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Mitigation of Water Crisis and Growing Crops in Lean Period by Rainwater Harvesting Through Concreted Rooftops and Household Ponds in Sagar Island

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ABSTRACT

Groundwater occurring in the shallow aquifers is highly saline and is not suitable for drinking. Fresh potable ground water is occurring at great depth (245–325 m bgl). Occurrence of fresh ground water at deeper aquifers restricts large scale groundwater development, because it is beyond the economic capacity of common people. Source of drinking water is mainly Government owned hand pump fitted tube wells. Approximately per 70 households only one such tube well has been allocated. Many of these tube wells are yielding very less quantity of water during peak summer. Hence, the island is suffering from potable water scarcity especially during summer for around 4-5 months. Water supply is available in very few villages. Almost all the households are having one or two ponds. Most of the ponds are dried up during summer. Therefore, people in the island are facing water shortage round the year. The island receives very good precipitation (1900 mm) during monsoon. Major quantum of rainfall is lost as surface run-off to the sea or rivers. If this rain water run-off can be arrested and stored, island may be developed in many ways. There is a vast scope of Rain Water Harvesting (RWH) in Sagar Island. Water conservation can help to minimize the huge monsoon run-off. Roof top rain water harvesting can solve the drinking and domestic needs of the people of Sagar Island. In this context, harvesting and conservation of roof top rainwater during monsoon in storage tanks and ponds were explored, so that the same can be utilized in the lean periods. Present study has aimed to understand total amount of water may likely to be available from the concrete roofs of different existing buildings like public offices, schools, guest houses and individual houses as well as household ponds. At present, total water requirement of Sagar island in peak summer (4-5 months) for drinking and domestic uses is around 1589947.50 cu. m. Total amount of rain water be conserved through small household ponds (12418) and concrete roof tops (3194) is 3692853 cu. m**.** of which ponds contribute 3588976 cu. m. water and concrete roof tops used to contribute 10,38,77 cu. m. water. Thus, this conserved rain water could able to benefit in catering 492380 people (*i.e*., more than double of present population) of Sagar Island for five months in peak summer for drinking and domestic uses.

Key words: Concrete roof, Household ponds, Rainwater and Rooftop harvesting.

INTRODUCTION

Sagar island is located in the southern part of South 24 Parganas district, West Bengal (ÿþ / ÿþÿþ / 21.8; 88.121°312 N &ÿþ / ÿþ 88.03°Eÿþ / 21.8; 88.1). Ground water in shallow aquifer is highly saline and not good for drinking purposes. For drinking, people are dependent on fresh ground water occurring below 250 m bgl depth, which yield very less water during summer. Ponds also get dry in summer. In spite of copious rain fall, the island suffers from enormous water crisis in non-monsoon period. Population is increasing rapid rate, therefore, water demand for various uses is increasing in parity of that (Anon, 2001).

Hydrogeology

Sagar Islands is underlain by recent alluvium of clay, silt and sand deposited by river Ganga. Fresh group of aquifers occur within depth

span of 205 – 325 m bgl and overlain by saline group of aquifers. Fresh ground water occurs under confined condition. Piezometric level varies from 3.58 to 5.09 m bgl and from 3.10 to 5.78 m bgl in pre-monsoon and post-monsoon period respectively. Deep tube wells are tapping fresh water bearing zones within the depth range of 245 to 325 m bgl (Anon, 2005).

Source of water supply in the islands

Main source of domestic supply in the Islands is ground water. There are six Government owned deep tube wells rendering piped ground water supply to the few villages. Numbers of functioning tube wells are 685. Average number of households per tube well in the Island is 72.44. In the areas having no tube wells are depending on pond water for drinking. River water is saline due to tidal effect and not fit domestic purpose. Rainwater stored in ponds, tanks and canals are only sources of irrigation. There are no River Lift Irrigation, Shallow Tube Well and Deep Tube Well are operational as irrigation sources.

Problems in ground water development

Fresh ground water occurs at deeper level, so exploitation of ground water is expensive for common people. Moreover, recharge to deeper aquifer is not feasible in the present hydrogeological set up. Deep tube wells are very less in number to meet the drinking and domestic water demand. Shallow tube wells are saline/brackish and are not suitable for drinking. Irregular electric supply is the hindrance and expensive to withdraw ground water. Alternate source of solar energy is insufficient.

Salinity problem

To understand the suitability of groundwater and surface water quality of Sagar Island for irrigation purposes, it must be mentioned that the observations have been made on single set of water samples collected during February, 2012 with the presumptions that the sample was fully representative of hydro chemical conditions of the area. The nature and concentration of dissolved constituents in ground water showed not only the spatial but temporal variations also. Although it was generally presumed that quality of ground water did not show marked changes as in surface waters.

In the study area of Sagar groundwater samples analysed 100% were found to have high salinity having EC from 750ìs/cm to 2250ìs/cm. Such waters require adequate drainage, special management for salinity control to grow plants of good salt tolerance. These type of waters are not fit for irrigation under ordinary conditions, but may be occasionally used under very special conditions with adoption of appropriate technologies. Artificial drainage is a costly affair and is not recommended. However, such waters may be safely used by blending with good quality surface water where-ever available for use as irrigation purpose.

DISCUSSION

Detailed survey has been conducted in the Sagar Island of South 24 Parganas district of West Bengal State to understand the scope of

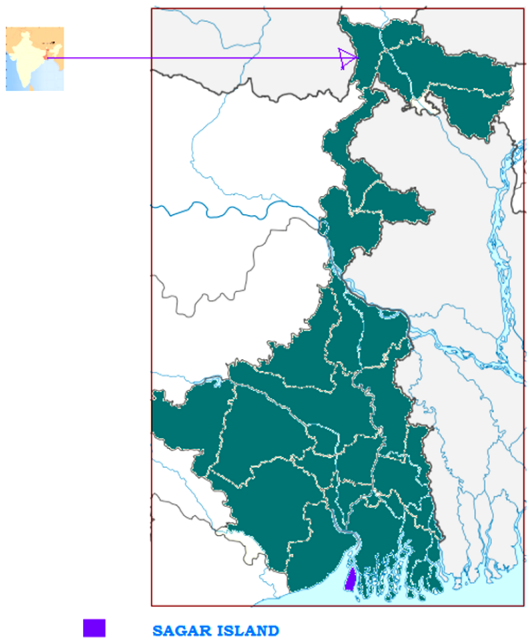

Fig. 1: Location map of Sagar Island

Table 1: Census wise rate of increase in total populations

Census	Male	Female	Total
1991	79242	74960	154202
2001	95572	90058	185630
2011	109827	102165	211993

rainwater conservation through concreted roof tops and household small ponds. This study is aiming at to calculate the amount of rain water that can be conserved from the existing concrete roof tops and household small ponds and their contribution towards the drinking and domestic water demand during lean period. In view of the above, details of existing concrete (*pacca*) buildings with cemented roof tops and household ponds (Fig. 2) have been collected, where from rainwater could be harvested during monsoon period. With respect to 1991 census, growth rate of population has been increased to 20.38% in 2001census, whereas in comparison to 2001 census growth rate of population has been raised to 14.20 % in 2011 census (Anon,2001).

This roof top rain water conservation during monsoon would play dual roles namely i) will help to minimize the wastage of rainwater through surface run-off and ii) would be useful during non-monsoon periods especially for domestic, drinking

Fig. 2: Roof top rain water harvesting and Pond water conservation

Table 2: Gram Panchayet wise number of small ponds in all households along with their dimensions and quantity of rain water conserved

Name of the conservation structure	Name of the G.P.	Number of Ponds present	Dimension (cu. m.)	Quantity of water conserved in each Small Ponds(cu. m.)	Total quantity of water conserved in Small ponds(cu. m.)
Small households ponds	Ghoramara	815	12.19x15.24x0.91	169.06	137783.90
	Muri Ganga-I	1375	12.19x18.29x1.22	272.01	374013.75
	Muri Ganga-II	1439	15.24x19.81x1.22	368.32	530012.48
	Dhaspara -Sumatinagar-I	1472	10.67x13.72x1.22	178.60	262899.20
	Dhaspara -Sumatinagar-II	1394	13.72x15.24x1.22	255.76	356529.44
	Ramkarchar	1723	15.24x19.81x1.22	368.32	634615.36
	Rudranagar	1585	14.02x18.29x1.22	312.86	495883.10
	Dhablat	1233	13.72x16.76x1.22	280.60	345979.80
	Gangasagar	1397	15.24x17.37x1.22	323.02	451258.94
	Total	12418		2528.55	3588976.00cu m

and house surrounding growing vegetable crops wherever irrigation water required.

At present, total water requirement of Sagar Island in peak summer (4-5 months) for drinking and domestic uses is around 1589947.50 cu. m. Total amount of rainwater could be conserved through small household ponds (12418) and concrete roof tops (3194) was 3692853 cu m of which ponds could contribute 3588976 cu m water and concrete roof tops could contribute 10,38,77 cu m water. Thus, this conserved rain water would able to cater the need of 492380 people (i.e., more than double of present population) of Sagar Island for five months in peak summer for drinking and domestic uses.

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Table 3: Details of existing concrete buildings (approx.) with average roof area and total rain water can be conserved

Sl. No.	Type of Building	No. of Buildings Having cemented roofs	Average Roof area (Sq. m)	Amount of Rain Water can be conserved from the total existing roof tops (Cu m)
1	College	1	647	936
2	High School	30	13087	19020
3	High Madrasa	3	810	3456
4	Junior High School	3	766	3240
5	Primary School	124	22900	32240
6	Hospital	1	1008	1440
7	Village Hospital	5	2915	4375
8	Panchayet	9	1944	2610
9	A.D.A. Office	1	112	145
10	Panchayet Samitee	1	322	460
11	B.D.O. Office	1	144	216
12	B.L.D.O. Office	1	66	87
13	Bunglow	5	1035	1440
14	P.H. Bunglow	1	162	216
15	Jela Parishad	1	288	400
16	Guest House	1	294	430
17	Kolkata Byabsai Samitee	1	396	570
18	Hariyana Bhaban	1	396	570
19	Ganges Bhaban	1	207	290
20	Bharat Sevashram	1	574	820
21	Balaka Bhaban	1	162	216
22	Larika Bhaban	1	275	400
23	Individual households having cemented roofs	3000	70	30300
Total no. of concrete buildings:		3194 no.	48580	10, 38,77 Cum

Total rain water can be conserved in a year from concrete building roof tops of Sagar Island

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