28.1	23–24/05/1952	36.7	23–25/05/1952
7	KURNOOL	MADDIKERA	12.8	02/09/1981	19.8	24–25/05/1952	30.4	23–25/05/1952
8	KURNOOL	NANDIKOTTUR	25.8	23/05/1952	38.6	23–24/05/1952	44.6	23–25/05/1952
9	KURNOOL	YEMMIGANUR	21.9	31/10/1916	26.5	30–31/10/1916	27.3	30/10–1/11/1916
10	MAHBUBNAGAR	UPPAL	20.2	30/09/1964	34.9	29–30/09/1964	35.9	29–31/09/1964
11	BELLARY	BELLARY (O)	16.2	21/05/1940	18.0	21–22/05/1940	21.5	30/11–2/12/1966
12	BELLARY	HOSPET	14.2	12/09/1979	21.8	10–11/08/1939	24.4	10–12/08/1939
13	BELLARY	KURUGODU	18.0	16/09/1973	27.0	16–17/09/1973	32.4	15–17/09/1973
14	CHICKMAGALUR	KADUR	15.7	08/05/1928	15.7	08–09/05/1928	18.7	08–10/05/1928
15	CHICKMAGALUR	KALASAPUR	10.2	01/05/1966	12.8	15–16/05/1983	15.8	28–30/10/1983
16	CHITRADURGA	BAGUR	16.0	29/04/1986	26.0	28–29/04/1986	26.0	27–29/04/1986
17	CHITRADURGA	CHITRADURG (O)	18.2	21/05/1955	20.4	16–17/11/1992	21.2	19–21/05/1955
18	CHITRADURGA	DHARAMPUR	15.5	24/10/1953	23.0	14–15/05/1972	30.5	12–14/09/1979
19	CHITRADURGA	HIRIYUR	13.0	17/09/1986	23.5	14–15/05/1972	27.4	14–16/05/1972
20	CHITRADURGA	JAGALUR (Davangere)	17.7	07/11/1932	18.8	06–07/11/1932	19.9	05–07/11/1932
21	CHITRADURGA	MOLAKMURU	15.4	10/08/1939	23.7	27–28/08/1988	28.4	27–29/08/1988
22	CHITRADURGA	PARSURAMPUR	10.6	15/05/1972	16.4	14–15/05/1972	17.1	14–16/05/1972
23	CHITRADURGA	SRIRAMPUR	13.2	19/09/1989	21.2	08–09/10/1977	22.9	07–09/10/1977
24	HASSAN	ARSIKERE	14.4	19/10/1935	22.0	07–08/10/1989	26.2	06–08/10/1989
25	HASSAN	HALEBID	17.8	28/07/1999	34.8	28–29/07/1999	49.3	27–29/07/1999
26	RAICHUR	GANGAVATI	18.3	27/10/1962	21.5	17–18/11/1992	27.9	17–19/11/1992
27	RAICHUR	KUSHTAGI	16.5	18/11/1992	20.1	17–18/11/1992	20.8	16–18/11/1992
28	RAICHUR	SINDHANOOR	26.1	25/07/1993	33.5	17–18/11/1992	36.6	17–19/11/1992
29	RAICHUR	SIRWAR	18.0	30/09/1978	19.0	23–24/07/1975	31.0	28–30/09/1978
30	TUMKUR	BARAGUR	14.5	17/06/1972	23.3	14–15/05/1972	34.8	13–15/05/1972
31	TUMKUR	CHIKNAYAKANIHALLI	18.4	13/10/1928	20.4	12–13/10/1928	22.0	13–15/11/1940
32	TUMKUR	HONNAVALLI	28.8	06/06/2000	34.2	06–07/06/2000	40.2	06–08/06/2000
33	TUMKUR	KALLAMBELLA	15.8	14/05/1972	26.8	14–15/05/1972	29.3	13–15/05/1972
34	TUMKUR	NELHAL	20.9	15/05/1972	33.1	14–15/05/1972	35.6	14–16/05/1972
35	TUMKUR	SIRA	18.4	27/09/1978	22.1	03–04/09/1933	25.9	02–04/09/1933
36	TUMKUR	TOVINKERE	14.5	25/10/1975	18.6	04–05/10/1974	22.1	03–05/10/1974
		Approx. Range	***(10 – 29)***		***(13 – 39)***		***(16 – 49)***	

TABLE 11

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungahadra (Sub catchment No. 310)

Highest 1, 2 and 3–day rainfall (cm)

No.	District	Station Name	1–day rainfall (cm)	Date	2–day rainfall (cm)	Date	3–day rainfall (cm)	Date
1	GUNTUR	MACHARLA	19.1	19/10/1945	23.0	23–24/08/1947	26.7	21–23/09/1991
2	GUNTUR	MANGALGIRI	22.3	18/05/1969	31.2	17–18/05/1969	41.9	02–04/07/1958
3	GUNTUR	RENTACHINTALA (O)	22.7	29/09/1964	27.5	15–16/06/1996	28.8	14–16/06/1996
4	GUNTUR	SATHENAPALLI	23.6	02/11/1927	28.8	29–30/08/1903	32.4	17–19/05/1969
5	HYDERABAD	BEGUMPET (O)	24.2	24/08/2000	31.4	23–24/08/2000	31.6	22–24/08/2000
6	HYDERABAD	GANDIPET (OSMANSAGAR)	24.6	15/08/1978	33.2	10–11/09/1950	40.4	10–12/09/1950
7	HYDERABAD	IBRAHIMPATNAM	18.8	22/09/1991	27.3	22–23/09/1991	29.3	22–24/09/1991
8	HYDERABAD	JANWADA	23.1	27/09/1908	32.0	26–27/09/1908	38.1	26–28/09/1908
9	HYDERABAD	SHAHABAD (CHEVELLA)	12.3	08/09/1962	16.1	15–16/06/1980	16.3	14–16/06/1980
10	KHAMMAM	KHAMMAM (O)	30.0	10/07/1954	32.3	10–11/07/1954	40.3	19–21/05/1969
11	KHAMMAM	MADHIRA	33.0	20/11/1977	42.3	27–28/09/1964	50.8	19–21/05/1969
12	KHAMMAM	PALAIR	22.6	23/07/1989	41.1	23–24/07/1989	42.0	22–24/07/1989
13	KHAMMAM	YELLANDU	22.0	20/05/1969	27.3	23–24/07/1989	30.4	11–13/08/1986
14	KRISHNA	AVANIGADDA	50.0	17/10/1969	65.4	16–17/10/1969	73.4	16–18/10/1969
15	KRISHNA	KANKIPADU	26.9	06/10/1994	35.0	10–11/05/1990	39.0	10–12/05/1990
16	KRISHNA	KODERU I.B.	41.3	17/10/1969	50.7	16–17/10/1969	55.2	16–18/10/1969
17	KRISHNA	MUTCHINTALA	29.0	22/09/1991	41.1	06–07/10/1994	45.0	22–24/07/1989
18	KRISHNA	NIMMAGADDA LOCK	38.5	17/10/1969	56.8	16–17/10/1969	59.3	16–18/10/1969
19	KRISHNA	POLAMPALLI	38.1	12/05/1990	41.0	12–13/05/1990	54.0	21–23/07/1989
20	KRISHNA	PULIGADDA LOCK	49.5	17/10/1969	60.1	16–17/10/1969	68.1	16–18/10/1969
21	KRISHNA	T.KOTHAPALEM	50.9	17/10/1969	66.9	16–17/10/1969	82.2	16–18/10/1969
22	KRISHNA	TIRUVUR (TIRUVVRU)	37.8	23/07/1989	45.0	23–24/07/1989	46.9	22–24/07/1989
23	KRISHNA	VALLURIPALEM LOC	24.3	06/10/1994	32.8	01–02/11/1994	35.9	01–03/11/1994
24	KRISHNA	VIJAYAWADA (O)	32.4	17/05/1925	38.7	18–19/05/1969	46.4	17–19/05/1969
25	KURNOOL	ATMAKUR	25.2	05/10/1929	31.8	04–05/10/1929	34.8	20–22/09/1949
26	KURNOOL	LAKKINISULA	25.0	06/10/1994	45.0	05–06/10/1994	46.5	04–06/10/1994
27	MAHBUBNAGAR	ATMAKAUR	35.6	28/09/1964	58.9	28–29/09/1964	62.1	28–30/09/1964
28	MAHBUBNAGAR	CHANDRASAGAR	21.0	13/05/1979	27.6	13–14/05/1979	28.5	13–15/05/1979
29	MAHBUBNAGAR	KODANGAL	20.2	17/09/1980	22.0	17–18/09/1980	22.3	16–18/09/1980
30	MAHBUBNAGAR	KOLLAPUR (KOLHAPUR)	29.8	11/07/1992	36.3	19–20/08/1955	37.6	18–20/08/1955
31	MAHBUBNAGAR	MAHBUBNAGAR (O)	25.2	15/08/1978	27.0	14–15/08/1978	27.5	13–15/08/1978
32	MAHBUBNAGAR	MAKTHAL (MUKTHAL)	25.0	27/07/1981	25.0	26–27/07/1981	25.0	25–27/07/1981
33	MAHBUBNAGAR	NAGARKURNOOL	26.7	23/05/1952	37.6	23–24/05/1952	41.7	23–25/05/1952
34	MEDAK	GHANAPUR	21.8	23/07/1989	38.7	23–24/07/1989	39.9	22–24/07/1989
35	NALGONDA	DEVARKONDA	16.4	23/08/1983	25.6	22–23/09/1991	26.2	21–23/09/1991
36	NALGONDA	HUZURNAGAR	23.0	22/09/1991	26.2	27–28/09/1954	31.4	20–22/09/1991
37	NALGONDA	NALGONDA	20.5	27/08/1949	29.7	21–22/05/1940	30.5	21–23/09/1991
38	NALGONDA	PALLIWADA P	21.6	19/07/1956	23.0	18–19/07/1988	25.2	10–12/09/1950
39	WARANGAL	GHANPUR	32.5	13/08/1986	42.0	13–14/08/1986	49.4	12–14/08/1986
40	WARANGAL	MAHBUBABAD	19.5	23/07/1989	31.1	23–24/07/1989	31.9	22–24/07/1989
41	WARANGAL	NARSAMPET	23.0	25/07/1945	25.9	04–05/07/1958	38.7	28–30/06/1959
42	RAICHUR	RAICHUR (O)	17.1	07/10/1975	24.3	21–22/09/1949	35.7	29–31/10/1916
		Approx. Range	*(12 – 51)*		*(16 – 67)*		*(16 – 82)*	

TABLE 12

River Krishna upto its confluence with River Bhima, excluding river Bhima (Sub catchment No. 306)

Probable Maximum Precipitation (PMP) estimates (cm) (By Statistical method)

No.	District	Station Name	PMP estimates (cm) for durations of		
			1–day	2–day	3–day
1	BELGAUM	ATHANI	25.15	32.96	39.59
2	BELGAUM	BELGAUM (O)	37.86	56.71	72.90
3	BELGAUM	CHIKODI	24.35	29.66	35.23
4	BELGAUM	GOKAK	23.31	29.49	33.32
5	BELGAUM	KHANAPUR	42.73	63.96	85.72
6	BELGAUM	RAMDURG	23.15	28.84	36.18
7	BELGAUM	SAMBRA AERO (O)	26.94	43.66	57.50
8	BELGAUM	SAUNDATTI	24.72	30.91	38.04
9	BIJAPUR	BADAMI	25.42	31.00	35.41
10	BIJAPUR	BAGEWADI	30.32	34.42	40.55
11	BIJAPUR	BILGI	25.57	32.22	39.06
12	BIJAPUR	JAMKHANDI	23.30	28.37	35.78
13	BIJAPUR	MUDDEBIHAL	23.01	29.77	35.43
14	DHARWAR	DHARWAR	22.52	32.24	39.29
15	DHARWAR	GADAG (O)	37.02	45.68	56.23
16	GULBARGA	SHAHPUR	31.75	39.55	48.41
17	RAICHUR	DEODURGA	33.78	41.13	49.44
18	RAICHUR	LINGASUGUR	21.92	28.49	32.91
19	KOLHAPUR	AJRA	32.97	51.81	70.24
20	KOLHAPUR	CHANDGAD	39.03	61.37	86.82
21	KOLHAPUR	GADHINGLAJ	26.99	43.75	55.27
22	KOLHAPUR	GARGOTI	30.55	49.59	69.12
23	KOLHAPUR	KOLHAPUR (O)	30.67	43.21	55.63
24	KOLHAPUR	KURUNDWAD	18.12	27.44	38.32
25	KOLHAPUR	PANHALA	32.00	45.10	61.08
26	KOLHAPUR	RADHANAGARI	43.88	69.04	101.38
27	KOLHAPUR	SHAHUWADI	40.50	55.27	74.68
28	SANGLI	ISLAMPUR	27.83	36.32	42.67
29	SANGLI	MIRAJ (O)	23.14	29.22	35.52
30	SANGLI	SHIRALA	29.68	40.34	50.59
31	SANGLI	TASGAON	23.40	27.03	31.49
32	SATARA	KARAD	25.65	34.86	41.88
33	SATARA	KOREGAON	23.19	34.03	41.72
34	SATARA	MAHABALESHWAR (O)	59.68	85.98	128.15
35	SATARA	MEDHA	33.62	49.81	69.55
36	SATARA	PANCHGANI	32.86	50.83	71.57
37	SATARA	PATAN	38.52	57.48	81.28
38	SATARA	SATARA (O)	32.32	44.50	56.76
39	SATARA	VADUJ	22.27	27.35	34.10
40	SATARA	WAI	25.29	35.44	43.67
		Approx. Range	***(18 – 60)***	***(27 – 86)***	***(32 – 128)***

TABLE 13

River Bhima
(Sub catchment No. 307)

Probable Maximum Precipitation (PMP) estimates (cm) (By Statistical method)

No.	District	Station Name	PMP estimates (cm) for durations of		
			1–day	2–day	3–day
1	HYDERABAD	PARGI	30.41	37.92	40.85
2	HYDERABAD	VIKARABAD	35.17	44.86	47.54
3	BIJAPUR	BIJAPUR (O)	28.34	33.66	38.23
4	BIJAPUR	INDI	24.19	30.34	34.76
5	BIJAPUR	SINDGI	28.45	32.26	37.32
6	GULBARGA	AFZALPUR	24.18	27.93	32.38
7	GULBARGA	ALAND	33.87	39.98	43.48
8	GULBARGA	CHINCHOLI	28.69	36.54	43.64
9	GULBARGA	GULBARGA (O)	25.51	32.98	38.98
10	GULBARGA	JEWARGI	32.41	40.09	43.21
11	GULBARGA	SERAM	25.97	35.60	41.77
12	GULBARGA	YADGIR	30.64	38.18	44.55
13	AHMEDNAGAR	AHMEDNAGAR (O)	30.49	35.75	38.97
14	AHMEDNAGAR	JAMKHED	29.13	40.10	44.40
15	AHMEDNAGAR	MIRAJGAON	30.36	36.57	42.45
16	OSMANABAD	OSMANABAD	31.32	40.39	44.06
17	OSMANABAD	TULJAPUR	29.14	36.24	41.60
18	POONA	BARAMATI (O)	24.34	30.82	36.93
19	POONA	BHOR	30.56	43.54	53.47
20	POONA	DHOND	23.54	33.49	36.59
21	POONA	INDAPUR	28.15	33.62	40.30
22	POONA	JEJURI	29.84	34.36	37.95
23	POONA	JUNNAR	36.05	46.80	54.63
24	POONA	KHANDALA (O)	78.38	131.57	172.00
25	POONA	KHED	23.90	32.49	39.17
26	POONA	LONAVALA (O)	57.98	96.96	122.93
27	POONA	POONA (O)	26.03	33.28	40.02
28	POONA	SIRUR	26.35	32.56	36.53
29	POONA	VADGAON	34.82	48.48	59.34
30	POONA	VELHE	46.20	84.17	106.98
31	SANGLI	JATH	28.15	34.89	40.66
32	SATARA	MHASWAD	26.31	30.20	36.29
33	SATARA	PHALTAN	25.23	31.71	35.32
34	SHOLAPUR	BARSI	25.69	29.62	36.02
35	SHOLAPUR	KARMALA	30.55	35.88	41.50
36	SHOLAPUR	MADHA	26.38	29.71	35.52
37	SHOLAPUR	MALSIRAS	26.76	34.42	38.86
38	SHOLAPUR	PANDHARPUR	31.13	41.74	47.93
39	SHOLAPUR	SHOLAPUR (O)	28.16	33.68	38.79
		Approx. Range	***(24 – 78)***	***(28 – 132)***	***(32 – 172)***

TABLE 14

River Tungabhadra upto dam site
(Sub catchment No. 308)

Probable Maximum Precipitation (PMP) estimates (cm) (By Statistical method)

No.	District	Station Name	PMP estimates (cm) for durations of		
			1–day	2–day	3–day
1	BELLARY	HADAGALLI	32.23	36.76	45.64
2	BELLARY	HARAPANAHALLI	36.66	45.29	49.10
3	BELLARY	KUDLIGI	36.08	43.68	49.32
4	CHICKMAGALUR	HIREBYLE	75.46	131.80	163.15
5	CHICKMAGALUR	KALASA	60.49	96.78	123.99
6	CHICKMAGALUR	KOPPA (BALGADI)	52.34	81.64	93.40
7	CHICKMAGALUR	NARASIMHARAJAPURA	42.90	65.44	79.39
8	CHICKMAGALUR	SRINGERI	47.72	72.99	89.81
9	CHICKMAGALUR	TARIKERE	40.78	45.59	50.64
10	CHITRADURGA	MALEBENNUR	51.35	54.80	59.08
11	CHITRADURGA	RAMGIRI	36.41	41.80	44.72
12	DHARWAR	HANGAL	34.26	47.80	55.83
13	DHARWAR	HAVERI	39.62	46.67	49.03
14	DHARWAR	HIREKERUR	36.86	44.63	48.44
15	DHARWAR	RANEBENNUR	43.29	47.81	50.42
16	DHARWAR	SHIGGAON	31.02	40.41	44.26
17	DHARWAR	SHIRHATTI	36.86	45.26	49.82
18	KANARA NORTH	SIDDAPUR	59.19	92.85	110.35
19	RAICHUR	YALBURGA	28.52	33.07	35.78
20	SHIMOGA	AGUMBE (O)	66.34	102.99	124.48
21	SHIMOGA	ANANDAPURAM	52.68	73.05	86.20
22	SHIMOGA	ARASALU	64.09	82.42	102.87
23	SHIMOGA	HONNALI	37.48	44.82	50.31
24	SHIMOGA	SAGAR	48.86	72.65	85.65
25	SHIMOGA	SHIMOGA (O)	33.73	44.00	50.32
26	SHIMOGA	SHIRALKOPPA	36.94	43.71	49.08
27	SHIMOGA	SORAB	47.34	68.37	80.61
28	SHIMOGA	THALAGUPPA	54.60	93.42	116.03
29	SHIMOGA	THIRTHAHALLI	54.70	81.86	100.23
		Approx. Range	*(29 – 75)*	*(33 – 132)*	*(36 – 163)*

TABLE 15

River Tungabhadra from the dam site to its confluence with river Krishna and River Vedavati
(Sub catchment No. 309)

Probable Maximum Precipitation (PMP) estimates (cm) (By Statistical method)

No.	District	Station Name	PMP estimates (cm) for durations of		
			1–day	2–day	3–day
1	ANANTAPUR	KANEKAL	26.34	33.45	45.28
2	KURNOOL	ADONI	31.30	34.97	46.95
3	KURNOOL	DHONE	32.70	41.16	51.72
4	KURNOOL	HELALAGUNDI	32.70	40.45	58.70
5	KURNOOL	KOSIGI (KESIGI)	30.89	38.48	50.92
6	KURNOOL	KURNOOL (O)	29.88	43.44	56.69
7	KURNOOL	MADDIKERA	26.97	34.37	49.87
8	KURNOOL	NANDIKOTTUR	36.60	49.28	63.51
9	KURNOOL	YEMMIGANUR	31.93	40.36	50.21
10	MAHBUBNAGAR	UPPAL	38.52	59.10	72.66
11	BELLARY	BELLARY (O)	30.96	35.59	45.98
12	BELLARY	HOSPET	26.25	36.51	45.34
13	BELLARY	KURUGODU	33.68	40.20	51.72
14	CHICKMAGALUR	KADUR	24.07	30.26	37.87
15	CHICKMAGALUR	KALASAPUR	23.07	30.34	38.57
16	CHITRADURGA	BAGUR	30.52	41.36	52.20
17	CHITRADURGA	CHITRADURG (O)	28.46	33.44	40.61
18	CHITRADURGA	DHARAMPUR	37.93	47.64	66.99
19	CHITRADURGA	HIRIYUR	26.92	36.44	47.40
20	CHITRADURGA	JAGALUR (Davangere)	32.35	35.08	42.77
21	CHITRADURGA	MOLAKMURU	26.91	37.14	46.25
22	CHITRADURGA	PARSURAMPUR	23.74	28.00	35.75
23	CHITRADURGA	SRIRAMPUR	24.52	36.61	42.71
24	HASSAN	ARSIKERE	25.95	31.87	43.08
25	HASSAN	HALEBID	34.77	51.79	78.55
26	RAICHUR	GANGAVATI	33.09	38.79	52.99
27	RAICHUR	KUSHTAGI	31.67	38.65	47.00
28	RAICHUR	SINDHANOOR	45.40	59.89	73.95
29	RAICHUR	SIRWAR	34.43	35.72	54.43
30	TUMKUR	BARAGUR	31.88	39.38	60.75
31	TUMKUR	CHIKNAYAKANIHALLI	29.47	34.61	45.16
32	TUMKUR	HONNAVALLI	42.21	47.31	62.21
33	TUMKUR	KALLAMBELLA	26.86	39.66	51.14
34	TUMKUR	NELHAL	42.61	54.41	70.14
35	TUMKUR	SIRA	30.76	38.60	48.39
36	TUMKUR	TOVINKERE	29.76	33.68	48.09
		Approx. Range	*(23 – 45)*	*(28 – 60)*	*(36 – 74)*

TABLE 16

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungabhadra (Sub catchment No. 310)

Probable Maximum Precipitation (PMP) estimates (cm) (By Statistical method)

No.	District	Station Name	PMP estimates (cm) for durations of		
			1–day	2–day	3–day
1	GUNTUR	MACHARLA	32.15	39.61	45.03
2	GUNTUR	MANGALGIRI	39.57	52.03	64.82
3	GUNTUR	RENTACHINTALA (O)	38.22	44.72	48.29
4	GUNTUR	SATHENAPALLI	32.96	45.55	52.71
5	HYDERABAD	BEGUMPET (O)	33.37	44.37	48.29
6	HYDERABAD	GANDIPET (OSMANSAGAR)	43.05	51.37	61.54
7	HYDERABAD	IBRAHIMPATNAM	37.41	45.48	51.71
8	HYDERABAD	JANWADA	34.08	44.97	54.98
9	HYDERABAD	SHAHABAD (CHEVELLA)	28.30	34.67	37.14
10	KHAMMAM	KHAMMAM (O)	45.04	52.20	59.41
11	KHAMMAM	MADHIRA	61.37	75.35	84.46
12	KHAMMAM	PALAIR	35.97	54.09	58.96
13	KHAMMAM	YELLANDU	31.58	36.76	41.28
14	KRISHNA	AVANIGADDA	60.96	75.80	92.25
15	KRISHNA	KANKIPADU	45.13	57.63	66.40
16	KRISHNA	KODERU I.B.	62.35	74.46	86.30
17	KRISHNA	MUTCHINTALA	59.81	76.34	90.84
18	KRISHNA	NIMMAGADDA LOCK	57.79	72.07	80.62
19	KRISHNA	POLAMPALLI	71.90	75.52	95.02
20	KRISHNA	PULIGADDA LOCK	65.97	80.46	91.93
21	KRISHNA	T.KOTHAPALEM	79.03	90.67	113.16
22	KRISHNA	TIRUVUR (TIRUVVRU)	46.60	54.54	62.04
23	KRISHNA	VALLURIPALEM LOC	44.81	56.33	71.52
24	KRISHNA	VIJAYAWADA (O)	44.84	56.48	66.33
25	KURNOOL	ATMAKUR	40.29	51.40	58.06
26	KURNOOL	LAKKINISULA	40.21	63.64	68.20
27	MAHBUBNAGAR	ATMAKAUR	53.75	78.93	88.48
28	MAHBUBNAGAR	CHANDRASAGAR	51.59	59.07	64.37
29	MAHBUBNAGAR	KODANGAL	36.45	40.43	45.65
30	MAHBUBNAGAR	KOLLAPUR (KOLHAPUR)	54.25	69.92	76.20
31	MAHBUBNAGAR	MAHBUBNAGAR (O)	32.78	39.23	46.35
32	MAHBUBNAGAR	MAKTHAL (MUKTHAL)	38.28	39.99	41.93
33	MAHBUBNAGAR	NAGARKURNOOL	38.06	51.72	59.17
34	MEDAK	GHANAPUR	39.84	55.59	62.48
35	NALGONDA	DEVARKONDA	35.81	44.23	48.71
36	NALGONDA	HUZURNAGAR	44.09	50.36	59.70
37	NALGONDA	NALGONDA	35.71	49.35	54.15
38	NALGONDA	PALLIWADA P	36.00	44.94	52.27
39	WARANGAL	GHANPUR	50.79	63.48	76.14
40	WARANGAL	MAHBUBABAD	34.89	51.69	57.72
41	WARANGAL	NARSAMPET	40.55	49.74	58.62
42	RAICHUR	RAICHUR (O)	29.73	40.77	51.61
		Approx. Range	***(28 – 79)***	***(35 – 91)***	***(37 – 113)***

TABLE 17

River Krishna upto its confluence with River Bhima, excluding river Bhima
(Sub catchment No. 306)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	1-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELGAUM	ATHANI	12.87	14.44	16.00	19.60	21.15	24.74
2	BELGAUM	BELGAUM (O)	19.45	21.97	24.46	30.23	32.71	38.46
3	BELGAUM	CHIKODI	12.18	13.70	15.20	18.68	20.17	23.64
4	BELGAUM	GOKAK	11.94	13.35	14.75	17.98	19.36	22.58
5	BELGAUM	KHANAPUR	23.90	26.77	29.62	36.20	39.03	45.60
6	BELGAUM	RAMDURG	12.01	13.42	14.82	18.06	19.45	22.68
7	BELGAUM	SAMBRA AERO (O)	14.82	16.54	18.25	22.20	23.90	27.84
8	BELGAUM	SAUNDATTI	12.40	13.93	15.45	18.97	20.49	24.00
9	BIJAPUR	BADAMI	13.21	14.79	16.35	19.97	21.52	25.13
10	BIJAPUR	BAGEWADI	14.93	16.89	18.83	23.31	25.24	29.71
11	BIJAPUR	BILGI	13.18	14.76	16.34	19.98	21.54	25.17
12	BIJAPUR	JAMKHANDI	12.04	13.46	14.86	18.10	19.49	22.72
13	BIJAPUR	MUDDEBIHAL	12.11	13.49	14.87	18.05	19.42	22.60
14	DHARWAR	DHARWAR	12.05	13.39	14.71	17.77	19.08	22.13
15	DHARWAR	GADAG (O)	17.34	19.80	22.25	27.91	30.35	35.99
16	GULBARGA	SHAHPUR	17.45	19.50	21.53	26.22	28.24	32.92
17	RAICHUR	DEODURGA	17.88	20.14	22.38	27.56	29.79	34.95
18	RAICHUR	LINGASUGUR	11.70	13.01	14.31	17.32	18.61	21.61
19	KOLHAPUR	AJRA	22.02	24.15	26.25	31.13	33.22	38.08
20	KOLHAPUR	CHANDGAD	23.94	26.32	28.68	34.12	36.46	41.90
21	KOLHAPUR	GADHINGLAJ	14.43	16.09	17.74	21.55	23.19	27.00
22	KOLHAPUR	GARGOTI	17.23	19.12	20.99	25.30	27.16	31.47
23	KOLHAPUR	KOLHAPUR (O)	15.85	17.83	19.79	24.32	26.26	30.78
24	KOLHAPUR	KURUNDWAD	9.82	10.87	11.91	14.32	15.35	17.75
25	KOLHAPUR	PANHALA	20.19	22.38	24.56	29.59	31.75	36.77
26	KOLHAPUR	RADHANAGARI	28.42	31.17	33.91	40.22	42.93	49.24
27	KOLHAPUR	SHAHUWADI	23.52	26.46	29.37	36.10	38.99	45.70
28	SANGLI	ISLAMPUR	13.69	15.44	17.19	21.21	22.94	26.96
29	SANGLI	MIRAJ (O)	12.02	13.48	14.92	18.27	19.71	23.05
30	SANGLI	SHIRALA	15.22	17.06	18.89	23.11	24.92	29.13
31	SANGLI	TASGAON	12.10	13.54	14.97	18.28	19.71	23.01
32	SATARA	KARAD	13.16	14.76	16.35	20.02	21.60	25.27
33	SATARA	KOREGAON	12.00	13.42	14.83	18.08	19.48	22.73
34	SATARA	MAHABALESHWAR (O)	43.02	46.90	50.75	59.65	63.48	72.36
35	SATARA	MEDHA	19.81	21.87	23.91	28.64	30.67	35.38
36	SATARA	PANCHGANI	19.04	21.05	23.04	27.64	29.62	34.21
37	SATARA	PATAN	21.46	23.95	26.42	32.12	34.57	40.26
38	SATARA	SATARA (O)	16.47	18.60	20.71	25.60	27.69	32.56
39	SATARA	VADUJ	11.48	12.83	14.17	17.26	18.59	21.67
40	SATARA	WAI	13.18	14.74	16.30	19.89	21.44	25.02
		Approx. Range	*(10– 43)*	*(11 – 47)*	*(12 – 51)*	*(14 – 60)*	*(15 – 64)*	*(18 – 72)*

TABLE 18

River Bhima
(Sub catchment No. 307)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	1-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	HYDERABAD	PARGI	17.10	19.05	20.98	25.43	27.35	31.79
2	HYDERABAD	VIKARABAD	18.26	20.59	22.92	28.28	30.59	35.94
3	BIJAPUR	BIJAPUR (O)	13.88	15.65	17.40	21.44	23.18	27.22
4	BIJAPUR	INDI	12.66	14.08	15.49	18.76	20.17	23.43
5	BIJAPUR	SINDGI	14.17	15.94	17.70	21.77	23.52	27.58
6	GULBARGA	AFZALPUR	13.14	14.59	16.03	19.36	20.79	24.11
7	GULBARGA	ALAND	17.78	20.05	22.31	27.53	29.77	34.97
8	GULBARGA	CHINCHOLI	15.63	17.44	19.24	23.38	25.17	29.31
9	GULBARGA	GULBARGA (O)	13.66	15.17	16.67	20.12	21.61	25.06
10	GULBARGA	JEWARGI	16.81	18.95	21.06	25.96	28.06	32.94
11	GULBARGA	SERAM	14.55	16.12	17.67	21.27	22.81	26.40
12	GULBARGA	YADGIR	15.56	17.46	19.33	23.68	25.54	29.88
13	AHMEDNAGAR	AHMEDNAGAR (O)	15.49	17.42	19.34	23.77	25.68	30.11
14	AHMEDNAGAR	JAMKHED	15.12	16.94	18.74	22.90	24.69	28.84
15	AHMEDNAGAR	MIRAJGAON	15.21	17.15	19.09	23.56	25.48	29.93
16	OSMANABAD	OSMANABAD	15.75	17.74	19.71	24.26	26.22	30.76
17	OSMANABAD	TULJAPUR	16.17	18.08	19.98	24.36	26.25	30.63
18	POONA	BARAMATI (O)	12.61	14.05	15.48	18.79	20.21	23.51
19	POONA	BHOR	15.51	17.45	19.37	23.82	25.73	30.16
20	POONA	DHOND	12.15	13.55	14.95	18.17	19.55	22.77
21	POONA	INDAPUR	13.84	15.62	17.39	21.47	23.23	27.30
22	POONA	JEJURI	13.88	15.79	17.68	22.06	23.94	28.31
23	POONA	JUNNAR	16.77	19.16	21.54	27.03	29.39	34.87
24	POONA	KHANDALA (O)	47.76	54.90	62.00	78.39	85.43	101.79
25	POONA	KHED	12.37	13.79	15.20	18.47	19.87	23.13
26	POONA	LONAVALA (O)	41.62	46.14	50.62	60.99	65.44	75.79
27	POONA	POONA (O)	13.21	14.79	16.35	19.97	21.53	25.14
28	POONA	SIRUR	13.08	14.71	16.33	20.06	21.67	25.39
29	POONA	VADGAON	18.02	20.27	22.52	27.69	29.92	35.09
30	POONA	VELHE	30.96	34.60	38.22	46.57	50.16	58.49
31	SANGLI	JATH	13.54	15.29	17.03	21.04	22.76	26.76
32	SATARA	MHASWAD	12.84	14.44	16.01	19.66	21.23	24.87
33	SATARA	PHALTAN	12.60	14.14	15.68	19.22	20.74	24.28
34	SHOLAPUR	BARSI	13.35	14.89	16.41	19.94	21.46	24.98
35	SHOLAPUR	KARMALA	15.32	17.26	19.19	23.65	25.56	30.01
36	SHOLAPUR	MADHA	13.51	15.08	16.64	20.25	21.81	25.41
37	SHOLAPUR	MALSIRAS	13.33	14.99	16.64	20.45	22.09	25.90
38	SHOLAPUR	PANDHARPUR	15.60	17.58	19.55	24.11	26.06	30.61
39	SHOLAPUR	SHOLAPUR (O)	14.45	16.18	17.91	21.89	23.61	27.58
		Approx. Range	*(12 – 48)*	*(14 – 55)*	*(15 – 62)*	*(19 – 78)*	*(20 – 85)*	*(23 – 102)*

TABLE 19

River Tungabhadra upto dam site
(Sub catchment No. 308)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	1–day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELLARY	HADAGALLI	12.58	14.05	15.52	18.90	20.36	23.74
2	BELLARY	HARAPANAHALLI	13.76	15.46	17.15	21.06	22.73	26.63
3	BELLARY	KUDLIGI	13.61	15.29	16.97	20.84	22.50	26.36
4	CHICKMAGALUR	HIREBYLE	38.36	43.67	48.94	61.12	66.35	78.50
5	CHICKMAGALUR	KALASA	34.43	38.26	42.07	50.87	54.65	63.43
6	CHICKMAGALUR	KOPPA (BALGADI)	27.21	30.12	33.01	39.69	42.56	49.23
7	CHICKMAGALUR	NARASIMHARAJAPURA	18.45	20.59	22.71	27.62	29.72	34.62
8	CHICKMAGALUR	SRINGERI	27.38	29.93	32.46	38.30	40.82	46.65
9	CHICKMAGALUR	TARIKERE	15.00	16.90	18.78	23.12	24.99	29.32
10	CHITRADURGA	MALEBENNUR	15.29	17.60	19.89	25.19	27.47	32.76
11	CHITRADURGA	RAMGIRI	12.83	14.56	16.28	20.26	21.97	25.94
12	DHARWAR	HANGAL	13.86	15.45	17.02	20.66	22.22	25.85
13	DHARWAR	HAVERI	14.02	15.84	17.65	21.82	23.61	27.78
14	DHARWAR	HIREKERUR	14.01	15.75	17.47	21.45	23.16	27.13
15	DHARWAR	RANEBENNUR	13.95	15.79	17.62	21.84	23.66	27.87
16	DHARWAR	SHIGGAON	11.44	12.84	14.22	17.42	18.80	21.99
17	DHARWAR	SHIRHATTI	14.09	15.85	17.60	21.63	23.36	27.39
18	KANARA NORTH	SIDDAPUR	29.98	33.47	36.93	44.93	48.37	56.35
19	RAICHUR	YALBURGA	11.77	13.09	14.39	17.40	18.70	21.71
20	SHIMOGA	AGUMBE (O)	46.96	51.74	56.48	67.44	72.15	83.09
21	SHIMOGA	ANANDAPURAM	21.47	24.33	27.16	33.70	36.51	43.04
22	SHIMOGA	ARASALU	25.39	29.02	32.63	40.95	44.53	52.84
23	SHIMOGA	HONNALI	12.99	14.65	16.29	20.10	21.73	25.53
24	SHIMOGA	SAGAR	22.35	24.93	27.49	33.41	35.95	41.85
25	SHIMOGA	SHIMOGA (O)	13.13	14.69	16.24	19.82	21.36	24.93
26	SHIMOGA	SHIRALKOPPA	14.91	16.73	18.53	22.70	24.49	28.65
27	SHIMOGA	SORAB	20.02	22.46	24.88	30.46	32.87	38.44
28	SHIMOGA	THALAGUPPA	26.86	30.02	33.16	40.41	43.53	50.76
29	SHIMOGA	THIRTHAHALLI	28.62	31.73	34.82	41.97	45.04	52.16
		Approx. Range	***(12 – 47)***	***(13 – 52)***	***(14 – 56)***	***(17 – 67)***	***(189– 72)***	***(22 – 83)***

TABLE 20

River Tungabhadra from the dam site to its confluence with river Krishna (Sub catchment No. 309)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	1-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	ANANTAPUR	KANEKAL	11.64	13.03	14.40	17.58	18.95	22.13
2	KURNOOL	ADONI	14.03	15.74	17.43	21.33	23.01	26.91
3	KURNOOL	DHONE	14.22	16.04	17.86	22.06	23.86	28.05
4	KURNOOL	HELALAGUNDI	14.72	16.64	18.54	22.93	24.82	29.20
5	KURNOOL	KOSIGI (KESIGI)	13.56	15.28	16.97	20.90	22.59	26.51
6	KURNOOL	KURNOOL (O)	13.33	14.96	16.58	20.32	21.92	25.66
7	KURNOOL	MADDIKERA	12.17	13.64	15.10	18.48	19.93	23.29
8	KURNOOL	NANDIKOTTUR	15.78	17.90	19.99	24.84	26.92	31.76
9	KURNOOL	YEMMIGANUR	13.91	15.67	17.42	21.46	23.19	27.22
10	MAHBUBNAGAR	UPPAL	16.69	19.10	21.48	27.00	29.37	34.87
11	BELLARY	BELLARY (O)	13.56	15.27	16.97	20.89	22.57	26.48
12	BELLARY	HOSPET	12.55	13.93	15.29	18.44	19.80	22.95
13	BELLARY	KURUGODU	16.03	18.03	20.01	24.58	26.55	31.12
14	CHICKMAGALUR	KADUR	10.97	12.18	13.37	16.13	17.32	20.07
15	CHICKMAGALUR	KALASAPUR	10.54	11.72	12.89	15.60	16.76	19.47
16	CHITRADURGA	BAGUR	14.77	16.56	18.33	22.41	24.17	28.25
17	CHITRADURGA	CHITRADURG (O)	12.86	14.38	15.89	19.38	20.88	24.36
18	CHITRADURGA	DHARAMPUR	14.96	17.22	19.46	24.63	26.85	32.01
19	CHITRADURGA	HIRIYUR	12.55	13.97	15.37	18.61	20.00	23.24
20	CHITRADURGA	JAGALUR (Davangere)	13.57	15.37	17.15	21.29	23.06	27.18
21	CHITRADURGA	MOLAKMURU	12.59	14.01	15.42	18.67	20.07	23.32
22	CHITRADURGA	PARSURAMPUR	10.98	12.21	13.42	16.22	17.43	20.22
23	CHITRADURGA	SRIRAMPUR	12.05	13.34	14.63	17.61	18.89	21.86
24	HASSAN	ARSIKERE	11.82	13.17	14.51	17.60	18.93	22.02
25	HASSAN	HALEBID	15.29	17.40	19.49	24.31	26.39	31.20
26	RAICHUR	GANGAVATI	15.40	17.34	19.27	23.72	25.64	30.08
27	RAICHUR	KUSHTAGI	13.58	15.37	17.14	21.23	22.99	27.08
28	RAICHUR	SINDHANOOR	19.35	22.17	24.98	31.47	34.25	40.73
29	RAICHUR	SIRWAR	15.35	17.40	19.44	24.14	26.16	30.85
30	TUMKUR	BARAGUR	12.87	14.65	16.43	20.52	22.28	26.37
31	TUMKUR	CHIKNAYAKANIHALLI	13.80	15.41	17.01	20.72	22.31	26.01
32	TUMKUR	HONNAVALLI	16.02	18.39	20.74	26.18	28.52	33.95
33	TUMKUR	KALLAMBELLA	12.61	14.06	15.51	18.84	20.28	23.61
34	TUMKUR	NELHAL	19.09	21.88	24.65	31.05	33.80	40.19
35	TUMKUR	SIRA	13.79	15.49	17.18	21.08	22.75	26.64
36	TUMKUR	TOVINKERE	15.33	17.06	18.78	22.75	24.46	28.42
		Approx. Range	*(11 – 19)*	*(12 – 22)*	*(13 – 25)*	*(16–– 31)*	*(16 – 34)*	*(19 – 41)*

TABLE 21

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungahadra (Sub catchment No. 310)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	1-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	GUNTUR	MACHARLA	14.39	16.18	17.95	22.05	23.81	27.90
2	GUNTUR	MANGALGIRI	18.22	20.49	22.74	27.94	30.18	35.38
3	GUNTUR	RENTACHINTALA (O)	16.69	18.96	21.20	26.39	28.62	33.80
4	GUNTUR	SATHENAPALLI	15.03	16.84	18.64	22.79	24.58	28.72
5	HYDERABAD	BEGUMPET (O)	14.70	16.55	18.39	22.64	24.47	28.71
6	HYDERABAD	GANDIPET (OSMANSAGAR)	18.30	20.85	23.37	29.21	31.72	37.54
7	HYDERABAD	IBRAHIMPATNAM	16.37	18.63	20.86	26.03	28.25	33.41
8	HYDERABAD	JANWADA	14.79	16.70	18.60	22.97	24.86	29.22
9	HYDERABAD	SHAHABAD (CHEVELLA)	13.42	15.04	16.65	20.36	21.96	25.66
10	KHAMMAM	KHAMMAM (O)	19.40	22.02	24.62	30.63	33.21	39.21
11	KHAMMAM	MADHIRA	25.19	29.06	32.91	41.79	45.61	54.48
12	KHAMMAM	PALAIR	16.65	18.72	20.77	25.52	27.56	32.29
13	KHAMMAM	YELLANDU	13.72	15.45	17.18	21.16	22.88	26.85
14	KRISHNA	AVANIGADDA	25.93	29.57	33.20	41.56	45.16	53.51
15	KRISHNA	KANKIPADU	21.18	23.96	26.71	33.06	35.80	42.14
16	KRISHNA	KODERU I.B.	27.54	31.51	35.44	44.53	48.44	57.51
17	KRISHNA	MUTCHINTALA	26.23	30.13	34.00	42.94	46.78	55.70
18	KRISHNA	NIMMAGADDA LOCK	25.72	29.32	32.89	41.13	44.68	52.91
19	KRISHNA	POLAMPALLI	30.62	35.47	40.28	51.39	56.17	67.26
20	KRISHNA	PULIGADDA LOCK	26.84	30.63	34.40	43.09	46.82	55.50
21	KRISHNA	T.KOTHAPALEM	33.20	38.25	43.26	54.84	59.82	71.37
22	KRISHNA	TIRUVUR (TIRUVVRU)	19.89	22.52	25.14	31.18	33.78	39.81
23	KRISHNA	VALLURIPALEM LOC	20.65	23.45	26.23	32.66	35.42	41.84
24	KRISHNA	VIJAYAWADA (O)	19.58	22.19	24.79	30.78	33.36	39.33
25	KURNOOL	ATMAKUR	17.31	19.63	21.93	27.24	29.52	34.83
26	KURNOOL	LAKKINISULA	16.48	18.84	21.19	26.63	28.96	34.38
27	MAHBUBNAGAR	ATMAKAUR	21.64	24.87	28.07	35.47	38.65	46.03
28	MAHBUBNAGAR	CHANDRASAGAR	22.14	25.45	28.73	36.33	39.59	47.16
29	MAHBUBNAGAR	KODANGAL	16.84	18.98	21.10	26.00	28.11	33.00
30	MAHBUBNAGAR	KOLLAPUR (KOLHAPUR)	22.46	25.87	29.25	37.06	40.42	48.21
31	MAHBUBNAGAR	MAHBUBNAGAR (O)	14.88	16.67	18.44	22.54	24.30	28.39
32	MAHBUBNAGAR	MAKTHAL (MUKTHAL)	16.29	18.52	20.73	25.85	28.05	33.16
33	MAHBUBNAGAR	NAGARKURNOOL	16.03	18.23	20.41	25.45	27.62	32.65
34	MEDAK	GHANAPUR	18.66	21.01	23.35	28.75	31.07	36.45
35	NALGONDA	DEVARKONDA	16.58	18.66	20.73	25.51	27.56	32.33
36	NALGONDA	HUZURNAGAR	19.35	22.06	24.74	30.94	33.61	39.79
37	NALGONDA	NALGONDA	16.06	18.10	20.12	24.79	26.80	31.47
38	NALGONDA	PALLIWADA P	15.51	17.66	19.79	24.72	26.83	31.75
39	WARANGAL	GHANPUR	21.45	24.51	27.54	34.55	37.56	44.56
40	WARANGAL	MAHBUBABAD	16.60	18.56	20.51	25.00	26.93	31.42
41	WARANGAL	NARSAMPET	19.35	21.73	24.09	29.55	31.90	37.35
42	RAICHUR	RAICHUR (O)	13.89	15.51	17.12	20.84	22.44	26.16
		Approx. Range	***(13 – 33)***	***(15 – 38)***	***(16 – 44)***	***(20 – 55)***	***(21 – 60)***	***(25 – 71)***

TABLE 22

River Krishna upto its confluence with River Bhima, excluding river Bhima
(Sub catchment No. 306)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	2-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELGAUM	ATHANI	16.64	18.72	20.78	25.54	27.59	32.35
2	BELGAUM	BELGAUM (O)	29.89	33.83	37.74	46.76	50.64	59.65
3	BELGAUM	CHIKODI	15.16	16.96	18.74	22.87	24.64	28.76
4	BELGAUM	GOKAK	15.02	16.82	18.62	22.75	24.53	28.66
5	BELGAUM	KHANAPUR	38.14	42.65	47.13	57.48	61.92	72.25
6	BELGAUM	RAMDURG	14.70	16.47	18.22	22.27	24.01	28.05
7	BELGAUM	SAMBRA AERO (O)	22.90	25.78	28.64	35.25	38.09	44.68
8	BELGAUM	SAUNDATTI	15.21	17.13	19.03	23.43	25.32	29.70
9	BIJAPUR	BADAMI	16.02	17.92	19.79	24.13	26.00	30.33
10	BIJAPUR	BAGEWADI	17.49	19.64	21.78	26.71	28.83	33.75
11	BIJAPUR	BILGI	16.36	18.36	20.35	24.94	26.92	31.50
12	BIJAPUR	JAMKHANDI	14.94	16.63	18.30	22.17	23.84	27.70
13	BIJAPUR	MUDDEBIHAL	15.21	17.00	18.78	22.89	24.66	28.77
14	DHARWAR	DHARWAR	16.81	18.77	20.72	25.24	27.18	31.68
15	DHARWAR	GADAG (O)	20.77	23.73	26.68	33.47	36.39	43.17
16	GULBARGA	SHAHPUR	21.51	24.09	26.65	32.56	35.10	40.99
17	RAICHUR	DEODURGA	21.25	23.94	26.62	32.80	35.45	41.62
18	RAICHUR	LINGASUGUR	14.93	16.65	18.36	22.30	24.00	27.93
19	KOLHAPUR	AJRA	36.66	40.14	43.60	51.60	55.04	63.02
20	KOLHAPUR	CHANDGAD	40.92	45.01	49.08	58.47	62.50	71.87
21	KOLHAPUR	GADHINGLAJ	22.40	25.23	28.03	34.52	37.30	43.77
22	KOLHAPUR	GARGOTI	28.43	31.68	34.90	42.34	45.55	52.97
23	KOLHAPUR	KOLHAPUR (O)	22.51	25.34	28.16	34.67	37.47	43.96
24	KOLHAPUR	KURUNDWAD	13.41	15.07	16.71	20.51	22.14	25.93
25	KOLHAPUR	PANHALA	30.39	33.43	36.44	43.40	46.40	53.34
26	KOLHAPUR	RADHANAGARI	48.86	53.63	58.36	69.29	73.99	84.91
27	KOLHAPUR	SHAHUWADI	33.94	37.59	41.21	49.58	53.19	61.54
28	SANGLI	ISLAMPUR	18.18	20.50	22.80	28.11	30.39	35.69
29	SANGLI	MIRAJ (O)	15.31	17.16	18.99	23.22	25.04	29.26
30	SANGLI	SHIRALA	21.25	23.82	26.38	32.28	34.82	40.71
31	SANGLI	TASGAON	14.52	16.12	17.71	21.38	22.95	26.61
32	SATARA	KARAD	18.02	20.23	22.42	27.49	29.67	34.72
33	SATARA	KOREGAON	17.30	19.43	21.54	26.43	28.53	33.40
34	SATARA	MAHABALESHWAR (O)	71.42	77.44	83.42	97.24	103.18	116.96
35	SATARA	MEDHA	31.77	34.92	38.05	45.29	48.40	55.61
36	SATARA	PANCHGANI	31.20	34.45	37.67	45.13	48.33	55.77
37	SATARA	PATAN	34.73	38.66	42.55	51.55	55.42	64.40
38	SATARA	SATARA (O)	23.49	26.46	29.41	36.23	39.16	45.96
39	SATARA	VADUJ	14.35	16.00	17.62	21.39	23.01	26.76
40	SATARA	WAI	18.68	20.91	23.13	28.25	30.45	35.57
		Approx. Range	*(13 – 71)*	*(15 – 77)*	*(16 – 83)*	*(20 – 97)*	*(22 – 103*	*(25 –117)*

TABLE 23

River Bhima
(Sub catchment No. 307)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	2-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	HYDERABAD	PARGI	21.55	23.96	26.36	31.91	34.30	39.83
2	HYDERABAD	VIKARABAD	23.64	26.67	29.68	36.64	39.63	46.57
3	BIJAPUR	BIJAPUR (O)	17.03	19.15	21.26	26.13	28.22	33.08
4	BIJAPUR	INDI	15.95	17.81	19.65	23.91	25.75	30.00
5	BIJAPUR	SINDGI	16.74	18.76	20.76	25.40	27.39	32.01
6	GULBARGA	AFZALPUR	15.55	17.19	18.81	22.57	24.18	27.93
7	GULBARGA	ALAND	21.33	23.97	26.59	32.65	35.26	41.30
8	GULBARGA	CHINCHOLI	20.20	22.52	24.83	30.16	32.45	37.77
9	GULBARGA	GULBARGA (O)	17.83	19.83	21.81	26.39	28.36	32.93
10	GULBARGA	JEWARGI	21.12	23.79	26.44	32.57	35.20	41.31
11	GULBARGA	SERAM	19.58	21.86	24.12	29.33	31.58	36.78
12	GULBARGA	YADGIR	19.99	22.44	24.86	30.47	32.89	38.48
13	AHMEDNAGAR	AHMEDNAGAR (O)	18.71	20.95	23.18	28.33	30.55	35.68
14	AHMEDNAGAR	JAMKHED	20.52	23.12	25.70	31.66	34.23	40.18
15	AHMEDNAGAR	MIRAJGAON	18.93	21.29	23.63	29.05	31.38	36.78
16	OSMANABAD	OSMANABAD	20.90	23.51	26.11	32.09	34.67	40.64
17	OSMANABAD	TULJAPUR	20.27	22.62	24.96	30.35	32.66	38.04
18	POONA	BARAMATI (O)	16.07	17.98	19.87	24.25	26.14	30.50
19	POONA	BHOR	22.71	25.58	28.43	35.02	37.85	44.42
20	POONA	DHOND	16.59	18.68	20.76	25.56	27.62	32.41
21	POONA	INDAPUR	17.02	19.15	21.27	26.16	28.26	33.13
22	POONA	JEJURI	16.56	18.80	21.02	26.16	28.36	33.49
23	POONA	JUNNAR	22.85	26.06	29.25	36.63	39.80	47.15
24	POONA	KHANDALA (O)	77.32	88.98	100.55	127.30	138.80	165.49
25	POONA	KHED	17.09	19.11	21.13	25.77	27.77	32.41
26	POONA	LONAVALA (O)	68.05	75.32	82.54	99.21	106.38	123.02
27	POONA	POONA (O)	17.39	19.45	21.49	26.22	28.25	32.97
28	POONA	SIRUR	16.71	18.76	20.79	25.49	27.51	32.20
29	POONA	VADGAON	26.03	29.26	32.47	39.89	43.08	50.48
30	POONA	VELHE	54.79	61.54	68.24	83.73	90.39	105.84
31	SANGLI	JATH	17.45	19.70	21.92	27.07	29.29	34.43
32	SATARA	MHASWAD	15.82	17.67	19.51	23.76	25.59	29.82
33	SATARA	PHALTAN	16.16	18.16	20.14	24.73	26.70	31.27
34	SHOLAPUR	BARSI	16.10	17.86	19.60	23.62	25.35	29.37
35	SHOLAPUR	KARMALA	18.73	21.01	23.27	28.49	30.74	35.95
36	SHOLAPUR	MADHA	16.21	17.96	19.70	23.72	25.45	29.45
37	SHOLAPUR	MALSIRAS	17.41	19.61	21.81	26.87	29.05	34.10
38	SHOLAPUR	PANDHARPUR	20.77	23.49	26.18	32.41	35.09	41.31
39	SHOLAPUR	SHOLAPUR (O)	17.87	19.96	22.03	26.82	28.88	33.65
		Approx. Range	*(15 – 68)*	*(17 – 75)*	*(18 – 101*	*(22 – 127*	*(24 – 139)*	(27 – 165)

TABLE 24

River Tungabhadra upto dam site
(Sub catchment No. 308)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	2-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELLARY	HADAGALLI	14.96	16.69	18.40	22.36	24.07	28.02
2	BELLARY	HARAPANAHALLI	17.28	19.47	21.64	26.65	28.81	33.81
3	BELLARY	KUDLIGI	16.95	19.07	21.16	26.01	28.10	32.94
4	CHICKMAGALUR	HIREBYLE	68.35	78.23	88.05	110.72	120.47	143.10
5	CHICKMAGALUR	KALASA	57.79	64.21	70.59	85.32	91.65	106.35
6	CHICKMAGALUR	KOPPA (BALGADI)	44.71	49.46	54.18	65.07	69.76	80.63
7	CHICKMAGALUR	NARASIMHARAJAPURA	29.40	32.84	36.26	44.15	47.54	55.41
8	CHICKMAGALUR	SRINGERI	44.89	48.84	52.76	61.81	65.70	74.73
9	CHICKMAGALUR	TARIKERE	18.24	20.43	22.60	27.61	29.77	34.77
10	CHITRADURGA	MALEBENNUR	18.24	20.82	23.38	29.30	31.85	37.76
11	CHITRADURGA	RAMGIRI	15.92	18.02	20.11	24.93	27.00	31.82
12	DHARWAR	HANGAL	19.87	22.23	24.57	29.97	32.29	37.68
13	DHARWAR	HAVERI	16.89	19.09	21.28	26.33	28.50	33.54
14	DHARWAR	HIREKERUR	17.79	19.96	22.11	27.08	29.22	34.18
15	DHARWAR	RANEBENNUR	16.82	19.00	21.16	26.15	28.30	33.28
16	DHARWAR	SHIGGAON	15.33	17.27	19.19	23.62	25.53	29.96
17	DHARWAR	SHIRHATTI	18.01	20.25	22.46	27.59	29.79	34.90
18	KANARA NORTH	SIDDAPUR	49.47	55.18	60.86	73.98	79.62	92.70
19	RAICHUR	YALBURGA	14.35	15.91	17.45	21.01	22.55	26.10
20	SHIMOGA	AGUMBE (O)	77.10	84.44	91.72	108.55	115.78	132.58
21	SHIMOGA	ANANDAPURAM	32.41	36.55	40.65	50.14	54.21	63.68
22	SHIMOGA	ARASALU	36.15	41.03	45.86	57.04	61.84	73.00
23	SHIMOGA	HONNALI	16.28	18.36	20.43	25.21	27.27	32.04
24	SHIMOGA	SAGAR	35.21	39.22	43.20	52.40	56.35	65.53
25	SHIMOGA	SHIMOGA (O)	17.73	19.86	21.98	26.88	28.99	33.87
26	SHIMOGA	SHIRALKOPPA	18.90	21.07	23.23	28.22	30.36	35.33
27	SHIMOGA	SORAB	30.14	33.81	37.44	45.85	49.46	57.85
28	SHIMOGA	THALAGUPPA	47.31	53.21	59.07	72.59	78.41	91.91
29	SHIMOGA	THIRTHAHALLI	45.62	50.38	55.11	66.04	70.74	81.65
		Approx. Range	***(14 – 77)***	***(15 – 84)***	***(17 – 92)***	***(21 – 109)***	***(22 – 116)***	***(29 – 132)***

TABLE 25

River Tungabhadra from the dam site to its confluence with river Krishna (Sub catchment No. 309)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	2-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	ANANTAPUR	KANEKAL	14.76	16.58	18.40	22.58	24.38	28.56
2	KURNOOL	ADONI	16.12	17.98	19.83	24.10	25.93	30.20
3	KURNOOL	DHONE	18.05	20.40	22.74	28.15	30.47	35.87
4	KURNOOL	HELALAGUNDI	18.19	20.62	23.03	28.60	30.99	36.55
5	KURNOOL	KOSIGI (KESIGI)	16.69	18.85	21.00	25.96	28.09	33.04
6	KURNOOL	KURNOOL (O)	18.77	21.30	23.81	29.61	32.10	37.89
7	KURNOOL	MADDIKERA	15.55	17.47	19.38	23.80	25.70	30.10
8	KURNOOL	NANDIKOTTUR	20.93	23.83	26.71	33.36	36.22	42.87
9	KURNOOL	YEMMIGANUR	17.94	20.25	22.54	27.85	30.13	35.42
10	MAHBUBNAGAR	UPPAL	24.35	28.13	31.89	40.58	44.31	52.98
11	BELLARY	BELLARY (O)	16.05	18.01	19.96	24.46	26.39	30.88
12	BELLARY	HOSPET	17.29	19.33	21.36	26.05	28.06	32.74
13	BELLARY	KURUGODU	18.74	21.07	23.39	28.74	31.04	36.39
14	CHICKMAGALUR	KADUR	14.08	15.65	17.20	20.81	22.35	25.95
15	CHICKMAGALUR	KALASAPUR	14.12	15.73	17.33	21.02	22.61	26.29
16	CHITRADURGA	BAGUR	19.93	22.43	24.92	30.66	33.13	38.86
17	CHITRADURGA	CHITRADURG (O)	15.62	17.42	19.20	23.33	25.10	29.22
18	CHITRADURGA	DHARAMPUR	19.16	22.12	25.05	31.83	34.75	41.52
19	CHITRADURGA	HIRIYUR	16.78	18.82	20.83	25.50	27.50	32.15
20	CHITRADURGA	JAGALUR (Davangere)	15.68	17.62	19.55	24.01	25.93	30.37
21	CHITRADURGA	MOLAKMURU	16.92	18.99	21.04	25.78	27.82	32.56
22	CHITRADURGA	PARSURAMPUR	13.76	15.23	16.69	20.07	21.52	24.89
23	CHITRADURGA	SRIRAMPUR	17.10	19.21	21.31	26.16	28.24	33.08
24	HASSAN	ARSIKERE	14.78	16.46	18.13	21.98	23.64	27.48
25	HASSAN	HALEBID	21.62	24.73	27.81	34.93	37.99	45.10
26	RAICHUR	GANGAVATI	18.34	20.65	22.94	28.23	30.51	35.79
27	RAICHUR	KUSHTAGI	17.02	19.28	21.52	26.69	28.92	34.08
28	RAICHUR	SINDHANOOR	24.98	28.72	32.44	41.03	44.72	53.29
29	RAICHUR	SIRWAR	17.12	19.19	21.24	25.99	28.03	32.77
30	TUMKUR	BARAGUR	15.96	18.19	20.40	25.50	27.69	32.78
31	TUMKUR	CHIKNAYAKANIHALLI	16.78	18.68	20.57	24.93	26.80	31.15
32	TUMKUR	HONNAVALLI	18.88	21.52	24.15	30.22	32.82	38.88
33	TUMKUR	KALLAMBELLA	17.51	19.75	21.98	27.13	29.34	34.48
34	TUMKUR	NELHAL	23.27	26.77	30.25	38.27	41.72	49.73
35	TUMKUR	SIRA	17.42	19.60	21.77	26.78	28.94	33.94
36	TUMKUR	TOVINKERE	17.88	19.80	21.71	26.12	28.02	32.41
		Approx. Range	*(13 – 25)*	*(15 – 28)*	*(16 – 32)*	*(20 – 41)*	*(21 – 45)*	*(25 – 53)*

TABLE 26

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungahadra (Sub catchment No. 310)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	2-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	GUNTUR	MACHARLA	18.46	20.77	23.06	28.36	30.63	35.92
2	GUNTUR	MANGALGIRI	24.78	28.02	31.23	38.67	41.86	49.28
3	GUNTUR	RENTACHINTALA (O)	20.55	23.28	25.99	32.24	34.93	41.17
4	GUNTUR	SATHENAPALLI	21.31	24.03	26.73	32.96	35.64	41.87
5	HYDERABAD	BEGUMPET (O)	19.90	22.51	25.10	31.08	33.65	39.61
6	HYDERABAD	GANDIPET (OSMANSAGAR)	23.12	26.34	29.53	36.91	40.08	47.43
7	HYDERABAD	IBRAHIMPATNAM	21.00	23.86	26.71	33.29	36.11	42.68
8	HYDERABAD	JANWADA	20.32	23.02	25.71	31.92	34.58	40.77
9	HYDERABAD	SHAHABAD (CHEVELLA)	17.37	19.40	21.41	26.07	28.08	32.73
10	KHAMMAM	KHAMMAM (O)	24.56	27.79	31.00	38.41	41.60	49.00
11	KHAMMAM	MADHIRA	33.19	38.33	43.44	55.23	60.30	72.06
12	KHAMMAM	PALAIR	24.62	27.99	31.33	39.07	42.39	50.11
13	KHAMMAM	YELLANDU	17.42	19.67	21.92	27.09	29.32	34.49
14	KRISHNA	AVANIGADDA	34.96	39.93	44.86	56.27	61.17	72.55
15	KRISHNA	KANKIPADU	28.45	32.29	36.10	44.91	48.70	57.49
16	KRISHNA	KODERU I.B.	35.96	41.20	46.41	58.45	63.62	75.63
17	KRISHNA	MUTCHINTALA	36.32	41.79	47.23	59.80	65.20	77.74
18	KRISHNA	NIMMAGADDA LOCK	33.74	38.44	43.11	53.89	58.52	69.28
19	KRISHNA	POLAMPALLI	37.08	42.64	48.16	60.91	66.39	79.12
20	KRISHNA	PULIGADDA LOCK	36.70	42.03	47.33	59.57	64.83	77.04
21	KRISHNA	T.KOTHAPALEM	41.95	48.09	54.19	68.28	74.33	88.39
22	KRISHNA	TIRUVUR (TIRUVVRU)	25.53	28.87	32.19	39.86	43.16	50.81
23	KRISHNA	VALLURIPALEM LOC	27.83	31.63	35.41	44.13	47.89	56.59
24	KRISHNA	VIJAYAWADA (O)	25.82	29.40	32.94	41.13	44.66	52.83
25	KURNOOL	ATMAKUR	23.18	26.38	29.55	36.87	40.02	47.33
26	KURNOOL	LAKKINISULA	25.57	29.44	33.28	42.16	45.98	54.84
27	MAHBUBNAGAR	ATMAKAUR	31.50	36.49	41.45	52.92	57.84	69.28
28	MAHBUBNAGAR	CHANDRASAGAR	27.50	31.52	35.52	44.75	48.72	57.93
29	MAHBUBNAGAR	KODANGAL	20.22	22.68	25.13	30.78	33.21	38.84
30	MAHBUBNAGAR	KOLLAPUR (KOLHAPUR)	30.64	35.41	40.15	51.08	55.78	66.70
31	MAHBUBNAGAR	MAHBUBNAGAR (O)	19.10	21.36	23.59	28.76	30.98	36.14
32	MAHBUBNAGAR	MAKTHAL (MUKTHAL)	18.80	21.18	23.55	29.01	31.36	36.80
33	MAHBUBNAGAR	NAGARKURNOOL	22.04	25.21	28.35	35.61	38.73	45.97
34	MEDAK	GHANAPUR	26.99	30.55	34.09	42.27	45.79	53.95
35	NALGONDA	DEVARKONDA	21.43	24.19	26.92	33.24	35.96	42.27
36	NALGONDA	HUZURNAGAR	24.32	27.58	30.80	38.26	41.47	48.91
37	NALGONDA	NALGONDA	22.08	25.11	28.12	35.06	38.05	44.98
38	NALGONDA	PALLIWADA P	19.88	22.69	25.48	31.93	34.70	41.14
39	WARANGAL	GHANPUR	29.16	33.34	37.48	47.05	51.17	60.72
40	WARANGAL	MAHBUBABAD	25.07	28.30	31.49	38.89	42.07	49.44
41	WARANGAL	NARSAMPET	25.62	28.71	31.79	38.89	41.95	49.04
42	RAICHUR	RAICHUR (O)	18.85	21.23	23.59	29.04	31.39	36.83
		Approx. Range	*(17 – 42)*	*(19 – 48)*	*(21 – 54)*	*(26 – 68)*	*(28 – 74)*	*(32 – 88)*

TABLE 27

River Krishna upto its confluence with River Bhima, excluding river Bhima
(Sub catchment No. 306)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	3-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELGAUM	ATHANI	18.90	21.25	23.58	28.98	31.29	36.67
2	BELGAUM	BELGAUM (O)	36.14	40.78	45.39	56.05	60.63	71.26
3	BELGAUM	CHIKODI	17.09	19.12	21.13	25.79	27.79	32.44
4	BELGAUM	GOKAK	16.40	18.31	20.20	24.57	26.45	30.81
5	BELGAUM	KHANAPUR	48.00	53.51	58.97	71.59	77.02	89.62
6	BELGAUM	RAMDURG	17.09	19.20	21.29	26.13	28.21	33.03
7	BELGAUM	SAMBRA AERO (O)	28.01	31.58	35.12	43.31	46.83	55.01
8	BELGAUM	SAUNDATTI	17.85	20.12	22.37	27.57	29.81	35.00
9	BIJAPUR	BADAMI	17.53	19.50	21.47	26.00	27.95	32.48
10	BIJAPUR	BAGEWADI	19.58	21.98	24.35	29.83	32.19	37.66
11	BIJAPUR	BILGI	18.68	20.98	23.27	28.54	30.81	36.08
12	BIJAPUR	JAMKHANDI	17.62	19.67	21.71	26.42	28.45	33.15
13	BIJAPUR	MUDDEBIHAL	17.32	19.34	21.34	25.97	27.97	32.59
14	DHARWAR	DHARWAR	19.43	21.71	23.98	29.21	31.46	36.68
15	DHARWAR	GADAG (O)	24.02	27.48	30.92	38.87	42.28	50.21
16	GULBARGA	SHAHPUR	24.91	27.87	30.81	37.61	40.53	47.31
17	RAICHUR	DEODURGA	24.39	27.45	30.48	37.50	40.52	47.53
18	RAICHUR	LINGASUGUR	16.57	18.43	20.28	24.55	26.38	30.64
19	KOLHAPUR	AJRA	47.24	51.57	55.87	65.81	70.09	80.00
20	KOLHAPUR	CHANDGAD	53.82	59.10	64.34	76.46	81.66	93.75
21	KOLHAPUR	GADHINGLAJ	26.64	29.97	33.27	40.92	44.20	51.83
22	KOLHAPUR	GARGOTI	37.31	41.55	45.76	55.49	59.67	69.38
23	KOLHAPUR	KOLHAPUR (O)	27.43	30.87	34.28	42.17	45.56	53.44
24	KOLHAPUR	KURUNDWAD	16.77	19.02	21.26	26.43	28.65	33.81
25	KOLHAPUR	PANHALA	38.46	42.36	46.24	55.20	59.05	67.99
26	KOLHAPUR	RADHANAGARI	66.17	72.61	79.00	93.77	100.12	114.86
27	KOLHAPUR	SHAHUWADI	42.65	47.12	51.55	61.79	66.20	76.42
28	SANGLI	ISLAMPUR	20.44	22.99	25.51	31.35	33.86	39.68
29	SANGLI	MIRAJ (O)	17.48	19.63	21.76	26.69	28.81	33.73
30	SANGLI	SHIRALA	24.97	28.04	31.09	38.13	41.16	48.18
31	SANGLI	TASGAON	16.16	17.90	19.62	23.62	25.33	29.32
32	SATARA	KARAD	20.56	23.05	25.53	31.25	33.72	39.43
33	SATARA	KOREGAON	20.25	22.72	25.18	30.85	33.29	38.95
34	SATARA	MAHABALESHWAR (O)	95.80	103.93	112.00	130.64	138.66	157.26
35	SATARA	MEDHA	41.44	45.55	49.64	59.08	63.14	72.57
36	SATARA	PANCHGANI	40.79	45.12	49.41	59.33	63.59	73.49
37	SATARA	PATAN	45.58	50.75	55.88	67.73	72.82	84.64
38	SATARA	SATARA (O)	28.49	32.02	35.51	43.59	47.07	55.13
39	SATARA	VADUJ	16.79	18.77	20.75	25.30	27.26	31.81
40	SATARA	WAI	21.87	24.47	27.04	32.98	35.54	41.47
		Approx. Range	*(16 – 96)*	*(17 – 104*	*(19 – 112*	*(23 – 131*	*(25 – 139*	*(29 – 157)*

TABLE 28

River Bhima
(Sub catchment No. 307)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	3-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	HYDERABAD	PARGI	23.58	26.07	28.53	34.23	36.67	42.36
2	HYDERABAD	VIKARABAD	25.29	28.39	31.46	38.58	41.63	48.73
3	BIJAPUR	BIJAPUR (O)	19.43	21.84	24.24	29.78	32.17	37.69
4	BIJAPUR	INDI	18.24	20.37	22.49	27.38	29.48	34.35
5	BIJAPUR	SINDGI	19.27	21.61	23.94	29.31	31.62	36.98
6	GULBARGA	AFZALPUR	17.86	19.76	21.65	26.01	27.89	32.24
7	GULBARGA	ALAND	23.61	26.43	29.22	35.68	38.46	44.91
8	GULBARGA	CHINCHOLI	23.99	26.76	29.50	35.85	38.57	44.90
9	GULBARGA	GULBARGA (O)	20.93	23.30	25.65	31.09	33.43	38.86
10	GULBARGA	JEWARGI	22.86	25.66	28.44	34.87	37.64	44.05
11	GULBARGA	SERAM	22.63	25.33	28.00	34.20	36.86	43.03
12	GULBARGA	YADGIR	23.61	26.47	29.30	35.85	38.67	45.20
13	AHMEDNAGAR	AHMEDNAGAR (O)	20.56	22.95	25.32	30.80	33.16	38.62
14	AHMEDNAGAR	JAMKHED	22.82	25.65	28.46	34.95	37.74	44.21
15	AHMEDNAGAR	MIRAJGAON	21.71	24.46	27.18	33.46	36.17	42.44
16	OSMANABAD	OSMANABAD	23.22	26.02	28.79	35.20	37.96	44.36
17	OSMANABAD	TULJAPUR	23.56	26.21	28.84	34.93	37.54	43.61
18	POONA	BARAMATI (O)	19.01	21.33	23.63	28.94	31.23	36.53
19	POONA	BHOR	27.89	31.43	34.94	43.07	46.56	54.67
20	POONA	DHOND	18.25	20.51	22.75	27.92	30.15	35.31
21	POONA	INDAPUR	20.24	22.84	25.42	31.39	33.96	39.91
22	POONA	JEJURI	18.39	20.84	23.27	28.89	31.30	36.90
23	POONA	JUNNAR	26.78	30.50	34.20	42.74	46.41	54.94
24	POONA	KHANDALA (O)	98.90	113.86	128.72	163.05	177.81	212.06
25	POONA	KHED	20.34	22.81	25.26	30.92	33.35	39.00
26	POONA	LONAVALA (O)	86.23	95.07	103.84	124.11	132.82	153.04
27	POONA	POONA (O)	20.62	23.12	25.60	31.33	33.80	39.52
28	POONA	SIRUR	18.84	21.14	23.42	28.68	30.95	36.20
29	POONA	VADGAON	32.07	36.01	39.91	48.94	52.82	61.83
30	POONA	VELHE	70.36	78.92	87.41	107.04	115.48	135.06
31	SANGLI	JATH	20.18	22.81	25.41	31.43	34.02	40.03
32	SATARA	MHASWAD	18.62	20.87	23.10	28.26	30.47	35.62
33	SATARA	PHALTAN	18.19	20.41	22.61	27.69	29.88	34.95
34	SHOLAPUR	BARSI	19.37	21.53	23.67	28.62	30.75	35.69
35	SHOLAPUR	KARMALA	21.40	24.02	26.62	32.64	35.22	41.22
36	SHOLAPUR	MADHA	19.16	21.30	23.43	28.34	30.45	35.35
37	SHOLAPUR	MALSIRAS	19.74	22.22	24.69	30.39	32.84	38.52
38	SHOLAPUR	PANDHARPUR	24.01	27.12	30.22	37.37	40.44	47.57
39	SHOLAPUR	SHOLAPUR (O)	20.58	22.97	25.34	30.81	33.17	38.63
		Approx. Range	*(17 – 98)*	*(19 –114)*	*(21– 129)*	*(26 – 163*	*(27 – 178)*	*(32 –212)*

TABLE 29

River Tungabhadra upto dam site
(Sub catchment No. 308)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	3-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	BELLARY	HADAGALLI	18.32	20.55	22.77	27.90	30.10	35.21
2	BELLARY	HARAPANAHALLI	19.38	21.81	24.21	29.77	32.16	37.71
3	BELLARY	KUDLIGI	19.53	21.96	24.38	29.96	32.36	37.93
4	CHICKMAGALUR	HIREBYLE	90.76	103.99	117.12	147.48	160.52	190.81
5	CHICKMAGALUR	KALASA	79.22	88.37	97.45	118.43	127.45	148.39
6	CHICKMAGALUR	KOPPA (BALGADI)	55.80	61.34	66.84	79.55	85.01	97.69
7	CHICKMAGALUR	NARASIMHARAJAPURA	37.56	41.91	46.22	56.18	60.47	70.41
8	CHICKMAGALUR	SRINGERI	59.23	64.34	69.41	81.13	86.17	97.87
9	CHICKMAGALUR	TARIKERE	21.32	23.79	26.24	31.89	34.33	39.97
10	CHITRADURGA	MALEBENNUR	19.95	22.71	25.45	31.78	34.50	40.82
11	CHITRADURGA	RAMGIRI	17.56	19.82	22.07	27.25	29.48	34.65
12	DHARWAR	HANGAL	23.56	26.35	29.12	35.53	38.28	44.68
13	DHARWAR	HAVERI	18.60	20.93	23.25	28.61	30.92	36.27
14	DHARWAR	HIREKERUR	19.93	22.32	24.68	30.15	32.50	37.96
15	DHARWAR	RANEBENNUR	18.25	20.57	22.87	28.19	30.48	35.79
16	DHARWAR	SHIGGAON	17.49	19.61	21.72	26.60	28.69	33.56
17	DHARWAR	SHIRHATTI	19.84	22.25	24.64	30.16	32.53	38.03
18	KANARA NORTH	SIDDAPUR	63.43	70.58	77.68	94.08	101.13	117.49
19	RAICHUR	YALBURGA	15.90	17.56	19.20	23.00	24.63	28.42
20	SHIMOGA	AGUMBE (O)	101.39	110.88	120.30	142.06	151.42	173.13
21	SHIMOGA	ANANDAPURAM	39.44	44.48	49.47	61.01	65.97	77.49
22	SHIMOGA	ARASALU	46.39	52.76	59.07	73.67	79.94	94.51
23	SHIMOGA	HONNALI	18.90	21.34	23.75	29.33	31.73	37.30
24	SHIMOGA	SAGAR	44.11	48.98	53.82	64.99	69.80	80.95
25	SHIMOGA	SHIMOGA (O)	20.76	23.24	25.71	31.41	33.85	39.54
26	SHIMOGA	SHIRALKOPPA	21.94	24.40	26.84	32.48	34.91	40.54
27	SHIMOGA	SORAB	37.35	41.79	46.19	56.38	60.76	70.93
28	SHIMOGA	THALAGUPPA	62.25	70.09	77.86	95.82	103.54	121.47
29	SHIMOGA	THIRTHAHALLI	59.76	65.98	72.16	86.44	92.58	106.83
		Approx. Range	***(15 – 101)***	***(17 – 111)***	***(19 – 120)***	***(23 – 147)***	***(24 – 160)***	***(28 – 173)***

TABLE 30

River Tungabhadra from the dam site to its confluence with river Krishna (Sub catchment No. 309)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	3-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	ANANTAPUR	KANEKAL	17.80	20.07	22.32	27.53	29.77	34.97
2	KURNOOL	ADONI	18.88	21.13	23.36	28.53	30.75	35.91
3	KURNOOL	DHONE	20.23	22.85	25.46	31.48	34.07	40.07
4	KURNOOL	HELALAGUNDI	21.71	24.75	27.77	34.74	37.74	44.70
5	KURNOOL	KOSIGI (KESIGI)	19.32	21.84	24.34	30.12	32.61	38.38
6	KURNOOL	KURNOOL (O)	21.83	24.77	27.67	34.39	37.28	43.99
7	KURNOOL	MADDIKERA	18.90	21.37	23.83	29.51	31.95	37.61
8	KURNOOL	NANDIKOTTUR	23.20	26.45	29.67	37.12	40.32	47.75
9	KURNOOL	YEMMIGANUR	19.79	22.33	24.85	30.69	33.19	39.01
10	MAHBUBNAGAR	UPPAL	27.34	31.56	35.74	45.40	49.55	59.19
11	BELLARY	BELLARY (O)	18.52	20.80	23.07	28.31	30.57	35.80
12	BELLARY	HOSPET	19.20	21.45	23.68	28.85	31.06	36.22
13	BELLARY	KURUGODU	20.81	23.46	26.08	32.14	34.75	40.80
14	CHICKMAGALUR	KADUR	16.04	17.82	19.58	23.66	25.41	29.48
15	CHICKMAGALUR	KALASAPUR	16.69	18.54	20.37	24.62	26.44	30.68
16	CHITRADURGA	BAGUR	22.77	25.59	28.40	34.89	37.68	44.15
17	CHITRADURGA	CHITRADURG (O)	17.25	19.20	21.14	25.61	27.53	31.99
18	CHITRADURGA	DHARAMPUR	23.11	26.74	30.33	38.64	42.21	50.50
19	CHITRADURGA	HIRIYUR	19.39	21.77	24.14	29.60	31.95	37.39
20	CHITRADURGA	JAGALUR (Davangere)	17.21	19.31	21.40	26.23	28.31	33.13
21	CHITRADURGA	MOLAKMURU	18.75	21.03	23.30	28.53	30.78	36.01
22	CHITRADURGA	PARSURAMPUR	15.53	17.26	18.97	22.93	24.64	28.59
23	CHITRADURGA	SRIRAMPUR	18.10	20.25	22.38	27.30	29.42	34.33
24	HASSAN	ARSIKERE	17.89	19.97	22.04	26.81	28.87	33.63
25	HASSAN	HALEBID	27.40	31.48	35.52	44.87	48.89	58.22
26	RAICHUR	GANGAVATI	21.82	24.67	27.49	34.01	36.82	43.33
27	RAICHUR	KUSHTAGI	18.80	21.21	23.59	29.11	31.49	36.99
28	RAICHUR	SINDHANOOR	27.89	32.03	36.13	45.62	49.70	59.17
29	RAICHUR	SIRWAR	21.78	24.64	27.47	34.03	36.85	43.39
30	TUMKUR	BARAGUR	20.90	24.01	27.11	34.26	37.34	44.48
31	TUMKUR	CHIKNAYAKANIHALLI	19.54	21.77	23.99	29.12	31.32	36.44
32	TUMKUR	HONNAVALLI	21.67	24.74	27.79	34.84	37.87	44.90
33	TUMKUR	KALLAMBELLA	20.63	23.29	25.92	32.01	34.63	40.71
34	TUMKUR	NELHAL	26.69	30.69	34.65	43.81	47.75	56.89
35	TUMKUR	SIRA	19.58	22.01	24.43	30.02	32.42	38.00
36	TUMKUR	TOVINKERE	21.96	24.54	27.09	32.99	35.52	41.41
		Approx. Range	*(15 – 28)*	*(17 – 32)*	*(18– 36)*	*(22 – 46)*	*(24 – 50)*	*(30 – 59)*

TABLE 31

River Krishna from its confluence with river Bhima to its mouth, excluding the Tungahadra (Sub catchment No. 310)

Estimation of maximum rainfall values (cm) for different Return Periods

No.	District	Station Name	3-day duration					
			25 yrs	50 yrs	100 yrs	500 yrs	1000 yrs	5000 yrs
1	GUNTUR	MACHARLA	20.67	23.21	25.73	31.55	34.05	39.87
2	GUNTUR	MANGALGIRI	29.08	33.02	36.93	45.96	49.84	58.86
3	GUNTUR	RENTACHINTALA (O)	21.74	24.55	27.33	33.77	36.53	42.96
4	GUNTUR	SATHENAPALLI	23.74	26.78	29.81	36.80	39.81	46.79
5	HYDERABAD	BEGUMPET (O)	21.65	24.39	27.10	33.37	36.06	42.31
6	HYDERABAD	GANDIPET (OSMANSAGAR)	26.42	30.18	33.90	42.51	46.22	54.81
7	HYDERABAD	IBRAHIMPATNAM	23.16	26.30	29.41	36.61	39.71	46.90
8	HYDERABAD	JANWADA	23.78	26.98	30.16	37.50	40.65	47.98
9	HYDERABAD	SHAHABAD (CHEVELLA)	18.24	20.28	22.31	26.99	29.00	33.67
10	KHAMMAM	KHAMMAM (O)	27.23	30.76	34.26	42.35	45.82	53.89
11	KHAMMAM	MADHIRA	36.00	41.47	46.89	59.41	64.80	77.29
12	KHAMMAM	PALAIR	26.55	30.08	33.58	41.67	45.14	53.22
13	KHAMMAM	YELLANDU	19.12	21.56	23.99	29.60	32.01	37.61
14	KRISHNA	AVANIGADDA	40.31	46.13	51.92	65.28	71.02	84.35
15	KRISHNA	KANKIPADU	31.93	36.18	40.41	50.17	54.36	64.10
16	KRISHNA	KODERU I.B.	40.25	46.09	51.88	65.28	71.03	84.40
17	KRISHNA	MUTCHINTALA	40.81	46.97	53.08	67.21	73.28	87.38
18	KRISHNA	NIMMAGADDA LOCK	37.84	42.99	48.10	59.91	64.99	76.77
19	KRISHNA	POLAMPALLI	44.04	50.73	57.38	72.73	79.34	94.66
20	KRISHNA	PULIGADDA LOCK	41.40	47.29	53.13	66.63	72.44	85.91
21	KRISHNA	T.KOTHAPALEM	49.74	57.08	64.36	81.18	88.41	105.20
22	KRISHNA	TIRUVUR (TIRUVVRU)	28.42	32.09	35.72	44.13	47.74	56.13
23	KRISHNA	VALLURIPALEM LOC	33.76	38.46	43.13	53.92	58.55	69.32
24	KRISHNA	VIJAYAWADA (O)	29.25	33.28	37.28	46.52	50.49	59.71
25	KURNOOL	ATMAKUR	25.73	29.23	32.70	40.72	44.17	52.17
26	KURNOOL	LAKKINISULA	27.59	31.58	35.54	44.70	48.63	57.77
27	MAHBUBNAGAR	ATMAKAUR	34.29	39.68	45.03	57.39	62.71	75.04
28	MAHBUBNAGAR	CHANDRASAGAR	29.06	33.25	37.41	47.04	51.17	60.77
29	MAHBUBNAGAR	KODANGAL	22.28	24.95	27.60	33.71	36.34	42.45
30	MAHBUBNAGAR	KOLLAPUR (KOLHAPUR)	33.06	38.05	43.00	54.44	59.36	70.77
31	MAHBUBNAGAR	MAHBUBNAGAR (O)	22.20	24.80	27.38	33.34	35.90	41.85
32	MAHBUBNAGAR	MAKTHAL (MUKTHAL)	19.71	22.08	24.43	29.87	32.21	37.64
33	MAHBUBNAGAR	NAGARKURNOOL	24.46	27.94	31.39	39.37	42.80	50.77
34	MEDAK	GHANAPUR	30.18	34.09	37.96	46.93	50.78	59.72
35	NALGONDA	DEVARKONDA	23.06	25.95	28.83	35.47	38.32	44.95
36	NALGONDA	HUZURNAGAR	27.76	31.52	35.24	43.85	47.55	56.14
37	NALGONDA	NALGONDA	24.01	27.19	30.35	37.65	40.79	48.07
38	NALGONDA	PALLIWADA P	22.17	25.31	28.43	35.63	38.73	45.92
39	WARANGAL	GHANPUR	34.14	38.96	43.75	54.81	59.56	70.60
40	WARANGAL	MAHBUBABAD	27.87	31.35	34.80	42.78	46.21	54.17
41	WARANGAL	NARSAMPET	29.48	32.99	36.48	44.55	48.02	56.06
42	RAICHUR	RAICHUR (O)	22.52	25.46	28.38	35.14	38.04	44.78
		Approx. Range	*(18 – 50)*	*(20 – 57)*	*(22 – 64)*	*(26 – 81)*	*(29 – 88)*	*(33 – 105)*

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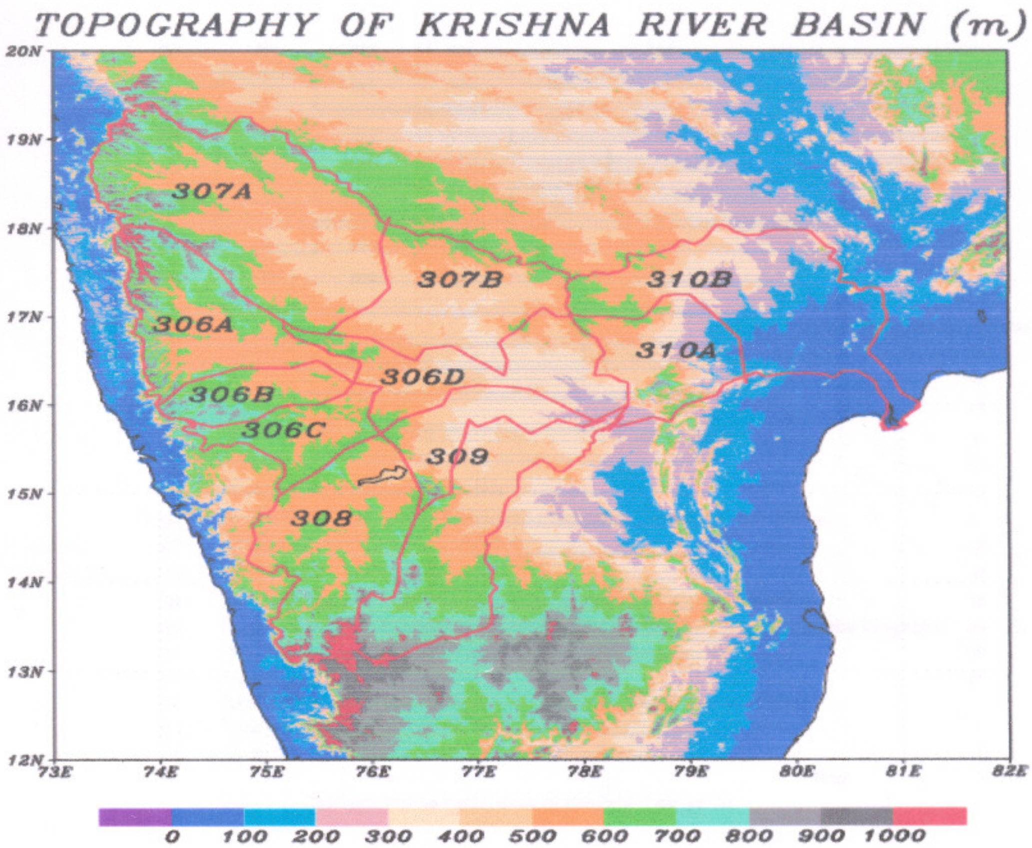


Fig. 1 : Orographic features of the Krishna river basin

(**Source:** US Geological Survey with a resolution of 30 seconds)

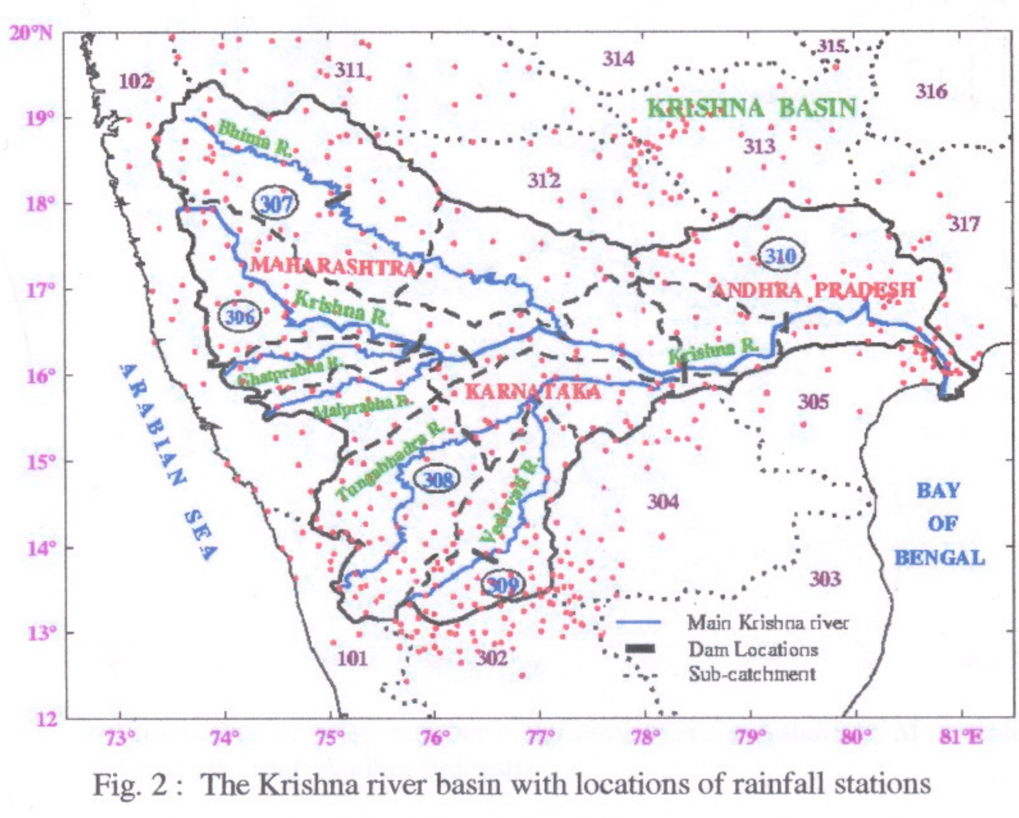
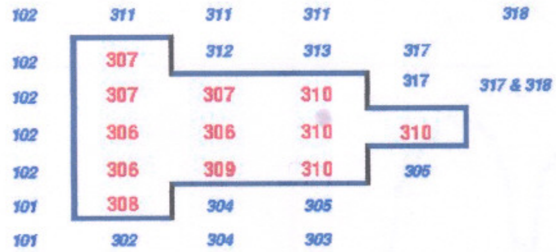


Fig. 2 : The Krishna river basin with locations of rainfall stations



	Catch. No.		No. of stations in each catchment	
	101	Streams from Caps Comorin to the Tadri, excluding the Tadri	12	
	102	Streams from the Tadri to but excluding the Tapti	24	
	302	River Cauvery	48	
	303	River Palar and other rivers bet. River Cauvery and Pennar, both excluding	3	
	304	River Pennar	37	
	305	Rivers bet. River Pennar and Krishna	18	
	306	**River Krishna upto its confluence with River Bhima, excluding river Bhima**	60	
Krishna	307	**River Bhima**	62	
Catchment	308	**River Tungabhadra up to dam site**	49	321
	309	**River Tungabhadra from the dam site to its confluence with river Krishna**	75	
	310	**River Krishna from its confluence with river Bhima to its mouth, excluding the Tungabhs**	75	
	311	River Godavari up to its confluence with river Manjra, excluding river Manjra	30	
	312	River Manjra	25	
	313	River Godavari up to its confluence with river Manjra, excluding river Manjra	38	
	317	River Godavari from its confluence with river Wainganga to its mouth	7	
	318	Rivers bet. River Mahanadi and Godavari	7	
		Total =	570	

Fig. 2 : Catchmentwise (grid) map of Krishna river basin

Fig.3 : Schematic diagram showing sub-catchmentwise number of rainfall stations in and around the Krishna river basin.

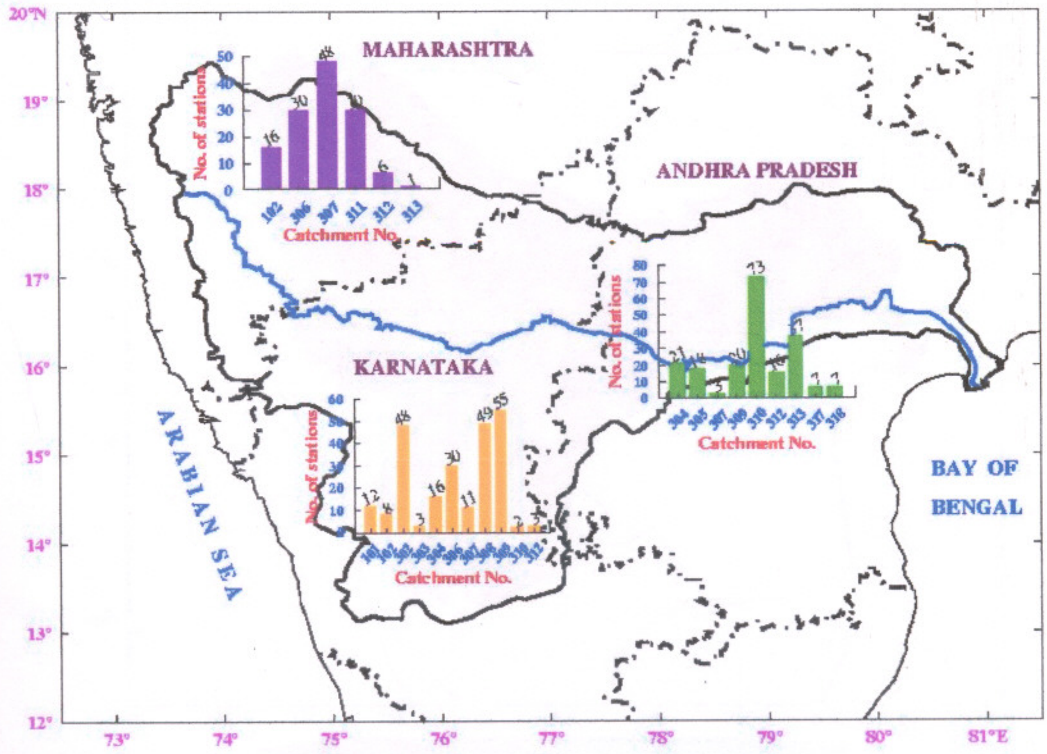


Fig. 4 : Sub-catchmentwise number of stations over the 3 states of Maharashtra, Karnataka and Andhra Pradesh.

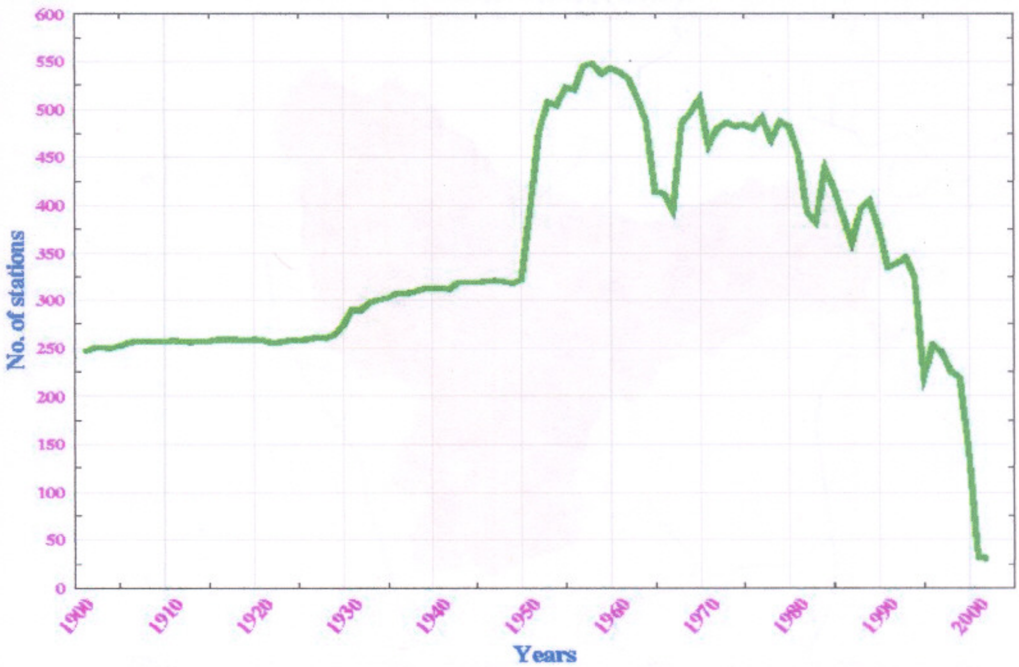


Fig.5 : Time series plot of rainfall data availability for the Krishna river basin

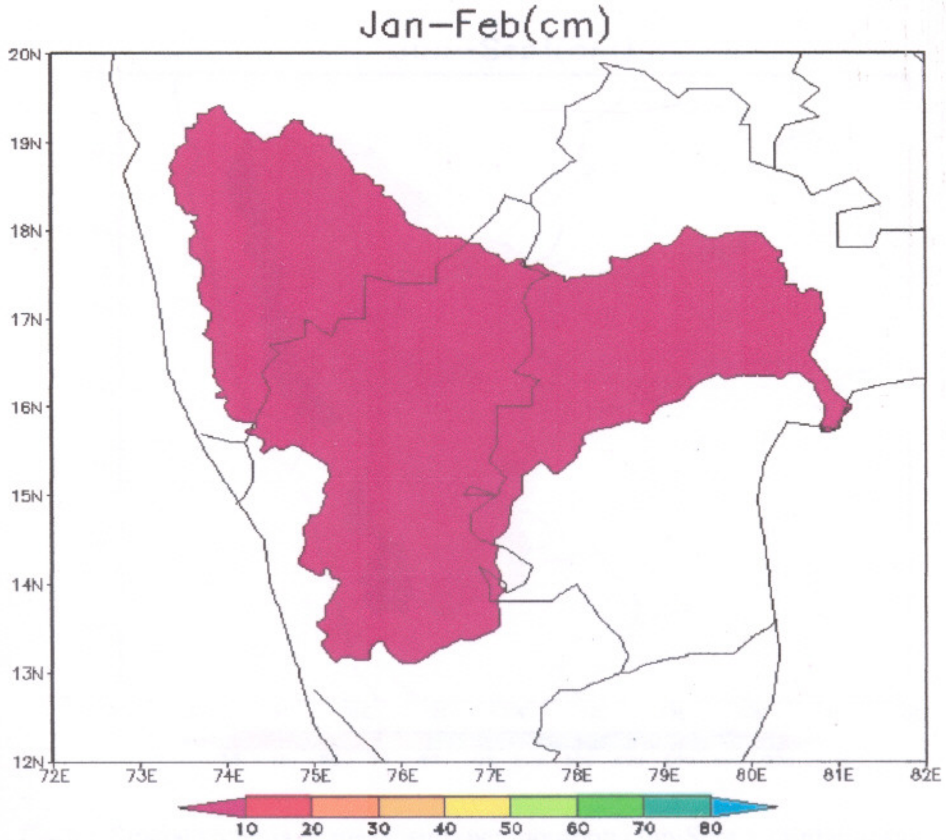


Fig.6 : Spatial patterns of mean winter seasonal(Jan.-Feb.) rainfall (cm) over the Krishna basin.

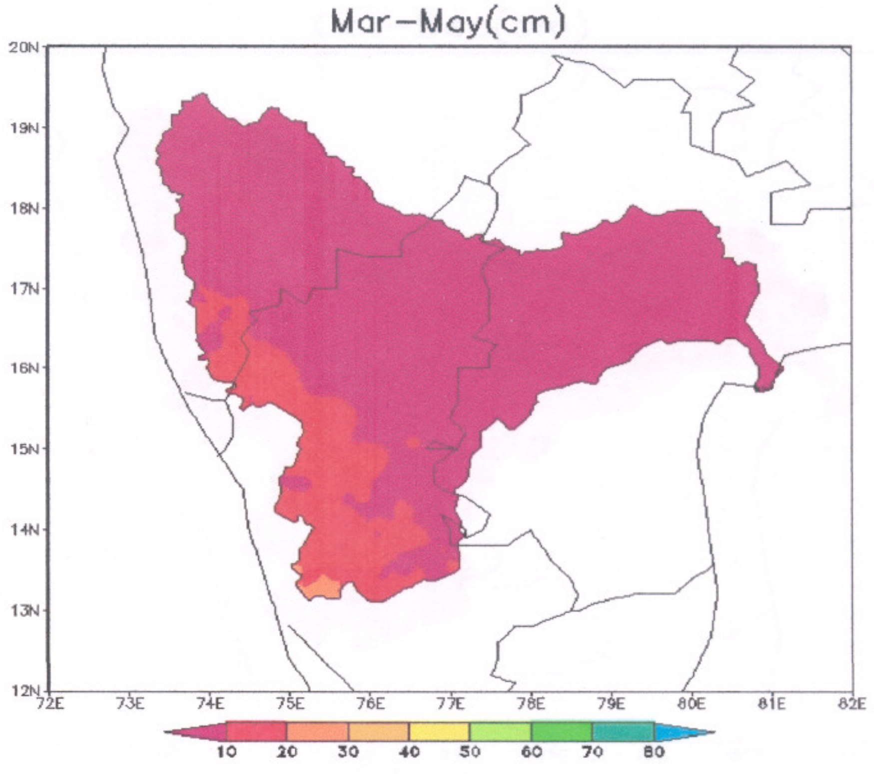


Fig.7 : Spatial patterns of pre-monsoon(Mar.-May)) rainfall(cm) over the Krishna basin.

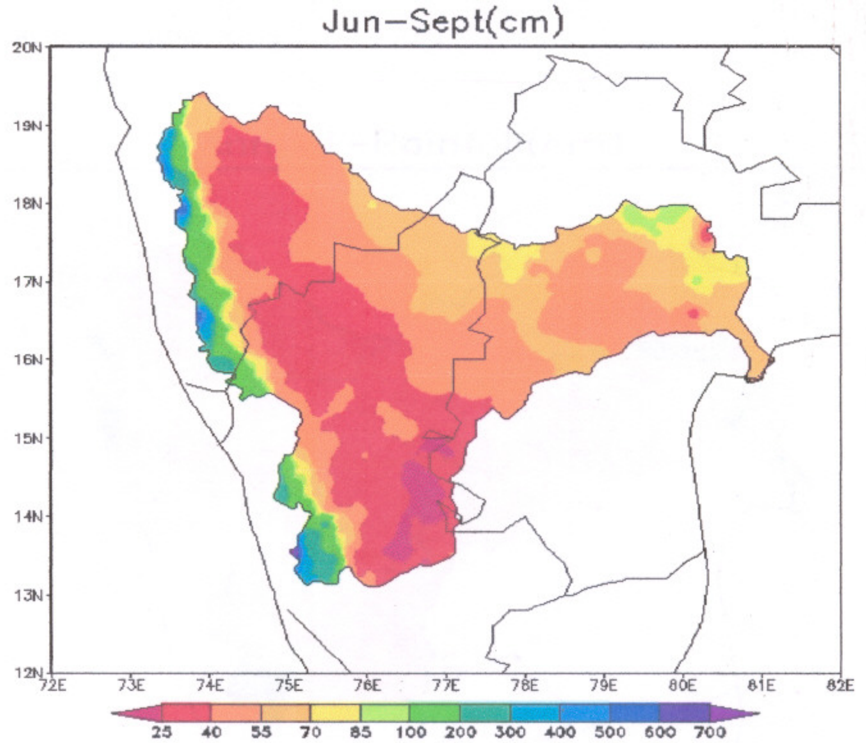


Fig.8 : Spatial patterns of mean summer monsoon (Jun-Sept.) rainfall (cm) over the Krishna basin.

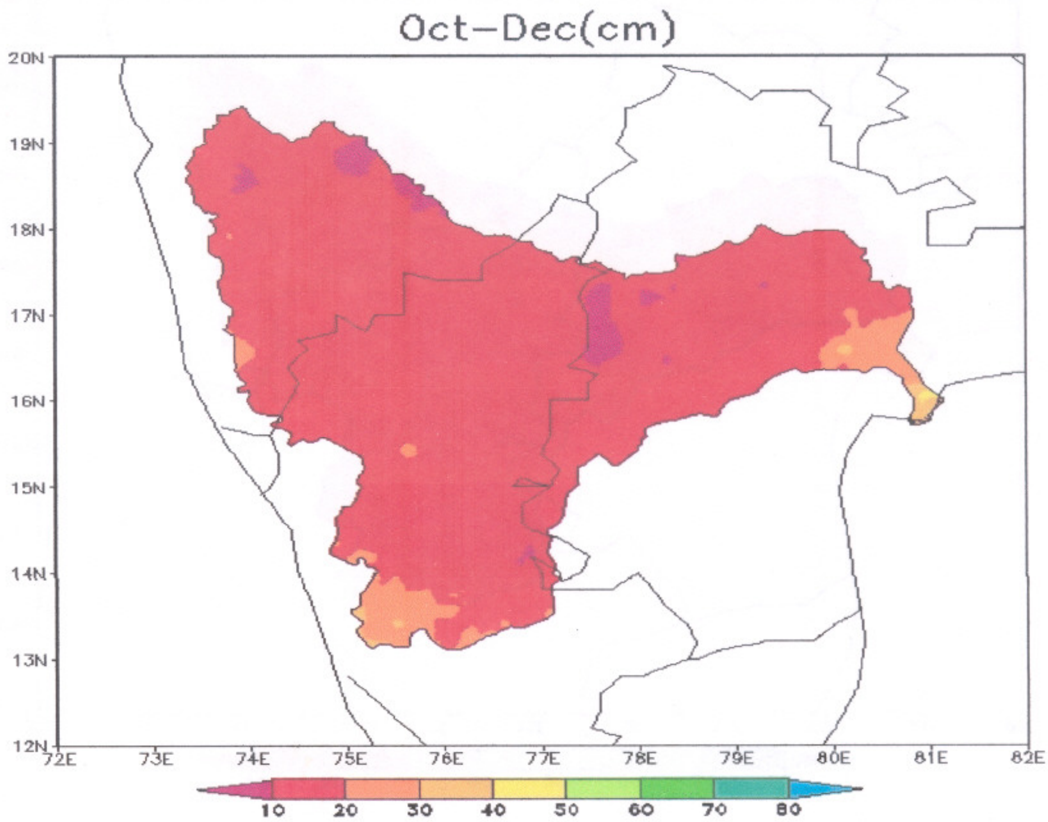


Fig.9: Spatial patterns of mean northeast monsoon rainfall(cm) (Oct.-Dec) over the Krishna basin.

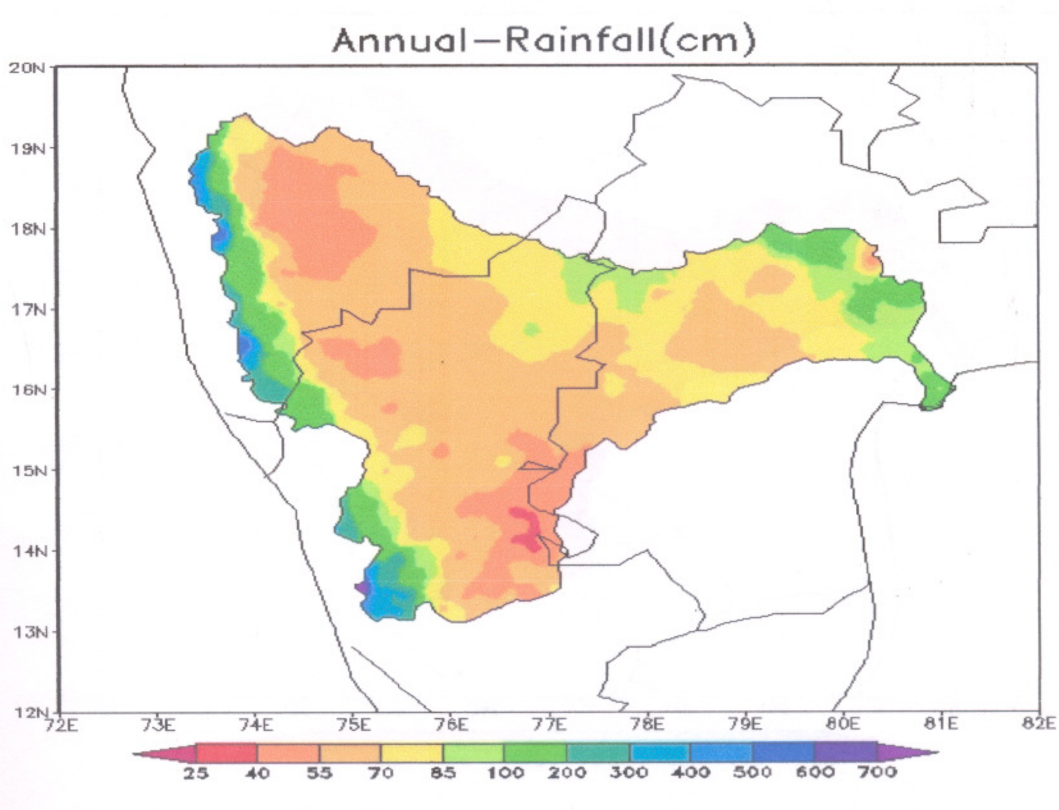


Fig.10 : Spatial patterns of mean annual rainfall(cm) over the Krishna basin.

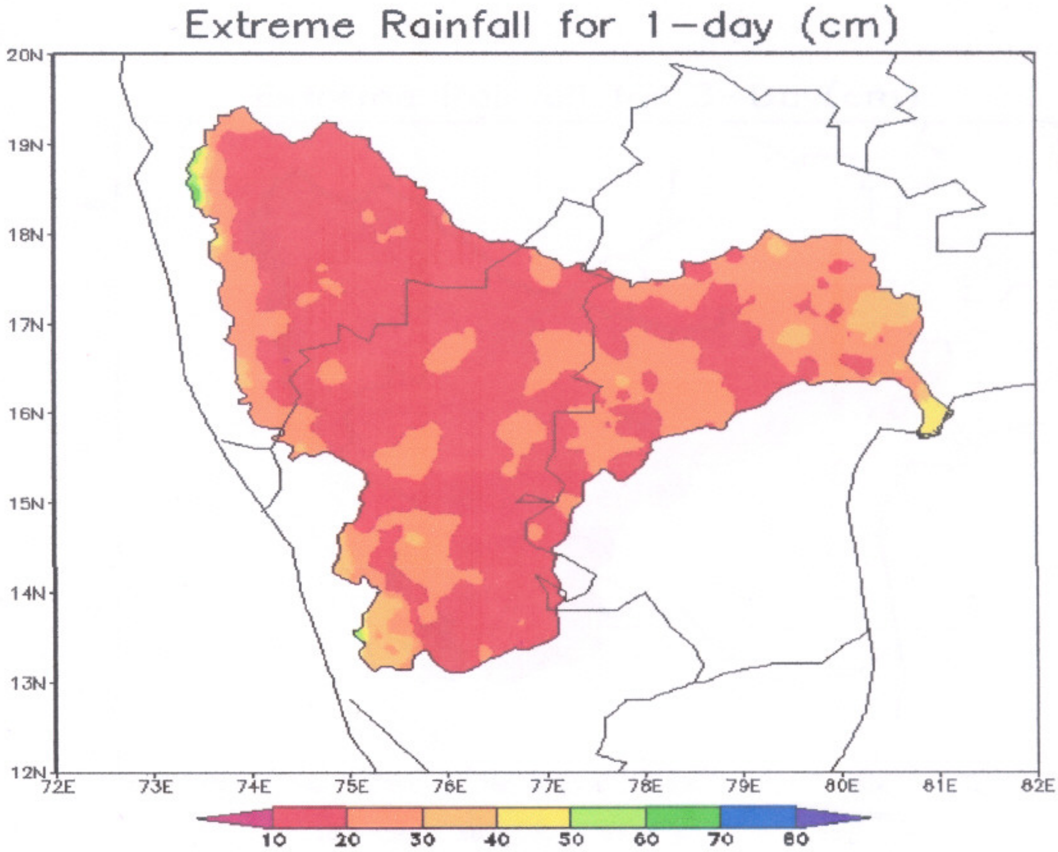


Fig.11 : Spatial patterns of highest ever-recorded 1-day rainfall(cm) over the Krishna river basin.

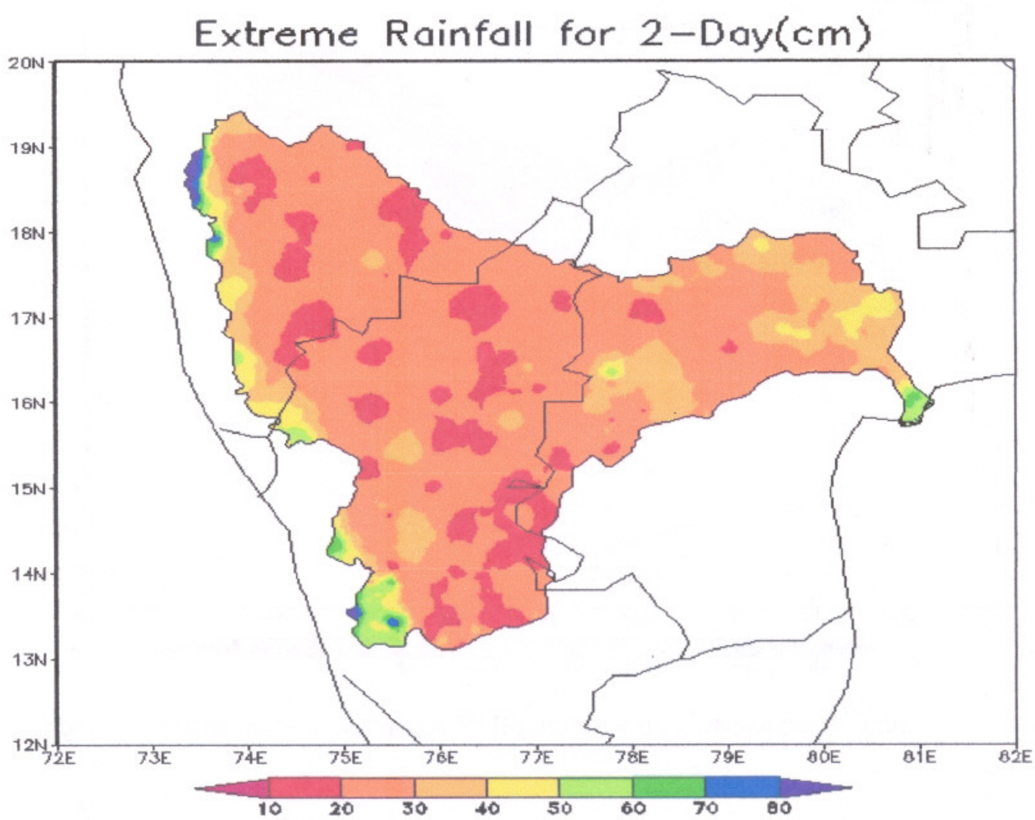


Fig.12 : Spatial patterns of highest ever-recorded 2-day rainfall (cm) over the Krishna river basin.

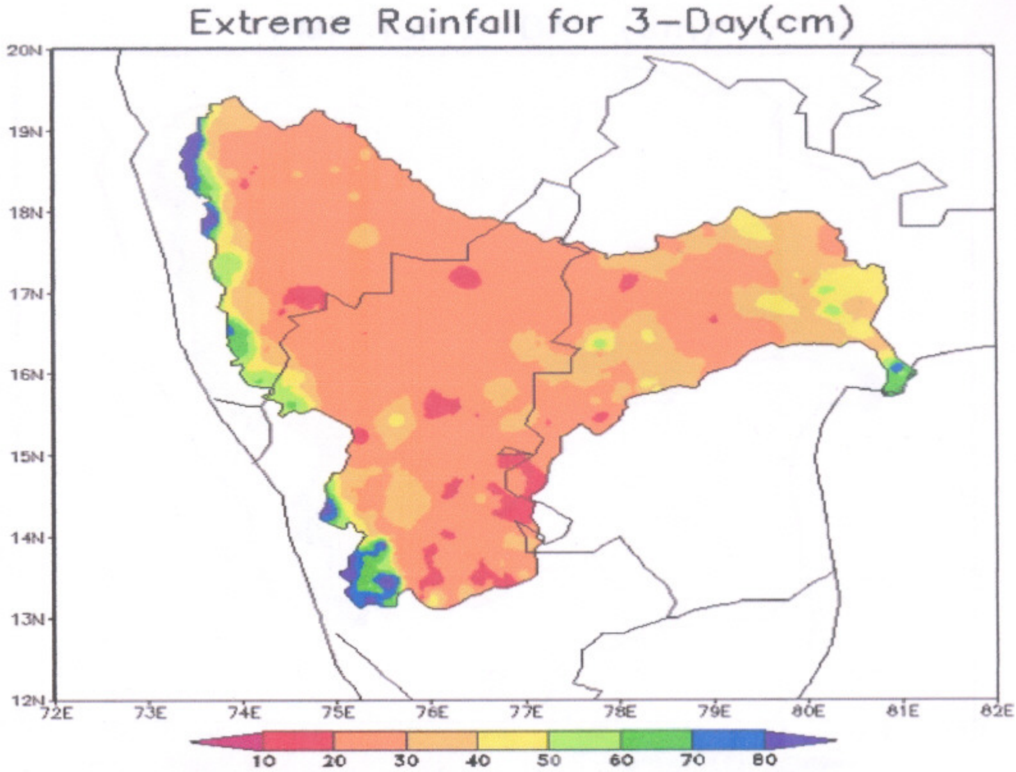


Fig.13 : Spatial patterns of highest ever-recorded 3-day rainfall(cm) over the Krishna river basin.

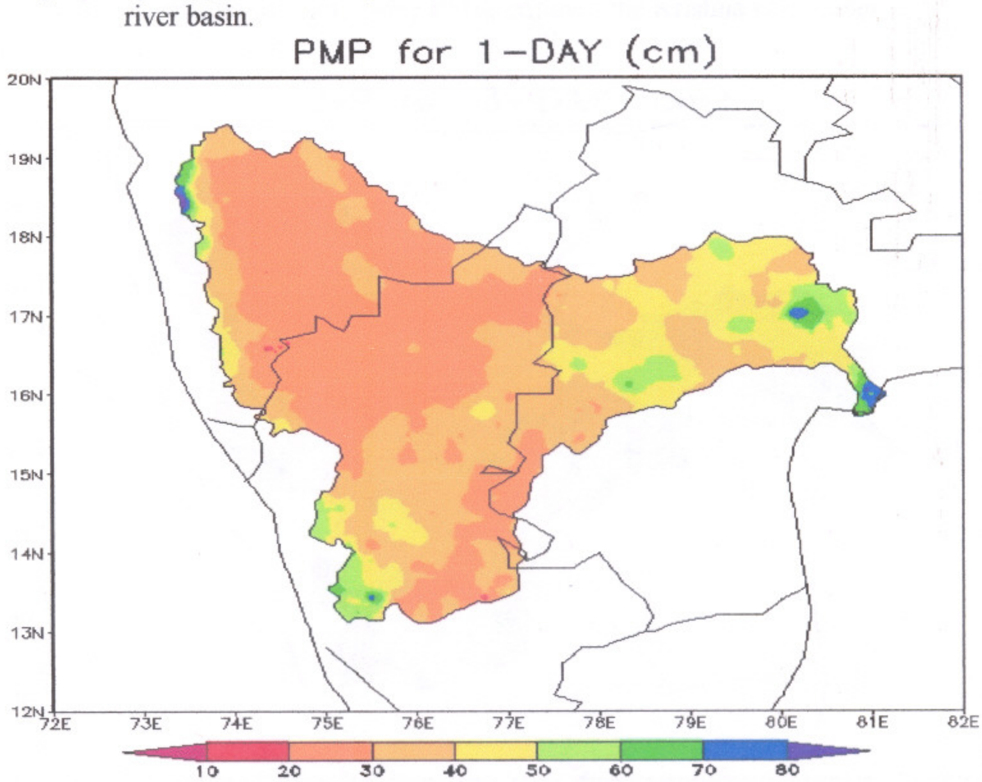


Fig. 14 : Spatial patterns of 1-day PMP(cm) over the Krishna river basin.

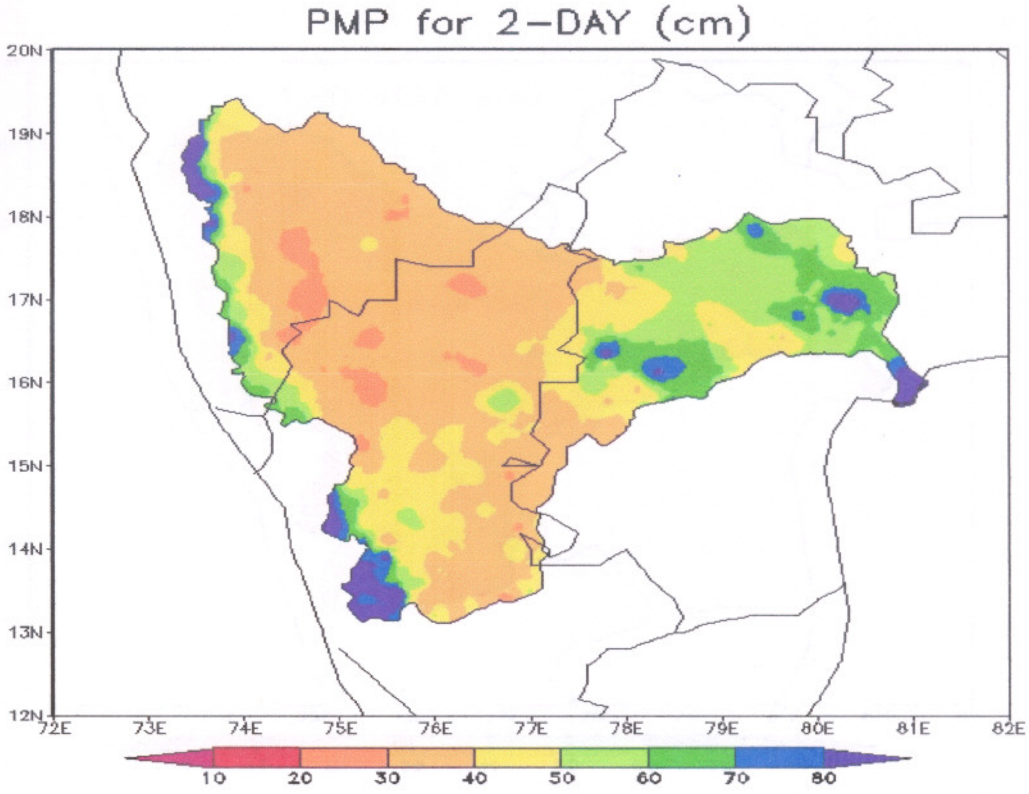


Fig.15: Spatial patterns of 2-day PMP(cm) over the Krishna river basin

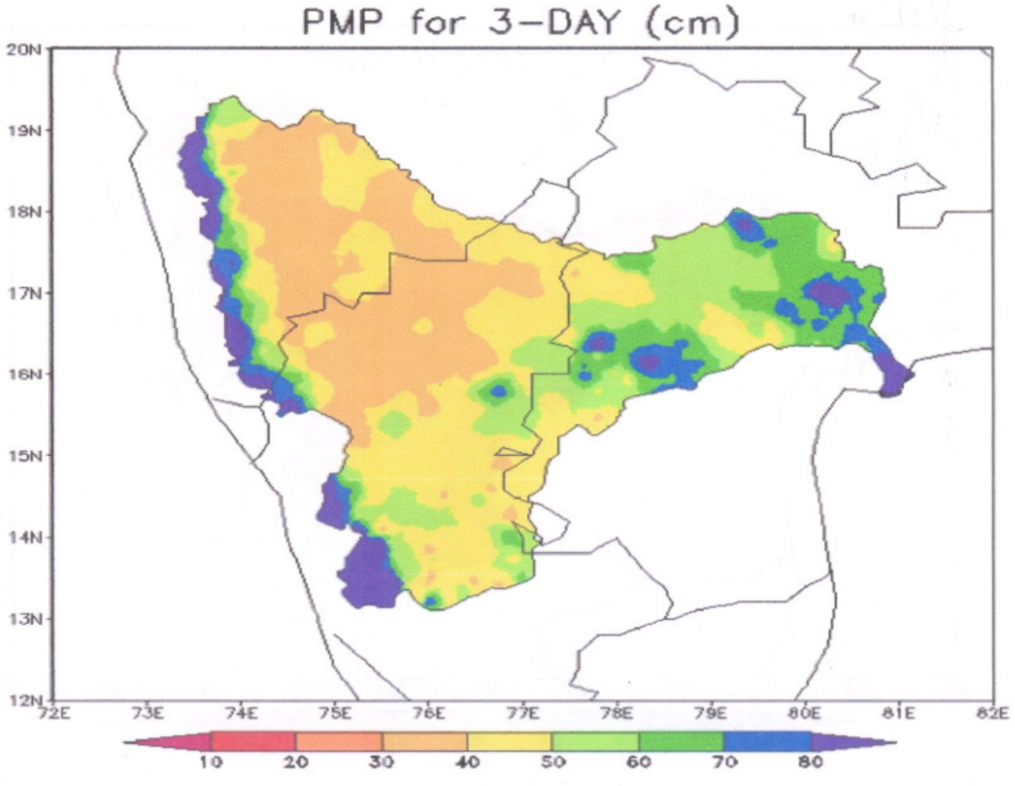


Fig.16: Spatial patterns of 3-day PMP(cm) over the Krishna river basin

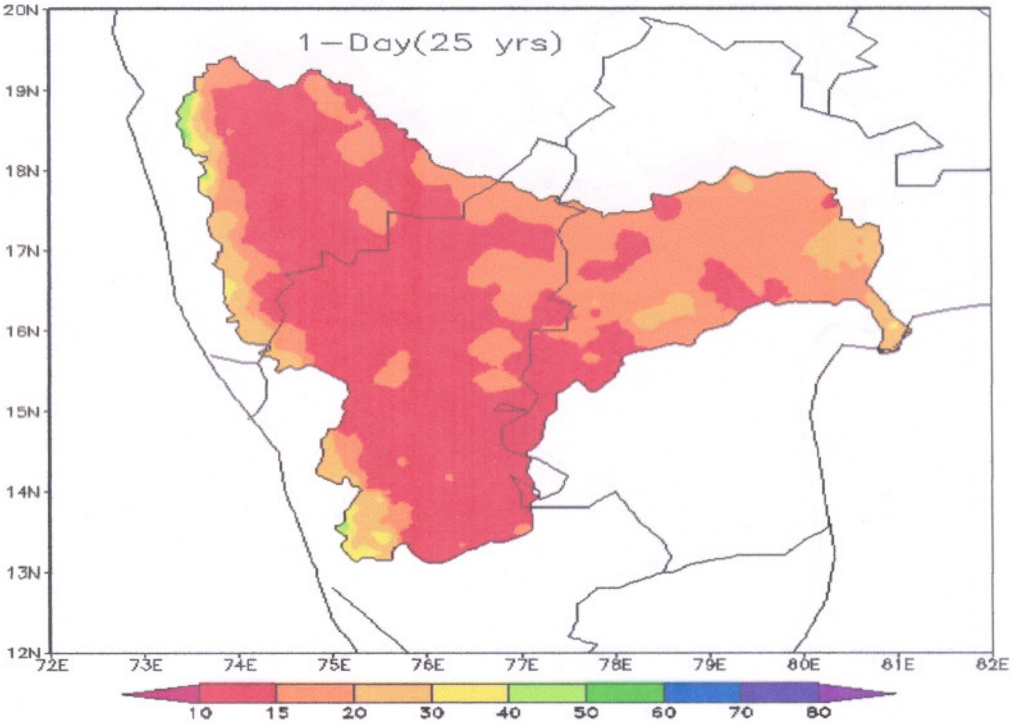


Fig.17 : Estimates of maximum 1-day rainfall(cm) for 25-yr return period over the Krishna basin.

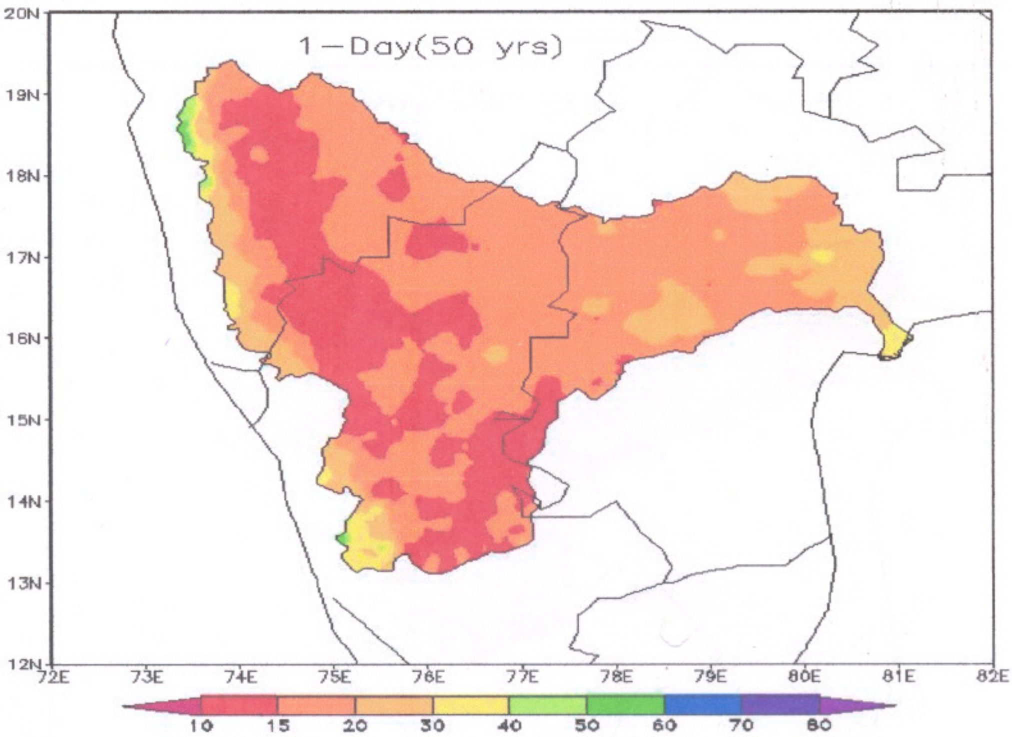


Fig.18 : Estimates of maximum 1-day rainfall(cm) for 50-yr return period over the Krishna basin.

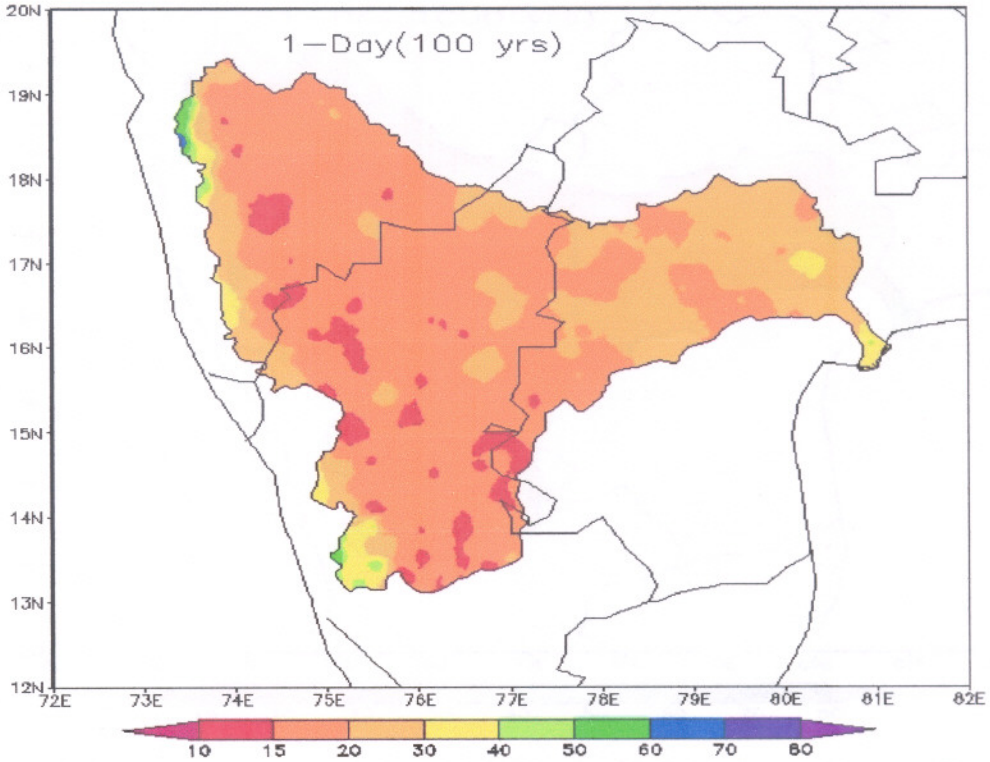


Fig.19: Estimates of maximum 1-day rainfall cm) for 100-yr return period over the Krishna basin.

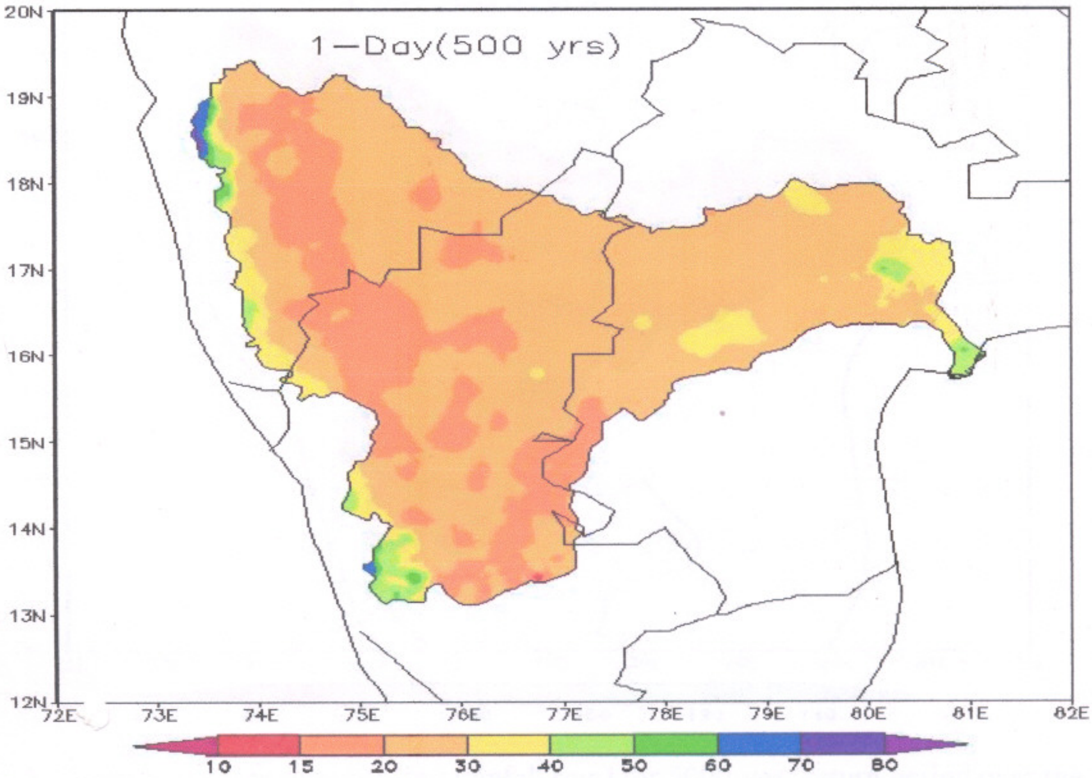


Fig.20 : Estimates of maximum 1-day rainfall(cm) for 500-yr return period over the Krishna basin

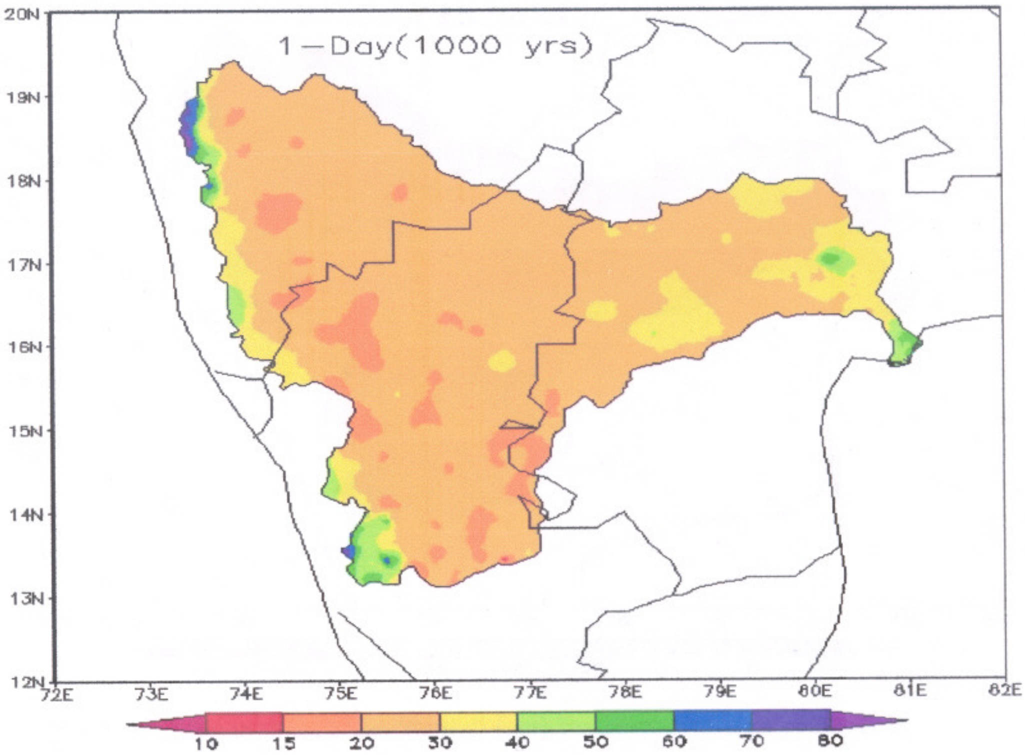


Fig.21: Estimates of maximum 1-day rainfall (cm) for 1000-yr return period over the Krishna basin.

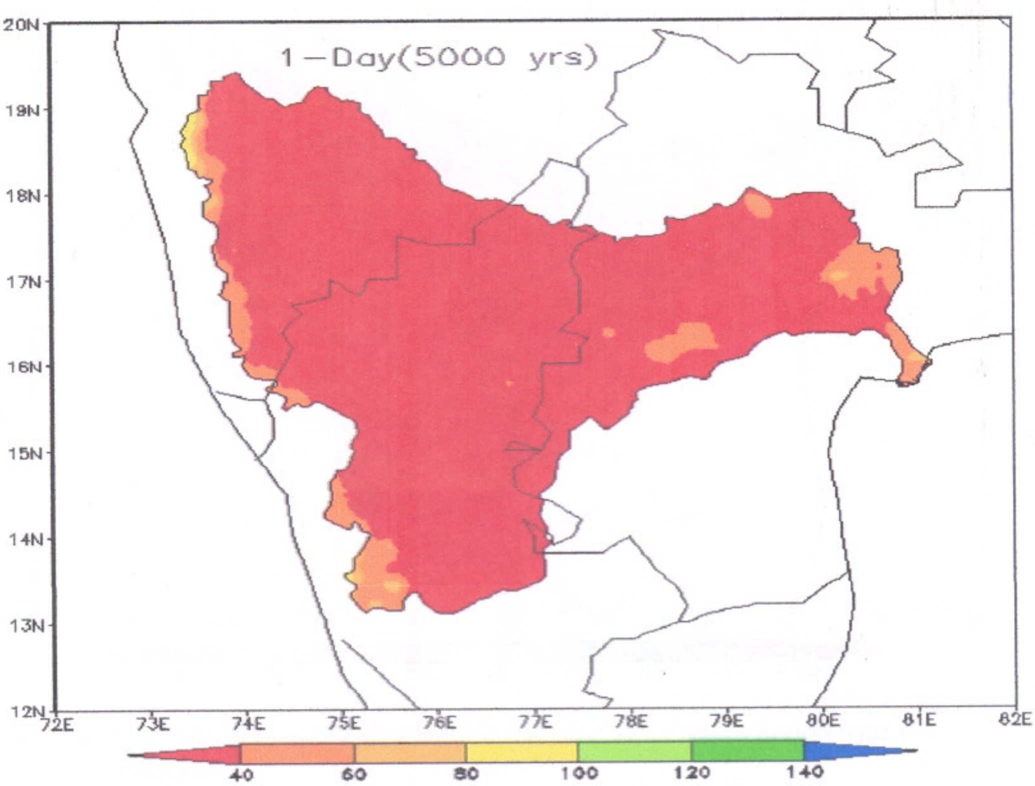


Fig.22. Estimates of maximum 1-day rainfall (cm) for 5000-year return period over the Krishna basin.

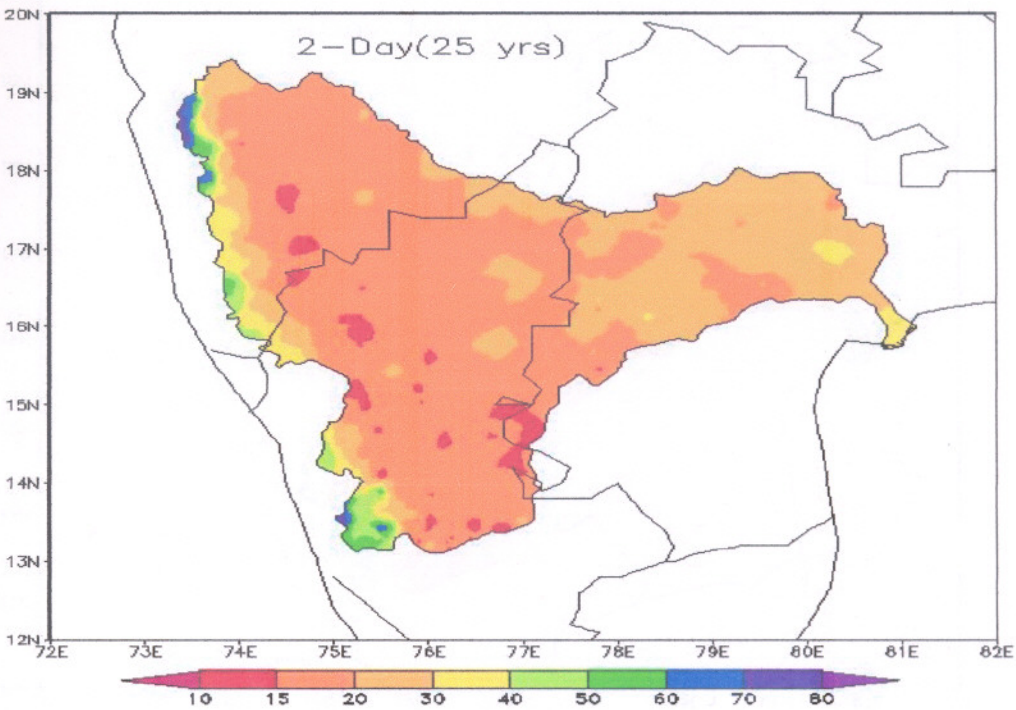


Fig.23 : Estimates of maximum 2-day rainfall (cm) for 25-yr return period over the Krishna basin.

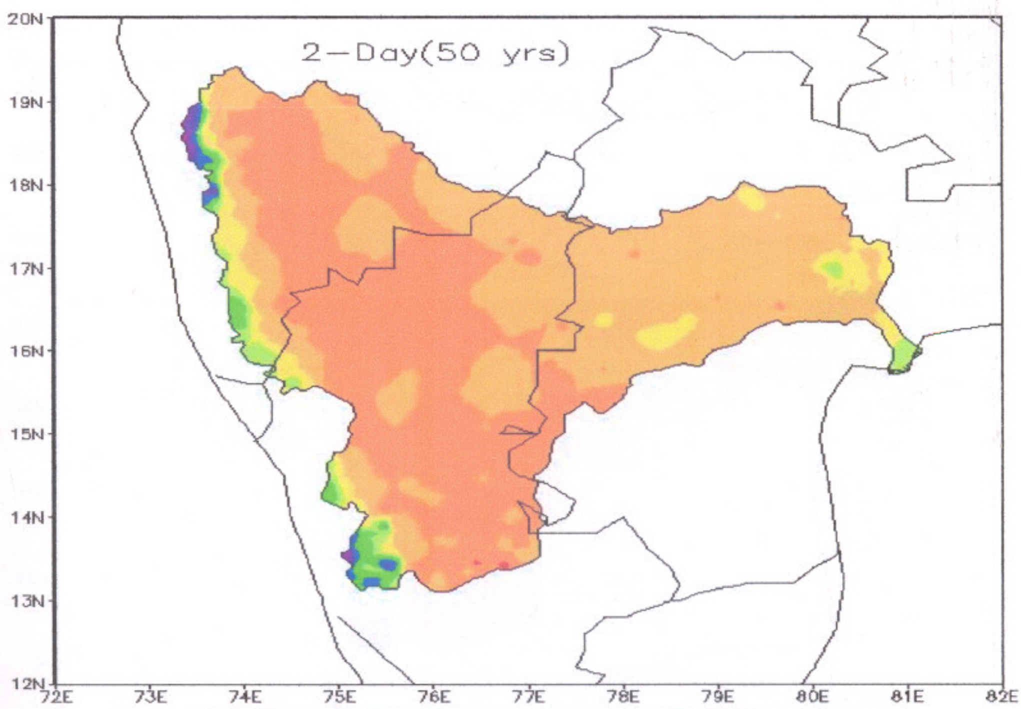


Fig.24: Estimates of maximum 2-day rainfall (cm) for 50-yr return period over the Krishna basin

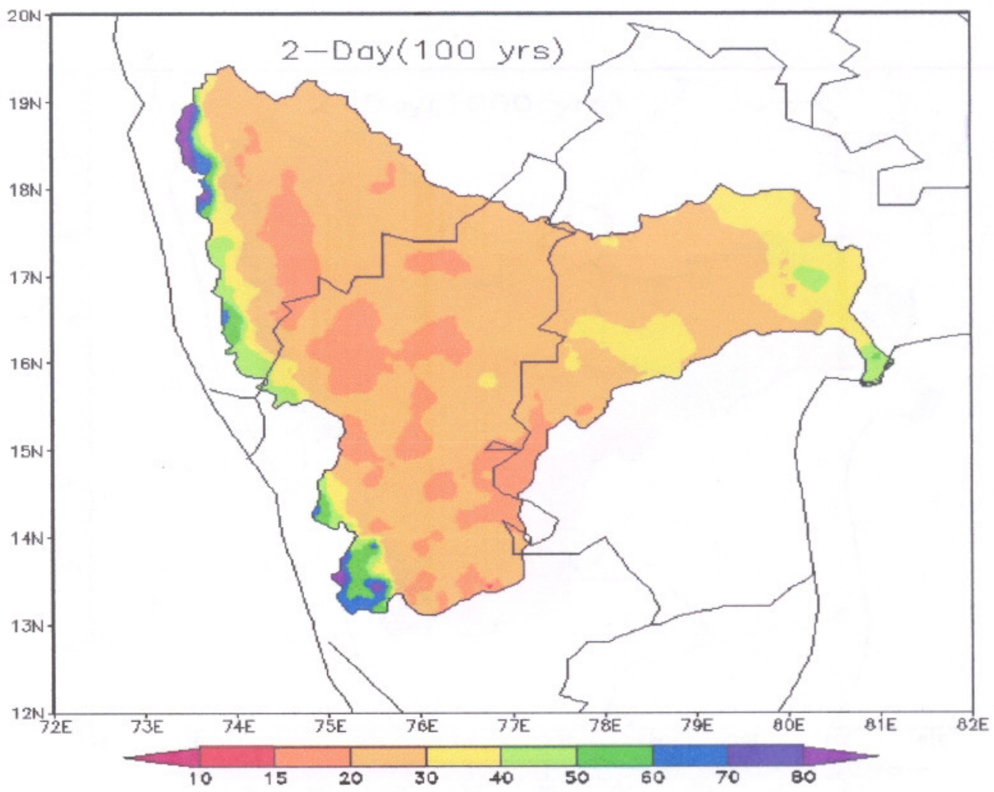


Fig.25 : Estimates of maximum 2-day rainfall (cm) for 100-yr return period over the Krishna basin.

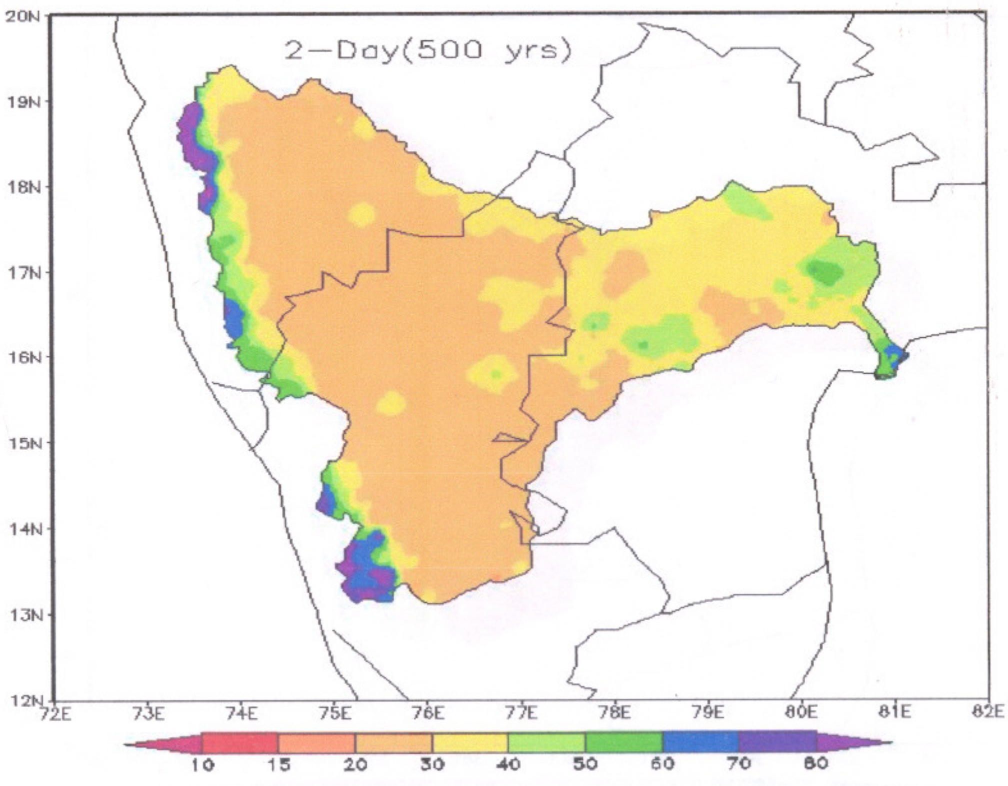


Fig.26: Estimates of maximum 2-day rainfall (cm) for 500-yr return period over the Krishna basin.

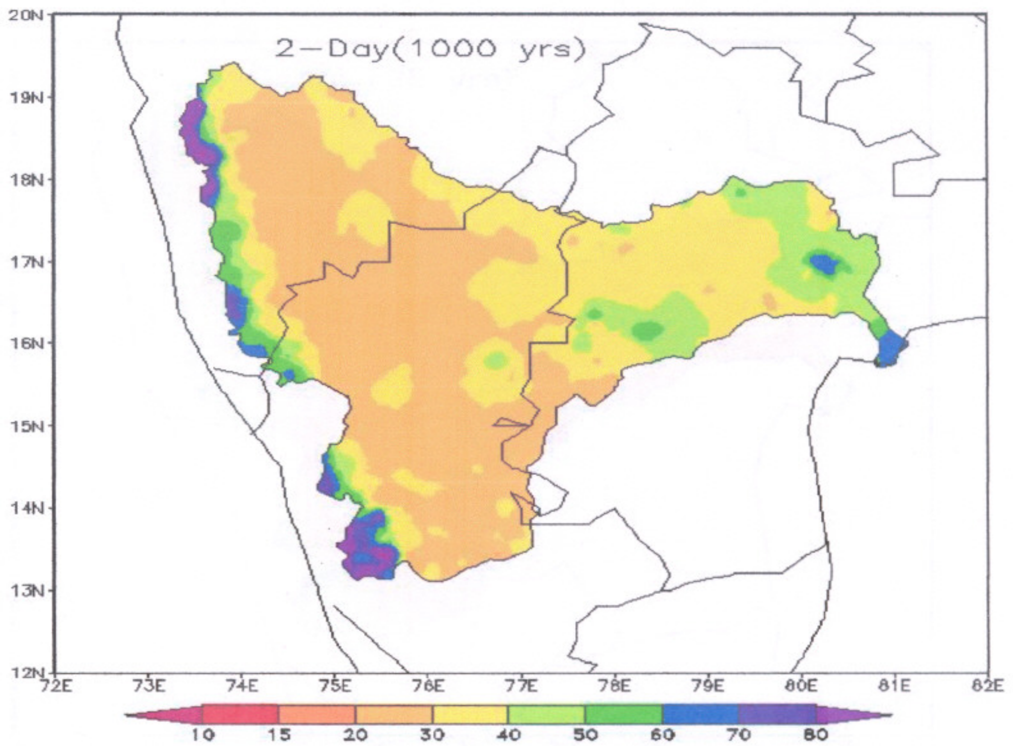


Fig.27 : Estimates of maximum 2-day rainfall (cm) for 1000-yr return period over the Krishna basin.

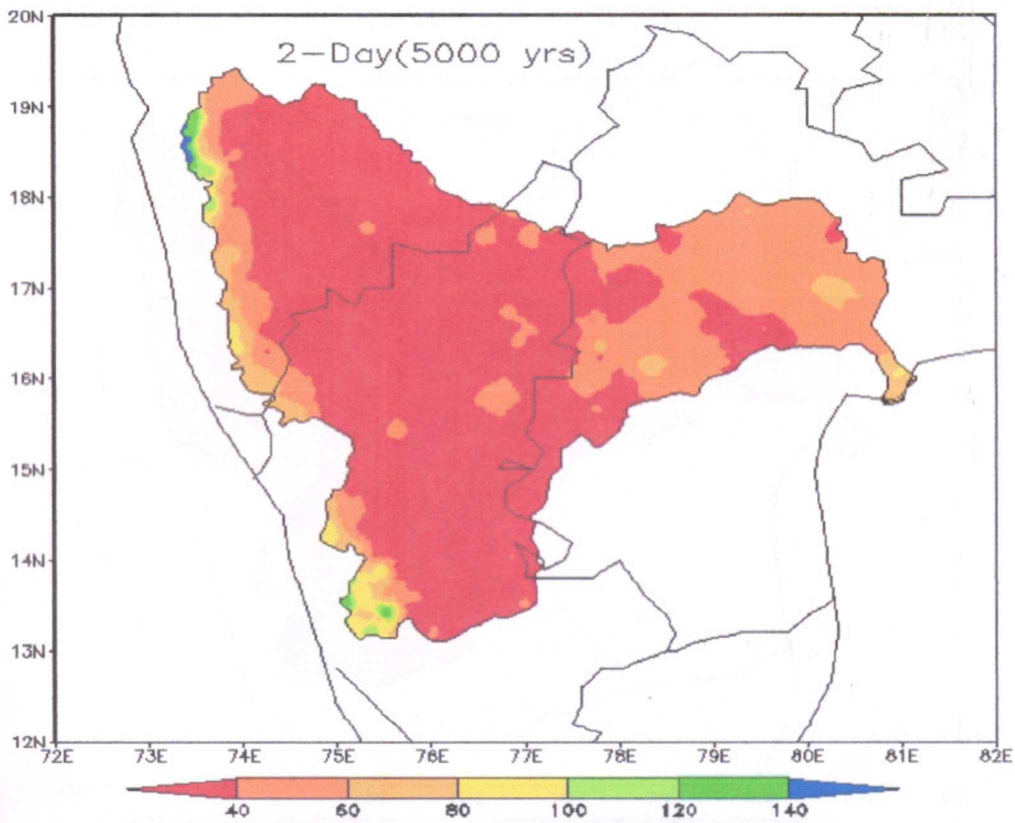


Fig.28: Estimates of maximum 2-day rainfall (cm) for 5000-yr return period over the Krishna basin

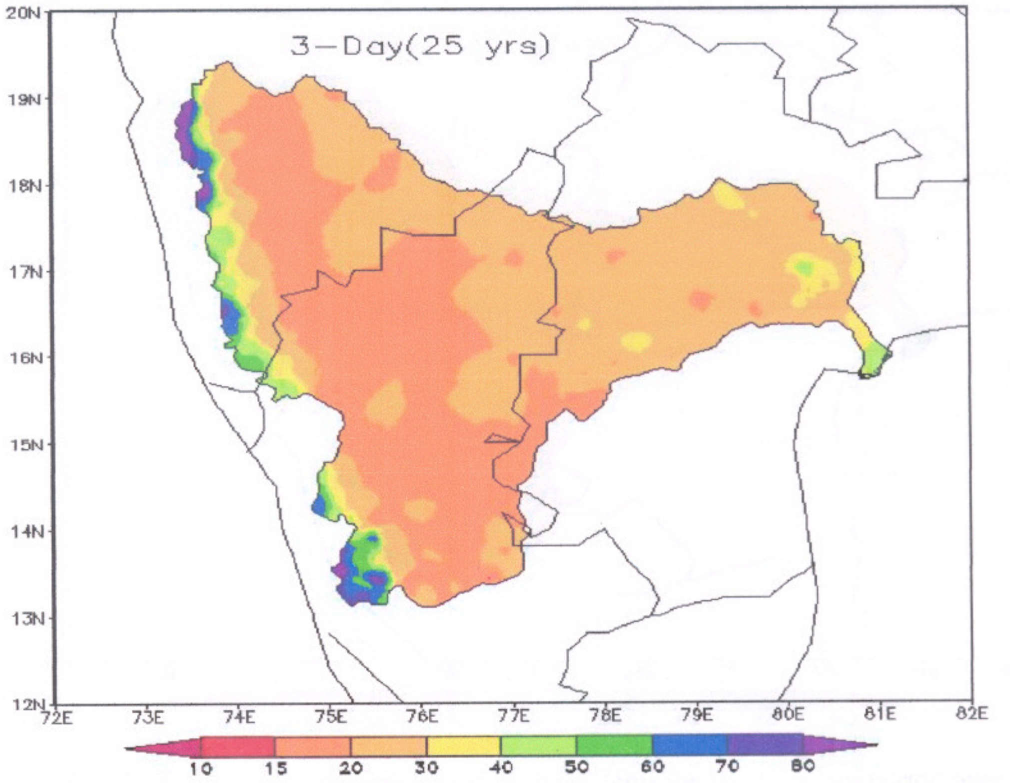


Fig.29: Estimates of maximum 3-day rainfall (cm) for 25-yr return period over the Krishna basin.

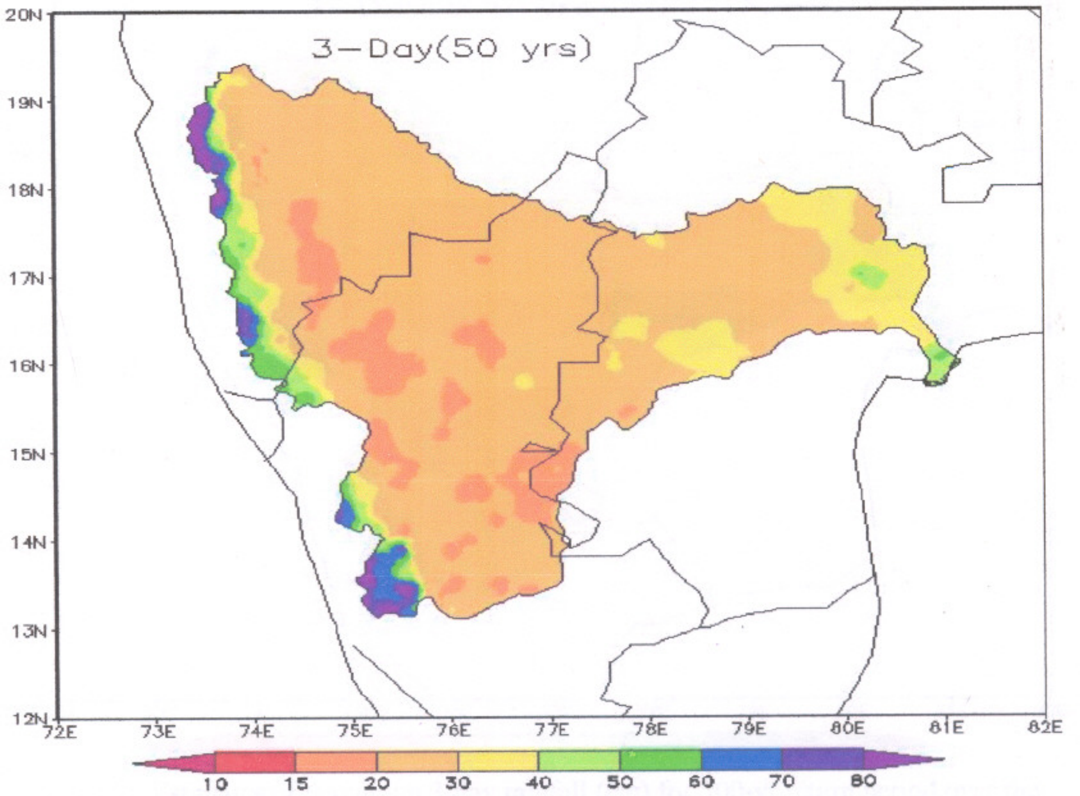


Fig.30 : Estimates of maximum 3-day rainfall (cm) for 50-yr return period over the Krishna basin.

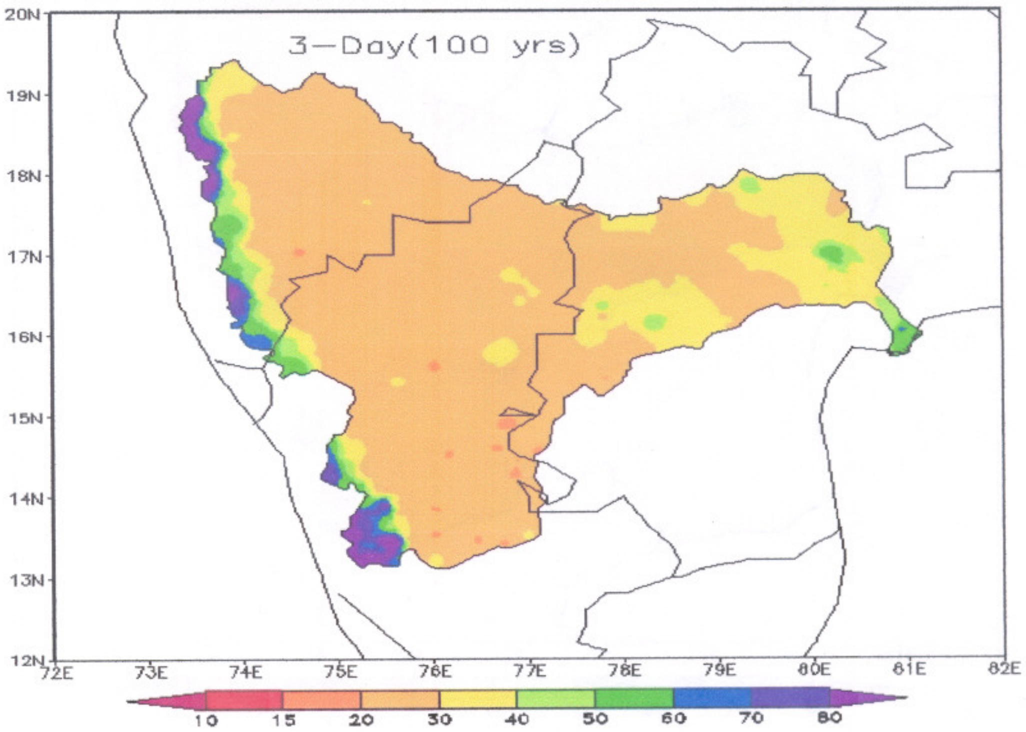


Fig.31: Estimates of maximum 3-day rainfall (cm) for 100-yr return period over the Krishna basin.

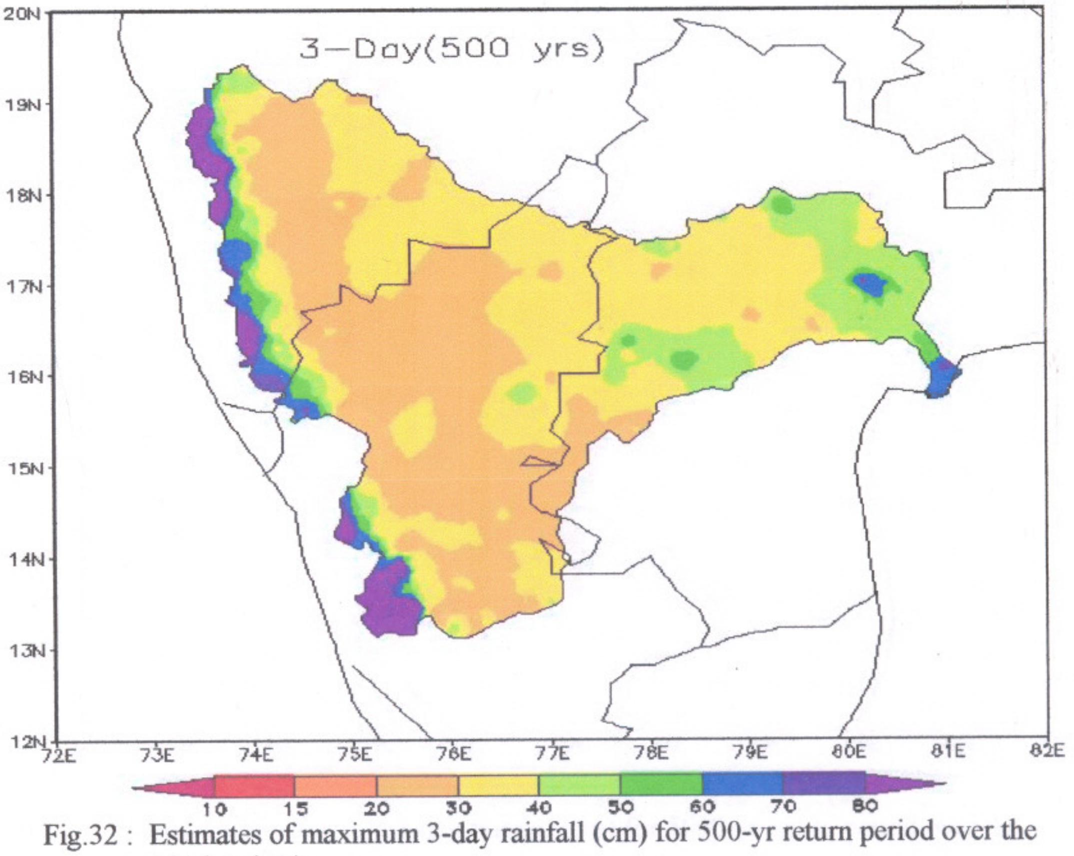


Fig.32 : Estimates of maximum 3-day rainfall (cm) for 500-yr return period over the Krishna basin.

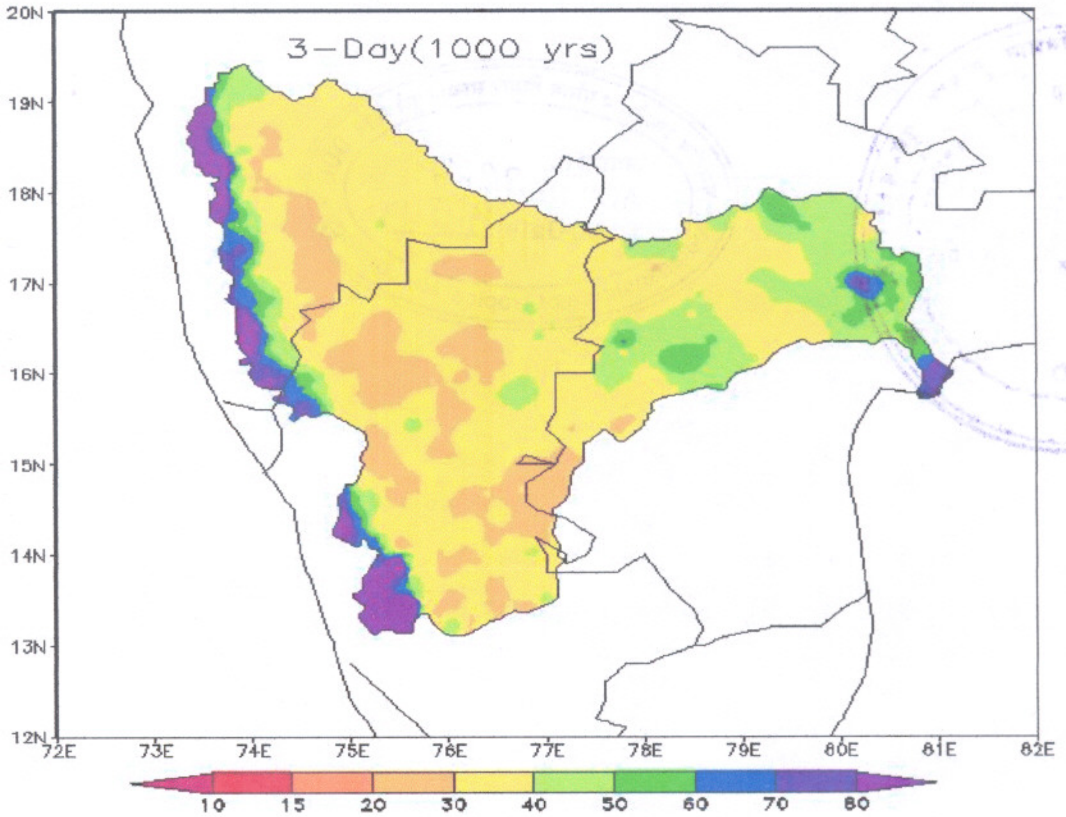


Fig.33 : Estimates of maximum 3-day rainfall (cm) for 1000-yr return period over the Krishna basin.

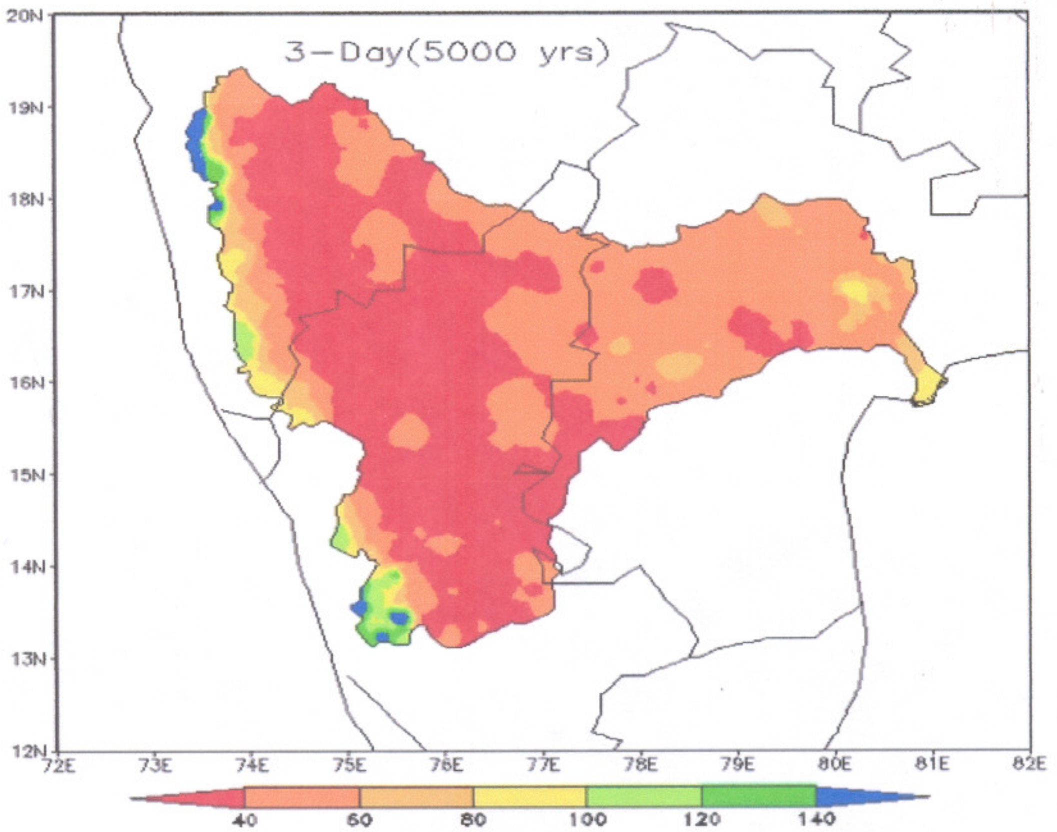


Fig.34 : Estimates of maximum 3-day rainfall (cm) for 5000-yr return period over the Krishna basin.