Rooftop Rainwater harvesting possibility in Karnataka

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Introduction: The process of collecting and storing rainwater falling on rooftops called **rooftop rainwater harvesting** has recently re-emerged worldwide as a possible sustainable solution for the provision of potable drinking water both in urban and rural areas. The recent 10th International Rainwater Catchment Systems Association (IRCSA) conference held in September 2001 in Mannheim, Germany saw participants from 68 countries evidencing the interest worldwide **(1).** In India itself the **National Water Policy** and many state water policies speak of the need to take up rainwater harvesting wherever feasible and wherever possible. Many states for example Rajasthan and Gujarat have a long tradition of rooftop rainwater harvesting and Mahatma Gandhiji's ancestral house in Porbandar, Gujarat is reported to have a rooftop rainwater harvesting structure **(2).** This paper however seeks to look at the Southern Indian state of Karnataka and examine the feasibility of rooftop rainwater harvesting as a sustainable source of potable water for both urban and rural, habitations.

Background: In the southern Indian state of Karnataka with regard to the supply of potable water two basic issues emerge. The issue of **quantity** of water supplied and the issue of **quality** of the water supplied**.** A quick glance at the position with regard to urban and rural habitations are as below:

TABLE 1

KARNATAKA				
	Habitations Total	**Standard of supply** Liters per capita per day	**Habitationswith Shortfall**	**Quality issues**
Urban Areas	208	100 to 200 lpcd	190	Nil
Rural Area	56682	55 lpcd	22120	21008

Of the total of 21008 habitations faced with quality problems excess fluoride is reported in 5839 habitations, excess iron in 6,633 habitations, excess nitrate in 4,077 habitations and brackishness in 4460 habitations **(3).**

Challenges in water supply: The Rural Water Supply and Panchayati Raj Department of the Govt. of Karnataka describes the challenges succinctly thus ' Sustainability of water sources has posed a major problem ever since the water table has been observed to fall sharply in many taluks due to excess and indiscriminate drawl of ground water. The depletion of the water table has resulted in the non-functioning of large number of bore-wells and very low yields. Hence, there is an urgent need to adopt appropriate measures for augmenting the recharge of ground water aquifers….to provide safe drinking water to the 20929 quality affected habitations is an enormous task and substantial funds will be required to achieve the task.'

Issues with rainwater harvesting: There is significant apprehension on 'acid rain' as a cause of concern with regard to harvesting rainwater. However water quality checks in several samples collected in Bangalore city show the ph value to be between 6.80 and 7.50 well within the range prescribed by the I.S 10500/1991 drinking water specifications which stipulates a ph range between 6.50 to 8.50 with no relaxation.

The total quantity of rainfall and its distribution is also a matter of concern. However data available with the Drought Monitoring cell and with the Agricultural department belie the fear with the state receiving an average rainfall of 1150 mm and all districts reporting in excess of 500 mm average rainfall **(4).** A further probability analysis would be needed to determine a 95% probable rain in a given year to optimize the system and to determine its reliability in providing water to a family during particularly a drought year.

Assuming an average family size of 5 and with a drinking water demand of 2 litres per person per day and a total cooking demand of 10 litres per family per day. Total potable water demand can be taken as 20 litres per family per day. The yearly potable water demand would therefore be 20 x 365= 7300 litres. Supply of rainwater from an average roof area of 20 square metre, which is the typical 'Ashraya' house under the Karnataka governments Rural Housing programme and with a minimum rainfall of 500 mm in a year would be 10,000 litres of which at 80% efficiency 8000 litres could be easily harvested. The supply is comparable and slightly in excess of demand.

Case study: A small Mangalore tiled roof has been built on a construction site in Vidyaranyapura, Bangalore. The effective roof area of the construction is 20 square metres. As part of the building design itself the plinth area was kept at 20 square metres so as to match a typical rural house being supported by the Government of Karnataka in rural areas. The government supports the construction of approximately 200,000 houses over a 5-year period and the case study house has the easy potential of replicability.

Design consideration for rooftop rainwater harvesting: The slope of the roof was fixed as 23 degree to accentuate the runoff, which is typically between 0.80 to 0.90 as a coefficient. A singly sloping roof was considered to minimize the length of collection gutter. The gutter itself was designed with galvanized iron sheets. A first rain separator to segregate the first 1.0 mm of rain and an up flow filter to filter the water was designed and put in place. A drum is being used to collect rainwater for various uses.

A rain gauge is about 1 kilo-metre as the crow flies from the house. The rain gauge belongs to the University of Agricultural Science, Bangalore and is functioning very well. Rainfall data is therefore available for a period of 28 years to optimize the design of a system.

Leaf shedding is a problem on the rooftop because of the presence of tall 'Acacia' trees adjacent. A system of cleaning the rooftops regularly has been devised and put in to place. The rooftop is cleaned once every week on a Sunday.

The rooftop rainwater harvesting system is working adequately and the quantum of water harvested has been substantial. Water quality checks indicate that in terms of physical and chemical parameters meet potable standard in terms of IS 10500/1991.

Rooftop Rainwater test sample results

Parameter	Requirement (Desirablelimit) source	Permissible limit in the Absence of alternate	Result
Colour, Hazen units, max	5	25	0.00
Odour	Unobjectionable	---	Unobjectionable
Taste	Agreeable	---	Agreeable
Turbidity,NTU,MAX	5	10	0.00
pH value	6.5 – 8.5	No relaxation	7.20
Total hardness (as CaCO3), mg/l max	300	600	35.0
Iron (as Fe), mg/l, max.	0.30	1.0	0.00
Chlorides (as Cl), mg/l, max	250	1000	0.00
Residual free chlorine, mg/l, min.	0.20	--	0.00
Total dissolved solids, mg/l max	500	2000	60
Calcium (as Ca), mg/l, max.	75	200	12.0
Copper (as Cu), mg/l max.	0.05	1.50	0.0
Manganese (as Mn), mg/l, max.	0.1	0.3	0.0
Sulphate (as SO4), mg/l max.	200	400	0.0
Nitrate (as NO3), mg/l	45	100	0.0
Fluoride (as F), mg/l, max.	1.0	1.5	0.0
Phenolic Compounds (as C6H5OH), mg/l, max.	0.001	0.002	Nil
Mercury (as Hg), mg/l, max.	0.001	No relaxation	Nil
Cadmium (as Cd), mg/l, max	0.01	No relaxation	Nil
Selenium (as Se), mg/l, max	0.01	No relaxation	Nil
Arsenic (as As), mg/l, max.	0.05	No relaxation	Nil
Cyanide (as Cn), mg/l, max.	0.05	No relaxation	Nil
Lead (as Pb), mg/l, max	0.05	No relaxation	Nil
Zinc (as Zn), mg/l, max	5	15	Nil
Chromium (as Cr6+), mg/l, max.	0.05	No relaxation	Nil
Mineral Oil, mg/l, max.	0.01	0.03	Nil
Alkalinity, mg/l, max.	200	600	50
Aluminium (as Al), mg/l, max.	0.03	0.2	Nil
Boron (as B), mg/l, max.	1	5	Nil

Conclusion: Rooftop rainwater harvesting has a tremendous potential in providing clean potable water in areas where the alternate source is contaminated with either fluoride, iron, arsenic or salts. While physical contamination can be handled through a series of steps like a clean roof, first rain separation and filtration and chemical contamination of rainwater does not seem to be an issue further work is required on determining the bacteriological characteristics of stored rainwater and simple mechanisms like solar dis-infection to treat biological contamination if any. In many habitations in Karnataka the only source of water is groundwater and adequately treating this water or providing rainwater seem the only way that people will have universal access to potable water which is not life threatening or crippling.

References:

(1) Mannheim Germany. (10-14th September 2001) Statement of the International Rainwater Catchments Systems Association
(2) Centre for Science and Environment(2000)–Making water everybody's business
(3) Govt.ofKarnataka,(2002).Departmental Medium Term Fiscal Plan 2002-03 to 2005-06 for Rural Water Supply and Sanitation, Rural Development and Panchayati Raj Department,
(4) – Website of the Drought Monitoring cell. www. dmc.kar.nic.in

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