FATEHABAD DISTRICT HARYANA

CENTRAL GROUND WATER BOARD
Ministry of Water Resources
Government of India
North Western Region
CHANDIGARH
2013

Contributors

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Our Vision

“Water Security through Ground water Management”

GROUND WATER INFORMATION BOOKLET
FATEHABAD DISTRICT, HARYANA

C O N T E N T S

FATEHABAD DISTRICT AT GALANCE

Sl. NO.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	Geographical Area (sq. km.)	2490
	Administrative Divisions	
	Number Of Tehsils (3)	1. Fatehabad 2. Ratia 3. Tohana
	Number Of Blocks (5)	1. Fatehabad 2. Ratia 3. Tohana 4. Bhattu Kalan 5. Bhuna
	Number Of Panchayats	-
	Number Of Villages	243
	Population (As per 2011Census)	941522
	Average Annual Rainfall (mm)	373
2.	GEOMORPHOLOGY	
	Major Physiographic Units	Alluvial Plains
	Major Drainage	River Ghaggar
3.	LAND USE (Sq.Km.)	
	a. Forest Area:	Less than 5 Sq.Km
	b. Net area sown:	2250
	c. Cultivable area:	2280
4.	MAJOR SOIL TYPES	Sandy loams to loamy sands
5.	AREA UNDER PRINCIPAL CROPS (Sq. Km.)	2499
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and Number Of Structures) Sq.Km	
	Dug wells	-
	Tubewells/Bore wells	760 sq.km. 30,164/-
	Tanks/ponds	-
	Canals	1400 sq.km.
	Other sources	-
	Net Irrigated area	2160 sq.km.
	Gross irrigated area	3840 sq. km.
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB	
	No. of dug wells	13

	No of Piezometers	1
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium
9.	HYDROGEOLOGY	
	*Major Water bearing formation	Alluvium (Sand & Gravel)
	*(Pre-monsoon depth to water level)	1.42m-15.30mbgl
	*(Post-monsoon depth to water level)	0.45 -15.18 mbgl
	*Long term water level trend in 10 yrs in m /yr	Declining trend 0.04 to 0.68 m/year. Rising trend 0.08 and 0.47m/year.
10.	GROUND WATER EXPLORATION BY CGWB	
	No. of wells drilled	
	EW	12
	OW	-
	PZ	5
	SH	-
	Depth range (m)	187-345m
	Discharge (liters per minute)	177-4116 lpm
	Storativity (S)	$5.4 X10^{-2}$ - $7.7X10^{-3}$
	Transmissivity (m^2/day)	187- 2900
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit	
	EC, in micromhos at 25^0C	800-5610
	F, in mg/l	1.65-6.30
	As, in mg/l	0.057
	Fe, in mg/l	-
	SO_4, in mg/l (Exception)	2252
	Type of water	Mixed
12	DYNAMIC GROUND WATER RESOURCES (2011) MCM	
	Annual Replenish able Ground water Resources	606.05
	Net Annual Ground water Draft	1087.19
	Projected Demand for Domestic and industrial Uses up to 2025	18.10
	Stage of Groundwater Development	179%
13	AWARENESS AND TRAINING ACTIVITY	-
	Mass Awareness Programmes organized	-
	Date	-
	Place	-
	No of participants	-
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING	-

	Projects completed by CGWB (No.&Amount spent)	-
	Projects under technical guidance of CGWB (Numbers)	-
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks.	4
	No. Critical Blocks	-
	No. of blocks notified	-
16	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Declining of water levels Saline aquifers at shallow depths

HYDROGEOLOGICAL INFORMATION BOOKLET OF FATEHABAD DISTRICT, HARYANA

1.0 INTRODUCTION

The district of Fatehabad is bounded by $28^0$48'15" to $29^0$17'10" North latitudes and $76^0$28'40" to $77^0$12'45" East longitude covering an area of 2490 sq.km. Fatehabad is one of the smallest districts in the Haryana State and covers 5.69 % area of the state. The district is surrounded by Punjab state in the north, Jind district in the east, Sirsa district in the west direction, Hissar district and Rajasthan state in the South. The district headquarter, Fatehabad is connected by metalled roads with important cities of the state and Delhi. It is also connected by broad gauge railway line with Delhi. Tohana, Ratia, Bhuna and Bhattu Kalan are important towns in the district.

Fatehabad district is one of the sparsely populated districts of the state. The total population of the district as per 2001 census is 806158. The population density is 323 persons per sq.km against the state average of 477 persons per sq.km.

Fatehabad district had been a part of Hissar district and was covered during hydrogeological studies of Hissar district. Kidwai A.L. (G.S.I.) carried out systematic hydrogeological investigations during 1968-69 in the eastern most part of the district covering an area of about 950 Sq.km. During 1968-69 Jatti K.K. had given E. log interpretations for boreholes drilled in part of the district. Sinha B.P.C. and Srivastava J.P. (G.S.I.) have carried out some short-term investigations during 1968 and 1969, respectively.

Under ground water exploration programme, Central Ground Water Board has drilled 12 exploratory boreholes, down to a depth ranging between 188.65 and 344.42 m covering the entire district Basic data reports for the boreholes in district and results of exploration have been brought out by Agashe R. M. Based on the exploratory studies carried out by Central Ground Water Board. It has been established that the ground water at deeper levels is highly mineralised almost in the entire district except in the Ghaggar river belt in the southern part of the district. Saini D.S (C.G.W.B.) covered about 750 Sq.Km. in the western parts under systematic hydrogeological investigations during 1976-77 field season.

Under the U.N.D.P. aided Ghaggar river Basin project , C.G.W.B. have carried out detailed hydrogeological studies in the entire Ghaggar river belt of which about **1500** Sq.Km. area falls in Fatehabad district. Reddy G. M carried out reappraisal hydrogeological survey in Hissar district in 1977-78.

2.0 RAINFALL AND CLIMATE

Climate

Fatehabad district can be classified into tropical desert& steppe, arid and hot which is mainly dry with very hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrates into the district. The hot weather season starts from mid March to last week of the June followed by the south-west monsoon which lasts till September. The transition period from September to October forms the post-monsoon season. The winter season starts late in November and remains up to first week of March.

Rainfall

The normal annual rainfall of the district is 373 mm which is unevenly distributed over the area in 22 days. The south west monsoon sets in from last week of June and withdraws in end of September, contributed about 80% of annual rainfall. July and August are the wettest months. Rest 20% rainfall is received during non-monsoon period in the wake of western disturbances and thunder storms. Generally rainfall in the district increases from southwest to northeast.

Normal Annual Rainfall	: 373 mm
Normal monsoon Rainfall	: 297 mm
Temperature	
Mean Maximum	: 41.6°C(May June)
Mean Minimum	: 5.5 °C(January)
Normal Rainy days	: 22

3.0 GEOMORPHOLOGY AND SOIL TYPES

Physiography

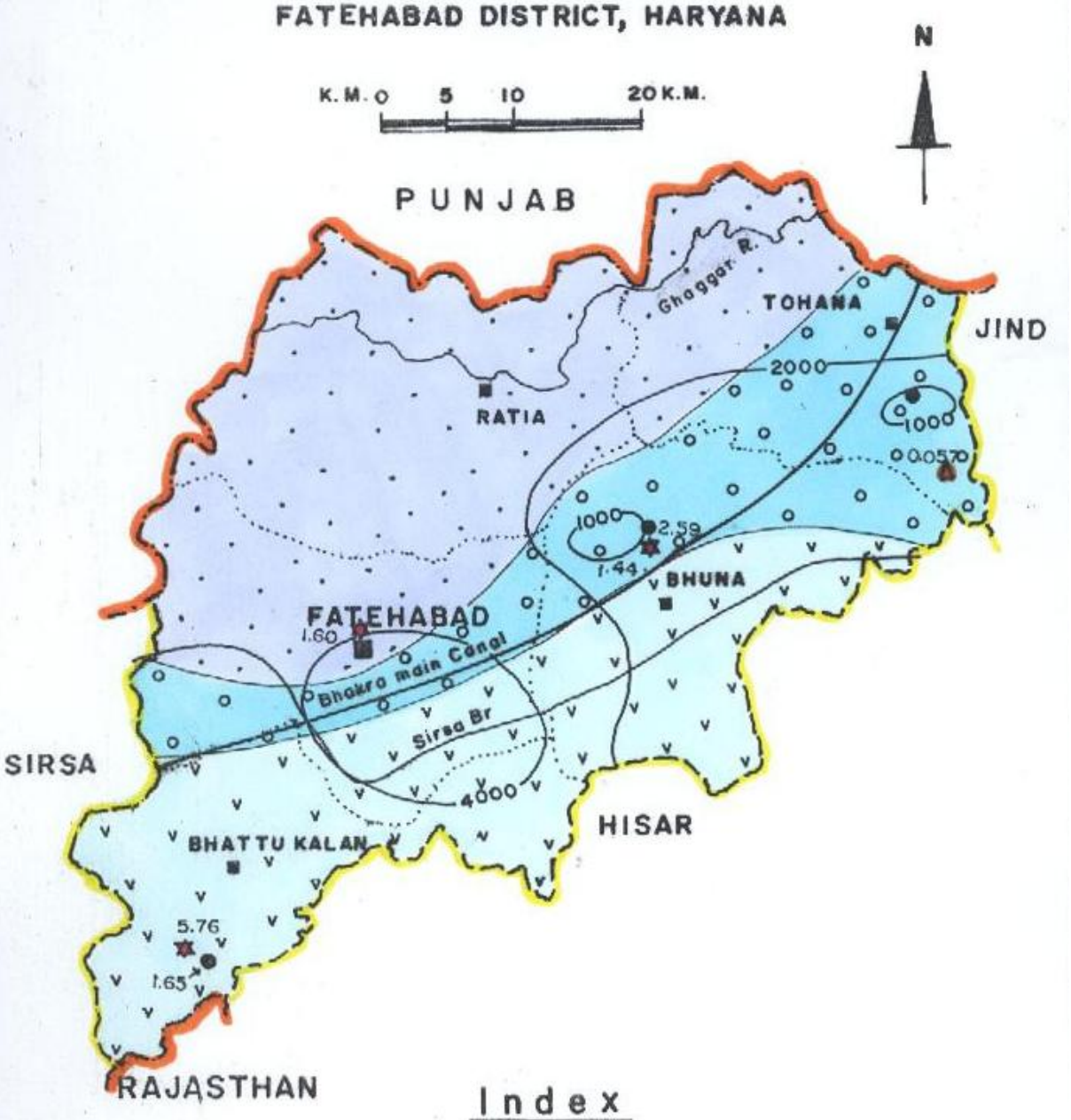
The district is located in the Indo-gangetic alluvial Plains, is by and large flat and plain flat terrain is interrupted by the randomly located sand dunes along the Ghaggar river. The land slopes from north to south with elevation difference in eastern part of the district from North to South is about 6m (222-216m above m.s.l.) In the rest of the district it is about 7 m (214.6-207.6m amsl) The two above said slopes result in a master slope towards south west with an average gradient of 0.27m/km. The soils of the district is sandy loam to loamy sands.

Drainage

The area being a flat terrain is conspicuous by absence of any well defined natural drainage system but the Ghaggar River drains the northern part of district. The river course falling in this area is very narrow and often causes floods when heavy rainfall occurs in the catchment area. In the rest of the area the drainage is of inland type and the excess rainwater, accumulated in natural /artificial depressions.

HYDROGEOLOGY

FATEHABAD DISTRICT, HARYANA



Index

	WELLS FEASIBLE	RIGS SUITABLE	DEPTH OF WELL (m)	DISCHARGE (lpm)	SUITABLE ARTIFICIAL RECHARGE STRUCTURES
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	30 – 50	> 720	RECHARGE TRENCH WITH INJECTION WELL
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	10 – 30	600 – 720	RECHARGE TRENCH AND RECHARGE SHAFT
SOFT ROCK AQUIFER	TUBE WELLS DUG WELLS	REVERSE / DIRECT ROTARY MANUAL	5 – 20	480 – 600	RECHARGE TRENCH AND RECHARGE SHAFT

ELECTRICAL CONDUCTIVITY (MICROMHOS / CM AT 25°C)

1000

1.65 ● FLUORIDE > PERMISSIBLE LIMIT 1.5 ppm

1.60 ✡ IRON > PERMISSIBLE LIMIT 1.0 ppm

0.057 ▲ ARSENIC > PERMISSIBLE LIMIT 0.01

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

Water bearing formations

The geological formations met within the district are Indo-Gangetic alluvium consisting of Newer and older alluvium with a thin blanket of aeolian deposits. The age of these formations range from upper-Pleistocene to Recent. Though the formations were laid down from upper-Pleistocene to Recent age, they are conformable with each other. Exploratory drilling in this area indicates that these Quaternary unconsolidated sediments are underlain by hard rock formations of Achaean age comprising of Granites, schists and gneisses.

Older Alluvium

The older alluvium is characterised by dark brown colour, rich in concretions and nodules of impure calcium carbonate known as kankars and forms slightly elevated terraces, generally above the flood level of present drainage, The older alluvium consists of inter bedded lenticular and inter fingering beds of clay, sands, gravels, silts, silty sands, silty clays with kankar mixed in various proportions poorly sorted, fine grained. The most porous and permeable zones in this formation constitute of fine to coarse grained sands, gravels. Some times kankar beds yield moderate to large quantities of water.

Newer Alluvium

The unconsolidated Newer alluvium occurring mainly along the flood plains of Ghaggar river in the area is light coloured and poor in calcareous matter. It contains lenticular beds of sands, gravel and clays. Gravels and sands form the main aquifer zones and are normally known to yield large quantities of water.

Aeolian Deposits

Aeolian deposits, loess and sand dunes are found in almost in the entire district but become less frequent in the northern parts of the district. The loess is fine grained buff or grey coloured wind blown dust of sandy to clayey constitution. Wind blown formations are deposited irrespective of altitude of lowered surface and essentially a deposits of arid regions. At places sands are pilled up into dunes which are constantly being shifted by winds blowing from south west. The dunes are either longitudinal or crescentic type depending on the wind action. Sands and sand dunes of Aeolian deposits may form very good aquifers but normally rest above the ground water table in the area.

Occurrence of ground water

Sub-surface Geology

A fence diagram prepared by utilizing the litho logical logs indicates that the clay group of formations dominates the sand group. However, the sand proportion increases in the central and northern parts of the district whereas clays predominate in southern part of the district. The granular zones are more of

lenticular type in the southern and north eastern part of the district but more persistent in the rest of the area. A striking feature of the formation in the area is that the clay beds are invariably thicker than permeable granular zones in the area. The bed rock which was touched in 3 boreholes in the south western part of the area is of Pre-Cambrian age and comprises of granite, mica schist and gneisses. Bed rock is shallow in south western part and thickness of alluvium increases gradually towards northeast. The maximum thickness of alluvium so far recorded in the boreholes drilled in Fatehabad district is 365.7m at Jallinia ($29^{o}31'00$" and $75^{o}34'30$").

IRRIGATION AND DRINKING WATER SUPPLY

Irrigation Projects

The Fatehabad district is bestowed with good irrigation facilities. The district is irrigated through Bhakra main canal. About 1400 sq.km. area is irrigated through the canal network which forms 70% of the total irrigated area in the district. The canal irrigation is mainly done in those areas are mainly underlain by poor quality ground water. About 30% of the area is irrigated by ground water through 30,164 shallow tubewells. These tubewells are located in areas where ground water is fresh at shallow depths and can be used for irrigation. Maximum ground water irrigation is done in Tohana and Ratia blocks. Canal irrigation is supplemented by ground water wherever quality of ground water is marginal.

Drinking Water Supply

All the villages in Fatehabad district have been provided with piped drinking water facilities. All the major towns like Fatehabad, Tohana, Ratia, Bhattu Kalan etc have water supply through pipes. Towns and villages located in fresh water areas have tubewell water supply where as others have canal based water supply. In most of the towns and villages domestic water supply is being augmented by hand pumps which the users have installed as per the requirement.

GROUND WATER EXPLORATION

The ground water exploration in Fatehabad district has been undertaken to delineate aquifer and to know the quality of ground water in deeper aquifers. In all 12 exploratory boreholes have been drilled in Fatehabad district. Under Ghaggar project 4 exploratory boreholes were drilled along Ghaggar river to know the potentiality of aquifers. Out of 12 exploratory boreholes, 2 were abandoned due to poor quality of ground water and lack of promising aquifers located in southern part of the district. In general, 6-14 granular zones mainly comprise fine sand, silt, clay and kankar. The discharge of successful exploratory wells varies between 177 and 4116 lpm with draw down of 3.0- 10.5m. To assess the aquifer parameters, aquifer performance tests were conducted on 12 wells. The transmissivity values in the area vary between 187 and 2900m^2/day. The storativity values vary from 5.4×10^{-2} to 7.7×10^{-3}.

Ground Water Sources

The principal source of ground water recharge is rainfall. However, major part of the rainfall is lost as run off and evapo-transpiration. A fraction of rainfall percolates down and recharges the ground water system. The other factors contributing to ground water recharge are inflow of ground water from north eastern parts, percolation from surface water bodies like ponds, seepage from canals and return flow of irrigation water. The area along the Ghaggar is underlain by recent flood plains, which is hydraulically connected with river and is getting recharge from the river during floods.

Occurrence of Ground Water

Granular zones inter-bedded with clay in unconsolidated formations form the principal ground water reservoir. Thickness of upper zone extending down to a maximum depth of 70 mbgl varies from place to place and water occurs under water table condition. The aquifers available at deeper levels are normally interbedded with impervious clay layers and ground water occur under confined to semi confined conditions. The ground water occurring under unconfined conditions are tapped by shallow tube wells and dug wells whereas the deeper/confined aquifers are tapped through medium to deep tube wells.

Behaviour of water level

Pre-Monsoon :-During pre-monsoon period depth to water level varies between 1.42 m bgl and 15.30 mbgl. Water levels are deeper in the Northern and Western parts of the district. It varies between 10-20m along the patch nearly parallel to the Ghaggar River. Shallow water level (<2 m) occurs in around 30% of district area. In major portion of the district water levels occur between 5-10m bgl.

Post Monsoon:-During Post Monsoon season water level varies between 0.45 m bgl and 15.18 mbgl. Depth to water level less than 10m occurs in northern and northwestern parts of the district. Very shallow water levels (1-2m) are observed from some parts of the district. In major portion of the district water levels occur between 5-10m bgl.

Seasonal Fluctuation (May-November-2011)

Over a large part of the area there is not much change in the water levels and fluctuation is restricted to -0.84 to 1.25. 75% of the Central and northern parts of the district have registered decline. Decline of less than 1 m is observed in small parts in central part of the district. Rainfall is the main source of recharge in the district. The rise is more prominent in saline water area due to less abstraction of ground water. In northern parts the recharge to ground water due to rainfall is nullified due to over abstraction.

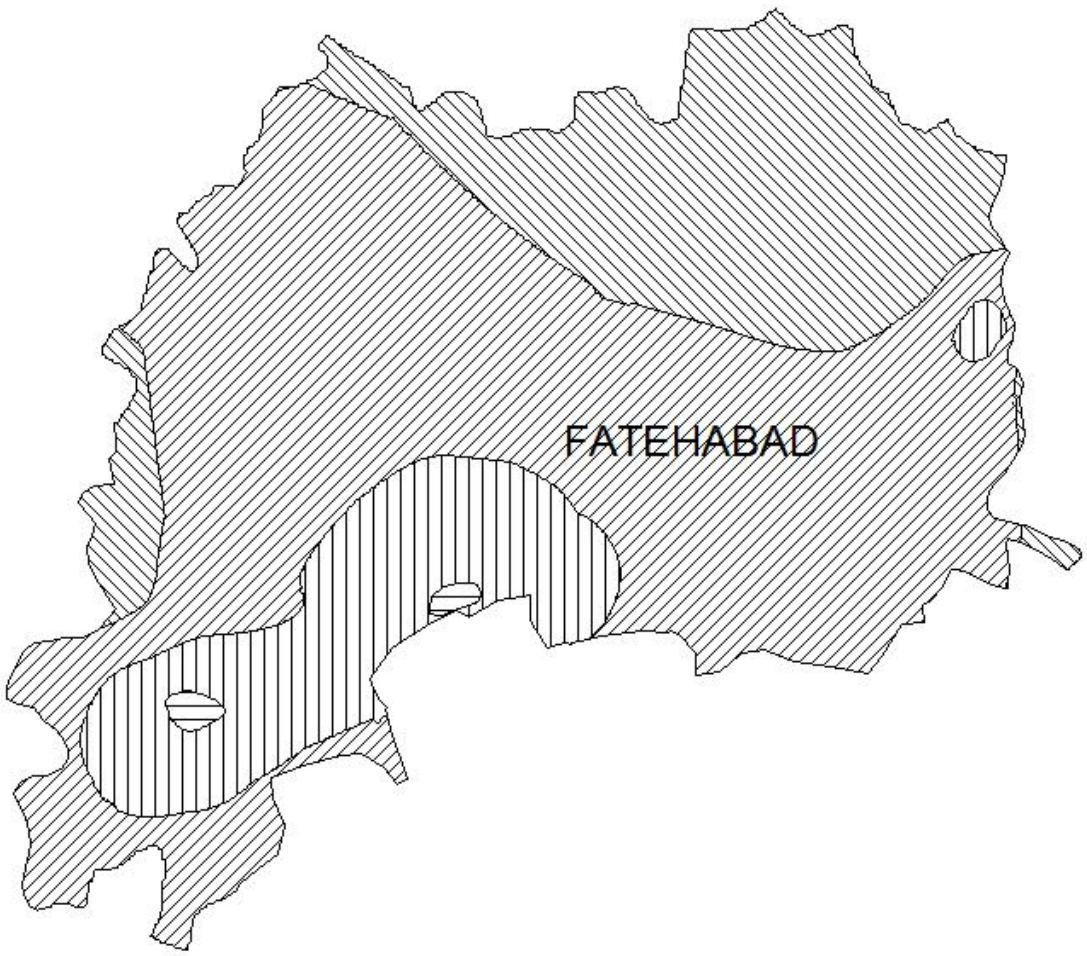
Long Term Water Level Trend

Southern & central parts of district have rising water levels as the ground water development is minimum due to occurrence of saline ground water at

DEPTH TO WATER LEVEL MAP
FATEHABAD
MAY 2011

0 10 20
kilometers

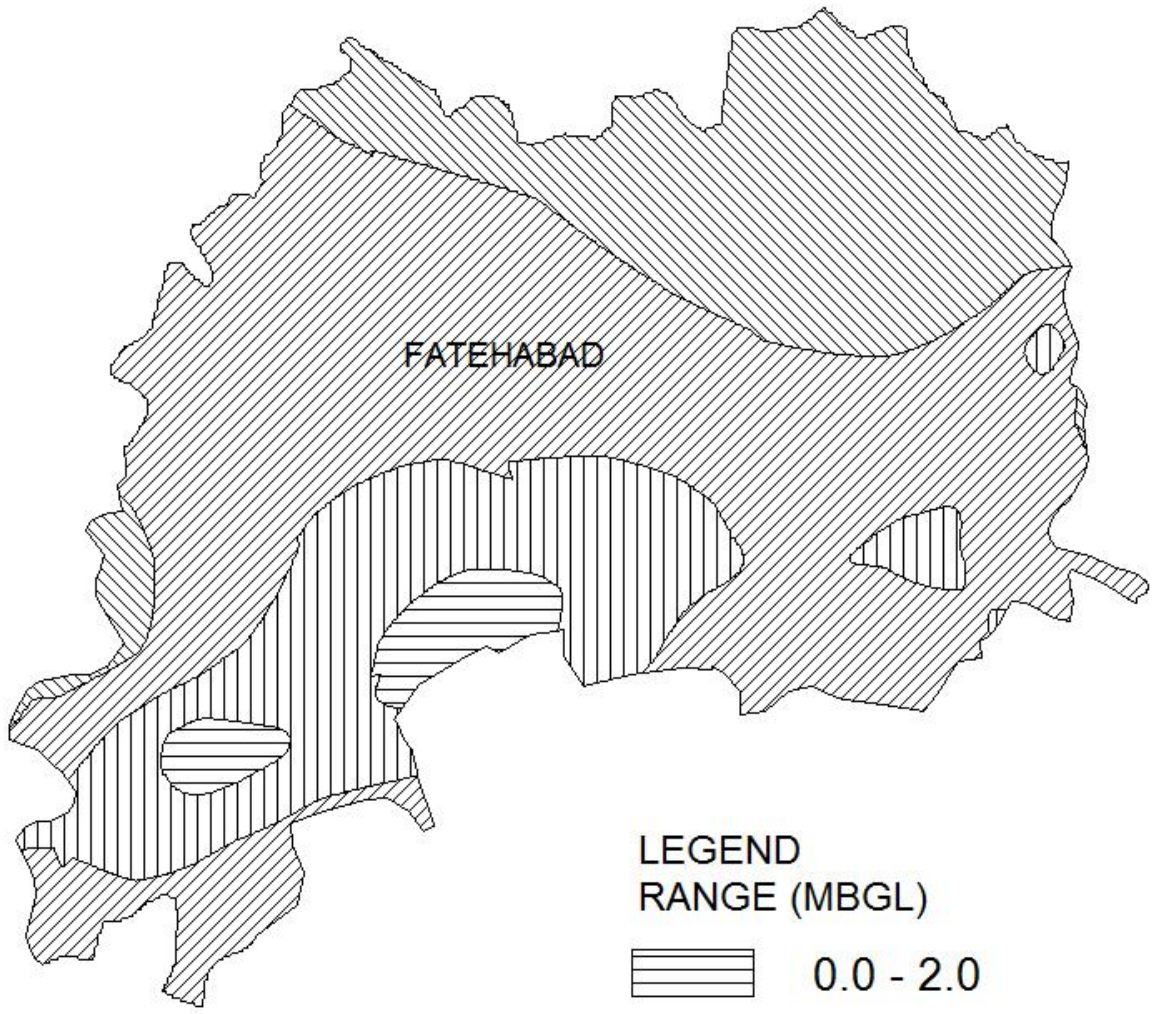
N
W E
S



LEGEND RANGE (MBGL)

- <2.0
- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 to 20.0

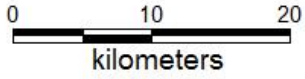
DEPTH TO WATER LEVEL MAP
FATEHABAD
NOVEMBER 2011

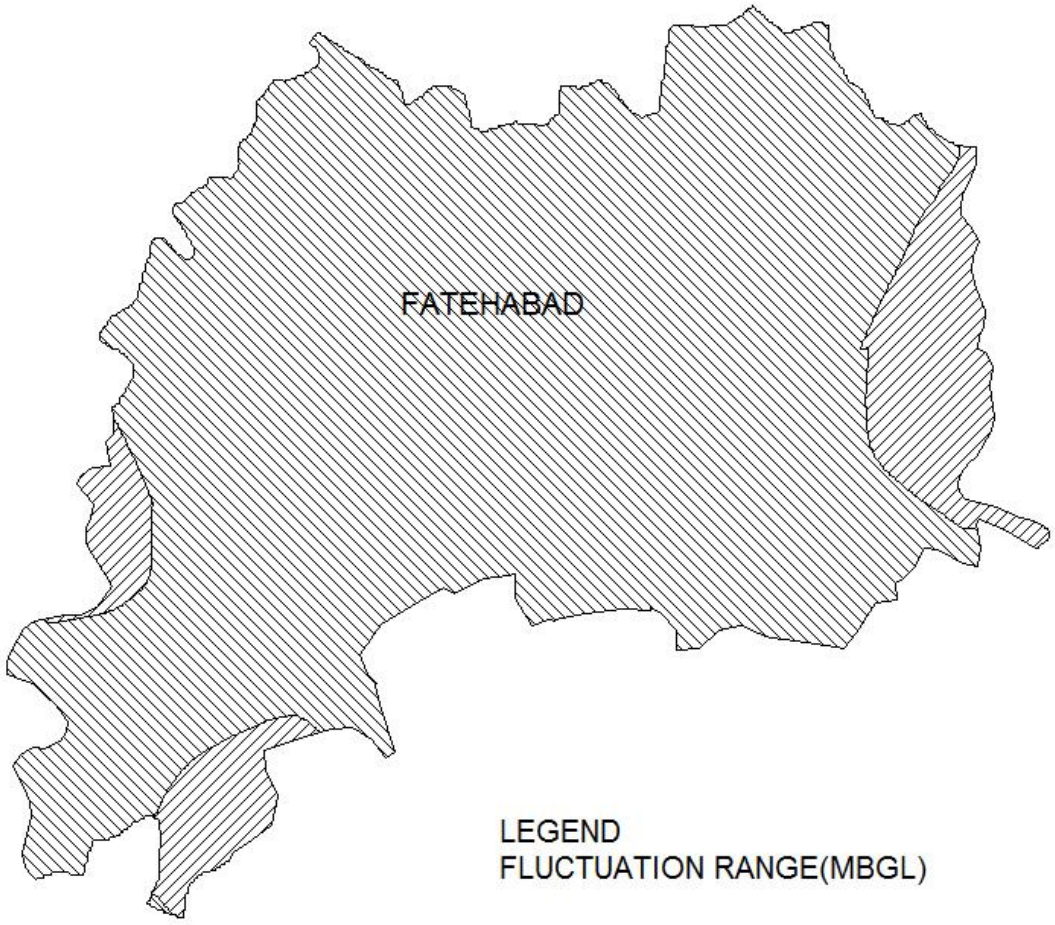


LEGEND
RANGE (MBGL)

- 0.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 20.0

SEASONAL WATER LEVEL FLUCTUATION MAP
FATEHABAD
MAY 2011 & NOVEMBER 2011





LEGEND
FLUCTUATION RANGE(MBGL)

-2.0 to 0.0

0.0 to 2.0

shallow depths, whereas Northern, northwestern & northeastern parts have registered declining water level trends. Presence of fresh water bearing aquifers at shallow depth has resulted in over exploitation of ground water. The declining trend ranges from 0.04 to 0.68 m/year. 45% of the stations show rising trend, whereas rising trends, which vary, between 0.08 and 0.47m/year.

Water Table Behaviour

The water table elevation in the district varies between 192 and 219 m above mean sea level. The elevation is higher in eastern parts. The highest water table has been recorded at Simani where water table elevation is 219 m AMSL. The ground water flows in westerly direction. The hydrologic gradient is 1.6m/km in the area.

4.2 Ground Water Resources

The block wise ground water resource potentials in the district were assessed as per GEC-97 as on March 2011.The stage of ground water development ranges between 61% (block- Bhattu Kalan) to 242% (block- Fatehabad). The total replenish able ground water resource in the district is 606.05 MCM, and ground water draft by all means is 1087.19 MCM. The net utilizable ground water resources for future irrigation development are -485.21 MCM. Stage of ground water development is 179%

GROUND WATER RESOURCE AND DEVELOPMENT POTENTIAL OF FATEHABAD DISTRICT, HARYANAAS ON 31ST MARCH, 2011 in ha m

Block	Net annual ground water availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross ground water draft for all uses (ham)	Provision for domestic & industrial requirement supply to 2025 (ham)	Net annual ground water availability for future irrigation development (ham)	Stage of ground water development (%)	catagory
Bhattu Kalan	5752	3132	3495	762	1858	61	SAFE
Bhuna	6868	4727	4748	29	2112	69	SAFE
Fatehabad	9314	22229	22507	278	-13193	242	OVER EXPLOITED
Ratia	19144	35586	35954	368	-16810	188	OVER EXPLOITED
Tohana	14085	30442	30635	193	-16550	218	OVER EXPLOITED
Jakhal	5442	11200	11380	180	-5938	209	OVER EXPLOITED
TOTAL	**60605**	**107316**	**108719**	**1810**	**-48521**	**179**	

Ground Water Quality

The results of chemical analysis of water samples from both from shallow and deep aquifers indicate that all major cations (Ca, Mg, Na, K) and anions (CO_3, HCO_3, Cl, SO_4) are within the permissible limits set by BIS, 1991, in majority of ground water samples.

An exceptionally high concentration of Sulphate is found at village Badopal (2252 mg/L). The physical parameter such as electrical conductivity shows a wide variation between 800µS/cm in southern & northern area and 5610µS/cm in the central part of the district. Nitrate concentration (104 mg/L) above the prescribed permissible limit is recorded at village Badopal and high concentration of fluoride of 6.3 mg/L, 1.65 mg/L and 2.59 mg/L are reported at villages Loha Khera, Sadalpur and Dhaula, respectively. 58.5% of the groundwater samples show sodium as the dominant cation whereas none of the anions is particularly dominant. Ground water generally depicts a mixed type of chemical character. Iron, an essential plant and animal nutrient, is found to be above permissible limits at Bhattu (1.44) Bhattu Kalan (5.75) and Fatehabad (1.60) whereas in rest of district iron is found to be below the permissible limit. Arsenic is found above the prescribed limit at Samain (0.0570 mg/L) in Tohana Block. Concentration of various constituents in ground water is given in the table.

Constituents	Concentration	
	Minimum	Maximum
pH	7.78	8.95
EC Micromhos /cm at 25 ^{0}C	800	5610
CO_3 (mg/l)	0	98
HCO_3 (mg/l)	100	672
Cl (mg/l)	28	764
SO_4 (mg/l)	0	2252
NO_3 (mg/l)	3	104
F (mg/l)	0.61	6.30
Ca (mg/l)	12	248
Mg (mg/l)	10	199
Na (mg/l)	56	980
K (mg/l)	5	155
TH (Total Hardness as $CaCO_3$)	90	1381

Type of water

The ground water in the district is alkaline in nature with medium to high salinity and is of mixed type.

Suitability of water

Domestic

50% of the ground water in the south eastern area in the district is suitable for drinking purposes and the rest of the water is unsuitable due to any one or all of the parameters (EC, F, NO_3) being more than the prescribed limit of BIS for drinking water.

Irrigation

The suitability of groundwater for irrigation purpose calculated by SAR and RSC values. The SAR value is below the permissible limit of 10.0 in entire district with exceptions at village Badopal (12.11) and Dhaula (12.44). The RSC value is above the prescribed limit of 2.0 is also recorded at two locations, viz., Loha Khera and Dhaula. As per USSL diagram, ground water of the district falls in high to very high salinity hazard and low to medium sodium hazard and can be used for irrigation by mixing or as such in absence of an alternative source.

4.4 Status of Ground Water Development

The Ghaggar is perennial River and descending from Himalayas in Himachal Pradesh and carry a small quantity of water. The discharge of shallow tube wells varies between 480 lpm and 720 lpm, whereas the discharge of deep tube wells varies between 2000 lpm and 3500 lpm. The depth of shallow tube wells ranges between 10-50m, whereas deep tube wells range up to 270m depths. Of the shallow tube wells 12147 are diesel engine operated and remaining 18717 are run by electric motors. The drinking water supply is partly ground water based and partly canal water based in the district, besides piped water supply, the Public Health Department and public in general has installed hand pump as most convenient water source to meet water shortage in villages and towns.

5.0 GROUND WATER MANAGEMENT STRATEGY

Scope of Artificial Recharge

Northern parts of district are facing lowering of water table. There is ample scope of artificial recharge. An area of 1210 sq.km in Fatehabad and Tohana blocks is suitable for recharge. The total of 1202 MCM water can be recharged to ground water system. The recharge structures suitable in the area are recharge wells, recharge shafts and trenches, of them, most suitable recharge structure is be trench with injection well.. The surplus water available in the form of rainfall runoff contains considerable suspended particles. It is felt necessary to provide sand filters in the recharge structures. Check dams can be constructed in Ghaggar River to obstruct flow so that river water gets sufficient time for infiltration.

5.1 Ground Water Development

The hydro geological data generated through exploratory drilling has proved a vital information regarding identification of aquifer systems, demarcation of their vertical and lateral extent, delineation of potential aquifer characteristics. These studies have provided information on well design and drilling techniques. The exploratory wells at Bhuna and Haroli have been abandoned either due to less potentials or poor quality of ground water. A well assembly of 203mm dia, using about 20m to 40m long housing pipe and MS slot pipe with slots of 1.19 mm to 1.59 mm size would be ideal in the district area. “V” wires galvanized Screen having 0.25- 1.0 mm slot can also be used as it can provide more open area than the conventional slotted pipes, which reduces the chances of sand pumping in the area. Entrance velocity of water in the well an important factor has to be kept in mind while designing the well assembly. Reverse/ Direct circulation rig is suitable for carrying out the drilling in the district.

6.0 GROUND WATER RELATED ISSUES & PROBLEMS

Unscientific approach towards the utilization and development of water resources in the district has led to several problems. In certain parts irrigation as well as other water requirements are based entirely on ground water causing over abstraction and resulting in depletion of water table where as in other areas extensive canal irrigation and under utilization of ground water is causing rise of water table and causing water logging. These are discussed as below:-

Declining water levels

There are certain areas in the district, which have recorded water level decline in recent past. Since ground water is the main source of irrigation in major part of the district, which has put the ground water aquifers under great stress as the demand for demand for irrigation and industrial sector, has increased many folds. Necessary remedial measures need to taken to arrest further declining of water levels in the areas and suitable methodology to be adopted to recharge the aquifers.

Tube well Failure

There are frequent cases of well failure of tube well reported from all over the district. The tube wells render maximum 4-5 years of service and become defunct. Their discharge either has decreased or reported to have become Silty. The shortening of life of the tube wells is due to chemical action known as incrustation. Water tends to deposit mineral on the screen surface and in the pores of the formation, thus plugging the screen opening and the pores of the formation just

out side the screen thereby decreasing discharge of the tube well. The pH of water in the area is more than 7.5 and is the reason of frequent failure of tube wells.

Water logging

The areas which are mainly underlain by marginal to saline water, have very low development of ground water are facing ground water logging problems. The rise of water table in certain areas less than 2m below ground level is adversely affecting the soils, crops as well as civil structures. The canals either unlined or with damaged lining increase percolation. As water table gradient in the area is very gentle and out flow of ground water is very slow. 40-sq.km area is under water-logged condition in addition to another 30 sq.km prone to water logging in the district mainly confined to Bhattu Kalan block.

Preventive measures to check the water logging

1. Conjunctive use of surface and ground water
2. Propagating sprinkler and drip irrigation to avoid excessive irrigation.
3. Encouragement of salt tolerant crops like barley, wheat, cotton etc.
4. Providing efficient drainage system to drain out excess water.
5. Lining of canals.

Water Table Depleted Areas

Requirement of irrigation, domestic and other purposes are met through ground water in some parts of the district. The sole dependence on ground water has resulted in unregulated abstraction of ground water causing decline in water level. This situation has further worsened due to less recharge from rainfall as effective drainage system has been put in place. Rainfall received by the area is drained without getting sufficient time for recharge. Water level decline of 0.90 to 4.15 m have been noticed in about 1500 sq.km area falling in parts Ratia and Tohana blocks and surroundings. The trends of water levels decline vary between 0.1 and 0.68 m per year.

Conjunctive Use of Surface and Ground Water

Sole dependence of water requirement on one or the other source has led to the creation of the problems which otherwise could be avoided with scientific utilization of water resources. Considerable area in the district underlain by marginal ground water with E.C 2000-6000 micro-mhos /cm at 25^0C. has canall net work has ample scope to use ground water conjunctively with surface water. It is recommended that canal allowance may be reduced by 25% in the area for irrigation so that private shallow tubewells will be constructed to augment the irrigation. The other way to use ground water is by construction of shallow tubewells along the canal and mixing ground water in canal itself in suitable proportion. Thus canal water saved can be diverted to the areas facing depletion of ground water.

8.0 RECOMMENDATIONS

Tube wells tapping Shallow aquifers in depth range of 50-80 m yield around 25m^3/h GPH in the district The yield is higher in northern parts along Ghaggar river and lower in southern parts. Higher yield and fresh quality of water has resulted in high density of tube wells in northern parts comprising Ratia and Tohana blocks causing decline in water levels. In safe blocks viz Fatehabad, Bhuna and Bhttukalan, 8664 shallow tube wells can be constructed to augment the canal irrigation in the district. There is sufficient scope of artificial recharge with district in Ratia and Tohana blocks. Above 1210Sq km area in the district is suitable for artificial recharge. The rainfall runoff and surplus water from Ghaggar river water can be used for recharging the ground water. The ground water in northern parts of the district is low as these area is underlain; by saline ground water (>6000 Micro mhos/cm). Tohana and Ratia blocks are underlain by fresh ground water, which is extensively utlised for irrigation purpose that led to over development, and these blocks fall in over-exploited category. Marginal to saline ground water mainly underlies the remaining blocks. Due to intensive canal irrigation, groundwater development in these blocks is low and fall in safe category. At places water logging condition has developed causing adverse impact on agriculture.