RAIN WATER HARVESTING AND CONSERVATION: A CASE STUDY OF GADAG DISTRICT

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Abstract

Water is our most precious natural resource and something that most of us take for granted. We are now increasingly becoming aware of the importance of water to our survival and its limited supply. The human beings require water for various purposes. The most part of the earth surface i.e. about 71 % is covered by water. Out of total volume of water available on the surface of the earth 97 % is saline water, 2 % water is in the form of ice and glaciers and only 1 % is fresh and potable water. Out of total rainfall in India, runoff is about 85 %,percolation is about 7%, evaporation is about 5% and human use is about is about 3%. The problem of water shortage in arid and semi-arid regions is one due to low rainfall and uneven distribution throughout the season, which makes rain fed agriculture a risky enterprise. Rain water harvesting for dry-land agriculture is a traditional water management technology to ease future water scarcity in many arid and semi-arid regions of world. The water harvesting methods applied strongly depend on local conditions and include such widely differing practices as bunding, pitting, micro catchments water harvesting, flood water and ground water harvesting. The paper discusses the use of water harvesting as an effective tool for water management and outlines what need to be done.

Key words*: Fresh water, harvesting and conservation of water, water reuse, Gadag* **district**

1. Introduction

Water is essential for all life and used in many different ways, it is also a part of the larger ecosystem in the reproduction of the bio- diversity depends. Fresh water scarcity is not limited to the arid climate regions, but in areas with good supply the access of safe water is becoming critical problem. Lack of water is caused by low water storage capacity, low infiltration, larger inter annual and annual fluctuations of precipitation (due to monsoon rains) and high evaporation demand. The term water harvesting was probably used first by Geddes of the University of Sydney. He defined as the collection and storage of any form of water either runoff or creek flow for irrigation use. Meyer's of USDA, USA has defined it as the practice of collecting water from an area treated to increase runoff from rainfall. Recently Currier, USA has defined it as the process of collecting natural precipitation from prepared watershed for beneficial use. Now a day's water harvesting has become a general term for collecting and storing runoff water or creek flow, resulting from rain in soil profile and reservoirs both over surface /under surface. Previously this was used for arid and semi arid areas, but recently their use has been extended to sub humid and humid regions too. In India water harvesting means utilizing the erratic monsoon rain for raising good crops in dry tracks and conserve the excess runoff water for drinking and for recharging purpose.

2. Review of Rain Water Harvesting

Water harvesting like many techniques in use today is not new. It is practiced as early as 4500 B.C. by the people of Ur and also latest by the Nabateans and other people of the Middle East. While the early water harvesting techniques used natural materials, 20th century technology has made it possible to use artificial means for increasing runoff from precipitation. The system involved clearing hill sides to smooth the soil and increase runoff and then building contour ditches to collect the water and carry it to low lying fields farms had evolved into relatively sophisticated systems. The next significant development was the construction of roadbed catchments as described by the public works Department of Western Australia in 1956. They are so called because the soil is graded into ditches. These ditches convey the collected water to a storage reservoir. Lauritzan, USA has done pioneering work in evaluating plastic and artificial rubber membranes for the construction of catchments and reservoirs during 1950's. In 1959, Mayer of water conservation laboratory, USA began to investigate materials that caused soil to become hydrophobic or water repellent. Early 1960, research programmes in water harvesting were also initiated in Israel. Water harvesting was

practiced more than 1000 years back in South India, by way of construction of irrigation tank, over tanks, temple tanks, farm ponds etc, but the research in India on this subject is of recent one. Work is taken up at ICRISAT, Hyderabad, Central arid Zone Research Institute Jodhpur, Central Research Institute for dry land Agriculture (CRIDA), Hyderabad, State Agricultural Universities and other dry land research centres throughout India. In Pakistan, in the mountainous and dry province of Balukhistan, bunds are constructed across the slopes to force the runoff to infiltrate. In China, with its vast population is actively promoting rain and stream water harvesting. One very old but still common flood diversion technique is called 'Warping' (harvesting water as well as sediment). When water harvesting technique are used for runoff farming, the storage reservoir will be soil itself, but when the water is to be used for livestock, supplementary irrigation or human consumption, a storage facility of some kind will have to be produced. In countries where land is abundant, water harvesting involves; harvesting or reaping the entire rainwater, store it and utilize it for various purposes. In India, it is not possible to use the land area only to harvest water and hence water harvesting means use the rain water at the place where it falls to the maximum and the excess water is collected and again reused in the same area. Therefore the meaning of water harvesting is different in different area/ countries. The methods explained above are used for both agriculture and to increase the ground water availability. The water harvesting for household and for recharging purposes are also in existence for long years in the world. During rainy days, the people in the villages used to collect the roof water in the vessels and use the same for household purposes including drinking. In South East Asian countries people used to collect the roof water (thatched roof by providing gutters) by placing 4 big earthen drums in 4 corners of their houses. They use this water for all household purposes and if it is exhausted only they will go for well water. The main building of the Agricultural College at Coimbatore was constructed 100 years ago and they have collected all the roof water by pipes and stored in a big underground masonry storage tanks by the sides of the building. This rainwater is used for all labs, which require pure and good quality of water. In the same way the rainwater falling on the terrace in all the building constructed subsequently are collected and stored in the underground masonry tanks Even the surface water flowing in the Nalla's in the campus are also diverted by providing obstructions, to the open wells to recharge ground water. Hence Rainwater harvesting is as old as civilization and practiced continuously in different ways for different purposes in the world the only thing is that it has not been done

systematically in all places. Need has come to harvest the rainwater including roof water to solve the water problems everywhere not only in the arid but also in the humid region.

3. Need for Rain Water Harvesting:

Water is a becoming a scarce commodity and it is considered as a liquid gold in this part of the country. The demand of water is also increasing day by day not only for Agriculture, but also for household and Industrial purposes. It is estimated that water need for drinking and other municipal uses will be increased from 3.3 to7.00 MHm in 2020/25. Similarly the demand of water for industries will be increased by 4 fold i.e. from 3.0 to 12.00 MHm during this period at the same time more area should be brought under irrigation to feed the escalating population of the country, which also needs more water. But we are not going to get one litre more water than we get at present though the demand is alarming. The perennial rivers are becoming dry and ground water table is depleting in most of the areas. Country is facing floods and drought in the many states. This is because, no concrete action was taken to conserve, harvest and manage the rain water efficiently. The rainfall is abundant in the India and also in a State. But it is not evenly distributed in all places. India being the monsoonic country, the rain falls only for 3 to 4 months in a year with high intensity, which results more runoff and soil erosion. Total rain occurs only in about 100 hours out of 8760 hours in a year. It also erratic and fails once in 3 or 4 years. This is very common in many parts of the country and State.

3. Why harvest rainwater?

This is perhaps one of the most frequently asked questions, as to why one should harvest rainwater. There are many reasons but following are some of the important ones.

1. To arrest ground water decline and augment ground water table.

2. To beneficiate water quality in aquifers.

3. To conserve surface water runoff during monsoon.

4. To reduce soil erosion.

5. To inculcate a culture of water conservation.

4. How to harvest rainwater:

Broadly there are two ways of harvesting rainwater:

a) Surface runoff harvesting. b) Roof top rainwater harvesting.

5. Surface runoff harvesting:

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

6. Roof top rainwater harvesting (RTRWH):

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

7. Recharging ground water aquifers:

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:-

a) Recharging of bore wells. b) Recharging of dug wells.

c) Recharge pits. d) Recharge Trenches.

e) Soak ways or Recharge Shafts. f) Percolation Tanks.

9. Techniques of Rain Water Harvesting:

The various rain water harvesting techniques can be broadly classified into following six categories.

1. Rooftop water harvesting. 2. Water harvesting for animal consumption.

3. Inter-row water harvesting. 4. Micro catchment water harvesting.

5. Medium-sized catchment water harvesting. 6. Large catchment water harvesting.

Total water collection/recharge per bore well

Average rainfall (Say) = 780 mm

Available for harvesting = 390 mm

(@ 50%) after evaporation to harvest 10% of above = 39 mm (0.039 M)

Total water recharge for = 10,000 x 0.039 M = 10,000 Sq M = 3, 90,000 Liters

This water is available in one year (90 days of rains) per bore well assuming unpaved area around bore well.

4. Methods of Water Harvesting in Rural and Urban Areas

There are different / various system of water harvesting depending upon the source of water supply and places as classified below.

a) In situ Rainwater harvesting:

1. Bunding and terracing. 2.Vegetative / stone contour barriers. 3. Contour trenching.

4. Contour stone walls. 5.Contour farming. 6.Micro catchments.

7.Tie ridging methods 8.Farm ponds.

b) Direct surface runoff harvesting:

1. Roof water collection 2.Dug out ponds / storage tanks 3.Tanks

4. Kundis 5.Ooranis 6. Temple tanks

7. Diversion bunds 8. Water spreading

c) Stream flow / runoff harvesting

1. Nalla bunding 2. Gully control structure 3. Check dams – Temporary Permanent

4. Silt detention tanks 5. Percolation ponds

d) Sub surface flow harvesting

1. Sub surface dams. 2. Diaphragm dams

e) Micro catchment's / watershed

1. Inter terrace / inter plot water harvesting 2.Conservation bench terrace

f) Runoff inducement by surface treatment

1. Goaded catchments.

2.Use of cover materials – Aluminum foils, Plastic sheet, betonies, Rubber, etc

3. Using chemicals for water proofing, water repellent etc. to get more runoff water

Rain water harvesting system for village community

This system is designed for the village community situated in locality where there is scarcity of water. The annual rainfall is 650 mm per year. The water is supplied by panchayat/local authority alternate day. In case of summer season the water is supplied by tankers. So it is proposed to conserve the rain water by allowing it to percolate so as to meet underground water. It is proposed to conserve rain water collected on top of every house and common rain water harvesting system is designed for group of 10 houses having approximate area of 70 m2 each.

Estimate for rain water harvesting system for village community

Area of group of houses: 700 m2, Perimeter: 340 m, Average annual rainfall: 650 mm

Coefficient of runoff: 0.8, Quantity of water to be harvested per year: 364 m3

Requirement of soak pit: 3 m x 3 m x 2 m

I) Cost of excavation: 18 m3 x Rs.60/- = Rs. 1080/-

II) Cost of material for filling of soak pit. A. 75 mm to 100 mm size aggregate = Rs. 2500/-

B. 15 mm to 25 mm size aggregate = Rs. 2500/-

C. Sand = Rs. 2000/-

Causes of Fall In Ground Water Levels

• Over exploitation or excessive pumpage either locally or over large areas to meet increasing water demands.

• Non-availability of other sources of water. Therefore, sole dependence is on ground water.

• Unreliability of municipal water supplies both in terms of quantity and timings, driving people to their own sources.

• Disuse of ancient means of water conservation like village ponds, baolis, percolation tanks and

Therefore, higher pressure on ground water development.

Effects Of Over Exploitation of Ground Water Resources

• Drastic fall in water levels in some area.

• Drying up wells/ borewells.

• Enhanced use of energy.

• Deterioration in ground water quality.

• Ingress of sea water in coastal areas.

Proposed Policy Measures For Rain Water Harvesting

• Provides at least one roof-top rain water harvesting structure for every house/plot in urban areas.

• Revive/ rehabilitation all village ponds.

• Subject to technical feasibility, provides at least one check dam / KT weir / Sub- surface dyke in each streamlet with catchments of 1 to 3 sq. km.

• Provide all drinking water wells with a recharge structure.

• Ban construction of irrigation wells / tubewells within a distance of 200 m or less (depending on scientific criteria) of the drinking water supply well.

8. Objective of Rain Water Harvesting

• To Store excess water for use at subsequent times.

• To improve physical and chemical quality of ground water.

• To Reduced storm water runoff and soil erosion.

• To recycle urban and industrial wastewater etc.

• To rehabilitate the existing traditional water harvesting structure

• With minor scientific modifications and redesigning, convert the traditional water harvesting structure into ground water recharge facilities.

• To Use the existing defunct wells and bore wells after cleaning and also the operational wells as recharge structures.

9. Methodology

Secondary data and Primary is used for analysing the Rain Water harvesting in Gadag district by simple analytical method. Rainfall and Sample Study has taken for study.

STYDY AREA

Gadag district came into existence on 1st November 1997. The new district comprises five taluka Viz., Gadag, Nargund, Ron, Shirahatti, and Mundargi. Gadag district is located in northern parts of Karnataka and situated in between 15 15 north to 15 45 northern latitudes and 75 20 east to 75 47 eastern longitudes. It is bounded by Koppal district on east, Bagalkot district on north, Haveri district on south and Dharwad district on west. The district for administratively dived into 5 talukas and 337 villages. It consist of 3 town municipalities, 5 town panchayaths and 11 hob lies.

The district falls in the semi-arid tracts of Karnataka. The annual rainfall is generally less than 75.0 cm. It lies to the east of the Western Ghats in the rain-shadow region. Hence receives low rainfall and generally drought prone and it is a part of Krishna major basin the district drained by two main rivers namely Malaprabha and Tungabhadra. Malaprabha along with its tributary Bennihalla drains northern parts and two rivers join at Ron taluk. The Malaprabha and Tungabhadra sub basins have the area of 2768 sq km and 1889.2 sq km respectively.

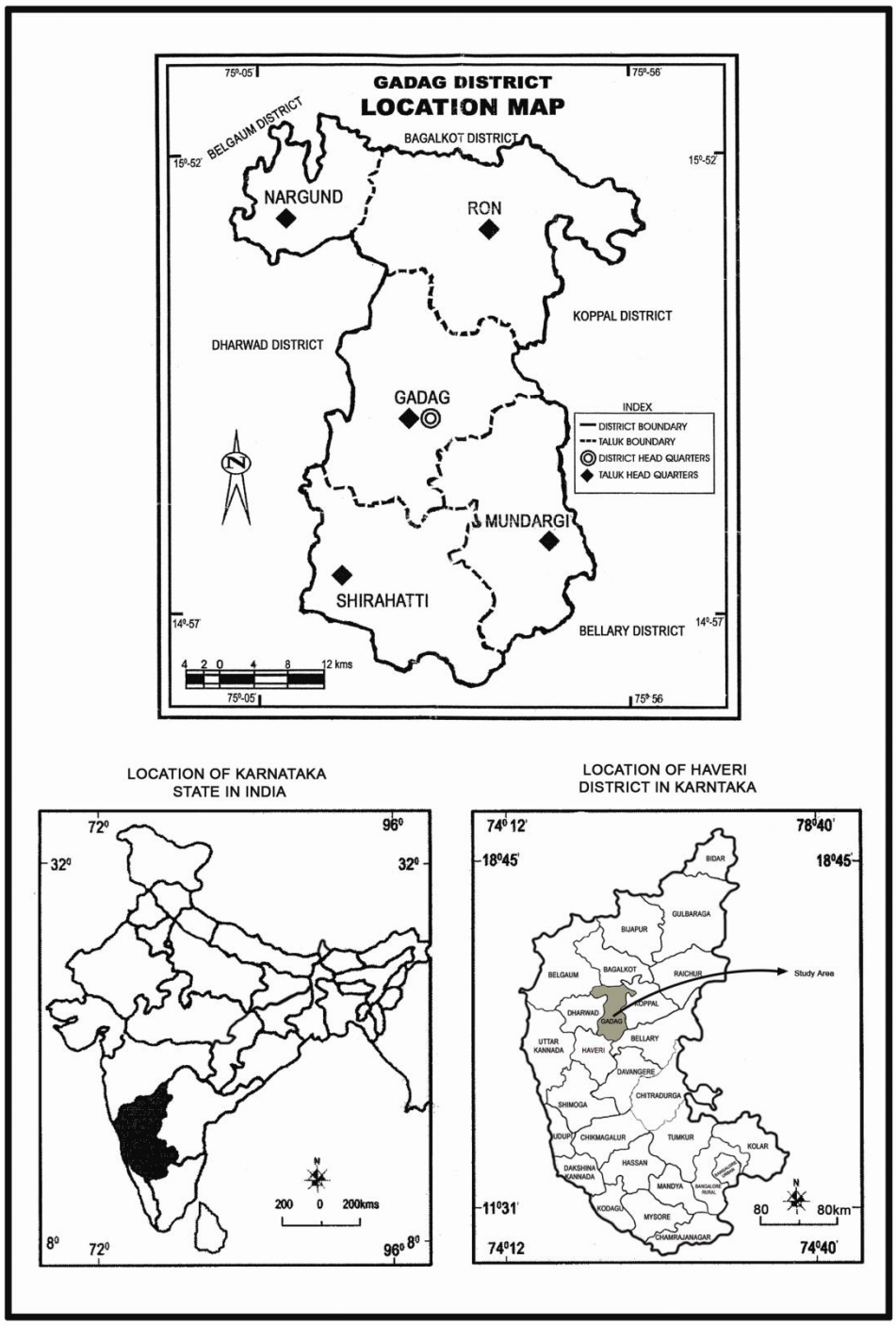

Fig. 1

RAINFALL AND CLIMATE

The district falls under semi-arid tract of the state and it is categorized as drought prone. And normal rainfall is 61.3 cm. The north-east monsoon contributes nearly 24.8% and prevails from October to mid December. And about 54.7% precipitation takes place during south-west monsoon period from June to September. And remaining 20.5% takes place

during rest of the year. In the district from December to February month is winter season. During April to May temperature reach up to 42 0C and December And January temperature will go down up to 16 0C. The average standard deviation of rainfall in the districts is abo9ut 14.6 cm. South West monsoon is dominant followed by north-east monsoon. In the district during 2007-08 about 80% area is net irrigated, about 7% of the area is covered by forest and net sown area is about 83% of geographical area**. LAND USE**:

	Geo-graphical Area	Forest	Cultivable waste	Barren current	Permanent Pasture	Net area sown	Area sown more than once
Gadag	109751	1749	291	18302	1054	85004	15366
Mundargi	88398	17646	163	8126	280	57031	--
Naragund	43562	--	--	2996	52	36205	1003
Ron	129091	276	370	--	428	120588	3701
Shirhattia	94913	12943	186	388	778	74368	15984
Total	465715	32614	1010	29812	2592	373196	36054

RAINFALL AND CLIMATE

The district falls under semi-arid tract of the state and it is categorized as draught prone. And normal rainfall is 613 mm. The north-east monsoon contributes nearly 24.8% and prevails from October to early December. And about 54.7% Precipitation takes place during south-west monsoon period from June to September. And remaining 20.5% takes place during rest of the year. In the district from December to February month is winter season. During April to May temperature reaches up to 42*C and December and January temperature will go down to 16*C. The standard deviation of rainfall in the district varies from 1.3 to

263.5mm from the west to east. The average standard deviation for the district is about 146mm. south-west monsoon is dominant followed by north-east monsoon.

Table-No-2 Taluka wise rainfall details of Gadag district, Karnataka.

Taluks	Working Rain Gauges	Actual rainy days (05)	Normal rain fall in mm	Actual rain fall in mm	Normal rainy days 1901-1970
Gadag	3	55	665.7	773.7	46
Mundargi	34	38	489.0	482.4	34
Naragund	2	44	545.0	435.3	39
Ron	3	43	613.1	680.8	42
Sshirhatti	4	48	748.9	673.5	55
Total	16	46	612.3	609.1	43

Do's and Don’ts

Harvested rainwater is used for direct usage or for recharging aquifers. It is most important to ensure that the rainwater caught is free from pollutants. Following precautionary measures should be taken while harvesting rainwater:-

1. Roof or terraces uses for harvesting should be clean, free from dust, algal plants etc.

2. Roof should not be painted since most paints contain toxic substances and may peel off.

3. Do not store chemicals, rusting iron, manure or detergent on the roof.

4. Nesting of birds on the roof should be prevented.

5. Terraces should not be used for toilets either by human beings or by pets.

6. Provide gratings at mouth of each drainpipe on terraces to trap leaves debris and floating materials.

7. Provision of first rain separator should be made to flush off first rains.

8. Do not use polluted water to recharge ground water.

9. Ground water should only be recharged by rainwater.

10. Before recharging, suitable arrangements of filtering should be provided.

11. Filter media should be cleaned before every monsoon season.

12. During rainy season, the whole system (roof catchment, pipes, screens, first flush, filters, and tanks) should be checked before and after each rain and preferably cleaned after every dry period exceeding a month.

13. At the end of the dry season and just before the first shower of rain is anticipated, the storage tank should be scrubbed and flushed off all sediments and debris.

Conclusions

Water is essential element of life. It is very important to make water everybody's business. It means a role for everybody with respect to water. Every household and community has to become involved in the provision of water and in the protection of water resources. Make water the subject of a people's movement. It means the empowerment of our Urban and Rural community, i.e., to manage their own affairs with the state playing a critical supportive role.

Irrespective of fast development in all fields of science there can be no substitute to water. Hence, it is necessary to opt for various water harvesting measures. It is the responsibility of government organization as well as individual to harvest each drop of water falling on earth surface. For this, it is necessary that each person collect the raindrops failing on his roof, plot, and farm and recharges it under ground. Further involving people will give the people greater ownership over the water project including watershed development, Soil and Water conservation and water harvesting will go a long way towards reducing misuse of government funds. It will also develop the ownership (own water supply by systems), they will also take good care of them. In this way it is possible to solve water problems facing the county in the 21st century.

Mr.Totappa Angadi Village : **Neeralagi** Tq &Disrct; Gadag Activity : Bore recharge


Mr.Mahadevagouda Patil Village Name : **Neeralagi** Tq: Disrcit : Gadag Activity : Bore recharge


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