Impact of Human Population on Water Resources: A Case Study of Rajiv Gandhi Chandigarh Technology Park, Chandigarh

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ABSTRACT: The present research was done to investigate the impact of human population on water resources with special reference to Rajiv Gandhi Chandigarh Technology Park (RGCTP), Chandigarh. The various parameters regarding water quality was studied experimentally. Samples were collected for testing the chemical characterization of the ground water. Ground water was collected in two periods, One, in the month of June (pre-monsoon sample collection), and the other in the month of October (post-monsoon sample collection) because these two periods are ideal for obtaining information on the maximum concentration of various constituents present in surface water. After analyzing the various parameters (conductivity, pH, TSS (Total Suspended Solids), TDS (Total Dissolved Solids), turbidity, COD (Chemical Oxygen Demand), nitrate nitrogen, oil and grease, phosphate, sulphate, alkalinity, ammonical nitrogen, chloride, calcium, fluoride, total hardness and magnesium) of water quality it was found that there was no change in water quality due to the RGCTP. After calculating the domestic water requirements for the RGCTP, it was concluded that the RGCTP was exerting burden on the ground water aquifers, which were being tapped to meet the water demand. The water level in the tube wells had gone down drastically due to excessive use of underground water and as no canal water was available for I.T. (Information Technology) Park.

INTRODUCTION

Over two thirds of earth's surface is covered by water; less than a third is taken up by land. As earth's population continues to grow, people are putting ever-increasing pressure on the planet's water resources. In a sense, our oceans, rivers, and other inland waters are being "squeezed" by human activities — not so they take up less room, but so their quality is reduced. Poorer water quality means water pollution.

We know that pollution is a human problem because it is a relatively recent development in the planet's history: before the 19th century 'Industrial Revolution', people lived more in harmony with their immediate environment. As industrialization has spread around the globe, so the problem of pollution has spread with it. When earth's population was much smaller, no one believed pollution would ever present a serious problem. It was once popularly believed that the oceans were far too big to pollute. Today, with around 7 billion people on the planet, it has become apparent that there are limits. Pollution is one of the signs that humans have exceeded those limits.

How serious is the problem? According to the environmental campaign organization WWF: *"Pollution from toxic chemicals threatens life on this planet. Every ocean and every continent, from the*

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tropics to the once-pristine polar regions, is contaminated." In this research paper we focus how I.T. Sector, which is considered a neat and clean and also eco-friendly sector, indirectly degrade the water quality. This research work was done at the Rajiv Gandhi Chandigarh Technology Park, Chandigarh. (Gupta, 2005; Arya and Sharma,'95; Department of Environment. 2002; Government of India, 2008).

RSEARCH METHODOLOGY

Preliminary Survey

Preliminary survey of the research area was carried out by investigating the nature of industry, raw material used, the process involved and the product manufactured. The type of waste produced and the mode of its disposal was also noted down for each industry near the research area. The information so collected was transferred to a pre-modulated questionnaire. Reconnaissance of the study area with a preliminary survey and their related information was collected from the monitoring stations such as CGWB (Central Ground Water Board), North Western Region, Chandigarh, CPCB (Central Pollution Control Board), SPCB (State Pollution Control Board), etc. and other local administrative offices. (Department of Environment. 2002; Directorate of Economics and Statistics. 2002; CPCB,'98).

A general oral survey was also carried out by questioning the local people about any adverse effects related to drinking water and other surface water problems. Some approximate information about the depth of water-table was also obtained from the owner of hand-pumps and open wells at some of the sites.

In order to study the environmental impact of the Rajiv Gandhi Chandigarh Technology Park, baseline data on various environmental parameters were collected with reference to guidelines for New Industrial Projects (National Productivity Council, Chandigarh, and Idma Laboratories Limited, Chandigarh, *.n.d., unpublished report*).

The sample study of water was carried out during the research work. The water samples were taken from the four different areas during the pre-monsoon and post-monsoon season in the year 2007, 2008 and 2009. Three samples were collected from the each research area. These were analyzed at the CPCC (Central Pollution Control Committee), Chandigarh. The environmental status of the RGCTP has been assessed through generation and collection of the primary and secondary data on Rajiv Gandhi Chandigarh Technology Park.

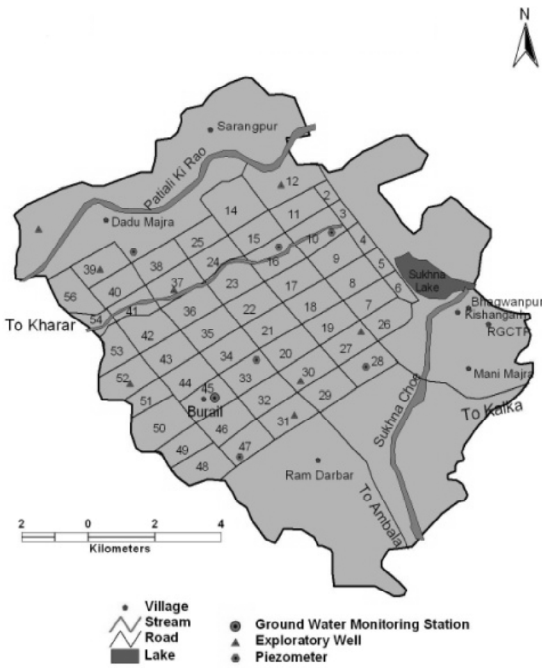
DISCUSSION

Firstly, the aquifer geometry of the research area was studied through the secondary sources collected from the Central Ground Water Research Institute (CGWRI) located in Sector-27 at Chandigarh.

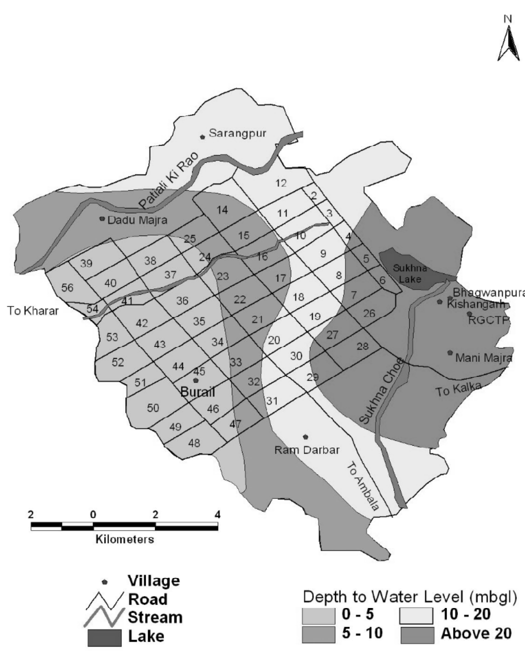
GEOLOGICAL CROSS-SECTION ALONG AA' (NW-SE)

According to Central Ground Water Research Institute (CGWRI, Chandigarh) sub-surface geological cross-section drawn along Madhya Marg (NW-SE) passing through village Sarangpur, Sector 12,17,7,26 and Manimajra indicates that thick aquifers exist in Manimajra as compared to other areas. A clay zone of 10m thickness overlies the shallow aquifers at all the places. In Manimajra area falling east of Sukhna *choe*, a shallow aquifer of 60m thickness extend laterally and is comprised of boulder, cobble, pebble, gravel and sand. The thickness of unconfined aquifer decreases towards north western part due to presence of clay intercalation. In Manimajra area, the aquifers below 80m depth are under confined conditions. There are about 11 aquifers of 4 to 18m thickness alternating with clay horizons. In Manimajra area, the aquifer material is coarse composed of boulder, cobble, pebble, gravel and sand alternating with thin clay zones. In remaining areas, the aquifers down to 450m depth are composed of medium to coarse sand mixed with gravel and occasional pebble. The clays are brownish red in colour and are hard and plastic in nature. It is inferred from the cross section that the deposits have been formed by small rivulets and in Manimajra area thick aquifers occur as the sediments had been deposited by the Ghaggar river.

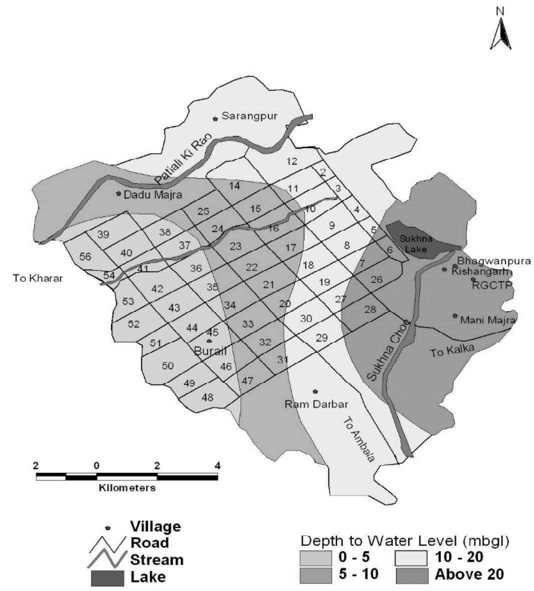
In the eastern part of the city covering Manimajra area, the aquifers comprise of boulder, cobble, pebble, gravel and sand. The thickness of individual confined aquifer is 10 to 30m and sand is medium to coarse-grained. The water bearing zones are highly potential and yield about 2000 liters per minute.



Map 1: Water Monitoring in Chandigarh



Map 2: Depth of Water Level: Shallow Aquifer (Pre-Monsoon)



Map 3: Depth of Water Level: Shallow Aquifer (Post-Monsoon)

In Manimajra area falling East of Sukhna Lake, an unconfined aquifer occurs up to 80m, extended laterally and composed of boulders, cobbles, pebbles, gravels and sand. The total thickness of the boulder zone is 60m, out of which the upper 30m is dry.

TABLE 1

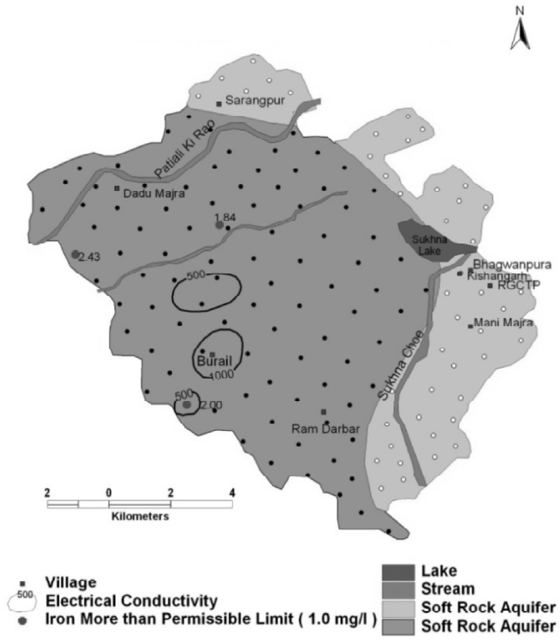
Chandigarh (UT) water data at a glance

Sl. No.	Items	Statistics
1.	*General information*	
	a) Geographical area	114 sq km
	b) Normal annual rainfall	1061mm
2.	*Geomorphology*	
	a) Major physiographic units	Shiwalik Hills Piedmont Zone (Kandi) Sirowal Zone Alluvial Plain
	b) Major drainage	Sukhna Choe Patiala-Ki-Rao
3.	*Land use (2000)*	
	a) Forest area	2.1 sq km
	b) Net sown area	15.22 sq km
	c) Cultivable area	20.55 sq km
4.	*Major soil types*	Sand to Sandy Loam (Northern part) Loamy to Silt Loam (Southern part)

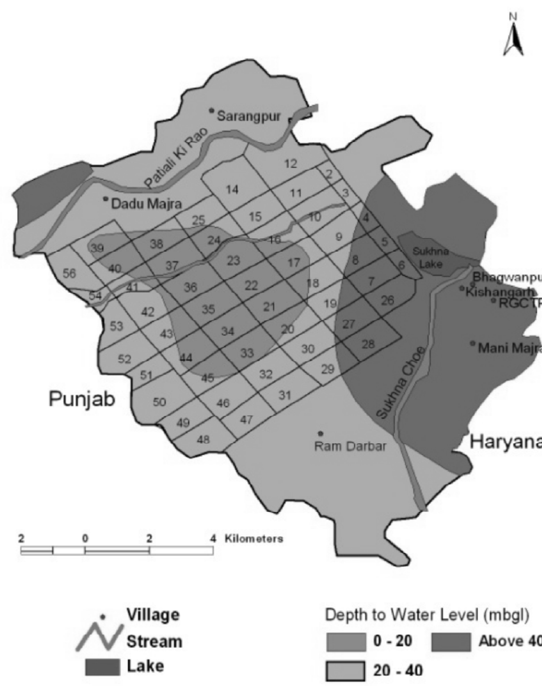
contd table

Sl. No.	Items	Statistics
5.	*Urban water supply (2001)*	
	a) Demand	0.522 MCM (115 MGD)
	b) Available supply	0.281 MCM (62 MGD)
	c) Canal supply	0.224 MCM (49.5 MGD)
	d) Ground water supply	0.63 M (14 MGD)
	e) Water available from tertiary treated sewage water	0.13 M (3 MGD)
	f) No. of tube wells	163
	g) Water supply per capita	218 liters/day (48 gallon/day)
6.	*Rural water supply*	
	a) Water supply per capita	182 liters/day (40 gallon/day)
	b) Canal supply	Nil
	c) Ground water supply	32 Tube Wells
7.	*Irrigation*	
	a) No. of tube wells	35
	b) Area under irrigation	15.22 sq km
8.	*Horticulture*	
	a) Area	26.7 sq km
	b) No. of tube wells	3
9.	*Ground water resources*	
	a) Recharge	33 MCM
	b) Draft	80 MCM
10.	*Depth of water level*	
	a) Shallow (unconfined aquifer)	5 to 10 mbgl
	b) Deep (confined aquifer)	20-45 mbgl
11.	*Depth of tube wells*	
	a) Shallow (Horticulture)	90m
	b) Deep	240 to 350m
12.	*No. of tube wells*	
	a) Urban water supply	163
	b) Rural water supply	32
	c) Irrigation	35
	d) Horticulture	3
	e) Private agriculture	90
	f) Others	239
	Total	562
13.	*Projected water demands*	
	a) 2011	0.621 MCM (137 MGD)
	b) 2016	0.671 MCM (148 MGD)
	c) 2020	0.721 MCM (157 MGD)
14.	*River basin*	
	a) Basin	Indus
	b) Area	114 sq. km
	c) Sub Basin	Ghaggar

Source: Government of India, 2002.



Map 4: State of Aquifers in Chandigarh



Map 5: Deep Aquifer Pre-Monsoon

ANALYSIS OF WATER

TABLE 2

Analysis report of the water sample in the research area

Parameter	CTP		M-23		Bhagwanpura		M-4	
	Pre-monsoon	Pre-monsoon	Pre-monsoon	Post-monsoon	Post-monsoon	Post-monsoon	Post-monsoon	Post-monsoon
COD	25	25.35	15.6	8	6	16	13.65	4
pH	7.16	6.84	7.08	7.96	7.03	8.2	7.13	7.96
Conductivity	516	533	529	521	551	486	526	520
TDS	265	284	281	308	326	291	273	302
TSS	1.7	1.3	1.7	1.9	1.4	1.8	1.2	1.3
Chloride	11	12	10	8.3	9.13	8.3	13	8.3
Turbidity	BDL	0.1	1.4				BDL	
Total hardness	196	194	186	202	200	196	192	186
Calcium hardness	130	132	126	128	140	132	114	115
Magnesium hardness	66	62	60	74	60	64	78	71
Alkalinity	246	266	262	588	590	542	260	588
Ammonical nitrogen	0.24	0.24	0.24	0.12	0.11	0.13	0.25	0.13
Nitrate nitrogen	2.31	1	0.53	1	1.15	1.2	0.52	0.85
Phosphate	0.02	0.042	0.017	0.04	BDL	BDL	0.013	0.03
Sulphate	2	4.64	0.93	BDL	3.53	BDL	9.63	BDL
Oil and grease	4.2	6.64	4.66				32	
Fluoride	0.082	BDL	BDL	0.18	0.41	BDL	BDL	BDL
Calcium ion	52	53	50	51.2	56	52.8	46	46
Magnesium ion	16	15	15	18	15	16	19	17

After analyzing the various parameters of water quality it was found that there was no change in water quality due to the RGCTP. Also, it was found that there was no wastewater produced in this industry. Finally, there was no seepage of groundwater in the research area except rainwater.

EFFECT ON WATER QUANTITY

Water quality of ground as well as surface resources of the study area has been studied for assessing the water environment and to evaluate the anticipated impact of the project. Ground water samples were drawn from deep bore tube well in CTP, Kishangarh and Bhagwanpura, and were analysed. Sukhna Lake is the only perennial surface water source in Chandigarh. No river flows through Chandigarh. Only Ghaggar river flows from one end i.e. the western end of Chandigarh. The Chandigarh is drained by two seasonal rivulets, i.e. Sukhna *choe* in the east and Patiala-Ki-Rao *choe* in the west. Samples have been taken at various locations, i.e. Sukhna Lake, Sukhna *choe* and 3BRD outlet.

The domestic water requirement for the RGCTP after the full occupation will be 990m^3/day. An area of about 12 ha is available for green belt, landscaping and gardens. The water requirement for irrigation purpose is 320m^3/day. They have installed air conditioning plants, and water is required for cooling towers. In addition to this, water is to be provided for firefighting as per standards laid down by Bureau of Indian Standards. As such, the engineering department of Chandigarh administration has provided two deep bore tube wells with design discharge of 81m^3/hour. As a result, 3268m^3/day of water is available for daily use if the tube wells are operated for 20 hours in a day. An underground storage water tank of 1112m^3 is provided at the RGCTP also.

WATER SUPPLY SYSTEM

The details of water supply existing in the I.T. Park are as under:

The total water supply to I.T. Park is based on underground water supply system. For this purpose three tube wells have been installed under Phase-I scheme of the I.T. Park and two tube wells have been installed in the Phase-II scheme of the I.T. Park. The approximate discharge of the tube wells is as under:

(a) I.T Park Phase-I

TABLE 3

Water discharge from various tube wells installed in IT Park Phase-I

Tube well	Present discharge
Tube well near DLF	13150GPH
Tube well near Local Bus Stand	20000GPH
Tube well near Booster	13000GPH
Total 46150GPH	

(b) I.T. PARK PHASE-II

TABLE 4

Water discharge from various tube wells installed in IT Park Phase-II

Tube well	Present discharge
Tube well-I	20000GPH
Tube well-II	20000GPH

Out of the five tube wells mentioned above, the three tube wells of I.T. Park, Phase-I are in running condition, whereas the two tube wells of I.T. Park, Phase-II are likely to be commissioned shortly. All three tube wells of I.T. Park, Phase-I are operated as per the requirement of water by various consumers of the I.T. Park.

Even Phase-I of the I.T. Park is not fully developed. The allotment of land in Phase-II of the I.T. Park has been recently made. Few companies like Tech Mahindra, Bharti Airtel, etc. have started their construction work but it will take about two years for full development of both the phases of the I.T. Park. The water from the three tube wells is collected in the underground reservoirs of about 250,000 gallon capacity. The underground water from the tube wells is potable water. However, chlorination of the water is carried out at the tube well as well as at the booster to provide safe drinking water to the users of the I.T. Park.

As per present development, about 488,000 gallon water is supplied per day to the various consumers of the I.T. Park which includes water for denting purpose and construction as well as for maintenance of green spaces. The ultimate requirement of water is going to increase for which an additional two tube wells have already been installed and are likely to be commissioned in the near future.

A separate UGR of 250,000 gallon capacity has also been proposed for Phase-II of the I.T. Park which is yet to be constructed.

The water level in the tube wells has gone down drastically due to excessive use of underground water as no canal water is available for the I.T. Park and nearby Kishangarh, Manimajra and Panchkula. At the time of commissioning of tube wells of I.T. Park, Phase-I, the water level was at 250 ft. below ground level which at present has gone down to 305 ft.

All this leads to the conclusion that the RGCTP is exerting burden on the ground water aquifers, which are being tapped to meet the water demand.

CONCLUSION

Water Quality: After analyzing the various parameters (conductivity, pH, TSS, turbidity, C.O.D, nitrate nitrogen, oil and grease, phosphate, sulphate, alkalinity, ammonical nitrogen, chloride, calcium, fluoride, total hardness and magnesium) of water quality it was found that there was no change in water quality due to the RGCTP. Also, it was found that there was no wastewater produced in this industry. Finally, there was no seepage of groundwater in the research area except rainwater.

Water Quantity: After calculating the domestic water requirements for the RGCTP, it was concluded that the RGCTP was exerting burden on the ground water aquifers, which were being tapped to meet the water demand.

The water level in the tube wells had gone down drastically due to excessive use of underground water, as no canal water was available for the I.T. Park and nearby Kishangarh, Manimajra and Panchkula. At the time of commissioning of tube wells of I.T. Park, Phase-I, the water level was at 250 ft. below ground level, which at present had gone down to 305 ft. This was supported by the water data in Bangalore after the establishment of the I.T. Park. In Bangalore, the average water consumption per day by different categories like domestic, non-domestic, public fountain, etc. increased every year. Water consumption for the public fountain increased manifold since 1985-86 to 2000-2001 (Raj Bala; 2006).

So, water quality had no effect but the pressure on water-increased manifold due to RGCTP.

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