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Institutional Responsibilities to Recharge Ground Water, Need for Policy Implementation: A Case Study of Banaras Hindu University Campus

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Abstract

In some large cities of India situated in the Ganga plains, one of which is Varanasi, 50% of water supplied is tapped from the ground and hence ground water levels are falling down deeper and deeper year after year. Besides a large military cantonment and a large manufacturing unit (Diesel Locomotive Works), there are three large universities one of which is Banaras Hindu University, in Varanasi City. These institutions draw groundwater to meet their various needs. Banaras Hindu University alone occupying about 1270 acres, accommodating about 20000 residents (students and staff) is drawing about 20.00 lakhs liters per day through its 20 boreholes. Of course, it doesn't take a single drop of water from Corporation's supply. Since, it is extracting enormous volume of water every day; it should harvest rain water to recharge the ground water. Just as there are many policies/guidelines for individuals, there must be policies/guidelines for institutions to tap ground water as well as responsibilities to recharge ground water. The current study emphasizes on, how much BHU campus can harvest out of the rain it receives and on the storages to impound the harvested water for some campus uses as well as recharge sources. Surface water yield is worked out and measures are suggested to direct harvested water into the recharge storages.

Keywords: Groundwater; Extraction; Recharge; Institutional Responsibilities.

1. Introduction

Our planet Earth is unique because it has life; it has life because it has water. A better part of the animals' bodies contain water and earth too as an organic body has water over and within it. Most of the biotic life on the continents of the earth depends on surface water. But humans need ground water too to meet their various needs. Insufficiency of surface water to meet all our domestic, industrial and agriculture demands has put tremendous pressure on our ground water sources. In this regard the observations of Kerr (2009) and Fan et al., (2013) are noteworthy. Further, poor quality of surface water and insufficient supply is responsible for our dependence on ground water to meet especially the domestic needs. About 85 percent of our potable water needs are met from ground water sources(Nandita Roy, 2010; WORLD BANK, 2012.). Almost 85 percent of ground water extracted is used for irrigation purposes and about 15 percent for industrial and domestic purposes; and, 70-80 percent of India's agriculture output is also dependent on ground water sources (Kumar, 2011; Kaur and Malik, 2012). According to World Bank News of 1st March 2012, India is the largest user of ground water in the world(Vijay Shankar et al., 2011;Gun, 2012; Sheetal Sekhri, 2012). Consequently, many states of India are coming in danger zone (Fan et al., 2013). There are many policies enacted by Central Government regarding ground water. One of the first policies that has been introduced across many states is mandated Rain Water Harvesting.

Various enactments concerning controls and measures to regulate uses of groundwater are more flouted than followed by almost all--individuals (both for domestic and agricultural uses), industries as well as large institutes. In a large institute like Banaras Hindu University occupying an area of about 1270 acres in Varanasi and accommodating about 20000 staff and students within its campus, withdrawal of ground water is huge because of the fact that it doesn't take any water from city's water supply system. There are many institutes and industries in many parts of our country especially in flood plains of rivers drawing huge quantities of ground water. Now the question is, whether they have made or are making any special efforts to recharge ground water or not? The answer obviously is a no. Utsav (2014) excellently presents different methods and objectives for rain water harvesting specially in a campus area in Visnagar, Gujarat, to recharge ground water. Pawar et al. (2013) has worked out on Pirwadi village on water efficiency issue to find out the total potential of roof rain water harvesting which would be more than enough to satisfy the total annual drinking water requirement. Jebamalar (2011) attempts to investigate the implementation of rain water harvesting structures and its hydrological responses in two hydro-geologically different localities of Chennai city. Dwivedi et al. (2009) has evaluated the size of the water tank required to fulfil the drinking and cooking water demand from rooftop area of different extents. Singhal (2015) has assessed the sustainability of groundwater resources of Roorkee town and evaluated the annual groundwater recharge as well as the stage of groundwater development in terms observed water demand and other factors. The present study is an attempt to give a fact-file of Banaras Hindu University in terms of its bore holes and quantities of ground water withdrawal and to show how Banaras Hindu University should plan and implement a program of recharging ground water.

2. Extraction of Ground Water in Banaras Hindu University Campus

Banaras Hindu University has twenty bore holes within its campus (Fig.1) and is drawing about 2000m^3 of water per day, 60000m^3 water per month and 730000m^3 water per year, through its boreholes and is providing water at 100 lcpd to its 20,000 residents (including students).

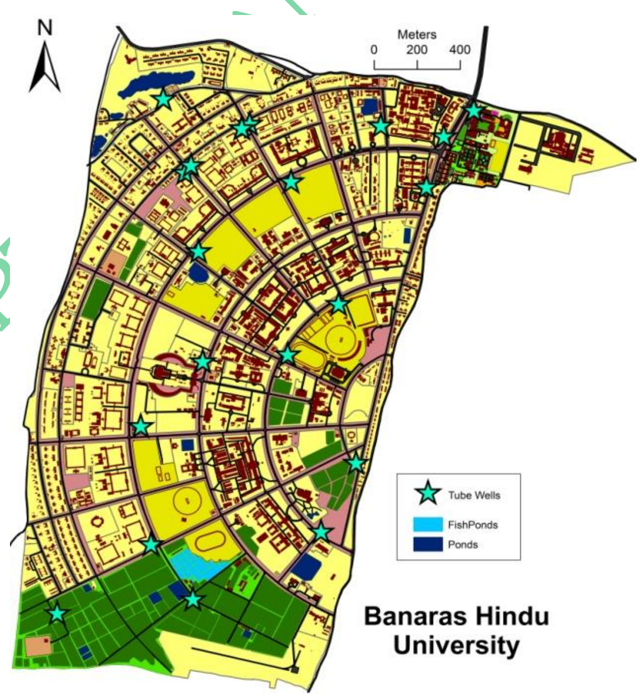

Figure.1 Location of Tube Wells, Fish Ponds and Ponds in BHU campus

The average diameter of 20 bore holes is 350mm and average depth is about 150m. In geological terms, from the surface clay and sand clay accounts for a thickness of about 60m, from 60.87m it is medium sand with kankar, from 87-156m it is medium course sand and from 156-174m it is all medium fine sand. BHU is drawing water from an average depth of 150m, though the average depth of drilling is done up to 161m (minimum depth of bore at 126m and maximum depth of bore at 227m). The rate of ground water withdrawal from all its 20 bores is about 100m^3 per hour. At this rate, the 20 bores of BHU run cumulatively for about 200 hours in a day accounting for about 2000m^3 of water per day. At this rate of ground water withdrawal it is providing about 100 litres water per capita per day and this is the main reason for its dependency on groundwater because municipal water supply can't afford to supply such a huge amount of water uninterrupted as it is not able to meet the demand of water from the city population. Considering that the majority of population in the campus is composed of students, this quantity of water (100 lcpd) is sufficient enough and there was never a question of water problem within the BHU campus. Of course, even in the lean season of summer when ground water levels go down, with students leaving the campus, the resident staff never felt a problem.

3. Water Harvesting Potential in BHU Campus

BHU has enormous space of about 1270 acres and hence has tremendous water harvesting potential. The campus receives an average (2002-12) rainfall of 875m. Worked out with an annual rainfall of 828mm (of 2012) and a run-off coefficient of 0.45 taking the campus as a sub-urban area with many types of land uses with dominance of un-built surfaces, the total yield of water from BHU campus as a whole is around 1914981m^3 (Fig.2).

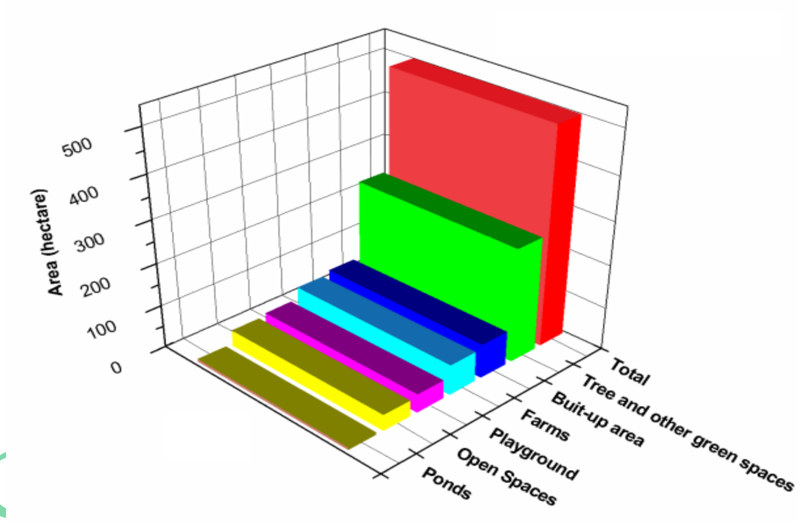

Figure: 2 Land Use Details of BHU Campus

The yield of water from different types of surfaces is calculated using several run-off coefficients sourced through internet (http://www.gwinnettcounty.com/portal/gwinnett/Home) and presented in Table 1.

Table 1: Details of yield of water in BHU campus

Types of Surfaces	**Run-off Coefficient**	**Area(m^2)**	***Water Yield in m^3**
Sub-Urban Area (BHU campus as a whole)	0.45	5139508	1914981
Built-up Area	0.95	491379	386051
Open Spaces	0.50	380497	157335
Playground	0.30	432155	125087
Agriculture	0.60	186308	92446
Forest	0.15	208953	25920

*Yield is calculated with Annual Rainfall of 828mm

BHU is drawing 730000 m^3 of water per annum from the ground. It is meeting its own requirements. But ground water is not entirely its own. During summer when levels go down substantially, several wells and hand pumps in the neighbourhood of the campus go dry and some of those never recovered even in rainy season. In fact, within the campus also, though there is no problem with water supply in summer season (because of the absence of student community), several times it so happened, a couple or more of the pumps were shut down because of summer depletion of ground water. As the ground water aquifer is not confined to just within the boundary of the BHU campus, the extraction of huge quantities of ground water by BHU campus is affecting the neighbourhood. When calculated with the average run-off coefficient of 0.50 for whole campus then approximate water yield is about 2127756 m^3. That means an equal amount of water or even more is available for percolation. Besides catering to students' hostels (76 with an accommodation for about 15000 students), resident staff, academic departments (93), guest houses (6) and other building (69), water is also utilized for agricultural farms (around 18 ha), fish ponds (2.33 ha), a dairy farm with about 150 animals and a swimming pool. Most of the residential buildings (around 300) have vast spaces (on an average 200m^2 for each residential building) in which residents raise vegetable crops round the year. Moreover, academic and administrative complexes have many vast lawn spaces which are maintained round the year.

BHU has seventeen water ponds (Fig.1) within its campus covering a total area of 4.26 hectares. Some details connected with these ponds are given in Table 2. Of these sixteen ponds (4.26 ha) no ponds is being used earnestly for water harvesting. One of the ponds (near JK Badminton Hall) is half filled-up by garbage and has turned filthy. All the shallow ponds in Sunderbagia colony have turned filthy. Floored and lined pond in Swatantrata Bhavan compound is of no consequence as it is simply ornamental. The lined pond near IIT Administrative offices is used for religious purposes. The deep semi-circular pond/depression on either side of the Vishwanath Temple which went into disuse long back are now being filled up for landscaping and raising gardens and lawns. All in all finally, there is no programme of water harvesting in BHU campus. That means only one pond with very small catchment in the Madhuban garden is being used for water harvesting.

Table-2: Details of ponds in BHU campus

Sl. No.	Pond Location	Area (ha)	Depth (m) from ground level/bund top	*Use/Remarks
1	Behind MalaviyaBhavan/International Centre	0.53	1.5/no bund	This is filled up now
2	Madhuban Garden	0.22	1.5/3.5	Storm water collects into it; but turned filthy because of poor maintenance
3	Sunderbagia-1	0.22	1.0/no bund	Water enters into all these ponds from surroundings including of drainage; filthy
4	Sunderbagia-2	0.17	1.0/no bund	
5	Sunderbagia-3	0.20	1.0/no bund	
6	Sunderbagia-4	0.44	1.5/no bund	
7	Near JK Badminton Hall	0.61	2.5/no bund	Used for garbage dumping
8	Near IIT Administrative Office	0.31	2.0/no bund	Floored and lined
9	SwatantrataBhavan	0.11	1.0/no bund	Flooded and lined; part of landscape architecture
10	Near BHU Press	1.15	2.0/5.0	For some time used to dump garbage rimmed by high bund; no entry for water from surroundings
11	Agriculture Farm-1	0.12	2.0/3.5	Used for various agricultural purposes including pisciculture
12	Agriculture Farm-2	0.53	1.5/2.5	
13	Agriculture Farm-3	0.26	1.5/2.5	
14	Agriculture Farm-4	0.12	1.5/no bund	
15	Agriculture Farm-5	0.16	1.5/2.5	
16	Agriculture Farm-6	0.11	1.5/2.5	
	Total Area	**4.26**		

*All the ponds dry up by December-January

As for ground water extraction, Central Ground Water Authority under the Ministry of Water Resources (CGWA Guidelines, 2012), Government of India laid down several guidelines one of which for Schools/educational & State/Central Government recognized research Institutions/Universities, is -"Concurrent with the construction of groundwater structures, the organization shall undertake artificial recharge to groundwater through rain water harvesting structure in the premises within 45 days of issuance of NOC and will confirm to the Authorized Officer for verification." This guideline is more flouted than observed! And, BHU is no exception. Further, in BHU, water is being used not only for domestic needs but also for agricultural purposes

(18-20ha). A huge quantity is being used towards raising vegetables in the front and backyards of about 300 residential buildings (6-8ha), maintaining lawns and other gardens of residences, hostels, departmental and administrative buildings. But when it (BHU) is drawing so much of groundwater (730000m^3 per annum) it is naturally incumbent upon it to create facilities sufficient enough to hold at least the same quantity of rain water its campus as a whole yields (about 1914981 m^3 calculated with an average annual rainfall of 828mm and a run-off coefficient of 0.45--taking the total area as a sub-urban area--with an area of 1270 acres). With enormous rooftop surface (of all buildings) of about 4, 91,379 m^2, the yield would be much greater than the figure (1914981 m^3) given above. BHU campus is fortunate enough to have so many small to large ponds within its campus. If these ponds are deepened and done up to receive water not only from surroundings but also from roof tops and other places, they can hold at least a part of the water that is draining off into the Ganga, from within the campus. The catchments of many of these ponds are small and to fill them full (after sufficiently deepening them), water from the other areas and roof tops can be directed into them. There is an important aspect of garbage collection and disposal to be taken care of in BHU campus before plans are developed for water harvesting. BHU at present is not only drawing enormous quantities of ground water, it is as well polluting the ground water because of poor garbage collection and disposal. The less said the better about this aspect of garbage collection and disposal in BHU campus!

4. Conclusion

There are policies in our country but their implementation is very poor. It is a different case with individuals but in case of institutions it is a different matter. Institutions like BHU should stand as a role model institution for groundwater conservation by strictly implementing existing guidelines and policies of Government of India regarding rainwater harvesting and groundwater recharge with the help of its ponds and tanks with minimum of expenditure. What is required is a will to do. Institutes coming under the umbrella of Govt. of India should be issued strict directives to implement the guidelines as far as ground water extraction and recharge are concerned. Unless punitive measures are strictly implemented there is not going to be any result on water harvesting front.

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