



Water resource management through rain water harvesting

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Abstract: This study presents analysis of the water table position their decline rate due to the urbanization and management through rain water harvesting. The study was performed at 17 piezometers installed by Central Ground Water Board (CGWB). The water table in Lucknow shows the declining behavior where on an average the water table decline is at 1 meter per year. The Lucknow urban centre shows a continuous escalation since 1931. The population of Lucknow in 1901 was 2, 56,239 which became 22, 45,509 in 2001. In order to recognize the economic value of water, it is desirable to undertake policy and institutional changes in the process of water management in the country.

Key words: Urbanization, Water resource, Rain water harvesting

Introduction

Urbanization and other demographic processes create some of the greatest pressures on water resources quantity and quality. These development processes directly affect water availability and quality through increased water demands and consumption and through pollution resulting from use of water in different ways. Water is the most valuable natural resource on the earth and without it, life cannot survive. The presence of good quality, safe and reliable source of water is thus an essential prerequisite for the establishment of a healthy community. Lucknow, the capital of Uttar Pradesh is one of the oldest cities of the world, having religious, historical, tourist and commercial importance cities of northern India, but presently facing the problems of burgeoning population and decline of water table.

Lucknow is geographically located at 26°30' to 27° 10' N latitude and 80° 34' to 81° 12' E longitude. The Lucknow forms part of the great Indo- Gangetic plain formed by the deposits laid down by the rivers in the post -tertiary period. The geology of the Lucknow does not reveal anything striking except ordinary Gangetic alluvium. The entire three important geomorphic surfaces are well depicted in the Lucknow urban region which is of moderate physiography with highest altitude 127 m at Alambagh in the south and 114 m at Nagaram in east and traversed by the Gomati from west to east. The geomorphology of the Gomati river in Lucknow shows mature topography. The Lucknow urban area can be grouped in two broad geologic units: younger alluvium along the river basin and flood plains and the older alluvium along the uplands and as natural levees. The ground water occurs under unconfined to confined conditions.

The management of ground water requires a better understanding of aquifer system, fluctuation in groundwater level, flow and recharge mechanisms. Several well-documented works to evaluate the aquifer parameters were carried out to augmented groundwater supply. Importance of hydrogeology was well documented by Ven Te Chow (1964). Later, detailed works on ground water assessment and evaluation management in relation to hydrology and water resource engineering were initiated by several authors (Walton, 1970; Todd, 1980; Prince, 1985; Ward and Robinson, 1989; Raghunath, 1990). Hall (1984) studied the urban hydrology and basic groundwater hydrology.

Life poses us with so many contradictions. Despite being one of the water shortage has reached alarming proportions. Technically speaking, water harvesting means capturing the rain where it falls, or capturing the run-off in one's own village or town experts suggest various ways of harvesting water: capturing run-off from rooftops; capturing run-off from local catchments; capturing seasonal flood water from local streams; and conserving water through watershed management.

Materials and Methods

The research has been conducted in two stages and data have been collected from the concerned organizations and institutions at Lucknow. The first stage involved collection of background information through various reports, publications of various organizations to understand the state of urbanization in the city, followed by interviews with various heads and authorities of the concerned departments. Observation techniques were also used to verify the authenticity of the information given by the respondents. In the second stage data is collected from the 17

Table -1: Water table position, their decline rate and projected year of subsidence in Lucknow urban area

S.No.	Locality	Depth of SWL (mbgl)	Rate of decline 2003-2008	Shallowest regional clays	Projected year of subsidence
1	Gomati Nagar	21.35	1.69	Chinhat Vishal khand CMS	46-50 47-50 47-55 2026
2	Indira Nagar	26.13	1.10	B block Sec 10 C block Bhoonthnath Mkt	43-46 39-42 35-39 48-52 Not expected
3	Vikas Nagar	26.60	1.13	Sec 1 Sec 5 Sec 2 Pant Nagar	45-50 45-50 46-53 44-49 2030
4	Aliganj Scheme	18.40	0.71	Sec P Sec E Sec I	42-46 47-54 34-38 Not expected
5	Jankipuram	12.25	0.65	Bio-Tech CDRI Eng. College	47-50 47-52 46-49 2067
6	Mahanagr	28.30	0.95	Horner School Hanuman Mandir Sec A	49-58 49-55 39-44 2037
7	Nirala Nagar	29.55	0.79	P.O. Nagar Nigam Sch. Saraswati Shishu Daliganj Rly. Stn.	36-40 28-32 32-36 35-39 Not expected
8	New Hydrabad	22.40	0.97	Phool Park Paper Mill Badshah Nagar	43-46 42-45 41-45 2033
9	Lucknow University	28.35	0.80	LU Premises	52-58 Data insufficient
10	Hazaratganj- Narhi	32.35	1.06	DRM Office Jawahar Bhawan Shakti Bhawan CM Awas Sikandar Bagh Raj Bhawan Butler Palace Queens College	46-50 47-50 48-50 45-50 43-48 45-48 42-48 44-48 2024
11	River bank colony	22.30	0.81	Judges Colony	45-49 Data insufficient
12	Aminabad	14.55	0.81	Hanuman Mandir Jhandewala Park Rajendra Nagar	52-58 53-58 53-57 2061
13	Cantonment	22.45	1.01	Lal Kurti	31-34 Data insufficient
14	Dilkusha	31.70	0.56	—	—
15	Gulistan colony	33.10	0.69	Loreto Convent	40-45 Data insufficient
16	Charbagh	19.9	0.81	Guru Nanak Mkt. NER Rly. Stn. KKC	27-30 26-31 29-32 2021
17	Rajajipuram	28.60	Not known	Sec. E Sec. C	38-41 37-41 Data insufficient

(Source- CGWB)

piezometers installed by Central Ground Water Board (CGWB) at Lucknow urban centre.

Results

The Table 1 and Fig. 1 is indicating the past, present and future scenario of the demographic profile of the Lucknow urban agglomeration. The figure shows a continuous escalation since 1931. The population of Lucknow in 1901 was 2, 56,239 which becomes 22, 45,509 in 2001. The population growth rate was negative in last two decades of last millennium, after that continuous growth is occurring in population. The growth rate in between 1951 - 61 was 31.96% which was decreased to 23.79% in next two decades. In year 1961 to 1981, the decreasing population of an urban area shows the poor economic base. In 1991 – 2001, the population growth rate was 34.53%. Official records show that Lucknow’s population grew more than that of other cities in the 1980s – mainly due to the extension of the jurisdiction of the Lucknow Municipal Corporation from 14,594 hectares in 1981 to 33,750 hectares in 1991. In the 1990s, average growth was comparable to that of cities of similar size more than Kanpur and Nagpur, but lower than Jaipur and Surat. The expansion in the 1980s meant the population density decreased from 69 persons per hectare to 49 persons per hectare, but has now increased to 67 persons per hectare due to population growth. The projected population of Lucknow will be approximate 4500000 in 2021; this is on the basis of popular projection methods and last decadal surveys.

As per the study of 17 piezometers (Table 1) installed by Central Ground Water Board (CGWB), the water table in Lucknow shows the declining behavior where on an average the water table decline is at 1 meter per year. Clays in the depth interval 20 to 60 mbgl, delineated in each locality through Geophysical logs (Self potential, short-long normal resistivity and natural gamma), are placed alongside. Going with the present un-scrupulous mining of the source from the shallow proven zones, finally it is computed as how much time will elapse in lowering of water table to the level of regionally occurring shallow clays.

Discussion

Growth rate was almost uniform till 1981, after which a sudden increase in population by almost 66% was recorded in 1991 census. This fact should not be considered as population explosion, in-fact the reason behind this was the inclusion of many adjoining tahsils areas into the jurisdiction of city Municipal Corporation. Although current levels of migration are lower compared to cities of similar size, population growth in Lucknow city growth over the next few years will likely be somewhat higher than elsewhere (around 4 %). The majority of migrants are coming from the surrounding districts.

Ground water is a dependable source for drinking and irrigation. Since the population is growing in Lucknow the levels of

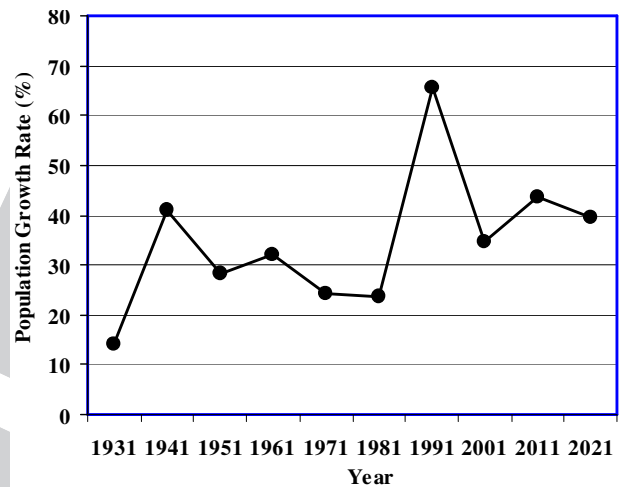


Fig. 1: Decadal growth rate of Lucknow urban agglomeration

Table - 1: Decadal growth of Lucknow urban agglomeration (1901 – 2021)

Year	Population	Lucknow urban agglomeration	
		No.	Decadal growth rate %
1901	256239	-	-
1911	252114	-4125	-1.61
1921	240566	-11548	-4.58
1931	274659	34093	14.17
1941	387177	112518	40.97
1951	496861	109684	28.33
1961	655673	158812	31.96
1971	813982	158309	24.14
1981	1007604	193622	23.79
1991	1669204	661600	65.66
2001	2245509	576305	34.53
2011*	3226000	980491	43.66
2021*	4500000	1274000	39.49

(Source: Master plan 2021 LDA, Lucknow * projected population)

ground water is decline. According to a report of the U.P. Jal Nigam in 2005, Lucknow has around 407 tube wells of which 387 are in working condition. These 407 tube wells produce around 190 MLD of water. Additionally there are about 100 tube wells that have been installed by various institutions and private colonies to meet their water demand. This situation has resulted in depletion of ground water and falling levels and in fact, in some localities it is reported that the fall is more than five meters during the last decade.

The state does not have a ‘ground water law’ that regulates its exploitation and this aggravates the situation. The ground water levels are likely to reduce further and attempts to tap the next layer of ground water are already underway. Regulation of ground water exploitation is mandatory to check its exploitation and use. The demand in the periphery of the city and villages are mostly met through hand pumps. Within the city, hand pumps have been installed

in slums to supply drinking water. The Lucknow Jal Sansthan reports that around 6,150 India Mark II hand pumps are installed in those areas inhabited by the economically weaker sections of society. These hand pumps on the whole yield around 15 MLD of water. However with the falling ground water table these hand pumps may not be able to sustain their yield. There are very high possibilities of these hand pumps going dry in the years to come especially in the summer months, as the average depth of these pumps is only around 120 metres. The area inside the city with relatively best developed aquifers in both cis- and trans- sides are defined as Rajajipuram- Alambagh and St. Fidelis College- Indira Nagar-Chinhat tracts, respectively.

The future ground water prospects are moderate over the city areas. Deeper aquifers in the districts have got high ground water prospects, which remain to be explored and exploited. An auto flow condition has been found at many places in the town. The aquifers occurring below the depth of 400 m. are likely to yield over 1000 lpm. of fresh water. The shallow aquifers down to the depth of

200 m. are under stress. Further exploitation of this aquifer should be restricted.

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