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Examining the Need and Necessity of Water Harvesting in Greater Noida, India: A Planning Approach

Ashwini Kumar[1], Nauman Najamuddin[2], Mohammad Arif Kamal[3,*]

[1]Institute of Town Planners of India, New Delhi-110002, India
[2]Master of Planning, CEPT University, Ahmedabad-380009, India
[3]Architecture Section, Aligarh Muslim University, Aligarh-202002, India
*Corresponding author: architectarif@gmail.com

Abstract Water shortage is one of the major problems of the 21st century which incidentally is also the beginning of the new millennium. Horrible predictors are being made regarding the water problems being faced by the mankind during the next 50 years. If the last 50 years are any guide, there is no double that the world is going to face a serious problem. Since water is life we cannot do without it, we all have to think how to deal with this situation. Until the scientists can think of better and durable solutions we must do whatever is possible at the grass root level.

Keywords: *water harvesting, Greater Noida, India*

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1. Introduction

Water the nectar of life has become the most vulnerable and endangered commodity due to imbalance caused in its demand and supply. Drying up of streams, depletion of ground water levels and contamination of surface/ subsurface water due to industrial effluents, fertilizers and sewage pollutants are now common feathers. Availability of free electricity in agriculture sector has also put immense stress on water resources. Farmers even in rain scarce areas have changed their cropping patterns from traditional crops to cotton, wheat and other cash crops thereby depending on the irrigation solely on ground water. The impact is realized soon as depleting water levels and quality deterioration due to over-exploitation and over application of pesticides and fertilizers. A natural recharge to the aquifers is not able to meet exploitation rate, it has resulted into drying up of shallow ground water extraction structures. As per National Council of Applied Economic Research Report 1999, only 34.7% of Indian farmers have 50% of their gross crop area under irrigation and 52% of the villages in country depend on unprotected / unsafe sources of water. Similar is the situation in urban and industrial sectors of the country. About 50% of industrial requirements of water are presently being fulfilled by the ground water resources [1].

2. Need and Necessity of Water Harvesting in Greater Noida, India

There is no doubt that country is facing water crises. As per The Energy and Resources Institutes (TERI) Report of 1997 per capita water availability will drop to 1500 cubic meters in the year 2017, which was around 6000 cubic meters in 1947. In certain areas of Tamil Nadu it is already down to 400 cubic meters [2]. Figure 1 shows the Ecological regions of India. Today we need an integrated watershed development where rivers canal, lakes underground reservoir and available rain water of a given area should be tapped to address the local population water need. Community initiatives to manage water resources in a sustainable manner at local level are most required. In present scenario, when surface water resources are fully committed and there is immense pressure on underground reservoirs in state of Punjab, Haryana, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu, the only surplus water available for utilization is rain water which generally goes as waste into sea.

The most feasible option is to harvest the rain water at the place where we get it (i.e. streams storm water drains, roof tops, pavements, garden etc.) and store it in the natural subsurface geology environment for eventual recovery from wells. Rain water harvesting is an effective tool to utilize a large amount of high quality water which otherwise goes as waste to sea. Rain water harvesting is the process to capture and store rain fall to prevent its run off, evaporation and seepage for its efficient utilization and conservation in watershed.

Urban water needs can be divided into various sectors on the basis of the diverse kind of uses. The water demand of a city has two aspects (a) Domestic water demand (b) water demand at city level. As per Indian Standards (IS 1172-1971), the average domestic consumption in an Indian City is approximately 135 litres per capita per day (lpcd) in the different activities of daily routine as drinking, cooking, bathing, washing of cloths, utensils,

washing and cleaning of houses and residences flushing of latrines, etc. [3].

The city level demands various according to the population size. On an average there is a big gap urban and rural demand. As urban demand is about 150 lpcd to 300 lpcd rural demand is 70 to 100 lpcd On an average of world's urban water demand is 150 lpcd or about 55 cum per year and average rural water consumption is only 50 lpcd or 18 cum per year. As per Indian Standard (IS1172-1971), the breakup is for domestic 135 lpcd for industrial 50 lpcd commercial 20 lpcd public 10 lpcd and waste and theft it is 55 lpcd and total water required for city is approx. 270 lpcd. The pre and post-monsoon water level in Greater Noida is shown in Table 2.

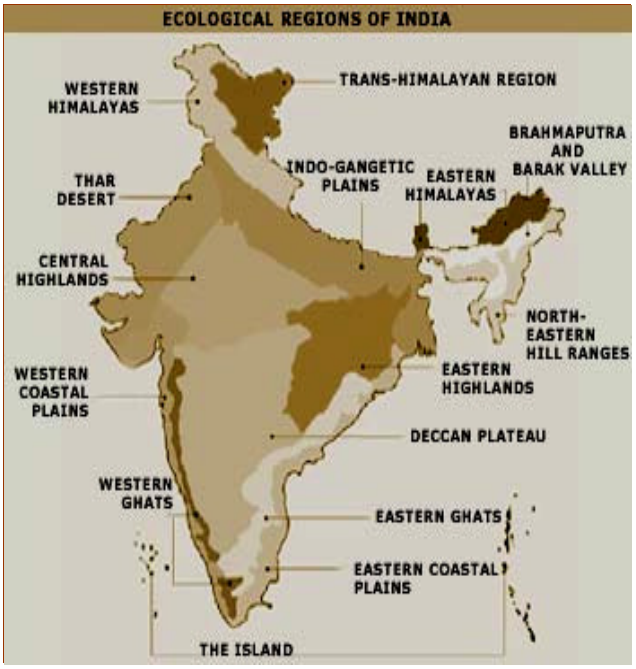

Figure 1. Ecological Regions of India

Ancient tradition of community based water harvesting practices has declined in the country as states are given major role in water supply and management in post independent era (Figure 2 & Figure 3). The present surface is the management of water resources both surface as well as underground has reflected in to water scarcity and occurrence of droughts. Over exploitation of water by farmers even in rainy season and colonizers developers and municipal supply has resulting the lowering of water table of ground water. Studying the ground water survey in different sectors of Greater Noida we found that approx 20 years before the Water Table was approximately 10-12 feet deep example the traditional hand pumps were in use for less depth. Then Bharat Machinery type hand pumps were in use to pump out the water from the depth of 15-20 feet.

Figure 2. Underground water storage system

Figure 3. Indigenous water supply system

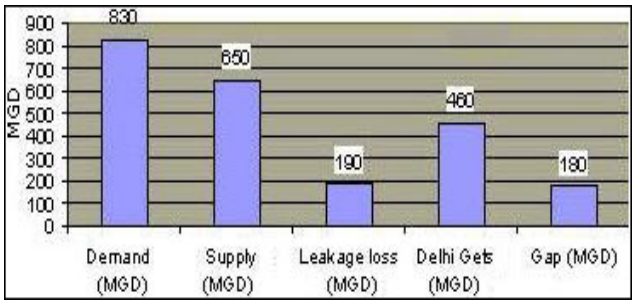

Figure 4. Ground level water distribution system

Table 1. Block wise ground water availability in different villages of Gretaer Noida [5]

S. No.	Blocks	Annual ground water recharge (in hectare meter - ham)	Net Annual ground water availability (in ham)	Existing gross ground water draft for all uses (in ham)	Net ground water availability for the future irrigation (in ham)	Stage of ground water development (in %)	Category of block
1.	Bisrakh	9528.38	9051.96	6756.76	2079.39	74.64	Safe
2.	Dadri	20355.50	19337.73	5024.83	14155.37	25.98	Safe
3.	Dankaur	17673.36	16789.69	9762.34	6933.23	58.14	Safe
4.	Jewar	15509.17	14733.71	9248.54	5424.44	62.77	Safe
	Total	**63066.42**	**59913.10**	**30792.48**	**28592.44**	**51.40**	

Table 2. Pre and Post Monsoon water level city area in Greater Noida

Pre and Post Monsoon Water Level City Area, Greater Noida														
			Water level – Below Ground Level (BGL) in Meters											
S. No	Name of Place	Depth of peizom (M)	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon
			2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011
1	Alpha	42.6	6.16	6.03	6.69	6.97	7.53	7.43	7.92	8.05	8.73	7.52	7.91	8.16
2	City Park	41.1	5.88	5.85	6.46	6.83	7.69	7.21	8.4	7.75	8.41	7.05	7.95	8.15
3	Gamma	40.6	5.85	5.6	6.09	5.93	6.77	6.42	7	7.23	7.4	6.69	7.06	7.41
4	D.M. Office	40.65	3.8	3.57	3.91	4.01	4.42	4.37	4.75	4.93	5.45	4.56	4.76	4.81
5	Surajpur	39	5.55	5.41	5.81	6.23	6.05	5.86	6.65	6.71	6.75	6.08	6.22	6.16
6	D.P.S.	41.6	4.4	5.36	5.64	5.36	5.58	4.79	5.75	5.66	6.41	4.88	5.01	5.39
7	Chaurasia Estate	44.05	6.5	5.87	6.28	6.44	6.79	6.23	6.7	6.49	7.23	5.76	6.91	7.04
8	Police Line	40.62	3.15	2.21	2.89	3.24	3.21	2.53	3.46	3.95	4.76	1.73	3.14	2.49
9	Sector-36	40.55	14.85	14.68	14.8	15.59	-	-	-	-	-	-	-	-
10	Delta-3	41.65	6.65	3.31	6.66	6.58	6.58	6.56	6.55	6.49	7.38	5.84	6.44	6.73
11	Pie Sygma-3	40.2	6.3	4.73	5.13	-	-	-	-	-	6.31	5.13	5.76	5.52
12	Pie-2	43.8	5.65	5.88	6.19	6.17	6.58	5.83	8.05	6.91	7.66	5.87	6.96	-
13	Anox Air Products	33.45	5.45	5.2	5.68	7.18	7.18	6.59	6.35	6.85	7.35	6.26	6.64	6.67
14	Huldoni Turning	39.1	6.05	5.62	6.27	6.17	6.24	5.97	-	-	-	5.64	6.21	5.71
15	Honda Syal	39.8	5.82	5.47	5.84	5.79	6.15	6.12	7.45	7.44	7.6	6.53	7.14	6.96
16	Green Nursery (H.P. Gas)	36.3	3.85	3.6	4.04	3.93	4.13	4.29	7.05	7.18	6.81	5.51	5.41	6.4
17	Knowledge Park-3	39.25	6.08	5.63	6.56	6.57	7.91	7.31	8.81	8.88	9.59	5.88	6.47	6.5
18	I.T.S. Dental College	38.85	4.5	4.16	4.64	4.76	5.07	4.66	6.47	-	6.06	3.89	4.42	-
19	Gulistanpur Pri. School	33.4	12.35	11.95	12.64	11.91	12.51	12.29	-	-	-	-	-	-
20	Musical Park	37.3	5.9	5.22	5.58	5.71	6.06	5.63	6.1	6.7	7.38	6.03	5.78	5.64
21	Safipur	39	9.05	8.45	8.93	9.17	9.06	8.72	-	8.85	9.51	7.72	8.31	7.93
22	Pari Chauk	39	5.92	5.66	6.59	6.72	7.66	6.67	7.95	8.05	9.35	7.64	8.61	8.41
23	N.T.P.C. Colony	38.75	5.75	5.22	5.62	5.38	5.75	5.21	6.57	-	-	-	-	-
24	Tusiyana Turning	39.7	5.85	4.83	5.24	4.98	5.58	5.26	5.76	5.93	6.15	4.79	5.46	5.52
25	Hanuman Mandir (Bisruck)	34	3.85	3.83	3.62	4.56	4.05	3.29	4.05	4.38	5.24	2.26	3.42	2.28
26	A.C.C.	35.65	9.55	8.93	9.54	9.61	10.05	9.54	10.05	10.43	11.07	9.26	9.06	9.51
27	Sakipur Pri..School	36.1	11.9	10.98	11.62	11	11.68	11.36	11.63	11.93	12.64	10.8	11.08	-
28	Deep Memorial School	33.9	10	9.19	9.68	9.26	9.85	9.58	10.07	10.25	11.04	8.86	9.94	9.81
29	Piyajo Factory	35.9	3.85	3.38	3.81	3.84	4.1	3.64	4.61	4.72	5.53	3.41	4.31	4.07

As the water table lowering down the electric motor with pump set were installed at a depth of 10' deep pit to take out the water from 30' deep water table, The depth of pit was lower down to another 5' as the water table went down to 35- 40 feet (Figure 4). Over exploitation and non seepage of rain and surface water to ground water replaced the electric motor pump sets to Jet Pumps to pump out the ground water and finally now we are using submersible pumps for our urban needs as the water table is approximately 45-50 feet deep. The municipal water supply for restricted timings in urban areas having a population of approximately 12.0 lakhs increased the personal arrangements to get the water from ground resulting the lowering of ground water table. Surajpur, a slum in Greater Noida with a population of 10,000 residents, compelled to consume highly contaminated drinking water with heavy metals like chromium, cadmium, lead, iron and mercury [4].

The whole areas witness severe ground water contamination mainly because of its geographical location on the bank of highly polluted Hindon River and also due to the leaching of liquid and solid waste from industries in upside area and Greater Noida. Block wise ground water resources using GEC, 1997 methodology are tabulated in Table 1.

Women often have to walk many miles to collect a pot of drinking water of dubious quality. About 2.31 lakhs villages or 40% of the villagers in the country were designated problem villages by the drinking water mission during sixth plan under rural needs mainly two sectors area there. First one is irrigation and second one drinking and livestock. It has been estimated that under irrigation sector the present demand is 630 Billion Cubic Meter

(BCM) and by the year 2025 it will increased to 770 BCM. The world's average rural water consumption per capita is only 50 lpcd or 18 cum per year. The city level demand varies according to the population size. On an average the per capita demand for Indian cities may vary as shown in the following table. It must be beyond that there is a big gap urban and rural demand. As urban demand is about 150 lpcd to 300 lpcd rural demand is 70 to 100 lpcd. On an average of world's urban water demand is 150 lpcd or about 55 Cubic meter (cum) per year and average rural water consumption is only 50 lpcd or 18 cum per year [6]. As the rains starts some feels relief and many gets troubles. This is the actual pictures of Greater Noida general public, teachers, and parents, workers, and hawkers, even administrators gets in trouble because of weaker planning and implementation in rural part of Greater Noida. Lack of base work non-cleaning and distillation of nalas make the villages a pond full of water. While the main recharging source Rain water flood away through surface canals and nalas making the general people life difficult. This situation can be reversed by social mobilization of village/urban communities to harvest rain water so that the ground water can be recharged every year Ground water play a major role in our rural and urban areas set up. It not only fulfills drinking needs of over 90% of area but also 50% of net irrigation area is also dependent on ground water resources. Greater Noida is developing city and moving fast to become the developed city in the process exploitation of natural resources required to develop the economic development of the country. Over exploitation of sources creates the scarcity and big problems. As over exploitation of ground water, lowering the water table and affecting the quality of ground water. As per Central Soil and Water Conservation Research and Training Institute, India, countries such as Thailand, Denmark and even the highly urbanized countries such as Japan, China and USA are among the few countries where rain water harvesting is now being practiced to meet the water needs of the growing populations (S.W.C.R.T.I., 1996). India with its strong tradition of harvesting structures throughout the country developed to suit the requirements of the area and the society is not far behind. We have modern examples like systems of harvesting rainwater in cities of Chennai, Hyderabad where these systems have been successful. Rain water that is collected is not used only for domestic needs but also for artificial recharge of ground water by improved soil and water conservation practices [7].

3. Plan of Action for Rain Water Harvesting in Greater Noida

The rainwater harvesting is an old technique and is practiced in many countries including India from time immemorial. But government and people remember this only when water is not available even for drinking purpose. There is no use of spending huge sum of money when we notice the water scarcity for drinking, industry and agriculture. This activities/structure should be constructed before the rainy season so that the rain water which goes as runoff outside the sub watershed/city limits can be collected and used directly or by recharging into the ground. Government is undertaking the wasteland/watershed development programs, but not done in a comprehensive/integrated manner/holistic saturating the watershed in all water harvesting measures. Hence there is a need to take up watershed development programs – mainly water harvesting measures in a scientific and systematic manner. The Greater Noida Authority has laid condition that in any building construction, water harvesting work should be included and executed, but in practice, it is not perfect. The authorities concerned should monitor the program so that the drinking water problem can be solved in municipalities without any difficulty to some extent [8]. Rain water harvesting and augmentation of ground water by artificial recharge should be encouraged in areas where ground water levels have gone down. Direct recharge techniques may be applied in such areas where shallow aquifers are capped by thick clays. There is a considerable scope of roof top rainwater harvesting for ground water recharge in urban areas [9].

4. Policy Initiatives for Rain Water Harvesting in Greater Noida

There are some key solutions, which need to be addressed with effective intervention [10]:

1. Separate Institutional mechanism with regulatory framework and adequate and skilled infrastructure is required to be developed so as to promote, guide, implement, co-ordinate and monitor rain water harvesting and recharging activities.
2. There should be a "State Plan" for rain water harvesting and ground water recharge with prioritization of separate Micro Plans for problematic areas of urban, rural and industrial segments. These plans and the identified problematic areas should be made public in order to sensitize and create awareness.
3. Problematic areas should be prioritized and be fully saturated first with site specific rain water harvesting activities in order to achieve cumulative impact on depleting ground water.
4. Understanding Aquifer Geometry is an important pre-requisite for Rain water harvesting / recharging and other management requirements. Along with rain water harvesting, Conjunctive Management of surface and ground water resources in both urban and rural areas should be taken up on priority basis.
5. Area specific guidelines, technical specifications & appropriate practices should be strictly followed during the design and implementation stage. In problematic areas, indiscriminate/excessive exploitation of ground water should be discouraged and the roastering system should be enforced.
6. To assess the impact of rain water harvesting especially in alluvial aquifers, Research and Development should be taken-up side by side.

5. Conclusion

For sustaining and recharging the groundwater along with judicious use of the limited fresh water resources is the need of the hour. If sufficient measures are not taken up immediately, we will face a crisis which will be

detrimental to the very survival of mankind. Efficient management of water resources and education about judicious utilization of water resources along with measures of harnessing, recharging and maintaining the quality of water and water bodies has to be taken care of [11]. Rain water harvesting cannot only provide a source of water to increase water supplies but also involve the public in water management making water management every body's business. It will also reduce the demand on the government institutions to meet water needs of the people. It would also help everyone to internalize the full costs of their water requirements thus encouraging people to be more conscious of their water demand. Major institutional policy and technological initiatives are required for an efficient socially equitable and environmentally sustainable management of our water resources. Development of water resources must be to an extent such that it ensures the sustainability of the resources, both for the present and future generations. There is an urgent need to re-link urban planning with consideration on the local resource potentials of nature like rainwater.

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