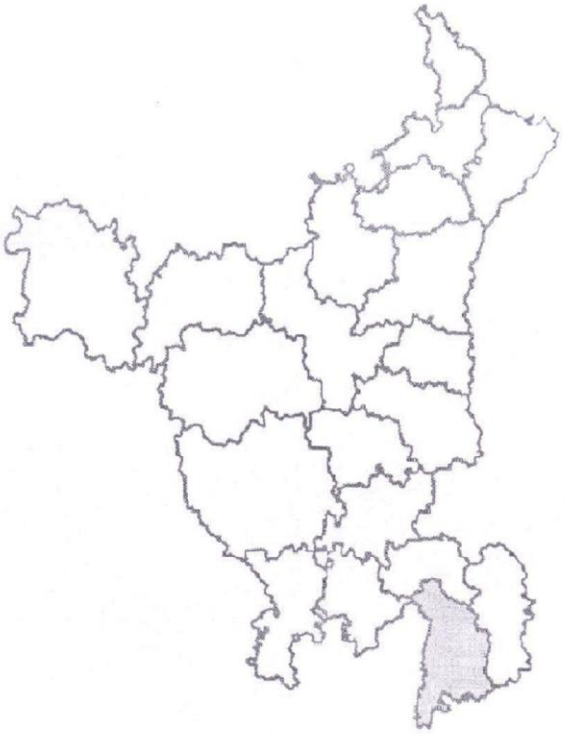
Ground Water Information Booklet

MEWAT DISTRICT



CENTRAL GROUND WATER BOARD
Ministry of Water Resources
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STA (Hg)

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GROUND WATER INFORMATION BOOKLET, MEWAT DISTRICT, HARYANA.

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GROUND WATER INFORMATION BOOKLET, MEWAT DISTRICT, HARYANA

1.0 INTRODUCTION

Mewat district is one of the 21 districts of Haryana state in northern India. The district was carved as the 20th district of Haryana from erstwhile Gurgaon and Hathin Block of Faridabad districts on 4 April 2005. though Hathin Sub Division was shifted to New district Palwal in 2008.It is bounded by Gurgaon district on the north, Rewari district on the west and Faridabad and Palwal districts on the east. Nuh town is the headquarters of this district. The district occupies an area of 1859.61 km². The district has a population of 10,89,263 (2011 census). Mewat is populated by the Meos, who are agriculturalists.

Nuh town is Mewat district's headquarter. The district comprises Nuh, Taoru, Nagina, Firozpur Jhirka and Punhana blocks and 431 villages

Mewat district lies between $27^0$39', 28^0 20' North latitude and $76^0$51' and $77^0$20' East longitudes. The area is largely occupied by alluvial plains, traversed by elongated ridges of Delhi quartzites. The ground water in the district area is saline,and salinity increases with depth. The district is socio-economically backward. Agriculture, the base economic activity of the people is deprived of irrigation. There is no river and area is drained by artificial drains namely Nuh, Ujina & Kotla drains. They carry rain water into Yamuna river. Gurgaon canal carries water to the area which is distributed through Nuh, Firozpur Jhirka, Uttawar, Mandkola, Hathin and Chhyansa distributaries.

Potable drinking water is still a problem except in the areas at the base of ridges and hillocks of the district. The Central Ground Water Board has carried out hydrogeological investigations, ground water exploration, geophysical studies and micro level studies of water logged areas in the district.

2.0 RAINFALL & CLIMATE

The climate of the district can be classified as tropical steppe, semi-arid and hot which is mainly characterized by the extreme dryness of the Air except during monsoon months, intensely hot summers and cold winters. During three months of south west monsoon from July to September, the moist air of oceanic origin penetrate into the district and causes high humidity, cloudiness and monsoon rainfall. The period from October to December constitutes post

monsoon season. The cold weather season prevails from January to the beginning of March and followed by the hot weather or summer season which prevail upto the last week of June.

RAINFALL: The normal annual rainfall in Mewat district is about 594 mm spread over 31 days. The south west monsoon sets in the last week of June and withdraws towards the end of September and contributes about 75% of the annual rainfall. July and August are the wettest months. 25% of the annual rainfall occurs during the non-monsoon months in the wake of thunder storms and western disturbances

Normal Annual Rainfall	: 594 mm
Normal monsoon Rainfall	: 445 mm

Temperature

Mean Maximum	: 40°C(May&June)
Mean Minimum	: 5.1°C(January)
Normal Rainy days	: 31

3.0 GEOMORPHOLOGY & SOILS TYPES

The district area has undulating topography and is more or less bowl shaped. The sporadic ridges and hillocks make a semi- circle to the west, south and east of Punhana (27^0 51'45":77^0 12'30").The area does not have a general slope and rather shows distinct altitude differences in certain domains. The general slope in the area is NW-SE in the western part, NE-SW in north-eastern part. The central part is more or less flat. Seasonal streams from the hills west of Nuh drain flow towards southeast and fill up the natural depressions in central part of the district. Some topographic depressions in the area give rise to natural lakes.

Soils of the Mewat district are mostly salt affected. The soils are medium textured loamy sand and falls in low to medium category with 0.2 %to 0.75 % organic content. The average conductivity of the soil is not more than (0.80 u mhos/cm) and the average pH of the soil is between 6.5 to 8.7. Soils of the district are suitable for cultivation of variety of crops

4.0 GROUND WATER SCENARIO

4.1 HYDROGEOLOGY

The district area is mainly underlain by alluvium of Quaternary age which forms the principal ground water reservoir. Some amount of ground water also occurs in fractures, joints and crevices of hard rocks found as strike ridge in the district. The ground water in the upper zone, is known to exist down to 70 m depth, and hold water under phreatic condition. The aquifers that occur at deeper levels are confined to semi-confined. Central Ground Water Board has carried out exploratory drilling in Mewat district with the depth ranging between 39and 291 m. The data of the exploratory boreholes reveal that in the deeper zones, alluvial formation comprises sand, clay and kankar in varying proportions. These sediments rests upon the basement of rocks of Delhi System. Alluvium thickness varies from almost insignificant near to hill ranges to above 291meters in the area. The exploratory drilling in the area has revealed that at Alduka (28°07':77°07') in the central part the bed rock was encountered below a depth of 291 m bgl . At Gharrot in the east the depth bed rock was 222m while at Bahin in southeast, the bed rock was reported at a depth of 147.5m while in Thekraka, at a place around central part, the depth to bed rock was mere 45m. indicating highly undulating bed rock in entire Mewat area. In the northwest at Didhara (28°12'30":76°50') , the bed rock was encountered below 182m. In the southeast, at Hathangaon (27°43'40":77°15'50"), the bed rock was encountered at 84m depth. At Raoli (27°48':76°56') in the south, the bed rock was encountered below a depth of 88m in the form of alternate bands of slates and quartzites. Hence, it is concluded that thickness of alluvium is within 300 m in the central and eastern parts while in the remaining parts of Mewat it varies at few places around Santhabari, Raoli, Pingawan being within 90m bgl in general.

The ground water exploration data shows that the alluvial sediments consists of fine to medium sand, clay and kankar. Clay and sand beds are mostly mixed up with kankar. In Nuh block sand layers are few and the whole lithology is made up of clay and kankar. In Punhana block, sand ratio predominates at 30 m depth zone. Otherwise clay ratio predominates at all other depth ranges through out the district.

Aquifer Characteristics

In alluvium thin granular zones exist down to the entire thickness, which is negligible near quartzite outcrops. The quality of ground water is not fresh in shallow as well as deeper horizons in most parts of the district. Larger parts of Nuh, Nagina and Firozpur Jhirka blocks are underlain by brackish/saline ground water even at shallow levels. Significantly the density of tube wells is more in Taoru block, and it is less in Nuh, Nagina, Firozpur-Jhirka, and Punhana blocks.

Exploratory drilling at 24 sites was carried out by CGWB in alluvial as well as in hard rock formation in the district. Boreholes located at Hathangaon in Punhana block and at Palri proved successful. The boreholes at most of the sites had to be abandoned due to poor quality of formation water and/or inadequate aquifer zones. At Hathangaon , the tubewell tapped aquifer zones of 21 to 33 meter deep and yield 910 lpm for 5.64 metres of drawdown . The aquifer parameters determined at this site were :

Transmissivity = 593 m^2/day
Specific yield = $2.63x10^{-2}$ (2.63%)

Drilling has been carried out to a depth of 175m and 130m at Ghagas in Nagina block and Sidhravat in Firozpur Jhirka block in the hard rock formation in the district. The discharge of the tube well at Ghagas was 103 lpm at a draw down of 54m and Transmissivity obtained was 0.5811 m^2 /day. Similarly the discharge of the tube well at Sidhravat was 144 lpm at a draw down of 28m and transmissivity value obtained was 1.9202 m^2/day.

The perusal of the data of exploratory boreholes also reveals that formation water in alluvial areas at deeper level is brackish to saline. The shallow ground water is fresh up to 20m depth.

Depth to Water Level

The depth to water table is between 2-32 mbgl. In central part it is between 2 to 10 m bgl. In Taoru block the depth to water varies from 12 to 32 mbgl. The shallowest water table is recorded to be 0.53 m bgl at Nuh Block. Water logging and shallow water conditions occur in a large area in the central and south eastern parts of the district covering blocks like Nuh, Nagina and Punhana with water level ranging between 3 – 5 mbgl.

Water Level Fluctuations

The area shows a seasonal rise in water levels between 1 to 4 metres, except small patches in parts of Punhana, Nuh, Nagina and Firozpur–Jhirka where the rise in water levels less than 1 metre is recorded. Maximum rise was recorded (3-5 m) in isolated patches of the southern parts of the district area.

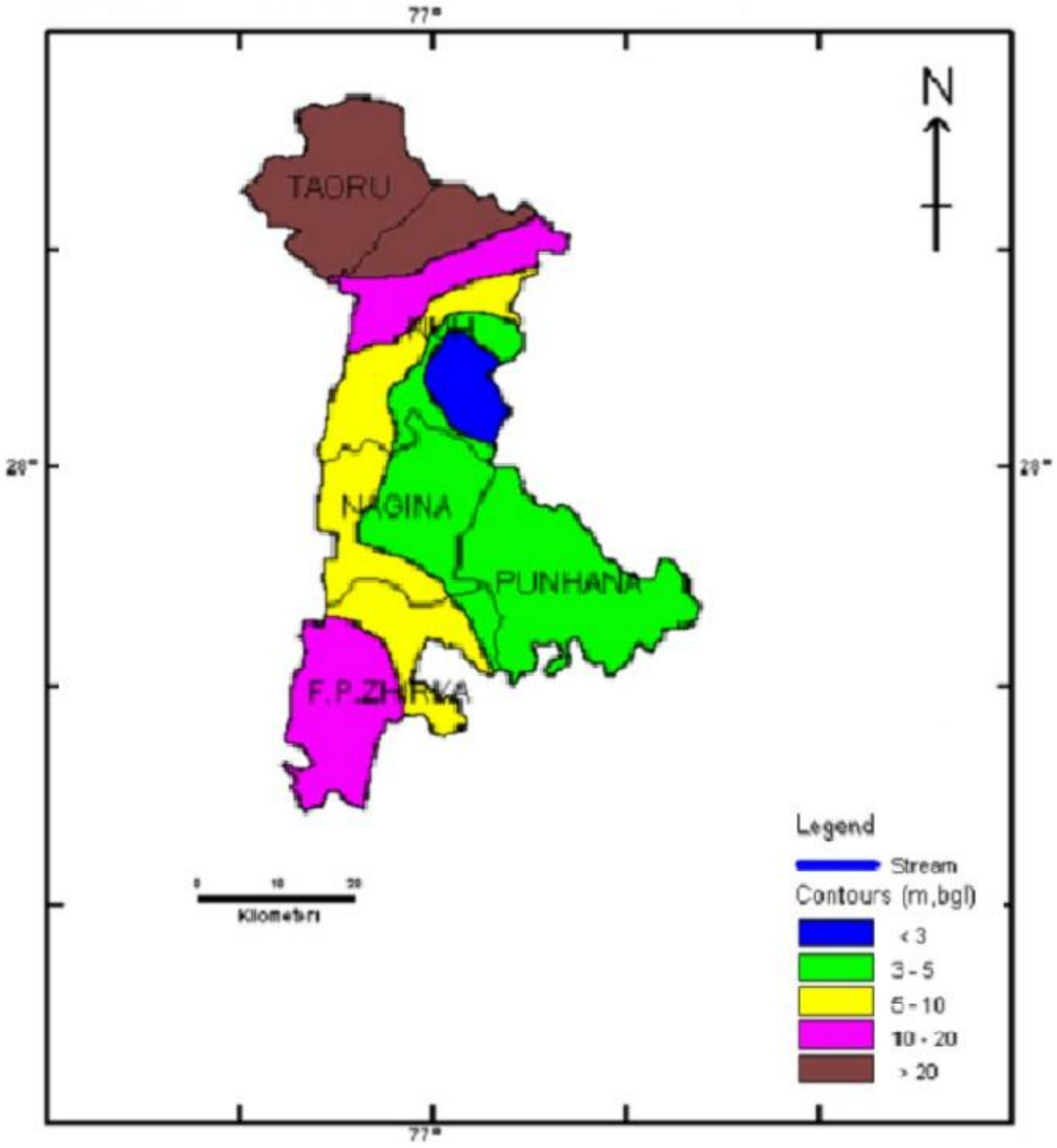
On a long term basis most parts of the district show rising trend of water levels from 0.20 to 4 m over the period of 10 years. Quality of ground water is a major factor in the district for rising or stagnant water level trends. The area is having saline ground water even at shallow depth. Therefore the withdrawal of ground water is negligible in the area causing water logging at places.

However, the Southern part of the district shows declining trend from 0.50 to 3.45 m bgl covering Ferozepur Jhirka block. Taoru block registers maximum declining trend in last 10 year ranging from 1.25 to 11.60 m bgl.

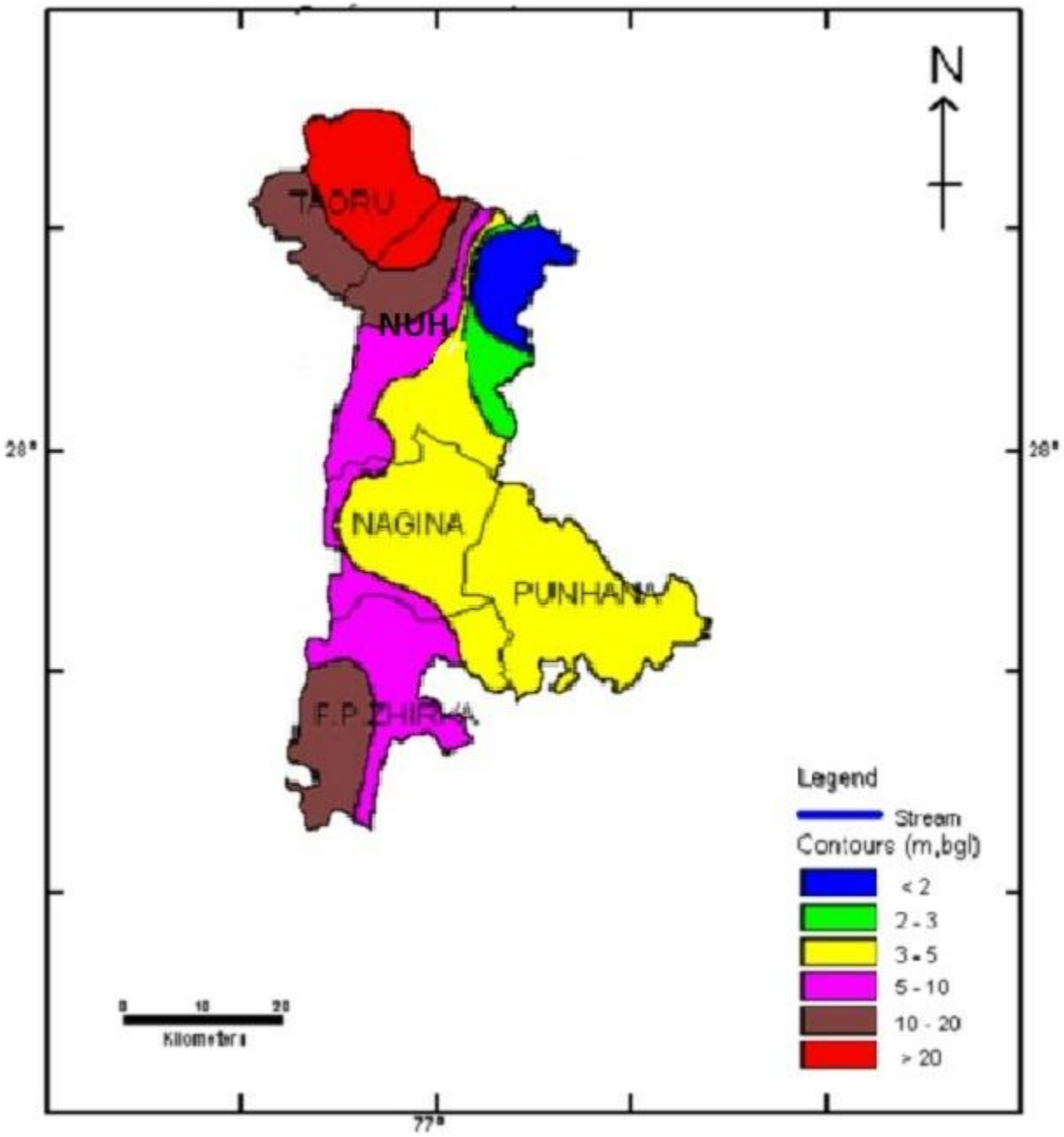
Ground Water Flow

Water table slopes north to south and south to north indicating natural trough in Nuh block. The ridge trending NNE-SSW direction, act as a ground water divide between the western and eastern part of area as indicated by the configuration of the water table on either side of the ridge.

Depth to Water Level- Pre Monsoon (2012)



Depth to Water Level Post Monsoon (2012)



4.2 Ground Water Resource Potential

The blockwise ground water potentials have been estimated based on methodology recommended by Ground Water Estimation Committee (1997) as on 31st March 2009. The net annual ground water availability in Mewat district is 21623 Ham out of this1830 Ham has been kept reserved for domestic and industrial purposes upto next 25 years. The present net ground water draft in the district is 14453 Ham. The average level of ground water development in the district is 67% and falls in critical category. Therefore care is required for further development of ground water. In Tauru block (126 %) and Ferozepur Jhirka block (64%) which fall in overexploited category, no further development of ground water should be taken up. Since a large area has shallow ground water levels with in 5.0m, there is substantial potential recharge in the district.

GROUND WATER RESOURCE AND DEVELOPMENT POTENTIAL

Assessment Unit/Block	Net Ground Water Availability Ham	Existing Gross Ground Water Draft for irrigation Ham	Existing Gross Ground Water Draft for all uses Ham	Allocation for domestic and industrial requirement supply upto next 25 years Ham	Net Ground Water Availability for future irrigation development Ham	Stage of ground water Develop-ment in %	Category of Block
Ferozpur Jhirka	4727	2741	3011	450	1536	64	Over Exploited
Nagina	4185	1813	2025	354	2018	48	safe
Nuh	4526	1701	2011	507	2318	44	Safe
Punhana	5420	3724	3910	323	1373	72	Critical
Tauru	2765	3301	3496	195	-731	126	Over Exploited
Total	21623	13280	14453	1830	6513	67	

4.3 Ground Water Quality

(Irrigation and drinking point of view)

Chemical quality data of shallow aquifers reveals that ground water is alkaline in nature & is moderate to highly saline with EC values generally ranging from 1890µS/cm to 9370µS/cm. A significant number of samples have conductivity values more than 3000 µS/cm. Concentration of vital chemical constituents such fluoride and nitrate in about 65% of the water samples are within permissible limits assigned by BIS 1991. Among trace metals, lead and iron are found to be present in high concentrations.

On comparing the observed concentrations with the concentration limits set by BIS, it is found that groundwater, in general, is not suitable for drinking use due to high levels of salinity, nitrate, iron and lead.

Plot of USSL diagram used for the classification of irrigation waters indicates that ground water fall under C_3S_1, C_3S_2, C_4S_1, C_4S_2 and C_4S_4 classes. More than 75% ground water, when used for customary irrigation, is likely to cause salinity hazards and thus should be used on well-drained soils for semi-salt to salt tolerant crops such as wheat, gram and rice etc.

Presence of chemical constituents more than the permissible limits in the District is given below:

Constituent	**No. of wells**	**Location with conc.**
EC > 3000 µS/cm (n=11)	6	Max. 9370µS/cm at Sikarwa
Fluoride >1.5 mg/l (n=11)	1	Luhinge Kalan, 3.99mg/l
Arsenic > 0.01mg/l (n=8)	nil	--
Iron>1.0mg/l (n=12)	3	Max 1.95 mg/l at Akaira

Type of water: Mostly Na-Cl, Mixed cation-Cl type

SUITABILITY OF WATER

Domestic

Ground water occurring in the shallow aquifer is by and large saline, however potable water at places along canals and surface water bodies like ponds, where salinity has decreased, and in the areas falling near foot hills is collected for drinking purposes.

Irrigation

The shallow ground water upto a depth of 20m is by and large fresh and fit for irrigation. The deep ground water is saline, salinity increases with depth and that water is not fit for irrigation. However in a proximity of the hills fresh water occurs and is fit for irrigation.

Potability of Water (Based On Geophysical Survey)

Geophysical surveys in the district have brought out the following picture regarding ground water quality:

(i) Ground water is saline at all levels in almost 55% of area (1050 sq.km.) which includes mainly the Central, Southern and Southeastern parts of Mewat around Nuh, Malab, Punhana.

(ii) Only 26 to 30 %(500 to 575 sq,Km.) area bears fresh water within 30m depth in entire Mewat. This area lies over northwest and southwest and includes the localities around Tauru block, Mohun, Ghata-shamsabad.

(iii) Only 13 % area (250 sq.km.) bears fresh water vertically beyond 40 m depth.(over Northwest and Southwest) in entire Mewat as evident from the qualitative analysis of apparent resistivity data for half current electrode separation of 50m,80m.,100m and 150m.These areas lie around Touru block in Northwest, Patkhori, Patan-udaipuri in Southwest of Mewat.

4.4 Status of Ground Water Development

Most of the villages and towns in Mewat district is having piped water supply . The water supply is mainly based on canal water and tube wells-located at the base of the ridges and hillocks in the district and maintained by Public Health Deptt. The water supply is erratic in Nuh, Nagina, Punhana , Firozpur Jhirka blocks the ground water quality is brackish to saline. The ground water is found to be fresh along the hill ranges.

The district is mainly irrigated by shallow tube wells. In Nuh and Nagina blocks the density of minor irrigation units is 4 per sq.km. In some parts of

these blocks there is fresh water but it is confined upto 20 metres depth only. The dug wells and tube wells (cavity and filter type) in these areas to meet the irrigational requirements are constructed down to a depth of 10 to 20 metres and their discharge ranges from 150 to 750 lpm.Hathin and Punhana blocks have some area under canal irrigation.

4.5 Geophysical Studies

CGWB has carried out geophysical studies to assess the depth-wise potability of water in Mewat area through the analysis of iso-resistivity maps at half current electrode separation of 10m to 150m.Based on the qualitative and quantitative interpretation of resistivity data in corroboration with the existing borehole data, an attempt has also been made to assess the depth to bed rock in the Mewat area. The criterion of rise in bottom layer resistivity, the apparent resistivity at the larger half current electrode separation, and data pertaining to previous exploratory drilling at some of the select places has been taken into account for the depth to bed rock assessment. The studies show that depth to bedrock in major part of Mewat is not uniform and the bedrock has an undulating topography.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water Development Prospects

A review of ground water budget of Mewat district shows that the average stage of ground water development is 67% and falls in semi critical category. Therefore caution is required for the further development of the resources. Due to presence of saline ground water in these blocks ,efforts have been taken up to delineate the fresh water pockets/areas for development. While ground water is available practically everywhere in the study area but for economical abstraction of water, proper design of ground water structure is very significant. The type and design of structure to be constructed at the site is dependent on formation characteristics like hydraulic properties of formations, quality of water and prevailing hydrogeological conditions. Hydrogeological studies conducted in the district have revealed that there are diverse hydrogeological and hydrochemical conditions exist in the district.

Therefore utmost care is required to design the ground water structures to make them successful and economical. Shallow tube wells and cavity wells upto a depth of 50 m and 20m respectively can make sizeable contribution for irrigation in the district. The design of shallow tubewells should have 80-100 mm dia. straight assembly tapping 5-10 m of saturated zones with slot size 1.16 mm or coir strainer with pea gravel of 3 to 6 mm. For economy as well as to avoid corrosion, PVC pipes can also be used. The shallow tubewells within the Quaternary alluvium can be constructed by rotary drilling rig. The well

should be developed by over pumping to remove finer particles from the aquifer in the vicinity of tubewell. These shallow tubewells can be operated by submersible pumps or by centrifugal pumps in case water level is shallow.

The other type of shallow tubewells is cavity type. The cavity type of tubewells are feasible where compact clay bed overlies the sand aquifer. The cavity wells are open at bottom and blank pipe is lowered upto bottom of the clay bed which is of considerable thickness in the district. After construction over pumping is done to remove fine sand from the aquifer which causes formation of semi-spherical cavity in aquifer . The cavity wells are operated by centrifugal pumps. The average discharge of shallow tubewells/cavity wells range between 150-400 lpm. The average cost of a cavity well using PVC pipe is about Rs. 60,000/-.

The deep tubewells constructed at the base of the ridges and hillocks of the district in the depth ranging between 100 to 150m can have 200 to 250 mm diameter housing pipes and 35 to 70m length. About 15-20 m thick saturated granular zones are required to be screened by 1.6 mm slot size with 2-6 mm of pea gravel. For drilling in alluvial areas, rotary rig will be most suitable for construction of deep tubewells. In the hard rock area DTH drilling rig can be used to construct tubewells upto 60 m depth. Due to the high cost of drilling in the hard rock formations low discharge and comparatively more chances of failure the construction of tubewells in hard rock formations is not recommended without hydrogeological survey and designing of tubewells from a technical person. The unit cost of deep tube wells of 60m depth is about Rs.2lakh.

5.2 Awareness Program:

Mass Awareness Programme on 'Ground Water Conservation and Management' was organised by NWR at village Nuh, Mewat District, Haryana on 10.02.2011. Sh. Aftab Ahmed, MLA, Nuh was Chief Guest while Sh. Sushil Gupta, Member (SML), CGWB was the Guest of Honour. Sh. C.R.Rana, Deputy Commissioner, Mewat presided over the function for creating Awareness regarding Water conservation, Artificial Recharge and Rain Water Harvesting system. About 500 participants including villagers**,** members of village panchayat of Village Nuh, Mewat, stake holders and officers and officials of CGWB were present.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Water Logging

The blocks which are mainly affected by water logging due to salinity are Feroz pur Jhirka, Nagina, Nuh, and Punhana. The ground water balance in Nuh, Nagina and Punhana blocks of the district continues to increase due to low rate of withdrawal . The net annual withdrawal is very less against the recharge. These natural as well as anthropogenic factors, therefore, results ponding of water in the depression areas, first on the surface and then below the surface, creating almost water logging conditions. In the areas, where water level is shallow, ground water brought upward by capillary action and the dissolved salts due to evaporation are left at surface. Such salts affected lands are seen in parts of the areas around Nuh, Malab, Akaira and parts of Punhana block.

There is urgent need to take measures to check water logging in the area. The water logging conditions are more severe during post monsoon period and have caused soil salinity resulting in decline of agriculture production The following remedial measures are suggested to check the water logging in the area.

1. Redesign and Realignment to culverts should be taken up to make natural drainage system effective.
2. Effective lining of canals to minimize seepage.
3. On farm management technologies like land leveling, use of micro irrigation systems like drip and sprinkler methods.
4. Regulations of canal water supply, especially during monsoon months in the area facing rise of water table. Water thus saved can be diverted to the area facing decline in water table.
5. There is an urgent need to rationalize water allowance in different canal command areas to avoid excessive use of water for irrigation.
6. In the area where water table is shallow and has rising trend, conjunctive use of canal water and poor quality ground water through shallow tubewells be encouraged. In such areas electric connections and other infrastructural facilities be provided on priority and at subsidized rates.
7. Micro-Levels surveys should be conducted in water logged areas to find out the possibilities of vertical as well as horizontal subsurface drainage.
8. Specific plantations may be done in consultation with agriculturists to lower water table through bio drainage. The plantations should meet the cost of O & M after maturity by public auction.

9. Collector wells can be constructed in the areas where fresh to marginal ground waster can be skimmed from shallow depths.

Salinity

(i) Salt Encrustation

The salinity in the area has lead to formation of two main soil units viz. vertisol and salanchalks. The vertisol is silt-clayey soil and its salt affected variety is called salanchalk. This variety (salt affected) has a widespread extension in the Nuh and Nagina blocks and can be recognized easily due to absence of vegetation in the affected areas. This soil is hard, poorly drained and has low permeability. The pH varies between 7.26 and 8.25 and is abnormally enriched in Ca, Mg, Cl, SO4 and HCO3 ions in soluble parts. On account of their inability to sustain proper plant growth these surface are classified as waste land. Such surface develops a white encrustation of salts during summer which is difficult to till for cultivation . The marginally salt affected soils are, however, cultivated but their yield is about half of the normal vertisol.

(ii) Ground Water Salinity

Ground water as well as soil in the Mewat district, lying in depressions are characterized by the inordinate concentration of salts .The ground water in about 75% of Nuh and Nagina blocks is unfit for drinking and agriculture on account of high TDS (upto 9680 ppm). Analytical data show the enrichment of Na, Ca, Mg, HCO_3, Cl and SO_4 ions in such water .

The ground water is moderate to highly saline with EC values generally ranging from 1890µS/cm to 9370µS/cm. A significant number of samples have conductivity values more than 3000 µS/cm.

High Fluoride

There are large areas in the district especially in north central and southern parts showing high values of fluorides and exceeding the permissible limits of 1.5 mg/l. There is wide variation of fluoride content in the district. The consumption of these water has lead to dental carries, body pains, breathing problems etc. among the population using high fluoride water for long period . The presence of high fluoride attributed to the proximity of Delhi quartzites and other formation which have concentrations of fluoride minerals

7.0 RECOMMENDATIONS

The multifaceted deleterious impact of salinity on the economic and social development of region calls for devising a sustainable strategy, which can ameliorate the salinity and facilitate the optimum use of ground water and soil. To achieve this objective following remedial measures are suggested:

i) Excessive surface runoff should be drained out of the area.

ii) Shallow borewells be installed so that the withdrawal of ground water at least equals the annual recharge. This will control the rise of water table and reduce the scope of evaporation.

iii) Plantation of eucalyptus trees should be encouraged where water table is less than 5 m deep. This will serve a dual purpose, first by lowering the water table through rapid transpiration and secondly by providing economic support to local farmers.

iv) Regulated irrigation by fresh water through canals may be arranged. Use of saline ground water for the irrigation should be discontinued, if not discontinued, it will enhance the salinity and render the marginal soil as wasteland.

v) Possibility of Prawn culture using saline ground water could be explored. If feasible, it will uplift economic status of people.

vi) Wherever possible, mulching may be practiced during summer to reduce evaporation.

vii) The corrosive resistant PVC pipe should be used for well assembly.

viii) Salt tolerant crops like barley, wheat, cotton, and sunflower, water melon, tomato, olive, grapes etc. may be grown in the area.

ix) About 140.29sq.km. area is underlain by hard rock of Delhi System, may be taken up for artificial recharge through bunding and Gabion structures across the seasonal streams flowing to the area.

x) Local populace to be educated regarding consequences of mining of ground water and need for its economic use.