CS-21

HYDROLOGICAL ASPECTS OF DROUGHT IN 1985-86

(Final Report)

NATIONAL INSTITUTE OF HYDROLOGY
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P R E F A C E

Drought is basically a phenomena associated with the situation of below normal water availability to support the established or normal activities of an area or region. The occurrence of drought leads to depletion of soil moisture, reduction in surface storages and depletion of ground water, decline in agricultural and fodder production, migration of human and cattle population in search of food & water, and socio-economic distress. The problem of droughts in the country has wider dimensions and of recurrent in nature. Nearly 1/3rd of the country's area (i.e. 107 million ha) spread over 99 districts in 13 states is affected by or prone to drought comprising of about 39% of the culturable area of country. In this century so far the country faced drought in 20 years.

The National Institute of Hydrology established the Drought Studies Division in 1986 with the major objective of studying the hydrological aspects of drought and develop drought indices and short term and long term drought management strategies including drought proofing measures. In view of the gravity of the concurrent drought situation in the country, as a first step, it was envisaged to study the drought on 1985-86. Due to extensive data requirement, for the first study, 12 drought affected districts (2 in each state) were taken up for the study. The districts Banswara and Barmer in Rajasthan; Khargaon and Jhabua in M.P.; Cuddapah and Anantpur in A.P.; Ahmednagar and Solapur in Maharashtra; Bijapur and Belgaum in Karnataka and Rajkot and Jamnagar in Gujarat were selected for analysis. The required data were collected for last 8-10 years including the latest data for 1985-86 by sending scientific teams to various States.

The analysis has been carried out for daily, monthly and annual rainfall; soil moisture analysis (for one district with selected crops for which data could be available); ground water level variation for 12 districts; stream flow analysis for nine sites of Krishna basin and a simple approach has been described to forecast monsoon runoff for seven sites of Krishna basin.

These studies were initiated by Sri A.K. Sikka, Scientist-in-Charge and based on the limited available data and preliminary analysis, an interim report entitled 'Hydrological Aspects of Drought in 1985-86' was brought out by Drought Studies Division. The data were collected by a team of scientists comprising of Dr. B. Soni, and Sarvasri S.K. Jain, A.G.Chachadi, C.P. Kumar, J. Harikrishna, M.K. Santoshi and N.Nikhil. They were supported by scientific staff namely Sarvasri S.K. Verma, Ravi Kumar, A.K. Nigam, Y. Panwar, Pankaj Garg and Tanvear Ahmed. The final report for Drought of 1985-86 has been prepared by a team of scientists comprising of Sarvasri A.K. Sikka, V.K. Lohani, N.K. Goel, Pawan Kumar, Avdhesh Kumar, P.K. Verma and Jagdish Parwani. They were supported by Sarvasri S.K. Goyal, Anupam Srivastava, Achal Goel and S.K. Singhal, the scientific assistants of the division.

The report is an attempt of the Institute to highlight the hydrological aspects of drought in six States during 1985-86. It is proposed to conduct more exhaustive studies in more number of States with additional districts.

Satish Chandra
(SATISH CHANDRA)

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ABSTRACT

National Institute of Hydrology established a Drought studies Division in February 1986 with the major objective to study the hydrological aspects of drought and develop both short and long term drought management strategies. In view of the gravity of the drought situation during 1985-86, the Institute sent-out scientific and technical teams four times to the states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan to acquaint with the drought situation and to collect necessary data and information for drought studies with emphasis on hydrological aspects. To start with, two districts in each state namely Banswara and Barmer in Rajasthan; Khargone and Jhabua in M.P.; Cuddapah and Anantpur in A.P.; Bijapur and Belgaum in Karnataka; Ahmadnagar and Solapur in Maharashtra; and Jamnagar and Rajkot in Gujarat were selected for analysis. On the basis of available data and the analysis, conclusions have been drawn in respect of hydrological aspects of drought during 1985-86.

In case of rainfall analysis the daily, monthly and annual rainfall data have been subjected to various types of analysis viz. seasonal departure analysis from 1970-86, monthly departure analysis for 1985-86, probability analysis of annual rainfall from 1901-86, Herbst's analysis of monthly rainfall of monsoon season from 1951-86 and dry spell analysis of daily rainfall data from 1981-86. The analysis has indicated that in general the areas selected for study are drought affected areas and year 1985-86 recorded seasonal rainfall deficit of more than 20% of normal.

The soil moisture analysis for drought studies has been done with the data available from Jodhpur for Pearl millet crop. A criterial for defining drought severity levels based on soil moisture status

has been defined.

The ground water level data for about 10 years (1975-1986) as available for 12 districts as located in six states have been analysed and a trend in ground water level has been worked out which has been compared with the trend in rainfall. In general, declining trend in ground water level has been observed in all districts with some exceptions. However, due to non-availability of abstraction data exact correlation between rainfall and ground water regime could not be established.

The analysis of stream flow data was done for nine selected sites in Krishna basin. At these sites stream flow data of last 20 years was analysed. The various types of analysis included comparison of simple flow hydrographs with long term values, development of flow duration curves and low flow index values and deficit volume and deficit duration analysis. The results indicated that during 1985-86 the flow conditions experienced drought.

A simple approach to forecast monsoon runoff has been described and has been used for seven sites in Krishna basin. The efficiency of runoff forecast has been found quite satisfactory in all sites excepting one case.

The report is an attempt of the drought studies division of the Institute to highlight the hydrological aspects of drought in six states during 1985-86. Further studies with more types of analysis will be included in forthcoming such reports.

1.0 INTRODUCTION

Drought is generally viewed as a sustained and regionally extensive occurrence of below normal natural water availability. Drought not only leads to serious economic consequences but it also leaves behind untold human misery. Amongst all the natural disasters droughts affect largest number of people in the world. The highest number of drought affected victims lived in India during 1960s and 70s as per the global statistics. The variability of hydrological, hydro-meteorological and agroclimatological conditions in India over space and time have created a situation that about one-third of the geographical area of the country (107 mil ha) spread over 99 districts and about 29% of the population of the country are affected by drought. It affects about 39% of the culturable area of the country. Deccan Plateau alone constitutes about 50% of the drought prone area.

The problem of drought is recurrent in the country. In this century so far the country had severe droughts in 22 years. The situation of 1985-86 drought has been unprecedented in the country as it looms over many States and mainly in the States of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Rajasthan. The drought of 1985-86 affected about 260 districts, 1490 lakh population.

The occurrence of drought leads to reduction in streamflow, and consequent reduction in reservoir and tank levels and depletion of soil moisture and ground water. This on a continued basis leads to reduced availability of fodder and decline in agricultural production. The drought characteristics and associated problems vary from area to area, depending upon the amount of variability of available water supplies and the demand of water for specified users.

In view of the fact that hydrological aspects of drought are generally neglected and have not been studied, efforts have been made by the Institute to prepare a technical report on the hydrological aspects of drought in 1985-86 to analyse hydrological aspects of drought in six states. The report deals with rainfall deficit and moisture indices including analysis of dry spells, soil moisture index for drought analysis, stream flow analysis including low flow analysis for drought investigation, reservoir inflow forecasting and response of drought on ground water regime. The districts from each selected states viz. Banswara and Barmer from Rajas--than, Khargone and Jhabua from Madhya Pradesh, Cuddapah and Anantpur from Andhra Pradesh, Bijapur and Belgaum from Karnataka, Ahemadnagar and Solapur from Maharashtra, and Jamnagar and Rajkot from Gujarat have been chosen in the present study. Raingauge stations and groundwater observation wells are plotted on the district maps. District averages for rainfall as well as ground water levels have been calculated by Thiessen polygon method.

Analysis on rainfall includes seasonal Rainfall Departure Analysis for 1970-86, Monthly Rainfall Departure Analysis for year 1985-86, Frequency Analysis of annual rainfall for 1901-86; Herbst Analysis for monsoon months for 1951-86 and

Dry Spell Analysis for monsoon season for 1981-86. Departure Analysis in general gives the idea of percentage departure from normal rainfall. Frequency analysis of annual Rainfall is helpful in classifying the area as drought prone based on long term data. Herbst Analysis gives the onset and termination of drought as also the drought intensity and severity of the drought. Occurrence of dry spells (i.e. rainfall less than or equal to 5mm continuing for two weeks or more) may cause partial to total crop failure; as such dry spell analysis during monsoon months is equally important from the viewpoint of agriculture.

Soil moisture analysis is helpful in defining drought frequency, its severity and duration for a particular crop in a drought prone area. For the purpose of the analysis, Bajra crop at Jodhpur has been selected. A criteria to define a day as drought day has been fixed based on ratio of soil moisture deficit and available water holding capacity for the selected crop.

The drought severity, frequency and duration can be studied by the analysing the gross availability of streamflows, the flow duration characteristics of river flows and the extent to which the water is available in storages. Twenty years streamflow data of nine selected sites in Krishna basin has been subjected to low flow analysis to study/develope simple indices, low flow duration curves, deficit volumes and deficit duration at various demand levels.

For ground water analysis, average monthly/seasonal ground water level has been computed for each district and plotted against corresponding time. Simple linear regression analysis is then used to find out the trend in ground water level fluctuations. Similar analysis has been carried out on rainfall also to compare the trend of ground water level regime with that of rainfall. Analysis gives some idea of abstraction from ground water and rainfall recharge since these factors influence ground water fluctuation and its regime.

The forecasting of monsoon runoff based upon available runoff data upto the end of June, July, August and September could be an important aspect for drought management in planning and operation of surface water reservoirs. Regression relationship correlating monsoon runoff with the total runoff upto the end of June, July, August and September as developed at NIH has been used to forecast monsoon runoff at the end of August and September. Seven sites in Krishna basin have been selected for the study.

Based on the above analysis, conclusions have been drawn. Recommendations for future studies have also been made.

2.0 DESCRIPTION OF STUDY AREA

Drought Studies Division in the Institute was established on 28th Feb'1986 with the objectives to study the hydrological aspects of droughts in the selected drought prone areas of the various States. To start with, six drought prone states namely, Andhra Pradesh, Gujrat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan were chosen for carrying out studies (Fig. 2.1). Earlier, the Central Water Commission had identified 99 districts as drought prone in the entire country (Fig. 2.2 and Table 2.1). Scientific and technical teams of the Institute underlook visits to the State Headquarters and other drought affected districts during March and May months in 1986 and June and September in 1987 and collected the relevant data from various drought affected districts of the State. During the visits discussions were held with the district level officers of various departments regarding their on going relief programmes and allied measures for combating drought conditions. The State Govt. Departments visited by the teams included Irrigation, Ground Water, Agriculture, Soil Conservation, Economics and Statistics, Revenue board, Public Health Engineering, District Rural Development Authority etc. List of Departments contacted and the districts visited by the teams is given in Appendix II-1. Efforts were made to collect the required data for last 8 to 10 years including the latest ones for 1985-86.

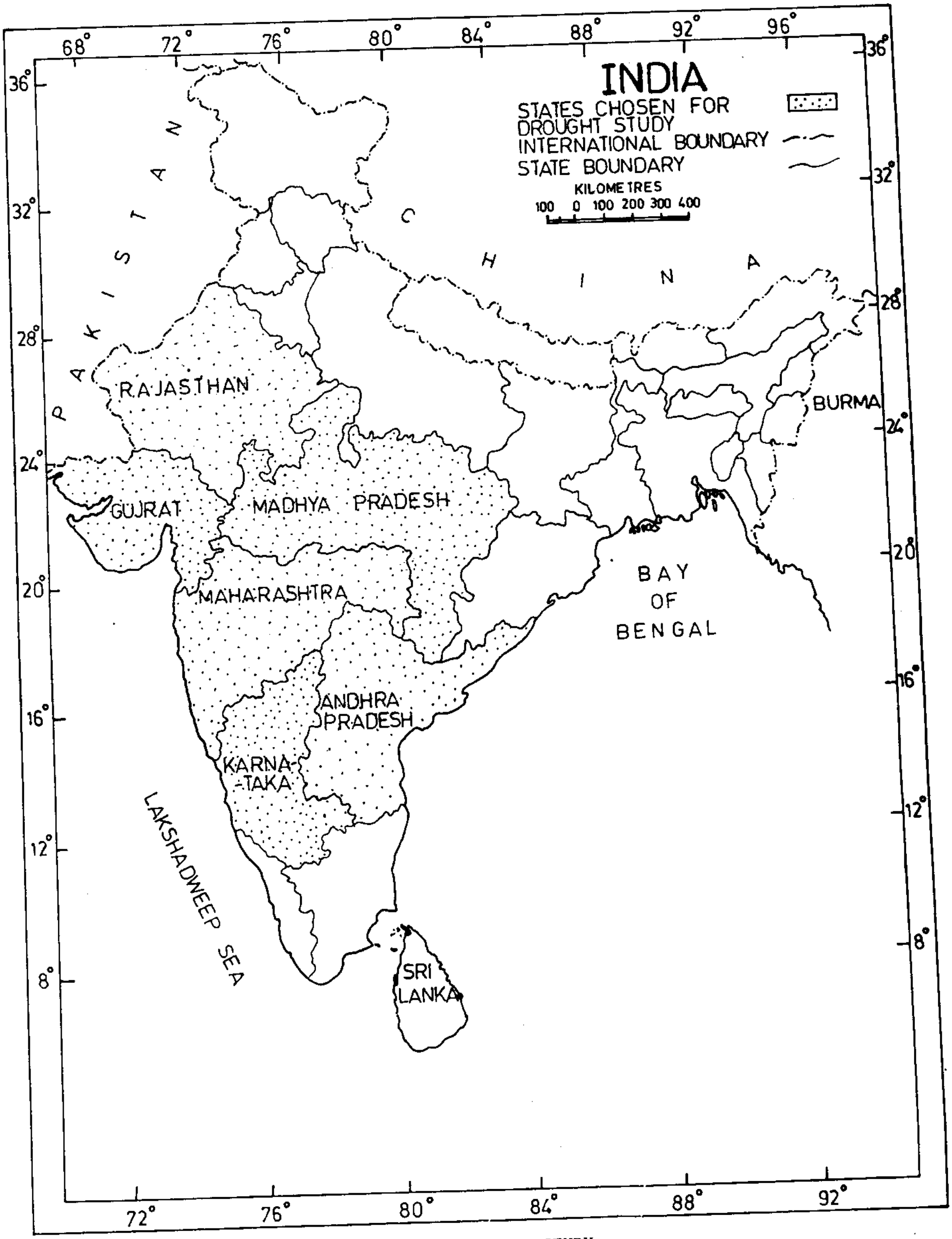


FIG.2.1 STATES TAKEN UP FOR THE STUDY

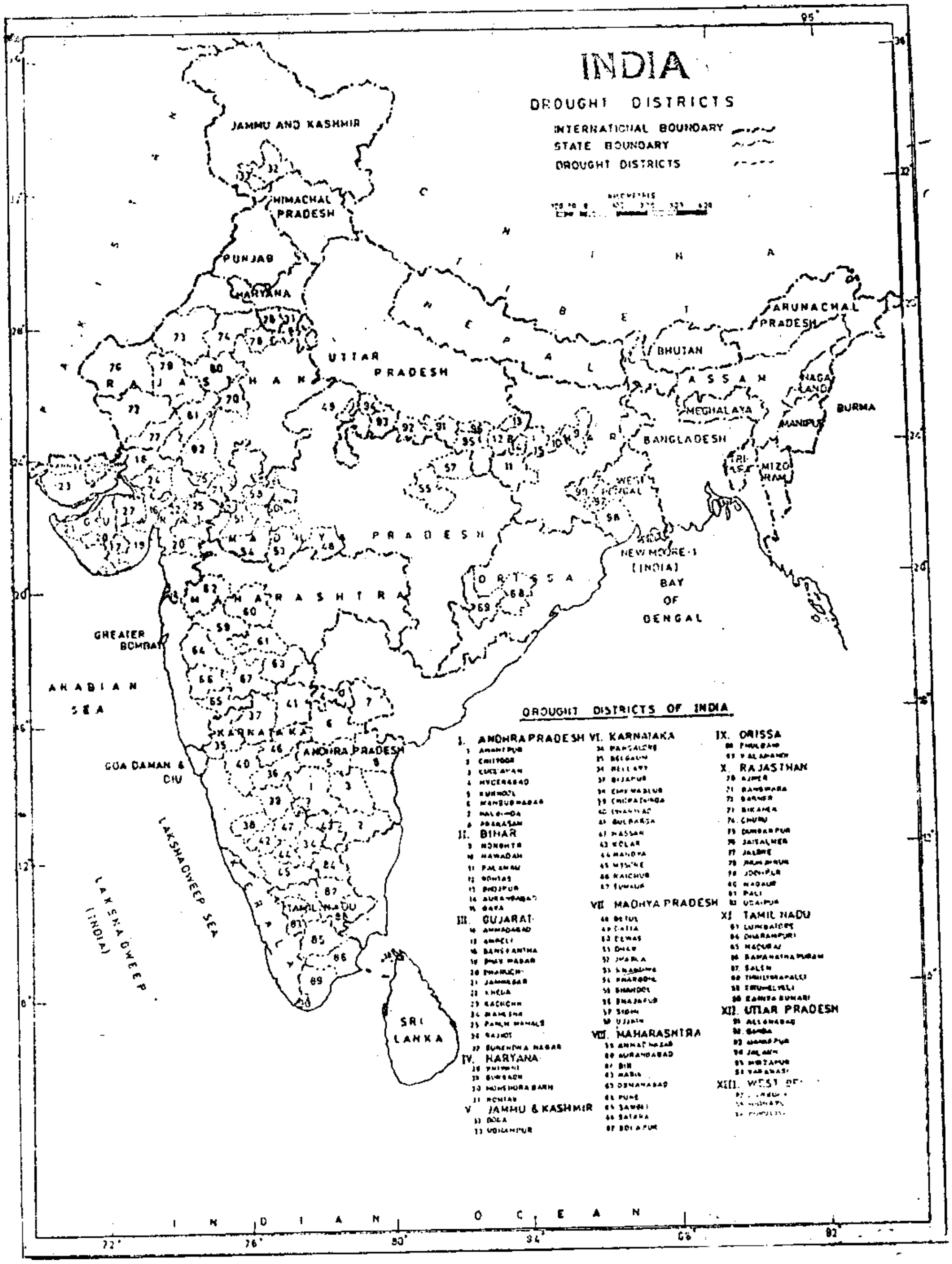


FIG.2.2 DROUGHT PRONE DISTRICTS IN INDIA

TABLE 2.1 : DROUGHT PRONE DISTRICTS

Sl.No.	State	Area in 1000 sq km	Population lakhs	Major rivers streams	Normal rainfall	* Drought Prone Distt. in 1985	District in which study was done by C.W.C.	Distt. covered in this study	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10
1.	Andhra Pradesh	275	535	Godavari	900	Anantpur	Anantpur	Anantpur	
				Krishna		Kurnool	Kurnool	-	
				Vansadhara		Chittoor	Chittoor		
				Nagavelli		Cuddapah	Cuddapah	Cuddapah	
				Pennar		Mahbbob-nagar	Mahboobnagar		
						Pakasam	Pakasam		
						RangaReddy	-	-	
						Nalgonda	Nalgonda	-	
							Hyderabad	-	
2.	Gujarat	196	341	Tapi	350-	Ahmedabad	Ahmedabad		
				Narmada		Rajkot	Rajkot	Rajkot	
						Kutch	Kutch		
						Amreli	Amreli		
						Jamnagar	Jamnagar	Jamnagar	
						Surendra-nagar	Surendra-nagar		
						Bhavnagar	Bhavnagar		
						Panch-mahals	Panch-mahals		
							Benas-Kantha		
							Kheda		
							Bharuch		
							Mehsana		

*Source: District declared drought-prone under DPAP during Seventh Plan.
**Source: Brochure on Drought-March 1982',Drought Area Study and Investigation, C.W.C. and Govt. of India.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10
3.	Karnataka	192	371	Sharvathi	1355	Bijapur	Bijapur	Bijapur	
				Kali		Tumkur	Tumkur		
				Natravati		Dharwar	Dhanwar		
				Varahi		Belgaum	Belgaum	Belgaum	
				Bedthi		Kolar	Kolar		
				Aghanashini		Bidar	-	-	
				Krishna		Chikm-	Chikm-		
						aglur	aglur	-	
				Ghataprabha					
				Malaprabha		Chitra-	Chitra-		
						durga	durga		
				Bhima					
				Tungabhadra		Gulbarga	Gulbarga	-	
				Cauvery		Bellary	Belary	-	
				Pennar		Raichur	Raichur	-	
				Palar		-	Bangalore	-	
						-	Hassan	-	
						-	Mandya	-	
						-	Mysore	-	
4.	Madhya								
	Pradesh	443	522	Narmada	1140	Betul	Betul		
				Mehanadi		Shahdol	Shahdol		
				Tapti		Khargon	Khargon	Khargon	
				Mahi		Dhar	Dhar		
				Chambal		Jhabua	Jhabua	Jhabua	
				Betwa		Sidhi	Sidhi		
				Sone		-	Datia	-	
				Indrawati		-	Dewas	-	
						-	Khandwa	-	
						-	Shajapur	-	
						-	Ujjain	-	

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
5.	Maharashtra	308	623	Tapti	60-120	Ahmad-nagar	Ahmed-nagar	Ahmednagar	
				Godavari		Sangli	Sangli		
				Krishna		Jalna	-	-	
						Dhule	-	-	
						Aurangabad	Auranga-bad	-	
						Solapur	Solapur	Solapur	
						Jalgaon	-	-	
						Nasik	Nasik		
						Satara	Satara		
						Beed	Beed		
						Osma-nabad	Osma-nabad		
						Pune	Pune		
6.	Rajasthan	342	343	Chambal	59	Udai-pur	Udai-pur		
						Dunga-pur	Dunga-pur		
						Bans-wara	Bans-wara	Banswara	
						Ajmer	Ajmer		
						Sawai Madhopur	-	-	
						Tonk	-	-	
						Kota	-	-	
						Jhalawer	-	-	
						-	Barmer	Barmer	
						-	Bikaner	-	
						-	Churu	-	
						-	Jaisalmer	-	
						-	Jalore	-	
						-	Jhunjhunun	-	
						-	Nagaur	-	
						-	Pali	-	

Based on the data collected an interim report on hydrological aspects of droughts has been brought out with some interim conclusions. However, detailed analysis was continued along with collection of more data. The results of detailed analysis are being presented in this report. A brief description of the States and the districts chosen for detailed analysis is given in following sections;

2.1 Andhra Pradesh

In Andhra Pradesh, the S.W. Monsoon generally sets in from early June and lasts until about the end of September whereas the N.E. Monsoon occurs from October to December. The annual average rainfall in coastal A.P., Rayalaseema and Telangana regions is 700-1500 mm, 400-700 mm, and 700-1200 mm respectively. About 60.74% area of the State is under agriculture. Major crops of the State are Jowar, Bajra, Rice, Pulses Groundnut, Cotton, Tobacco etc.

As per studies carried out by the Central Water Commission in year 1982, eight districts namely, Anantpur, Chittoor, Cuddapah, Hyderabad, Prakasam, Kurnool, Mahbubnagar, and Nalgonda were declared drought prone in Andhra Pradesh (Fig. 2.2). Out of these eight drought prone districts it was decided to choose districts of Cuddapah and Anantpur for study. The locations of these two districts on state map are shown in Fig. 2.3. The district maps showing taluk boundaries, locations of raingauge

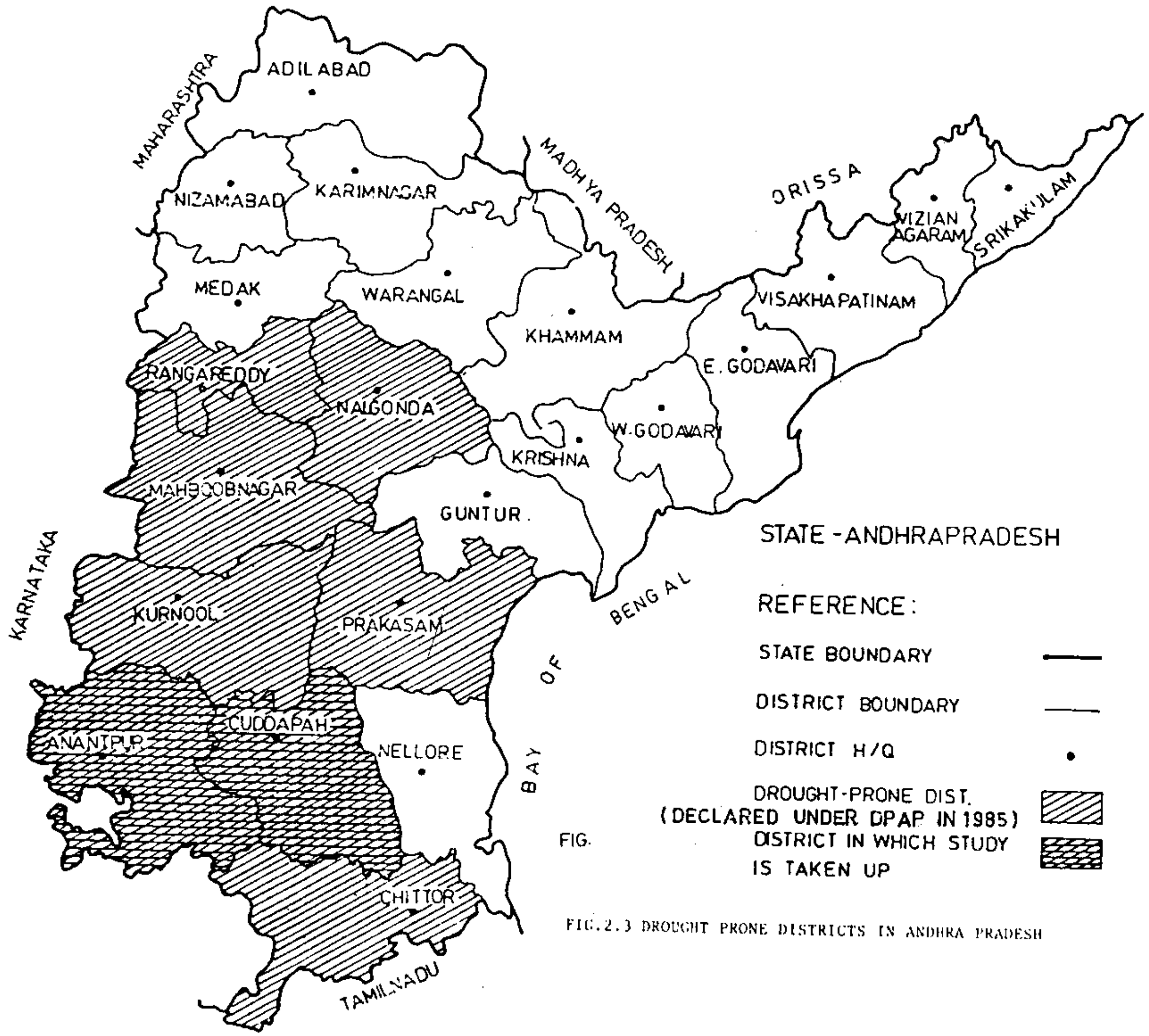


FIG.

FIG. 2.3 DROUGHT PRONE DISTRICTS IN ANDHRA PRADESH

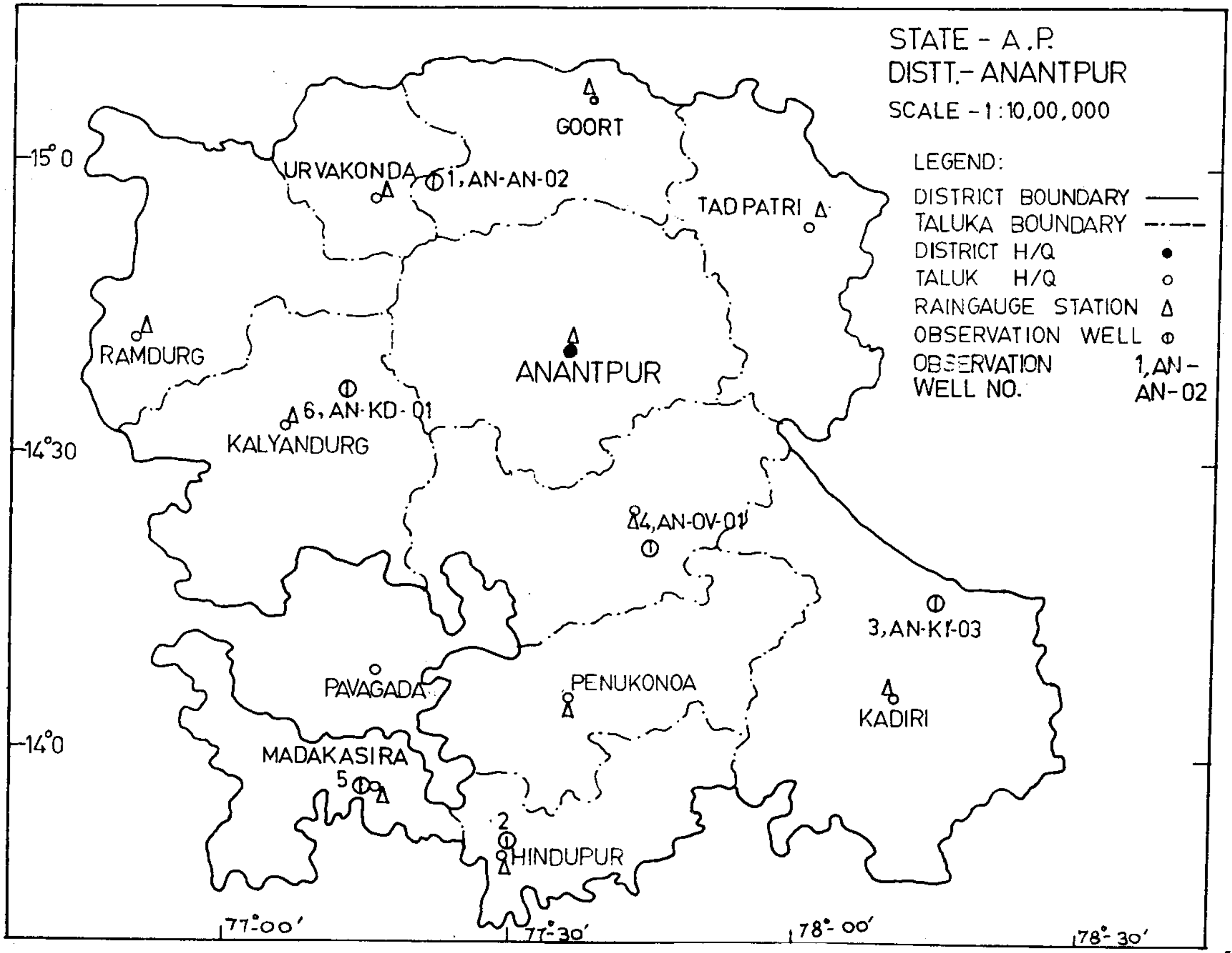


FIG.2.4 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT ANANTPUR

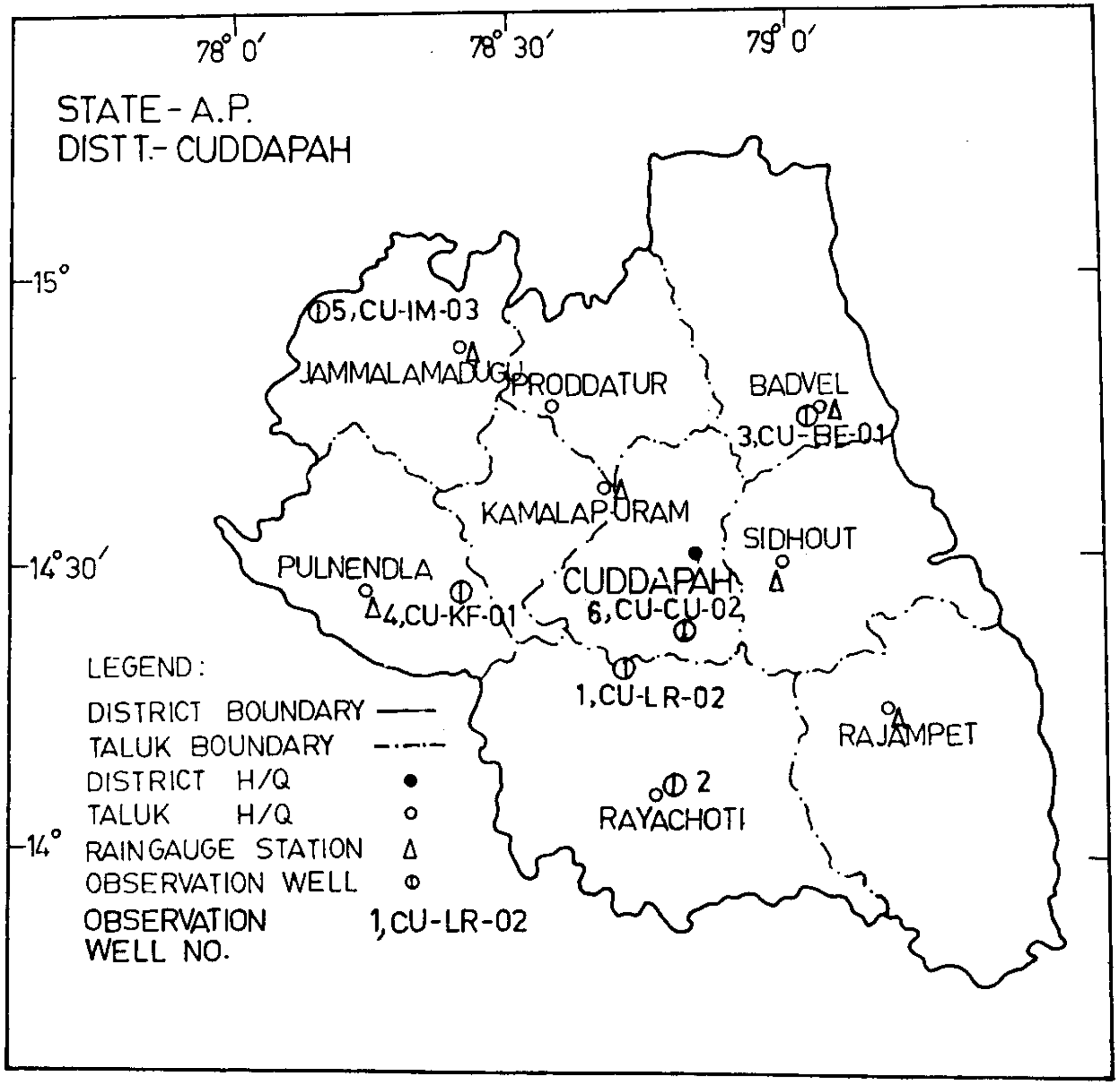


FIG.2.5 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT CUDDAPAH

stations, and ground water observation wells as chosen for study are shown in Figure 2.4 and 2.5. for carrying out the detailed analysis rainfall data from 1901-1985, ground water observation data from 1975-85 as available from concerned departments in respect of these two districts have been used.

2.2 Gujarat

In Gujarat, the average annual precipitation over different parts of the State varies widely from 300 mm in the Western half of Kutch to 1500 mm in the Southern parts of the Valsad District and Dengs. The monsoon usually commences by the middle of June and withdraws by the end of September. According to the figures available the irrigated area in Gujarat state was about 15% of the total cultivated area. The soils of Gujarat can be broadly classified as: Residual loamy soils, Alluvial Deep clay soils, Alluvial clayey soils, Alluvial sandy soils, Alluvial sandy loam, Coastal littoral soils and Saline soils. Out of the total geographical area of 196 lakh ha of the state, about 50% is under cultivation. Among the individual crops groundnut and cotton occupy the largest area which is about 20% each. Live-stock and poultry raising forms a very substantial part of the occupation of almost all the farms.

Central Water Commission in 1982 identified 12 districts, namely, Ahmedabad, Rajkot, Kutch, amereli, Jamnagar,

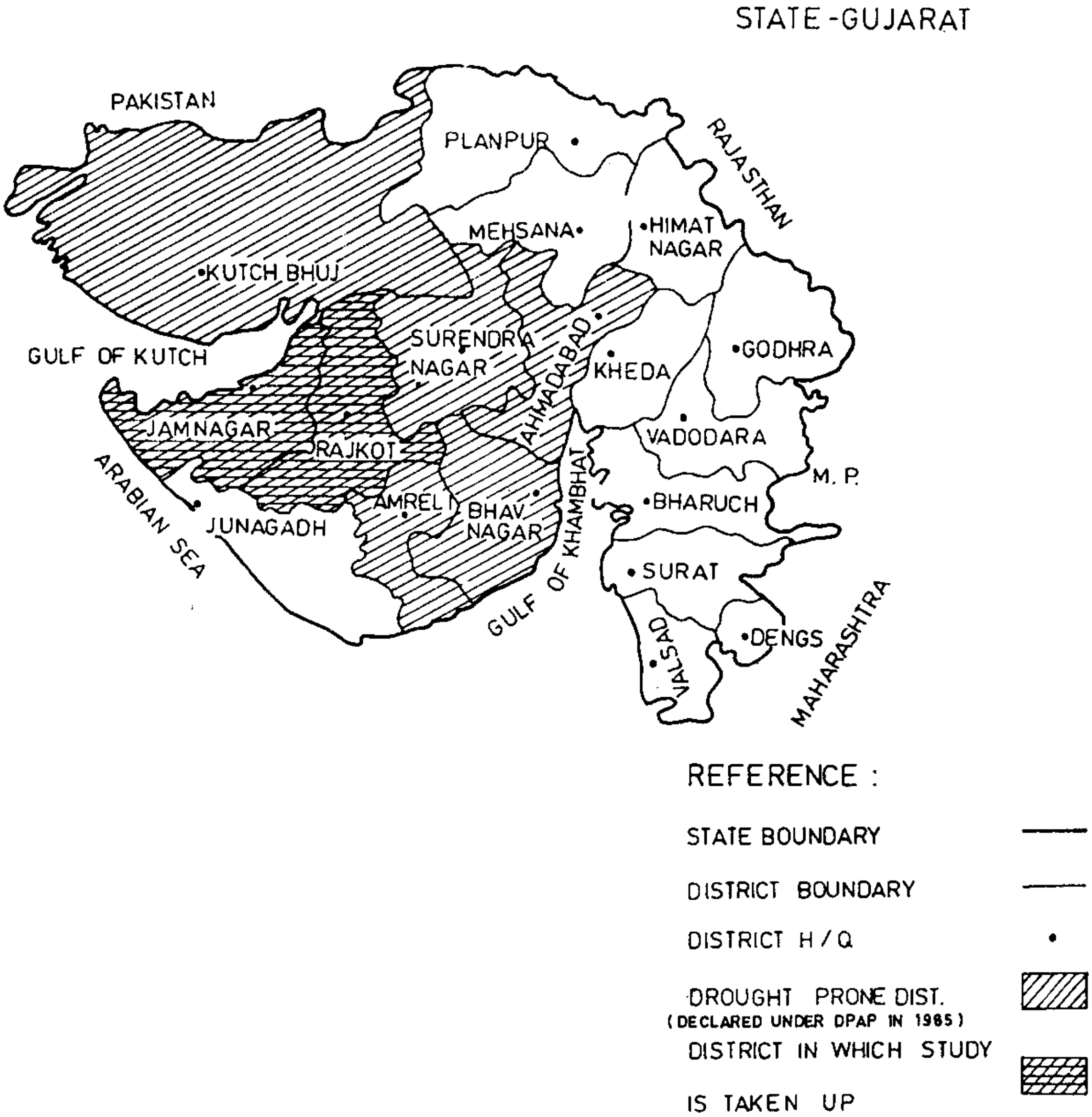


FIG.2.6 DROUGHT PRONE DISTRICTS IN GUJARAT

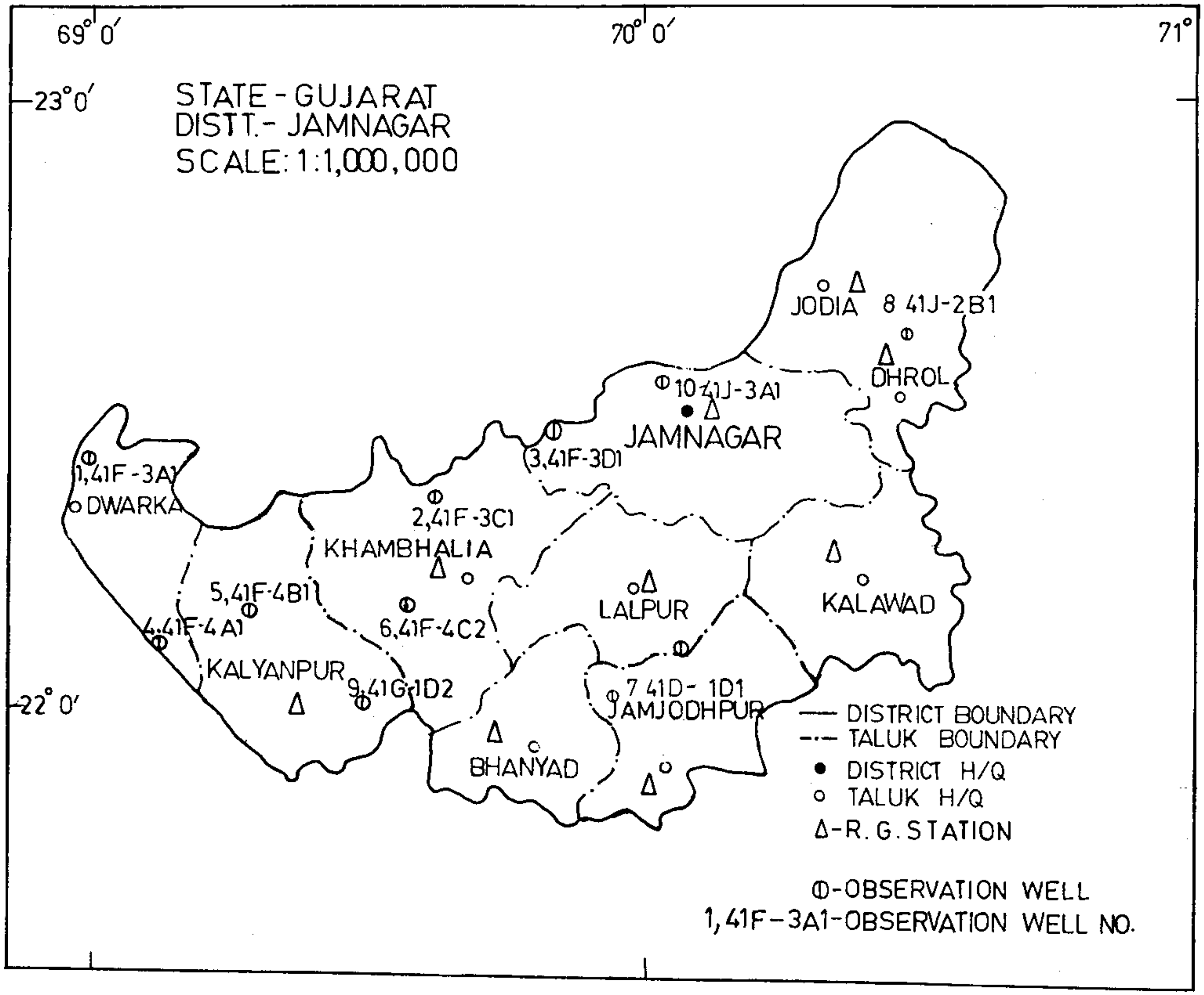


FIG.2.7 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT JAMNAGAR

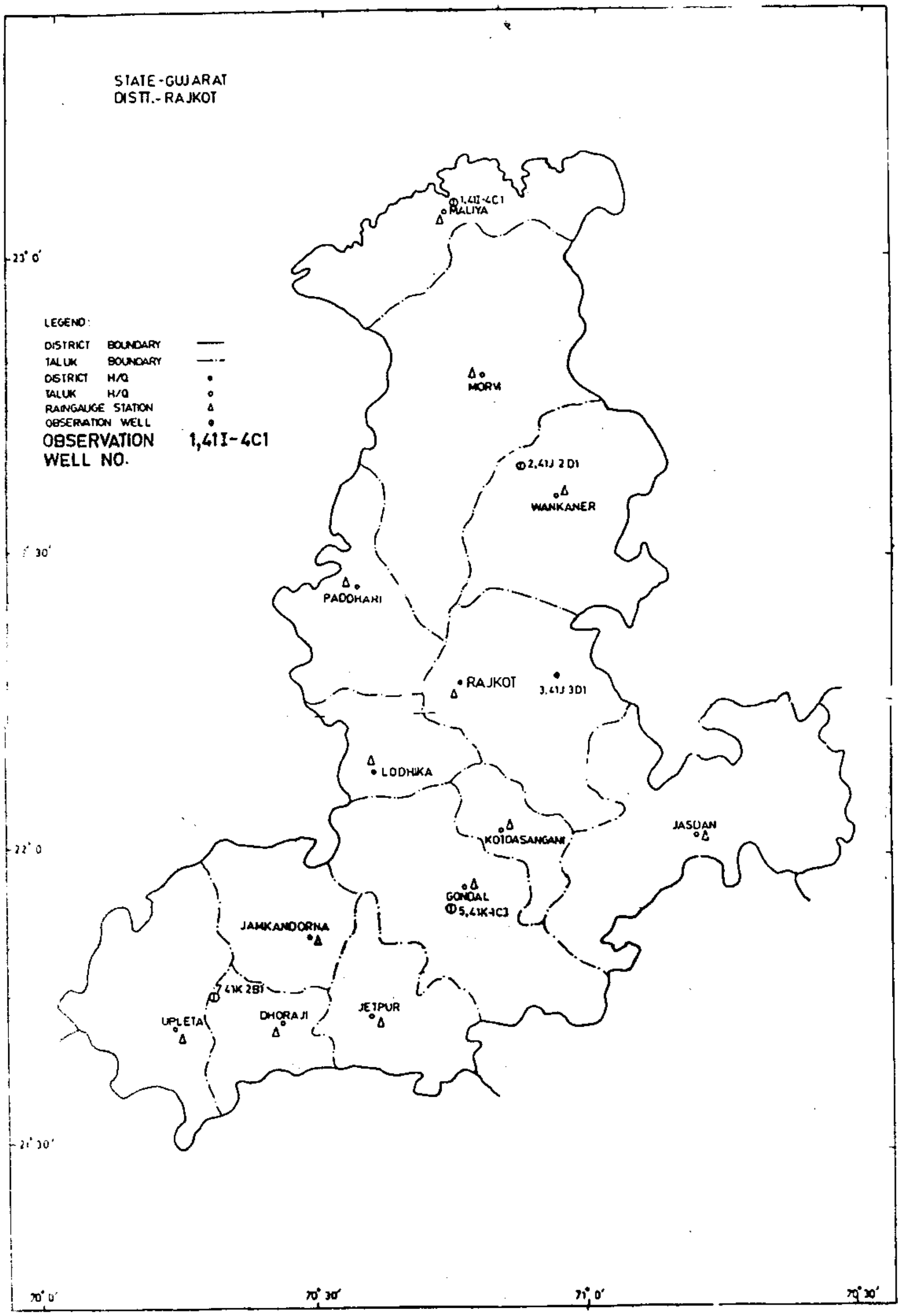


FIG.2.8 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT RAJKOT

Surendranagar, Bhavnagar, Panchmahals, Banas-Kantha, Kheda, Bharuch, and Mehsana in Gujarat State as drought prone (Fig. 2.2) out of which two districts viz. Jamnagar and Rajkot has been taken up for the study. The locations of these two districts along with other drought prone districts of the state is shown in Fig. 2.6. The district maps showing taluks, location of raingauges and location of G.W. Wells as chosen for study are presented in figures 2.7 and 2.8. Rainfall data from 1901-85 and ground water data from 1978-85 as was made available by concerned departments in respect of these two districts have been used in the detailed analysis.

2.3 Karnataka

In Karnataka, the Western Ghats and Malnad region receive an annual rainfall ranging from 4000 mm to 8000mm over the Western Ghats and decreasing eastwards to about 2000 mm at the eastern edge of the region. The northern Malnad region is an estensive undulating plateau with an elevation ranging from 350 to 650 metres from the northern parts of the State and includes the districts of Bidar, Gulbarga, Bijapur, Dharwar, Bellary and Belgaum except the extreme south western parts. The annual rainfall received in this region varies from 1500 mm to 500 mm decreasing from west to east. The Southern Malnad region which includes the districts of Chitradurga, Tumkur, Kolar, Bangalore, Mandya and most of Mysore leaving the extreme south western parts and those parts of Hassan, Chikamagalur and Shimoga districts outside the Malnad region receive an annual rainfall from 2000 mm in the western edge to about 460 mm in the eastern edge in the Chitradurga district. The State enjoys the benefits of two monsoon viz., the south-west monsoon and North-East monsoon. The South-West monsoon which extends over four months from June to September contributing around 73 percent or about three fourth of the average rainfall received in the State.

The Central Water Commission in 1982 identified 14 drought districts namely, Bijapur, Tumkur, Dharwar, Belgaum, Kolar, Chikmaglur, Chitradurga, Gulbarga, Bellary, Raichur, Bangalore, Hassan, Mandya and Mysore in the state (Fig. 2.2). Out of 14 districts, identified as drought prone by Central Water Commission, two districts viz. Bijapur and Belgaum have been selected for the study. The location of these two districts along with other drought prone districts of the state is shown in Fig. 2.9. the district maps with taluk boundaries, location of raingauges and location of ground water well as chosen for study have been shown in figures 2.10 and 2.11. For analysis, rainfall data from 1901-85 and ground water data from 1977-85 as made available by concerned departments in respect of these two districts have been used in the analysis.

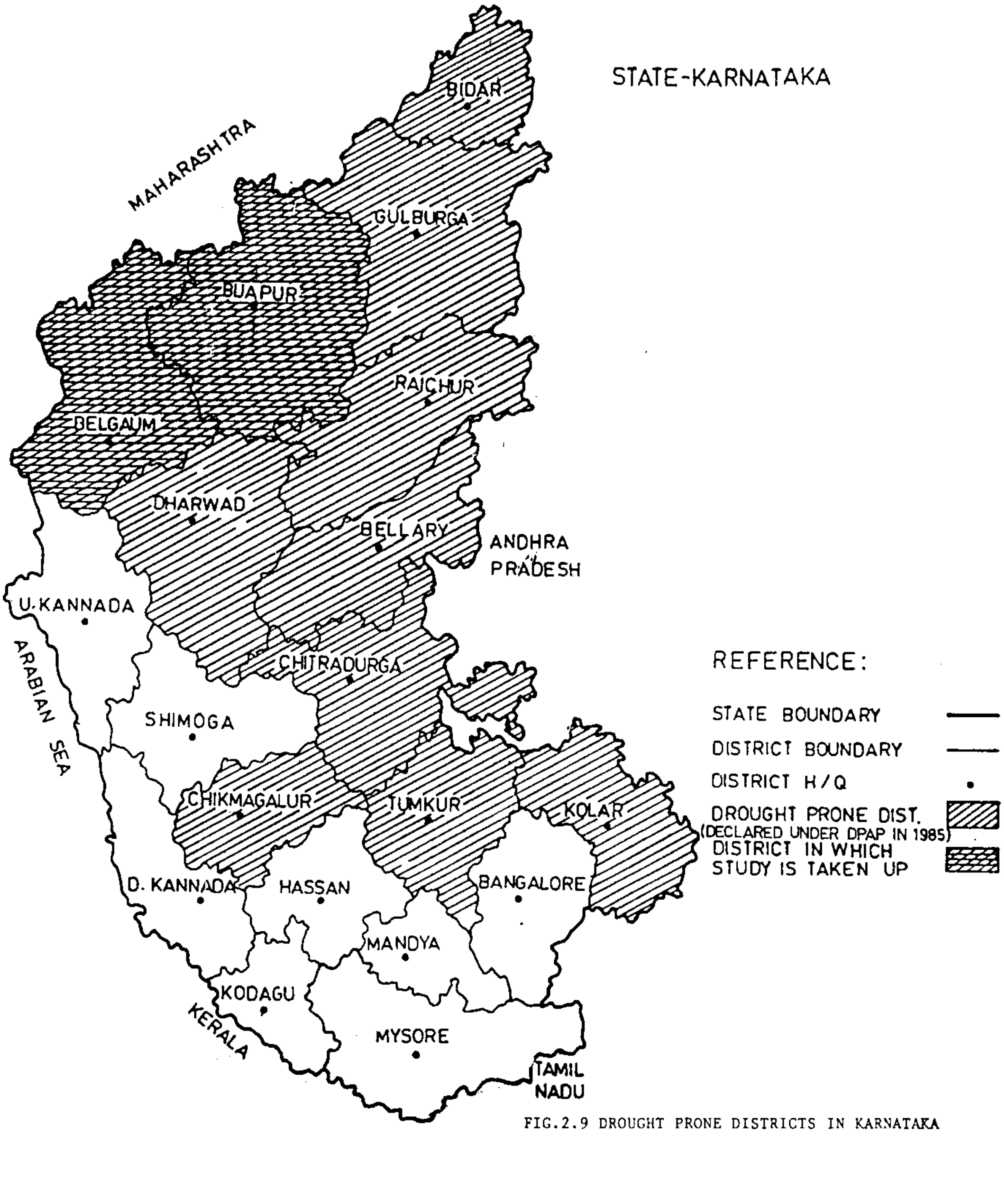


FIG.2.9 DROUGHT PRONE DISTRICTS IN KARNATAKA

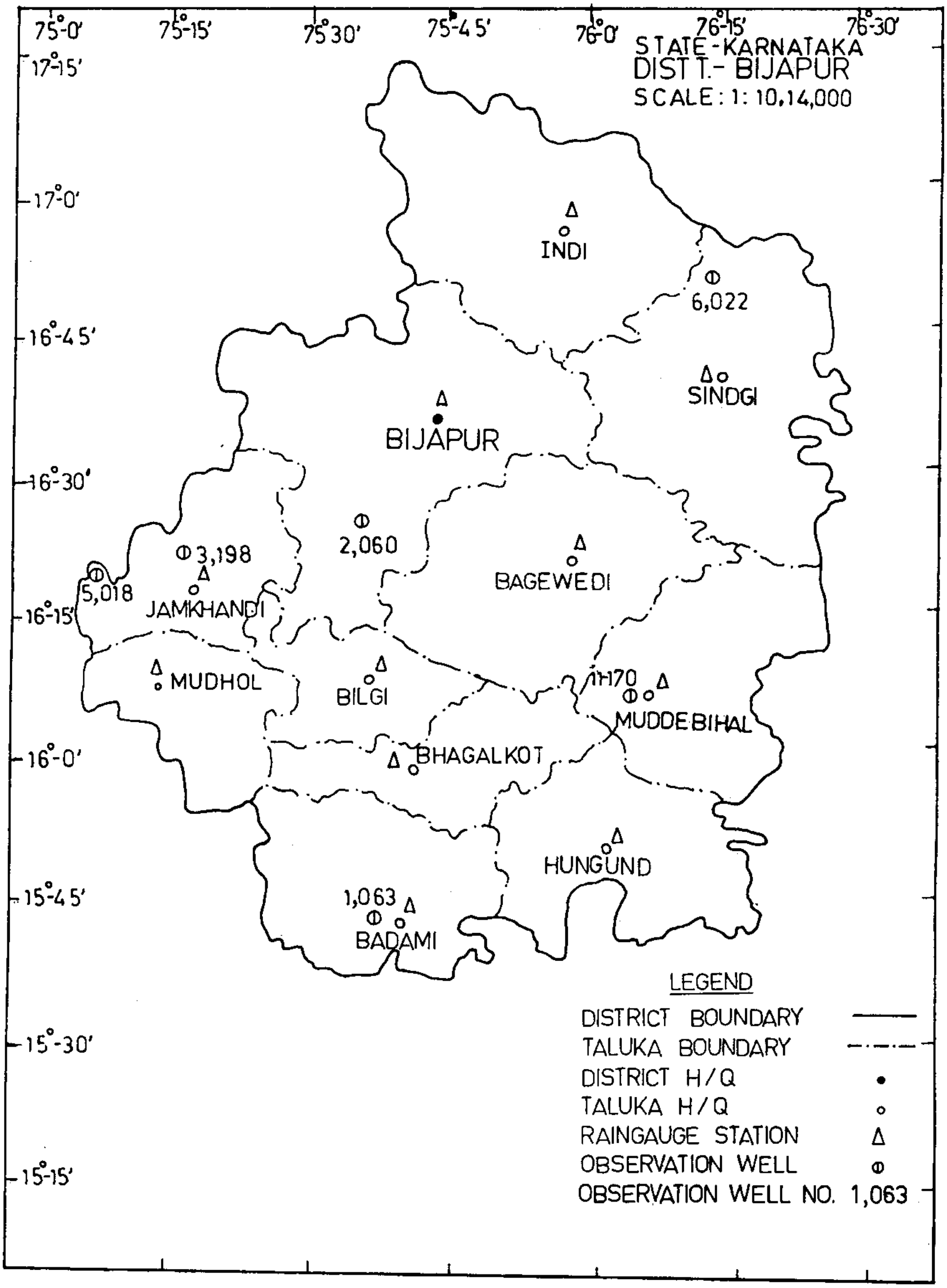


FIG.2.10 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT BIJAPUR

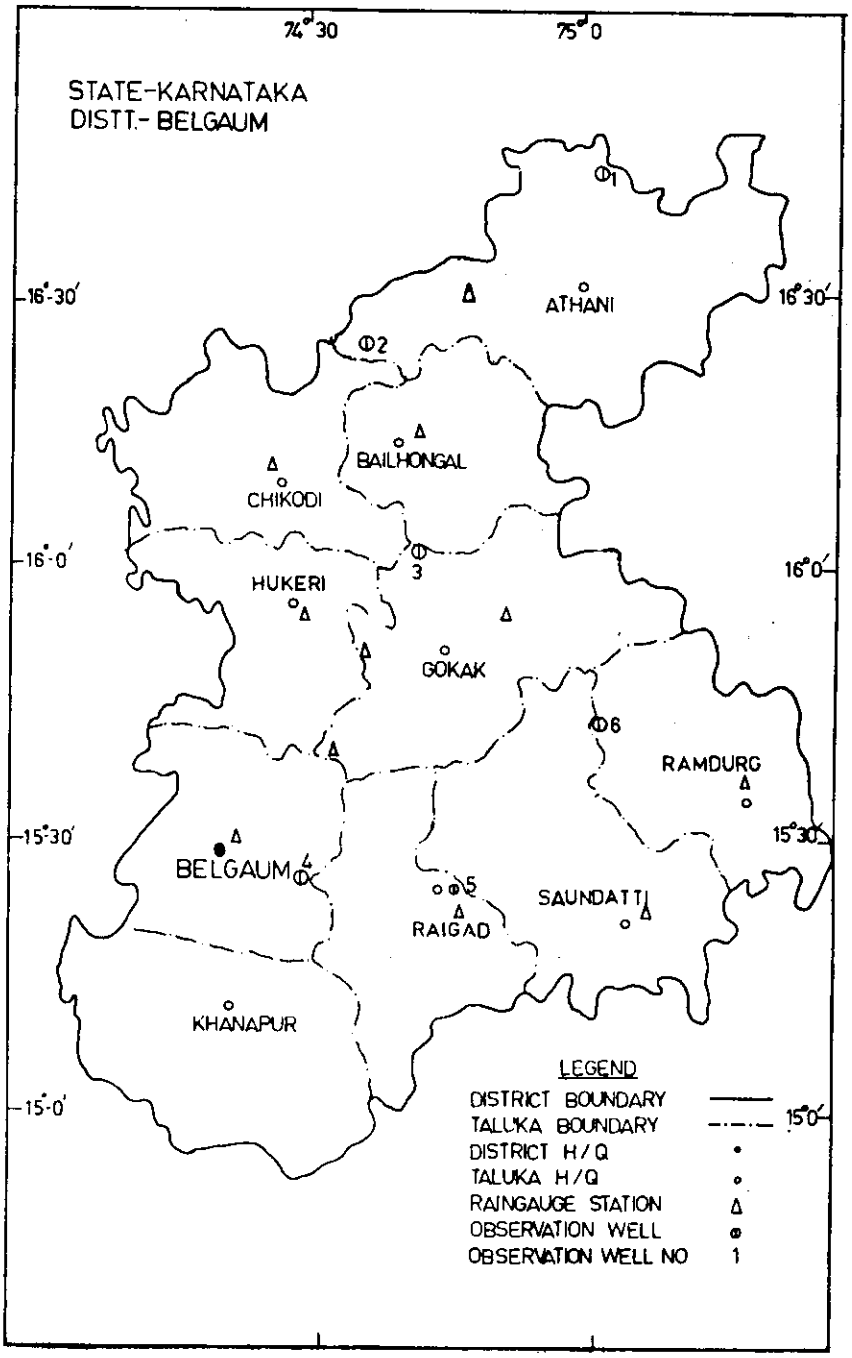


FIG.2.11 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT BELGAUM

2.4 Madhya Pradesh

In Madhya Pradesh monsoon generally breaks about in the middle of June and continues upto the end of September, with short dry spells in between. As a result, normally the northern portion of Madhya Pradesh receives a rainfall of about 750 to 850 mm and the Malwa plateau receives 750mm to 1250 mm annually. The hilly areas of Vindhyas and Satpuras receive rainfall of 1050 to 1750 mm whereas the Bastar plateau receives a maximum of 1600 to 1800 mm annually. The state of Madhya Pradesh has twelve agroclimatic zones. Boardly, it could be sub-divided into five major crop zones viz. rice zone, wheat zone, wheat-rice zone, wheat-jowar zone and cotton-jowar zone. The main crops produced in the State are wheat, Jowar, Rice, Grams, Maize, Groundnut, Sugarcane and Cotton. The major portion of state's economy is due to agriculture which involves nearly 80% of its population. Madhya Pradesh is however, much below the national average of 27.5% (as in 1983-84) in the field of irrigation.

The Central Water Commission identified in year 1982, 11 districts namely, Betul, Shahdol, Khargon, Dhar, Jhabua, Sidhi, Datia, Dewas, Khandwa , Shajapur and Ujjain as drought affect in the State (Fig. 2.2). Two districts namely Jhabua and Khargone out of 11 drought affected districts have been taken up for the detailed analysis. The locations of these two districts along with other drought affected districts in the state in shown in Fig. 2.12. The district maps with taluk boundaries, raingauges locations and ground water well locations as chosen for study have been shown in figure 2.13 and 2.14. The rainfall data from 1901-85 and ground water data from 1975-85 as made available by concerned departments in respect of these two districts have been used in the analysis.

2.5 Maharashtra

In Maharashtra, the coastal belt of Konkan and the windward side of the Western Ghats receive an annual rainfall of over 200 to 250 cm, rainfall decreases rapidly to less than 60 cm over the western districts of Madhya Maharashtra. Parts of Dhule, Nasik, Pune, Satara and Solapur districts receive less than 50 cm. Marathwada receives 60-90 cm annually. The rainfall in 17 districts out of 27 in the State is 100 cm or less annually. Rainfall is more than 150 cm in many parts of Vidarbha. The soil over major part of the State to the east of the Western Ghats and to the west of eastern Vidarbha is of the medium black variety interspersed by long patches of deep black soil. The land utilisation pattern reveals about 60% area is under cultivation including about 8% under irrigation, 18% under forest and remaining 22% under miscellaneous land use. The dry farming area in the State accounts for nearly 70% of the geographical area of the State. Jowar and Bajra are the principal crops followed by Wheat and Sugarcane in the interior districts. Rice is the principal crop in coastal districts.

As per studies carried out by Central Water Commission in 1982, 9 districts namely, Ahmednagar, Sangli, Aurangabad,

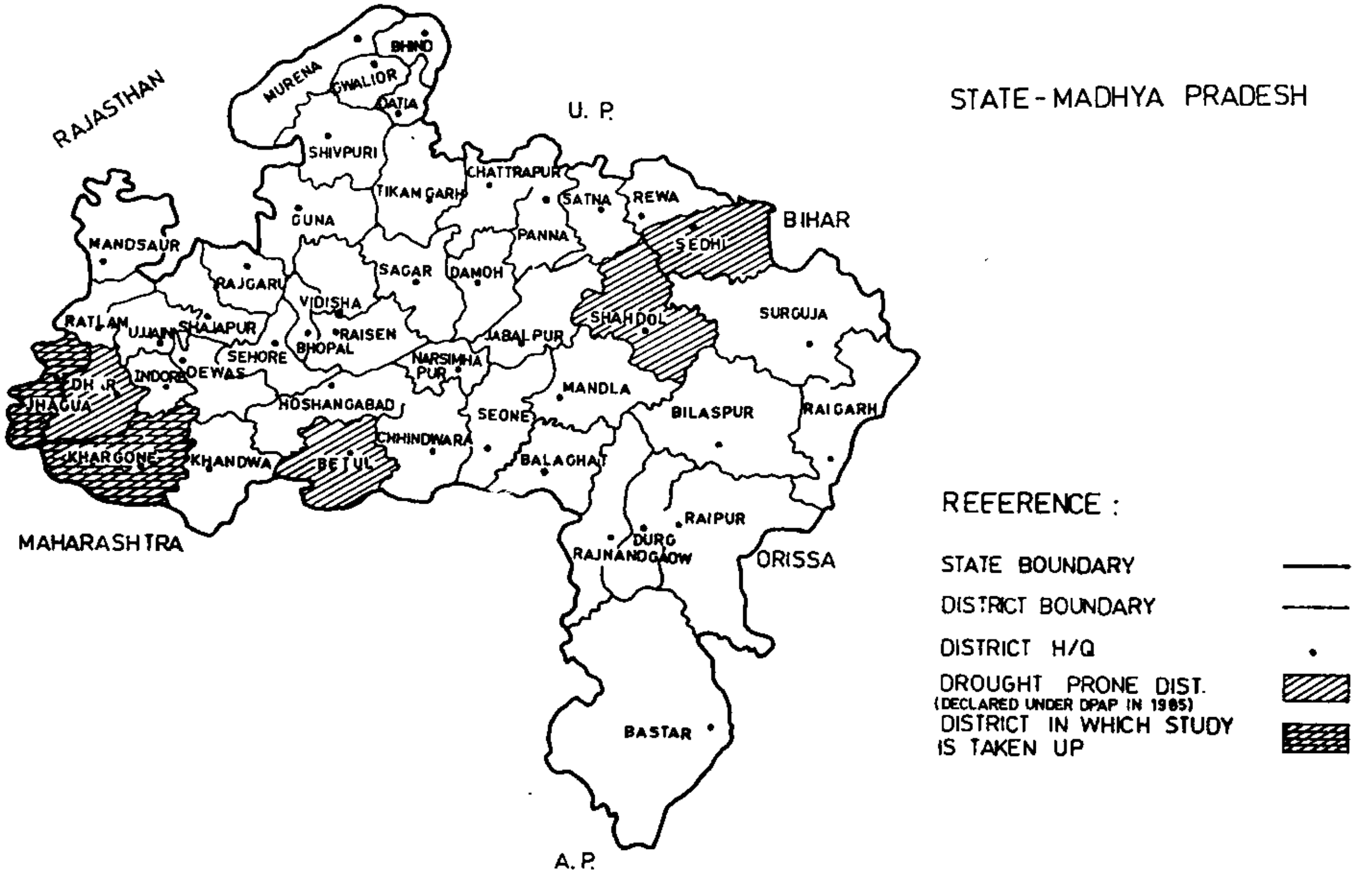


FIG.2.12 DROUGHT PRONE DISTRICTS IN MADHYA PRADESH

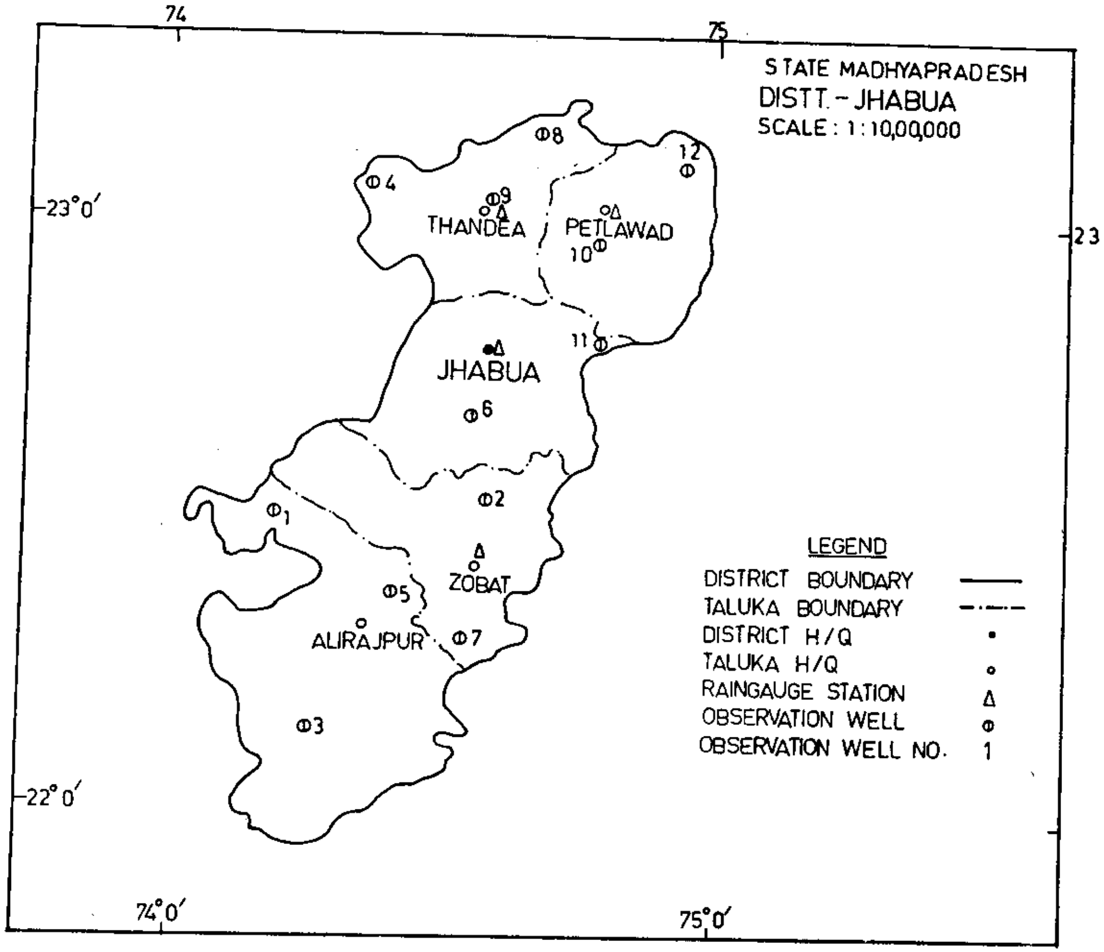


FIG.2.13 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT JHABUA

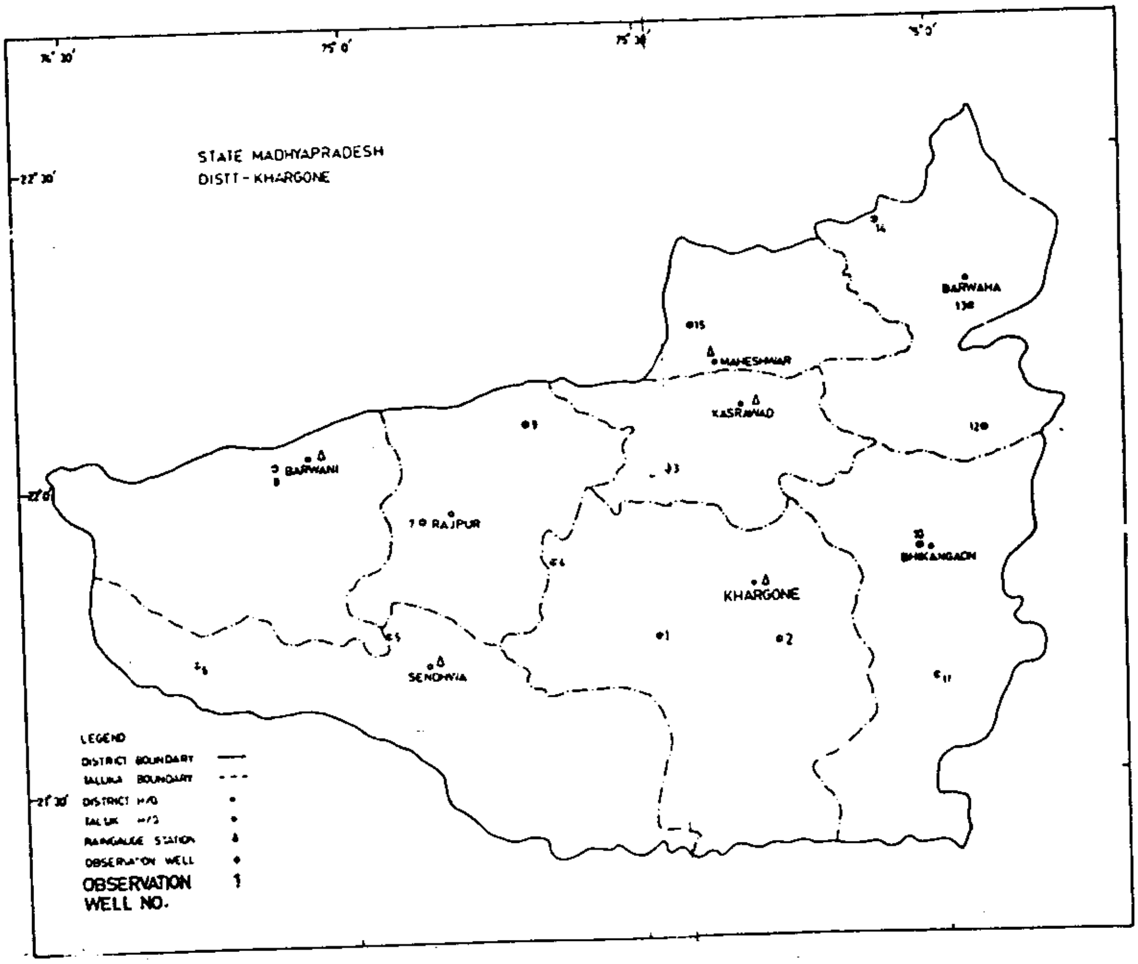


FIG.2.14 LOCATION OF RAINGAUGE AND GROUNDWATER WELL
IN DISTRICT KHARGONE

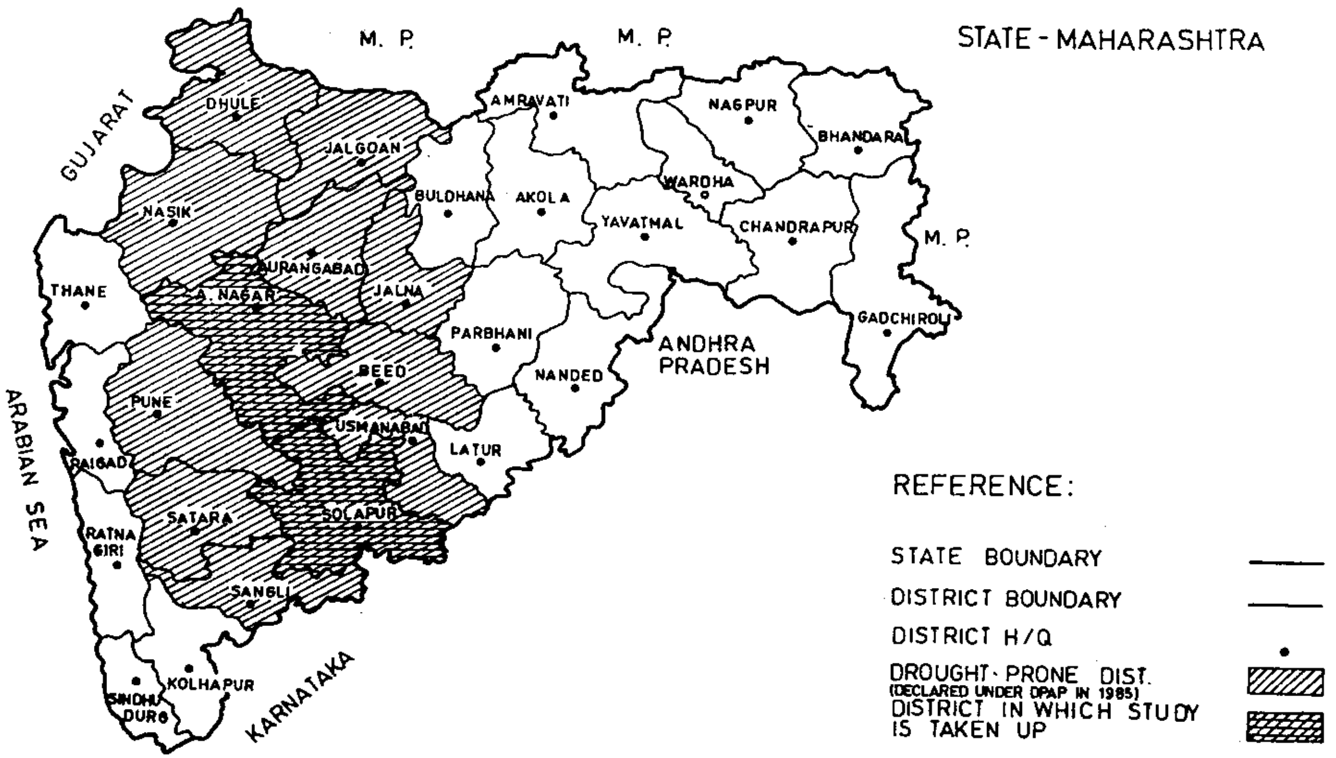


FIG.2.15 DROUGHT PRONE DISTRICTS IN MAHARASHTRA

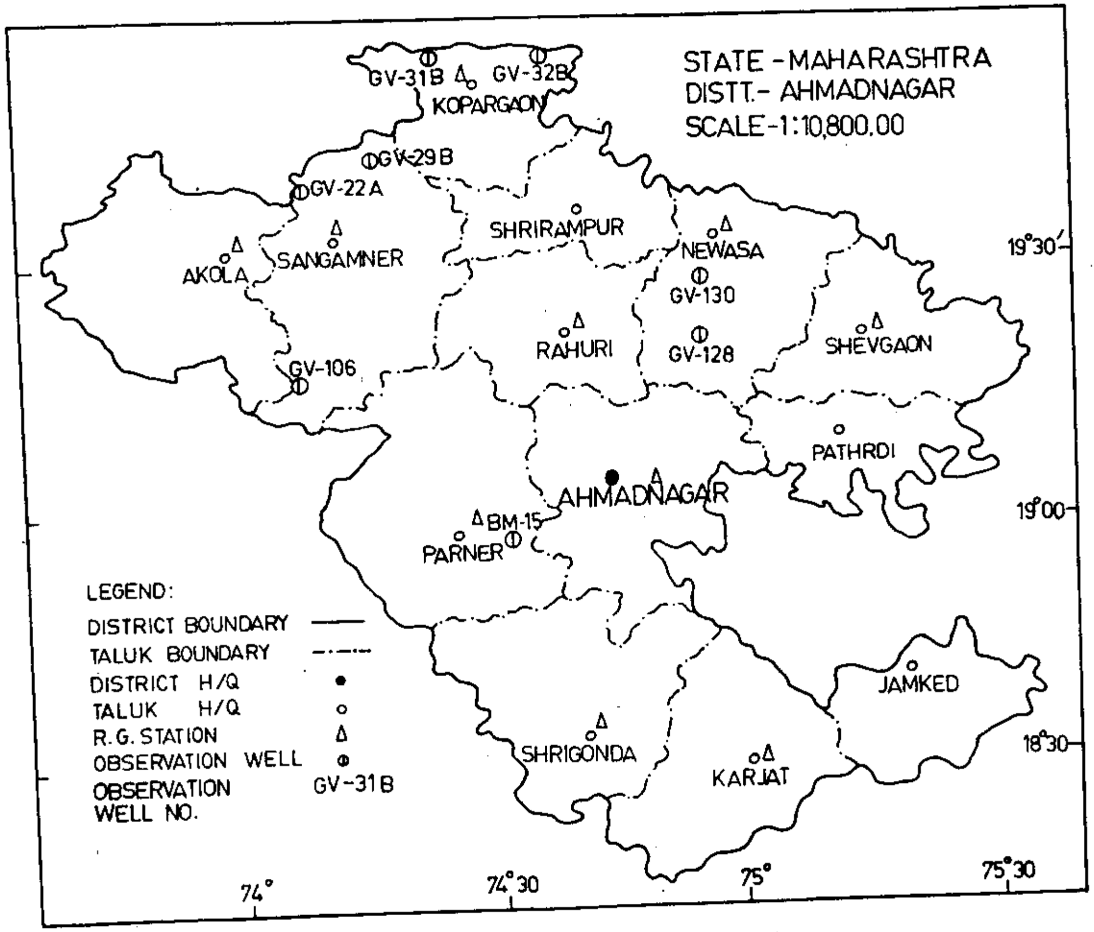


FIG.2.16 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT AHMEDNAGAR

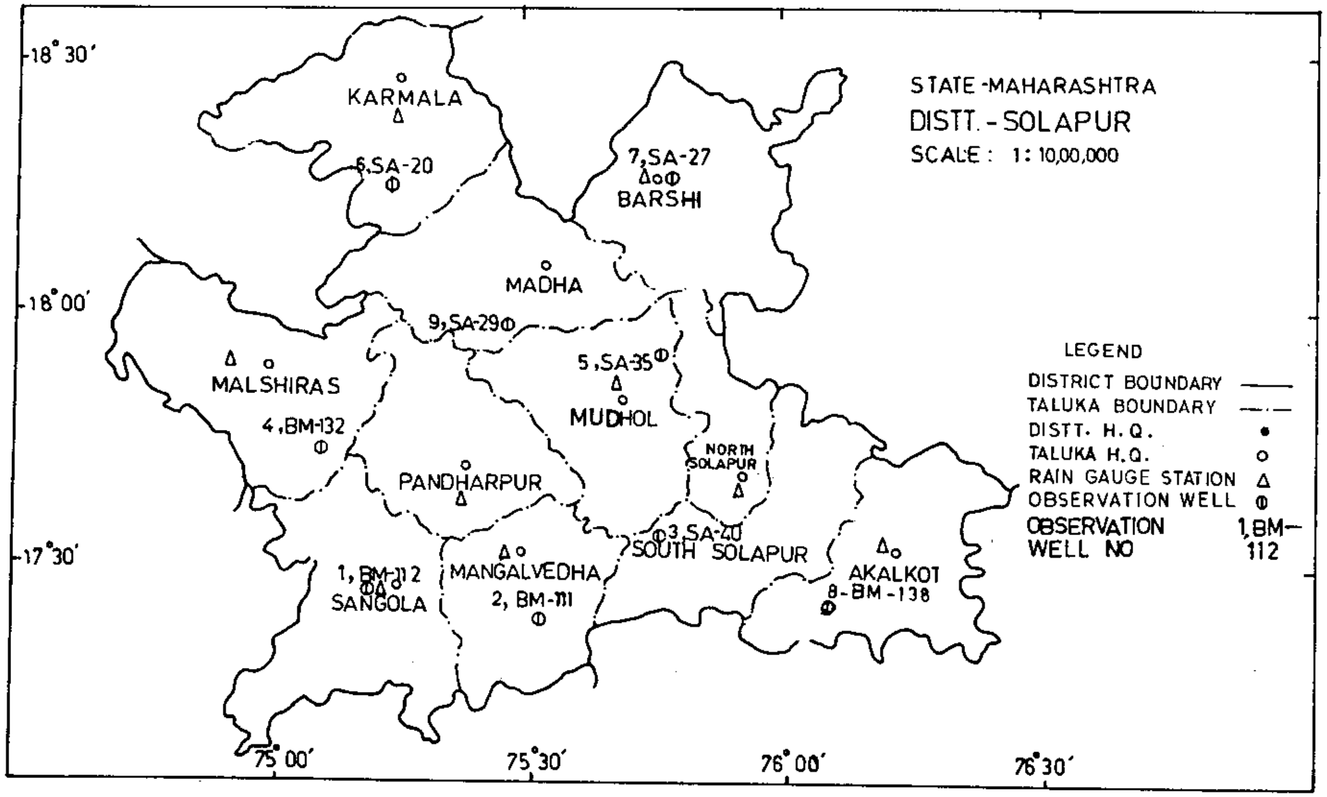


FIG.2.17 LOCATION OF RAINGAUGE AND GROUNDWATER WELL
IN DISTRICT SOLAPUR

Solapur,Nasik,Satara,Beed,Osmanabad & Pune were declared as drought prone in Maharashtra (Fig. 2.2). Out of these nine districts, two namely Solapur and Ahmadnagar have been selected for study. The location of these districts on state map along with other drought affected districts is shown in figure 2.15. The districts maps showing taluk boundaries, raingauges and ground water wells as chosen for study have been shown in figure 2.16 and 2.17. The rainfall data from 1901-85 and ground water data from 1975-85 have been used for analysis.

2.6 Rajasthan

Rajasthan receives rainfall from South-West monsoon. The duration of monsoon in Rajasthan is hardly three months from 15th June to 15th September. There are 12 basic types of soils viz., Desert soils, Desert rivweive soils, Alluvial serozems Gray Brown soils, Non-calcic brown soil, Brown soils saline phase, Alluvial soil recent origin, Gray Brown alluvial soils, Yellow brown soil, Red loamy, Deep and medium black soils and Hilly soils. Major crops of the State are Jowar, Bajara, Maize, Pulses, Wheat etc. Major source of irrigation in drought prone areas of state is through irrigation-tanks supplemented by ground water.'

Central Water Commission in year 1982 identified thirteen districts namely, Udaipur, Dungarpur , Banswara, Ajmer, Barmer , Bikaner, Churu, Jaisalmer, Jalore, Jhunjhunun, Nagaur, Pali in Rajasthan as drought prone (Fig. 2.2). Out of these 13 districts two districts viz. Barmer and Banswara have been selected for the present study. The location of these two districts on State map along with other drought affected districts is shown in figure 2.18. The district maps showing locations of taluks, raingauges and ground water wells as chosen for study have been shown in figure 2.19 and 2.20. The rainfall data from 1901-85 and ground water data from 1975-85 have been used for the analysis.

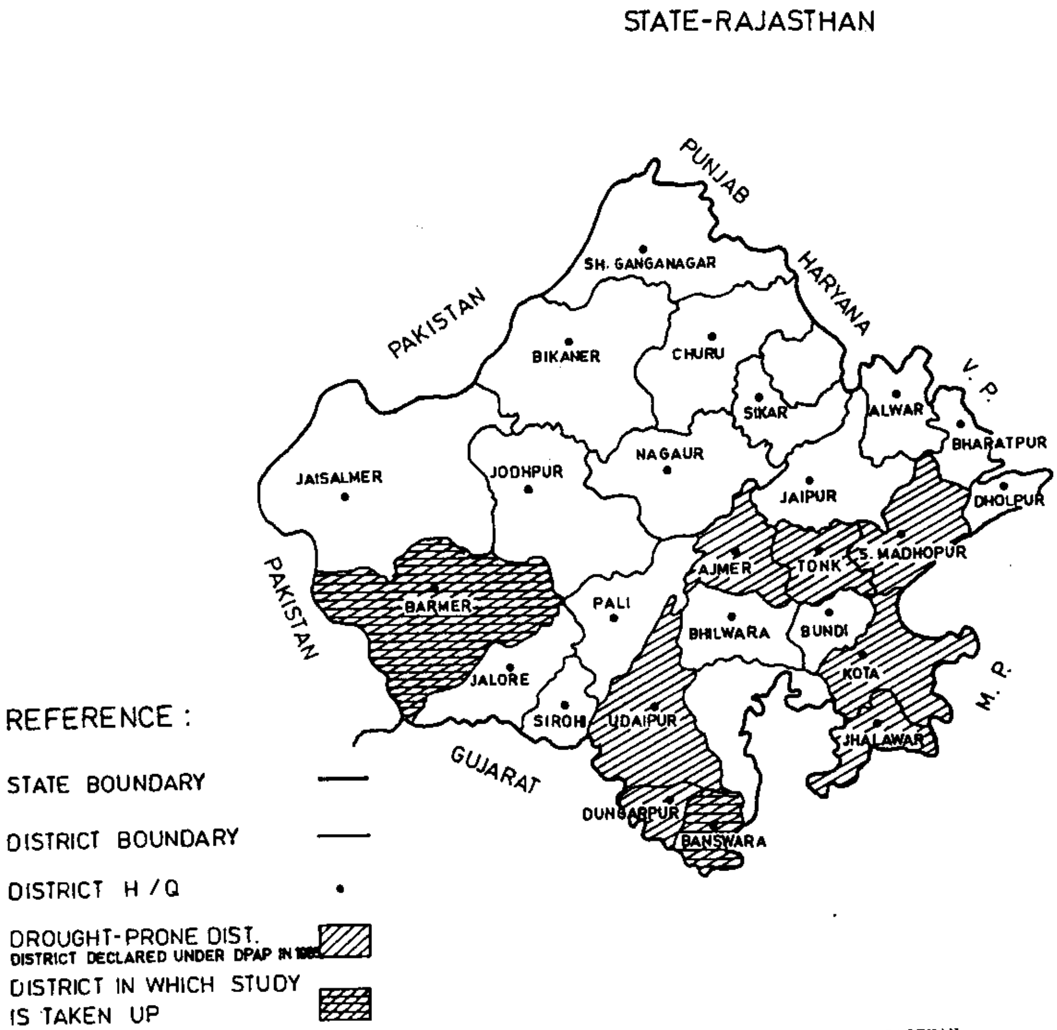


FIG.2.18 DROUGHT PRONE DISTRICTS IN RAJASTHAN

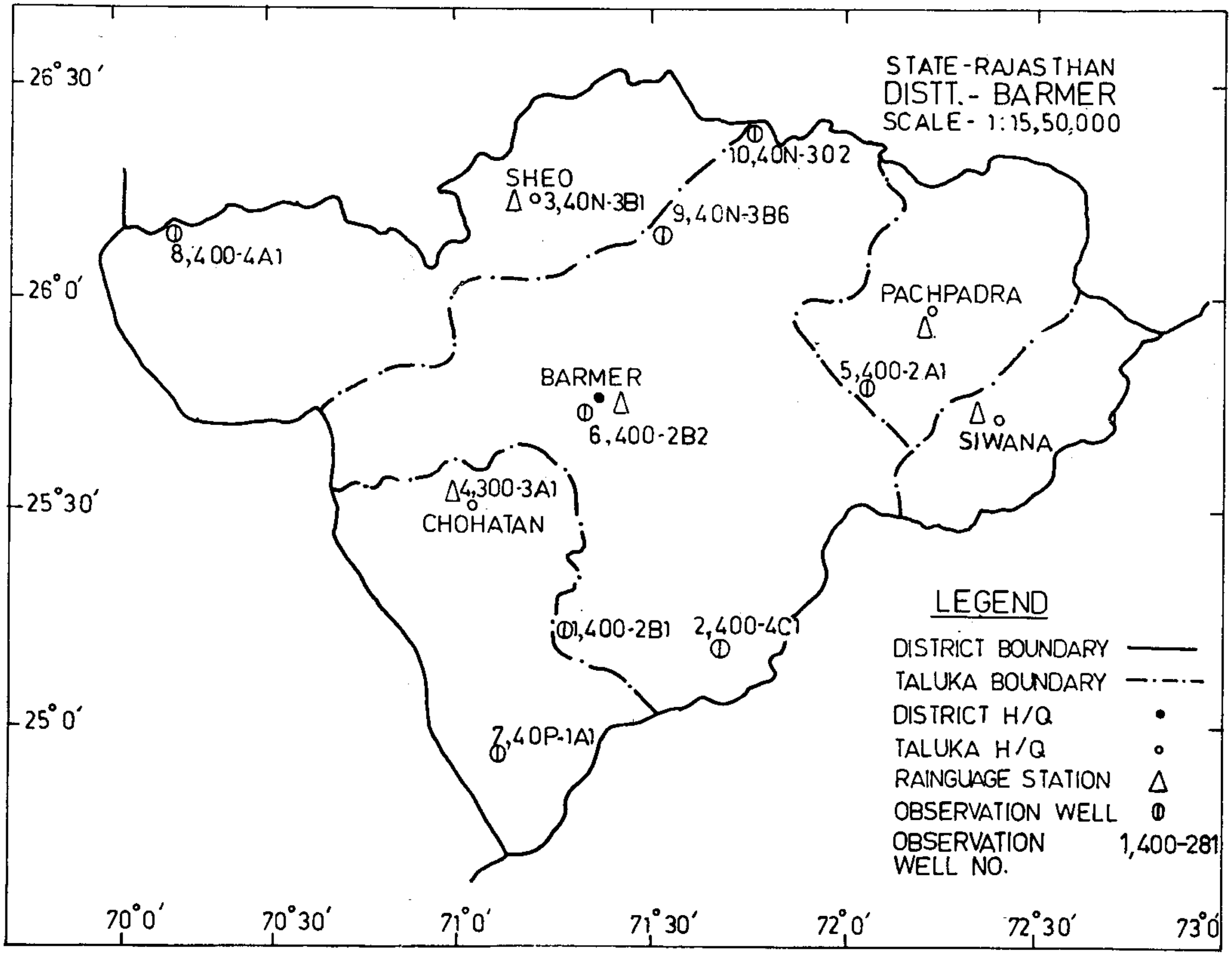


FIG.2.19 LOCATION OF RAINGAUGE AND GROUNDWATER WELL IN DISTRICT BARMER

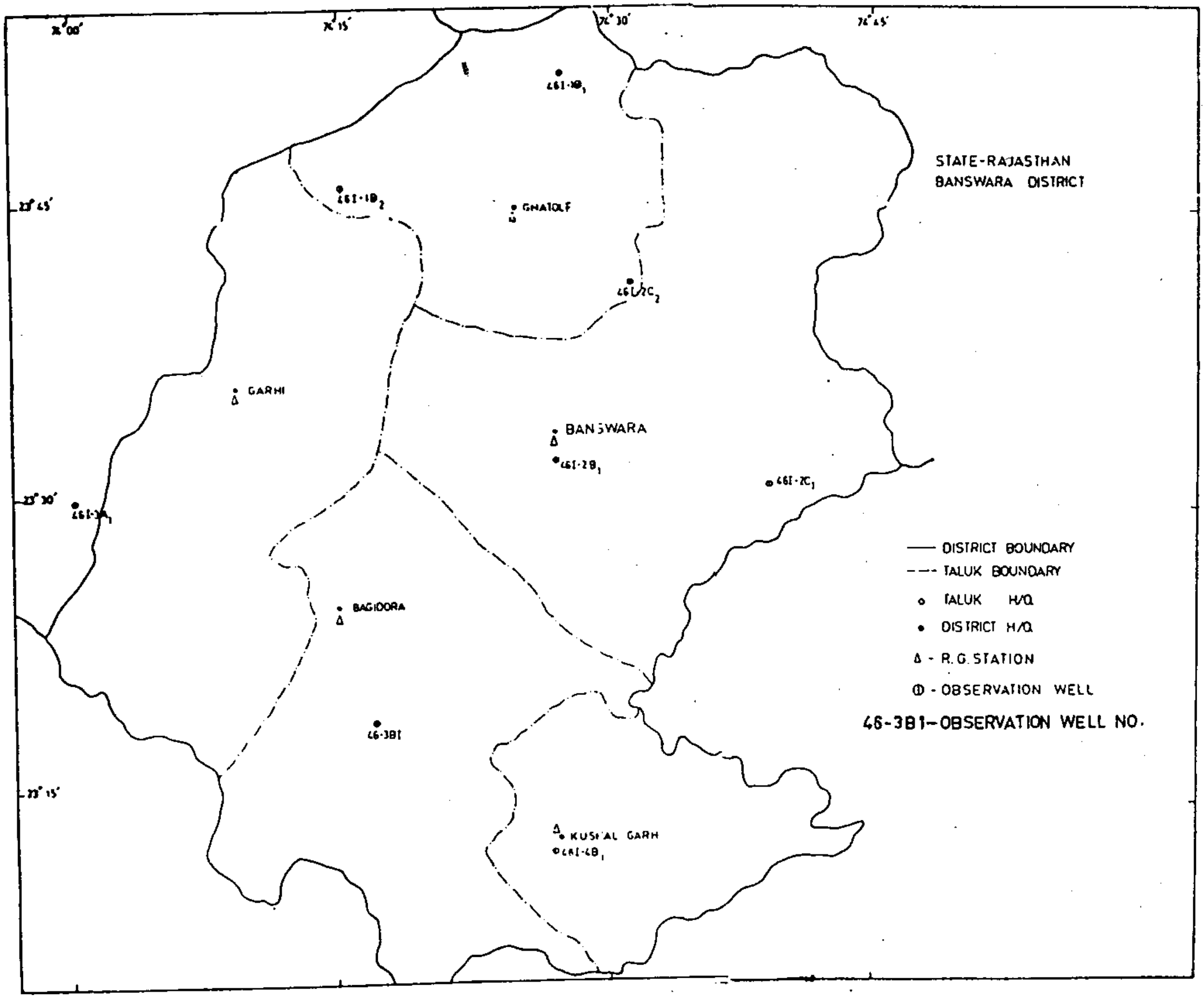


FIG.2.20 LOCATION OF RAINGAUGE AND GROUNDWATER WELI IN DISTRICT BANSWARA

3.0 RAINFALL ANALYSIS

3.1 General

As mentioned in section 2.0 two districts from each of the six states have been selected for rainfall analysis. One representative raingauge station from each taluk in each district has been selected for the study. The locations of raingauges in various taluks on a district map has been shown in figures presented in Chapter 2. The raingauge stations selected are the ones which were selected by Central Water Commission for carrying out studies for identification of drought prone areas in 1982.

The rainfall analysis has been carried out with the data from year 1901-1986. The data from 1901 to 1980 have been taken from CWC Reports (CWC, 99 District Reports, 1982). The rainfall data from 1981 to 1986 have been collected during visits of scientific teams to various States as has been described in section 2.0.

3.2 Rainfall Departure Analysis

3.2.1 Seasonal rainfall departure

Rainfall departure analysis has been carried out on seasonal basis from 1970-1985 for all the 12 districts in 6 states. For analysis purpose the rainfall data of every year from May to Nov. have been used for all the 12 districts. In order to work out the normal rainfall for a district, the normal rainfall values of the taluks are multiplied by their respective thiessen weights and summed up. Percentage departures on seasonal basis are worked out based on rainfall and normal values from May to Nov. The difference of seasonal rainfall (May-Nov.) and seasonal normal gives the departure which is converted into percentages as has been shown in Table 3.1.

The departure from normal expressed in percentage from 1970 to 1985 have been plotted which is shown in Figure 3.1(a) through 3.1.(c).

As can be seen from figures 3.1(a) through 3.1(c) and Table 3.1(a) to 3.1(f), most of the districts were affected by deficiency of rainfall during May-Nov. in 1970-1985. The major inferences that could be drawn from the analysis are as below:

a) All the 12 districts in six states chosen for analysis recorded rainfall deficit greater than 20% in year 1985.

b) Districts recording greater than 20% seasonal rainfall departures from normal in 1984 were Belgaum (Karnataka), Cuddapah (A.P), Khargone (M.P), and Barmer (Rajasthan).

c) District recording greater than 20% seasonal rainfall departures from Normal in 1983 was Banswara (Raj.).

d) Districts recording greater than 20% seasonal rainfall departures from Normal in 1982 were Khargone (M.P), Jamnagar (Gujrat), Rajkot (Gujrat) and Barmer (Rajasthan).

e) No district experienced seasonal rainfall deficit greater than 20% in 1981.

f) Districts recording greater than 20% seasonal rainfall departures from Normal in 1980 were Bijapur (karnataka), Cudapah (A.P.), Khargone (M.P), and Barmer (Raj.).

TABLE 3.1 : DISTRICTWISE SEASONAL RAINFALL DEPARTURES

District Banswara (Rajasthan)				District Barmer (Rajasthan)			
Year	Seasonal Rainfall	Seasonal normal Rainfall	% Dep.	Year	Seasonal Rainfall	Seasonal normal Rainfall	% Dep.
1970	960.4	872.11	+ 10.12		246.32	230.3	+ 6.95
1971	922.6		+ 5.78		195.03		-15.32
1972	591.6		- 32.16		167.03		-27.14
1973	1681.1		+ 92.76		487.28		+111.58
1974	716.6		- 17.83		83.3		-63.82
1975	1028.9		+ 17.92		540.02		+134.5
1976	1241.6		+ 42.71		444.8		+93.14
1977	-		-		240.08		+ 4.2
1978	-		-		264.52		+14.85
1979	1101.9		+ 26.3		287.2		+24.7
1980	797.0		- 8.6		162.4		-29.5
1981	1043.54		+ 19.6		187.4		-18.62
1982	725.46		- 16.81		174.88		-24.06
1983	648.84		- 25.6		352.14		+52.9
1984	1013.2		+ 16.17		184.2		-20.01
1985	550.5		- 36.87		165.0		-28.35

District Jhabua (M.P.)				District Khargone (M.P.)		
Year	Seasonal Rainfall	Seasonal normal Rainfall	% Dep.	Seasonal Rainfall	Seasonal normal Rainfall	% Dep.
1968	604.0	833.68	- 27.55	-	-	-
1969	961.02		+ 15.27	-	-	-
1970	1123.36		- 34.75	1132.89	792.74	+ 42.91
1971	976.66		+ 17.15	698.47		- 11.89
1972	528.46		- 36.61	457.13		- 42.34
1973	-		-	1186.0		+ 49.61
1974	615.6		- 26.16	592.19		- 25.30
1975	608.18		- 27.05	801.68		+ 1.13
1976	1337.16		+ 60.39	907.96		+ 14.53
1977	1175.76		+ 41.03	679.77		- 14.25
1978	1033.98		+ 24.03	790.69		- 0.26
1979	729.48		- 12.5	726.31		- 8.38
1980	776.70		- 6.83	609.99		- 23.05
1981	1017.10		+ 22.0	976.6		+ 23.19
1982	731.6		- 12.24	530.9		- 33.03
1983	1034.64		+ 24.10	819.1		+ 3.33
1984	763.1		- 8.47	561.8		- 29.13
1985	423.84		- 49.16	440.7		- 44.41

District Jamnagar (Gujarat)				District Rajkot (Gujarat)		
Year	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.
1970	821.94	557.14	+ 47.53	924.67	577.43	+ 60.14
1971	531.48		- 04.61	490.60		- 15.04
1972	261.86		- 53.0	269.06		- 53.4
1973	330.15		- 40.74	400.51		- 30.63
1974	182.07		- 67.32	253.92		- 56.02
1975	874.78		- 57.01	687.43		+ 19.05
1976	604.39		+ 8.48	767.47		+ 32.91
1977	566.95		+ 1.76	635.11		+ 9.98
1978	515.88		- 7.41	481.17		- 16.67
1979	1554.01		178.93	909.77		+ 57.55
1980	978.65		+ 75.66	725.59		+ 25.65
1981	863.67*		+ 55.02	644.04*		+ 11.53
1982	388.36		- 30.29	431.25		- 25.31
1983	1011.64		+ 81.58	796.98		+ 38.02
1984	449.24		- 19.37	478.32		- 17.16
1985	231.6		- 58.43	241.9		- 58.11

* Seasonal value was equivalent to annual. Hence annual value was taken for analysis.

District Anantpur (A.P.)				District Guddapah (A.P.)		
Year	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.
1970	524.87	476.12	+ 10.20	665.9	653.59	+ 1.88
1971	486.81		+ 2.25	455.8		- 30.26
1972	520.63		+ 9.35	647.6		- 0.92
1973	640.85		+ 34.60	667.6		+ 2.14
1974	627.94		+ 31.89	698.6		+ 6.89
1975	757.7		+ 59.14	998.7		+ 52.80
1976	334.71		- 29.70	717.4		+ 9.76
1977	722.29		+ 51.70	806.7		+ 23.43
1978	485.6		+ 1.99	774.9		+ 18.56
1979	626.58		+ 31.60	699.7		+ 7.05
1980	422.86		- 11.19	424.3		- 24.37
1981	689.58		+ 44.83	655.3		+ 0.26
1982	552.25		+ 15.99	546.0		- 16.46
1983	542.19		+ 13.88	904.7		+ 38.46
1984	396.1		- 16.81	474.6		- 27.39
1985	330.6		- 30.56	429.1		- 34.35

District Bijapur*(Karnataka)				District Belgaum (Karnataka)		
Year	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.
1970	620.73	537.47	+ 15.5	709.46	806.82	- 12.0
1971	591.3		+ 10.0	633.79		- 21.4
1972	335.3		- 37.6	620.58		- 23.1
1973	635.56		+ 18.2	763.21		- 5.4
1974	689.21		+ 28.2	886.65		+ 9.9
1975	869.36		+ 61.7	1009.69		+ 25.1
1976	356.38		- 33.7	660.32		- 18.1
1977	657.16		+ 22.2	852.32		+ 5.6
1978	703.79		+ 30.9	816.0		+ 1.1
1979	688.81		+ 28.1	925.39		+ 14.7
1980	397.32		- 26.0	742.0		- 8.0
1981	843.78*		+ 56.99	860.6**		+ 6.67
1982	570.18		+ 6.08	688.02**		- 14.72
1983	534.0*		- 0.65	763.1		- 5.4
1984	435.7		- 19.06	575.2		- 29.08
1985	418.7		- 22.22	528.35		- 34.51

* Based on average of Bijapur Taluk, Indi, Bagalkot, Mudebihal, Mudhol and taluks only. Other data not available.

** Values are based on average rainfall of Belgaum, Chikodi, Athni and Gokak taluks only, since data for other taluks were not available.

District Ahmednagar (MS)				District Sholapur (MS)		
Year	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.	Seasonal Rainfall	Seasonal Normal Rainfall	% Dep.
1970	464.6	501.46	- 7.3	660.1	545.41	+ 21.0
1971	434.4		- 13.3	554.1		+ 1.6
1972	217.6		- 56.6	227.9		- 58.2
1973	587.8		+ 17.2	729.9		+ 33.8
1974	693.2		+ 38.2	835.8		+ 53.2
1975	663.7		+ 32.3	442.3		- 18.9
1976	496.7		- 0.95	409.4		- 24.9
1977	367.4		- 26.7	527.1		- 3.3
1978	-		-	760.6		+ 39.4
1979	-		-	-		-
1980	-		-	-		-
1981	540.9		+ 7.8	782.6		+ 43.4
1982	429.5		- 14.3	525.2		- 3.7
1983	704.14		+ 40.4	771.7		+ 41.5
1984	423.6		- 15.5	548.6		+ 0.58
1985	392.96		- 21.6	403.6		- 26.0

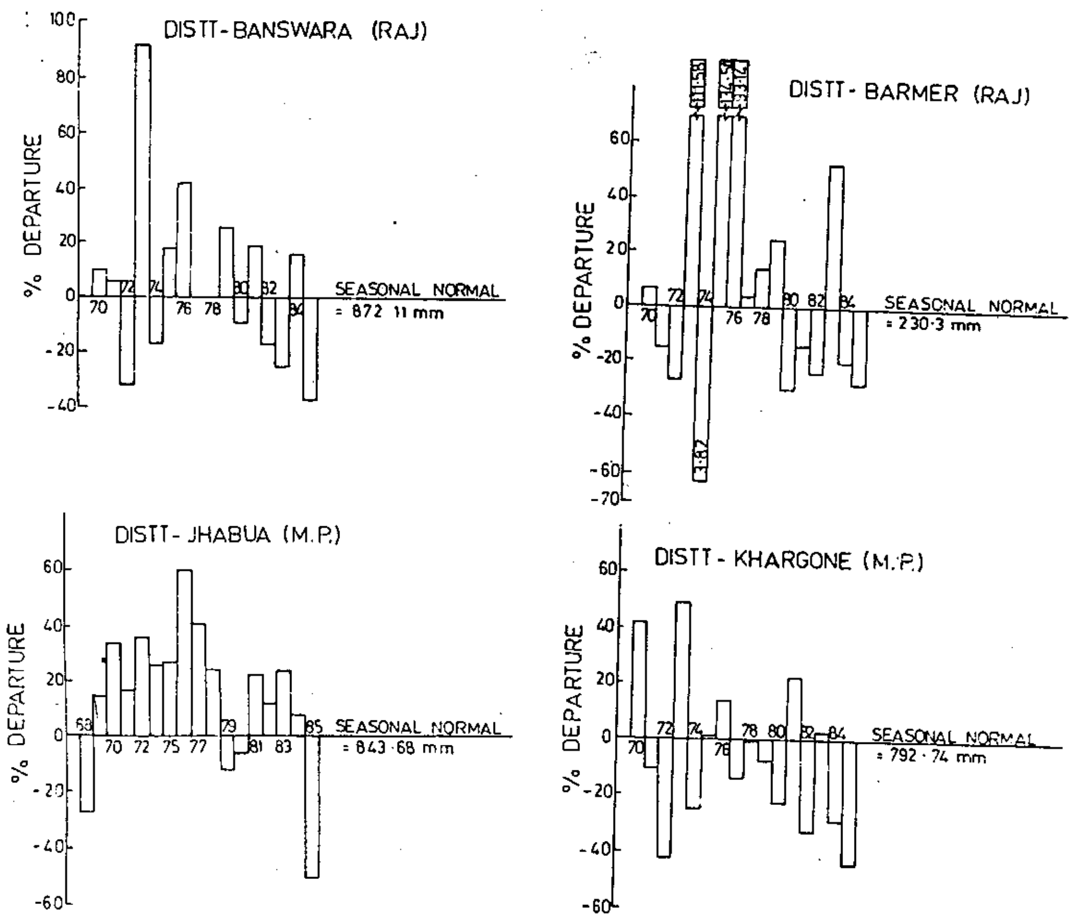


FIG 3·1 (a) - DISTRICTWISE SEASONAL RAINFALL DEPARTURES

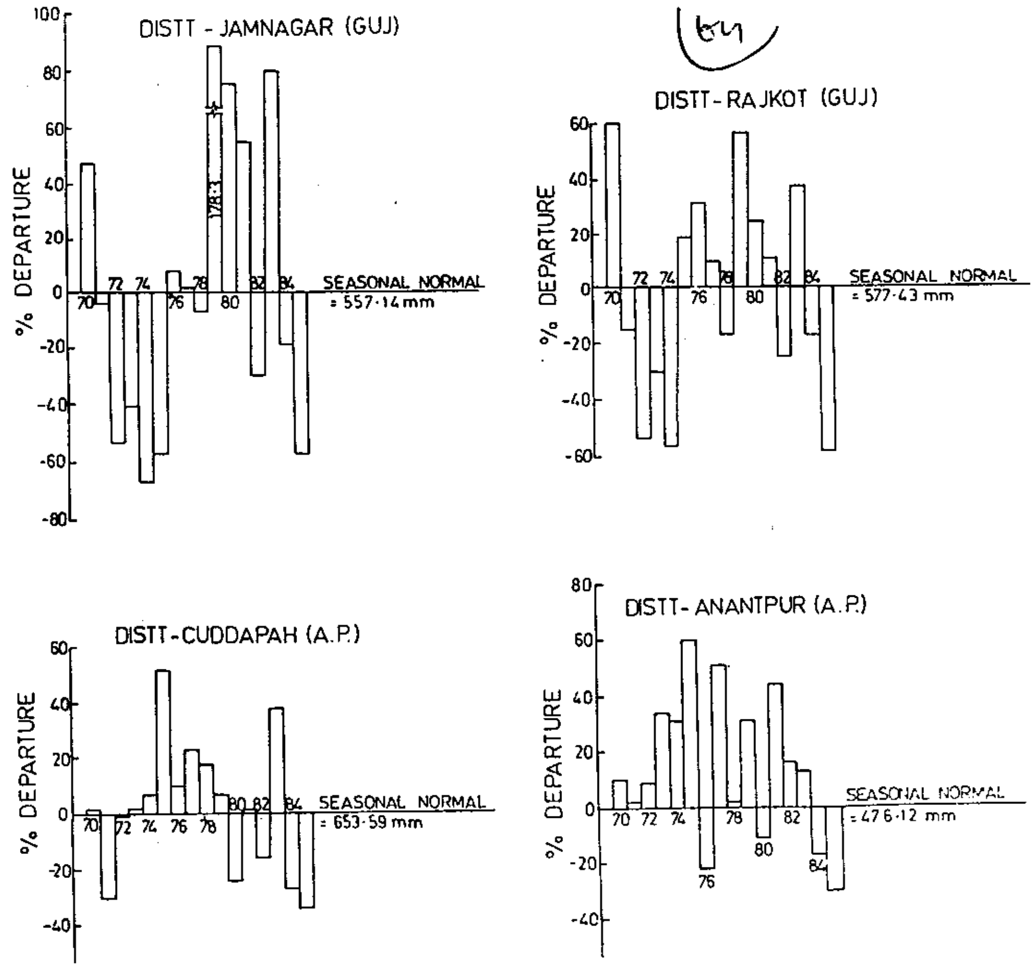


FIG. 3·1·(b)-DISTRICTWISE SEASONAL RAINFALL DEPARTURE

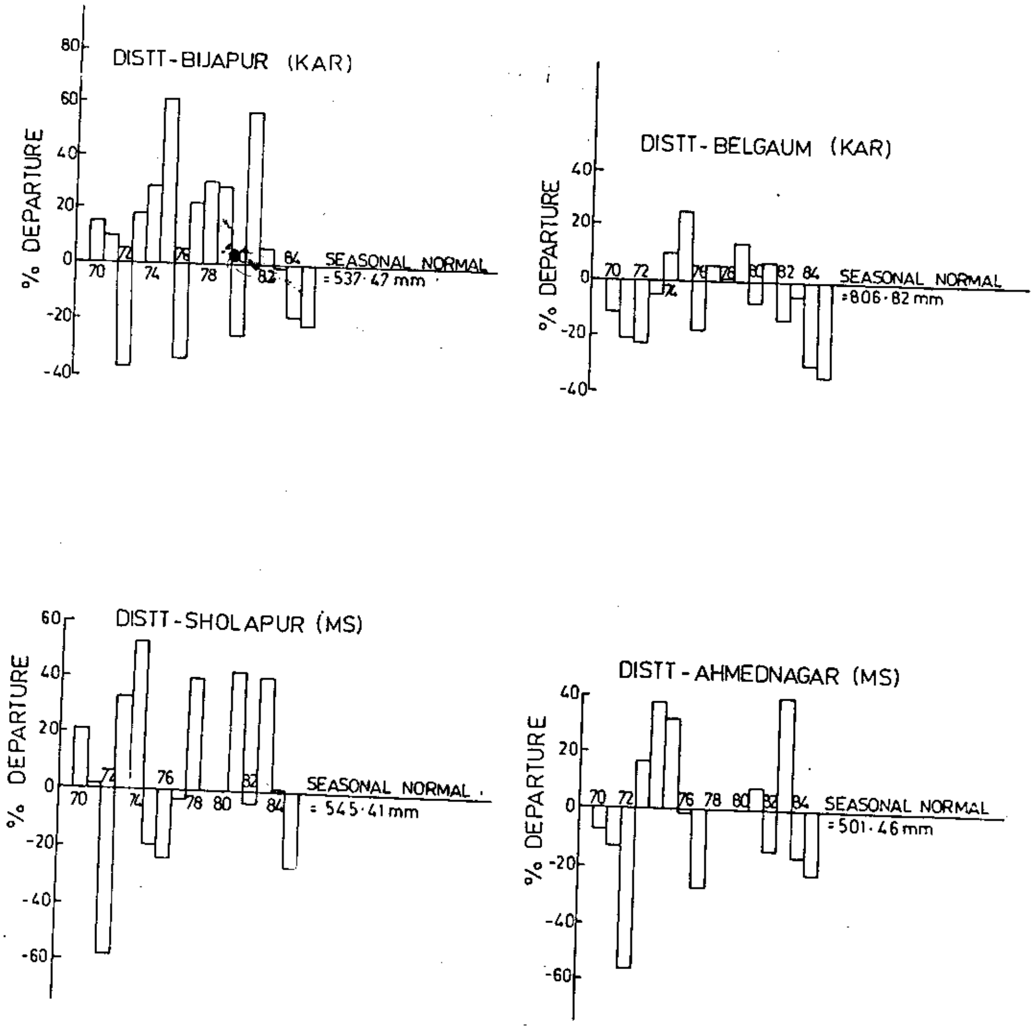


FIG:3·1-(c)-DISTRICTWISE SEASONAL RAINFALL DEPARTURES

g) Ahmadnagar (Ms.), Solapur (Ms.), Ananpur (A.P.), Jhabua (M.P) and Banswara (Raj.) districts recorded rainfall deficits greater than 20% in 1985 but the deficits in rainfall of these districts in 1984 was less than 20%. However, districts of Belgaum (Kar.), Cudapah (A.P), Khargone (M.P), and Barmer (Raj.) experienced rainfall deficits more than 20% successively during 1984 and 1985.

h) As during year 1985, all districts chosen for analysis reocrded rainfall deficits for more than 20% of normal rainfall, the drought conditions as analysed by seasonal rainfall failure were relatively severe during year 1985 in these 12 districts.

3.2.2 Monthly rainfall departures for 1985-86

Five taluks from each district and district as a whole have been selected for monthly departure analysis. Monthly rainfall values for a district for May to Nov. months in 1985 were taken as weighted average rainfall of all the taluks based on their weights assigned to the taluks. While calculating the district average, only those taluks were considered for which rainfall data were available. Monthly normals of the taluks were multiplied by respective thiessen weights and summation was obtained over the entire district to represent as monthly normal of the district. Normals for the taluks were picked up directly from CWC's Report on Identification of drought prone areas prepared for various districts in a series 'Identification Series', as it was verified that normals updated upto year 1985 do not vary significantly from the ones used in reports of CWC.

In case of some of the taluks and districts, the monthly rainfall values for year 1986 were not available. So, in these cases, the analysis was restricted to rainfall data from May 1985 to Nov. 1985 only.

In order to study variability of rainfall monthwise, monthly rainfall and corresponding normals have been plotted for all districts and chosen taluks of the districts for water year May 1985- April 1986 to visualise the departure of monthly rainfall from Normal. These plots for districts are shown in figures 3.2(a) through 3.2(c). The departure values for taluks and districts as a whole and plots for taluks are given in appendix III-1(A) and (B). Table 3.2 shows taluks/districts in 6 states which experienced rainfall deficit during monsoon months of 1985-86 in two ranges viz. 20 to 50 percent and 50 percent and above. The following inferences can be drawn from the results as shown/presented in figures 3.2 (a) through 3.2 (c); Appendix III-1 and Table 3.2:

(a) In Rajasthan, Banswara district as a whole as well as the taluks recorded rainfall deficit during monsson months (June-Sept.'85) with the exception of October 1985. In case of district Barmer also, in general the rainfall deficits were more than 20.0 percent for all the five taluks and district as a whole. However, few taluks had above normal rainfall during some months. Taluk Barmer experienced no rainfall from May 85 to May'86, except in July and August in 1985 and May, 1986. Deficit in rest of the months were always much more than 20 percent. The analysis is in coherence with the results of seasonal analysis presented earlier.

(b) In M.P., district of Jhabua and Khargone alongwith their 5 taluks experienced rainfall less than respective normals in all months except Oct. 1985. Both districts experienced rainfall deficit of more than 20% in all months except Oct. 1985. This compares well with the seasonal analysis

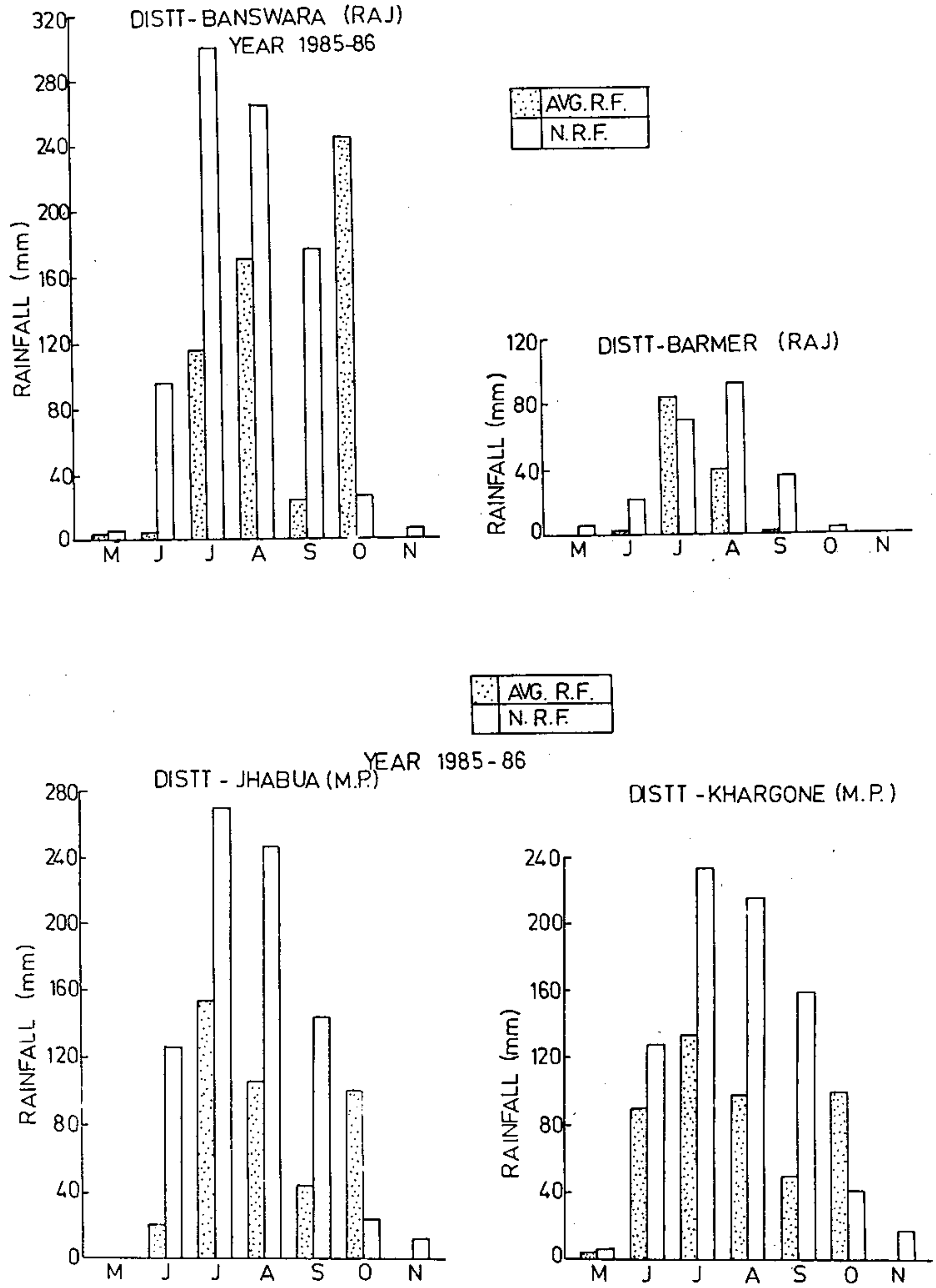


FIG. 3.2-(a)-DISTRICTWISE MONTHLY RAINFALL DEPARTURES

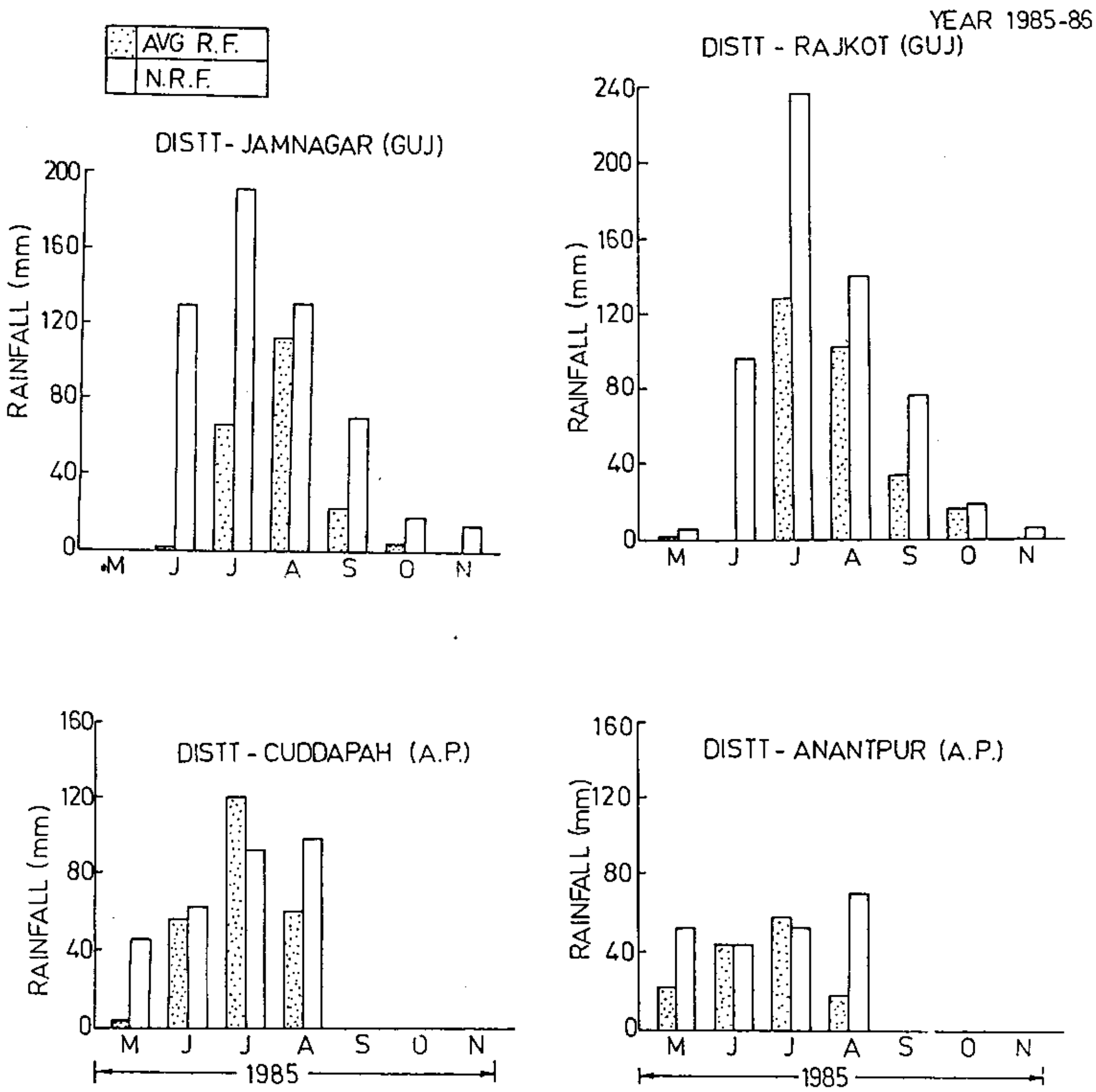


FIG. 3·2 (b)- DISTRICTWISE MONTHLY RAINFALL DEPARTURES

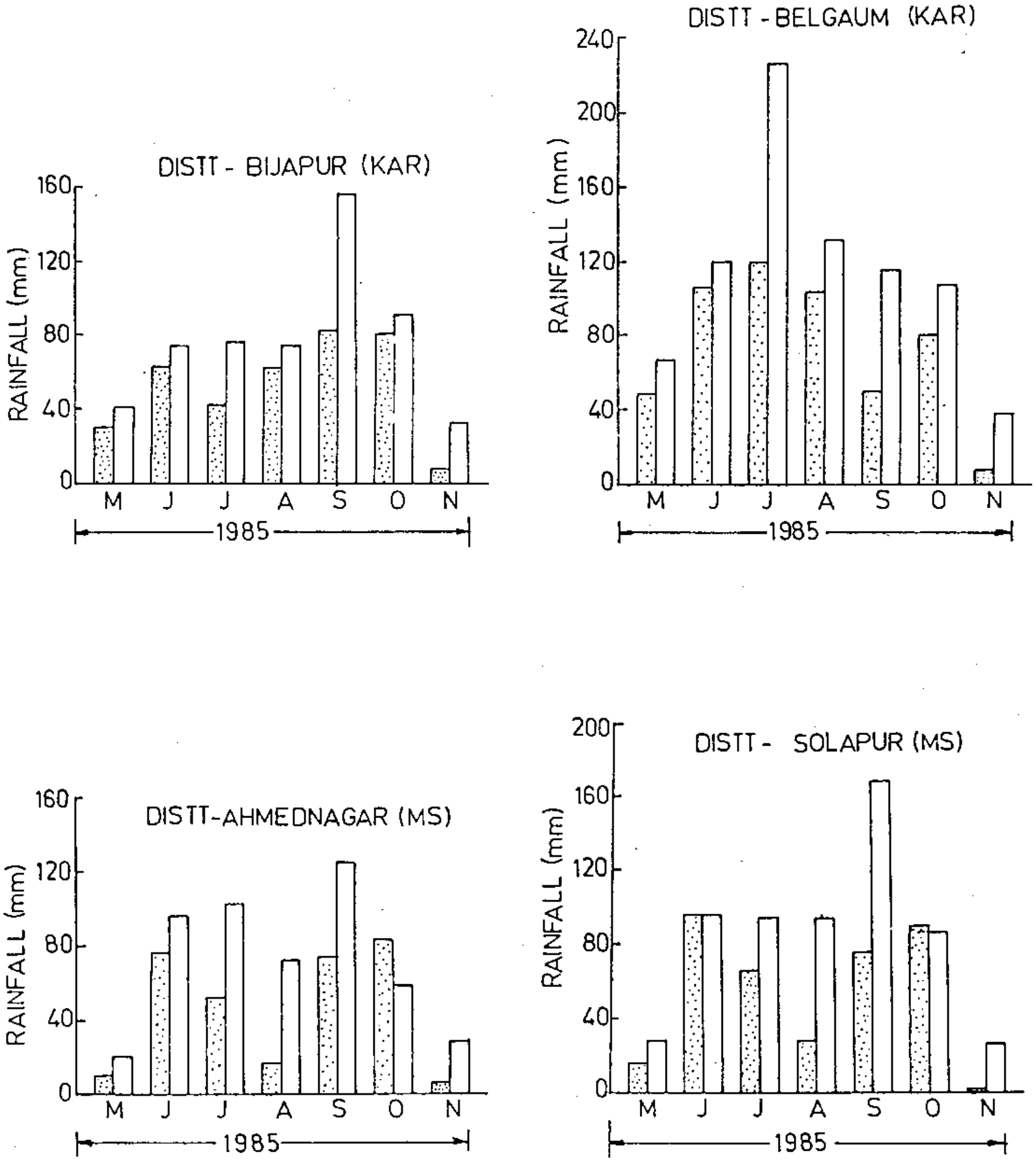


FIG. 3·2 (c)-DISTRICTWISE MONTHLY RAINFALL DEPARTURES

Table: 3.2 Districts/Taluks Recorded Deficient Rainfall During 1985-86.

Distt. (State)	Months of 85-86	Group of Ranges of deficiency in rainfall (expressed in percentages of normal) 20 to 50	50 and above	Remarks
Ahmadnagar (MS)	June	Sangamner, Ahmadnagar and distt. Ahmadnagar	Akola, Newasa, Sheogaon,	
	July	Newasa, Ahmadnagar Distt. Ahmadnagar	Akola, Sangamner, Sheogaon,	
	Aug.	Newasa	Akola, Sangamner, Sheogaon, Ahmadnagar & Distt. Ahmadnagar	
	Sept.	Distt. Ahmadnagar	Akola, Sangamner, Newasa and Sheogaon	
	Oct.			
	Nov'85	Ahmadnagar	Akola, Sangamner, Newasa, Sheogaon & Distt. Ahmadnagar	
Solapur	June'85	Barsi,	Distt. Sholapur	
	July	Malsiva, Solapur Distt. Sholapur	Akalkot, Barsi	
	Aug.	Sholapur	Akalkot, Barsi, Malasira, Sangola & Distt. Sholapur	
	Sept.		All five taluks and district Solapur	
	Oct.	Akalkot, Malasira		
	Nov'85		All five taluks and distt. Solapur as a whole	
Bijapur (KAR)	May'85	Bhagalkot, & Distt. Bijapur	Indi, Mudhol	
	June		Indi, Mudhol, Bhagalkot	
	July	Distt. Bijapur	Indi, Bhagalkot, Muddbihal	
	Aug	Mudhol, Bhagalkot Muddbihal,	Indi,	
	Sept	Indi, Bhagalkot,Distt. Bijapur	Bijapur, Mudhol, Muddibihal	
	Oct.		Bhagalkot	
	Nov.'85		Indi, Bijapur, Mudhol, Muddbihal & Dist.Bijapur	
Belgaum	May'85	Gokak & Distt. Belgaum	Sundatti,	
	June	Hukeri,	Sundatti,G okak,Athni	

Distt.	Months	Group of range of deficiency in rainfall expressed in percentages of normal		Remarks
		20 to 50	50 and above	
Belgaum Contd.	July	Belgaum, Hukeri, Gokak & Distt. Belgaum	Sundatti	
	Aug	Distt. Belgaum	Sundatti, Gokak,Athni,	
	Sept		Belgaum, Sundatti, Hukeri, Gokakt, & Distt. Belgaum	
	Oct.	Hukeri, Athni, & Distt Belgaum		
	Nov'85		All the five taluks & distt. Belgaum	
Cuddapah (A.P.)	May'85		All the five taluks and distt.	
	June	Proddatur, Badvel, Sidhout	Cuddapah	
	July	Cudapah		
	Aug'85	Sidhout,Distt.Cuddapah	Proddatur, Badvel, Jammalamadugu, Cuddapah	
Anantpur	May'85	Penukonda, Madakasira	Anantpur, & Distt. Anantpur	
	June	Madakasira	Anantpur, Ramdurg,	
	Jul'85	Penukonda, Ramdurg	Anantpur	
	Aug'85	Madakasira	Urvakonda, Anantpur, Penukonda, Ramdurg, & distt. Anantpur.	
Jamnagar	May'85		Lalpur, Jamnagar, Bhawad& Kalwad Taluk	
	June		All five taluks and distt. Jamnagar	
	July		All five taluks and distt. Jamnagar	
	Aug	Lalpur	Bhanvad	
	Sept.		Kalyanpur,Jamnagar,Bhanvad, Kalawad & distt. Jamnagar	
	Oct.		All the five taluks & distt	
	Nov'85		All the five taluks & distt	
Rajkot	May'85		Wankaner, Rajkot, Jasdan, Upleta & distt. Rajkot	
	June		All five taluks & distt. Rajkot	
	July	Wankaner,& distt.Rajkot	Rajkot,Jasdon & Upleta	

Distt.	Month	Range of deficiency in rainfall expressed in percentage of normal: 20 to 50	50 to above	Remarks
	Aug	Wankaner, Rajkot, Jasdon & distt. Rajkot	Morvi,	
	Sept	Rajkot	Morvi, Wankaner, Upleta & distt. Rajkot	
	Oct.		Rajkot	
	Nov'85		All 5 taluks and distt.	
Khargone (M.P.)	June'85	Khargone, Keserwad, & distt. Khargone	Raipur	
	July		All five taluks & distt. Khargone	
Khargone	Aug.	Raipur	Barwani, Khargone, Sendhwa, Keserwad, & distt. Khargone	
	Sept	Raipur	Barwani, Khargone, Sendhwa, Keserwad & district	
	Oct.	No deficit. Rainfall more than Normal occure everywhere		
Jhabua	Jun'85		All five taluks and distt. Jhabua	
	July	Distt. Jhabua	Jhabua, Thandla, & Petlwad	
	Aug	Petlwad	Thandla, Jobat, Alirajpur, Jhabua & distt. Jhabua	
	Sept.		All five taluks & distt.	
	Oct.	Rainfall more than normal occurred		
Barmer (Raj)	May'85		All 5 taluks & distt.	
	June	Siwana	Barmer, Chohtan, Pachpadra, Sheo & distt .Barmer	
	July	Chohton	Sheo	
	Aug.	Barmer, Chohtan	Siwana, & Pachpadra taluks distt. Barmer	
	Sept.		All the five taluks & distt.	
	Oct.		All the five taluks & distt.	
	Jan-April'86		Barmer taluk	Analysis for 1986 was carried for Barmer taluk only since the data for other taluks were not available

Distt.	Month	Range of deficiency in rainfall expressed in percentage of normal		Remarks
		20 to 50	50 to above	
Banswara	May'85	Distt. Banswara	All five taluks except Bagidone	
	June		All five taluks & distt.	
	July	Ghotal	Banswara,Garhi, Khusalgarh,Bagidora,& district	
	Aug.	Garhi,Ghotal & distt. Banswara	Khusalgarh, Bagidora	
	Sept.		All five taluks & distt.	
	Oct.	-No rainfall deficit anywhere-		
	Nov'85		All five taluks & distt as a whole	
	Jan - April		Taluk Banswara	Analysis for '86 was carried out only for Banswara taluk since data for other taluks could not be made readily available.

presented in earlier section.

(c) In Gujarat, district Jamnagar recorded rainfall deficits more than 20% of normal except in May and August 1985. The rainfall deficit in case of Rajkot district was also more than 20% except in Oct. 1985. In all taluks of both districts the rainfall deficits were more than 20% except August in case of taluks of Jamnagar and except October in case of taluks of Rajkot. The analysis compares well with seasonal analysis.

(d) In A.P., the rainfall data for Cuddapah and Anantpur districts were available only upto August, 1985. So the analysis was restricted upto Aug., 1985 only. The monthly rainfall in both the districts was deficient by more than 20% in May and August, 1985. In case of taluks of Cuddapah, the rainfall was deficient in all months excepting July, 1985. In the taluks of Anantpur, monthly rainfall was less than normal in all months except May 1985. Since the analysis was done for May-Aug. 1985 data therefore the results may not be compared with seasonal analysis which was done for May-November months.

(e) In the state of Karnataka, on the basis of monthly rainfall departures, it can be inferred that most of the taluks in Bijapur and Belgaum and districts as a whole experienced deficient rainfall in most of the months. This compares with the seasonal analysis.

(f) The departure analysis for Maharashtra showed that except in Oct., 1985 in view taluks in Ahmadnagar district as well as in the district as a whole the rainfall was deficient, the deficiency being more than 20% in all the taluks. In case of Solapur district and its taluks, the rainfall was found to be deficient in monsoon season except June 1985. This analysis compares well with the conclusions drawn for seasonal analysis.

3.3 Frequency of Rainfall

3.31 Probability distribution of annual rainfall

Probability is a constant characterising a given set of objects or incidents in a particular period. The probability analysis of annual rainfall is useful to predict with reasonable accuracy the relative frequency of occurrence in different group intervals of annual rainfall. It is also possible to work out the percentage probability of occurrence of 75% of annual rainfall or more for identification of drought proneness of the district/taluk.

Two taluks from each district and district as a whole have been selected for probability analysis of annual rainfall. The analysis has been carried out based on the data available from 1901 to 1986 and the probability distribution expressed both in no. of years of occurrence and the percentage of years for each group interval. Group interval of 100 mm has been considered for the analysis.

The probability distribution curves have been drawn by plotting the values of percentage of commulative probability in respect of various groups at their corresponding mid-point. The commulative percentages have been worked out starting from the maximum rainfall group downwards adding the successive percentage (Appendix III-2A). Probability distribution graphs for all 12 districts as also for two selected taluks in each district has been shown in figure 3.3 (a) through 3.3 (c).

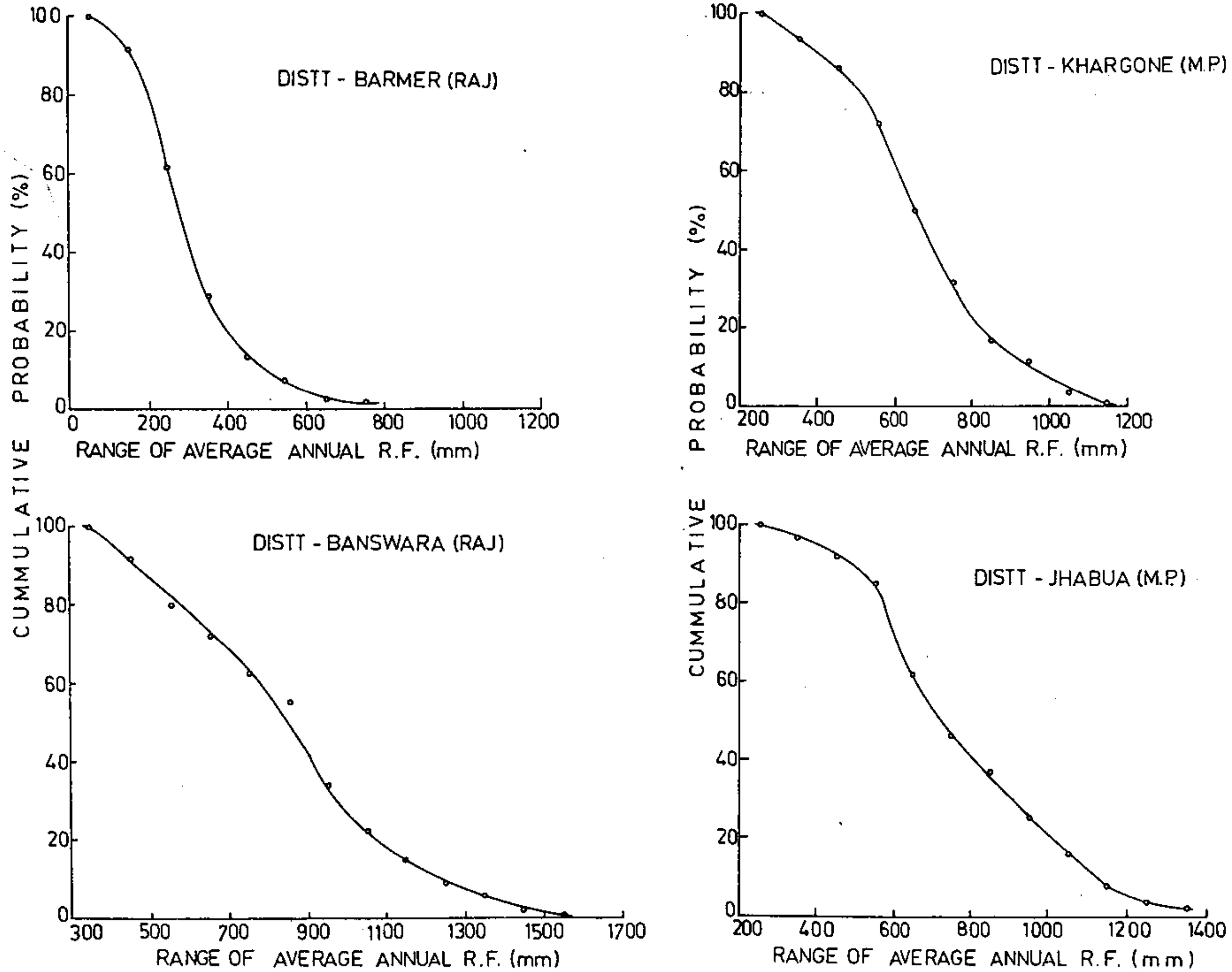


FIG. 3.3a PROBABILITY DISTRIBUTION OF ANNUAL RAINFALL

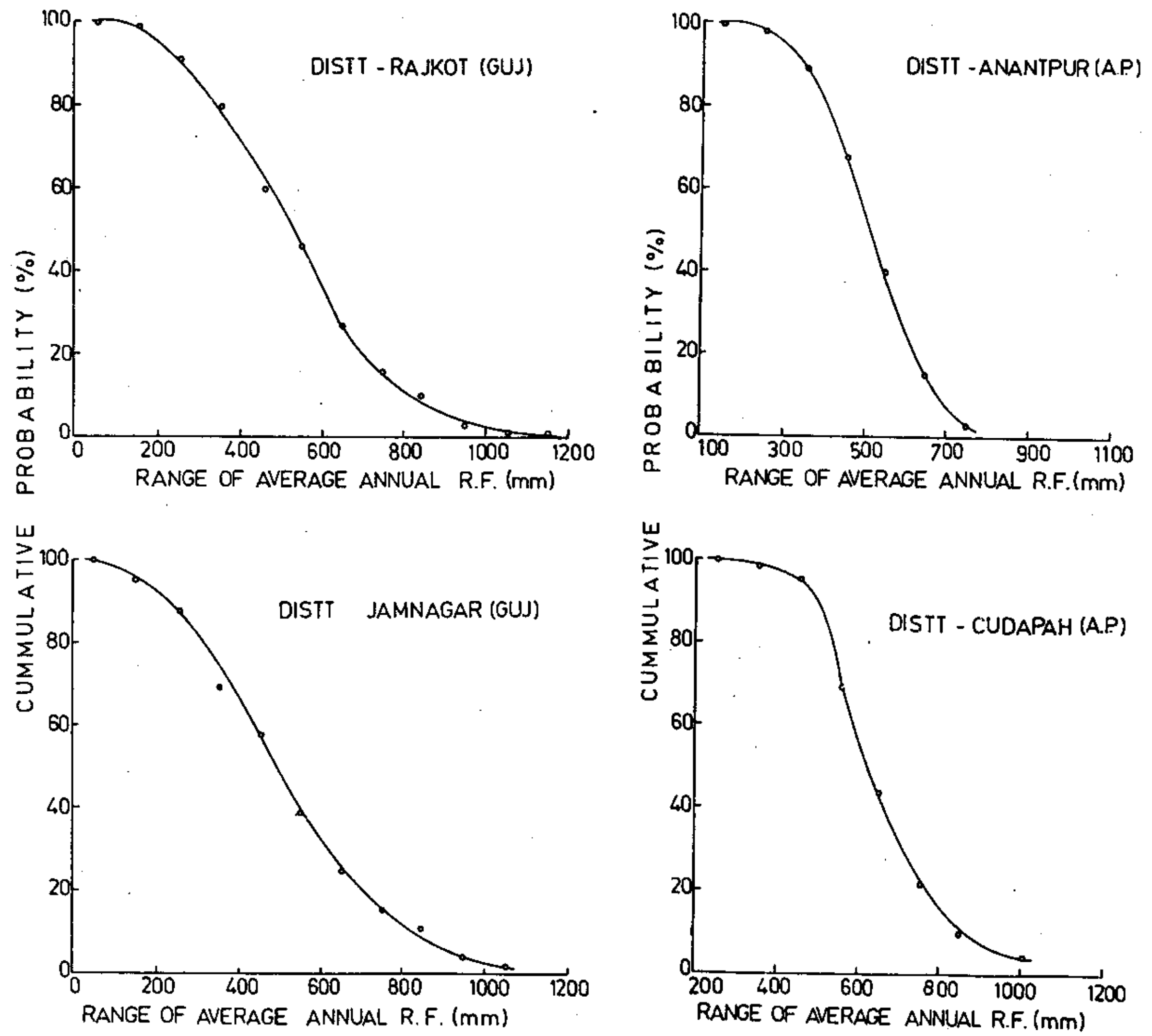


FIG. 3.3(b) PROBABILITY DISTRIBUTION OF ANNUAL RAINFALL

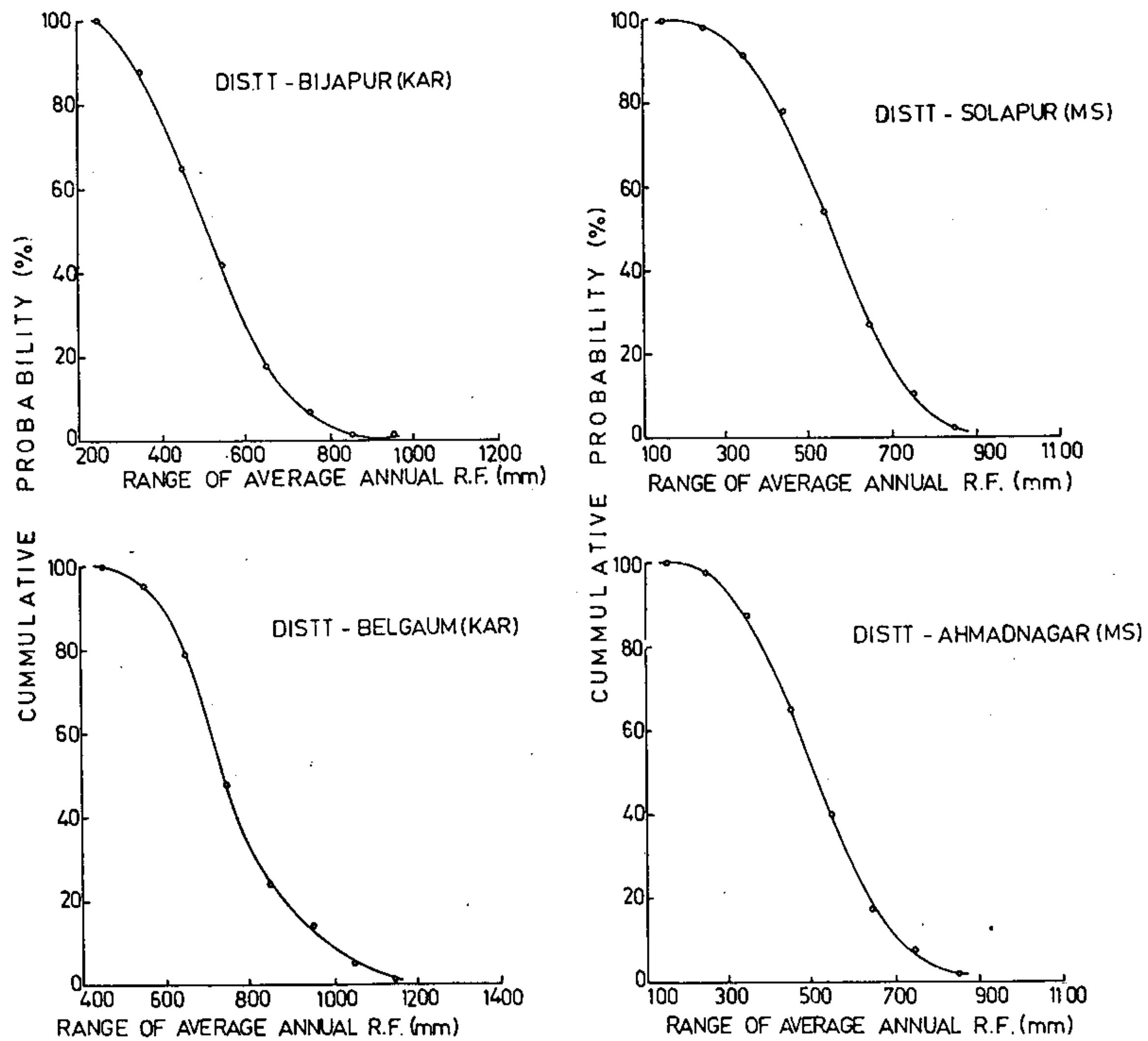


FIG. 3.3(c) PROBABILITY DISTRIBUTION OF ANNUAL RAINFALL

The range of rainfall group for the taluk and district which has a probability occurrence of 75% or more has been read from the probability distribution graphs and tabulated in table 3.3.

As can be seen in table 3.3 that Ahmadnagar district has a 75% or more probability of getting rainfall in the group range of 400-500 mm. Similarly Akola and Ahmadnagar taluks have 75% or more probability of getting rainfall in the group range of 200-300 mm and 400-500 mm, respectively. Similar in-ferences can be drawn for other districts and their taluks from table 3.3 which is self explanatory.

3.3.2 Probability of occurrence of rainfall equivalent to 75% of the Normal Rainfall

For Identification of drought proneness of the district/taluk, the percentage probability of occurrence of rainfall equivalent to the 75% of the normal rainfall or more has also been worked out from the figures 3.3(a) to (c), and Appendix III-2 and the values are presented in table 3.3. As per I.M.D. criteria, an area would be classified as drought prone if probability of rainfall equivalent to 75% of normal is below 80 percent indicating that more that 20 percent of years, the area experienced scarcity of rain. Central Water Commission has carried out analysis and identified drought prone areas on this ground (CWC, 99 District Report). Using this criterion the inference drawn from values in table 3.3 is as below:

Table 3.3 : Probability Distribution of Annual Rainfall

Sl. No.	District (State)	Name of Taluks	At 75% Probability and above (Range in mm.)	Probability of occurrence of rainfall equivalent to 75 percent Normal (in %age)
1.	Ahmadnagar (Maharashtra)	1. Akola	200-300	79
		2. Ahmadnagar	400-500	70
		3. District as a whole	400-500	77
2.	Solapur (Maharashtra)	1. Akalkot	300-400	67
		2. Sholapur	500-600	73
		2. District as a whole	400-500	73
3.	Jhabua (M.P.)	1. Jhabua	500-600	66
		2. Alirajpur	500-600	61
		3. District as a whole	500-600	64
4.	Khargone (M.P.)	1. Barwani	500-600	77
		2. Khargone	500-600	69
		3. District as a whole	500-600	60
5.	Barmer (Rajasthan)	1. Barmer	100-200	74
		2. Siwana	200-300	78
		3. District as a whole	200-300	79
6.	Banswara (Rajasthan)	1. Khusalgarth	600-700	67
		2. Banswara	700-800	74
		3. District as a whole	600-700	71

Table 3.3 : Probability Distribution of Annual Rainfall

Sr. No.	District	Name of taluks	At 75% Probability and above (Range in	Probability of occurrence of rainfall equivalent to 75 percent Normal (in %age)
7.	Rajkot (Gujarat)	1. Morvi	200-300	68
		2. Rajkot	300-400	56
		3. District as a whole	300-400	63
8.	Jamnagar (Gujarat)	1. Kalyanpur	100-200	55
		2. Jamnagar	300-400	63
		3. District as a whole	300-400	60
9.	Bijapur (Karnataka)	1. Bagalkot	400-500	70
		2. Bijapur	300-400	65
		3. District as a whole	400-500	72
10.	Belgaum (Karnataka)	1. Belgaum	1000-1100	74
		2. Chikodi	400-500	75
		3. District as a whole	600-700	79
11.	Anantpur (A.P.)	1. Anantpur	400-500	74
		2. Madakasiva	400-500	75
		3. District as a whole	400-500	79
12.	Cudapah (A.P.)	1. Jamalanadu	400-500	62
		2. Cudapah	500-600	70
		3. District as a whole	500-600	74

(a) In Rajasthan state the probability of occurrence of 75% normal rainfall for Barmer taluk and Siwana taluk and district Barmer as a whole is found to the 74, 78 and 79 percent respectively. these figures for Khusalgarh and Banswara taluks and Banswara district as a whole are 67, 74 and 71 percent respectively. These figures indicate that the scarcity of rainfall is more than 20 percent of years and as such these districts also fall under drought affected conditions.

(b) In case of Madhya Pradesh, Jhabua and Khargone districts alongwith their two taluks viz. Jhabua and Alirajpur of Jhabua district and Barwani and Khargone of Khargone district are found to be severely drought affected. The values of probability of occurrence of 75% normal for Jhabua and Khargone districts are found to be 64 and 60% respectively indicate that 36 and 40 percent of the years (figures being much above 20 percent) scarcity of rainfall was experienced in these districts, which is indication of severe drought conditions.

(c) In Gujarat state, districts Jamnagar and Rajkot experienced scaricity in rainfall during 40 and 37% of the years, respectively indicating the districts to be drought prone. Similar results were obtained for taluks of both districts.

(d) In Andhra Pradesh, for districts Anantpur and Cuddapah the figures corresponding to 75% of respective normals are 79 and 74% respectively meaning that the districts are drought prone. The taluks also showed the similar results.

(e) In Karnataka the Bijapur and Belgaum districts are also found to fall in category of drought affected areas since probability of occurrence 75% normal rainfall is 72 and 79, respectively which is below 80%. Similarly for the two taluks of these districts also, figure is less than 80 percent at 75 percent normal rainfall.

(f) In case of Maharashtra state, both the districts i.e., Ahmadnagar and Solapur are found to be drought prone since ,the probability of occurrence of rainfall equivalent to 75 percent of normal rainfall is 77 and 73 percent, respectively. The taluks also indicated similar results.

The results presented in table 3.3 confirm that percentage of years receiving rainfall equivalent to 75 percent normal is les than 80 percent for the taluks of these districts. As such these taluks alongwith the districts as a whole are drought affected as per I.M.D. criteria.

3.4 Excess Deficient Rainfall Using Herbst Approach

The excess/deficit rainfall analysis can be done using the Herbst et al. (1966) approach. This is based on monthly rainfall values. Long term monthly rainfall values are used to find monthly deficits. Carry over effects of rainfall from month to month are used to calculate effective monthly rainfall. The negative difference between effective rainfall and mean rainfall for a month is taken as deficit. These deficits along with zero values for surplus months are used to calculate mean monthly deficits (MMD) and mean annual deficits (MAD). Using a sliding scale as described by Herbst et al (1966) the onset, continuation and termination of a drought is determined. In the present analysis it was presumed that major portion of annual rainfall falls during monsoon season. Therefore, rainfall data for monsoon season have been used for analysis.

Severity of droughts is defined by using drought intensity index. The average monthly drought intensity related to the sum of the monthly mean deficits over the same duration gives the intensity index as below:

$$Y = \frac{\sum_{t=1}^{D} [(E_t - M_t) - (MMD)_t]}{\sum_{t=1}^{D} (MMD)_t}$$

And, the severity of drought is given by as index as below:

Severity Index = Y x D

Where, M_t = Mean rainfall for a month (t=1 to n where n is number of months considered for analysis for each year).

$(MMD)_t$ = Mean Monthly Deficit

D = Duration of drought in months

E_t = Effective rainfall for a month

Five selected taluks in each district for rainfall departure analysis were subjected to Herbst analysis. Monthly rainfall data (of Monsoon Season only) from 1951 to 1986 were used in this analysis. for Karnataka and Andhra pradesh rainfall data from May to Nov. were used for analysis due to effects of both south-west and north-east monsoon. In case of other states, viz. Rajasthan, Madhya Pradesh, Gujarat and Maharashtra, the data from June to September has been used.

The analysis was performed using the computer programme of Herbst's approach. The analysis gives the month of begining and termination of drought in various years alongwith corresponding drought intensity and severity Index, (Appendix III-3A). Figures showing the beginning and termination of drought in various years versus corresponding drought intensity has been shown in figures as presented in appendix III-3(b). The following inferences can be drawn from the analysis.

(a) In Rajasthan, it is found that the drought was experienced in Barmer taluk during 1980, 1981 and 1982; in Chohtan during 1981, 1982 and 1984; in Pachpadra and Sheo during 1980-82 and 1984-85; and in Siwana during 1980-81 and 1984-85. However, in Banswara district; the drought was experienced in Ghotal taluk during 1980, 1983 and 1985; in Banswara taluk during 1980-83 and 1985; in Khusalgarh during 1980, 1983 and 1985 and in Bagidora during 1980, 1983 and 1985.The drought intensity has been found out to be maximum since 1980 during 1985 in all taluks of

Banswara. However, in case of Barmer district the trend in drought intensity is varying over years.

(b) In Madhya Pradesh, taluks Kasarwad and Sendhawa in Khargone district and Alirajpur and Jobat in Jhabua district experienced drought in 1984-85. All the 10 taluks in these districts experienced drought in 1985 and the intensity of drought during 1985 was observed maximum as compared to previous 4-5 years.

(c) In Gujarat, the analysis of data by Herbst's approach indicated that all the 10 taluks, 5 each in Rajkot and Jamnagar districts were affected by drought during 1985. In all taluks the intensity of drought was maximum during 1985 as compared with last four years excepting Wankaner taluk of Rajkot district wherein 1982 showed the maximum intensity.

(d) In Andhra Pradesh, since the monthly rainfall data for full monsoon period could not be collected therefore analysis was done upto 1984. During 1984 ten taluks, five each in Cuddapah and Anantpur districts experienced droughts.

(e) In case of Karnataka state all the four taluks in Belgaum viz. Athani, Belgaum, Gokak and Chikodi experienced drought in monsoon of 1984 and 1985 in succession. In Bijapur district, two taluks viz. Bagalkot and Mudhol experienced drought in 1984 and 1985 in succession. In general in Belgaum district all taluks except Athani and Chikodi showed maximum drought intensity during 1985 as compared with last 4 years. However, the trend of drought intensity over last 4-5 years in Bijapur district is not well defined.

(f) In Maharashtra state, Herbst analysis for Ahmadnagar and Solapur showed that 1985 was a drought year. Akola and Shevgaon taluks in Ahmadnagar experienced drought in all the monsoon months from 1982 to 1985 and from 1981 to 1985 in succession, respectively. In Ahmadnagar, the trend of drought intensity over last 4-5 years is not clearly defined. However, the four taluks in Solapur district viz. Akalkot, Barshi, Sangola and Solapur experienced maximum intensity during 1985.

3.5 Dry Spell Analysis

The analysis of dry spells (weeks) within monsoon season is very important specially for rain fed agriculture in the country. The occurrence of dry spells may result in drought occurrence even if the total amount of rainfall during monsoon season is about 75% of the normal rainfall in that period. Occurrence of dry spells may cause partial to total crop failure. If a long dry spell occurs during active growing period of crops, especially during fruiting and flowering stages it will be disastrous for crops. Therefore, an attempt has been made to identify the dry spells of two or more than two weeks duration during monsoon period (4th June to 15th Sept.) by selecting one taluk from each state.

The criteria for the selection of dry spell is that the daily rainfall should be less than or equal to 5 mm(as a day is assumed as rainy day if daily rainfall exceeds 5 mm) occurring continuously for at least two weeks i.e. 14 days) or more. For counting number of spells the start of monsoon season has been assumed from fourth June(beginning of 23rd standard week) every year. The duration and time of occurrence and no. of such dry spells talukwise have been given in Appendix III-4(A). The number of dry spells have been counted starting from the monsoon season of 1981 to 1986. However, in case of some of the taluks, the daily rainfall data for year 1986 were not available and as such, the analysis has been restricted upto 1985 only. The statistical analysis of the dry spells has also been carried out.

For statistical analysis, the duration of dry spells were represented as range (in days) and no. of spells falling in that range were counted. The number of spells falling in various ranges of duration of spells were represented as percentage of total no. of spells occuring from 1981-1986 and cummulative percentage was obtained starting from the maximum duration of dry spell group downwards adding successive percentages (Appendix III-4(B)). The probability curves have been drawn showing range of duration of dry spells as abscissa and cummulative percentage of no. of spells as ordinates. The plots are showing in figures 3.4(a) and 3.4(b).

Probability distribution graphs as showing in figures 3.4(a) and 3.4(b), have been used to read the values of duration of dry spells (in days) at 75% probability level and have been given in table 3.4. From table 3.4 it can be concluded that at 75% probability the duration of dry spell is 21-28 days for all the taluks selected for dry spell analysis. This analysis is specially important from the viewpoint of agriculture as it can give some idea about likelihood of dry spells based on which alternate arrangements can be made for providing water during initial growth stages to avoid hazardous effects on yields.

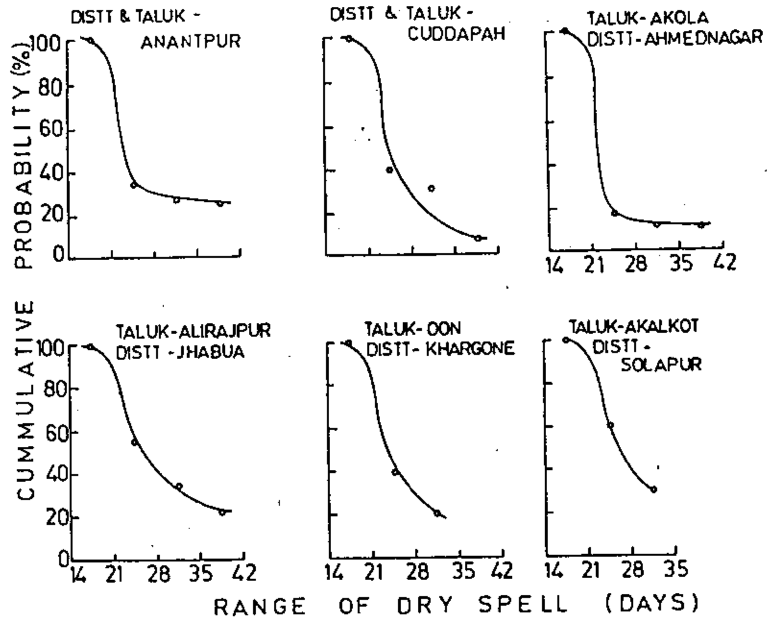


FIG.3·4 (a)- PROBABILITY DISTRIBUTION OF DRY SPELLS

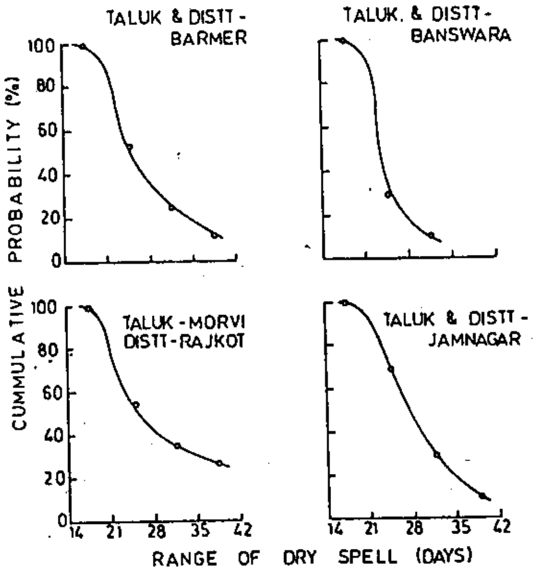


FIG. 3·4-(b)- PROBABILITY DISTRIBUTION OF DRY SPELLS

Table 3.4 Range of Duration of Dry Spells for 75% Probability of

S.No.	Taluk (Distt.)	At 75% Probability, duration of dry spells (in days)
1.	Anantpur (Distt.Anantpur)	21 - 28
2.	Cudapah (Distt.Cudapah)	21 - 28
3.	Alirajpur (Distt.Jhabua)	21 - 28
4.	Station-Oon (Distt.Khargone)	21 - 28
5.	Akalkot (Distt.Solapur)	21 - 28
6.	Akola (Distt. Ahmadnagar)	21 - 28
7.	Barmer (Distt. Barmer)	21 - 28
8.	Banswara (Distt. Banswara)	21 - 28
9.	Morvi (Distt. Rajkot)	21 - 28
10.	Jamnagar (Distt. Jamnagar)	21 - 28

4.0 SOIL MOISTURE INDICES

4.1 General

Soil moisture is one of the important components of land phase of hydrologic cycle. Soil is the store house of water from where plants extract moisture for their evapotranspirational needs. Availability of useful soil moisture to the vegetation therefore, appears to be a better index of analysing drought and planning management practices. Soil moisture between the field capacity and permanent wilting point is known as the soil moisture which is available to plants. But even in the soil moisture range the entire soil moisture can not be extracted by the plants. It is a well established fact that the soil moisture beyond a certain limit adversely affects the plant growth and causes wilting of plants. This results in declining agricultural production which is normally taken as a measure of agricultural drought. The severity of drought for a given crop can be studied by defining different levels of soil moisture deficits. The incidence of drought can be characteristised by determining the number of days during the growth season of the crop when soil moisture is below a value which known to impede crop growth appreciably. These threshold values for some of the crops and soil types have been experimentally found out at a number of places in the country. This operational definition which gives soil moisture stress for a crop can be used to analyse drought frequency, severity and duration for a particular crop in a given drought prone area. In the next section analysis of soil moisture data of Bajra (Pearl millet) crop at Jodhpur has been presented for drought studies.

4.2 Soil Moisture Deficit and Incidence of Drought

The following criteria has been used in the soil moisture analysis to define a day as drought day based on soil moisture deficit:

If,	SWD/AWC	=	0.7 to 0.8	Moderate Drought
	SWD/AWC	=	0.8 to 0.9	Severe Drought
	SWD/AWC		0.9	Disastrous Drought

Using the above criterion analysis of soil moisture monitoring data for Pearl millet crop as obtained from CAZRI, Jodhpur has been done. Bajra being a drought hardly crop can tolerate the moisture stress upto 75% depletion of available soil moisture. The severity levels for defining drought conditions have been used as described above.

Field capacity and permanent wilting point of the loamy sand soils of Jodhpur are taken 135 mm and 45 mm respectively. Therefore:

Available water holding capacity (AWC) = 135-45 = 90mm

Soil Water deficit (SWD) = 90 x 0.7 = 63mm

SWD of 63mmcorresponds to 72 cm (say 70 mm) soil moisture content. So, 70 mm is taken as threshold value and similarly 60 mm as the level of severe drought.

The weekly variation of average soil moisture (from 4 depths) for four growing seasons i.e. 1983-86 is plotted in figure 4.1. The series is truncated at 60 mm soil moisture level to separate the time series in drought and non drought periods. The period when soil moisture continuously runs below this truncation level, it indicates the period of drought (i.e duration or run length). The magnitude of drought is given by the average deviation and severity by cumulative deviations. In order to quantify effect of drought, the moisture stress during vegetative and reproductive stages of crop growth has been considered and given equal weightage with some consideration to that of seedling stage. The analysis of run lengths indicates that during 1985 and 1986 there was a period of SWD of 16 and 20 days during vegetative and reproductive growth stages of crop with an average deficit of 8 and 10 mm respectively. For a small period of time (5-7 days) soil moisture remained even below severe deficit level during reproductive stage in both the years causing serious crop damages. It indicates that 1985 and 1986 were severe drought years, from the view point of soil moisture shortage in the root zone. While year 1983 was not a drought year as for almost all the time during vegetative and reproductive stage soil moisture remained above 60 mm. There was a mild drought in 1984 in which soil moisture remained below 60 mm in early vegetative and late reproductive stages for a brief period of about one week. The crop production data collected for these years also substantiate these results and confirm that 1985 and 1986 were severe drought years as the crop yield was 5.7 and 6.8 Q/ha for years 1985 and 1986, respectively as against 25 and 12.7 Q/ha reported for 1983 and 1984 respectively.

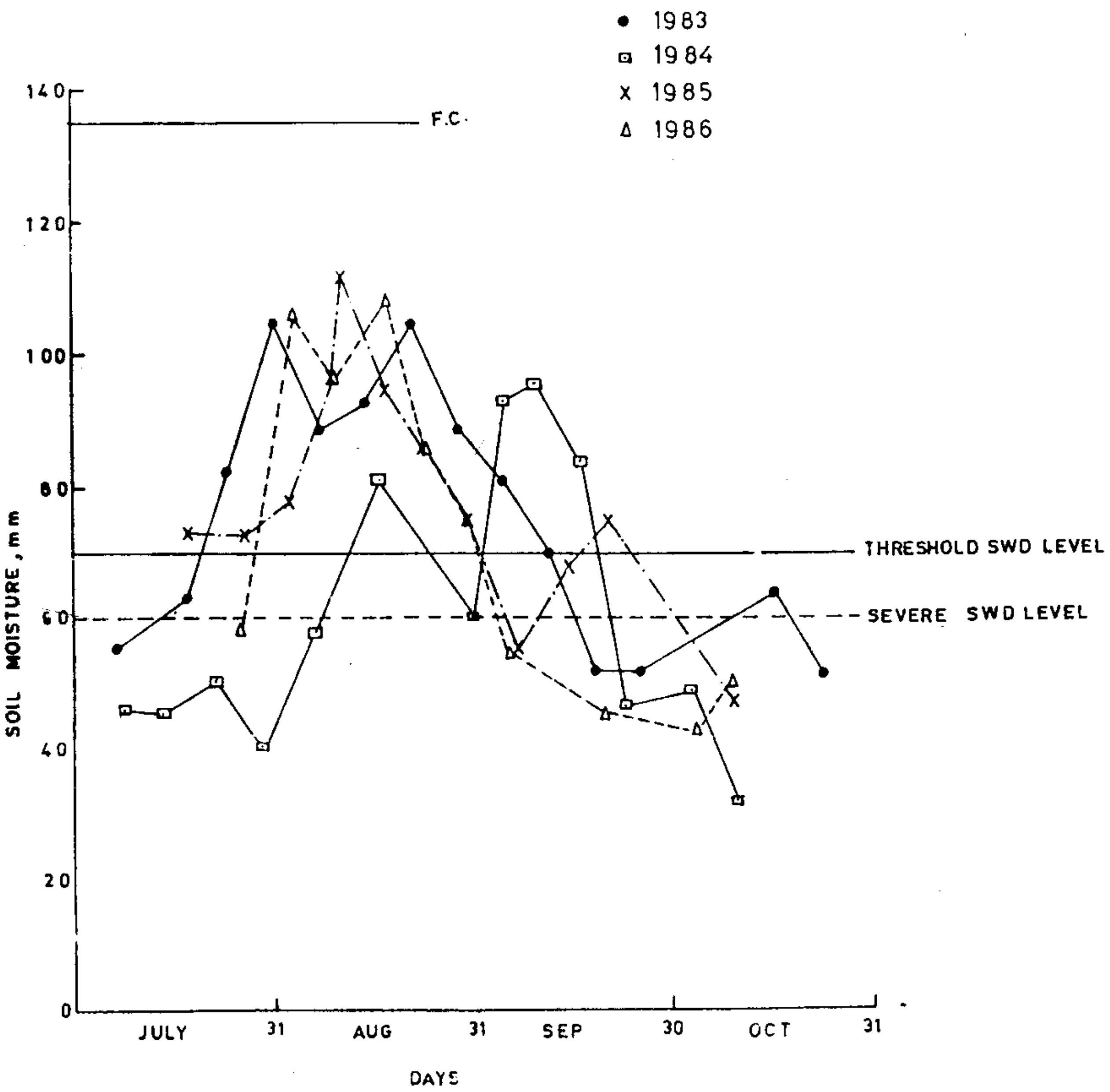


FIG.4.1- WEEKLY SOIL MOISTURE VARIATION FOR DROUGHT STUDIES

5.0 SURFACE WATER DEFICIT

5.1 General

The deficits in surface water are reflected through low stream flows and reduced reservoir storages. During period of deficient rainfall the deviation from normal conditions is greater for stream flows than for rainfall. Streamflow is one of the important hydrological parameters as it represents the runoff from a basin or catchment and determines the quantity of water available in various surface water resources. The precipitation deficiency is reflected in the resulted streamflow. Not only this, even the catchment characteristics, land use, vegetation etc. are also responsible for generated runoff. The drought phenomenon may be better studied from the hydrology of river basins for which local singularities are eliminated. The low stream flows and reduced reservoir storages are indicative of drought situations. When the flows are not sufficient enough to meet the required demand of water, it is considered that the drought has set in. The drought severity, frequency and duration can be studied by analysing the gross availability of streamflows, the flow duration characteristics of river flows and the extent to which the water is available in storages.

5.2 Stream Flow

In order to carry out low flow studies, twenty years data of few selected sites in Krishna basin have been analysed. The basin map showing the location of sites and other details are shown in figure 5.1. The details of sites

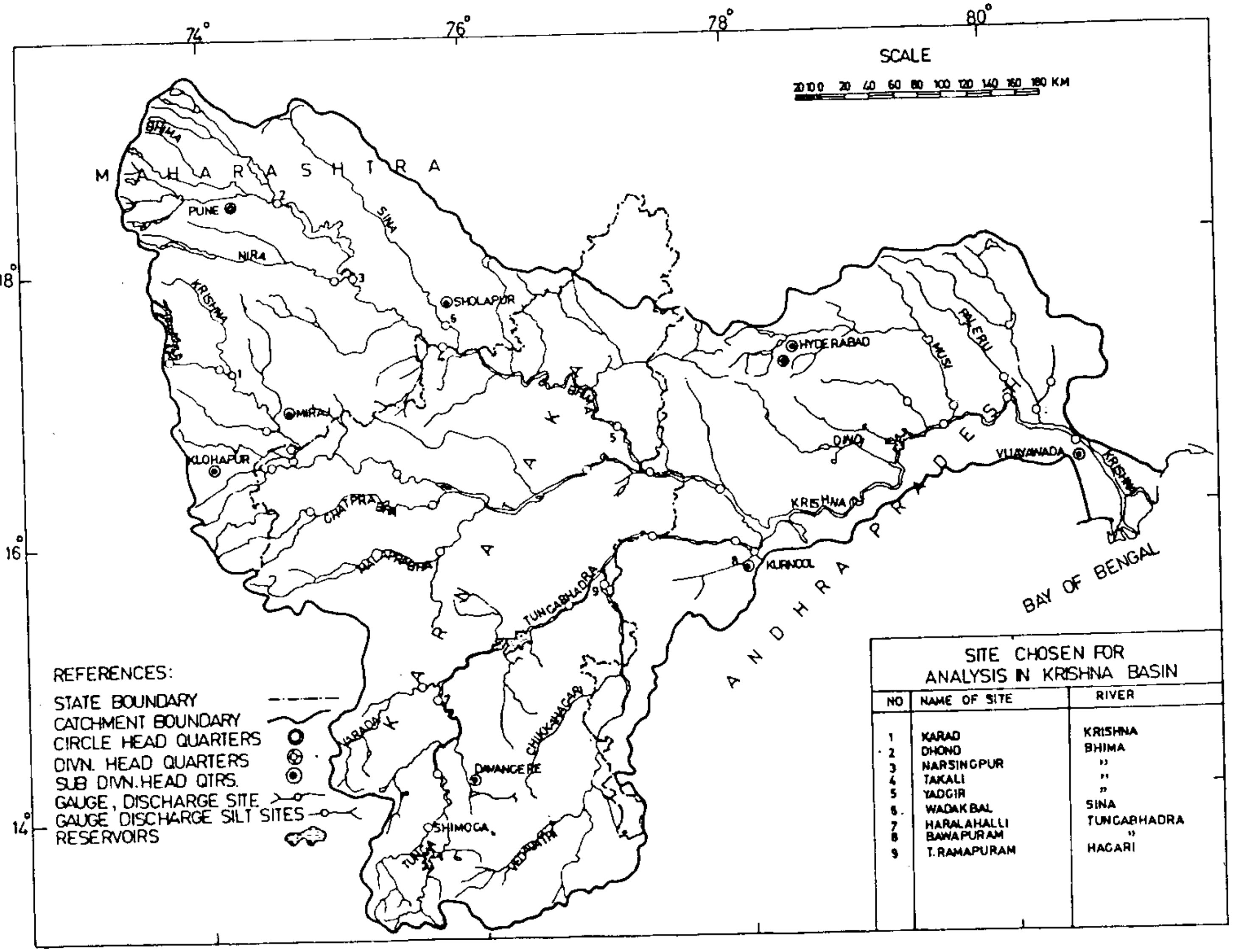


Fig.5.1 - SITES CHOSEN FOR ANALYSIS

chosen are given in table 5.1. The analysis has been carried out to study/develop simple indices, low flow duration curves, deficit volume and deficit duration analysis at various demand levels.

Table 5.1: Details of Sites Chosen for Low Flow Studies in Krishna Basin

Sl.No.	Name of site	Distt.	State	Stream	Catchment area(Km^2)
1.	Karad	Satara	Maharashtra	Krishna	5462
2.	Dhond	Poona	Maharashtra	Bhima	11,660
3.	Narsingpur	Sholapur	-do	Bhima	22,856
4.	Takali	Sholapur	-do-	Bhima	33,916
5.	Yadgir	Gulburga	Karnataka	Bhima	69,863
6.	Wadakbal	Sholapur	Maharashtra	Bhima	12,092
7.	Haralahalli	Dharwar	Karnataka	Tungabhadra	14,582
8.	Bawapuram	Kurnool	Andhra Pradesh	Tungabhadra	67,180
9.	T. Ramapuram	Bellary	Karnataka	Tungabhadra	23,500

5.2.1 Hydrograph Analysis

The monthly flow hydrographs at the site chosen for analysis were plotted for year 1984-85 and year 1985-86 in order to compare the flows with the discontinuous values of mean flow and minimum flow recorded during last 20 years (1966-86). These are shown in Fig. 5.2 through 5.10. The hydrographs illustrate a marked difference between the response of river flows in 1984-85 and 1985-86 and meanflows for chosen sites. All the chosen sites were affected by drought situation during 1985-86.

5.2.2 Simple indices

A commonly used simplest index is to compare the runoff depth or volume for a given duration i.e. fortnight,

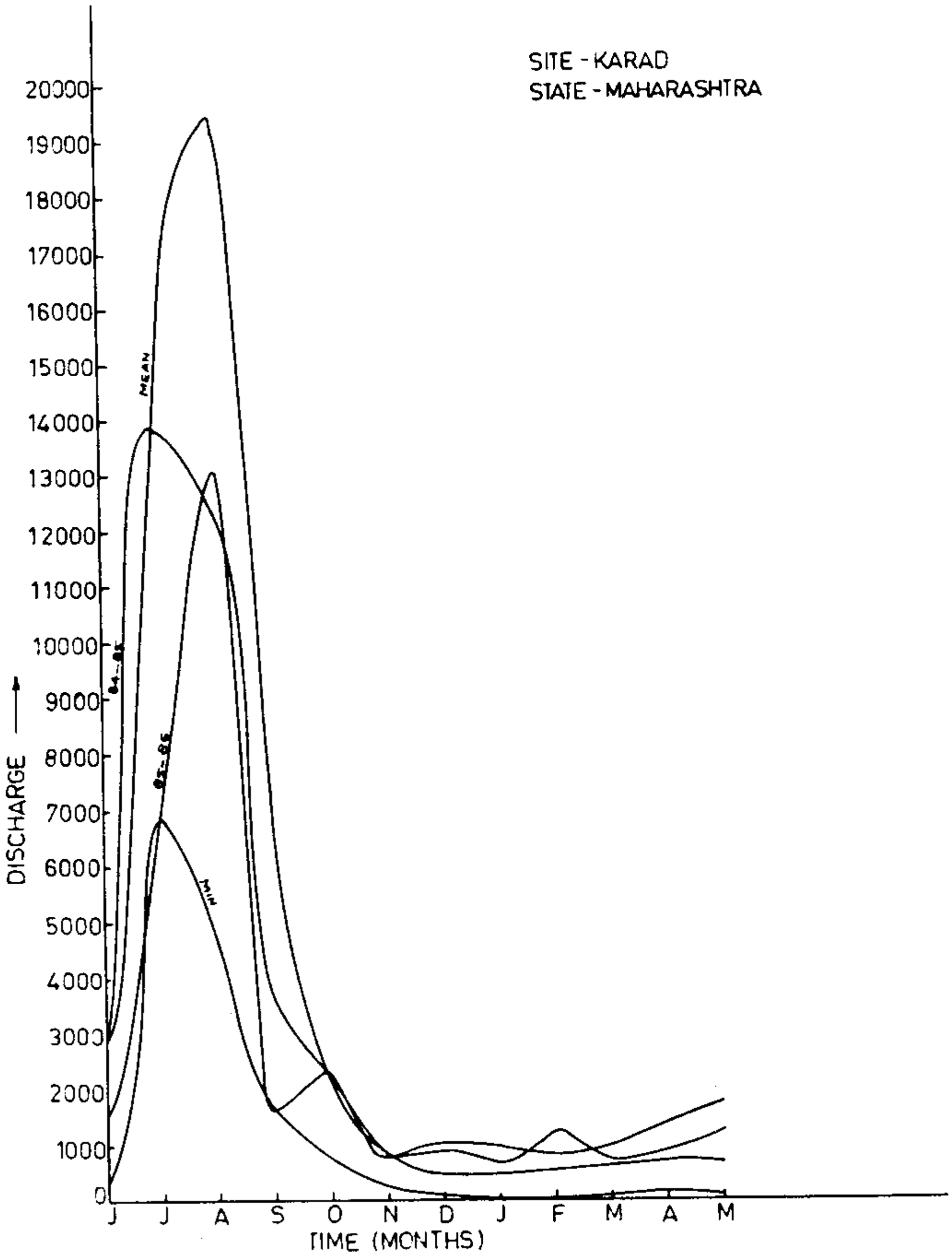


FIG 5.2- FLOW HYDROGRAPH FOR KARAD

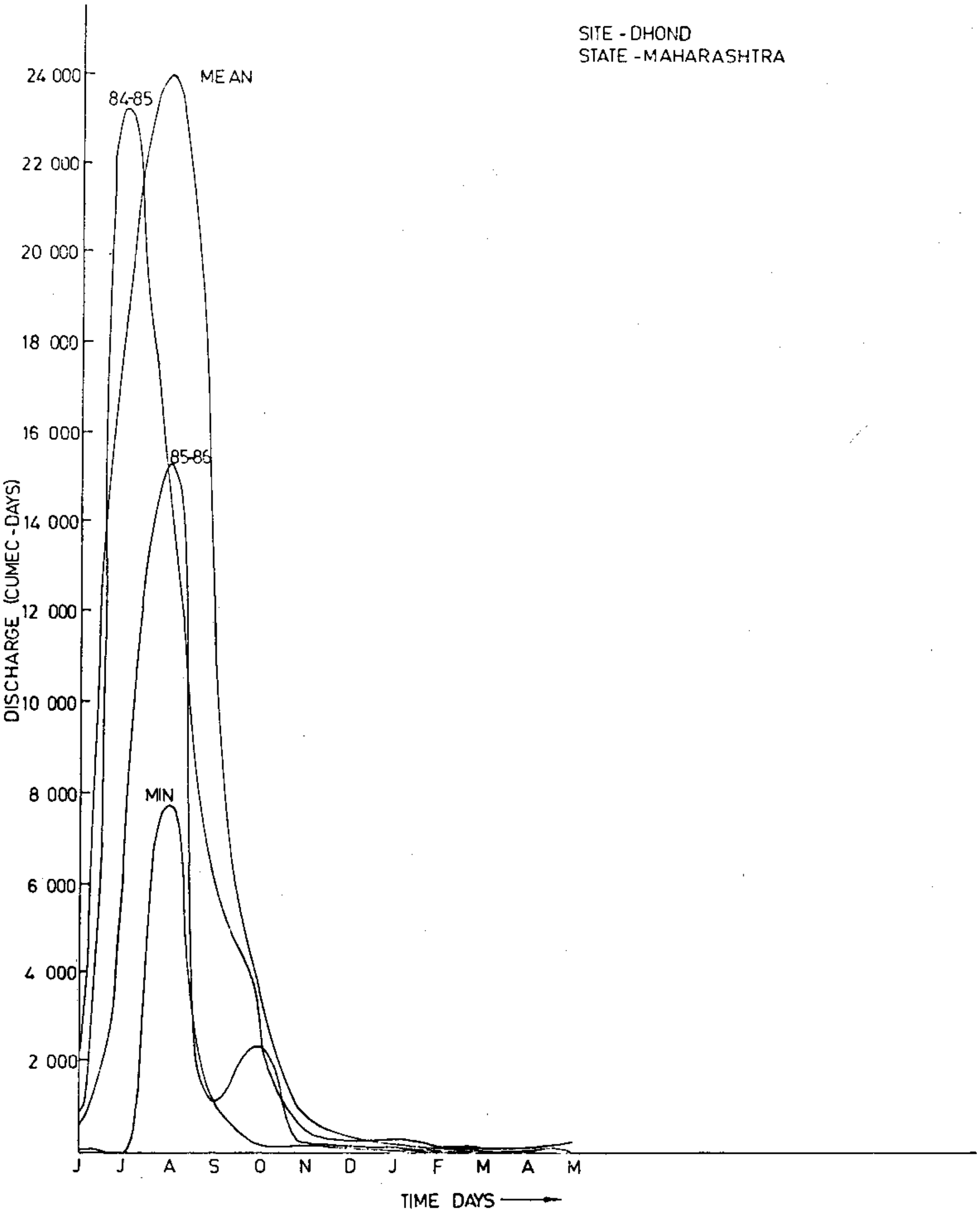


FIG.5.3 - FLOW HYDROGRAPH FOR DHOND

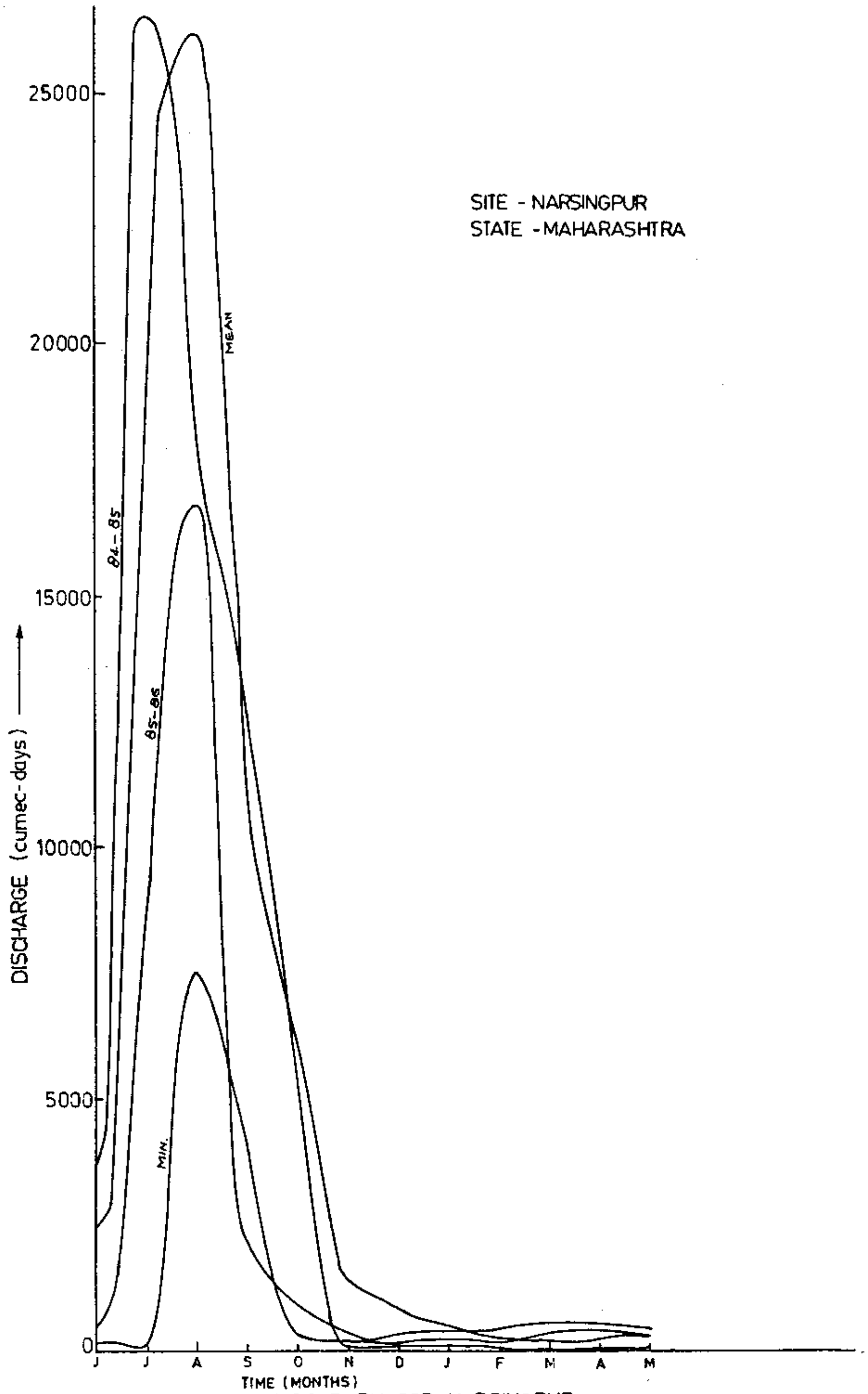


FIG.5·4· FLOW HYDROGRAPH FOR NARSINGPUR

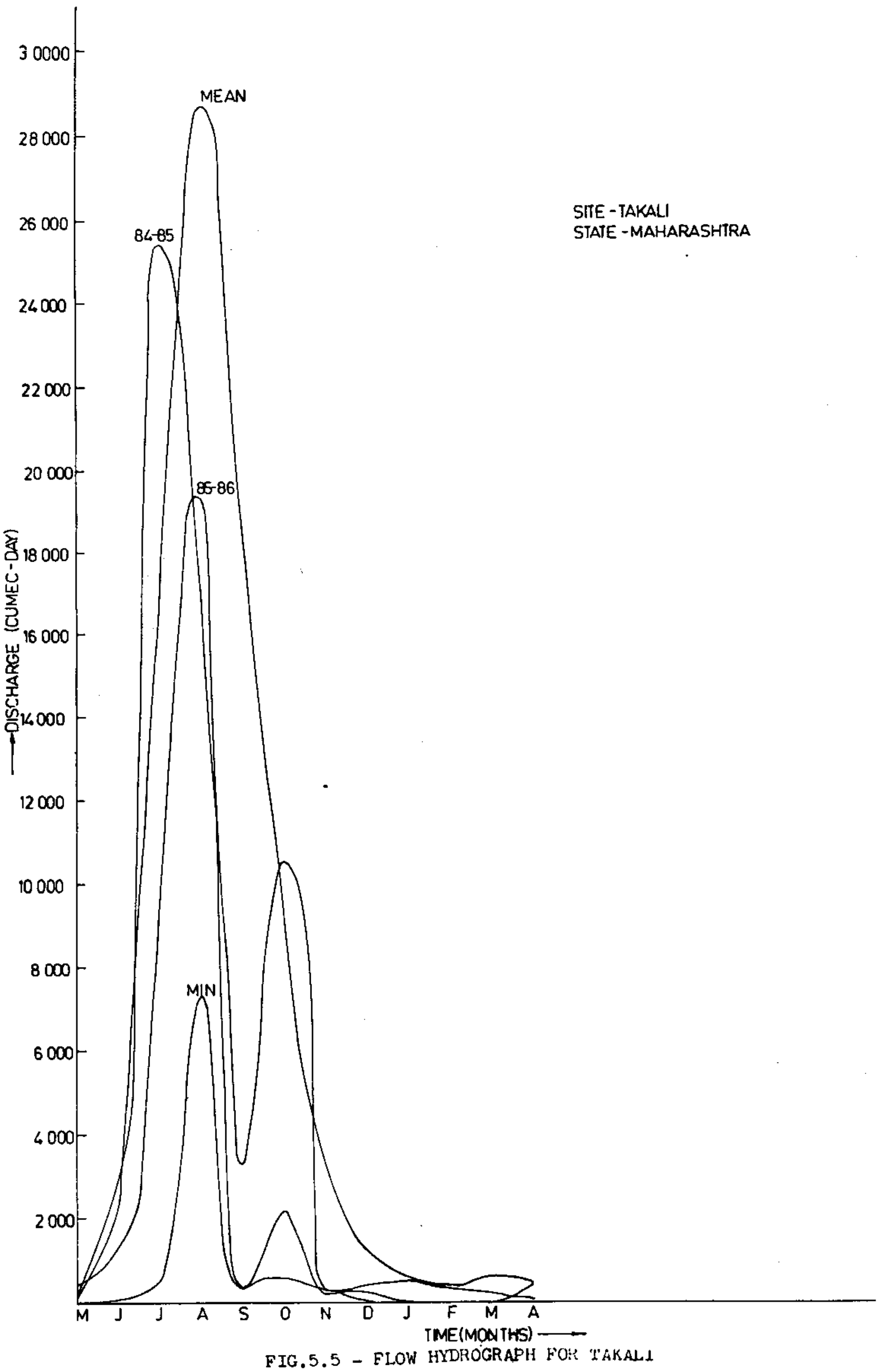


FIG.5.5 - FLOW HYDROGRAPH FOR TAKALI

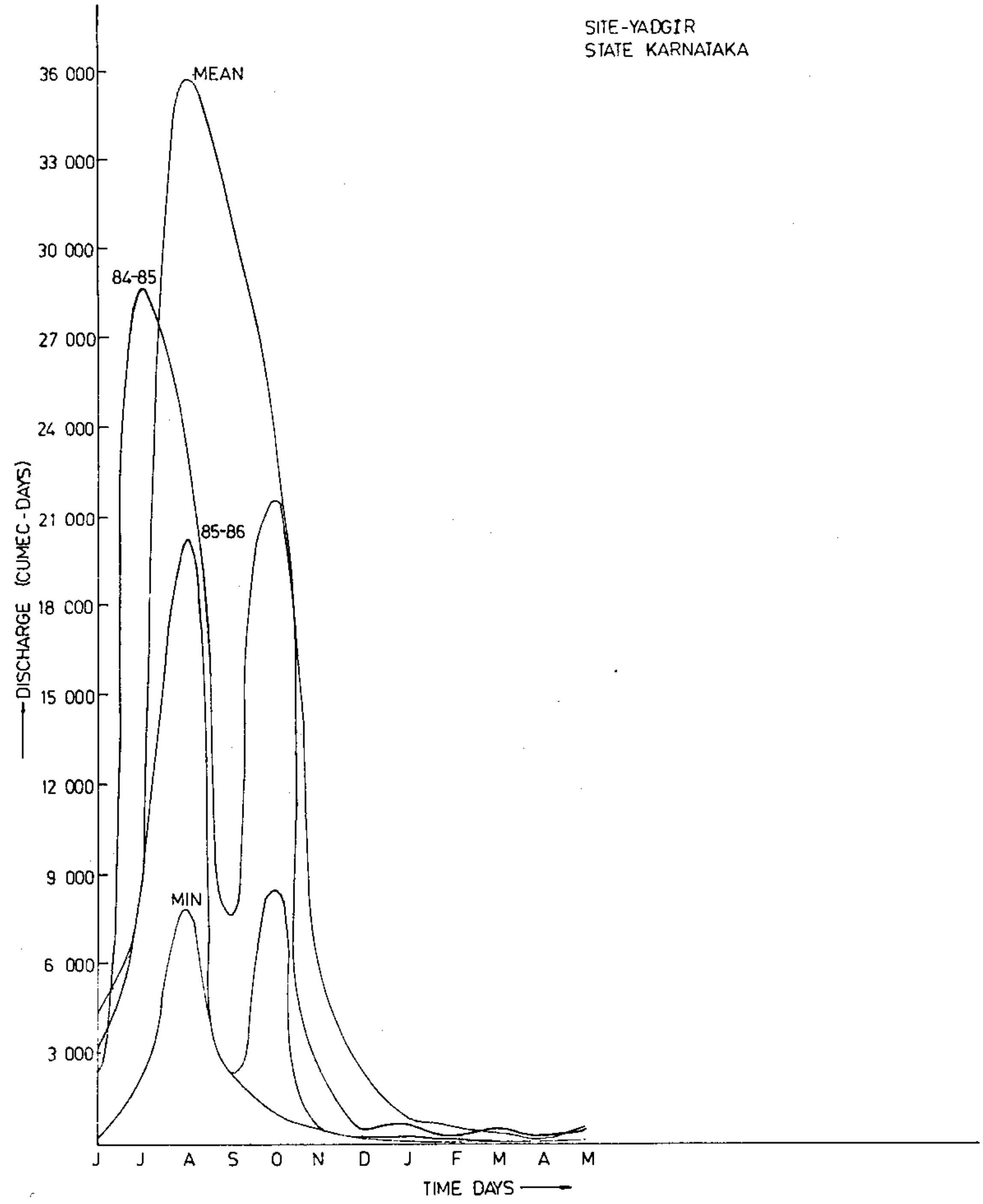


FIG.5.6 - FLOW HYDROGRAPH FOR YADGIR

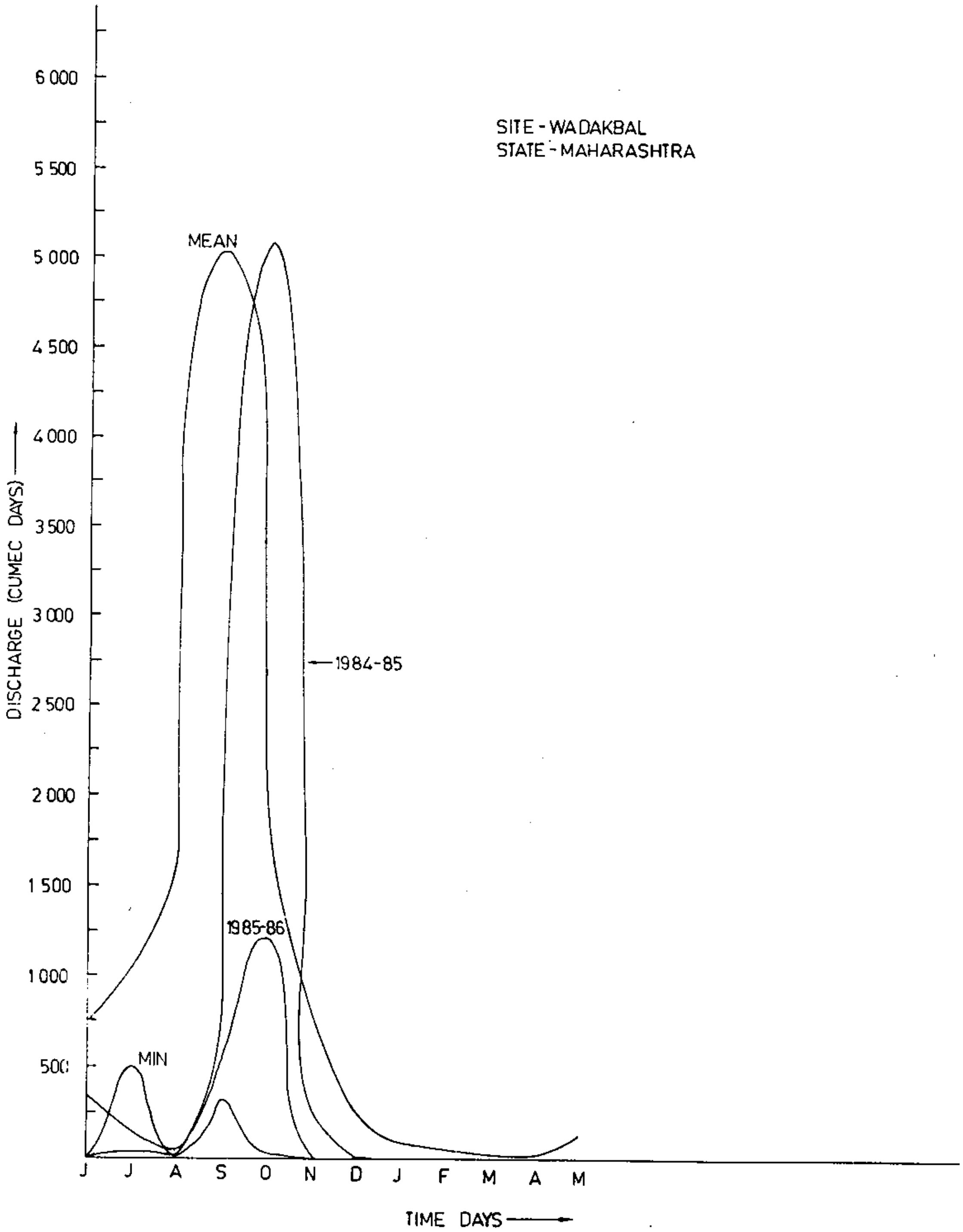


FIG.5.7 - FLOW HYDROGRAPH FOR WADAKBAL

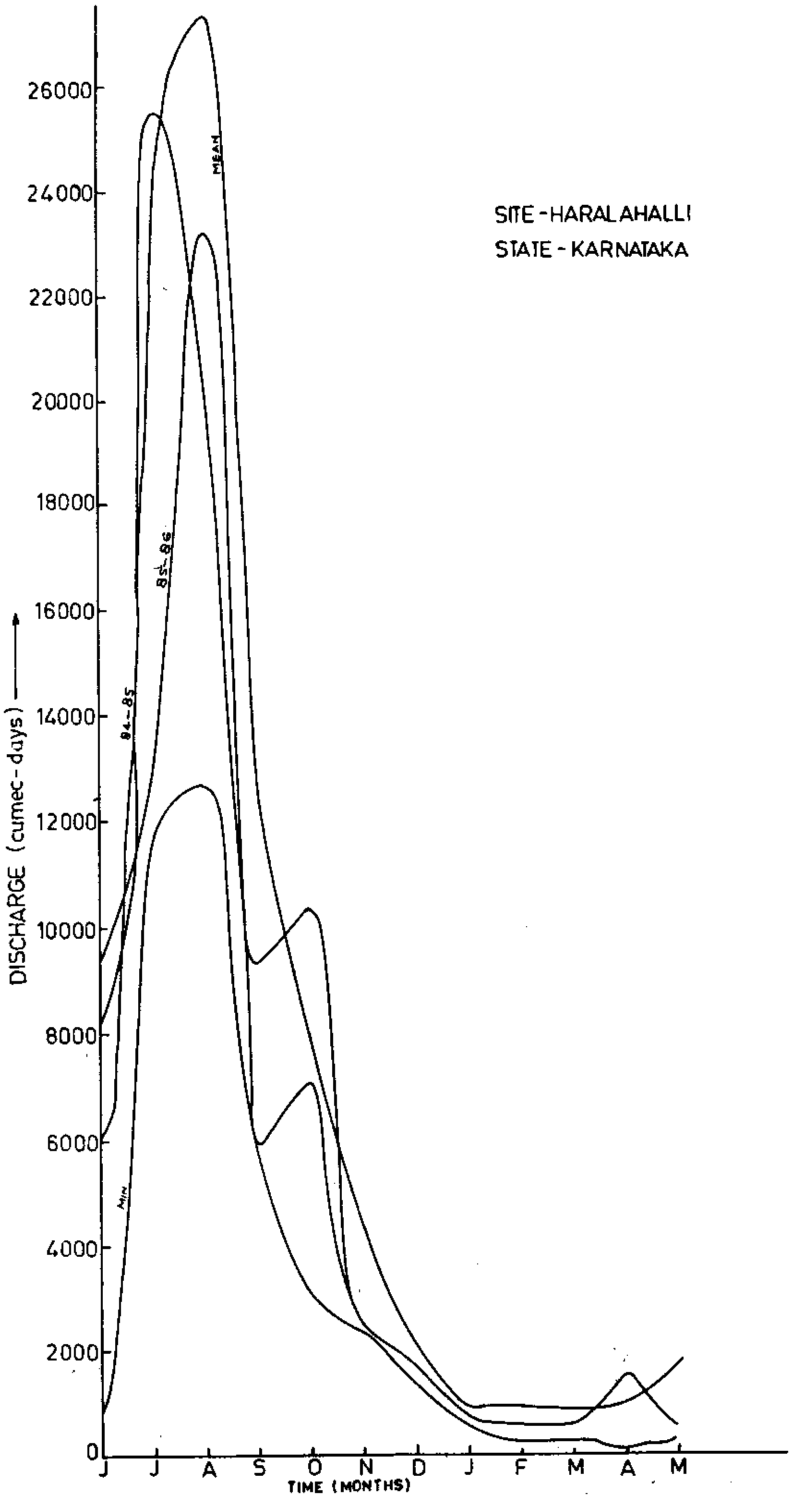


FIG.5·8-FLOW HYDROGRAPH FOR HARALAHALLI

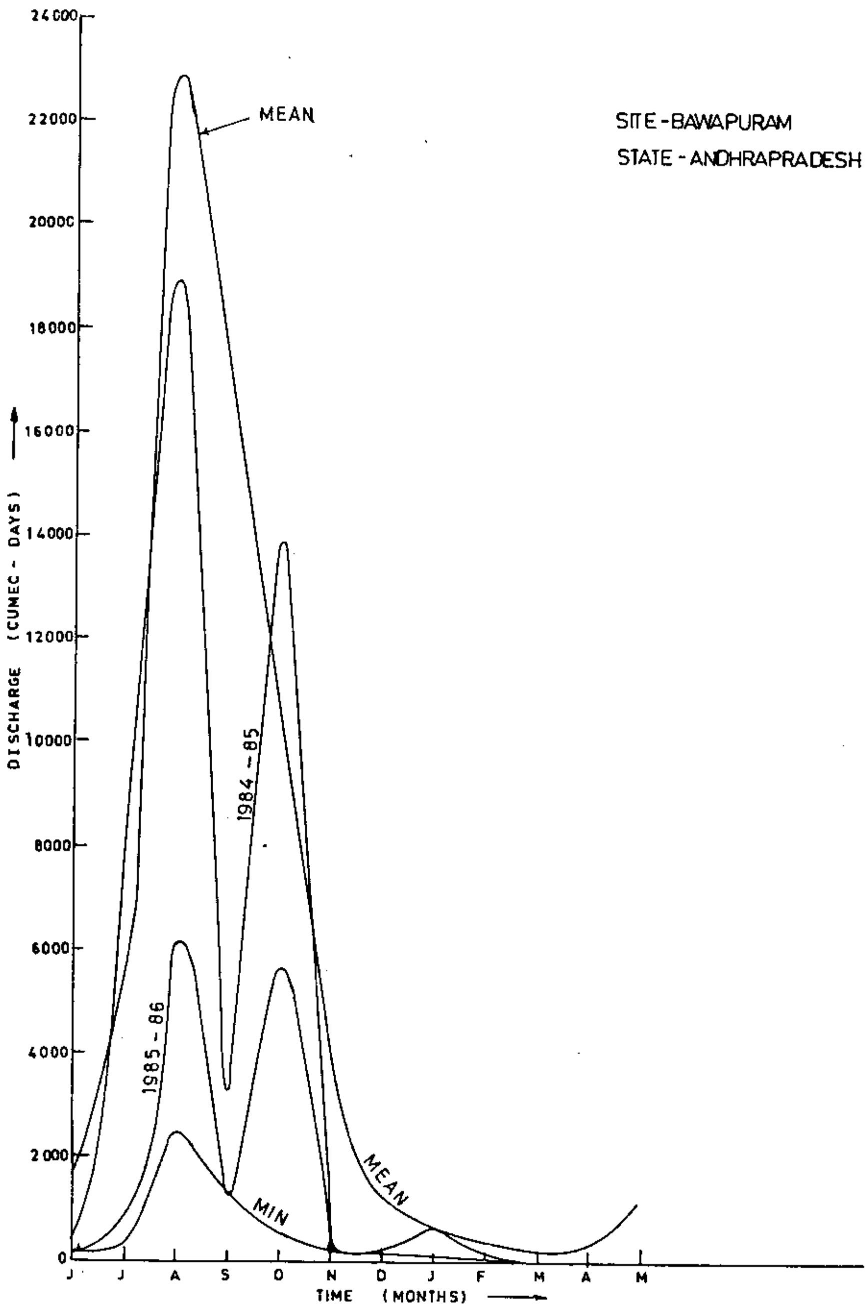


FIG.5-9— FLOW HYDROGRAPH FOR BAWAPURAM

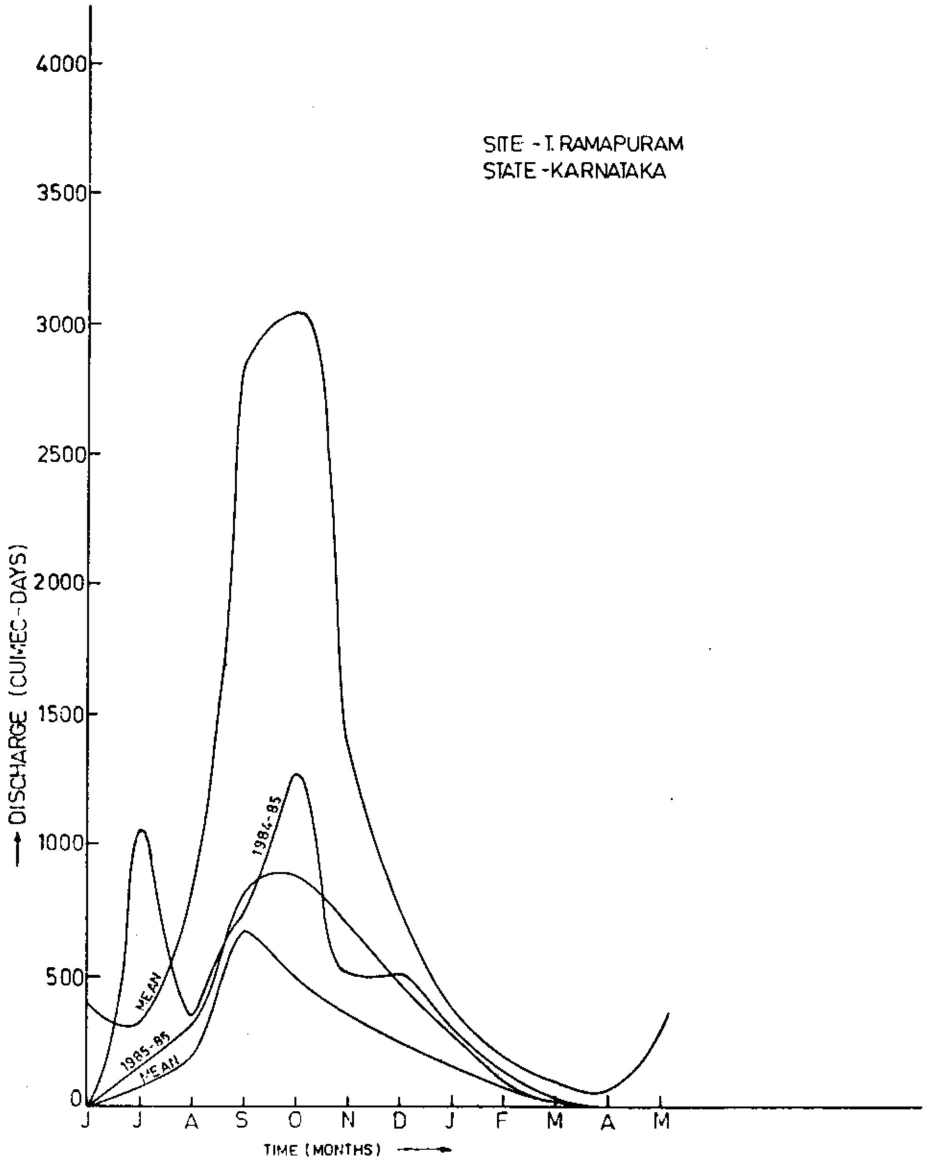


FIG 5·10 - FLOW HYDROGRAPH FOR T. RAMAPURAM month or a year with long term mean or standard period normal value for the given duration. It is considered that if the runoff is found to be less than the 75% of the normal runoff, year would be considered as drought year and if it occurs in 25% or more than 25% of years, the area would be considered to be drought prone (CWC, 1982).

The table 5.2 through 5.4 give the result of the deviation of annual flows from long term average flow for chosen sites. As the tables indicate that the annual flows for the year 1985-86 for all chosen sites were deficient more than 25% of normal flow indicating year 1985-86 as drought year. The tables clearly indicate that all the sites chosen were facing drought during 1985-86. The deficiency in flows was compared for sites chosen for a small north-west sub basin of Krishna basin (all lying in Maharashtra) (table 5.2). It can be seen from table 5.2 that the greatest negative departure was recorded at Narsingpur site followed by Dhond and Karad. The sites chosen in central part of the basin showed maximum negative departure in case of Wadakbal site followed by Yadgir and Takali (Table 5.3). Similarly, the sites chosen in south central part of the basin showed largest negative departure for Bawapuram site followed by T Ramapuram and Haralahalli.

5.2.3 Low flow analysis

Hydrologists are mainly concerned with the following three main characteristics in low flow analysis:

i) The magnitude of low flow

ii) The duration of low flow

TABLE 5.2 : DEVIATION OF ANNUAL FLOWS FROM LONG TERM AVERAGE FLOWS

Sl. No	Year	Karad % Departure	Dhond % Departure	Narsingpur % Departure
1.	1965-66			
2.	66-67	- 10.10		
3.	67-78	+ 51.48		+ 2.66
4.	68-69	- 34.12*	- 50.40*	- 20.88
5.	69-70	+ 54.11	+ 36.35	+ 60.73
6.	70-71	+ 16.52	- 0.47	- 0.92
7.	71-72	- 3.75	+ 27.30	+ 13.47
8.	72-73	- 45.40*	- 42.40*	- 52.32
9.	73-74	+ 11.32	+ 43.48	+ 27.27
10.	74-75	- 26.52*	- 11.92	- 8.82
11.	75-76	+ 17.39	+ 28.83	+ 22.97
12.	76-77	+ 55.02	+ 60.97	- 64.70
13.	77-78	+ 2.59	- 7.85	- 6.44
14.	78-79	+ 15.24	- 10.70	- 6.18
15.	79-80	+ 6.08	+ 4.21	+ 8.90
16.	80-81	+ 21.33	+ 18.14	+ 13.52
17.	81-82	- 14.95	+ 13.87	+ 20.52
18.	82-83	- 38.30*	- 43.46*	- 59.36
19.	83-84	- 20.39	+ 5.20	+ 2.51
20.	84-85	- 20.60	- 16.87	- 21.76
21.	85-86	- 36.36*	- 53.97*	- 60.50

*Runoff deficit is more than 25% of normal.

TABLE 5.3 : DEVIATION OF ANNUAL FLOWS FROM LONG TERM AVERAGE FLOWS

Sl. No.	Year	Takali % Departure	Yadgir % Departure	Wadakbal % Departure
1.	1965-66	- 4.26	- 7.52	- 17.57
2.	66-67	- 6.82	- 27.34	- 22.72
3.	67-68	+ 25.86	+ 35.19	+ 31.60
4.	68-69	- 24.97	- 23.34	- 38.02
5.	69-70	+ 43.50	+ 40.25	+123.82
6.	70-71	- 1.0	+ 2.87	+ 73.13
7.	71-72	+ 15.11	+ 0.98	+ 24.47
8.	72-73	- 61.79	- 69.90	- 89.78
9.	73-74	+ 24.50	+ 31.73	+ 37.80
10.	74-75	+ 6.67	+ 7.45	+ 19.55
11.	75-76	+ 55.89	+101.19	+101.72
12.	76-77	+ 56.49	+ 18.59	- 76.35
13.	77-78	- 21.10	- 20.29	- 40.38
14.	78-79	- 12.67	- 19.31	- 15.66
15.	79-80	+ 27.46	+ 18.15	+ 20.25
16.	80-81	- 6.11	- 22.06	- 17.02
17.	81-82	+ 28.69	+ 21.23	- 46.77
18.	82-83	- 63.17	- 60.53	- 87.04
19.	83-84	+ 4.74	+ 38.05	+145.48
20.	84-85	- 24.30	- 29.91	- 46.58
21.	85-86	- 60.54	- 64.08	- 80.96

TABLE 5.4 : DEVIATION OF ANNUAL FLOWS FROM LONG TERM AVERAGE FLOWS

Sl. No.	Year	Harlahalli % Departure	Ba''apuram % Departure	T. Ramapuram % Departure
1.	1965-66			
2.	66-67		- 38.65	- 2.60
3.	67-68	- 8.85	- 15.07	- 49.80*
4.	68-69	- 9.06	+ 10.01	+ 20.46
5.	69-70	+ 13.18	+ 19.18	- 14.74
6.	70-71	+ 26.31	+ 73.02	+ 15.59
7.	71-72	- 3.41	- 20.60	+ 17.51
8.	72-73	- 25.88*	- 61.83	- 33.40*
9.	73-74	- 3.40	+ 2.93	+ 17.10
10.	74-75	- 14.06	+ 3.01	+ 19.60
11.	75-76	+ 39.51	+153.45	+169.25
12.	76-77	- 37.57*	- 83.38	- 55.25*
13.	77-78	- 10.81	- 38.64	+ 1.63
14.	78-79	+ 60.97	+101.82	+ 20.94
15.	79-80	- 18.74	- 34.63	- 14.62
16.	80-81	+ 36.65	+ 54.11	- 40.15*
17.	81-82	+ 0.82	+ 18.22	+ 67.38
18.	82-83	- 7.20	- 19.32	- 5.16
19.	83-84	- 6.20	- 17.85	- 16.02
20.	84-85	- 5.97	- 32.59	- 53.39*
21.	85-86	- 26.31*	- 78.19	- 64.34*

*Runoff deficit is more than 25% of normal.

iii) The frequency of occurrence of low flow.

The magnitude of low flow is the quantity of water flowing through a given section of a stream for a specified period of time. It determines the amount of water available for use. The duration depends on natural conditions as well as man made effects and may reflect some specified water use practices. The duration also depends on period of water deficit tolerable to the user or some other requirements.

(a) Flow duration curves

Low flow data are normally specified in terms of the magnitude of low flow for a given time interval within a year or a season. In analysing the streamflow drought, one of the simplest technique is to construct a flow duration curve for the given river or stream. The flow duration curve shows graphically the relationship between any given discharge and the percentage of time the discharge exceeded. In other words, it is a cummulative frequency curve that shows the percentage of time during which specified discharges were equalled or exceeded during the period of record. The curve can be drawn for daily or monthly flow data or for any consecutive N days or month period. Flow duration curves values of 90%, 95% and 99% are used as a measure of stream low flow potential in hydrologic studies. The 90% value of used as a measure of ground water contribution to streamflow. Flow duration curve is also used to define low flow index (LFI) as the 10 days average flow which is exceeded 95% of time of the duration of series (Institute of Hydrology, 1980), or

$$\text{Low Flow Index (LFI)} = (Q_{10})_{95}$$

The low flow index can be used for planning in drought conditions. Flow duration curves of 7, 10, 30, 60, 120 and 365 days period for sites chosen using 20 years data have been constructed and shown in figure 5.11 through 5.18. The low flow index values are estimated from 10 days flow duration curve and given in table 5.5 for all sites chosen for analysis.

TABLE 5.5 : LOW FLOW INDEX

Sl.No.	Site	Period of Analysis	L.F.I($10^4 m^3/km^2$)
1.	Karad	1965-86	8.70
2.	Dhond	1968-86	1.33
3.	Narsingpur	1967-86	1.264
4.	Takali	1965-86	0.265
5.	Yadgir	1965-86	0.310
6.	Wadakbal	1965-86	0.289
7.	Haralahalli	1967-86	1.586
8.	Bawapuram	1966-86	2.872
9.	T Ramapuram	1966-86	0.629

5.2.4 Analysis of low flow spells

Generally it is of interest both in amenity and water quality work to know for how long a low flow is maintained and how large a deficit can built up. Thus, the 95% flow on the flow duration curve is defined to be exceeded 95% of the time. In other words, in a period of 100 years there will be 1826 days (5% x 365 x 100) when the flow is lower. However, no information is available on how these days will

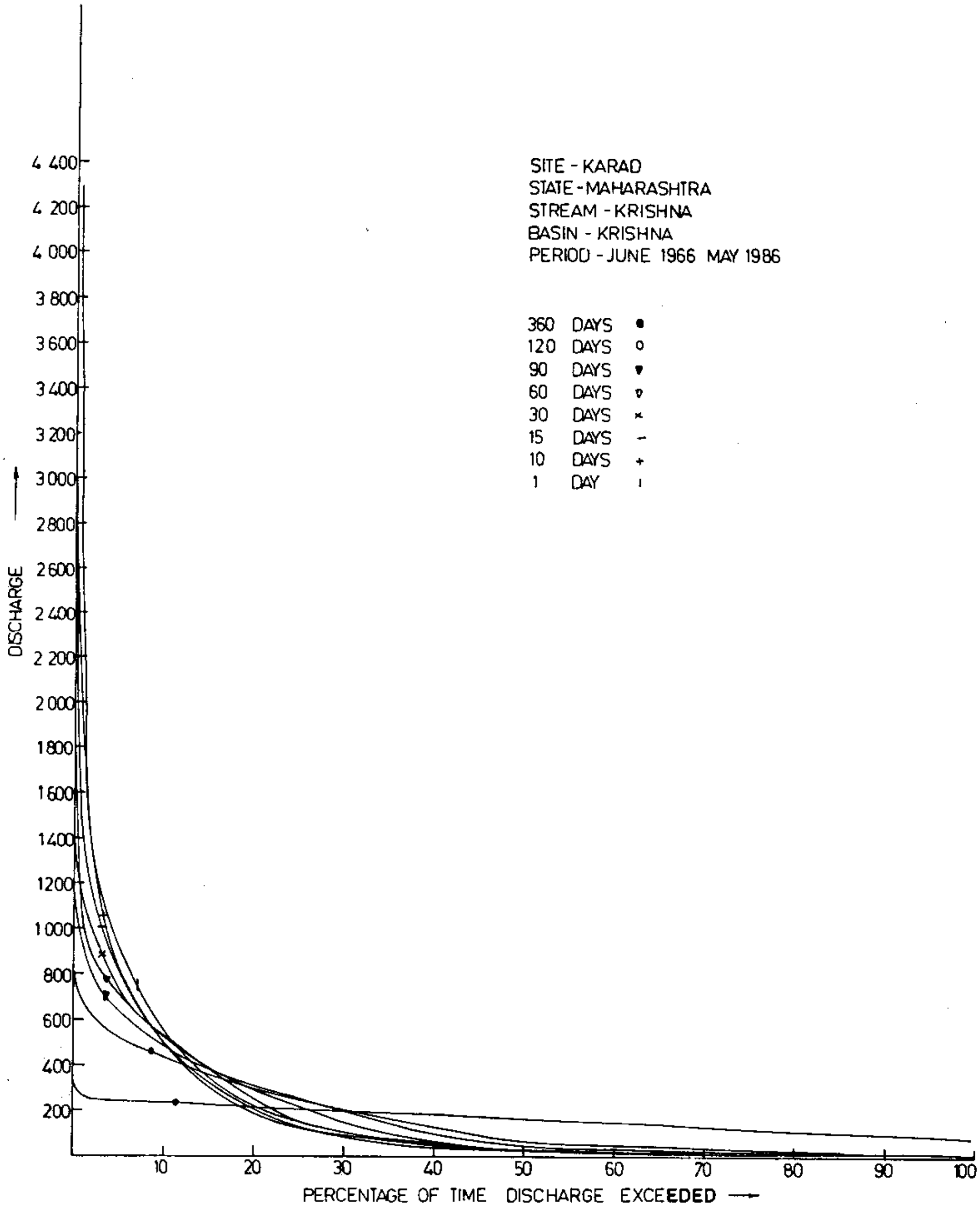


FIG.5.11 - FLOW DURATION CURVE FOR KARAD

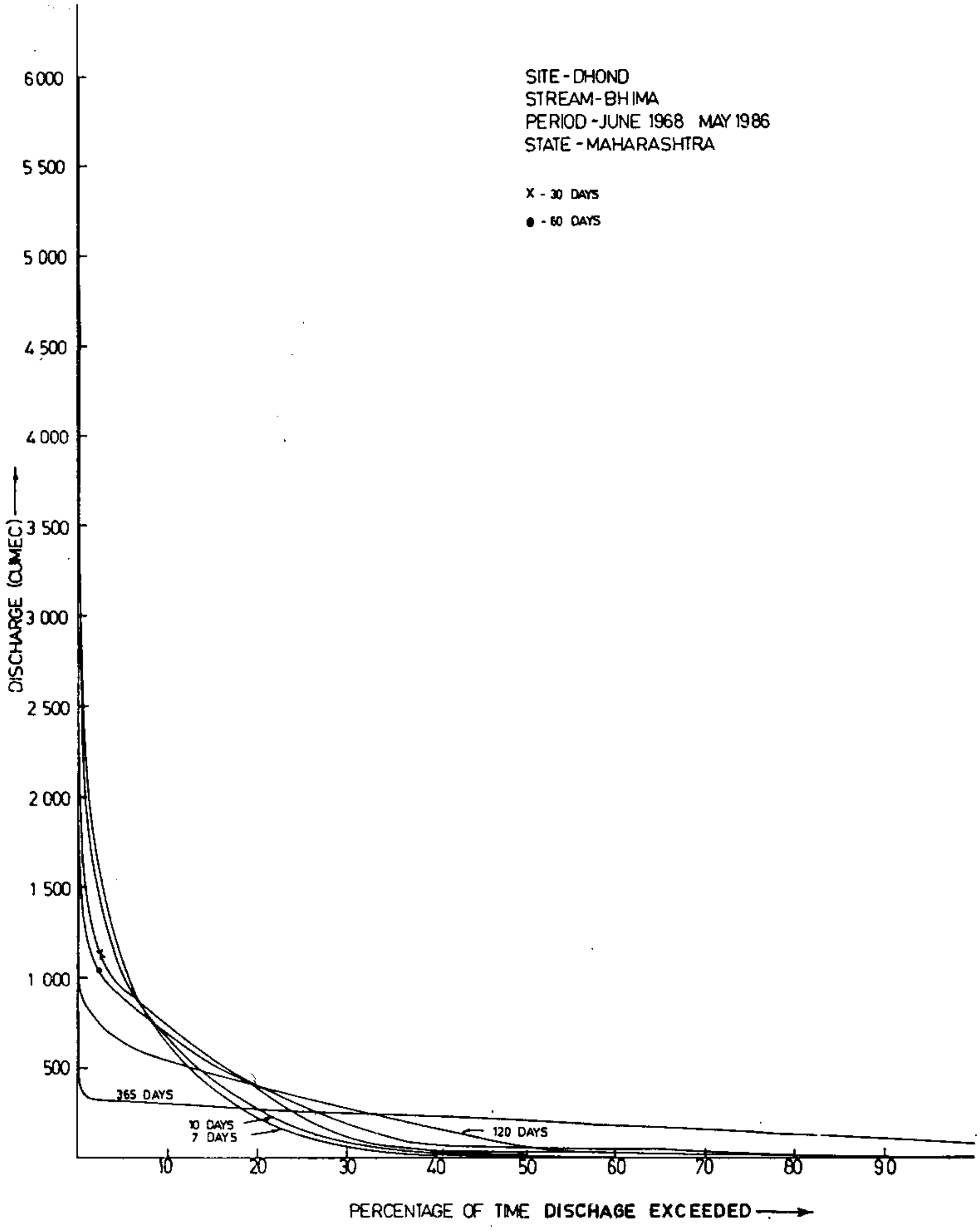


FIG.5.12 - FLOW DURATION CURVE FOR DHOND.

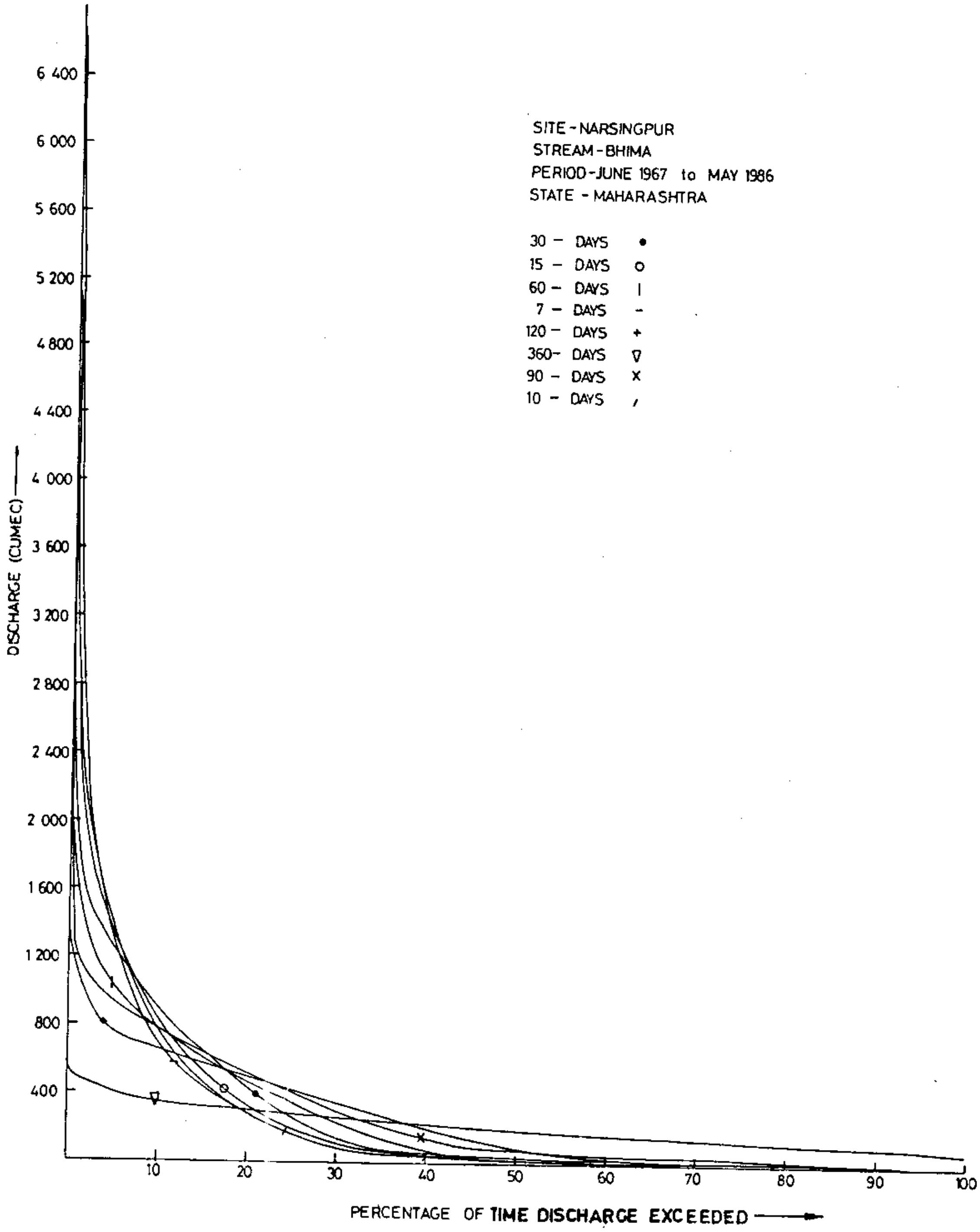


FIG.5.13 - FLOW DURATION CURVE FOR NARSINGPUR

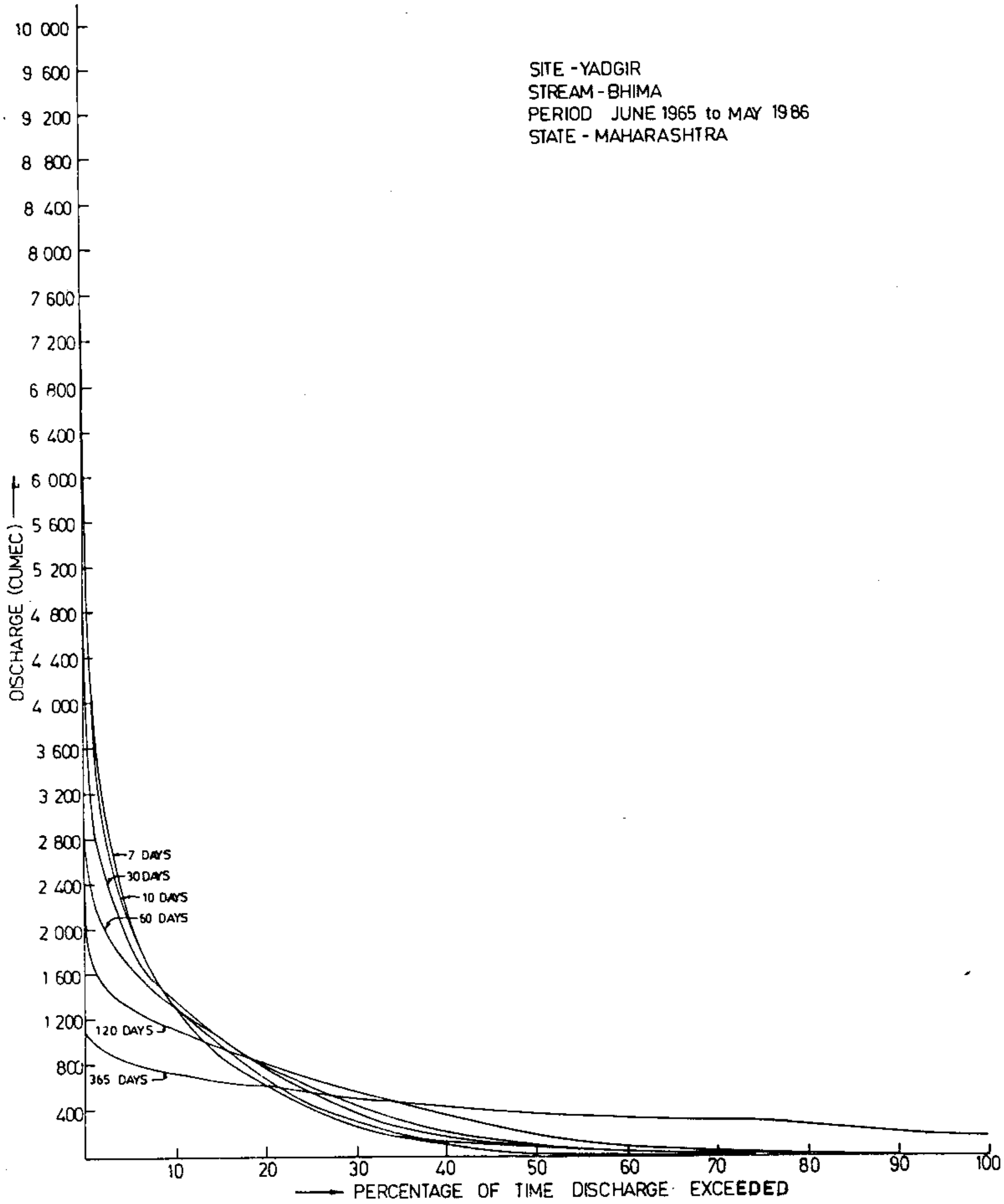


FIG.5.14 - FLOW DURATION CURVE FOR YADGIR

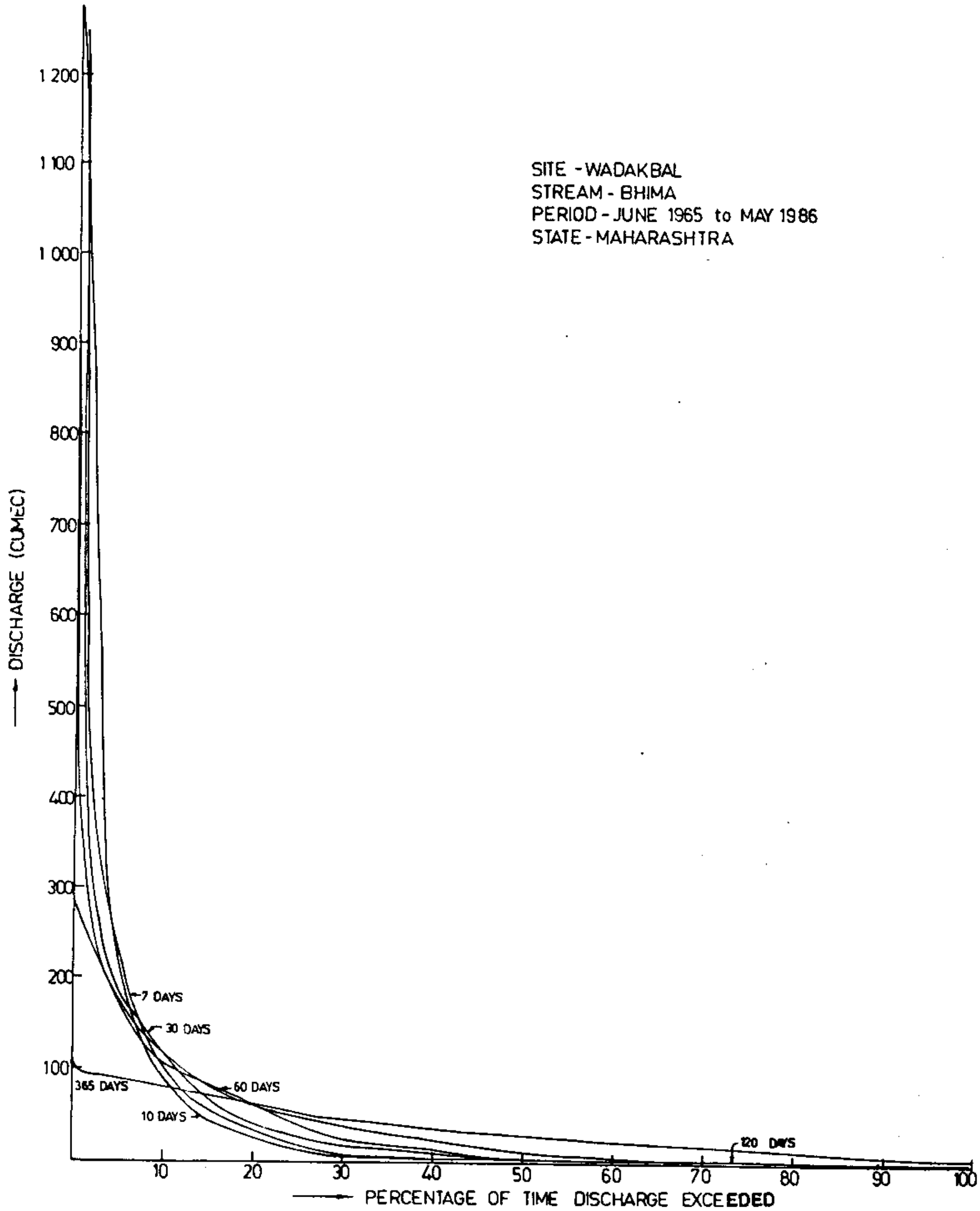


FIG.5.15 - FLOW DURATION CURVE FOR WADAKBAL

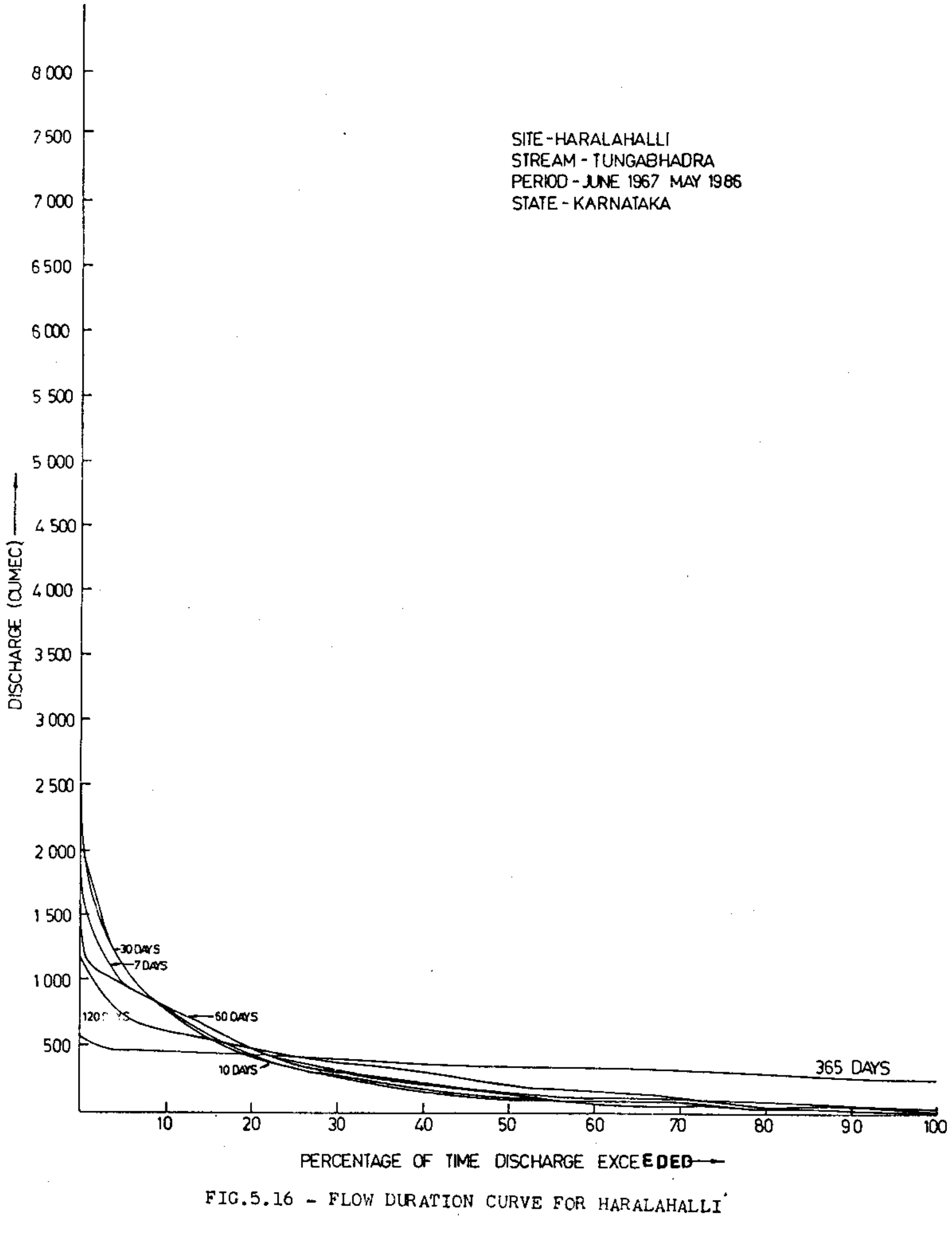


FIG.5.16 - FLOW DURATION CURVE FOR HARALAHALLI

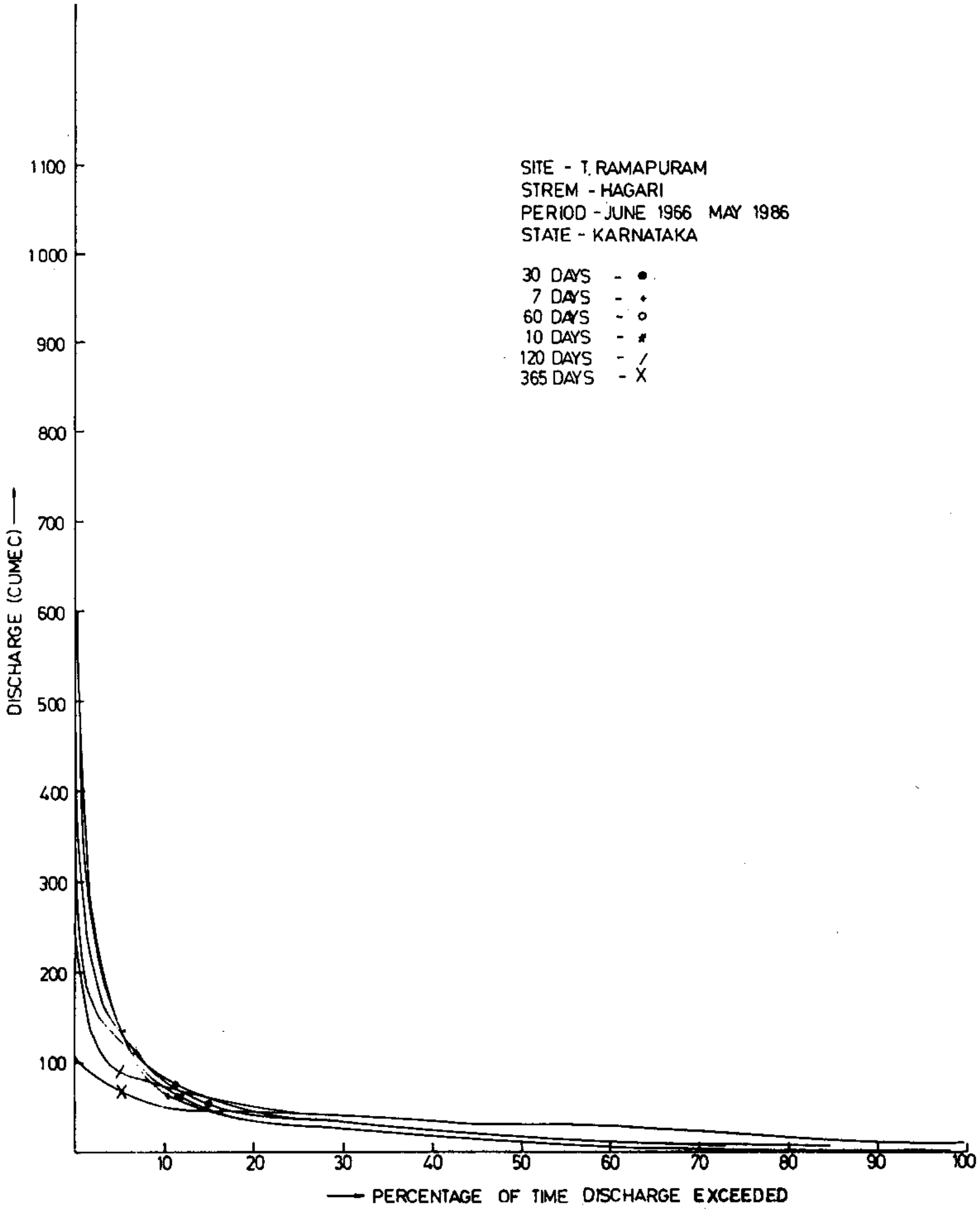


FIG.5.18 - FLOW DURATION CURVE FOR T.RAMAPURAM

occur. These 1826 days may be divided into many short spells or alternatively into fewer long spells. In U.K. Institute of Hydrology (1980) described the spell durations and deficiency volumes which provide this information.

The frequency of spell duration and deficit volumes can be expressed in two ways:

a) Frequency per 100 years of an event.

b) Proportion of years in which a defict duration or volume is exceeded.

5.2.4.1 Analysis for frequency of spell duration and frequency of deficiency volume:

The analysis procedure has the following steps:

i) Select a number of class interval (in days) with chosen lower and upper class limits in days for duration of spells below given threshold.

ii) Consider a threshold discharge (q_o) as some percentage of average daily flow (5, 10, 20, 40, 60, 80 percent) or at the discharge corresponding to 95% percentile from the 10 daily flow duration curve.

iii) Find out the frequency of spell durations expressed as the number of events in class interval per 100 years.

iv) Plot the frequency of spells per 100 years for given duration versus duration of spells below given threshold in days.

v) Commulative sum yield data for the number of occasions when spells of longer than a given duration occur.

vi) Repeat step (i) to (iii) for frequency of deficit volumes.

vii) Plot the frequency of deficiency volume versus the deficiency volume as percentage annual runoff volume.

viii) Repeat step (v) for the frequency of deficiency volume to yield data for the number of occasions when deficit volume larger than a given deficit volume occurs.

Analysis for frequency of spell duration and frequency of deficiency volume have been performed for sites Dhond, Narsingpur, Yadgir, Wadakbal, Haralahalli, & T. Ramapuram on annual basis. In this analysis long term average daily flow has been computed by taking the average of available daily flow data for different years. Various demand levels were considered as 10%, 30%, 50%, 70% and 90% of the computed average daily flow. Different spells of deficit volume and corresponding duration were computed. Spell frequency analysis was performed for each chosen site and the results of spell analysis are given in table 5.6 through 5.17. Using these results, various frequency curves were prepared. These curves show the frequency of deficiency volume per 100 year corresponding various deficiency volumes at different demand levels. Fig. 5.19 to 5.24 illustrate these curves for various chosen sites. Similar type of curves were also prepared for deficit duration. These curves are shown in figure 5.25 to 5.30 for various chosen sites.

TABLE 5.6 : FREQUENCY OF DEFICIENCY VOLUME

Site : DHOND — Average daily flow : 161.0 cumec

Period of Analysis: June 1968-May 1986 — Average annual runoff: 58805.25 cumec/day

Threshold % average Daily flow	Class limit % annual runoff							
	Lower	0.0	0.0025	0.01	0.04	0.4	0.5	0.54
	Upper	0.0025	0.010	0.04	0.4	0.5	0.54	0.6
10		477	72	55	33	-	-	-
30		272	122	77	100	-	-	-
50		366	88	127	116	11	-	-
70		350	150	116	111	44	-	-
90		288	177	122	88	33	33	33

Note: * Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.7 : FREQUENCY OF DEFICIENCY VOLUME

Site : Narsingpur

Average daily flow : 200.4 cumec

Period of analysis : June 1967-May 1986

Average annual runoff : 73196.1 cumec/day

Threshold % average daily flow	Class limit % annual runoff					
	Lower	0.0	0.004	0.015	0.10	0.5
	Upper	0.004	0.015	0.10	0.5	0.6
10		689	79	74	-	-
30		415	147	84	79	-
50		310	142	126	19	-
70		310	152	163	100	-
90		305	172	158	68	58

Note: *Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.8 : FREQUENCY OF DEFICIENCY VOLUME

Site : Yadgir | Average daily flow : 348.2 cumec

Period of analysis : June 1965-May 1986 | Average annual runoff : 127180.05 cumec/day

Threshold % average daily flow	Class limit % annual runoff						
	Lower	0.0	0.0010	0.0080	0.030	0.25	0.5
	Upper	0.0010	0.0080	0.030	0.25	0.50	0.6
10		276	123	76	23	-	-
30		223	157	104	104	-	-
50		161	157	147	109	23	-
70		195	166	119	119	90	-
90		142	180	128	138	80	19

Note: *Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.9 : FREQUENCY OF DEFICIENCY VOLUME

Site : Wadakbal

Period of analysis : June 1965-May 1986

Average daily flow : 34.6 cumec

Average annual runoff : 12637.65 cumec/day

Threshold % average daily flow	Class limit % annual runoff					
	Lower	0.0	0.0030	0.020	0.07	0.4
	Upper	0.0030	0.020	0.07	0.4	0.65
10		514	166	81	-	-
30		364	295	90	86	-
50		314	286	138	133	-
70		310	229	205	148	10
90		267	219	210	114	76

Note: * Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.10 : FREQUENCY OF DEFICIENCY VOLUME

Site : Haralahalli

Period of anlysis : June 1967-May 1986

Average daily flow : 233.9 cumec

Average annual runoff : 85431.97 cumec/day

Threshold % average daily flow	Class limit % annual runoff					
	Lower	0.0	0.0015	0.015	0.06	0.40
	Upper	0.0015	0.015	0.06	0.40	0.50
10		500	68	-	-	-
30		263	200	74	42	-
50		195	163	84	100	-
70		215	158	142	116	-
90		215	158	142	74	42

Note: * Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.10 : FREQUENCY OF DEFICIENCY VOLUME

Site : Haralahalli | Average daily flow : 233.9 cumec

Period of anlysis : June 1967-May 1986 | Average annual runoff : 85431.97 cumec/day

Threshold % average daily flow	Class limit % annual runoff					
	Lower	0.0	0.0015	0.015	0.06	0.40
	Upper	0.0015	0.015	0.06	0.40	0.50
10		500	68	-	-	-
30		263	200	74	42	-
50		195	163	84	100	-
70		215	158	142	116	-
90		215	158	142	74	42

Note: * Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.11 : FREQUENCY OF DEFICIENCY VOLUME

Site : T.Ramapuram — Average daily flow : 28.7 cumec

Period of analysis : June 1966-May 1986 — Average annual runoff: 10483.04 cumec/day

Threshold % average daily flow	Class limits % annual runoff					
	Lower	0.0	0.0010	0.010	0.05	0.2
	Upper	0.0010	0.010	0.05	0.2	0.5
10		535	215	25	-	-
30		340	370	170	35	-
50		335	305	240	120	-
70		370	275	245	135	45
90		250	355	225	160	80

Note: * Frequency is expressed as the number of events in class interval per 100 years.

TABLE 5.12 : FREQUENCY OF SPELL DURATION

Site : Dhond

Average daily flow : 161.0 cumec

Period of analysis : June 1968-May 1986

Average annual runoff: 58805.25 cumec/day

Threshold % average daily flow	Class limit days	Spell duration					
	Lower	1	4	11	41	221	241
	Upper	3	10	40	220	240	260
10%		244	177	111	100	5	-
30%		200	133	133	61	38	5
50%		316	127	155	55	50	5
70%		322	183	150	50	50	16
90%		311	188	150	55	50	22

NOTE: Frequency is expressed as the number event in class interval per 100 years.

TABLE 5.13 : FREQUENCY OF SPELL DURATION

Site : Narsingpur | Average daily flow : 200.4 cumec

Period of analysis : June 1967--May 1986 | Average annual runoff: 73196.1 cumec/day

Threshold % average daily flow	Class limit days	Spell duration					
	Lower	1	4	11	51	200	225
	Upper	3	10	50	200	225	255
10%		331	221	189	94	5	-
30%		242	215	152	68	36	10
50%		242	152	173	36	36	36
70%		268	168	178	26	42	42
90%		257	210	184	26	31	52

NOTE: Frequency is expressed as the number event in class interval per 100 years.

TABLE 5.14 : FREQUENCY OF SPELL DURATION

Site : Yadgir

Average daily flow : 348.2 cumec

Period of analysis : June 1965-May 1986

Average annual runoff: 127180.05 cumec/day

Threshold % average daily flow	Class limit days	Spell duration						
	Lower	1	4	11	26	151	201	225
	Upper	3	10	25	150	200	225	255
10%		190.48	109.52	80.95	80.35	33.33	4.76	0
30%		190.48	157.14	104.76	57.14	52.38	23.81	4.76
50%		171.43	147.62	142.86	47.62	42.86	28.57	19.05
70%		214.29	185.71	123.81	76.19	42.86	28.57	19.05
90%		209.52	180.95	123.81	76.19	38.09	42.86	19.05

NOTE: **Frequency is expressed as the number event in class interval per 100 years.**

TABLE 5.15 : FREQUENCY OF SPELL DURATION

Site : Wadakbal

Average daily flow : 34.6 cumec

Period of analysis : June 1965 - May 1986

Average annual runoff: 12637.65 cumec/day

Threshold % average daily flow	Class limit days	Spell duration							
	Lower	1	4	11	21	30	150	201	225
	Upper	3	10	20	35	150	200	225	255
10%		261.90	180.95	100.00	80.95	109.52	23.81	4.76	-
30%		238.09	200.00	142.86	90.48	85.71	52.38	14.20	9.52
50%		280.95	176.19	138.08	109.52	76.19	47.62	33.33	9.52
70%		304.76	171.43	147.62	90.48	95.24	42.86	38.09	9.52
90%		300.0	152.38	142.86	109.52	90.48	33.33	42.86	14.29

NOTE: Frequency is expressed as the number event in class interval per 100 years.

TABLE 5.16 : FREQUENCY OF SPELL DURATION

Site : Haralahalli

Period of analysis : June 1967-May 1986

Average daily flow : 233.9 cumec

Average annual runoff: 85431.975 cumec/day

Threshold % average daily flow	Class limit days	Spell duration				
	Lower	1	5	16	51	225
	Upper	4	15	50	225	255
10%		315	157	68	26	-
30%		184	189	100	105	-
50%		173	157	105	105	-
70%		168	136	136	100	-
90%		215	178	136	89	10

NOTE: Frequency is expressed as the number event in class interval per 100 years.

TABLE 5.17 : FREQUENCY OF SPELL DURATION

Site : T. Ramapuram

Average daily flow : 28.7 cumec

Period of analysis: June 1966 - May 1986

Average annual runoff: 10483.04 cumec/day

Threshold % average daily flow	Class limit days	Spell duration							
	Lower	1	3	7	16	41	101	161	201
	Upper	2	6	15	40	100	160	200	250
10%		285	180	160	90	60	0	0	0
30%		275	180	175	155	110	20	0	0
50%		275	195	190	175	95	70	0	0
70%		310	200	200	170	115	55	20	0
90%		190	290	195	185	125	45	35	5

NOTE: Frequency is expressed as the number event in class interval per 100 years.

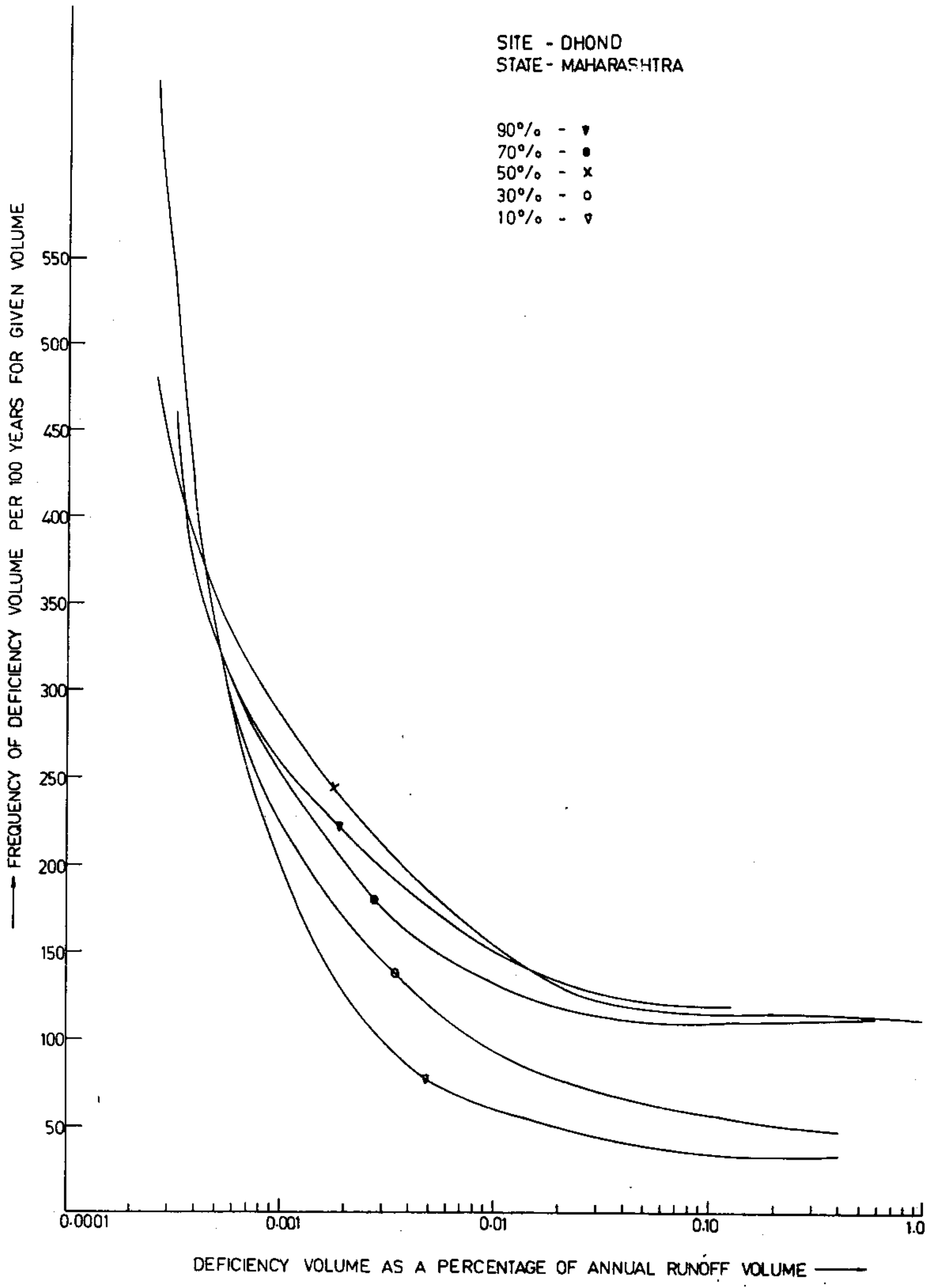


FIG.5.19 - FREQUENCY OF DEFICIENCY VOLUME AT DIFFERENT THRESHOLD LIMITS

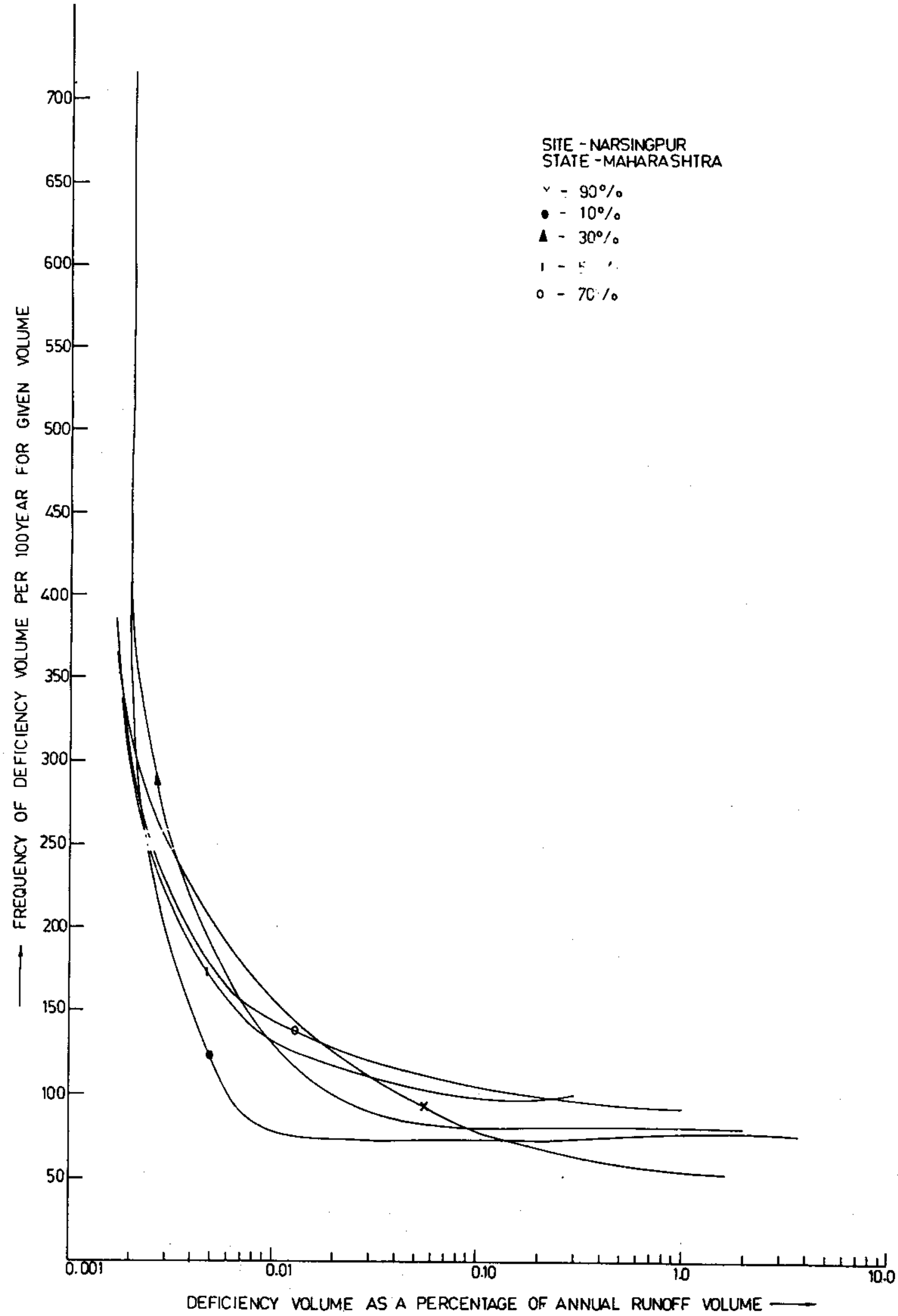


FIG.5.20 - FREQUENCY OF DEFICIENCY VOLUME FOR NARSINGPUR AT DIFFERENT THRESHOLD LIMITS

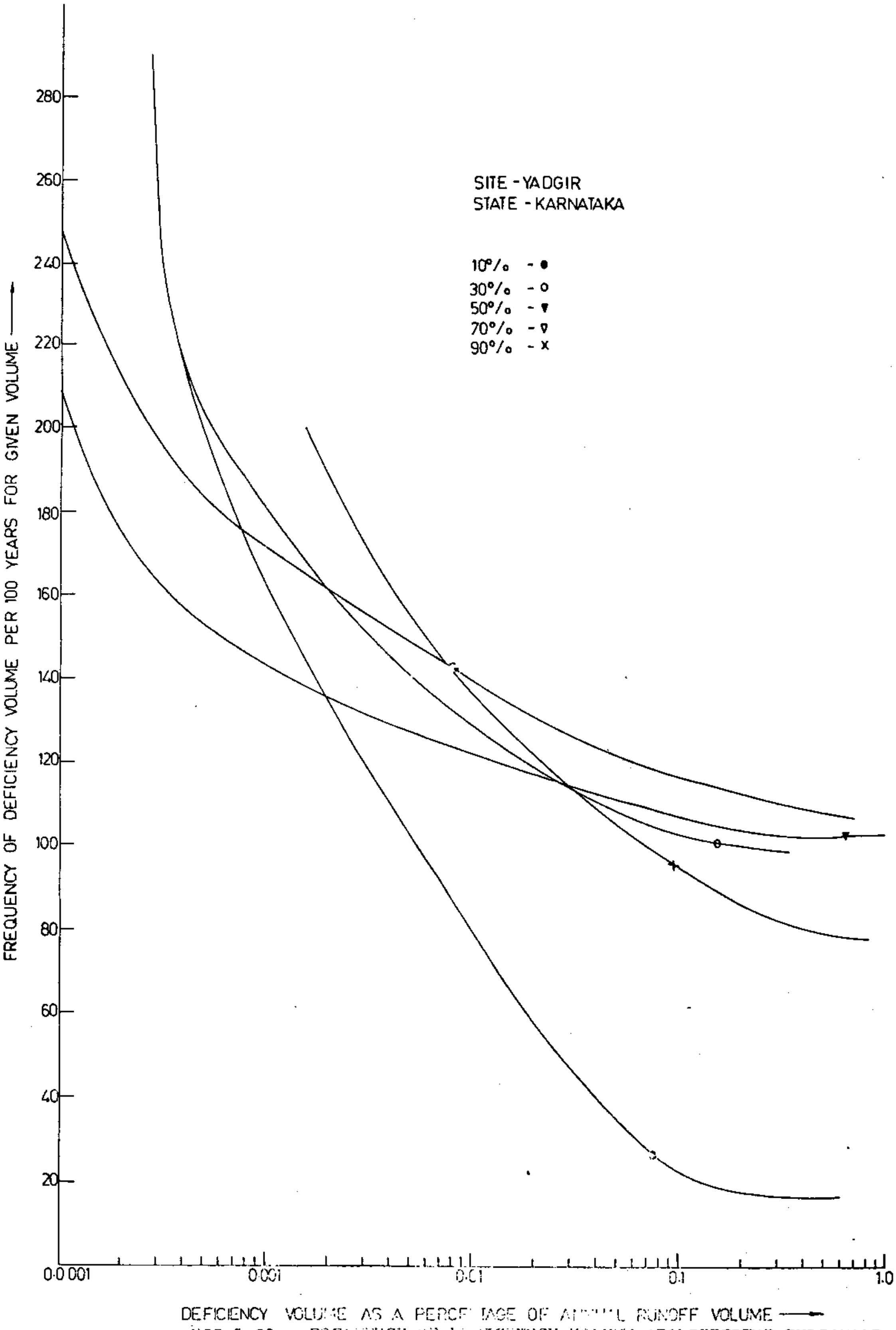


FIG.5.21 - FREQUENCY OF DEFICIENCY VOLUME AT DIFFERENT THRESHOLD LEVELS

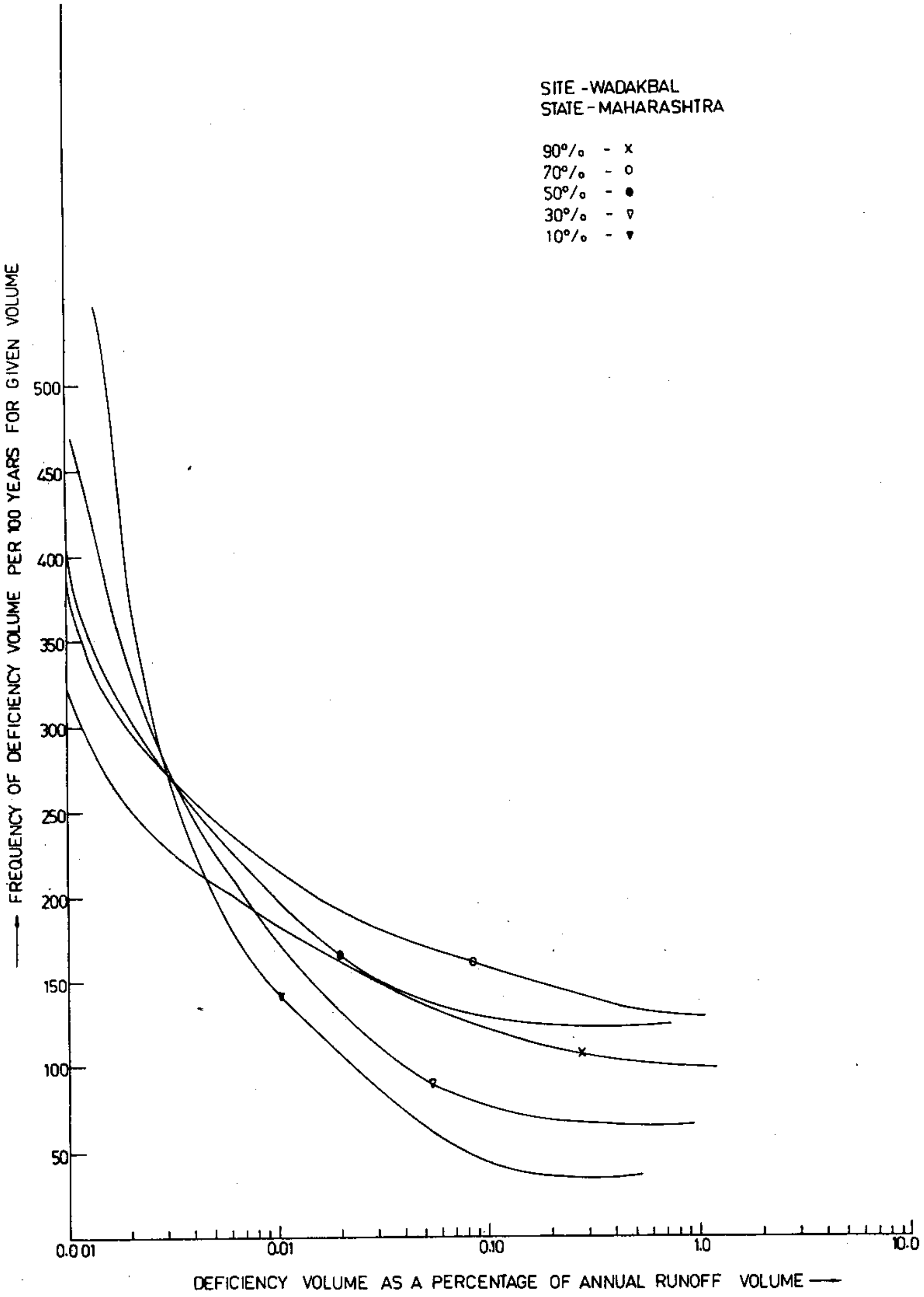


FIG.5.22 - FREQUENCY OF DEFICIENCY VOLUME AT DIFFERENT THRESHOLD LIMITS

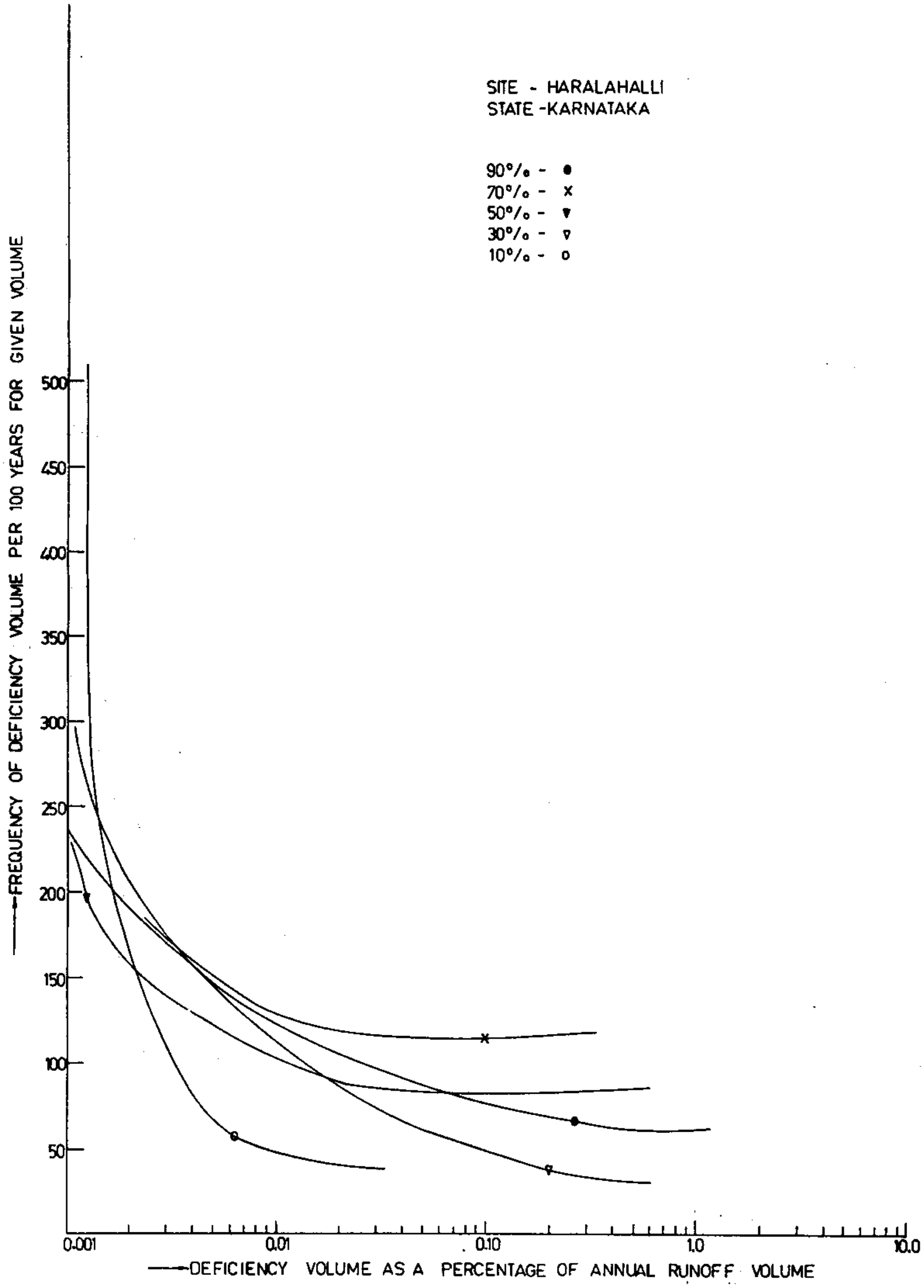


FIG.5.23 - FREQUENCY OF DEFICIENCY VOLUME AT DIFFERENT THRESHOLD LIMITS

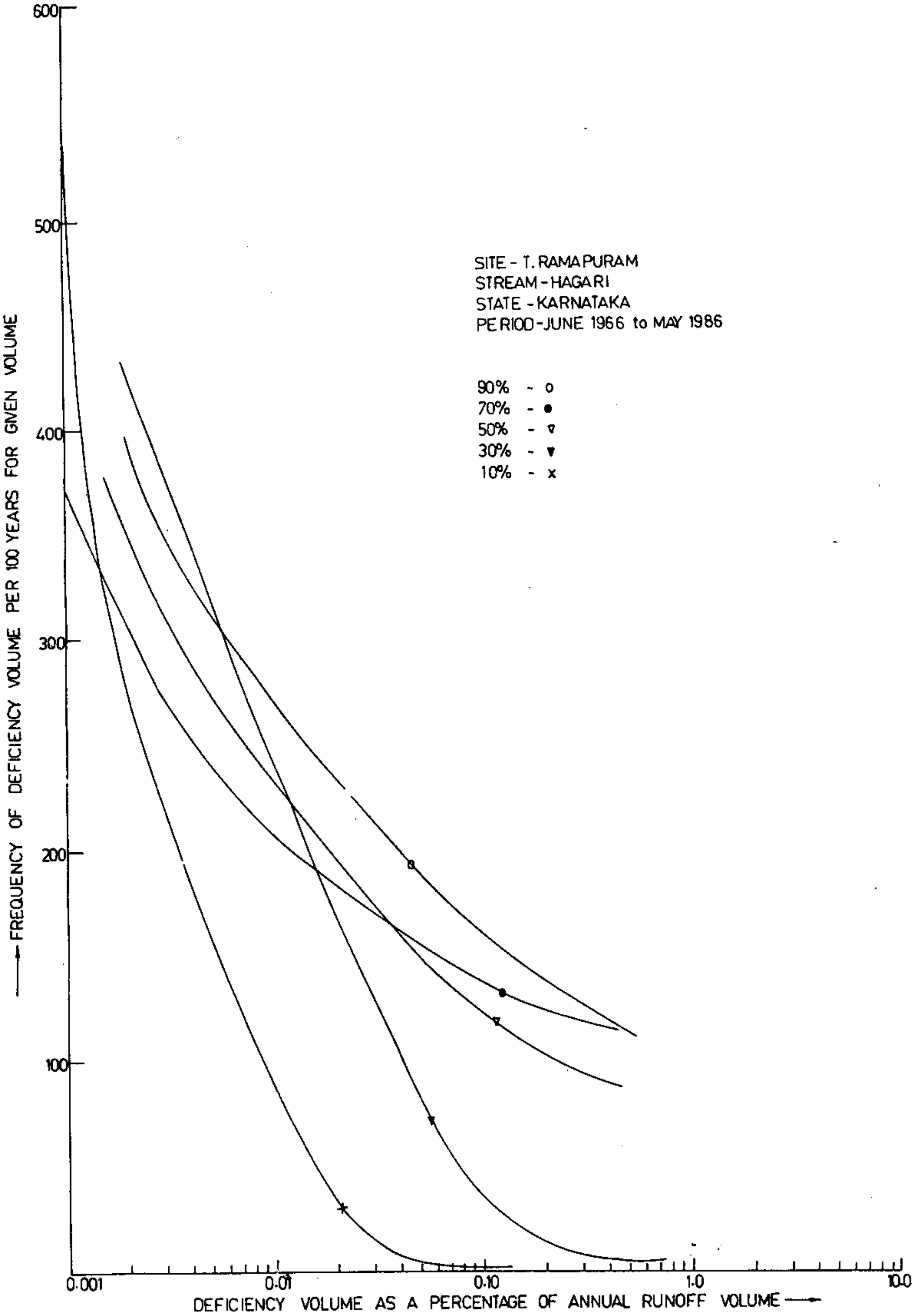


FIG.5.24 - FREQUENCY OF DEFICIENCY VOLUME AT DIFFERENT THRESHOLD LIMITS

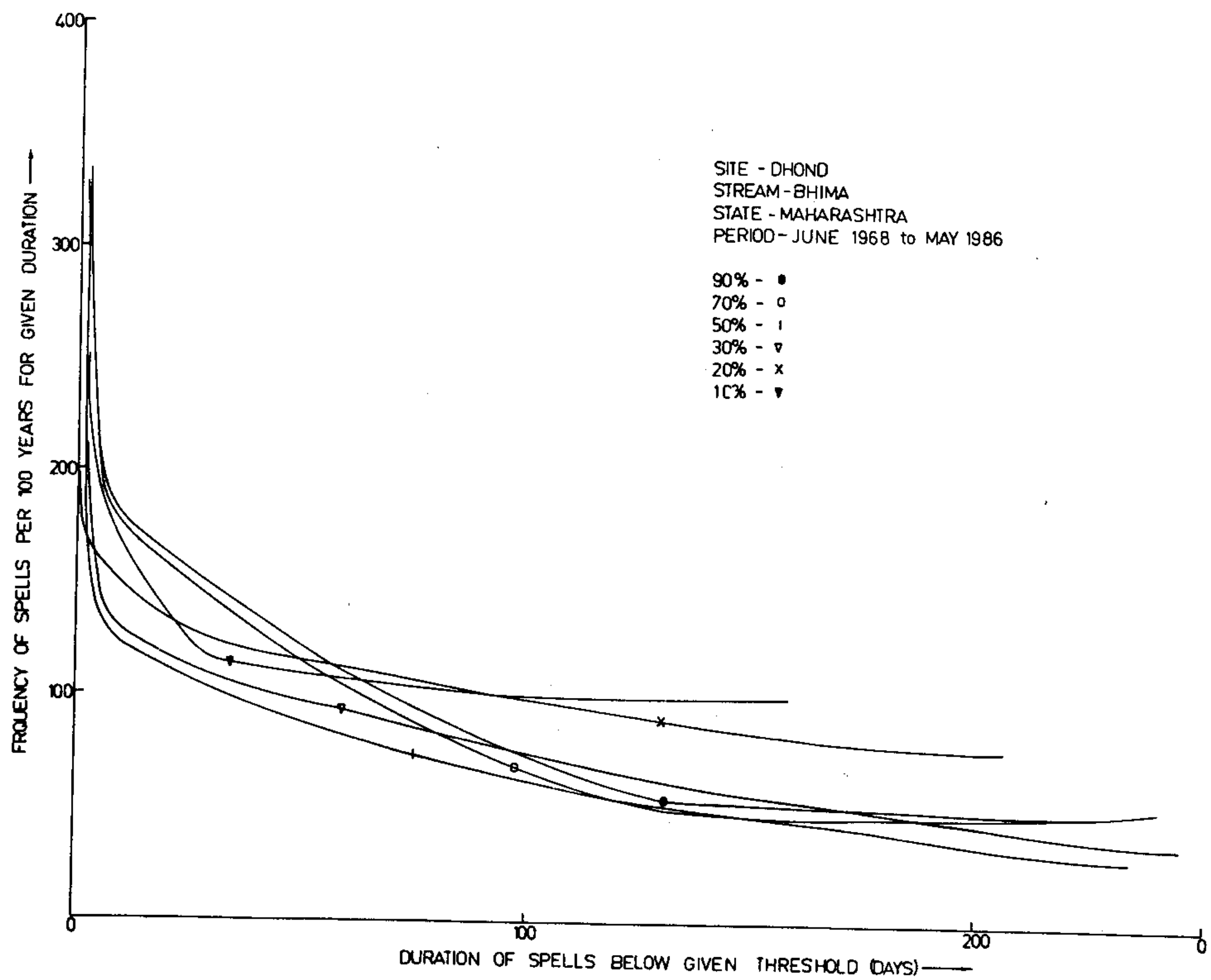


FIG.5.25 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

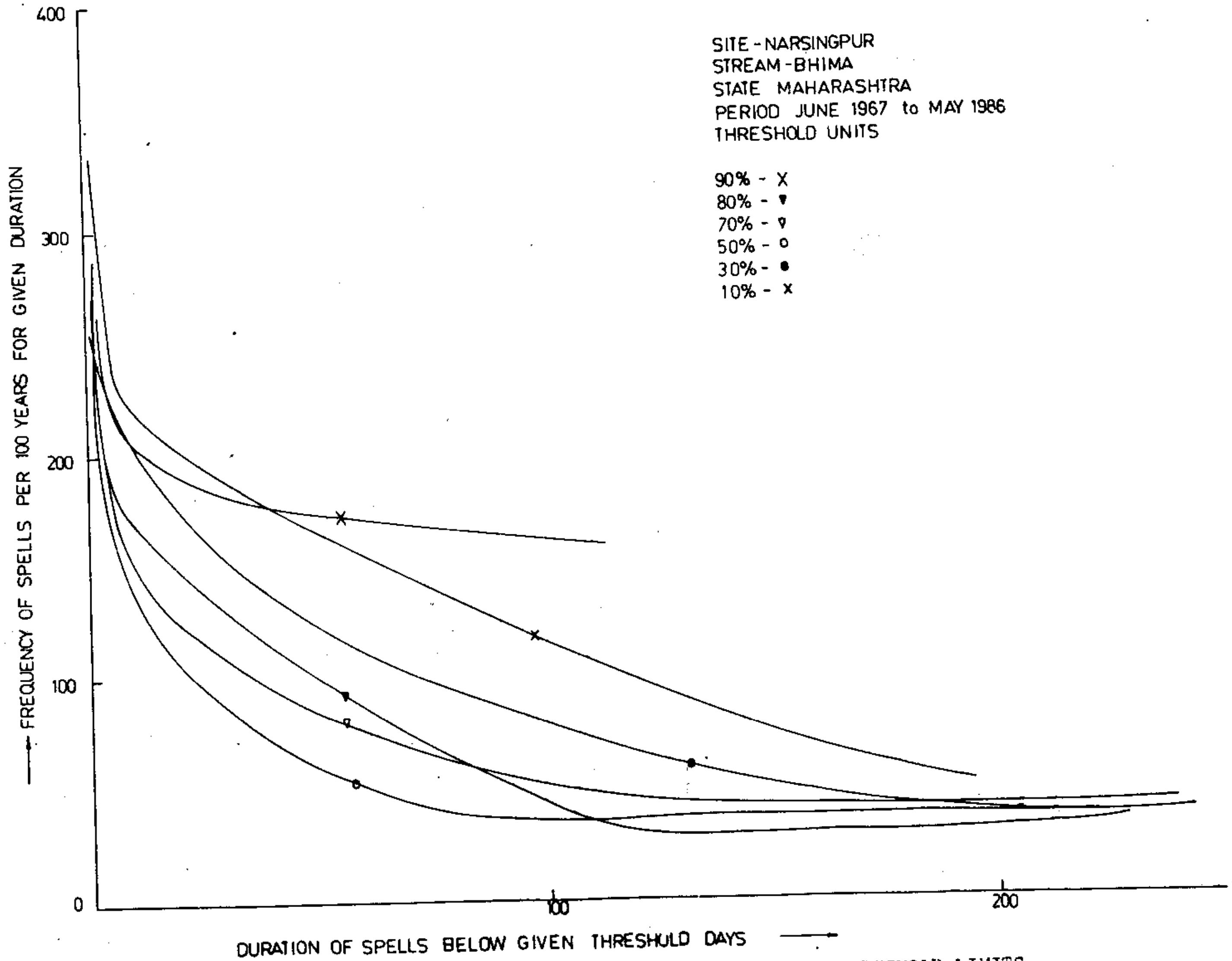


FIG.5.26 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

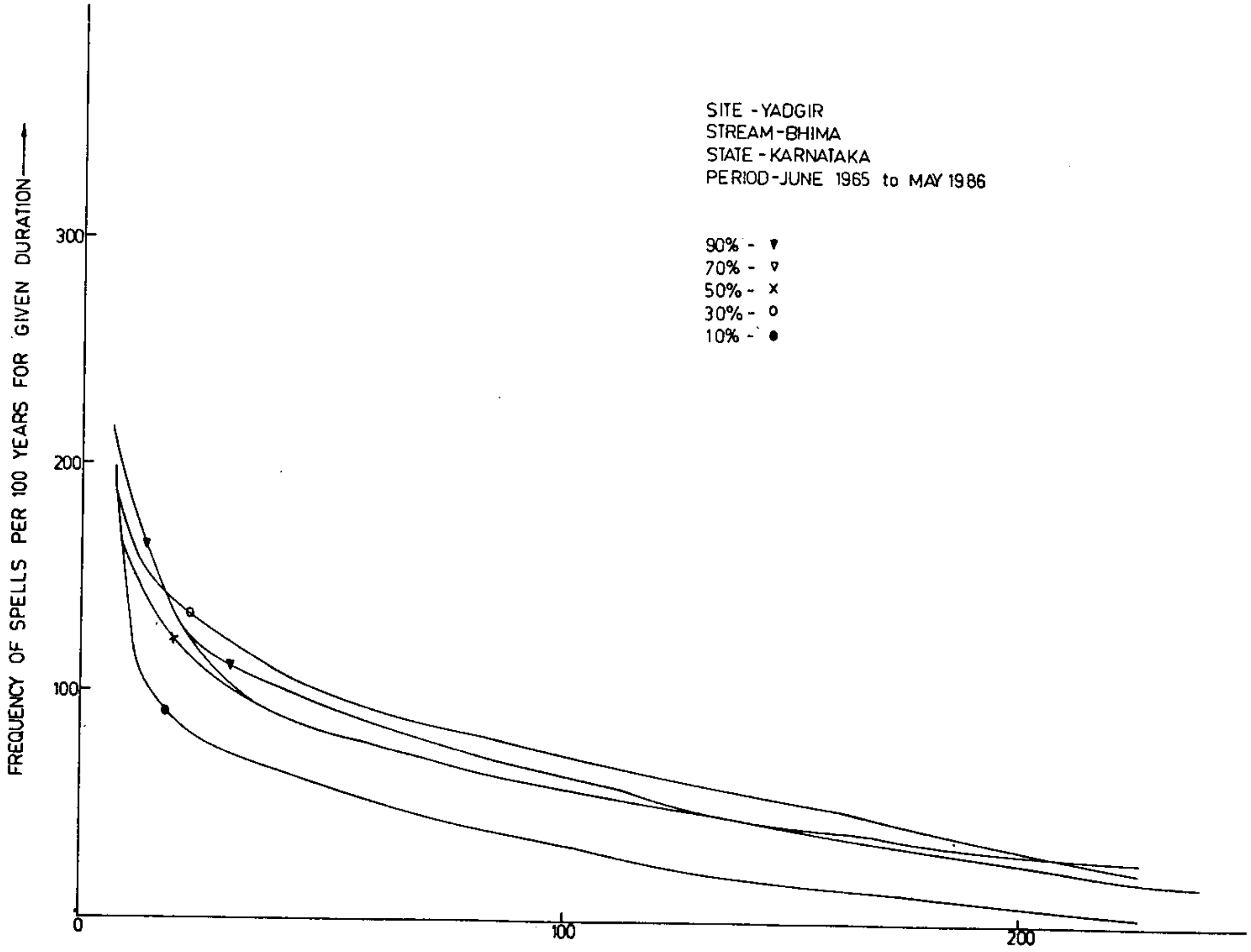


FIG.5.27 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

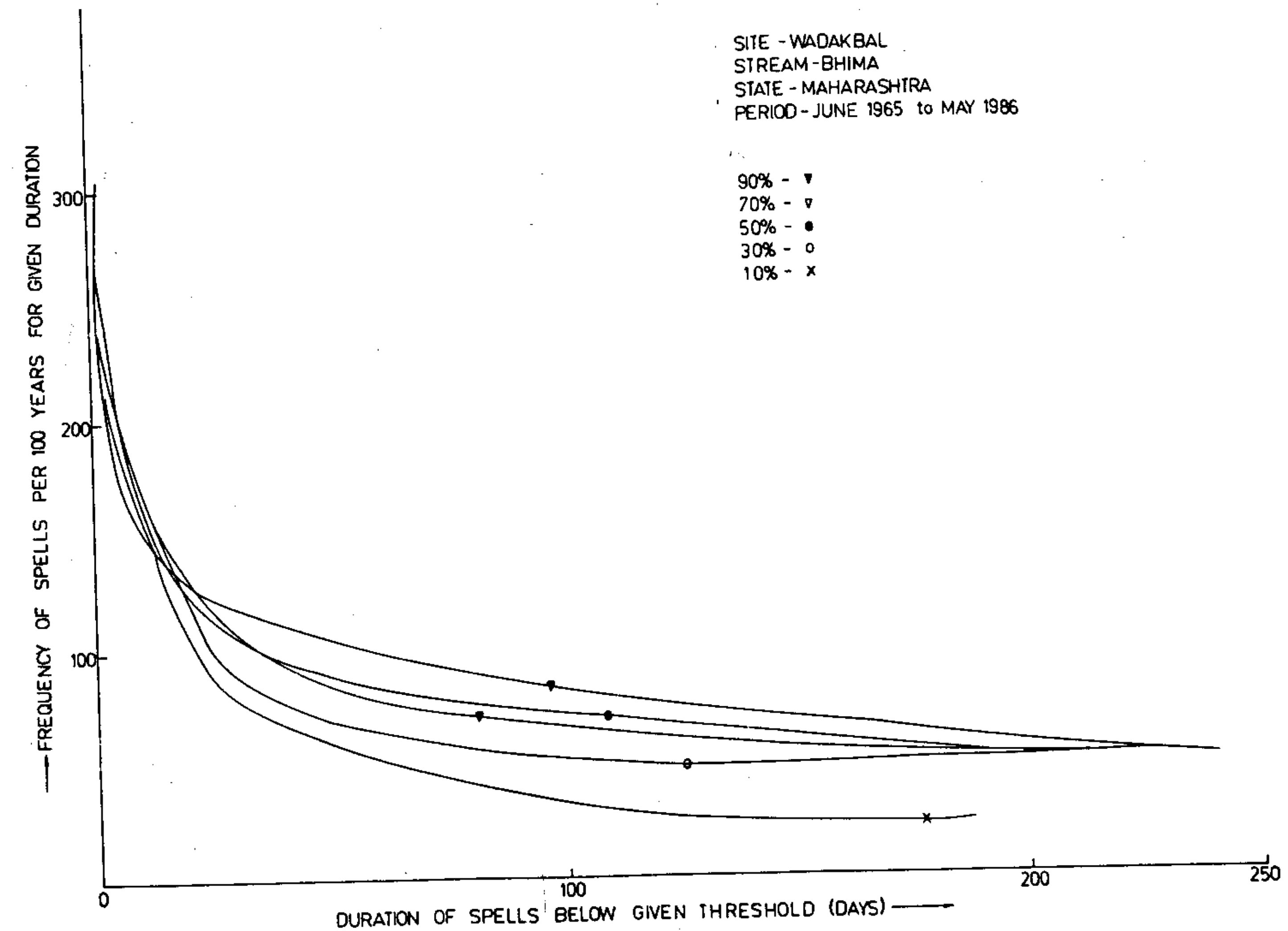


FIG.5.28 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

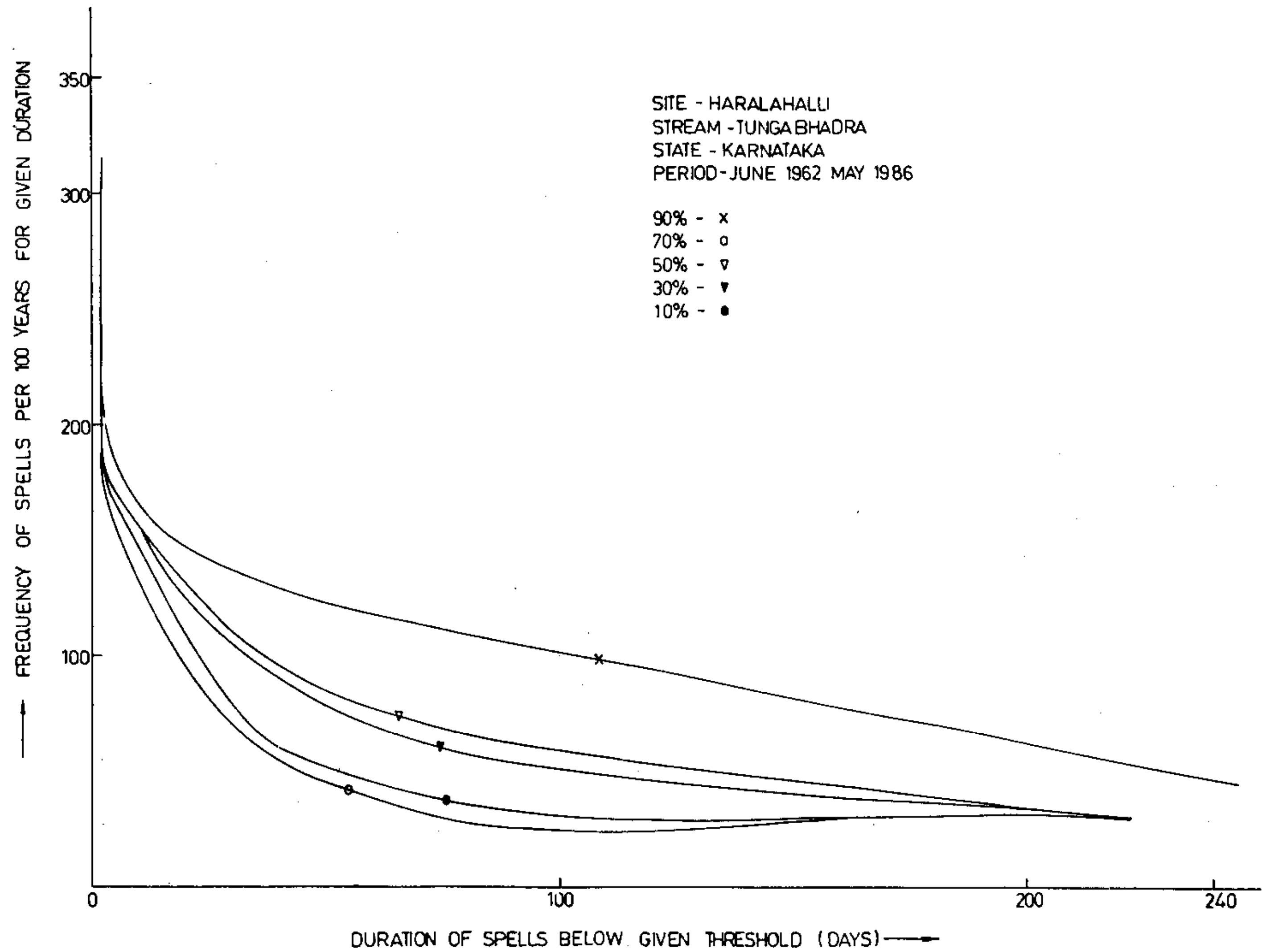


FIG.5.29 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

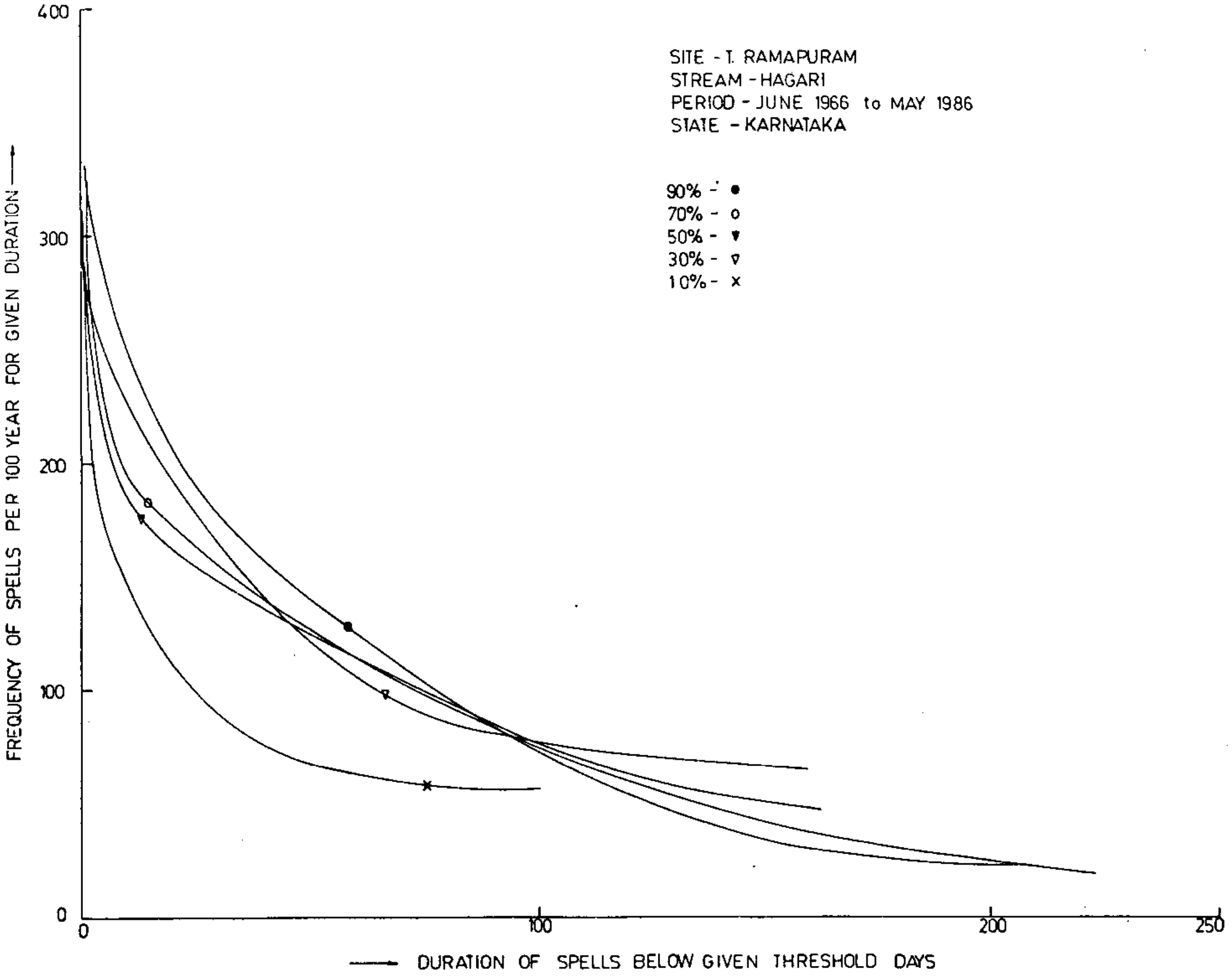


FIG.5.30 - FREQUENCY OF SPELL DURATION AT DIFFERENT THRESHOLD LIMITS

5.2.4.2 Analysis of annual maximum durations of low flow spells and annual maximum deficiency volume of low flow spells.

The analysis procedure has the following steps:

i) Consider a threshold discharge (q_o)

ii) Find out the annual maximum durations of low flow spells i.e. the longest duration, for which the flow is below a threshold discharge (90) within that year.

iii) Repeat step (i) and (ii) for different threshold discharge (q_o) to get different series of annual maximum duration.

iv) Similarly find out the annual maximum deficit volumes relative to some specific threshold discharge (q_o). At the end of each positive element the net deficit is calculated and when this becomes negative the drought is deemed to be over. When demand level (threshold discharge) is high there may be two or three separate drought events in any year, each having one or more elements but when threshold discharge q_o is low there is usually only one drought or perhaps none.

v) Repeat step (iv) for different threshold discharge (q_o). Thus different series of annual maximum, drought volume (deficit volume) are resulted taking different percentages of threshold discharge.

The calculated values of maximum duration of low flow spells and annual maximum deficiency volume of low flow spells corresponding to demand level as 10%, 30%, 50%, 70% and 90% of average daily flow for sites namely Dhond, Narsingpur, Yadgir, Wadakbal, Haralahalli and T Ramapuram are given in table 5.18 through 5.29. The maximum deficiency volumes corresponding to different years have been plotted for sites Dhond, Narsingpur, Yadgir, Wadakbal, Haralahalli and T Ramapuram and shown in figures 5.31 through 5.36, From the above analysis it was observed that the number of low flow spells and maximum deficient volume in different low flow spells were highest for 1985-86 as compared with previous years with the exception of the values corresponding to 10% ADF at some sites. Therefore, it indicates that the drought during 1985-86 was more intense that previous years as for as its effects on flows are concerned. There was drought during the year 1984-85 and 1985-86. However, it has been observed that spells of the maximum deficiency volumes and maximum deficit duration generally fall during the nonmonsoon period. Therefore, the analysis carried out on the annual basis may not be able to reflect the effect of failure of monsoon and hence similar analysis for only monsoon period is presented in following section.

In order to see the effect of monsoon, analysis has been performed using daily flow data of monsoon period (Ist June-31st October) for different gauging sites namely Karad, Dhond, Narsingpur, Takali, Wadakbal, Haralahalli, Bawapuram and T Ramapuram. The average daily flow were computed using five months (June-Oct.) daily flow data for the period of 20 years. Then the threshold discharge limit of 10%, 30%, 50%, 70% and 90% of average daily flow were computed.

TABLE 5.18 : ANNUAL MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Dhond Average daily flow : 161.0 cumec

Analysis period : June 1968-86

Threshold limit % average daily flow	Duration in days				
	10	30	50	70	90
1966-67					
67-68					
68-69	217	225	229	230	230
69-70	175	236	236	236	236
70-71	209	226	226	226	226
71-72	201	214	214	219	219
72-73	225	249	252	252	252
73-74	188	210	213	213	213
74-75	79	192	202	205	205
75-76	173	179	194	210	210
76-77	93	234	235	237	244
77-78	142	176	180	180	183
78-79	140	183	220	243	243
79-80	160	221	224	226	226
80-81	157	233	234	235	239
81-82	191	210	213	213	238
82-83	193	198	240	242	242
83-84	74	206	224	224	230
84-85	191	216	216	228	228
85-86	200	227	229	231	232

TABLE 5.19 : ANNUAL MAXIMUM DURATION OF LOW SPELLS

Site : Narsingpur   Average daily flow : 200.4 cumec

Analysis period : June 1967 - May 1986

Threshold limit % average daily flow	Duration in days				
	10	30	50	70	90
1967-68	129	164	164	168	168
68-69	191	222	223	227	228
69-70	144	200	234	250	257
70-71	173	218	220	220	225
71-72	189	211	216	217	218
72-73	203	207	208	208	256
73-74	164	193	207	210	212
74-75	69	187	198	203	206
75-76	143	176	202	206	208
76-77	129	189	234	237	247
77-78	18	92	169	174	177
78-79	168	181	199	203	203
79-80	116	131	176	180	182
80-81	151	228	232	237	237
81-82	81	102	233	242	242
82-83	136	203	243	243	243
83-84	74	205	227	227	227
84-85	103	214	214	215	230
85-86	70	236	237	237	237

TABLE 5.20 : ANNUAL MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Yadgir Average daily flow : 348.2 cumec

Analysis period : June 1965 - May 1986

Threshold limit % average daily flow	Duration in days				
	10	30	50	70	90
1965-66	92	111	117	123	222
66-67	155	182	187	189	191
67-68	81	154	158	160	162
68-69	164	192	201	218	220
69-70	135	181	211	213	214
70-71	162	205	215	219	222
71-72	152	200	208	211	212
72-73	196	201	248	250	251
73-74	113	176	190	196	202
74-75	95	125	186	196	298
75-76	92	162	174	187	193
76-77	130	223	231	236	246
77-78	30	113	114	114	171
78-79	117	157	172	176	197
79-80	97	131	167	173	178
80-81	157	223	231	236	236
81-82	108	179	191	194	224
82-83	182	195	198	199	199
83-84	140	194	205	213	216
84-85	140	204	207	214	214
85-86	219	226	230	231	232

TABLE 5.21 : ANNUAL MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Wadakbal Average daily flow : 34.6 cumec

Analysis period : June 1965 - May 1986

Threshold limit % average daily flow	Duration in days				
	10	30	50	70	90
1965-66	92	213	218	219	221
66-67	129	170	178	188	191
67-68	38	86	86	87	87
68-69	166	197	200	200	201
69-70	95	160	195	198	199
70-71	129	181	201	207	213
71-72	145	193	204	209	212
72-73	206	208	208	208	253
73-74	129	178	192	194	203
74-75	98	174	190	197	200
75-76	46	92	180	190	194
76-77	197	135	234	248	248
77-78	70	147	158	163	167
78-79	150	185	192	196	199
79-80	51	132	157	165	172
80-81	118	130	131	131	131
81-82	158	206	209	210	210
82-83	195	200	202	202	203
83-84	103	180	195	201	207
84-85	189	197	202	203	204
85-86	135	232	234	234	235

TABLE 5.22 : ANNUAL MAXIMUM DURATION OF LOW SPELLS

Site : Haralahalli   Average daily flow : 233.9 cumec

Analysis period : June 1967 - May 1986

Threshold limit % average daily flow	Duration in days 10	30	50	70	90
1967-68	6	137	222	228	230
68-69	2	118	148	154	203
69-70	0	122	141	149	175
70-71	1	70	152	196	211
71-72	0	65	175	201	203
72-73	42	147	182	185	210
73-74	9	159	190	208	215
74-75	5	142	184	211	213
75-76	1	120	174	194	201
76-77	77	165	169	185	187
77-78	14	150	163	165	181
78-79	14	148	183	194	196
79-80	20	109	145	182	187
80-81	25	64	162	154	164
81-82	62	149	198	202	207
82-83	59	173	198	201	202
83-84	37	81	118	203	205
84-85	22	86	150	215	225
85-86	66	175	199	227	229

TABLE 5.23 : ANNUAL MAXIMUM DURATION OF LOW FLOW SPELLS

Site : T. Ramapuram Average daily flow : 28.4 cumec

Analysis period : June 1966 - May 1986

Threshold limit % average daily flow	Duration in days				
	10	30	50	70	90
1966-67	64	43	67	76	81
67-68	33	118	148	157	170
68-69	36	70	81	81	88
69-70	22	69	69	99	103
70-71	35	96	145	146	147
71-72	65	111	119	132	136
72-73	65	97	125	126	126
73-74	52	72	102	145	170
74-75	46	85	104	120	124
75-76	14	43	72	84	90
76-77	44	98	158	191	205
77-78	44	73	111	158	172
78-79	41	94	95	97	143
79-80	22	72	106	165	174
80-81	34	76	105	107	110
81-82	18	70	97	163	165
82-83	43	97	101	130	132
83-84	34	57	143	172	183
84-85	93	126	132	169	174
85-86	98	130	132	132	133

TABLE 5.24 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : Dhond Average daily flow : 161.0 cumec

Period of analysis : June 1968 - May 1986

Period	Threshold % average daily flow	Volume in cumec-days				
		10%	30%	50%	70%	90%
1968-69		2943.002	10143.123	17519.351	24895.084	32299.246
1969-70		2296.182	10172.995	17770.258	25367.595	32964.816
1970-71		2681.642	9871.813	17147.170	24422.543	31697.883
1971-72		2411.076	9232.166	16121.211	23263.930	30313.941
1972-73		2621.977	10613.736	18674.434	26786.781	34899.121
1973-74		1906.729	8417.016	15237.028	22093.893	28950.760
1974-75		369.976	6526.637	12872.358	19420.623	26019.941
1975-76		1427.291	7160.198	13117.916	19887.078	26647.371
1976-77		711.819	7938.019	15482.978	23087.914	31215.316
1977-78		1525.618	6753.135	12515.305	18309.840	24201.160
1978-79		1319.226	7112.251	15156.387	23764.129	31586.752
1979-80		1438.644	7613.083	14789.011	22051.723	29337.072
1980-81		1517.956	9213.328	16742.205	24278.764	31912.090
1981-82		1999.217	8606.716	15413.334	22270.195	31319.730
1982-83		2478.411	8799.462	17111.590	24868.793	32659.191
1983-84		582.696	7273.065	14527.406	21738.381	29285.240
1984-85		1921.817	8849.640	15803.067	23490.754	30830.510
1985-86		2589.081	10014.513	17361.910	24764.992	32215.559

TABLE 5.25 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : Narsingpur Average daily flow : 200.4 cumec

Period of analysis : June 1967 - May 1986

Period	Threshold % average daily flow 10%	Volume in cumec days 30%	50%	70%	90%
1967-68	1729.690	8080.921	14652.694	21402.859	28134.932
1968-69	2536.955	11118.501	20049.609	29161.225	38288.117
1969-70	1969.068	9895.935	19880.790	30208.303	40234.586
1970-71	2234.609	10867.472	19651.068	28466.865	37502.168
1971-72	2359.483	10642.616	19268.764	27955.707	36665.230
1972-73	3331.386	11560.089	19857.412	28192.342	43518.934
1973-74	1782.186	9105.983	17424.744	25795.654	34255.977
1974-75	463.076	7125.837	14834.837	22887.291	31075.934
1975-76	1696.232	8267.256	15900.554	24110.756	32436.757
1976-77	1834.630	8623.353	19230.293	28714.621	38718.168
1977-78	157.298	2843.605	11062.234	17942.410	24982.869
1978-79	2107.929	9092.294	16954.322	25039.699	33174.258
1979-80	1489.063	6484.606	13229.690	20370.416	27642.598
1980-81	1845.919	11359.949	20577.629	29902.826	39399.824
1981-82	1173.307	4752.583	18552.523	28141.307	37838.680
1982-83	1761.780	10633.856	21341.400	31078.852	40316.293
1983-84	627.694	9277.277	19211.049	28307.320	37403.621
1984-85	996.496	9785.944	18361.309	26955.410	37381.699
1985-86	1009.212	11780.609	21254.137	30751.125	40248.156

TABLE 5.26 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : Yadgir Average daily flow : 348.2 cumec

Period of analysis : June 1965 - May 1986

Period	Threshold % average daily flow	Volume in cumec days			
	10%	30%	50%	70%	90%
1965-66	2782.622	9297.387	16471.484	25239.047	63426.699
1966-67	3806.371	15872.003	28794.744	41900.617	55077.258
1967-68	2153.004	12441.851	23313.055	34396.992	45612.172
1968-69	3947.550	16594.707	30233.816	46006.629	61283.207
1969-70	3233.675	14953.349	29288.613	44079.832	58954.852
1970-71	3427.910	16750.973	31433.807	46575.184	61948.477
1971-72	3634.321	16739.584	30986.246	45609.086	60359.188
1972-73	6381.383	20251.510	39586.234	56949.238	74359.273
1973-74	2767.729	14263.943	27307.223	40764.176	54659.797
1974-75	1716.782	10228.229	24417.033	37655.570	51382.004
1975-76	1848.423	10741.224	22464.936	35153.727	48441.113
1976-77	3508.477	17190.752	33030.395	49343.742	66376.648
1977-78	494.294	8130.418	16036.283	23975.197	44416.285
1978-79	2599.818	12639.629	24227.541	36405.598	53270.117
1979-80	2341.621	10380.284	21376.242	33256.188	45469.934
1980-81	3895.711	18664.045	34539.598	50847.043	67281.945
1981-82	2373.539	12934.133	25973.928	39363.691	55720.438
1982-83	4824.506	18093.785	31747.531	45569.930	59429.176
1983-84	2825.274	15430.623	29446.914	44192.246	59220.605
1984-85	2540.474	17415.414	31788.525	46419.781	61322.637
1985-86	6224.438	21762.824	37707.895	53768.773	69913.227

TABLE 5.27 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : Wadakbal   Average daily flow : 34.6 cumec

Period of analysis : June 1965 - May 1986

Period	Threshold % average daily flow	Volume in cumec days				
		10%	30%	50%	70%	90%
1965-66		281.884	1820.945	3326.916	4841.409	6374.894
1966-67		346.093	1444.751	2652.349	3940.118	5252.703
1967-68		108.149	793.766	1388.931	1990.516	2592.601
1968-69		434.983	1735.290	3110.436	4490.537	5884.872
1969-70		203.364	1155.263	2560.629	3925.156	5299.558
1970-71		286.473	1424.819	2763.455	4179.312	5634.316
1971-72		371.871	1617.468	2994.939	4424.332	5881.648
1972-73		701.264	2131.989	3571.455	5010.910	7727.230
1973-74		307.473	1438.177	2714.647	4050.828	5467.887
1974-75		268.505	1309.054	2580.643	3922.493	5295.661
1975-76		140.272	700.331	2020.730	3304.638	4633.103
1976-77		615.372	2289.680	3924.403	5696.694	7412.97
1977-78		255.018	1184.735	2248.802	3361.247	4501.762
1978-79		392.439	1604.841	2919.746	4267.064	5631.208
1979-80		139.671	823.762	1845.901	2957.096	4125.174
1980-81		382.610	1941.237	2169.267	3075.851	3982.445
1981-82		466.321	1941.237	3377.167	4824.064	6277.372
1982-83		851.851	2025.552	3417.257	4815.190	6218.977
1983-84		322.506	1508.338	2827.549	4200.571	5604.348
1984-85		597.819	1951.940	3356.688	4758.842	6169.149
1985-86		425.735	2313.239	3927.897	5547.287	7169.827

TABLE 5.28 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : Haralahalli Average daily flow : 233.9 cumec

Period of analysis : June 1967 - May 1986

Period	Threshold % average daily flow 10%	Volumes in cumec-days 30%	50%	70%	90%
1967-68	24.913	4659.061	14800.350	25411.344	36131.688
1968-69	2.071	2593.685	8840. 07	15929.427	30101.908
1969-70	0.0	3910.011	10428.513	7364.832	27633.719
1970-71	4.986	1689.365	8948.817	18436.240	28500.131
1971-72	0.0	1607.282	10422.758	19773.371	29237.195
1972-73	412.693	6553.329	14683.347	23272.982	34364.012
1973-74	49.970	5698.210	14040.372	24293.371	34301.259
1974-75	28.328	5060.645	12896.805	24332.256	34265.707
1975-76	15.486	3738.398	13042.132	21988.385	31382.355
1976-77	874.187	8122.148	15957.292	25006.699	33699.980
1977-78	54.192	5917.197	13265.324	20950.721	30603.363
1978-79	73.198	5614.185	14114.575	23053.779	32171.714
1979-80	57.311	4427.376	11657.921	27591.697	30243.494
1980-81	162.539	3115.725	11855.519	19027.035	26630.170
1981-82	420.504	5928.141	15434.495	24813.877	34378.398
1982-83	572.048	7637.500	16498.500	25856.568	35244.300
1983-84	377.065	3675.88	88485.074	24643.17	34185.250
1984-85	201.182	3075.37	11561.361	26501.854	37898.844
1985-86	998.346	9662.313	18973.621	29934.943	40601.125

TABLE 5.29 : ANNUAL MAXIMUM DEFICIENCY VOLUME OF LOW FLOW SPELLS

Site : T. Ramapuram Average daily flow : 28.7 cumec

Period of analysis : June 1966 - May 1986

Period	Threshold % average daily flow	Volumes in cumec/days			
	10%	30%	50%	70%	90%
1966-67	90.861	465.774	844.382	1228.296	1617.664
1967-68	38.736	671.498	1560.786	2464.359	3612.754
1968-69	52.941	308.083	751.134	1215.268	1707.197
1969-70	21.130	346.660	742.033	1385.561	1963.276
1970-71	42.176	465.627	1515.042	2347.553	3188.425
1971-72	110.026	693.853	1369.980	2110.881	2882.288
1972-73	139.266	681.562	1590.579	2310.290	3032.276
1973-74	61.681	482.245	1114.862	2033.298	2957.983
1974-75	67.381	462.481	1028.911	1739.519	2441.365
1975-76	22.210	182.188	574.208	1026.733	1536.368
1976-77	58.751	503.807	1366.258	2439.625	3655.358
1977-78	52.961	407.840	1026.687	2034.115	2987.855
1978-79	45.066	537.736	1079.186	1629.550	2592.983
1979-80	34.010	325.745	855.462	2102.500	3083.625
1980-81	70.711	517.225	1112.237	1719.102	2342.572
1981-82	17.970	325.355	986.136	1559.581	2905.959
1982-83	91.296	583.222	1149.232	1943.470	2699.248
1983-84	57.511	321.355	1422.091	2349.388	3374.093
1984-85	185.347	833.479	1571.615	2668.022	3658.424
1985-86	292.952	919.238	1670.795	2427.160	3188.612

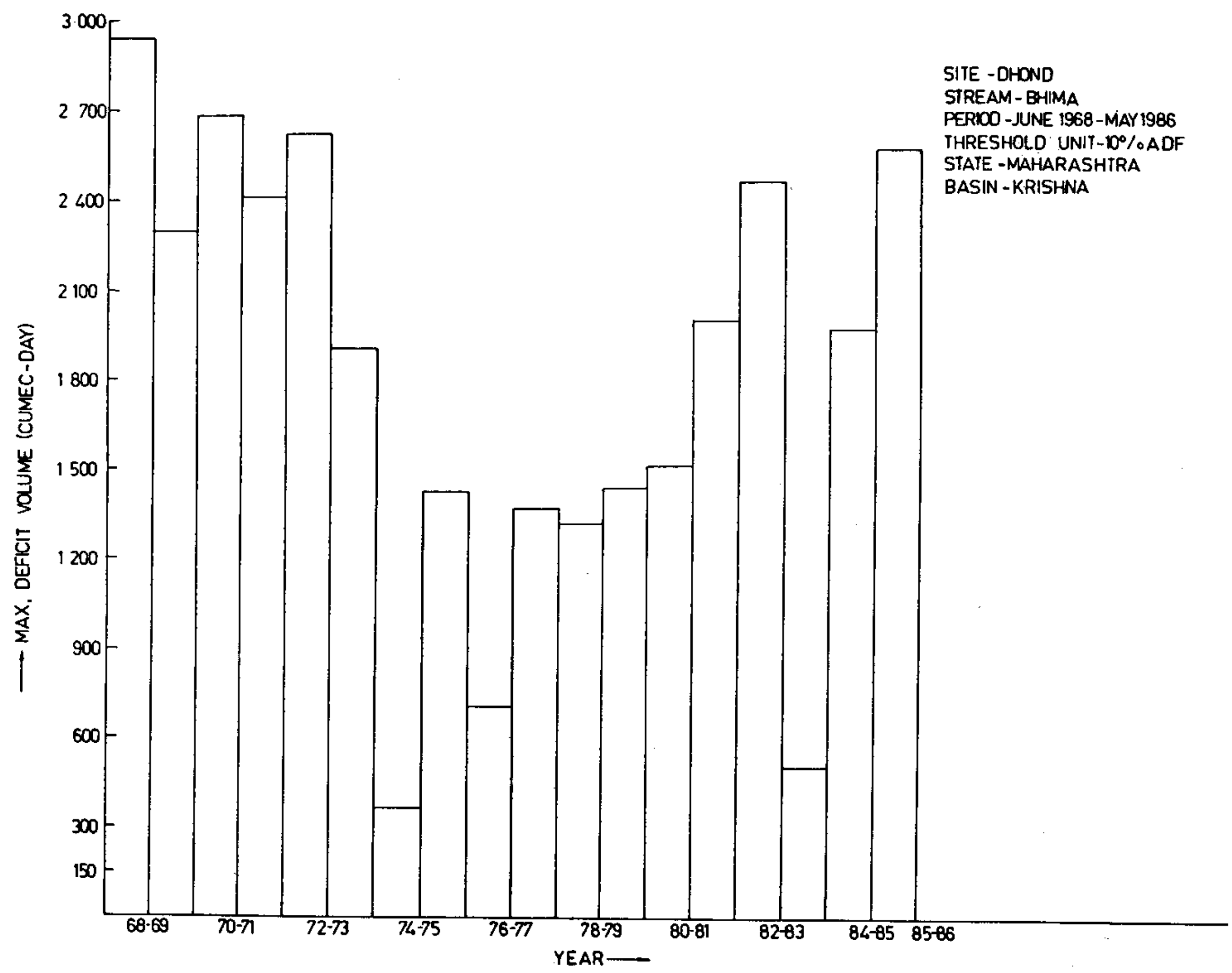


FIG.5.31 - VARIATION OF MAXIMUM DEFICIT VOLUMES

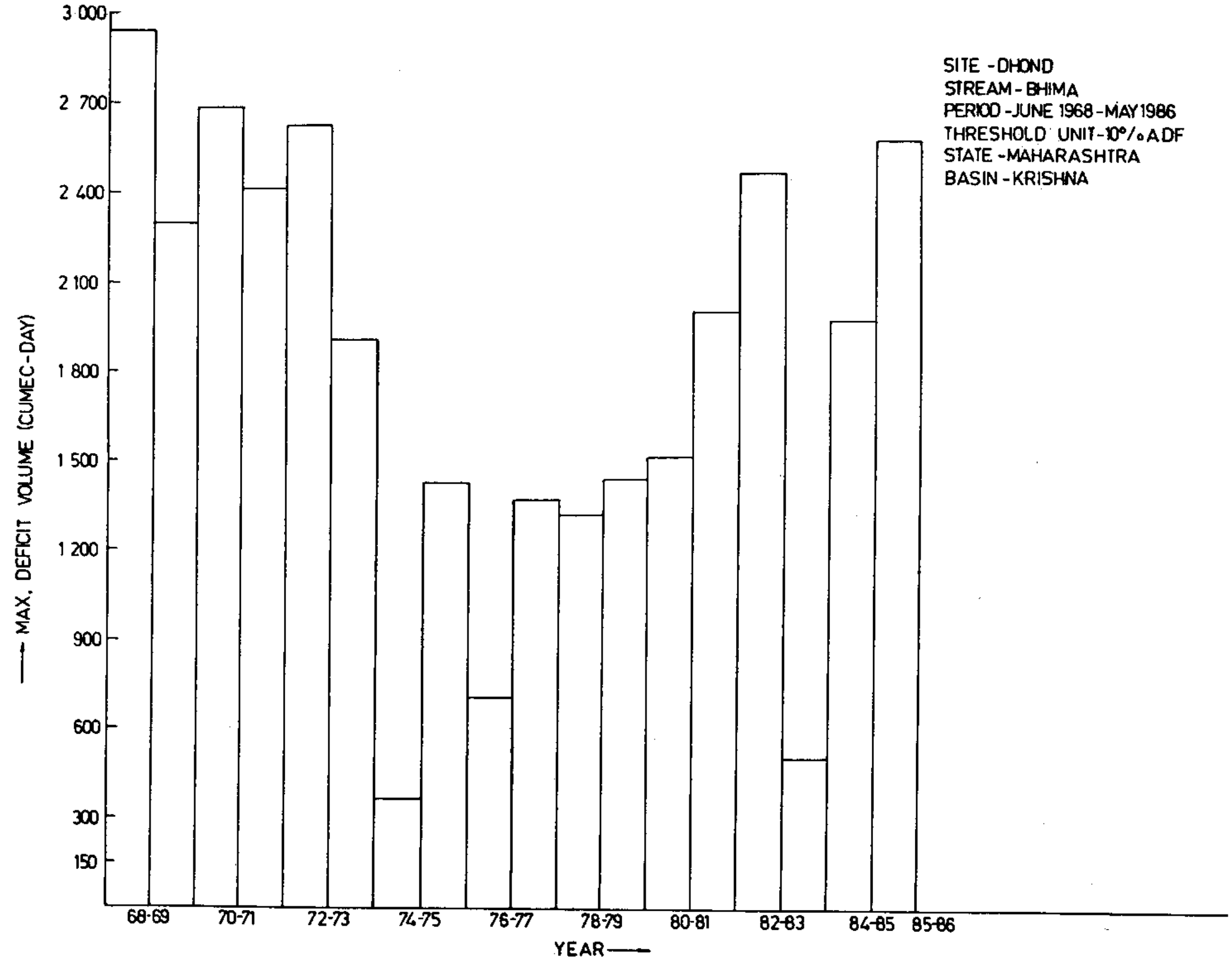
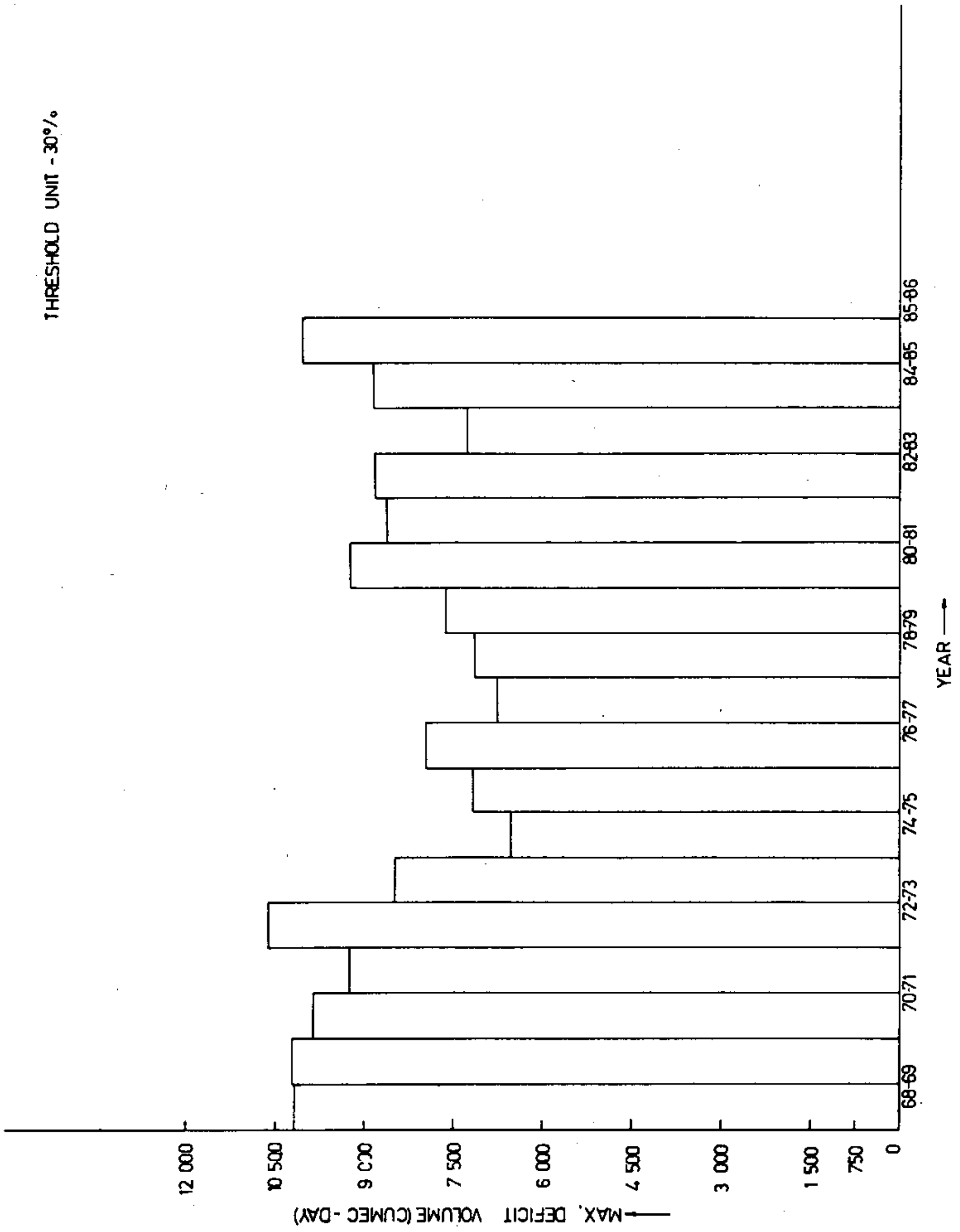
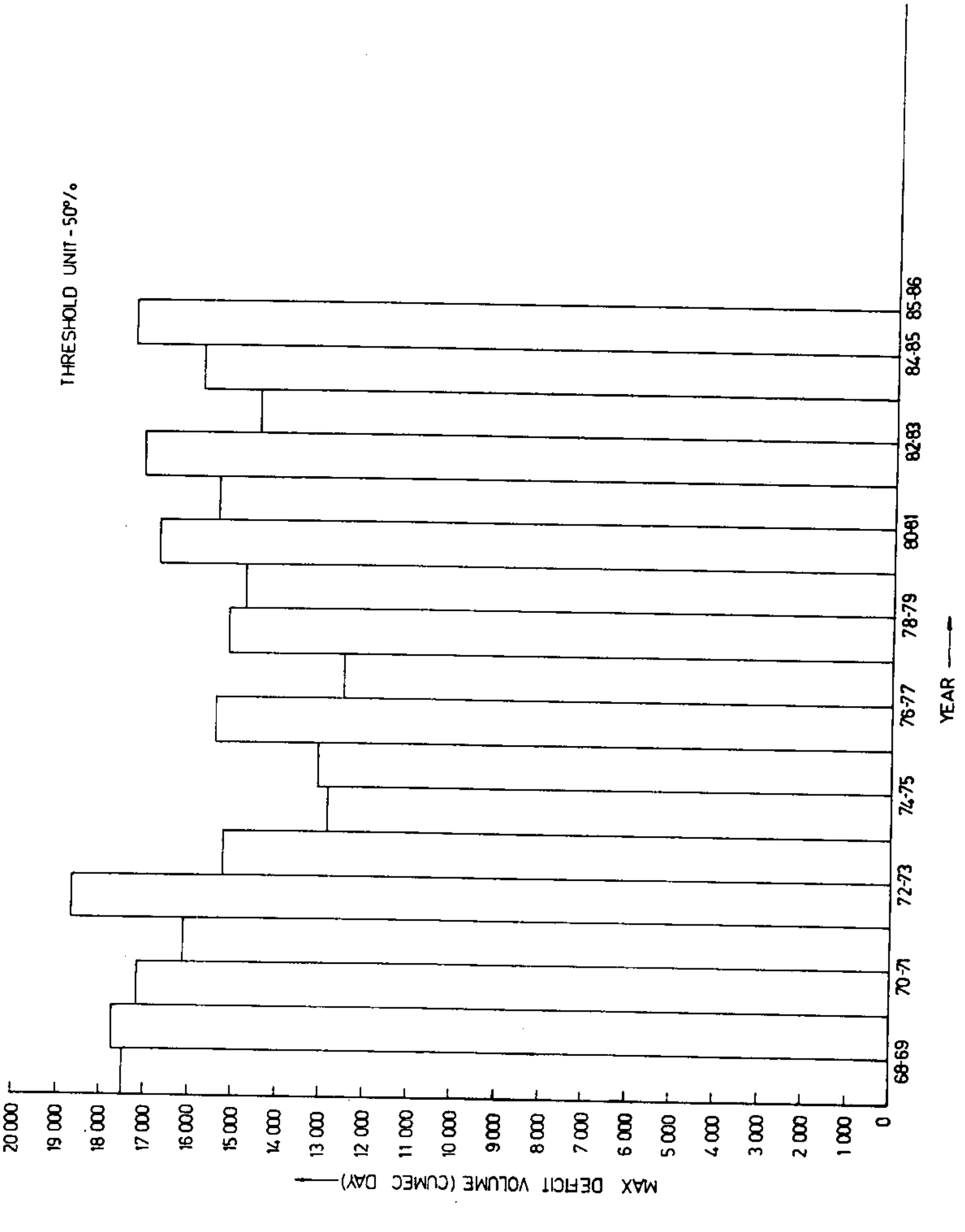
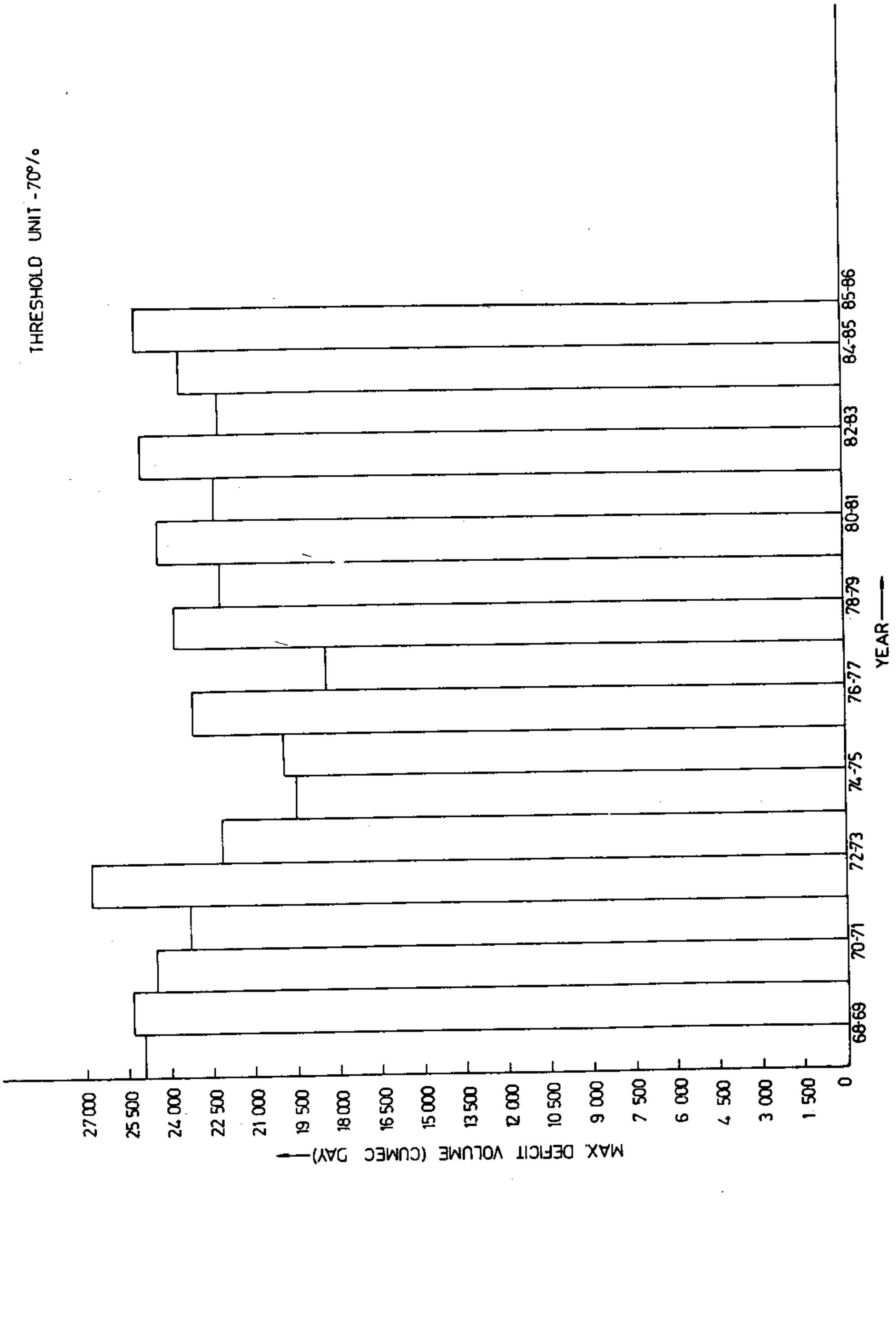
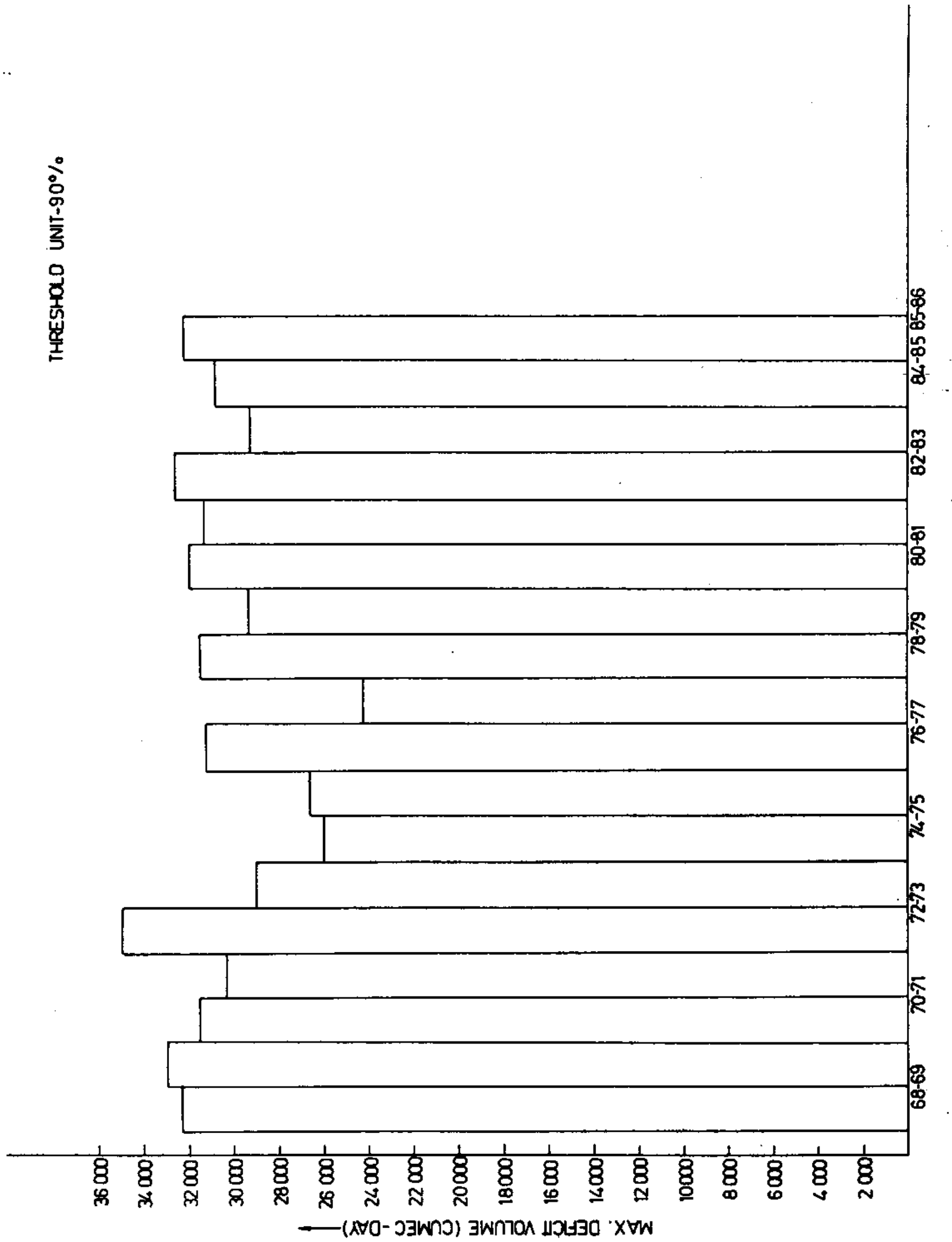


FIG.5.31 - VARIATION OF MAXIMUM DEFICIT VOLUMES


THRESHOLD UNIT - 30%
MAX. DEFICIT VOLUME (CUMEC - DAY)
12 000
10 500
9 000
7 500
6 000
4 500
3 000
1 500
750
0
68-69
70-71
72-73
74-75
76-77
78-79
80-81
82-83
84-85
85-86
YEAR


THRESHOLD UNIT - 50%
MAX DEFICIT VOLUME (CUMEC DAY)
20 000
19 000
18 000
17 000
16 000
15 000
14 000
13 000
12 000
11 000
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
0
68-69
70-71
72-73
74-75
76-77
78-79
80-81
82-83
84-85
85-86
YEAR


THRESHOLD UNIT - 70%
MAX. DEFICIT VOLUME (CUMEC DAY)
27 000
25 500
24 000
22 500
21 000
19 500
18 000
16 500
15 000
13 500
12 000
10 500
9 000
7 500
6 000
4 500
3 000
1 500
0
68-69
70-71
72-73
74-75
76-77
78-79
80-81
82-83
84-85
85-86
YEAR


THRESHOLD UNIT-90%
MAX. DEFICIT VOLUME (CUMEC-DAY)
36 000
34 000
32 000
30 000
28 000
26 000
24 000
22 000
20 000
18 000
16 000
14 000
12 000
10 000
8 000
6 000
4 000
2 000
68-69
70-71
72-73
74-75
76-77
78-79
80-81
82-83
84-85
85-86

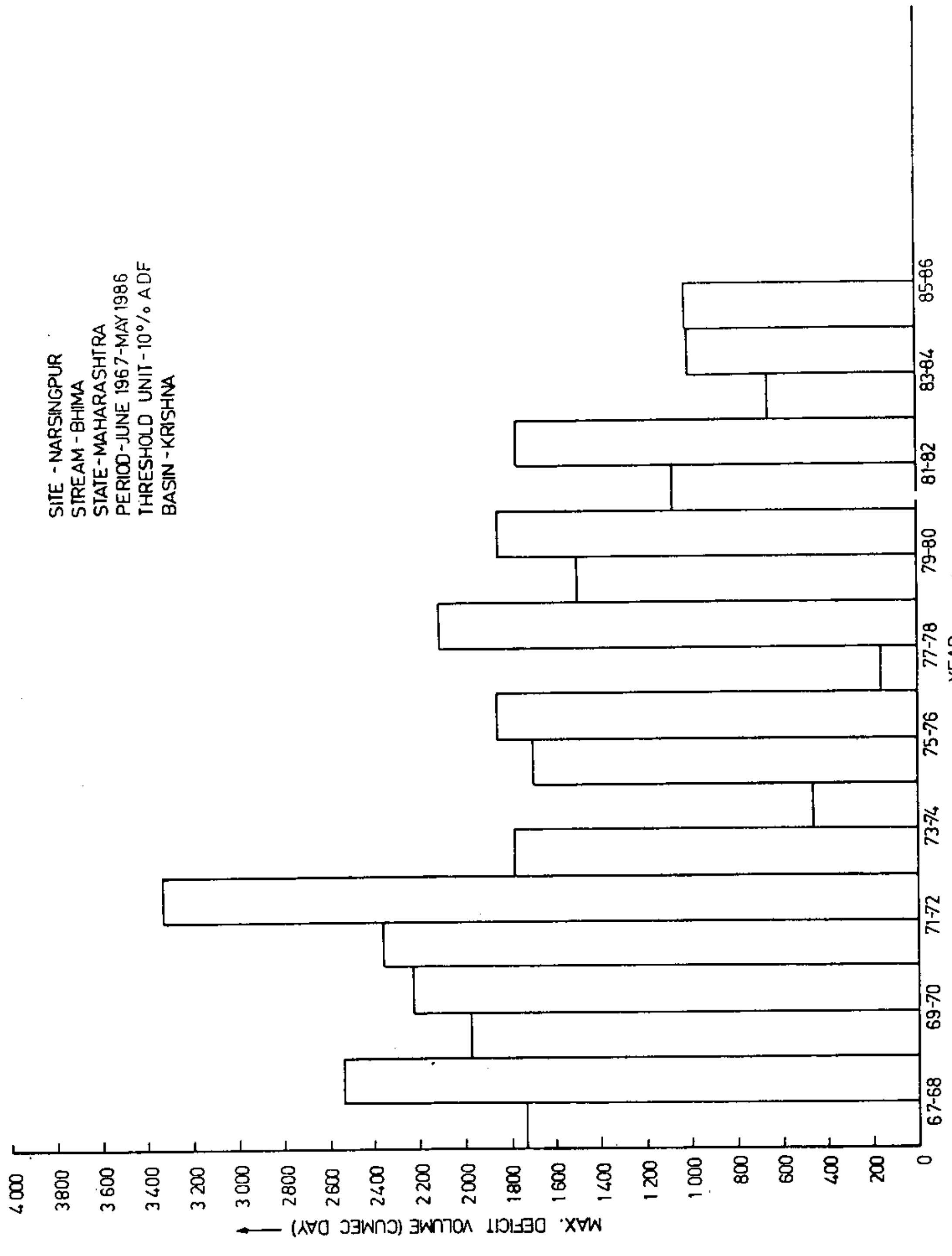
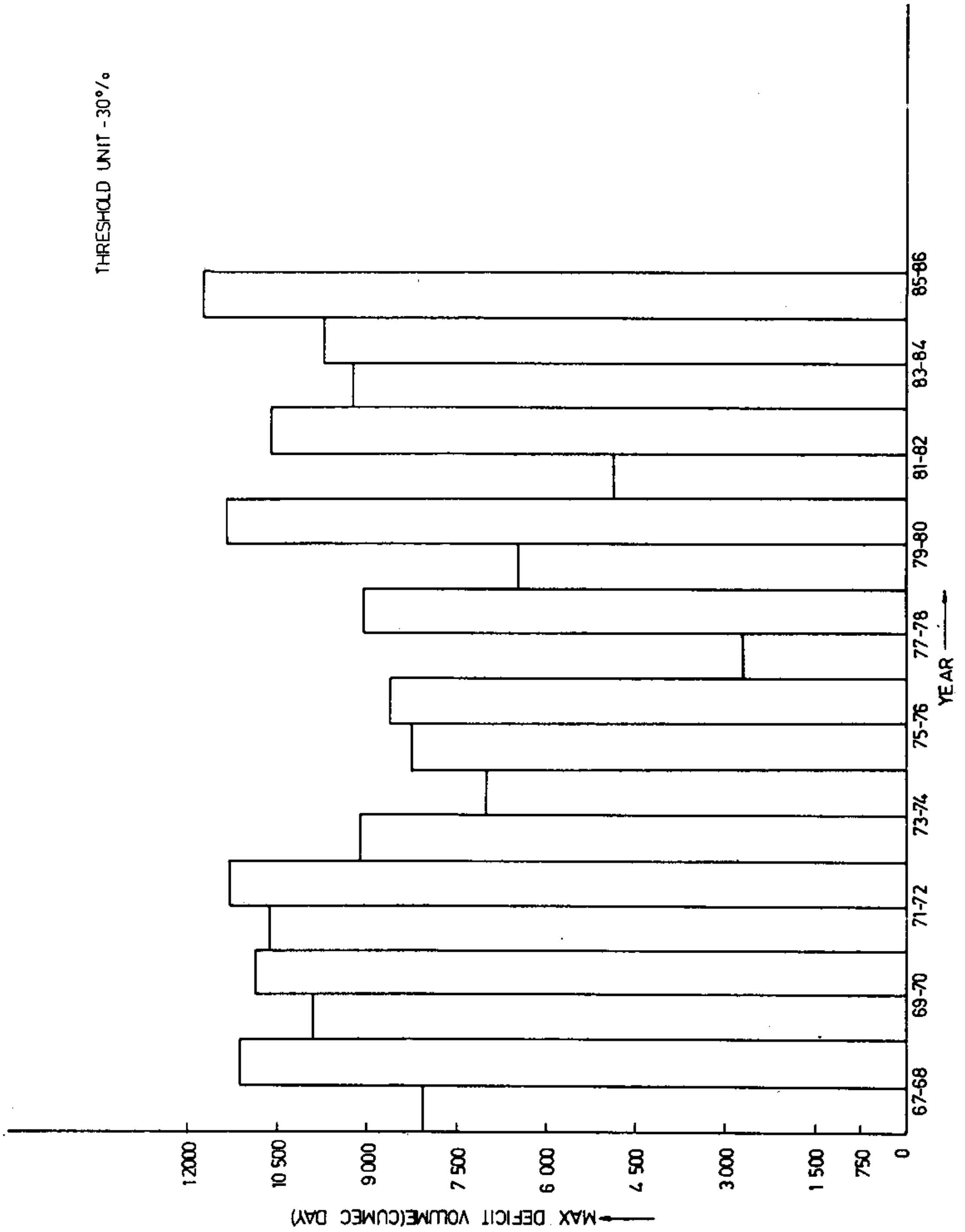
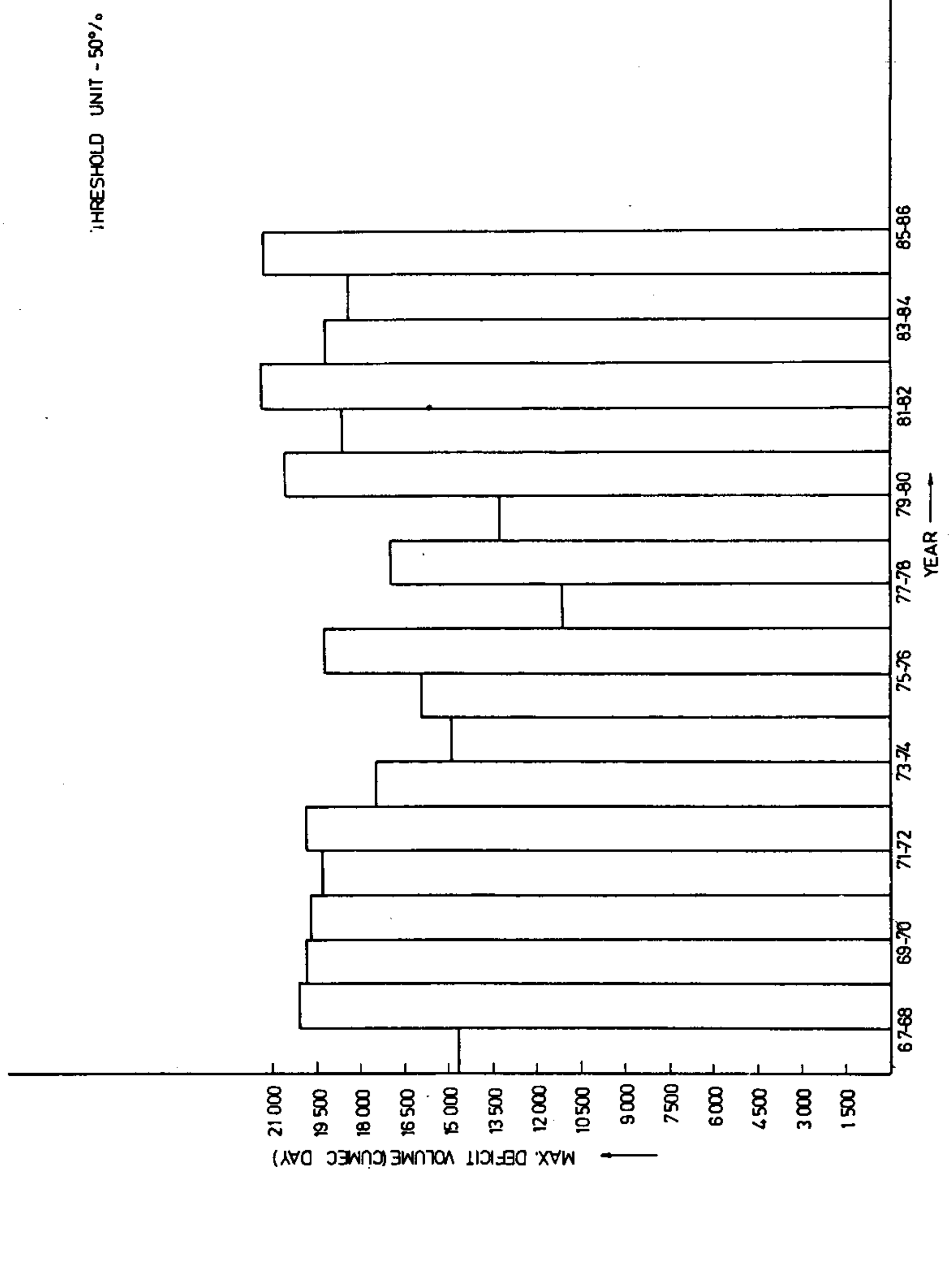
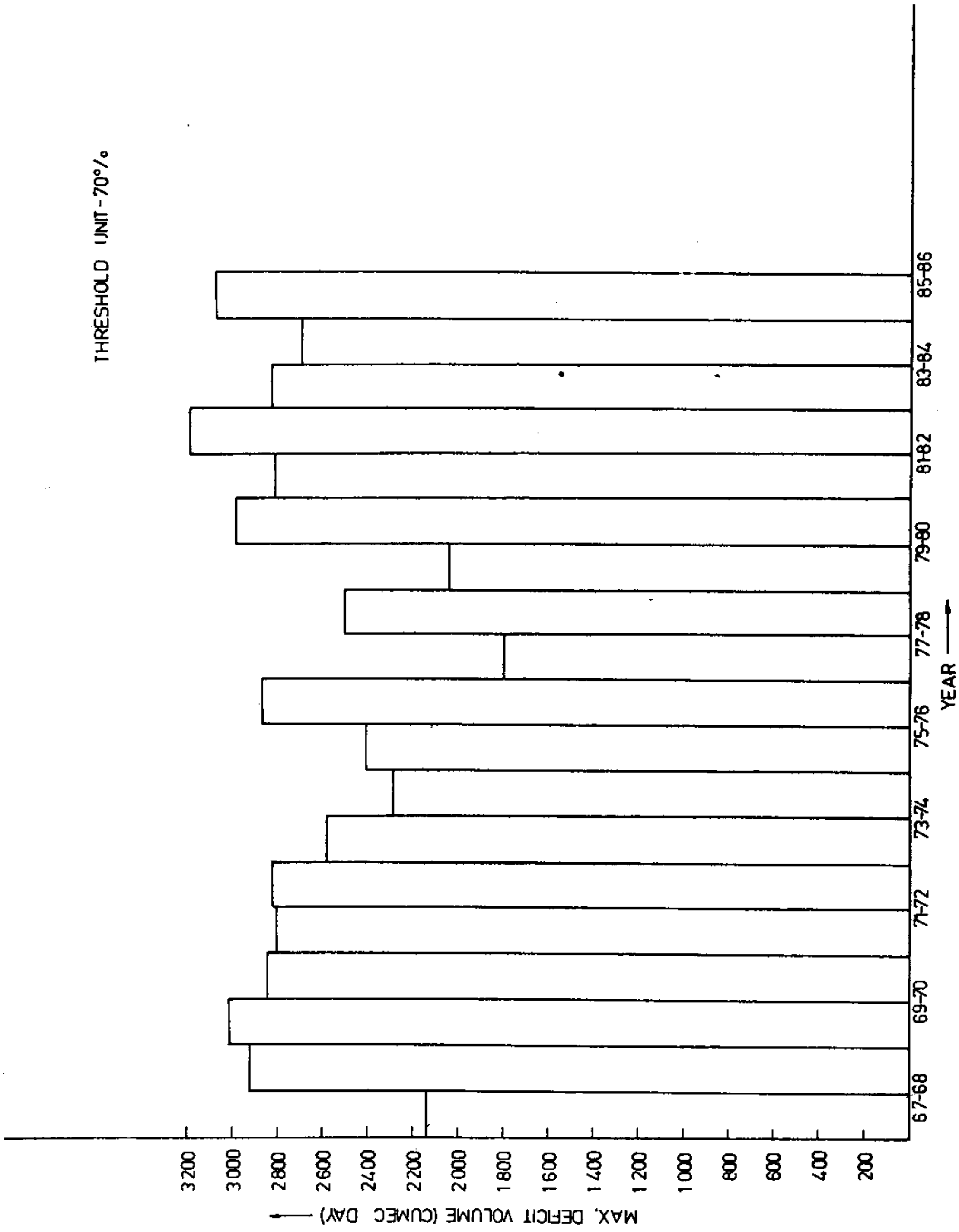


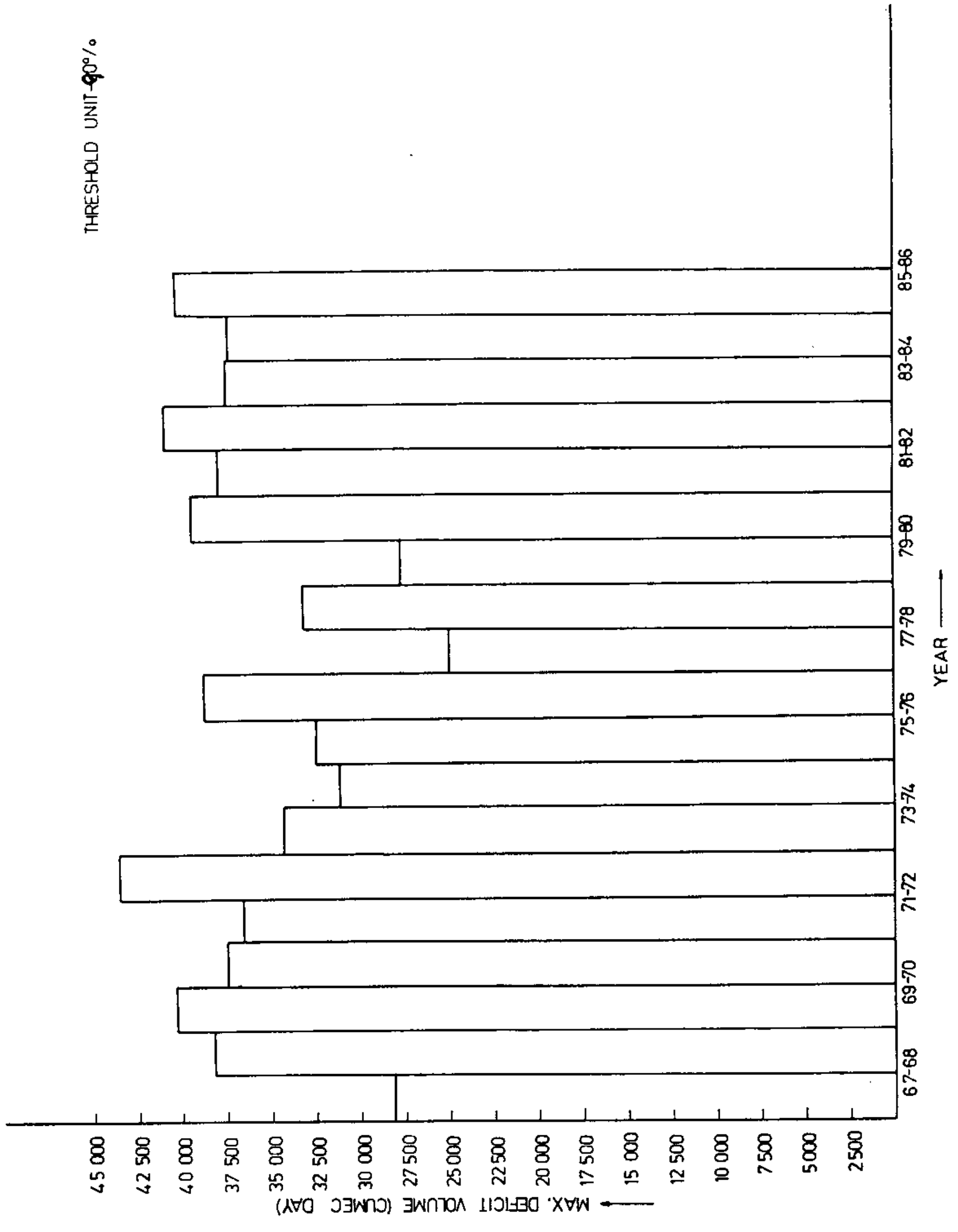
FIG.5.32 - VARIATION OF MAXIMUM DEFICIT VOLUMES


THRESHOLD UNIT -30%
MAX DEFICIT VOLUME(CUMEC DAY)
12000
10 500
9 000
7 500
6 000
4 500
3 000
1 500
750
0
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR



THRESHOLD UNIT - 50%
MAX. DEFICIT VOLUME (CUMEC DAY)
21 000
19 500
18 000
16 500
15 000
13 500
12 000
10 500
9 000
7500
6 000
4 500
3 000
1 500
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR


THRESHOLD UNIT-70%
MAX. DEFICIT VOLUME (CUMEC DAY)
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR



THRESHOLD UNIT
MAX. DEFICIT VOLUME (CUMEC DAY)
45 000
42 500
40 000
37 500
35 000
32 500
30 000
27 500
25 000
22 500
20 000
17 500
15 000
12 500
10 000
7 500
5 000
2500
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR

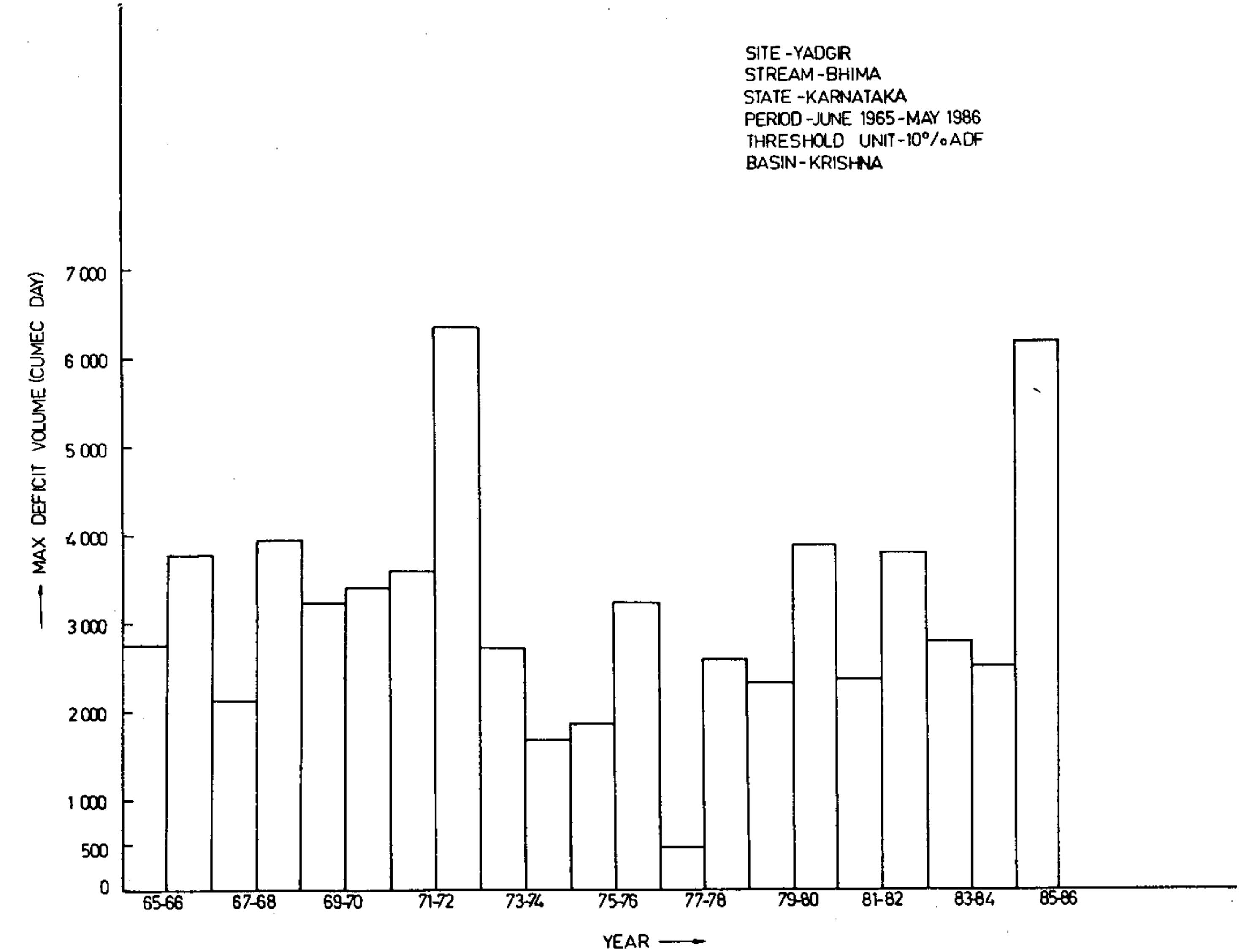
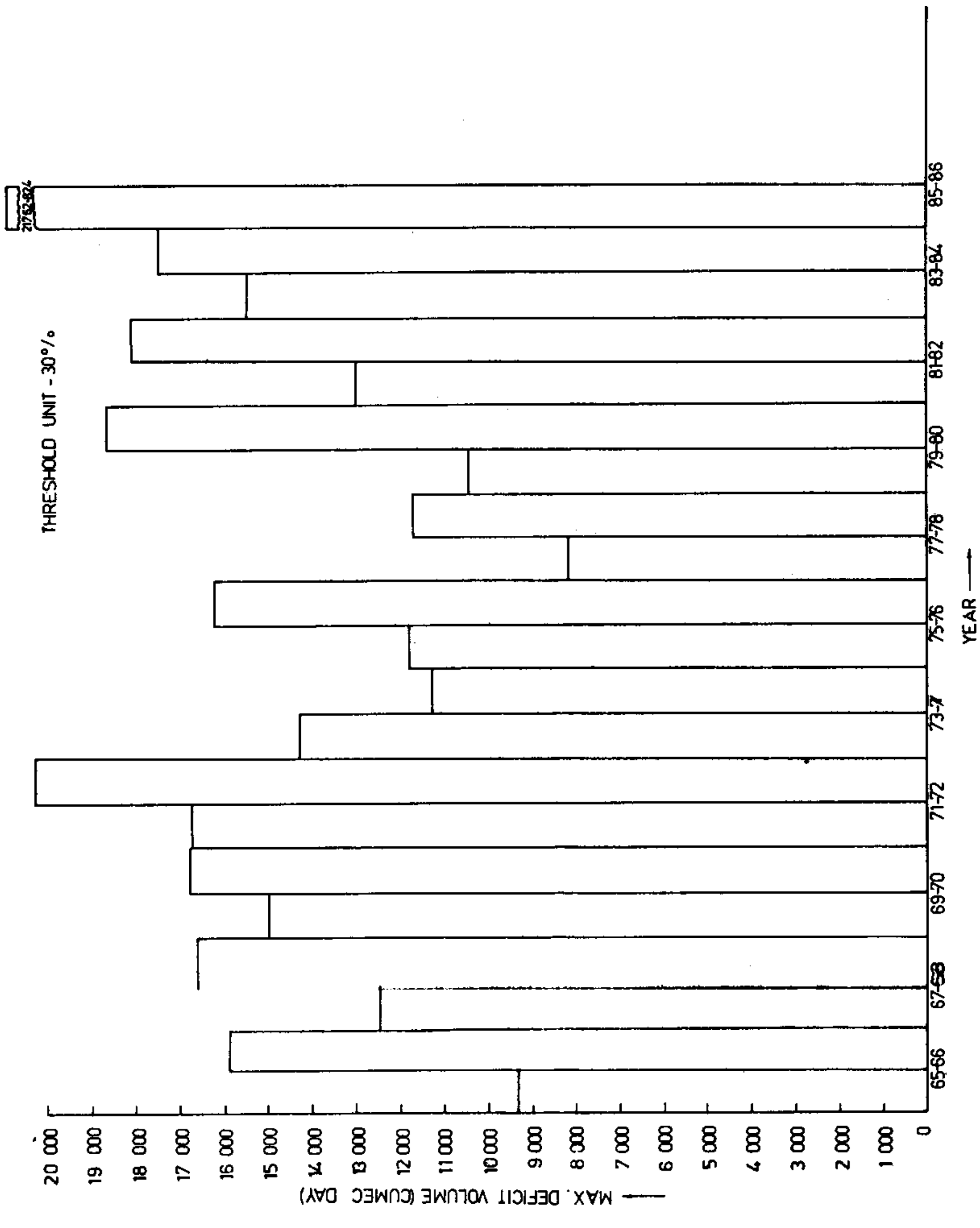
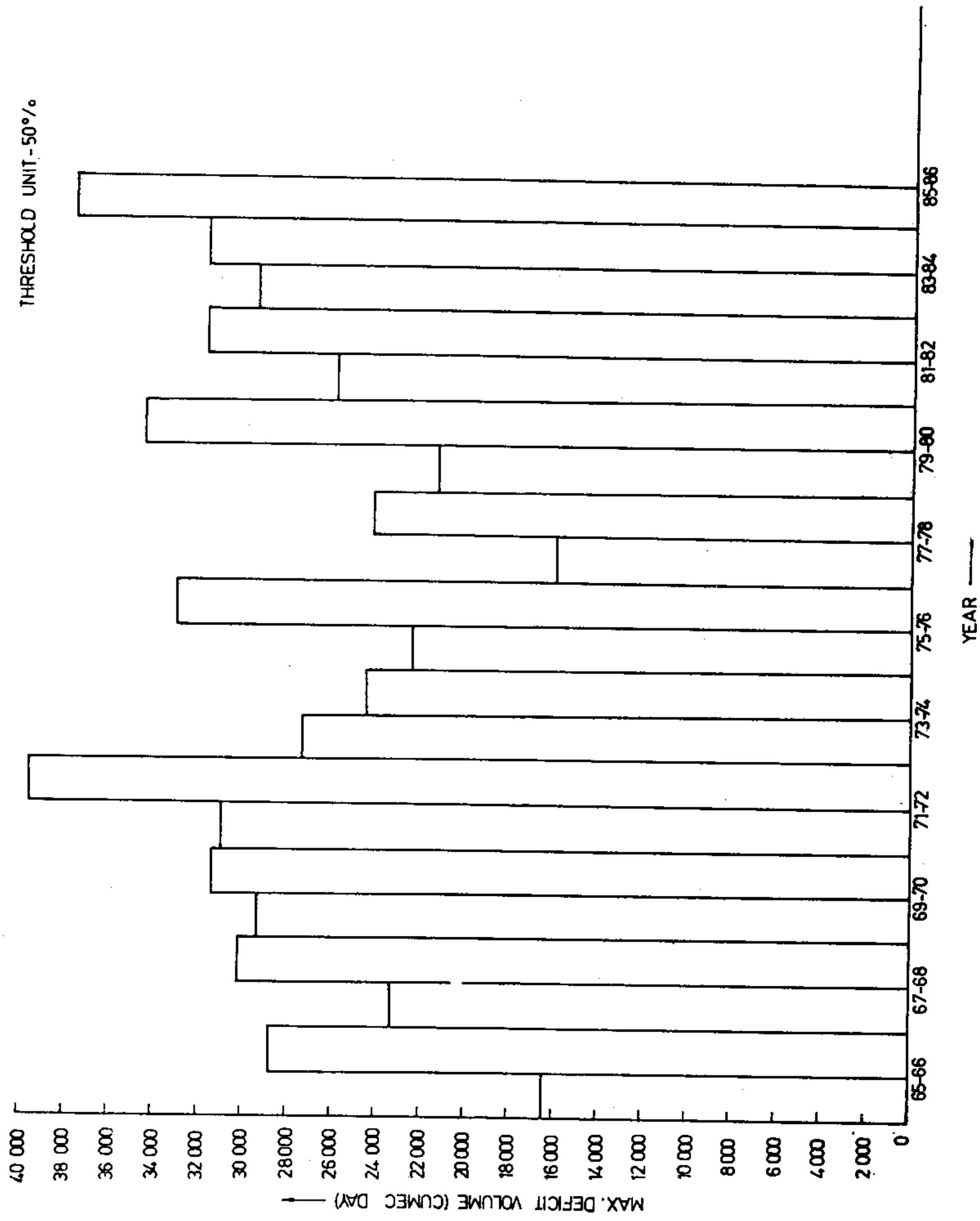
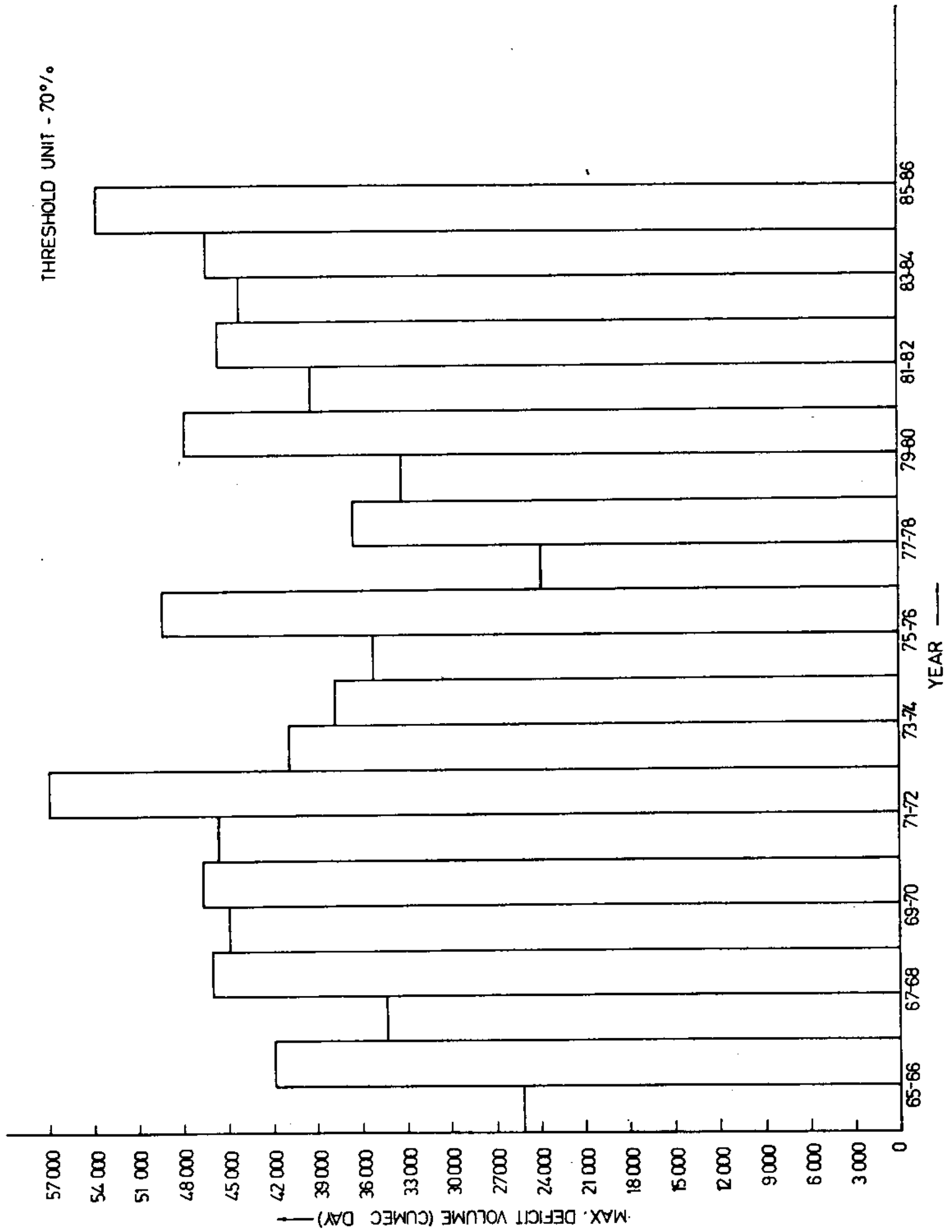


FIG.5.33 - VARIATION OF MAXIMUM DEFICIT VOLUMES

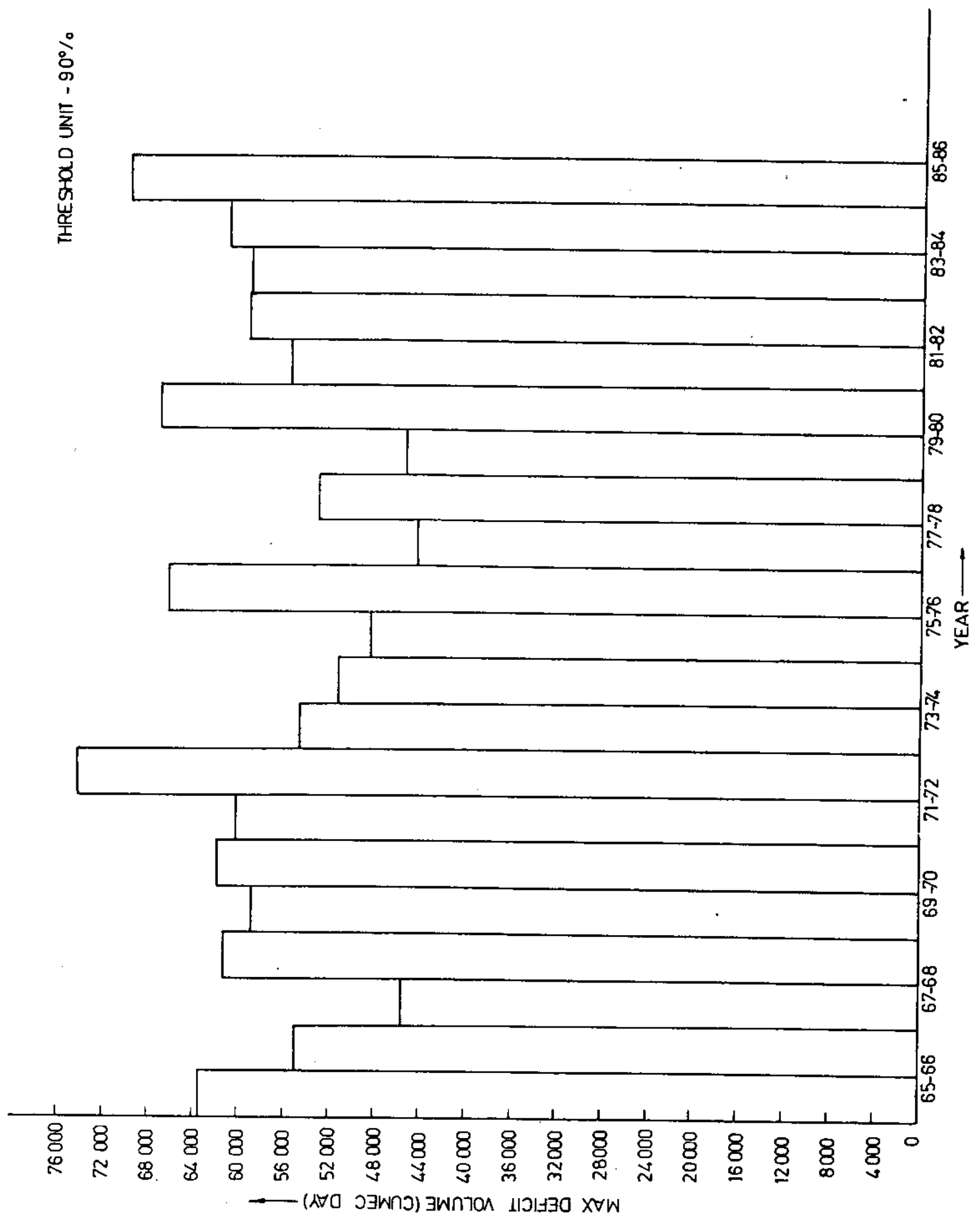

THRESHOLD UNIT - 30°/o
MAX. DEFICIT VOLUME (CUMEC DAY)
0
1 000
2 000
3 000
4 000
5 000
6 000
7 000
8 000
9 000
10 000
11 000
12 000
13 000
14 000
15 000
16 000
17 000
18 000
19 000
20 000
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR



THRESHOLD UNIT-50%
MAX. DEFICIT VOLUME (CUMEC DAY)
YEAR
40 000
38 000
36 000
34 000
32 000
30 000
28 000
26 000
24 000
22 000
20 000
18 000
16 000
14 000
12 000
10 000
8 000
6 000
4 000
2 000
0
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86



THRESHOLD UNIT - 70°/o
MAX. DEFICIT VOLUME (CUMEC DAY)
0
3 000
6 000
9 000
12 000
15 000
18 000
21 000
24 000
27 000
30 000
33 000
36 000
39 000
42 000
45 000
48 000
51 000
54 000
57 000
YEAR
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86


THRESHOLD UNIT - 90%
MAX DEFICIT VOLUME (CUMEC DAY)
76 000
72 000
68 000
64 000
60 000
56 000
52 000
48 000
44 000
40 000
36 000
32 000
28 000
24 000
20 000
16 000
12 000
8 000
4 000
0
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR

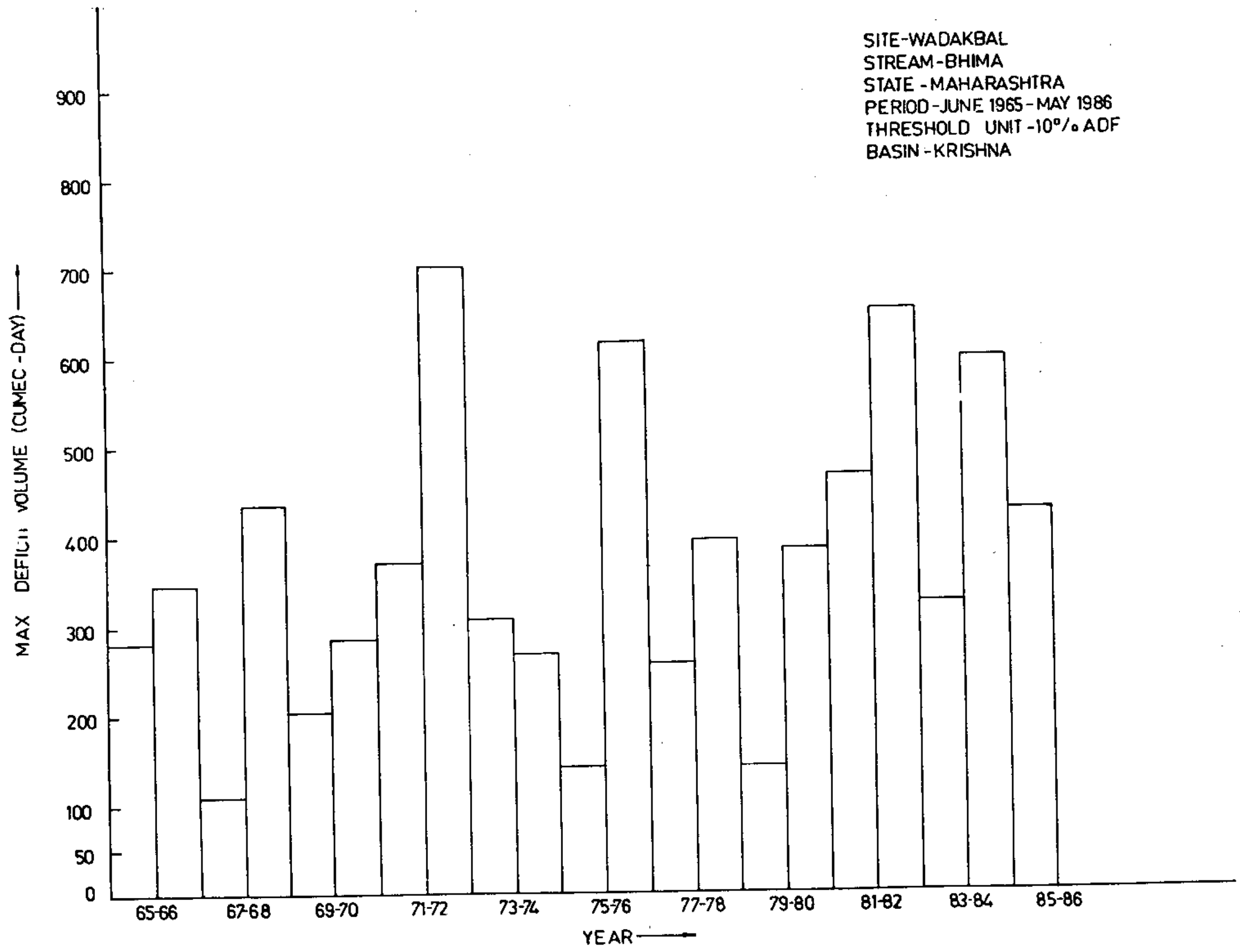
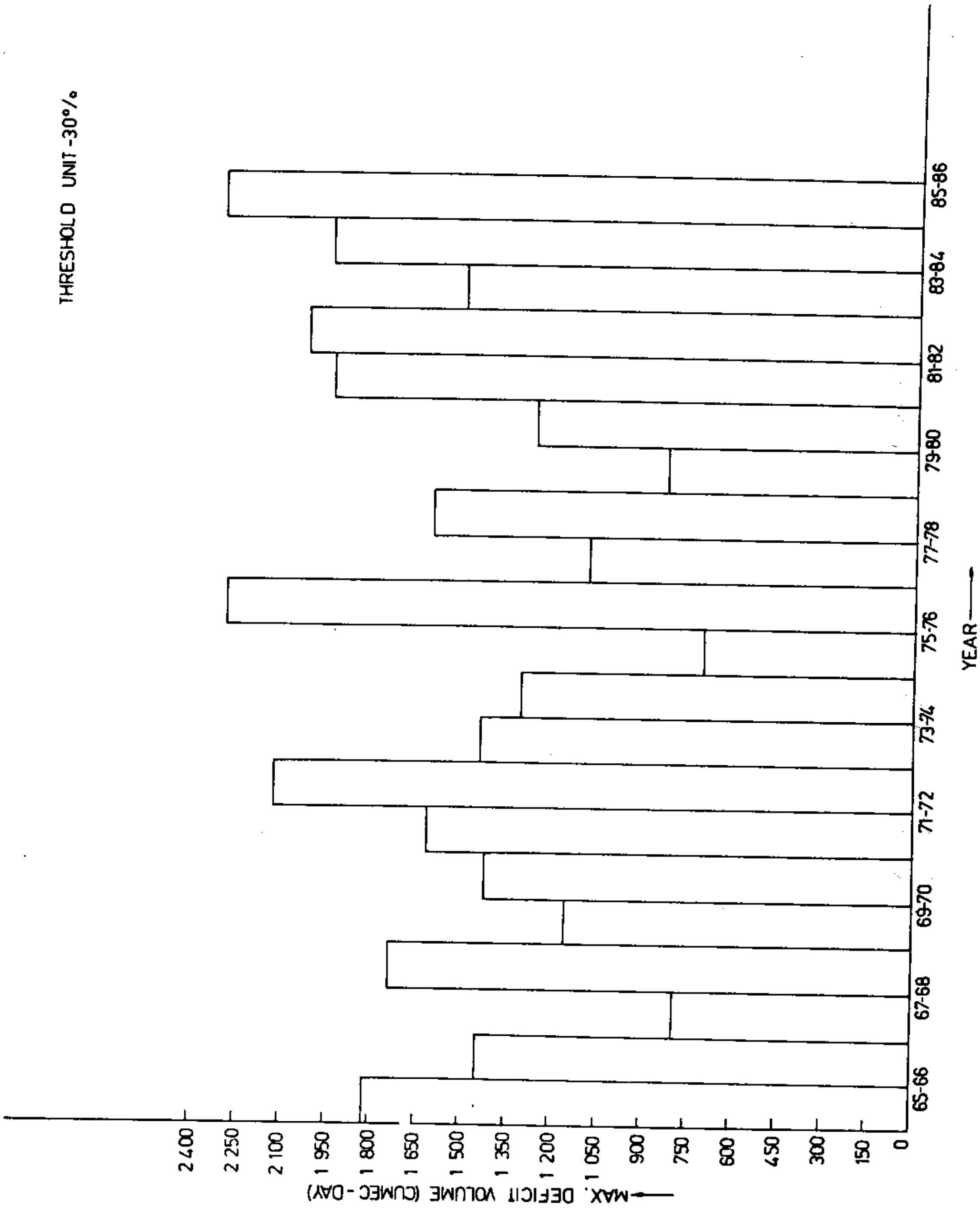
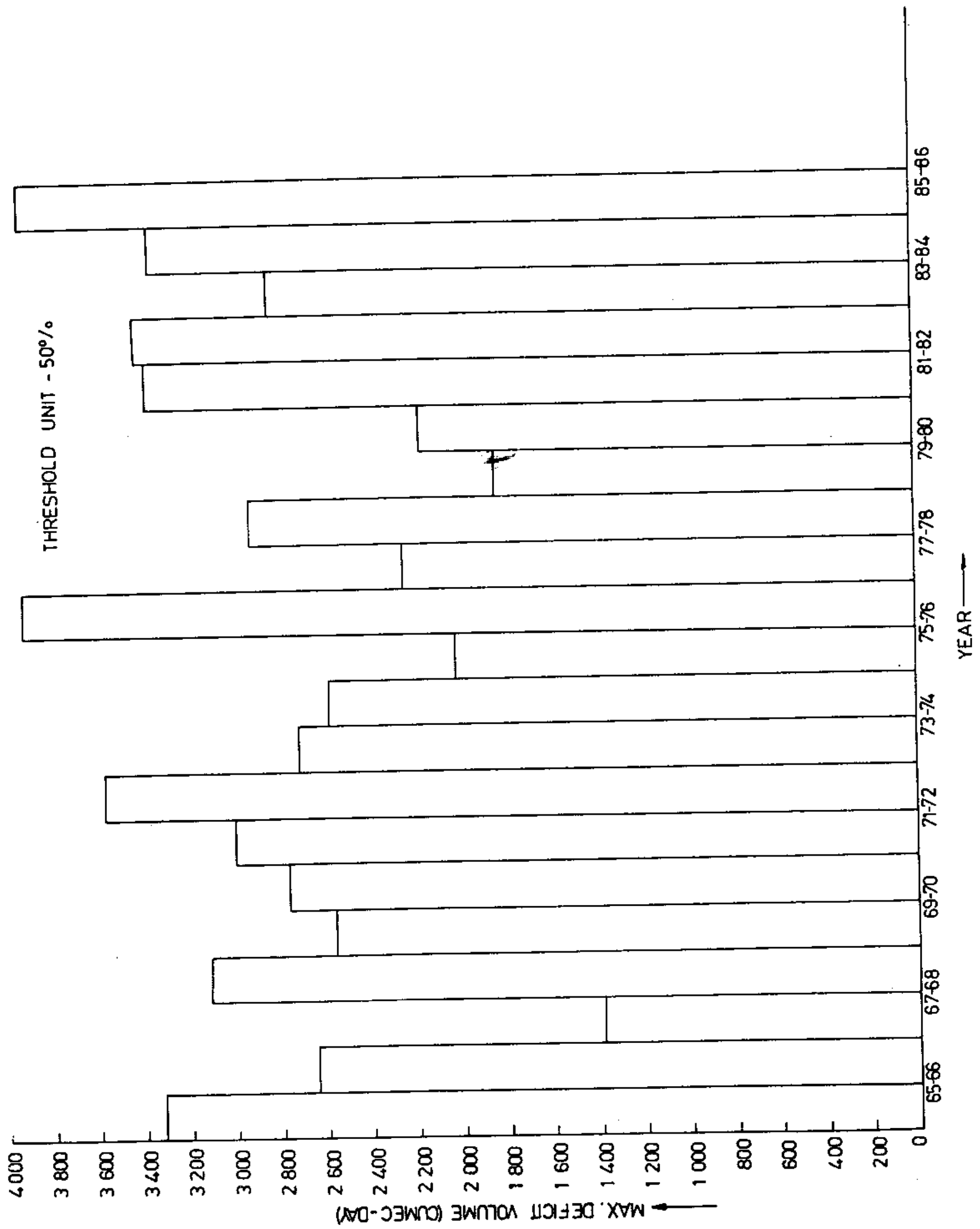


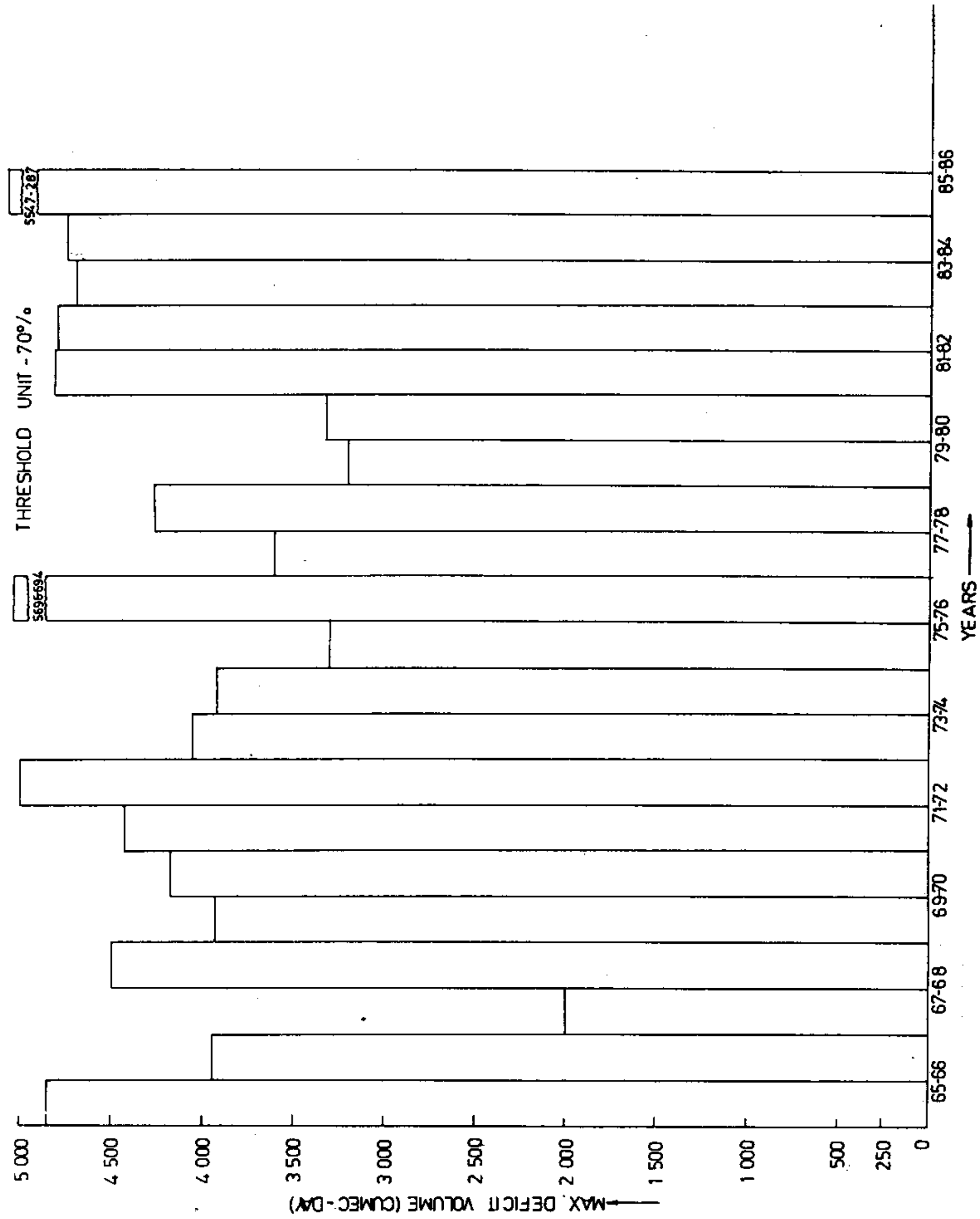
FIG.5.34 - VARIATION OF MAXIMUM DEFICIT VOLUME

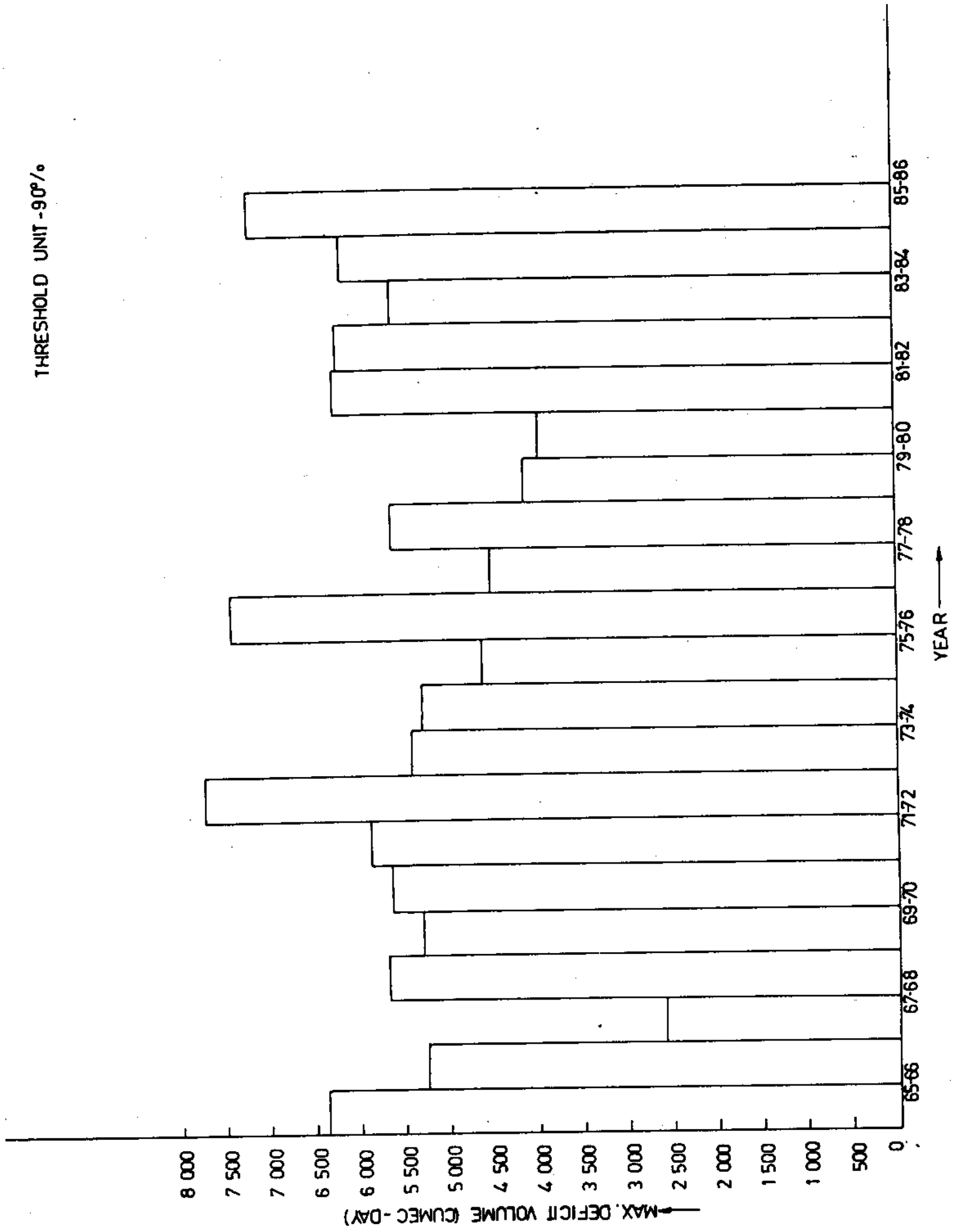


THRESHOLD UNIT -30%
MAX. DEFICIT VOLUME (CUMEC - DAY)
0
150
300
450
600
750
900
1 050
1 200
1 350
1 500
1 650
1 800
1 950
2 100
2 250
2 400
YEAR
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86



THRESHOLD UNIT - 50%
MAX. DEFICIT VOLUME (CUMEC-DAY)
0
200
400
600
800
1 000
1 200
1 400
1 600
1 800
2 000
2 200
2 400
2 600
2 800
3 000
3 200
3 400
3 600
3 800
4 000
YEAR
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86


THRESHOLD UNIT - 70%
5547.287
5696.694
MAX. DEFICIT VOLUME (CUMEC-DAY)
5 000
4 500
4 000
3 500
3 000
2 500
2 000
1 500
1 000
500
250
0
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEARS


THRESHOLD UNIT -90%
MAX. DEFICIT VOLUME (CUMEC-DAY)
0
500
1 000
1 500
2 000
2 500
3 000
3 500
4 000
4 500
5 000
5 500
6 000
6 500
7 000
7 500
8 000
65-66
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR

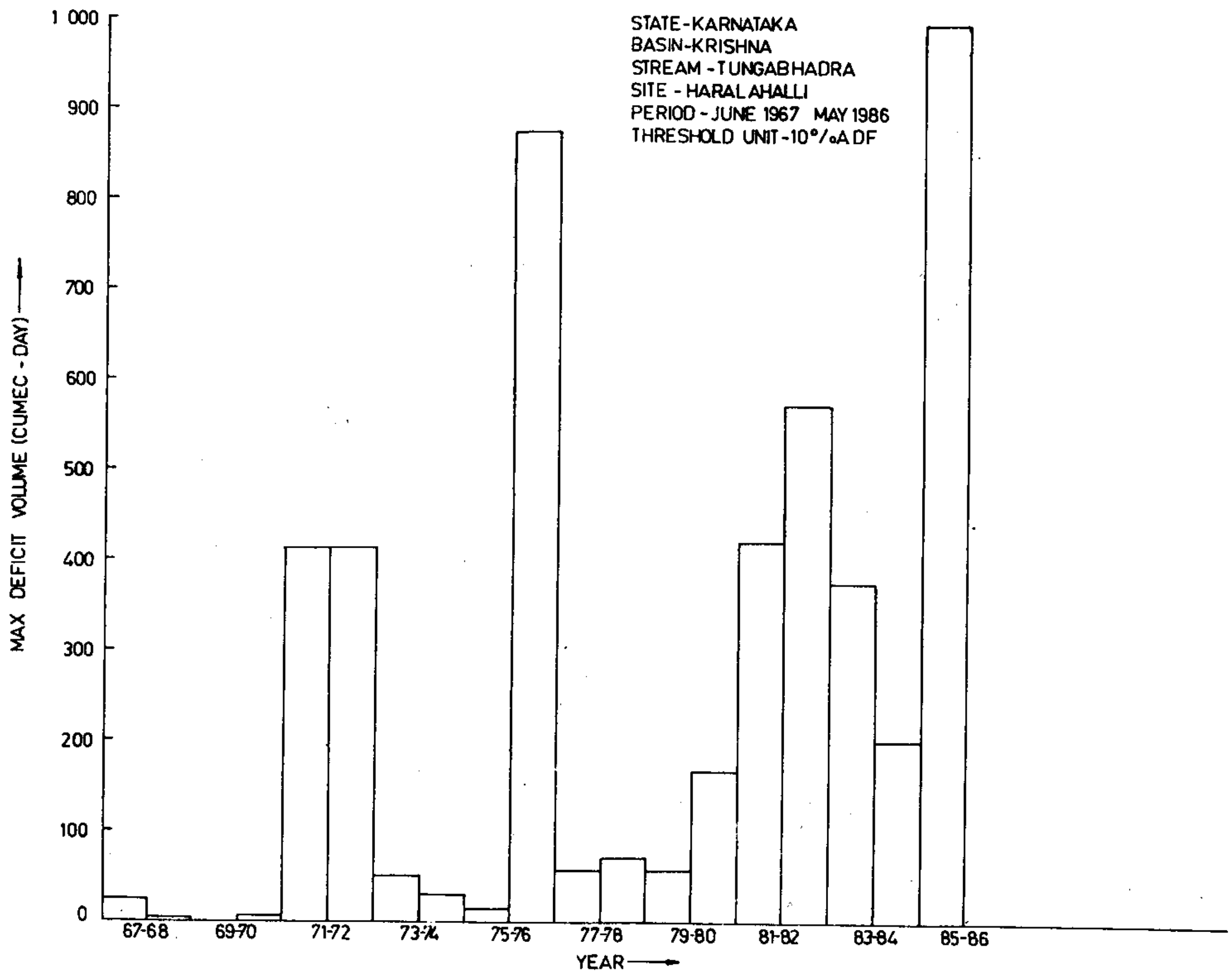
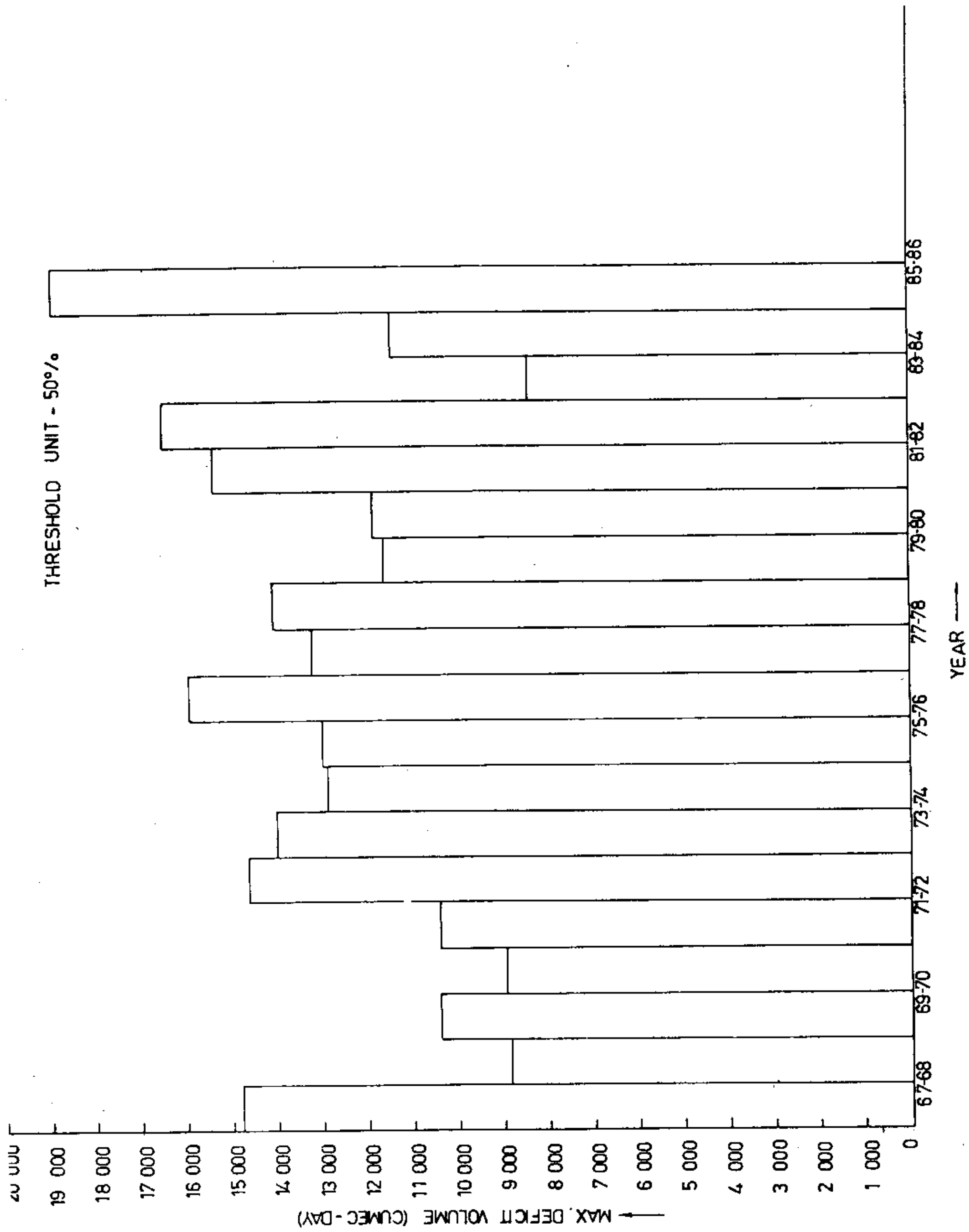
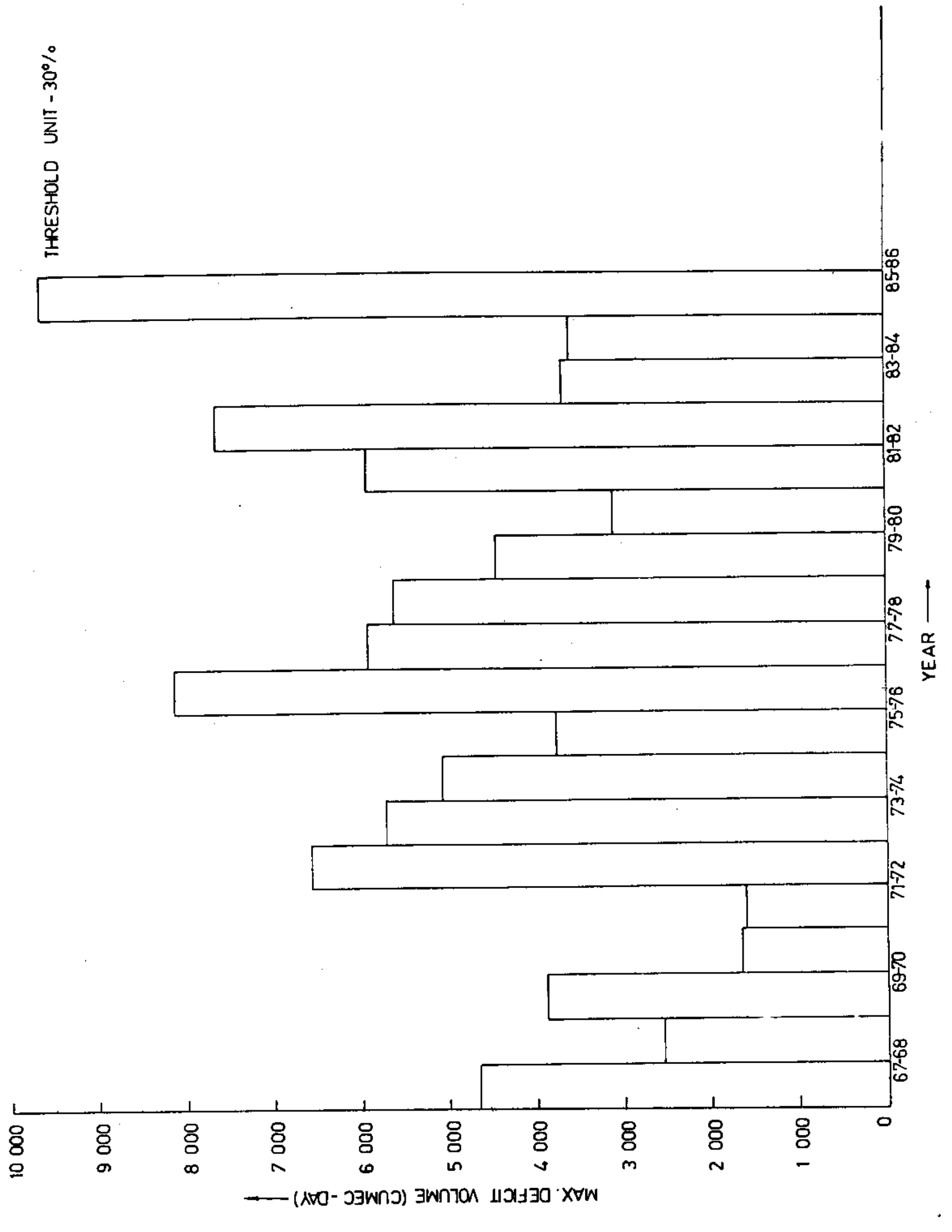
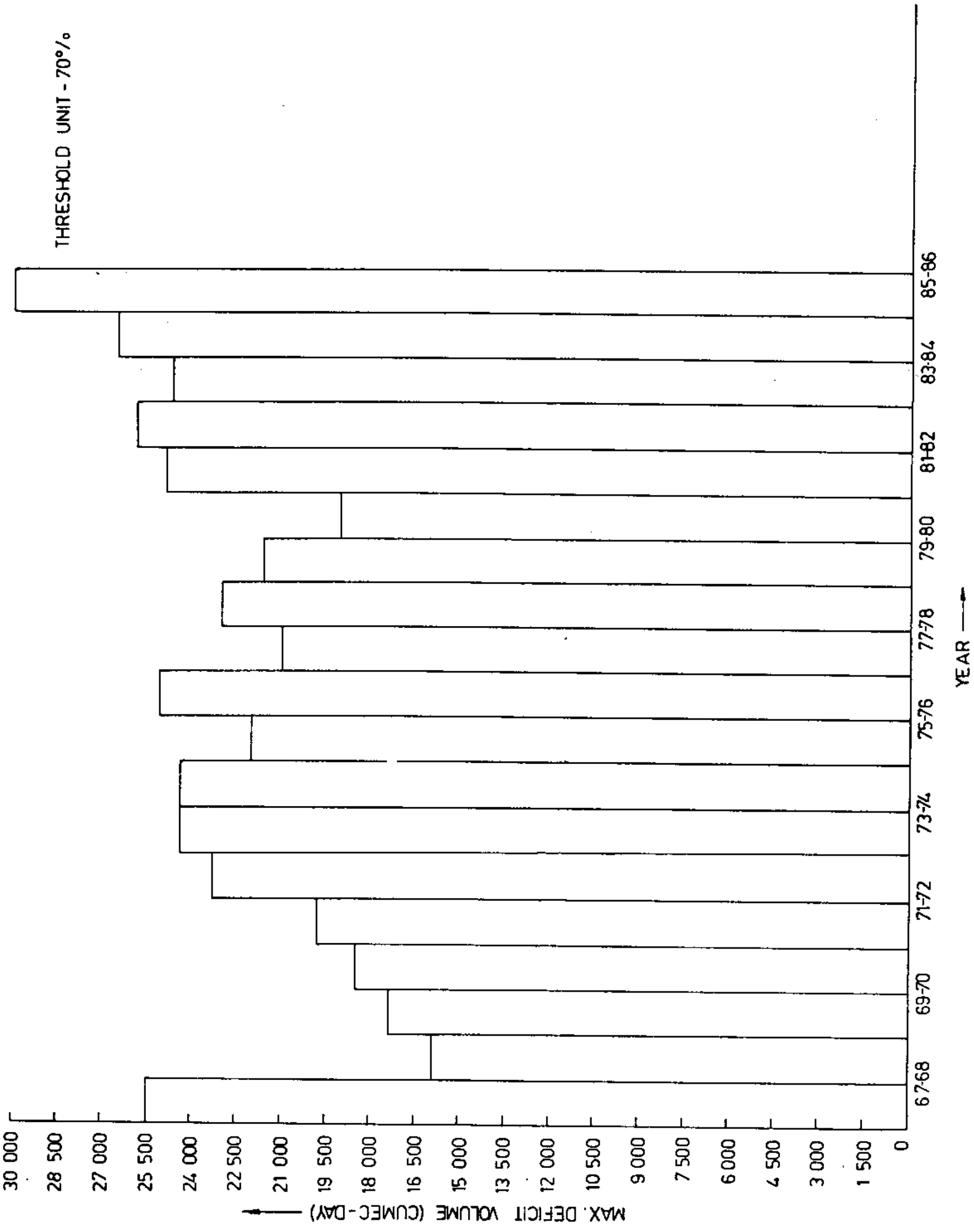
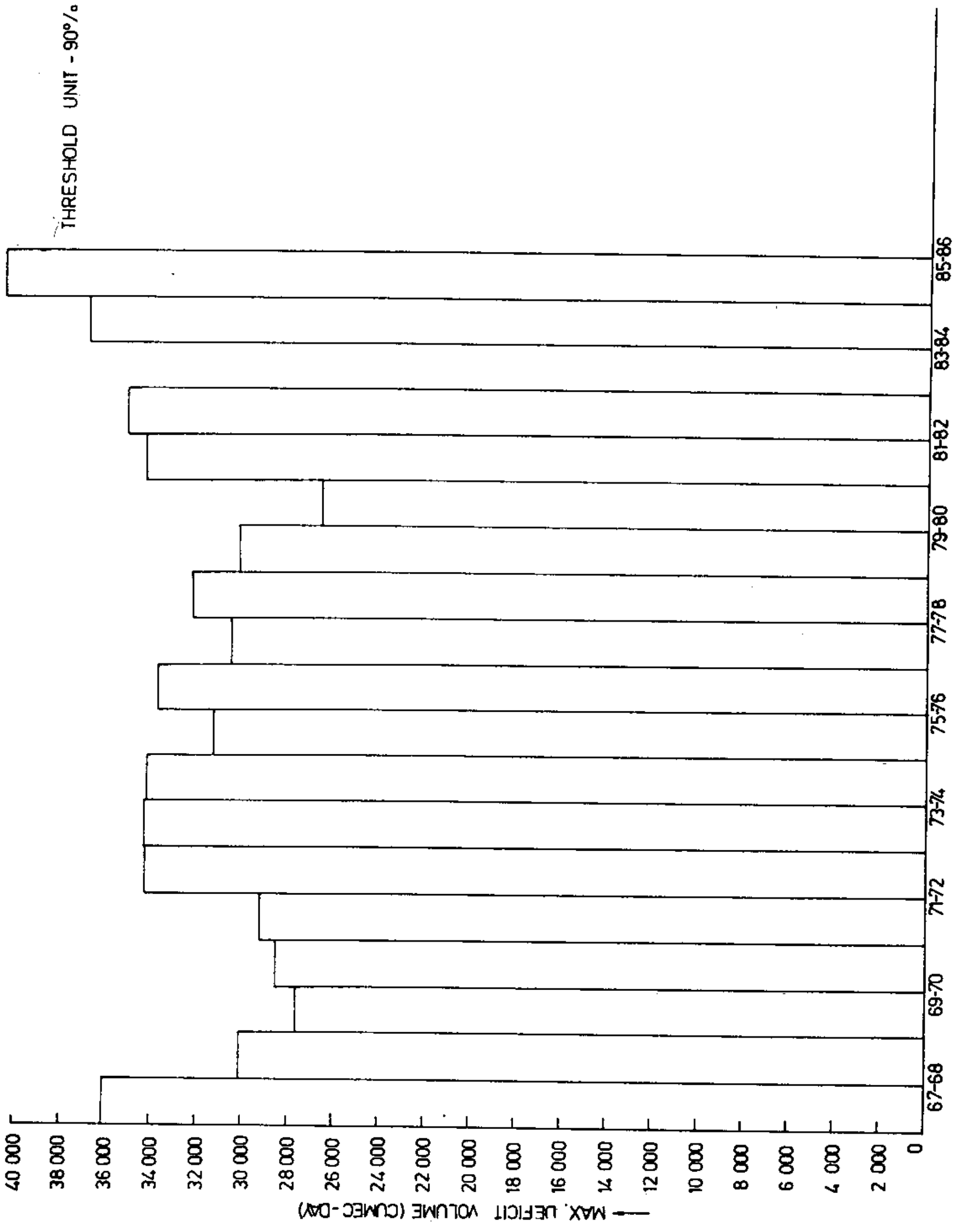


FIG.5.35 - VARIATION OF MAXIMUM DEFICIT VOLUME


THRESHOLD UNIT - 50%
MAX. DEFICIT VOLUME (CUMEC - DAY)
YEAR
20 000
19 000
18 000
17 000
16 000
15 000
14 000
13 000
12 000
11 000
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
0
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86


THRESHOLD UNIT - 30%
MAX. DEFICIT VOLUME (CUMEC - DAY)
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
0
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR


THRESHOLD UNIT - 70%
MAX. DEFICIT VOLUME (CUMEC-DAY)
30 000
28 500
27 000
25 500
24 000
22 500
21 000
19 500
18 000
16 500
15 000
13 500
12 000
10 500
9 000
7 500
6 000
4 500
3 000
1 500
0
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86
YEAR


THRESHOLD UNIT - 90%
MAX. DEFICIT VOLUME (CUMEC-DAY)
40 000
38 000
36 000
34 000
32 000
30 000
28 000
26 000
24 000
22 000
20 000
18 000
16 000
14 000
12 000
10 000
8 000
6 000
4 000
2 000
0
67-68
69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
85-86

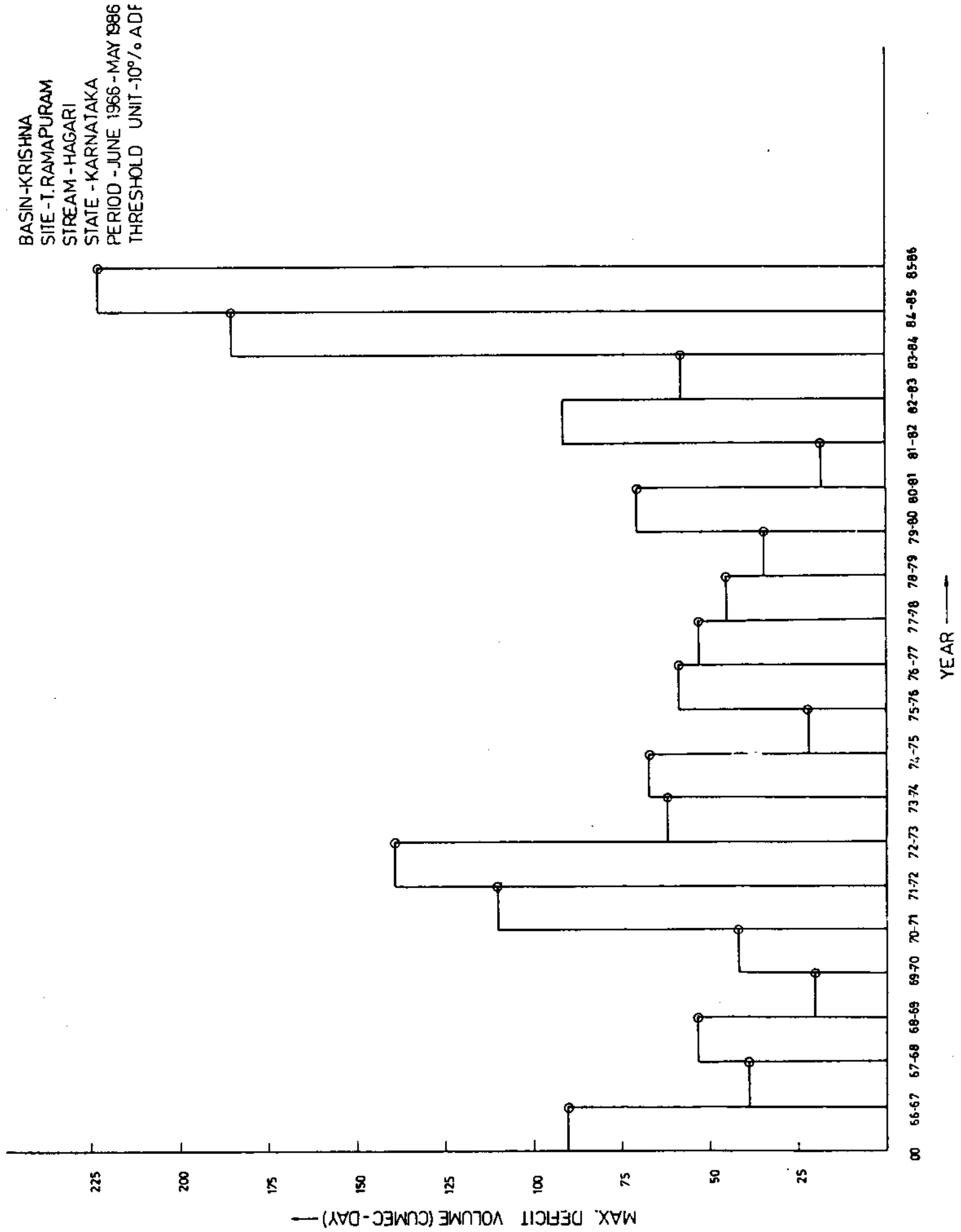
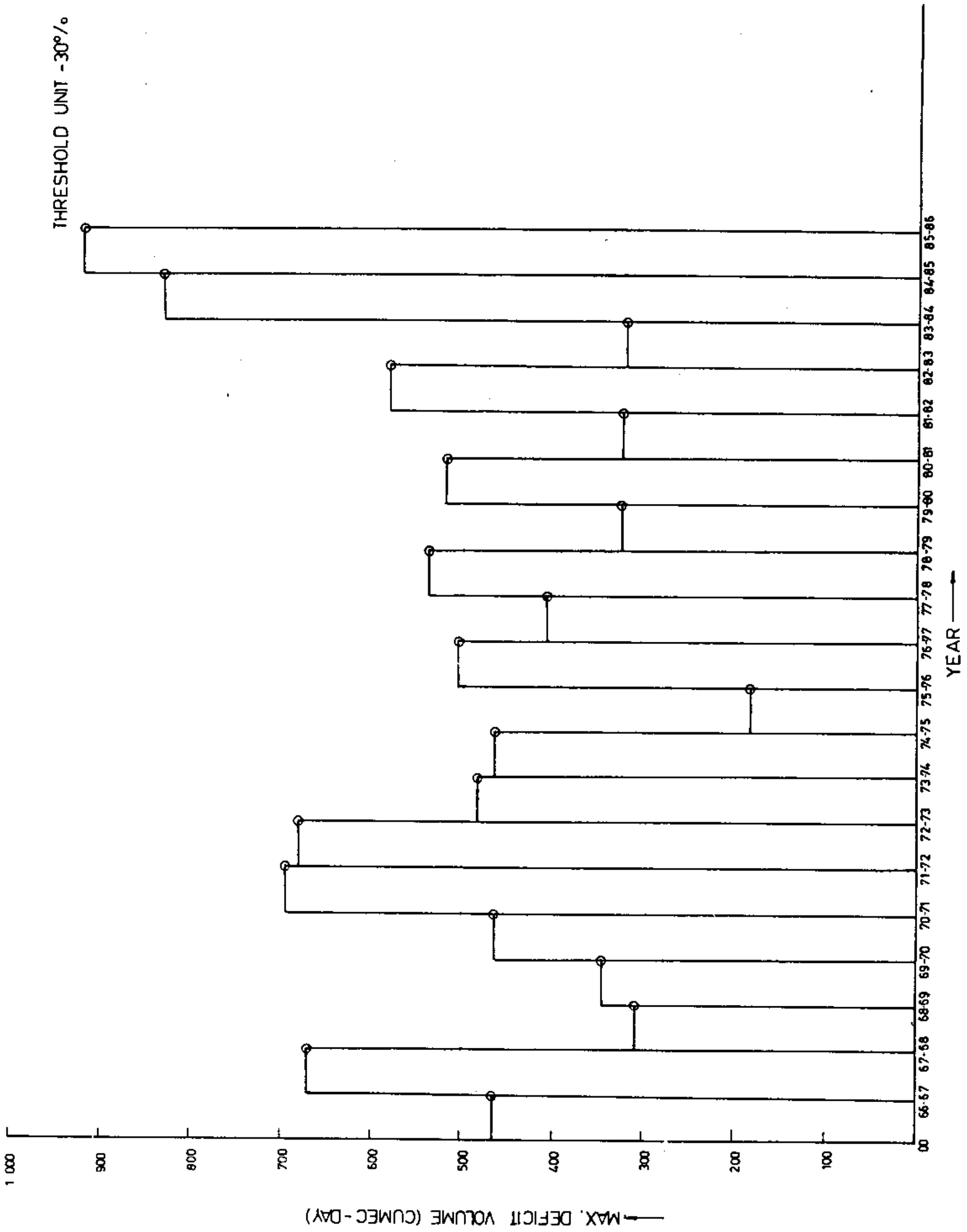
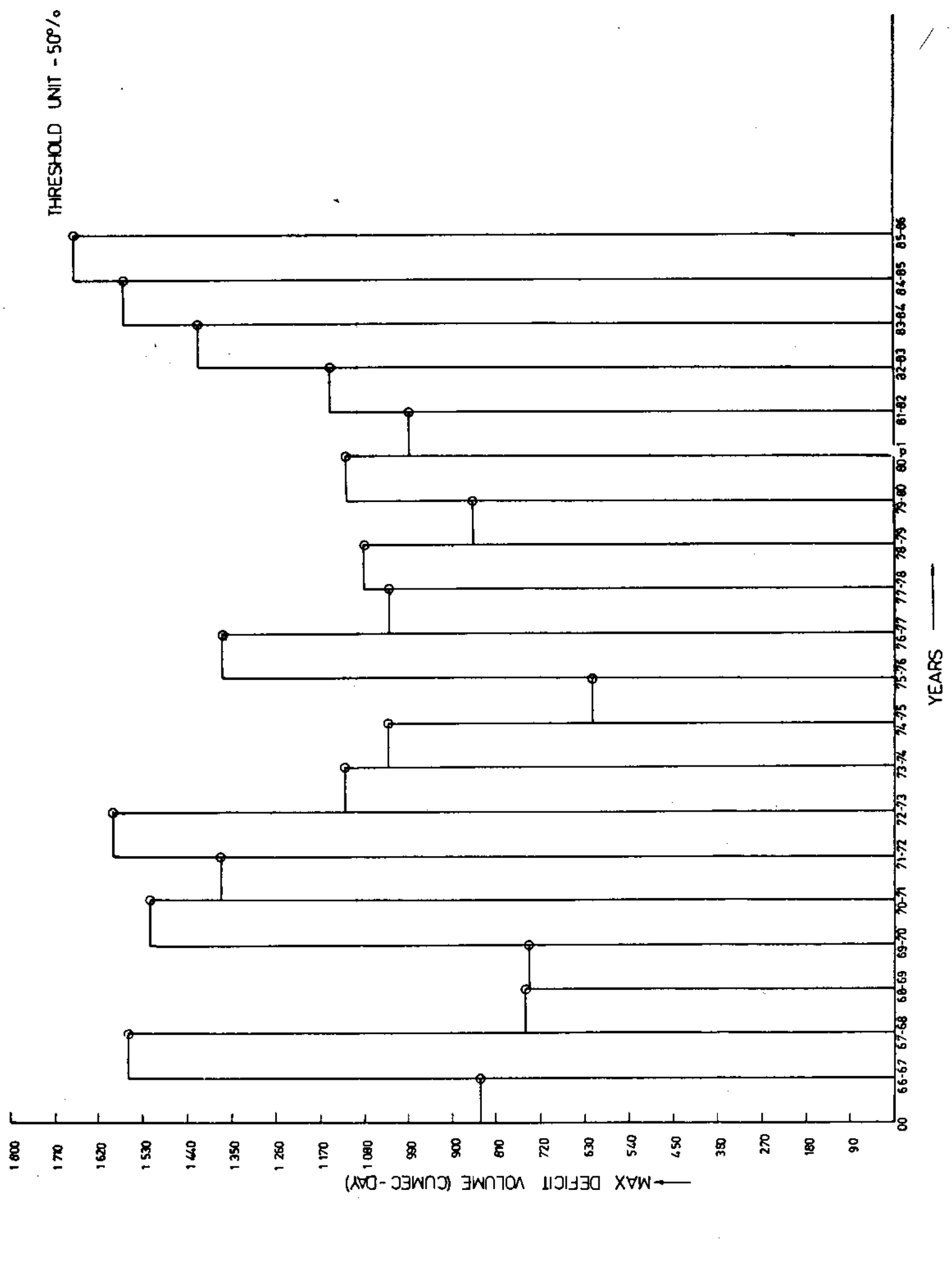
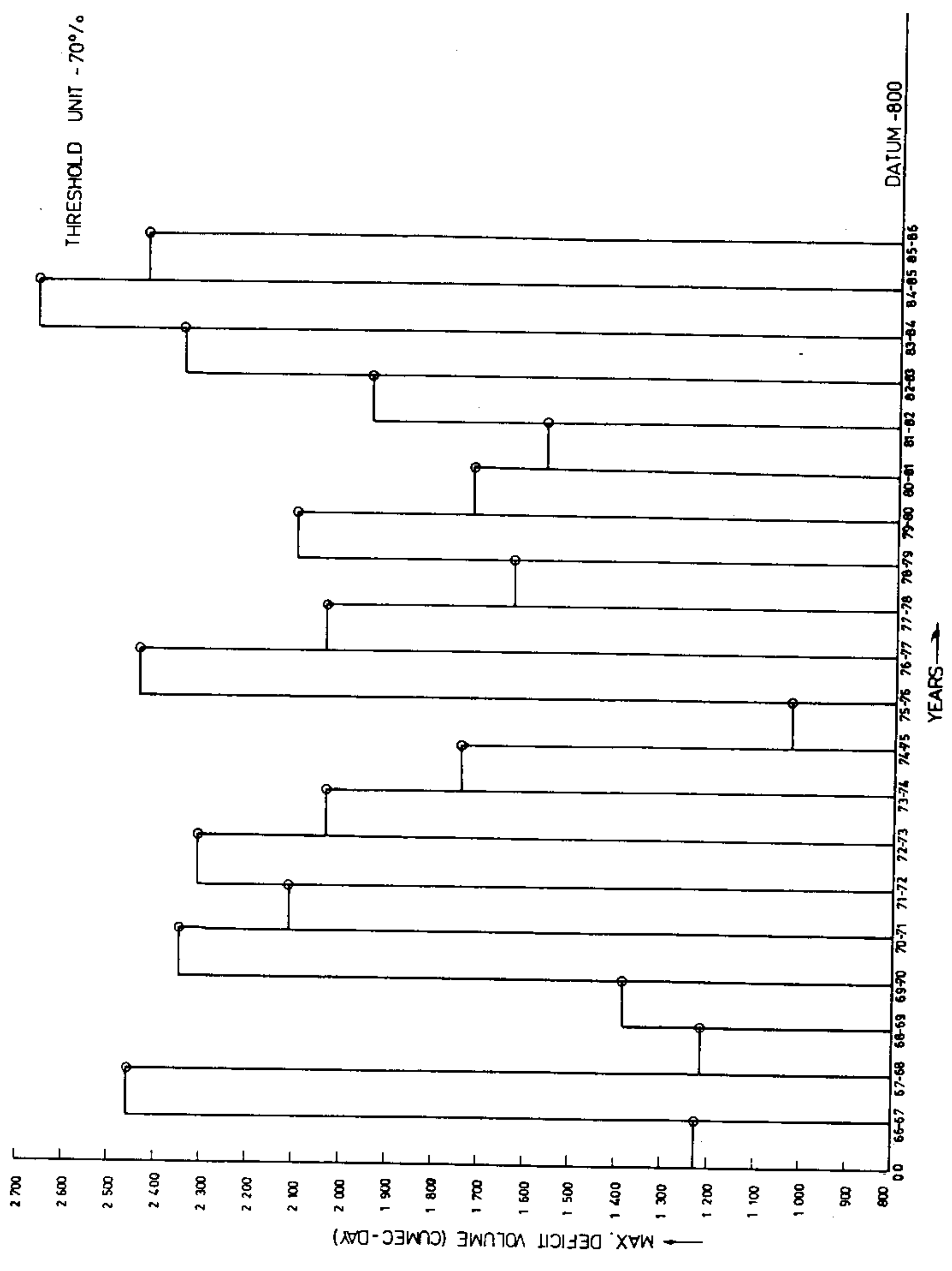


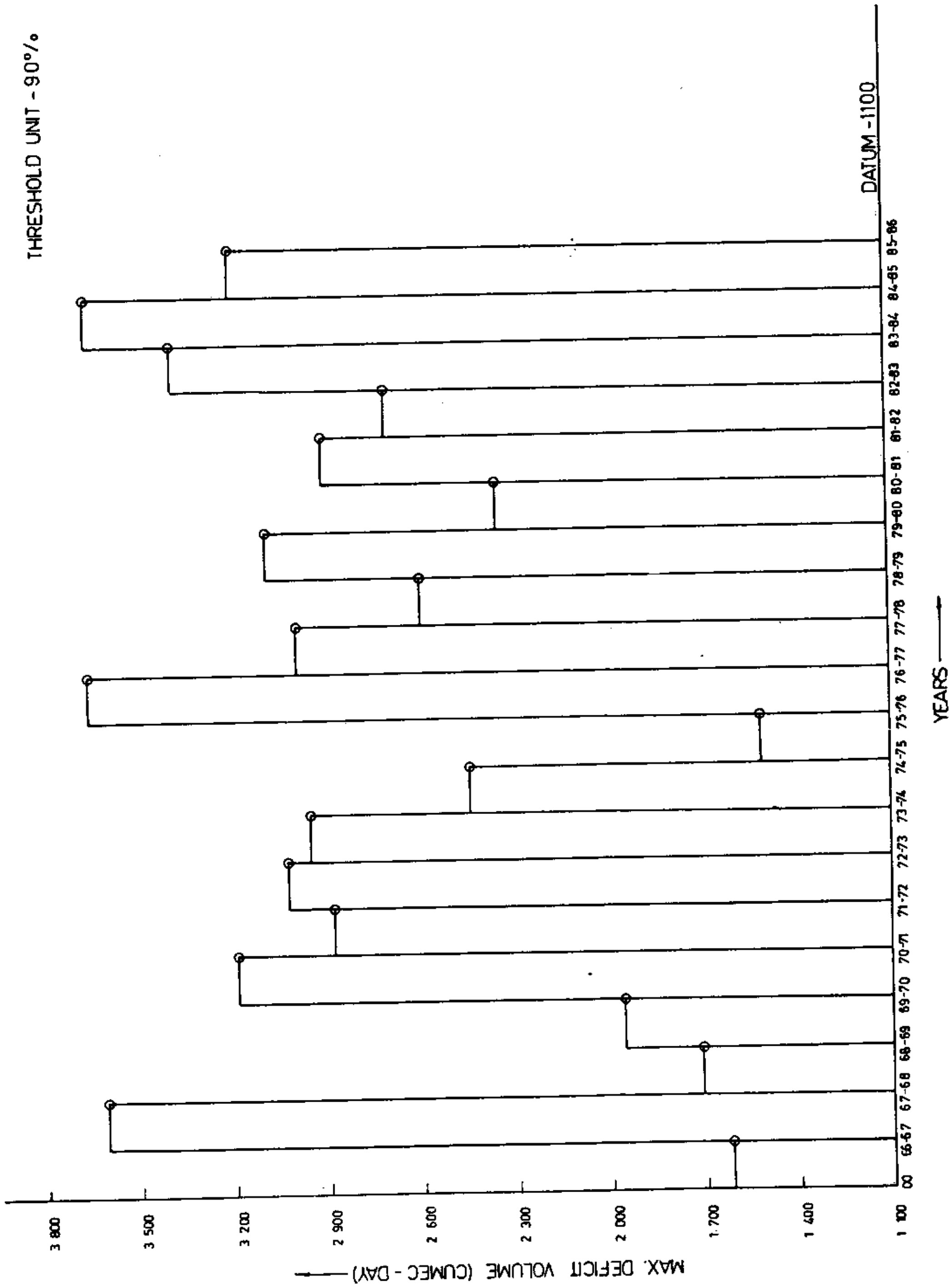
Fig.5.36 - VARIATION OF MAXIMUM DEFICIT VOLUME


THRESHOLD UNIT - 30%
YEAR
MAX. DEFICIT VOLUME (CUMEC-DAY)
00
100
200
300
400
500
600
700
800
900
1 000
66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81 81-82 82-83 83-84 84-85 85-86



THRESHOLD UNIT -50%
MAX DEFICIT VOLUME (CUMEC-DAY)
YEARS
00
90
180
270
360
450
540
630
720
810
900
990
1080
1170
1260
1350
1440
1530
1620
1710
1800
66-67
67-68
68-69
69-70
70-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
79-80
80-81
81-82
82-83
83-84
84-85
85-86


THRESHOLD UNIT - 70%
DATUM-800
YEARS
MAX. DEFICIT VOLUME (CUMEC-DAY)
800
900
1 000
1 100
1 200
1 300
1 400
1 500
1 600
1 700
1 800
1 900
2 000
2 100
2 200
2 300
2 400
2 500
2 600
2 700
66-67
67-68
68-69
69-70
70-71
71-72
72-73
73-74
74-75
75-76
76-77
77-78
78-79
79-80
80-81
81-82
82-83
83-84
84-85
85-86



THRESHOLD UNIT - 90%
DATUM - 1100
MAX. DEFICIT VOLUME (CUMEC - DAY)
1 100
1 400
1 700
2 000
2 300
2 600
2 900
3 200
3 500
3 800
YEARS
66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81 81-82 82-83 83-84 84-85 85-86

The maximum deficit volume and maximum deficit duration based on various ADF levels were computed for all chosen sites. Tables 5.30 through 5.38 show the maximum deficiency voluem and Tables 5.39 through 5.47 show maximum deficit duration for all sites. it is clearly indicated by tables that during 1984 and 1985 the deficit volume and deficit duration were large as compared to previous years. Therefore, it can be concluded that all gauging sites were faciing drought during 1985.

Based on calculations of deficit volumes and deficit durations, drought intensity was worked out. Drought intensity can be defined as the ratio of maximum deficiency volume and the corresponding deficit duration. Drought intensities were calculated for all chosen sites. The results are presented in Table 5.48 to 5.56. It can be seen from these tables that the drought intensity in year 1985 as compared to previous three/four years is more, indicating 1985 as drought year.

TABLE 5.30 : MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site : Karad   Average daily flow : 313.0362 cumec

Base period : 1st June - 31st October

Period	Threshold unit % ADF 10%	30%	Volume in cumec/days 50%	70%	90%	7 day low flow
1966	349.943	2760.034	5325.842	8449.967	11329.898	5.70
1967	289.351	2325.054	4122.175	5937.785	7753.395	0.42
1968	200.029	1488.228	2929.179	5231.563	8540.608	25.10
1969	376.851	2608.448	5169.615	8014.766	10907.633	4.30
1970	332.343	1213.552	2090.053	3110.607	8227.065	22.30
1971	70.443	1173.528	2586.416	4063.408	6423.940	198.70
1972	434.072	3073.234	5990.351	11608.500	16124.181	9.45
1973	123.122	929.174	1947.208	3203.659	4841.712	114.50
1974	216.333	2219.658	4285.697	6351.737	8417.775	26.30
1975	335.647	1449.684	2701.544	3891.082	5080.620	6.70
1976	273.072	1763.283	3391.071	5018.859	6646.647	110.30
1977	144.525	1225.528	2593.898	4449.759	10248.898	74.60
1978	186.151	1114.363	3473.663	7770.294	11010.695	108.30
1979	358.880	1925.072	3490.253	5055.434	6320.614	37.90
1980	274.265	1830.515	5388.159	8756.069	12136.860	94.30
1981	235.333	1618.439	3665.362	5606.186	7585.470	29.80
1982	434.558	1629.972	6006.133	10099.047	14015.486	14.20
1983	181.436	1590.339	3302.443	5197.186	7138.243	73.10
1984	227.541	976.541	1894.072	4962.038	1161.188	48.80
1985	151.840	1202.839	3094.543	6051.839	14635.010	79.10

TABLE 5.31 : MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site : Dhond Average daily flow : 379.5900 cumecs

Base Period : 1st June to 31st October

Period	Threshold unit % ADF 10%	Volumes in Cumec days 30%	50%	70%	90%	7 day low flow
1968	1176.729	4572.264	7988.573	11404.882	14821.191	0.0
1969	458.557	3004.983	5206.605	9054.220	12143.572	26.80
1970	427.803	2295.002	5263.330	7844.541	10425.755	66.80
1971	173.072	1144.301	2131.235	3118.169	4598.758	108.00
1972	1123.788	4025.280	7454.370	10972.411	14540.561	7.30
1973	614.121	3510.849	6319.815	9128.780	11937.748	22.80
1974	778.975	2805.679	4853.465	6970.677	10308.755	35.40
1975	133.008	1722.717	3496.371	5698.303	8051.761	144.60
1976	402.580	2148.425	4858.840	8041.780	13636.873	99.20
1977	338.203	1807.917	6850.056	10631.051	14426.954	114.60
1978	237.567	2208.287	4577.141	7006.515	9435.894	133.40
1979	522.452	2648.156	4773.860	6952.390	9229.931	112.80
1980	342.521	1997.348	3994.161	6333.517	8762.893	132.50
1981	206.531	1701.163	5131.841	7561.216	9990.593	84.10
1982	1077.342	5145.504	9093.239	13040.978	17153.406	28.80
1983	758.475	3770.479	6975.789	10225.659	14987.551	5.30
1984	286.072	1756.209	5025.641	7455.016	9884.392	10.70
1985	476.967	2837.933	6563.860	15407.401	21259.717	1.70

TABLE 5.32 : MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site : Narsingpur Average daily flow : 464.3876 cumec

Base period : 1st June to 31st October

Period	Threshold unit % ADF 10%	30%	50%	70%	90%	7 day low flow
		Volume in cumec days				
1967	615.520	2157.493	7495.878	14102.980		25.50
1968	360.849	1963.491	4395.233	9017.198		18.70
1969	559.243	3242.089	6503.159	10125.383		13.00
1970	237.326	3533.587	6877.178	10220.769		145.10
1971	270.349	1953.409	3718.082	7142.456		89.40
1972	1429.857	4739.268	8805.428	12921.710		7.90
1973	580.470	3206.872	6230.001	10314.913		24.30
1974	947.947	3615.672	7075.677	10419.269		32.29
1975	274.820	2369.291	4928.026	7896.985		188.40
1976	296.059	2287.207	6182.627	10636.037		192.00
1977	538.977	2118.605	3883.278	10606.037		40.30
1978	136.026	2538.507	6522.548	10330.527		223.30
1979	1245.857	6524.564	11447.072	17142.799		49.20
1980	538.281	2275.291	5059.614	7845.941		71.40
1981	260.443	2273.407	5168.415	7982.713		126.70
1982	1996.80	6547.798	11098.793	16108.010		5.70
1983	826.392	5009.053	8724.151	12454.325		41.30
1984	543.559	2122.477	3966.245	6288.184		64.90
1985	1844.045	6167.467	10532.709	22960.359		5.70

TABLE 5.33 : MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site : Takali Average daily flow : 501.1620 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF 10%	30%	50%	70%	90%	7 day low flow
	Volume in cumec days					
1965	672.421	4293.445	9241.646	13752.106	18262.561	40.00
1966	979.738	3774.459	7054.174	13823.787	18935.637	23.20
1967	630.711	2463.169	4721.363	7026.709	14112.681	8.30
1968	412.762	2086.024	6413.592	9621.032	12828.469	15.50
1969	585.811	3043.516	5549.325	8558.598	12318.443	11.70
1970	563.973	3947.348	7756.180	11565.013	15373.845	101.80
1971	210.230	1685.375	4552.587	7258.864	9965.140	142.00
1972	1745.800	5454.399	9162.999	13192.992	17603.219	0.0
1973	466.427	3451.658	6458.631	9465.604	12472.577	61.70
1974	715.289	3608.107	7399.798	11108.399	14816.999	88.30
1975	216.778	2866.864	6156.656	9587.372	14117.781	163.20
1976	350.813	2314.813	6393.927	11129.644	16042.794	0.0
1977	456.127	2055.575	3958.439	5921.169	7925.817	65.30
1978	118.246	1930.267	7569.385	11879.378	16189.372	247.20
1979	1802.632	7641.225	13053.775	19831.871	26379.623	0.0
1980	394.795	2160.870	6758.092	9965.531	13172.969	143.20
1981	175.781	1263.475	3180.001	5446.523	8417.529	229.00
1982	1638.900	6625.483	11654.833	16766.689	22024.492	0.40
1983	1595.465	5779.842	9998.464	14308.479	23181.236	39.90
1984	393.746	2616.172	4620.820	10768.780	15149.520	44.50
1985	1475.964	5793.489	10303.947	15912.771	29864.781	18.90

TABLE 5.34 : MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site : Yadgir

Average daily flow (ADF) = 760.1973 cumec

Base period : 1st June to 31st October

Period	Threshold unit % ADF 10%	Volume in cumec days 30%	50%	70%	90%	7 day low flow
1965	814.857	4722.712	11839.340	18529.074	25218.816	57.00
1966	998.475	4420.021	9717.647	16011.139	28657.029	52.50
1967	1215.425	3800.106	6384.777	19377.873	26067.615	0.0
1968	995.146	4817.023	9930.125	17416.770	23802.432	12.0
1969	431.678	4342.598	8534.662	13070.280	17783.504	140.10
1970	67.438	4557.690	10278.948	16733.762	22967.381	464.70
1971	164.118	1368.233	4070.877	7194.862	10382.429	392.60
1972	2558.089	8639.666	14721.245	20802.822	26884.402	0.0
1973	336.217	5645.275	10206.458	14817.584	19530.811	0.0
1974	64.859	1606.129	6724.958	11286.141	23466.047	571.30
1975	369.318	3616.098	7994.149	16907.377	23597.113	430.80
1976	754.297	2571.120	7674.149	14466.851	21502.047	3.50
1977	577.358	2567.788	5111.076	8062.162	17378.547	19.60
1978	112.978	2304.924	5941.663	10270.004	14679.150	420.40
1979	1439.314	6707.730	20119.025	28937.311	40883.270	25.30
1980	438.318	2660.284	6503.566	12949.695	18119.037	281.70
1981	504.158	1720.473	2936.789	4687.686	7489.975	82.20
1982	1069.393	6059.048	12236.546	18319.119	24424.881	184.20
1983	1448.474	5097.420	8746.366	12395.314	16044.262	7.30
1984	1608.474	5257.420	9038.565	17372.646	23150.148	30.30
1985	844.796	6083.985	12469.741	23624.178	31530.238	86.70

TABLE 5.35

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: Wadakbal
Base Period: 1st June to 31st Oct.

Average daily flow(ADF):
73.16883 Cumec

Threshold Unit % ADF Period	10%	30%	50%	70%	90%	7 day low flow
			Volumes in Cumec days			
1965	52.787(17)	514.273	1060.408	1623.338	2208.678	25.10
1966	119.655	502.470	1143.092	1727.727	2313.078	3.80
1967	116.270	412.816	775.310	1141.155	1519.551	0.00
1968	100.507	591.773	1275.030	1904.282	2533.533	1.25
1969	67.469	294.714	1001.039	1527.855	2054.670	11.55
1970	20.501	135.156	509.873	817.182	1714.918	31.00
1971	347.445	1188.138	2048.180	2911.573	3774.966	1.90
1972	358.999	1490.009	3416.608	4865.531	6314.093	6.00
1973	77.487	370.914	715.526	1076.455	1494.803	7.00
1974	75.536	469.921	939.586	1436.518	1946.618	4.70
1975	74.786	668.523	1195.339	1722.155	3067.906	1.80
1976	163.988	910.034	1689.258	2565.954	3415.465	0.00
1977	144.022	534.068	1196.561	1796.546	2396.530	0.00
1978	18.918	371.821	860.901	2661.100	3626.929	32.30
1979	297.792	1142.135	1932.359	2722.581	3512.805	0.00
1980	27.686	737.786	1567.296	2423.073	3286.465	28.10
1981	222.791	1477.898	2581.900	3822.990	5022.960	0.00
1982	392.496	1370.943	2908.431	4196.202	7026.575	0.00
1983	190.256	585.368	980.479	1575.591	1770.702	0.00
1984	321.943	965.828	1609.715	2578.615	3364.157	0.00
1985	257.058	827.775	1582.884	2573.501	5554.376	0.00

TABLE 5.36

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: Haralahalli
Base Period: 1st June to 31st October

Average daily flow(ADF):
491.7371 Cumecs

Threshold Unit % ADF / Period	10%	30%	50%	70%	90%	7 day low Flow
			Volumes in Cumec days			
1967	394.953	3519.534	6469.958	9420.379	12383.364	147.40
1968	126.616	1941.486	4203.477	6799.900	10637.857	217.80
1969	150.663	2397.286	4739.746	7843.279	10793.702	204.00
1970	0.00	722.496	2168.229	3752.572	5470.941	558.10
1971	0.00	259.506	751.243	2481.972	7386.618	1179.30
1972	381.874	3092.492	5846.220	8619.162	11471.239	177.50
1973	101.295	1094.575	2712.257	7780.748	13380.478	441.20
1974	207.011	3384.461	6924.967	10465.476	14005.483	191.70
1975	119.490	1998.143	4063.440	6128.736	8194.031	226.00
1976	180.290	2075.807	7044.811	11138.970	15765.161	172.40
1977	346.006	2213.801	4082.403	6347.769	8700.021	115.00
1978	183.637	1607.638	3181.197	4754.756	6328.314	199.50
1979	216.437	2689.449	5246.483	7803.516	12715.771	149.80
1980	0.00	241.206	2006.534	3776.788	6250.448	812.50
1981	14.347	810.039	3468.072	5435.020	7938.948	375.20
1982	160.890	1615.138	3664.440	6368.995	9601.756	201.70
1983	439.006	1914.217	5215.551	7961.148	10777.439	82.50
1984	112.895	1602.138	3175.697	4749.256	6322.814	257.90
1985	125.990	1946.301	3898.271	5865.219	8417.073	222.40

TABLE 5.35

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: Wadakbal
Base Period: 1st June to 31st Oct.

Average daily flow(ADF):
73.16883 Cumec

Threshold Unit % ADF Period	10%	30%	50%	70%	90%	7 day low flow
			Volumes in Cumec days			
1965	52.787(17)	514.273	1060.408	1623.338	2208.678	25.10
1966	119.655	502.470	1143.092	1727.727	2313.078	3.80
1967	116.270	412.816	775.310	1141.155	1519.551	0.00
1968	100.507	591.773	1275.030	1904.282	2533.533	1.25
1969	67.469	294.714	1001.039	1527.855	2054.670	11.55
1970	20.501	135.156	509.873	817.182	1714.918	31.00
1971	347.445	1188.138	2048.180	2911.573	3774.966	1.90
1972	358.999	1490.009	3416.608	4865.531	6314.093	6.00
1973	77.487	370.914	715.526	1076.455	1494.803	7.00
1974	75.536	469.921	939.586	1436.518	1946.618	4.70
1975	74.786	668.523	1195.339	1722.155	3067.906	1.80
1976	163.988	910.034	1689.258	2565.954	3415.465	0.00
1977	144.022	534.068	1196.561	1796.546	2396.530	0.00
1978	18.918	371.821	860.901	2661.100	3626.929	32.30
1979	297.792	1142.135	1932.359	2722.581	3512.805	0.00
1980	27.686	737.786	1567.296	2423.073	3286.465	28.10
1981	222.791	1477.898	2581.900	3822.990	5022.960	0.00
1982	392.496	1370.943	2908.431	4196.202	7026.575	0.00
1983	190.256	585.368	980.479	1575.591	1770.702	0.00
1984	321.943	965.828	1609.715	2578.615	3364.157	0.00
1985	257.058	827.775	1582.884	2573.501	5554.376	0.00

TABLE 5.36

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: Haralahalli
Base Period: 1st June to 31st October

Average daily flow(ADF): 491.7371 Cumecs

Threshold Unit % ADF Period	10%	30%	50%	70%	90%	7 day low Flow
			Volumes in Cumec days			
1967	394.953	3519.534	6469.958	9420.379	12383.364	147.40
1968	126.616	1941.486	4203.477	6799.900	10637.857	217.80
1969	150.663	2397.286	4739.746	7843.279	10793.702	204.00
1970	0.00	722.496	2168.229	3752.572	5470.941	558.10
1971	0.00	259.506	751.243	2481.972	7386.618	1179.30
1972	381.874	3092.492	5846.220	8619.162	11471.239	177.50
1973	101.295	1094.575	2712.257	7780.748	13380.478	441.20
1974	207.011	3384.461	6924.967	10465.476	14005.483	191.70
1975	119.490	1998.143	4063.440	6128.736	8194.031	226.00
1976	180.290	2075.807	7044.811	11138.970	15765.161	172.40
1977	346.006	2213.801	4082.403	6347.769	8700.021	115.00
1978	183.637	1607.638	3181.197	4754.756	6328.314	199.50
1979	216.437	2689.449	5246.483	7803.516	12715.771	149.80
1980	0.00	241.206	2006.534	3776.788	6250.448	812.50
1981	14.347	810.039	3468.072	5435.020	7938.948	375.20
1982	160.890	1615.138	3664.440	6368.995	9601.756	201.70
1983	439.006	1914.217	5215.551	7961.148	10777.439	82.50
1984	112.895	1602.138	3175.697	4749.256	6322.814	257.90
1985	125.990	1946.301	3898.271	5865.219	8417.073	222.40

TABLE 5.37

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: Bawapuram
Base Period: 1st June to 31st October

Average daily flow(ADF): 393.3645 Cumecs

Threshold Unit % ADF	10%	30%	50%	70%	90%	7 day low Flow
Period			Volumes in Cumec days			
1966	434.710	2200.343	12754.972	19992.879	27230.775	35.50
1967	816.275	4342.021	7913.983	11532.940	15151.893	17.30
1968	895.684	3951.221	7595.466	11333.647	15109.947	17.40
1969	422.274	1445.022	9576.852	14218.555	18860.258	37.70
1970	58.046	1706.043	7088.169	11819.221	16696.941	259.70
1971	172.428	2974.565	7831.305	12236.987	16642.670	112.20
1972	176.792	3163.693	8920.298	19339.516	27206.813	104.90
1973	111.082	1297.968	5993.439	10290.533	14675.071	241.00
1974	1052.039	4362.303	8686.275	18164.955	24380.119	28.20
1975	533.229	4050.593	8181.273	12115.360	16049.005	25.90
1976	754.711	5235.606	14201.028	20730.877	27260.729	31.20
1977	817.011	2874.162	5097.286	7420.155	16604.018	21.40
1978	687.675	4410.912	7872.520	11334.128	14795.735	15.00
1979	1223.612	5785.614	10112.625	18628.926	24372.047	10.70
1980	372.510	1717.578	3415.210	8659.141	11570.036	35.00
1981	984.021	3912.956	7084.690	10305.917	13610.180	17.90
1982	678.729	2507.862	4710.703	6913.545	12666.623	16.50
1983	613.920	3407.928	6161.479	8915.031	17528.127	14.90
1984	901.884	4119.774	7462.054	10766.317	14070.581	27.10
1985	2044.014	6673.352	11315.052	15956.155	26114.520	5.40

TABLE 5.38

MAXIMUM DEFICIT VOLUME OF LOW FLOW SPELLS

Site: T. Ramapuram

Average daily flow(ADF) = 49.14037

Base Period: 1st June - 31st Oct.

Threshold Unit % ADF / Period	10%	30%	50%	70%	90%	7 day low Flow
	Volumes in Cumec days					
1966	49.955	297.393	625.091	959.248	1403.884	1.40
1967	43.811	209.013	942.350	1608.599	2278.509	11.10
1968	37.009	445.315	881.065	1323.331	3376.568	19.30
1969	12.284	184.644	669.358	1184.619	1705.510	25.90
1970	12.413	163.317	593.632	1219.624	2489.142	22.50
1971	22.941	463.352	1413.668	2219.574	3025.483	16.40
1972	22.483	265.250	603.762	1915.985	2654.822	16.10
1973	4.814	139.644	384.899	658.537	1185.258	41.40
1974	25.041	424.930	860.836	1312.930	1765.024	14.60
1975	32.739	362.704	1028.028	1548.919	2069.810	20.10
1976	45.041	225.597	728.019	1339.311	1879.858	2.60
1977	13.341	290.208	602.951	918.650	1720.910	23.30
1978	49.539	399.577	738.562	1082.547	1426.531	6.90
1979	61.994	617.079	1635.030	2519.563	3404.095	4.20
1980	91.022	459.272	1212.375	1949.486	2780.228	7.40
1981	37.525	289.782	810.565	1252.831	1789.131	12.00
1982	85.380	352.182	627.369	1619.582	2376.349	3.90
1983	67.066	510.983	991.147	1479.123	1970.531	9.30
1984	191.691	604.473	1017.254	1430.036	1842.817	0.70
1985	160.778	785.563	1348.780	1918.811	2488.843	0.70

TABLE 5.39

MAXIMUM DURATION OF LOW FLOW SPELLS

Site: Karad
Base Period: 1st June - 31st Oct.

Average daily flow(ADF):
313.0362 Cumecs

Threshold Unit % ADF / Period	Duration in days				
	10%	30%	50%	70%	90%
1966	14	40	41	47	48
1967	14	28	29	29	29
1968	10	25	32	38	39
1969	15	37	45	46	47
1970	12	16	18	21	48
1971	12	21	23	24	35
1972	20	40	47	67	73
1973	06	16	17	26	28
1974	09	33	33	33	33
1975	13	17	19	19	19
1976	20	26	26	26	26
1977	12	21	22	26	49
1978	14	20	31	51	52
1979	22	25	27	30	32
1980	18	29	53	54	54
1981	12	22	31	38	39
1982	16	25	55	61	64
1983	11	28	30	31	32
1984	11	13	23	37	61
1985	11	22	30	41	74

TABLE 5.40 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Dhond Average daily flow : 379.5900 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
				Duration in days		
1968		31.00	45.00	45.00	45.00	45.00
1969		23.00	29.00	29.00	40.00	41.00
1970		17.00	26.00	34.00	34.00	34.00
1971		8.00	13.00	13.00	15.00	18.00
1972		37.00	40.00	46.00	47.00	47.00
1973		19.00	37.00	37.00	37.00	37.00
1974		25.00	27.00	27.00	29.00	34.00
1975		12.00	21.00	26.00	31.00	31.00
1976		20.00	25.00	32.00	37.00	54.00
1977		17.00	25.00	49.00	50.00	50.00
1978		13.00	31.00	32.00	32.00	32.00
1979		29.00	28.00	28.00	30.00	32.00
1980		19.00	24.00	28.00	32.00	32.00
1981		9.00	19.00	32.00	35.00	38.00
1982		38.00	52.00	52.00	52.00	55.00
1983		25.00	40.00	42.00	43.00	50.00
1984		8.00	17.00	32.00	32.00	32.00
1985		18.00	29.00	48.00	77.00	78.00

TABLE 5.41 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Narsingpur Average daily flow: 464.3876 cumec

Base period : 1st June to 31st Oct.

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
		Duration in days				
1967		17	19	36	53	
1968		9	24	27	42	
1969		14	38	39	39	
1970		11	36	36	39	
1971		9	19	19	26	
1972		35	41	44	45	
1973		16	29	32	38	
1974		27	29	36	36	
1975		16	24	28	32	
1976		17	25	44	48	
1977		15	19	22	37	
1978		11	25	41	41	
1979		35	53	53	63	
1980		15	24	30	30	
1981		14	25	30	31	
1982		49	49	49	52	
1983		23	40	40	41	
1984		17	17	25	25	
1985		48	48	48	75	

TABLE 5.42 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Takali Average daily flow : 501.1620 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
		Duration in days				
1965		26	40	45	45	45
1966		27	30	35	51	51
1967		16	22	23	23	41
1968		10	19	32	36	38
1969		13	25	26	37	38
1970		23	38	38	38	38
1971		8	18	27	27	27
1972		37	41	42	44	44
1973		14	30	30	30	30
1974		24	31	37	37	37
1975		11	26	34	35	41
1976		14	27	46	48	50
1977		14	18	20	21	21
1978		9	25	43	43	43
1979		39	54	54	65	66
1980		12	22	32	32	32
1981		5	18	21	24	29
1982		37	49	51	51	61
1983		41	42	43	43	62
1984		10	20	21	43	44
1985		41	45	45	50	74

TABLE 5.43 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Yadgir Average daily flow : 760.1973 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
				Duration in days		
1965		16	34	44	44	44
1966		19	25	39	43	54
1967		17	18	26	44	44
1968		14	33	34	42	42
1969		9	27	28	31	36
1970		7	37	38	41	41
1971		6	10	17	20	21
1972		40	40	40	41	62
1973		14	30	30	31	31
1974		4	14	30	30	47
1975		6	27	30	44	44
1976		10	24	37	46	47
1977		11	17	18	20	38
1978		9	19	28	29	29
1979		26	36	58	58	68
1980		8	20	25	34	34
1981		8	9	14	18	19
1982		25	38	40	40	41
1983		24	24	24	24	24
1984		24	24	25	38	28
1985		15	42	43	52	52

TABLE 5.44 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Wadakbal

Average daily flow (ADF)

Base period : 1st June to 31st October

= 73.16883 cumec

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
				Duration in days		
1965		18	35	38	40	40
1966		21	31	39	40	40
1967		16	24	25	25	26
1968		30	35	43	43	43
1969		10	22	36	36	36
1970		6	10	21	21	36
1971		56	58	59	59	59
1972		55	75	99	99	99
1973		17	22	24	25	27
1974		22	32	33	34	35
1975		15	36	36	36	54
1976		31	52	54	60	60
1977		25	27	41	41	41
1978		9	32	32	66	66
1979		41	54	54	54	54
1980		11	55	58	59	59
1981		35	75	77	82	82
1982		59	66	88	88	113
1983		27	27	27	27	27
1984		44	44	44	53	54
1985		39	39	46	55	90

TABLE 5.45 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Haralahalli Average daily flow : 491.7371 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
		Duration in days				
1967		17	30	30	30	33
1968		7	23	23	25	34
1969		9	23	24	30	30
1970		0.0	14	15	17	18
1971		0.0	5	11	17	35
1972		20	28	28	29	39
1973		4	13	30	53	58
1974		13	36	36	36	36
1975		8	21	21	21	26
1976		8	26	45	52	53
1977		15	19	19	23	24
1978		10	16	16	16	20
1979		10	26	26	29	50
1980		0.0	6	18	26	26
1981		2.0	11	20	20	26
1982		8	18	29	31	34
1983		15	15	27	28	29
1984		6	16	16	17	33
1985		8	19	25	34	39

TABLE 5.46 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : Bawapuram Average daily flow : 393.3645 cumecs

Base period : 1st June to 31st October

Period	Threshold unit % ADF	10%	30%	50%	70%	90%
		Duration in days				
1966		14	29	92	92	92
1967		24	45	46	46	46
1968		27	45	47	48	48
1969		13	14	59	59	59
1970		4	26	58	62	62
1971		9	39	56	56	56
1972		11	42	79	100	100
1973		5	18	54	55	56
1974		34	43	52	79	79
1975		20	42	50	50	50
1976		33	54	83	83	83
1977		25	28	29	30	54
1978		24	44	44	44	44
1979		36	55	55	73	73
1980		14	19	22	37	37
1981		28	38	40	42	42
1982		20	28	28	28	40
1983		17	35	35	35	58
1984		27	40	42	42	42
1985		58	59	59	59	79

TABLE 5.47 : MAXIMUM DURATION OF LOW FLOW SPELLS

Site : T.Ramapuram

Base period : 1st June to 31st October

Average daily flow (ADF) = 49.14037 cumec

Period	Threshold unit % ADF 10%	30%	50%	70%	90%
	Duration in days				
1966	13	33	34	34	37
1967	15	25	59	66	68
1968	22	43	45	45	89
1969	6	20	52	53	53
1970	11	17	36	50	73
1971	10	51	82	82	82
1972	13	32	35	75	76
1973	2	20	30	34	36
1974	14	41	46	46	46
1975	17	38	53	53	53
1976	10	26	43	55	64
1977	10	31	32	33	53
1978	17	35	35	35	35
1979	28	54	90	90	90
1980	30	42	75	75	80
1981	16	28	45	45	50
1982	27	28	31	77	77
1983	26	47	49	50	50
1984	42	42	42	42	42
1985	34	56	58	60	60

TABLE 5.48

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Karad

Threshold Unit % ADF	Drought intensity in Cumes				
Year	10%	30%	50%	70%	90%
1966	29.162	69.001	129.899	179.787	236.040
1967	20.668	83.038	141.799	204.751	267.358
1968	25.004	58.729	91.537	163.486	218.990
1969	26.918	70.499	114.880	174.234	232.077
1970	27.695	75.847	116.114	148.124	171.397
1971	5.870	55.882	112.453	169.309	183.541
1972	21.704	76.831	127.954	173.261	220.879
1973	20.520	58.073	114.542	123.218	172.918
1974	24.037	67.262	129.870	192.477	255.023
1975	25.819	85.276	142.187	204.794	267.401
1976	13.654	67.819	130.426	193.033	255.640
1977	20.646	58.358	117.904	171.145	209.161
1978	13.297	55.718	112.054	152.359	211.744
1979	16.313	77.003	129.269	168.514	197.519
1980	15.237	63.121	101.663	162.149	224.757
1981	26.148	73.565	118.237	147.531	194.499
1982	27.160	65.199	109.202	165.558	218.992
1983	18.144	56.798	110.081	167.651	223.070
1984	20.704	75.119	82.351	134.109	182.970
1985	13.804	54.675	103.151	147.606	197.770

TABLE 5.49

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Dhond

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1968	37.959	101.606	177.524	253.442	329.358
1969	19.937	103.620	179.538	226.356	296.160
1970	25.165	88.269	154.804	230.722	306.640
1971	21.634	88.023	163.941	207.878	255.487
1972	30.373	100.632	162.052	233.456	309.374
1973	32.322	94.888	170.806	246.724	322.642
1974	31.159	103.914	179.832	240.368	303.199
1975	11.084	82.034	134.476	183.816	259.734
1976	20.129	85.937	151.839	217.345	252.535
1977	19.894	72.317	139.797	212.621	288.539
1978	18.274	71.235	143.036	218.954	294.872
1979	18.659	94.577	170.495	231.746	288.435
1980	18.027	83.223	142.649	197.922	273.840
1981	22.948	89.535	160.370	216.035	262.910
1982	28.351	98.952	174.870	250.788	311.880
1983	30.339	94.262	166.090	237.806	299.751
1984	35.759	103.306	157.051	232.969	308.887
1985	26.498	97.860	136.747	200.096	272.560

TABLE 5.50

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Narsingpur

Threshold Unit % ADF / Year	Drought intensity in Cumecs				
	10%	30%	50%	70%	90%
1967	38.470	119.861	208.219	266.094	358.971
1968	40.094	81.812	162.786	214.695	300.498
1969	39.946	108.070	166.748	259.625	352.487
1970	21.575	98.155	191.033	283.910	376.788
1971	30.039	102.811	195.689	275.095	367.972
1972	40.844	115.592	200.123	287.149	380.027
1973	36.279	110.582	210.313	271.445	364.322
1974	35.109	124.678	196.530	289.424	382.302
1975	17.176	98.720	176.001	246.781	331.306
1976	17.415	91.488	140.514	221.586	303.717
1977	35.898	111.506	204.38	286.650	379.527
1978	12.366	101.540	159.087	251.964	338.025
1979	35.596	123.105	215.982	272.108	359.633
1980	35.952	94.804	168.654	261.531	366.202
1981	18.603	90.936	172.281	257.507	330.742
1982	40.751	133.629	226.506	309.769	372.304
1983	35.930	125.226	218.104	303.764	348.809
1984	31.974	124.852	158.650	251.527	344.405
1985	38.418	131.223	224.100	306.138	394.786

TABLE 5.51

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Takali

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1965	25.862	107.336	205.370	305.602	405.835
1966	36.287	125.815	213.763	271.055	371.287
1967	48.516	111.962	205.277	305.509	344.212
1968	41.276	109.791	200.425	300.657	400.890
1969	45.062	121.741	221.973	321.313	324.170
1970	24.521	103.878	204.11	304.342	404.575
1971	26.279	93.632	168.614	268.847	369.079
1972	47.184	147.416	247.649	299.841	400.073
1973	33.316	115.055	215.288	315.520	415.753
1974	29.804	116.391	199.995	300.227	400.459
1975	19.707	110.264	181.078	273.925	344.336
1976	50.116	85.734	138.998	231.868	320.856
1977	32.581	114.199	208.339	296.058	396.291
1978	13.138	80.428	176.032	276.265	376.497
1979	46.221	141.504	241.737	305.106	399.691
1980	32.900	98.221	211.190	311.423	411.655
1981	35.156	70.193	151.429	226.938	290.260
1982	44.295	135.214	228.526	328.759	361.057
1983	38.914	137.615	232.523	332.755	373.891
1984	43.750	130.809	220.039	250.437	344.307
1985	35.999	128.744	228.977	318.255	403.578

TABLE 5.52

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Yadgir

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1965	62.681	138.903	269.076	421.115	573.155
1966	52.513	184.168	249.170	372.352	530.687
1967	71.496	223.536	245.568	440.406	592.446
1968	71.082	145.970	292.063	414.685	566.725
1969	47.964	160.837	304.809	421.622	573.661
1970	9.633	61.590	270.500	408.141	560.180
1971	27.353	152.026	239.463	359.743	494.401
1972	63.952	215.992	368.031	520.071	672.110
1973	76.020	188.176	340.215	361.404	630.026
1974	21.620	114.724	224.165	376.205	499.278
1975	61.553	133.930	266.489	384.258	536.298
1976	75.430	107.130	207.409	314.497	457.490
1977	52.487	171.181	283.949	403.108	457.330
1978	12.553	121.312	212.202	354.138	506.178
1979	55.358	186.326	346.880	498.919	601.225
1980	73.053	133.014	260.143	380.873	532.913
1981	63.020	215.059	367.099	260.427	394.209
1982	42.776	159.449	305.939	457.980	595.729
1983	60.353	212.393	364.432	476.743	668.500
1984	67.020	219.059	361.543	457.175	609.215
1985	56.320	144.857	289.994	454.311	606.351

TABLE 5.53

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Wadakbal

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1965	3.0	14.6945	27.9054	40.5834	55.2169
1966	5.6978	16.2087	29.3100	43.1931	57.8269
1967	7.2668	17.2006	31.0124	45.6462	58.4426
1968	3.3502	16.9078	29.6518	44.2856	58.9193
1969	5.1469	13.3960	27.8066	42.4404	57.0741
1970	3.4168	13.5156	24.2796	38.9134	48.9976
1971	6.2043	20.4851	34.7149	49.3486	63.9824
1972	6.5272	19.8668	34.5119	49.1464	63.7787
1973	4.5580	16.8597	29.8135	43.0582	55.3630
1974	5.3954	14.6850	28.4723	42.2505	55.6005
1975	6.7987	18.5700	33.2038	47.8376	56.8130
1976	7.1299	17.5006	31.2805	42.7659	57.8909
1977	5.7608	19.7802	29.1844	43.8181	58.4519
1978	2.7025	11.6194	26.9031	40.3196	54.9534
1979	7.2632	21.1506	35.7844	50.4181	65.0519
1980	2.5169	13.4142	27.0223	41.0690	55.7027
1981	6.3657	19.7053	33.5311	46.6218	61.2556
1982	6.6524	20.7718	33.0503	47.6841	62.182
1983	7.0465	21.6802	36.314	50.9478	65.5815
1984	7.3168	21.9506	36.5844	48.6531	62.299
1985	6.5912	21.225	34.4105	46.7909	61.7152

TABLE 5.54

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Haralahalli

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1967	23.232	117.318	215.665	314.013	375.253
1968	18.088	84.412	182.760	271.996	312.878
1969	17.407	104.230	197.489	261.443	359.790
1970	0.00	51.607	144.549	220.740	303.941
1971	0.00	51.091	68.295	145.998	211.046
1972	19.094	110.446	208.794	297.212	294.134
1973	25.324	84.198	75.340	146.807	267.610
1974	15.924	94.013	192.360	290.708	389.055
1975	14.936	95.150	193.497	291.845	315.153
1976	22.611	79.839	156.551	214.211	297.456
1977	23.067	116.516	214.863	275.990	362.501
1978	18.364	100.477	198.825	297.172	316.416
1979	21.644	103.440	201.788	269.087	254.315
1980	0.00	40.201	111.474	145.261	240.402
1981	7.173	73.640	173.404	271.751	305.344
1982	20.111	89.729	126.360	205.451	282.405
1983	29.267	127.614	193.169	284.327	371.636
1984	18.816	100.134	198.481	279.368	191.600
1985	15.749	102.437	155.931	172.506	215.822

TABLE 5.55

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: Bawapuram

Threshold Unit % ADF / Year	Drought intensity in Cumecs				
	10%	30%	50%	70%	90%
1966	31.051	84.629	138.641	217.314	295.987
1967	34.011	96.489	172.043	250.716	329.389
1968	33.173	87.805	161.606	236.118	314.791
1969	32.483	111.156	162.320	240.992	319.665
1970	14.512	65.617	122.210	190.633	296.306
1971	19.159	76.271	139.845	218.518	297.191
1972	22.099	75.326	112.915	193.395	272.068
1973	22.216	72.109	110.990	187.101	262.055
1974	30.942	101.449	167.044	229.936	308.609
1975	26.661	96.443	163.625	242.307	320.980
1976	30.188	96.956	171.097	249.770	328.442
1977	32.680	102.649	175.768	247.339	307.482
1978	28.653	100.284	178.921	257.594	336.267
1979	33.989	105.193	183.866	255.191	333.864
1980	26.608	90.399	155.237	234.031	312.704
1981	35.144	102.973	177.117	245.379	324.052
1982	33.936	89.567	168.239	246.912	316.666
1983	36.113	97.369	176.042	254.715	302.209
1984	33.403	102.994	177.668	256.341	335.014
1985	35.242	113.108	191.781	270.453	330.564

TABLE 5.56

DROUGHT INTENSITY IN DIFFERENT LOW FLOW SPELLS

Site: T. Ramapuram

Threshold Unit % ADF	Drought intensity in Cumecs				
Year	10%	30%	50%	70%	90%
1966	4.5412	9.0119	18.385	28.2131	37.9428
1967	2.9207	8.7088	15.972	24.3727	33.5074
1968	1.6822	10.3561	19.57922	29.4073	37.9389
1969	2.0473	9.2322	12.8722	22.3513	32.1794
1970	1.5515	9.6068	16.4897	24.3924	34.0978
1971	2.2941	9.08533	17.2398	27.0679	36.8961
1972	1.7294	8.2890	17.2503	25.5464	34.9318
1973	4.814	6.9822	14.2554	23.5191	32.9238
1974	2.504	10.3641	18.7138	28.5419	38.3700
1975	1.9258	9.5448	19.3967	29.224	39.0530
1976	4.504	8.6768	16.9306	24.3511	29.3727
1977	1.3341	9.3615	18.8422	27.8378	32.47
1978	2.9140	11.2736	21.1017	30.9299	40.758
1979	2.214	11.4273	18.167	27.9951	37.8232
1980	3.034	10.9350	16.165	25.9931	34.7528
1981	2.3453	10.3493	18.0125	27.8406	35.7826
1982	2.3075	12.5779	22.406	21.0335	30.8616
1983	2.5794	10.8719	20.2274	29.5824	39.4106
1984	4.564	14.3922	24.2203	34.0484	43.8765
1985	4.7287	14.02791	23.2548	33.0828	42.911

6.0 GROUND WATER DEFICIT

6.1 General

Ground water is the main source of water supply in drought affected areas because of meagre surface water supplies during droughts. Statistics recently compiled on the use of ground water and surface water show that in a number of states ground water is being over-exploited in certain pockets resulting in a fall in the water table. Increase demand of water during the drought period is an inherent feature. Due to deficiency of rain fall and higher rate of evapotranspiration, the demand for irrigation gets enhanced, thereby the water level goes down. This results in increased use of energy for pumping water from greater depths involving higher expenditure. As a policy, the withdrawal of groundwater should be restricted to average annual recharge. This will conserve water for over exploitation during drought periods. With a view to study the effects of successive droughts on ground water regime, analysis of data as carried out for selected districts in six drought prone states is presented in following section:

6.2 Ground Water level Analysis

As has been described in Chapter 2, the data of ground water levels were collected from six states with two districts in each state. Table 6.1 gives the details regarding length of data used for study, number of observation wells and source of data as has been used for ground water deficit analysis. As can be seen from table 6.1, in

TABLE : 6.1

STATUS OF GROUND WATER DATA

Sl.No.	State	District	Data available	No. of Obs. well	Source of data availability
1.	Andhra Pradesh	1. Anantpur	1978-79 (monthly)	6	State Groundwater Board, Hyderabad
		2. Cuddapah	1975-86 (monthlY)	6	-do-
2.	Gujarat	1. Jamnagar	1979-85(five times in a year)	10	C.G.W.B
		2. Rajkot	1978-86 (Pre ;Post Monsoon)	6	G.W.R.D.S,(Ahmedabad)
3.	Karnataka	1. Belgaum	1977-86(five times in a year)	6	C.S.W.B.
		2. Bijapur	1984-86(six times in a year)	6	C.G.W.B
4.	Madhya Pradesh	1. Jhabua	1975-84(Pre & Post Monsoon	11	State Groundwater Board
		2. Khargone	1975-85(do)	15	-do-
5.	Maharashtra	1. Ahmadnagar	1975-86 (-do)	8	Groundwater survey and Development Agency, Auragabad.
		2. Solapur	1978-86 -do-	9	-do-
6.	Rajasthan	1. Banswara	1979-86(five times in a year)	7	C.G.W.B.
		2. Barmer	1978-86 -do	10	C.G.W.B.

each district 6-15 wells uniformly distributed over the district were chosen for the analysis based on availability of data. The figures showing locations of wells chosen for study are presented in Chapter 2. The analysis was carried out using monthly/quarterly/seasonal data depending on the availability status. The list of observation wells for all 12 districts chosen in six states and corresponding latitute and longitude is given in Appendix VI-1.

The water levels in the wells have been calculated with respect to mean sea level. For each district, average ground water level has been calculated using Thiessen Polygon Method. For this purpose Theissen weights for all wells being considered for analysis were established and for each month theissen weight average ground water level for each district was calculated. For example, it can be seen from appendix VI-2, that for Jan. 74, the average ground water level for district Anantpur in Andhra Pradesh works out to be 472.27 m w.r.t. M.S.L. which has been calculated using water level data of six wells namely, Jallipalli, Hindupur, Talupula, Medapuram, Madakriya and Golla for which the Theissen weights were calculated as 0.2302, 0.0877, 0.1474, 0.2469, 0.0627 and 0.2251, respectively. Similar analysis was carried out for all districts and the computations have been shown in Appendix VI-2 through VI-13. The average values (monthly/seasonal) computed for districts were plotted against time unit. The trend in ground water level fluctuations was worked out by carrying out simple regression analysis. Similarly the total rainfall each year was plotted and again a simple regression line was fitted showing trend of rainfall over the period of ground water table data analysis. These graphs showing trends of rainfall and ground water levels over the period of analysis have been shown in figures 6.1 through 6.12.

Based on the analysis following broad inferences can be drawn:

(a) In Rajasthan, quarterly ground water levels have been plotted for the districts of Banswara and Barmer which show continuous decline in ground water levels (Figures 6.1 and 6.2). The reason for continuous declining of water level could be attributed to deficient natural rainfall recharge and increased dependence on ground water during drought. It is also evident from figures 6.1 and 6.2 that the rate of decline in ground water level is higher in case of Barmer as compared to Banswara district. However, the rainfall trend shows steeper decline in Banswara which infers that rate of abstraction could be higher in case of Barmer district. As can be seen in figure 6.1 that the ground water level during 1985-86 is lower as compared to ground water level during 1984-85. It may be due to less rainfall recharge to ground water during 1985-86. This fact can be supported by rainfall analysis presented in Chapter 3 where it has been found that rainfall was below normal by 37% and above normal by 16% during 1985-86 and 1984-85 respectively.

(b) In Madhya Pradesh, premonsoon and postmonsoon ground water levels have been plotted with respect to time for

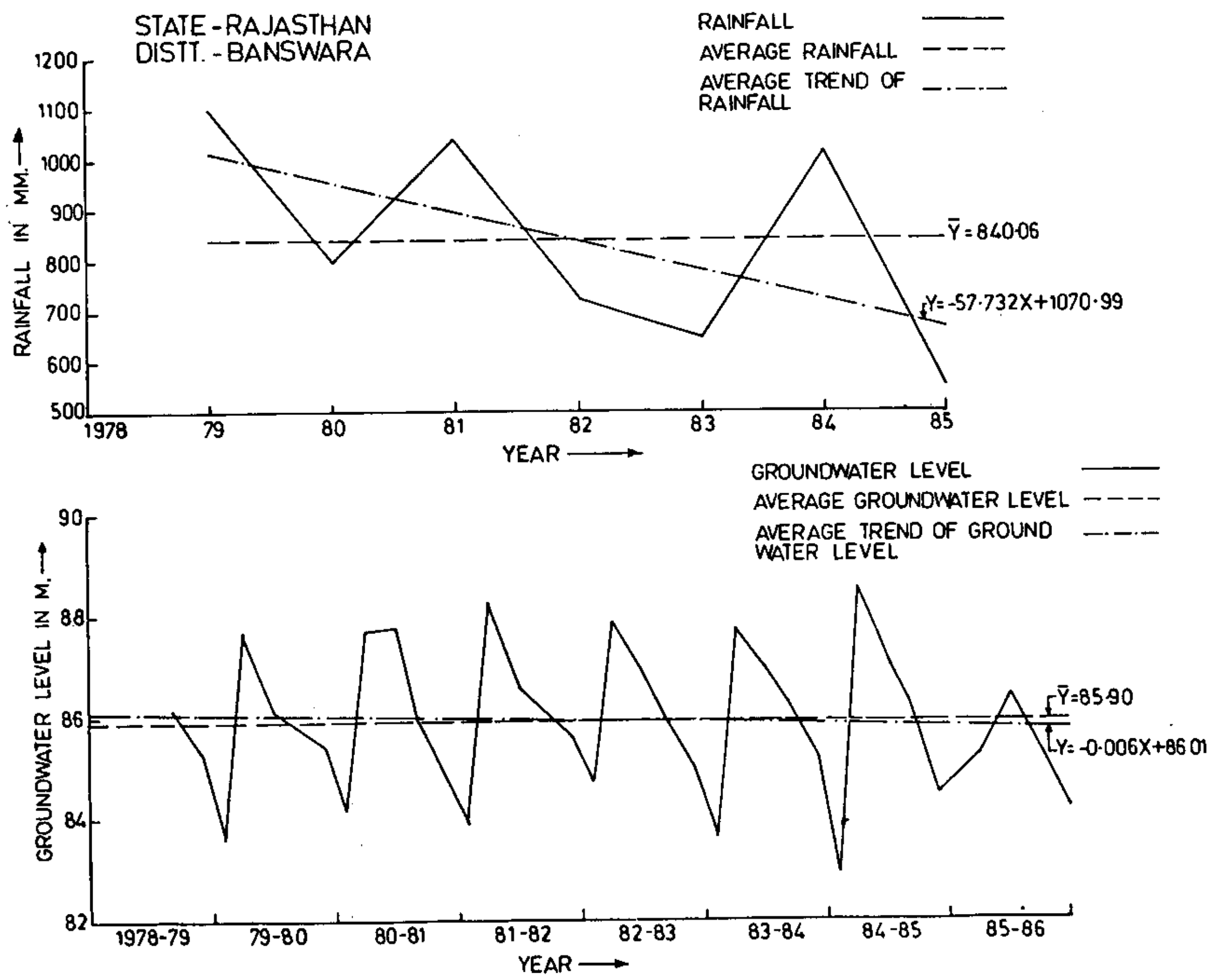


Fig. 6.1 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

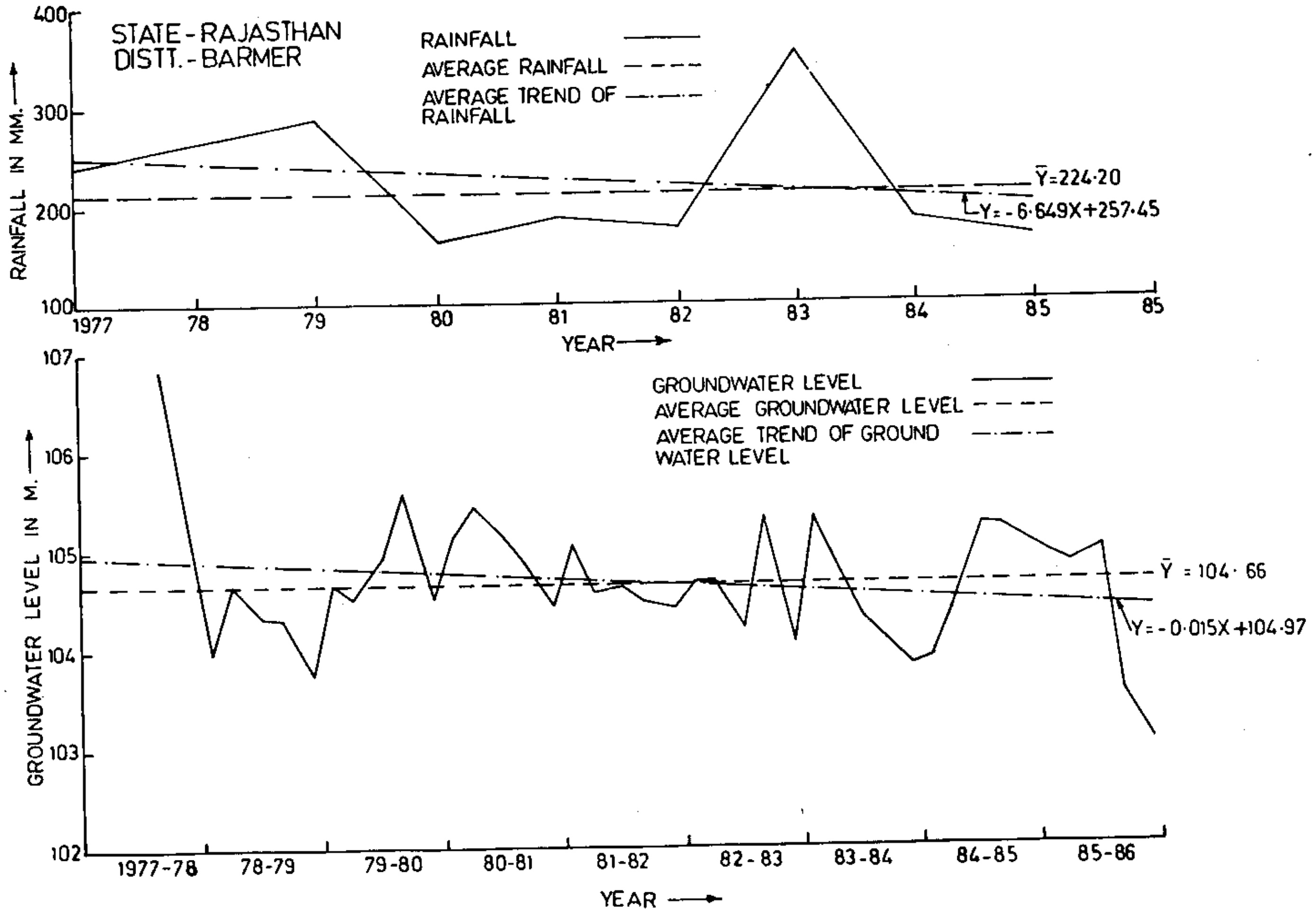


Fig. 6.2 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

VI-5

the districts of Jhabua and Khargaon (Fig. 6.3 and 6.4). As can be seen in these figures the ground water levels show continuous decreasing trend during the period of analysis. It is also evident from figures that the rate of decline in ground water level is relatively higher in Khargaon as compared with Jhabua district indicating that rate of abstraction from ground water was higher in case of Khargon district. Although the rate of declination of rainfall in case of Jhabua is relatively higher. It can be noticed from figure 6.4 that ground water level for post-monsoon has been continuously decreasing up to year 1980-81 which may be due to less rainfall recharge. However, the general trend show continuous declining trend of ground water level.

(c) In Gujarat, quarterly ground water levels have been plotted against time for the district of Jamnagar which shows moderate decreasing trend in ground water level (fig.6.5). The ground water levels have fallen below long term normal levels after 1982-83. It can be noticed from figure 6.5 that the ground water level fall below normal during 1985-86 which may be due to the less rainfall recharge. This fact can be supported by the results of analysis presented in chapter 3 where it has been found that the rainfall was about 55% below normal during that year. The seasonal ground water levels have been plotted for the district of Rajkot which shows very steep decreasing trend (figure 6.6). The decline has been severe after 1982-83. The continuous decline in water level may be due to continuous increase of draft and decrease in rainfall recharge. It can also be noticed

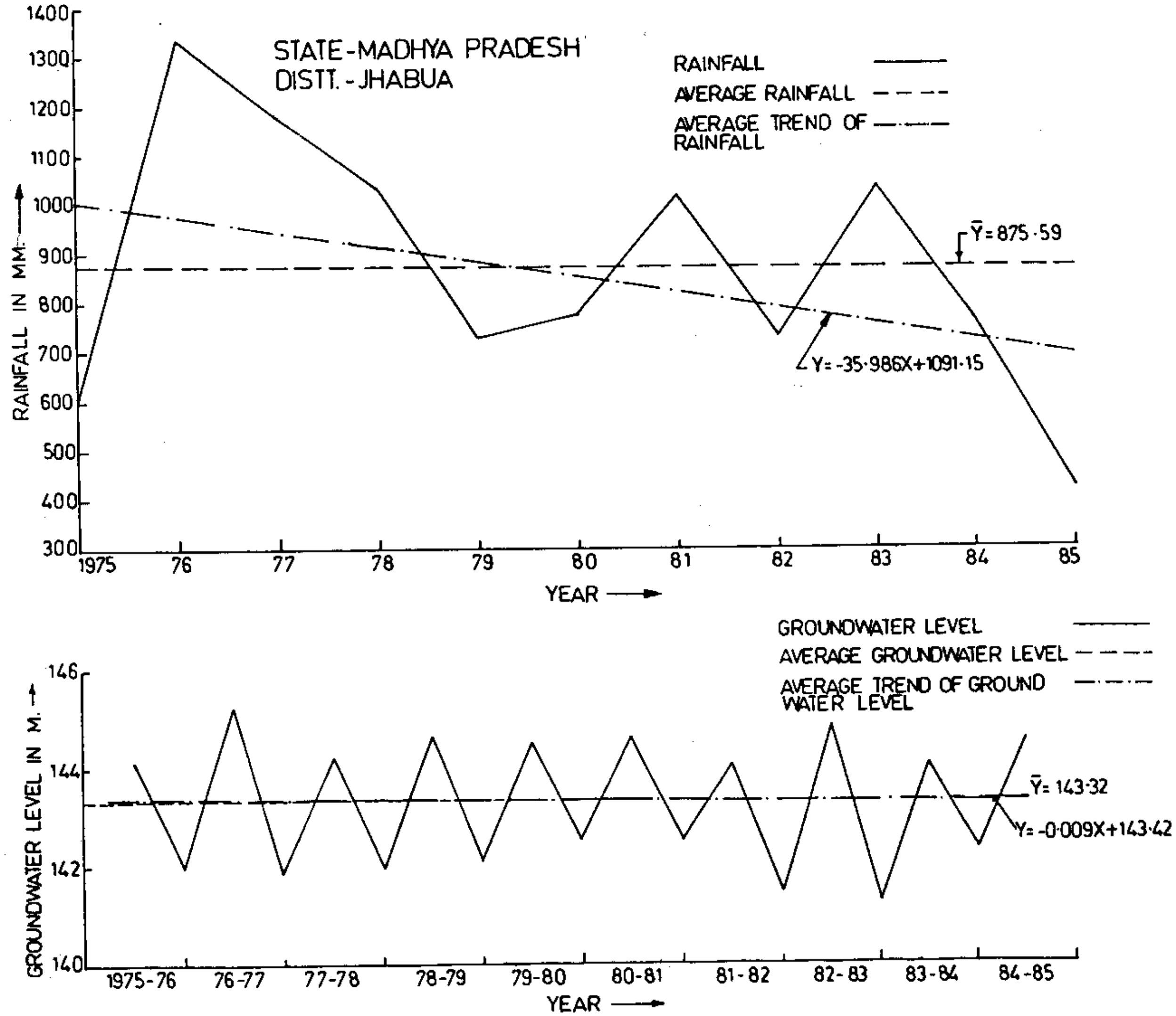


Fig. 6.3 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

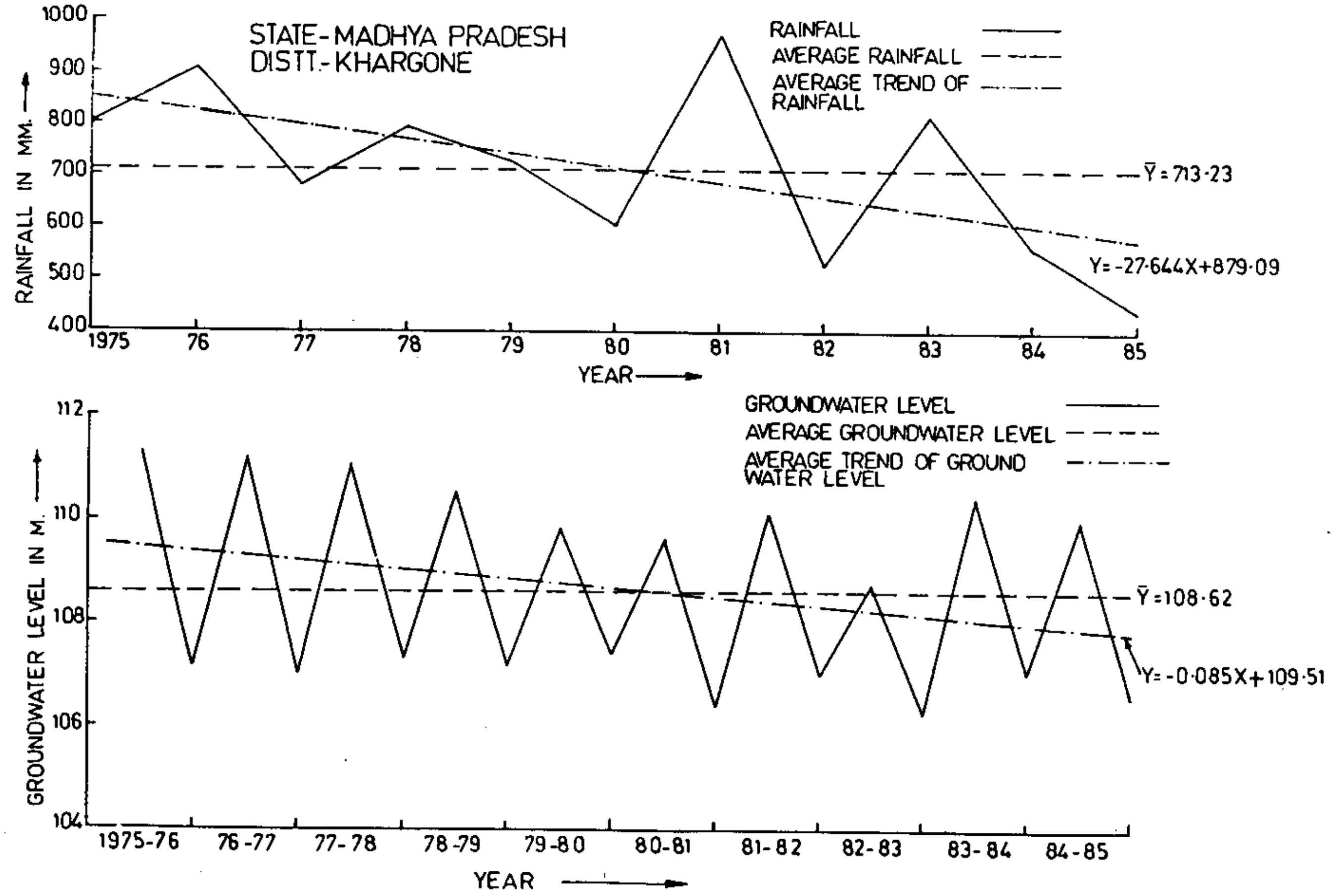


Fig. 6.4 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

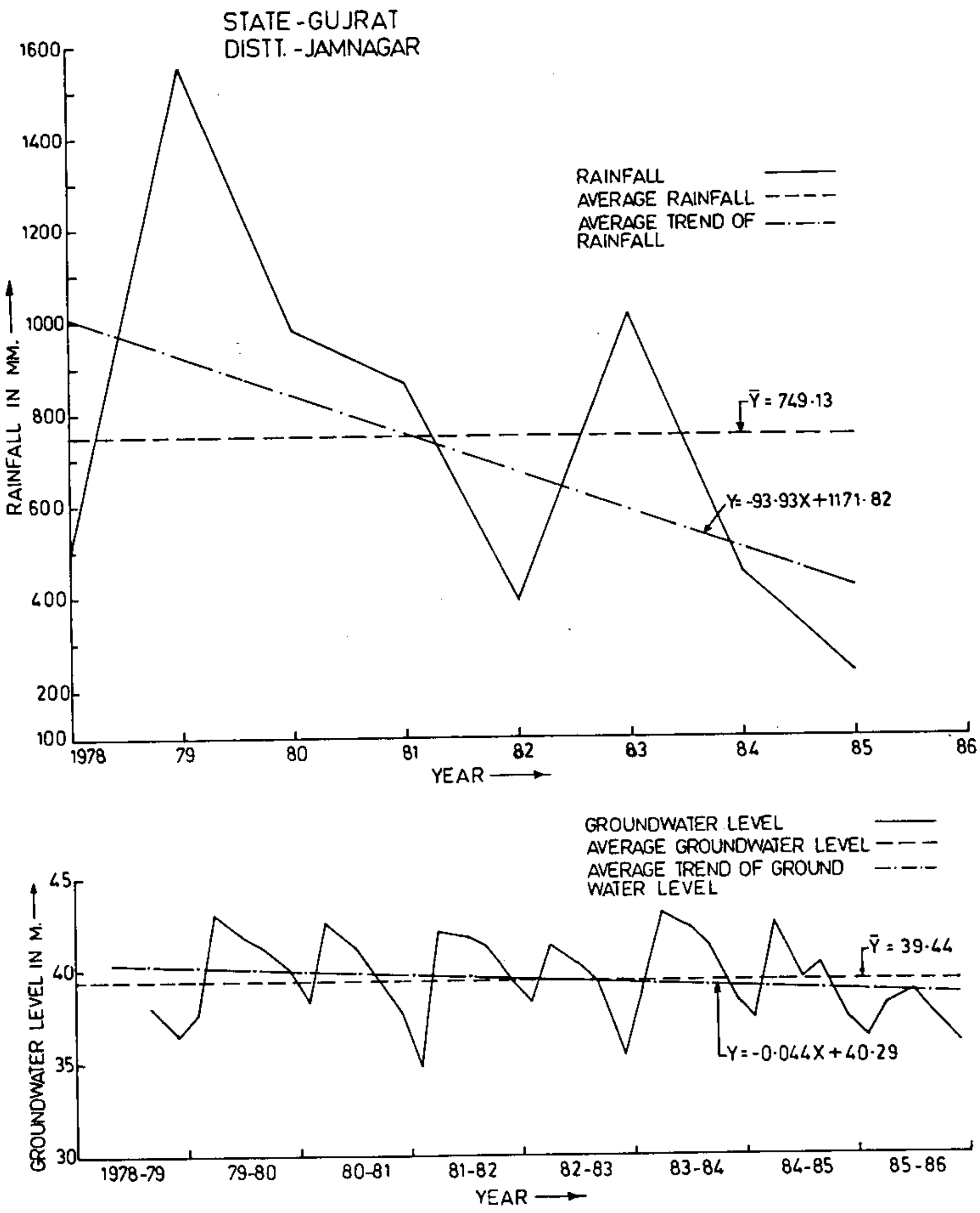


Fig. 6. 5 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

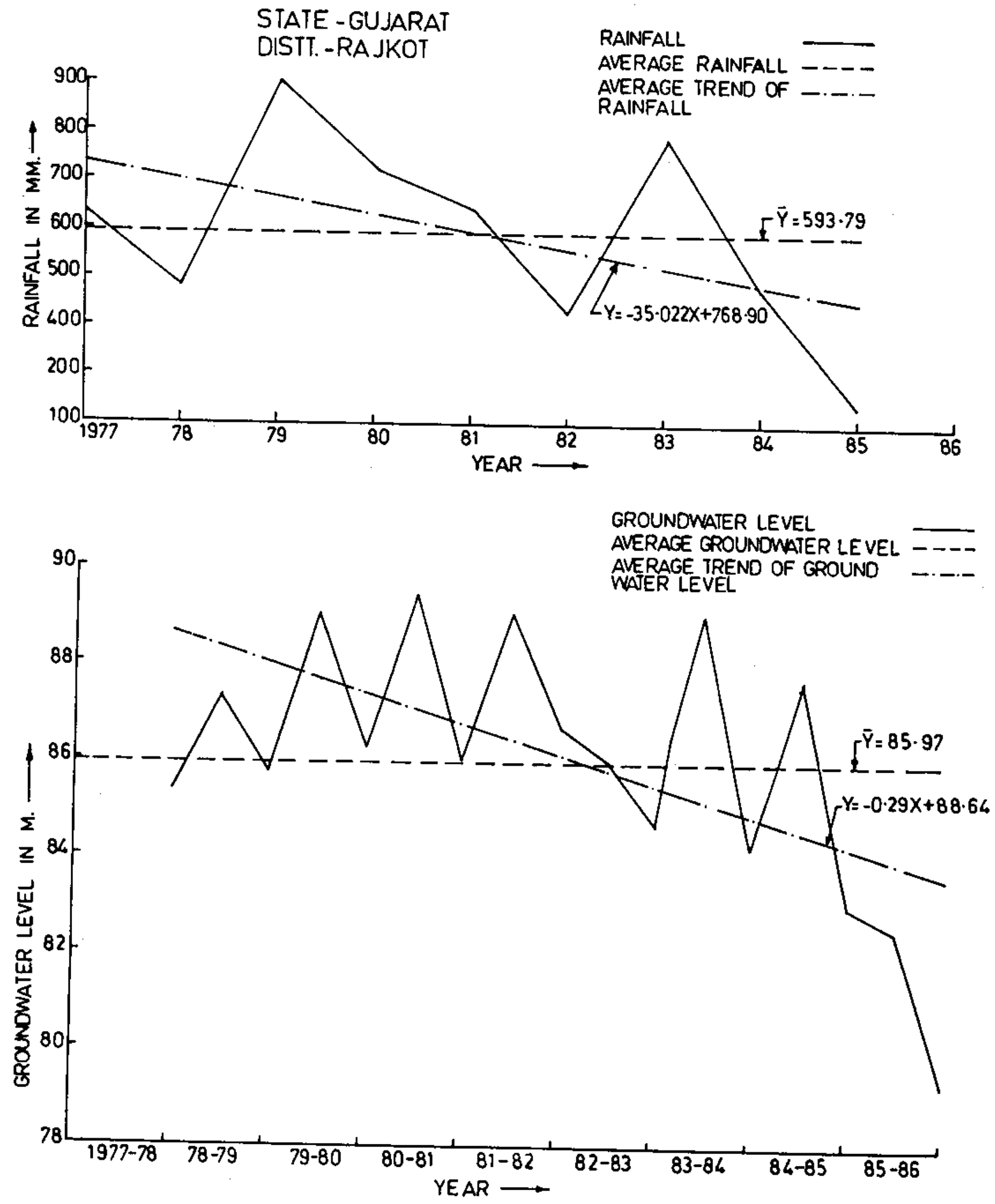


Fig. 6.6 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

that postmonsoon water level during 1985-86 is much below the premonsoon water level during 1984-85. This fact can be supported by the results of analysis presented in chapter 3 where it has been found that the rainfall was below normal by 58% during 1985-86. It is inferred that the draft is more than the rainfall recharge during 1985-86. The rate of decline of ground water level is higher in Rajkot as compared to Jamnagar. The trend analysis of rainfall showed steeper declination in case of Jamnagar as compared to Rajkot.

(d) In Andhra Pradesh, monthly average ground water levels and annual rainfall fluctuations have been plotted for the districts of Anantpur and Cuddapah (Fig. 6.7 and 6.8). As can be seen in these figures, the ground water levels show continuous decreasing trend during the period of analysis. The continuous decline in water levels may be either due to continuous increase of draft or decrease in rainfall recharge. The rainfall also shows a continuous declining trend over the period of analysis which means that due to declining trend in rainfall, the rainfall recharge was reduced resulting in reduced ground water levels.

As can be noticed from figure 6.8 in year 1983-84, in Cuddapah district ground water level is above the previous year i.e. 1982-83 which may be due to greater rainfall recharge to ground water. This fact can be supported by the results of analysis presented in chapter 3 where it has been found that the rainfall was above normal by 38% in Cuddapah district during 1983-84. In general, the ground water levels have been declining in both Anantpur and Cuddapah

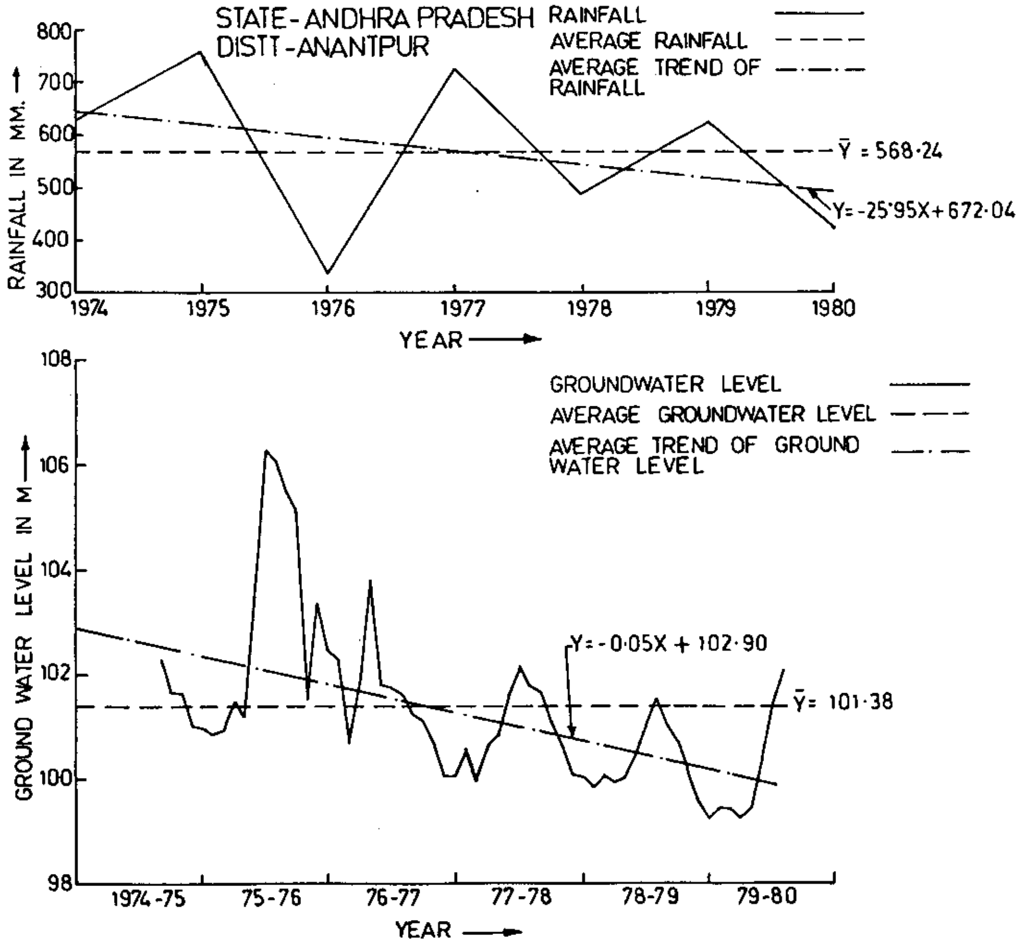


Fig. 6.7 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

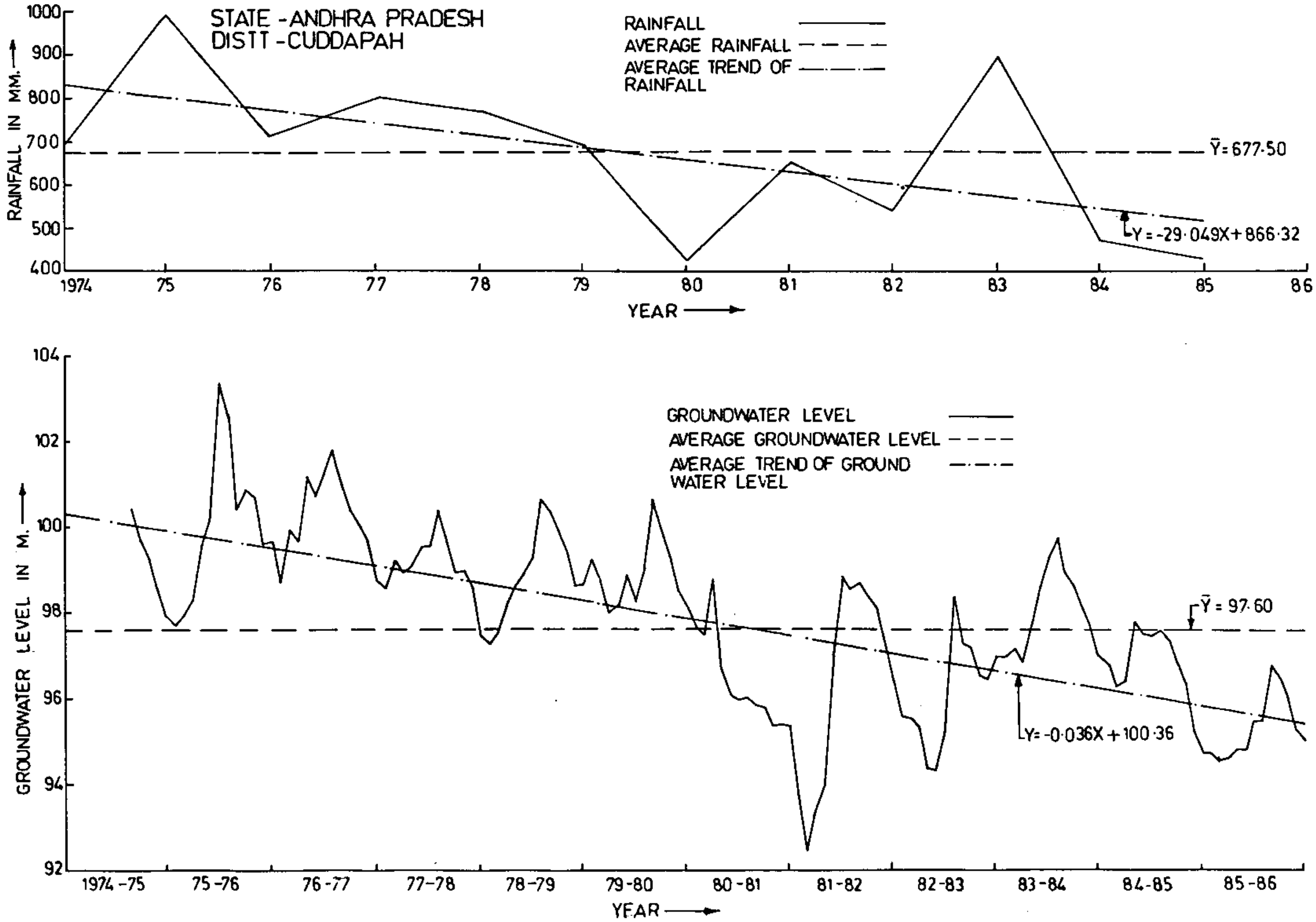


Fig. 6.8 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

districts. Declining trend may be either because of more abstraction from ground water or less rainfall recharge. The ground water levels in both the districts have fallen below longterm normal levels after 1976-77 in case of Anantpur and after 1980-81 in case of Cuddapah district. The rate of decline in ground water level is higher in case of Anantpur. The trend analysis of rainfall of these two districts showed that rainfall is also constantly declining over years of analysis; the declination being steeper in case of Cuddapah district. The trend analysis of rainfall re-inforces the conclusions drawn from trend analysis of ground water.

(e) In Karnataka, ground water levels have been plotted with respect to time for the districts of Bijapur and Belgaum (figure 6.9 and 6.10). It can be concluded that the draft over years, either from wells has been continuously increasing or rainfall recharge is continuously decreasing or both in Belgaum district indicating the declining trend in ground water. The trend in rainfall is also declining. The result of trend analysis of rainfall is in coherent with the result of trend analysis of ground water. It can be seen by the results of analysis presented in chapter 3 where it has been found that the rainfall was below seasonal normal after 1982 resulting less rainfall recharge to the ground water. For district Bijapur, since data for a substantial period could not be obtained, therfore, definite inferences are difficult to be drawn. However, based on limited data for 2-3 years, a decline in ground water level has been observed.

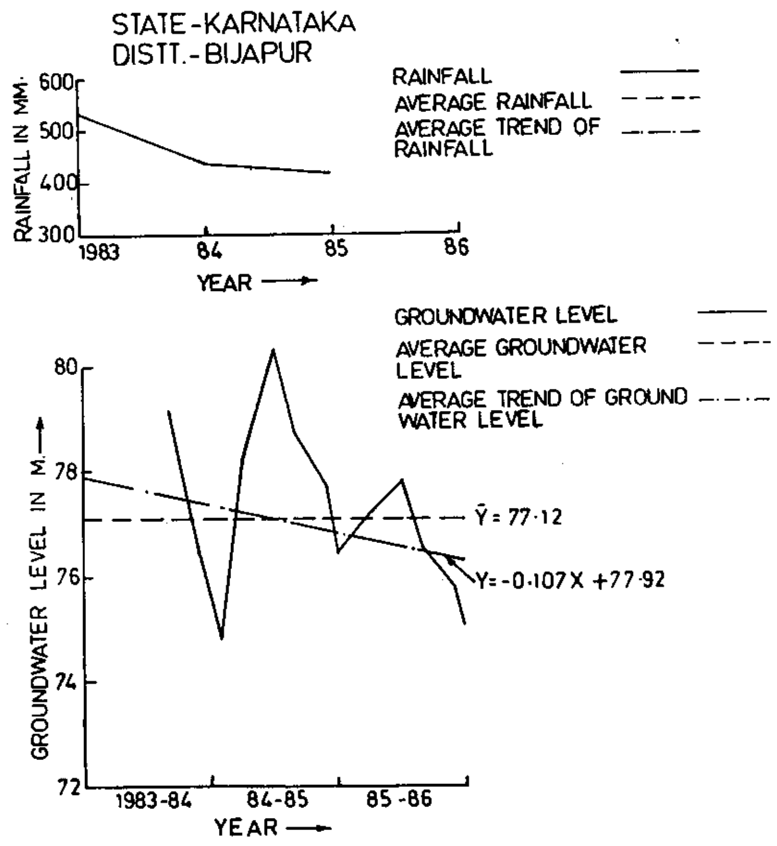


Fig. 6.9 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

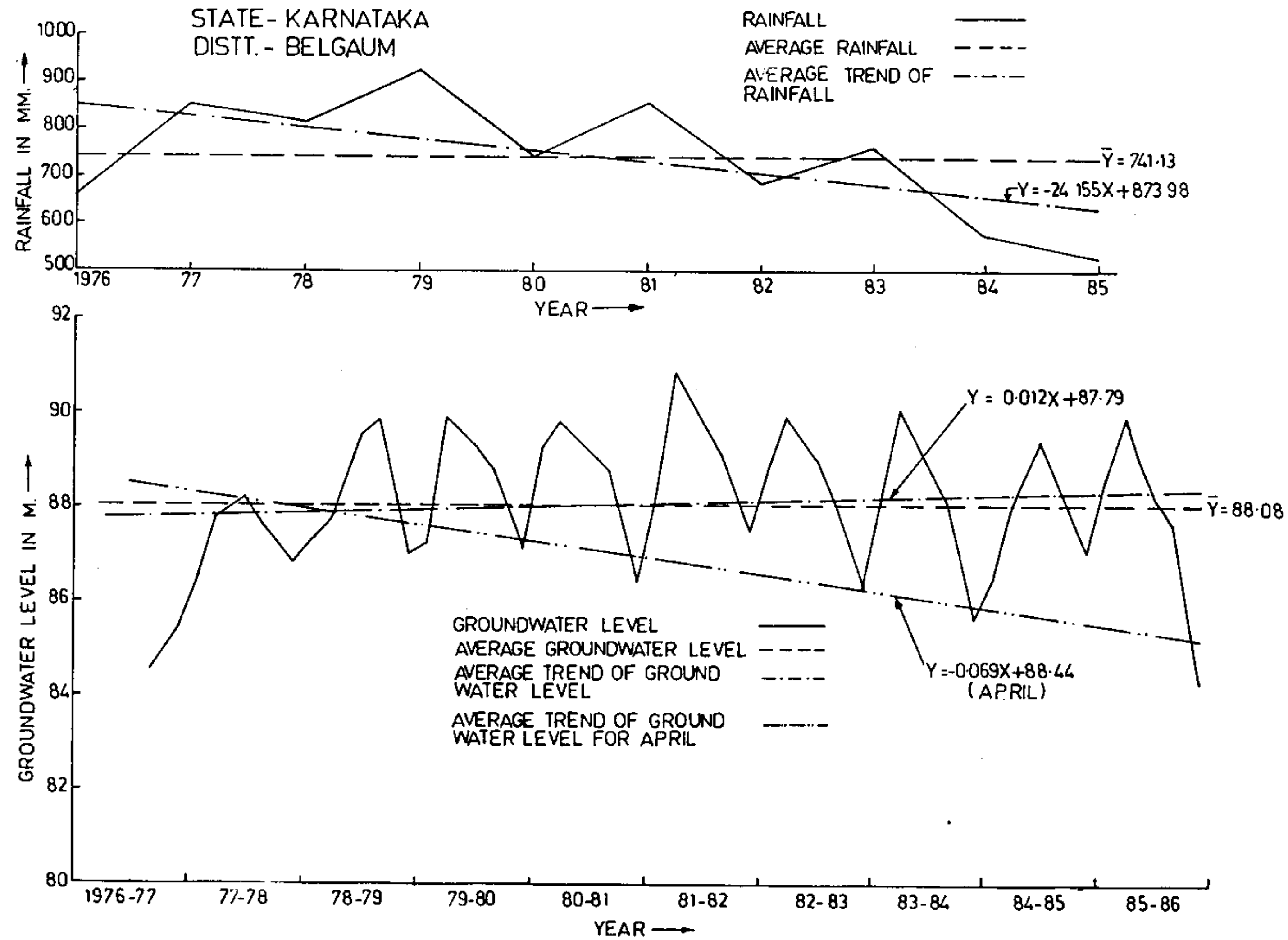


Fig. 6.10 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

(f) In Maharashtra, premonsoon and postmonsoon ground water levels have been plotted for the district of Ahmadnagar and Solapur (Figure 6.11 and 6.12). An increasing trend of ground water level has been observed in figure 6.11 which may be due to more rainfall recharge. However, the decline in premonsoon ground water levels have been observed, which shows that ground water table has been going down in premonsoon due to increase in draft. It can be seen from figure 6.12 that ground water level has been continuously decreasing in case of Solapur district. The trend analysis of rainfall is also declining over the years of analysis in case of both the districts; the declination being steeper in case of Solapur. Both the analysis show that abstractions from ground water has been more in case of Ahmadnagar.

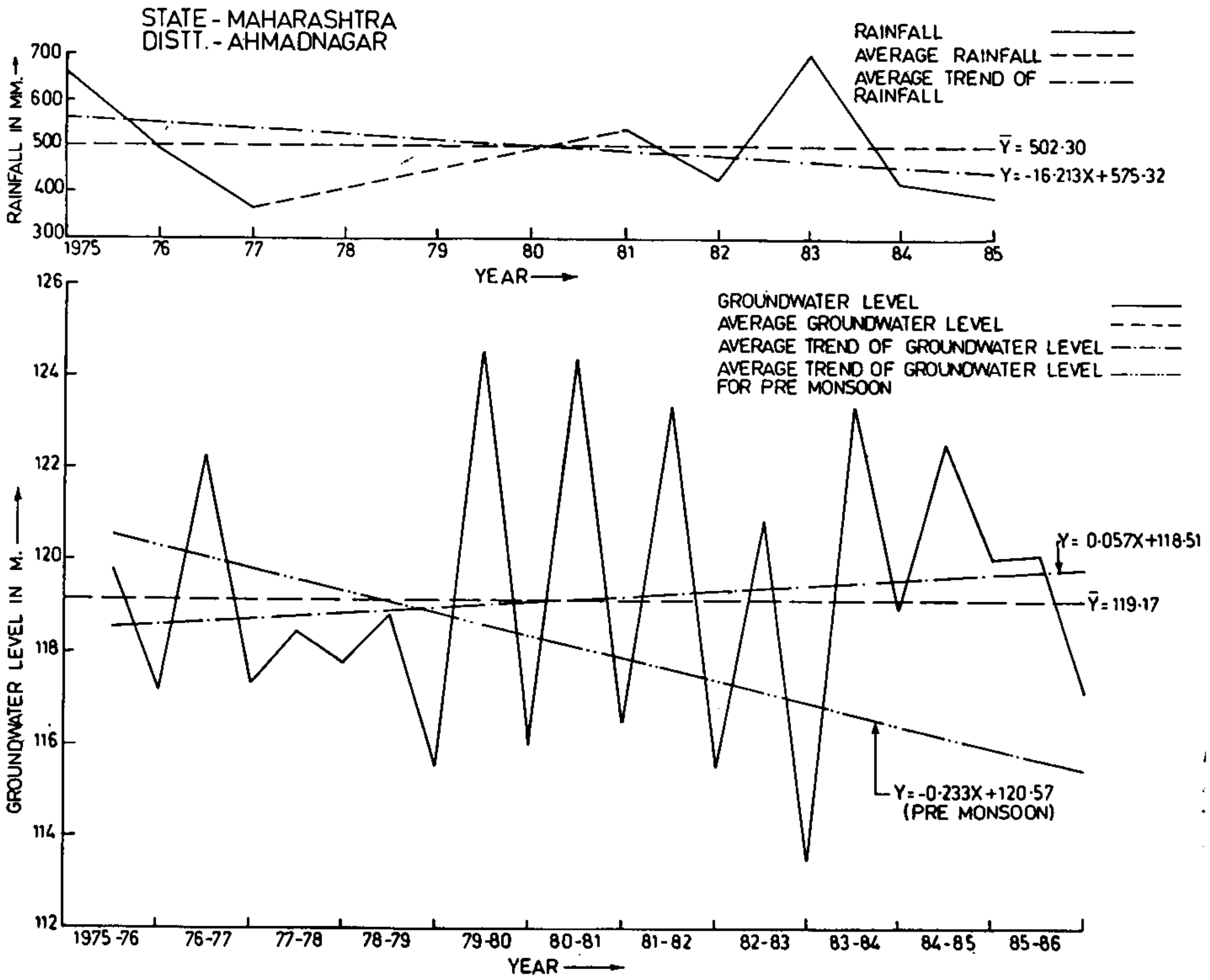


Fig. 6.11 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

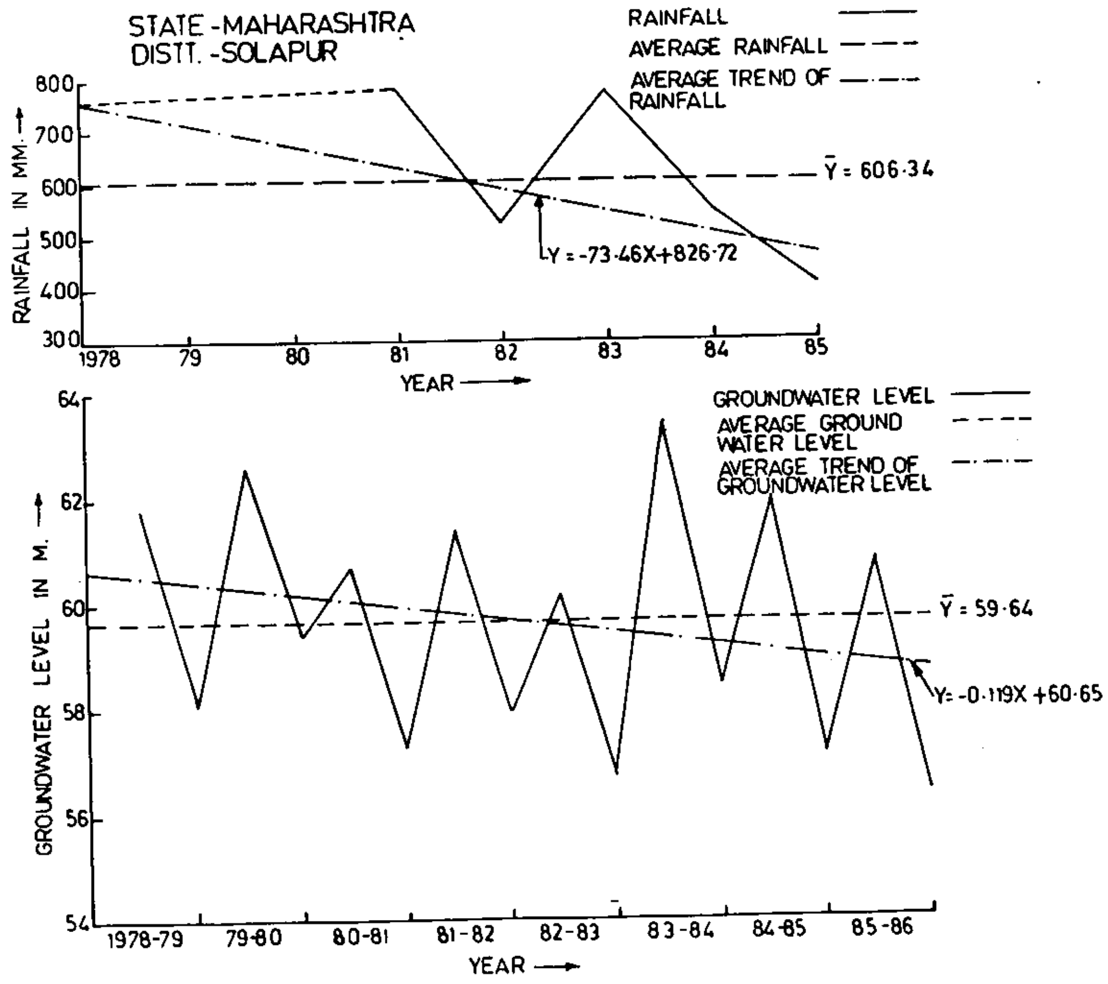


Fig. 6.12 : Ground Water Level Fluctuations and Rainfall and Trend Analysis

7.0 FORECASTING OF MONSOON RUNOFF

7.1 Inflow Forecasting

Drought prediction is one of the introguing problem of drought studies and can be considered as unpredictable with the present state-of-art on the subject using the hydrologic variables. Forcasting of streamflow can be attempted for drought forecasting. The water resources planning and operation activities are dependent mainly on the monsoon behaviour that being a crucial period contributing 80-90% of annual rainfall and runoff. The forecasing of monsoon runoff based upon the available runoff data up to the end of June, July, August and September could be an important aspect for drought management in planning and operation of surface water reservoirs. The correct and timely assessment of water resources before the beginning of their utilisation period say before Rabi is a must.

A simple approach using regression relationships to correlate monsoon runoff with the total runoff upto the end of June, July, August and Septemeber, developed at NIH while working for Hirakund, has been used. The forecasts of monsoon runoff based on the available runoff data for seven sites in Krishna basin i.e. i) Bhima at Dhond, ii) Bhimaat Wadakabal, iii) Bhima at Narsingpur, iv) Bhima at Takali, v) Bhima at Yadgir, vi) Tungbhadra at Haralhalli and vii) Tungbhadra at T Ramapuram have been made. The catchment areas for these rivers at the mentioned sites vary from 11660 km^2 to 69863 Km^2. The observed monsoon runoff and estimated monsoon runoff for these sites are plotted

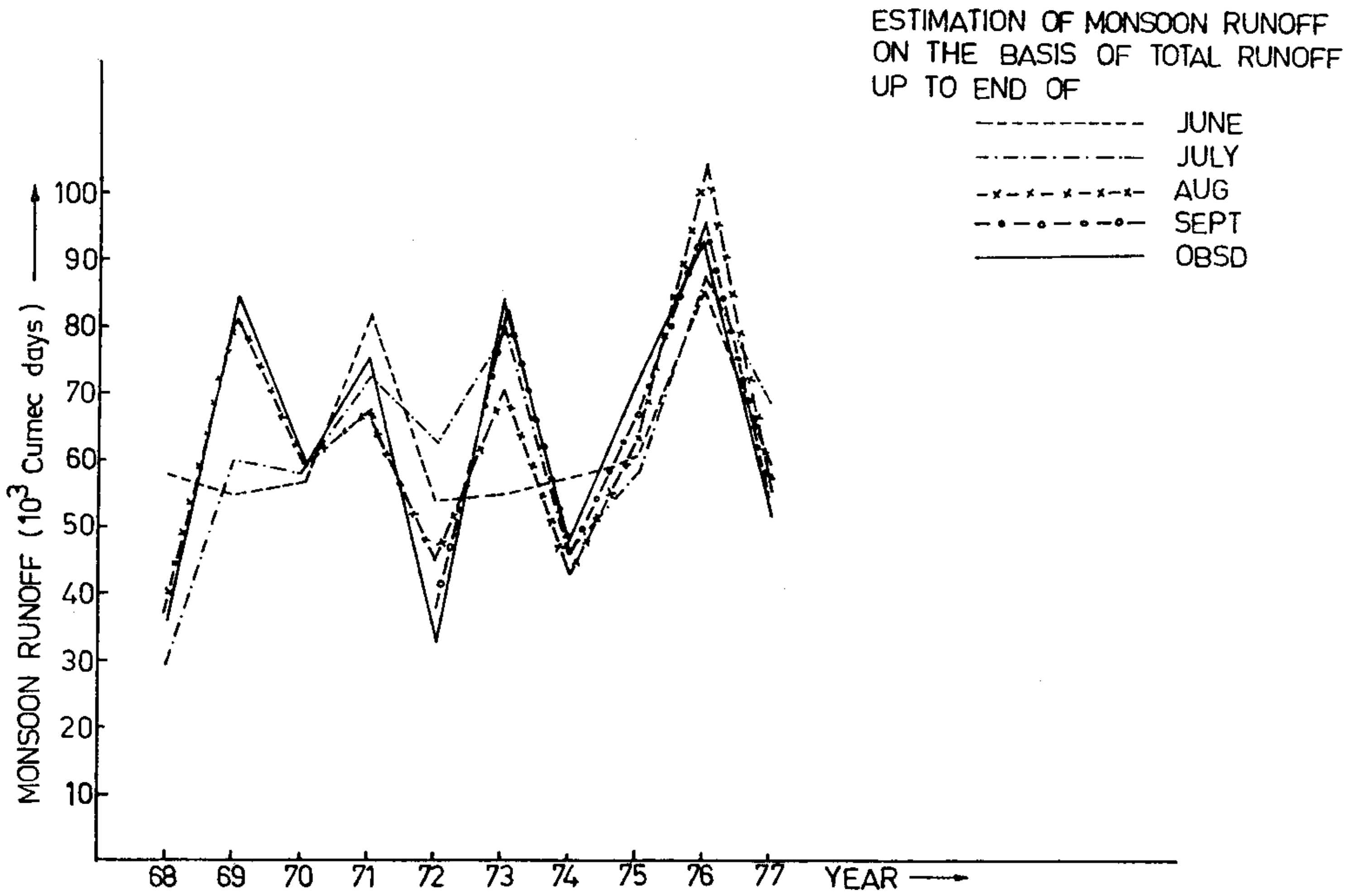


FIG. 7.1 ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1968 – 77) FOR BHIMA AT DHOND.

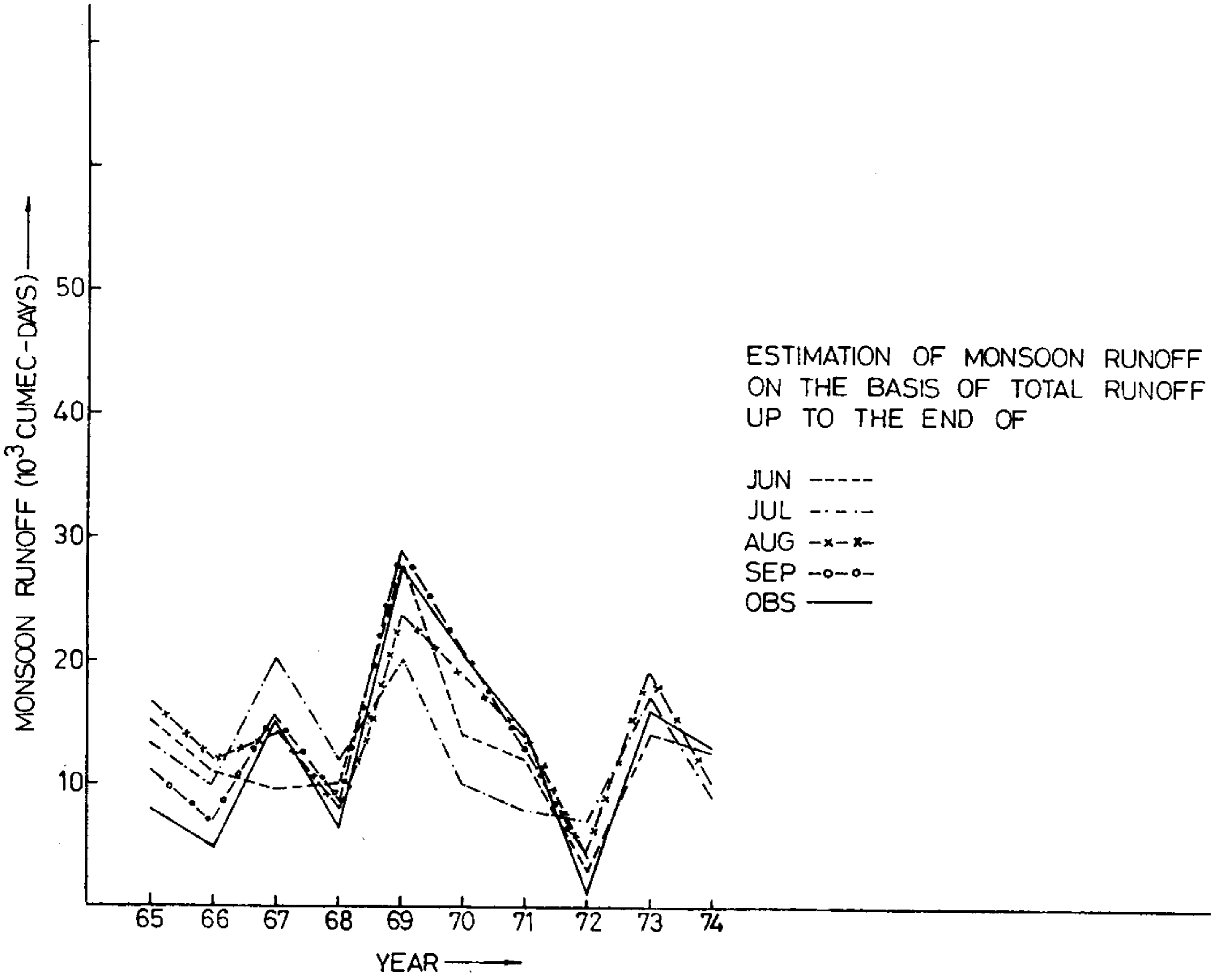


FIG. 7.2 ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1965-74) FOR BHIMA AT WADAKBAL

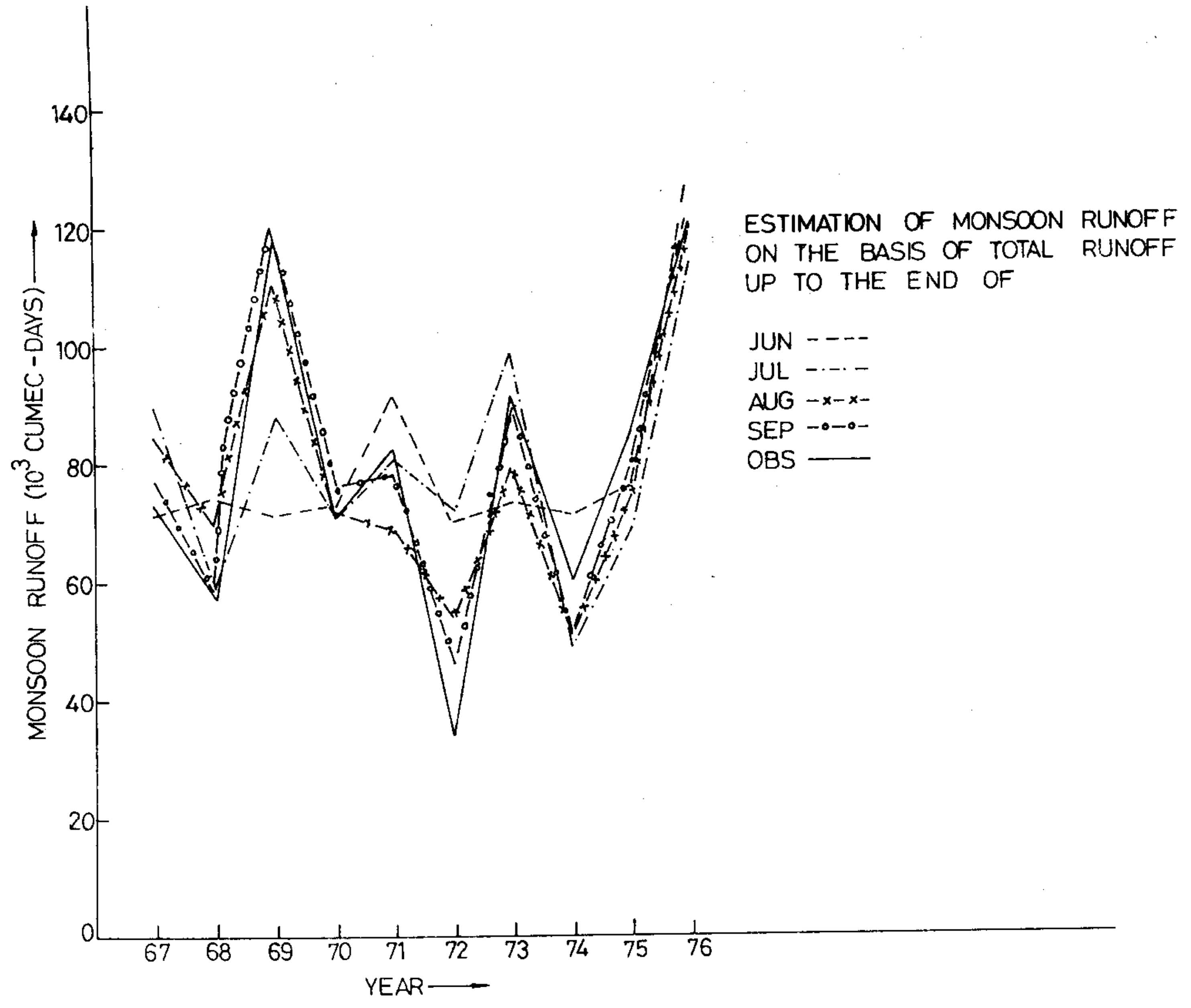


FIG. 7.3. ESTIMATION OF MONSOON OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1967-76) FOR BHIMA AT NARSINGPUR

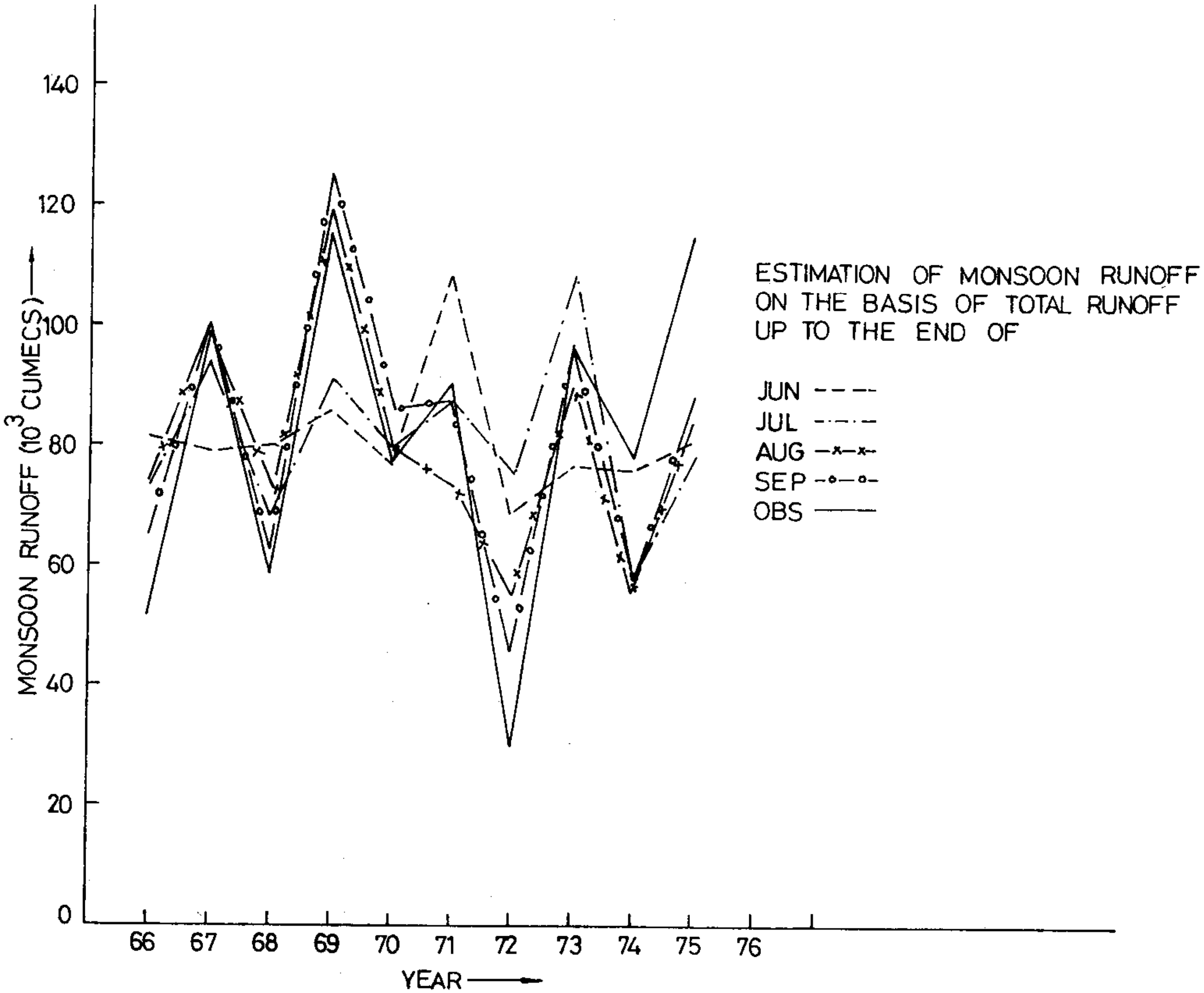


FIG. 7.4 ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1966-76) FOR BHIMA AT TAKALI

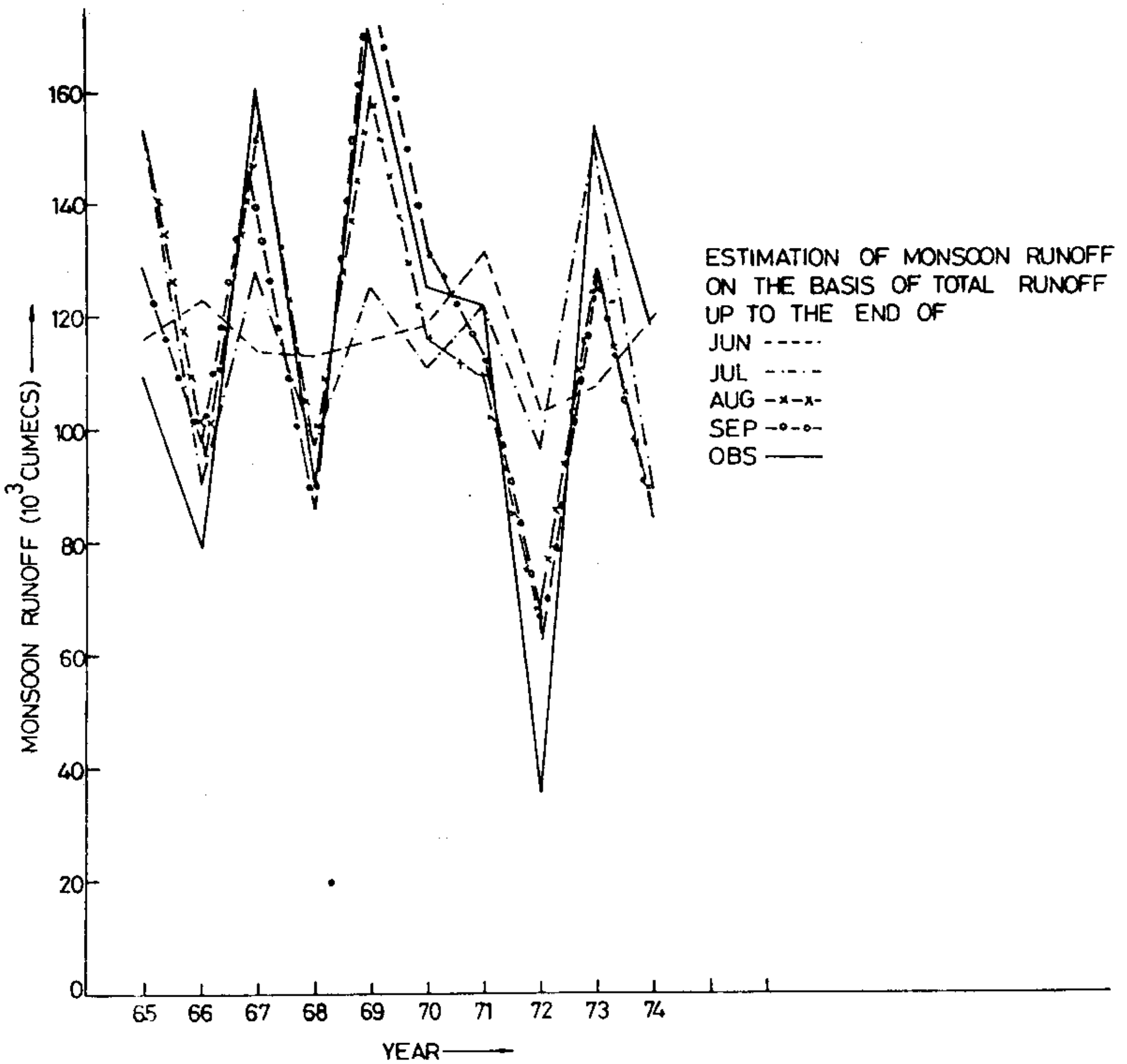


FIG. 7.5 ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1965-74) FOR BHIMA AT YADGIR

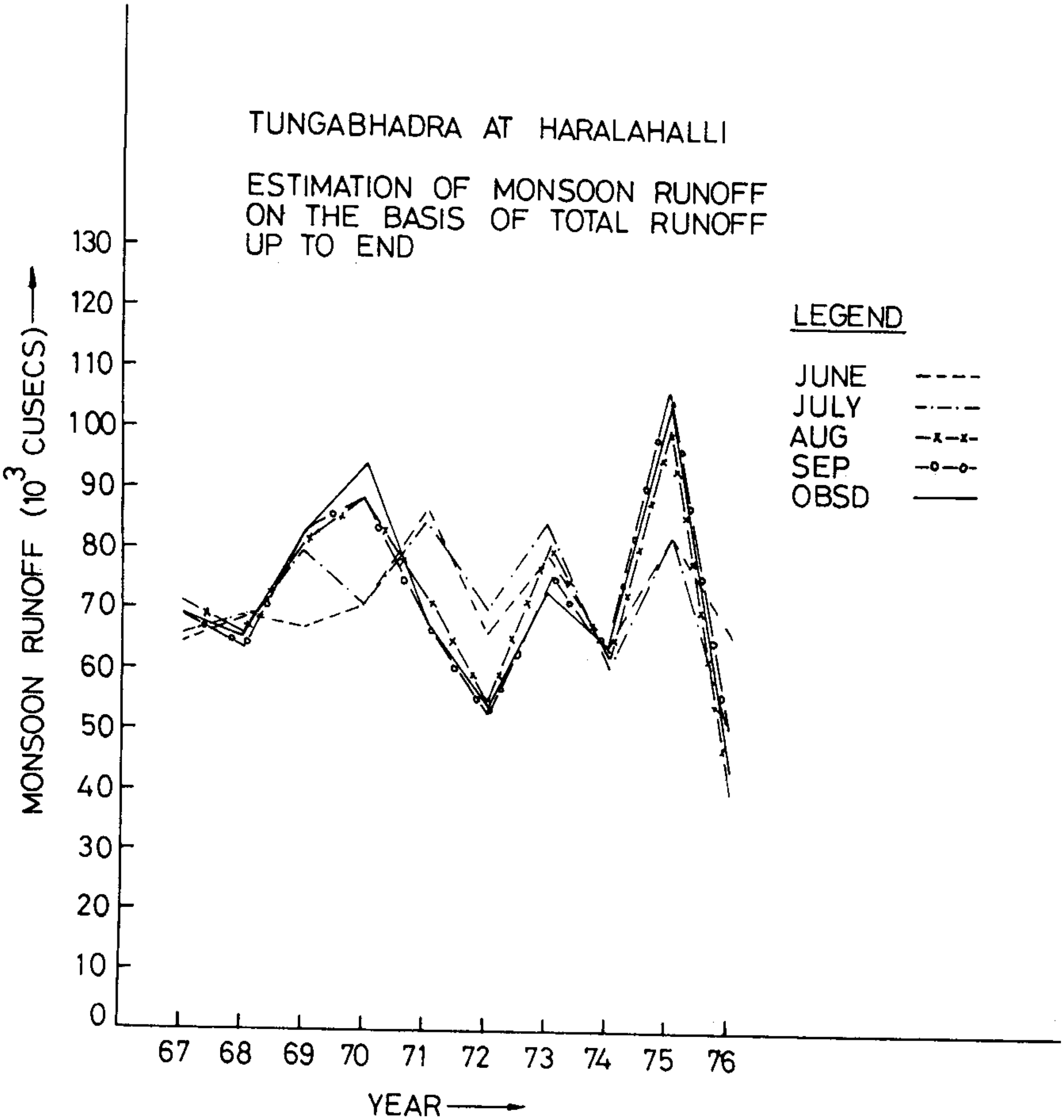
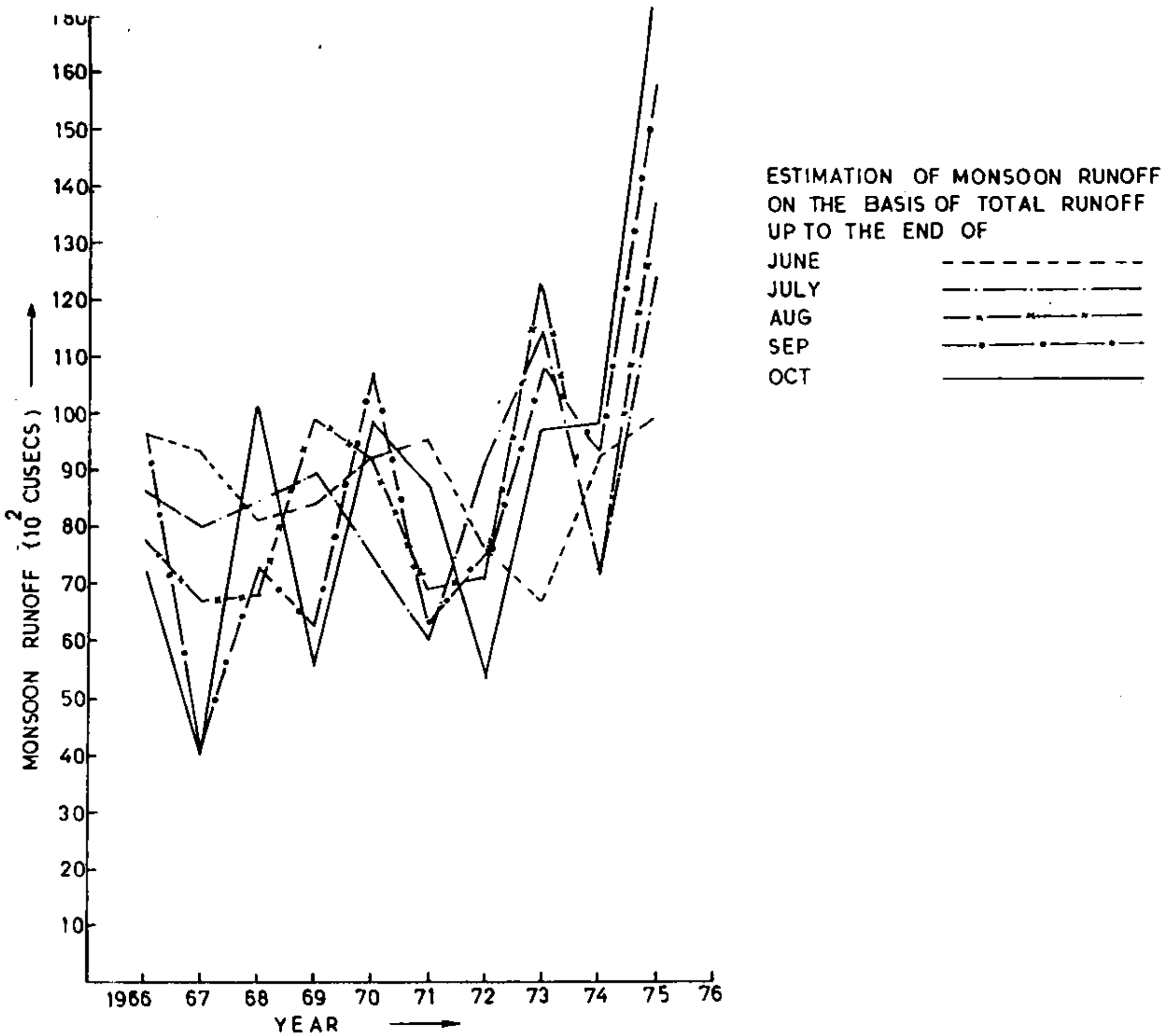


FIG. 7.6. ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1967-76) FOR TUNGABHADRA AT HARALAHALLI



EIG 7·7 ESTIMATION OF MONSOON RUNOFF FOR THE CALIBRATION RUN PERIOD (1966-76) FOR TUNGBHADRA AT T.RAMAPURAM

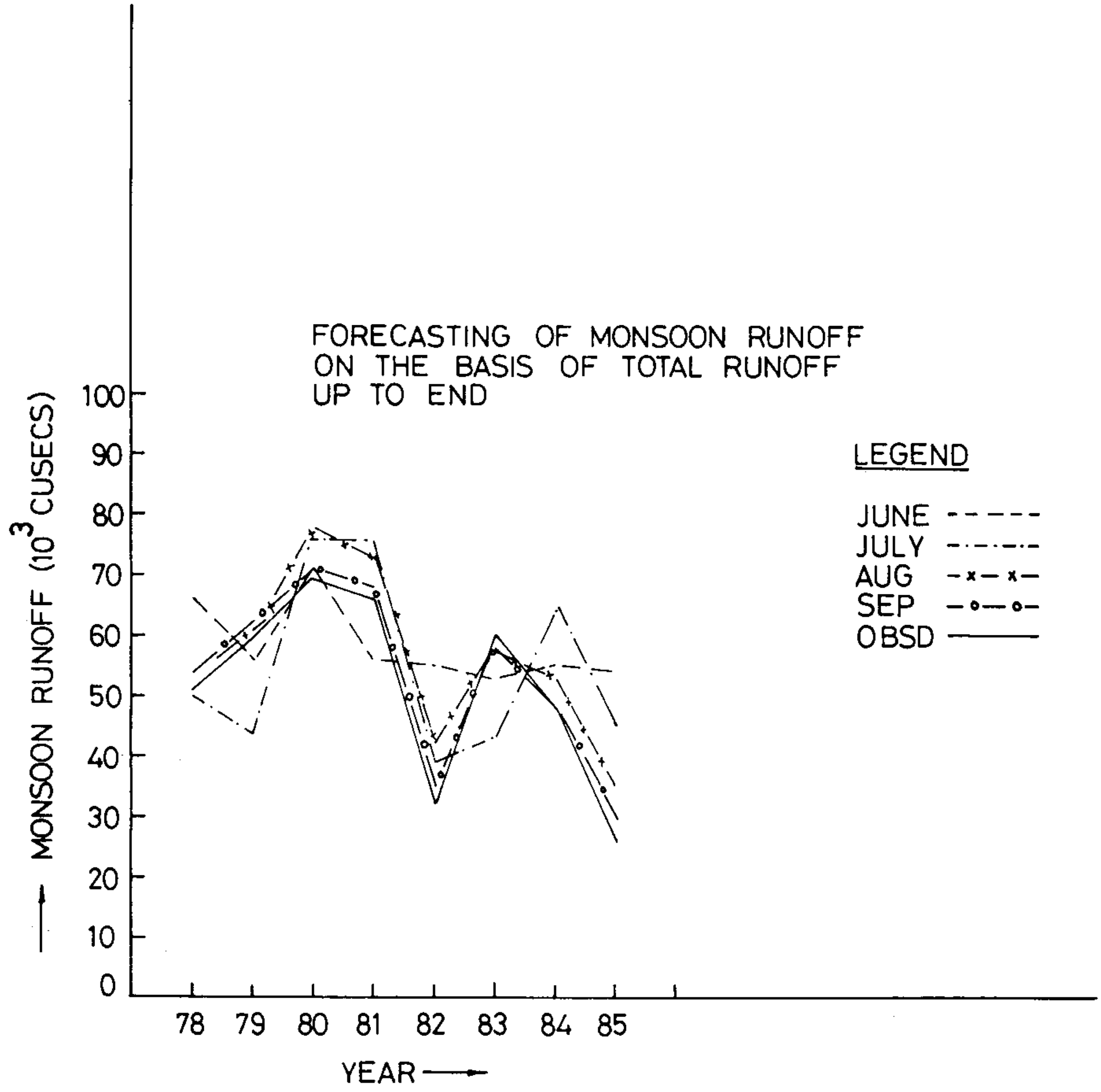


FIG. 7.8. FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1978 - 85) FOR DHOND

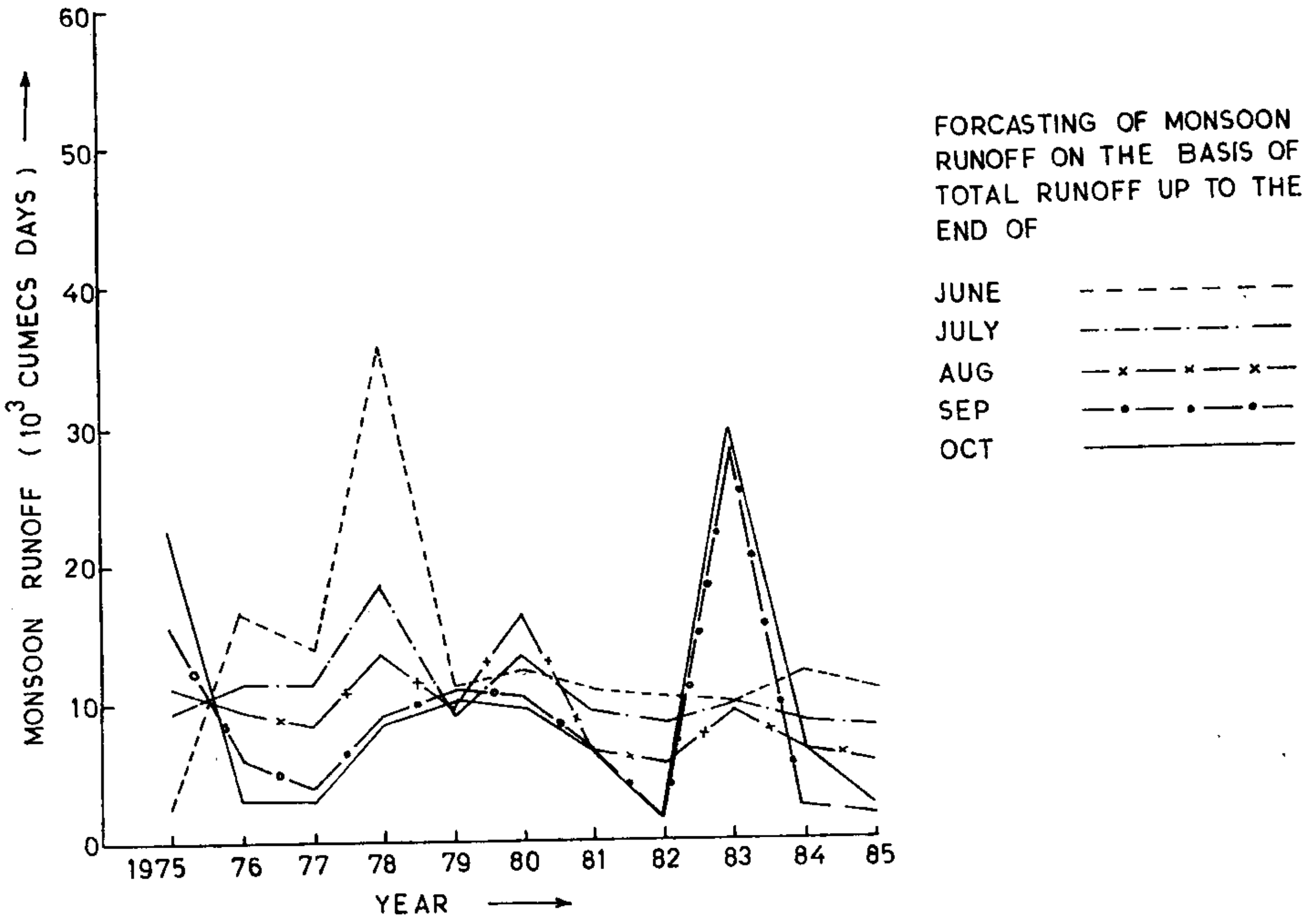


FIG. 7.9 FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1976-85) FOR WADAKBAL

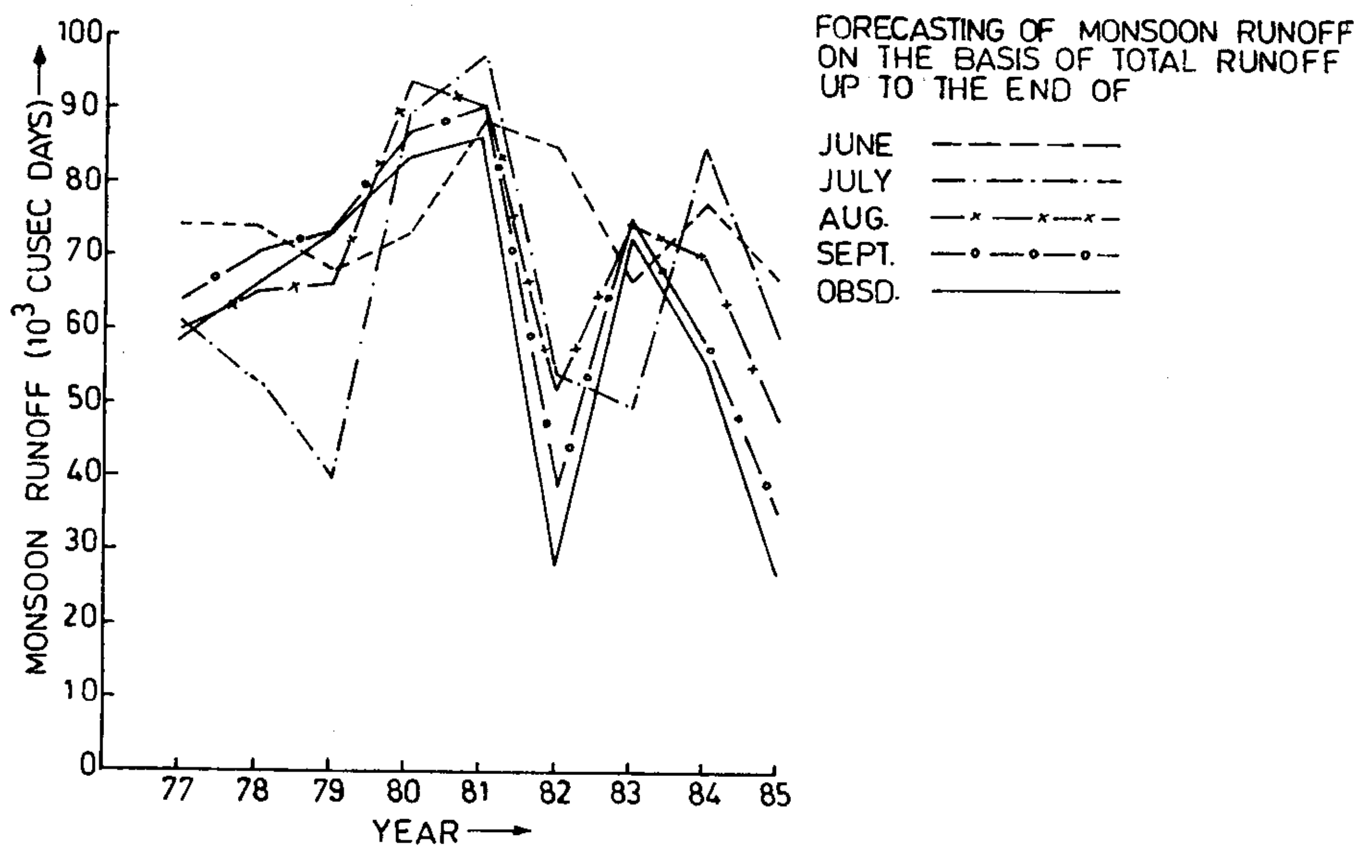


FIG.7.10-FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1977-85) FOR NARSINGPUR

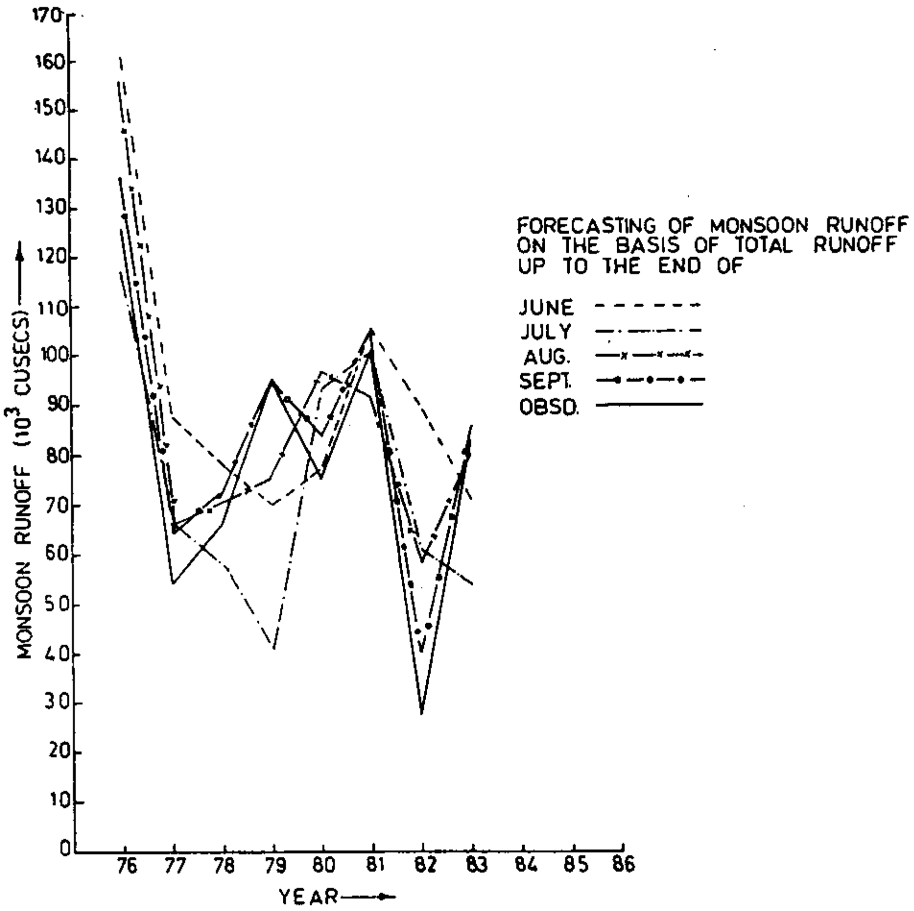


FIG. 7-11- FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1976-86) FOR BHIMA AT TAKALI.

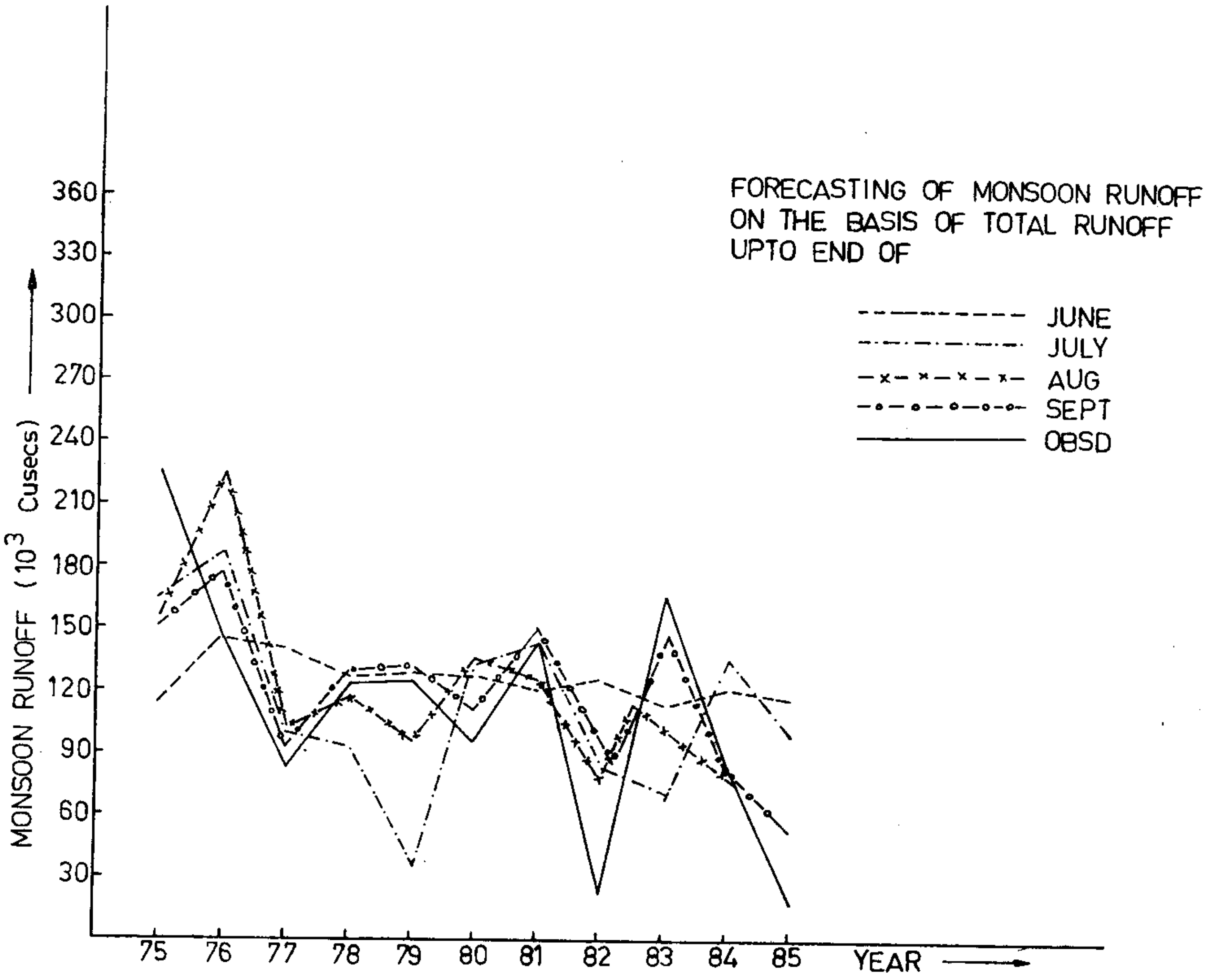


FIG. 7.12 FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1975 85) FOR BHIMA AT YADGIR

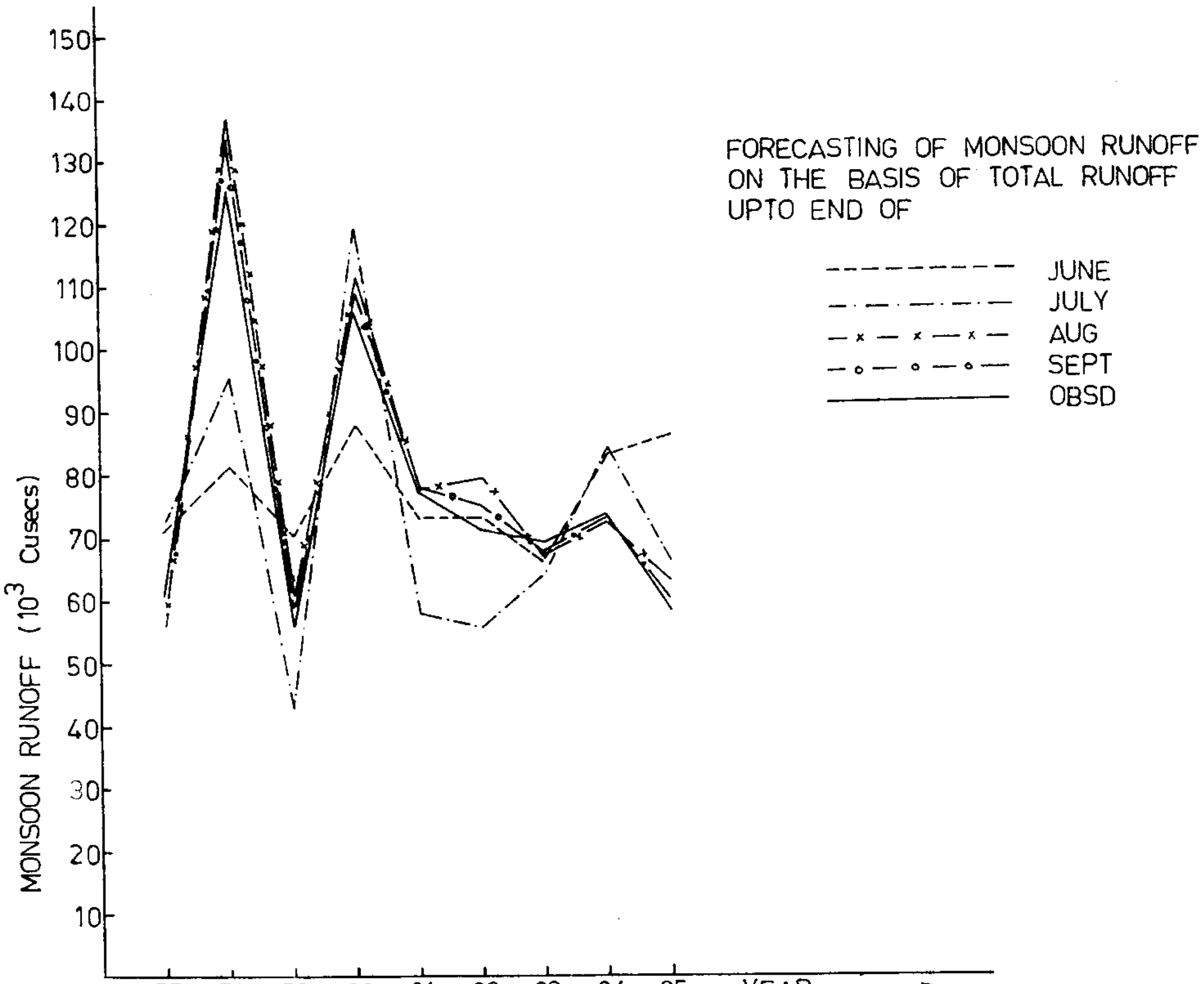


FIG.7.13 FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1977 85) FOR TUNGBHADRA AT HARLAHALLI

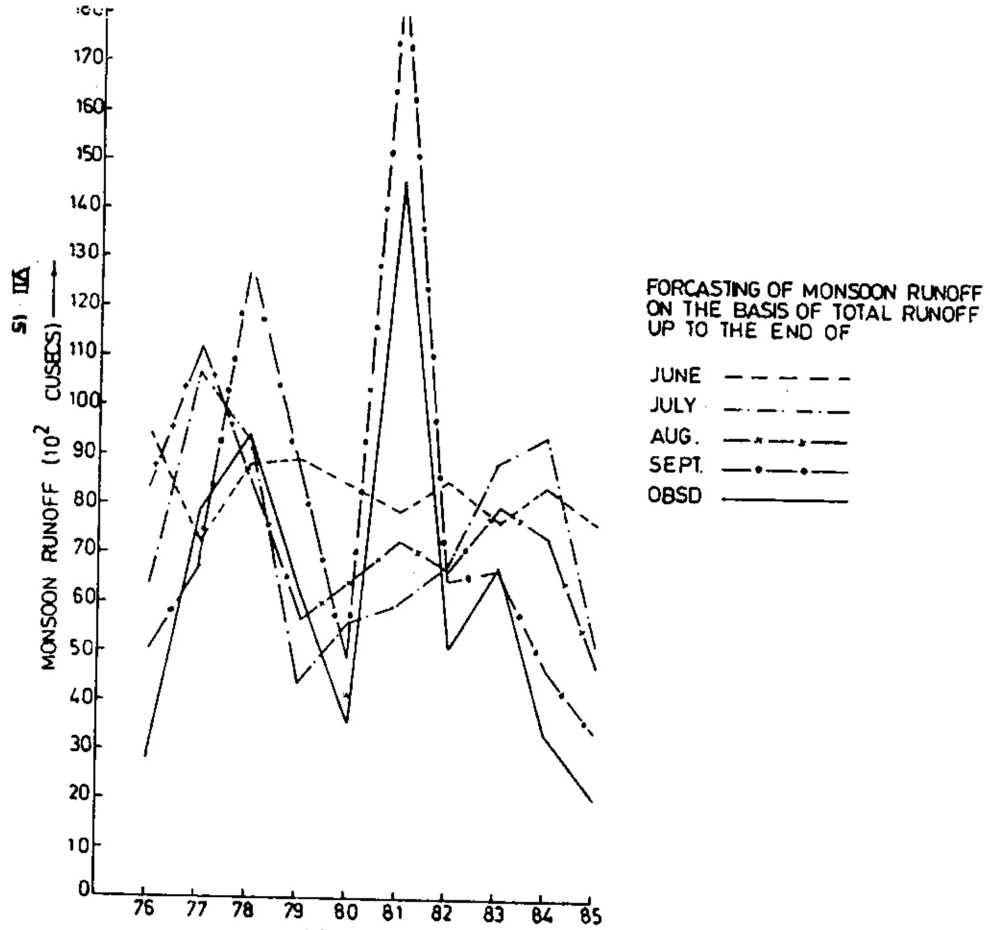


FIG. 7.14 FORECASTING OF MONSOON RUNOFF FOR THE PERIOD (1976-85) FOR TUNGBHADRA AT TRAMAPURAM.

FORECASTING OF MONSOON FLOWS FOR VARIOUS RIVERS OF KRISHNA BASIN

Sl. No.	Name of River	C.A (Km^2)	Length of data		Efficiency in % in Estimation of monsoon runoff on the basis of total runoff upto the end of				Length of Data		Efficiency in % in forecasting of monsoon runoff on the basis of total runoff upto the end of				Remarks
			Years	Period	June	July	Aug.	Sept.	Years	Period	June	July	Aug.	Sept.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Bhima at Dhond	11,600	10	1968-77	28.2	57.0	84.2	96.0	8	1978-85	26.1	42.6	85.4	98.4	
2.	Bhima at Wodakabal	12,092	10	1965-74	67.9	35.8	58.9	91.2	11	1975-85	-118.9	3.6	20.4	91.4	
3.	Bhima at Narsingpur	22,856	10	1967-76	33.0	51.0	78.5	93.4	9	1977-85	-4.9	17.8	75.1	95.2	
4.	Bhima at Takali	33,916	10	1966-75	14.1	27.2	52.5	74.3	8	1976-83	-3.1	21.0	58.0	92.4	
5.	Bhima at Yadgir	69,863	10	1965-74	3.8	33.5	64.3	75.6	11	1975-85	-5.1	9.2	35.1	77.6	
6.	Tungbhadra at Haralhalli	14,582	10	1967-76	21.3	39.1	94.3	98.3	9	1977-85	28.2	57.9	92.8	97.9	
7.	Tungbhadra at Tramapuram	23,500	10	1966-75	7.4	25.8	43.3	76.4	10	1976-85	-9.9	9.7	24.0	71.6	

in Fig. 7.1 - 7.7 for calibration period. The observed and forecasted monsoon runoff for forecasting period are plotted in Fig. 7.8 - 7.14. The efficiency of regression relationships in calibration and forecasting runoff for these sites are given in Table 7.1.

7.1.1 Bhima at Dhond

The efficiencies of monsoon runoff forecast are 26.1%, 42.6%, 85.4% and 98.4% respectively at the end of June, July, August and September. The results are pretty good inspite of the short length of data.

7.1.2 Bhima at Wadakabal

The efficiency of monsson runoff forecast are 118.9%, 3.6%, 20.4% and 91.4% respectively at the end of June, July, August and September. The results are very poor. This may be because of (i) measurement error in discharge data, (ii) short sample length and (iii) variability of flow. A critical examination of flows reveals that monsoon flows at Wadakabal are much lesser than the flows at Dhond while there is no diversion in between. This makes the reliability of discharge data at Wadakabal doubtful.

7.1.3 Bhima at Narsingpur

The efficiency of monsoon runoff forecast are -4.9%, 17.8%, 75.1% and 95.2%. This shows that monsoon flows can be forecasted with 75.1% and 95.2% reliability at the end of August and September respectively. The results are satisfactory.

7.1.4 Bhima at Takali

The efficiency of regression relationships in calibration and forecasting are 14.1%, 27.2%, 52.5%, 74.3% and - 3.1%, 21.1%, 58.0% and 92.4% respectively at the end of June, July, August and September. This indicates that monsoon flows can be forecasted with good reliability only at the end of September. This may be because of short sample length.

7.1.5 Bhima at Yadgir

The efficiency of regression relationships in calibration and forecasting are 3.8%, 33.5%, 64.3%, 75.6% and - 5.1%, 9.2%, 35.1% and 77.6% respectively at the end of June, July, August and September. The results are very poor. The critical examination of flows reveals that the flows at Yadgir are not virgin.

7.1.6 Tungbhadra at Haralhalli

The efficiency of regression relationships in calibration and forecasting are 21.3%, 39.1%, 94.3% 98.3% and -28.2%, 57.9%, 92.8% and 97.9% respectively at the end of June, July August and September. The results are very good inspite the short length of data.

7.1.1 Tungbhadra at T Ramapuram

The efficiency of regression relationships in calibration and forecasting are 7.4%, 25.8%, 43.3%, 76.4% and - 9.9%, 9.7%, 24.0% and 71.6% respectively at the end of June, July, August and September. The results are poor. The reason being that the flows at T Ramapuram are not virgin and affected by the structures upstream.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Rainfall

(i) Rainfall data have been analysed for twelve districts in six chosen states. Data have been collected form reports prepared by CWC, state departments dealing with irrigation and water resources, and other central agencies.

(ii) The average/normal rainfall for districts have been worked out using theissen weights assigned to each taluka of the district, while in case CWC studies arthematic average has been taken for working out district average. For each taluk one raingauge station (as chosen by CWC, 1962) has been chosen to represent the taluk's rainfall. However attempts can made to use all the raingauge stations in district to arrive at the district/taluk average/normal rainfall for analysis.

(iii) The results of seasonal analysis of rainfall data have shown that all 12 districts recorded seasonal rainfall deficit of more than 20% of respective district averages. These results are in coherence with the rainfall departure maps prepared by IMD for monsoon of 1985 (June-Sept., 1985). However, in the present analysis rainfall data for May-Nov. have been used.

(iv) The results of monthly rainfall analysis done for year 1985 have shown that in general all the five taluks of each district as district as a whole experienced monthly rainfall deficit of more than 20% of normal excepting few cases. The analysis presented in the report has been done only for five representative taluks. Similar analysis can be attempted by considering all taluks. The monthly analysis was initially aimed for whole water year 1985-86 (May 85- April 86) but due to unavailability of data in most of the cases the analysis was restricted to the data of May 85- Nov. 86.

(v) Probability analysis of annual rainfal was carried out for two selected taluks from each district and district as a whole using data of 1901-1986. Based on the analysis the group range of annual rainfall for districts/taluks at 75% or more probability was established. Also, the percen - tage probability of occurrence of rainfall equivalent to 75% of the normal or more has been established for all distri- cts and two selected taluks in each district. The analysis showed scarcity of rainfall in more than 20% of the years indicating drought conditions in selected districts/taluks as per IMD IMD criteria. Due to not availability of data for 1986,analysis was restricted in general upto 1985. The required/missing data is being made available at NIH and the same would be incorporated in next report.The monthly rainfall data of five selected taluks in each district analysed using Herbst's approach. Actually this analysis is carried out using entire 12 month's data. However, in the present analysis the data of only monsoon months was considered with the assumption that the carry over from month to month in non monsoon months is insigni- ficant. However, attempts will be made to do the similar analysis using entire length of monthly rainfall record considered.

(vii) The Herbst's analysis gives the months of beginning and termination of drought over years besides drought intensity and severity index. In general the analysis of data showed that most of the taluks experienced drought in monsoon season of 1985, the intensity being maximum during 1985 excepting for some taluks.

(viii) The spell analysis was carried out for one taluk from each district in six chosen states. A day is assumed as non rainy day if the daily rainfall was less than or equal to 5 mm and if this continued for 15 days in a row then the spell was selected as dry spell. The daily rainfall data from 1981 to 1986 were used for counting dry spells which was subjected to statistical analysis. Based on this analysis, it was found that at 75% probability the duration of dry spell is 21-28 days for all taluks selected for study. This analysis is important from agriculture point of view as the irrigations can be planned accordingly. However, as the analysis was done using only five years rainfall records therefore it would be worth while to do similar statistical analysis for longer length of records for which the daily rainfall data of monsoon would be required.

8.2 Soil Moisture

(i) Soil water deficit which is an indicator of water availability to crop, affects agricultural production, and this can be taken as an index of drought. Using soil moisture simulation models the soil moisture levels can be predicted using inputs of rainfall and potential evapotranspiration.

Based on the threshold values of soil moisture as selected for various types of crops the incidence, duration, frequency and severity of drought conditions can be evaluated. The success of this approach, however, will depend upon prediction of soil moisture levels and fixing up of threshold soil moisture values. Such values of soil moisture which will determine sensivity of various growth stages can be established after carrying out lot of experiments as these depend upon type of soil, physiographic conditions, type of crop etc. For proper calibration of soil moisture models more experimental data would be needed. Based on the simulated soil moisture levels, a series of soil moisture levels below present drought situation level can be made and frequency distribution analysis of such series would give drought severity at various probability levels. Also the past historical data of soil moisture availability over the growing season for various soil types to determine the safe growing season, critical moisture deficit periods which will assist in planning suitable cropping pattern in drought prone areas.

8.3 Surface Water Deficit

(i) The analysis of streamflow data for 20 years (1966-86) for nine sites well distributed over Krishna basin has been done to study the effect of drought on streamflow conditions. The data used for anlysis has been obtained from CWC. For rainfall and groundwater analysis six states have been chosen. However, for streamflow analysis only Krishna basin falling in maharashtra, Karnataka and Andhra Pradesh has been chosen. Out on nine sites selected for study, all have virgin flow excepting two sites.

(ii) In simple hydrograph analysis, comparison of monthly flow hydrograph for year 1985-86 with long term mean monthly hydrograph indicated deficit in monthly flows during 1985 for all selected sites.

(iii) In the analysis attempted to compare deviation of annual flows from the long term mean flow indicated that during 1985 the flows were deficient by more than 25% of long term average flows.

(iv) Low flow analysis was carried for all the sites and flow duration curves were established. With the help of these curves the probability of occurrence of a particular flow at the site can be established which is helpful in planning any water resources project. Also values of low flow index at all sites were established which indicate the low flow potential of the concerned site. The flow duration curve values of 90%, 95% and 99% are used as a measure of stream low flow potential in hydrologic studies.

(v) The deficit volume and deficit duration analysis at different demand levels has indicated that maximum deficit duration and maximum deficit volume in different low flow spells were highest for 1985-86 as compared with previous years with the exception of the values corresponding to 10% ADF. The similar analysis carried out for only monsoon period also confirm the same results. This type of analysis gives an idea about the required storage in the reservoirs in order to fulfil the demands taken as some percentage of long term mean. Similar analysis can be extended for other basins.

(vi) Frequency analysis of low flow provide an estimate of the low flow for given recurrence interval. The maximum deficit volume and maximum deficit duration may also be computed for different recurrence interval at different demand levels by carrying out the frequency analysis of the maximum deficit volume and maximum deficit duration.

8.4 Ground Water Deficit

(i) Ground Water Level Data from various observation wells in 12 districts of the six states chosen for the analysis were collected to study the effects of drought on groundwater regime. Generally the data was available for a duration of about 10 years i.e. from 1975-86. However, due to different types of frequency of data collection in different states the frequency of ground water data was not same as it was varying on monthly, quarterly and seasonal basis. Therefore, the analysis has also been done on the similar basis.

(ii) An attempt has been made in the report to correlate the affects of failure of rain-fall on ground water regime and it has been generally observed that due to failure of rainfall the groundwater level has declined in almost all 12 districts chosen for analysis over last 10 years. However, in case of Belgaum (Kar.) and Ahmadnagar (Mah.) the ground water regime did not show marked change though there was deficiency in rain-fall. But due to non-availability of abstraction data of ground water the exact correlation between the rainfall and the ground water level regime could not be established and the inferences have been made on presumption.

(iii) In the analysis of ground water level data some selected wells in each district (about 6-15 in number) were chosen for study. Based on which the influences has been drawn. However, data of more wells could be used to derive more general conclusions.

(iv) In the present analysis while correlating the rainfall data with the ground water level regime due to non-availability of the rainfall data on monthly basis the frequency of ground water and rainfall data could not be matched. However, it would be worth-while to attempt correlation between rainfall data and ground water level data monitored at the same frequency.

(v) The analysis of ground water data has been done district wise in six states. However, it will worthwhile attempting similar analysis sub-basin wise based on which more general conclusions can be drawn.

(vi) Due to poor status of ground water data availability the results of analysis could be just taken as guidelines. There is considerable scope for enhancing the utility such kind of analysis once data is available on a more better frequency and format.

(vii) It has been observed that different types of formats have been used in collection of ground water data in different states. In some cases mention of measuring point elevation has not been made. It may be worthwhile looking into these aspects to facilitate better analysis.

8.5 Forecasting of Monsoon Runoff

(i) The technique for monsoon flow forecasting based on regression relationships is a simple approach and gives quite accurate forecast of monsoon flows at the end of August and September.

(ii) For application of the technique the flows should be virgin.

(iii) For good application of the technique the data length should be adequate preverably more than 30 years.

(iv) The efficiency of forecast should increase as the drainage area of the river increases. This is not happening so in case of Bhima river. This may be because of possible diversions in the basin as the catchment areas increases.

In the present report analysis of hydrological data for higlighting hydrological aspects of drougt has been done in respect of two districts in six drought affected states. It is proposed to cover more districts in forth-coming studies eventually leading to carrying out such studies basinwise. The study was delayed as the required data could not be made readily available in time.

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APPENDIX-II-1

LIST OF OFFICES AND PLACES FROM WHERE DATA AND INFORMATION WERE COLECTED

ANDHRA PRADESH

Hyderabad	Irrigation Office State Groundwater Board Office Bureau of Economics and Statistics Panchayat Raj and Rural Development Department of Agriculture C.W.C. P.H.E.D.
Mahaboob Nagar	Irrigation Office Deputy Director (Agriculture) Planning Office
Prakasam	Irrigation Circle Office Deputy Director (Agriculture) Deputy Director (Water Management) Panchayat Raj Office
Anantapur	Irrigation Circle Office D.P.A.P. Division I.B.C. D.R.D.A. Office District Planning Office Agricultural Research Station
Chittoor	Irrigation Circle Office Chittor Irrigation Office (Madanpalli) A.P.I.D.C. Madanpalli D.R.D.A. Chittoor
Cuddapah	Irrigation Circle Office D.R.D.A. Office

GUJARAT

Gandhi Nagar	Secretary and Commissioner(RD),Govt. of Gujarat Chief Engineer(Panchayat), Gujarat Secretary Irrigation, Gujarat Superintending Engineer, Gandhinagar Panchayat, Irrigation Circle Chief Engineer,Gujarat Irrigation Department Director, Gujarat Water Resources Development Corporation Secretary, Gujarat Revenue Department, Secretary, CADA, Gujarat Gujarat Water Supply and Sewerage Board.

Rajkot	Zilla Panchayat Raj, Rajkot Deputy Director(Agriculture) Superintending Engineer, Minor Irrigation, Rajkot Circle Soil Officer, Soil Survey Department Superintending Engineer, P.H.E.D. Irrigation Department
Ahmedabad	W.R.I. Bhadra Fort Director, Agriculture Gujarat State Easter Gauging Division, Central Water Commission Flood Control Cell Additional Director of Agricultural Sciences Deputy Director, Central Flood Forecasting Division Central Water Commission
<u>KARNATAKA</u>	
Bangalore	Director,Dept. of Mines & Geology, Govt. of Karnataka Director, CGWB, South-Western Region, Director, DPAP/Rural Development, Chief Engineer, WRDO, Director, Bureau of Economics and Statistics, Chief Engineer, Minor Irrigation Director Department of Revenue, Director, Department of Agriculture, Govt. of Karnataka Directorate of Survey Settlement and Land Records Directorate of State, Groundwater Cell R.C.Road C.E., Public Health Engg. and PWD, Govt. of Karnataka Central Water Commission
Kolar	E.E.Minor Irrigation Deputy Commissioner (Special) DRDA Soil Conservation Department Irrigation Department.
Tumkur	E.E., Minor Irrigation Deputy Commissionr (Special) DRDA Soil Conservation Deptt. Irrigation Dept.
Chitradurga	E.E., Minor Irrigation Incharge of the DPAP Projects, DRDA Soil Conservtion Department, Irrigation Deptt.

Belgaum	E.E.,Minor Irrigation Incharge of the DPAP Projects DRDA Soil Conservation Deptt. Irrigation Dept. Asstt. Geologist, SGWC, Belgaum
Dharwad	E.E. Minor Irrigation DRDA Soil Conservation Dept. Irrigation Dept.
Mysore	DRDA, Soil Conservation Dept., & Irrigation Dept.
<u>MADHYA PRADESH</u>	
Bhopal	Engineer-in-Chief, Irrigation Dept. Director(D&H) Bodhi, CDO Chief Engineer, State Groundwater Survey Board, Deputy Commissioner, Rural Development Commission Additional Director, Dept. of Agriculture Dy. Director Statistics, Dept. of Agriculture Chief Engineer, PHE, Satpura Regional Meteorological Centre of IMD S.E./E.E/A.E.,Narmada Tapti Basin, Irrigation Dept., Bhopal S.E., Narmada Control Authority Regional Director, Central Groundwater Board
Dhar, Jhabua Khargone, Betul, Shahdol, Sidhi	District Collector District Statistical Officer, Supdt.Land Records S.E.(Irrigation Circle) Dy. Director, Agriculture Assistant Geohydrologist Executive Engineer, PHED
<u>MAHARASHTRA</u>	
Bombay	Irrigation Dept Maharashtra Secretary, Rural Development, Dept. of Agriculture Dept. of Forest and Revenue
Pune	Asstt. Director, ground Water Survey and Dev. Agency under Dept. of Rural Development. Met. Gr.I., Drought Research Unit, IMD, Pune Supdt., Engineer, Poona Irrigation Circle Director of Agriculture

	C.E.(Irrigation), Zilla Parishad Pune Gauging Division, C.W.C.
Aurangabad	Chief Engineer, Aurangabad, Irrigation Circle Executive Enginer, Aurangabad Irrigation Circle, S.E. Jayakwadi Proj. Stage-I, Aurangabad Irrigation Circle Department.
Solapur	Krishi Vidhyapeth, under All India Coordinated Dry Land Farming Project of ICAR,Solapur Zilla Parishad DRDA Chief Geologists Agronomist and Agr. Meteorologist NAPP Scarcity Zone, Mahatama Phule Krishi Vidhyapeth
Beed	Senior Geologist GSDA Collector's Office Zilla Parishad E.E.Irrigation Department
Parbhani	Agriculture Meteorology Dept., Marathwada Agricultural University, Collector's Office and Zilla Parishad
Ahmad Nagar	Zilla POarishad Collector's Office
Satara	Collector's Office, GSDA, Zilla Parishad
Sangli	Collector's Office, Zilla Parishad
<u>RAJASTHAN</u>	
Jaipur	Chief Engineer, Irrigation Department Dy. Director(Hydrology),Rajasthan Irrigation Dept. s.E.(Special Schemes),Rajashthan Irrigation Dept. Director, Irrigation Research, Rajasthan Irrigation Department Agronomist(Irrigation) Rajasthan Irrigation Dept. Directorate of Agriculture, Rajasthan S.E.(Soil Conservation) Dept. of Agriculture, Rajasthan Secretary, Special Schemes Organisation Rajasthan Secretary, Relief Rajasthan Dept. of Economics & Statistics, Rajasthan Directorate of Evaluation, Rajasthan

	Public Health Engg. Dept. Rajasthan Soil Survey Officer, Rajasthan Central Water Commission Field Office Central Ground Water Board, Regional Office
Ajmer	Irrigation Department
Udaipur	Agriculture Department
Banswara	Soil Conservation Office
Durgapur	District Rural Development Authority (DRDA)
Barmer	Land Record Office
Jodhpur	Groundwater Department Central Arib Zone Research Institute Chief Engineer, Rajasthan State Ground Water Department

Monthly Rainfall Departures for Districts and Taluks for 1985-86

(A) Rajasthan — Distt. Banswara

		Taluk Banswara			Taluk Garhi			Taluk Khusal Garh		
	Month	Monthly Rainfall	Monthly N ormal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	0.0	6.6	-100.0	0.0	9.12	-100.0	0.0	8.75	-100.0
	June	9.0	94.4	-90.4	0.0	97.5	-100.0	3.0	118.9	-97.4
	July	102.0	335.6	-69.6	65.0	264.1	-75.4	106.0	332.8	-68.1
	Aug.	306.0	313.9	-2.5	176.2	262.0	-32.7	104.0	315.24	-67.0
	Sept.	10.0	171.2	-94.1	29.8	153.7	-80.6	31.4	194.6	-83.8
	Oct.	216.0	28.4	+660.5	193.0	23.3	+728.3	287.4	32.9	+773.5
	Nov.	0.0	6.75	-100.0	0.0	7.08	-100.0	0.0	7.46	-100.0
	Dec.	0.0	2.16	-100.0	0.0	1.69	-100.0	0.0	2.26	-100.0
1986	Jan.	0.0	3.3	-100.0						
	Feb.	0.0	2.5	-100.0			DATA N.A.			
	March	0.0	2.0	-100.0						
	April	0.0	1.14	-100.0						
	May	0.0	6.6	-100.0						

Monthly Rainfall departures for Districts and Taluks for 1985-86

(A) Rajasthan

Distt. Banswara

		Taluk Bagidora			Taluk Ghotal			Distt. Banswara as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	18.0	4.49	+300.8	0.0	0.46	-100.0	3.64	5.08	-28.3
	June	5.0	81.1	-93.8	4.0	89.3	-95.52	4.8	95.45	-94.9
	July	65.0	250.76	-74.0	184.0	290.5	-36.67	115.47	299.01	-61.3
	Aug.	122.0	257.9	-52.0	140.2	193.5	-27.55	170.1	264.25	-35.6
	Sept.	45.8	155.6	-70.5	10.8	188.2	-94.26	23.44	176.1	-18.6
	Oct.	319.0	26.4	+1108.3	197.0	20.5	+859.57	243.8	26.23	+829.4
	Nov.	0.0	5.42	-100.0	0.0	4.42	-100.0	0.0	5.99	-100.0
	Dec.	0.0	1.98	-100.0	0.0	0.75	-100.0	0.0	1.7	-100.0

DISTT. BARMER

Year	Month	Taluk Barmer			Taluk Chohtan			Taluk Siwana		
		Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	%Dept.	Monthly Rainfall	Monthly Normal	%Dep.
1985	May	0.0	8.09	-100.0	0.8	3.5	-77.14	0.0	10.9	-100.0
	June	0.0	21.4	-100.00	0.0	17.7	-100.00	20.4	30.99	-34.17
	July	157.2	88.9	+76.8	62.0	79.15	-21.67	128.4	104.7	+22.6
	August	69.0	98.0	-29.5	68.8	88.8	-22.53	24.0	124.8	-80.7
	Sept.	0.0	33.06	-100.0	8.0	33.03	-75.78	0.2	54.26	-99.6
	Oct.	0.0	3.33	-100.0	0.0	2.51	-100.00	0.0	4.25	-100.0
	Nov.	0.0	2.05	-100.0						
	Dec.	0.0	1.33	-100.0						
1986	Jan.	0.0	1.99	-100.0						
	Feb.	0.0	2.92	-100.0						
	March	0.0	3.09	-100.0						
	April	0.0	2.02	-100.0						
	May	21.2	8.09	+162.05						

Year	Month	Taluk Pachpadra			Taluk Sheo			Distt. Barmer as a Whole		
		Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	%Dep.
1985	May	0.0	8.78	-100.0	0.0	7.12	-100.0	0.229	7.042	-96.7
	June	0.0	22.02	-100.0	0.0	18.72	-100.0	2.41	21.06	-88.5
	July	75.0	3.58	+1994.97	11.0	71.75	-84.67	83.43	69.44	+20.1
	August	17.6	81.85	-78.50	91.0	76.95	+18.26	41.03	91.47	-55.14
	Sept.	0.0	45.9	-100.0	0.0	24.97	-100.0	2.31	36.08	-93.6
	Oct.	0.0	5.05	-100.0	0.0	2.8	-100.0	0.0	3.41	-100.0

(B) MADHYA PRADESH

DISTRICT JHABUA

		Taluk Thandla			Taluk Jobat			Taluk Petalwad		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	%Dep.
1985	June	1.8	122.1	-198.5	16.4	139.3	-88.2%	53.5	135.26	-60.4
	July	125.2	280.7	-55.4	225.0	243.75	- 7.6	112.5	277.8	-59.5
	August	109.4	255.6	-57.2	74.0	244.2	-69.6	189.1	329.4	-42.6
	Sept.	58.6	120.84	-51.7	53.6	131.4	-59.2	37.3	144.7	-74.2
	Oct.	148.8	22.65	+556.9	73.6	12.82	+474.1	166.3	24.1	+590.0

		Taluk Alirajpur			Taluk Jhabua			Distt. Jhabua as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	June	26.6	124.6	-78.6	9.6	113.9	-91.5	21.58	126.2	-82.9
	July	248.4	286.3	-13.4	63.0	254.6	-75.2	154.82	271.6	-42.9
	Aug.	59.2	225.4	-73.5	97.8	216.75	-54.8	105.9	247.1	-57.1
	Sept.	15.4	163.9	-90.6	58.0	140.3	-58.7	44.58	145.6	-69.38
	Oct.	46.0	28.17	+63.3	69.0	24.04	+187.0	100.74	23.64	+326.14
	Nov.	0.0	11.25	-100.0	0.0	11.02	-100.0	0.0	12.59	-100.0
	Dec.	0.0	1.97	-100.0	0.0	2.47	-100.0	0.0	2.33	-100.0

DISTT: KHARGONE

		Taluk Barwani			Taluk Khargone			Taluk Raipur		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	June	127.6	121.64	+4.89	92.8	139.5	-33.98	36.0	118.76	-69.69
	July	75.8	180.3	-57.96	214.0	225.11	- 4.93	66.0	192.83	-65.77
	August	67.8	139.64	-51.45	73.6	208.1	-64.63	112.0	172.82	-35.19
	Sept.	52.3	131.76	-60.31	20.8	260.13	-92.00	96.0	140.5	-31.67
	Oct.	51.6	31.78	+62.37	148.6	33.33	+345.84	122.0	34.78	+250.78
	Nov.	0.0	16.3	-100	0.0	19.14	-100.00	0.0	16.89	-100.0
	Dec.	0.0	4.11	-100.00	0.0	7.11	-100.00	0.0	6.74	-100.0
1986	Jan.	0.0	4.01		3.2	2.0		0.0	2.1	
	Feb.	7.6	1.78		18.0	2.4		35.0	0.54	
	March	0.0	3.47		0.0	4.03		0.0	1.7	
	April	0.0	1.67		0.0	2.74		0.0	2.02	
	May	7.9	6.85		0.0	7.15		0.0	6.71	

DISTT.: KHARGONE

		Taluk Sendhewa			Taluk Keserwad			Distt. Khargone as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	Jan.							2.1	2.98	-29.53
	Feb.							15.51	1.81	+756.91
	March							0.0	3.03	-100.0
	April							0.0	1.98	-100.0
	May							3.142	6.34	-50.44
	June	104.4	129.31	-19.26	64.0	106.15	-39.71	90.17	128.05	-29.58
	July	127.6	272.25	-53.13	109.2	247.64	-55.90	134.07	233.86	-92.67
	August	104.0	222.39	-53.01	68.3	254.74	-73.19	97.19	215.84	-54.27
	Sept.	68.2	174.39	-60.87	24.9	153.73	-83.80	50.27	159.61	-68.50
	Oct.	88.4	39.23	+150.0	49.0	31.35	+46.41	100.05	42.11	+137.59
	Nov.	0.0	15.73	-100.0	0.0	14.63	-100.0	0.0	17.23	-100.0
	Dec.	0.0	6.79	-100.0	0.0	5.79	-100.0	0.0	7.08	-100.0
1986	Jan.	0.0	2.8		0.0	4.74				
	Feb.	0.0	0.75		0.0	2.08				
	March	0.0	1.12		0.0	4.62				
	April	0.0	2.17		0.0	0.21				
	May	11.4	6.31		0.0	3.32				

(C) GUJARAT DISTT:JAMNAGAR

Year	Month	Taluk Kalyanpur			Taluk Lalpur			Taluk Jamnagar		
		Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	15.0	1.64	+814.63	0.0	0.94	-100	0.0	0.74	-100.0
	June	0.0	148.74	-100.0	0.0	138.78	-100.00	0.0	80.39	-100.00
	July	34.0	171.28	- 80.15	37.2	161.81	- 77.01	92.9	203.32	- 54.31
	August	110.0	82.64	+33.11	104.4	158.36	- 34.07	129.9	117.95	+ 10.13
	Sept.	23.0	52.5	- 56.19	79.4	80.96	- 1.93	4.2	55.47	- 92.43
	Oct.	0.0	22.12	-100.0	0.0	23.64	-100.0	0.0	12.8	-100.0
	Nov.	0.0	2.99	-100.0	0.0	71.63	-100.0	0.0	4.99	-100.0

Year	Month	Taluk Bhanvad			Taluk Kalwad			Distt. Jamnagar as a whole		
		Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
*('£	May	0.0	0.91	-100	0.0	0.36	-100.0	3.6	1.11	+224.32
	June	0.0	167.11	-100	0.0	132.27	-100	0.97	130.18	- 99.25
	July	9.23	213.48	- 95.68	41.6	174.15	- 76.11	65.65	191.11	- 65.65
	August	48.2	191.37	- 74.81	102.7	115.64	- 11.19	113.7	131.8	- 13.73
	Sept.	0.0	72.17	-100.0	1.5	85.11	- 98.24	23.3	70.28	- 66.85
	Oct.	0.0	21.72	-100.0	10.0	22.89	- 56.31	5.21	18.35	- 71.61
	Nov.	0.0	3.76	-100.0	0.0	6.82	-100.0	0.0	14.31	-100.0

DISTT : RAJKOT

		Taluk Morvi			Taluk Wankaner			Taluk Rajkot		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	8.0	4.02	+ 99.00	0.0	4.82	-100.0	0.0	9.97	-100.0
	June	0.0	74.6	-100.0	0.0	93.98	-100.0	0.0	99.74	-100.0
	July	226.0	238.35	- 5.18	157.0	239.47	- 34.44	125.0	251.99	- 50.39
	August	40.0	152.89	- 73.84	99.0	133.06	- 25.60	91.0	146.78	- 38.00
	Sept.	0.0	64.08	-100.00	20.0	65.2	- 69.33	64.0	87.03	- 26.46
	Oct.	17.0	11.47	+ 48.21	16.0	14.0	+ 14.29	7.0	21.08	- 66.79
	Nov.	0.0	4.05	-100.0	0.0	7.78	-100.0	0.0	4.56	-100.0

		Taluk Jasdan			Taluk Upleta			Distt. Rajkot as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	0.0	8.91	-100.0	0.0	4.89	-100.0	1.25	6.59	- 81.03
	June	0.0	93.11	-100.0	0.0	105.19	-100.0	0.48	96.64	- 99.50
	July	63.0	229.96	- 72.60	100.0	244.73	- 59.14	127.37	235.75	- 45.97
	August	97.0	125.02	- 22.41	158.0	130.76	+ 20.83	101.04	139.06	- 27.34
	Sept.	80.0	90.08	- 11.19	11.0	94.01	- 88.30	34.33	75.52	- 54.54
	Oct.	32.0	22.2	+ 44.14	37.0	19.72	+ 87.63	16.35	17.81	- 8.20
	Nov.	0.0	7.86	-100.0	0.0	5.15	-100.0	0.0	6.06	-100.0

(B) ANDHRA PRADESH DISTT. : CUDDAPAH

		Taluk Jammalamadugu			Taluk Sidhout			Taluk Cuddapah		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	8.2	45.5	- 81.58	0.0	47.4	-100.0	2.8	41.8	-93.30
	June	53.9	61.7	-12.64	52.9	71.4	- 25.91	35.0	77.0	-54.60
	July	167.0	76.7	+11.73	150.4	116.9	+ 28.66	72.5	115.5	-37.23
	Aug.	43.8	90.7	-51.71	71.2	119.8	- 40.57	45.2	119.0	-62.01

		Taluk Proddattur			Taluk Badvel			Distt. Cuddapah as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normall	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	10.4	42.7	- 75.64	16.0	49.3	- 67.55	4.3	46.65	-90.78
	June	39.8	67.8	- 41.30	31.0	55.7	- 44.34	55.0	61.46	-10.51
	July	107.9	85.1	+126.79	92.0	91.9	+ 0.11	119.28	91.32	+30.62
	August	48.6	108.5	- 55.21	49.2	105.3	- 53.28	59.38	98.69	-39.83

DISTT: ANANTPUR

		Taluk Urvakonda			Taluk Anantpur			Taluk Penukonda		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	58.0	57.43	+ 0.99	1.6	57.15	- 97.20	30.0	65.45	-41.94
	June	36.4	44.23	-17.70	0.0	51.15	-100.0	46.6	48.33	- 3.58
	July	48.6	53.94	- 9.90	0.0	55.58	-100.0	42.0	57.73	-27.25
	Aug.	7.0	70.97	-90.14	0.0	74.66	-100.0	17.0	72.5	-76.55

		Taluk Ramdurg			Taluk Madakasira			Distt. Anantpur as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	59.0	62.64	- 5.81	44.0	75.95	-42.07	22.07	53.27	-58.57
	June	21.4	47.21	-54.67	39.2	50.09	-31.72	44.25	44.48	- 0.52
	July	21.8	39.28	-44.50	48.6	56.23	-13.57	57.59	52.26	- 0.10
	August	16.2	66.01	-75.46	51.3	70.81	-27.55	18.53	70.66	-73.78

		Taluk Indi			Taluk Bijapur			Taluk Mudhol		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	3.3	25.25	-86.25	44.7	36.05	+23.99	21.8	51.52	-57.69
	June	27.7	77.34	-64.18	135.4	79.17	+71.02	19.6	67.25	-70.86
	July	30.9	82.22	-62.42	65.7	74.19	-11.44	56.0	63.57	-11.91
	August	20.7	80.46	-74.27	146.2	75.15	+24.54	33.7	61.44	-45.15
	Sept.	105.3	172.02	-38.79	61.9	146.68	-57.80	56.4	132.94	-57.57
	Oct.	116.4	77.85	+49.52	97.4	93.38	+ 4.30	81.2	91.46	-11.22
	Nov.	0.0	33.48	-100.0	0.0	30.26	-100.0	4.5	36.01	-87.50

		Taluk Bhagalkot			Taluk Muddbihal			Distt. Bijapur as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	28.2	50.72	-44.40	55.6	41.97	+32.48	29.73	39.7	-25.11
	June	32.0	72.63	-55.94	85.8	72.81	+17.84	60.43	72.66	-16.83
	July	26.0	75.27	-65.46	38.7	77.89	-50.31	41.6	75.26	-44.72
	Aug.	45.0	66.93	-32.77	59.4	77.96	-23.81	60.5	73.05	-17.18
	Sept.	96.0	143.29	-35.26	73.2	163.81	-55.31	81.35	154.16	-47.23
	Oct.	27.0	101.86	-73.49	77.4	86.42	-10.44	80.0	89.55	-10.66
	Nov.	28.0	30.67	- 8.71	3.8	26.58	-85.70	7.55	31.08	-75.71

DISTT BELGAUM

		Taluk Belgaum			Taluk Sundatti			Taluk Hukeri		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	78.4	83.28	- 5.88	34.7	71.72	-51.62	118.4	82.73	+43.12
	June	118.6	199.76	- 5.59	19.7	67.73	-70.91	45.6	88.71	-48.60
	July	261.8	467.15	-47.96	29.0	85.28	-65.99	75.0	146.47	-48.79
	August	303.6	264.45	+14.80	5.7	70.87	-91.96	76.6	88.12	-13.07
	Sept.	21.0	122.99	-82.98	18.3	113.83	-83.92	32.2	107.67	-70.09
	Oct.	130.9	118.5	+10.46	93.6	111.75	-16.24	65.4	119.85	-45.43
	Nov.	8.8	38.66	-77.24	0.0	43.71	-100.0	0.0	42.58	-100.0

		Taluk Gokak			Taluk Athani			Distt. Belgaum as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May	53.9	67.79	-20.49	50.9	54.32	- 6.30	47.41	66.74	-28.96
	June	20.7	62.26	-66.75	21.6	72.12	-70.05	105.03	119.57	-12.16
	July	41.1	76.06	-45.96	78.2	75.51	+ 3.56	120.39	225.43	-46.60
	August	28.8	62.33	-53.69	6.2	66.24	-90.64	104.56	132.20	-20.91
	Sept.	11.4	102.06	-88.83	108.6	135.42	-19.81	50.07	115.94	-56.82
	Oct.	119.8	108.66	+10.25	50.0	96.52	-48.20	80.99	108.45	-25.32
	Nov.	4.4	29.28	-88.82	0.0	33.53	-100.0	7.21	38.49	-81.27

(F) MAHARASHTRA

DISTT. : AHMEDNAGAR

		Taluk Akola			Taluk Sangamner			Taluk Newasa		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May									
	June	30.0	98.4	-69.5	59.5	86.1	-30.8	36.5	116.5	-68.6
	July	32.0	154.0	-79.22	23.5	88.5	-73.4	69.5	109.8	-36.7
	August	24.0	83.7	-71.3	16.0	57.6	-72.2	51.3	83.7	-38.7
	Sept.	4.0	119.6	-96.66	26.0	125.4	-79.2	62.0	152.6	-59.5
	Oct.	93.5	62.4	+49.8	78.0	56.1	+39.0	82.0	60.5	+35.5
	Nov.	0.0	32.4	-100.0	0.0	32.7	-100	0.0	27.4	-100.00
	Dec.	0.0	2.3	-100	0.0	3.4	-100	0.0	7.7	-100.00

		Taluk Sheogaon			Taluk Ahmadnagar			Distt. Ahmadnagar as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	Jan.							1.08	3.9	-72.3
	Feb.							0.0	1.72	-100.00
	March							0.0	2.67	-100.00
	April							0.083	7.46	-98.8
	May							9.35	20.49	-54.3
	June	53.3	119.1	-53.5	60.2	119.0	-48.4	75.06	96.19	-21.9
	July	42.7	118.1	-63.8	54.6	95.2	-42.6	52.5	102.03	-48.5
	Aug.	17.0	98.6	-82.76	8.98	81.0	-89.1	15.07	71.71	-78.9
	Sept.	54.0	175.3	-69.2	198.1	163.3	+21.31	74.22	124.86	-40.5
	Oct.	58.0	52.0	+11.54	55.1	63.7	-13.5	82.53	57.9	+42.54
	Nov.	0.0	28.5	-100.0	16.8	31.9	-47.35	5.5	28.28	-80.55
	Dec.	0.0	4.0	-100.0	0.0	9.4	-100.0	0.0	5.25	-100.0

DISTT. : SOLAPUR

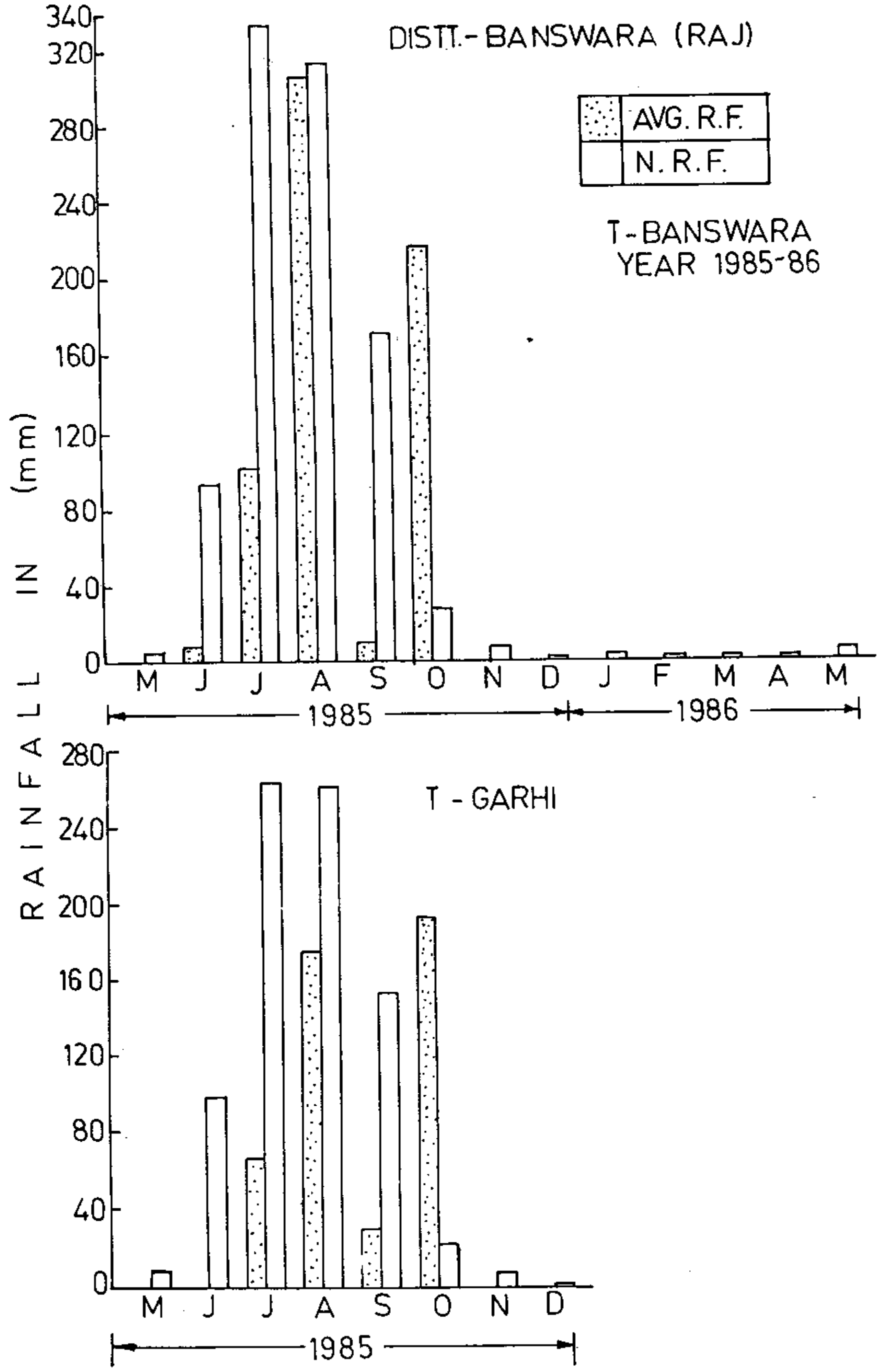
		Taluk Akalkot			Taluk Barsi			Taluk Malsira		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	June	110.4	104.6	+5.5	65.2	119.4	-45.3	110.4	82.1	+34.47
	July	47.9	139.7	-65.7	51.8	120.4	-56.9	47.9	63.5	-24.5
	August	25.7	126.1	-79.6	16.6	113.4	-85.3	25.7	58.9	-56.3
	Sept.	22.6	187.4	-87.9	90.2	181.5	-50.3	22.6	147.8	-84.7
	Oct.	56.0	83.4	-32.8	51.8	61.0	-15.0	56.0	77.7	-27.9
	Nov.	0.0	30.6	-100	4.8	29.2	-83.5	0.0	36.1	-100.00
	Dec.	0.0	4.8	-100	0.0	6.5	-100	0.0	6.8	-100.00
1986	Jan.	0.0	3.5	-100		3.9			4.7	
	Feb.	0.0	3.9	-100		2.5			1.0	
	March	0.0	4.8	-100		4.6			1.0	
	April	0.0	16.3	-100		9.2			10.7	
	May	0.0	26.3	-100		25.3			23.6	

DISTT.: SOLAPUR

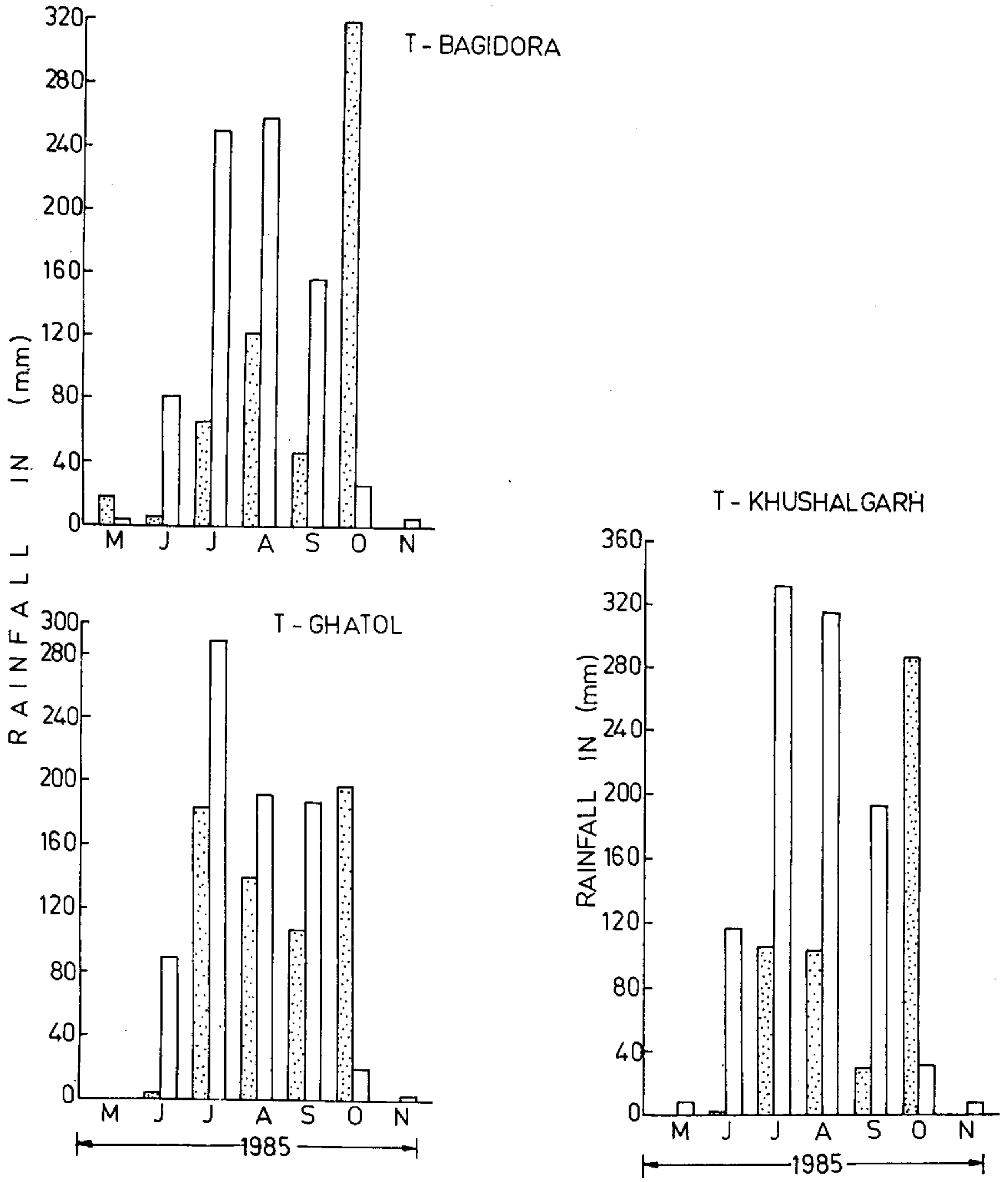
		Taluk Sangola			Taluk Solapur			Distt. Solapur as a whole		
Year	Month	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.	Monthly Rainfall	Monthly Normal	% Dep.
1985	May							15.5	27.35	-43.3
	June	159.1	94.5	+68.3	93.6	116.2	-19.4	96.43	95.56	+ 1.41
	July	60.0	66.1	- 9.2	71.6	118.2	-39.4	65.4	94.12	-30.5
	August	8.9	76.6	-88.3	71.6	113.6	-36.9	28.16	94.09	-70.07
	Sept.	78.4	160.5	-51.1	65.1	185.5	-64.9	76.37	167.9	-54.5
	Oct.	97.8	87.9	+11.2	85.3	84.4	+ 1.07	86.22	79.49	+ 8.4
	Nov.	8.2	36.5	-77.5	0.0	27.4	-100.0	2.62	26.9	-90.2
	Dec.	0.0	7.7	-100.0	0.0	6.9	-100.0	0.0	5.01	
1986	Jan.		3.7		25.0	4.4				
	Feb.		1.7		0.0	5.1				
	March		4.2		0.0	5.5				
	April		13.8		3.5	11.9				
	May		33.9		2.9	26.4				

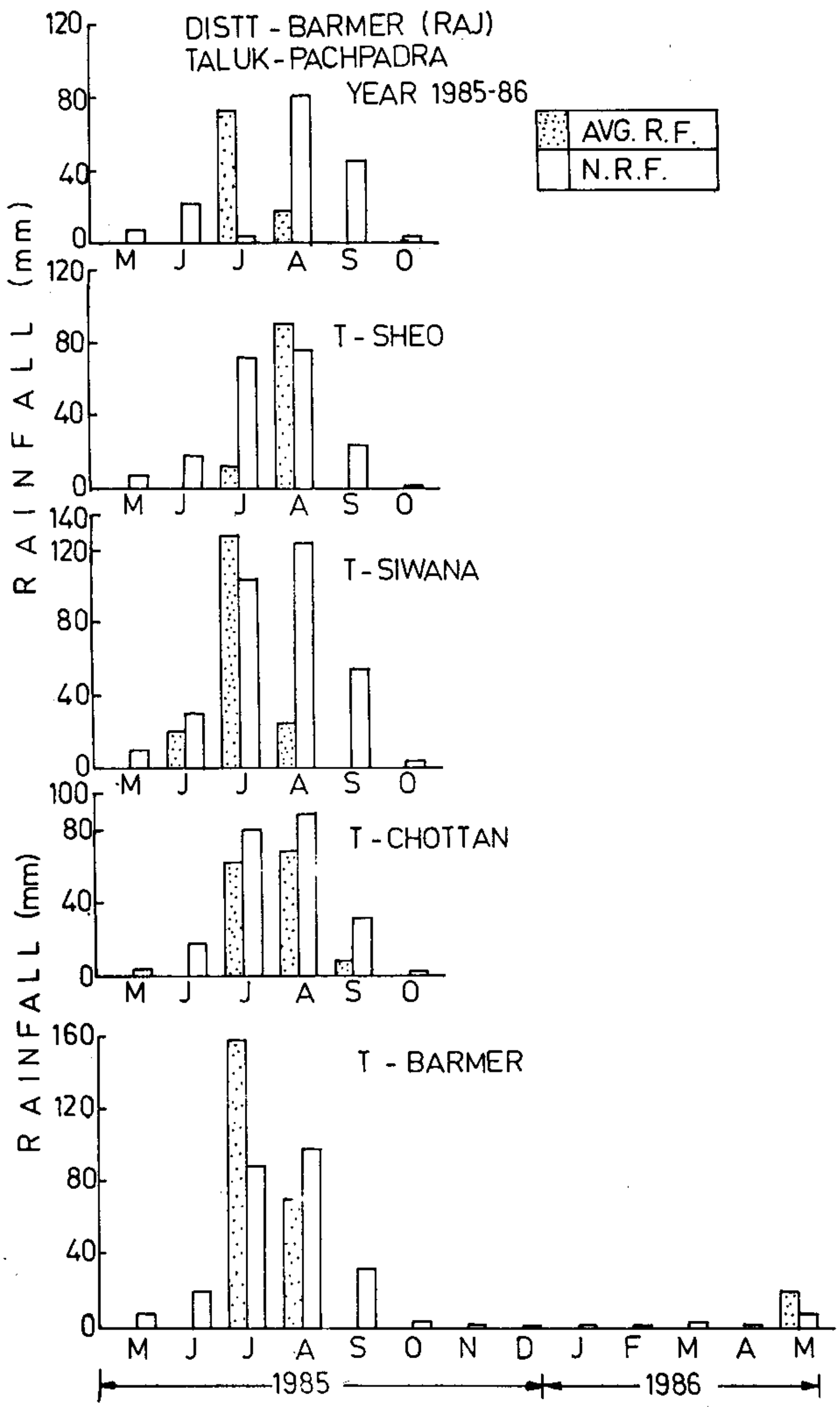
APPENDIX-III-1(B)

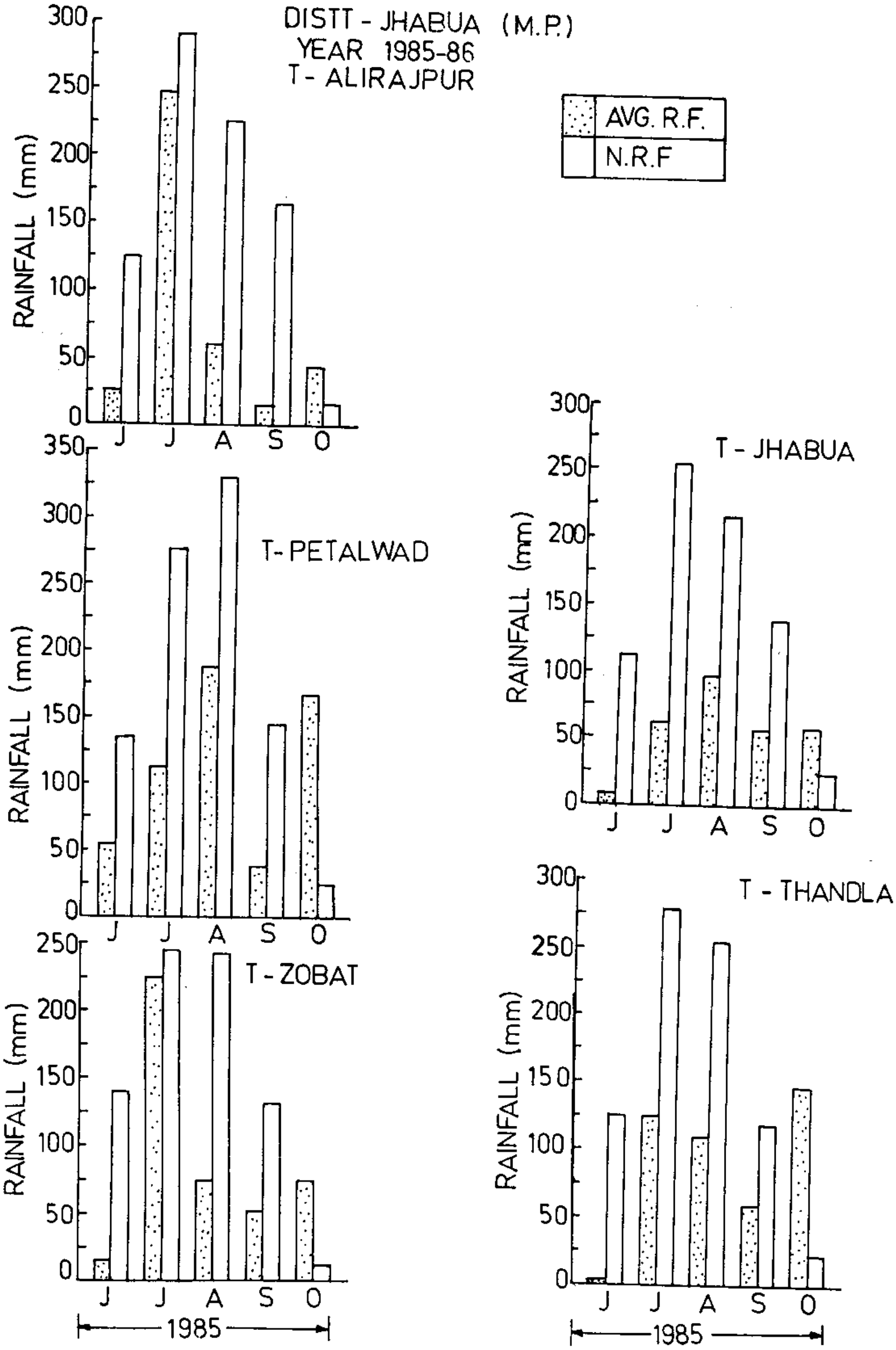
TALUKWISE MONTHLY RAINFALL DEPARTURES

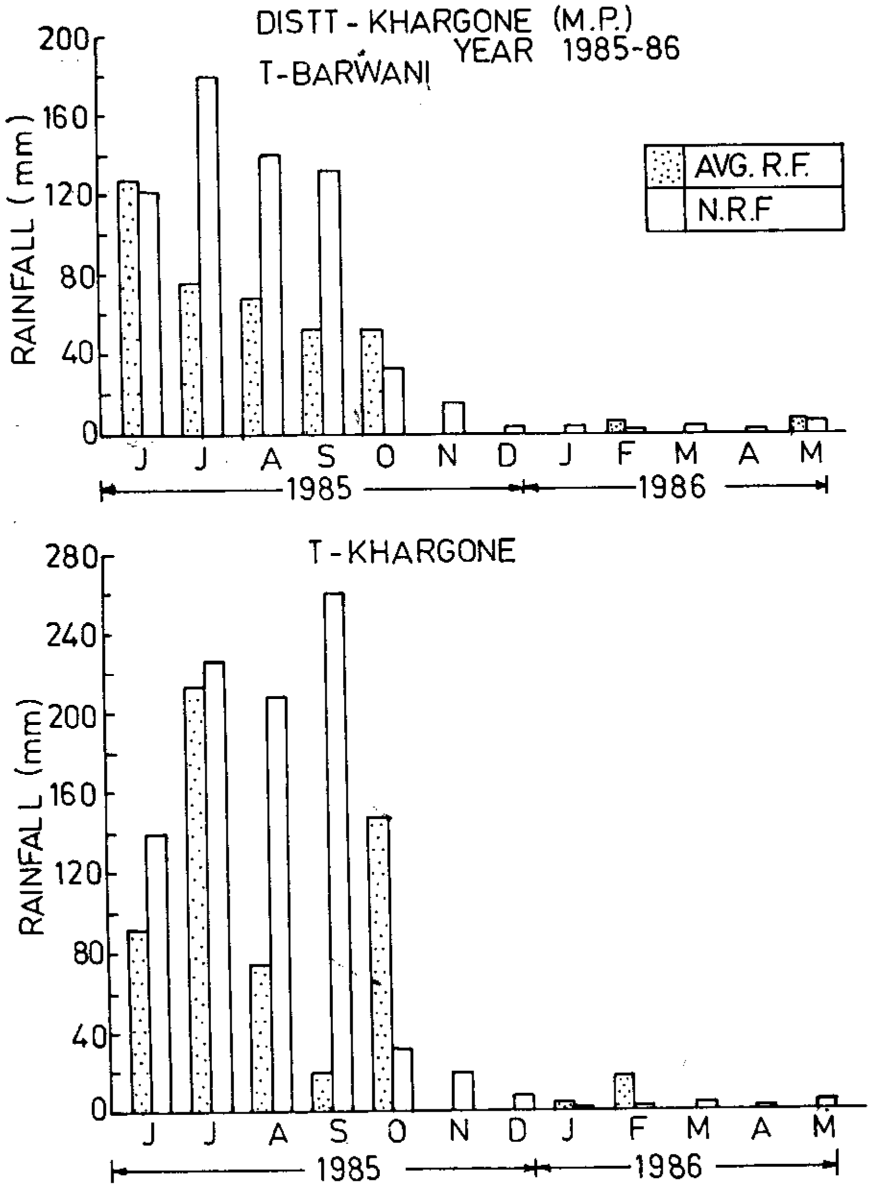


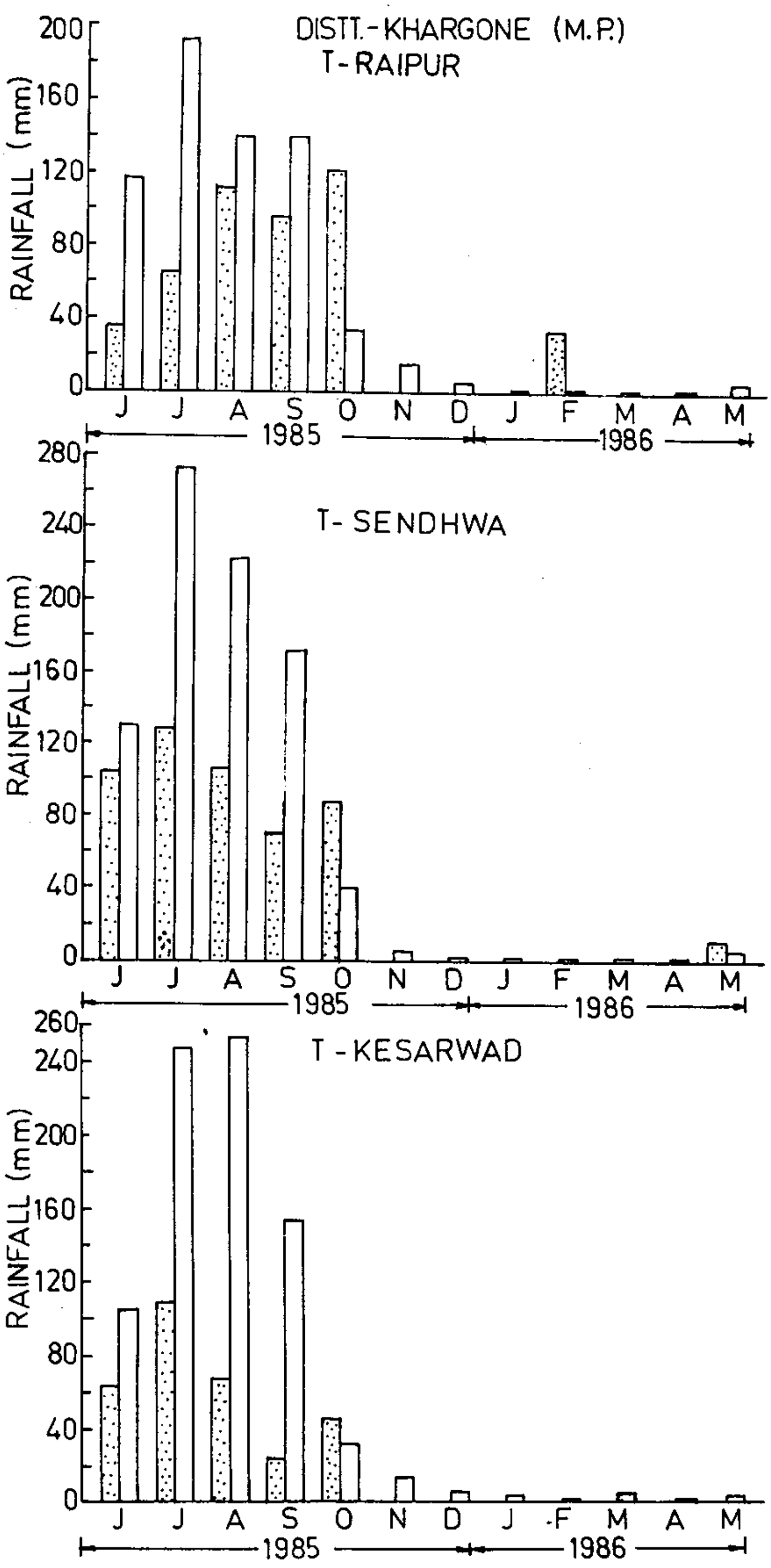
DISTT-BANSWARA (RAJ)

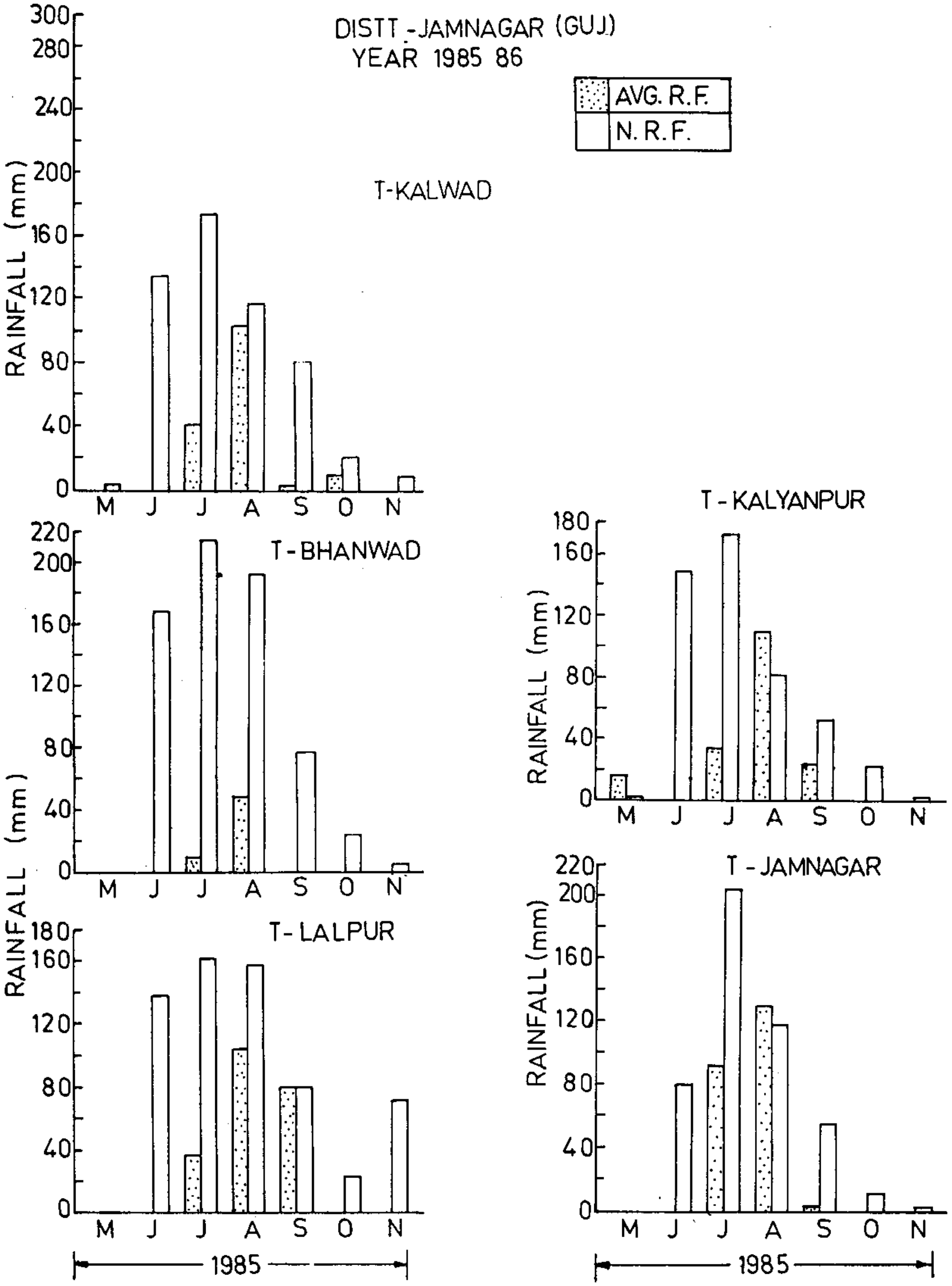



DISTT - BARMER (RAJ)
TALUK - PACHPADRA
YEAR 1985-86
AVG. R.F.
N.R.F.
RAINFALL (mm)
T - SHEO
T - SIWANA
T - CHOTTAN
RAINFALL (mm)
T - BARMER
M J J A S O N D J F M A M
1985
1986

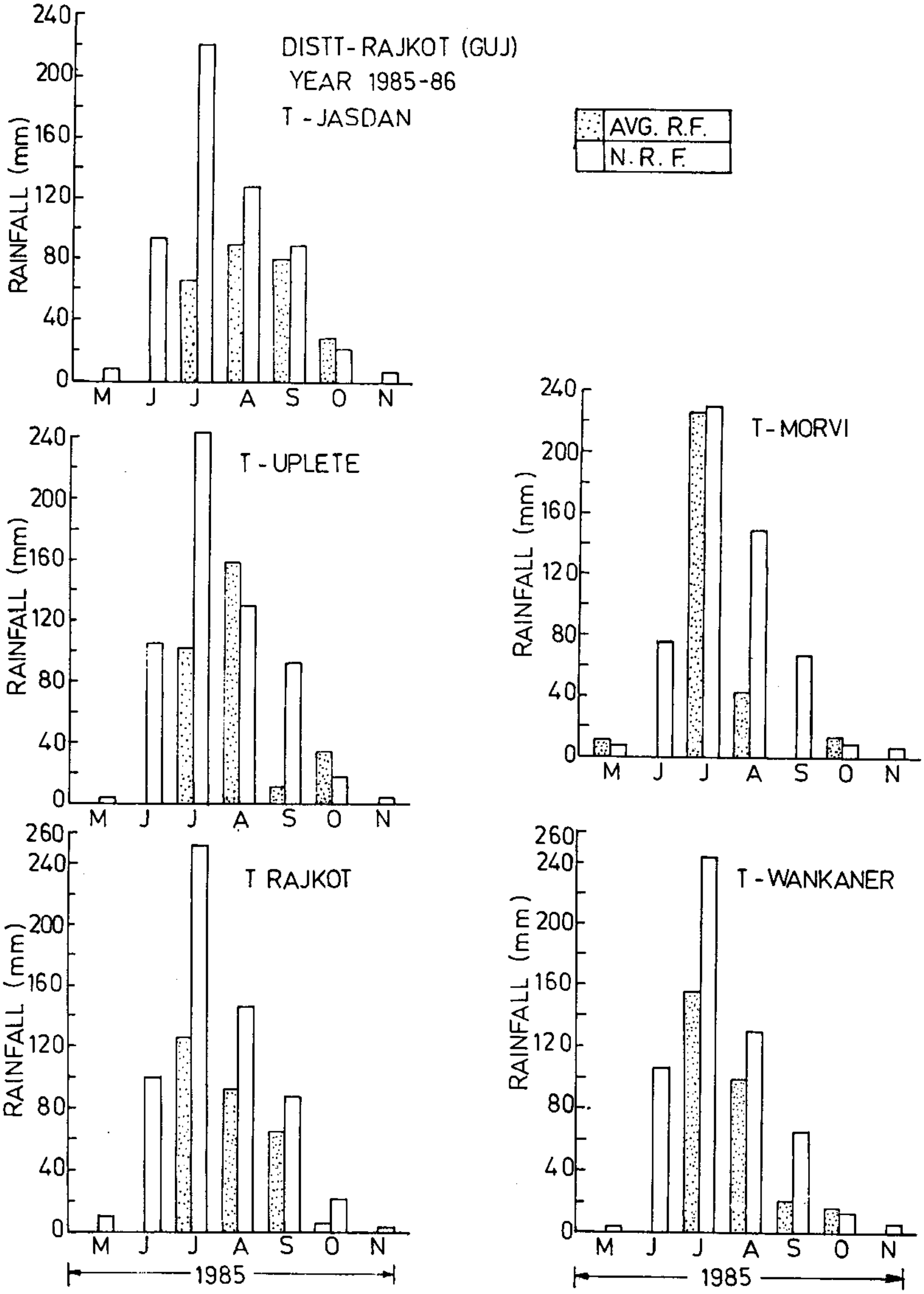

DISTT - JHABUA (M.P.)
YEAR 1985-86
T - ALIRAJPUR
AVG. R.F.
N.R.F
RAINFALL (mm)
T - JHABUA
T-PETALWAD
T - ZOBAT
T - THANDLA
J J A S O
1985


DISTT - KHARGONE (M.P.)
YEAR 1985-86
T-BARWANI
RAINFALL (mm)
AVG. R.F.
N.R.F
J J A S O N D J F M A M
1985
1986
T-KHARGONE
RAINFALL (mm)
J J A S O N D J F M A M
1985
1986

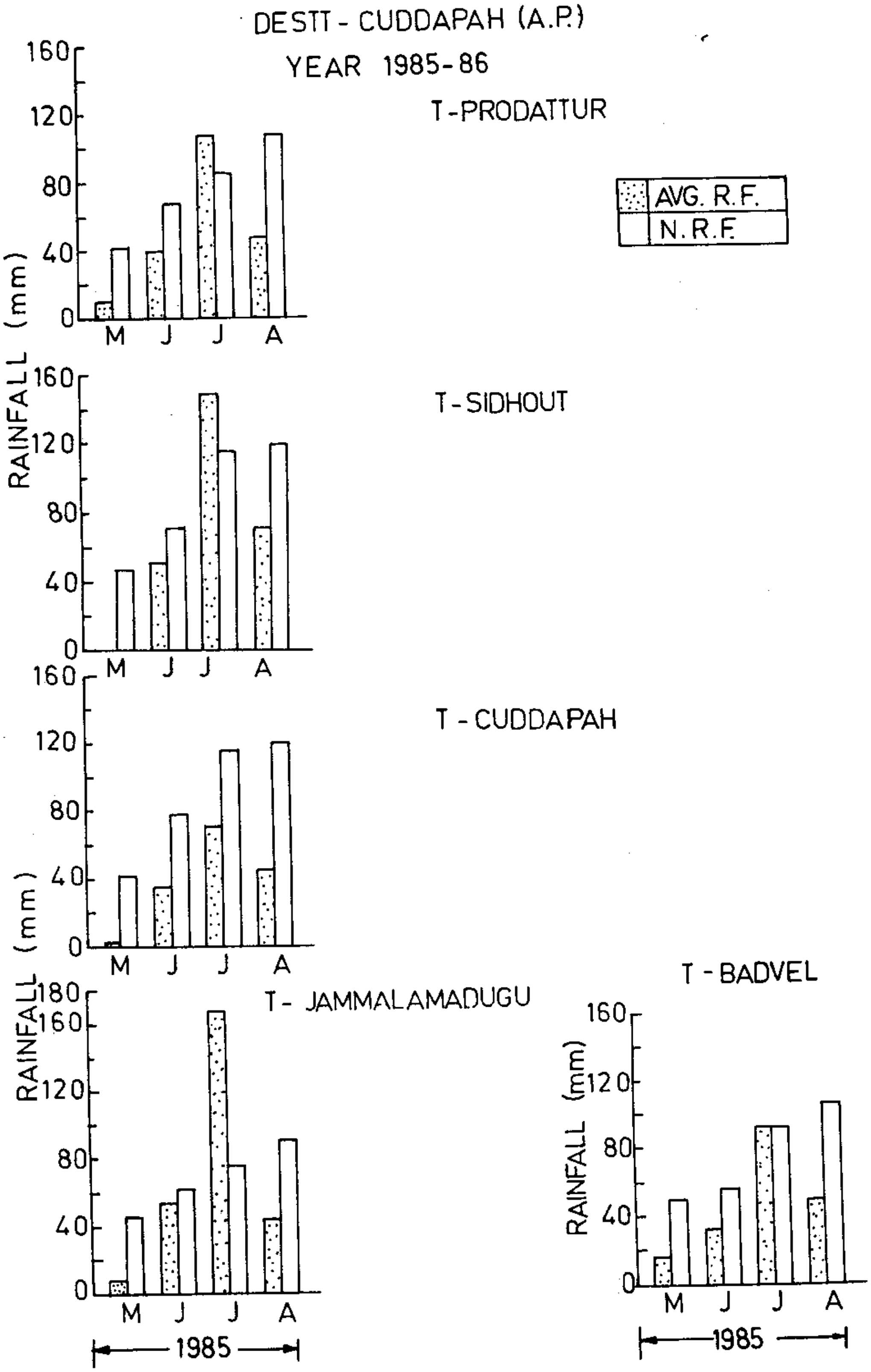

DISTT.-KHARGONE (M.P.)
T-RAIPUR
T-SENDHWA
T-KESARWAD
RAINFALL (mm)
0
40
80
120
160
200
240
260
280
J J A S O N D J F M A M
1985
1986

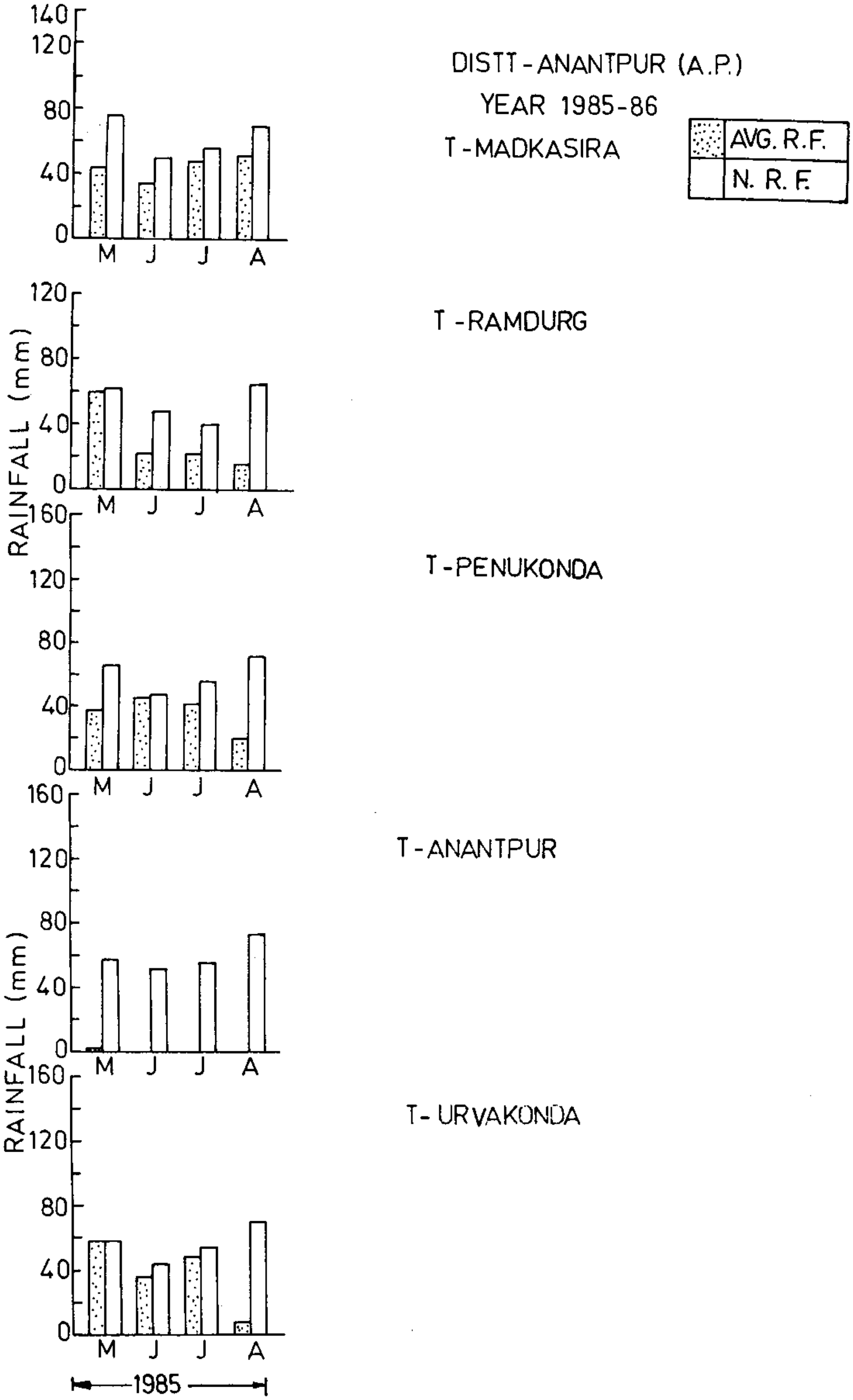


DISTT -JAMNAGAR (GUJ)
YEAR 1985 86
AVG. R.F.
N. R.F.
T-KALWAD
T-BHANWAD
T-LALPUR
T - KALYANPUR
T - JAMNAGAR
RAINFALL (mm)
M J J A S O N
1985

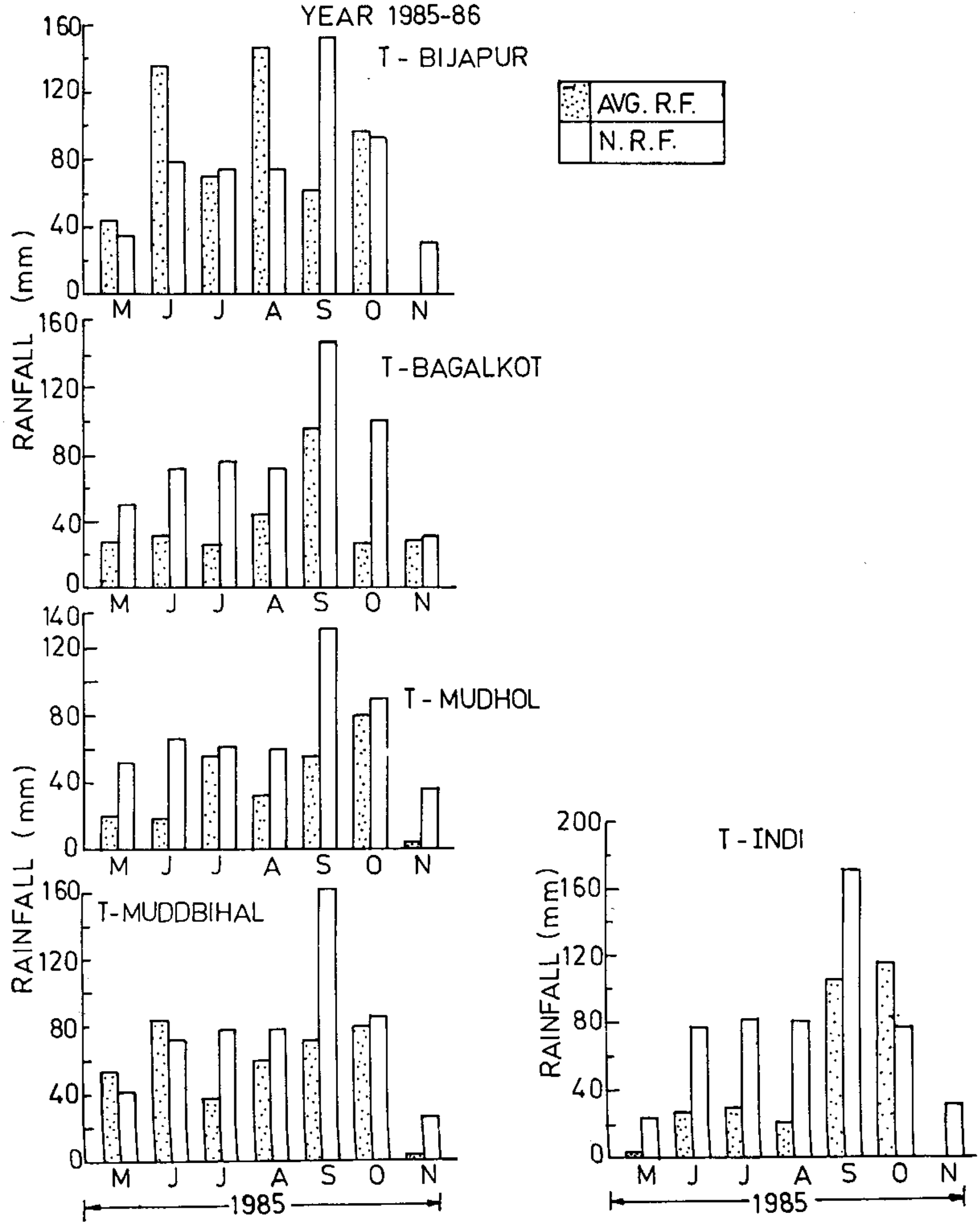


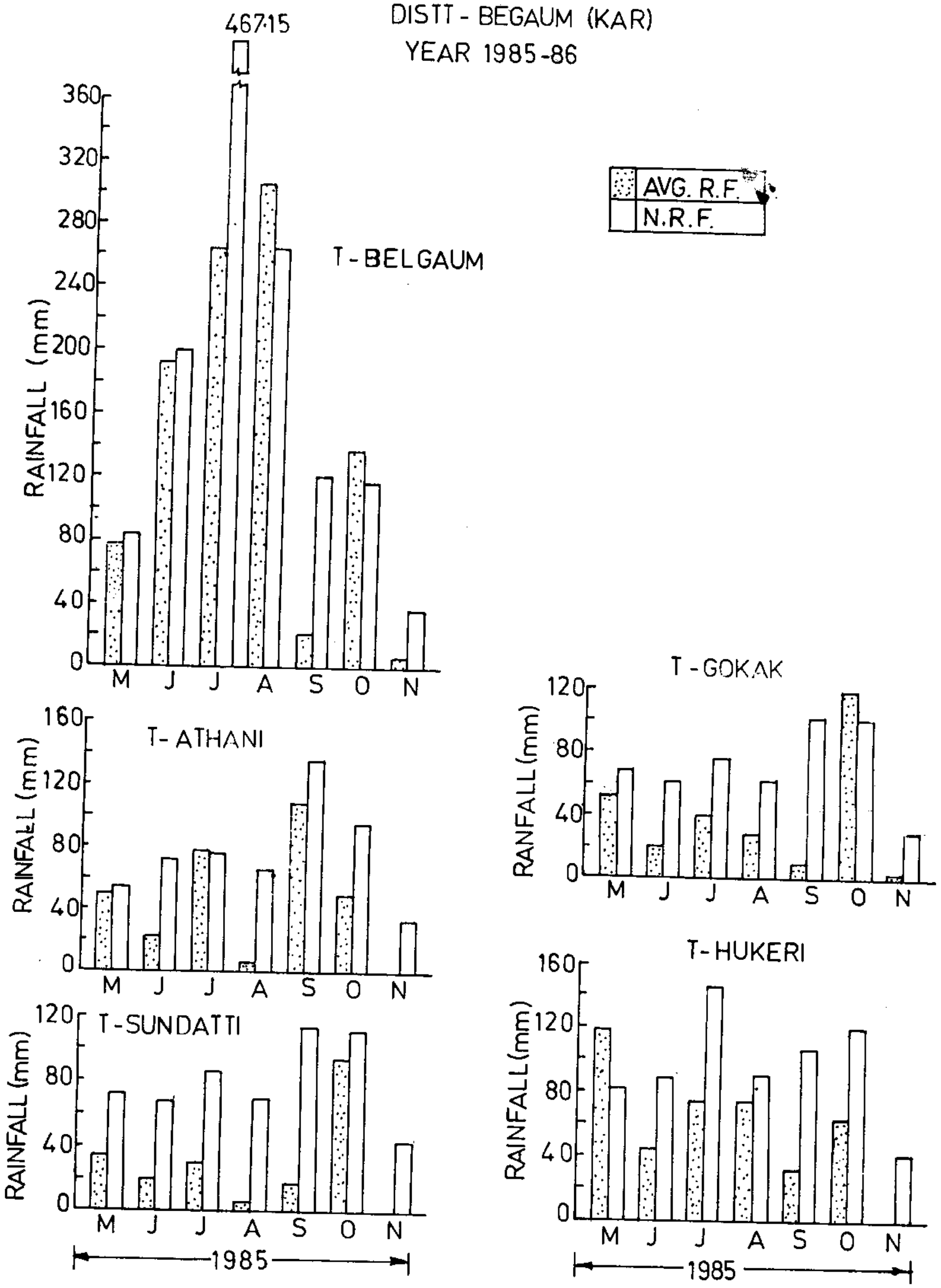
DISTT-RAJKOT (GUJ)
YEAR 1985-86
T - JASDAN
AVG. R.F.
N.R.F.
T - UPLETE
T - MORVI
T RAJKOT
T - WANKANER
RAINFALL (mm)
M J J A S O N
1985

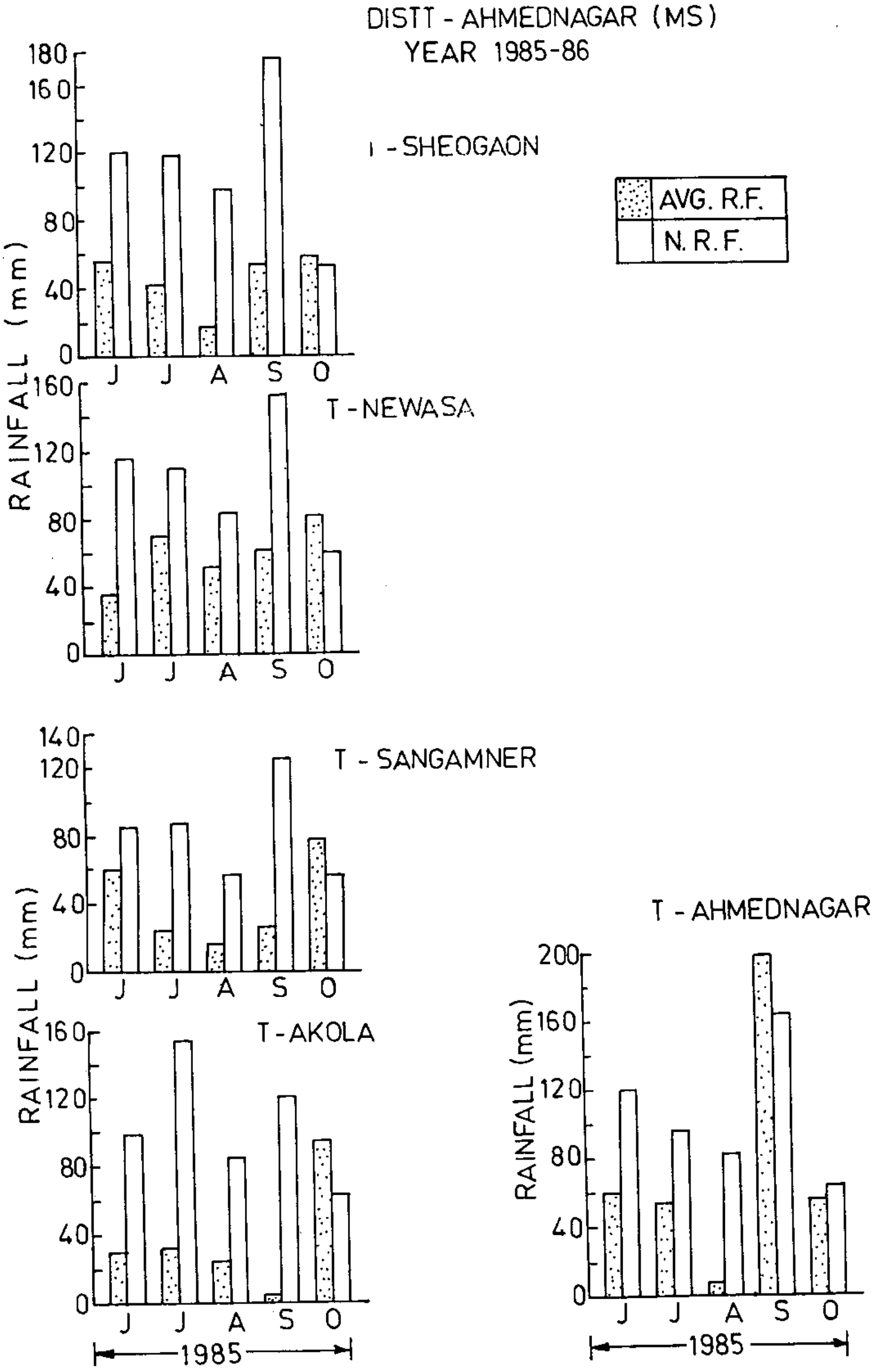

DESTT - CUDDAPAH (A.P.)
YEAR 1985-86
T-PRODATTUR
AVG. R.F.
N.R.F.
RAINFALL (mm)
160
120
80
40
0
M J J A
T-SIDHOUT
RAINFALL
160
120
80
40
0
M J J A
T - CUDDAPAH
160
120
80
40
0
M J J A
RAINFALL (mm)
T - JAMMALAMADUGU
180
160
120
80
40
0
M J J A
1985
T - BADVEL
RAINFALL (mm)
160
120
80
40
0
M J J A
1985


DISTT - ANANTPUR (A.P.)
YEAR 1985-86
T - MADKASIRA
AVG. R.F.
N. R. F.
T - RAMDURG
T - PENUKONDA
T - ANANTPUR
T - URVAKONDA
RAINFALL (mm)
M J J A
1985

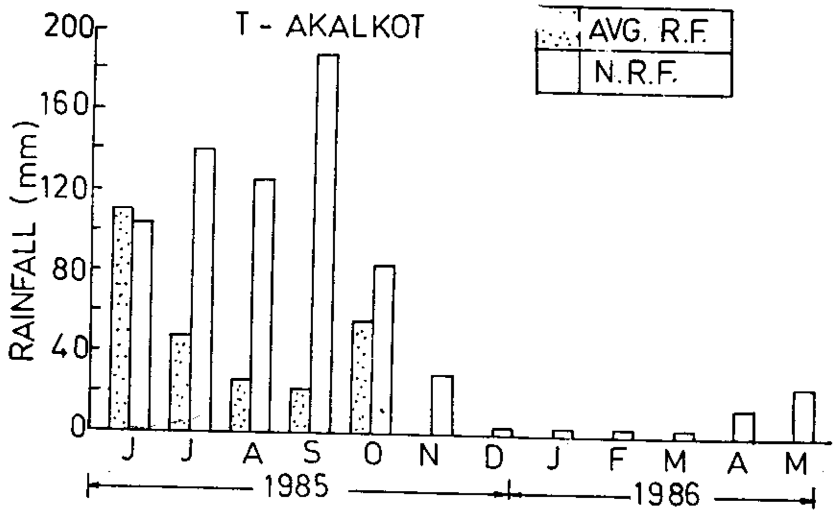
DISTT - BIJAPUR (KAR)
YEAR 1985-86

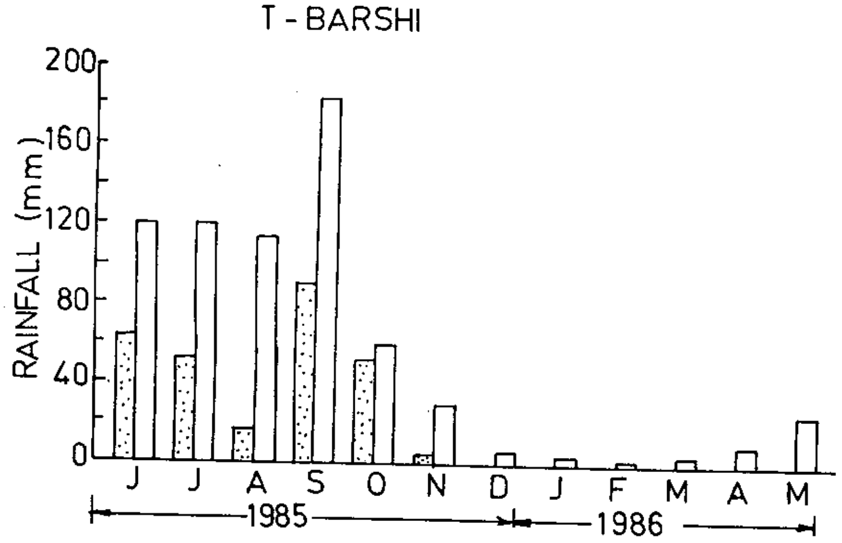



DISTT - BEGAUM (KAR)
YEAR 1985-86
AVG. R.F.
N.R.F.
467.15
T - BELGAUM
RAINFALL (mm)
0
40
80
120
160
200
240
280
320
360
M J J A S O N
T - ATHANI
T - GOKAK
T - SUNDATTI
T - HUKERI
RANFALL (mm)
1985

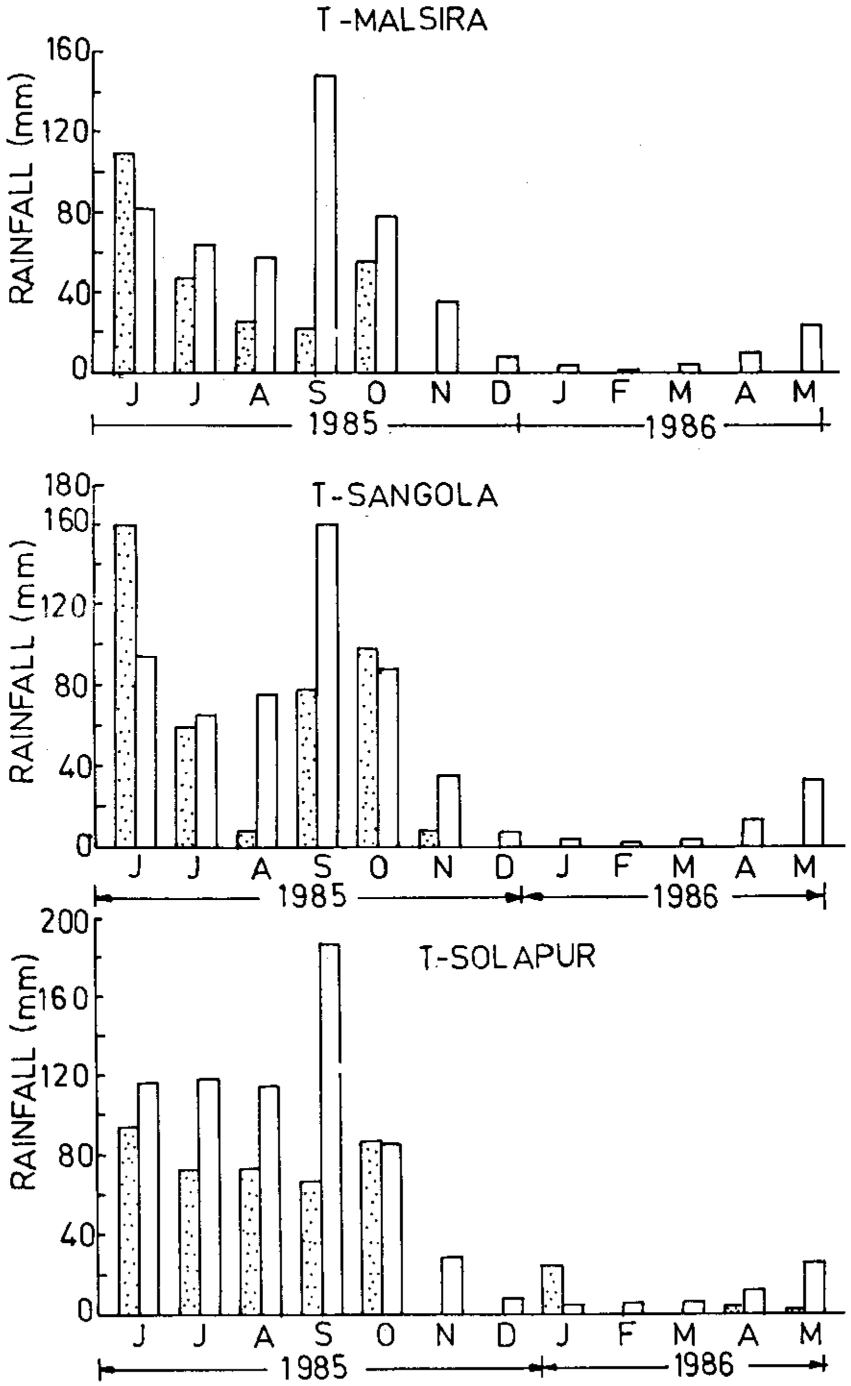

DISTT - AHMEDNAGAR (MS)
YEAR 1985-86
T - SHEOGAON
AVG. R.F.
N. R.F.
T - NEWASA
T - SANGAMNER
T - AKOLA
T - AHMEDNAGAR
RAINFALL (mm)
J J A S O
1985

DISTT.- SOLAPUR (MS)
YEAR 1985-86





DISTT.-SOLAPUR (MS)



Appendix-III-2(A)

The Probability Analysis of Annual Rainfall of District Banswara, State Rajasthan.

Sl No.	Class of Interval in m.m.	Distt: Banswara No. of yrs.	Percentage	Commulative, Probability	Taluk/Tehsil: KHUSHALGARH No. of years.	Percentage	Commulative, Probability	Taluk/Tehsil: BANSWARA No. of years	Percentage	Commulative, Prob.
1.	0-100	0								
2.	100-200	0			0					
3.	200-300	0			1	1.19	100.00	1	1.2	100.0
4.	300-400	0			1	1.19	98.97	0		
5.	400-500	7	8.43	100.0	3	3.57	97.58	7	8.15	98.8
6.	500-600	9	10.84	91.54	8	9.52	94.01	5	5.1	90.65
7.	600-700	7	8.43	80.7	6	7.14	84.49	15	17.5	84.85
8.	700-800	8	9.64	72.27	6	7.14	77.35	7	8.15	67.35
9.	800-900	6	7.23	62.62	10	11.90	70.21	6	6.95	59.2
10.	900-1000	17	20.48	55.4	8	9.52	58.31	10	11.6	52.25
11.	1000-1100	10	12.05	34.92	8	9.52	48.79	10	11.6	40.65
12.	1100-1200	6	7.23	22.87	7	8.33	39.27	10	11.6	29.05
13.	1200-1300	5	6.02	15.64	8	9.52	30.94	3	3.5	17.45
14.	1300-1400	3	3.61	9.62	8	9.52	21.42	2	2.3	13.95
15.	1400-1500	3	3.61	6.01	0	0.00	11.90	3	3.5	11.65
16.	1500-1600	1	1.20	2.4	10	11.90	11.90	7	8.15	8.15
17.	1600-1700	1	1.20	1.2						
		83			84			86		

Sl.	Class of Interval in mm.	Distt: Barmer			Taluk/Tahsil:Barmer			Taluk/Tehsil: Siwana		
		No. of years	Percentage	Commulative, Prob.	No. of Years	Percentage	Commulative, Prob.	No. of years	Percentage	Commulative, Prob.
1.	0-100	7	8.05	100.0	11	12.79	100.0	5	5.88	100.0
2.	100-200	26	29.89	91.95	20	24.14	86.21	10	11.76	94.13
3.	200-300	28	33.33	62.06	25	28.74	62.07	27	32.94	82.37
4.	300-400	12	13.79	28.73	15	17.24	33.33	19	22.35	49.43
5.	400-500	6	6.89	14.94	6	6.89	16.89	11	12.94	27.08
6.	500-600	4	4.60	8.05	5	5.75	9.2	4	4.71	14.14
7.	600-700	1	1.15	3.45	2	2.30	3.45	1	1.18	9.43
8.	700-800	2	2.30	2.30	0	0.00	1.15	4	4.71	8.25
9.	800-900	0			0	0.00	1.15	1	1.18	3.54
10.	900-1000	0			1	1.15	1.15	1	1.18	2.36
11.	1000-1100				0			1	1.18	1.18
12.	1100-1200				0			0	0.00	
13.	1200-1300				0			0	0.00	
		85			85			84		

Sl. No.	Class of Interval in mm.	Distt. Jhabua No. of years	Percentage	Commulative, Prob.	Taluka/Tehsil: JHABUA No. of Years	Percentage	Commulative, Prob.	Taluk/Tehsil: ALIRAJPUR No. of years	Percentage	Commulative, Prob.
1.	0-100	0			0			0		
2.	100-200	0			0			0		
3.	200-300	0			0			1	1.56	100.00
4.	300-400	2	2.67	100.00	4	5.88	100.00	1	1.56	98.44
5.	400-500	4	5.33	97.33	6	8.82	94.12	3	4.68	96.88
6.	500-600	5	6.67	92.0	10	14.71	85.3	6	9.38	92.20
7.	600-700	17	22.67	85.33	11	16.18	70.59	14	21.88	82.82
8.	700-800	12	16.00	62.66	12	17.65	54.41	12	18.75	60.94
9.	800-900	7	9.33	46.66	6	8.82	36.76	8	12.5	
10.	900-1000	9	12.00	37.33	12	17.65	27.94	10	15.63	29.69
11.	1000-1100	7	9,33	29.33	7	10.29	10.29	4	6.25	14.06
12.	1100-1200	6	8.00	16.00	0	0.00	0.00	5	7.81	7.81
13.	1200-1300	3	4.00	8.00						
14.	1300-1400	1	1.33	4.00						
15.	1400-1500	2	26.67	2.67						
		75			68			64		

Sl. No.	Class of Interval in mm.	District: KHARGAON			Taluk/Tehsil: KHARGAON			Taluk/Tehsil: BARWANI		
		No. of years	Percentage	Commulative, Prob.	No. of Years	Percentage	Commulative, Prob.	No. of years	Percentage	Commulative, Prob.
1.	0-100	0			0			0		
2.	100-200	0			0			0		
3.	200-300	0			0			4	4.70	100.00
4.	300-400	5	6.33	100.0	0			7	8.10	95.30
5.	400-500	6	7.59	93.63	2	4.00	100.00	19	22.1	87.20
6.	500-600	10	12.63	86.04	7	14.00	96.00	25	29.00	65.10
7.	600-700	18	22.78	73.41	12	24.00	82.00	13	15.10	36.10
8.	700-800	14	17.72	50.63	9	18.00	58.00	12	14.00	21.00
9.	800-900	13	15.19	32.91	5	10.00	40.00	3	3.50	7.00
10.	900-1000	4	5.06	17.72	4	8.00	30.00	2	2.30	3.50
11.	1000-1100	7	8.86	12.66	2	4.00	22.00	1	1.20	1.20
12.	1100-1200	2	2.53	3.80	6	12.00	18.00			
13.	1200-1300	1	1.27	1.27	3	6.00	6.00			
		79			50			86		

Sl. No.	Class of Interval in mm.	District: JAMNAGAR No. of years	Percentage	Commulative, Prob.	Taluk/Tehsil: KALYANPUR No. of Years	Percentage	Commulative, Prob.	Taluk/Tehsil: JAMNAGAR No. of years	Percentage	Commulative, Prob.
1.	0-100	4	4.7	100.0	0			3	4.55	100.00
2.	100-200	6	7.06	95.28	4	15.38	100.00	6	9.09	95.46
3.	200-300	17	2.0	88.22	4	15.38	84.61	17	25.75	86.37
4.	300-400	8	9.41	68.22	2	7.69	69.27	6	9.09	60.62
5.	400-500	16	18.82	58.81	4	15.38	61.54	7	10.6	51.53
6.	500-600	13	15.29	39.99	3	11.54	46.16	7	10.61	40.93
7.	600-700	8	9.41	24.7	3	11.54	34.62	9	13.64	30.32
8.	700-800	3	3.53	15.29	2	7.69	23.08	3	4.55	16.68
9.	800-900	6	7.06	11.76	2	7.69	15.39	5	7.58	12.13
10.	900-1000	2	2.35	4.70	1	3.85	7.7	1	1.52	4.55
11.	1000-1100	2	2.35	2.35	1	3.85	3.85	2	3.03	3.03
12.	1100-1200									
		85			26			60		

Sl. No.	Class of Interval in mm.	District: RAJKOT			Taluk/Tahsil: RAJKOT			Taluk/Tahsil: MORVI		
		No. of years	Percentage	Commulative, Prob.	No. of Years	Percentage	Commulative, Prob.	No. of years	Percentage	Commulative, Prob.
1.	0-100	0			0			2		100.00
2.	100-200	1	1.18	100.0	2	2.4	100.0	4	4.7	97.7
3.	200-300	6	7.05	98.81	8	9.64	97.56	9	10.6	93.0
4.	300-400	10	11.76	91.76	7	8.43	87.92	14	16.5	82.4
5.	400-500	17	2.0	80.00	15	18.07	79.49	9	10.6	65.9
6.	500-600	12	14.12	60.00	17	20.48	61.42	11	13.0	55.3
7.	600-700	16	18.82	45.88	11	13.25	40.94	11	13.0	42.3
8.	700-800	9	10.59	27.06	7	8.43	27.69	11	13.0	29.3
9.	800-900	5	5.88	16.47	9	10.84	19.26	7	8.2	16.3
10.	900-1000	6	7.06	10.59	2	2.41	8.42	2	2.3	8.1
11.	1000-1100	2	2.35	3.53	1	1.20	6.01	2	2.3	5.8
12.	1100-1200	0	0.00	1.18	3	3.61	4.81	2	2.3	3.5
13.	1200-1300	1	1.18	1.18	1	1.2	1.2	1	1.2	1.2
		85			83			85		

Sl. No.	Class of Interval in mm.	Distt: CUDAPAH No. of years	Percentage	Commulative, Prob.	Taluk/Tehsil: CUDAPPAH No. of Years	Percentage	Commulative, Prob.	Taluk/Tehsil: JAMALANADU No. of years	Percentage	Commulative, Prob.
1.	0-100				0					
2.	100-200	0			0					
3.	200-300	0			1	1.19	100.00	1	1.19	100.00
4.	300-400	1	1.19	100.00	1	1.19	98.82	6	7.14	98.9
5.	400-500	3	3.57	98.8	5	5.95	97.66	16	19.04	91.66
6.	500-600	22	26.19	95.23	14	16.67	91.68	19	22.62	72.62
7.	600-700	21	25.00	69.04	17	20.24	75.01	13	15.48	50.0
8.	700-800	18	21.43	44.04	11	13.09	54.77	20	23.81	34.52
9.	800-900	10	11.90	22.61	15	17.88	41.68	6	7.14	10.71
10.	900-1000	5	5.95	10.71	9	10.71	23.80	3	3.57	3.57
11.	1000-1100	4	4.76	4.76	5	5.95	13.09			
12.	1100-1200				3	3.57	7.14			
13.	1200-1300				3	3.57	3.57			
		84			84			84		

Sl. No.	Class of Interval in mm.	Distt: ANANTPUR No. of years	Percentage	Commulative, Prob.	Taluk/Tahsil: ANANTPUR No. of Years	Percentage	Commulative, Prob.	Taluk/Tahsil/MADAKASIRA No. of years	Percentage	Commulative, Prob.
1.	100-200	0			0			0		
2.	200-300	2	2.35	100.00	4	5.33	100.00	2	2.38	100.00
3.	300-400	7	8.24	97.65	7	9.33	94.67	7	8.33	97.62
4.	400-500	18	21.18	89.41	11	14.67	95.34	12	14.28	89.29
5.	500-600	24	28.23	68.23	23	30.62	70.67	17	20.24	75.01
6.	600-700	21	24.71	40.00	10	13.33	40.00	22	26.2	54.77
7.	700-800	10	11.76	15.29	15	20.00	26.67	16	19.05	28.57
8.	800-900	3	3.53	3.53	2	2.67	6.67	8	9.52	9.52
9.	900-1000				3	4.00	4.00			
		85			75			84		

Sl.	Class of Interval in mm.	District: BIJAPUR			Taluk/Tahsil:BIJAPUR			Taluk/Tahsil:BAGALKOT		
		No. of years	Percen-tage	Commulati-ve, Prob.	No. of Years	Percent-age	Commulati-ve, Prob.	No. of years	Percen-tage	Commula-tive,Prob.
1.	0-100				0			0		
2.	100-200				0			0		
3.	200-300				4	4.70	100.00	3	3.57	100.00
4.	300-400	10	11.76	100.00	15	17.60	95.20	9	10.71	96.42
5.	400-500	20	23.53	88.23	11	13.00	77.60	13	15.48	85.71
6.	500-600	19	22.35	64.70	19	22.30	64.60	26	30.95	70.23
7.	600-700	21	24.71	42.35	12	14.10	42.30	17	20.24	39.28
8.	700-800	9	10.59	17.64	12	14.10	28.90	8	9.52	19.04
9.	800-900	5	5.88	7.05	8	9.40	14.10	2	2.38	9.52
10.	900-1000	0	00.0	1.17	3	3.53	4.70	4	4.76	7.14
11.	1000-1100	1	1.17	1.17	0	0.00	1.17	1	1.19	2.38
12.	1100-1200				1	1.17	1.17	0	0.00	1.19
13.	1200-1300							1	1.19	1.19
		85			86			84		

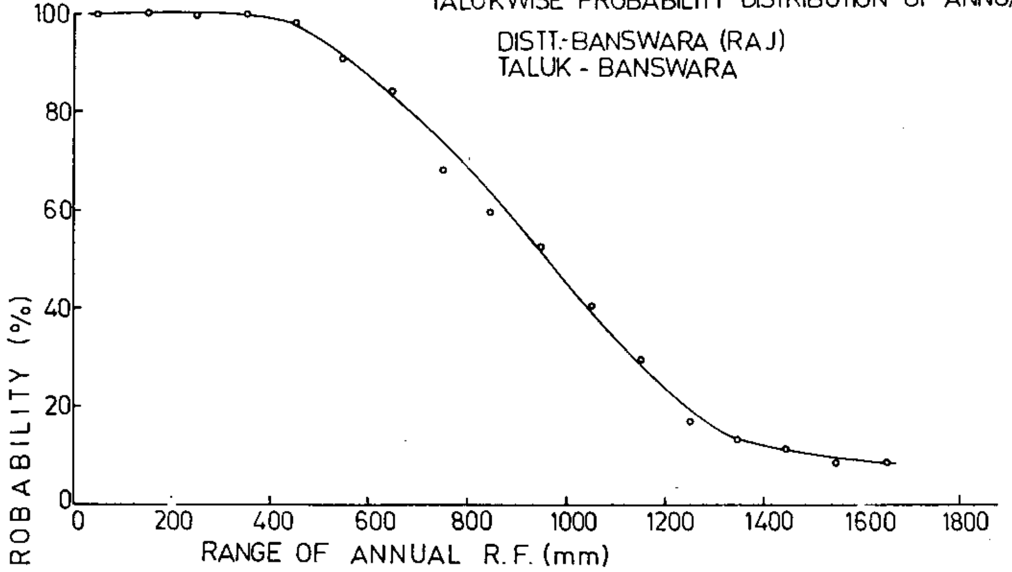
Sl.	Class of Interval in mm.	District: BELGAUM No. of years	Percen-tage	Commulati-ve, Prob.	Taluk/Tahsil:BELGAUM No. of Years	Percent-age	Commulati-ve, Prob.	Taluk/Tahsil:CHIKODI No. of years	Percen-tage	Commula-tive,Prob.
1.	0-100				0					
2.	100-200				0			0		
3.	200-300				0			1	1.2	100.00
4.	300-400				0			3	3.5	98.8
5.	400-500				0			12	13.9	95.3
6.	500-600	4	4.71	100.00	0			20	23.3	81.4
7.	600-700	14	16.47	95.31	0			23	26.7	58.1
8.	700-800	26	30.59	78.84	2	2.82	100.00	12	13.9	31.4
9.	800-900	20	23.53	48.25	1	1.41	97.18	9	10.5	17.5
10.	900-1000	9	10.59	24.72	0	0.00		4	4.7	7.0
11.	1000-1100	7	8.24	14.13	9	12.68	95.77	2	2.3	2.3
12.	1100-1200	4	4.71	5.89	0	0.00	83.09			
13.	1200-1300	1	1.18	1.18	18	25.35	83.09			
14.	1300-1400				10	14.08	57.74			
15.	1400-1500				9	12.68	43.66			
16.	1500-1600				7	9.86	30.98			
17.	1600-1700				4	5.63	21.12			
18.	1700&above				11	15.49	15.49			
		85			71			86		

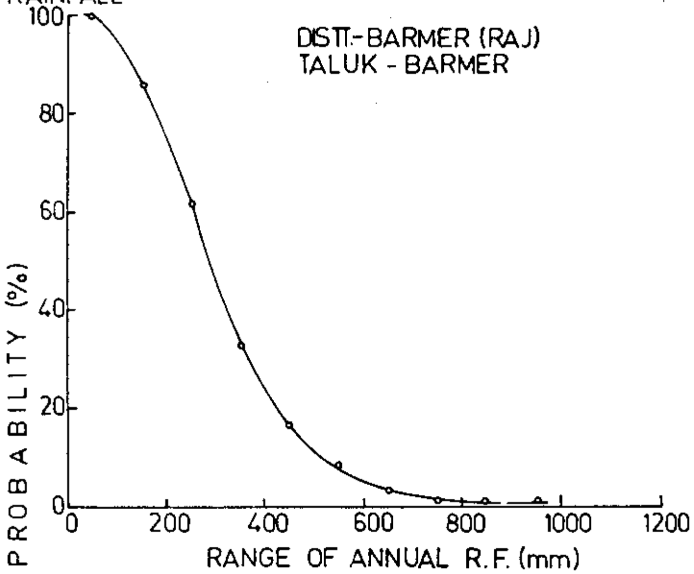
Sl.	Class of Interval in mm.	Distt: AHMADNAGAR			Taluk/Tahsil:AHMADNAGAR			Taluk/Tahsil:AKOLA		
		No. of years	Percen-tage	Commulati-ve, Prob.	No. of Years	Percent-age	Commulati-ve, Prob.	No. of years	Percen-tage	Commula-tive,Prob.
1.	0-100	0			0			1	1.2	100.00
2.	100-200	0			0			2	2.3	98.8
3.	200-300	2	2.44	100.00	2	2.41	100.00	14	16.3	96.5
4.	300-400	8	9.76	97.55	9	10.84	97.58	17	19.7	80.2
5.	400-500	18	21.95	87.89	15	18.07	86.74	21	24.4	60.5
6.	500-600	21	25.6	65.84	20	24.10	68.67	19	22.1	36.1
7.	600-700	19	23.17	40.24	12	14.45	44.57	5	5.8	14.0
8.	700-800	7	8.54	17.87	10	12.05	30.12	5	5.8	8.2
9.	800-900	5	6.09	8.53	9	10.84	18.07	1	1.2	2.4
10.	900-1000	2	2.44	2.44	4	4.82	7.23	1	1.2	1.2
11.	1000-1100	0			0	0.00	2.41			
12.	1100-1200	0			2	2.41	2.41			
13.	1200-1300				0					
14.	1300-1400									
		82			83			86		

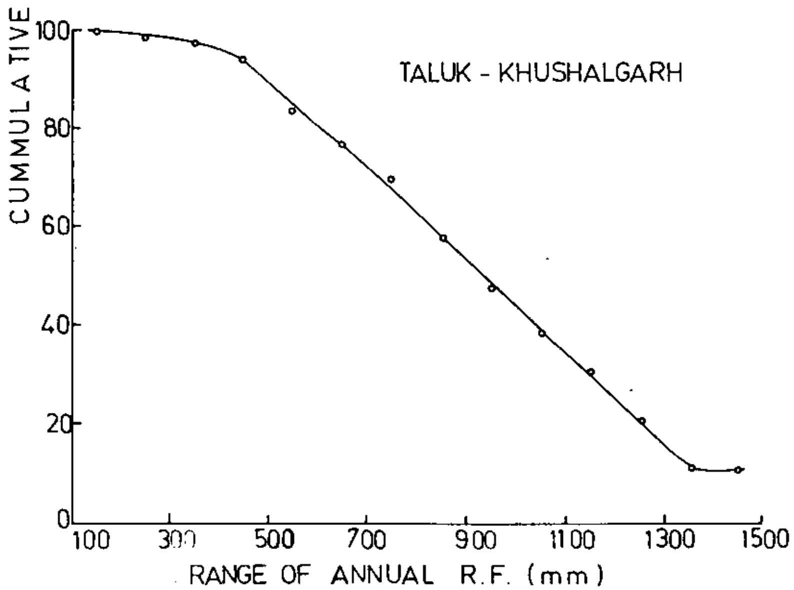
Sl.	Class of Interval in mm.	District: SOLAPUR			Taluk/Tahsil:SHOLAPUR			Taluk/Tahsil:AKALKOT		
		No. of years	Percen-tage	Commulati-ve, Prob.	No. of Years	Percent-age	Commulati-ve, Prob.	No. of years	Percen-tage	Commula-tive,Prob.
1.	0-100	0						1	1.2	100.00
2.	100-200	0						1	1.2	98.8
3.	200-300	1	1.21	100.00	0	0.00	0.00	7	8.6	97.6
4.	300-400	6	7.23	98.79	6	8.0	100.00	12	14.9	89.0
5.	400-500	11	13.25	91.56	8	0.8	92.4	11	13.6	74.1
6.	500-600	20	24.1	78.31	7	9.5	81.6	11	13.6	60.5
7.	600-700	22	26.5	54.21	16	21.6	72.1	15	18.5	46.9
8.	700-800	14	16.87	27.71	15	20.3	50.5	15	18.5	28.4
9.	800-900	7	8.43	10.84	11	15.9	30.2	5	6.2	9.9
10.	900-1000	2	2.41	2.41	4	5.4	15.3	0	0.0	3.7
11.	1000-1100				3	4.5	9.9	2	2.5	3.7
12.	1100-1200				2	2.7	5.4	0	0.0	1.2
13.	1200-1300				2	2.7	2.7	1	1.2	1.2
14.	1300-1400				0					
15.	1400-1500									
		83			74			81		

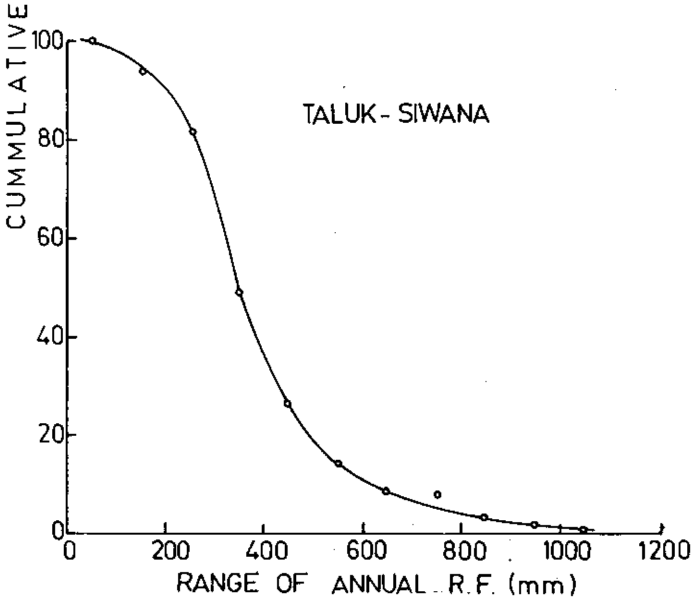
APPENDIX - III - 2 (B)

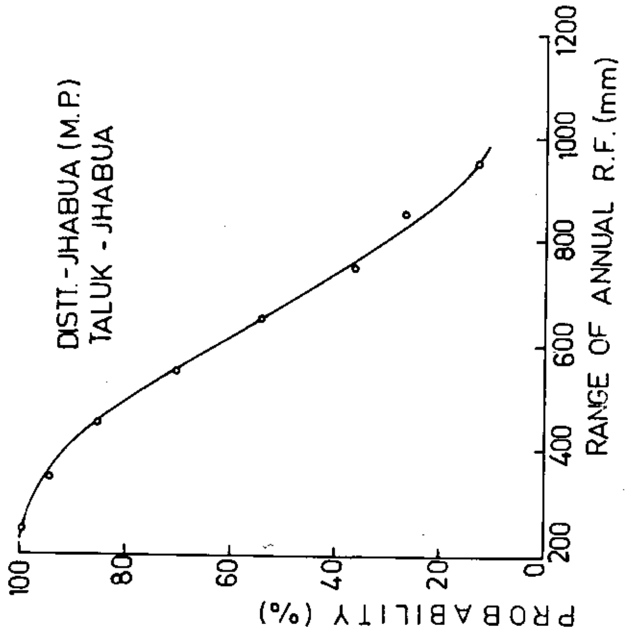
TALUKWISE PROBABILITY DISTRIBUTION OF ANNUAL RAINFALL



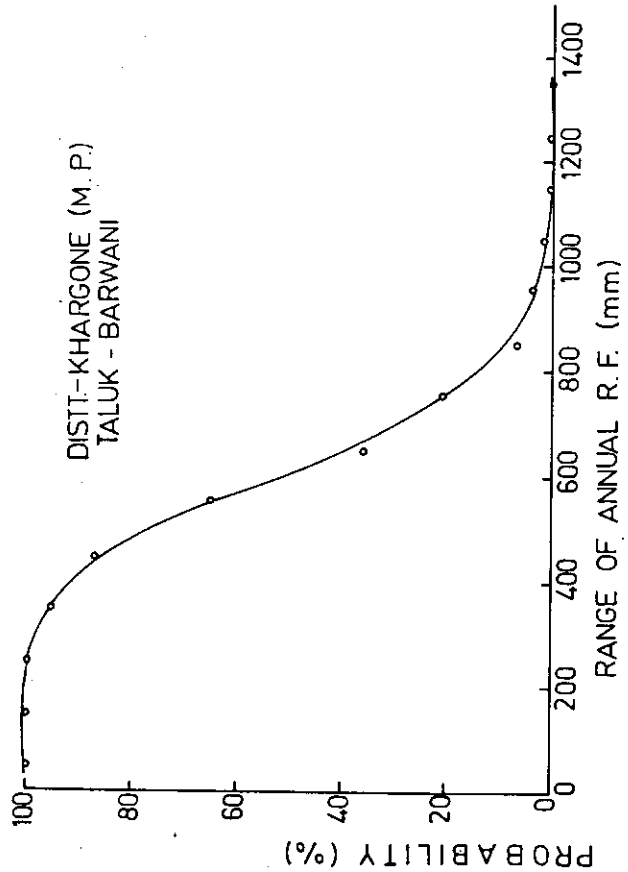




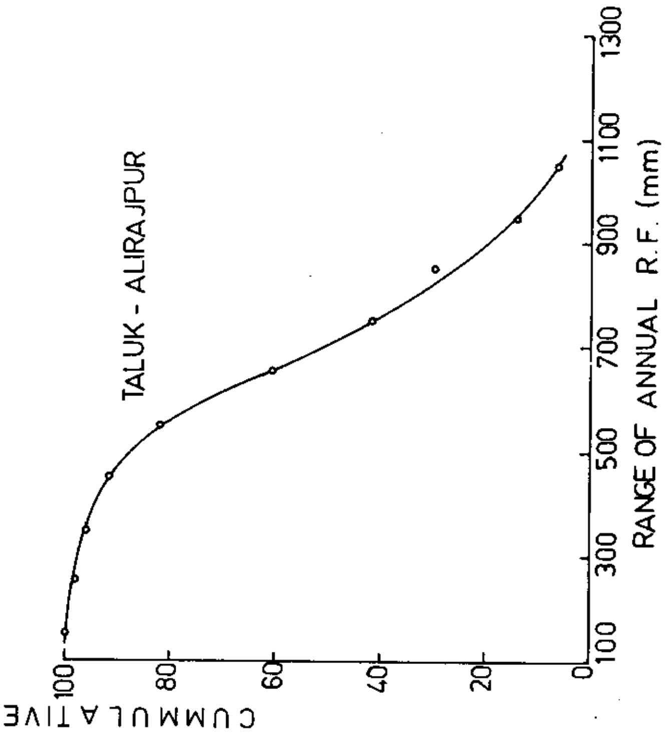




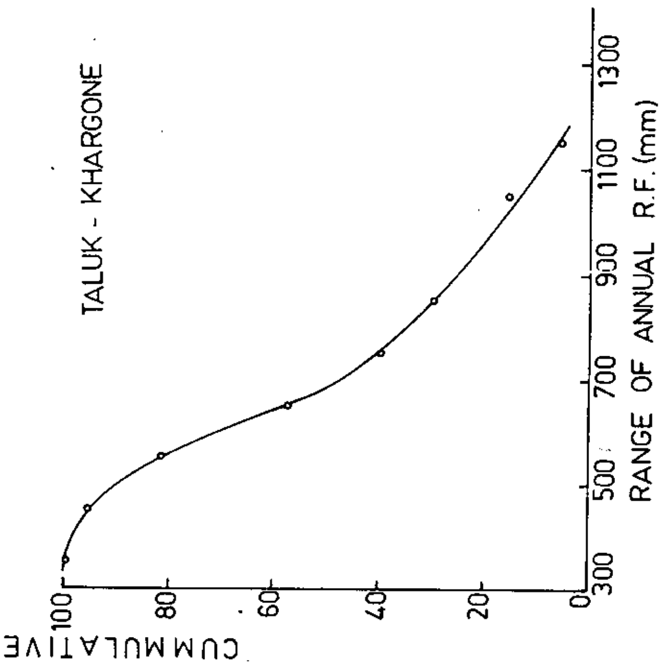
DISTT.-JHABUA (M.P.)
TALUK - JHABUA
PROBABILITY (%)
100
80
60
40
20
0
200
400
600
800
1000
1200
RANGE OF ANNUAL R.F. (mm)



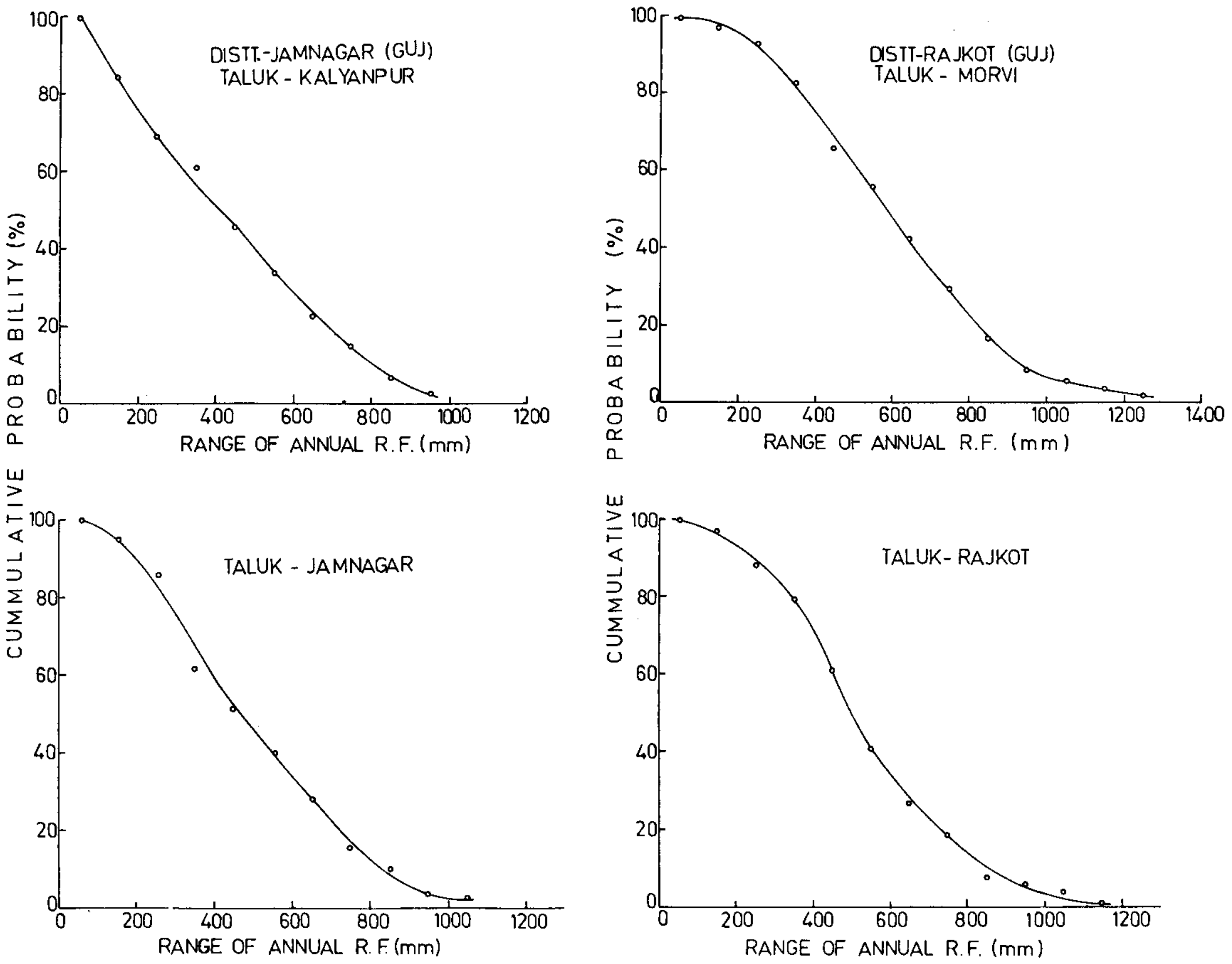
DISTT.-KHARGONE (M.P.)
TALUK - BARWANI
PROBABILITY (%)
100
80
60
40
20
0
200
400
600
800
1000
1200
1400
RANGE OF ANNUAL R.F. (mm)

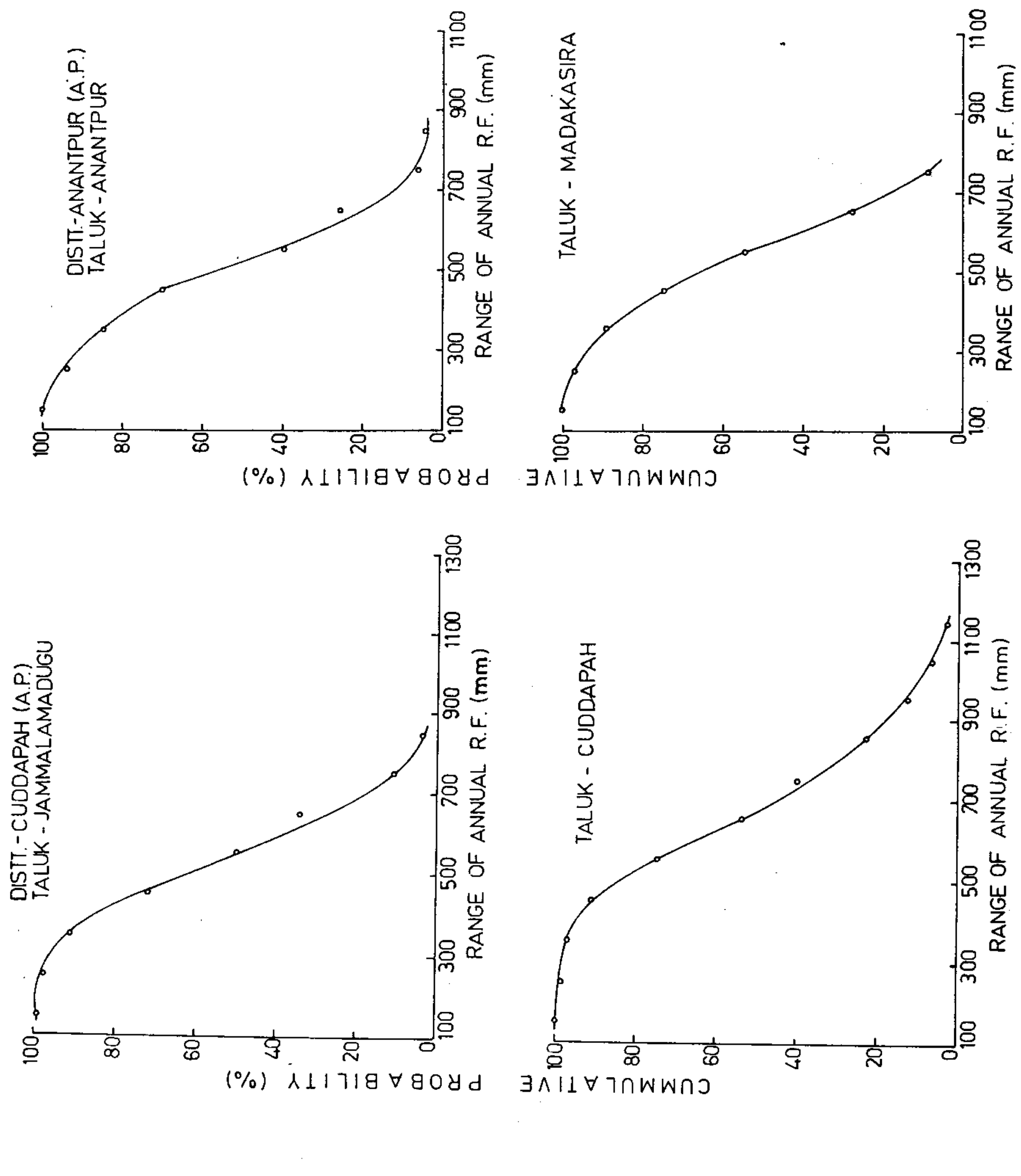


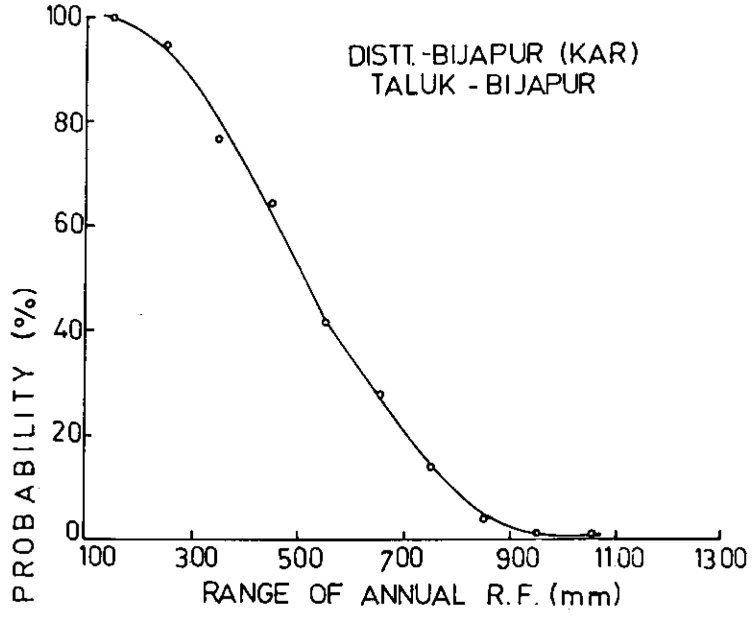
TALUK - ALIRAJPUR
CUMMULATIVE
100
80
60
40
20
0
100
300
500
700
900
1100
1300
RANGE OF ANNUAL R.F. (mm)

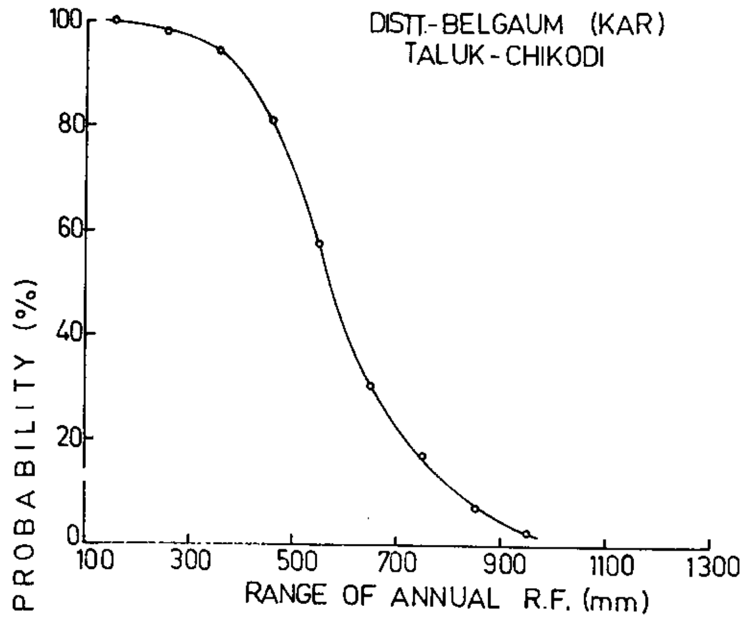


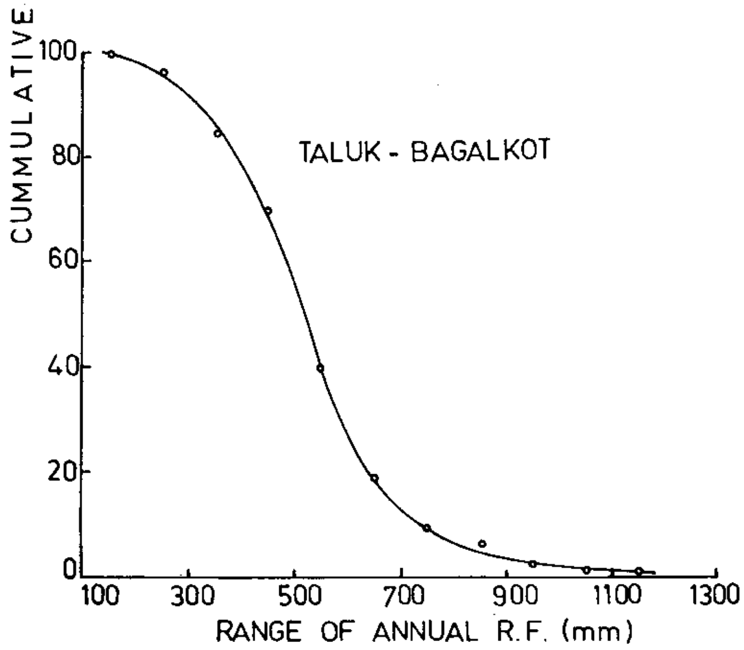
TALUK - KHARGONE
CUMMULATIVE
100
80
60
40
20
0
300
500
700
900
1100
1300
RANGE OF ANNUAL R.F. (mm)

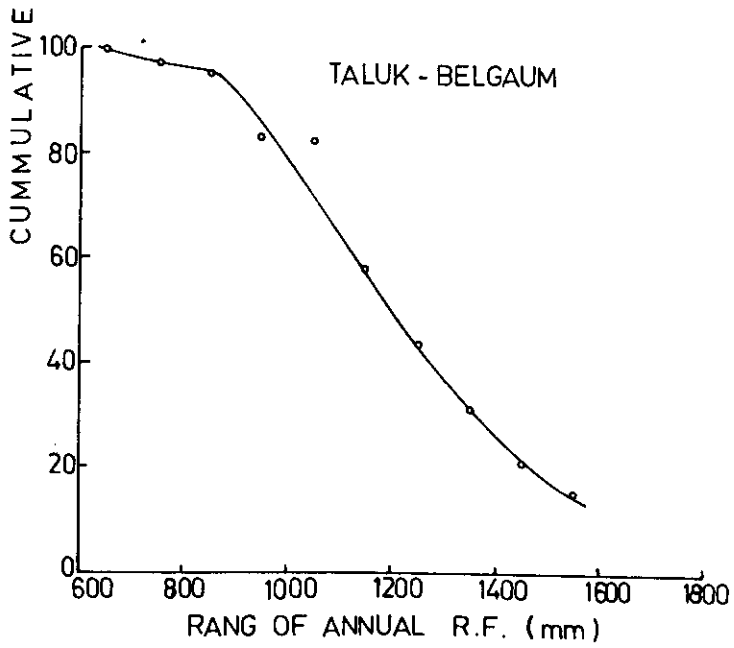

DISTT.-JAMNAGAR (GUJ)
TALUK - KALYANPUR
DISTT-RAJKOT (GUJ)
TALUK - MORVI
TALUK - JAMNAGAR
TALUK- RAJKOT
CUMMULATIVE PROBABILITY (%)
RANGE OF ANNUAL R.F. (mm)
0
20
40
60
80
100
200
400
600
800
1000
1200
1400


DISTT.-CUDDAPAH (A.P.)
TALUK - JAMMALAMADUGU
PROBABILITY (%)
RANGE OF ANNUAL R.F. (mm)
TALUK - CUDDAPAH
CUMMULATIVE
RANGE OF ANNUAL R.F. (mm)
DISTT.-ANANTPUR (A.P.)
TALUK - ANANTPUR
PROBABILITY (%)
RANGE OF ANNUAL R.F. (mm)
TALUK - MADAKASIRA
CUMMULATIVE
RANGE OF ANNUAL R.F. (mm)


DISTT.-BIJAPUR (KAR)
TALUK - BIJAPUR
PROBABILITY (%)
100
80
60
40
20
0
100
300
500
700
900
1100
1300
RANGE OF ANNUAL R.F. (mm)


DISTT.-BELGAUM (KAR)
TALUK - CHIKODI
PROBABILITY (%)
100
80
60
40
20
0
100
300
500
700
900
1100
1300
RANGE OF ANNUAL R.F. (mm)


TALUK - BAGALKOT
CUMMULATIVE
100
80
60
40
20
0
100
300
500
700
900
1100
1300
RANGE OF ANNUAL R.F. (mm)


TALUK - BELGAUM
CUMMULATIVE
100
80
60
40
20
0
600
800
1000
1200
1400
1600
1800
RANG OF ANNUAL R.F. (mm)

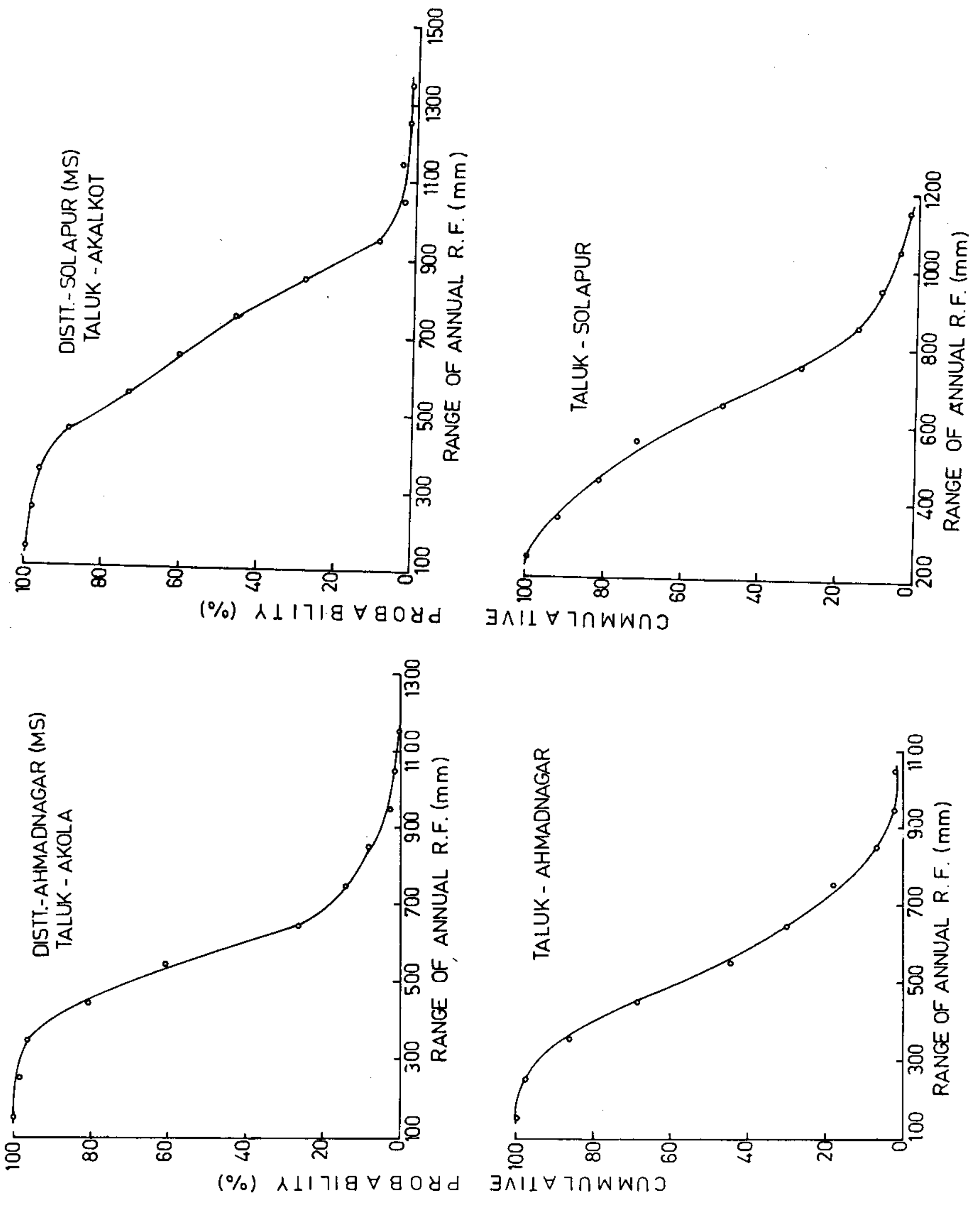

DISTT.-AHMADNAGAR (MS)
TALUK - AKOLA
PROBABILITY (%)
RANGE OF ANNUAL R.F. (mm)
TALUK - AHMADNAGAR
CUMMULATIVE
RANGE OF ANNUAL R.F. (mm)
DISTT.- SOLAPUR (MS)
TALUK - AKALKOT
PROBABILITY (%)
RANGE OF ANNUAL R.F. (mm)
TALUK - SOLAPUR
CUMMULATIVE
RANGE OF ANNUAL R.F. (mm)

TABLE : DROUGHT ANALYSIS OF BANSWARA DISTRICT BY HERBST METHOD
STATION AND TALUK/GHATOL

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	3.254	13.015
6	10	1953	4	5.337	21.347
6	10	1954	4	5.337	21.347
6	10	1955	4	5.337	21.347
6	10	1956	4	5.337	21.347
6	10	1957	4	3.142	12.568
6	10	1965	4	0.640	2.560
6	10	1969	4	4.276	17.104
8	10	1980	2	1.240	2.480
7	10	1983	3	0.512	1.537
6	10	1985	4	1.233	4.934

STATION AND TALUK/BANSWARA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	5.350	21.400
7	10	1953	3	1.946	5.837
6	9	1954	3	2.310	6.930
8	10	1956	2	1.157	2.315
6	10	1957	4	1.527	6.106
6	10	1960	4	1.069	4.276
7	10	1964	3	0.363	1.090
6	10	1965	4	2.042	8.169
6	10	1966	4	2.616	10.465
7	10	1972	3	0.866	2.599
6	10	1974	4	1.679	6.718
8	10	1980	2	2.117	4.234
6	10	1982	4	1.239	4.957
6	10	1983	4	0.611	2.445
6	10	1985	4	3.616	14.466

STATION AND TALUK/KUSHALGARH

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1951	2	1.158	2.316
6	10	1954	4	5.127	20.507
6	9	1958	3	0.931	2.793
7	10	1960	3	0.514	1.543
6	9	1961	3	3.483	10.450
6	10	1965	4	2.504	10.017
6	10	1966	4	1.255	5.018
7	10	1972	3	0.490	1.471

6	10	1974	4	2.508	10.032
6	10	1979	4	1.296	5.185
7	10	1980	3	2.392	7.175
7	10	1983	3	1.229	3.688
6	10	1985	4	3.950	15.798

STATION AND TALUK: BAGIDORA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1952	4	4.473	17.894
6	10	1953	4	1.885	7.539
6	9	1955	3	3.160	9.479
6	10	1956	4	4.217	16.867
6	9	1958	3	0.741	2.223
6	10	1959	4	4.473	17.894
7	10	1960	3	1.862	5.585
6	10	1961	4	4.473	17.894
6	10	1966	4	0.963	3.851
8	10	1974	2	0.414	0.829
6	10	1979	4	0.859	3.435
8	10	1980	2	0.721	1.441
6	10	1983	4	1.142	4.569
6	10	1985	4	2.170	8.679

TABLE : DROUGHT ANALYSIS OF BARMER DISTRICT BY HERBST METHOD

STATION AND TALUK/BARMER

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1952	4	1.070	4.279
7	10	1954	3	0.508	1.524
6	9	1955	3	2.242	6.727
6	10	1957	4	1.244	4.976
6	9	1958	3	2.610	7.829
6	10	1959	4	0.652	2.608
6	10	1962	4	1.390	5.562
6	9	1963	3	1.825	5.475
7	10	1966	3	0.990	2.969
6	10	1968	4	3.772	15.088
6	10	1969	4	3.097	12.389
7	10	1970	3	0.374	1.122
8	10	1971	2	0.624	1.248
7	10	1972	3	0.695	2.086
6	10	1974	4	3.946	15.782
7	10	1977	3	0.426	1.279
7	10	1979	3	0.326	0.977
7	10	1980	3	1.063	3.189
6	9	1981	3	0.605	1.816
6	10	1982	4	1.072	4.290

STATION AND TALUK: CHOHATAN

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	0.429	1.288
6	10	1952	4	2.759	11.037
6	9	1954	3	0.751	2.254
6	9	1955	3	1.126	3.378
6	10	1957	4	2.759	11.037
6	9	1958	3	1.214	3.642
6	10	1962	4	0.554	2.217
6	10	1963	4	1.214	4.858
6	10	1965	4	0.469	1.874
6	10	1966	4	0.980	3.920
6	10	1968	4	2.124	8.495
6	10	1969	4	1.834	7.337
7	9	1970	2	0.472	0.943
6	10	1973	4	2.759	11.037
6	10	1974	4	1.596	6.383
6	10	1981	4	0.511	2.044
8	10	1982	2	0.660	1.320
6	8	1984	2	0.991	1.981

STATION AND TALUK: PACHPADRA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	8	1955	2	2.618	5.237
6	10	1957	4	1.757	7.027
6	10	1958	4	0.879	3.518
6	10	1962	4	2.516	10.063
6	10	1963	4	3.773	15.093
6	9	1966	3	1.936	5.807
6	10	1968	4	4.096	16.384
6	10	1969	4	3.973	15.891
6	10	1972	4	1.039	4.156
6	10	1974	4	4.044	16.178
8	10	1980	2	1.153	2.306
7	10	1981	3	1.473	4.419
6	10	1982	4	2.141	8.565
6	10	1984	4	1.306	5.225
6	10	1985	4	1.872	7.489

STATION AND TALU: SHEO

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	1.766	7.065
6	8	1955	2	2.533	5.066
6	9	1958	3	1.303	3.910
6	10	1962	4	0.928	3.712
6	9	1963	3	1.098	3.293
6	10	1965	4	2.725	10.899
7	10	1966	3	0.777	2.332
6	10	1968	4	3.215	12.859
6	10	1969	4	1.866	7.462
6	10	1970	4	0.786	3.143
6	10	1974	4	3.637	14.549
6	10	1979	4	0.996	3.984
8	10	1980	2	0.399	0.798
6	10	1981	4	0.881	3.523
6	10	1982	4	0.698	2.793
6	10	1984	4	0.635	2.538
6	10	1985	4	1.346	5.383

STATION AND TALUK : SIWANA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	0.653	1.958
7	9	1958	2	1.312	2.625
6	10	1963	4	2.990	11.962
7	10	1966	3	0.485	1.454
6	10	1968	4	3.826	15.306
6	10	1969	4	4.899	19.598
7	10	1972	3	0.507	1.520
6	10	1974	4	4.882	19.527
6	10	1976	4	1.021	4.084
8	10	1980	2	0.642	1.284
7	10	1981	3	0.896	2.687
6	10	1984	4	1.769	7.077
8	10	1985	2	1.090	2.180

TABLE : DROUGHT ANALYSIS OF JHABUA DISTRICT BY HERBST METHOD

STATION AND TALUK: ALIRAJPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	9	1959	3	3.233	9.699
7	10	1960	3	0.644	1.931
6	10	1965	4	0.752	3.009
6	10	1966	4	1.233	4.931
6	10	1968	4	0.526	2.103
6	10	1972	4	1.405	5.621
6	10	1974	4	1.340	5.359
7	10	1975	3	0.505	1.514
6	10	1982	4	1.635	6.541
6	10	1984	4	1.109	4.435
6	10	1985	4	2.178	8.710

STATION AND TALUK : JHABUA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1957	4	1.054	4.216
7	10	1960	3	1.191	3.572
6	10	1965	4	3.159	12.635
6	10	1966	4	2.157	8.627
6	10	1974	4	3.103	12.412
6	10	1982	4	1.745	6.981
6	10	1985	4	4.133	16.533

STATION AND TALUK : JOBAT

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1965	4	1.160	4.642
6	9	1966	3	1.350	4.051
6	10	1968	4	1.254	5.017
6	10	1972	4	1.599	6.396
6	10	1974	4	1.642	6.569
6	10	1975	4	0.917	3.666
6	10	1984	4	1.083	4.332
6	10	1985	4	1.877	7.509

STATION AND TALUK : PETLAWAD

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1965	4	1.195	4.779
6	10	1966	4	1.802	7.207
8	10	1968	2	0.987	1.973
7	10	1972	3	1.044	3.133

6	10	1974	4	1.432	5.726
6	10	1975	4	0.877	3.509
6	10	1979	4	1.465	5.861
6	10	1985	4	2.729	10.914

STATION AND TALUK: THANDLA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1965	2	1.150	2.300
6	10	1966	4	1.456	5.822
7	10	1972	3	0.747	2.240
6	10	1975	4	2.497	9.987
6	10	1979	4	1.331	5.323
6	10	1985	4	2.839	11.356

TABLE : DROUGHT ANALYSIS OF KHARGONE DISTRICT BY HERBST METHOD

STATION AND TALUK : BARWANI

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	9	1962	3	1.754	5.261
6	10	1963	4	0.541	2.165
6	9	1964	3	0.785	2.356
6	10	1965	4	2.050	8.200
6	10	1966	4	1.371	5.483
7	10	1967	3	1.185	3.556
7	10	1972	3	0.886	2.659
6	10	1974	4	1.673	6.693
6	10	1982	4	1.993	7.971
7	10	1985	3	2.508	7.524

STATION AND TALUK: KASARWAD

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1957	4	1.091	4.362
6	10	1960	4	1.075	4.300
8	10	1965	2	1.674	3.348
8	10	1966	2	1.514	3.028
6	10	1972	4	1.711	6.843
7	10	1979	3	0.722	2.165
6	10	1982	4	3.999	15.995
6	10	1984	4	3.290	13.159
6	10	1985	4	4.181	16.724

STATION AND TALUK:KHARGONE

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1960	3	1.925	5.776
6	9	1962	3	1.666	4.997
6	10	1965	4	1.498	5.992
8	10	1967	2	1.383	2.766
6	10	1968	4	0.817	3.268
6	10	1971	4	0,482	1.929
6	10	1972	4	0.801	3.204
6	10	1974	4	0.697	2.787
6	10	1977	4	0.723	2.893
7	10	1979	3	0.874	2.623
7	10	1980	3	1.706	5.118
6	10	1982	4	1.782	7.127
8	10	1985	2	2.845	5.691

STATION AND TALUK: RAJPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1960	3	1.511	4.533
6	10	1962	4	1.551	6.203
7	10	1963	3	1.752	5.256
6	10	1964	4	0.504	2.014
6	10	1965	4	2.649	10.596
6	9	1971	3	1.311	3.932
6	10	1974	4	1.488	5.951
8	10	1980	2	1.625	3.250
8	10	1982	2	1.622	3.244
6	10	1985	4	2.143	8.573

STATION AND TALUK: SENDHWA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1960	3	1.009	3.027
6	9	1962	3	1.395	4.186
6	10	1965	4	1.046	4.184
6	10	1966	4	1.121	4.484
6	10	1972	4	1.302	5.207
6	10	1974	4	1.720	6.881
6	10	1975	4	0.659	2.635
6	10	1977	4	0.606	2.423
7	10	1980	3	0.846	2.537
6	10	1982	4	1.116	4.463
6	9	1983	3	1.580	4.739
6	10	1984	4	0.720	2.880
6	10	1985	4	2.222	8.886

TABLE : DROUGHT ANALYSIS OF JAMNAGAR DISTRICT BY HERBST METHOD

STATION AND TALUK: BHANWAD

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1960	4	0.304	1.216
6	9	1962	3	0.313	0.938
6	10	1963	4	1.014	4.054
6	9	1964	3	0.717	0.513
7	10	1965	3	0.408	1.225
6	10	1968	4	0.240	0.961
7	10	1972	3	0.946	2.838
6	10	1974	4	0.749	2.996
6	10	1975	4	0.449	1.795
6	9	1977	3	0.214	0.643
6	10	1982	4	0.516	2.064
6	9	1984	3	0.638	1.915
7	10	1985	3	1.346	4.039

STATION AND TALUK: JAMNAGAR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1962	4	1.242	4.969
6	10	1963	4	2.022	8.090
6	10	1965	4	0.628	2.512
6	10	1966	4	0.933	3.734
6	10	1968	4	0.807	3.229
6	10	1969	4	0.930	3.719
6	10	1972	4	0.912	3.646
6	10	1974	4	2.279	9.115
6	9	1977	3	0.435	1.305
6	10	1985	4	1.344	5.374

STATION AND TALUK: KALWAD

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	9	1962	3	1.787	5.361
6	10	1963	4	1.104	4.417
8	10	1965	2	1.150	2.299
6	10	1966	4	0.503	2.010
7	10	1972	3	0.898	2.694
6	10	1974	4	1.954	7.815
6	9	1975	3	0.800	2.400
6	10	1982	4	0.441	1.765
6	9	1984	3	1.369	4.107
6	10	1985	4	1.935	7.739

STATION AND TALUK: KALYANPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1963	4	1.617	6.467
6	9	1964	3	0.806	2.419
6	10	1965	4	0.926	3.704
6	10	1966	4	0.489	1.958
6	10	1968	4	0.640	2.561
7	10	1972	3	0.838	2.514
6	10	1974	4	0.943	3.772
6	10	1976	4	0.447	1.790
6	9	1977	3	0.731	2.192
6	9	1984	3	0.967	2.901
6	10	1985	4	1.100	4.399

STATION AND TALUK : LALPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1960	2	0.941	1.882
6	10	1963	4	1.514	6.056
8	10	1964	2	0.889	1.779
7	10	1965	3	0.853	2.560
6	10	1966	4	0.975	3.899
6	10	1968	4	0.797	3.186
8	10	1969	2	0.810	1.619
6	8	1970	2	1.056	2.112
7	10	1972	3	1.498	4.493
6	10	1974	4	1.672	6.689
6	10	1978	4	0.465	1.862
6	10	1985	4	1.485	5.938

TABLE : DROUGHT ANALYSIS OF RAJKOT DISTRICT BY HERBST METHOD

STATION AND TALUK : MORVI

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	0.837	3.347
6	9	1955	3	1.177	3.532
7	10	1957	3	0.858	2.573
6	9	1958	3	1.407	4.227
7	10	1960	3	0.975	2.926
6	10	1962	4	0.560	2.238
6	10	1963	4	2.311	9.245
6	8	1968	2	1.545	3.091
6	10	1969	4	1.456	5.824
6	8	1970	2	1.375	2.751
6	10	1972	4	1.556	6.223
6	10	1973	4	2.203	8.812
6	10	1974	4	3.794	15.117
8	10	1982	2	0.850	1.699
6	10	1984	4	0.691	2.764
6	10	1985	4	1.227	4.910

STATION AND TALUK: JASDAN

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	0.779	3.117
6	9	1955	3	1.832	5.497
7	10	1960	3	0.762	2.285
6	10	1962	4	0.559	2.237
6	10	1963	4	0.483	1.933
6	10	1964	4	3.409	13.637
6	10	1965	4	0.603	2.413
7	10	1966	3	0.646	1.939
6	10	1969	4	3.957	15.806
6	10	1971	4	3.960	15.840
6	10	1972	4	2.555	10.221
6	10	1974	4	1.381	5.522
6	10	1982	4	1.455	5.822
6	10	1985	4	1.892	7.568

STATION AND TALUK : RAJKOT

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1953	4	5.347	21.390
6	9	1958	3	0.916	2.747
6	10	1962	4	1.610	6.440
6	10	1963	4	0.980	3.921
6	10	1965	4	0.593	2.374
6	10	1969	4	1.445	5.779

8	10	1972	2	1.087	2.173
6	10	1973	4	1.558	6.231
6	10	1974	4	2.863	11.451
6	10	1982	4	1.208	4.830
6	10	1984	4	1.711	6.845
6	10	1985	4	2.462	9.848

STATION AND TALUK: WANKANER

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	1.381	5.523
6	10	1954	4	2.148	8.592
6	9	1955	3	1.140	3.421
6	9	1958	3	1.738	5.215
7	10	1960	3	0.578	1.733
6	10	1962	4	1.408	5.631
6	10	1963	4	2.115	8.461
6	10	1964	4	0.452	1.810
6	10	1969	4	0.520	2.080
6	10	1973	4	1.103	4.412
6	10	1974	4	3.490	13.961
6	10	1982	4	2.135	8.539
6	10	1985	4	1.500	5.998

STATION AND TALUK : UPLETE

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	0.370	1.479
6	10	1952	4	0.514	2.057
6	10	1955	4	0.393	1.570
6	9	1958	3	0.402	1.205
6	10	1962	4	0.686	2.744
6	10	1963	4	0.521	2.083
6	10	1966	4	0.715	2.862
7	10	1969	3	0.620	1.859
6	10	1972	4	1.570	6.281
7	10	1973	3	0.571	1.714
6	10	1974	4	1.152	4.607
6	9	1975	3	0.742	2.225
7	10	1977	3	0.430	1.289
6	10	1978	4	0.353	1.410
6	10	1979	4	0.697	2.788
7	10	1985	3	0.544	1.632

TABLE : DROUGHT ANALYSIS OF CUDDAPAH DISTRICT BY HERBST METHOD

STATION AND TALUK: JAMMALAMAD

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	2.411	9.643
7	10	1952	3	1.512	4.537
5	10	1953	5	0.895	4.473
8	10	1954	2	0.773	1.546
7	10	1957	3	0.718	2.155
8	10	1959	2	1.076	2.152
5	10	1960	5	0.362	1.810
8	10	1961	2	2.456	4.913
5	11	1968	6	1.166	6.994
6	10	1969	4	1.813	7.251
5	10	1971	5	2.131	10.653
7	11	1972	4	1.088	4.353
7	10	1974	3	0.832	2.495
5	10	1975	5	0.647	3.233
5	10	1976	5	0.840	4.201
6	10	1979	4	0.575	2.301
7	10	1980	3	0.391	1.174
5	10	1984	5	2.156	10.782

STATION AND TALUK : SIDHOUT

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	1.451	5.802
7	10	1952	3	1.854	5.562
5	10	1953	3	1.589	7.944
8	10	1956	2	0.304	0.609
5	10	1958	5	1.073	5.363
5	11	1960	6	1.562	9.372
5	10	1963	5	0.797	3.985
5	10	1968	5	1.855	9.273
6	10	1971	4	1.222	4.888
5	10	1973	5	0.804	4.020
6	10	1974	4	1.115	4.460
6	10	1977	4	1.114	4.456
6	10	1979	4	1.514	6.058
7	10	1982	3	1.358	4.073
5	10	1984	5	0.985	4.923

STATION AND TALUK : CUDDAPAH

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	1.523	4.570
7	10	1952	3	1.763	5.289
5	10	1953	5	1.764	8.822

9	10	1955	1	1.145	1.145
9	10	1957	1	1.206	1.206
5	10	1958	5	1.594	7.971
6	11	1960	5	1.136	5.678
5	10	1962	5	1.076	5.381
5	10	1965	5	0.726	3.628
5	10	1968	5	1.661	8.303
8	10	1969	2	1.240	2.481
5	10	1971	5	1.659	8.397
7	11	1972	4	1.317	5.267
6	10	1974	4	0.491	1.962
5	10	1976	5	1.319	6.594
9	11	1977	2	1.050	2.101
6	10	1979	4	0.457	1.828
5	10	1980	5	0.164	0.819
5	10	1981	5	0.922	4.612
7	10	1982	3	2.024	6.071
5	10	1984	5	1.707	8.536

STATION AND TALUK : BADVEL

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	2.119	8.474
7	10	1952	3	1.621	4.862
5	10	1953	5	0.863	4.314
7	10	1957	3	1.406	4.219
5	10	1959	5	1.084	5.419
5	11	1960	6	0.848	5.086
9	10	1961	1	2.175	2.175
6	10	1962	4	1.038	4.150
5	10	1968	5	1.381	6.904
6	10	1971	4	0.697	2.787
7	10	1972	3	1.711	5.133
7	10	1977	3	1.001	3.003
7	10	1978	3	0.032	0.097
6	10	1979	4	1.387	5.549
7	10	1982	3	2.261	6.782
5	10	1984	5	0.746	3.730

STATION AND TALUK : PRODDATUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
5	10	1951	5	2.157	10.786
5	10	1952	3	0.748	2.243
5	10	1953	5	0.741	3.707
5	10	1958	5	0.825	4.125
8	10	1959	2	0.665	1.330
8	10	1961	2	1.334	2.668
5	10	1963	5	0.886	4.428
5	10	1965	5	1.224	6.121

5	10	1968	5	1.972	9.862
6	10	1969	4	1.454	5.815
6	10	1970	4	0.399	1.595
6	10	1971	4	1.303	5.211
7	10	1972	3	1.722	5.167
5	10	1973	5	0.690	3.448
6	10	1974	4	1.210	4.840
9	11	1976	2	1.381	2.762
9	11	1977	2	0.375	0.751
5	10	1980	5	2.410	12.048
7	10	1982	3	2.219	6.658
5	10	1984	5	2.253	11.263

TABLE : DROUGHT ANALYSIS OF ANANTPUR DISTRICT BY HERBST METHOD

STATION AND TALUK : ANANTPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	1.520	4.559
6	10	1952	4	1.605	6.421
5	10	1954	5	1.434	7.170
7	10	1961	3	2.215	6.644
5	10	1965	5	0.824	4.120
8	10	1967	2	0.978	1.957
6	10	1968	4	1.253	5.012
5	10	1971	5	1.115	5.577
6	10	1972	4	1.116	4.464
5	10	1975	5	0.610	3.050
5	10	1976	5	1.794	8.970
5	10	1979	6	0.399	2.395
5	10	1980	5	1.306	6.530
8	10	1982	2	1.563	3.126
5	10	1984	5	1.335	6.679

STATION AND TALUK : MADAKASIRA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	1.533	4.598
7	10	1952	3	0.396	1.187
5	10	1953	5	0.709	3.546
5	10	1956	5	0.308	1.540
8	10	1957	2	1.774	3.547
6	10	1958	4	0.493	1.971
8	10	1961	2	2.665	5.329
5	10	1962	5	0.444	2.219
8	10	1967	2	0.855	1.709
5	10	1968	5	1.633	8.167
6	10	1970	4	1.516	6.065
5	10	1971	5	0.588	2.938
5	10	1976	5	1.557	7.786
7	10	1980	3	1.127	3.380
5	10	1984	5	0.999	4.996

STATION AND TALUK : RAYADURG

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
5	10	1951	5	2.167	10.837
5	10	1952	5	2.167	10.837
5	10	1953	5	2.167	10.837

9	10	1954	1	1.798	1.789
8	10	1961	2	2.798	5.597
7	10	1962	3	0.773	2.319
6	10	1963	4	0.604	2.417
5	8	1964	3	0.998	2.993
5	8	1965	3	1.527	4.581
8	10	1967	2	0.453	0.907
6	10	1974	4	0.424	1.696
5	10	1976	5	1.231	6.157
5	11	1978	6	0.168	1.009
5	10	1980	5	1.550	7.752
5	10	1981	5	0.385	1.926
8	10	1984	2	0.393	0.786

STATION AND TALUK: URAVAKONDA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1952	4	1.661	6.645
6	10	1954	2	2.207	4.415
6	10	1958	4	0.833	3.332
5	10	1960	5	1.083	5.414
7	10	1961	3	2.722	8.167
5	10	1962	5	1.398	6.991
8	10	1967	2	0.423	0.845
9	10	1969	1	1.002	1.002
6	10	1971	4	0.738	2.953
5	10	1972	5	0.887	4.437
5	10	1976	5	0.831	4.155
5	10	1978	5	0.667	3.333
5	11	1979	6	0.716	4.299
7	10	1980	3	0.667	2.002
7	10	1982	3	0.729	2.188
8	10	1984	2	2.127	4.255

STATION AND TALUK : PENUKONDA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1951	2	1.598	3.196
5	10	1952	5	0.816	4.079
5	10	1954	5	1.325	6.627
7	10	1957	3	1.223	3.670
6	11	1960	5	1.600	8.001
6	10	1961	4	2.084	8.334
5	10	1963	5	1.205	6.026
5	10	1965	5	1.173	5.865
8	10	1967	2	0.663	1.326
7	10	1968	3	1.125	3.376
6	10	1969	4	2.201	8.803
5	10	1971	5	0.939	4.696
7	10	1972	3	1.763	5.290
9	10	1976	1	1.167	1.167
8	10	1978	2	0.705	1.410
5	10	1979	5	0.452	2.259
7	10	1980	3	0.391	1.171
5	10	1984	5	1.026	5.130

TABLE : DROUGHT ANALYSIS OF BIJAPUR DISTRICT BY HERBST METHOD

STATION AND TALUK: BIJAPUR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1952	4	1.488	5.953
9	10	1954	1	1.052	1.052
6	10	1958	4	1.060	4.241
8	10	1959	2	1.251	2.503
8	10	1961	2	1.631	3.262
5	10	1965	5	0.779	3.897
6	10	1966	4	1.102	4.408
5	10	1967	5	0.868	4.341
5	10	1972	5	3.162	15.811
8	10	1977	2	1.972	3.944
5	11	1979	6	0.860	5.159
6	10	1980	4	1.158	4.632
8	10	1982	2	2.898	5.796
5	10	1984	5	2.528	12.642

STATION AND TALUK : BAGALKOT

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1951	2	0.218	0.436
8	10	1952	2	1.369	2.738
9	10	1954	1	1.307	1.307
9	10	1956	1	0.861	0.861
7	10	1957	3	1.453	4.358
6	10	1960	4	0.928	3.712
8	10	1961	2	1.895	3.791
5	10	1967	5	1.746	8.728
5	10	1969	5	1.277	6.383
5	10	1972	5	1.268	6.341
5	9	1974	4	0.863	3.452
5	10	1975	5	4.933	24.664
7	10	1980	3	1.823	5.470
8	10	1982	2	1.571	3.142
5	10	1984	5	2.293	11.463
5	10	1985	5	1.632	8.160

STATION AND TALUK : MUDDEBIHAL

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1952	2	2.064	4.128
9	11	1958	2	0.404	0.809
7	10	1959	3	0.274	0.823
9	10	1961	1	1.582	1.582
5	10	1967	5	1.112	5.559
5	10	1968	5	1.333	6.667
5	10	1970	5	4.403	22.014
5	10	1971	5	4.909	24.543
5	10	1972	5	4.909	24.543

7	10	1973	3	1.094	3.281
5	10	1976	5	4.909	24.543
7	10	1977	3	1.651	4.954
5	9	1979	4	0.547	2.189
7	10	1985	3	0.590	1.770

STATION AND TALUK : MUDHOL

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
5	10	1952	5	0.864	4.231
9	10	1954	1	1.472	1.472
5	10	1957	5	0.789	3.947
6	10	1958	4	0.773	3.091
7	10	1959	3	0.122	0.367
6	10	1961	4	1.342	5.370
6	10	1962	4	1.333	5.330
5	10	1965	5	1.434	7.172
5	10	1966	5	3.804	19.019
5	10	1967	5	0.404	2.018
5	9	1968	4	0.743	2.974
5	10	1972	5	3.804	19.019
5	10	1976	5	0.525	2.627
8	10	1982	2	1.001	2.001
5	10	1984	5	1.326	6.628
5	10	1985	5	0.898	4.491

STATION AND TALUK : INDI

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
5	10	1951	5	6.475	32.376
6	10	1952	4	1.219	4.876
6	10	1958	4	1.898	7.591
7	10	1959	3	0.241	0.723
8	10	1961	2	1.409	2.818
7	10	1966	3	0.256	0.768
5	10	1967	5	0.882	4.409
6	10	1971	4	0.904	3.617
5	10	1972	5	4.413	22.065
6	10	1974	4	0.588	2.351
5	10	1975	5	6.475	32.376
5	10	1976	5	6.475	32.376
9	11	1977	2	0.632	1.265
5	9	1979	4	0.711	2.844
8	10	1982	2	0.470	0.940
7	10	1984	3	0.336	1.007

TABLE : DROUGHT ANALYSIS OF BELGAUM DISTRICT BY HERBST METHOD

STATION AND TALUK: ATHANI

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1952	3	0.570	1.709
8	10	1953	2	1.626	3.252
9	10	1954	1	1.705	1.705
5	10	1956	5	3.140	15.700
9	10	1958	1	1.613	1.613
5	10	1965	5	1.087	5.435
5	10	1967	5	0.501	2.506
5	10	1968	5	1.230	6.150
5	10	1969	5	0.658	3.291
5	10	1970	5	1.879	9.393
6	10	1971	4	1.017	4.068
7	10	1972	3	1.458	4.374
5	10	1976	5	0.649	3.246
8	10	1977	2	2.507	5.015
7	10	1980	3	0.445	1.336
5	10	1983	5	0.438	2.191
5	10	1984	5	1.326	6.628
5	10	1985	5	0.766	3.829

STATION AND TALUK : BELGAUM

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
5	10	1957	5	0.794	3.969
5	10	1962	5	1.163	5.817
5	11	1964	6	1.352	8.110
8	10	1965	2	1.282	2.563
5	10	1968	5	1.140	5.698
5	10	1969	5	1.467	7.336
7	10	1971	3	0.661	1.984
6	10	1972	4	0.810	3.242
7	10	1973	3	0.667	2.002
6	10	1974	4	0.854	3.418
5	10	1976	5	0.822	4.110
5	10	1984	5	0.774	3.868
5	10	1985	5	1.488	7.442

STATION AND TALUK: GOKAK

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1951	3	1.918	5.755
5	8	1952	3	1.191	3.572
8	10	1953	2	1.813	3.627
9	10	1954	1	1.351	1.351
6	9	1955	3	0.868	2.603
8	10	1957	2	2.134	4.268
8	10	1958	2	1.165	2.330

5	10	1965	5	0.792	3.959
5	11	1966	6	0.385	2.311
5	10	1967	5	0.936	4.679
7	11	1968	4	0.781	3.125
5	10	1969	5	0.449	2.246
5	10	1970	5	0.555	2.773
5	10	1972	5	0.833	4.167
5	10	1973	5	0.534	2.670
6	9	1974	3	0.585	1.756
5	10	1976	5	1.326	6.632
7	10	1977	3	1.991	5.974
5	9	1978	4	0.632	2.527
8	10	1982	2	0.840	1.680
9	10	1983	1	1.179	1.179
5	10	1984	5	0.893	4.465
5	10	1985	5	1.317	6.586

STATION AND TALUK : CHIKODI

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1951	4	2.052	8.210
5	10	1952	5	0.600	2.998
9	10	1958	1	1.734	1.734
8	10	1961	2	1.283	2.566
5	10	1962	5	0.853	4.263
6	10	1963	4	1.269	5.078
5	10	1965	5	1.194	5.972
8	10	1966	2	1.245	2.491
5	10	1968	5	2.160	10.799
5	10	1970	5	1.886	9.432
5	10	1971	5	0.630	3.149
6	10	1972	4	1.856	7.422
6	10	1974	4	0.686	2.757
8	10	1977	2	0.944	1.887
5	10	1978	5	0.745	3.723
5	8	1979	3	1.011	3.034
7	10	1982	3	0.844	2.531
5	10	1984	5	0.487	2.435
7	10	1985	3	0.396	1.188

TABLE : DROUGHT ANALYSIS OF AHMADNAGAR DISTRICT BY HERBST METHOD

STATION AND TALUK : AHMADNAGAR

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
7	10	1952	3	1.929	5.788
8	10	1961	2	2.124	4.248
6	10	1966	4	1.507	6.027
6	9	1971	3	2.319	6.957
6	10	1972	4	2.775	11.098
6	10	1977	4	5.490	21.959
6	10	1978	4	1.905	7.622
6	10	1979	4	2.180	8.719
6	10	1980	4	2.764	11.055
7	10	1982	3	1.110	3.329
6	10	1985	4	1.371	5.483

STATION AND TALUK : AKOLA

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1955	4	1.077	4.307
6	9	1960	3	1.813	5.438
6	10	1966	4	0.718	2.872
6	10	1970	4	0.917	3.667
6	10	1972	4	1.152	4.609
6	9	1974	3	1.171	3.512
6	10	1978	4	0.821	3.384
7	10	1979	3	0.334	1.002
7	10	1980	3	0.615	1.845
6	10	1982	4	1.370	5.478
6	9	1983	3	0.911	2.734
6	10	1984	4	1.041	4.164
6	10	1985	4	2.882	11.528

STATION AND TALUK : JAMKHED

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1951	2	1.308	2.616
7	10	1952	3	2.282	6.846
6	10	1961	4	1.493	5.973
6	10	1966	4	1.862	7.449
6	10	1968	4	1.375	5.502
6	10	1971	4	0.738	2.952
6	10	1972	4	3.328	13.313
6	10	1974	4	0.738	2.952
7	10	1977	3	1.470	4.411
7	10	1978	3	1.584	4.751
7	10	1979	3	1.656	4.969
7	10	1981	3	1.720	5.159
7	9	1982	2	2.208	4.416
8	10	1985	2	1.171	2.341

STATION AND TALUK : SANGAMNER

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
8	10	1951	2	1.869	3.739
6	9	1955	3	1.073	3.218
6	9	1960	3	1.327	3.982
8	10	1961	2	1.537	3.074
8	10	1962	2	1.520	3.039
6	10	1965	4	1.293	5.174
6	9	1966	3	0.602	1.806
7	10	1970	3	1.068	3.204
6	9	1971	3	1.569	4.708
6	10	1972	4	1.454	5.815
6	10	1978	4	1.187	4.749
6	10	1979	4	1.297	5.188
7	10	1982	3	0.880	2.641
6	10	1984	4	2.278	9.111
6	10	1985	4	1.780	7.118

STATION AND TALUK : SHEVGAON

DROUGHT BEGAN FROM MONTH	TERMINATED IN	YEAR	DROUGHT DURATION	DROUGHT INTENSITY	SEVERITY INDEX
6	10	1952	4	0.481	1.924
6	9	1959	3	0.990	2.970
8	10	1961	2	1.590	3.180
6	9	1968	3	1.401	4.203
6	10	1970	4	0.700	2.799
6	10	1971	4	0.986	3.942
6	10	1972	4	3.352	13.407
6	10	1974	4	1.624	6.497
8	10	1976	2	1.542	3.084
7	10	1977	3	1.375	4.125
7	10	1978	3	2.415	7.244
6	10	1981	4	1.905	7.619
8	10	1982	2	1.766	3.533
6	9	1983	3	0.831	2.493
6	10	1984	4	1.880	7.521
6	10	1985	4	2.717	10.869

STATION AND TALUK - SANGOLA

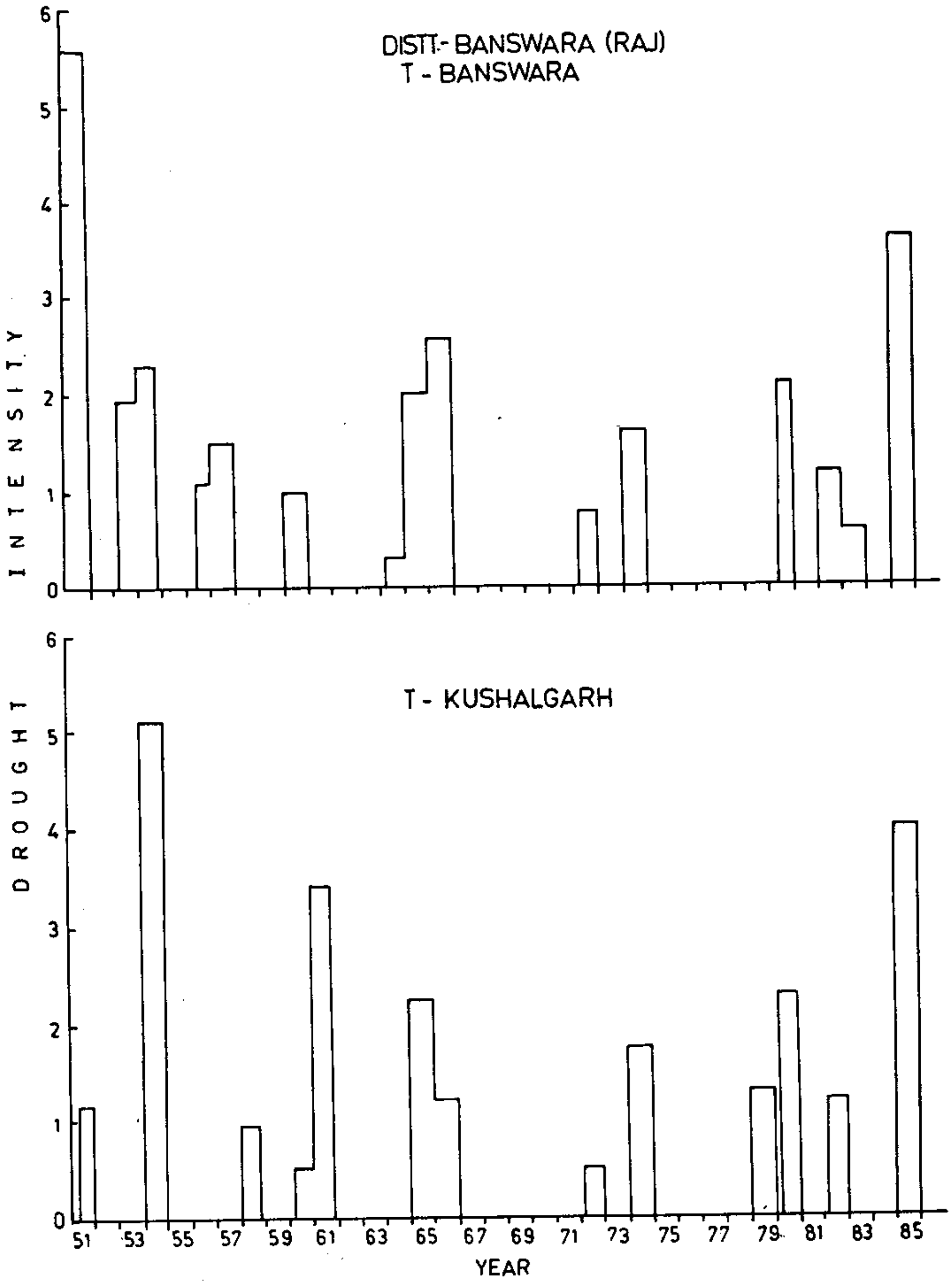
Drought Began from month	Termi- nated	Year	Drought Duration	Drought Intensity	Severity Index
8	10	1961	2	3.078	6.156
6	10	1965	4	1.023	4.093
6	10	1966	4	0.536	2.144
6	9	1970	3	1.535	4.604
6	8	1971	2	1.903	3.805
6	10	1972	4	2.491	9.962
6	9	1974	3	0.877	2.630
6	9	1975	3	1.189	3.566
7	10	1985	3	2.106	6.319

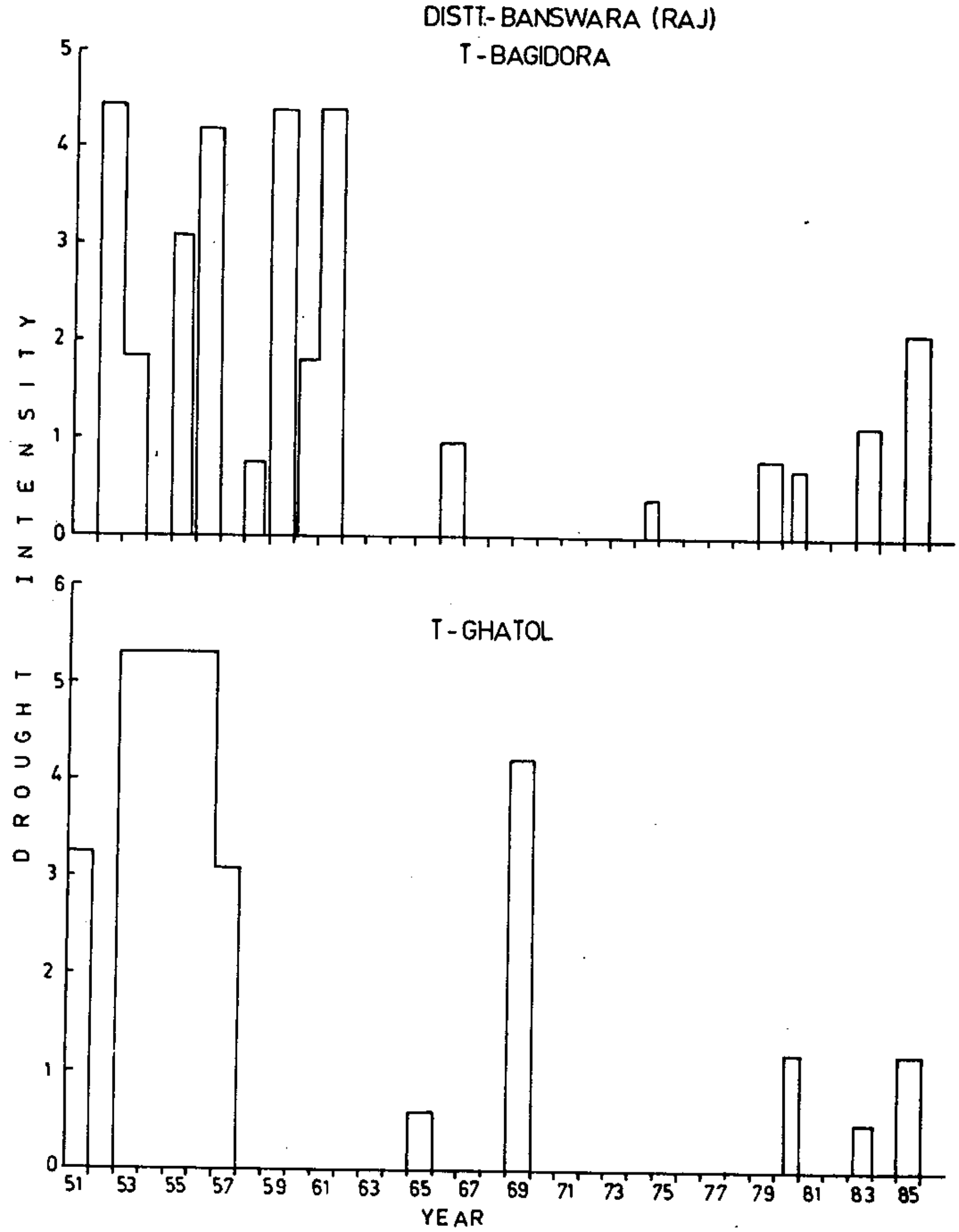
STATION AND TALUK - SOLAPUR

Drought Began from month	Termi- nated	Year	Drought Duration	Drought Intensity	Severity Index
8	10	1965	2	2.082	4.163
6	10	1971	4	2.638	10.553
6	10	1972	4	2.835	11.342
6	10	1976	4	1.324	5.295
6	10	1977	4	1.779	7.115
6	10	1985	4	1.317	5.270

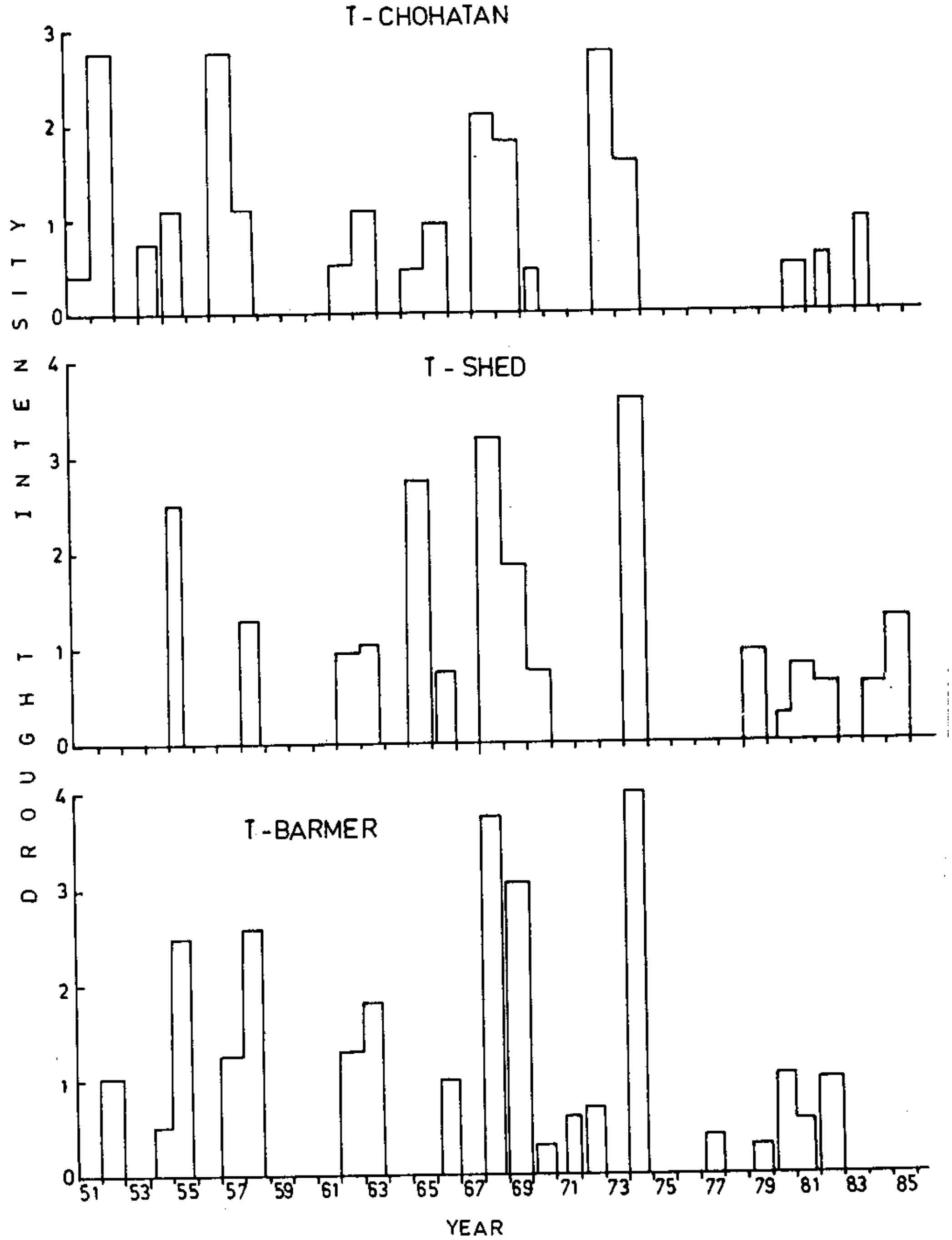
APPENDIX-III-3 (B)

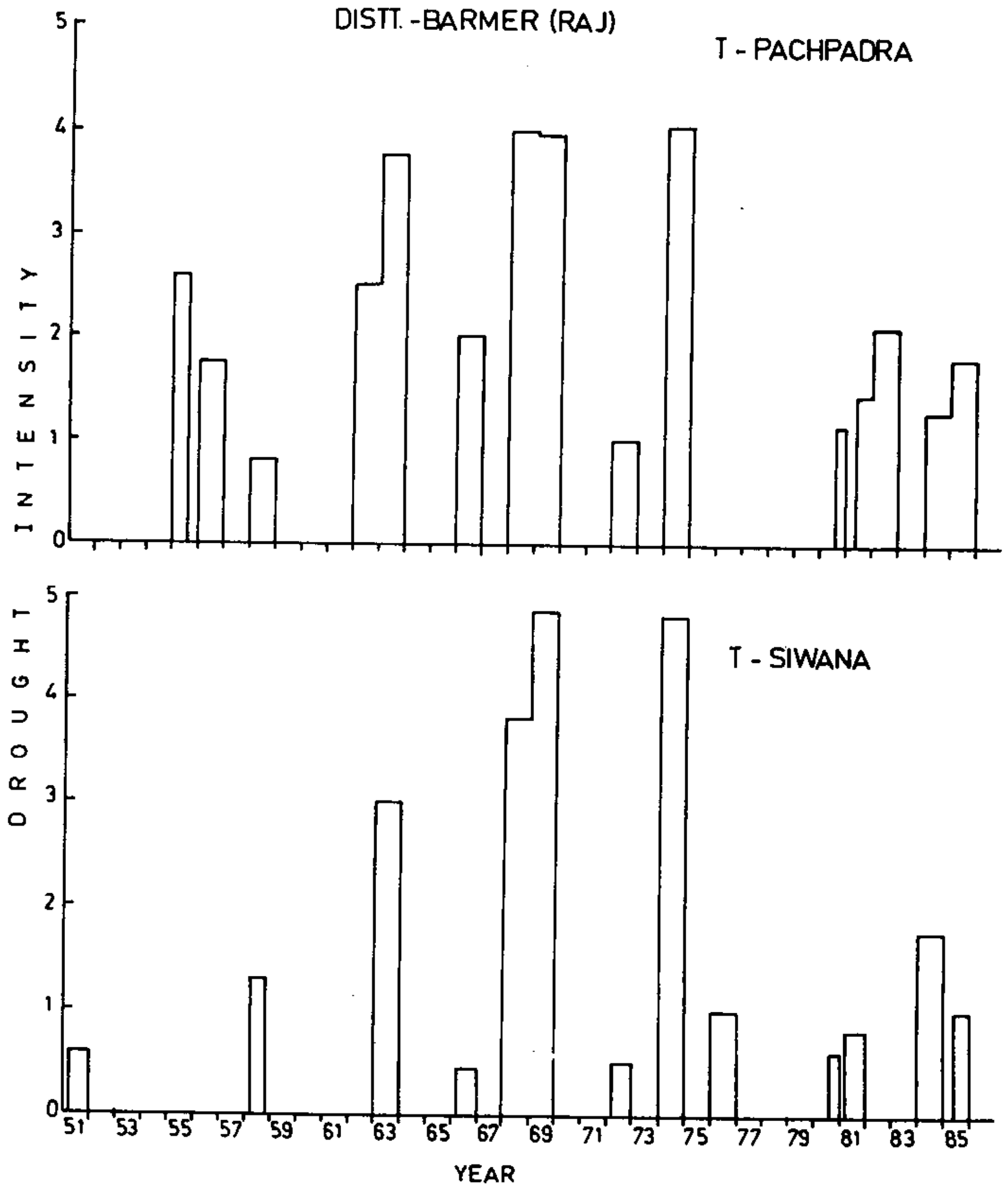
TALUKWISE DROUGHT ANALYSIS USING HERBST APPROACH

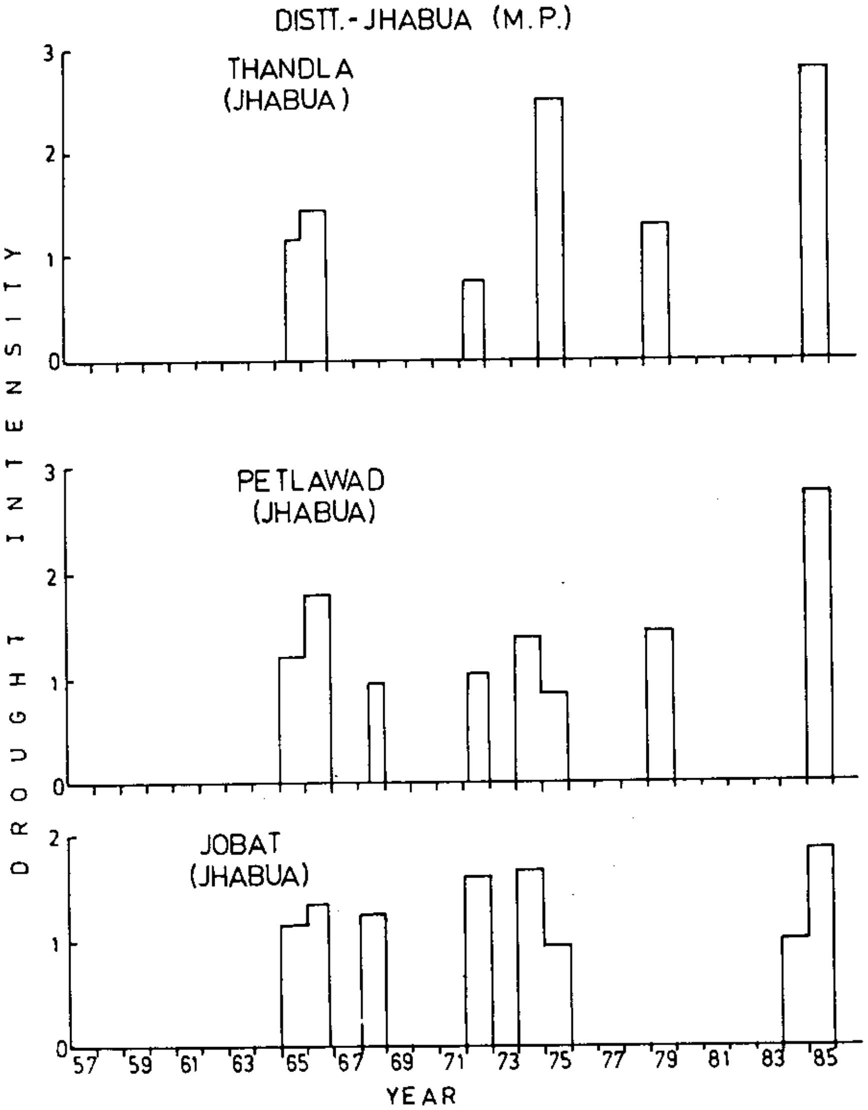



DISTT.- BANSWARA (RAJ)
T - BAGIDORA
T - GHATOL
DROUGHT INTENSITY
YEAR
0
1
2
3
4
5
6
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

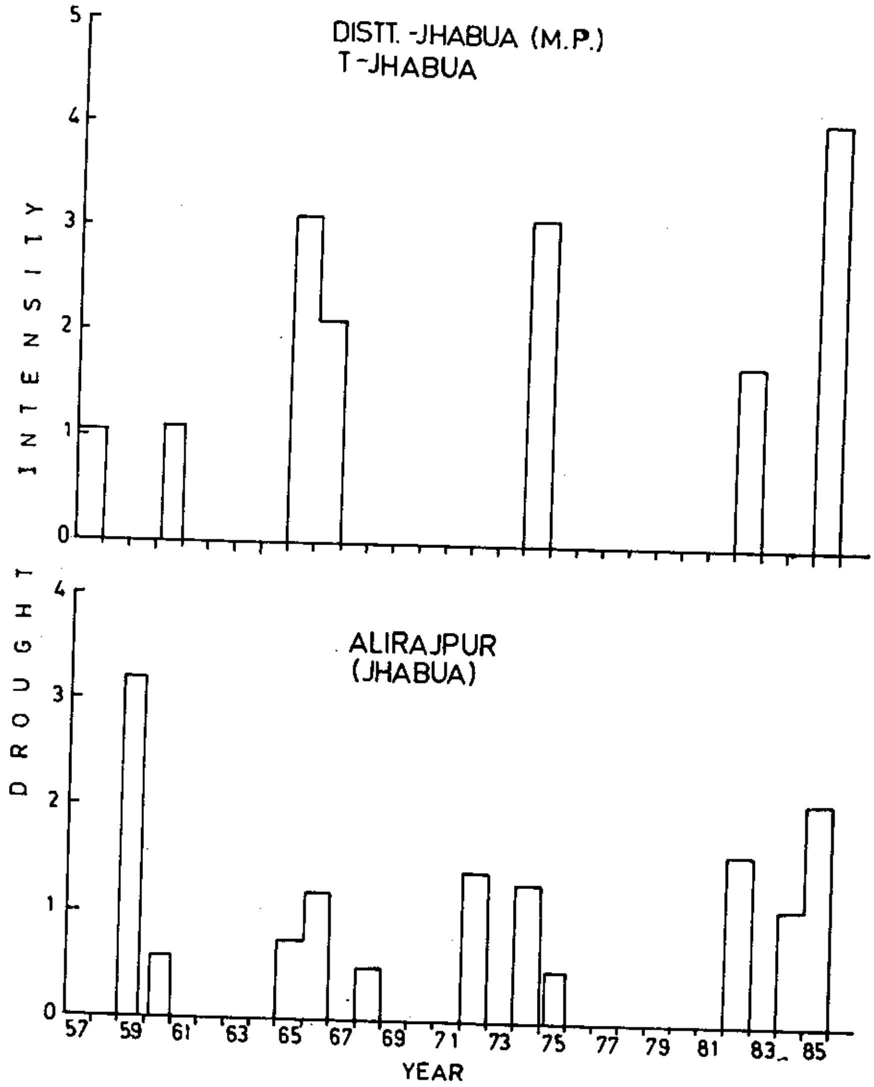
DISTT.-BARMER (RAJ)



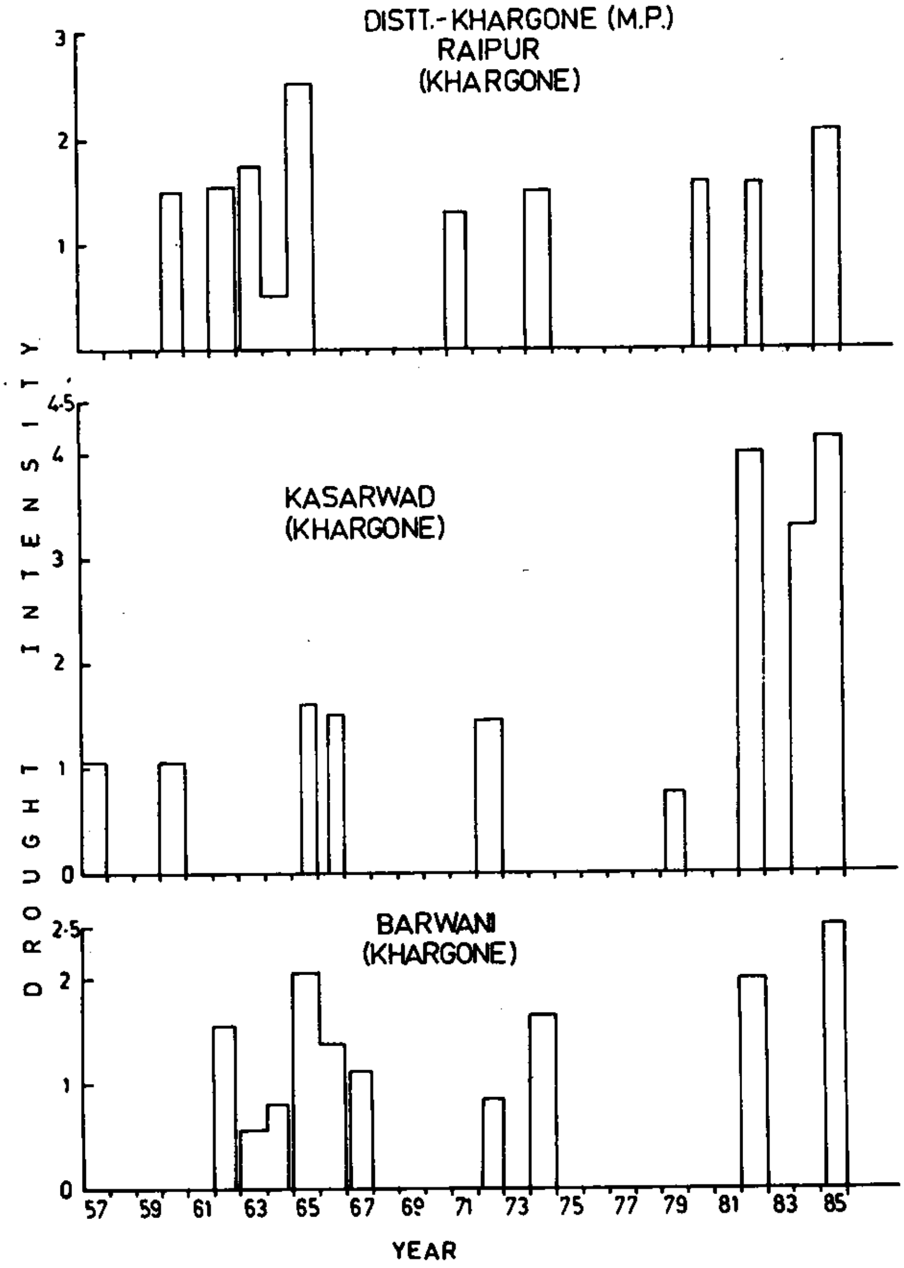

DISTT. -BARMER (RAJ)
T - PACHPADRA
T - SIWANA
DROUGHT INTENSITY
0
1
2
3
4
5
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85
YEAR



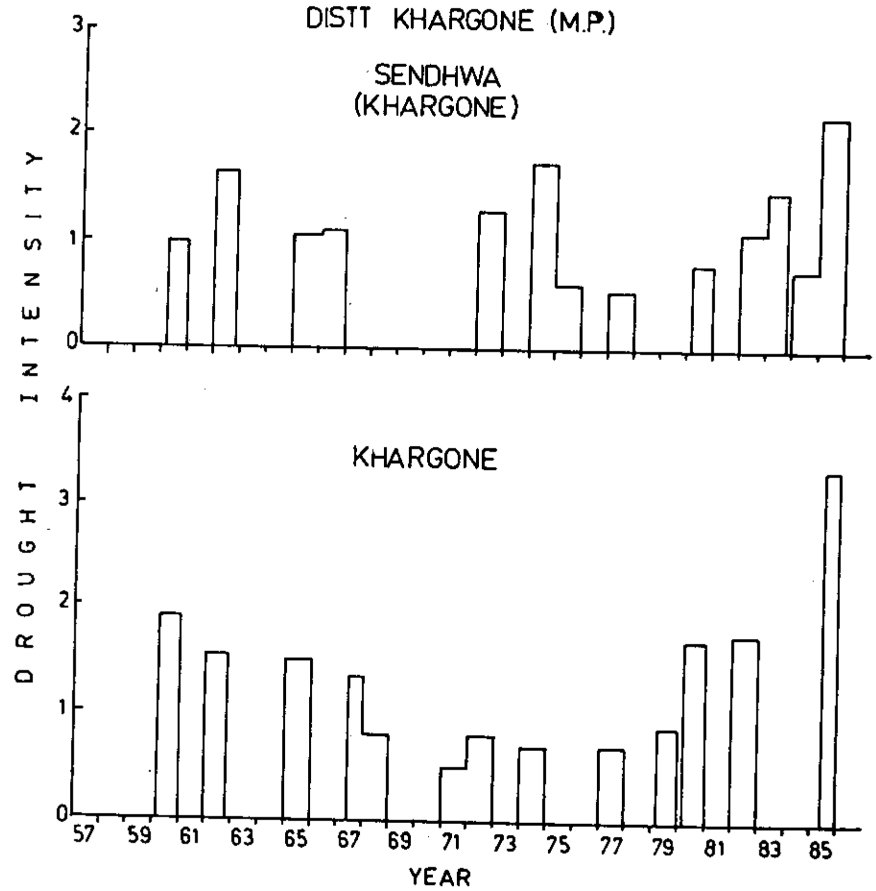
DISTT.- JHABUA (M.P.)
THANDLA
(JHABUA)
PETLAWAD
(JHABUA)
JOBAT
(JHABUA)
DROUGHT INTENSITY
YEAR
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85



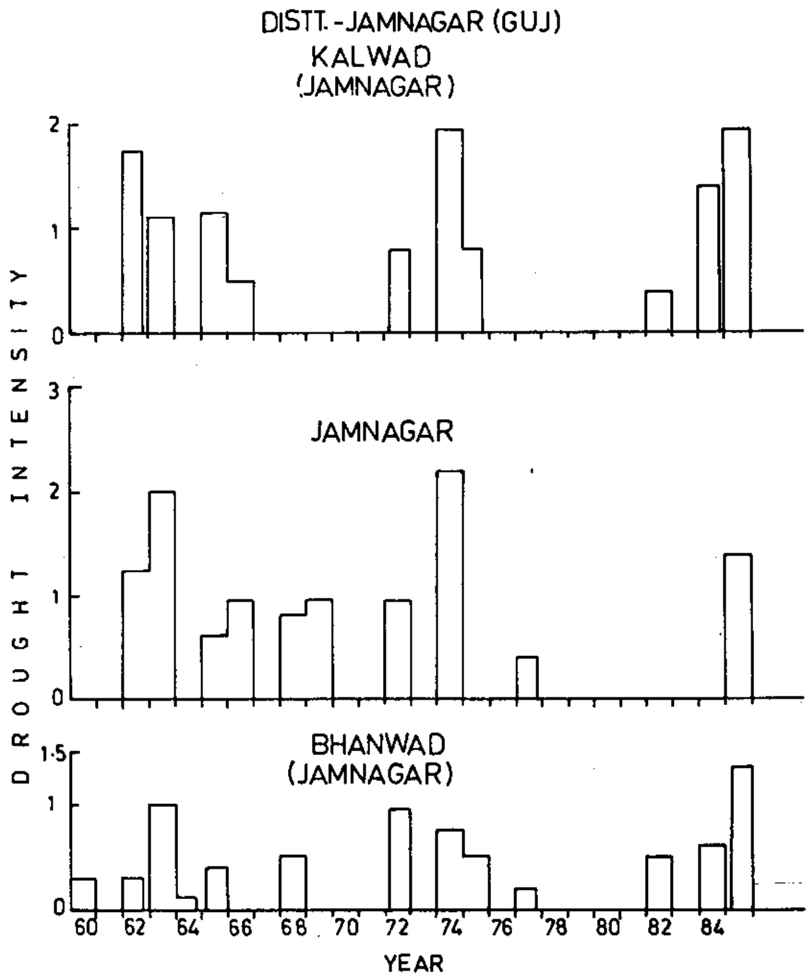
DISTT. -JHABUA (M.P.)
T-JHABUA
ALIRAJPUR
(JHABUA)
DROUGHT INTENSITY
YEAR
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

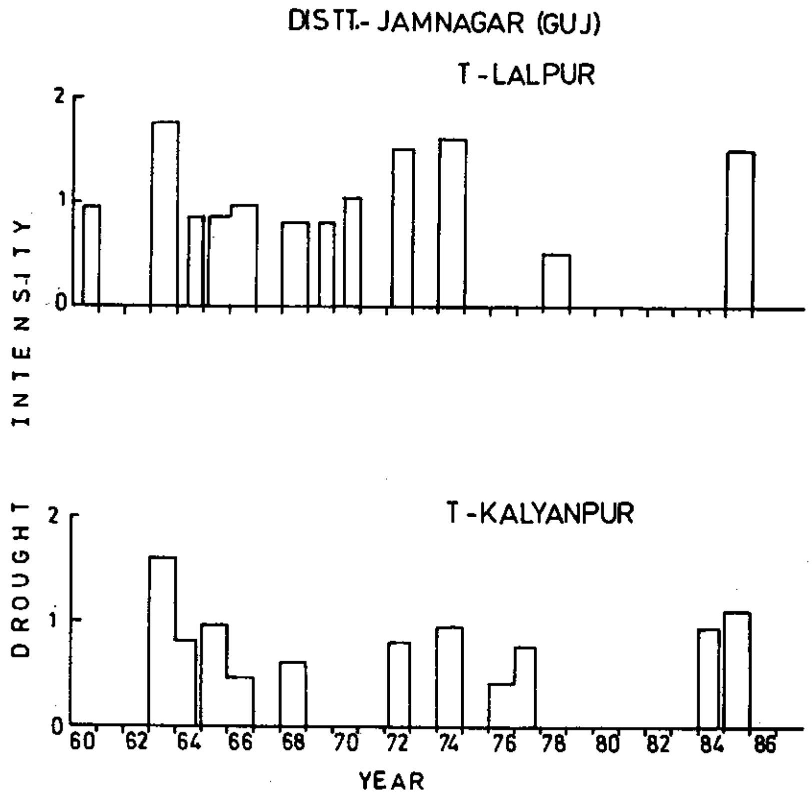


DISTT.-KHARGONE (M.P.)
RAIPUR
(KHARGONE)
KASARWAD
(KHARGONE)
BARWANI
(KHARGONE)
DROUGHT INTENSITY
YEAR
3
2
1
4.5
4
3
2
1
0
2.5
2
1
0
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

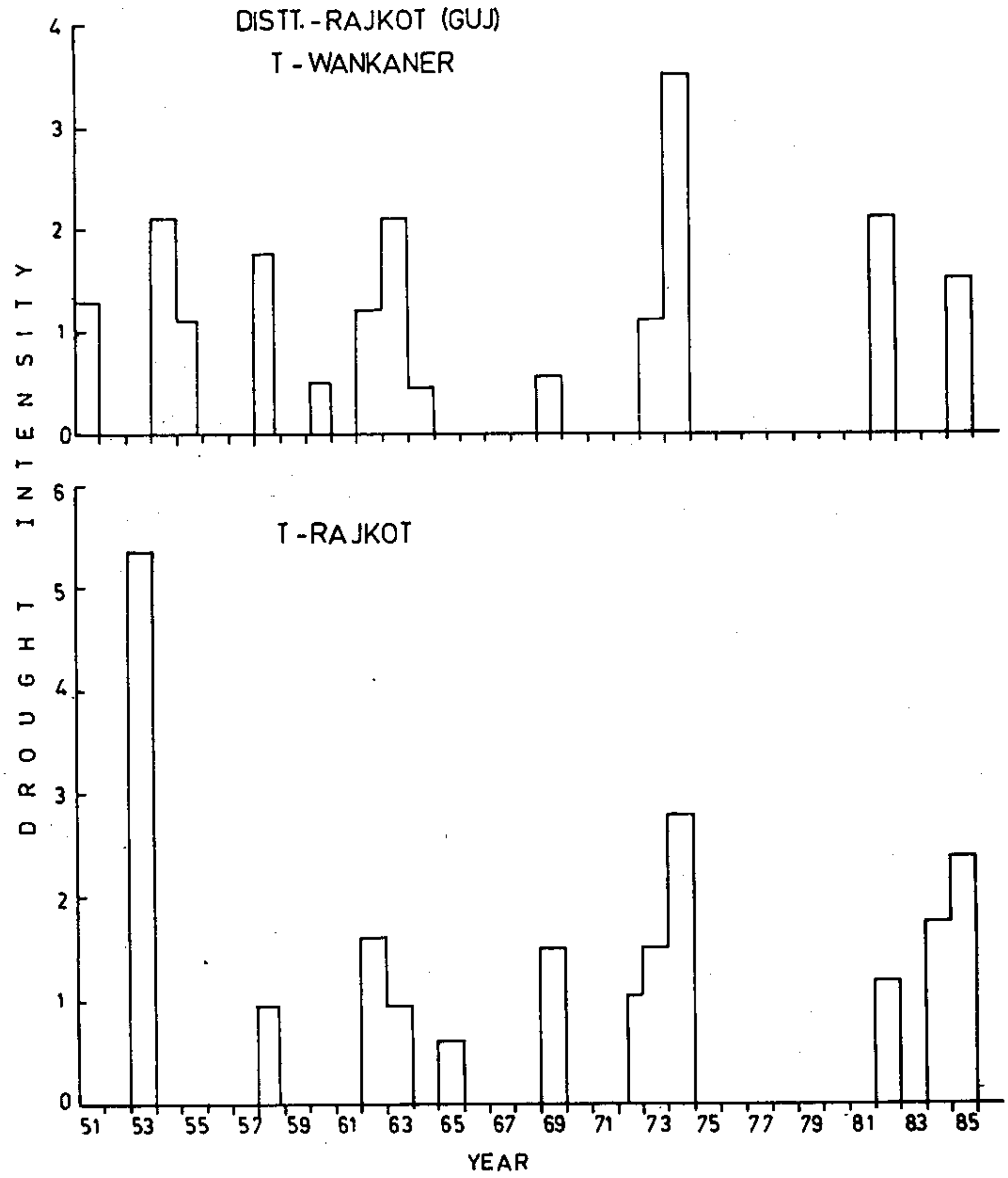


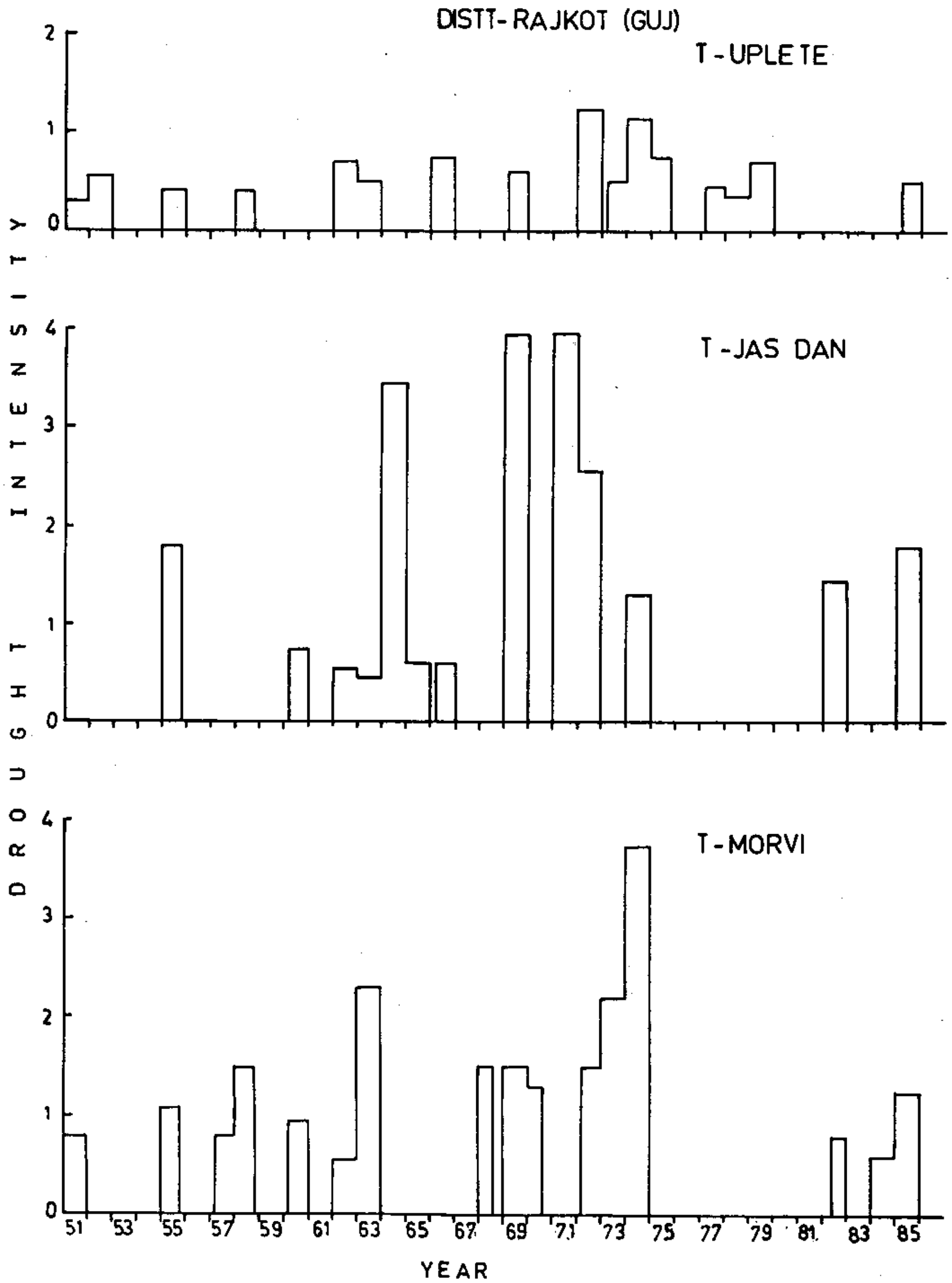
DISTT KHARGONE (M.P.)
SENDHWA
(KHARGONE)
KHARGONE
DROUGHT INTENSITY
YEAR
0
1
2
3
4
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85


DISTT.-JAMNAGAR (GUJ)
KALWAD
(JAMNAGAR)
JAMNAGAR
BHANWAD
(JAMNAGAR)
DROUGHT INTENSITY
YEAR
60
62
64
66
68
70
72
74
76
78
80
82
84

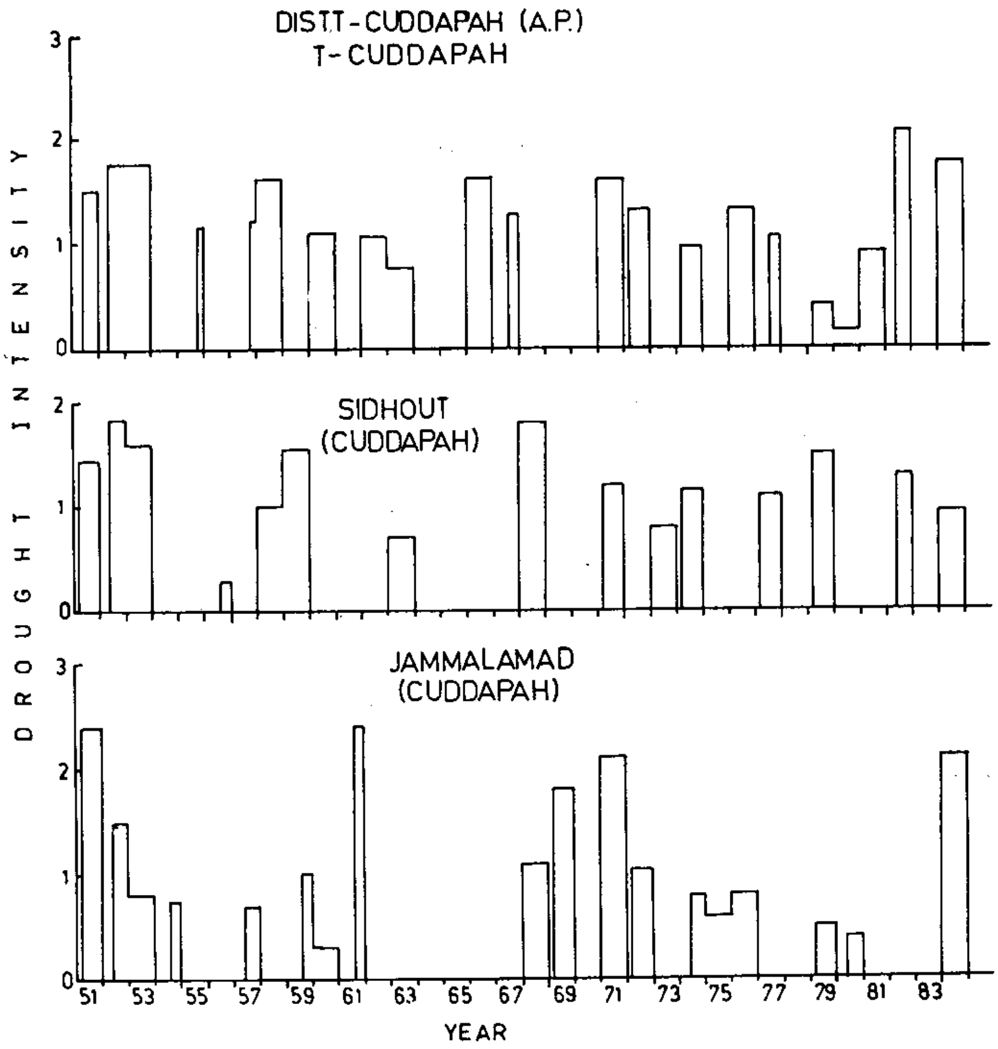


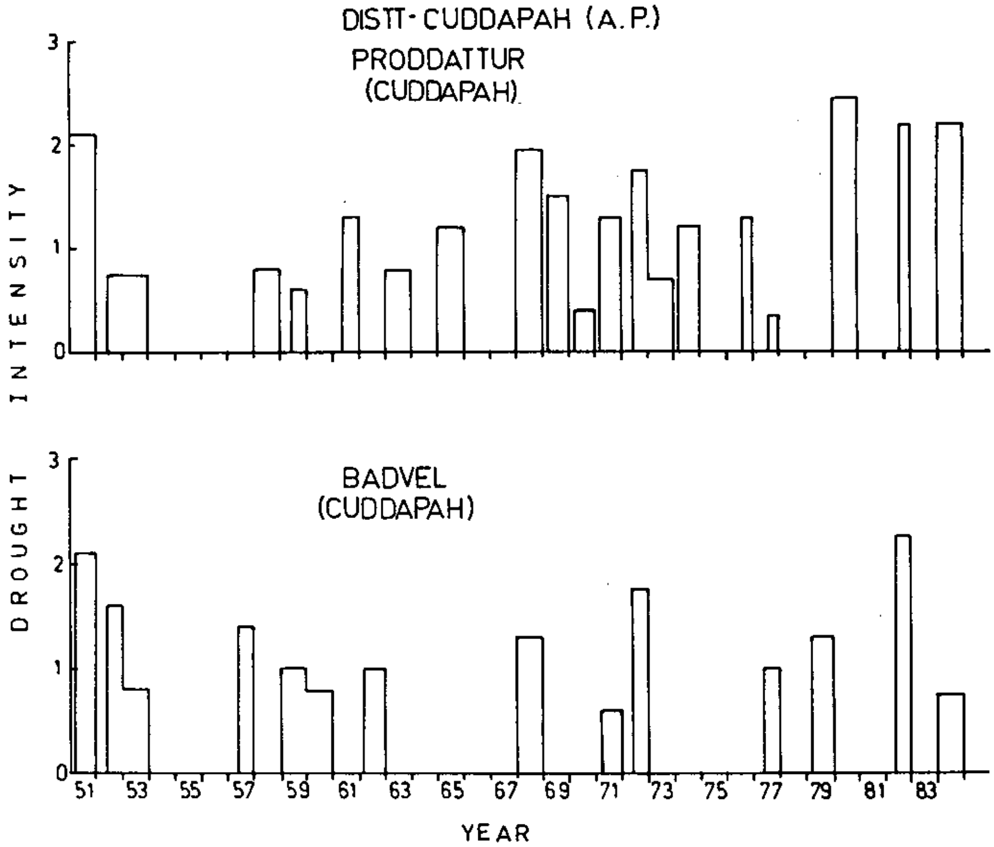
DISTT.- JAMNAGAR (GUJ)
T - LALPUR
T - KALYANPUR
DROUGHT INTENSITY
YEAR
0
1
2
60
62
64
66
68
70
72
74
76
78
80
82
84
86

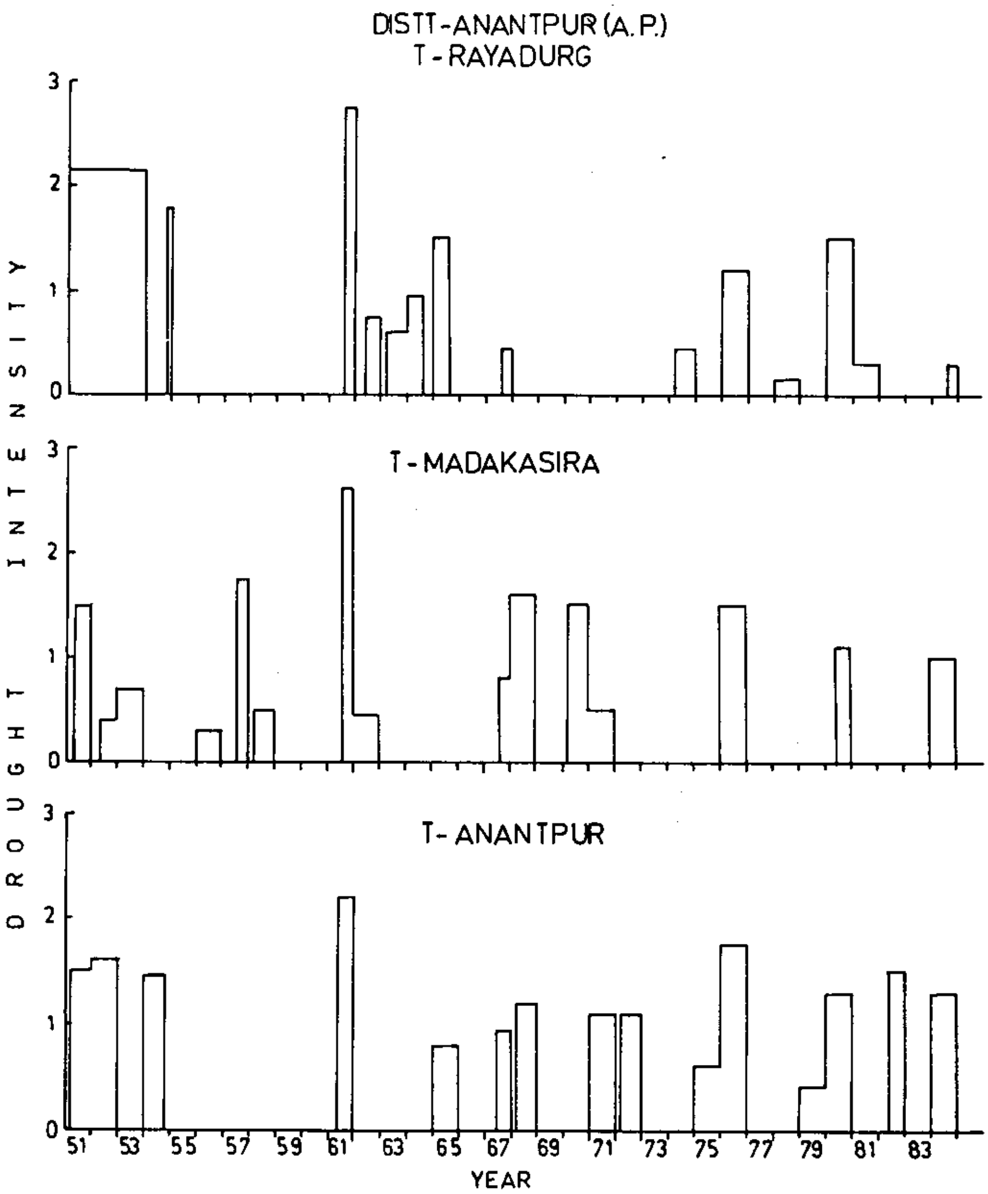

DISTT. - RAJKOT (GUJ)
T - WANKANER
T - RAJKOT
DROUGHT INTENSITY
YEAR
0
1
2
3
4
5
6
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

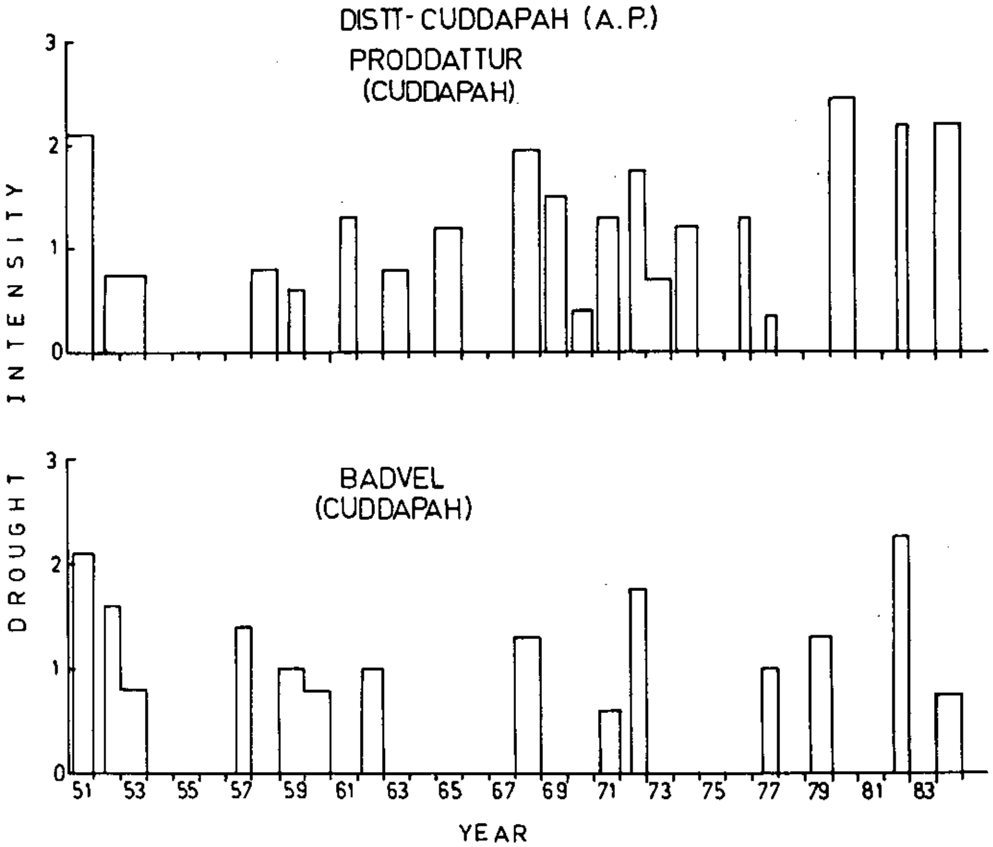


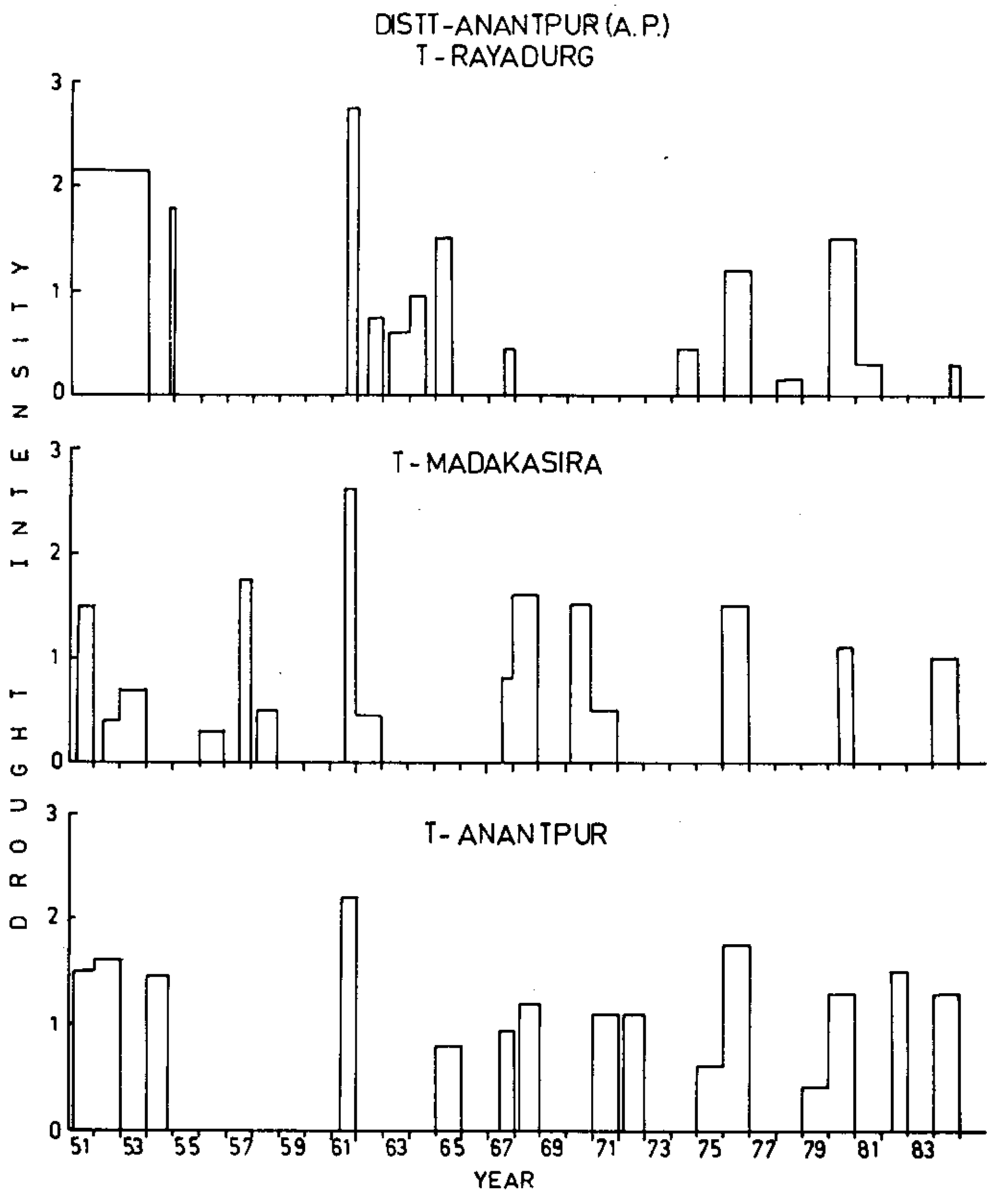
DISTT-RAJKOT (GUJ)
T-UPLETE
T-JAS DAN
T-MORVI
DROUGHT INTENSITY
YEAR
0
1
2
3
4
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

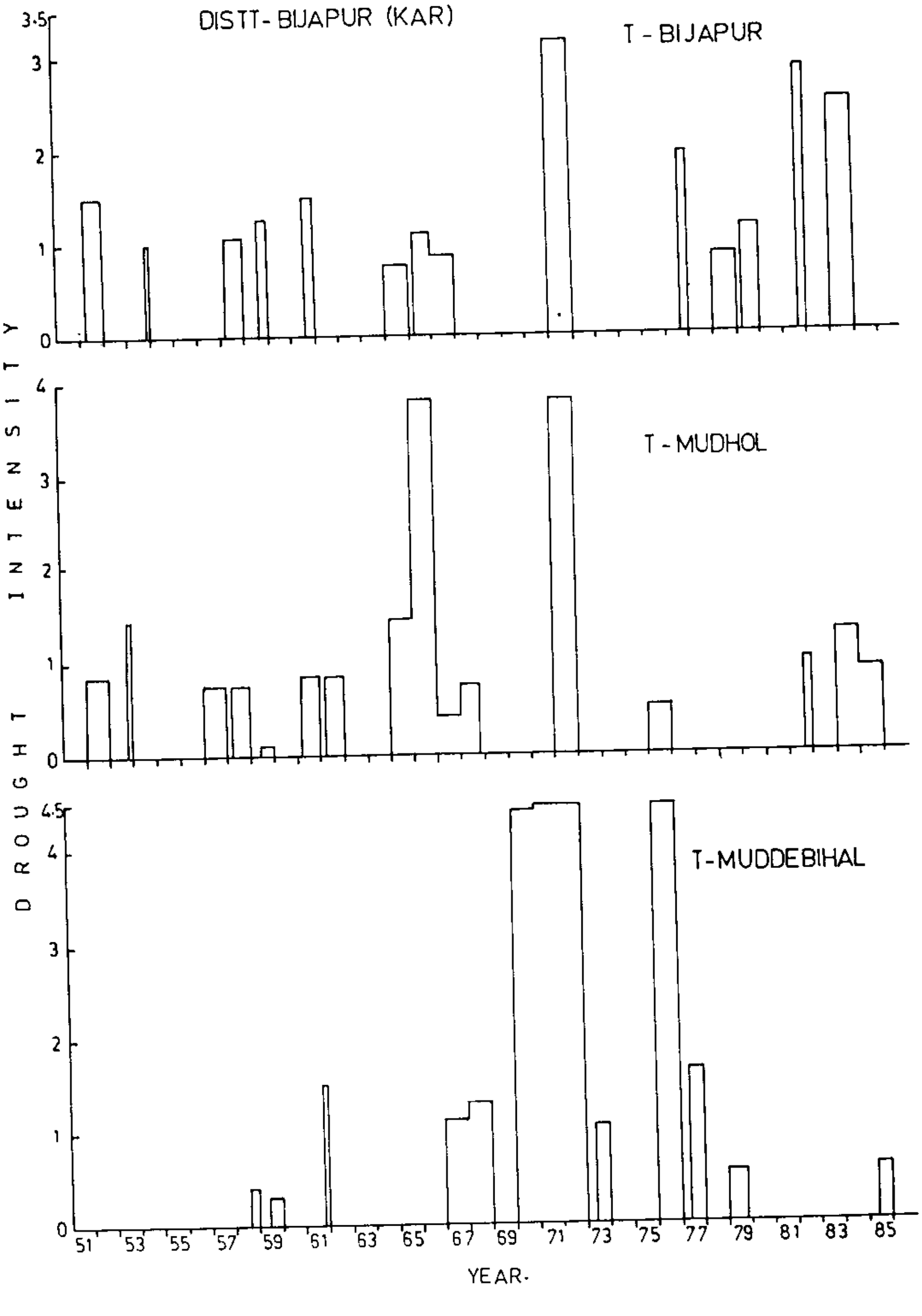

DISTT-CUDDAPAH (A.P.)
T-CUDDAPAH
SIDHOUT
(CUDDAPAH)
JAMMALAMAD
(CUDDAPAH)
DROUGHT INTENSITY
YEAR
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83


DISTT- CUDDAPAH (A.P.)
PRODDATTUR
(CUDDAPAH)
BADVEL
(CUDDAPAH)
DROUGHT INTENSITY
0
1
2
3
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
YEAR

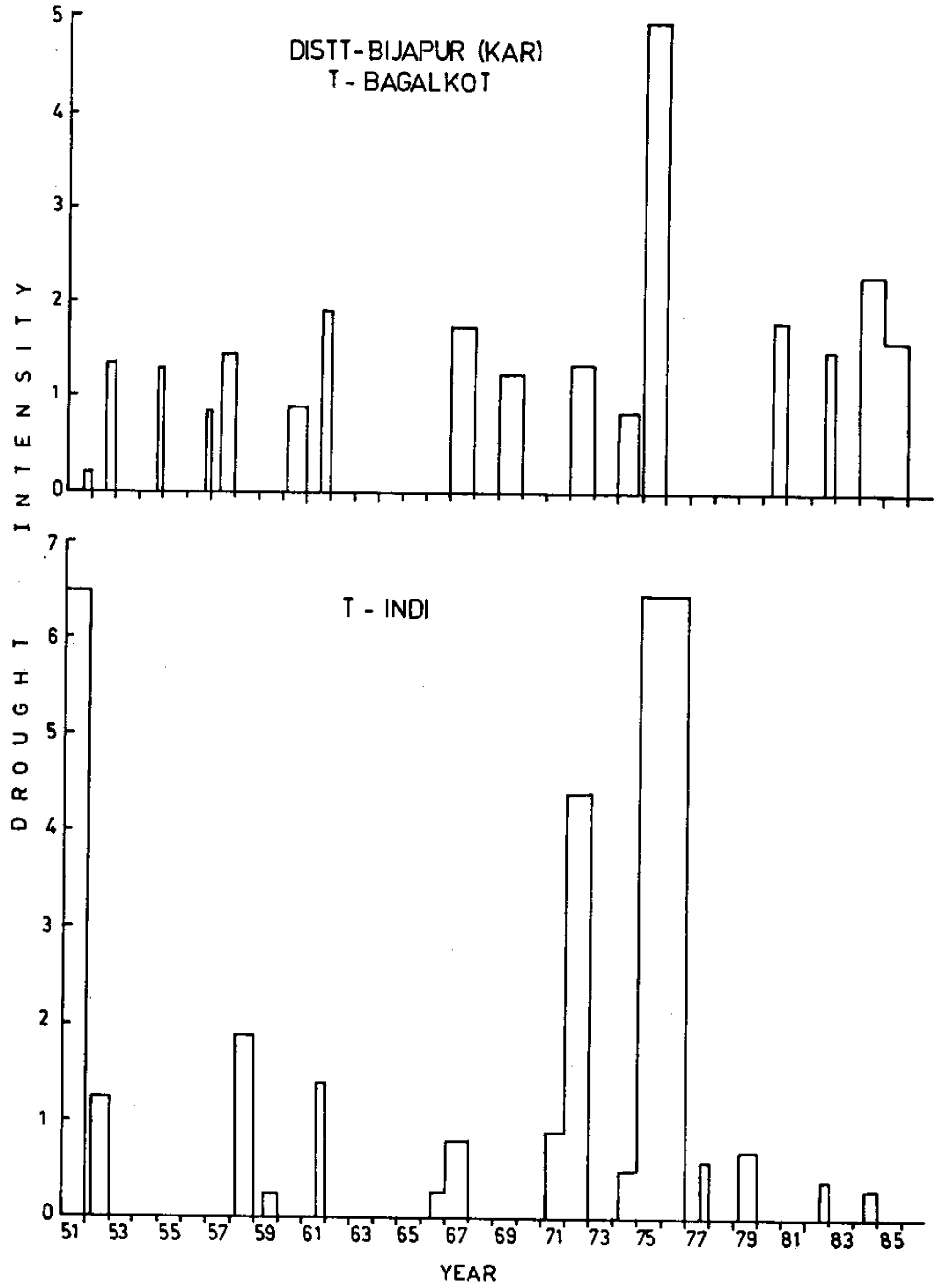

DISTT-ANANTPUR (A.P.)
T-RAYADURG
T-MADAKASIRA
T-ANANTPUR
DROUGHT INTENSITY
YEAR
0
1
2
3
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83

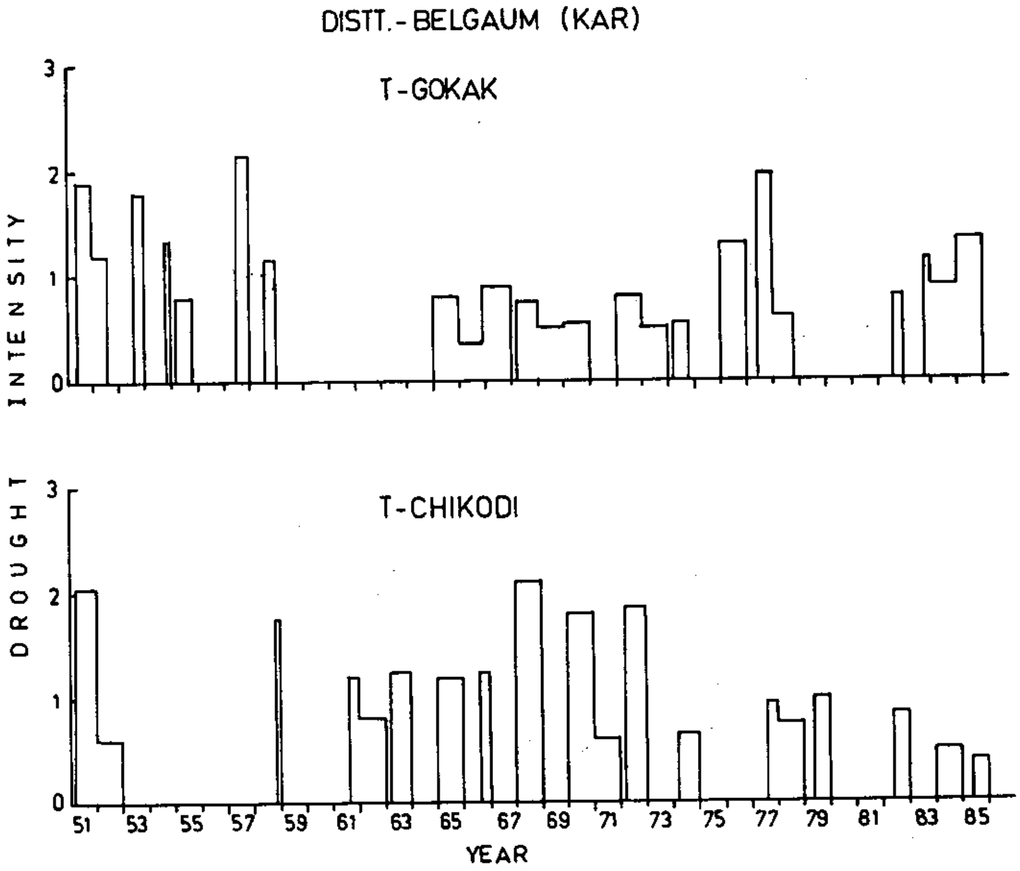

DISTT- CUDDAPAH (A.P.)
PRODDATTUR
(CUDDAPAH)
BADVEL
(CUDDAPAH)
DROUGHT INTENSITY
0
1
2
3
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
YEAR


DISTT-ANANTPUR (A.P.)
T-RAYADURG
T-MADAKASIRA
T-ANANTPUR
DROUGHT INTENSITY
0
1
2
3
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
YEAR

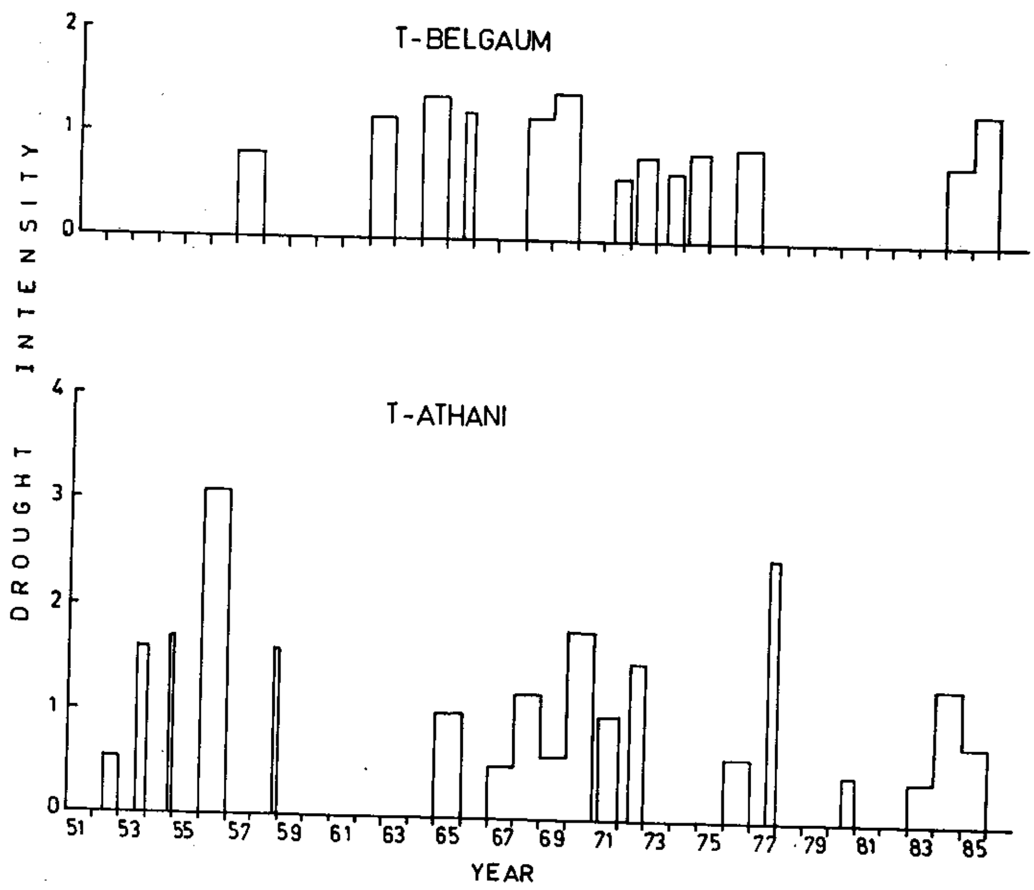


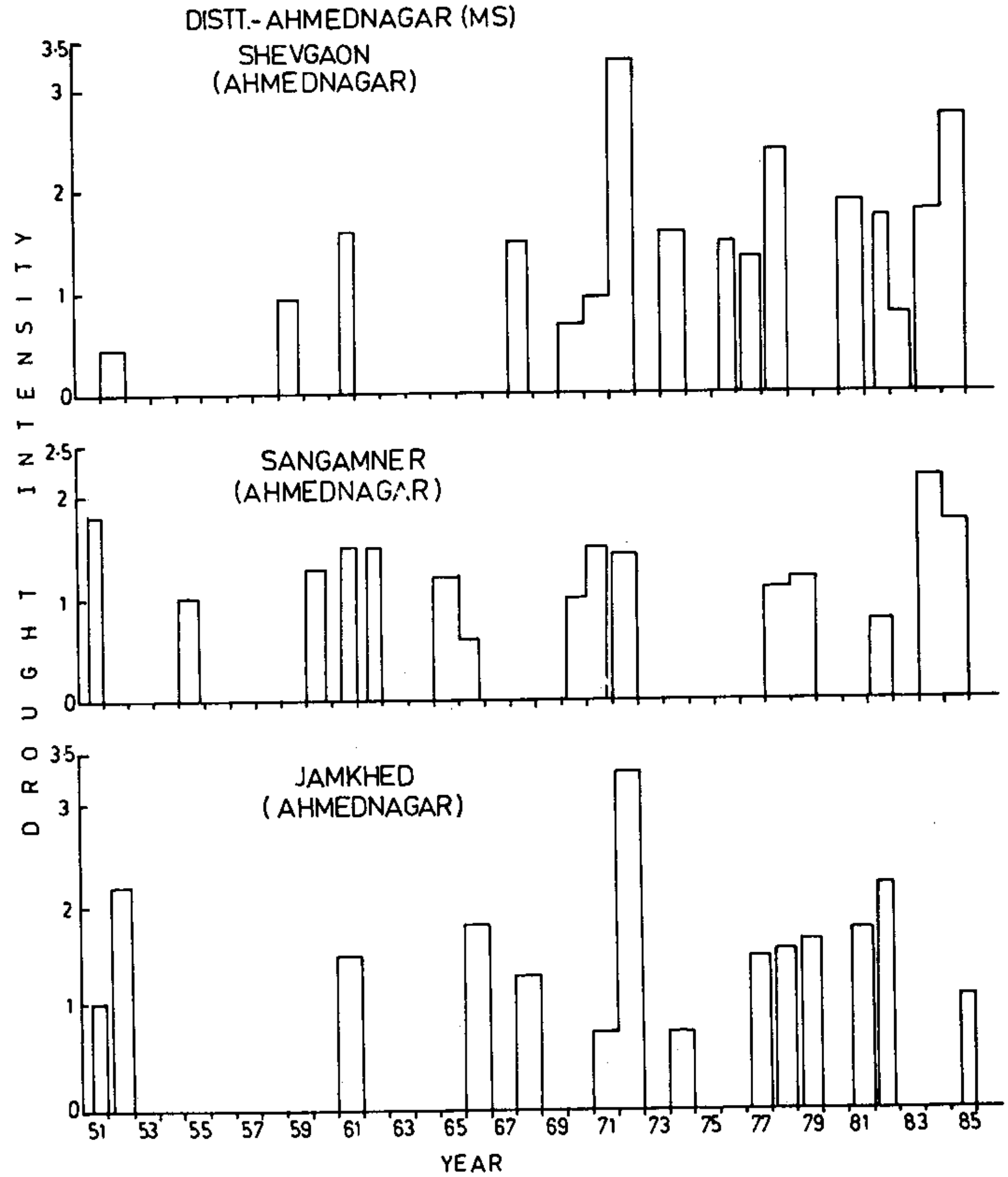
DISTT- BIJAPUR (KAR)
T - BIJAPUR
T - MUDHOL
T-MUDDEBIHAL
DROUGHT INTENSITY
YEAR
3.5
3
2
1
0
4
4.5
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

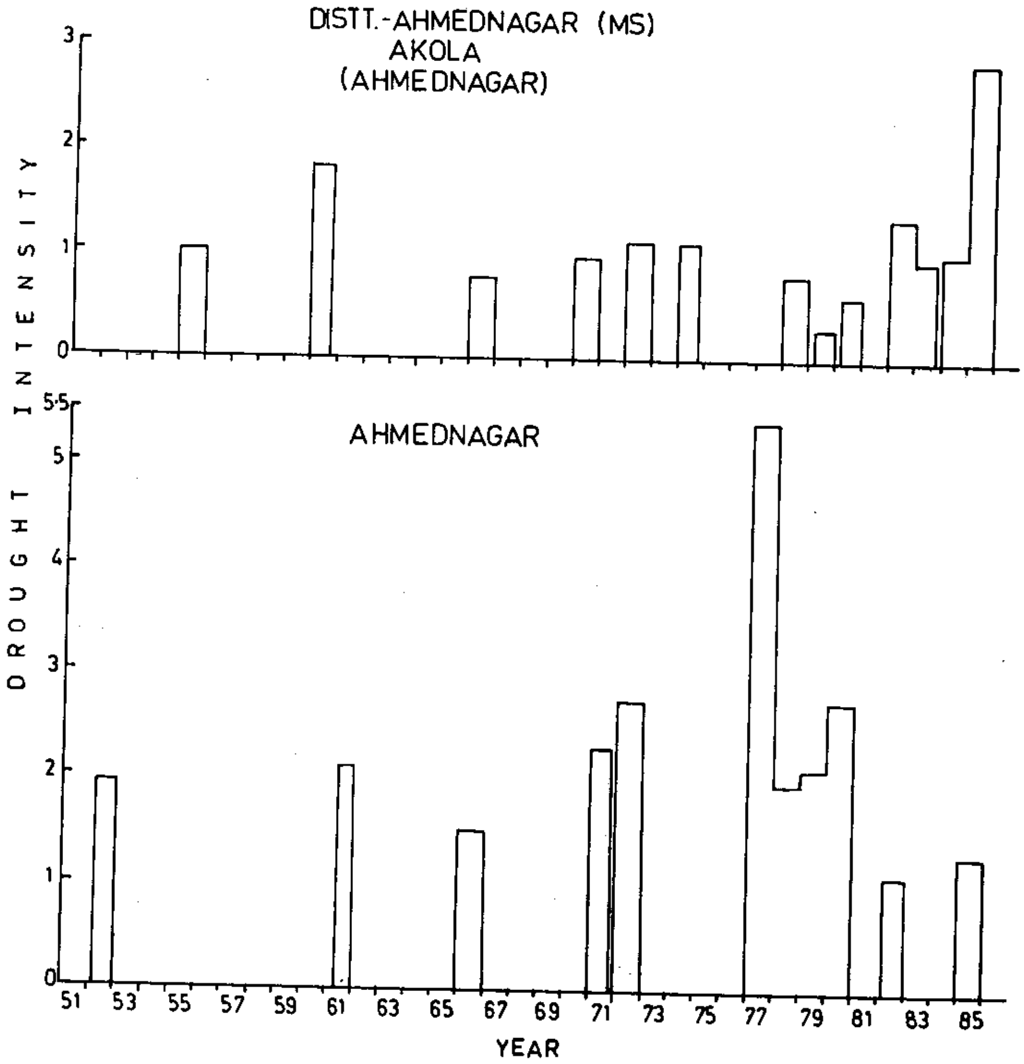

DISTT-BIJAPUR (KAR)
T-BAGALKOT
T - INDI
DROUGHT INTENSITY
YEAR
0
1
2
3
4
5
6
7
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

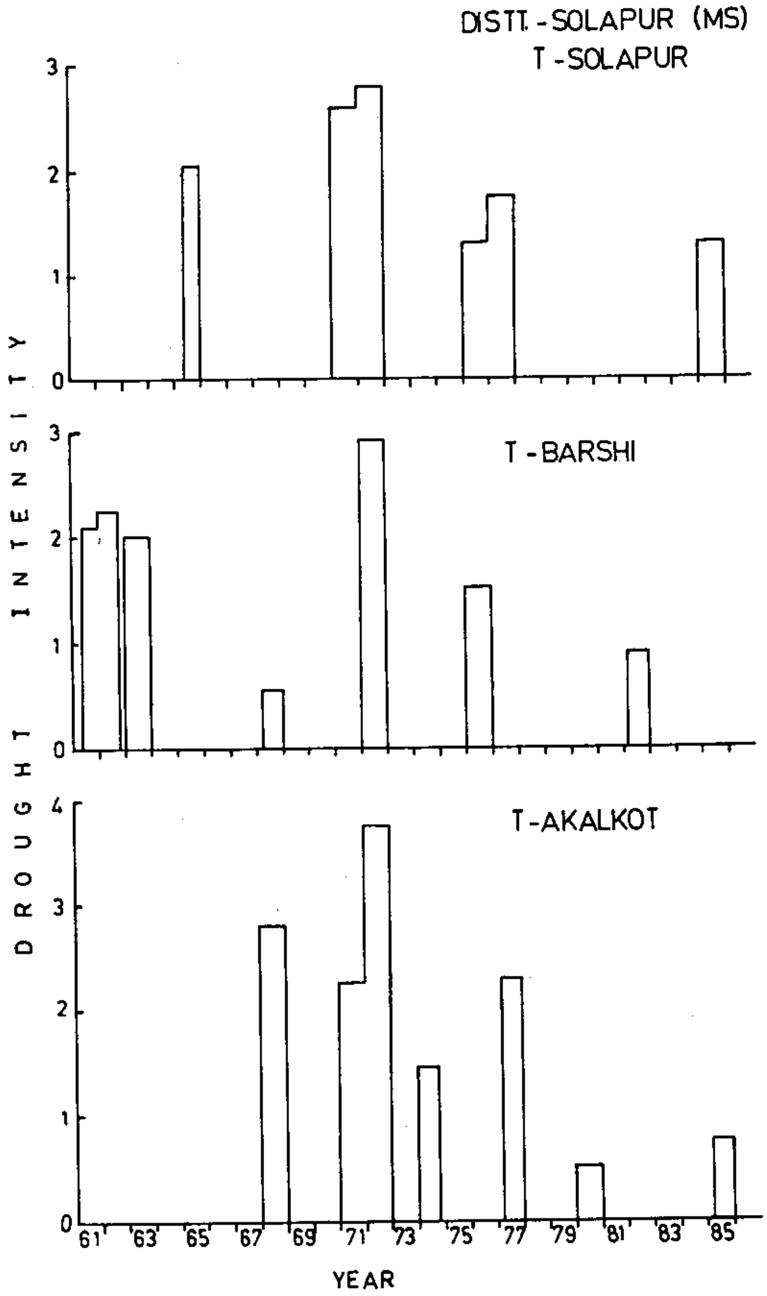

DISTT.- BELGAUM (KAR)
T-GOKAK
T-CHIKODI
DROUGHT INTENSITY
YEAR
0
1
2
3
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85

DISTT.-BELGAUM (KAR)

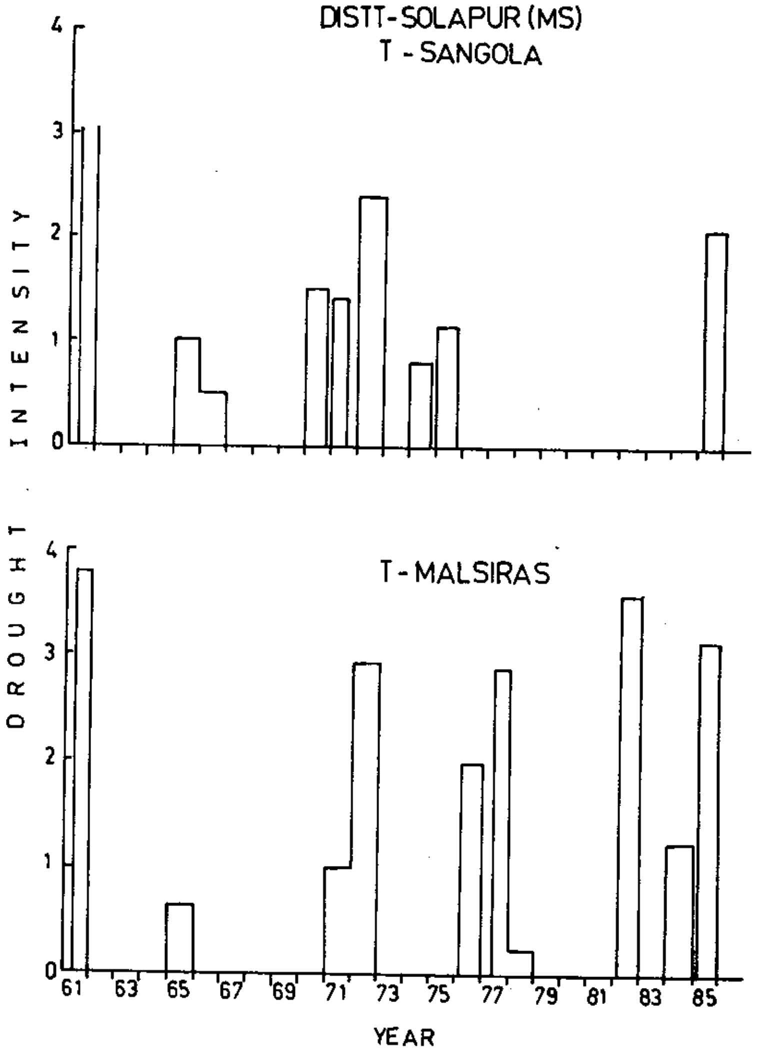



DISTT.- AHMEDNAGAR (MS)
SHEVGAON
(AHMEDNAGAR)
SANGAMNER
(AHMEDNAGAR)
JAMKHED
(AHMEDNAGAR)
DROUGHT INTENSITY
YEAR
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85


DISTT.-AHMEDNAGAR (MS)
AKOLA
(AHMEDNAGAR)
AHMEDNAGAR
DROUGHT INTENSITY
YEAR
0
1
2
3
4
5
5·5
51
53
55
57
59
61
63
65
67
69
71
73
75
77
79
81
83
85



DISTT.-SOLAPUR (MS)
T-SOLAPUR
T-BARSHI
T-AKALKOT
DROUGHT INTENSITY
YEAR
'61 '63 '65 '67 '69 '71 '73 '75 '77 '79 '81 '83 '85
0 1 2 3 4



DISTT-SOLAPUR (MS)
T - SANGOLA
T - MALSIRAS
DROUGHT INTENSITY
YEAR
0
1
2
3
4
61
63
65
67
69
71
73
75
77
79
81
83
85

DURATION AND NUMBER OF DRY SPELLS DURING MONSOON (4th June to 15th September)

ALIRAJPUR (JHABUA)				OON (KHARGONE)			
First day of monsoon	Date of beginning of dry spell	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year	First day of monsoon	Date of beginning of dry spell	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year
24.6.81	4.6.81	20	1	24.6.81	4.6.81	20	1
20.6.82	4.6.82	16	3	20.6.82	4.6.82	16	
	21.6.82	22			22.6.82	19	3
	25.8.82	16			24.8.82	19	
3.7.83	4.6.83	29	1	16.6.83	26.6.83	15	1
18.6.84	4.6.83	14	2	13.6.84	14.6.84	17	2
	21.8.83	26			20.8.84	27	
7.6.85	8.6.85	38	2	27.6.85	4.6.85	23	
	7.8.85	40			28.6.85	33	3
					15.8.85	32	
			9				10

DURATION AND NUMBER OF DRY SPELLS DURING MONSOON (4th JUNE TO 15th SEPTEMBER)

MORVI (RAJKOT)				JAMNAGAR (JAMNAGAR)			
First day of Monsoon	Date of beginning of dry spell	Duration of dry spell ($\geq$2 weeks in days)	Total No. of dry spell in a year	First day of Monsoon	Date of beginning of dry spells	Duration of dry spell ($\geq$2 weeks in days)	Total No. of dry spell in a year
21.6.81	4.6.81	23	2	27.6.81	4.6.81	23	3
	18.8.81	16			26.7.81	16	
					25.8.81	22	
4.6.82	5.6.82	36	2	1.7.82	4.6.82	27	2
	14.8.82	33*			22.8.82	17	
18.6.83	4.6.83	14	2	19.6.83	4.6.83	15	2
	21.8.83	26*			12.8.83	35	
15.6.84	17.6.84	15	3	15.6.84	14.8.84	31	1
	5.7.84	14					
	24.8.84	20					
13.7.85	4.6.85	39	2	17.7.85	4.6.85	43	2
	15.8.85	35			20.8.85	27*	
			11				10

* indicates the continuation of dry spell after 15th September

DURATION AND NUMBER OF DRY SPELLS DURING MONSOON (4th JUNE TO 15th SEPTEMBER)

AKALKOT (SHOLAPUR)				AKOLA (AHMEDNAGAR)			
First day of Monsoon	Date of beginning of dry spell	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year	First day of Monsoon	Date of beginning of dry spell	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year
4.6.81	8.7.81	16	1	13.6.81	17.7.81	20	
					7.8.81	16	3
					24.8.81	14	
14.6.82	15.6.82	14		17.6.82	18.6.82	36	
	16.7.82	14	3		26.7.82	17	3
	14.8.82	24			26.8.82	21	
4.6.83	-	-	-	22.6.83	4.6.83	18	2
					17.8.83	22	
3.7.84	4.6.84	29	2	7.6.84	18.6.84	14	
	10.8.84	31			20.7.84	15	
					6.8.84	21	4
					28.8.84	14	
9.6.85	3.7.85	21	2	25.6.85	4.6.85	21	
	17.8.85	23			26.6.85	21	
					18.7.85	20	
					8.8.85	39	4
4.6.86	29.6.86	33	2	5.6.86	24.6.86	24	2
	14.8.86	22			19.7.86	59	
			10				18

DURATION AND NUMBER OF DRY SPELLS DURING MONSOON (4th JUNE TO 15th SEPTEMBER)

ANANTPUR (ANANTPUR)				CUDDAPAH (CUDDAPH)			
First day of Monsoon	Date of beginning of dry spell	Duration of dry spell ($\geq$2 weeks in days)	Total No. of dry spell in a year	First day of Monsoon	Date of beginning of dry spell	Duration of dry spell ($\geq$2 weeks in days)	Total No. of dry spell in a year
2.8.81	4.6.81	59	2	27.6.81	4.6.81	23	3
	3.8.81	18			28.6.81	35	
					9.8.81	18	
15.6.82	27.7.82	15	2	10.6.82	18.6.82	20	
	14.8.82	24			14.7.82	15	3
					30.7.82	47	
5.6.83	26.6.83	15	1	5.6.83	-	-	
11.7.84	4.6.84	37		11.6.84	12.6.84	30	2
	14.7.84	18	4		3.8.84	29	
	2.8.84	21					
	28.8.84	19					
6.6.85	7.6.85	44	2	7.6.85	8.6.85	20	
	8.8.85	20			30.6.85	20	4
					28.7.85	18	
					28.8.85	19	
			11				12

DURATION AND NUMBER OF DRY SPELLS DURING MONSOON (4th JUNE TO 15th SEPTEMBER)

BANSWARA (BANSWARA)				BARMER (BARMER)			
First day of Monsoon	Date of beginning of dry	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year	First day of Monsoon	Date of beginning of dry	Duration of dry spell (≥2 weeks in days)	Total No. of dry spell in a year
24.6.81	4.6.81	20	2	26.6.81	4.6.81	22	
	24.8.81				26.7.81	17	3
					29.8.81	18	
20.6.82	4.6.82	16		20.6.82	4.6.82	16	
	23.6.82	17	3		21.6.82	31	
	25.8.82	16			26.7.82	19	4
					20.8.82	27*	
29.6.83	4.6.83	25	1	1.7.83	4.6.83	27	
					2.7.83	20	3
					19.8.83	14	
9.6.85	-	-		16.6.84	17.6.84	15	
					9.7.84	27	3
					13.8.84	34	
27.6.85	4.6.85	23	2	16.7.85	4.6.85	42	
	26.8.85	21			20.7.85	14	3
					6.8.85	41*	
16.6.86	1.7.86	15	2				
	17.8.86	30					
			10				16

*indicate the continuation of dry spell after 15 September

PROBABILITY ANALYSIS OF DRY SPELLS

Taluk or Station	Class Interval	No. of spells	Percentage	Cumulative Probability
Akolkot (Sholapur)	14-21	4	40.0	100.0
	22-28	3	30.0	60.0
	29-35	3	30.0	30.0
	>35	-	-	
		10		
Akola (Ahmadnagar)	14-21	13	81.25	100.0
	22-28	1	06.25	18.75
	29-35	-	-	12.50
	>35	2	12.50	12.50
		16		
Mirajpur (Jhabua)	14-21	4	44.4	100.0
	22-28	2	22.2	55.5
	29-35	1	11.1	33.3
	>35	2	22.2	22.2
		9		
Oon (Khargone)	14-21	6	60.0	100.0
	22-28	2	20.0	40.0
	29-35	2	20.0	20.0
	>35	-		
		10		

PROBABILITY ANALYSIS OF DRY SPELLS

Taluk or Station (District)	Class interval (in day)	Number of spells	Percentage	Cumulative Probability
Barmer (Barmer)	14-21	8	50.0	100.0
	22-28	4	25.0	50.0
	29-35	2	12.5	25.0
	35	2	12.5	12.5
		16		
Banswara (Banswara)	14-21	7	70.0	100.0
	22-28	2	20.0	30.0
	29-35	1	10.0	10.0
	35	-	-	-
		10		
Cuddapah (Cuddaph)	14-21	7	58.3	100.0
	22-28	1	8.3	41.6
	29-35	3	25.0	33.3
	35	1	8.3	8.3
		12		
Anantpur (Anantpur)	14-21	7	63.6	100.0
	22-28	1	9.1	36.4
	29-35	-	-	27.3
	35	3	27.3	27.3
		11		
Morvi (Rajkot)	14-21	5	45.4	100.0
	22-28	2	18.2	54.6
	29-35	1	9.1	36.4
	35	3	27.3	27.3
		11		
Jamnagar (Jamnagar)	14-21	3	30.0	100.0
	22-28	4	40.0	70.0
	29-35	2	20.0	30.0
	35	1	10.0	10.0
		10		

LIST OF OBSERVATION WELLS

State : Rajasthan

District : Banswara

Sl. No	Observation well No.	Name	R.L. of M.P.	Latitude	Longitude
1.	46I-3A1	Arthuna	153.73	23°29'45"	74°06'00"
2.	46I-2B1	Banswara	213.10	23°32'00"	74°27'00"
3.	46I-2C2	Bhungara	240.825	23°41'00"	74°31'00"
4.	46I-1B1	Dungsia	194.61	23°51'50"	74°27'30"
5.	46I-1B2	Ganora	179.72	23°46'00"	74°15'10"
6.	46I-2C1	Haria Beri	337.275	23°31'00"	74°39'00"
7.	46I-4B1	Kushalgarh	292.725	23 12'00"	74 27'00"

State : Rajasthan

District: Barmer

Sl. No.	Observation well No.	Name	R.L. of M.P.	Latitude	Longitude
1.	400-2B1	Barmer	213.41	25°44'10"	71°23'50"
2.	400-401	Guda	47.765	25°11'45"	71°43'15"
3.	40N-3B1	Bisukalan	243.39	26°16'30"	71°18'20"
4.	400-3A1	Chotan	168.35	25°28'30"	71°04'00"
5.	400-2A1	Kaluri	101.96	25°42'43"	72°03'30"
6.	400-2B2	Nimri	187.56	25°29'00"	71°17'00"
7.	40P-1A1	Sihaniya	49.68	24°55'55"	71°09'30"
8.	400-4A1	Sundra	115.54	26°05'45"	70°13'10"
9.	40N-3B6	Saron Ka Tala	231.79	26°18'30"	71°30'45"
10.	40N-302	Undu	230.04	26°20'30"	71°44'55"

LIST OF OBSERVATION WELLS

State : Madhya Pradesh

District : Jhabua

Sl. No.	Observation well No.	Name	R.L. of Obs. well	Lat.	Long.
1.		Kathiwada	280.00	22°30'00"	74°12'00"
2.		Udaigarh	440.00	22°32'00"	74°35'00"
3.		Kathiwad	340.00	22°08'00"	74°16'00"
4.		Dungripada	280.00	22°03'00"	74°22'00"
5.		Alirajpur	280.00	22°18'00"	74°22'00"
6.		Ranapur	360.00	22°40'00"	74°33'00"
7.		Nanpur	227.00	22°17'00"	74°33'00"
8.		Bhamel	404.00	23°08'00"	74°41'00"
9.		Thandla	300.00	23°02'00"	74°35'00"
10.		Raliyawan	440.00	22°58'00"	74°47'00"
11.		Umarkot	526.00	22°44'00"	74°49'00"

State : Madhya Pradesh

District: Khargaon

Sl. No.	Observation well No.	Name	R.L. of Obs. well	Lat.	Long.
1.		Piparkheda	318.00	21°44'00"	75°31'00"
2.		Bistan	320.00	21°43'00"	75°43'00"
3.		Balkwada	220.00	22°00'00"	75°32'00"
4.		Segaon	262.00	21°51'00"	75°21'00"
5.		Sendhwa	170.00	21°14'00"	75°03'00"
6.		Pansemal	306.00	21°43'00"	75°43'00"
7.		Rajpur	268.00	21°56'00"	75°08'00"
8.		Barwani	180.00	22°02'00"	74°52'00"
9.		Dawana	300.00	22°05'00"	74°19'00'
10.		Bhikangaon	340.00	21°52'00"	74°58'00"
11.		Zirma	360.00	21°39'00"	75°09'00"
12		Barwaha	253.00	22°03'00"	76°05'00"
13.		Barwaha	200.00	22°15'00"	76°04'00"
14.		Barwaha	300.00	22°24'00"	75°53'00"
15.		Maheshwar	208.00	22°13'00"	75°35'00"

LIST OF OBSERVATION WELLS

State : Gujarat

District : Jamnagar

Sl. No.	Observation well No.	Name	R.L. of M.P.	Lat.	Long.
1.	41F-3A1	Sarmesor	8.905	22°22'00"	69°06'00"
2.	41F-3C1	Salaya	3.491	22°18'00"	69°37'00"
3.	41F-3D1	Bed	12.260	22°25'30"	69°48'45"
4.	41F-4A1	Okhamadin	4.323	22°05'00"	69°07'00"
5.	41F-4B1	Bhatiya	27.095	22°05'00"	69°17'00"
6.	41F-4C2	Bhadthor	35.169	22°05'00"	69°35'00"
7.	41D-1D1	Ambardi	74.620	21°54'00"	69°52'00"
8.	41J-2B1	Dhrol	25.010	22°34'00"	70°30'00'
9.	41G-1B2	Raval	0.999	21°55'40"	69°29'30"
10.	41J-3A1	Jamnagar	11.905	22°27'30"	70°04'45"

State : Gujarat

District: Rajkot

Sl. No.	Observation well No.	Name	R.L. of M.P.	Lat.	Long.
1.	41I-4C1	Maliya	10.20	23°05'30"	70°45'30"
2.	41J-2D1	Wankener	90.08	22°37'00"	70°52'00"
3.	41J-3D1	Rajkot	128.96	22°18'00"	70°48'00"
4.	41K-2B1	Upleta	41.840	21°44'20"	70°17'13"
5.	41K-1CB	Gundal	126.90	21°54'30"	70°44'30"

LIST OF OBSERVATION WELLS

State : Karnataka

District : Bijapur

Sl. No.	Observation well No.	Name	R.L. of M.P.	Lat.	Long.
1.	063	Badami	696.00	15°54'00"	75°37'00"
2.	060	Bilgi	560.00	16°26'51"	75°36'55"
3.	198	Malapur	560.00	16°21'26"	75°16'34"
4.	170	Muddebipal	584.10	16°18'00"	76°41'00"
5.	018	Saidpur	567.70	16°22'32"	75°02'45"
6.	022	Sindgi	502.20	16°55'11"	76°14'12"

State : Karnataka

District : Belgaum

Sl. No.	Observation well No.	Name	R.L. of M.P.	Lat.	Long.
1.		Athani	564.00	16°43'45"	75°03'37"
2.		Chikkodi	643.00	16°25'25"	74°35'25"
3.		Ankalagi	670.00	16°01'30"	74°41'45"
4.		Londa	610.00	15°26'58"	74°29'48"
5.		Raibhag	664.00	15°29'40"	74°46'35"
6.		Kari Katti	655.00	15°43'55"	75°01'30"

LIST OF OBSERVATION WELLS

State : Maharashtra

District : Ahmadnagar

Sl. No.	Observation well No.	Name	R.L. of Obs. well	Lat.	Long.
1.	BM-15	Supa	710.36	18°57'35"	74°32'20"
2.	GV-22A	Saikhindi	630.48	19°38'10"	74°08'15"
3.	GV-29B	Telegaon	594.51	19°41'40"	74°17'45"
4.	GB-31B	Ta Kali	509.14	19°55'00"	74°23'00"
5.	GV-32B	Apegaon	521.64	19°55'15"	74°37'20"
6.	GV-10C	Bota	683.53	19°15'20"	74°08'50"
7.	GV-12B	Kukana	434.81	19°00'00"	74°20'00"
8.	GV-130	Mali Babhulg	692.07	19°26'05"	74°58'10"

State : Maharashtra

District : Solapur

Sl. No.	Observation well No.	Name	R.L. of Obs. Well	Lat.	Long.
1.	BM112	Wadegaon	486.28	17°26'00"	75°14'15"
2.	BM111	Diksal	474.08	17°24'25"	75°31'40"
3.	SA-40	Kandalgaon	466.46	17°43'25"	75°07'15"
4.	BM132	Musti	480.18	17°43'46"	76°04'50"
5.	SA-35	Kalman	493.90	17°55'45"	75°46'45"
6.	SA-20	Pende	542.68	18°14'30"	75°14'00"
7.	SA-27	Kuslam	562.50	18°16'50"	75°46'25"
8.	BN-138	Jeur	440.54	17°28'38"	76°06'30"
9.	SA-29	Uplai	493.90	17°58'00"	75°29'30"

APPENDIX VI-2

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT BANSWARA, STATE RAJASTHAN

Sl. No.	Name of Obs. well	Height of M.P. from MSL (in M)	Area influenced by well (sq.km.)	Area factor	1978-79 JUNE	1978-79 AUG	1978-79 NOV	1978-79 JAN	1978-79 APR	1979-80 JUNE	1979-80 AUG
1.	Arthuna	153.730	736.05	0.1461				148.63 (21.71)	147.16 (21.50)	145.63 (21.28)	150.12 (21.93)
2.	Banswara	213.100	923.80	0.1834				206.75 (37.92)	205.57 (37.70)	205.33 (37.66)	207.51 (38.06)
3.	Bhungara	240.825	747.59	0.1484				230.92 (34.27)	231.92 (34.42)	226.312 (33.59)	234.12 (34.74)
4.	Dungria	194.610	410.01	0.0814				188.14 (15.32)	188.25 (15.32)	186.99 (15.22)	190.70 (15.52)
5.	Ganora	179.720	577.16	0.1146				171.19 (19.62)	168.28 (19.29)	166.31 (19.06)	169.75 (19.45)
6.	Haria Beri	337.275	383.03	0.0760				332.95 (25.30)	331.81 (25.22)	332.46 (25.27)	335.43 (25.49)
7.	Kushalgarh	292.725	1259.37	0.2500				288.11 (72.04)	287.30 (71.82)	286.09 (71.52)	289.96 (72.49)
Average ground water level in meter from M.S.L.								226.16	225.27	223.60	227.69
Average ground water level w.r.t. datum								86.16	85.27	83.60	87.69

Note : For analysis, value in brackets represents ground water level multiplied by area weight.

Sl. No.	1981-82 JAN.	1981-82 APR.	1982-83 JUNE	1982-83 AUG.	1982-83 NOV.	1982-83 JAN.	1982-83 APR.	1983-84 JUNE	1983-84 AUG.	1983-84 NOV.	1983-84 JAN.
1.	148.54 (21.70)	148.32 (21.67)	146.23 (21.36)	151.05 (22.07)	149.73 (21.88)	148.23 (21.66)	147.47 (21.55)	145.78 (21.30)	150.20 (31.94)	148.96 (21.26)	147.97 (21.62)
2.	207.16 (37.99)	206.16 (37.81)	205.57 (37.79)	207.84 (38.12)	206.90 (37.95)	206.20 (37.82)	105.12 (37.62)	204.35 (37.48)	206.91 (37.95)	206.64 (37.90)	206.45 (37.86)
3.	233.34 (34.63)	232.40 (34.49)	231.92 (34.42)	234.53 (34.81)	233.57 (34.66)	232.73 (34.54)	231.47 (34.35)	230.12 (34.15)	234.21 (34.76)	233.92 (34.71)	232.80 (34.55)
4.	188.52 (15.35)	188.33 (15.33)	187.34 (15.25)	190.92 (15.54)	188.30* (15.33)	188.46 (15.34)	187.67 (15.28)	186.87 (15.21)	189.64 (15.44)	187.98 (15.30)	188.58 (15.35)
5.	167.89 (19.24)	166.73 (19.11)	165.99 (19.02)	167.87 (19.24)	167.69 (19.22)	167.27 (19.17)	166.40 (19.07)	164.52 (18.85)	170.74 (19.57)	170.88 (19.58)	169.74 (19.45)
6.	333.87 (25.37)	333.08 (25.31)	331.73 (25.21)	335.82* (25.52)	335.10 (25.47)	333.72 (25.36)	332.80 (25.29)	331.63* (25.20)	334.07 (25.39)	334.80* (25.45)	333.65 (25.36)
7.	288.45 (72.11)	287.63 (71.91)	287.05 (71.76)	290.23 (72.56)	289.57 (72.39)	288.42 (72.11)	287.51 (71.88)	285.71 (71.43)	290.65 (72.66)	288.93 (72.23)	288.30 (72.08)
	226.39	225.63	224.72	227.85	226.89	226.00	225.03	223.63	227.70	226.94	226.25
	86.39	85.63	84.72	87.85	86.39	86.00	85.03	83.63	87.70	86.94	86.26

*represents data generated.

Sl. No.	1983-84 APR.	1984-85 JUNE	AUG.	NOV.	JAN.	APR.	1985-86 JUNE	AUG.	NOV.	JAN.	APR	Remarks
1.	146.99 (21.48)	144.23 (21.07)	150.77 (22.03)	148.73 (21.73)	147.97 (21.62)	144.21 (21.07)		145.03 (21.19)	146.30 (21.37)	145.70 (21.29)	141.51 (20.68)	Assuming datum 140.0 meter from M.S.L.
2.	105.88 (37.76)	205.03 (36.60)	209.10 (38.35)	207.20 (38.00)	206.91 (37.95)	105.80 (37.74)		206.86 (37.94)	207.18 (38.00)	206.41 (37.86)	205.20 (37.63)	
3.	231.34 (34.33)	231.52 (34.36)	234.73 (37.83)	233.76 (34.19)	232.35 (34.48)	231.13 (34.30)		231.48 (34.35)	233.55 (34.66)	232.33 (34.48)	230.82 (34.25)	
4.	189.18 (15.40)	187.06 (15.23)	191.24 (15.57)	188.15* (15.32)	189.03 (15.39)	187.90 (15.30)		188.10 (15.31)	188.31 (15.33)	188.52 (15.35)	187.97 (15.30)	
5.	167.03 (19.14)	166.75 (19.11)	171.20* (19.62)	172.29 (19.74)	170.79 (19.57)	168.70 (19.31)		168.61 (19.32)	168.92 (19.36)	169.80 (19.46)	169.16 (19.39)	
6.	333.10* (25.32)	331.53 (25.20)	336.15 (25.55)	334.51 (25.42)	333.52 (25.35)	331.73 (25.21)		334.68 (25.44)	335.10 (25.47)	334.81 (25.45)	331.79 (25.22)	
7.	287.08 (71.77)	285.45 (71.36)	290.53 (72.63)	288.63 (72.16)	288.01 (72.00)	286.15 (71.54)		286.88 (71.71)	288.77 (72.19)	288.12 (72.03)	226.93 (71.73)	
	225.19	222.93	228.57	227.06	226.36	224.49		225.26	226.38	225.90	224.20	
	85.19	82.93	88.57	87.06	86.36	84.49		85.26	86.38	85.90	84.20	

*represents data generated.

APPENDIX VI-3

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT BARMER, STATE RAJASTHAN

Sl. No.	Name of Obs. well	Height of M.P. from MSL (in m)	Area influenced by well (sq.km.)	Area factor	1977-78					1978-79	
					JUNE	AUG.	NOV.	JAN.	APR.	JUNE	AUG.
1.	Barmer	213.410	2027.64	0.0714				205.83 (14.70)	178.60* (12.75)	178.55 (12.75)	178.40 (12.74)
2.	Guda	47.765	2179.77	0.0768				39.65* (3.05)	39.60 (3.04)	39.45 (3.03)	39.80* (3.06)
3.	Bisukalan	243.390	2558.28	0.0901				210.79 (18.99)	210.65 (18.98)	210.75 (18.99)	210.51 (18.97)
4.	Chohtan	168.350	3494.21	0.1231				119.28 (14.68)	127.20 (15.74)	118.92 (14.64)	119.51 (14.71)
5.	Kaluri	101.900	6395.72	0.2253				83.58 (18.83)	80.52 (18.14)	80.26 (18.08)	82.28 (18.54)
6.	Nimri	187.540	2950.19	0.1030				158.25 (16.44)	157.83 (16.40)	157.79 (16.39)	157.81 (16.34)
7.	Sihaniya	49.680	1562.72	0.0551				26.56 (1.46)	26.60 (1.47)	26.75 (1.47)	26.79 (1.48)
8.	Sundra	115.540	3211.85	0.1131				79.80* (9.03)	78.89 (8.92)	78.74 (8.91)	80.10 (9.06)
9.	Saran Ka Tala	231.740	2112.85	0.0744				178.50 (13.28)	177.80 (13.23)	177.60 (13.21)	178.35 (13.27)
10.	Undu	230.040	1893.76	0.0667				170.60 (11.38)	169.80 (11.33)	172.30 (11.49)	172.30 (11.49)

Average ground water level in meter from M.S.L.	121.84	120.00	118.97	119.65
Average ground water level w.r.t. datum	106.84	105.00	103.97	104.65

Note: For analysis, value in bracket represents ground water level multiplied by area weight

* Represents data generated.

Sl. No.	1978-79 NOV.	1978-79 JAN.	1978-79 APR.	1979-80 JUNE	1979-80 AUG.	1979-80 NOV.	1979-80 JAN.	1979-80 APR.	1980-81 JUNE	1980-81 AUG.	1980-81 NOV.
1.	180.20* (12.87)	178.31 (12.73)	178.31 (12.73)	178.31 (12.73)	178.31 (12.73)	178.31 (12.73)	199.63 (14.25)	119.08 (14.21)	198.87 (14.20)	198.83 (14.20)	203.11 (14.50)
2.	40.10 (3.08)	39.70 (3.05)	39.65 (3.05)	39.40 (3.03)	39.85 (3.06)	39.95 (3.07	39.60 (3.04)	39.55 (3.04)	39.85 (3.06)	39.80* (3.06)	39.85 (3.06)
3.	211.08 (19.02)	210.84 (19.00)	210.67 (18.98)	210.55 (18.97)	210.85 (19.00)	210.78 (18.99)	210.59 (18.97)	206.32 (18.59)	207.31 (18.68)	107.88 (18.73)	207.74 (18.72)
4.	119.64 (14.73)	118.73 (14.62)	118.22 (14.56)	117.62 (14.48)	119.28 (14.68)	118.65 (14.61)	118.52 (14.59)	48.10 (14.54)	117.62 (14.48)	118.42 (14.58)	118.19 (14.55)
5.	81.97 (18.47)	81.73 (18.41)	81.13 (18.28)	84.56 (19.05)	82.35* (18.55)	85.76 (19.32)	81.71 (18.40)	78.56 (17.70)	80.41 (18.12)	83.72 (18.86)	80.18 (18.07)
6.	157.07 (16.32)	157.50 (16.36)	155.92 (16.28)	157.19 (16.33)	156.37 (16.25)	155.51 (16.16)	156.91 (16.30)	156.88 (16.30)	156.71 (16.28)	156.88 (16.30)	156.65 (16.28)
7.	22.91 (1.26)	27.26 (1.50)	26.88 (1.48)	26.77 (1.48)	26.72 (1.47)	26.72 (1.47)	26.79 (1.47)	26.75 (1.47)	26.72 (1.47)	26.68 (1.47)	26.58 (1.47)
8.	79.85 (9.03)	79.64 (9.01)	79.24 (8.96)	78.59 (8.89)	79.65 (9.01)	79.97 (9.05)	78.54 (8.88)	79.14 (8.95)	80.15 (9.07)	75.79 (8.57)	79.04 (8.94)
9.	178.60* (13.29)	178.27 (13.26)	177.76 (13.23)	177.54 (13.21)	178.30 (13.27)	178.39 (13.27)	178.39 (13.27)	176.69 (12.15)	178.48 (13.28)	178.35* (13.27)	178.01 (13.24)
10.	168.80* (11.26)	170.49 (11.37)	169.95 (11.30)	172.20 (11.49)	172.24 (11.49)	168.64 (11.25)	170.55* (11.38)	173.11 (11.55)	172.28 (11.49)	170.90 (11.40)	169.77 (11.32)
	119.32	119.32	118.76	119.65	119.51	119.91	120.57	119.50	120.12	120.43	120.14
	104.32	104.32	103.76	104.65	104.51	104.91	105.57	104.50	105.12	105.43	105.14

* Represents data generated.

Sl. No.	1980-81 JAN.	1980-81 APR.	1981-82 JUNE	1981-82 AUG.	1981-82 NOV.	1981-82 JAN.	1981-82 APR.	1982-83 JUNE	1982-83 AUG.	1982-83 NOV.	1982-83 JAN.
1.	190.81 (13.62)	186.72 (12.22)	199.10* (14.22)	191.85* (13.70)	191.01 (13.64)	186.11 (13.29)	186.24 (12.36)	185.16 (13.22)	184.86 (13.20)	184.96 (13.21)	202.44 (14.45)
2.	39.80* (3.06)	40.10 (3.08	39.66 (3.05)	39.83 (3.06)	39.77 (3.05)	39.69 (3.05)	39.58 (3.04)	39.64 (3.04)	39.58 (3.04)	39.52 (3.04)	39.33 (3.02)
3.	208.61 (18.80)	208.78 (18.81)	208.99 (18.83)	109.36 (18.86)	208.51 (18.79)	209.25 (18.85)	209.74 (18.90)	209.66 (18.89)	209.62 (19.89)	209.84 (18.91)	209.75 (18.90)
4.	118.11 (14.54)	117.67 (14.49)	117.55 (14.47)	117.32 (14.44)	117.40 (14.45)	116.79 (14.38)	116.97 (14.40)	116.98 (14.40)	117.38 (14.45)	117.02 (14.41)	117.42 (14.45)
5.	81.81 (18.43)	81.88 (18.45)	81.71 (18.41)	82.08 (18.49)	81.86 (18.44)	81.60 (18.38)	81.45 (18.35)	81.93 (18.46)	82.36 (18.56)	80.27 (18.08)	80.18 (18.07)
6.	156.67* (16.28)	156.56 (16.27)	154.94 (16.10)	156.69 (16.28)	156.58 (16.27)	156.43 (16.25)	156.14 (16.22)	157.74 (16.39)	155.76 (16.18)	156.30* (16.24)	156.23 (16.23)
7.	26.74 (1.47)	26.74 (1.47)	26.69 (1.47)	26.70 (1.47)	26.60 (1.47)	26.63 (1.47)	26.66 (1.47)	25.78 (1.42)	26.70 (1.47)	26.70 (1.47)	26.65 (1.47)
8.	80.04 (9.05)	78.68 (8.90)	78.23 (8.85)	75.90 (8.58)	80.16 (9.07)	80.04 (9.05)	79.58 (9.00)	78.50* (8.88)	80.69 (9.13)	80.54 (9.11)	79.34 (8.97)
9.	177.97 (13.24)	178.22 (13.26)	178.35 (13.27)	178.41 (13.27)	177.27 (13.19)	178.45 (13.28)	178.39 (13.27)	177.92 (13.24)	178.21 (13.26)	178.11 (13.25)	178.25 (13.26)
10.	170.66 (11.38)	170.58 (11.38)	170.89 (11.40)	170.87 (11.40)	168.65 (11.25)	171.76 (11.46)	171.68 (11.45)	175.73 (11.72)	172.41 (11.50)	172.28 (11.49)	171.90 (11.47)
	119.87	119.43	120.05	119.56	119.61	119.46	119.40	119.66	119.67	119.19	120.29
	104.87	104.43	105.05	104.56	104.61	104.46	104.40	104.66	104.67	104.19	105.29

* Represents data generated

Sl. No.	1982-83 APR.	1983-84 JUNE	AUG.	NOV.	JAN.	APR.	1984-85 JUNE	AUG.	NOV.	JAN.	APR.
1.	184.29 (13.16)	183.38 (13.09)	183.98 (13.14)	184.49 (13.17)		183.91 (13.13)	183.44 (13.10)	183.61 (13.11)	184.70 (13.19)	202.51 (14.46)	
2.	29.49 (3.03)	39.38 (3.02)	39.87 (3.06)	39.71 (3.05)		39.49 (3.03)	39.48 (3.03)	39.72 (3.05)	39.62 (3.04)	39.50 (3.03)	
3.	209.87 (18.91)	209.86* (18.91)	205.92 (18.91)	210.41 (18.56)		109.65* (18.89)	210.05 (18.93)	209.96 (18.92)	209.79 (18.90)	209.41 (18.87)	
4.	116.69 (14.37)	116.97 (14.40)	117.66 (14.48)	117.41 (14.45)		116.84 (14.38)	116.94 (14.40)	117.35 (14.45)	117.85 (14.51)	117.43 (14.46)	
5.	79.92 (18.01)	83.08 (19.61)	82.23 (18.76)	82.21 (18.52)		79.63 (17.94)	81.60 (18.38)	82.04 (18.48)	84.56 (19.05)	81.99 (18.47)	
6.	155.41 (16.15)	156.03 (16.21)	155.49 (16.16)	156.14 (16.22)		156.08 (16.22)	154.05 (16.01)	154 12 (16.01)	156.86 (16.30)	155.36 (16.14)	
7.	29.60 (1.63)	26.65 (1.47)	26.59 (1.47)	26.62 (1.47)		26.51 (1.46)	26.36 (1.45)	26.53 (1.46)	26.54 (1.46)	26.47 (1.46)	
8.	80.49 (9.10)	78.70* (8.90)	80.77 (9.14)	80.71 (9.13)		80.30* (9.08)	80.71 (9.13)	80.71 (9.13)	80.44 (9.10)	79.40 (8.64)	
9.	178.35 (13.27)	178.00 (13.24)	178.46 (13.28)	178.40 (13.27)		178.25* (13.26)	178.10 (13.26)	178.47 (13.28)	177.79 (13.23)	177.78 (13.23)	
10.	171.35 (11.43)	171.80* (11.46)	172.37 (11.50)	172.06 (11.48)		171.15* (11.42)	168.02 (11.21)	171.92 (11.47)	171.67 (11.45)	171.66 (11.45)	
	119.05	120.32	119.89	119.31		118.81	118.88	119.36	120.23	120.21	
	104.05	105.32	104.89	104.31		103.81	103.88	104.36	105.23	105.21	

* Represents data generated.

Sl. No.	1985-86 JUNE	AUG.	NOV.	JAN.	APRIL	Remarks
1.	184.16 (13.15)	185.18 (13.22)	184.16 (13.15)	186.51 (13.32)	186.51 (13.31)	Assuming daum 15.0 m from M.S.L.
2.	39.42 (3.03)	40.22 (3.09)	39.42 (3.03)	39.35 (3.02)	39.15 (3.01)	
3.	209.97 (18.92)	209.99 (18.92)	209.97 (18.92)	290.96 (18.92)	210.29 (18.95)	
4.	117.15 (14.42)	117.59 (14.48)	117.15 (14.42)	117.85 (14.51)	116.25 (14.31)	
5.	81.98 (18.47)	82.39 (18.56)	81.98 (18.47)	81.16 (18.29)	80.35 (18.10)	
6.	157.08 (16.32)	155.77 (16.19)	157.08 (16.32)	155.96 (16.20)	152.56 (15.85)	
7.	26.53 (1.46)	26.59 (1.47)	26.53 (1.46)	26.50 (1.46)	26.63 (1.41)	
8.	81.17 (9.18)	80.88 (9.15)	81.17 (9.18)	81.18 (9.18)	80.78 (9.14)	
9.	178.37 (13.27)	178.38 (13.27)	179.34 (13.34)	168.26 (12.19)	168.38 (12.53)	
10.	175.18 (11.69)	172.32 (11.50)	175.18 (11.69)	171.84 (11.46)	171.04 (11.41)	
	119.91	119.83	119.98	118.54	118.02	
	104.91	104.83	104.98	103.54	103.02	

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT JHABUA, MADHYA PRADESH

Sl. No.	Name of Obs.well	R.L. of Obs. well (in mm)	Area influenced by well (sq.km.)	Area weight	1975-76		1976-77		1977-78		1978-79	
					Post mon.	Pre. mon.	Post. mon.	Pre. mon.	Post. mon.	Pre. mon.	Post. mon.	Pre. mon.
1.	Kathiwada	280.00	613.00	0.0904	273.65	270.15	275.60	270.95	273.95	270.91	275.73	271.50
					(24.74)	(24.42)	(24.91)	(24.49)	(24.77)	(24.49)	(24.93)	(24.54)
2.	Udaigarh	440.00	663.00	0.0978	438.30	434.85	436.15	434.25	437.70	435.10	437.70	434.15
					(42.87)	(42.53)	(42.66)	(42.47)	(42.81)	(42.55)	(42.81)	(42.46)
3.	Kathiwad	340.00	1133.00	0.1671	338.10	337.05	337.95	337.90	338.30	337.30	338.10	337.20
					(56.50)	(56.32)	(56.47)	(56.46)	(56.53)	(56.36)	(56.50)	(56.35)
4.	Dungipada	280.00	246.00	0.0363	275.90	271.20	271.90	270.95	273.90	270.88	276.30	273.15
					(10.02)	(9.85)	(9.87)	(9.84)	(9.94)	(9.83)	(10.03)	(9.92)
5.	Alirajpur	280.00	621.00	0.0916	272.10	270.90	273.05	271.60	273.85	272.05	276.60	274.80
					(24.92)	(24.81)	(25.01)	(24.88)	(25.09)	(24.92)	(25.34)	(25.17)
6.	Ranapur	360.00	874.00	0.1289	357.05	355.05	354.65	353.95	358.25	354.65	357.05	353.15
					(46.02)	(45.77)	(47.71)	(45.62)	(46.18)	(45.71)	(46.02)	(45.52)
7.	Nanpur	227.00	425.00	0.0627	219.50	217.05	218.95	216.40	217.75	217.15	221.85	219.80
					(13.76)	(13.61)	(13.73)	(13.57)	(13.65)	(13.62)	(13.91)	(13.34)
8.	Bhamel	404.00	279.00	0.0411	401.10	399.10	400.35	399.45	402.40	400.05	401.07	400.00
					(16.49)	(16.40)	(16.45)	(16.42)	(16.54)	(16.44)	(16.48)	(16.44)
9.	Thandia	300.00	589.00	0.0868	295.72	293.80	292.35	291.90	296.30	291.40	293.85	293.40
					(25.67)	(25.50)	(25.38)	(25.34)	(25.72)	(25.29)	(25.51)	(25.47)
10.	Raliyawan	440.00	819.00	0.1208	438.65	437.05	438.20	437.00	437.85	437.20	438.90	437.55
					(52.99)	(52.80)	(52.93)	(52.79)	(52.89)	(52.81)	(53.02)	(52.86)
11.	Umarkot	526.00	519.00	0.0765	525.35	523.90	523.93	523.00	523.90	522.85	524.00	523.85
					(40.19)	(40.08)	(40.08)	(40.01)	(40.08)	(40.00)	(40.09)	(40.08)
	Average ground water level (in m.) from M.S.L.		6781.00		354.16	352.08	355.21	351.89	354.19	352.04	354.63	352.14
	Average ground water level w.r.t. datum				144.16	142.08	145.21	141.89	144.19	142.04	144.63	142.14

Note: For analysis, data of May month have been used for pre-monsoon. Data of October month have been used for post-monsoon. Value in bracket represents groundwater level multiplied by area weight.

Sl. No.	1979-80 Post mon.	1979-80 Pre. mon.	1980-81 Post mon.	1980-81 Pre. mon.	1981-82 Post mon.	1981-82 Pre. mon.	1982-83 Post mon.	1982-83 Pre mon.	1983-84 Post mon.	1983-84 Pre mon.	1984-85 Post mon.	1984-85 Pre. mon.	1985-86 Post mon.	1985-86 Pre. mon.	Remark
1.	274.65 (24.83)	172.95 (24.86)	273.05 (24.68)	270.90 (24.49)	275.35 (24.89)	269.70 (24.38)	275.35 (24.89)	269.60 (24.37)	263.50 (23.82)	272.55 (24.64)	274.95 (24.86)	270.95 (24.49)	273.20 (24.70)		Assuming datum 210.00 m above M.S.L.
2.	437.95 (42.83)	433.20 (42.37)	438.00 (42.84)	434.60 (42.50)	437.90 (42.83)	434.90 (42.53)	437.20 (42.76)	434.30 (42.48)	438.40 (42.88)	434.30 (42.48)	437.30 (42.81)		435.00 (42.54)		
3.	337.95 (56.47)	337.20 (56.35)	337.80 (56.45)	337.40 (56.38)	338.75 (56.61)	336.75 (56.27)	338.20 (56.51)	337.00 (56.31)	338.10 (56.50)	337.50 (56.40)	338.15 (56.51)				
4.	276.25 (10.03)	272.45 (9.89	276.55 (10.04)	269.70 (9.79)	276.41 (10.03)	268.40 (9.74)	275.50 (10.00)	268.20 (9.74)	277.20 (10.06)	270.45 (9.82)	276.40 (10.03)				
5.	274.80 (25.17)	272.15 (24.93)	276.15 (25.30)	272.40 (24.95)	277.55 (24.42)	271.60 (24.88)	276.90 (25.36)	271.40 (24.86)	277.40 (25.41)	272.35 (24.95)	274.35 (25.16)				
6.	357.10 (46.03)	353.15 (45.52)	357.10 (46.03)	355.90 (45.88)	357.90 (46.13)	353.60 (45.58)	357.70 (46.11)	353.65 (45.59)	357.30 (46.06)	357.00 (46.02)	357.15 (46.04)				
7.	221.55 (13.89)	220.15 (13.80)	221.93 (13.92)	220.75 (13.84)	222.65 (13.96)	217.50 (13.65)	223.60 (14.02)	217.40 (13.63)	221.75 (13.90)	218.10 13.68)	220.90 (13.85)				
8.	401.05 (16.48)	400.93 (16.48)	401.83 (16.52)	400.40 (16.46)	399.15 (16.41)	398.50 (16.38)	399.35 (16.41)	398.70 (16.39)	401.30 (16.49)	400.50 (16.46)	401.25 (16.49)				
9.	295.80 (25.68)	293.75 (25.50)	296.40 (25.73)	292.50 (25.39)	295.75 (25.67)	291.80 (25.33)	296.05 (25.70)	292.10 (25.35)	297.35 (25.81)	295.15 (25.62)	296.80 (25.76)				
10.	438.95 (53.03)	437.90 (52.09)	438.97 (53.03)	437.80 (52.89)	438.55 (52.98)	436.50 (52.73)	438.30 (52.95)	435.80 (52.65)	438.80 (53.01)	436.00 (52.70)	438.45 (52.97)				
11.	523.95 (40.08)	523.05 (40.01)	524.06 (40.09)	522.85 (40.00)	524.60 (40.13)	522.75 (39.99)	524.30 (40.11)	522.80 (39.99)	524.20 (40.10)	519.00 (39.70)	524.05 (40.09)				
	354.52	352.49	354.61	352.56	354.06	351.45	354.82	351.35	354.04	352.38	354.56				
	144.52	142.49	144.61	142.56	144.06	141.45	144.82	141.35	144.04	142.38	144.56				

APPENDIX VI-5

AVERAGE GROUNDWATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT KHARGAON, MADHYA PRADESH

Sl. No.	Name of obs. well	R.L. of obs. well (in M)	Area influenced by well (sq.km.)	Area weight	1976-76 Post Mon.	1976-76 Pre. Mon.	1976-77 Post Mon.	1976-77 Pre Mon.	1977-78 Post Mon.	1977-78 Pre Mon.	1978-79 Post Mon.	1978-79 Pre. Mon.
1.	Piperkhada	318.00	1507.10	0.1117	314.05 (35.08)	311.95 (34.85)	314.10 (35.09)	311.65 (34.81)	313.85 (35.06)	312.05 (34.86)	313.90 (35.06)	311.65 (34.81)
2.	Bistan	320.00	1317.0	0.0976	318.80 (31.12)	315.90 (30.83)	318.20 (31.06)	315.85 (30.83)	318.25 (31.06)	315.75 (30.82)	317.95 (31.03)	315.95 (30.84)
3.	Balkwada	220.00	927.80	0.0688	216.75 (14.91)	213.75 (14.71)	216.85 (14.92)	213.70 (14.70)	216.50 (14.90)	213.70 (14.70)	216.85 (14.92)	213.65 (14.70)
4.	Segaon	262.00	661.10	0.0490	257.90 (12.64)	155.20 (12.51)	256.45 (12.57)	254.00 (12.45)	256.55 (12.57)	255.20 (12.51)	256.45 (12.57)	254.00 (12.45)
5.	Sendhwa	170.00	1212.40	0.0899	166.05 (14.93)	161.80 (14.55)	155.90 (14.91)	161.90 (14.56)	165.90 (14.91)	162.70 (14.63)	166.00 (14.92)	163.05 (14.66)
6.	Pansemal	306.00	979.70	0.0726	299.75 (21.76)	292.60 (21.24)	299.60 (21.75)	293.65 (21.32)	299.50 (21.74)	292.40 (21.23)	293.00 (21.27)	292.00 (21.20)
7.	Rajpur	268.00	610.50	0.0453	262.75 (11.90)	259.00 (11.73)	262.90 (11.91)	258.50 (11.71)	262.60 (11.90)	260.05 (11.78)	264.50 (11.98)	258.95 (11.73)
8.	Barwani	180.00	897.20	0.0665	173.20 (11.52)	167.90 (11.17)	173.85 (11.56)	167.70 (11.15)	173.55 (11.54)	168.60 (11.21)	172.90 (11.50)	170.90 (11.37)
9.	Dawana	300.00	516.90	0.0383	294.70 (11.29)	291.70 (11.17)	296.15 (11.34)	291.60 (11.17)	295.90 (11.33)	292.00 (11.18)	295.40 (11.31)	291.70 (11.17)
10.	Bhikangaon	340.00	904.60	0.0671	332.90 (22.34)	327.80 (22.00)	332.85 (22.33)	327.90 (22.00)	332.80 (22.33)	326.70 (21.92)	331.90 (22.27)	327.20 (21.96)
11.	Zirma	360.00	1148.00	0.0851	353.80 (30.11)	351.85 (29.94)	354.10 (30.13)	351.15 (29.88)	353.80 (30.11)	351.50 (29.91)	353.90 (30.12)	350.05 (29.79)

12. Barwaha	253.00	704.20	0.0522	248.90 (12.99)	242.60 (12.66)	248.65 (12.98)	242.50 (12.66)	248.45 (12.97)	243.05 (12.69)	247.90 (12.94)	242.35 (12.65)
13. Barwaha	200.00	708.60	0.0525	194.05 (10.19)	186.40 (9.79)	194.40 (10.21)	185.65 (9.75)	193.90 (10.18)	186.10 (9.77)	194.10 (10.19)	185.95 (9.76)
14. Barwaha	300.00	642.30	0.0476	295.90 (14.09)	292.05 (13.90)	295.50 (14.07)	291.85 (13.89)	196.10 (14.09)	291.85 (13.89)	295.90 (14.09)	291.40 (13.87)
15. Maheshwar	208.00	752.60	0.0558	204.10 (11.39)	199.40 (11.13)	203.30 (11.34)	199.15 (11.11)	203.35 (11.35)	199.30 (11.12)	203.35 (11.35)	200.50 (11.15)
Average ground water level (in meter) from M.S.L.				266.24	262.16	266.17	262.01	266.04	262.31	265.52	262.13
Average ground water level w.r.t. datum				111.24	107.16	111.17	107.01	111.04	107.31	110.52	107.13

Note: For analysis, data of May month have been used for pre-monsoon. Data of October month have been used for post-monsoon. Value in bracket represents groundwater level multiplied by area weight.

Sl. No.	1979-80		1980-81		1981-82		1982-83		1983-84		1984-85		Remarks
	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	
1.	313.00 (34.96)	311.60 (34.81)	313.00 (34.96)	311.40 (34.78)	313.90 (35.06)	311.80 (34.83)	308.85 (34.50)	311.30 (34.77)	314.10 (35.09)	309.05 (34.52)	314.05 (35.08)	308.85 (34.50)	Assuming datum 155.0 m above M.S.L.
2.	316.85 (30.93)	315.90 (30.83)	317.95 (31.03)	316.70 (30.91)	317.00 (30.94)	315.90 (30.83)	316.85 (30.93)	315.60 (30.80)	317.45 (30.98)	316.95 (30.84)	317.85 (31.02)	315.85 (30.83)	
3.	216.50 (14.90)	213.90 (14.72)	216.50 (14.90)	213.60 (14.70)	216.90 (14.92)	214.10 (14.73)	216.50 (14.90)	213.10 (14.66)	217.15 (14.94)	214.00 (14.72)	217.00 (14.93)	213.00 (14.65)	
4.	256.55 (12.57)	255.90 (12.54)	256.60 (12.57)	254.00 (12.45)	256.50 (12.57)	254.70 (12.48)	258.20 (12.65)	253.55 (12.42)	258.25 (12.65)	256.95 (12.59)	258.15 (12.65)	256.00 (12.54)	
5.	165.80 (14.91)	161.15 (14.49)	166.10 (14.93)	159.20 (14.31)	166.30 (14.95)	159.70 (14.36)	166.15 (14.94)	159.25 (14.32)	166.65 (14.98)	163.80 (14.73)	164.65 (14.80)	163.65 (14.71)	
6.	292.90 (21.27)	292.00 (21.20)	293.55 (21.32)	292.00 (21.20)	293.70 (21.32)	292.00 (21.20)	293.85 (21.33)	292.00 (21.20)	294.00 (21.34)	293.95 (21.34)	293.95 (21.34)	292.30 (21.22)	
7.	264.05 (11.96)	258.85 (11.73)	263.60 (11.94)	258.25 (11.70)	264.50 (11.98)	256.60 (11.62)	257.55 (11.67)	255.60 (11.58)	259.50 (11.76)	254.75 (11.54)	259.35 (11.75)	254.75 (11.54)	
8.	172.80 (11.49)	171.00 (11.37)	171.85 (11.43)	167.20 (11.12)	172.80 (11.49)	168.40 (11.20)	169.50)11.27)	167.75 (11.16)	171.90 (11.43)	167.10 (11.11)	171.75 (11.42)	166.95 (11.10)	
9.	294.70 (11.29)	292.40 (11.20)	292.40 (11.20)	289.45 (11.09)	294.70 (11.29)	291.50 (11.16)	290.80 (11.14)	289.40 (11.08)	293.85)11.25)	289.40 (11.08)	292.65 (11.21)	289.40 (11.08)	
10.	331.40 (22.24)	327.60 (21.98)	331.40 (22.24)	326.30 (21.89)	331.00 (22.21)	327.00 (21.94)	329.65 (22.12)	325.85 (21.86)	334.00 (22.41)	326.05 (21.88)	330.50 (22.38)	325.95 (21.87)	
11.	352.70 (30.02)	350.35 (29.82)	350.22 (29.80)	350.70 (29.85)	354.50 (30.17)	351.00 (29.87)	354.00 (30.13)	349.45 (29.74)	354.90 (30.20)	351.65 (29.93)	354.35 (30.16)	351.00 (29.87)	
12.	246.35 (12.86)	243.15 (12.69)	246.49 (12.87)	241.30 (12.60)	245.30 (12.81)	242.30 (12.65)	245.20 (12.80)	241.20 (12.59)	242.65 (12.67)	241.20 (12.59)	242.70 (12.67)	241.20 (12.59)	

Sl. No.	1979-80 Post Mon.	1979-80 Pre. Mon.	1980-81 Post Mon.	1980-81 Pre. Mon.	1981-82 Post Mon.	1981-82 Pre. Mon.	1982-83 Post Mon.	1982-83 Pre. Mon.	1983-84 Post Mon.	1983-84 Pre. Mon.	1984-85 Post Mon.	1984-85 Pre. Mon.
13.	192.35 (10.10)	190.85 (10.02)	192.80 (10.12)	190.90 (10.02)	192.90 (10.13)	190.65 (10.01)	192.85 (10.13)	189.80 (9.97)	194.45 (10.21)	190.30 (9.99)	194.30 (10.20)	189.80 (9.97)
14.	296.20 (14.10)	290.60 (13.83)	296.30 (14.10)	293.60 (13.98)	296.20 (14.10)	293.90 (13.99)	294.90 (14.04)	295.50 (14.07)	298.05 (14.19)	295.20 (14.05)	297.75 (14.17)	295.25 (14.05)
15.	201.40 (11.24)	200.50 (11.19)	200.50 (11.19)	198.00 (11.05)	200.70 (11.20)	200.80 (11.21)	201.50 (11.24)	198.00 (11.05)	202.40 (11.29)	199.30 (11.12)	201.40 (11.24)	198.75 (11.09)
	264.81	262.41	264.60	261.63	265.14	262.07	263.77	261.27	265.40	262.03	265.02	261.62
	109.81	107.41	109.60	106.63	110.14	107.07	108.77	106.27	110.40	107.03	110.02	106.62

AVERAGE GROUNDWATER LEVEL (IN METER) FROM M.S.L. FOR DISTRIST JAMNAGAR, GUJARAT

Sl. No.	Name of obs. well	Height of M.P. from MSL (in M)	Area influenced by well (sq.km.)	Area weight	1978-79					1979-80				
					JUNE	AUG	NOV	JAN	APR	JUNE	AUG	NOV	JAN	APR
1.	Sarmesor	8.905	391.00	0.0385				4.38 (0.17)	-0.57 (-0.02)	2.64 (0.10)	7.01 (0.27)	3.71 (0.14)	2.91 (0.11)	3.21 (0.12)
2.	Salaya	3.491	557.00	0.0549				-0.39 (0.02)	-0.58 (-0.03)	-0.44 (-0.02)	0.59 (0.03)	-0.11 (-0.01)	-0.11 (-0.01)	-0.43 (-0.02)
3.	Bed	12.260	598.00	0.0589				6.06 (0.36)	5.24 (0.31)	3.63 (0.21)	10.66 (0.63)	6.92 (0.41)	6.31 (0.37)	5.20 (0.31)
4.	Okhamadin	4.323	317.00	0.0312				-2.75 (-0.09)	-4.53 (-0.14)	-0.11 (0.00)	2.10 (0.07)	1.92 (0.06)	2.24 (0.07)	1.62 (0.05)
5.	Bhatiya	27.095	720.00	0.0710				13.80 (0.98)	11.83 (0.84)	15.13 (1.07)	24.67 (1.75)	22.75 (1.62)	22.00 (1.56)	20.10 (1.43)
6.	Bhadthar	35.169	667.00	0.0660				21.62 (1.43)	18.97 (1.25)	20.51 (1.35)	29.55 (1.95)	32.45 (2.14)	31.87 (2.10)	29.77 (1.97)
7.	Ambardi	74.620	2589.00	0.2552				65.93 (16.83)	63.35 (16.17)	62.32 (15.90)	72.62 (18.53)	72.42 (18.48)	72.60 (18.53)	67.91 (17.33)
8.	Dhrol	25.010	2474.00	0.2439				20.71 (5.05)	17.27 (4.21)	19.03 (4.65)	23.08 (5.63)	20.31 (4.95)	20.31 (4.95)	19.01 (4.64)
9.	Raval	0.999	720.00	0.0710				-5.70* (-0.41)	6.20 (0.44)	6.30 (0.45)	-0.28 (-0.02)	1.60 (0.11)	-6.80 (0.48)	6.70* (0.12)
10.	Jamnagar	11.905	1110.00	0.1094				7.38 (0.81)	6.73 (0.74)	8.15 (0.89)	10.74 (1.17)	8.78 (0.96)	9.46 (1.03)	9.32 (1.02)
Average groundwater level (in M.) from M.S.L.								25.10	23.76	24.60	30.01	28.87	28.24	26.96
Average ground water level w.r.t. datum								38.10	36.76	37.60	43.01	41.87	41.24	39.96

* Represents data generated.

Sl. No.	1980-81					1981-82					1982-83		
	JUNE	AUG.	NOV.	JAN.	APR.	JUNE	AUG.	NOV.	JAN.	APR.	JUNE	AUG.	NOV.
1.	2.75	5.08	3.75	3.30	2.79	2.36	5.93	4.08	4.82	3.88	3.20	6.20	4.29
	(0.11)	(0.20)	(0.14)	(0.13)	(0.11)	(0.09)	(0.23)	(0.16)	(0.19)	(0.15)	(0.12)	(0.24)	(0.17)
2.	-0.44	0.0	-0.11	-0.23	-0.18	-0.69	-4.56	-0.06	-0.22	-0.47	-0.53	0.01	-0.38
	(-0.02)	(0.0)	(-0.01)	(-0.01)	(-0.01)	(-0.04)	(-0.25)	(-0.0)	(-0.01)	(-0.03)	(-0.03)	(0.0)	(-0.02)
3.	7.76	7.36	4.76	5.26	3.95	2.90	9.31	7.38	7.12	5.95	5.[illegible]5	7.97	6.58
	(0.46)	(0.43)	(0.28)	(0.31)	(0.23)	(0.17)	(0.55)	(0.43)	(0.42)	(0.35)	(0.30)	(0.47)	(0.39)
4.	2.05	2.22	0.64	+1.54	-1.84	-4.03	2.19	1.56	2.19	2.17	1.22	2.26	2.22
	(0.06)	(0.07)	(0.02)	(0.05)	(-0.06)	(-0.13)	(0.07)	(0.05)	(0.07)	(0.07)	(0.04)	(0.07)	(0.07)
5.	17.77	23.29	18.47	15.37	13.70	11.30	24.65	22.86	21.52	20.65	16.98	24.36	19.29
	(1.26)	(1.65)	(1.31)	(1.09)	(0.97)	(0.80)	(1.75)	(1.62)	(1.53)	(1.47)	(1.21)	(1.73)	(1.37)
6.	29.44	32.19	31.39	30.35	22.06	21.81	33.56	35.54	31.86	30.54	28.33	31.85	29.85
	(1.94)	(2.13)	(2.07)	(2.00)	(1.46)	(1.44)	(2.22)	(2.35)	(2.10)	(2.02)	(1.87)	(2.10)	(1.97)
7.	63.94	72.82	72.46	67.34	67.91	65.56	72.22	72.49	72.40	70.73	67.97	69.41	68.92
	(16.32)	(18.58)	(18.49)	(17.19)	(17.33)	(16.73)	(18.43)	(18.46)	(18.48)	(18.05)	(17.35)	(17.71)	(17.59)
8.	20.30	21.19	19.58	18.51	16.23	11.61	20.54	20.38	18.79	16.43	17.57	20.36	19.75
	(4.95)	(5.17)	(4.78)	(4.52)	(3.96)	(2.83)	(13.01)	(4.97)	(4.58)	(4.01)	(4.29)	(4.97)	(4.82)
9.	-6.60*	-0.32	2.70	-6.10	-6.50*	-7.73	-0.48	-4.37	-1.79	-6.63	-6.80*	-1.20	-2.90
	(-0.47)	(-0.02)	(0.19)	(-0.43)	(-0.46)	(-0.55)	(-0.03)	(-0.31)	(-0.13)	(-0.47)	(-0.48)	(-0.09)	(-0.21)
10.	6.38	11.01	9.70	9.49	7.55	4.78	10.58	8.92	9.98	7.18	6.01	10.50	10.12
	(0.70)	(1.20)	(1.06)	(1.04)	(0.83)	(0.52)	(1.16)	(0.98)	(1.09)	(0.79)	(0.66)	(1.15)	(1.11)
	25.30	29.41	28.34	26.74	24.35	21.87	29.13	28.70	28.32	26.40	25.31	28.35	27.25
	38.30	42.41	41.35	39.74	37.35	34.87	42.13	41.70	41.32	39.40	38.31	41.35	40.25

* Represents data generated.

Sl. No.	1982-83		1983-84					1984-85				
	JAN	APR	JUNE	AUG	NOV	JAN	APR	JUNE	AUG	NOV	JAN	APR
1.	4.19 (0.16)	3.70 (0.14)	3.58 (0.14)	6.15 (0.24)	4.44 (0.17)	3.76 (0.15)	3.10 (0.12)	2.81 (0.11)	3.92 (0.15)	3.71 (0.14)	3.00 (0.12)	3.32 (0.13)
2.	-1.32 (-0.07)	-0.05 (-0.0)	1.07 (0.06)	0.99 (0.05)	0.54 (0.03)	0.32 (0.02)	0.26 (0.01)	0.13 (0.01)	0.70 (0.04)	0.49 (0.03)	-0.47 (-0.03)	-0.63 (-0.04)
3.	6.63 (0.39)	5.46 (0.32)	6.14 (0.36)	8.64 (0.50)	6.63 (0.39)	6.14 (0.36)	5.28 (0.31)	5.04 (0.30)	6.47 (0.38)	4.96 (0.39)	6.26 (0.37)	4.59 (0.27)
4.	3.12 (0.10)	2.30 (0.07)	3.24 (0.10)	3.07 (0.10)	3.06 (0.10)	2.96 (0.09)	1.79 (0.06)	0.27 (0.01)	2.25 (0.07)	1.22 (0.38)	2.12 (0.07)	0.92 (0.03)
5.	14.21 (1.01)	14.31 (1.00)	15.04 (1.07)	25.30 (1.80)	18.04 (1.28)	14.11 (1.00)	14.53 (1.03)	13.11 (0.93)	24.95 (1.77)	16.80 (1.19)	13.85 (0.98)	13.90 (0.99)
6.	31.44 (2.08)	23.25 (1.53)	29.47 (1.95)	35.15 (2.32)	33.15 (2.19)	31.03 (2.05)	23.66 (1.56)	24.77 (1.64)	29.19 (1.93)	31.10 (2.05)	29.97 (1.98)	22.57 (1.49)
7.	66.71 (17.02)	65.66 (16.76)	65.81 (16.80)	73.01 (18.63)	73.95 (18.87)	73.01 (18.63)	66.71 (17.02)	63.65 (16.24)	67.24 (17.16)	68.62 (17.51)	71.22 (18.18)	65.62 (16.75)
8.	20.40 (4.98)	10.12 (2.47)	16.99 (4.14)	22.72 (5.54)	21.62 (5.27)	21.66 (5.28)	19.38 (4.73)	19.30 (4.71)	17.37 (4.24)	17.33 (4.23)	20.51 (5.00)	18.41 (4.49)
9.	-7.20 (-0.51)	-7.32 (-0.52)	1.00 (0.07)	-0.04 (-0.00)	-1.52 (-0.11)	-6.24 (-0.44)	-7.11 (-0.51)	-6.25 (-0.45)	-4.35 (-0.31)	-3.80 (-0.27)	-6.62 (-0.47)	-7.50 (-0.53)
10.	9.72 (1.06)	8.46 (0.93)	11.32 (1.24)	10.37 (1.13)	10.29 (1.13)	10.01 (1.10)	8.16 (0.90)	8.02 (0.88)	10.80 (1.18)	9.21 (1.01)	9.53 (1.04)	7.53 (0.83)
	26.21	22.23	25.92	30.32	29.32	28.24	25.23	24.37	29.61	25.57	27.23	24.40
	39.21	35.23	38.92	43.32	42.32	41.24	38.23	37.37	42.61	38.57	40.23	37.40

Sl. No.	1985-86 JUNE	AUG	NOV.	JAN	APR	Remarks
1.	1.97 (0.08)	3.01 (0.12)	3.01 (0.12)	2.46 (0.10)	1.61 (0.06)	Assuming datum 13.0 m below M.S.L.
2.	-2.70 (-0.15)	0.01 (0.00)	-0.26 (-0.01)	-0.38 (-0.02)	-0.18 (-0.01)	
3.	4.59 (0.27)	5.93 (0.35)	5.26 (0.31)	8.96 (0.53)	4.66 (0.27)	
4.	-0.48 (-0.02)	1.42 (0.04)	0.12 (0.00)	0.02 (0.00)	-3.28 (-0.10)	
5.	12.30 (0.87)	13.70 (0.97)	15.90 (1.13)	14.50 (1.03)	13.10 (0.93)	
6.	22.97 (1.52)	27.97 (1.85)	29.37 (1.94)	26.57 (1.75)	20.77 (1.37)	
7.	62.42 (15.93)	66.12 (16.87)	67.62 (17.26)	67.42 (17.21)	65.62 (16.75)	
8.	18.21 (4.44)	16.21 (3.95)	16.01 (3.91)	10.21 (2.94)	13.01 (3.17)	
9.	-6.25 (-0.44)	-4.50 (-0.32)	-4.00 (-0.28)	-5.50 (-0.39)	-6.00 (-0.43)	
10.	7.41 (0.81)	10.31 (1.13)	8.51 (0.93)	9.41 (1.03)	8.40 (0.92)	
	23.31	24.96	25.89	24.54	22.94	
	36.31	37.96	38.89	37.54	35.94	

APPENDIX VI-7

AVERAGE GROUNDWATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT RAJKOT, GUJARAT

Sl. No.	Name of Obs. well	R.L. of Obs. well (in M.)	Area influenced by well (sq. km.)	Area weight	1977-78		1978-79		1979-80		1980-81	
					Post Mon.	Pre Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.
1.	Maliya	10.20	1347.8	0.1209		5.10 (0.62)	6.80 (0.82)	5.40 (0.65)	7.80 (0.94)	6.25 (0.76)	8.14 (0.98)	4.40 (0.53)
2.	Wankaner	90.80	2054.9	0.1843		85.40 (15.74)	86.25 (15.90)	84.90 (15.65)	87.93 (16.21)	82.40 (15.19)	86.57 (15.96)	85.30 (15.72)
3.	Rajkot	128.96	3618.3	0.3244	122.31 (39.68)	124.46 (40.35)	126.21 (40.94)	125.36 (40.67)	126.41 (41.01)	125.31 (40.65)	125.98 (40.87)	124.46 (40.38)
4.	Uplata	41.84	1869.3	0.1676		31.20 (5.23)	36.24 (6.07)	31.59 (5.29)	37.14 (6.23)	36.44 (6.11)	38.94 (6.53)	35.94 (6.03)
5.	Gondal	126.90	2262.0	0.2028		115.80 (23.48)	116.30 (23.59)	115.90 (23.50)	121.50 (24.64)	116.25 (23.54)	123.80 (25.11)	115.25 (23.37)
	Average ground water level (in M.) from M.S.L.					85.41	87.32	85.77	89.02	86.27	89.44	86.03

Note: For analysis, data of May month have been used for pre-monsoon. Data of October month have been used for post-monsoon. Value in bracket represents ground water level multiplied by area weight.

Sl. No.	1981-82		1982-83		1983-84		1984-85		1985-86		Remarks
	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	
1.	7.00 (0.85)	5.40 (0.65)	5.60 (0.68)	4.25 (0.51)	6.77 (0.82)	3.90 (0.47)	4.00 (0.48)	3.60 (0.44)	3.70 (0.45)	3.10 (0.37)	Assuming datum from M.S.L.
2.	86.00 (15.85)	85.40 (15.74)	84.80 (15.63)	83.65 (15.42)	85.54 (15.77)	84.30 (15.54)	84.80 (15.63)	84.30 (15.54)	83.10 (15.32)	80.80 (14.89)	
3.	125.26 (40.63)	125.11 (40.59)	125.46 (40.70)	122.06 (39.60)	125.21 (40.62)	119.26 (38.69)	124.96 (40.54)	118.96 (38.59)	119.36 (38.72)	114.96 (37.29)	
4.	38.04 (6.38)	36.89 (6.18)	35.84 (6.01)	33.94 (5.69)	39.86 (6.68)	36.34 (6.09)	36.44 (6.11)	29.44 (4.93)	26.64 (4.47)	22.74 (3.81)	
5.	125.00 (25.35)	116.40 (23.61)	117.30 (23.79)	115.90 (23.51)	124.00 (25.15)	115.40 (23.40)	122.90 (24.92)	115.95 (23.52)	116.10 (23.55)	113.20 (22.96)	
	89.06	86.77	86.00	84.72	89.03	84.19	87.68	83.01	82.49	79.33	

APPENDIX VI-8

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT CUDDAPAH, ANDHRA PRADESH

Sl. No.	Name of obs. well	Height of MP from MSL (in M)	Area influenced by Obs. well (sq. km.)	Area weight	1974-75 JAN.	FEB.	MARCH	APRIL	MAY
1.	Lokkireddy Palle	361.480	896.41	0.0583	354.78 (20.68)	353.83 (20.63)	353.43 (20.61)	352.88 (20.57)	352.63 (20.56)
2.	Rayachati	351.470	3883.25	0.2525	346.92 (87.60)	346.17 (87.41)	344.47 (86.98)	343.97 (86.85)	343.27 (86.68)
3.	Badvel	127.96	4008.24	0.2606	135.96 (35.43)	135.46 (35.30)	134.64 (34.09)	134.21 (34.98)	133.16 (34.70)
4.	Palagiri/ Kamalapuram	182.456	2687.61	0.1748	174.97 (30.58)	173.87 (30.39)	173.94 (31.45)	173.94 (30.40)	173.72 (30.37)
5.	Regadipally	216.998	1591.72	0.1035	210.80 (21.82)	210.40 (21.78)	212.90 (22.04)	209.85 (21.72)	209.30 (21.66)
6.	Booeddula Palle	165.742	2311.18	0.1503	161.59 (24.29)	160.89 (24.18)	160.59 (24.14)	159.99 (24.05)	159.49 (23.97)
	Average ground water level (in meter) from M.S.L.				220.40	219.69	219.30	218.57	217.94
	Average ground water level (in meter) w.r.t. datum				100.40	99.69	99.30	98.57	97.94

Note: For analysis, value in bracket represents ground water level multiplied by area weight.

Sl. No.	1975-76 JUNE										
1.	352.43 (20.55)	352.23 (20.54)	351.98 (20.52)	352.38 (20.54)	353.63 (20.62)	358.68 (20.91)	357.28 (20.83)	355.88 (20.75)	355.08 (20.70)	354.93 (20.69)	354.28 (20.66)
2.	342.57 (86.50)	343.77 (86.80)	345.27 (87.18)	348.72 (88.05)	348.67 (88.04)	349.97 (88.37)	349.47 (88.24)	348.72 (88.05)	348.07 (87.89)	347.12 (87.65)	345.77 (87.31)
3.	133.29 (34.74)	132.66 (34.57)	132.18 (34.45)	134.06 (34.94)	135.21 (35.24)	137.06 (35.72)	136.73 (35.63)	136.11 (34.47)	134.83 (35.14)	135.57 (35.33)	134.96 (35.17)
4.	173.58 (30.34)	173.44 (30.32)	173.39 (30.31)	173.51 (30.33)	174.34 (30.47)	179.43 (31.36)	178.51 (31.20)	176.57 (30.86)	175.50 (30.68)	175.64 (30.70)	173.94 (30.40)
5.	209.40 (21.67)	211.00 (21.84)	212.90 (22.04)	211.90 (21.93)	212.70 (22.01)	214.60 (22.21)	214.10 (22.16)	213.60 (22.11)	213.40 (22.09)	212.90 (22.04)	212.05 (21.95)
6.	159.09 (23.91)	158.79 (23.87)	158.30 (23.79)	158.19 (23.78)	158.09 (23.76)	164.89 (24.78)	163.69 (24.60)	162.89 (24.48)	161.89 (24.33)	161.49 (24.27)	160.69 (24.12)
	217.71	217.93	218.28	219.57	220.14	223.35	222.67	220.72	220.82	220.68	219.60
	97.71	97.93	98.28	99.57	100.14	103.35	102.67	100.72	100.82	100.68	99.60

Sl. No.	1975-76 MAY	1976-77 JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
1.	353.83 (20.63)	354.28 (20.66)	353.88 (20.63)	354.83 (20.69)	356.18 (20.77)	355.88 (20.75)	355.58 (20.73)	355.73 (20.74)	355.18 (20.71)	364.68 (20.68)
2.	344.97 (87.11)	343.97 (86.85)	348.97 (88.12)	346.52 (87.50)	349.47 (88.24)	348.27 (87.94)	348.82 (88.08)	349.97 (88.37)	348.87 (88.09)	348.22 (87.92)
3.	136.18 (35.49)	134.04 (34.93)	133.71 (34.85)	134.23 (34.98)	136.18 (35.49)	135.79 (35.39)	136.14 (35.48)	136.53 (35.58)	135.91 (35.42)	135.50 (35.31)
4.	174.08 (30.43)	173.27 (30.29)	173.89 (30.40)	174.10 (30.43)	174.69 (30.54)	174.83 (30.56)	175.21 (30.63)	175.26 (30.64)	174.19 (30.45)	173.25 (30.28)
5.	211.70 (21.91)	212.05 (21.95)	211.50 (21.88)	211.57 (21.90)	211.70 (21.91)	211.45 (21.89)	211.65 (21.91)	211.47 (21.89)	211.20 (21.86)	211.05 (21.84)
6.	160.24 (24.08)	159.94 (24.04)	160.09 (24.06)	160.29 (24.09)	161.04 (24.21)	160.99 (24.20)	162.24 (24.39)	163.59 (24.59)	162.89 (24.48)	162.04 (24.36)
	219.65	218.71	219.93	219.58	221.15	220.72	221.20	221.80	221.01	220.39
	99.65	98.71	99.93	99.58	101.15	100.72	101.20	101.80	101.01	100.39

Sl.	1976-77			1977-78						
No.	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT.	OCT.	NOV.	DEC.
1.	354.26 (20.65)	353.78 (20.63)	353.13 (20.59)	353.78 (20.63)	353.38 (20.60)	352.98 (20.58)	353.28 (20.60)	353.23 (20.59)	354.48 (20.67)	355.18 (20.71)
2.	347.42 (87.72)	346.77 (87.56)	344.97 (87.11)	345.07 (87.13)	345.82 (87.32)	344.87 (87.08)	345.87 (87.33)	348.07 (87.89)	347.14 (87.81)	348.32 (87.95)
3.	135.60 (35.34)	134.59 (35.07)	134.13 (34.95)	133.78 (34.86)	133.88 (34.89)	133.59 (34.81)	133.21 (34.72)	132.74 (34.59)	133.26 (34.73)	135.64 (35.35)
4.	172.93 (30.23)	174.43 (30.49)	172.93 (30.23)	173.04 (30.25)	174.68 (30.53)	174.92 (30.58)	175.29 (30.64)	175.14 (30.61)	175.69 (30.71)	175.49 (30.68)
5.	210.80 (21.82)	210.40 (21.78)	210.20 (21.76)	210.50 (21.79)	210.85 (21.82)	210.95 (21.83)	210.94 (21.83)	211.50 (21.89)	210.30 (21.77)	211.41 (21.88)
6.	161.59 (24.29)	160.74 (24.16)	160.29 (24.09)	159.94 (24.04)	159.84 (24.02)	159.89 (24.03)	159.54 (23.98)	159.24 (23.93)	158.84 (23.87)	158.69 (23.85)
	220.05	219.68	218.72	218.69	219.19	218.91	219.09	219.51	219.56	220.41
	100.05	99.68	98.72	98.69	99.19	98.91	99.09	99.51	99.56	100.41

Sl. No.	1977-78					1978-79				
	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
1.	354.93 (20.69)	354.28 (20.66)	353.88 (20.63)	353.38 (20.60)	353.08 (20.59)	353.38 (20.60)	352.68 (20.56)	355.08 (20.70)	354.43 (20.66)	354.48 (20.67)
2.	347.02 (87.62)	345.97 (87.36)	346.77 (87.56)	146.57 (87.51)	343.07 (86.63)	342.72 (86.54)	344.02 (86.87)	345.07 (87.13)	346.52 (87.50)	346.52 (87.50)
3.	135.19 (35.23)	134.09 (34.94)	134.00 (34.92)	133.60 (34.82)	132.81 (34.61)	132.63 (34.56)	132.64 (34.57)	132.31 (34.48)	132.12 (34.43)	132.42 (34.51)
4.	174.49 (30.50)	173.75 (30.37)	173.49 (30.33)	173.49 (30.33)	173.43 (30.32)	173.38 (30.31)	173.60 (30.35)	174.22 (30.45)	174.07 (30.43)	174.18 (30.45)
5.	211.15 (21.85)	210.95 (21.83)	210.80 (21.82)	209.74 (21.71)	210.20 (21.76)	210.30 (21.77)	210.35 (21.77)	210.65 (21.80)	210.85 (21.82)	211.05 (21.84)
6.	158.44 (23.81)	158.04 (23.75)	157.84 (23.72)	157.14 (23.62)	156.69 (23.55)	156.14 (23.47)	155.84 (23.42)	157.04 (23.60)	157.99 (23.75)	159.24 (23.93)
	219.71	218.91	218.98	218.58	217.44	217.24	217.53	218.17	218.59	218.89
	99.71	98.91	98.98	98.58	97.44	97.24	97.53	98.17	98.59	98.89

Sl. No.	1978-79							1979-80		
	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG
1.	354.03 (20.64)	354.98 (20.70)	354.63 (20.68)	354.18 (20.65)	353.78 (20.63)	353.38 (20.60)	352.98 (20.58)	353.38 (20.60)	357.68 (20.85)	352.48 (20.55)
2.	346.22 (87.42)	348.37 (87.96)	347.97 (87.86)	347.17 (87.66)	347.12 (87.65)	345.47 (87.23)	346.27 (87.43)	348.87 (88.09)	344.37 (86.93)	344.67 (87.03)
3.	133.27 (34.73)	134.71 (35.11)	134.86 (35.15)	134.51 (35.05)	134.10 (34.95)	133.17 (34.70)	132.71 (34.58)	132.55 (34.54)	132.40 (34.50)	132.25 (34.46)
4.	174.79 (30.55)	175.19 (30.62)	174.17 (30.44)	173.54 (30.33)	173.29 (30.29)	173.24 (30.28)	173.13 (30.26)	173.37 (30.30)	173.58 (30.34)	173.39 (30.31)
5.	211.15 (21.85)	211.07 (21.85)	211.07 (21.85)	211.05 (21.93)	210.45 (21.78)	210.00 (21.74)	209.80 (21.71)	210.02 (21.74)	214.80 (22.23)	210.20 (21.76)
6.	160.44 (24.11)	162.14 (24.37)	162.14 (24.37)	161.49 (24.27)	160.84 (24.18)	160.14 (24.07)	160.04 (24.05)	159.54 (23.98)	159.14 (23.95)	159.31 (23.95)
	219.31	220.60	220.34	219.89	219.47	218.62	218.63	219.26	218.78	218.05
	99.31	100.60	100.34	99.89	99.47	98.62	98.63	99.26	98.78	98.05

Sl. No.	1979-80 SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	1980-81 JUNE
1.	352.88 (20.57)	356.73 (20.80)	354.68 (20.68)	356.73 (20.80)	353.16 (20.59)	352.68 (20.56)	352.13 (20.53)	351.73 (20.51)	351.35 (20.48)	351.38 (20.49)
2.	345.27 (87.18)	345.87 (87.33)	346.27 (87.43)	345.57 (87.26)	347.57 (87.76)	346.47 (87.48)	345.27 (87.18)	343.47 (86.73)	343.47 (86.73)	341.97 (86.35)
3.	132.14 (34.44)	132.86 (34.62)	130.07 (33.90)	131.35 (34.23)	135.91 (35.42)	135.51 (35.31)	135.11 (35.21)	134.51 (35.05)	133.51 (34.79)	133.41 (34.77)
4.	173.75 (30.37)	174.26 (30.46)	174.77 (30.55)	176.05 (30.77)	175.76 (30.72)	174.51 (30.50)	174.11 (30.43)	173.81 (30.38)	173.61 (30.35)	173.51 (30.33)
5.	210.35 (21.77)	210.90 (21.83)	211.55 (21.90)	212.50 (21.99)	219.20 (21.96)	211.90 (21.93)	211.40 (21.88)	211.22 (21.86)	210.95 (21.83)	210.95 (21.83)
6.	158.84 (23.87)	158.59 (23.84)	158.44 (23.81)	159.54 (23.98)	160.94 (24.19)	160.34 (24.10)	159.89 (24.03)	159.34 (23.95)	159.19 (23.93)	158.74 (23.86)
	218.21	218.88	218.27	219.03	220.64	219.89	219.27	218.48	218.11	217.62
	98.21	98.88	98.27	99.03	100.64	99.89	99.27	98.48	98.11	97.62

Sl.	1980-81									
No.	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.
1.	351.28 (20.48)	350.98 (20.46)	350.73 (20.45)	350.98 (20.46)	351.11 (20.47)	351.30 (20.48)	351.43 (20.49)	351.38 (20.49)	351.13 (20.47)	350.93 (20.46)
2.	341.77 (86.30)	339.47 (87.72)	339.47 (85.72)	338.27 (85.41)	338.47 (85.46)	337.67 (85.26)	338.57 (85.49)	337.57 (85.24)	338.97 (85.59)	340.47 (85.97)
3.	133.36 (34.75)	133.01 (34.66)	133.31 (34.74)	132.76 (34.60)	132.26 (34.47)	133.21 (34.72)	132.41 (34.51)	133.91 (34.90)	131.36 (34.23)	130.61 (34.04)
4.	173.76 (30.37)	173.51 (30.33)	173.21 (30.28)	172.81 (30.21)	173.06 (30.25)	173.36 (30.30)	172.36 (30.13)	171.96 (30.06)	171.96 (30.06)	171.96 (30.06)
5.	210.95 (21.83)	210.95 (21.83)	211.05 (21.84)	210.70 (21.81)	211.00 (21.84)	210.95 (21.83)	210.70 (21.81)	210.70 (21.81)	210.70 (21.81)	210.30 (21.77)
6.	157.89 (23.73)	157.89 (23.73)	157.64 (23.69)	156.99 (23.60)	156.34 (23.50)	156.04 (23.45)	155.74 (23.41)	155.94 (23.29)	154.29 (23.19)	153.74 (23.11)
	217.47	218.73	216.72	216.08	215.99	216.05	215.83	215.77	215.35	215.40
	97.47	98.73	96.72	96.08	95.99	96.05	95.83	95.77	95.35	95.40

Sl. No.	1980-81 MAY	1981-82 JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.
1.	350.48 (20.43)	350.48 (20.44)	348.43 (20.31)	349.88 (20.40)	350.33 (20.42)	351.28 (20.48)	352.88 (20.57)	353.08 (20.59)	352.73 (20.56)	352.23 (20.49)
2.	341.97 (86.35)	340.47 (85.97)	338.42 (85.45)	338.87 (85.57)	340.47 (85.97)	343.47 (86.73)	346.47 (87.48)	345.92 (87.35)	345.12 (87.14)	344.92 (87.09)
3.	129.86 (33.84)	125.56 (32.72)	125.66 (32.75)	125.86 (32.80)	125.96 (32.83)	131.96 (34.39)	134.46 (35.04)	134.41 (35.03)	134.51 (35.05)	134.46 (35.04)
4.	171.96 (30.06)	171.96 (30.06)	171.96 (30.06)	172.36 (30.13)	173.06 (30.25)	174.86 (30.57)	175.45 (30.67)	174.86 (30.57)	174.86 (30.57)	174.06 (30.43)
5.	210.10 (21.75)	210.00 (21.74)	210.05 (21.74)	210.15 (21.75)	211.60 (21.90)	212.95 (22.04)	212.50 (21.99)	212.30 (21.97)	212.00 (21.94)	211.80 (21.92)
6.	152.74 (22.96)	151.94 (22.84)	151.34 (22.75)	151.04 (22.70)	150.89 (22.68)	151.89 (22.83)	153.34 (23.05)	153.59 (23.09)	155.99 (23.45)	155.74 (23.41)
	215.38	213.76	212.46	213.34	214.05	217.03	218.81	218.58	218.71	218.35
	95.38	93.76	92.46	93.34	94.05	97.03	98.81	98.58	98.71	98.37

Sl. No.	1981-82			1982-83						
	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1.	351.93 (20.52)	351.68 (20.50)	351.03 (20.47)	350.93 (20.46)	349.53 (20.38)	350.93 (20.46)	348.38 (20.31)	348.88 (20.34)	348.48 (20.32)	349.58 (20.38)
2.	344.67 (87.03)	343.37 (86.70)	341.62 (86.26)	339.37 (85.67)	339.52 (85.73)	339.97 (85.84)	336.72 (85.02)	337.57 (85.24)	339.02 (85.60)	348.32 (87.95)
3.	134.06 (34.94)	133.16 (34.70)	132.56 (34.55)	132.06 (34.42)	131.26 (34.21)	130.86 (34.10)	130.23 (33.94)	130.76 (34.08)	132.01 (34.40)	134.56 (35.07)
4.	173.51 (30.33)	173.26 (30.29)	173.11 (30.26)	172.96 (30.23)	174.06 (30.43)	173.16 (30.27)	174.80 (30.57)	172.81 (30.21)	174.31 (30.47)	173.66 (30.36)
5.	211.60 (21.90)	211.15 (21.85)	210.50 (21.79)	210.50 (21.79)	210.60 (21.80)	210.00 (21.74)	210.20 (21.76)	210.45 (21.78)	211.10 (21.85)	211.10 (21.85)
6.	155.14 (23.32)	154.24 (23.18)	153.64 (23.09)	153.19 (23.03)	152.94 (22.99)	152.54 (22.93)	151.59 (22.78)	150.94 (22.69)	150.46 (22.61)	151.54 (22.78)
	218.12.	217.23	216.41	215.59	215.52	215.33	214.38	214.33	215.25	218.38
	98.12	97.23	96.41	95.59	95.52	95.33	94.38	94.33	95.25	98.38

Sl.	1982-83					1983-84				
No.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
1.	348.68 (20.33)	348.48 (20.32)	348.08 (20.29)	347.28 (20.25)	347.08 (20.24)	347.63 (20.27)	357.33 (20.83)	346.88 (20.22)	353.78 (20.63)	354.03 (20.64)
2.	346.37 (87.46)	346.52 (87.50)	346.60 (87.52)	346.77 (87.56)	346.92 (87.60)	347.17 (87.66)	347.32 (87.70)	347.47 (87.74)	347.57 (87.76)	347.72 (87.80)
3.	134.26 (34.99)	133.96 (34.91)	132.71 (34.58)	132.31 (34.48)	133.61 (34.82)	132.81 (34.61)	130.40 (34.00)	132.26 (34.47)	131.66 (34.31)	131.21 (34.19)
4.	172.13 (30.09)	171.95 (30.06)	171.55 (29.99)	171.35 (29.95)	171.13 (29.91)	171.95 (30.06)	172.36 (30.13)	171.84 (30.04)	173.70 (30.36)	175.15 (30.62)
5.	209.60 (21.69)	209.40 (21.67)	209.20 (21.65)	209.60 (21.69)	209.05 (21.64)	210.15 (21.75)	209.90 (21.72)	208.90 (21.62)	209.50 (21.68)	209.90 (21.72)
6.	151.44 (22.76)	151.34 (22.75)	149.99 (22.54)	149.74 (22.51)	151.39 (22.75)	150.69 (22.65)	151.44 (22.76)	151.49 (22.77)	152.89 (22.98)	157.29 (23.64)
	217.32	217.20	216.58	216.44	216.95	216.99	217.14	216.85	217.72	218.62
	97.32	97.20	96.58	96.44	96.95	96.99	97.14	96.85	97.72	98.62

Sl.	1983-84							1984-85		
No.	NOV.	DEC.	JAN.	FEB.	MAR.	APR	MAY	JUNE	JULY	AUG.
1.	353.73	354.03	353.98	353.68	359.63	352.38	351.93	351.53	350.93	350.83
	(20.62)	(20.64)	(20.64)	(20.62)	(20.56)	(20.54)	(20.52)	(20.49)	(20.46)	(20.45)
2.	347.87	348.07	346.32	346.02	346.02	345.63	344.82	343.67	343.37	343.07
	(87.84)	(87.89)	(87.45)	(87.37)	(87.37)	(87.27)	(87.07)	(86.78)	(86.70)	(86.63)
3.	133.36	134.26	133.98	133.81	133.36	132.69	131.59	131.63	130.81	130.31
	(34.75)	(34.99)	(34.92)	(34.87)	(34.75)	(34.58)	(34.29)	(34.30)	(34.09)	(34.22)
4.	174.57	175.26	173.55	173.17	172.83	171.99	171.68	172.05	172.14	172.56
	(30.51)	(30.64)	(30.34)	(30.27)	(30.16)	(30.06)	(30.01)	(30.07)	(30.09)	(30.16)
5.	210.05	209.95	209.85	209.65	209.50	209.20	208.70	209.00	208.90	208.90
	(21.74)	(21.73)	(21.72)	(21.70)	(21.63)	(21.65)	(21.60)	(21.63)	(21.62)	(21.62)
6.	158.49	158.84	158.94	158.34	157.54	156.89	156.59	156.39	155.34	155.24
	(23.82)	(23.87)	(23.89)	(23.80)	(23.68)	(23.58)	(23.54)	(23.51)	(23.35)	(23.33)
	219.29	219.76	218.94	218.63	218.16	217.69	217.02	216.79	216.31	216.41
	99.29	99.76	98.94	98.63	98.16	97.69	97.02	96.79	96.31	96.41

Sl. No.	1984-85									1985-86
	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR	MAY	JUNE
1.	350.78 (20.45)	350.63 (20.44)	352.18 (20.53)	352.08 (20.53)	352.13 (20.53)	351.68 (20.50)	350.98 (20.46)	351.18 (20.47)	350.38 (20.43)	349.98 (20.40)
2.	342.82 (86.56)	347.47 (87.74)	346.92 (87.60)	347.02 (87.62)	347.07 (87.64)	346.17 (87.41)	345.32 (87.19)	344.27 (86.93)	342.07 (86.37)	344.57 (87.00)
3.	130.51 (34.01)	132.81 (34.61)	132.76 (34.60)	132.91 (34.64)	132.56 (34.55)	132.11 (34.43)	131.31 (34.22)	130.56 (34.02)	129.96 (33.87)	129.36 (33.71)
4.	172.30 (30.12)	172.20 (30.10)	172.30 (30.18)	172.26 (30.11)	171.65 (30.00)	170.65 (29.83)	171.36 (29.95)	170.18 (29.75)	172.46 (30.15)	169.50 (29.63)
5.	208.80 (21.61)	208.70 (21.60)	208.90 (21.62)	208.75 (21.61)	208.75 (21.61)	208.25 (21.66)	208.30 (21.56)	207.55 (21.48)	207.55 (21.48)	207.50 (21.48)
6.	153.54 (23.08)	153.44 (23.06)	153.14 (23.02)	153.59 (23.09)	153.34 (23.05)	152.74 (22.96)	152.04 (22.85)	150.24 (22.58)	149.39 (22.45)	149.74 (22.51)
	215.83	217.55	217.48	217.59	217.37	216.78	216.24	215.24	214.75	214.73
	95.83	97.55	97.48	97.59	97.37	96.78	96.24	95.24	94.75	94.73

Sl. No.	1985-86 JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	Remarks
1.	349.78 (20.39)	350.08 (20.41)	350.03 (20.41)	350.03 (20.41)	349.93 (20.40)	349.78 (20.39)	349.58 (20.38)	349.68 (20.39)	349.38 (20.37)	348.98 (20.35)	348.53 (20.32)	Assuming datum 120.00 M. above M.S.L.
2.	344.52 (86.99)	345.80 (87.32)	345.02 (87.12)	344.82 (87.07)	344.37 (86.95)	344.17 (86.90)	344.77 (87.05)	343.97 (86.85)	342.57 (86.50)	340.57 (85.99)	340.17 (85.89)	
3.	128.83 (33.57)	128.81 (33.57)	128.31 (33.44)	128.36 (33.45)	130.71 (34.06)	130.96 (34.13)	130.80 (34.09)	130.60 (34.03)	130.30 (33.96)	130.00 (33.88)	129.80 (33.83)	
4.	169.50 (29.63)	167.15 (29.22)	170.18 (29.75)	170.57 (29.82)	171.35 (29.95)	171.53 (29.98)	178.30 (31.17)	178.101 (31.13)	177.93 (31.10)	177.54 (31.03)	177.20 (30.98)	
5.	207.30 (21.46)	108.40 (21.57)	208.60 (21.59)	208.40 (21.57)	208.80 (21.61)	208.75 (21.61)	208.60 (21.59)	208.50 (21.56)	208.20 (21.55)	208.00 (21.53)	207.90 (21.52)	
6.	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	149.74 (22.51)	
	214.55	214.59	214.81	214.82	215.49	215.52	216.78	216.47	215.98	215.26	215.04	
	94.55	94.59	94.81	94.82	95.49	95.52	96.78	96.47	95.98	95.26	95.04	

APPENDIX VI-9

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT ANANTPUR, ANDHRA PRADESH

Sl. No.	Name of Obs. well	Height of M.P. from M.S.L. (in M)	Area Influenced by Obs. Well (sq. km.)	Area weight	1974-75					1975-76	
					JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY
1.	Jallipalli	435.54	4404.10	0.2302	420.34 (96.76)	418.84 (96.42)	420.04 (96.69)	419.74 (96.69)	420.04 (96.53)	419.34 (96.53)	419.54 (56.58)
2.	Hindupur	629.00	1677.20	0.0877	629.95 (56.46	620.00 (54.37)	620.00 (54.37)	620.05 (54.37)	620.10 (54.38)	620.10 (54.38)	620.10 (54.38)
3.	Talupula	405.9	2819.20	0.1474	401.83 (59.23)	401.62 (59.20)	401.04 (59.11)	400.87 (59.09)	400.41 (59.02)	400.30 (59.00)	400.58 (59.05)
4.	Medapuram	385.248	4723.00	0.2469	379.70 (93.75)	379.69 (93.75)	378.46 (93.56)	377.08 (93.10)	376.90 (93.06)	376.39 (92.93)	375.69 (92.76)
5.	Madakriya	895.9	1199.60	0.0627	891.20 (55.88)	888.75 (55.73)	888.65 (55.72)	888.50 (55.71)	888.30 (55.70)	888.70 (55.72)	887.70 (55.66)
6.	Golla	503.3	4306.90	0.2251	498.44 (112.20)	498.45 (112.20)	498.30 (112.17)	498.40 (112.12)	498.10 (112.13)	498.80 (112.28)	499.80 (112.51)
Average ground water level (in meter) from M.S.L.					472.27	471.66	471.63	471.02	470.97	470.85	470.93
Average ground water level (in meter) w.r.t. datum					102.27	101.66	101.63	101.02	100.97	100.85	100.93

Note: For analysis, value in bracket represents ground water level multiplied by area weight.

Sl. No.	1975-76									
	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY
1.	421.14 (96.95)	423.34 (97.45)	426.44 (98.17)	433.34 (99.76)	428.94 (98.74)	426.94 (98.28)	426.44 (98.17)	425.24 (97.89)	421.34 (96.99)	420.34 (96.76)
2.	620.20 (54.39)	620.50 (54.42)	621.00 (54.46)	621.35 (54.49)	621.10 (54.47)	622.10 (54.56)	621.00 (54.46)	621.80 (54.44)	620.75 (54.44)	620.60 (54.43)
3.	400.28 (59.00)	401.00 (59.11)	401.56 (59.19)	401.20 (59.14)	403.20 (59.43)	402.58 (59.34)	402.31 (59.30)	401.70 (59.21)	401.15 (59.13)	400.90 (59.09)
4.	375.41 (92.69)	375.53 (92.72)	375.44 (2.70)	379.14 (93.62)	382.34 (94.40)	383.09 (94.59)	383.17 (94.60)	383.15 (94.60)	382.29 (94.39)	380.05 (93.83)
5.	890.50 (55.83)	889.00 (55.74)	892.10 (55.94)	895.50 (56.15)	895.40 (56.14)	896.50 (56.21)	894.25 (56.26)	893.90 (59.92)	893.65 (56.03)	893.20 (56.00)
6.	500.30 (112.62)	501.30 (11.84)	502.20 (113.05)	502.60 (113.14)	501.20 (112.82)	499.80 (112.51)	499.10 (112.35)	499.60 (112.46)	499.20 (112.37)	499.00 (112.33)
	471.48	471.20	473.49	476.28	476.01	475.48	475.14	471.52	473.35	472.45
	101.48	101.20	103.49	106.28	106.01	105.48	105.14	101.52	103.35	102.45

Sl.	1976-77									
No.	JUNE	JULY								
1.	920.14 (96.72	420.00* (96.68)	422.54* (97.27)	428.44 (98.63)	422.04 (97.15)	422.54 (97.27)	421.84 (97.11)	420.04 (96.69)	420.24 (96.74)	420.14 (96.72)
2.	620.50 (54.42)	619.00 (54.29)	620.30 (54.40)	620.10 (54.38)	620.00 (54.37)	619.90 (54.37)	620.80 (54.36)	620.65 (54.43)	619.55 (54.34)	619.40 (54.32)
3.	400.80 (59.08)	401.02 (59.11)	401.20 (59.14)	402.45 (59.32)	401.10 (59.12)	401.65 (59.20)	402.65 (59.35)	402.05 (59.26)	400.80 (59.08)	401.40 (59.17)
4.	380.25 (93.88)	374.35 (92.43)	376.15 (92.87)	377.65 (93.24)	376.49 (92.96)	375.64 (92.75)	375.37 (92.68)	375.14 (92.62)	375.00 (92.87)	374.27 (92.41)
5.	892.80 (55.98)	892.70 (55.97)	892.20 (55.94)	891.80 (55.92)	891.50 (55.72)	891.20 (55.88)	890.80 (55.85)	892.30 (55.95)	890.50 (55.83)	890.10 (85.81)
6.	498.55 (112.22)	498.41 (112.19)	498.75 (112.27)	498.80 (112.28)	498.80 (112.28)	498.80 (112.28)	498.75 (112.27)	498.74 (112.27)	498.70 (112.26)	498.60 (112.24)
	470.85	470.67	471.89	473.77	471.78	471.74	471.62	471.22	471.11	470.65
	100.85	100.67	101.89	103.77	101.78	101.74	101.62	101.22	101.11	101.65

*Represents data generated.

Sl. No.	1976-77		1977-78							
	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.
1.	419.94 (96.67)	419.54 (96.58)	420.54 (96.81)	419.24 (96.51)	420.94 (96.90)	419.94 (96.67)	421.44 (97.02)	422.14 (97.12)	421.44 (97.02)	420.74 (96.85)
2.	619.75 (54.35)	619.20 (54.30)	619.10 (54.30)	616.30 (54.05)	618.90 (54.28)	618.80 (54.27)	618.55 (54.25)	618.45 (54.24)	618.30 (54.23)	619.20 (54.30)
3.	400.80 (59.08)	400.38 (59.02)	400.87 (59.09)	400.81 (59.08)	401.05 (59.12)	401.16 (59.13)	401.80 (59.23)	402.70 (59.36)	402.80 (59.37)	402.25 (59.29)
4.	373.15 (92.13)	374.35 (92.43)	374.36 (92.43)	374.15 (92.38)	374.10 (92.37)	375.73 (92.77)	376.08 (92.85)	376.08 (92.85)	375.47 (92.70)	375.32 (92.67)
5.	889.60 (55.78)	889.10 (55.75)	888.50 (55.71)	888.10 (55.68)	888.10 (55.68)	888.00 (55.68)	888.60 (55.72)	890.60 (55.84)	890.80 (55.85)	892.70 (55.97)
6.	497.70 (112.03)	497.50 (111.99)	498.60 (112.24)	498.75 (112.27)	499.00 (112.33)	499.20 (112.37)	499.80 (112.51)	500.35 (112.64)	500.20 (112.60)	500.15 (112.58)
	470.04	470.06	470.56	469.97	470.67	470.89	471.56	472.12	471.77	471.67
	100.04	100.06	100.56	99.97	100.67	100.89	100.56	102.12	101.77	101.67

Sl. No.	1977-78 FEB.	MAR.	APR.	MAY	1978-79 JUNE	JULY	AUG.	SEPT.	OCT.	NOV.
1.	420.54 (96.81)	420.04 (96.69)	419.24 (96.51)	419.94 (96.67)	419.84 (96.65)	420.24 (96.74)	420.54 (96.81)	420.84 (96.88)	421.74 (97.09)	420.64 (96.83)
2.	618.00 (54.20)	617.45 (54.15)	617.20 (54.13)	616.90 (54.10)	616.90 (54.10)	616.30 (54.23)	615.90 (54.01)	615.95 (54.02)	616.00 (54.02)	616.10 (54.03)
3.	401.85 (59.23)	401.35 (59.16)	400.90 (59.09)	400.25 (59.00)	399.95 (58.95)	399.55 (58.89)	400.04 (58.97)	399.30 (58.86)	400.15 (58.98)	399.75 (58.92)
4.	373.95 (92.33)	373.36 (92.18)	374.09 (92.36)	374.10 (92.37)	373.74 (92.28)	373.95 (92.33)	373.44 (92.20)	373.94 (92.33)	373.45 (92.21)	375.77 (92.78)
5.	891.20 (55.88)	891.70 (55.91)	890.55 (55.84)	890.00 (55.80)	889.05 (55.74)	889.50 (55.77)	890.50 (55.83)	890.90 (55.86)	890.05 (55.81)	889.85 (55.79)
6.	500.10 (112.57)	499.95 (112.54)	498.30 (112.17)	498.20 (112.15)	498.20 (112.15)	498.15 (112.13)	498.05 (112.11)	498.00 (112.100	499.20 (112.37)	500.50 (112.66)
	471.02	470.63	470.10	470.08	469.87	470.09	469.93	470.04	470.47	471.02
	101.02	100.63	100.10	100.08	99.87	100.09	99.93	100.04	100.47	100.02

Sl. No.	1978–79 DEC.	JAN.	FEB.	MAR.	APR.	MAY	1979–80 JUNE	JULY	AUG.	SEPT.
1.	420.99 (96.91)	420.24 (96.14)	419.54 (96.58)	419.44 (96.56)	418.04 (96.23)	418.94 (96.44)	419.04 (96.46)	418.74 (96.39)	418.94 (96.44)	419.04 96.46)
2.	615.90 (54.01)	616.75 (54.09)	615.10 (53.94)	615.15 (53.95)	616.60 (54.08)	614.50 (53.89)	614.40 (53.88)	614.30 (53.87)	614.20 (53.87)	613.70 (53.82)
3.	400.80 (59.08)	400.00 (58.96)	401.00 (59.11)	400.70 (59.06)	399.90 (58.95)	399.15 (58.84)	398.75 (58.78)	398.90 (58.80)	399.20 (58.84)	399.60 (58.90)
4.	377.15 (93.12)	376.64 (92.99)	376.08 (92.85)	375.39 (92.68)	374.05 (92.35)	373.95 (92.33)	375.05 (92.60)	374.91 (92.57)	373.75 (92.28)	373.95 (97.33)
5.	889.80 (55.79)	892.70 (55.97)	889.00 (55.74)	888.90 (55.73)	888.90 (55.73)	888.60 (55.72)	888.90* (55.73)	889.30* (55.76)	890.00 (55.80)	890.10 (55.81)
6.	500.35 (112.63)	498.75 (112.27)	499.84 (112.51)	498.50 (112.21)	498.60 (122.24)	497.80 (112.06)	497.74 (112.04)	497.78 (112.05)	497.80 (112.06)	498.30 (112.17)
	471.54	471.02	470.74	470.19	469.58	469.27	469.50	469.44	469.28	469.49
	101.54	101.02	100.74	100.19	99.58	99.27	99.50	99.44	99.28	99.49

Sl. No.	1979-80 OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	Remarks
1.	419.14 (96.49)	419.34 (96.53)	419.34 (96.53)						Assuming datum 370.00 M above M.S.L.
2.	614.30 (53.87)	615.10 (53.94)	615.50 (53.98)						
3.	400.00 (58.96)	400.40 (59.02)	401.20 (59.14)						
4.	377.25 (93.14)	379.13 (93.61)	380.76 (94.01)						
5.	888.90 (55.73)	889.10* (55.75)	889.10* (55.75)						
6.	498.30 (112.17)	500.20 (112.62)	500.56 (112.68)						
	470.36	471.47	472.08						
	100.36	101.47	102.08						

* Represents data generated.

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT BIJAPUR, KARNATAKA

Sl. No.	Name of Obs. well	R.L. of obs. well	Area in sq. km.	Area factor	1983-84 JAN	1983-84 APR.	1983-84 MAY	1984-85 JUNE	1984-85 AUG.
1.	Badami	696.00	2508.80	0.1470	684.07 (100.56)	681.50 (100.18)	680.35 (100.01)	679.20 (99.84)	681.62 (100.20)
2.	Bilgi	560.00	3880.40	0.2273	550.59 (125.14)	547.00 (124.33)	547.00 (124.33)	547.00 (124.33)	555.44 (126.25)
3.	Malapur	560.00	1354.10	0.0793	558.32 (44.28)	558.01 (44.25)	557.31 (44.19)	556.60 (44.14)	558.43 (44.28)
4.	Muddebipal	584.10	4503.50	0.2639	574.12 (151.51)	571.60 (150.85)	570.35 (150.52)	569.10 (150.19)	570.10 (150.44)
5.	Saidpur	567.70	519.20	0.0304	564.46 (17.60)	564.26 (17.15)	562.93 (17.11)	561.60 (17.07)	564.71 (17.17)
6.	Sindgi	502.20	4303.00	0.2521	496.15 (125.08)	494.41 (124.64)	493.61 (124.44)	492.81 (124.24)	495.21* (124.84)
Average ground water level (in Meter) from M.S.L.					564.17	561.41	560.61	559.81	563.18
Average ground water level w.r.t. datum					79.17	76.41	75.60	74.81	78.18

Note: For analysis, value in bracket represents ground water level multiplied by area weight.

* Represents data generated.

Sl. No.	1984-85 NOV	JAN	APRIL	MAY	JUN	1985-86 AUG	NOV	JAN	APRIL	MAY	Remarks
1.	685.15 (100.72)	683.46 (100.47)	682.46 (100.31)	681.35 (100.16)	Data not available	681.46 (100.16)	677.72 (99.63)	679.62 (99.90)	678.67* (99.76)	677.72 (99.63)	Assuming Datum-485.00M above M.S.L.
2.	558.73 (127.00)	555.79 (126.33)	553.80 (125.88)	551.97 (125.46)		547.00 (124.33)	551.86 (125.44)	549.65 (124.94)	548.33 (124.73)	547.00 (124.33)	
3.	558.48 (44.29)	558.10* (44.26)	557.50 (44.21)	557.10* (44.18)		558.29 (44.27)	558.78 (44.31)	558.38 (44.28)	557.20* (44.19)	557.20* (44.09)	
4.	571.05 (150.70)	569.10 (150.19)	569.10 (150.19)	569.10 (150.19)		570.49 (50.55)	570.73 (150.62)	569.10 (150.15)	570.30* (150.50)	571.58 (150.84)	
5.	564.93 (17.17)	564.55 (17.19)	563.20 (17.12)	561.85 (17.08)		564.26 (17.15)	564.76 (17.17)	556.78 (16.93)	558.40* (16.98)	560.00 (17.02)	
6.	497.80 (125.45)	497.10 (125.32)	495.85 (125.00)	494.60 (124.70)		498.53 (125.68)	498.46 (125.66)	496.90 (125.27)	494.70* (124.71)	492.50 (124.16)	
	565.32	563.72	562.71	561.75	-	562.17	562.82	561.50	560.78	560.07	
	80.32	78.72	77.71	76.75		77.17	77.82	76.50	75.78	75.07	

* represents data generated

APPENDIX : VI-11

AVERAGE GROUNDWATER LEVEL (IN METER) FROM M.S.D. FOR DISTRICT BELGAUM, STATE KARNATAKA

Sl. No.	Name of Obs.well	R.L. of Obs. well (in M.)	Area influenced by well (Sq.Km.)	Area factor	1976-77 JUNE	1976-77 AUG	1976-77 NOV	1976-77 JAN	1976-77 APR	1977-78 JUNE	1977-78 AUG
1.	ATHANI	564.00	1529.51	0.1136	553.15	551.70	551.05	550.95 (62.590	550.40 (62.53)	551.50 (62.65)	552.85 (63.80)
2.	CHIKKODI	643.00	1721.70	0.1279				632.10 (80.85)	634.60 (81.17)	633.60* (81.04)	632.80 (80.94)
3.	ANKALAGI	670.00	2824,23	0.2098	664.15	662.77	662.30	661.60 (138.80)	660.85 (138.65)	661.70 (138.83)	662.95 (139.09)
4.	LONDA	610.00	3038.10	0.2257				602.30 (135.94)	601.80 (135.83)	605.20* (136.59)	606.33 (136.85)
5.	RAIBHAG	664.00	1835.85	0.1364	650.62	648.85	648.25	648.25 (88.42)	648.25 (88.42)	651.30 (88.84)	656.10 (89.49)
6.	KARI KATTI	655.00	2511.41	0.1866				632.20 (117.97)	637.20 (118.90)	635.80* (118.64)	635.90 (118.66)
Average Ground water level (in meters) from M.S.L.								624.57	625.49	626.58	627.83
Average Ground water level (in meters) w.r.t. datum								84.57	85.49	86.58	87.83

Note: For analysis, Value in bracket represents ground water level multiplied by area weight.
* represents data generated

Sl. No.	1984-85 NOV	1984-85 JAN	1984-85 APRIL	1984-85 MAY	JUN	1985-86 AUG	1985-86 NOV	1985-86 JAN	1985-86 APRIL	1985-86 MAY	Remarks
1.	685.15 (100.72)	683.46 (100.47)	682.46 (100.31)	681.35 (100.16)	Data not available	681.46 (100.16)	677.72 (99.63)	679.62 (99.90)	678.67* (99.76)	677.72 (99.63)	Assuming Datum-485.00M above M.S.L.
2.	558.73 (127.00)	555.79 (126.33)	553.80 (125.88)	551.97 (125.46)		547.00 (124.33)	551.86 (125.44)	549.65 (124.94)	548.33 (124.73)	547.00 (124.33)	
3.	558.48 (44.29)	558.10* (44.26)	557.50 (44.21)	557.10* (44.18)		558.29 (44.27)	558.78 (44.31)	558.38 (44.28)	557.20* (44.19)	557.20* (44.09)	
4.	571.05 (150.70)	569.10 (150.19)	569.10 (150.19)	569.10 (150.19)		570.49 (50.55)	570.73 (150.62)	569.10 (150.15)	570.30* (150.50)	571.58 (150.84)	
5.	564.93 (17.17)	564.55 (17.19)	563.20 (17.12)	561.85 (17.08)		564.26 (17.15)	564.76 (17.17)	556.78 (16.93)	558.40* (16.98)	560.00 (17.02)	
6.	497.80 (125.45)	497.10 (125.32)	495.85 (125.00)	494.60 (124.70)		498.53 (125.68)	498.46 (125.66)	496.90 (125.27)	494.70* (124.71)	492.50 (124.16)	
	565.32	563.72	562.71	561.75	-	562.17	562.82	561.50	560.78	560.07	
	80.32	78.72	77.71	76.75		77.17	77.82	76.50	75.78	75.07	

* represents data generated

Sl.	1977-78			1978-79					1979-80		
No.	NOV	JAN	APR	JUNE	AUG	NOV	JAN	APR	JUN	AUG	NOV
1.	552.05 (62.71)	552.20 (72.73)	551.45 (62.65)	550.85 (62.58)	550.65 (62.55)	559.80 (63.59)	559.38 (63.55)	557.88 (63.38)	557..50 (63.33)	558.29 (63.43)	559.30 (63.54)
2.	636.40 (81.40)	635.20 (81.24)	635.40 (81.27)	634.10 (81.10)	634.30* (81.13)	636.50 (81.41)	637.52 (81.54)	635.25 (81.25)	633.80 (81.06)	635.20 (81.24)	636.70 (81.43)
3.	663.00 (139.10)	662.90 (139.08)	661.27 (138.73)	662.50 (138.99)	663.15 (139.13)	663.50 (139.20)	663.11 (139.12)	661.15 (138.71)	662.00 (138.89)	663.12 (139.12)	661.25 (138.73)
4.	604.55 (136.45)	604.27 (136.38)	602.00 (135.87)	606.80 (136.96)	608.16 (137.36)	604.40 (136.41)	602.69 (136.03)	602.30 (135.94)	605.20 (136.59)	607.48 (137.11)	605.04 (136.36)
5.	660.60 (90.11)	697.70 (89.71)	655.20 (89.37)	652.50 (89.00)	655.50 (89.41)	662.10 (90.31)	697.30 (89.66)	654.80 (89.32)	653.90 (89.19)	660.28 (90.06)	659.39 (89.94)
6.	634.80 (118.45)	634.50 (118.40)	637.61 (118.98)	636.15 (118.71)	633.95 (118.30)	635.40 (118.57)	637.23 (118.91)	634.71 (118.44)	633.10 (118.14)	637.36 (118.93)	638.31 (119.11)
	628.21 88.21	627.54 87.54	626.87 86.86	627.33 87.33	627.78 87.78	629.49 89.49	628.80 88.80	627.02 87.02	627.21 87.21	629.89 89.89	629.31 89.31

* represents data generated

Sl.	1979-80				1980-81				1981-82		
No.	JAN	APR	JUNE	AUG	NOV	JAN	APR	JUNE	AUG	NOV	JAN
1.	558.58 (63.46)	558.08 (63.40)	557.20 (63.30)	556.78 (63.25)	556.15 (63.18)	555.74 (63.13)	555.00 (63.05)	556.85 (63.26)	551.65 (63.35)	560.20 (63.64)	559.20 (63.53)
2.	636.10 (81.36)	635.90 (81.33)	634.45 (81.15)	634.80 (81.19)	635.20 (81.24)	634.90 (81.20)	631.50 (80.77)	633.45 (81.02)	635.45 (81.27)	636.80 (81.45)	636.20 (81.37)
3.	663.10 (139.12)	661.05 (138.69)	660.70 (138.62)	662.40 (138.97)	663.25 (138.15)	662.70 (139.03)	661.20 (138.72)	661.80 (138.46)	662.85 (139.07)	663.70 (139.24)	662.90 (139.08)
4.	602.77 (136.05)	601.42 (135.74)	607.06 (137.01)	608.07 (137.24)	605.15 (136.58)	604.10 (136.35)	600.90 (135.62)	604.80 (136.50)	607.63 (137.14)	604.98 (136.54)	603.65 (136.24)
5.	657.75 (89.72)	654.47 (89.27)	660.35 (90.07)	659.70 (89.98)	658.80* (89.86)	659.40 (89.94)	655.10 (89.36)	660.10* (90.04)	660.20 (90.05)	658.20 (89.78)	659.00* (89.89)
6.	638.18 (119.08)	636.05 (118.69)	638.05 (119.06)	638.75 (119.19)	638.95 (119.23)	638.18 (119.08)	637.05 (118.87)	638.00 (119.05)	642.88 (119.96)	638.60 (119.16)	637.80 (119.01)
	628.78 88.78	627.12 87.12	629.20 89.20	629.83 89.83	629.24 89.24	628.74 88.74	626.39 86.39	628.33 88.33	630.84 90.84	629.82 89.82	629.12 89.12

* represents data generated

Sl. No.	1981-82 APR.	JUNE	AUG.	1982-83 NOV.	JAN.	APR.	JUNE	1983-84 AUG.	NOV.	JAN.	APR.
1.	557.25 (63.30)	557.95 (63.38)	557.00 (63.28)	558.55 (63.45)	557.60 (63.34)	557.00 (63.28)	558.20 (63.41)	556.08 (63.17)	557.20* (63.30)	557.20 (63.38)	594.60 (63.44)
2.	635.00 (81.22)	634.10 (81.10)	633.35 (81.01)	632.80 (80.94)	631.50 (80.77)	634.10 (81.10)	633.80* (81.06)	635.70 (81.31)	634.60 (81.17)	636.94 (81.47)	633.75 (81.06)
3.	661.75 (138.62)	662.10 (138.91)	663.20 (139.14)	662.90 (139.08)	662.40 (138.97)	661.50 (138.78)	661.80 (138.85)	664.48 (139.41)	663.20 (139.14)	662.60 (139.01)	661.80* (138.85)
4.	600.90 (135.62)	602.80 (136.05)	608.21 (137.27)	604.93 (136.53)	602.50 (135.98)	598.70 (135.13)	601.30 (135.71)	606.90 (136.98)	604.20 (136.37)	600.05 (135.43)	598.15 (135.00)
5.	655.40 (89.40)	660.80 (90.13)	660.50* (90.09)	659.20 (89.92)	658.60 (89.83)	655.30 (89.38)	659.80 (90.00)	660.33 (90.07)	659.40 (89.94)	658.47 (89.82)	656.71 (89.58)
6.	638.30 (119.11)	639.30 (119.30)	638.38 (119.12)	638.70 (119.18)	638.60 (119.16)	635.60 (118.60	638.20 (119.09)	638.35 (119.12)	637.90* (118.94)	637.87 (119.03)	636.20 (118.72)
	627.48	628.87	629.91	629.09	628.06	626.27	628.12	630.05	628.85	628.13	625.63
	87.48	88.87	89.91	89.09	88.06	86.27	88.12	90.05	88.85	88.13	85.63

* Represents data generated.

Sl. No.	1984-85					1985-86					Remarks
	JUNE	AUG.	NOV.	JAN.	APR.	JUNE	AUG.	NOV.	JAN.	APR.	
1.	549.60 (62.44)	551.32 (62.63)	556.70 (63.24)	556.45 (63.21)	556.55 (63.22)	556.18 (63.18)	556.80 (63.25)	557.27 (63.31)	554.73 (63.02)	554.76 (63.02)	Assuming datum
2.	633.30* (81.00)	636.03 (81.35)	638.15 (81.62)	635.13 (81.23)	631.50 (80.77)	635.43 (81.27)	638.30 (81.64)	635.70 (81.31)	637.54 (81.54	631.50 (80.77)	540.0 M above
3.	661.20 (138.72)	662.20* (138.93)	663.58 (139.22)	662.95 (139.09)	662.05 (138.90	661.80 (138.85)	662.62 (139.02)	661.95 (138.88)	661.60* (138.80)	660.20 (138.51)	M.S.L.
4.	600.19 (135.46)	603.36 (136.18)	603.92 (136.31)	602.10 (135.89)	601.70 (135.80)	602.95 (136.09)	606.92 (136.98)	602.63 (136.01)	600.14 (135.45)	596.74 (134.68)	
5.	659.54 (89.96)	658.72 (89.85)	659.80 (90.00)	660.00 (90.02)	655.62 (89.43)	648.25 (88.42)	660.05 (90.03)	658.33 (89.80)	658.24 (89.78)	648.25 (88.42)	
6.	637.19 (118.90)	638.01 (119.05)	637.78 (119.01)	637.45 (118.95)	637.10 (118.88)	647.27 (120.78)	637.65 (118.99)	637.30 (118.92)	637.86 (119.03)	637.30 (118.92)	
	626.48	627.99	629.39	628.40	627.01	628.59	629.91	628.22	627.62	624.33	
	86.48	87.99	89.39	88.40	87.01	88.59	89.91	88.22	87.62	84.33	

* Represents data generated.

APPENDIX VI-12

AVERAGE GROUND WATER LEVEL ((N METER) FROM M.S.L. FOR DISTT. AHEMADNAGAR , MAHARASHTRA

Sl. No.	Name of Obs. well	R.L. of Obs. well(in M)	Area influenced by by Obs. Well (sq.km.)	Area weight	1975-76		1976-77		1977-78	
					Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre Mon.
1.	Supa	710.36	5958	0.3497	697.71 (243.99)	696.25 (243.78)	697.66 (243.97)	694.36 (243.17)	694.86 (242.99)	696.36 (243.52)
2.	Saikhindi	630.48	1291	0.0758	619.79 (46.98)	618.29 (46.87)	621.73 (47.13)	618.53 (46.89)	616.98 (46.77)	617.33 (46.79)
3.	Telegaon	594.51	1071	0.0629	587.12 (36.93)	584.11 (36.74)	586.61 (36.90)	583.61 (36.71)	583.81 (36.72)	583.61 (36.71)
4.	Takali	509.14	355	0.0208	503.68 (10.47)	502.98 (10.46)	503.49 (10.47)	502.47 (10.45)	504.64 (10.50)	502.44 (10.45)
5.	Apegaon	521.64	489	0.0287	514.63 (14.77)	516.01 (14.81)	518.04 (14.87)	512.59 (14.71)	517.89 (14.86)	512.64 (14.71)
6.	Bota	683.53	2122	0.1246	675.79 (84.20)	667.83 (83.21)	681.78 (84.95)	676.43 (84.28)	679.88 (84.71)	676.48 (84.29)
7.	Kukana	434.81	3991	0.2343	433.40 (101.55)	430.76 (100.93)	431.91 (101.20)	429.76 (100.69)	430.46 (100.86)	429.46 (100.62)
8.	Mali Babhulg	692.07	1758	0.1032	687.07 (70.91)	684.84 (70.68)	685.57 (70.75)	682.67 (70.45)	688.47 (71.05)	684.67 (70.66)
Average ground water level from M.S.L. in Meters					609.80	607.17	610.24	607.35	608.46	607.75
Ground water level w.r.t. datum					119.80	117.17	120.24	117.35	118.46	117.75

Note: For analysis, data of May month have been used for pre-monsoon. Data of October month have been used for post-monsoon. Value in bracket represents ground water level multiplied by area weight.

Sl. No.	1978-79		1979-80		1980-81		1981-82		1982-83	
	Post Mon	Pre. Mon.	Post Mon	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.
1.	698.96 (244.43)	692.11 (242.03)	708.06 (247.70)	693.40 (242.41)	708.06 (247.70)	693.40 (242.48)	707.66 (247.47)	692.50 (242.17	705.01 (246.57)	692.11 (242.03)
2.	617.08 (46.78)	620.93 (46.07)	626.93 (47.52)	624.08 (47.31)	627.58 (47.57)	623.53 (47.26)	627.28 (47.55)	622.98 (47.22)	623.38 (47.25)	623.43 (47.26)
3.	584.71 (36.78)	580.81 (36.53)	587.01 (36.92)	582.61 (36.65)	586.11 (36.87)	581.71 (36.59)	584.61 (36.77)	580.81 (36.53)	584.36 (36.76)	580.81 (36.53)
4.	503.24 (10.47)	500.89 (10.42)	504.04 (10.48)	501.84 (10.44)	502.84 (10.46)	502.24 (10.45)	502.54 (10.45)	500.34 (10.41)	500.64 (10.41)	499.94 (10.40)
5.	512.49 (14.71)	512.54 (14.71)	514.54 (14.77)	514.64 (14.77)	516.94 (14.84)	516.29 (14.82)	515.29 (14.79)	513.44 (14.74)	512.84 (14.72)	512.19 (14.70)
6.	674.88 (84.09)	675.13 (84.12)	682.23 (85.01)	674.83 (84.09)	682.23 (85.01)	673.98 (83.98)	681.73 (84.94)	675.03 (84.11)	674.03 (83.98)	673.08 (83.87)
7.	430.71 (100.92)	428.31 (100.35)	432.31 (101.290	426.11 (99.84)	431.56 (101.12)	426.72 (99.98)	429.96 (100.74)	427.41 (100.14)	430.46 (100.86)	420.31 (98.48)
8.	684.47 (70.64)	680.97 (70.28)	686.22 (70.82)	683.47 (70.53)	686.17 (70.81)	686.97 (70.90)	684.47 (70.64)	679.87 (70.16)	681.27 (70.31)	681.22 (70.30)
	608.80	605.51	614.51	606.03	614.37	606.45	613.35	605.48	610.86	603.57
	118.80	115.51	124.51	116.03	124.37	116.45	123.35	115.48	120.88	113.57

Sl. No.	1983-84 Post Mon.	1983-84 Pre. Mon.	1984-85 Post Mon.	1984-85 Pre. Mon.	1985-86 Post Mon.	1985-86 Pre. Mon.	Remarks
1.	708.86 (247.89)	705.26 (246.63)	707.86 (247.54)	702.36 (245.62)	705.35 (246.66)	703.61 (246.05)	Assuming datum 490.00 M above M.S.L.
2.	627.13 (47.54)	624.38 (47.33)	625.48 (47.41)	623.08 (47.23)	622.88 (47.21)	622.48 (47.18)	
3.	585.61 (36.84)	580.81 (36.53)	583.11 (36.68)	580.81 (36.53)	582.71 (36.65)	580.81 (36.54)	
4.	503.50 (10.47)	503.04 (10.46)	501.54 (10.43)	498.29 (10.36)	498.29 (10.36)	498.29 (10.36)	
5.	514.39 (14.76)	513.21 (14.73)	512.84 (14.72)	513.19 (14.73)	511.34 (14.68)	512.19 (14.70)	
6.	677.68 (84.44)	675.33 (84.15)	681.33 (84.89)	675.53 (84.17)	672.93 (83.85)	671.63 (83.69)	
7.	429.19 (100.56)	420.36 (98.49)	427.91 (100.26)	431.41 (101.08)	428.30 (100.35)	420.11 (98.43)	
8.	686.62 (70.86)	684.37 (70.63)	684.47 (70.64)	681.37 (70.32)	681.67 (70.35)	679.87 (70.16)	
	613.35	608.95	612.57	610.04	610.12	607.11	
	123.35	118.95	122.57	120.04	120.12	117.11	

APPENDIX VI-13

AVERAGE GROUND WATER LEVEL (IN METER) FROM M.S.L. FOR DISTRICT SOLAPUR, MAHARASHTRA

Sl. No.	Name of Obs. well	R.L. of Obs. well in meters	Area Influenced by well (sq.km)	Area weight	1978-79		1979-80		1980-81	
					Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.	Post Mon.	Pre. Mon.
1.	Wadegaon	486.28	1601.60	0.1066	482.08 (51.39)	479.23 (51.09)	483.48 (51.54)	479.58 (51.12)	480.73 (51.25)	478.38 (51.00)
2.	Diksal	474.08	1508.45	0.1004	473.98 (47.59)	472.43 (47.43)	473.98 (47.59)	473.03 (47.49)	472.53 (47.44)	470.28 (47.22)
3.	Kandalgaon	466.46	1186.81	0.079	460.51 (36.38)	461.86 (36.49)	463.86 (36.65)	461.71 (36.48)	461.91 (36.49)	459.81 (36.33)
4.	Musti	480.18	2311.29	0.1539	474.08 (72.96)	473.98 (72.95)	474.63 (73.05)	474.18 (72.98)	474.93 (73.09)	473.93 (72.94)
5.	Kalman	493.90	1239.32	0.0825	491.65 (40.56)	485.1 (40.02)	491.85 (40.58)	487.9 (40.25)	491.8 (40.57)	484.55 (39.98)
6.	Pende	542.68	2065.54	0.1375	538.08 (73.99)	534.48 (73.49)	537.73 (73.94)	535.83 (73.68)	538.78 (74.08)	535.03 (73.57)
7.	Kuslamb	562.50	1505.10	0.1002	561.2 (56.23)	550.7 (55.18)	561.35 (56.25)	550.55 (55.17)	560.55 (56.16)	549.95 (55.11)
8.	Jeur	440.54	1795.57	0.1195	434.54 (51.93)	433.89 (51.85)	436.59 (52.17)	435.44 (52.04)	436.84 (52.200	432.5 (51.74)
9.	Uplai	493.90	1807.32	0.1203	489.1 (58.84)	479.0 (57.62)	489.1 (58.83)	483.8 (58.20)	477.4 (57.43)	477.5 (54.44)
Average ground water level (in M.) from M.S.L.					489.86	486.12	490.58	487.40	488.72	485.31
Average ground water level w.r.t. datum					61.86	58.12	62.58	59.40	60.72	57.31

Note: For analysis, Data of May month have been used for pre-monsoon. Data of October month have been used for post-monsoon. Value in bracket represents ground water level multiplied by area weight.

Sl. No.	1981-82 Post Mon.	1981-82 Pre. Mon.	1982-83 Post Mon.	1982-83 Pre. Mon.	1983-84 Post Mon.	1983-84 Pre. Mon.	1984-85 Post Mon.	1984-85 Pre. Mon.	1985-86 Post Mon.	1985-86 Pre. Mon.	Remarks
1.	482.98 (51.48)	479.48 (51.11)	482.50 (51.44)	477.28 (50.88)	482.48 (51.43)	479.28 (51.09)	481.73 (51.35)	478.78 (51.04)	480.99 (51.27)	478.10 (50.97)	Assuming datum - 428.0 M above M.S.L.
2.	473.68 (47.56)	472.48 (47.44)	473.13 (47.50)	471.08 (47.30)	473.98 (47.59)	471.88 (47.38)	473.78 (47.57)	471.98 (47.39)	473.51 (47.54)	471.52 (47.34)	
3.	464.06 (36.66)	461.46 (36.46)	461.81 (36.48)	459.66 (36.32)	464.61 (36.70)	460.16 (36.35)	462.96 (36.57)	459.76 (36.32)	462.51 (36.54)	459.26 (36.28)	
4.	475.13 (73.12)	473.93 (72.94)	474.33 (73.00)	472.78 (72.76)	475.48 (73.18)	474.08 (72.96)	474.93 (73.09)	473.08 (72.81)	473.56 (72.88)	471.78 (72.61)	
5.	491.45 (40.55)	484.55 (39.98)	487.15 (40.19)	484.20 (39.95)	492.50 (40.63)	484.20 (39.95)	492.70 (40.65)	483.20 (39.86)	491.60 (40.55)	489.04 (39.93)	
6.	537.38 (73.89)	433.48 (73.35)	435.28 (73.60)	432.43 (73.21)	439.38 (74.16)	432.43 (73.21)	437.78 (73.94)	533.78 (73.39)	536.43 (73.76)	532.34 (73.20)	
7.	559.2 (56.03)	550.75 (55.19)	550.95 (55.21)	549.95 (55.11)	561.15 (55.23)	550.00 (55.10)	558.75 (55.99)	549.95 (55.10)	555.70 (55.68)	549.95 (55.10)	
8.	438.59 (52.41)	434.89 (51.97)	437.89 (52.33)	433.04 (51.75)	439.14 (52.48)	433.74 (51.83)	436.89 (52.21)	434.54 (51.93)	434.82 (51.96)	433.04 (51.75)	
9.	479.4 (57.67)	477.55 (57.45)	485.20 (58.37)	477.40 (57.43)	490.50 (59.01)	486.80 (58.56)	487.70 (58.67)	475.20 (57.17)	487.08 (58.60)	476.12 (57.28)	
	489.38	485.87	485.11	484.69	491.41	486.43	490.04	485.09	488.79	484.44	
	61.38	57.87	60.11	56.69	63.41	58.43	62.04	57.09	60.70	56.44	

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