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Use of wetland resources of Mohanlalganj administrative division for solving water crisis in urban areas of Lucknow: A model study on utilization of wetland resources as a remedy for water deficient areas

Abstract

The present work deals with the utilization of excess available water present in the wetlands adjacent to city of Lucknow to address the problem of depletion of ground water and the consequent water scarcity in the urban areas of Lucknow. It was observed that the water level of pre- and post-monsoon period in the Mohanlalganj and Gosainganj areas is 0 to 2 m below ground level. As a result of the high water table large parts of Mohanlalganj administrative division are affected by the problem of water-logging. This study has been designed to solve the r problem of water scarcity in Lucknow city by transferring excess water from water logged areas of Mohanlalganj tehsil, thus also addressing the problem of water logging in Mohanlalganj administrative division. The proposed study can serve as a potentially viable and sustainable solution for addressing the problem of water scarcity due to ground water depletion in an area by sourcing water from adjacent areas with surplus ground water resources.

Author Info

Mujeeb Akhter*[1], Noorul Huda[2] and Gauher Mahmood[3]
[1]GeologyDepartment, University of Lucknow, Lucknow-226007, India
[2]Department of Civil Engineering, LDC Institute of Technical Studies, Soraon, Allahabad-212502, India
[3] Department of Civil Engineering, Jamia Millia Islamia, Jamia Nagar, New Delhi-110025, India
***Corresponding author e-mail:** mujeeballahabad321@gmail.com

Keywords

Wetland, ground water, water scarcity, water resources, Lucknow

Introduction

As the most important resource for life, water has been a central issue on the international agenda for several decades. Nowadays, many areas of the world are affected by water scarcity (Alcamo and Kaspar, 1997) The increasing demand for water over the years has led to severe water scarcity in many parts of the world. With constantly increasing pressure on available fresh water resources for agriculture, industrial and domestic use, a severe fresh water crisis seems imminent. India is no exception, and we are faced with an impending freshwater water crisis mainly due to improper management of water resources and environmental degradation, which has lead to a lack of access to safe water supply to the people (Pahlow *et al.*, 2015). This fresh water crisis is already apparent in many parts of India, varying in scale and intensity depending mainly The unpredictable nature of the monsoon in recent years has further aggravated the situation and made us more dependable on different ground water resources for agricultural, industrial and other domestic needs (Atwia *et al*., 1997). This has led to a rapid depletion of ground water resources leading towards an impending fresh water crisis. This problem is especially marked in the urban centers of India because of rapidly increasing populations and insufficient groundwater recharge due to improper management of rainwater in these heavily constructed areas. As during monsoons there is short duration of heavy rain and most of the rain falling on the surface tends to flow away rapidly from the constructed areas in the urban centers leaving very little for recharge of groundwater. The constantly rising demands of water supply specially in urban areas does not match with the sub-surface water sources, as a result of which water reserves beneath the ground level are being over utilized leading to a rapid fall in groundwater levels. This is resulting in emergence of a number of other problems also like degradation in quality of groundwater and the problem of land subsidence.

Lucknow has experienced an exponential growth in the population since the beginning of the twentieth century. This has put tremendous pressure on the existing civic services including supply of drinking water. The Lucknow water supply utility (LWSU) has a total gross available supply of about 490 Ml/d – of which around 240 Ml/d is derived from up to 500 tube wells and 250 Ml/d from surface water, with the Gomati intake having been replaced by an authorized off take from the Sharda Irrigation Canal because of reduced base flows and quality deterioration at theriver intake. The gap between demand and supply is partly being met by extraction of ground water through wells, tube wells, deep bore, hand pumps etc.

The present study has been formulated to solve the water problem of these two areas i.e. Lucknowcity and Mohanlalganj tehsil by transferring and using excess water in Mohanlalganj tehsil is recharging in the water crisis zone of Lucknow city in both the areas were delineates. As little has been done so far regarding conjunctively use surface and ground water for overall sustainability of the water resources in the district of Lucknow.

Materials and Methods

The present study has been divided in to two parts

1. Field study: a) Scanning, projecting, geo-referencing and digitizing different thematic layers on satellite images. **b)** Dug well study in the field. **c)** Map composition of various thematic layers along with comparative analysis.

2. Laboratory study: a) Collection of water samples from selected locations in urban and suburban areas (Mohanlalganj tehsil) of Lucknow district command. **b)** Analysis of the water samples for qualitative and quantitative study

First the area was selected through Survey of India toposheets of Lucknow district at 1: 50,000 scale (Table -1). The SOI toposheets used for the study are given below in the table-1.

Water table data is collected from the dug wells in the study area and their location is marked by GPS (Global positioning System) and on that basis water table contour map was made. Various land use / land cover features were studied and a base map was prepared by visual interpretation using toposheets and false color composite image of ETM+ sensor samples (Subramani and Mathialagan, 2018) **Field studies: 1)** Collection of dug well data from selected locations. **2)** Location of sample points were determined on the basis of satellite imagery and toposheets data. **3)** Water table data was plotted to monitor the changes in the areas and field photographs were taken for verification.

Fig.1: (A) Wetland from Karaila Jhil, Mohanlalganj, Lucknow. (Left Bank) **(B)** Wetland from Karaila Jhil, Mohanlalganj, Lucknow. (Right Bank)

Table- 1: SOI Index in 1:50,000

S No.	Name of administrative areas	Toposheets No.
1	Mohanlalganj	63 B/14 and 63F/2
1.1	Kukra and ugana tal Near sisandi	63 B/14
1.2	KarelaJheel near Baldikhera	63 F/2
1.3	Mahada, Aglauna, Digri and Dheran Tals North- West of Sameri and North East of Mastipur	63 F/2
1.4	Konch Tal, Poni Tal, Newara Tal, North of Mastipur.	63 F/2
1.5	Bijra Tal, East of Nigohan Bazar	63 F/2
1.6	Alel Tal near Anaiya	63 F/2
1.7	Occurrence of a meandering course of river near Mohaddipur, North of Mohanlalganj South of Sarthua.	63 B/14

Results and Discussion

The assessment of the role of lakes and impoundments at regional and global scales, e.g., in biogeochemical cycles, requires good estimates of the areal extent and shape of water bodies (Verpoorter, *et al.*, 2012). The water body map is an important aspect of the study related to recharge and water conjunctive use (Fig. 2 - A). It gives the information regarding the size, extent and arrangement of water bodies in the region. The water body map of the study area i.e. Mohanlaganj and Gosaiganj blocks have been prepared using ETM+ data of 2000 (GLCF-ESDI data). In the Mohanlaganj region it is clearly seen that the water bodies are larger in size and the extent is also mappable. The cluster of small water bodies can be seen near the Sai River in the south-western region of the area. These water bodies are mainly the cut-off meanders, palaeochannels and ox-bow lake with concentration in the direction of south-east. In the Gosaiganj block the water bodies can be seen smaller in size but the frequency is higher as compared to the Mohanlalganj block. The north-eastern region of the Gosaiganj block is however marked by the presence of larger water bodies in the form of ox-bow lakes, cut-off meanders and low lying areas. This region lies close to the vicinity of Gomati River and thus it can be said that the region is controlled by its watershed.

The slope map of Lucknow district (Fig. 2- B).) shows the region has gentle slope with values ranging between 0 - 6 degrees. The Mohanlaganj and Gosaiganj blocks are of small variation and due to this the whole Lucknow district was taken for consideration. The general slope of the district is mainly between 0 – 2 degrees.

The Mohanlaganj and Gosaiganj blocks also slope within this range but at some instances the slope varies between 2 – 4 degrees. The variation in the slope in the entire district hardly goes beyond 1 - 2 degrees while, along the vicinity of the rivers due to the basin margins and active flood plain the slope varies from 3 to 4 degrees and 4 - 6 degrees respectively. The Lucknow district contains vast range of palaeo-channels, ox-bow lakes and old meanders but their slope does not show any large scale sloping angle depression.

The Constant monitoring of the ground water level will be done as soon as, the ground water level falls below the optimum

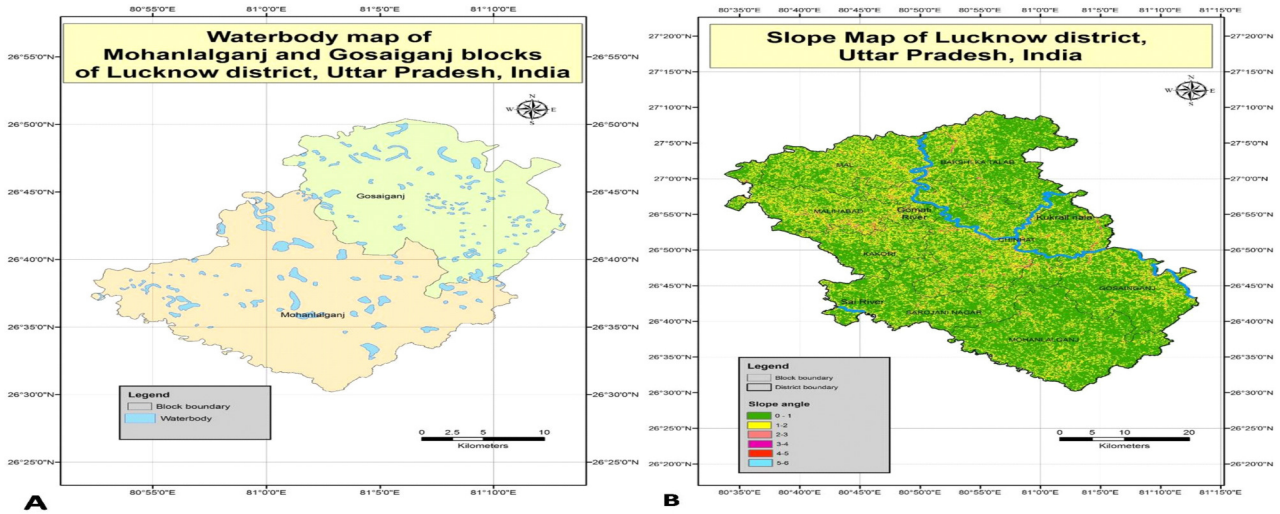

Fig. 2: (A) Water body map of Mohanlalganj and adjacent blocks of Lucknow district, U.P. **(B)** Slope Map of Lucknow district, U.P.

Table-2: Water table data of dug well in Mohanlalganj, Lucknow

Spot	Latitude/longitude	Elevation	Height of well from ground (h) (m)	Depth of water			
				pre-mansoon 2004	post mansoon 2004	pre-mansoon 2005	post mansoon 2005
Sabakhera mohanlal ganj,near road	N-26^0 44" 27.3' E80 ^{0}57" 5.1'	106	0.2	3.4	1.75	5.64	4.2
Kalli pachim ,mohanlal ganj,(ramu caterers)	N-26 ^{0} 43" 51.4' E-8^0 57" 1.5'	106	0.35	3.55	2.15	5.49	4.37
Gareniankhera mohanlalganj	N- 26^0 43" 9.1' E-8 ^{0}56" 00 '	106	0.6	5.4	5.15	5.96	5.3
Amola mohanlalganj	N- 26 43" 26.1' E- 80^0 55" 58.6'	106	0.7	3.65	3.45	5.15	4.9
Matee mohanlalganj	N-26^0 42" 56.9' E- 80^0 55" 29.5'	106	0.4	4.7	5.3	6.35	6.2
Harkansgarhee,mohanlalganj	N-26^0 43" 17.6' E- 80^{0}57" 59.0'	110	0.5	3.75	3	6.18	4.6
Dalona mohanlalganj	N- 26^0 35" 56 .6' E- 8^{0}8" 52.5'	108	0.45	4.7	1.85	4.99	3.4
Nagar, mohanlalganj	N-26^0 42" 47.1' E- 80^0 57" 59.7'	108	0.35	3.05	2.11	6.8	5.27
Gopalkhera,mohanlalganj	N-26^0 42 "40.7' E- 80^{0}58 "43.2'	108	0.25	3.83	3.65	7.65	6.05
Pursaini,mohanlalganj (G.S. Sriv. house)	N- 26^0 42" 19.5' E-8^0 59" 9.2 '	108	0.18	3.33	3.17	5.68	5.22
Atrauli	N- 26^0 38" 40.3' E- 81^{0}11" 31'	-	0.22	6.9	6.65	7.6	7.2
Bishunkhera	N-26^0 35" 10.1' E- 81 ^{0}01" 46.2'	-	0.19	3.85	3.65	4.21	3.9
Bhawakhera	N- 26 ^{0}44" 21' E-80^0 59" 5.4 '	-	0.24	8.1	7.9	8.9	8.4
Jagatkhrea	N- 26^0 44" 58' E- 80^0 59" 5.4 '	-	0.29	7.9	7.65	8.2	8
Biraura	N-26 ^{0}44" 58' E- 80 ^{0}59 "48.2'	-	0.33	8.5	8.35	8.71	8.2
Bharsawa	N-26 ^{0}38 "40.3' E- 81^0 11" 31 '	-	0.39	8.2	7.95	8.3	8
Karora	N-26^0 35" 10' E-81^0 01 "46.2'	-	0.31	4.9	4.75	5.12	4.9
Garhi	N-26^0 44" 21' E-80^0 59" 5.4'	-	0.24	4.6	4.42	3.9	3.7
Dhanwara tikara	N-26^0 44" 58' E-80^0 59 ".48 .2 '	-	0.32	6.13	0	13.1	1.7
Dharwat khera	N-26^0 35" 39.1' E-81^0 00 "55.8'	-	0.19	5.02	2.03	4.8	2
Mastipur	N- 26^0 41" 28.1' E- 80^0 58" 52.2'	-	0.38	8.1	7.16	10.9	8.8
Mohanlalganj	N-26^0 37" 10.2' E-81^{0}8" 13.3'	-	0.23	0	0	7.2	4.4
Nagram	N-26^0 33" 45.2' E-81^0 8" 13.3'	-	0.28	6.05	3.78	3.7	2.5
Nigoha	N-26^{0}39.2" 5' E-80^0 54" 53.8'	-	0.25	9.9	6.58	9.2	7.15
Sisendi bazar	N-26^0 39" 2.5' E-80^{0}54" 53.8'	-	0.13	6.62	4.77	7.8	5.2
Mau	N-26^0 39" 23.5 'E- 80 ^{0}55" 00 .8'	-	0.21	7.4	5.3	9.3	7.2
Rani khera	N-26^0 43" 48.8' E-80^0 57 "41'	-	0.32	7.1	5	7.5	5.35
Marui	N-26^0 45" 28.5 'E- 8^0 59" 35.9 '	-	0.27	6.9	6	8	6.5
Babu khera	-	-	0.24	5.9	4.95	6.32	4.8
Sewai	-	-	0.36	4.85	3.2	5.12	3.4
Kushmaurya	-	-	0.17	8.15	7.2	9.2	7.5
Jabrauli	N-26^0 38" 10.2' E- 81^0 6" 53.1'	-	0.32	6.75	5.25	7.8	5.6
Gaura	-	-	0.7	7.6	6	8.25	6.5
Barseen khera		-	0.34	4.4	3.1	4.91	3.15

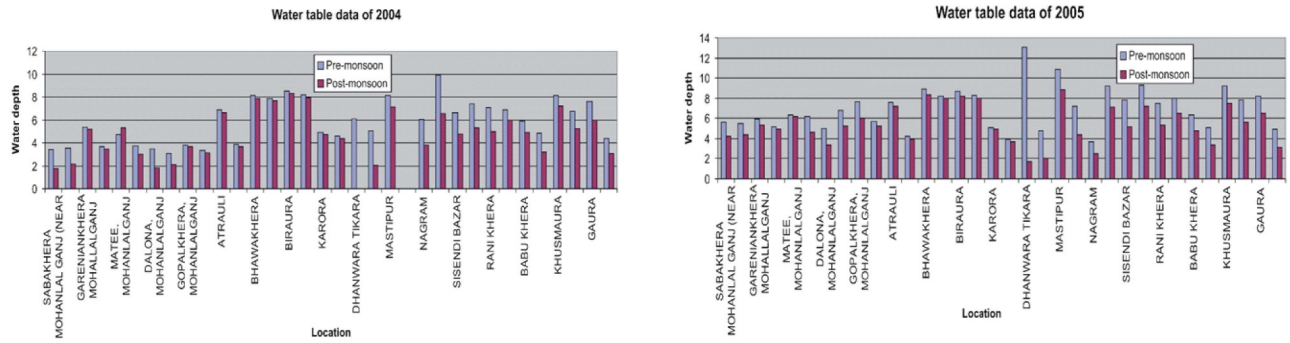

Fig.3: Graph showing water table of pre and post monsoon of 2004 and 2005

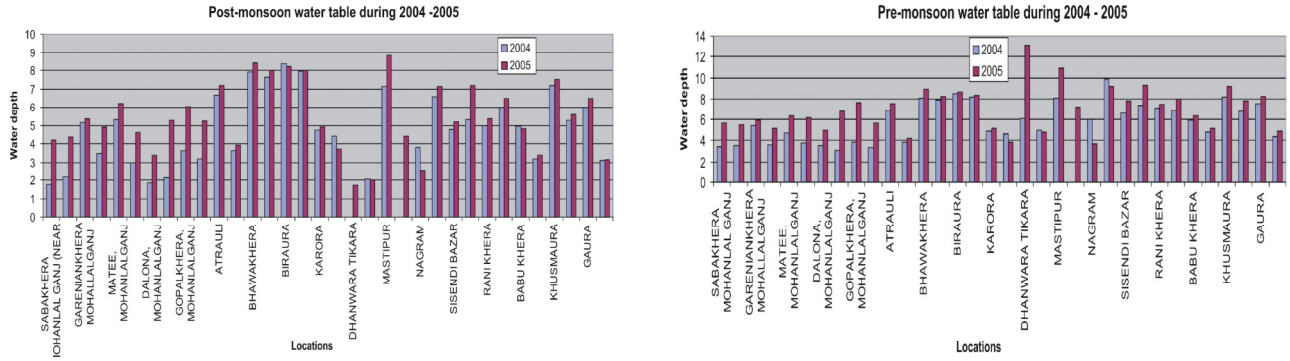

Fig.4: Graph showing water comparison of pre and post monsoon of Mohanlalganj, Lucknow, 2004-05

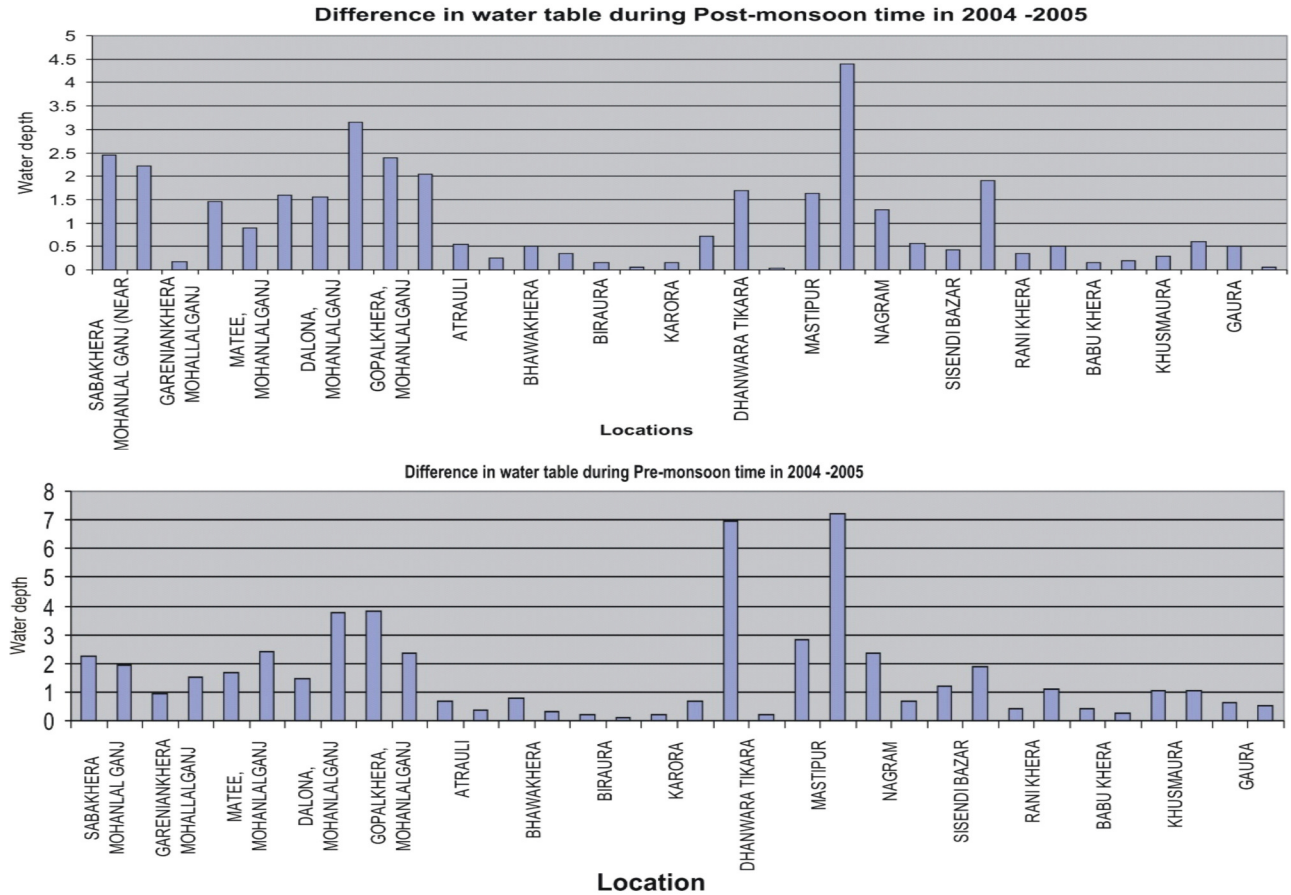

Fig. 5: Graph showing difference in pre and post monsoon of Mohanlalganj,Lucknow, 2004-05

level these bore well again be stopped and water supply will be supplied from the ground water surplus area through the pipeline. This cycle will continue till the next monsoon and this cycle would be maintained every year.

The present study would have potential applications in solving the problem of ground water depletion and the consequent water scarcity in the urban areas of Lucknow.

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