CASE STUDY

CS (AR) 165

GROUNDWATER - TANK INTERACTION IN JABALPUR DISTRICT, MADHYA PRADESH

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PREFACE

Jabalpur district in Madhya Pradesh is bestowed with many tanks of sizes ranging from 0.10 to 0.4 sq.km.and capacity varying from 2 to 20 M cu.m. There are about 100 such tanks and many amongst them are being used as a source of irrigation after being developed by the Irrigation department of Madhya Pradesh Government. These tanks cater for a command area of approximately 640 Sq.km. of agricultural land.

Interaction of groundwater and surface water is an important component of the hydrologic study of a basin. As a part of the Comprehensive Hydrological study of the Narmada River basin upto Bargi dam taken up by the Institute in this year, the study has been undertaken. The groundwater and related data that were collected from various authorities working in the development of Narmada basin have been used and analysed in the study The contribution of these tanks to groundwater has been estimated for pre and post monsoon seasons.

This report entitled "Groundwater tank interaction in Jabalpur district, Madhya Pradesh" is part of the work programme of the Lake Hydrology Division of the Institute for 1994-95 and has been prepared by Shri A.K.Bhar, Scientist-E.

(S.M.Seth)
Director

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Abstract

Jabalpur district in Madhya Pradesh is bestowed with many tanks of sizes ranging from 0.10 to 0.4 sq.km.and capacity varying from 2 to 20 M cu.m. There are about 100 such tanks and many amongst them are being used as a source of irrigation after being developed by the Irrigation department of Madhya Pradesh Government. These tanks cater for a command area of approximately 640 Sq.km. of agricultural land and a inventory of these tanks along with their respective command area blockwise has been incorporated.

Interaction of groundwater and surface water is an important component of the hydrologic study of a basin. As a part of the Comprehensive Hydrological study of the Narmada River basin upto Bargi dam taken up by the Institute in this year, the study has been undertaken. The groundwater and related data that were collected from various authorities working in the development of Narmada basin have been used and analysed in the study The contribution of these tanks to groundwater has been estimated for the pre and postmonsoon seasons from 1989 to 1993.

The groundwater contours are similar between season to season and amongst different years. As such it could be inferred that the groundwater regime has been stabilised over years due to developing the tanks as sources of minor irrigation by the Irrigation department. Groundwater contours are flat in the northern portion of the district and the contours are within 1:1000 to 1:500 in slope, whereas the contours in the southern portion and specially along the southern district boundary the contours are steep and is 1:100 or less. As there is no pump test data available in the area for the determination of transmissivity of the aquifer, the transmissivity values of 1000sq.meters per day and 100 sq.meters per day have been assumed for the northern and southern portions of the district respectively on the basis of the contour slopes. Locations in the contours wherein the groundwater mounds have occurred are quite naturally the places where sizable tanks are located either on the mound or very near to the mound. It is observed that interaction of tanks with groundwater is quite conspicuous along the boundary of the district espcially in the southern half. It has been estimated that the average contribution from the tanks to groundwater are 1.4 and 1.7 mcu.m in pre and post monsoon seasons respectively.

1.0 Introduction

Jabalpur district is one of the North Eastern district of Madhya Pradesh having four tahsils and covering area of 10.10 lakh Ha. The highest elevation is near village Harduli in Kundam Block district Jabalpur. The lowest elevation is near village Neemkhera block Shahpura in Jabalpur District.

Fiftynine percent of the district lies in Narmada and forty one percent lies in Ganga basin. The main rivers of the district are Gaur, Hiran and Chhoti Mahanadi. Their catchment area etc. are given in Table -1.

Table 1.River system in Jabalpur district

	Catchment area in the distt. (Sq.Km.)	Percentage in the district.	Length in district km.
Narmada			
Gaur	1103	10.89	42
Hiran	4776	47.17	I88
Direct	179	1.78	90
Catchment	6058		320
Ganga			
Chhoti Mahanadi	4066	40.16	135
Total	10124		455

The main geological strata encountered in the district are the alluvium, deccan trap, lameta Jabalpur, Vindhyan and Archeans.

Geohydrological Surveys have been carried out almost in all blocks of this district from the year 1976. The rainfall in the district varies between 1271 to 1397 mm. The maximum and minimum

temperature recorded at Jabalpur observatory are 45.4^{0}C (5/81) and 1.9^{0}C (1/86). Blockwise estimate made by Irrigation Department, M.P (1985) on the ground water potential are given.

Table 2. Blockwise groundwater potential in Jabalpur District
(Source: Engineer in Chief, Irrigation Dept., M.P)

BNLOCK	GROSS RECHAR-GE Mcum.	NET RECHA-RGE 50% Mcum	PRESENT ANNUAL DRAFT Mcum.	GROUND WATER BALANCE TO FURTHER DEVELOPMENT Mcum
BARGI	63.43	31.715	5.68	26.035
BARWARA	143.81	71.905	4.99	66.915
BAHORIBUND	124.00	62.000	11.50	50.500
DHEEMARKHEDA	102.85	51.425	5.00	46.425
KATNI	74.88	37.440	16.00	20.840
KUNDAM	77.11	38.555	2.40	36.065
MAJHOLI	85.71	42.855	10.00	32.855
PANAGAR	74.10	37.050	10.95	26.100
PATAN	126.33	63.165	30.34	32.825
RITHI	84.00	42.000	1.67	40.330
SHAHPURA	172.05	86.025	13.85	72.175
SIHORA	84.28	42.140	7.50	34.640
VIJAY-RAGHOGARH	112.93	56.465	3.87	52.595
GRAND TOTAL	1325.48	662.740	124.44	538.300

It could be seen from the above Table-2 that the groundwater potential in each block has been worked out assuming 50% of gross recharge as net recharge to groundwater. Though not explicit, it seemed that the gross recharge has been arrived at taking some percentage of average rainfall over the block area. But as all the blocks have quite a good number of tanks (more than 100) and these are being used as source of minor irrigation extensively to irrigate an area of about 650 Sq.km.in the district, it is expedient to find the interaction of these tanks to the groundwater in the district.

2.0 Tanks in Jabalpur district

As stated, there are over 100 tanks in Jabalpur district and these are being used and developed as source of irrigation by the M.P.Irrigation Department for quite a long time. List of the tanks given in Table 3 contains most of them which are either already developed to serve as a source of irrigation or being /will be developed to serve as a irrigation source in future. A list of tanks in the 13 blocks are given in Table 3 and as the name of the tanks are as per the village's name, the index map (Map-1) of the district given at the end of the report could be used to find out their locations.

Table 3.List of tanks in different blocks in Jabalpur district.

Sl.No.	Name of the Tank	Desiqned Area(Ha)
BAGRI BLOCK		
1.	Purvatola tank	41
2.	Lodhi tank	150
3.	Indradaman tank	295

4.	Mehgaontola tank	1680
5.	Pipariya tank	133
6.	Keolari tank	97
7.	Deori Patpara tank	1002*
8.	Rani Durgawati tank	2833*
		6231

BADWARA BLOCK

9.	Datla tank	2150
10.	Khitoli tank	1623
11.	Jaguwa tank	324
12.	Jhirgiri tank	1113
13.	Bhajiya tank	117
14.	Malhan tank	265
15.	Lohwan tank	306
16.	Jhapi tank	248
17.	Upper Kihitola tank	2833*
18.	Amheri tank	202*
19.	Sarai tank	81*
		9262

BAHORIBUND BLOCK

20.	Bahoribund tank	2714
21.	Silpuri tank	249
22.	Masanda tank	445
23.	Sakarwara tank	992
24.	Padwar tank	121
25.	Kaundia tank	202
26.	Chhapra tank	219
27.	Kachhargaon tank	101

28.	Patne nalla tank	139
29.	Chhapri tank	380
30.	Deori tank	437
31.	Rampatan tank	397
32.	Salaiya tank	180
33.	Upper Kachhargaon tank	405*
34.	Gidurha tank	607*
35.	Pali Chargawan tank	425*
36.	Hinoti tank	162*
		8175

DHEEMARKHEDA BLOCK

37.	Prachital tank	53
38.	Kisgee tank	143
39.	Dharwara tank	405
40.	Sagona tank	2348
41.	Atariya tank	200
42.	Dehri tank	93
43.	Jajnagra tank	206
44.	Kude tank	206
45.	Khamariya tank	180
46.	Bandori tank	210
47.	Bichhua tank	822
48.	Chhitapal tank	1376*
49.	Katri tank	53*
50.	Kusmi tank	356*
51.	Jhinna Pipariya tank	494*
		7628

KATNI BLOCK

52.	Simrar tank	1659

53.	Surkhi Pondi tank	809
54.	Jrwahi tank	61
55.	Niwar Amehta tank	888
56.	Basadi tank	77
57.	Sarra tank	1134
58.	Ghangri tank	105
59.	Pondi Pipariya tank	162
60.	Imlai tank	153
61.	Saroli tank	168
62.	Hansapur tank	72
63.	Bairagi tank	120
64.	Jhiriya tank	142
65.	Tilhari tank	160
66.	Kachhargaon Imlyia	186*
		5896

KUNDAM BLOCK

67.	Harduli tank	40
68.	Khina tank	344
		384

MAJHOLI BLOCK

69.	Narela tank	51
70.	Gutehi tank	454
71.	Hatoli tank	71
72.	Gorha tank	336
73.	Jamunia tank	223
74.	Changawan tank	165
75.	Deori Amgawan tank	400*
76.	Roopnath tank	607*

77.	Koni Khurd tank	91*
78.	Megai tank	162*
79.	Suhajni tank	162*
		2722

PANAGAR BLOCK

80.	Jabalpur tank	648
81.	Panagar tank	162
82.	Barera & Mohari tank	1474
83.	Pariat tank	971
84.	Chhatarpur tank	81
85.	Kakarhai tank	235
86.	Lamti tank	211
		3782

RITHI BLOCK

87.	Pali tank	121
88.	Bhartala tank	243
89.	Hardwara tank	134
90.	Pabra tank	91
91.	Gorha bunda tank	297
92.	Borina Upper & Lower tank	405
93.	Sugwan tank	122
94.	Patohan tank	138
95.	Godana tank	261
96.	Ghinochi tank	360
97.	Imlaiya tank	170
98.	Basudha tank	324
99.	Barheta tank	702
100.	Kumharwara tank	213

101.	Chikhla tank	97
102.	Ahirgawan tank	109
103.	Imlaj tank	134
104.	Bolha tank	182
105.	Ghughara tank	487*
106.	Aloni tank	497*
107.	Viruhali tank	86*
108.	Simara tank	243*
109.	Ghumchi tank	405*
110.	Tehari tank	429*
		14250
SIHORA BLOCK		
111.	Barnoo tank	2137
112.	Madai tank	2329
113.	Khitola tank	254
		4720
SHAHPURA BLOCK II		
114.	Chhapara tank	67
		67
VIJAYRAGHOGARH BLOCK		
115.	Sijehni tank	111
116.	Pathrehta tank	275
117.	Mohas tank	67
118.	Amadi tank	850
119.	Nanhwara tank	121
120.	Puraini tank	144
		1568

Total designed area:64685 Ha.

* Projects are to be completed

FIG. 1 GROUNDWATER LEVEL PREMONSOON 1989

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

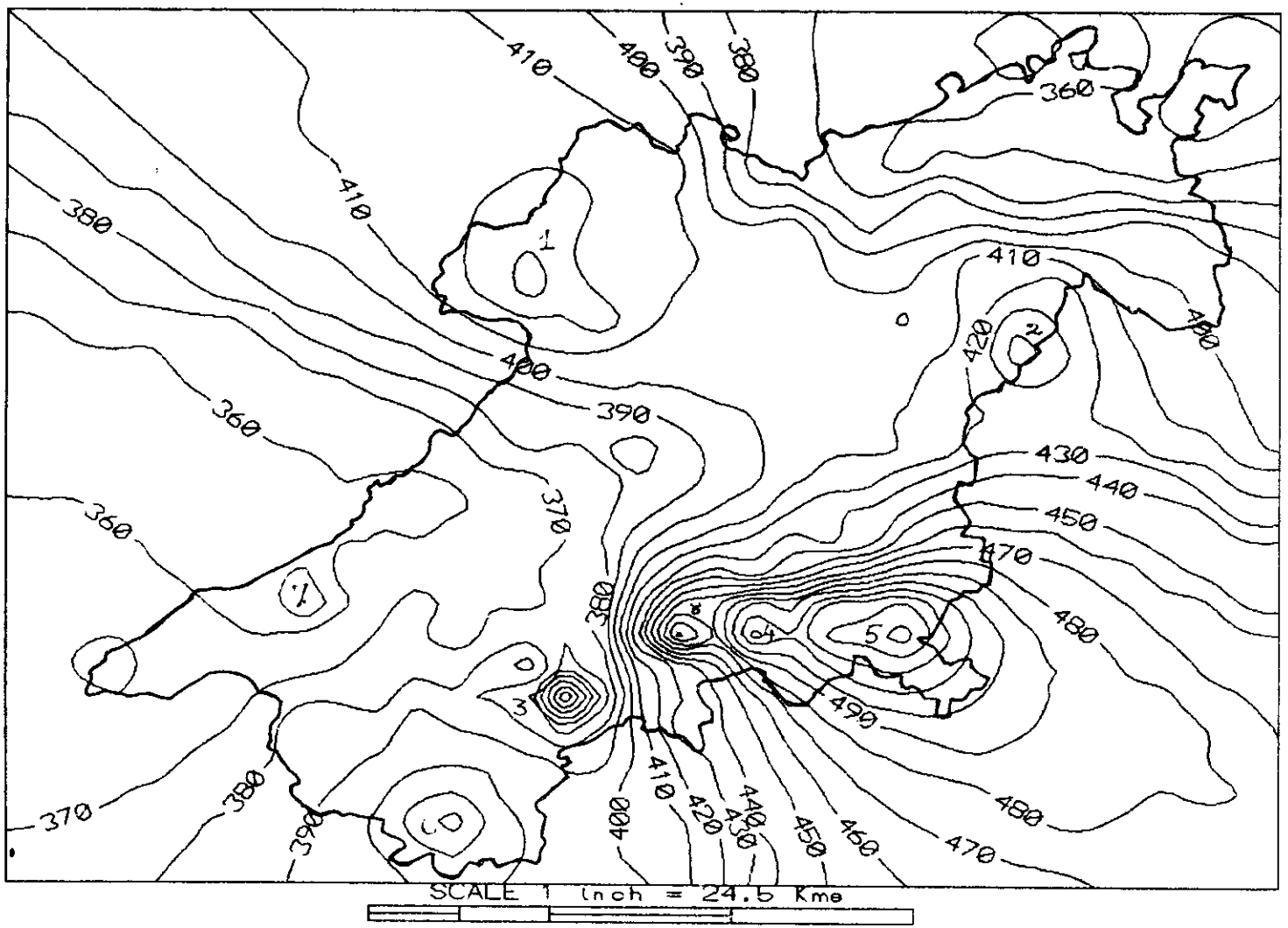


FIG.2 GROUNDWATER LEVEL POSTMONSOON 1989

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

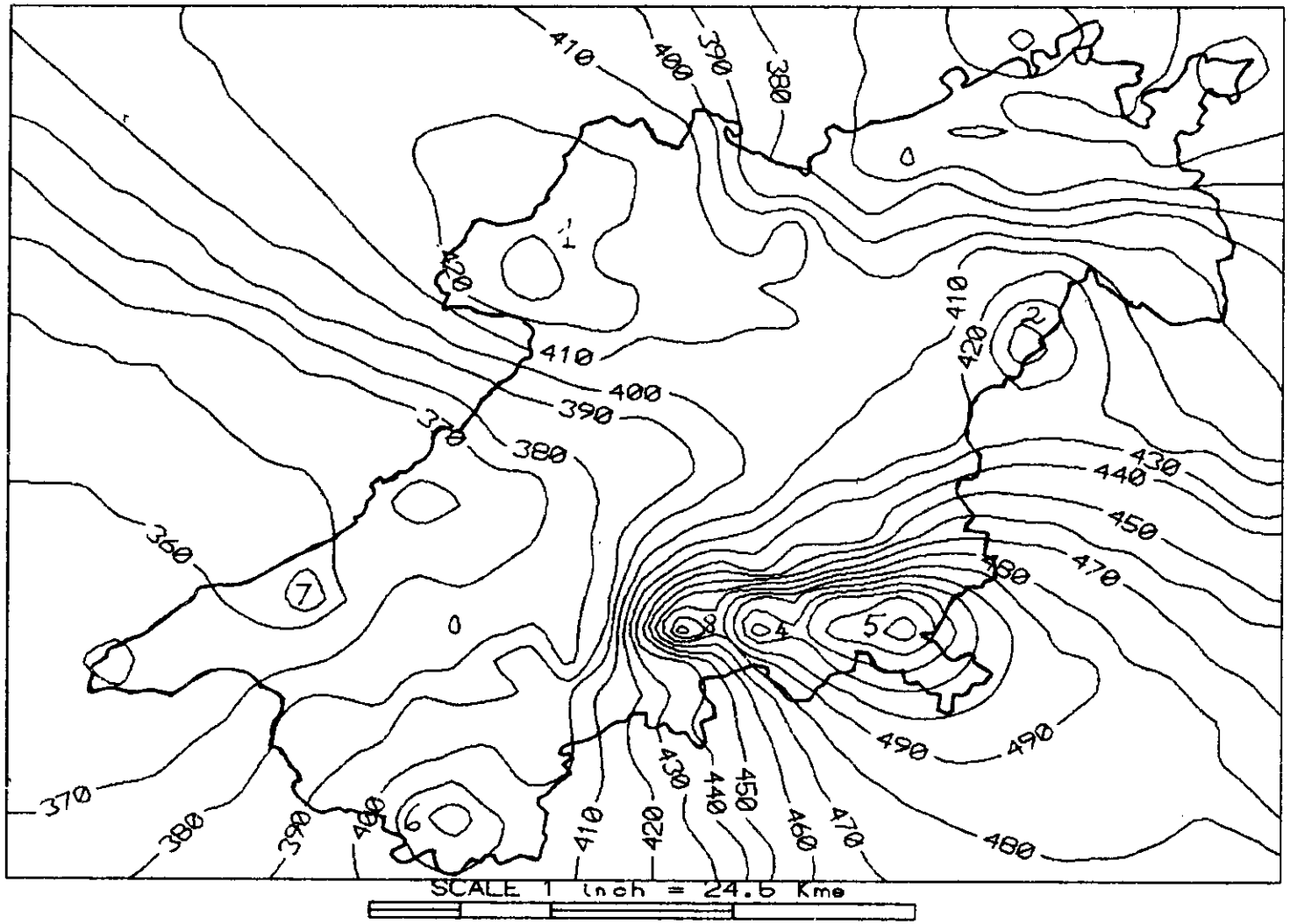


FIG.3 GROUNDWATER LEVEL PREMONSOON 1990

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

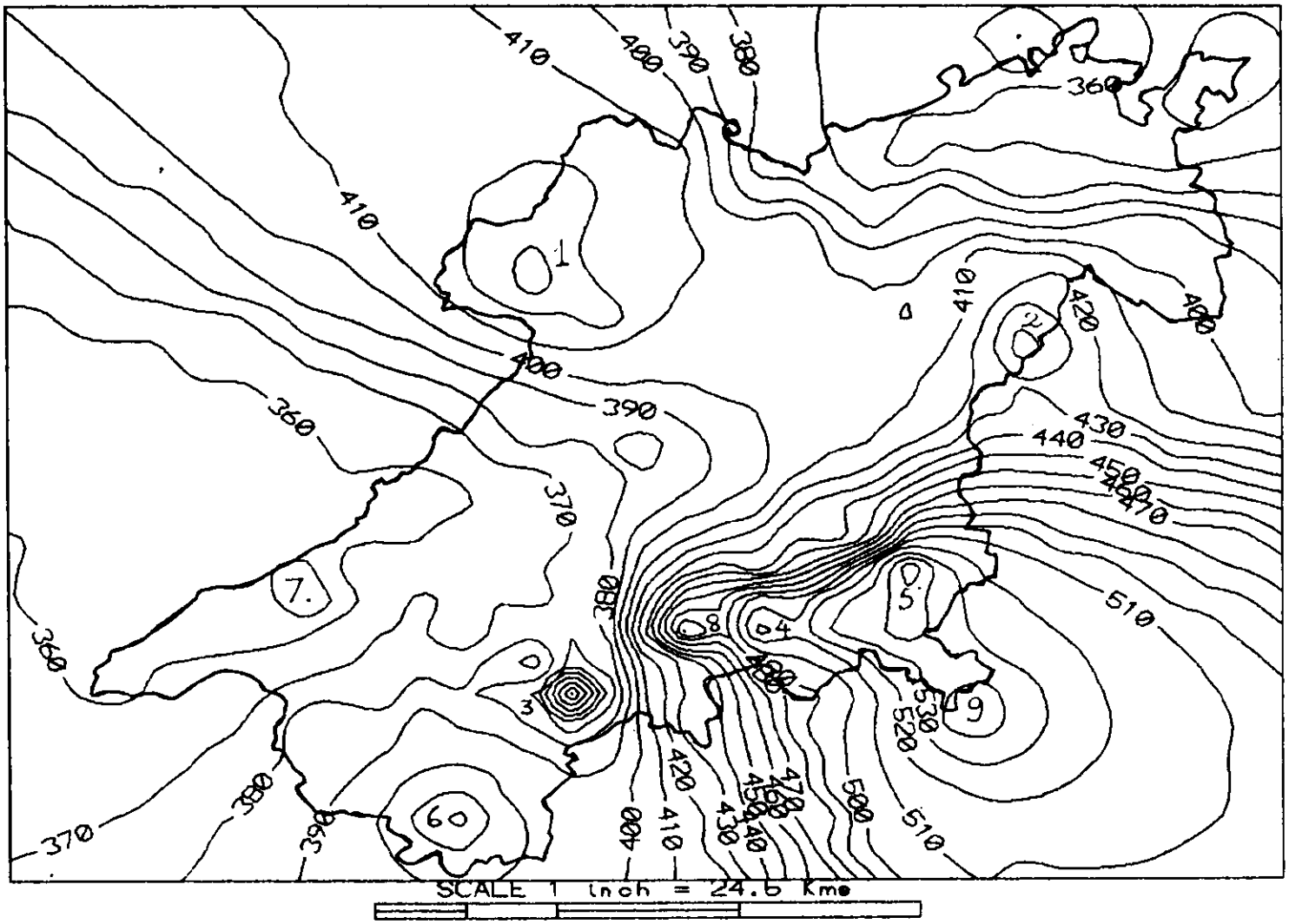


FIG.4 GROUNDWATER LEVEL POSTMONSOON 1990

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

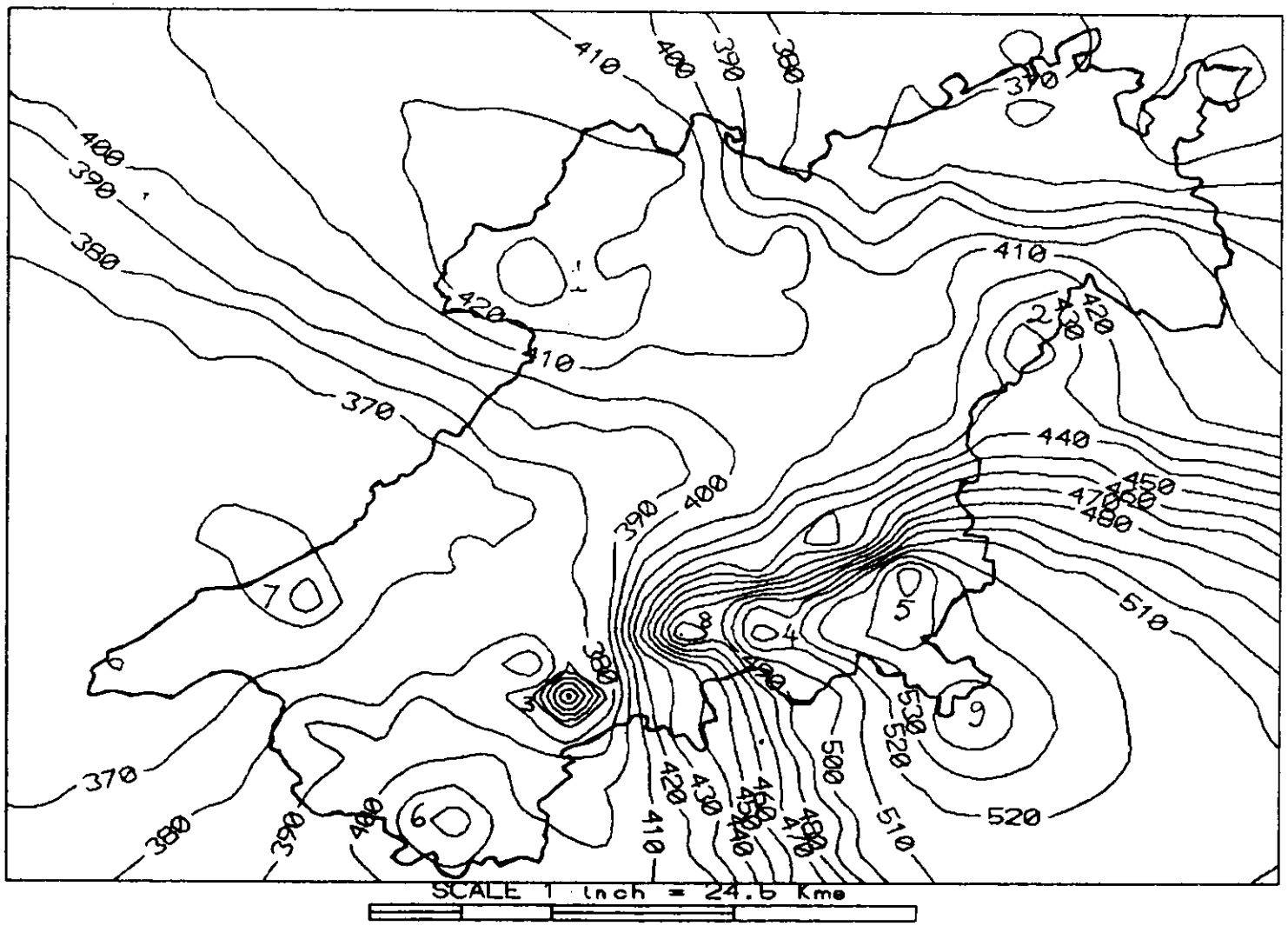


FIG.5 GROUNDWATER LEVEL PREMONSOON 1991

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS. INTERVAL =10 M

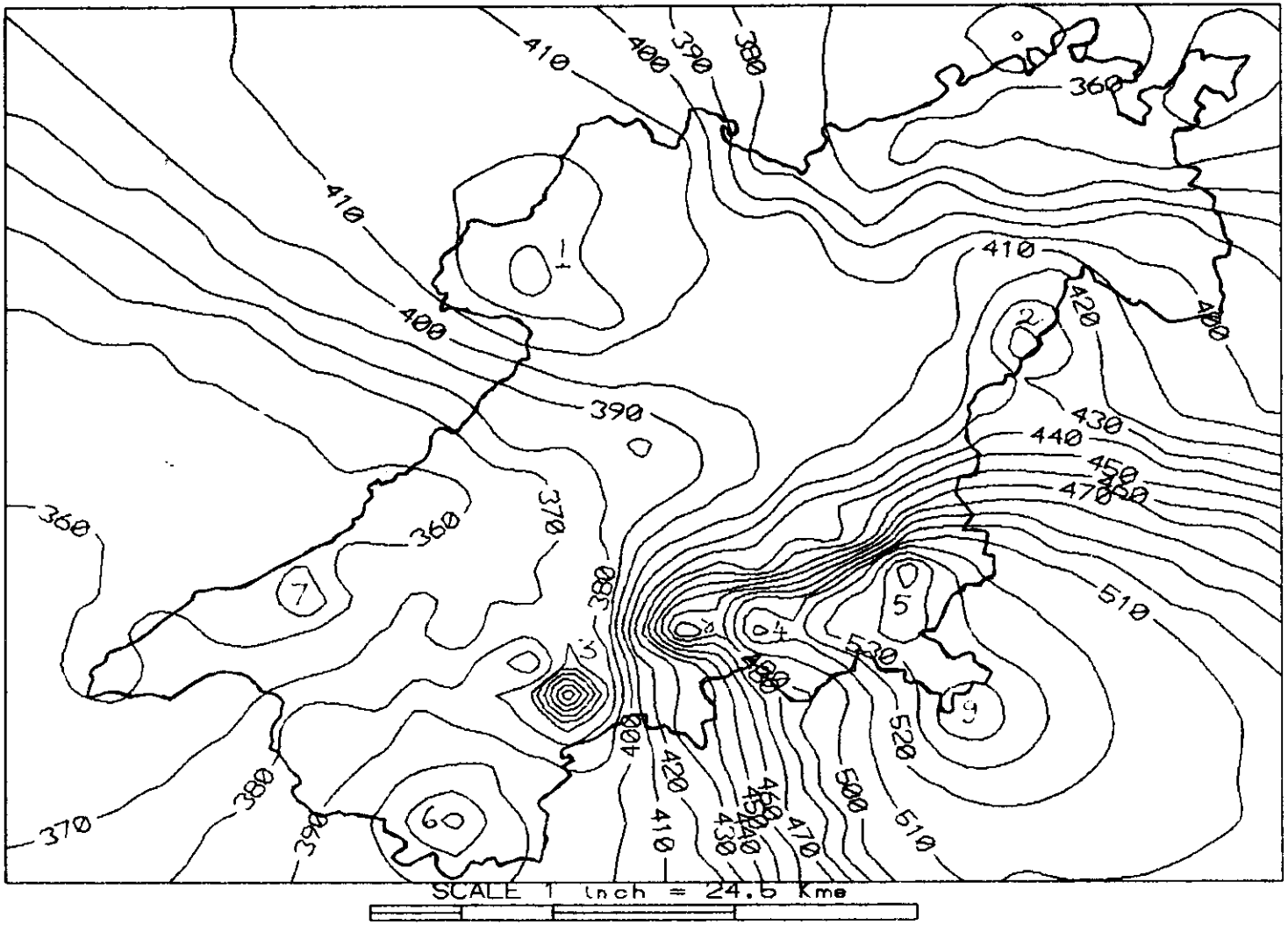


FIG.6 GROUNDWATER LEVEL POSTMONSOON 1991

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

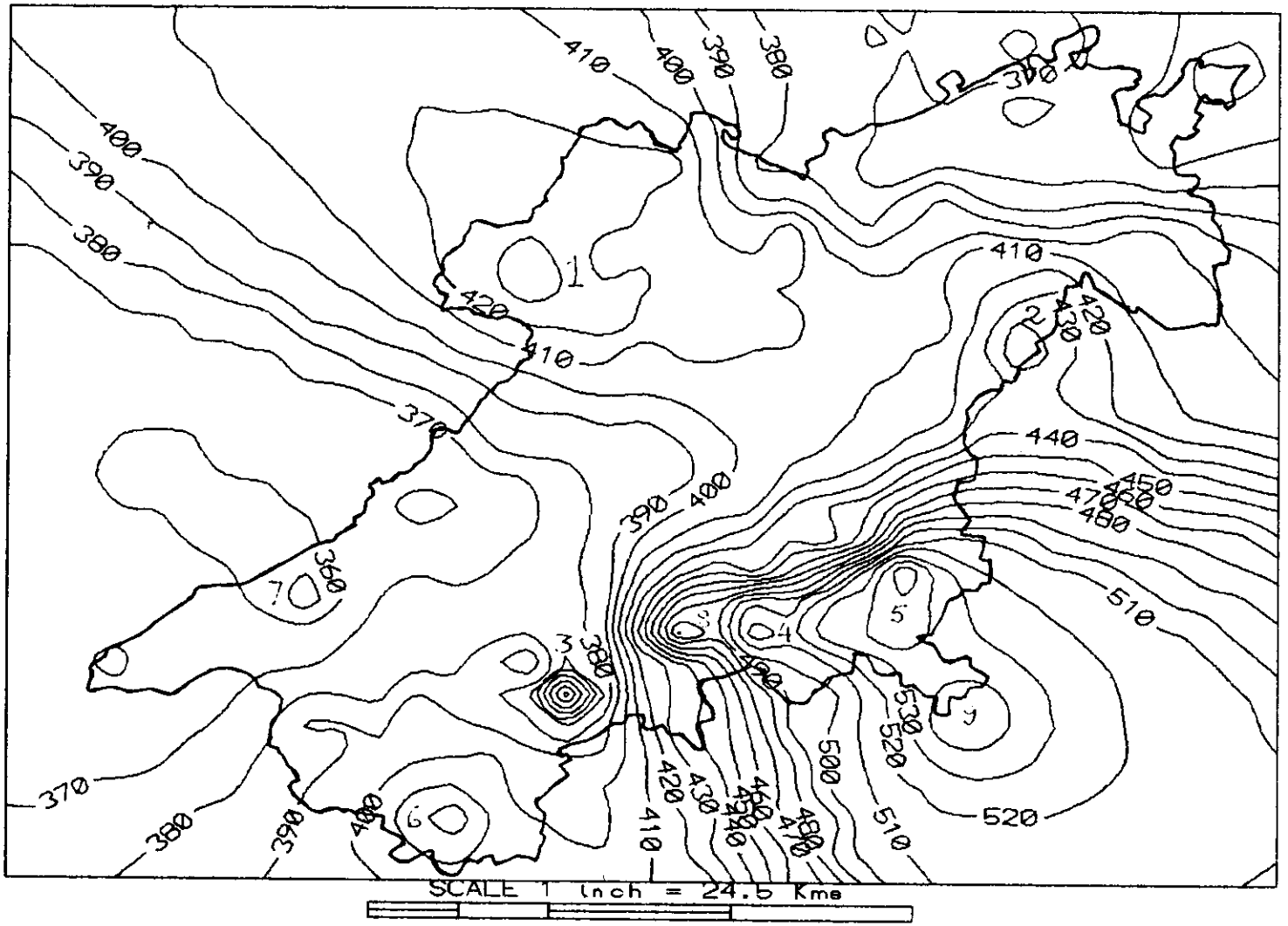


FIG.7 GROUNDWATER LEVEL PREMONSOON 1992

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

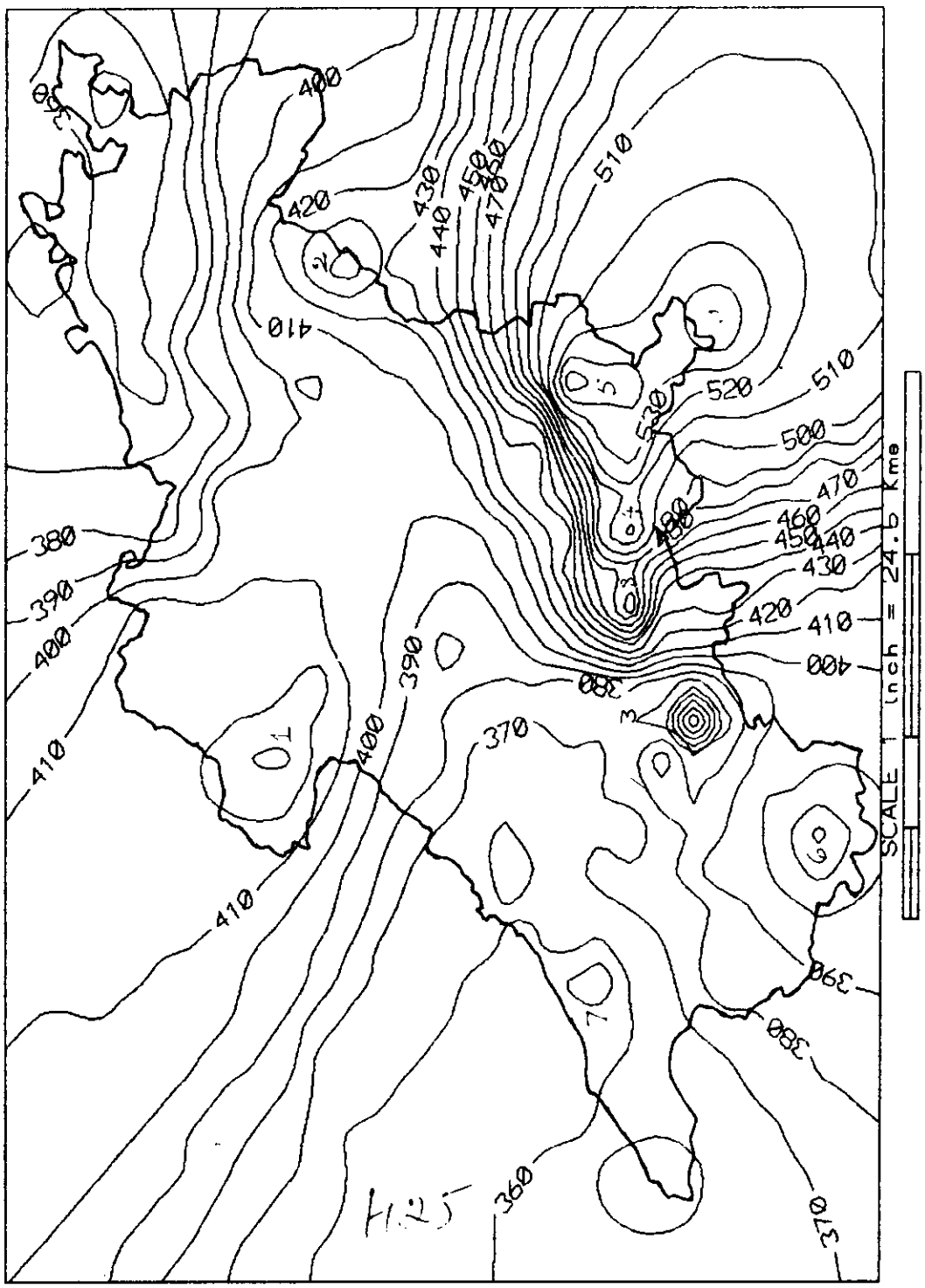


FIG.8 GROUNDWATER LEVEL POSTMONSOON 1992

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS. INTERVAL =10 M

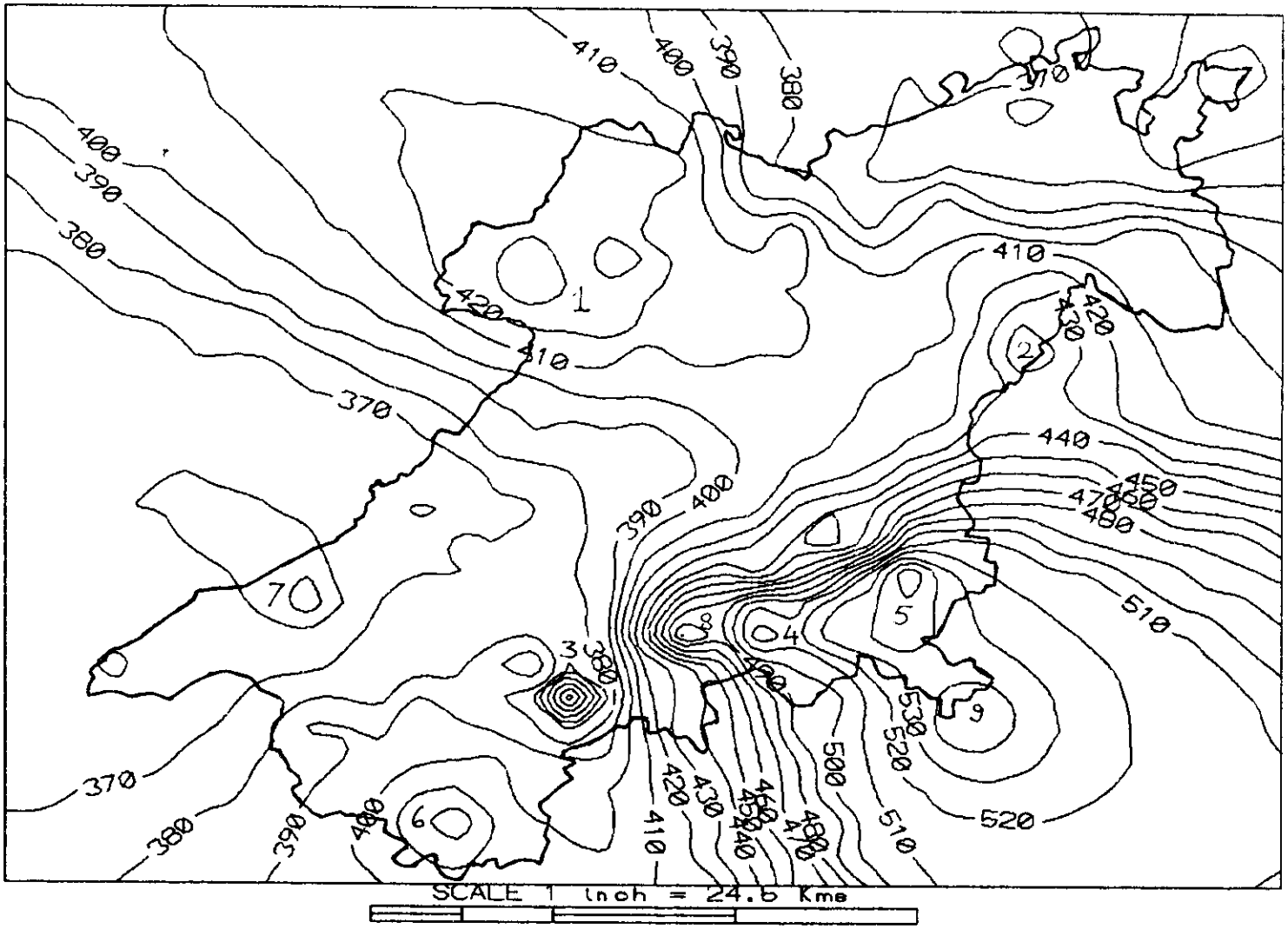


FIG.9 GROUNDWATER LEVEL PREMONSOON 1993

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M

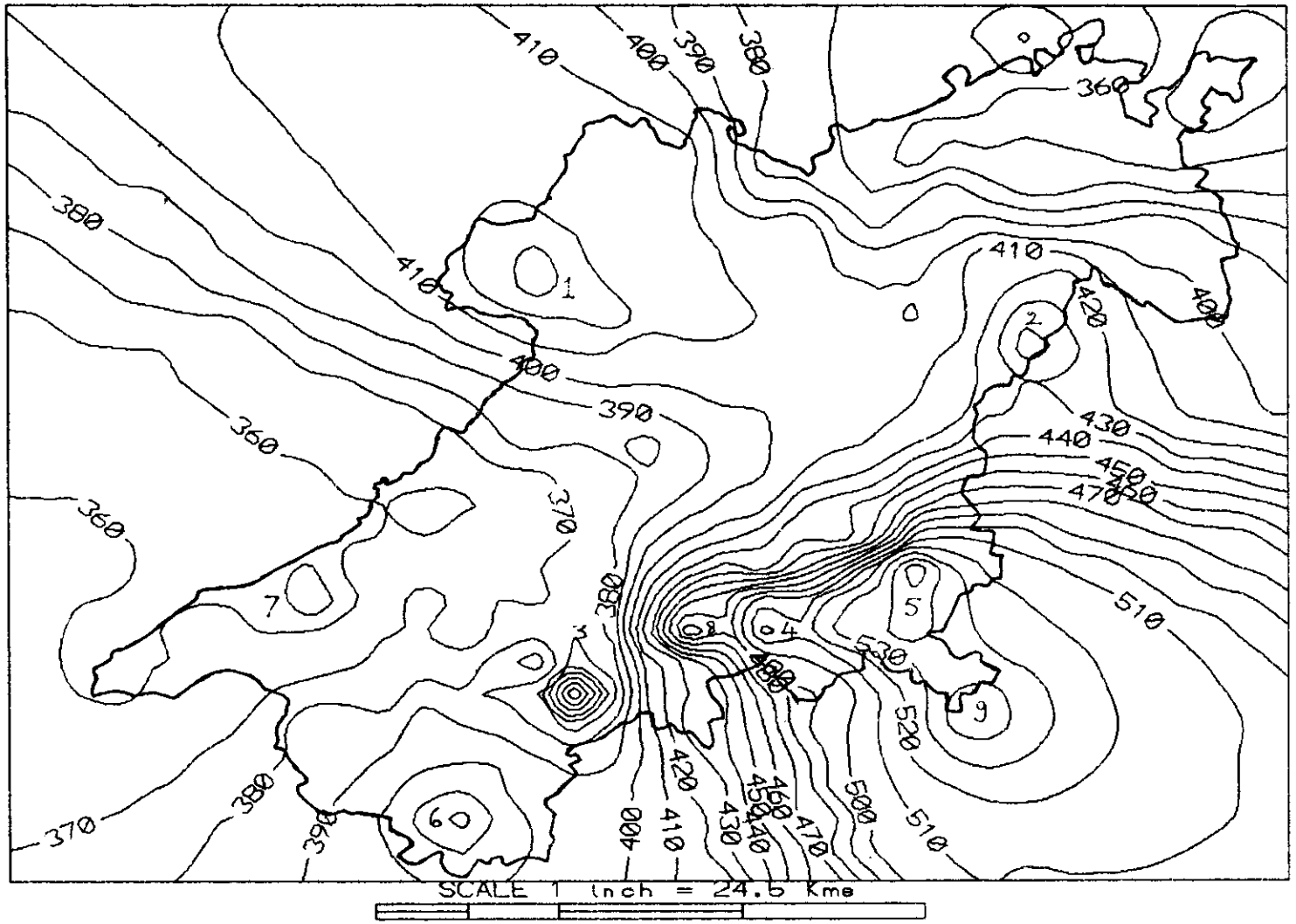
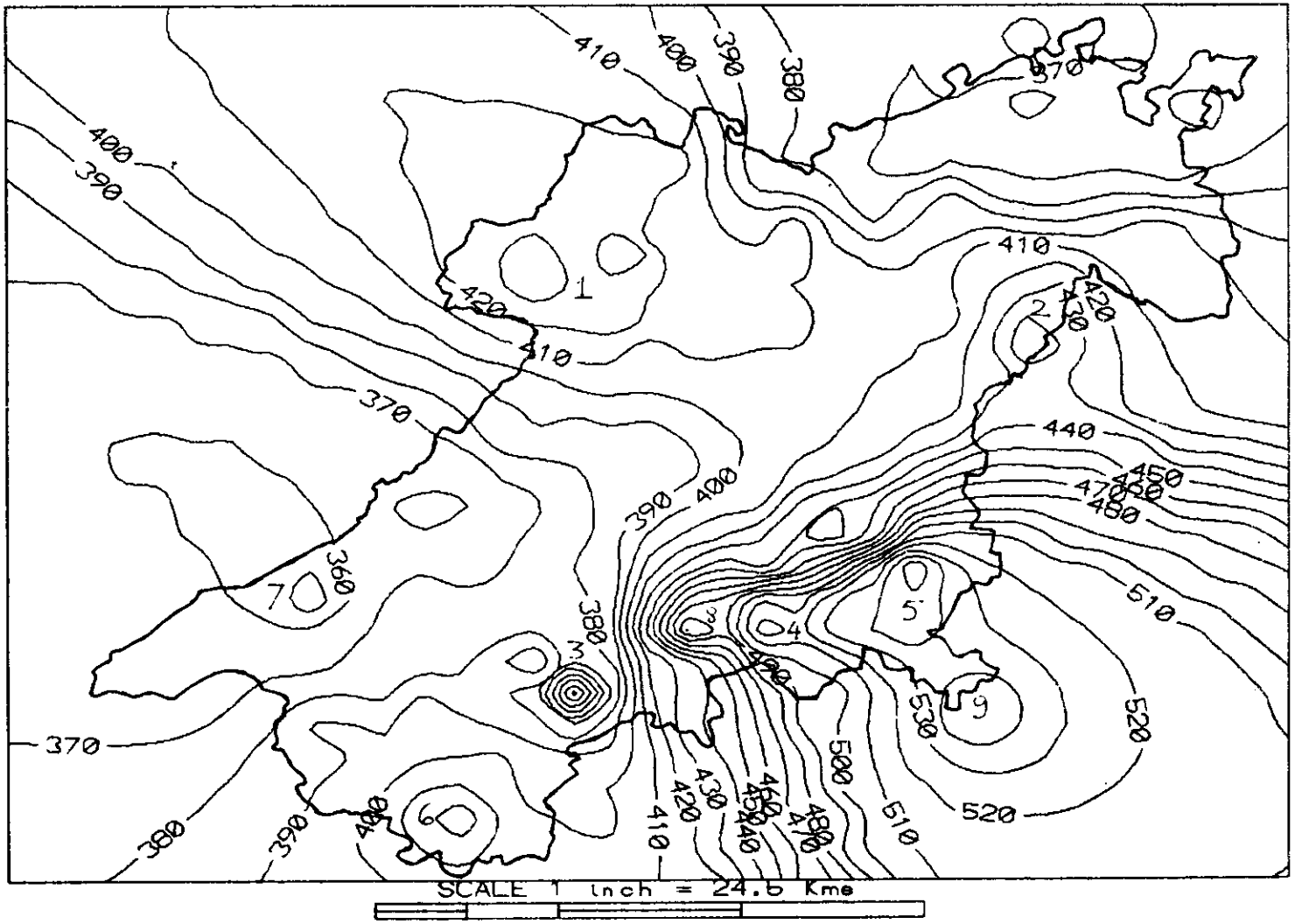


FIG.10 GROUNDWATER LEVEL POSTMONSOON 1993

JABALPUR DISTRICT, MADHYA PRADESH
CONTOURS ARE IN METERS, INTERVAL =10 M



3.0 Tank- Groundwater interaction

Pre and post monsoon groundwater level data are available for about 50 to 100 well points for the period of 1974-94. Out of these available data, the recent data for last 5 years i.e.,for the period between 1989 to 1993 have been used for the study. The groundwater contours have been drawn for the pre and post monsoon seasons of each year.(Figs.1 to 10). A perusal of the contours reveals that the pattern of the contours are similar between seasons and amongst the years. As such it could be inferred that the groundwater regime has been stabilised over years and developing the tanks as sources of minor irrigation by the

Irrigation department. There are prominent places varying in number between 7 to 9 where ground water mound could be observed in the contours. These are marked as 1,2,3...9 in the contour maps. Groundwater contours are flat in the northern portion of the district and the contours in locations 1 and 2 (in north western and northeastern part) are within 1:1000 to 1:500 in slope, whereas the contours in the southern portion and specially along the southern district boundary where rest of the mound's locations lie the contours are steep and is 1:100 or less. As there is no pump test data available in the area for the determination of transmissivity of the aquifer, the transmissivity values of 1000sq.meters per day and 100 sq.meters per day have been assumed for the northern and southern portions of the district respectively on the basis of the groundwater contour slopes. Locations in the contours wherein the groundwater mounds have occurred are quite naturally the places where sizable tanks are located either on the mound or very near to the mound. The Table 4 lists the most prominent and larger tanks of the district. An

attempt has been made to correlate the position of these prominent tanks and the groundwater mounds. The figure/s in the brackets in column 2 of the Table giving name/s of the tank/s indicate the position of the places where groundwater mounds have been observed in the contours. It is observed that interaction of tanks with groundwater is quite conspicuous along the boundary of the district espcially in the southern half. It could be noted from the information furnished in Table 4 that the most prominent and sizeable tanks in the district are situated along the boundary of the district and these places have been manifested as groundwater mounds.

Table 4.Prominent Tanks in Jabalpur District (Source:Irrigation Deptt., Madhya Pradesh,1985)

Sl No.	Name of the Tank Block	Stream/ Nalla	Latitude Longitude	Catchment Area (Sq.Km)	Storage Capacity (Mcum)	Cultur Area (Sq.km)
Panagar Block						
1.	Barera, (4,5,8)	Thobar	23:20 80:05	11.85	4.11	29.34
2.	Jabalpur, (3)	Nalla	23:12 79:55	12.43	3.38	15.73
3.	Mohari (4,5,8)	Nalla	23:15 80:05	13.55	2.24	N.A
4.	Pariat (8)	Pariat	23:15 80:10	108.78	20.34	25.00
Katni Block						
5.	Niwar Ametha (2)	Niwar	23:38 80:26	40.92	7.34	14.76
6.	Sarra (2)	Jalangar	23:44 80:28	24.32	3.78	8.13
7.	Simrar (2)	Simrar	23:42 80:26	45.70	12.94	25.20
Sihora Block						
8.	Barnoo (4,5,8)	Barnoo	23:21 80:07	32.80	10.32	21.44

9. Madai (4,5,8)	Madai	23:20 80:09	26.88	8.70	N.A
Badware Block					
10. Datla (2)	Datla	23:43 80:34	48.80	8.00	39.41
11. Khitoli (2)	Nalla	23:42 80:50	102.10	1.60	N.A
Bargi Block					
12. Mehgaontola (9)	Bidri	23:05 80:10	29.00	11.62	21.00
Dhemarkhedda Block					
13. Sagona (4,5,8)	Mohari	23:26 80:26	32.18	7.93	15.00
Bahoribund Block					
14. Sarkarwara (1)	Sarkarwar	23:47 79:52	22.00	1.80	19.05

4.0 Results and discussions

It has been observed from the groundwater contours for different years i.e., 1989 to 1993 that tank water is contributing to groundwater in both pre and post monsoon season. In other words, the tanks in the Jabalpur district are contributing water to groundwater and are influent with respect to groundwater. The respective share of this total contribution from each mound marked 1 to 9 in the groundwater contour maps has been estimated by the equation

$$Q = \text{Transmissivity} * \frac{\text{Circumference of the mound}}{\text{Groundwater gradient}}$$

The gradient is calculated by dividing the difference of groundwater potential values at the outer and inner ring by the distance between them. The transmissivity has been assumed depending on the flatness and steepness of the groundwater contour. As stated earlier the groundwater contour is quite flat in the northern portion of the district and a transmissivity value of 1000 sq.m/day has been assumed. The groundwater contour is

fairly steep in the southern portion of the district particularly at the boundary of the district and a transmissivity value of 100 sq.m/day is taken for the estimation of flow from the tanks to groundwater. The circumference of the outer contour is measured by a rotameter. Table 5 provides the estimated recharge of groundwater from the tanks in the district.

Table 5.Yearly groundwater recharge from tanks in Jabalpur District

Sl.No	Year	Recharge		Rainfall
		Premonsoon	Postmonsoon	(mm)
		(Cu.m per day)		
1.	1989	264500	249200	850
2.	1990	243000	288300	1451
3.	1991	246200	330800	N.A
4.	1992	182700	264900	N.A
5.	1993	227200	305500	N.A
	Average	232700	287740	

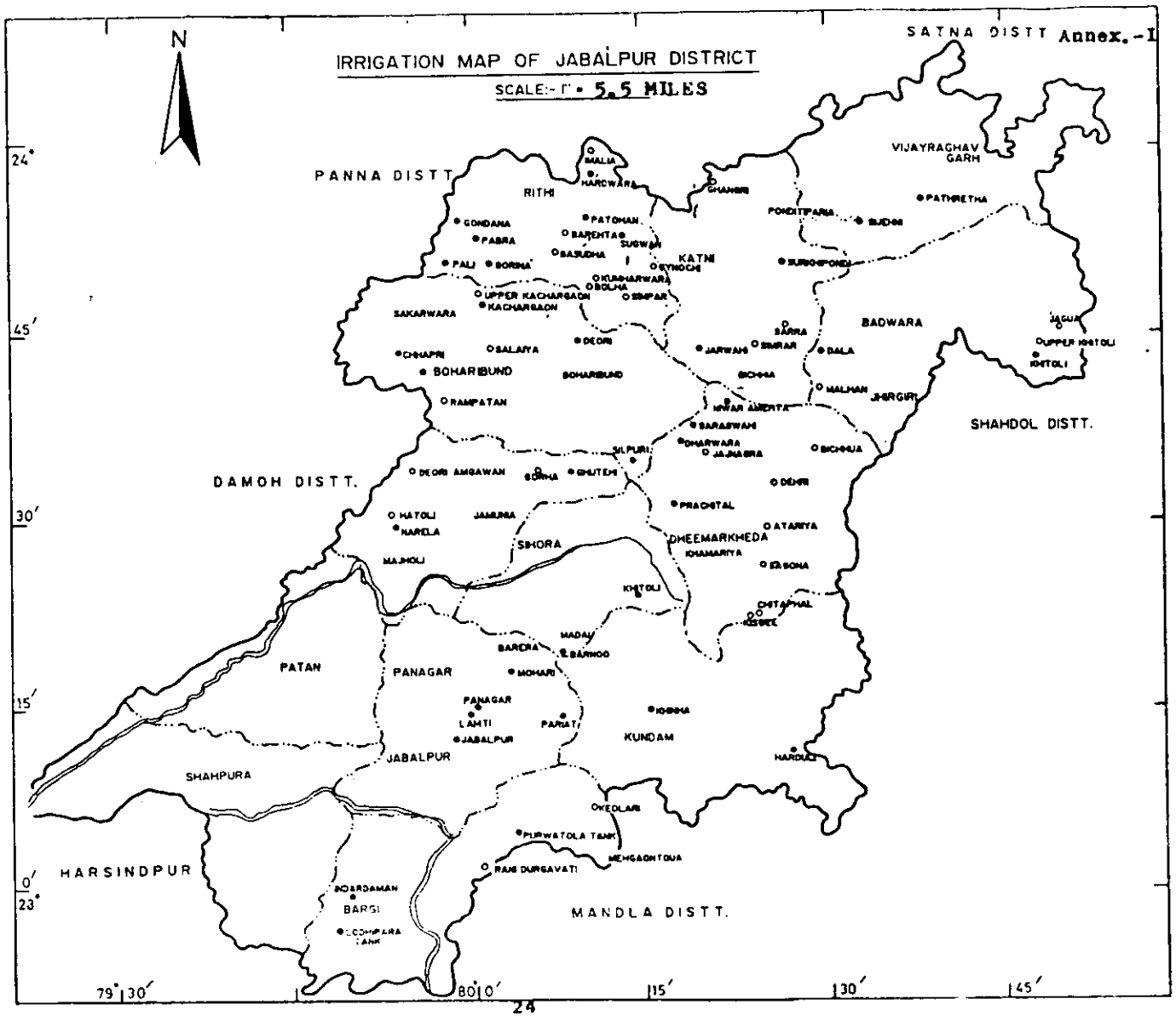
From the rainfall pattern, a full year could be divided into the premonsoon and postmonsoon seasons of 6 months each i.e., May to October and November to April respectively. So, the groundwater recharge in the pre and post monsoon seasons are estimated to be 1.4 M and 1.7 M Cu.m respectively.

An extensive data base that is required for meticulous groundwater tank study are not available. But the with the limitation of data and other constrains, the groundwater level measured by the Irrigation department, M.P are utilised herein to indicate the level, extent and order of interaction between tanks

and groundwater in Jabalpur district. This first hand and preliminary estimate of the interaction could be refined further. The proper inventory and monitoring of all the tanks including their physical size, depth, capacity,command area, water level,nearby ground water levels in the direction of flow, siltation status etc. should be done at proper interval of time say atleast twice a year i.e., before the onset of monsoon and after the end of monsoon. Pump tests should be organised in different portion of the district to ascertain the transmissivity and specific yield of the aquifer and their spatial variations in different parts of the district. The extent of hydraulic connection should be drawn between the water bearing formations and the tanks from the lithologs and geophysical methods.

Reference

1. Engineer in Chief, Irrigation Department,Bhopal(1985),"Water Resources Development of Jabalpur District", Report No. 3/43(85)


IRRIGATION MAP OF JABALPUR DISTRICT
SCALE:- 1" = 5.5 MILES
N
SATNA DISTT
PANNA DISTT
VIJAYRAGHAV GARH
RITHI
MALIA
HARDWARA
GHANSIR
PATHRETHA
PONDITPARA
SUDHNI
PATOHAN
GONDANA
PABRA
BARENTA
SUGWAN
BAIRUDHA
KATNI
PALI
BORNA
KEYMOCHI
KURMHARWARA
BOLHA
SIMPAR
UPPER KACHARGAON
KACHARGAON
SAKARWARA
BADWARA
BARRA
JARWAHI
BIMRAR
BALA
JAGUA
UPPER KHITOLI
KHITOLI
CHHAPRI
SALAIYA
DEORI
BOHARIBUND
MALHAN
JHIRGIRI
RAMPATAN
SHAHDOL DISTT.
SARASWAHI
DHARWARA
JAJHARA
BICHHUA
DAMOH DISTT.
DEORI AMGAWAN
SIMRA
GHUTERI
SILPURI
DEHRI
PRAGSTAL
HATOLI
HARELA
JAMURRA
ATARIYA
DHEEMARKHEDA
KHAMARIYA
SIKORA
MAJHOLI
KHITOLI
CHETAPHAL
MADAU
BARERA
BARHOO
PATAN
PANAGAR
MOHARI
PANAGAR
LAHTI
PARIAT
KUNDAM
JABALPUR
SHAHPURA
OKEDLARI
PURWATOLA TANK
MEHGAONTOLA
RANI DURGAVATI
HARSINDPUR
BORDAMAN
BARGI
MANDLA DISTT.
79°30′
80°0′
15′
30′
45′
24°
45′
30′
15′
0′
23°

Director: Dr.S.M.Seth

Study Group:A.K.BHAR