GROUND WATER BROCHURE OF MUZAFFAR NAGAR DISTRICT, U.P.

By

A.K. Bhargava

Scientist 'C'

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ii.	Administrative Divisions (as on 31.03.2005) Number of Tehsil/Block Number of Panchayat/Villages	:	 5/14 112/1025
iii.	Population (as on 2001 census)	:	3543362
iv.	Average Annual Rainfall (mm)	:	753
2.	**GEOMORPHOLOGY**	:	Middle Ganga Plain
	Major Physiographic Units	:	Younger alluvium Older alluvium Flood plain
	Major Drainages	:	Ganga, Yamuna,Hindon
3.	**LAND USE (Sq. Km.)**		
a)	Forest area	:	280.20
b)	Net area sown	:	3272.66
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4.	**MAJOR SOIL TYPES**	:	Sandy loam
5.	**AREA UNDER PRINCIPAL CROPS Sq. Km. (As on 2005-06)**	:	3840 (Wheat, Rice, Sugarcane)
6.	**IRRIGATION BY DIFFERENT SOURCES (Sq. Km. and Numbers of structures) 2005-06**		
	Dugwells	:	1.05 / 245
	Tubewells / Borewells	:	59.81 / 466, 2259.52 / 82879
	Canals	:	761.61 / 1336 Km.
	Other Sources	:	0.10
	Net Irrigated Area	:	3082.31
	Gross Irrigated Area	:	4746.54
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2007)**		
	No. of Dugwells	:	8
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8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	:	Quaternary alluvium

9.	**HYDROGEOLOGY AND AQUIFER GROUP**		Quaternary alluvium deposited by Ganga and Yamuna river systems. Ist aquifer down to 185m IInd aquifer depth 115-235 IIIrd aquifer 255-329 IVth aquifer 255-488
	Major water bearing formation	:	Sand, silt and gravel
	Pre-monsoon Depth to water level during May' 2007	:	3.20 to 9.95 mbgl
	Post-monsoon Depth to water level during Nov' 2007	:	2.50 to 7.95 mbgl
	Long term water level trend in 10 years (1998-2007) in m/yr	:	Premonsoon Rise – 8 cm/yr. Fall 7 – 47 cm/yr.
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10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-3-2007)**		
	No of wells drilled (EW, OW, PZ, SH, Total)	:	EW-5, PZ-08
	Depth range (m)	:	210 – 452
	Discharge (litres per second)	:	33 – 76
	Storativity (S)	:	2.40×10^{-6} to 5.90×10^{-2}
	Transmissivity (m^2/day)	:	530 – 2580 m^2/day
11.	**GROUND WATER QUALITY**		
	Presence of chemical constituents more than permissible limit (e.g. EC, F, As, Fe)	:	No constituents above permissible limit
	Type of water	:	Good
12.	**DYNAMIC GROUND WATER RESOURCES (mcm) as on 2004**		
	Annual Replenishable Ground Water Resources	:	1722.26
	Gross Annual Ground Water Draft	:	1415.06
	Projected Demand for Domestic and Industrial Uses upto 2029	:	146.87
	Stage of Ground Water Development	:	82.0%
13.	**AWARENESS AND TRAINING ACTIVITY**	:	-
	Mass Awareness Programmes organized		Nil
	Date		
	Place		
	No. of participants		
	Water Management Training Programmes Organized		Nil
	Date		
	Place		
	No. of participants		

14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**		
	Projects completed by CGWB (No. & amount spent)	:	Nil
	Projects under technical guidance of CGWB (Numbers)	:	
15.	**GROUND WATER CONTROL AND REGULATION**	:	
	Number of OE Blocks	:	2 (Shahpur, Un)
	No of Semi Critical Blocks	:	-
	No of blocks notified	:	-
16.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	:	Declining trend, Two blocks are over exploited & five blocks are in semi-critical category.

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I. INTRODUCTION

1.1 Administrative Details:

Muzaffar Nagar district lies in the northwest of Uttar Pradesh, covering an area of 4008 sq. km. It is bounded by the Saharanpur district in the north, Haridwar district of Uttaranchal in the northeast, Bijnor district in the east, Meerut district in the south and river Yamuna separates it from the adjoining state of Haryana in the west. The eastern boundary of the district with Bijnor district is formed by river Ganga. The district falls in Survey of India Toposheet No. 53C, covering north latitudes $29^0$01'50" and $29^0$44'20" and east longitude $77^0$02' and $78^0$07'.

For administrative purposes, the district has been sub-divided into five tehsils and 14 developmental blocks.

1.2 Basin and Sub-Basin:

The district occupies the northern part of Ganga – Yamuna basin.

1.3 Drainage:

Muzaffar Nagar district is demarcated by river Ganga in the east and by river Yamuna in the west. In fact, the drainage pattern of the district is strictly governed by these two major rivers. Both the rivers in their respective course flow more or less north to south. Major tributary of Ganga is Solani river. Yamuna has the tributaries named Hindon, Krisni and Hari rivers and the Katna nala.

1.4 Irrigation Practices:

Entire district of Muzaffar Nagar falls between the rivers Ganga and Yamuna. The loamy soils of the area is very fertile. About 80% of the total geographical area of the district is cultivated. The main rabi crops are wheat and oil seeds while paddy and

pulses are the main kharif crops. The abundantly produced sugarcane is a perennial crop.

Muzaffar Nagar district is one of the highly developed districts privileged with the Ganga and Yamuna canal systems. Besides the Ganga canal & Eastern Yamuna canals, the irrigational needs are met by ground water.

The canal irrigation is maximum in Khatauli block followed by Purkaji block. The canal irrigation is minimum in Budhana block. The area irrigated by tubewells is maximum in Uoon block and minimum in Purkaji block. The area irrigated by different sources is as follows:

		Area in Sq. Km. and No. of Structure
Dug wells	:	1.05 / 245
Tubewells / Borewells	:	59.81 / 466, 2259.52 / 82879
Canals	:	761.61 / 1336 Km.
Other sources	:	0.10
Net irrigated area	:	3082.31
Gross irrigated area	:	4746.54

1.5 Studies / Activities Carried Out by CGWB:

Central Ground Water Board has drilled 5 exploratory wells and 8 piezometers. The depth of wells ranges from 210 m to 452 m and yield (lps) from 33 to 76.

CGWB is monitoring the ground water regime for the changes in water level and water quality through 8 dugwells and 8 piezometers. The monitoring of water levels are carried out during May (premonsoon) August, November (postmonsoon) and January to study the impact of rainfall on ground water regime, water samples are collected during May for determining the changes in chemical quality of ground water.

II. RAINFALL & CLIMATE

The average annual rainfall is 753.2 mm. The climate is sub humid and it is characterised by general dryness except in the brief monsoon season, a hot summer

and pleasant cold season. About 80% of rainfall takes places from June to September. During monsoon surplus water is available for deep percolation to ground water.

There is a meteorological observatory at Meerut, which may be taken as representative of meteorological condition. May is the hottest month. The mean daily maximum temperature is about 40^0C, mean daily minimum temperature is about 24^0C and maximum temperature some time rises to 44^0C. With the onset of southern monsoon by the end of June, there is appreciable drop in temperature. January is the coldest month with mean daily temperature at about 20^0C and mean daily minimum at 7^0C.

The air is dry during the year. In south-west monsoon season, the air is very humid and April and May are usually driest months. The mean monthly relative humidity is 67%. The mean wind velocity is 6.70 Km.p.h. The potential evapotranspiration is 1545.90 mm.

III. GEOMORPHOLOGY AND SOIL TYPES

The entire Muzaffar Nagar district is a flat terrain falling in middle Ganga plain. The highest point in the district is 201.00 mamsl in the north and lowest in the south is 222.00 mamsl giving rise an average slope of about 0.40 m/km. north to south. The district can be sub divided into 5 geographic units.

a. *Sand Bars:*

Along the courses of Ganga and Yamuna rivers, the sand bars are characteristic which dynamically change during floods.

b. *Flood Plain:*

The flat, low lying poorly drained area adjacent to Ganga and Yamuna rivers forms the flood plains frequented by floods during monsoons.

c. *Ravines:*

In the western part of the district, this unit is characterised by the gullies along the rivers Kari, Hindon and Krishni. This is probably due to the erosion of unconsolidated material by localised surface run off forming channels and

ultimately giving rise to undulating topography and hence the formation of ravines.

d. Younger Alluvial Plains:

The gently sloping (southward) and slightly undulating terrain having ox-bow lakes, back swamp and paleo-channels forms this geomorphologic unit along the western bank of Ganga and eastern bank of Yamuna river in the district. This unit is also called Khadar. In the western part of the district, the Yamuna Khadar in the east of Yamuna river spreads about 12 kms. in the north and narrows down towards the south. In the eastern part of the district the Ganga Khadar (west of river Ganga) is widest (about 20 Kms.) in the north and gradually narrows down to 2 Kms. width around the place called Bhokerhedi.

e. Older Alluvial Plain:

Older alluvial plain may be divided into three parts-

(i) Tract between Ganga canal and Kali river: This is upland with general east to west slopes more considerable than the regional slope of the area i.e. north to south. It is marked by natural levees as sand belt stretching north south with heights ranging 3-18 m.

(ii) Tract between Kali and Hindon rivers: Between these two rivers, the upland slopes down to both rivers side and marked by broken grounds which is more in southern part of the district than that in the northern part.

(iii) Tract between Hindon and Yamuna: Between the Yamuna Khadar and Hindon river there is an elevated plateau, where topography along the rivers is uneven due to poor soil character. The area is drained by Yamuna canal and Katna Nala.

Land Forms:

(i) Water logged area: Along the main Ganga canal, due to seepage, the water logged areas have developed. In the northern part of the canal, the water logged areas occurs along the western side while that in the southern part of the area water logged area found in the eastern side of the canal.

(ii) Back swamp: The low lying swampy land is formed along the flood plains of Ganga river in the north-eastern part of the district around Majlispur and Farukhpur.

(iii) Palaeo-channels: In the western part of the district, cut-off meanders forming ox-bow lakes suggest the buried paleo-channels in the younger alluvial plains which area along the course of river Yamuna.

(iv) Levee deposit: These deposits are characteristic of river Ganga in the eastern part of the district which are older high tracts of the river ranging 3-18 m. in height. The prominent levee stretches north-south from Purkaj in the north to Hasanwadi in the south with east-west width ranging from 0.50-2.00 m.

IV. GROUND WATER SCENARIO

4.1 Hydrogeology:

The entire Muzaffar Nagar district underlains by the quaternary alluvium deposited by Ganga and Yamuna river system. Lithologically the alluvial sediments comprise of sand, silt, clay and kankars in varying proportions.

The perusal of all available lithological logs of the tubewells in the area reveal the complex configuration of alluvial sediments showing quick alteration from finer to coarser lithology. By and large the four distinct groups of permeable layers occurs in the area down to 450.00 mbgl. The top sandy clay bed 3-75 m in thickness covers the entire district. After top clayey layer first aquifer starts and with varying thickness at different places continues down to 185 mbgl. Lithologically the aquifer comprises mostly medium to coarse sand but gravels and kankars are also encountered sometimes. This aquifer at places, can be sub divided into two sub groups due to the presence of either clay lenses or sub regional clay layers.

The second aquifer occurring at varying depths between 115 and 235 mbgl is separated by 10-15 m thick clay layer from the first upper aquifer. The second group of aquifer consists of less coarse sediments than that of first one and at places kankar and clay lenses also occur.

The third aquifer is separated by second aquifer by thick clay layer. The fine textural third aquifer ranges in thickness between the depths 255 to 329 mbgl.

The third aquifer is followed by a clay layer. The thickness of the fourth aquifer varies between the depths 355-488 mbgl.

The aquifer material becomes coarser from west to east. The top clay layer is thickest at Lakkheri, Rajpur and Budhana in the south western part of the district but is almost absent at Sukratal in the eastern most part of the district. In general it can be observed that the river Ganga has deposited coarser material compared to those deposited by river Yamuna.

Ground Water Condition:

Ground water occurs in pore spaces and interstices of unconsolidated alluvial sediments under phreatic to semi confined to confined conditions. The near surface aquifer is under unconfined / water table condition. The shallow phreatic aquifer is tapped by dugwells. The depth to water ranges from 3.20 to 9.95 mbgl in pre monsoon period whereas it ranges from 2.50 to 7.95 mbgl in post monsoon period. The water level fluctuation varies from 0.70 to 2.00 m. The pre, post and fluctuation data is given below (Table 1). The depth to water level map of premonsoon presented in Plate-2 and for post monsoon in Plate-3. The trend of water level from 1999 to 2008 is given in Table-2 for pre, post and annual.

Table-1

WATER LEVEL FLUCTUATION (PRE AND POST) FOR THE SELECTED YEAR 2008

State : Uttar Pradesh

District : Muzaffar Nagar

Sl. No.	Well Name	Premonsoon (mbgl)	Postmonsoon (mbgl)	Fluctuation (m)
1.	Baghra	9.22	8.29	0.93
2.	Barla	-	2.75	-
3.	Basera	7.57	-	-
4.	Chartawal	7.65	6.08	1.57
5.	Jansath-2	4.40	-	-
6.	Khatauli	9.05	-	-
7.	Sukratal	4.05	3.29	0.76

Long Term Fluctuation:

The long term water level fluctuation for the period 1998-2007 indicates both rise and fall in water level in the area. In the premonsoon the rise was of the order of 8 cm per year, while the fall in water level range from 7 to 47 cm per year. In postmonsoon there was no rise in water level, while the fall in water level range from 6 to 64 cm per year.

4.1.2. Aquifer Parameters:

Discharge (Liters per second)	-	33 to 76
Storativity (S)	-	2.4×10^{-6} to 5.9×10^{-2}
Transimissivity (m^2/day)	-	530 to 2580

Table-2

TREND OF WATER LEVEL OF NHS

From Year 1999 to 2008

Sl. No.	Location	Pre Monsoon			Post Monsoon			Annual		
		Data Points	***Rise (m/year)***	***Fall (m/year)***	***Data (Points)***	***Rise (m/year)***	***Fall (m/yea)***	***Data Points***	***Rise (m/year)***	***Fall (m/year)***
1.	Morna	5			4			17		
2	Barla	9		0.0934	10		0.0818	40		0.0566
3	Basera	8		0.3910	9		0.2011	33		0.3162
4	Sukratal	10		0.0454	10		0.0338	39		0.0592
5	Jansath 2	10	0.0852		8	0.1168		37	0.0678	
6	Khatauli	9		0.7012	8		0.0417	33		0.4477
7	Chatarwal	10		0.1848	10		0.1171	38		0.1733
8	Mansoorpur	8		0.0785	9		0.0543	33		0.0743
9	Aterna	6		0.4650	6		0.4048	24		0.3619

4.2 Ground Water Resource:

The ground water resource have been computed jointly by Central Ground Water Board and Ground Water Department, U.P. as on 31st March 2004. The salient features of the computations are furnished below (Table-3):

Table-3

DYNAMIC GROUND WATER RESOURCES OF MUZAFFAR NAGAR DISTRICT, U.P.
As on 31.03.2004

Sl. No.	Assessment units - blocks	Annual ground water recharge (in ham)	Net annual ground water availability (in ham)	Existing gross ground water draft for all uses (in ham)	Net ground water availability for future irrigation development (in ham)	Stage of ground water development (in %)	Category of block
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.	Baghra	10879.55	9791.60	8435.93	1043.22	86.15	Safe
2.	Budhana	7914.21	7122.79	6370.75	598.54	89.44	Safe
3.	Charthawal	13069.16	12415.70	11126.23	1014.21	89.61	Safe
4.	Jansath	22930.55	20637.49	13123.93	7027.49	63.59	Safe
5.	Kairana	12208.51	10987.66	9661.06	968.79	87.93	Semi critical
6.	Kandhala	12855.81	11570.23	9728.50	1481.41	84.08	Semi critical
7.	Khatauli	17467.39	16594.02	13277.51	2824.74	80.01	Semi critical
8.	Morana	16884.94	15196.44	7592.04	7323.21	49.96	Safe
9.	Muzaffar Nagar	12010.81	10809.73	9718.71	856.98	89.91	Safe
10.	Purkazi	18049.89	16244.90	8073.58	7872.30	49.70	Safe
11.	Shahpur	8709.24	7838.31	10811.91	-3374.04	137.94	Over exploited
12.	Shamli	9592.97	9113.33	7934.35	885.11	87.06	Semi critical
13.	Thanabhawan	11746.67	11159.34	10138.97	644.85	90.86	Semi critical
14.	Uoon	14160.57	12744.52	15513.01	-3343.05	121.72	Over exploited
	Total	**188480.27**	**172226.05**	**141506.49**	**25823.77**	**82.16**	

4.3 Ground Water Quality:

Ground water in phreatic aquifer in general, is colourless, odourless and slightly alkaline in nature. The specific electrical conductance of ground water in phreatic zone ranges from 224 – 1885 μs/cm at 25^0C. Fluoride ranges from 0 – 0.79 mg/l, which is within permissible limit.

It is observed that the ground water is suitable for drinking and domestic uses in respect of all the constituents. Nitrate is found in excess of permissible limit

(>45mg/l) in few samples analysed, which is likely due to return irrigation flow from agricultural fields and often improper waste disposal. Phosphate is not found in ground water.

The Arsenic content is within limit of permissibility of BIS.

4.4 Status of Ground Water Development:

Presently ground water is being developed through 82879 private tubewells & borewells in addition to 245 dugwells. The total ground water draft is 141506.49 ham, which is being used in present for domestic irrigation & industrial purposes against the ground water availability of 172226.05 ham.

Out of 14 blocks, two blocks falls under over exploited category are Shahpur and Uoon, five blocks under semi critical and rest seven blocks falls under safe category and presented in Plate-IV. The percentage wise development is given in Table-2.

Ground water development is basically is peoples programme undertaken through individual and collective efforts from finance obtained as loans from institutional sources or invested by the farmers from their own sources. Ground water development has several advantages over surface water development methods and has become a vital factor in promoting innovating agriculture practices through high yielding varieties of crops. Ground water is widely distributed and provides an assured and dependable source of irrigation input. Net water avaibility for future irrigation is 25823.77 ham.

V. GROUND WATER MANAGEMENT STRATEGY

Based upon the studies carried out it is observed that water levgel is declining very fast in the district and it is strongly recommended that exploitation of ground water through private and state tubewells be stopped in the over exploited blocks of Shahpur and Uoon. The declining water level have caused adverse effect on the ecological balance as minor drainage ways which used to have water are now almost dry. This obviously is the result of massive ground water exploitation for irrigation as well as for industrial need in these two blocks. Dug well have become defunct due to

lowering of water table. It is therefore suggested that piezometers should be constructed down to 40.00 m depth to monitor water levels where the dug wells are defunct. Exploitation of deeper aquifers be made in systematic manner which are capable of yielding good water at moderate draw down.

5.1 Water Conservation and Artificial Recharge:

CGWB has prepared a master plan to augment ground water potential by saturating the shallow aquifer taking into consideration the available unsaturated space during post monsoon and available on committed surplus runoff. Subsequently, computations have been made for over exploited and critical blocks in the district warranting immediate attention.

Subsequently state government agencies have constructed artificial recharge structures with their own funds or with fund from central government for various government programmes.

There is considerable scope for implementation of Roof Top Rain Water Harvesting in the urban areas of the district. Check dams, cement plugs, renovation and construction of ponds with recharge shafts are ideal structures for rain water harvesting in rural areas. Central Ground Water Board is also providing free technical guidance for implementation of roof top rain water harvesting schemes.

VI. GROUND WATER RELATED ISSUES AND PROBLEMS

The development of ground water in the district, in general, is high. As many as 7 out of 14 blocks in the district have been categorised as over exploited and critical. The trend analysis of historical ground water level data also indicates a long term fall in a major part of the district. Based on the factors mentioned, it is inferred that a major part of the district could be considered vulnerable to various environmental impacts of water level depletion such as declining ground water levels, drying up of shallow wells, decrease in yield of bore wells and increased expenditure and power consumption for drawing water from progressively greater depths.

Excessive use of fertilizers and pesticides in agriculture has also reportedly resulted in localised enrichment of Nitrate in the phreatic zone.

VII. AWARENESS & TRAINING ACTIVITY

7.1 Mass Awareness Programme (MAP) and Water Management Training Programme (WMTP) by CGWB.

(i) Mass Awareness Programme - Nil.

(ii) Water Management Training Programme - Nil

7.2 Participation in Mela, Exhibition, Fair etc. - Nil

7.3 Presentation and Lectures Delivered in Public from Radio / T.V. / Institution of Repute / Grassroots Associations / NGO / Academic Institution - Nil

VIII. AREA NOTIFIED BY CGWA/SGWA

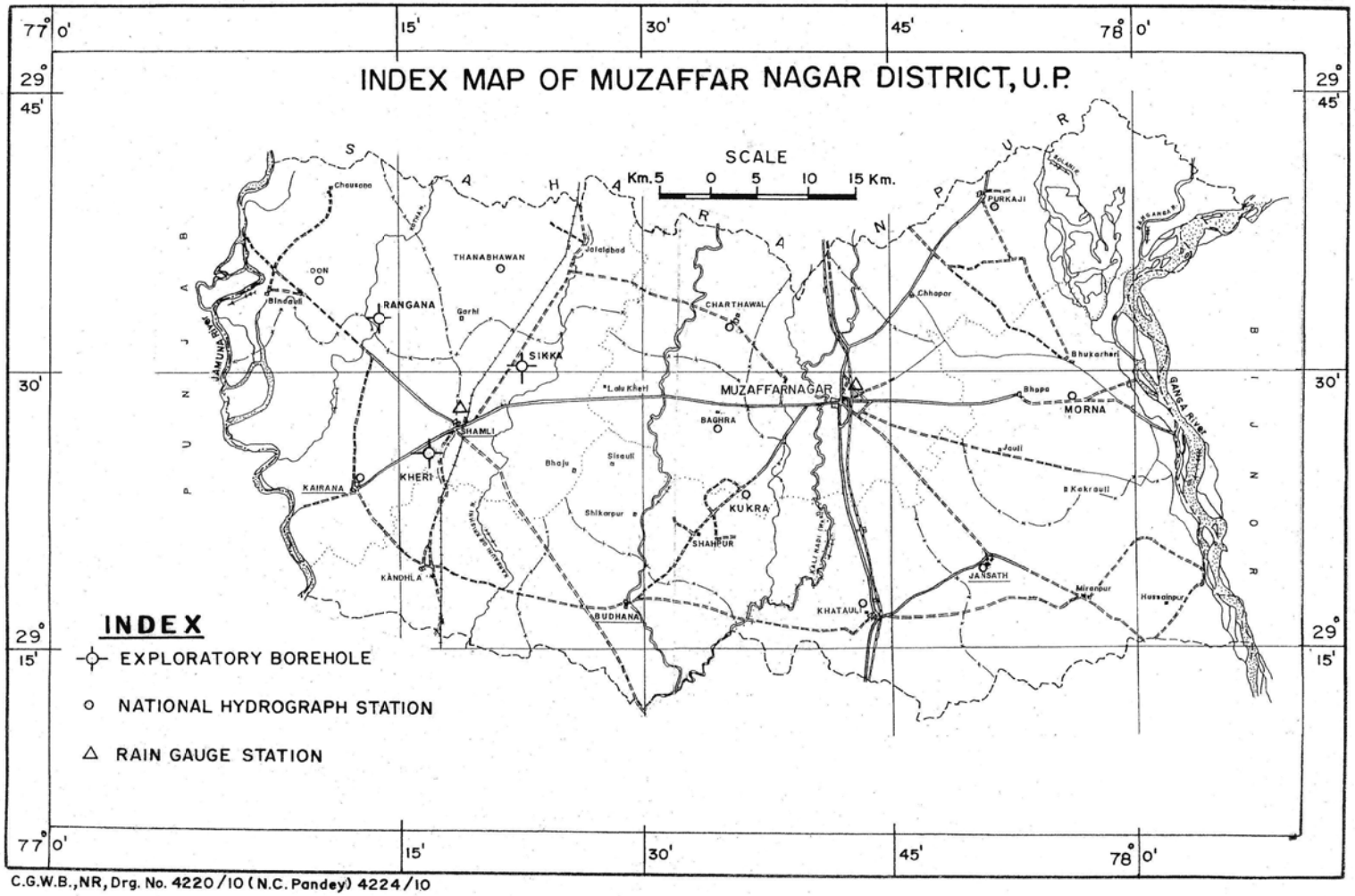
List of the areas - Nil

IX. RECOMMENDATIONS

Two blocks are over exploited and five blocks as semi critical and rest one as safe, hence it is recommended that development of ground water in these two over exploited blocks has to be carried out with extreme caution. Necessary measures for regulation of ground water abstraction from over exploited blocks may be initiated without further delay. The Purkaji block has been assessed as with most ground water resource potential since it has been assessed with 49.70% level of development.

It is general, recommended that western most and central part of the district needs more ground water cautions approach. In the blocks of Shahpur, Uoon, Kairana, Kandhla, Khatauli, Shamli and Thana Bhawan, the rain water harvesting and artificial recharge is recommended.

PLATE-I



C.G.W.B., NR, Drg. No. 4220/10 (N.C. Pandey) 4224/10

PLATE-II

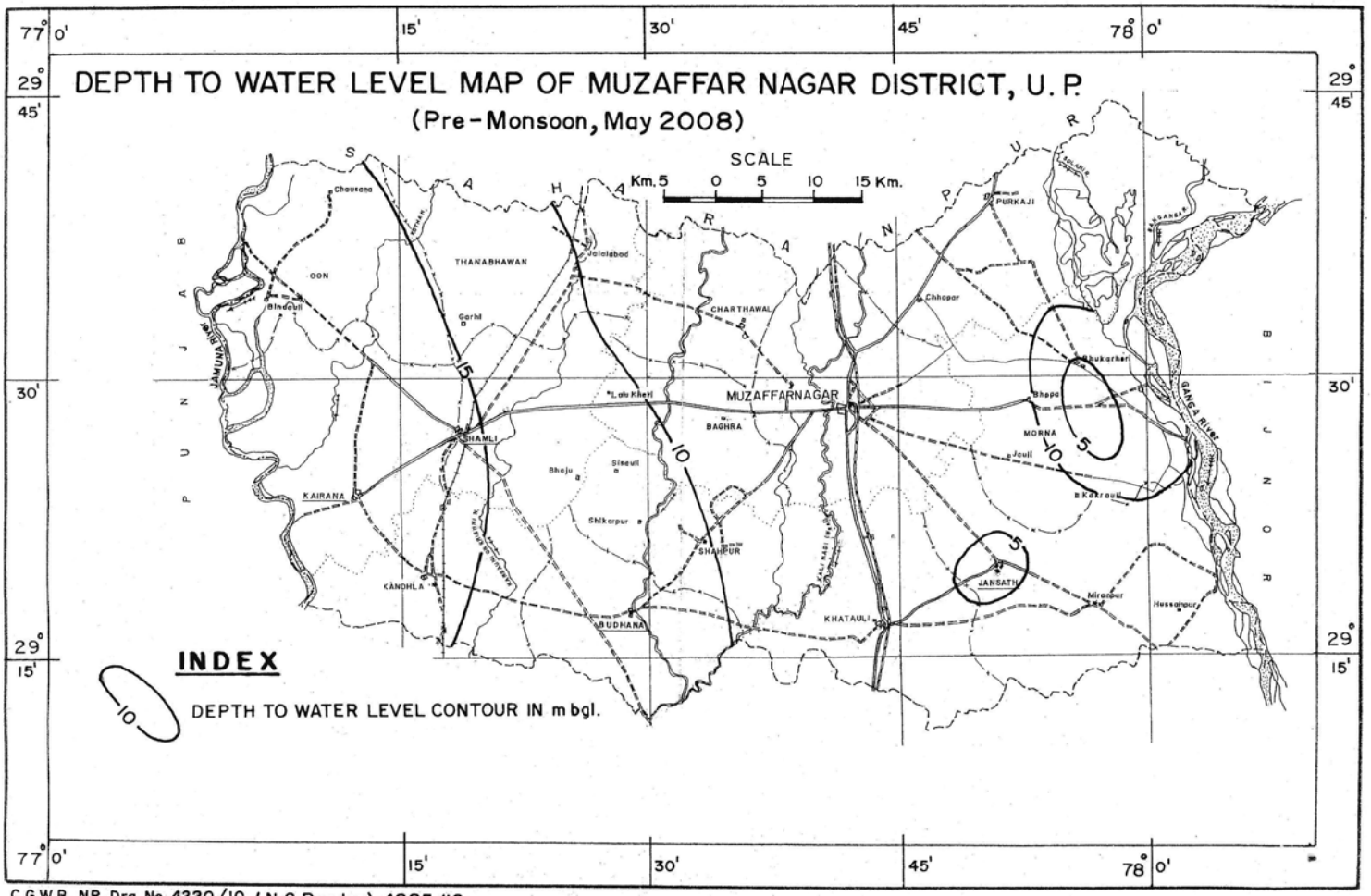


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PLATE-III

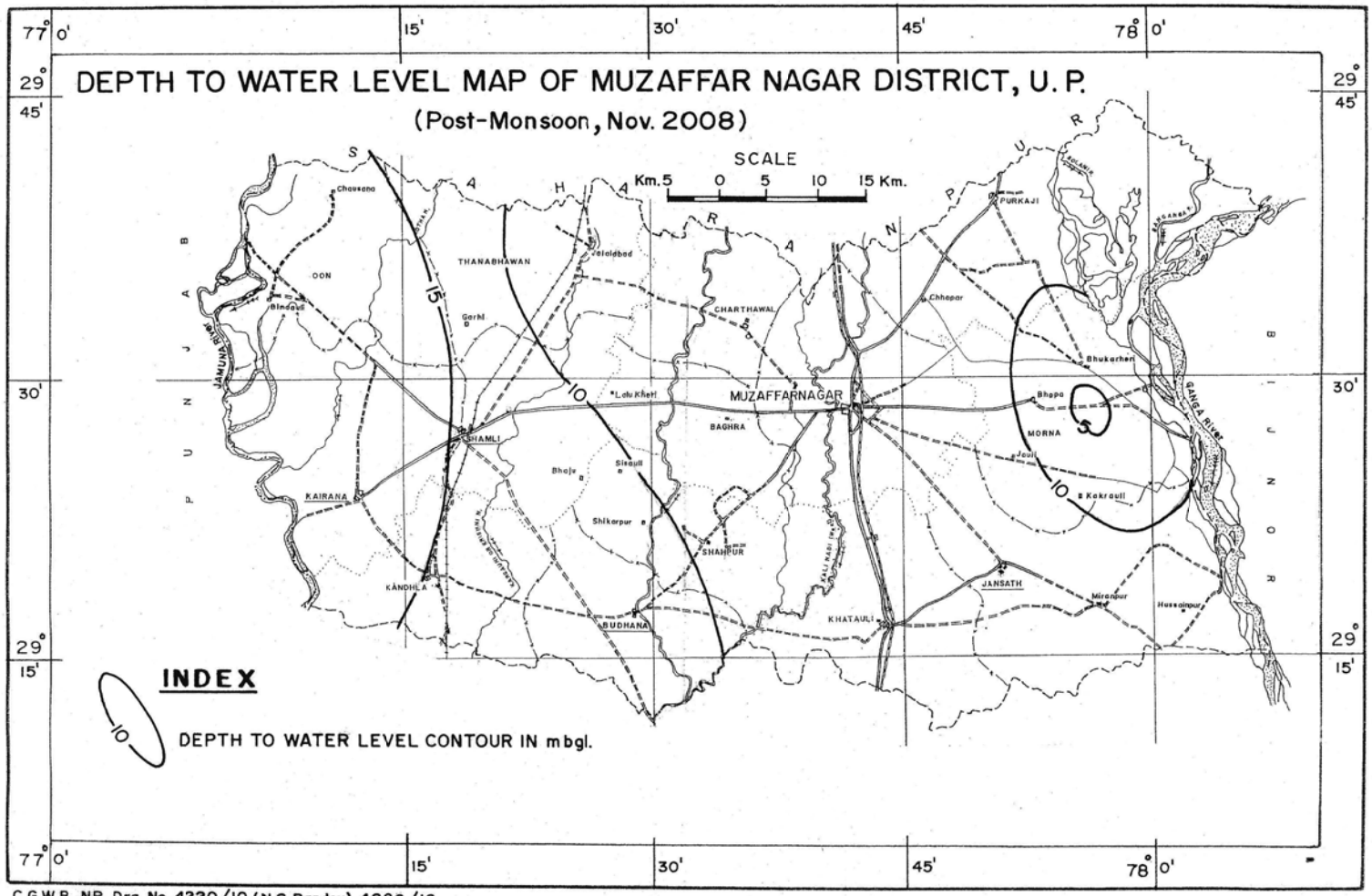

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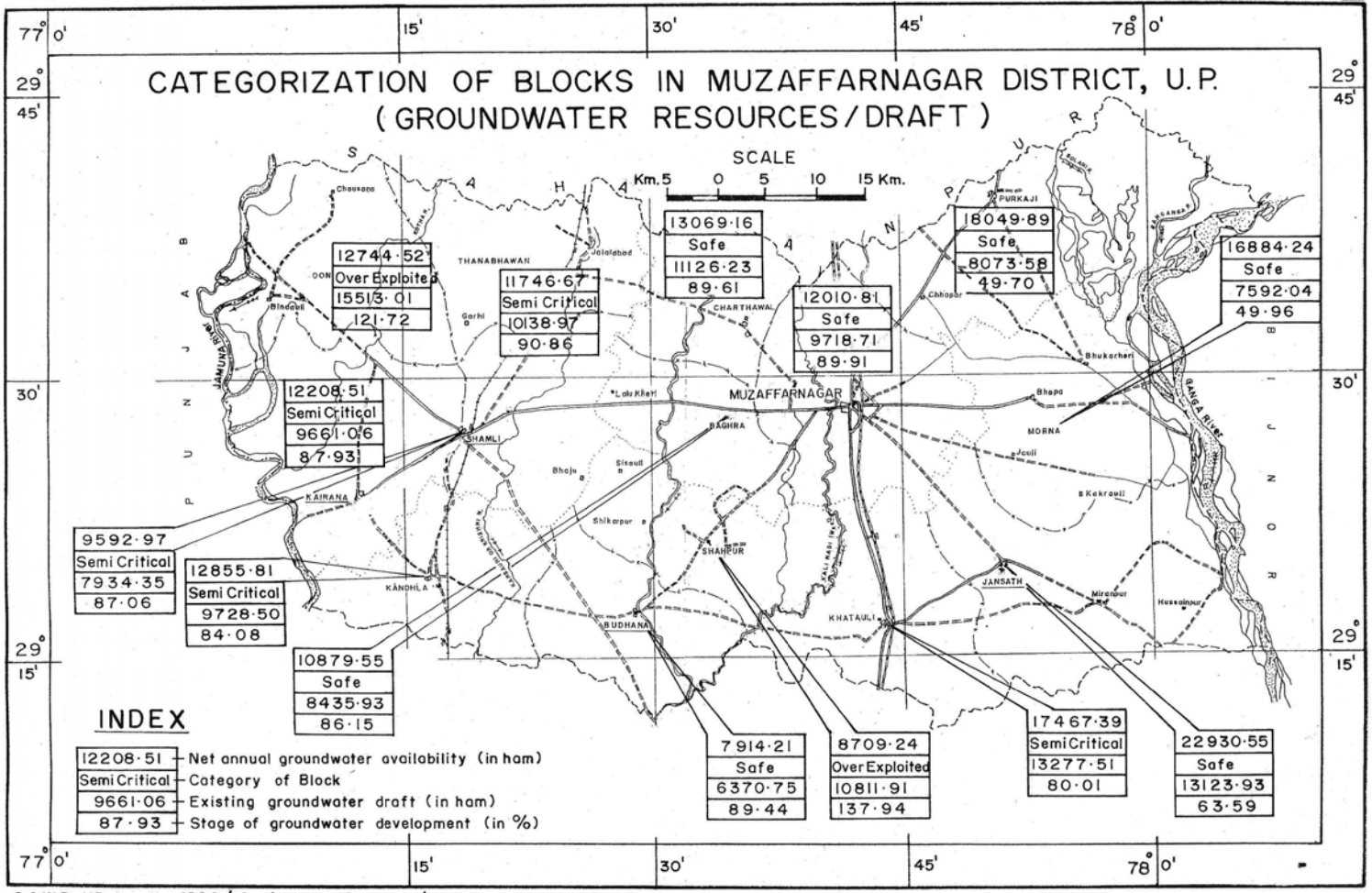
PLATE -IV



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