GROUND WATER INFORMATION BOOKLET, AMRITSAR DISTRICT, PUNJAB

C O N T E N T S

AMRITSAR DISTRICT AT A GLANCE

S. NO.	Items	Statistics
1.	GENERAL INFORMATION	
	i. Geographical Area (sq km.)	2403
	ii. Administrative Divisions	
	Number of Tehsils	04 Amritsar I, Amritsar II, Baba Bakala & Ajnala
	Number of Blocks	09 Tarsikka, Rayya, Ajnala, Chogawaan, Majitha, Verka, Jandiala Guru, Harsha China & Atari
	Number of Panchayats	-
	Number of Villages	1104
	iii. Population (as per 2011 Census)	24,90,891
	iv. Average Annual Rainfall (mm)	542
2.	GEOMORPHOLOGY	
	Major Physiographic Units	Alluvium Plain
	Major Drainage	Kian Saki Nalla, Hudiara Nala, Kasur Nala, Patti Nala
3.	LAND USE (Sq Km)	
	a. Forest Area:	100
	b. Net area sown:	2170
	c. Total cropped area:	4240
4.	MAJOR SOIL TYPES	Loamy sand, Sandy Loam
5.	AREA UNDER PRINCIPAL CROPS	
6.	AREA IRRIGATED BY DIFFERENT SOURCES	
	Dug wells	-
	Tube wells/Bore wells	1630
	Tanks/ponds	-
	Canals	540
	Other sources	-
	Net Irrigated area	2170
	Gross irrigated area	4240
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB.	
	No. of dug wells	07
	No of Piezometers	04

8.	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium
9.	HYDROGEOLOGY	
	*Major Water bearing formation *(Pre-monsoon depth to water level) *(Post-monsoon depth to water level) *Long term water level trend in 10 yrs in m /yr	Sand & Gravel 11.61-24.30 m bgl 12.26-24.04 m bgl 0.27-0.74 m (Fall)
10.	GROUND WATER EXPLORATION BY CGWB	
	EW OW PZ SH	01 - - 04
	Depth range (m)	302.0-450.0
	Discharge (liters per minute)	4510
	Storativity (S)	-
	Transmissivity (m^2/day)	$2.64*10^{-3}$
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit EC, in micromhos at 25^0C F, in mg/l Fe, in mg/l As, in mg/l	 366-2120 0.26-2.54 Nd-9.774 Nd-0.0184
	Type of water	Ca-Mg-HCO_3 Type & Few exception of $NaHCO_3$ Type
12	DYNAMIC GROUND WATER RESOURCES (2009)	
	Annual Replenish able Ground water Resources	123026
	Net Annual Ground water Draft	220547
	Projected Demand for Domestic and Industrial uses up to 2025	7516
	Stage of Ground water Development	179%
13	AWARENESS AND TRAINING ACTIVITY	Nil
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING	Four pilot projects for artificial recharge to ground water and one roof top rain water harvesting.
	Projects completed by CGWB (No. & Amount spent)	Two, 10.75 lacs
	Projects under technical guidance of CGWB (Numbers)	Five
15.	GROUND WATER CONTROL AND REGULATION	
	Number of Over Exploited Blocks.	08
	Number of Semi Critical Blocks	-
	Number of blocks notified	01 (Ajnala)
16	.MAJOR GROUND WATER PROBLEMS AND ISSUES.	Over exploitation and Declining Water Table

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1.0 Introduction

Amritsar district is located in northern part of Punjab state and lies between 31^0 28' 30" to 32^0 03' 15" north latitude & 74^0 29' 30" to 75^0 24' 15" east longitude. Total area of the district is 2647 sq km. Amritsar I, Amritsar II, Baba Bakala and Ajnala are four teshils of the district, where as Majitha, Attari, Tarsikka, Lopoke and Ramdas are subtehsils in the district. There are eight development blocks namely Ajnala, Chogawaan, Harsha China Jandiala Majitha, Rayya, Tarsika and Verka. The total population of the district is 24,90,891 as per 2011 census which constitutes 8.99 % of the total population of the state. Total population of Amritsar district in 2001 was 21,57,020 which shows that there has been 15.48 % decennial growth (2001-2011) in the district. The population density of district is 932 persons per sq km against the state average of 550 persons per sq km. Amritsar district falls between river Ravi and Beas. As per agriculture census 2011-2012 total tubewells energized in the district was 80954.

Net area irrigated in the district is 2170 sq km and percentage of net area irrigated to net area shown is 100 %. In 2011-12 area under rice, wheat and maize cultivation was 3450 sq km, 3710 sq km and 30 sq km respectively. Amritsar has 5.25 % of district wise area to the state where as it has 5.52 % of district wise net area shown to Gross cropped area in the district is 4240 sq km and gross irrigated area is 4242 sq km, hence percentage of gross irrigated area to gross cropped area is 100 %. In the district Gross Irrigated area under Rice and Wheat is 17850 and 18530.

Major canal in the area is Upper Bari Doab canal which give rise to various branches as Lahore Branch, Kasur branch etc. theses canals further feed their distributaries.

2.0 Rainfall & Climate

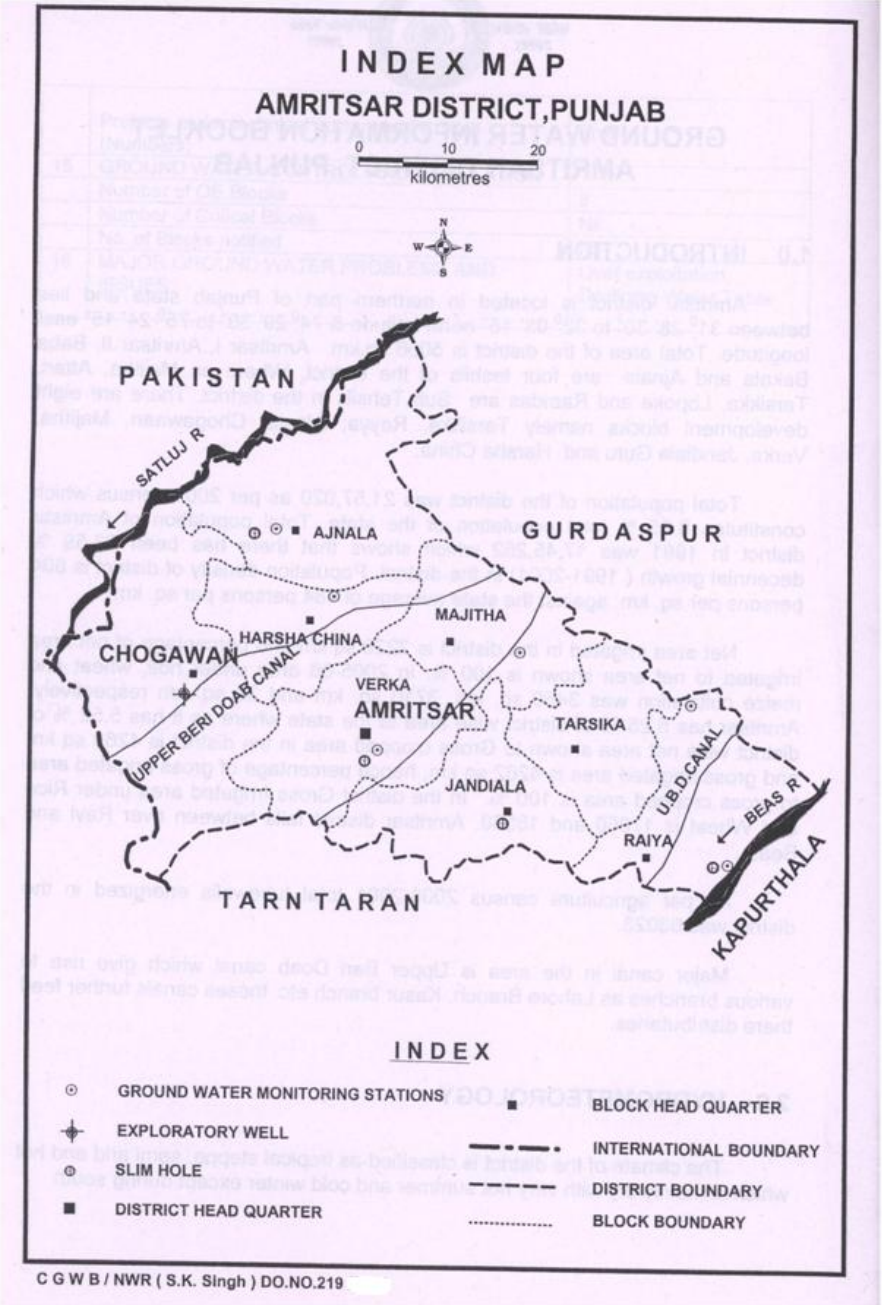
The climate of the district is classified as tropical, semi arid and hot which is mainly dry with very hot summer and cold winter except during south west monsoon season. There are four seasons in a year namely cold season from November to March, hot season from April to June, south west monsoon season from last week of June to middle September and post monsoon season from September to beginning of November. During cold season, series of western disturbances affect the climate of the district.

The normal annual rainfall of the district is 680 mm unevenly distributed over 31 rainy days. The south west monsoon contributes 75% rainfall and sets in last week of June and withdraws in middle of September. Rest 25% of annual rainfall occurs in the in non monsoon months in the wake of western disturbances and thunder storms. The rainfall increases from southwest to northeastern part of the district.

3.0 Geomorphology & Soil Types

Amritsar district falls in between Ravi River and Beas River. Ravi river flows in north west of the district and forms international border with Pakistan. Beas River flows in the eastern part of the district. There are three nalas which drains Amritsar district from north east to south west. Kiran Saiki nala flows in the northern part of the district. Hudiara nala and Kasur nala drains the central part of the district where as Patti nala drains south eastern part of the district. Upper Bari Doab canal is the main canal passing through central part of the district. Lahore branch and Kasur branch lower are the major distributaries of the Upper Bari Doab canal.

Soils in the western part of the district are coarse loamy, calcareous soils, where as in the central part of the district soils are fine loamy, calcareous and are well drained. The soils are Ustochrepts to Haplustaff type.



4.0 Ground Water Scenario

4.1 Hydrogeology

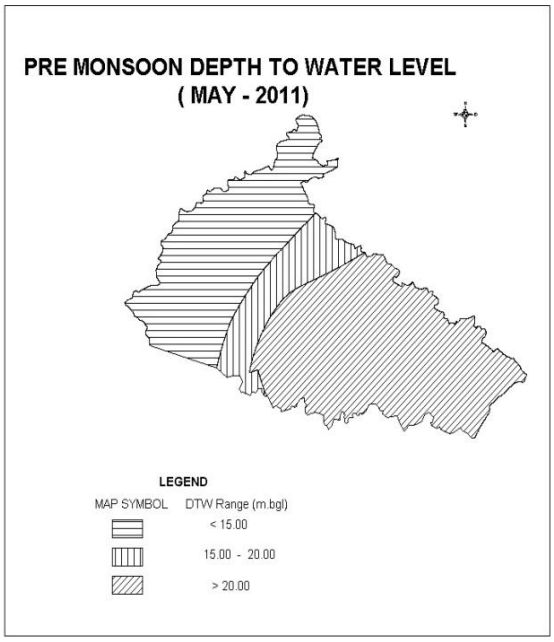
The district forms part of Uppar Bari Doab and is underlain by formations of Quaternary age comprising of alluvium deposits belonging to vast Indus alluvial plains. Sub surface geological formations comprise of fine to coarse grained sand, silt, clay and kankar. Gravel associated with sand beds occurs along left bank of Ravi. The beds of thin clay exists alternating with thick sand beds and pinches out at short distances against sand beds.

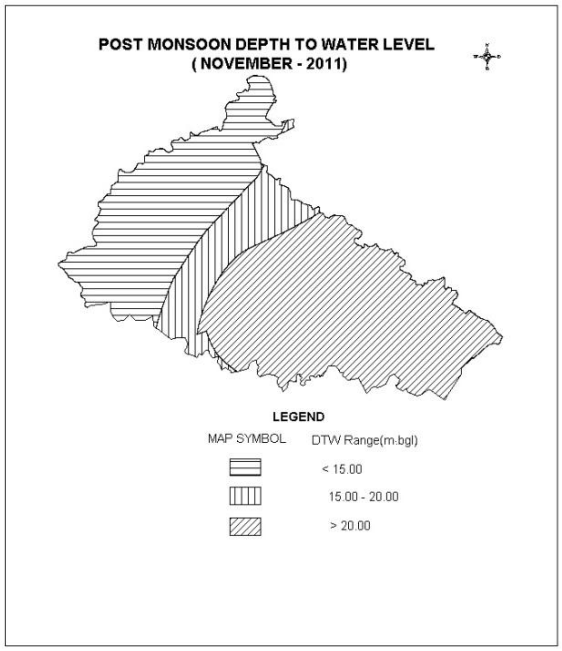
Central Ground Water Board has carried out ground water exploration up to a depth of 450 meters at village Kohala (Lopoke) in Chogwan block. Total thickness of alluvium is expected to be more than 450 m as bedrock has not been encountered up to that depth.

Water level behavior

Depth to water level in the district ranges from 11.61 to 24.30 m bgl during pre monsoon period and between 12.26 to 24.04 m bgl during post monsoon period. Water level in the northern and eastern part of the district comprising Ajnala, Chogawan and Harsha China blocks are less than 15 m while in Verka, Majhitha, Jandiala, Raya and Tarsikka blocks it is > 20 m.

Long term water level fluctuation (May 2002-May 2012) shows a decline of 0.27 m to 0.74 m in whole of the district. The decline in water levels is more in the central and eastern part of the district.





Ground water flow

Water level elevation in the district ranges from 200 m amsl to 230 m amsl. The ground water flow direction is from northeast to southwest. The gradient of water table elevation is steep in the north east part and gentle in the south west part of the district. In the area around Amritsar the ground water flow from all directions is towards city and a ground water trough has been formed in the central part of the city.

4.2 Ground Water Resources

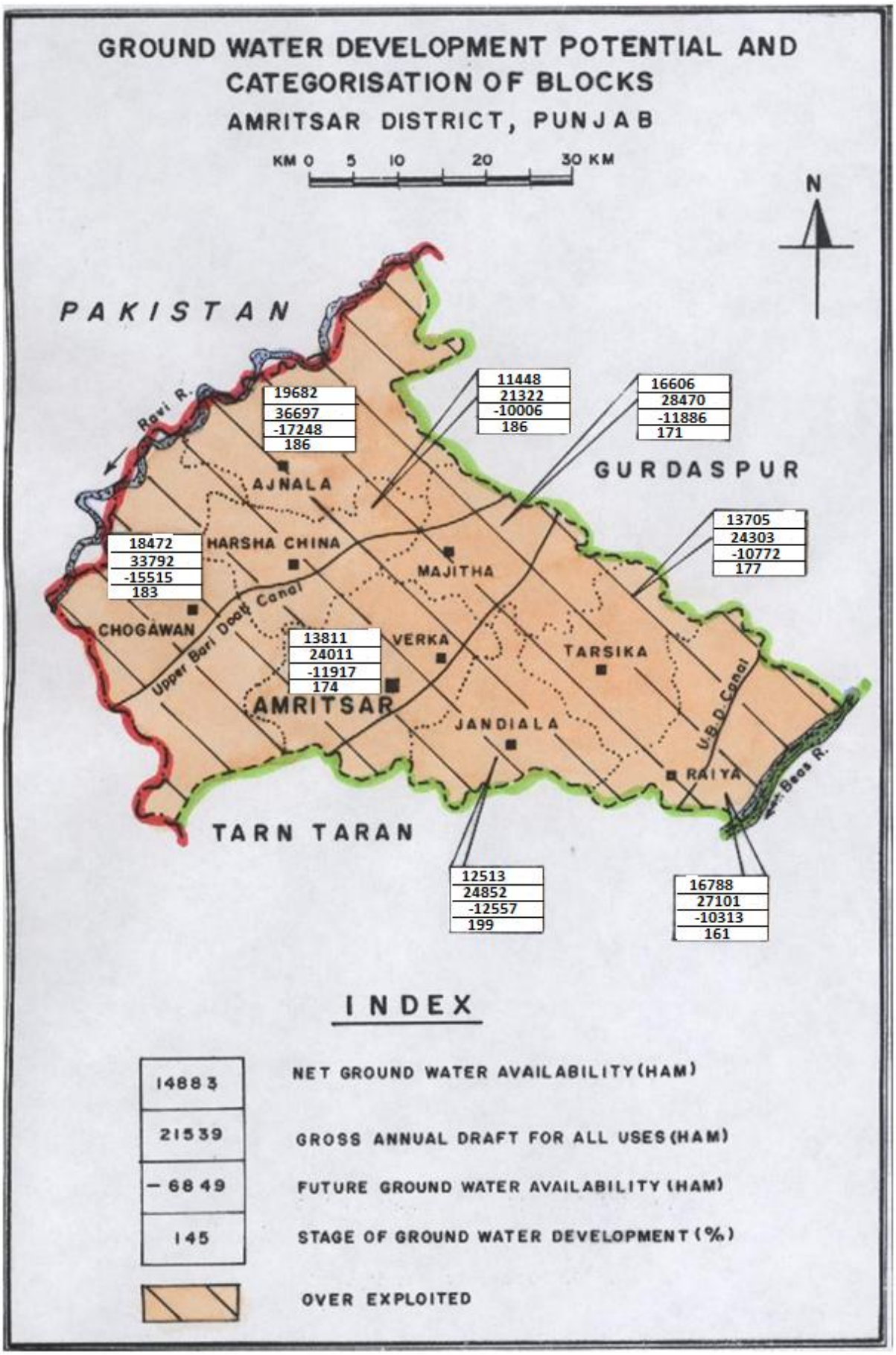
The block wise ground water resource potential of the district has been assessed as per GEC-97. The net replenishable ground water availability in the district has been assessed as 123026 ham. Gross ground water draft for all uses in the district is 220547 ham, leaving a shortfall (over draft) of 100214 ham. Ground water development in all the blocks has exceeded available recharge; hence all the blocks have been categorized as over exploited. The stage of ground water development ranges from 161 % (block Rayya) to 199 % (block Jandiala). The stage of ground water development in Amritsar district has been assessed as 179 %.

Ground Water Resources and Development Potential, Amritsar District, Punjab (as on 31-03-2009)

Block	Net Ground Water Availability (Ham)	Existing Gross Ground Water Draft for Irrigation (Ham)	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)	Allocation for Domestic and Industrial Requirement Supply up to next 25 years (Ham)	Net Ground Water Availability for Future Irrigation Development (Ham)	Stage of Ground Water Development (%)	Category of Block
Ajnala	19682	36294	403	36697	636	-17248	186	Over Exploited
Chogawan	18472	33461	331	33792	526	-15515	183	Over Exploited
Harsha China	11448	21098	223	21322	355	-10006	186	Over Exploited
Jandiala	12513	24466	386	24852	604	-12557	199	Over Exploited
Majitha	16606	28431	039	28470	062	-11886	171	Over Exploited
Rayya	16788	27087	014	27101	014	-10313	161	Over Exploited
Tarsika	13705	24007	295	24303	470	-10772	177	Over Exploited
Verka	13811	20879	3131	24011	4849	-11917	174	Over Exploited
Total	**123026**	**215724**	**4823**	**220547**	**7516**	**-100214**	**179**	**Over Exploited**

GROUND WATER DEVELOPMENT POTENTIAL AND CATEGORISATION OF BLOCKS

AMRITSAR DISTRICT, PUNJAB



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14883	NET GROUND WATER AVAILABILITY (HAM)
21539	GROSS ANNUAL DRAFT FOR ALL USES (HAM)
– 6849	FUTURE GROUND WATER AVAILABILITY (HAM)
145	STAGE OF GROUND WATER DEVELOPMENT (%)
	OVER EXPLOITED

4.3 Ground Water Quality

Chemical quality of ground water of shallow aquifer shows that all parameters are within the permissible limits for drinking purpose set by the BIS, 1991. Electrical conductivity, Chloride, Nitrate and Flouride are the important parameters that are normally considered for evaluating the suitability of ground water for drinking uses. Ground water occurs within desirable levels with respect to EC (less than 1000 micromohos/cm at 25^0C), Chloride (<250 mg/l), Nitrate (<45 mg/l) and Flouride (<1 mg/l) in all samples. As per geo-chemical classification, the shallow ground water is Ca-Mg-HCO_3 type with few exception where water is Na-HCO_3 type.

Type of Water

The suitability of ground water for irrigation is generally assessed considering salinity (EC), Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC) and Boron parameters. Ground water from Amritsar district falls in C_2S_1 category which is suitable for irrigating semi salt tolerant crops on all soils. Similarly from RSC & Boron point of view, ground water is suitable for irrigation purposes.

Suitability of Water

To study ground water pollution study in Amritsar City, 27 water samples were collected from shallow aquifers and 23 ground water samples from deeper aquifers. Two water samples were also collected from the effluents of Municipal Corporation. The Hydro-chemical studies have indicated that electrical conductivity, sulphate, nitrate and fluoride concentration in shallow ground water is higher as compared to deeper aquifer. The pollution in the form of nitrates at shallow depth is due to sewage effluent. The heavy metals (copper, lead, manganese and iron) in shallow ground water are more than the desirable limit, where as in deeper levels the concentration of heavy metals is comparatively low. In general the shallow ground water is comparatively more polluted than the deeper aquifers due to industrial pollution.

4.4 Status of Ground Water Development

Agriculture and allied activities is the main occupation in the district. As per agriculture census 2010 there are 62184 tubewells in the district. The details of block wise tubewells in the district are as follows:

It is seen from above that maximum numbers of tubewells are in Ajnala block followed by Chogwan and Raiya blocks. Dependence on ground water is more in whole of the district.

Depth of tubewells in north eastern part of the district in Majitha block ranges from 80 to 210 m. Discharge of theses tubewells ranges from 2000 lpm to 4000 lpm. In major part of the district covering eastern part of Ajnala, Harsha China and Chogwan blocks and Verka, Jandiala, Tarsika and Raiya blocks depth of tubewells ranges from 30 to 105 m. Discharge of tubewells in theses blocks ranges from 1000 lpm to 2000 lpm. In the western part of the district in western part of

Ajnala and Harsha China blocks and Chogwan block depth of wells is in the range of 30 to 90 m and discharge of tubewells ranges from 800 to 1000 lpm.

Net area under irrigation through canals is 650 sq km and area under irrigation through tubewells is 1570 sq km.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The whole district is suitable for ground water development. But due to over exploitation of ground water in all eight blocks of the district a check is required for overall ground water development.

Ground water exploration in the eastern part shows alluvium exists down the explored depth of 450 m. Based upon ground water exploration carried out in the district a well assembly of 305 mm/203 mm with about 50 m of housing length and 1.19 mm slot size and shrouded with 1.6 -8 mm gravel would be suitable in the district. Shallow tubewells can be constructed by lowering single diameter assembly of 203 mm and tapping granular zones below 25 m. Reverse rotary/Direct rotary rig would be suitable in the district.

5.2 Water Conservation & Artificial Recharge

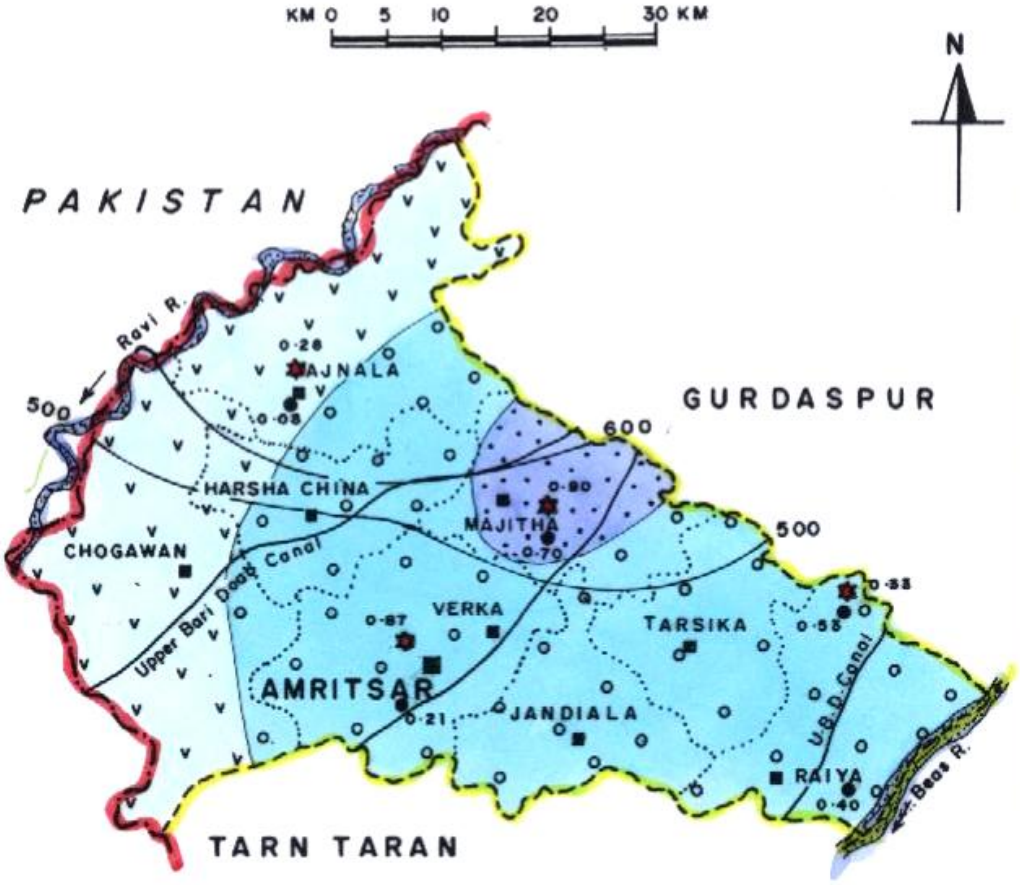
Central Ground Water Board has taken up rain water harvesting and artificial recharge studies in the district. Two pilot projects were implemented in Golden Temple and at Kheti Bhawan at Amritsar.

In Golden Temple Complex, Amritsar, the surplus Sarovar water which otherwise goes waste in to the drain, waste water generated during washing of Parikarma, Charan Ganga waste water and rooftop water rainwater of the buildings constructed around Parikarma utilized for artificial recharge to ground water. The Sarovar is filled with canal water and in order to replace the water it is pumped regularly. Approximately 4,82,112 m^3 surplus water from Sarovar, 51,00 m^3 waste water from washing of Parikarma, 23,652 m^3 from Charan Ganga and 7,232 m^3 rainfall runoff(varies from year to year due to rainfall variability) is available annually for artificial recharge to ground water. Total surplus water available for recharge is 5,64,096 m^3. During the experiment period from July 2000 to June 2003 about 13,24,512 m^3 water was recharged. For recharging the ground water two recharge wells were constructed in Galliara area and two recharge wells in open space opposite Dewan Hall. The recharge wells were constructed to a depth of about 37 meters.

In Kheti Bhawan Amritsar total rooftop area of the building (585 m^2) is utilized for rainwater harvesting and artificial recharge to ground water. One recharge well was constructed to a depth of 24 meters and all roof top rainfall was channalized to the recharge well. Total annual availability of water for recharge is 319 m^3 in the Kheti bhawan.

HYDROGEOLOGY

AMRITSAR DISTRICT, PUNJAB



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	WELLS FEASIBLE	RIGS SUITABLE	DEPTH OF WELL (m)	DISCHARGE (lpm)	SUITABLE ARTIFICIAL RECHARGE STRUCTURES
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	80 – 210	2000 – 4000	RECHARGE SHAFT AND RECHARGE TRENCH
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	30 – 105	1000 – 2000	RECHARGE TRENCH WITH INJECTION WELL
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	30 – 90	800 – 1000	RECHARGE TRENCH WITH INJECTION WELL

ELECTRICAL CONDUCTIVITY (MICROMHOS/CM AT 25°C)

500

0·88 FLUORIDE > PERMISSIBLE LIMIT 1·5 ppm

0·28 IRON > PERMISSIBLE LIMIT 1·0 ppm

As per master plan for artificial recharge to ground water, 2666 km^2 has been identified for artificial recharge to ground water in Amritsar district. Rooftop rain water harvesting can be adopted in all buildings of the district.

Due to declining of water levels in the area, rainwater harvesting and artificial recharge to ground water is feasible in whole of the Amritsar district. Types of recharge structures suitable are; Trenches and injection wells. Injection wells of 30 to 50 m depth can be constructed depending upon the local hydrogeological conditions.

The trenches of three meter depth be constructed and filled with inverted filter material up to 2m of depth, remaining one meter of depth will be kept as free board which acts as storage of storm water. The trench serves dual purpose of storing the excess water and filtering the suspended particles / silt. For construction of recharge well borehole of 450mm (18") dia is to be got drilled with the Reverse Rotary method of drilling. In case sufficient space is not available in areas close to buildings, the drilling may be taken up with hand boring and dia of borehole should be 10". Recharge well assembly of 4" dia should be lowered into the borehole. The annular space between the assembly and borehole is to be filled with gravel of 3-5 mm size. The aquifers zones to be recharged should be screened by PVC/M.S. slotted pipes. Within the trench two PVC/M.S. slotted pipes having 3 mm slot size are to be fixed on either side of the 4" dia. pipe for filtered water to enter into the recharge well. Only aquifers encountered at the bottom of borehole should be screened. After construction of trench cum recharge well, the channelized water is to be connected with the recharge structures through R.C.C. or M.S. pipes.

6.0 Ground Water Related Issues & Problems

Water levels are declining in the district. In the last decade (2002-2012) water levels have declined at the rate of 0.27 - 0.75 m/year. Rate of decline is more in the northern and central part of the district.

In general ground water is potable in the district. At few places in Amritsar town, shallow ground water is polluted by heavy metals like Fe, Cu, Pb & Mn. The presence of heavy metals in ground water is due to Industrial pollution.

7.0 Awareness & Training Activity

Awareness was provided to local administration and other central govt. agencies by providing guidance for various recharge projects in the district.

8.0 Areas Notified By CGWA/SGWA

Central Ground Water Authority has notified Ajnala block in the district for ground water registration/ regulation on 27-11-2012. There is an urgent need that a "Modal Bill" to regulate and control the development and management of ground water be prepared by the State Government.

9.0 Recommendations

The following remedial measures are recommended to reduce the over exploitation of ground water in Amritsar district and declining trend of ground water.

- All eight blocks in Amritsar district are over exploited; hence it is necessary to notify all blocks for registration of ground water abstraction structures and for regulation of ground water abstraction. After the notification permission should be sought from Central Ground Water Authority for construction of any tubewell.
- Rainwater harvesting and artificial recharge to ground water should be adopted to check further decline in ground water, since natural recharge to aquifer system is not adequate to support heavy withdrawal of ground water.
- In the Holy town of Amritsar, industries are discharging toxic effluents either on ground in the industrial premises or into city sewerage drains. Industrial effluents should be suitably disposed off after tertiary treatment and solid waste be treated using scientific techniques.
- Farmers have adopted paddy cultivation due to its profitability and incentives from Government. Paddy requires much more irrigation water as comparison to other crops. Thus a change in cropping pattern is required.
- Paddy shown in the month of May requires more evapotranspiration than paddy shown after 15th June. Thus a lot of water can be saved by timely plantation of Paddy. Farmers should be made be aware of timely plantation of paddy.
- Canal command area in the district is very small; hence most of the irrigation is done through tubewells. More area should be brought under canal command area. A change in irrigation policy in the district is required.
- Efficient irrigation practices like sprinkler irrigation should be adopted.
- Mass awareness camps be organised throughout the district to educate people for ground water management and need for its efficient/economic use.