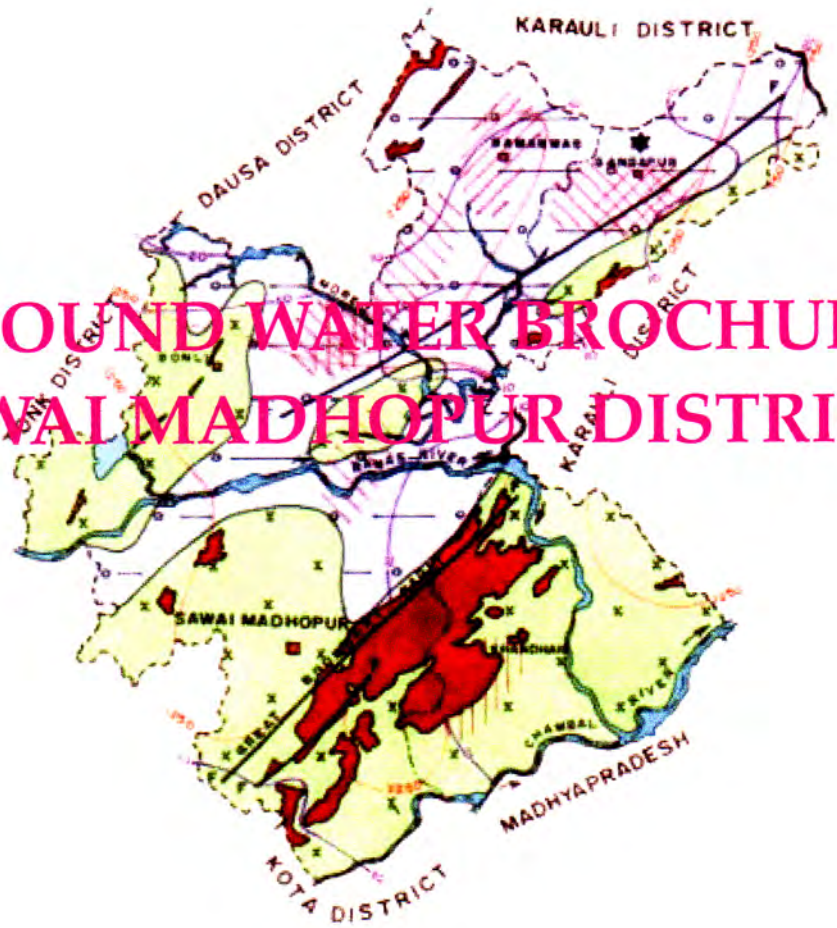
CENTRAL GROUND WATER BOARD

MINISTRY OF WATER RESOURCES

GOVERNMENT OF INDIA



GROUND WATER BROCHURE
SAWAI MADHOPUR DISTRICT

WESTERN REGION

JAIPUR

MARCH, 2009

GROUND WATER BROCHURE

SAWAI MADHOPUR DISTRICT

CONTENTS

GROUND WATER BROCHURE, SAWAI MADHOPUR DISTRICT

AT A GLANCE

1	GENERAL INFORMATION		
i	**Geographical area (sq.km.)**		5020.65
ii	**Administrative Divisions**		4(Gangapur, Bamanwas, Bonli & Sawai Madhopur)
	No.of Tehsils		7(Gangapur, Bamanwas, Malarna Dungar, Bonli, Couth Ka Barwara, Sawai Madhopur & Khandar)
	No. of Blocks		5(Sawai Madhopur, Gangapur, Bolni, Khandar & Bamanwas)
	No. of Villages		800 (Habited-718+Inhabited-82)
	No. of Towns		2(Gangapur, Sawai Madhopur)
	Number of Municipalities		2
iii	**Population(as per 2001 census)**		1117057
iv	**Population Density (persons/sq.km. of area)**		248
v	**Average annual rainfall(mm) (1971-2007)**		697.6
2	GEOMORPHOLOGY		
i	**Major physiographical units**	i	Hilly terrain in south-south eastern part of district
		ii	Alluvial plains with isolated hills in central part of district
		iii	Alluvial plain mostly confined to western part of district
ii	**Major Drainage**		Chambal (perennial river), Banas & Morel (ephemeral/seasonal rivers)
3	LAND USE (sq.km.)		
i	**Forest area**		78039(15.67%)
Ii	**Net area sown**		276784(55.57%)
iii	**Total area sown**		3378.85(75.03%)
4	MAJOR SOIL TYPES	i	Recent alluvial soil
		ii	Older alluvial soil
		iii	Lithosols and regosols of hills
5	AREA UNDER PRINCIPAL CROPS (sq.km.) (2003-04)		
i	**Food grains**		
	Bajra		1052.74
	Wheat		609.47
	Jowar		75.15
	Barley		17.49
	Maize		9.34
	Rice		1.58
	Total		**1765.77**
ii	**Cereals**		377.99

iii	**Spices**		38.38		
iv	**Fruits**		2.26		
v	**Vegatables**		11.12		
vi	**Oil seeds**		1440.94		
vii	**Non food grains**		1541.49		
viii	**Others**		100.55		
	Total of food and non food grains		**3737.20**		
6	IRRIGATION BY DIFFERENT SOURCES (sq.km.) (2003-04)				
i	**Dug wells/Tube wells and Bore wells**		1384.63 (84.97%)		
ii	**Tanks/Ponds**		29.95		
iii	**Canals**		195.53		
iv	**Other Sources**		19.35		
v	**Gross Irrigated Area**		**1629.48**		
7	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB				
i	**No. of dug wells**		20		
Ii	**No. of piezometers**		4		
8	PREDOMINANT GEOLOGICAL FORMATIONS		Bhilwara Super Group (quartzite, shale, slate, schist, phyllite)		
			Vindhyan Super Group(sandstone, shale& limestone)		
			Quaternary Alluvium		
9	HYDROGEOLOGY				
i	**Principal Water Bearing Formations**		Bhilwara Super Group(quartzite, shale, slate, schist, phyllite)		
			Vindhyan Super Group(sandstone, shale & limestone)		
			Quaternary Alluvium		
ii	**Pre-monsoon depth to water level during 2008 (mbgl)**		2.16 - 21.35		
iii	**Post-monsoon depth to water level during 2008 (mbgl)**		3.19 - 22.21		
iv	**Long term water level trend in last 10 years (1999-2008) m/year**		0.051 - 1.664		
10	GROUND WATER EXPLORATION BY CGWB (as on 31.03.2008)				
i	**No. of wells drilled**	**Type of wells**	**Formation**		**Total**
			Alluvium	**Hard rock**	
		EW	12	35	47
		SH	7	-	7
		PZ	2	1	3

ii	**Depth Range (m)**		**Alluvium**	**Hard rock** (Vindhyan sandstone,shale & limestone and Bhilwara schist, phyllite, quartzite)
			30 - 62	75 - 175
iii	**Discharge (lpm)**		45 - 660	< 50 - 1250
iv	**Transmissivity (m^2 /day)**		75.2 - 272	40 - 158
v	**Storativity**		1.55×10^{-4}– 5.8×10^{-4}	-
11	GROUND WATER QUALITY			
i	**Presence of chemical constituents more than permissible limit**	**EC(>3000 ms/cm at 25^0 C)**	Constituted by 10% of stations	
		F(>1.5 mg/l)	Constituted by 25% of stations	
		NO_3(>100mg/l)	Constituted by 15% of stations	
		Iron (>1.0mg/l)	Constituted by 20% of stations	
Ii	**Type of water**		Alkaline	
12	DYNAMIC GROUND WATER RESOURCES (as on 31.03.2004) (*EXCLUDING SALINE)* (Figures in mcm)			
i	**Net annual ground water availability**		366.4393	
Ii	**Gross ground water draft for all uses**		413.9479	
Iii	**Projected demand for domestic and industrial uses up to 2025**		121.5800	
iv	**Stage of ground water development (%)**		112.96	
13	AWARENESS AND TRAINING ACTIVITIES			
	Mass awareness programme organized		Nil	
ii	**Water management training programmes organized**		Nil	
14	EFFORTS OF ARTIFICIAL RECHARGE AND RAINWATER HARVESTING			
	Scheme on artificial recharge of ground water through dug wells in the district including entire Rajasthan State under implementation by Govt. of India, Ministry of Water Resources.			

15	GROUND WATER CONTROL AND REGULATION	
i	**Number of OE blocks**	2 (Gangapur and S.Madhopur)
ii	**Number of critical blocks**	3 (Bamanwas, Bonli and Khandar)
iii	**Number of semi critical blocks**	Nil
iv	**Number of blocks notified**	Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	
i	**Declining water level**	
ii	**Over-draft of ground water**	

GROUND WATER BROCHURE
SAWAI MADHOPUR DISTRICT

1.0 INTRODUCTION

Sawai Madhopur district is located in the eastern part of the Rajasthan State and lies between 25°44'59" and 26°45'00" North latitudes and between 75°59'00" and 76°58'50" East longitudes covering the geographical area of 5020.65 sq. km (Figure1). Administratively, the district is divided into 4 sub-divisions viz. Gangapur, Bamanwas, Bonli and Sawai Madhopur and has seven viz. Gangapur, Bamanwas, Malarna Dungar, Bonli, Chouth Ka Barwara, Sawai Madhopur & Khandar. It has five development block viz. Sawai Madhopur, Bonli, Khandar, Gangapur, Bamanwas.

The total population of the district is 1117057(census 2001). Out of this 19.04% of total population lives in towns and 80.96% in rural area. The population density is 222 persons per sq. km of area.

The land use statistics of the district is furnished below.

Year-2003-04

Sl.No.	**Particulars**	**(figures in sq.km.)**
1	Area not suitable for cultivation	715.29
2	Hills & hilly forest	780.39 (17.35%)
3	Area suitable for cultivation but not cultivated	338.10
4	**Total area under cultivation**	**3737.20**
i	Area irrigated by Dugwells/Tubewells/**Total**	1066.17/318.46/**1384.63(84.97%)**
ii	Area irrigated by canals	195.53
iii	Area irrigated by tanks/ponds	29.97
iv	Area irrigated by other sources	19.35
	Total irrigated area	**1629.48**
v	**Unirrigated area**	**2107.72(56.40%)**

Agriculture activity is spreaded over both for kharif and Rabi cultivation. Kharif cultivation is rainfed and Rabi cultivation is mostly based on ground water but in some areas viz. in parts of Malarna Dungar, Gangapur, Bamanwas, Bonli, Sawai Madhopur tehsils where surface water irrigation facilities are available. The main kharif crops grown in the area are Bajra, Jowar, Maize and pulses where as principal Rabi crops are Wheat, Gram, Barley and oil seeds.

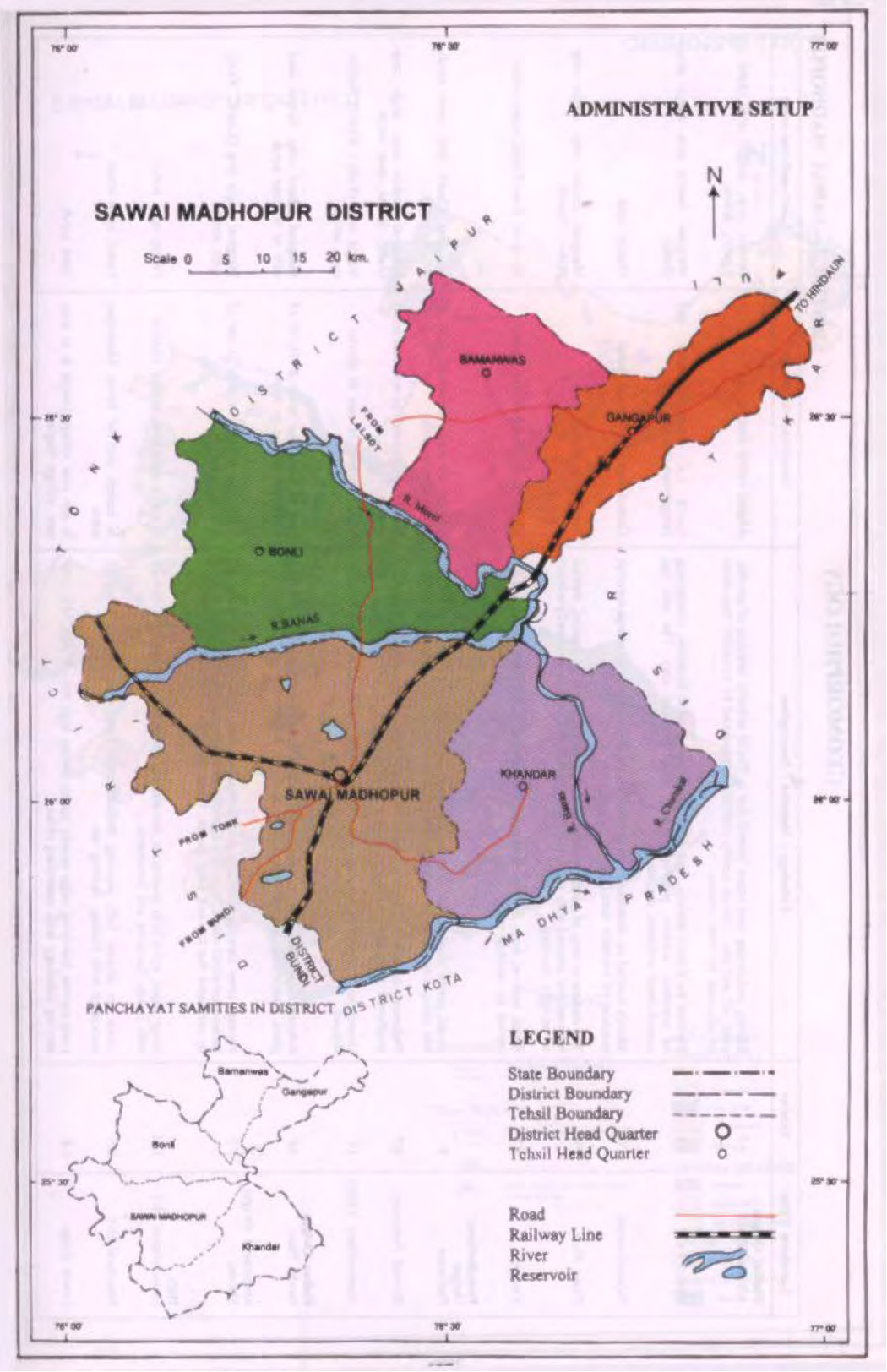
The total sown area is 3737.20 sq. km., out of which 1629.48sq.km (forming 43.60%) is irrigated. Tehsil wise break up of area under various seasonal crops is given below.

Year-2003-04)

Tehsil	**Kharif**		**Rabi**		**Jayad Rabi**	
	Area sown	**Irrigated**	**Area sown**	**Irrigated**	**Area sown**	**Irrigated**
Sawai Madhopur	362.61	2.17	385.06	333.28	0.27	0.27
Chouth Ka Barwara	124.67	1.28	275.78	227.81	0.04	0.04
Bonli	200.52	0.33	338.12	247.05	1.00	0.11
Malarna Dungar	119.89	0.13	219.83	185.08	-	-
Khandar	236.14	19.47	194.25	157.51	1.29	0.39
Gangapur	275.09	2.95	367.73	254.11	0.92	0.84
Bamanwas	229.95	1.13	403.96	19.53	0.08	-

(Area in sq.km.)

FIGURE-1


ADMINISTRATIVE SETUP
SAWAI MADHOPUR DISTRICT
Scale 0 5 10 15 20 km.
N
DISTRICT JAIPUR
TO HINDAUN
BAMANWAS
GANGAPUR
FROM LALSOT
R. Morel
BONLI
R.BANAS
SAWAI MADHOPUR
KHANDAR
R. Banas
R. Chambal
FROM TONK
FROM BUNDI
DISTRICT BUNDI
DISTRICT KOTA
MADHYA PRADESH
PANCHAYAT SAMITIES IN DISTRICT
Bamanwas
Gangapur
Bonli
SAWAI MADHOPUR
Khandar
LEGEND
State Boundary
District Boundary
Tehsil Boundary
District Head Quarter
Tehsil Head Quarter
Road
Railway Line
River
Reservoir

The area irrigated is mostly by ground water forming 84.97% of total area irrigated. Source wise irrigation detail is given below.

Year-2003-04

Tehsil	Wells/Tube wells	Ponds	Canals	Others	Gross area irrigated
	Area irrigated	Area irrigated	Area irrigated		
Sawai Madhopur	318.57	-	17.15	-	335.72
Chouth Ka Barwara	228.73	-	0.40	-	229.13
Bonli	209.58	9.97	27.94	-	247.49
Malarna Dungar	110.09	-	72.81	2.31	185.21
Khandar	173.37	-	3.97	0.03	177.37
Gangapur	189.55	8.64	45..21	14.50	257.90
Bamanwas	154.74	11.36	28.05	2.51	196.66

(Area in sq.km.)

Systematic hydrogeological surveys were carried out by the officers of Geological Survey of India during 1965-66 and by Central Ground Water Board during 1976-80. Reappraisal ground water survey in various phases during 1992-93, 1996-97 carried out by Central Ground Water Board. On the basis of hydrogeological studies, exploratory drilling programmes were undertaken by Central Ground Water Board during different periods in parts of district and constructed 12 EW in alluvium and 35 EW in hard rock area. Later 3 piezometers were constructed for long term monitoring of ground water regime. Monitoring of National Hydrograph Stations established in the district is being done by Central Ground Water Board since 1960. Based on the hydrogeological studies carried out by Board, the comprehensive report of Sawai Madhopur district entitled “Ground Water Resources and Development Potential of Sawai Madhopur District” has been prepared in 1988. In this series, it was revised during 2000.

2.0 RAINFALL AND CLIMATE

The climate of the district can be classified as semi-humid. It is characterized by very hot summers and very cold winters with fairly good rainfall during south-west monsoon period. In May, the maximum temperature may sometimes goes up to 40.6^{o}C. The potential evapotranspiration rates are quite high, especially during May and June. The total annual potential evapotranspiration is 1658.0mm and is highest in the month of June (220mm).

The mean annual rainfall of the district, based on 37 years data (1971-2007), works out to be 697.6mm whereas normal annual rainfall (1901-70) of the district is 701.6mm is slightly higher than average rainfall. The most of the rainfall is received (93.5%) during the monsoon months. District is prone to mild and normal type of droughts. Probability of average annual rainfall exceeding around 1000mm is only 10%. However there is 90% probability that the average rainfall will be more rthan 380mm.The probability of occurrence of mean annual rainfall is about 50%.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Physiographically, the district can be divided into three units as given below:

Sl. No.	Physiographic Unit	Extension
1	Hilly terrain	Occupies the south and south eastern parts of district. The hills follow a general trend of NE-SW direction starting from Jamaira in the north eastern part of the district to Odera in the south western part.
2	Alluvial plains with isolated hills	Occupies the central part of district
3	Alluvial plains	Mostly confined to the western part of district, however some northern and north western parts are also occupied by the alluvial plains.

Development of ravines with bad land topography along with Chambal river and its tributaries have a conspicuous physiographic region in the district.
The surface elevation of ground ranges from 223 m amsl in the north east to about 507 m amsl in the south western part of the district.

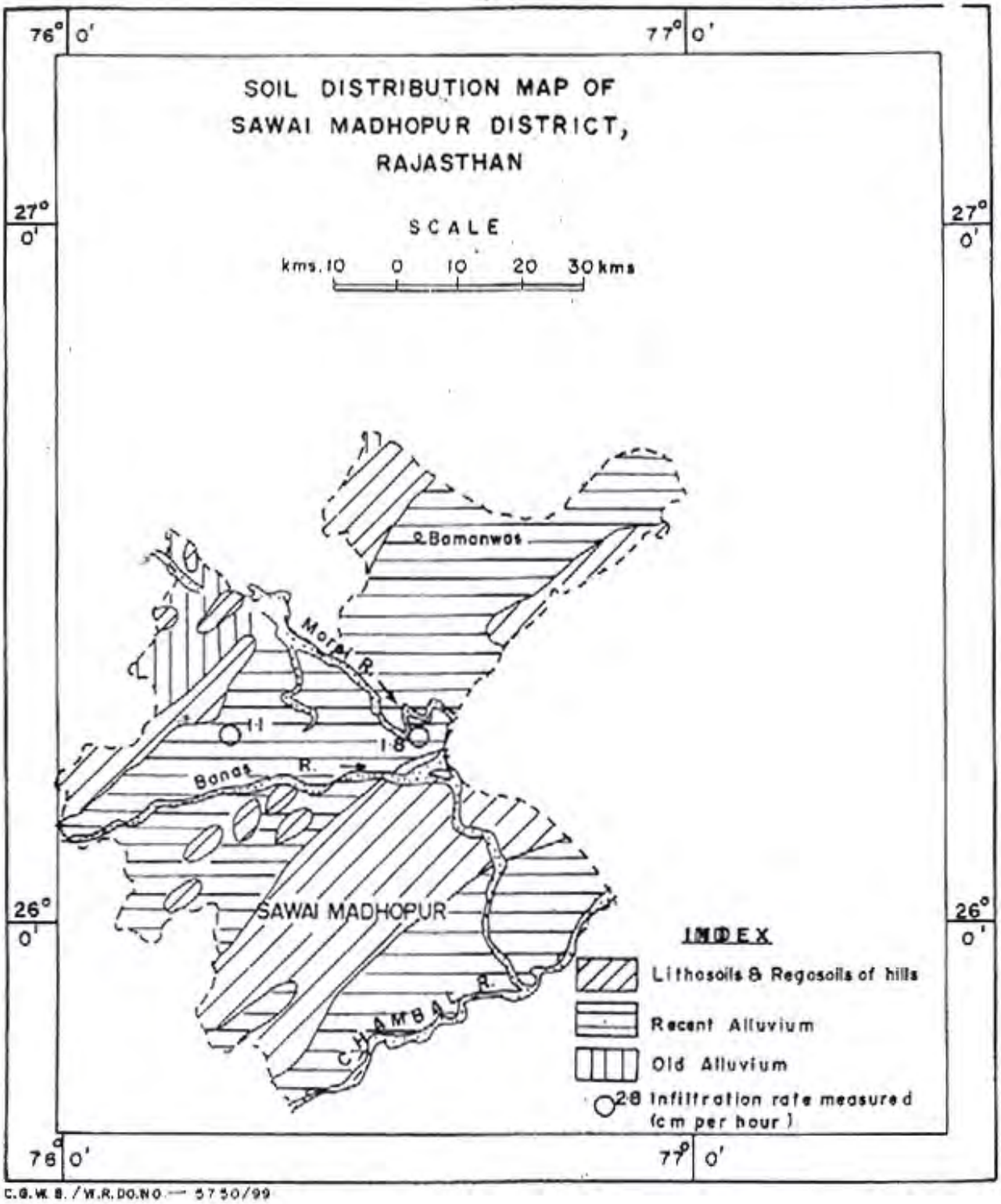
The drainage system of the district is well developed with Chambal, Banas and Morel as main rivers and their tributaries. Chambal is the only perennial river and enters this district near village Karanpura and flows in north-easterly direction along interstate border with Madhya Pradesh. It is joined by Parbati river near village Pali. Other two main non-perennial rivers are Banas which flows west to east through the central part of the district and then turning in south direction joining Chambal river. Morel river flows from north west to south east direction joining Banas river.

Drainage in the rocky terrain is sub-parallel type while in plain area, it is dendritic type. The drainage density in the district increases gradually towards south. The drainage density around Bamanwas, Malarna Dungar ranges from 0.30 to 0.50 km/sq.km. In the southern part of the district it is more than 0.70km/sq.km. This part covers the Vindhyan rocks and high density indicates substantial runoff. The distribution of soil is given below in table and depicted in figure2.

Distribution of soil, Sawai Madhopur district

Soil	Distribution
Older alluvium	Rests in parts of Bonli & Bamanwas block. These are derived from alluvium. They are non-calcareous,more clayey, semi consolidated to unconsolidated brown soils with high percentage of kankar, loamy sand to sandy loam in texture. They are well drained and occupy gently sloping terrains.
Lithosols and Regosols of Hills	Occupies the parts of Khandar, Sawai Madhopur, Bonli, Bamanwas and Gangapur blocks. These are in situ soils on the hills, and hill slopes. These soils are shallow with gravels very near the surface, light textured, fairly drained (with slightly higher rate of filtration to alluvial soils), reddish brown in colour. Cultivation is restricted because of a limited root zone.
Recent Alluvium	Occupies the major part of the district and rests in parts of all the five blocks. These are found along the flood plains of Chambal and Banas and Morel rivers and are developed on alluvium forming the plain agriculture area of the district. In Bamanwas, parts of Gangapur and Sawai Madhopur blocks these soils are deep medium to heavy textures and black grey or dark brown in colour. In Gangapur, Bonli, parts of Sawai Madhopur and small parts of Bamanwas blocks areas have deep light textured yellowish brown soils.

FIGURE- 2



C.G.W.B. / W.R.DO.NO — 5750/99

Irrigation projects

Area is drained by Chambal perennial river and Banas & Morel ephemeral rivers and their tributaries. The following irrigation projects exist in the district :

Type	Total no.	Name of Project
Major	Nil	-
Medium	4	Mora Sagar (Bamanwas tehsil) Capacity-6411.10CCA in hec.
		Dheel (Bonli tehsil) Capacity-5940.90CCA in hec
		Mansarovar (Khandar tehsil)-3055.00 CCA in hec.
		Surwal (Sawai Madhopur tehsil)-4130.00 CCA in hec.
Minor	8	Bamanwas tehsil
	13	Bonli tehsil
	1	Khandar tehsil
	5	Swai Madhopur tehsil

Out of total 162948 hectare of irrigated area, 24485 hectare (15.03%) area is irrigated by surface water body including canals, tanks / ponds (data based on 2003-04).

4.0 GROUND WATER SCENARIO

4.1 Aquifer System

The ground water occurs both in unconsolidated and consolidated formations of the district (Figure3).

Consolidated formation

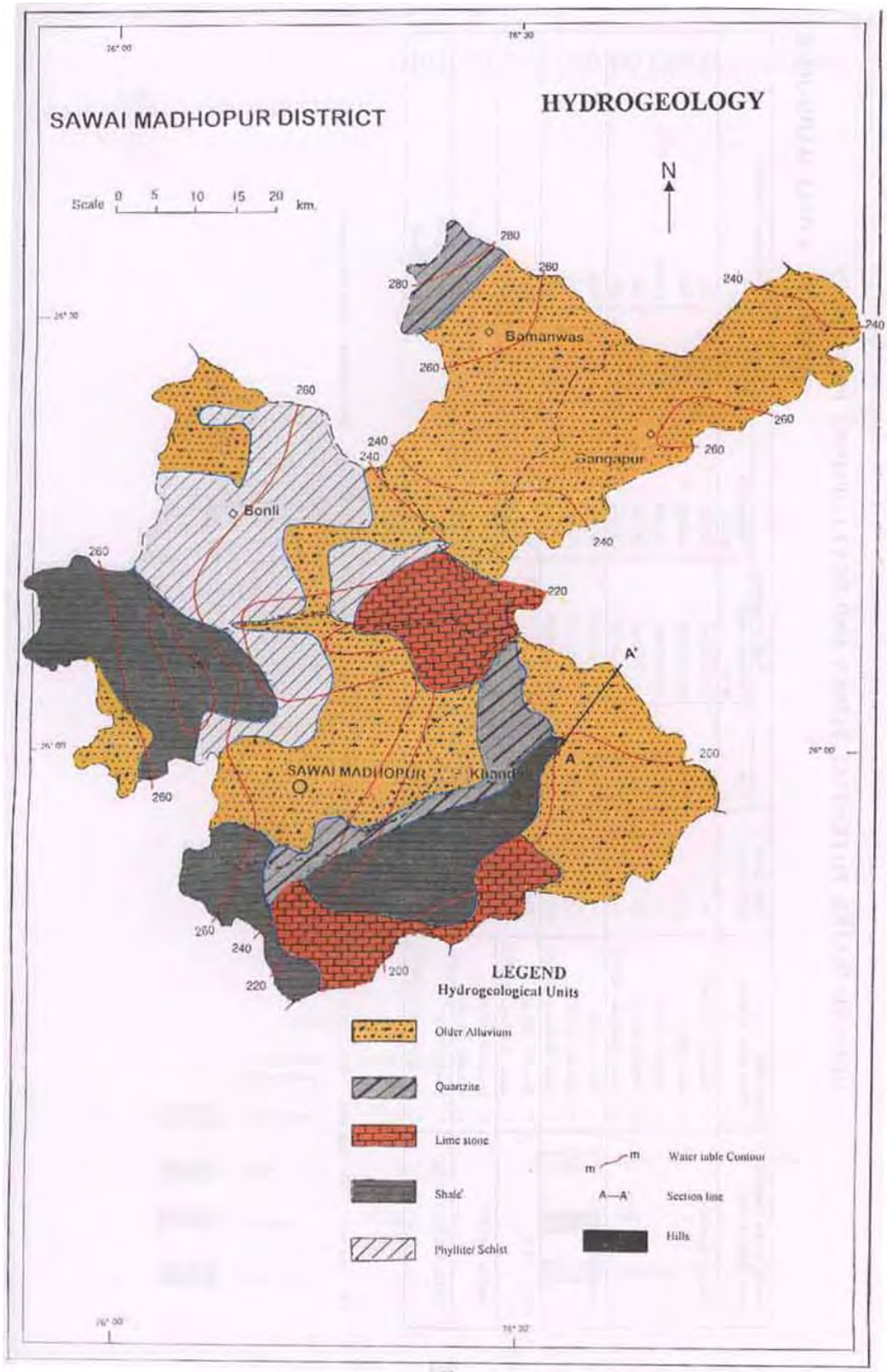
Consolidated formation includes schist, phyllite, shale, slate, quartzite of Bhilwara Super Group; sandstone, shale ,limestone of Vindhyan Super Group); quartzite, schist, gneiss of Delhi Super Group covering about 60% of district forms the principal aquifer in the district. The ground water occurs under unconfined condition in weathered and fractures portion of the consolidated formations. These form generally poorer aquifer than alluvium and are tapped by open wells, dug cum bore wells, and bore wells. The ground water condition in various formations is described in the following paragraphs.

Schists and gneisses

Mica schist form important aquifer in Sawai Madhopur and Bonli blocks. The thickness of weathered zone is more compared to gneisses but even the yield of wells is poor as the weathered product is mainly clayey. Yield of dug wells varies from 40 to 100 m^3/day. Intrusives of pegmatite and quartz veins in the country rock increase the yield of the wells and recuperation is fast.

Phyllites and slatesThese form aquifer in limited area lying south west of Sawai Madhopur. The depth of weathering ranges from 2 to 3 m and fractured zone generally extend down to 10 m depth. Yield of wells

FIGURE-3


SAWAI MADHOPUR DISTRICT
HYDROGEOLOGY
N
Scale 0 5 10 15 20 km.
Bamanwas
Gangapur
Bonli
SAWAI MADHOPUR
Khand
A
A'
LEGEND
Hydrogeological Units
Older Alluvium
Quartzite
Lime stone
Shale
Phyllite/ Schist
Water table Contour
Section line
Hills

upon the thickness of weathered zone. Yield of wells tapping this formation ranges from 20 to 300m^3/day. Recupeartion is faster than mica schist. Around Pachala west of Sawi Madhopur, the phyllite is main water bearing unit.

Quartzite

Quartzite form aquifers southwest of Sawai Madhopur and is highly fractures and jointed. Inter-bedding of slate and phyllites are common with the formation.The thickness of fractured zone extendsfrom 2 to 14 m. Thickness of weathered zone is not significant.

Dolomitic limestone

This forms aquifer in a small area to the west of Sawai Madhopur and overlain by 2 to 4m thick zone of calcareous clay. The yield of wells ranges from 30 to 120m^3/day.

Vindhyan shale

Vindhyan shales are forming aquifer in extreme southern and south eastern part of the district. These are intercalated with thin layers of calcareous matter. The shales are highly fractured and splintery in nature. Weathered and fractured zone extends from 2 to 17m in the thickness and yield of dug wells varies from 20 to 350m^3/day.

Vindhyan limestone

In a small area around Malarna Dungar in Bonli block, the limestone is forming aquifer althrough it is devoid of karst structure. Yield of dug wells tapping this formation ranges from 10 to 40 m^3/day.

Vindhyan sandstone

The sandstone is forming most prominent aquifer after alluvium in the areal extent. These are occurring in south eastern and eastern part of the district.Bhandar sandstone occurs as aquifer in southern and eastern part of the district around Bhankri, Machilpur and Langra. This is also resistant to weathering and has two sets of joints. Ground water occurs under unconfined condition. Yield of wells ranges from 15 to 145m^3/day.

Unconsolidated formation

The ground water occurs under unconfined to confined conditions in unconsolidated formation (alluvium of Quaternary age) which is tapped through various ground water abstraction structures viz. dug well, dug cum borewell and tube well.

Alluvium

Alluvium forms aquifer in large part of the area lying in central, northern and north western part of the district and in area along Chambal river in south eastern part of the district. It consists of gravel, sand, silt, clay and kankar. Out of these, sand, clay and silty clay with kankar forms the most dominating constituent which generally occur in upper zone and is being tapped by dug wells. Gravel generally occurs at depth near the basement and these too generally do not form continuous layer. Alluvium forms most important aquifer which is being tapped by dug wells, dug cum

borewells and tube wells. The ground water occurs under unconfined , semi-confined and confined conditions in these formations. The yield of dug wells varies from50 to 150m^3/day.

The status of ground water exploration as on 31.03.2008 is furnished below.

Type of boreholes	Unconsolidated Formation	Consolidated Formation	Total
EW	12	35	47
SH	7	-	7
PZ	2	1	3

12 exploratory, 7 slim holes and 2 piezometers have been drilled in alluvium. The maximum thickness of alluvium at places is varying between a few metres to 65 meter. The phreatic aquifer around Bamanwas, north of Gangapur and around Phulwara in Moral river basin is characteristically clay rich. In a narrow strip along the Chambal river, forming southern and south-eastern part of the district, alluvium is forming the main aquifer. This is mainly ravine area. Thickness of alluvium is not much. Discharge of tube wells varies from 45 to 660 lpm for drawdown 5.17 to 15.2 m. the transmissivity value of the aquifer ranges between 75.2 to 272 m^2/day and storage co-efficient value ranges 1.55×10^{-4} to 5.8×10^{-4}, and specific capacities ranges from 0.255 to 0.065 m3/min/m. 35 exploratory bore wells, 1 piezometer have been drilled in hard rocks of Bhilwara, Delhi and Vindhyan Super Groups. Bhilwara Super Group, comprises of interbedded sequence of shale, slate, schist, quartzites, phyllites and limestones occur mostly in the south-central part of the district. The Delhi Supergroup of rocks are found unconformably overlying the mica schist and gneisses of Bhilwara Supergroup and consist of quartzite, calc-gneiss, mica-schist. The Vindhyan Supergroup of rock consisting mainly of various types of shales, sandstones and the limestones. Occupy the south eastern part of the district and are separated from the older rocks by a major reverse fault known as Great-Boundary fault, trending NE-SW direction.

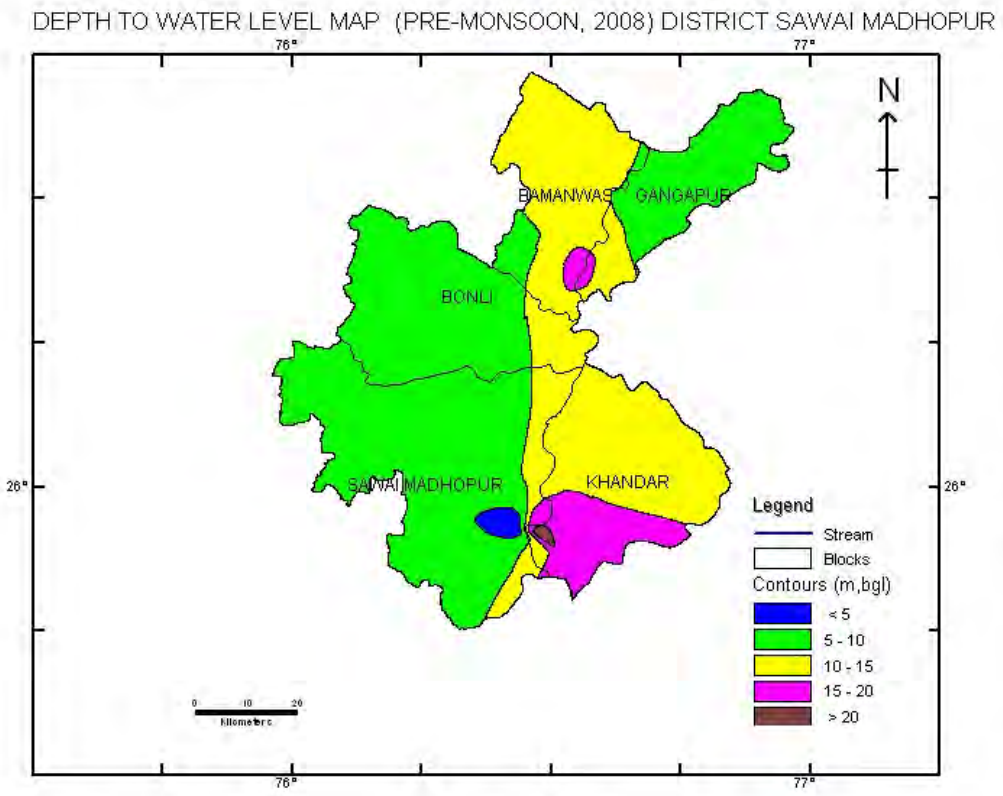
The depth of bore wells in hard rock ranges from 75 to 175m. Discharge of bore wells in hard rock formation ranges generally less than 50 lpm to 1250 lpm for draw down 5.6 to 44.0 m. The transmissivity values of the aquifer ranges from 40 to 158 m^2/day. High yielding bore well have been drilled at Malarna Dungar(1200lpm), Gothra(1250lpm), Chakchainpura(468lpm),Sawai Madhopur (594lpm), Sukhwas(415lpm), Bheronda(500lpm).

4.2 Depth to water level

The total number of hydrograph stations in the district is 24 comprising of 20 dug wells and 4 piezometers. Depth to water level varies from 2.16 to 21.35m during pre-monsoon, 2008 (Figure 4) and 3.19 to 22.21m during post-monsoon,2008. Deeper water level i.e. more than 20m is constituted by only 5% stations and lies in the south west part of Khandar block. Depth to water level between 15 to 20m is constituted by 10% of stations covering southern part of Khandar block and localized

pocket in southern part of Bamanwas block. 25% of stations forms water level between 10 and 15m which lies mainly in Bamanwas, Khandar block and in eastern parts of Bonli and Sawai Madhopur block.

FIGURE-4



The study of long term water level trend for the last ten years (pre-monsoon,1999-2008) reveals that 90% of hydrograph stations exhibit declining trend ranging from 0.051 to 1.664 m/year whereas only 10% of stations show marginal rising trend ranging from .009m to 3.092m/year. Maximum declining trend has been noticed in Gangapur, Bamanwas, Bonli and part of Sawai Madhopur & Khandar bl.ocks (Figure-5). The representative hydrographs of select stations (Gangapur, Bonli, Bamanwas, Kushtala and Khandar) have been depicted in Figure- 6 to 10. Hydrographs of Kushtala show maximum decline of about 0.45m/year where as hydrographs of Gangapur, Bonli, Bamanwas show decline in water level ranging from 0.149 to 0.182m/year. The hydrograph of Khandar is almost flat showing lesser withdrawal of ground water.

FIGURE- 5

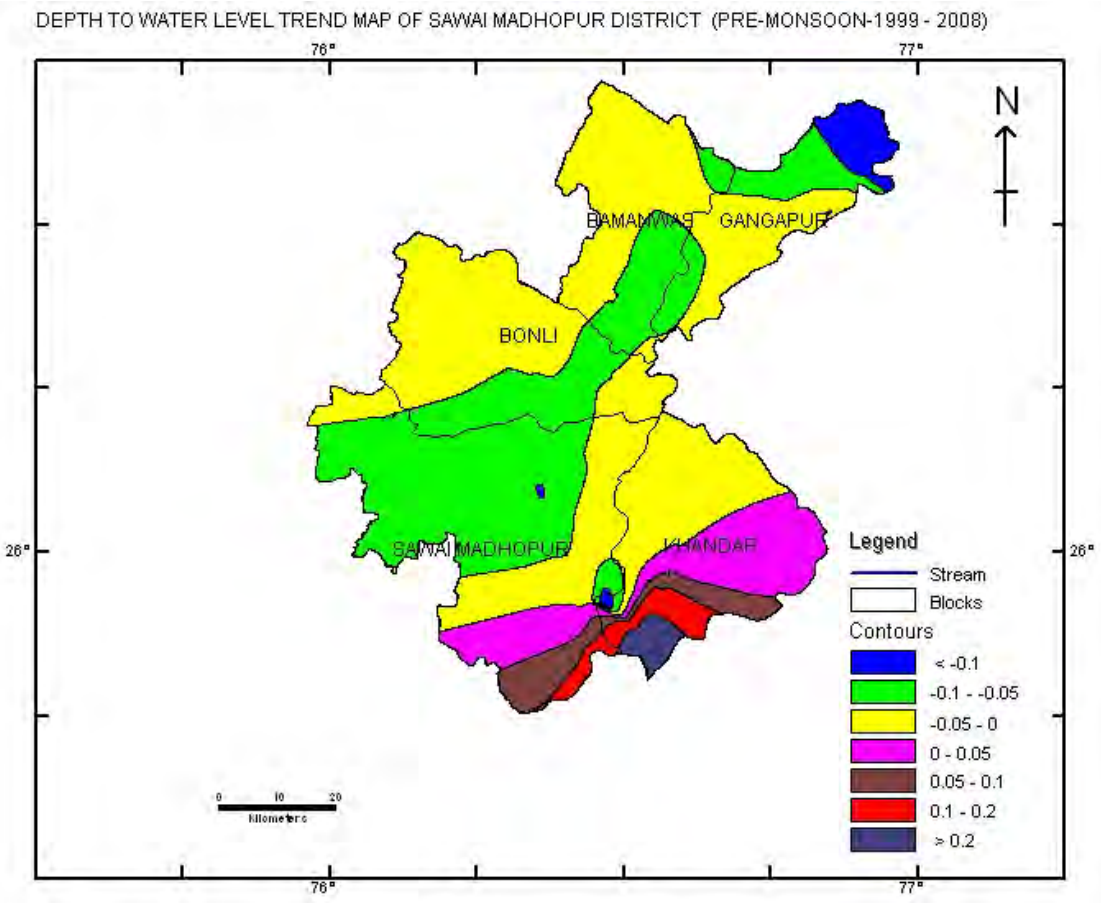


FIGURE-6

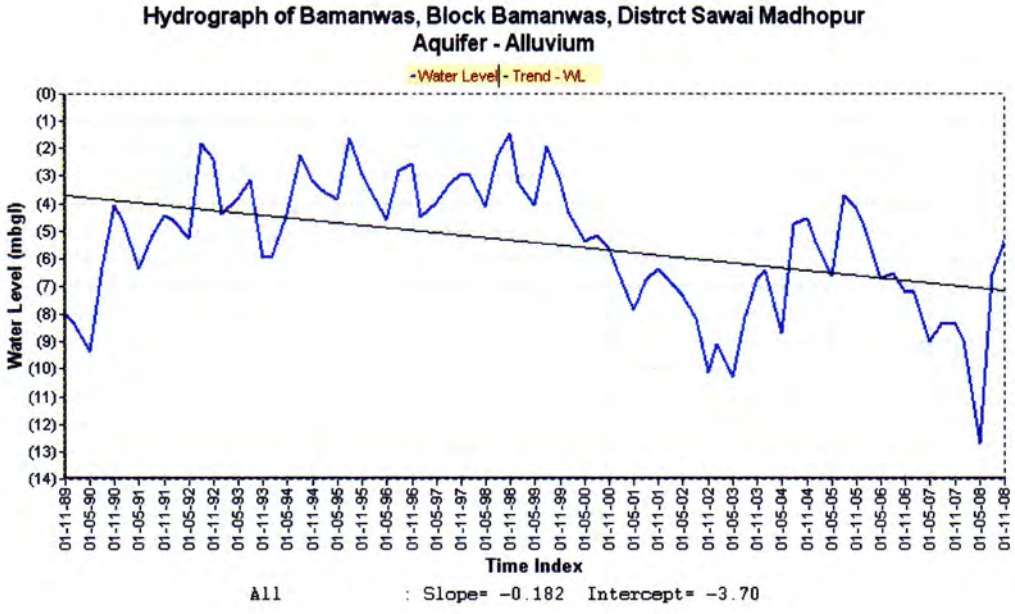


FIGURE-7

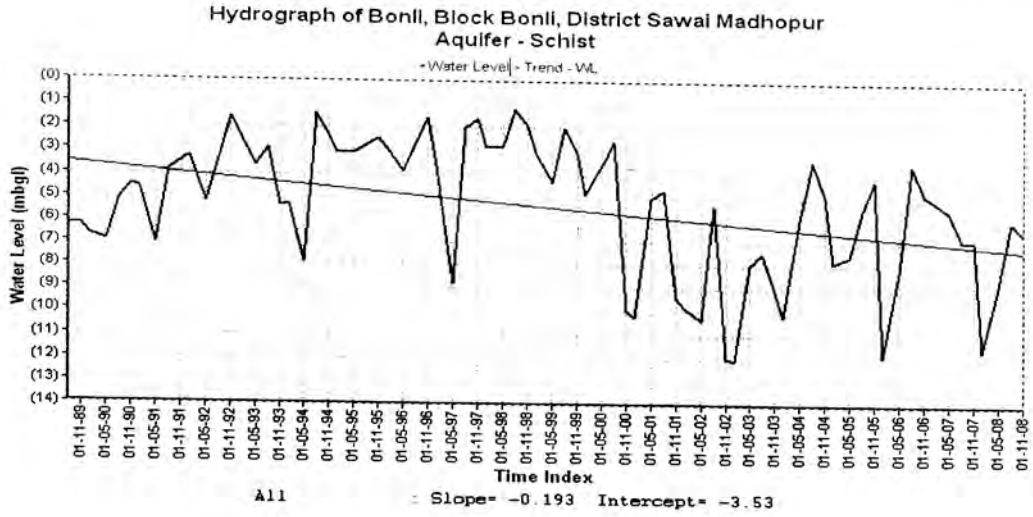


FIGURE-8

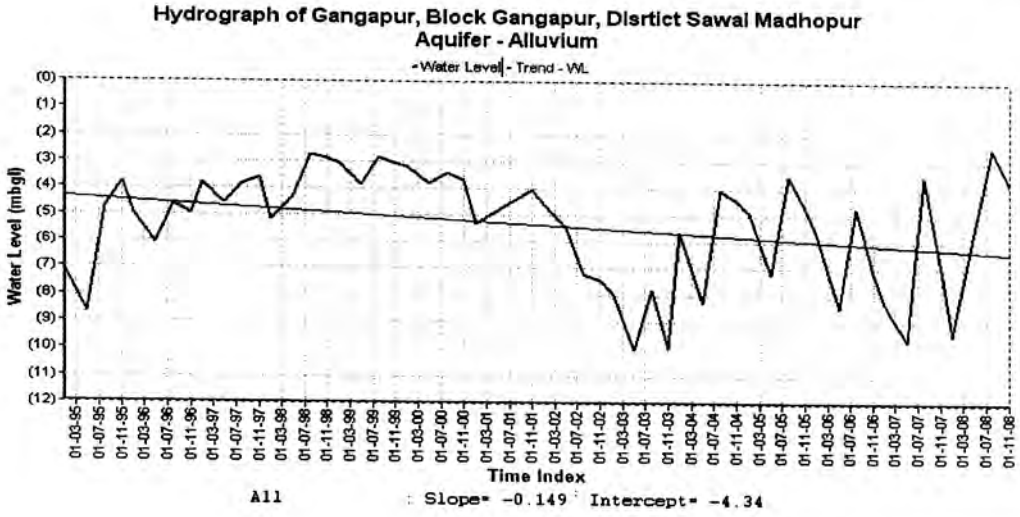


FIGURE-9

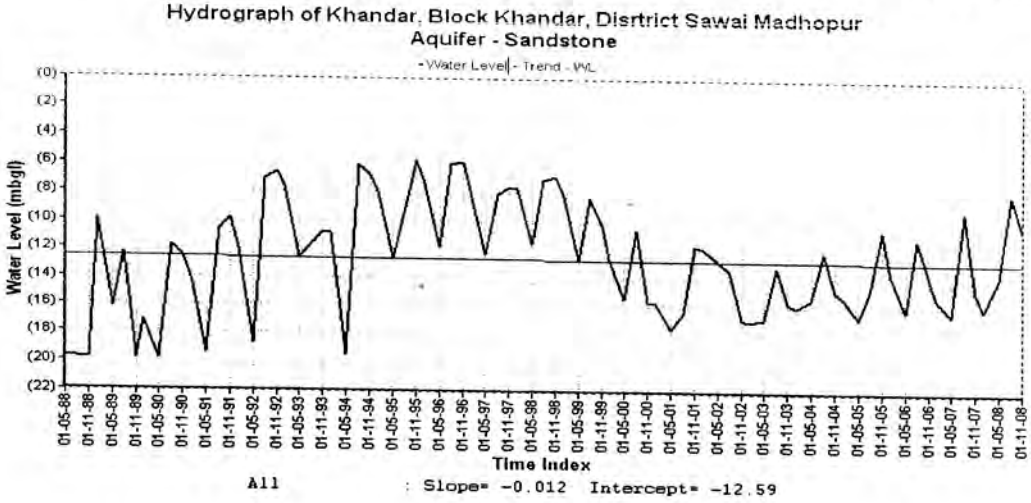
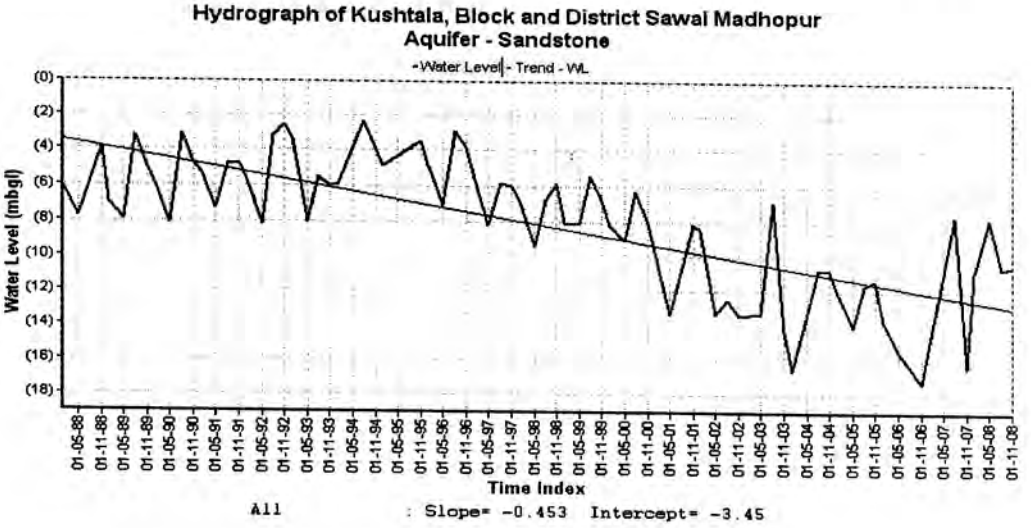


FIGURE-10



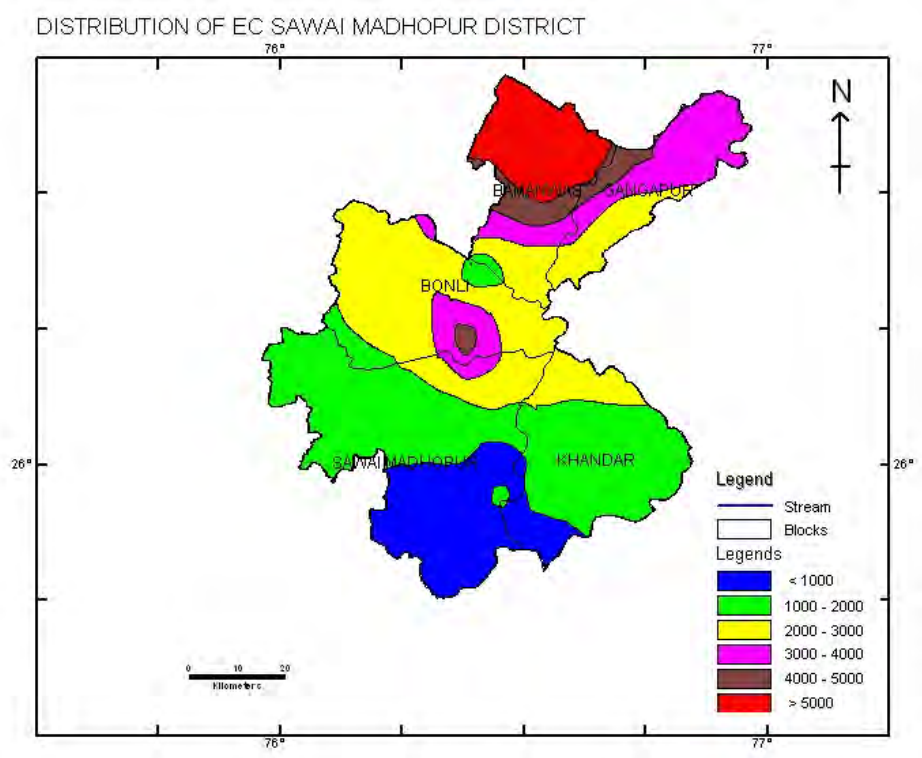
The hydraulic slope in the district closely follows the ground water slope. Steepness of water table is more in north western part of the district while it is gentle in western and northern part of the district. The gentle slope indicates comparatively more permeable aquifer. In the western part of the district around Bonli, the ground water slope is towards west.

4.3 Ground water quality

The chemical quality of ground water in major part of the area is generally with in permissible limit for agriculture, domestic and industrial uses. The specific conductance ranges between 500 to 5500 micro mhos/cm at 25°C. In greater part of the area, it is with in 2000 micro mhos/cm at 25°C. Higher values have been observed only in the northern part of the district. The specific conductance contents more than 3000micro mhos/cm at 25°C is constituted by only 10% of stations in the district (Figure-11).

Fluoride content in ground water is less than 1.5 ppm in major part of the district, except a few pockets in central, northern and south eastern parts of the district. Around Bhadoli, Jastana, Morel Tiwara, Padritop Khana, Phariya and Sewa, the fluoride content is more than 1.5 mg/l constituted by about 25% of stations.Nitrate concentration in ground water is within permissible limit in major part of the district. The nitrate content more than 100 mg/l constituted by about 15% of stations only.Iron concentration in ground water is within permissible limit in major part of the district. The iron concentration more than 1.00mg/l constituted by about 20% of stations

FIGURE-11



Depth wise ground water salinity variation

- Vertical zonation of ground water quality is observed and on this basis, the areas can be grouped as under.
- Fresh ground water overlies saline water in areas south of Bamanwas, between Banas river and Sawai Madhopur.
- Fresh ground water underlies saline water in areas around Bamanwas, Seba, Sanet.
- Ground water saline at all levels in area extreme north of Gangapur touching district boundary.

4.4 Ground Water Resources

The dynamic ground water resources as per Ground Water Estimation as on 31.03.2004 is furnished below in table.

Ground Water Resources Estimation as 31.03.2004

Block	Area of Block (Sq.Km.)	Type of area	Net Annual G W Availabi-lity (mcm)	Existing Gross Ground Water Draft for Irrigation (mcm)	Existing Gross Ground Water Draft for Dom.& Industrial Use (mcm)	Existing Gross Ground Water Draft for All Uses (mcm)	Net G.W. Availabi-lity for future Irrigation Develop-ment (mcm)	Stage of Groun d Water Develo p-ment (%)	Categ ory
1	2	3	4	5	6	7	8	9	10
Bamanwas	721.10	NC/C	67.5390	56.1275	7.5486	63.6761	(-) 1.3385	94.28	Crit.
Bonli	1004.50	NC/C	63.2600	49.2840	13.2609	62.5449	(-) 11.5240	98.87	Crit.
Gangapur	645.50	NC/C	59.4662	79.3800	18.2454	97.6254	(-) 49.5038	164.17	OE
Khandar	1453.81	NC	81.6701	66.5310	11.1718	77.7028	(-) 1.8509	95.13	Crit.
Sawai Madhopur	1195.74	NC	94.4940	89.1096	23.2891	112.3987	(-) 31.3556	118.95	OE
Total of District	5020.65	NC/C	366.4393	340.4321	73.5158	413.9479	(-) 95.5728	112.96	-

Gangapur and Sawai Madhopur blocks fall in over-exploited category due to excessive use of ground water being the only major source of irrigation. Bamanwas, Bonli and Khandar blocks fall under critical category having stage of ground water development ranging from 94.28% to 98.87%.

5.0 GROUND WATER RELATED ISSUES AND PROBLEMS

5.1 Declining water level

Long term water level data (pre-monsoon, 1998-2009) have indicated declining water level trend ranging from 0.051 to 1.664m/year. As a result of which two blocks viz. Gangapur and Sawai Madhopur fall under over-exploited category which is needed to be controlled through conservation of ground water resources and adopting artificial recharge to ground water through rain water harvesting and surplus canal water if available.

5.2 Ground water salinity

The electrical conductivity more than 3000 mmhos/cm at 25°C is represented by 10% of stations only and is noticed in the northern part of district in Bamanwas and Gangapur blocks.

6.0 GROUND WATER DEVELOPMENT AND MANAGEMENT STRATEGY

6.1 Ground Water Development

The stage of ground water development for the district is 112.96%. Out of total 5 blocks, two blocks viz. Gangapur, Sawai Madhopur have stage of ground water development as 118.95% and 164.17% respectively and falls in over-exploited category. No recommendation is extended for additional ground water development except for drinking purposes.

6.2 Ground water management

6.2.1 As the district has 112.96% stage of ground water development (two blocks viz. Gangapur and Sawai Madhopur fall under over-exploited category), thereby leaving little scope of further ground water development for irrigation in these blocks except for drinking purpose which may be taken only in very restricted and planned way to avoid deterioration of situation further. Three blocks viz. Bamanwas, Bonli and Khandar (falling under critical category) having stage of ground water development ranging from 94.28% to 98.87% have has also limited scope for ground water development.

6.2.2 Ground water should be used judiciously taking in to account of modern agriculture water management techniques by cultivating crops requiring less watering and use of sprinkler system and drip irrigation should be encouraged.

6.2.3 A modern agriculture management has to be taken into account for effective water management techniques involving economic distribution of water maintaining minimum pumping hours and also by selecting amost suitable cost effective crops pattern i.e. for getting maximum agriculture production through minimum withdrawal. Adopting proper soil and water management even the ground water with some what dissolved solids(TDS) may also be suitable for irrigation for salt tolerant crops in the area having high salinity.

6.2.4 Northern part of the district is underlain by unsaturated moderate thickness of alluvium which provides sufficient scope of artificially augmentation to the ground water body as alluvial formation has very good storage and transmission capacity. In the district, there is rainfall of about 3502.4054mcm/annum considering the area and average annual rainfall. Out of this, 366.4393mcm is annual natural recharge as per the ground water estimation as on 31.03.2004. The above data indicate the availability of surplus water which can be used for artificial recharge through the various techniques feasible in alluvial and hard rock terrain**.**

In alluvial area, following ways of recharge techniques may be adopted.

i) Roof top/paved area rain water harvesting for recharge to ground water in urban and industrial area.
ii) Village water runoff/roof top rain water harvesting by dug wells/percolation tanks in rural area.
iii) Construction of recharge shafts with gabion structures in nalas.
iv) Recharge by dug well/percolation pit in agriculture farm.

In hard rock terrain nala bunding, anicuts, dug wells, percolation tanks etc. are feasible structures which may be used to recharge the ground water body. These will certainly enhance the recharge to ground water body resulting in arrest of decline in water level.

6.2.5 Mass awareness programmes should be arranged at local level to make common mass aware of importance of ground water resources, its better practices of use in domestic, irrigation and industrial fronts, present status of ground water scenario, its conservation etc.

6.2.6 Training programmes on water management should be arranged at local level to aware and adopt various techniques of artificial recharge to ground water through rain water harvesting and surplus canal water, if available.

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