TARN TARAN DISTRICT PUNJAB

CENTRAL GROUND WATER BOARD

Ministry of Water Resources
Government of India North Western Region

CHANDIGARH
2013

Contributor

S.K.SAIGAL
Scientist 'C'

Prepared under supervision of

A.K.BHATIA

Regional Director

GROUND WATER INFORMATION BOOKLET

TARN TARAN DISTRICT, PUNJAB.

By

S.K.SAIGAL
Scientist 'C'

CONTENTS

EXECUTIVE SUMMARY

DISTRICT AT A GLANCE

1.0 INTRODUCTION

- **1.1 Location**
- **1.2 Administrative Set up**
- **1.3 Soil Characteristics**
- **1.4 Land Use, agriculture, and Irrigation**

2.0 CLIMATE

- **2.1 Rainfall Distribution**

3.0 GEOMORPHOLOGY

- **3.1 Physiography**
- **3.2 Drainage**

4.0 GEOLOGY

5.0 GROUND WATER EXPLORATION

6.0 HYDROGEOLOGY

- **6.1 Aquifer System**
- **6.2 Water Level Fluctuation**
- **6.3 Well Design**

7.0 GROUND WATER RESOURCES

8.0 HYDROCHEMISTRY

9.0 GROUND WATER PROBLEMS

- **9.1 Over Exploitation of Ground Water**

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

10.2 Recommendations

11.0 GROUND WATER MANAGEMENT STRATEGY

EXECUTIVE SUMMARY

The purpose of this report is to serve a guide for judicious planning, development, and management of ground water resources in the district. Tarn Taran district lies between $31^0$05',and $31^0$30'05" north latitude and 74^0 30' and 75^0 15' 05" east longitudes. The area is occupied by alluvial plains. And covers an area of 2583 sq.km. It is bounded by Amritsar district in the north ,Kaputhala district in the east, Pakistan in the west , and Firozpur district in the south.

The district head quarters is located at Tarn Taran. The district is divided into 8 development blocks namely Gandiwind, Bhikiwind,Tarn Taran, Khadur Sahib, Naushera Pannuan, Chohla Sahib,Patti. and Valtoha. The total population of the district is 1120070 (census- 2011).The district has a decadal growth of 19.28%.

Physiographically the area a alluvial plain and is drained by the Patti Nadi which flows from north east to south west and drain water to the river Sutlej. The area is irrigated by net work of Upper Bari Doab canal and it is upto 71% in Patti block and about 59% in Tarn Taran block. The area is irrigated by ground water through 27500 MIU. The district has 100 % irrigation facility. The area receives about 545 mm normal rain fall out of which 74 % occurs during south west monsoon.

The district area occupies the Indo-Gangetic alluvial plain of Quaternary age. The exploratory drilling at 8 sites for the identification of aquifer system , demarcation of their vertical and lateral extent , delineation of potential aquifer zones ,evaluation of aquifer characteristics etc. was taken up by Central Ground Water Board. The exploratory drilling in the area has revealed that the ground water is fresh upto 500m depth. Ground water occurs in alluvium comprising silt, clay, and sand, under water table conditions and the same occurs in semi confined to confined conditions in deeper granular zones. Water level in the area varies from 11 m to 19 m below land surface .Central Ground Water Board is monitoring ground water level four times in a year. It is observed that during the period 2002 to 2011 there is a decline in the water level and it is in the order of 0.45m/year in the district.

The ground water resources potential of the district has been worked out as on 31-3-2009. The net annual ground water availability of the district is 104368 Ham., out of this 4068 Ham has been kept reserved for domestic and industrial purposes upto 2025. The existing groundwater draft for all uses is 189011 Ham. The average level of ground water development in the district is 181% and falls in over exploited category. Central Ground Water Authority has notified Patti & Tatan Taran blocks. Therefore, judicious planning is required for further development of ground water in the district.

TARN TARAN DISTRICT AT A GLANCE

Sl.NO.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i. Geographical Area (sq. km.)	2583
	ii. Administrative Divisions (As on31-3-2011)	
	Number of Teshils	3
	Number of Blocks	8
	Number Of Villages	490
	iii. Population (As per 2011Census)	1120070
	iv. Average Annual Rainfall (mm)	545
2.	GEOMORPHOLOGY	
	Major physiographic Units	Alluvium
	Major Drainage	Patti Nadi
3.	LAND USE (Hectare)	
	a. Forest Area:	5176
	b.Net area sown:	217541
	b. Cross cropped area:	384541
	c. Cropping Intensity:	>200 %
4.	MAJOR SOIL TYPES	Sandy loam
5.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2012)	
	No. of dug wells	3

	No of Piezometers	6
7.	PRINCIPAL AQUIFER	Alluvium
	Major Aquifer	Older Alluvium, Aeolian alluvium, Younger alluvium
8.	HYDROGEOLOGY	
	*Major Water bearing formation *(Pre-monsoon depth to water level during 2011) *(Post-monsoon depth to water level during 2011) *Long term water level trend in 10 yrs(2002-2011) in m /yr (Mohawa, Block Gandiwind)	Sand,Gravel 11.30 m-19.62 mbgl 11.94 m-18.93 mbgl 0.45m/year
9.	GROUND WATER EXPLORATION BY CGWB (Ason31-3-2012)	
	No. of wells drilled - EW	8
10.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit EC (micro mhos at 25^{o}C) F (mg/l) As (mg/l)	 366-2120 0.26 to 2.54 0 to 0.3975
	Type of water	Alkaline (Ca + Mg-HCO_3)
11	DYNAMIC GROUND WATER RESOURCES(2009)-in ham	
	Net Annual Ground Water Availability	104368
	Existing ground Water Draft for All uses	189011

	Projected Demand for Domestic and industrial Uses up to 2025	4068
	Net Ground Water Availability for future irrigation development	-86141
	Stage of Ground Water Development	181 %
12	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Ground water decline
	AREAS NOTIFIED BY CENTRAL GROUND WATER AUTHORITY	Patti & Tatan Taran blocks

GROUND WATER INFORMATION BOOKLET
TARN TARAN DISTRICT, PUNJAB

By

S.K.SAIGAL

Scientist'C'

1.0 INTRODUCTION

The demand for the water has multiplied manifold with a rapid growth in population, agriculture /irrigation and industries. It has affected both the available surface and ground water resources. This has given acceleration to the ground water development. With the large scale development of ground water, it has become essential to monitor the behavior and to suggest measures to salvage the changed situation of the ground water system.

1.1 LOCATION

Tarn Taran district lies between 31^{o} 05', and 31^{o} 30' 05 north latitude and 74^{o} 30' and 75^{o} 15' 05" east longitudes. The area falls in Survey of India toposheet Nos 44-I & 44-M. It has a geographical area of 2583 sq. km. It is bounded by Amritsar district in the north ,Kaputhala district in the east Pakistant in the west , and Firozpure district in the south. The district head quarters is located at Tarn Taran. The total population of the district is 1120070 (census-2011)The district has decennial growth rate of 19.28 %. Density of population per square kilometre is 464. The area is well connected by roads and railways. National highways 1, 1a, and 15 pass through the area and connect the important towns falling in the tract. Major towns are connected with broad gauge line of Northern Railways run through Khem Karan- Patti- Tarn Taran to Amritsar.

1.2 ADMINISTRATIVE SET UP

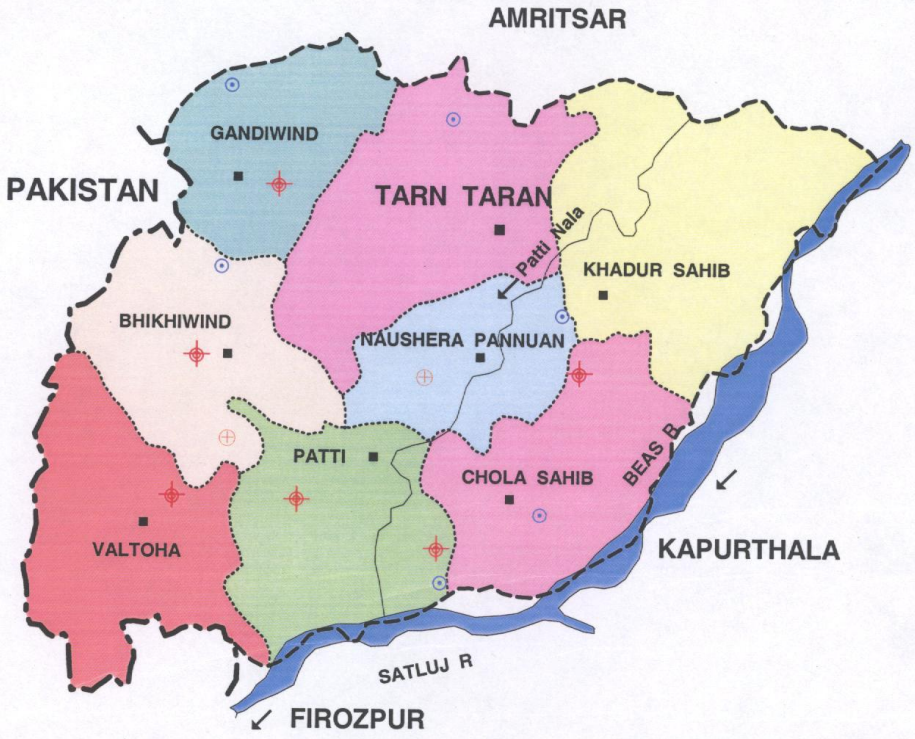
There are three tehsils namely Tarn Taran , Patti, and Khadur Sahib and five sub tehsils namely Jhabal, Chohla sahib, Khem Karan, Bhikiwind and Goindwal Sahib in the district.The district is divided into 8 development blocks namely Gandiwind, Bhikiwind,Tarn Taran, Khadur Sahib, Naushera Pannuan, Chohla Sahib,Patti. and Valtoha.

INDEX MAP

TARN TARAN DISTRICT,PUNJAB

0 10 20
kilometres

NORTH



INDEX

- GROUND WATER MONITORING STATION
- EXPLORATORY WELL
- SLIM HOLE
- DISTRICT HEAD QUARTER
- BLOCK HEAD QUARTER
- INTERNATIONAL BOUNDARY
- DISTRICT BOUNDARY
- BLOCK BOUNDARY

C G W B / N W R (S.K. Singh) D.O. NO. 75 /2008

1.3 SOIL CHARACTERISTICS

Saline and alkaline soils occur in the district. Soils with salt content exceeding 0.2% are considered to be high salt soils and this concentration is injurious for plant growth. Soils whose pH values exceeds 9.0 have been classified as high alkali soils.The alkalinity render the soil impervious. The alkali soils present in the area has low fertility as compared to normal soils. The Soils of the district are categorized as tropical arid brown (weakly SOLONIZED),and arid brown soil (SOLONIZED).These soils are deficient in NPK.

1.4 LAND USE, AGRICULTURE AND IRRIGATION

Tarn Taran is primarily an agricultural district. Agriculture constitutes the main source of economy, and most of the area fit for agriculture is being cultivated. The land utilization in the district is as follows:

1. Area under forests 5176 hac
2. Net area sown 217541 hac
3. Total cropped area 384541 hac

The main Rabi crops grown in the district are- wheat (185800 hect.), gram and barley,where as kharif crops grown are- rice (166000 hect.), maize, bajra,sugar cane and cotton.

The district has a net work of Upper bari Doab canal which give rise to various branches such as Sabraon branch, Lower kasur branch etc. These canals further feed their distributaries. The district has 100% irrigation facility, out of which 44.73% comes from ground water source. About 71% area of Patti block and 59% area of Tarn Taran Block is irrigated by canal water, and rest of the area of the district is irrigated with ground water.

2.0 CLIMATE

The climate of the district can be classified as tropical steppe,semi-arid and hot, which is mainly characterized by general dryness except for a short period during southwest monsoon season. There are four seasons in a year namely the cold season from November to March, hot season from April to June, south west monsoon season from the last week of June to the middle of September and the post monsoon season from September till the beginning of November. During cold

season, a series of western disturbances affect the climate of the district. During the summer months i.e.from April to June, weather is very hot, dry and uncomfortable. The weather becomes humid and cloudy during July to September.

2.1 RAINFALL

The normal annual rainfall of the district is 545 mm, which is unevenly distributed over the area in 30days. The south-west monsoon which contributes 74%, sets in last week of June and withdraws in middle of September. July and August are the rainiest months. Rest 26% of annual rainfall occurs in the non-monsoon months in the wake of western disturbances and thunder storms.

Normal Annual Rainfall : 545 mm

Normal monsoon Rainfall : 405 mm

Temperature

Mean Maximum : 40.5^0C(May&June)

Mean Minimum : 4.5^0C(January)

Normal Rainy days : 30

3.0 GEOMORPHOLOGY

3.1 Physiography:

Physiographically the district represents alluvial plain. The topographic gradient is about 0.4m/km in the district**.** The district falls in Ravi sub basin, Beas Sub basin and Satluj sub basin of Indus Basin. The area of the district in Ravi sub basin in the northern part of the district is 1440 sq. Km. Whereas Beas sub basin in the central part of the district covers an area of 783 sq. Km. Satluj sub basin covers an area of 361 sq km in the eastern part of the district.

3.2 Drainage

The area is drained by Patti and Nakash Nadi besides several artificial drains. The area is however broadly drained by the river Sutlej and its distributaries from the southern boundary of the district.

4.0 GEOLOGY

The geological formations in the Tarn Taran district are of Recent deposits known collectively as the Indo-Gangetic alluvium of quaternary age, which consists of sand, clay and silt, beds of gravels and

very coarse sand are rarely seen. The concretionary form of calcium carbonate, known as kankar is found in beds generally at a shallow depth below the ground surface at the upper margin of the impermeable subsoil. The kankar beds are mainly found in Varpal in Tarn Taran. Kankar also occurs at Bala Chak and Gohlwart. Geologically, the alluvium is divided into khadar i.e. the newer alluvium generally sandy light coloured, less concretionary in composition and Bhangar i.e. the older alluvium, more clayey composition , generally of dark appearance and full of kankar. A few occasional pebble beds are also present.

5.0 GROUND WATER EXPLORATION

The district is mainly underlain by Indo-gangetic alluvium comprising clay ,silt, sand and kakar of Quaternary age which forms the principal ground water reservoir. The nature and disposition of alluvial sediments down to a depth of 500m is known through ground water exploration carried out at 8 sites by CGWB in the district. The soil cover in the area is very thin and the thickness varies from place to place upto 2m.

The block wise details of ground water exploration is given in Table 1 (Plate-I).

Table-1

BLOCKWISE STATUS OF GROUND WATER EXPLORATION
DISTRICT TARN TARAN (PUNJAB)

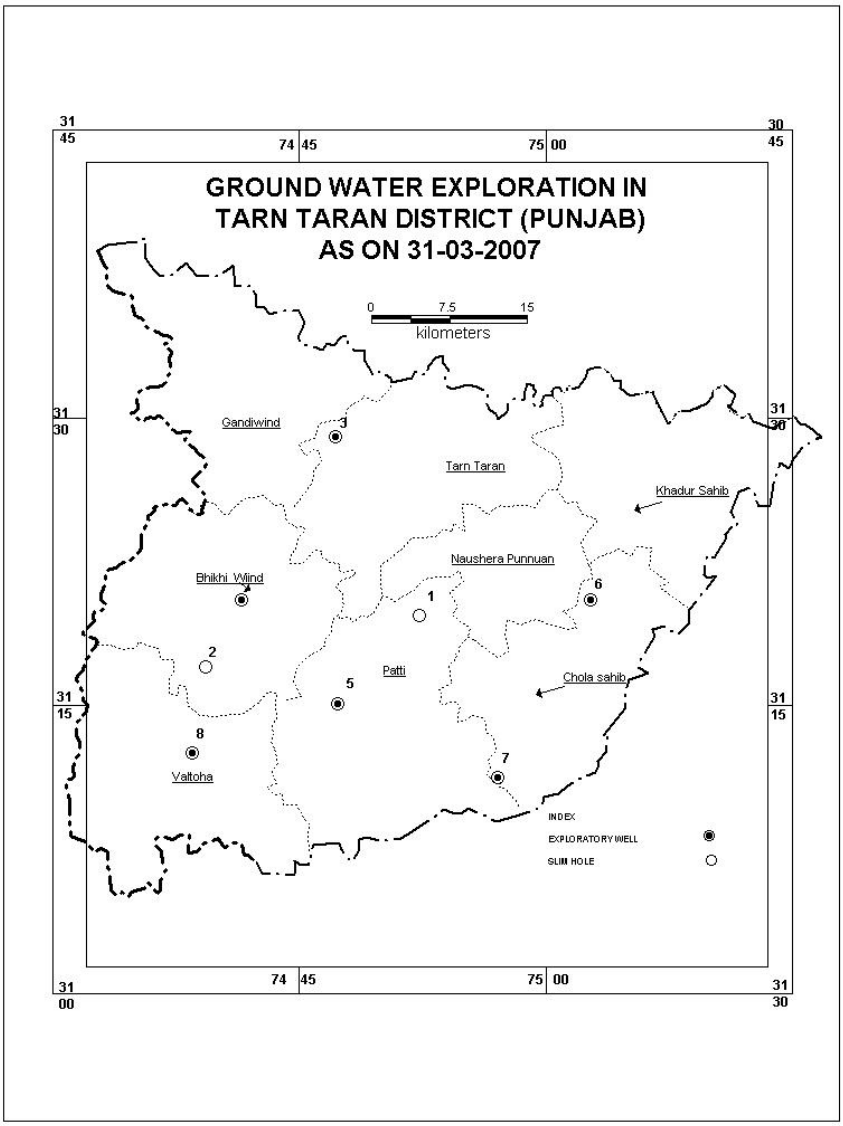
(As on 31-03-2011)

DISTRICT	Block	LOCATION	Ref No. on map	Type of well
TAN TARAN	BHIKHIWIND	Bhikhiwind	4	EW
		Algoukothi	2	SH
	CHOLA SAHIB*	-	-	-
	GANDIWIND*	-	-	-
	KHADUR SAHIB*	-	-	-
	NAUSHERA PANUAN	Jamerai	6	EW
	PATTI	Kairon	1	SH

		Boparai	5	EW
		Jamake	7	EW
	TARN TARAN	Chhabal	3	EW
	VALTOHA	Valtoha	8	SH

* No ground water exploration carried out in the block

Plate-1



Nearly 5 to 9 permeable granular zones of various thicknesses separated by clay beds, comprising fine to medium sand occur in the district upto a depth of 500m. All the aquifers have large lateral extent from NNE to SSW and are separated with 5 to 18 m thick clay layers. On the basis of hydrogeological data generated through exploratory drilling some cross sections (Plate- II,III & IV) have been described.

Section- AA' (Bhikhiwind-Jaunke section)

The section covers the area between Bhikhiwind on the NW and Jaunke on the SE (Plate-II). It reveals the occurrence of major sand bodies separated by thick clay beds as compared to other areas. The thickness of clay beds varies from 8-18m. Ten thick granular zones occur down to the depth of 450m bgl. All the clay beds are persistent in nature except the clay zone occurring at Bhikhiwind between 54 to 68m which pinch out in the SE direction. The aquifer material is composed of fine to medium sand.

Section – BB' (Chabal – Valtoha)

The section drawn between Chabal and Valtoha (Plate III). The section has given an idea of the nature and disposition of alluvial sediments down to the depth of 440 m bgl. This section reveals the presence of 5 to 7 thick potential aquifer zones. The soil cover at all the places is very thin (less then 2 m). All the aquifers have large lateral extent from NNE-to SSW direction and are separated by clay layers. In this section, most of the clay beds occurring between 220 and 230 m bgl bifurcates into two beds around Bhikhiwind. The clay bed which occurs between 350 – 372 m bgl bifurcates in the NNE directions. The water table aquifer extends upto 22 m bgl and composed of fine to medium sand. The deeper aquifers are under semi-confined conditions. The aquifer material of deeper aquifers are fine sand and it is silty in nature.

Section- DD' (Jame Rai – Jaunke)

This section is drawn parallel to right bank of Beas river extends between Jame Rai and Jaunke (Plate IV). It reveals the presence of 7 to 9 thick permeable granular zones in the depth range of 300 – 500 m bgl. The soil cover at all the places is very thin (2.5 m approxi.). All the aquifers have large lateral extent and are separated by 5 to 18 m thick clay beds. A thick clay bed occurs between 460 – 546m bgl at Jame Rai. The aquifer material is fine to medium grained, occurring below 200 m depth consists of fine sand and silt. The first aquifer is under phreatic condition and extends up to 5 m in the NW part of the section but it extends up to 42m in the SW part. The deeper aquifers are under semi confined conditions.

The discharge of the deep tube wells ranges from 1788 to 4504 lpm at a draw down ranging from 2m to 10m.The transmissivity 'T' values vary from1452m^2/day to 5800m^2/day . The storativity 'S' values obtained are ranging from 2.41x10^{-2} to 1.8x10^{-3}.

6.0 HYDROGEOLOGY

6.1 Aquifer System

Water table slopes mainly from north -east to south- west indicating the flow direction in the district. Ground water in the district occurs under water table, Semi confined to confined conditions. The water table aquifer extends upto 22m bgl and composed of fine to medium grained sand. The deeper aquifer are under semi-confined condition and composed of fine sand and are silty in nature. Depth to water level maps of pre and post monsoon (2011) are given in plate V &VI. It has been observed that in major part of the district depth to water level ranges from 10 to 20 meters. The depth to water level varies between 11.30 to 19.62 m bgl during pre monsoon period and 11.94 to 18.93 m bgl during post monsoon period.

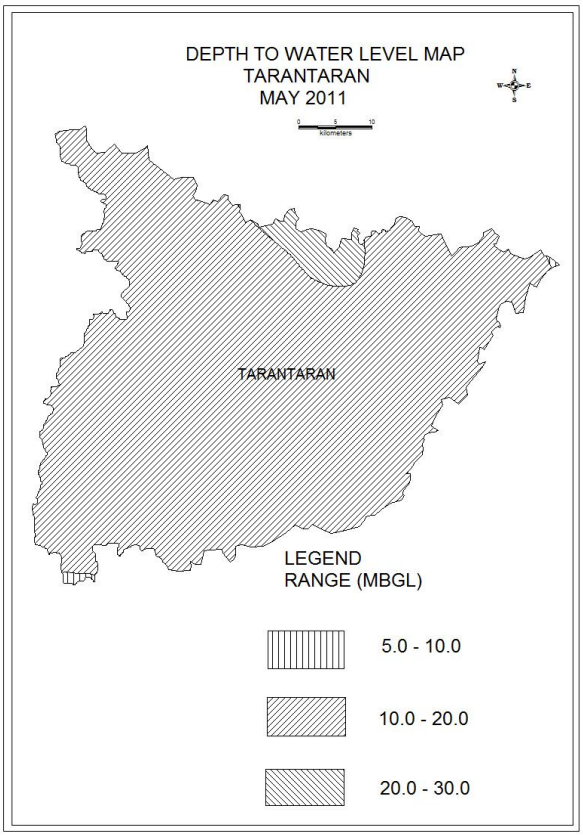
6.2 Water Level Fluctuations

The area shows a remarkable decline in water levels which is 0.45m/year from 2002 to 2011in the district over a period of 10 years. Seasonal fluctuations (Pre & Post Monsoon), 2011 in the district ranges from -0.64 to 0.69 meters (Plate VII).

6.3 Well Design

The deep tubewells can be constructed in the district with the depth ranging between 100 to 150m. The diameter of housing pipes may be 200 to 250 mm having 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

Plate V & VI


DEPTH TO WATER LEVEL MAP
TARANTARAN
MAY 2011
kilometers
TARANTARAN
LEGEND
RANGE (MBGL)
5.0 - 10.0
10.0 - 20.0
20.0 - 30.0

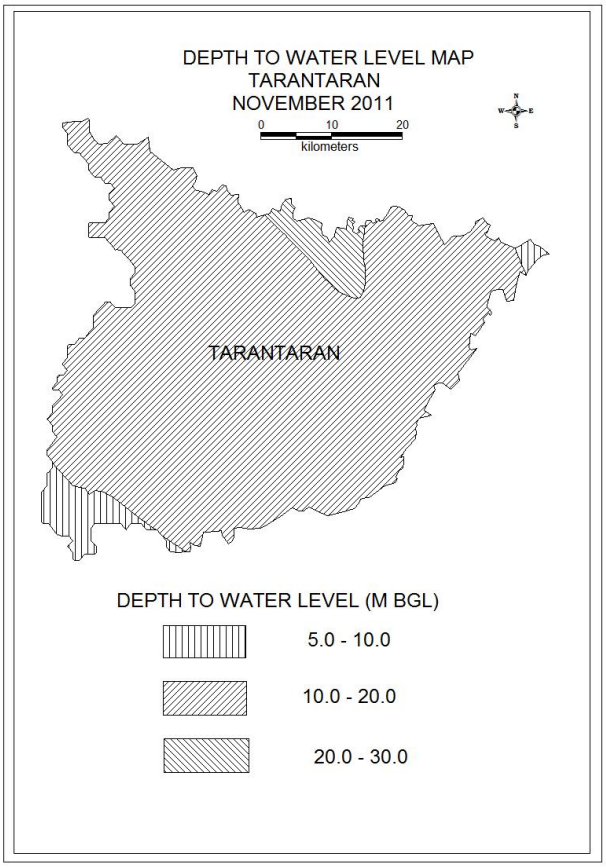
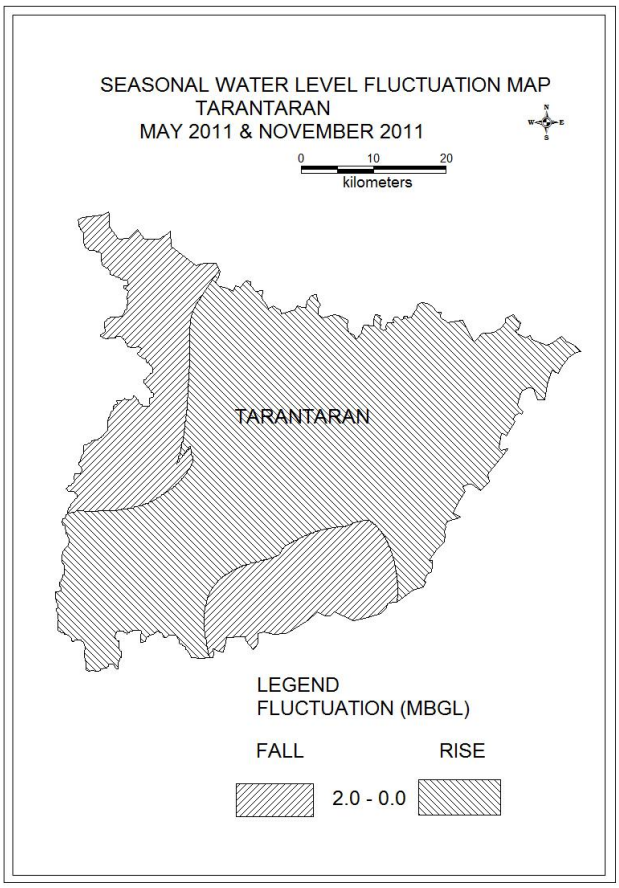

DEPTH TO WATER LEVEL MAP
TARANTARAN
NOVEMBER 2011
0
10
20
kilometers
TARANTARAN
DEPTH TO WATER LEVEL (M BGL)
5.0 - 10.0
10.0 - 20.0
20.0 - 30.0

Plate-VII



7.0 GROUND WATER RESOURCE POTENTIAL

The block wise ground water resource potentials have been estimated based on methodology recommended by Ground Water Estimation Committee (1997). The block wise ground water resource and development potential of Tarn Taran district as on 31st March 2009 is as follows. The net annual ground water availability in Tarn Taran district is 104368 Ham out of this 4068 Ham has been kept reserved for domestic and industrial purposes up to 2025. The existing ground water draft for all users in the district is 189011 Ham. The average level of ground water development in the district is 181% and falls in over exploited category. Therefore care is required for further development of ground water, and no further development of ground water should be taken up.

Block-wise Groundwater Resource of Tarn Taran district as on 31.03.2009

Block Name	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 Ground Water Availability for future irrigation development (ham)	Stage Ground Water Developme-nt (%)	Category
Bhikiwind	13209	21956	22298	544	-9290	169	Over-Exploited
Chola Sabib	11160	18663	18909	390	-7894	169	Over-Exploited
Gandiwind	16149	28626	28922	470	-12947	179	Over-Exploited
Khadur Sahib	15633	25711	26031	509	-10586	167	Over-Exploited
Naushehra Panuan	7864	16278	16493	343	-8756	210	Over-Exploited
Patti	12380	25483	25883	632	-13735	209	Over-Exploited
Tarn Taran	14704	27842	28397	870	-14008	193	Over-Exploited
Valtoha	13268	21883	22078	310	-8925	166	Over-Exploited
Total	**104368**	**186441**	**189011**	**4068**	**-86141**	**181**	Over-Exploited

8.0 HYDROCHEMISTRY

The range of concentration of different constituents in the shallow ground water in the district is given below :

Constituent	Range	
Ec (micro mohs at 25^0 C	366	2120
pH	7.71	8.22
F (mg/l)	0.26	2.54
Fe (mg/l)	0	0.98
Cl (mg/l)	48	186
No_3(mg/l)	1	41
As (mg/l)	0	0.3975

The shallow ground water in the district is alkaline in nature. Ground water in general is potable in the district. However at few places shallow ground water with high fluoride

content has been reported. High Arsenic more than permissible limit of BIS standard has been reported at Harike.

Salinity (Ec), Sodium adsorption ration (SAR) and Residual Sodium Carbonate (RSC) are the basic parameters considered for ascertaining the suitability of ground water for irrigation uses. As per USSL classification plot of USSL diagram used of irrigation waters, it indicated that ground water falls under C_2S_1 (medium salinity & low sodium) and C_3S_1 (high salinity & low sodium category). These types of ground water generally donot have any type of problem in irrigation in all types of soil.

9.0 GROUND WATER PROBLEMS

9.1 Over Exploitation of Ground Water

All the blocks of the district are affected by over- exploitation of ground water. The average stage of ground water development of the district has reached to 181%. In Naushehra Panuan block, the stage of ground water development has reached to 210%.The over exploitation of ground water is mainly due to paddy cultivation which is one of the major crops grown in the area. Subsidised electricity, absence of good rain fall, and non availability of canal water make the farmers to be more dependent on ground water irrigation. If over exploitation of ground water is not checked, would lead to further depletion of water level in the district. Change in cropping pattern should be adopted by the farmers of the district. Electricity should be supplied at commercial rate and canal irrigation facility should be more accessible to the farmers of the district.

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

Tarn Taran district is underlain by alluvial deposits of Quaternary age comprising sand, silt, clay, and kankar which forms the ground water reservoir. Ground water exploitation so far carried out to a depth of 500m has revealed 5 to 9 permeable granular zones of various thickness and are separated by 5 to 18m thick clay layers. Ground water in the area occurs under water table, semi confined to confined conditions. The discharge of the deep tube wells ranges from 1788 to 4504 lpm at a drawdown ranging from 2m to 10m. The depth to water level varies from 11.30 m to 19.62 m bgl during pre- monsoon period and 11.94 to 18.93 m bgl during pos-t monsoon period. Water table slopes mainly from north east to southwest indicating the flow direction. There is a decline of 0.45 m/year in water levels over a period of 10 years (2002 to 2011). Seasonal fluctuation

(May 2011 to Nov 2011) shows decline from 0.00 to 2.00 m in water level in northwest and southern part of the district, whereas central & western part of the district shows rise in water levels from 0.00 to 2.00m A review of of ground water budget of the district shows that the average stage of ground water development is 181% and falls in over exploited category. With the growing paddy and sugar cane crops there is a tremendous pressure on ground water resource of the district. Ground water upto a tested depth of 500m is potable and fit for drinking and irrigation purposes. Good natural and artificial drainage system exist in the district and recharge schemes like rain water harvesting through bunding across Patti and Nakash Nadi and drains are feasible.

Patti & Taran Taran blocks have been notified by Central Ground Water Authority on 27.11.2012 as "Over Exploited Areas" in view of ground water withdrawal being more than its replenishable limits resulting in decline in ground water levels and drying up of wells in those area and issued the following directives:

1. No person/agency/organization industry will construct/ install any new structure for extraction of ground water resources without prior specific approval of the Authorized Officer i.e. Chief Officer in charge of revenue District (whether called District Collector, Deputy Commissioner or by any other name) of the district and subject to the guidelines /safeguards envisaged from time to time in this connection by the Authority for ground water extraction and rain water harvesting / recharge etc.
2. The authorized officer shall ensure that no person/organization lindustry/builder/developer shall undertake the operation of drilling, construction, installation of new abstraction structure and any scheme/project for ground water development and management in the notified area without his prior specific approval after the publication of this Public Notice

10.2 RECOMMENDATIONS

- As all the blocks fall under Over Exploited category, and it is need of the hour to notifie all blocks of the district in view of declining of water levels.
- All ground water abstraction structures should be registered and for the construction of any tubewell, prior permission should be sought as per notification of the Central Ground Water Authority/ state administration.

- Local populace to be educated regarding consequences of mining of ground water and need for its economic use.
- Ground water based irrigation should be supplemented with canal water. More areas should brought under canal irrigation.
- Artificial recharge structures along/across the natural/ artificial drains may be developed.
- Change in cropping pattern should be popularized among the farmers and less water consuming crops such as oil seeds and pulses be grown in place of paddy and sugarcane.

11.0 GROUND WATER MANAGEMENT STRATEGY

GROUND WATER DEPLETION

During the past two decades, significant water table decline has been observed in most parts of Tarn Taran district.The main cause of ground water depletion is its over-exploitation to meet the increasing demand of Agriculture sector. Extensive paddy cultivation, especially during summer months has affected the available ground water resources adversely. Due to declining water table, the tubewells have to be deepened and the farmers are shifting to the use of submersible pumps in place of centrifugal pumps being used by them till now, resulting in additional expenditure and extra power consumption. This has adversely affected the socio-economic condition of the small farmers. This declining water table trend, if not checked, would assume an alarming situation in the near future affecting agricultural production and thus economic condition of the farmers. To overcome this situation, the following action plan is suggested.

a) Ground Water Recharge

Due to reduction in forest and green areas, the natural recharge to ground water has got reduced. Further, improvement in drainage pattern and lowering of water table have also affected ground water recharge. There is an urgent need to take up schemes for recharge to ground water to arrest further decline of water table. The recharge schemes using following source water is considered feasible:

(i) Unpolluted rain water harvested from rooftops, roads and used water of Sarovers.

(ii) Surplus canal water during monsoon period particularly in good rainfall years.

(iii) Unpolluted stored water in depressions and ponds.

(iv) Accumulated water in the low lying areas around agricultural fields.

(v) Monsoon runoff and escape canal water in drains.

(vi) Existing dugwells, dug-cum-borewells, abandoned tubewells, cavity wells, recharge wells in trenches, shaft-cum-recharge wells and excavated ponds are utilized/ considered effective ground water recharge structures.

b) Ground Water Conservation

Ground water conservation is proposed to be carried out by following methods:

i) Change in cropping pattern

The farmers have adopted paddy cultivation due to profitability. There is an urgent need to change the cropping pattern and to adopt cultivation of those crops which require less irrigation. Paddy is the main Kharif crop of the district and area under paddy is increasing year after year. Studies been carried out have indicated that by replacing paddy crop with maize, groundnut, kharif pulse, soybean, bajra, fodder, about thousand Hectare Meter irrigation water can be saved. To bring out desired change in cropping pattern, it is necessary that adequate support price and processing facilities are made available for the referred crops.

ii) Change in Irrigation Policy

The irrigation policy is required to be modified as per the prevailing ground water conditions. The canal water allowances can be increased to save ground water. Thus, rationalization of the irrigation policy will help in controlling ground water depletion in the over-exploited areas.

iii) Timely Plantation of Paddy

It has been estimated that paddy which is sown in the month of May requires 77 cms of evapotranspiration (E.T.) whereas paddy which is sown on or after 16th June requires only 62 cms of E.T. Thus, substantial water can be saved by postponing paddy cultivation from early May to late June. State Govt. has made an Act titled “The Punjab Preservation of Sub Soil Water Act, 2009” in year 2009 to preserve the sub soil water. It provides for the prohibition of sowing nursery of paddy before 10th May and transplanting paddy as notified by the state Government i.e before 10th of June.

iv) Promotion of Sprinkler and Drip Irrigation

Wherever feasible, pipe conveyance system fitted with modern pressurized irrigation practices such as Sprinkler and Drip Irrigation should be introduced to conserve water

and increase the yield of crops. It has been observed that by using drip irrigation system in sandy areas, about 60% water can be saved. Use of sprinkler irrigation results in water saving to the extent of 20%. 'More crop per drop' concept should be popularized.

v) Realistic Irrigation Power Pricing

Rate of power for tubewell irrigation is irrational and requires modification. There should be no free power for irrigation so that due care will be taken by the consumers for its economic and judicious use. Instead of flat rates, metering may be introduced.

vi) Mass Awareness Program

Management of ground water resources cannot be successful without public participation. Therefore, public awareness is of prime necessity. To make the public aware, it is necessary to organize mass awareness program at grass root level and impart training on rainwater harvesting techniques for ground water recharge to various State government agencies at regular intervals so that water policies made by government can be effectively implemented. Central Ground Water Board has taken a lead in this and conducting Tier III, Training Programs on ‘Village Level Aquifer Management Plan” at Block level under Aquifer Mapping programme.

vii) Ground Water Regulation

Ground Water regulation may be enforced for management of ground water resources as has been done by Central Ground Water Authority.