Rain Water Harvesting

Shree Padre

" .....Shree Padre's book on RWH is timely because it presents a topic that can solve the nation's water scarcity and flood control problems in the long run."

-The Hindu

" This book attempts to quench the thirst of water scarcity solution seekers. Written in simple layman's English, the book (***Rainwater Harvesting***) , is a practical guide for the beginners."

- CATCH WATER

Shree Padre is a farmer by profession, a journalist by obsession. Since the last six years, he is zealously collecting and documenting information on Rainwater Harvesting (RWH) from world over. As a founder editor of Adike Patrike, a popular farm magazine by of and for farmers in Kannada, he started disseminating information on RWH. Shree has written five books on RWH in Kannada. He is listed among the world's RWH activists in one of the latest prestigious publication, 'The Rainwater Technology Handbook' in German Language. He is the convener of the recently launched informal forum, jalakoota, whose objective is to create awareness about rain harvesting.

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To the great soul, late Anil Agarwal

That sincerely fought for many
unglamourous environmental causes

Concealing own tragedy and sorrow

The pioneer in spreading awareness about
water,

People's right over water and out
traditional knowledge bank;

Offered help for right causes without
waiting to be approached

This garland is dedicated.

EDITOR'S NOTE

A few weeks back I received a collection of journalistic pieces on the subject of rain water harvesting prepared by Shree Padre. The task to edit and process these articles in the form of a book was also burdened upon me. Sure, I have completed the work and frankly speaking I feel so happy.

As the title announces, the book in the present form is indeed a genuine work on rain water harvesting. Out of the eight chapters, the first one describes the causes of droughtes and decline of water table. Chapter two to seven focus mainly on the theoratical aspects of the technology while the last and comparitively big one reveals a number of success stories of rain water harvesting in India and abroad.

Though this is not an authentic book on the theory of rain water harvesting, supplementing with success stories it appears to be a valuable practicle guide. I sincerely hope this book will serve to propagate the concept of rain water harvesting throughout the country and enable the readers to know the importance of conservation of the most valuable liquid in the globe, the life giving water.

Thrissur
23-3-2002

C. K. Sujithkumar

Dear Shree Padre,

I was really happy to receive your book on Rain harvesting. You have tried to bring in the essence of rain harvesting and have focussed its necessity quite effectively. One has to wipe out the dust from the mirror to see the reflection on his face properly. Similarly, I hope that your book will help in wiping out the mental blocks our society might have in this issue.

I am sure that whoever reads your book will realise how important and emergent it is to take up conservation of water. If we do this work today, there is no doubt that our tomorrows would be happy and prosperous.

I sincerely wish that the mission of water you have taken up through your pen would further intensify and spread faster. Let those people who read this book appreciate the problem we are facing and be inspired to implement water recharging. Success of your book lies in this fact that if ten people out of thousands who read it practice that in their areas. I am sure that this would happen.

Let the almighty bless you with opportunities to write more and more books on this subject. Same way, I wish your book would be well received by the society and in turn, the society inspires you to write more. I am sure you take up this work further. Let this book be a well-wisher for our community.

Dr. Rajendra Singh

Tarun Bharat Sangh
Bhikampura, Alwar.
Rajasthan

Models, there are plenty....

"The Keralites worry for water only from January to June". It is none other than TNN Bhattathiripad, hailed as pioneer of check-dams, who has made this meaningful statement. Unfortunately, this comment holds good for most of us, Indians, at large.

If water is your problem, there is a way. Hold a 'funnel' to the sky. It is what rain harvesting is all about. Rain is decentralised. So, our solution to water scarcity also should not be centralised.

"Rain harvesting, what's it?", many people ask me. The phrase might be relatively new, but the *vidya* is not. Even before this name was given to the technique, our ancestors were doing it through centuries old *tankas, madakas*, tanks, forts etc.

It is simple. Instead of allowing the rain to go its way, we are checking it for our future use. It is not a *brahmavidya*. Anybody who is keen can learn it. Use your common sense; evolve some area-specific method. Make trial and error, go ahead!

The principle is the same everywhere. Once the rain starts flowing away from the area of its fall, it attains more force. Hence you need more energy, resource, may be expertise, inputs from the cities like cement and steel and also Government help.

Compare this to the methods of catching water in the area of its fall. This is what is called as in-situ rain harvesting, like the roof water harvesting, digging infiltration pits trenches or planting trees and the like. How affordable it is. You need not worry about the Government, subsidy, expert guidance, inputs from city etc.

Many of our cities and states are not rain poor. But they are water scarce. Even in Cherrapunji that boasts of a record 11,000-mm of rain, water is being sold in summer! Why? The reason is we have not cared to capture rain as our forefathers did. Today the quantity of rain an area gets is immaterial; what matters is how much the particular community catches.

What we have to realise first is tap, overhead tank or bore-well, tap or overhead tank is not the source of water, and it is the rain and rain alone. Instead of pinning our hopes on the Government to deliver water, we have to convince ourselves that water is *our* problem. If each one contributes a little to bring up our declining water table, the problem will melt sooner than we have expected. Today, thanks to a number of dedicated souls like Rajendra Singh, Anna Hazare and Shyamjibhai Antala, Norphael Chewang etc, there are methods to suit perhaps any city, any agro-climatic zone of the country. What are needed are people's resolve, sinking small differences, and seeing issues in a community perspective.

If Rajasthan with its 250-mm to 500-mm rainfall can create a history by reviving five of its rivulets, why should rivers in heavy rainfall areas dry in February? Why our housewives have to wage a daily war in front of public taps? Why should be the water made a commodity of commerce?

You might have many doubts and mental blocks about rain harvesting. "Whether it will work in my area or not? Whether my neighbour too will be benefited" etc.

I have only one answer to the second doubt. If you want to lose 5 rupees by being stingy for 50 paise, that is your problem. For the first doubt, as Jim Goodwin had long back uttered, "The impossible is often untried"? Why not give a try? Best of Luck.

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INTRODUCTION

Those who know the value of water call it as *jeevjal*. It is one of the bases of life. You can live for more than a month without food, but can not sustain even for more than ten days without water. Unfortunately, we do not realise the importance of this natural resource. It is being wasted everywhere - in houses public places, gardens and industries. If somebody were asked to point out fingers at the major reason for the water crisis, the finger would turn to each one of us.

The root of the problem lies with each one of us disowning our responsibilities towards water. Situation was not like this, centuries ago. More than 150 years ago no Government anywhere in the world provided water! Once it was centralised and the state started 'providing' water, problems started rising. The modern technologies starting from dam, bore-well, submersible pumps, deep boring drills, PVC pipes all contributed their share for excessive use and wastage of water. The nature or rain dose provide us the water, but we have failed in discharging the duty of an efficient custodian of this precious liquid. Water can not be manufactured, as such, we have no right to waste it. Just think of this: A leak of just one-drop per second wastes 45,000 litres of water a year. This would have been sufficient for a person for 15 months! If only we realise that each on of us has a responsibility towards water, things would start improving.

Let us view the overall situation in our country. With an average rainfall of 1170-mm, we are blessed with good rain. Yet, water scarcity is increasing year by year. Many of the once water-rich areas are now trying hard to meet their water requirement in summer. Cherrapunji that has 15,000-mm rainfall is a classic example of

decline. After independence, the country has spent 70,000 crore rupees on water developing works. Out of this, 10,556 crores alone has been spent on dams. Yet, severe water crisis continues in thousand of cities and villages.

In the last three decades, there have been five surveys of villages with water problems. Though a large number of villages are covered between two surveys, the number of problem villages keeps growing. For instance, in 1980, there should not have been more than 56,000 problem villages as per statistics. But, in reality, we have 2,31,000 villages.

N.C. Saxena, former rural development secretary, puts it this way, "In our mathematics, 2,00,000 problem villages minus 2,00,000 problem villages is still 2,00,000 problem villages". (See table below)

Year of Survey	No of problem villages identified	No of villages covered till next survey	No of villages not covered before the next survey
1972	150,000	94,000	56,000
1980	231,000	192,000	39,000
1985	161,722	161,652	70
1994	140,975	110,371	30,064
1997	61,747		

Gujarath, Rajasthan, Western Madhya Pradesh, Orissa and Andhra Pradesh are areas that face acute drinking water shortage. Trade of water is flourishing not only in cities, but in small towns too. In many states, agricultural sector faces acute shortage of water for 2-3 months. According to a study conducted by International Water Management Institute (IWMI), an estimated 104 billion people, amounting to a quarter of world's population, or one third population of developing countries, are living in regions that will experience severe water scarcity within the first quarter of the next century. This includes 280 million Indians.

CAUSES FOR
CONTINUOUS DECLINE OF WATER TABLE

Why drought is raising its ugly head so frequently? What are the reasons for continuous decline in water table?

There are more reasons than one. Wrong land use pattern, deforestation, wastage and excess use of ground water, uncontrolled pumping through bore-wells, urbanisation, increase in population etc.

Let us first try to understand the relation between forests and water. Wherever thick forests are there, perennial water sources also exist. Enter a forest, hours after a heavy downpour. You will still hear the rhythmic sound of water drops that keep on trickling down from trees.

Rain is the only source of water for us. A good portion of this has to be got into the earth if water has to last till the next summer. It is the barriers on the earth that check the rain and facilitate its percolation into the soil. In the absence of barriers, most of the rain finds its way to sea.

Forest is a natural and one of the best barriers. It is not just a group of trees, but diversity such as big and small trees, vines, shrubs, plants,

Rajasthan and Gujarat, Witness severe drought in the country

weeds etc. Rain is first checked by the leaves of big trees. Water slowly descends through twigs and trunk. Smaller trees and shrubs further reduce the speed of falling water-drops. Down below all the plants there will be a thick bed of dry leaves. The lowest layer of these leaves might have transformed into humus - a substance that has a great capacity to hold water. Humus is the intermediate stage of organic matter before converting itself to soil. It also liberally allows water to pass down through its air spaces.

Down below the layer of humus, lies the forest soil. Rich in all the nutrients, it always remains moist. Each tree has a root zone that is though not as big as the canopy, has a considerable covering area. These roots, during their growth, make cavities in soil.

Added to all these, but what is generally neglected is the role of tiny creatures like earthworms, millipedes, centipedes etc which burrow into the topsoil and enhance water percolation. Invisible to our eyes are many more microorganisms that make the soil very loose and fertile by their activity.

The wonderful multi-barrier system called forest is capable of reducing the speed on any downpour to such an extent that for the earth lying below, it becomes easier to percolate most of the falling drops of rain.

If the forest is dense, in an area of 2,500-mm rainfall, it can pass down 1000 to 1500-mm of rain. One hectare of forest can store about 6 to 7 lakh tons of water after filtering it. The topsoil itself can hold 1.2 lakh tons of water.

Any country or land area should have at least one third of dense forest cover if life has to be sustainable there. In hilly regions like Western Ghats and Aravali forest ranges, instead of 33 per cent, 66 per cent forest cover is essential. What we have in our country today is an average of 10-11 per cent of forests. About the density of these forests, lesser-said, better. Decline in forest cover is the major reason for our lowering water table, increasing drought and an alarming rate of soil erosion. According to one estimate, only an average of 8-10 per cent rainwater gets absorbed by the land in Karnataka. Situation is not better in other parts of the country.

Once the forest cover is gone, soil gets washed away

With the advent of green revolution in sixties, irrigation facilities increased. Electric pump-sets, PVC pipes and the submersible pumps have facilitated easy lifting of groundwater. Shifting from foodgrain production to cash crops is on the increase throughout the country wherever assured irrigation is available. As a result, lifting of groundwater has increased multifold. The natural recharge during monsoon is not adequate to reimburse this high use of groundwater. The net result is that the gap between water consumption and natural recharge is going on growing.

In our domestic and agricultural use, a lot of water is being wasted. Most of our public taps remain leaking. It is high time we consider designing water saving taps and such other utilities. We spend 20-22 per cent of our daily requirement of domestic water at toilets. It is to be noted that for flushing the toilet and gardening, low quality water is also okay.

World Health Organisation (WHO) has estimated the per day requirement of water for us as 135 liters. This includes the water needed to flush the western closettes. However, in Indian conditions, we can easily make do with 100 lpd (litres per day), provided we become water -conscious.

Another reason for water crisis is urbanisation. With the expansion of cities, a lot of cementing is done for house construction, roads, parks, shops, schools etc. This disturbs the natural rainwater recharge of that area. Moreover, in cities, the population goes on steeply increasing. All our cities have centralised water supplies planned decades ago. This has to come from a long distance using considerable energy to pump the same. More and more groundwater is consumed for supplying to the city.

Just have a look at the statistics of municipal water supply in a Gujarath town during the severe drought of 2000. (See table below)

Place	Availability of drinking water
Rajkot (1)	30 minutes every alternate day
Jamnagar, Jasden and Amreli (1)	20 minutes once in 3 days
Jadiya town, Jamnagar District (2)	20 minutes in 12 days
Shral town, Jamnagar District (2)	Half the population gets water once in 8 days

Source : (1) Janyala Sreenivas 2000, Forget the sensex for a second, look what else is going down, Indian Express, New Delhi, April 19, p.1.
(2) Janyala Sreenivas, Once a fortnight, they get few drops and that too for 20 minutes, Indian Express, New Delhi, April 21, p.1.

Population increase is no doubt, a factor to seriously concern with. But as far as with regard to water resource, we have adequate water to supply all of our countrymen. Where we are erring is in its management. If only we can harvest and conserve water, we have more than the required amount for a careful consumption pattern.

"Keralites think about water only from January to June", comments TNN Bhattathiripad, the noted water conservationist of Kerala. For that matter, not only Keralites, most of our countrymen consume water without care. TNN has coined an interesting phrase called 'water literacy'. According to him, "Water literacy is having a working knowledge of our water resources and using water so as to maintain a balance between the availability and consumption". How many of us are water literates?

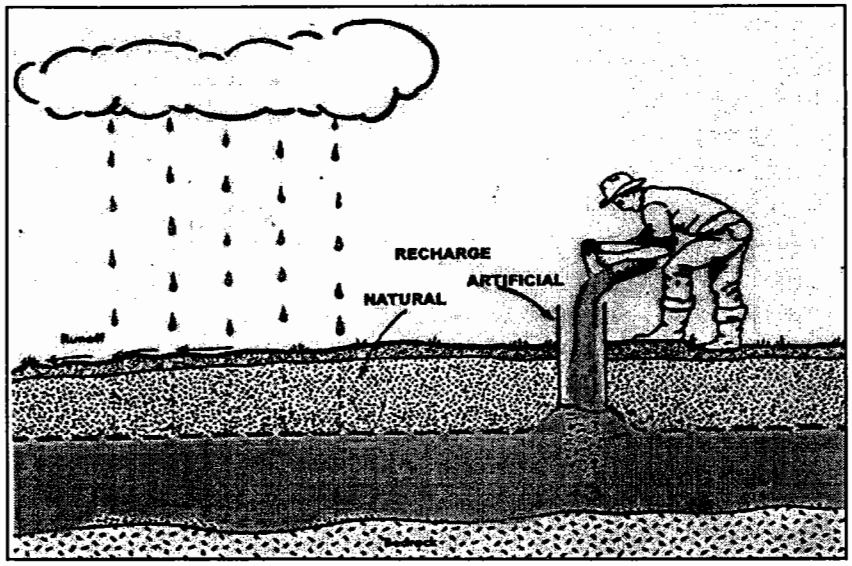
RAINWATER HARVESTING

Our country being one of the most well endowed nations in the world in terms of average rainfall, there is no reason why we should suffer from drought. As Anil Agarwal, former director, Centre for Science and Environment, the NGO in the forefront of advocating rain harvesting puts it, "It doesn't matter how much rain you get, question is how much of it you are harvesting." Asserts he, "there is no village in India that cannot meet its basic drinking, cooking and reasonable irrigation needs through rainwater harvesting".

The question then is what is rainwater harvesting? It is a simple and effective technology that has been practiced by our ancestors, since centuries. Rain Water Harvesting (RWH) is checking the rainwater that goes wasted as run-off and conserving it by recharging the groundwater or by storing it in tanks.

Our ancestors were harvesting the rain directly. From rooftops, they collected water and stored in *tankas* built beneath the house as in Gujarath and Rajasthan.

From open lands, they collected rain and run-off, stored it in *kundis* and *johads* as in Rajasthan and in *madakas* as in parts of Karnataka and Kerala.



Let us look at some of the basic principles of rain harvesting. All the rain-harvesting structures should be in contour line. The line joining many imaginary points at equal heights from the sea level is contour line.

Imagine a piece of land that is surrounded by hillocks from all the four sides. If water is stored in the valley in between, then all the points the upper level of water touches is at equal heights from sea level. This and its parallel lines are contour lines.

Why so much importance is attached to contour lines? In rain harvesting, our objective is to check the rain/run-off and to percolate it then and there. Water flows very slowly in a level land. If there is a slope, it gains speed. More the speed, higher the soil erosion. Hence all the structures, barriers we create for rain harvesting have to be on contour line.

However, in the case of roof water harvesting, construction of check-dams, percolation tanks etc, this principle has no relevance. In planting vetiver hedges, digging infiltration pits and trenches, construction of bunds etc adhering to pre-marked contour lines is desired.

LET US UNDERSTAND
OUR SOIL

Rain is our only water source. We need a huge tank to store the rainwater till the next monsoon. Soil or the earth, the mammoth tank nature has provided us.

Water storing capacity of the soil depends on its physical properties like soil type, amount of organic content etc. Main properties that affect the performance of soil with regard to water are soil texture, structure, sand content, water, water holding capacity, infiltration capacity etc.

Depending on its structure, soil type is mainly classified into sandy soil, silty soil and clay.

Sandy soil has a very good infiltration and percolation capacity. But its water holding capacity is very poor. Silty soil has less percolation and infiltration capacities when compared to ordinary soil. But its water holding capacity is more. Clay soil has a very poor percolation and infiltration capacity. Its water holding capacity is very high.

In between the soil particles, macropores exist. The minute pores inside the soil particles are called micropores. Both these pores absorb

water. Macropores release water faster, but the micropore does so slowly. Soil particles do not release all the water they have absorbed. Only after these particles are saturated, they release the excessive water.

If there are not enough bondage between the soil particles, the rainwater that falls on them flows away as run-off. This bondage of soil particles is a combination of the organic contents they possess. The organic contents have to come from the plant and animal residues.

Agriculture itself is a human interference in nature. As and when we go on cultivating the land, the organic content of the soil goes on decreasing. The forest soil contains very good humus and organic contents.

Humus decides the quality of the soil. All the plant and trees shed their dry leaves. After death, plants and animals get decayed. All these waste, with the action of microorganisms' gets decayed and converted into shapeless organic non-crystal product called humus. It is brown or black in color. Humus easily gets mixed with the clay.

When this mixture of clay and humus join together, it attains granular form. In between the granules, there is good air space. This permits easily percolation of water. The water gets filled inside the micropores of soil particles. This is easily available for plants. If soil contains good percentage of humus, crops grow very nicely.

There is a lot of difference between the forest soil and the soil of farmlands. In the forest, organic wastes go on mixing with the soil. Formation of humus is an eternal process here. The soil structure always remains very good. This is why the forest soil always remains lose and moist. You can simply pick it up with your bare hands. Forest soil's infiltration, percolation and water holding capacities are always very high. That is why, though nobody irrigates, the forest produces a great amount biomass. As and when the humus is consumed, if it is not recreated, soil health goes down. With the decline of forests, say by diminishing of its density, the soil quality also will be affected. The granules of soil get broken into smaller individual particles. Soil devoid of humus can not hold water.

Chemical farming, unfortunately, has overlooked the soil health. In its over anxiety for feeding NPK to the crops artificially, it has turned its eyes on the role of microorganisms. Ignoring physical

properties of the soil is the basic mistake of chemical farming that gives rise to a chain of problems later. In natural farming, when dried leaves fall and decay in the soil, a good amount of macropores is created in the topsoil. Soil remains lose and healthy. The macropores permit air entry. It can then manage without tilling.

When it rains, the macropores in the soil absorb water and an equal amount of air comes out. The micropores and non-crystalline constituents, in their turn, absorb a portion of water from this. In farmlands, macropores go on reducing and as a result, the relation between the macropores and micropores get changed from the ideal condition. As a result, the physical properties of the soil like infiltration, percolation and water holding capacity gets reduced. If we go on adding organic material and cow-dung, we can check this decline of the soil and the productivity.

Absorption of rainwater into the topsoil is called infiltration. Its subsequent travel to the sub-soil and lower strata is termed percolation. If infiltration is less, rainwater flows from over the surface of the soil as run-off. When run-off is more, percolation is less.

If we enhance the infiltration capacity of the soil, then run-off decreases. If this is done in a larger area of a catchment, then we can control floods too. In an unchecked area, if the slope is more, the run-off gets more speed. Always the run-off travels in a great speed. In a matter of a day, it can travel hundreds of kilometers. Scientists have noted that from the forests of Wayanad in Kerala, it took only 24 hours for the run-off to reach the Arabian Sea. Quite in contrast, if the rainwater infiltrates into the soil, its subsequent travel is very slow. Scientists of Centre for Water Resources Development and Management (CWRDM), Kozhikode, Kerala have estimated the travelling speed of water that has entered the laterite soil in the state. It is, according to them, about a metre per day.

Apart from the downward travel of water, in the soil, there is a process in which it travels up and gets evaporated. This process is called capillary action.

Soil - Water - Forest

Soil and water are closely related. So is forest with each of these natural resources. The topsoil that is present in the uppermost layer

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of six inches to one foot has all the required nutrients to grow food. Sub-soil does not have all these vital nutrients.

According to soil scientists, about a thousand years are required to produce an inch of topsoil. When organic materials such as dry leaves, plant and animal waste etc get mixed with the soil, it becomes more and more fertile. Organic content increases the water holding capacity and permeability of the soil. As and when we go on cultivating the land, the organic contents get decreased. If we do not incorporate more organic matter, the soil loses its water holding and percolation capacities. For a farmer, the first practical step towards water conservation is enriching the land with more and more organic materials. Planting trees is a good idea. It goes on providing the organic material to the land in the form of dry leaves.

If there are barriers to check the rain, the land beneath acts as a reservoir of water. That way, we need soil to hold the precious rainwater till the next monsoon.

Without water, topsoil can not produce food for living beings. To conserve both soil and water, and umbrella of forests is a must. If tree cover is not there, rainwater does not percolate in the soil. It starts flowing from over the land surface as run-off and finally gets wasted by joining to sea.

The run-off takes a huge quantity of topsoil along with it- more the speed, more the soil loss. According to one calculation, we lose 40-50 tons of topsoil from a hectare of land annually. If reddish water flows in your rivers during monsoon, it indicates that there is considerable soil erosion. In areas with good land cover, you can find crystal clear water in rivers.

Continuous loss of topsoil makes the farmlands less fertile. Activities of microorganisms decrease. To maintain the same yield levels, farmers have to apply more and more manure each time. The eroded soil gets deposited in the tanks, rivers and other water-bodies. Shrinking of storage space is the obvious ill effect of silting. There is an indirect loss that is more serious. The recharging function of these water-bodies goes a decreasing and stops after a stage. According to a study by the National Committee on Integrated Water Resources Development, the loss of storage capacity due to silting of tanks has deprived the country a whopping 5,000 crore rupees as capital loss.

In fact, the loss of soil is greater than the water loss. For the nature to produce topsoil, generations are required. But, unfortunately, most people do not take the issue of soil erosion seriously. There is a silver lining amidst the clouds. With the harvesting of rain where it falls, run-off gets checked. So, wherever proper rain harvesting measures are implemented, soil erosion also stops.

According to Central Soil and Water Conservation Research Training Institute (CSWCRTI), Dehradun, 5334 million tons of soil is being eroded annually. Of this, 29 per cent is being permanently lost to sea, 10 per cent is deposited in reservoirs as silt, 61per cent displaced from one location to another. This study warns that present annual average loss of topsoil is approximately 16 tons/hectare; this is far above the permissible limit of 4 tons/hectare.

Another point we have to keep in mind is that flood and drought are two faces of the same coin. Both are symptoms of an impending grave tragedy. If forests are denuded, cattle overgraze in hills, watershed becomes eroded, and both the above symptoms might show up. That is a nature's warning to man that if no remedial measures are taken, the land will turn to a desert. Since the reason for drought and floods are mostly man-made, man has to have solution too for these problems.

SOIL AND WATER CONSERVATION TECHNIQUES

Soil and water conservation techniques can be classified in two ways. Depending on the approach, it is divided into vegetative (or agronomic) methods and mechanical (engineering/artificial) methods.

Vegetative methods include changing in planting pattern, addition of organic material and such other agronomic changes. Mechanical methods include those that involve engineering calculations and artificial soil and water conservation structures like trenches, bunds that need implements like pickaxe, spade etc.

Vegetative Methods

Mixed Cropping

Some of the crops do not utilise all the available sunlight. Similarly, they are not able to check the rain to the maximum. In such a plantation, developing inter-crops that do not compete with the main crop is a good soil and water conservation method. When the inter-crops spread their canopy, they prevent soil erosion and make more rain to percolate. For Example, Banana crops with coconut or Areca nut, Mangosteen with Coconut etc. The inter-crops do not require all

the amount of water that is conserved by them for their own consumption.

Multi-tired Cropping

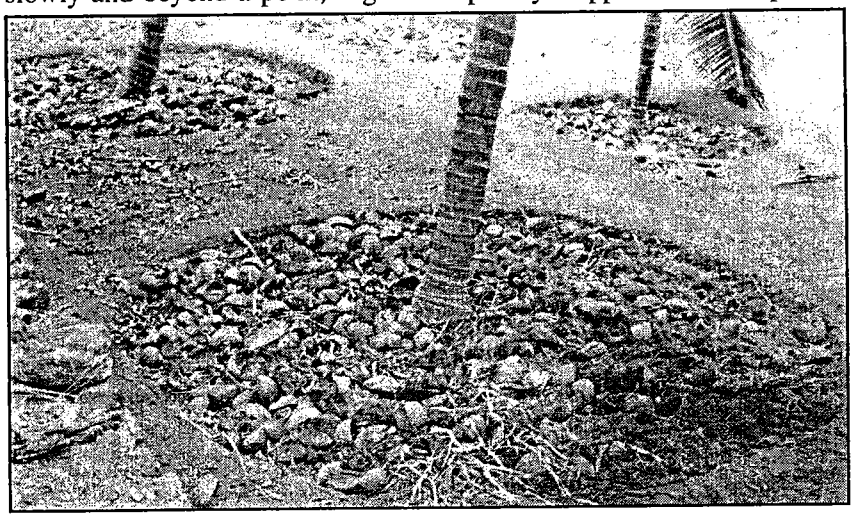
If crops of different heights and canopy that does not compete with each other are intelligently mixed in the same land, we can harvest sunrays and rain to the maximum extent. Examples : Coconut, Pepper and Vanilla; Areca nut, Pepper and Coffee.

Growing Legumes and Grass

Some lands have very little topsoil. In such places it is difficult to grow any perennial or tree crops. The only crop you can raise there is legumes or grass. During the first rains, the land can be moderately dug with the help of a fork and the grass/legume seeds can be broadcast. When they grow up, they check soil erosion. Their roots facilitate infiltration to some extent. This method is suitable for laterite areas too. Legumes enrich the soil by fixing atmospheric nitrogen.

Mulching

When the sunrays fall on it, the moisture from the topsoil evaporates. Once the topsoil turns dry, through capillary action, soil loses its water content from micropores. The activity of microorganisms diminishes slowly and beyond a point, it gets completely stopped. Direct exposure



Mulching with Coconut husks, a common farmer practice

of topsoil to sunrays has to be avoided. Mulching with organic material, mostly dry leaves, is age-old farmers' practice. It retains the moisture, provides organic material and darkness all of which are necessary for the activity of microorganisms. Hectic activity of microorganism increases the soil health by improving the nutrient status and porosity. That is why a lot of importance is given to mulching in organic farming.

Drawing from their experience in Sarang, Kerala, Gopalakrishnan says, "With continuous mulching for three years, you can bring the degraded soil back to fertility".

Cover Crops

Cover crops do the same work as mulching. If the over crop used is a legume, it gives additional advantage of adding nitrogen to the soil. Puereria phaseoloides, Calapagonium mucunoides, Mucuna bracteata are some of the cover crops used in Rubber plantations.

Vetiver

In recent years, Vetiver (Veiveira zizanoides) has attained worldwide importance in soil and water conservation and in bioengineering. According to the *Vetiver Network,* floated by the World Bank, planting vetiver is the cheapest way of conserving soil and water.

In small slopes, live fences of vetiver would be sufficed to check the soil erosion. It also facilitates water infiltration through the air gaps created by its profuse roots.

Compared to trenching, planting vetiver is easy, less laborious and does not need any maintenance. In Gundlupete, Karnataka, local farmers have been using this since centuries.

There are many reasons why vetiver has found a place in watershed development activity. Some of its virtues are as following:

- It is capable of growing in a wide range of climates - from 300-mm rainfall to 1,000-mm and from 15 degree Celsius to about 55 degree Celsius temperature. It is able to withstand long and sustain drought for more than 6 months.
- It s deep, massive fibrous root system can reach down 2-3 metres in the first year.
- This massive root system is likened to 'living nails' binding the soil together.

- Once planted, it will live for long and cattle do not graze it except when it is very young.
- The measured maximum resistance of vetiver roots in soil is equivalent to one sixth that of mild steel and they are stronger than most tree roots.
- The fibrous mat of roots strengthens earthen structures and removes many contaminants from soil and water.
- It is perennial, free from pests and diseases and can be easily removed when no longer required.
- Vetiver system protects structures such as roads, ponds, drains, canals and building sites. Also used for land and gully rehabilitation.
- Play a vital role in watershed protection slowing down and spreading run-off, recharging groundwater, reducing siltation of drainage systems and water-bodies.
- Vetiver system costs from 55 per cent to 85 per cent less than traditional engineering systems like trenching.
- It protects ponds, reservoirs and riverbank erosion caused by wave action, strengthens earthen dams against collapse and reduces maintenance cost of canals and riverbanks etc.

Filter Strips

Though the run-off is minimised by soil and water conservation measures like trenching, a small amount of silt gets deposited in the structures like pits and trenches. Depending on the quantity of silt deposited, you have to dig the structures again, say, in 5-6 years. To prevent this, slightly above the structures, in a line, vetiver plants are planted very closely in a row. This prevents silt from entering the pits. Because of its function, this strip is called filter strip.

When a massive watershed programme is planned, it is very important to raise a nursery of vetiver at least one year in advance. If this is done, when the time for implementation comes, you can have the necessary number of vetiver slips for planting immediately.

The *Vetiver Network* at USA produces a newsletter and has a web-site too. Recently, Indian Vetiver Network is also started. Any further information on vetiver can by had by them.

Though India is a country that has centuries of history of vetiver

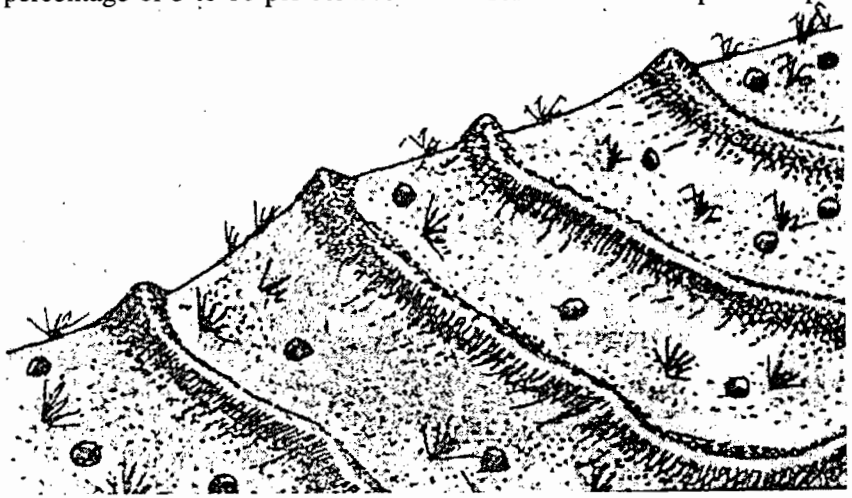
use, even after World Bank's Research and Development, unfortunately, our country has not shown interest in exploiting vetiver's capabilities to save our land and water.

Mechanical Methods

Contour Bunds

You have seen humps on asphalt roads. Contour bunds resemble these humps. Only difference is that it is constructed on a contour line. When complete, the contour bund will have a deep furrow on top and an earthen ridge beneath. Contour can be marked used tube level (dumpy level) or 'A' frame. Planting a filter strip of vetiver would be ideal.

Contour bunds are suitable for areas with lesser rainfall and a slope percentage of 5 to 10 per cent. It can be followed till a slope of 20 per



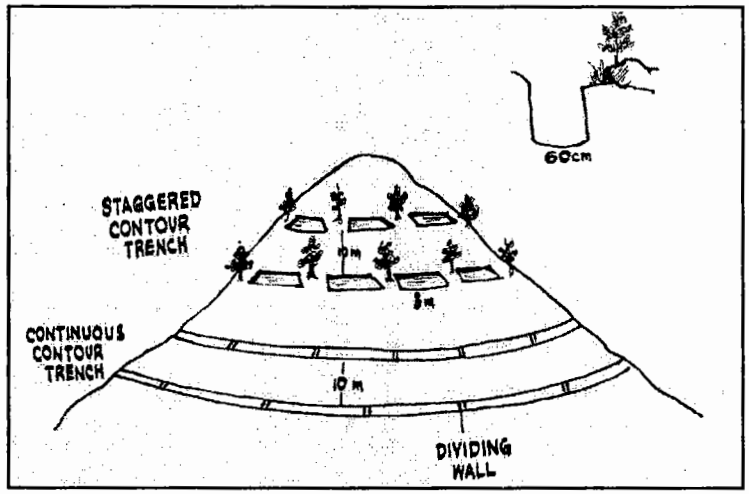
Contour Bunds

cent, but the height of the bund might have to be increased. Instead of this, bunds of lesser height at lesser vertical distance are better for practical reasons.

Contour Trenches

In areas of heavy rainfall, the bunds may not be sufficient to stop the run-off. Trenches are ideal for these regions. As a thumb rule, one can dig trenches of half a metre width and depth. If you are planning to dig continuous trenches, marking contour line is essential.

If there is a level difference in the spot where you have to dig trenches, keeping small septas (walls) in between will save considerable labour. The dug out soil has to be put on the lower side,



slightly away from the cutting. Otherwise, there is a chance of the soil getting into the trench during heavy downpour. It is better to stamp the dug out soil with foot to stabilise it, covering the fresh soil with scraped grass mats (like they do by the sides of newly constructed railway lines) or planting vetiver slips would further help in preventing erosion.

While digging continuous trenches also, you can keep a few walls in between. Even if there are slight errors while marking the contour lines, this step will reduce the damage. Instead of continuous trenches, you can opt to dig staggered trenches. While doing so, the run-off from the untreated area between two trenches of the upper row is caught by another trench in the lower row.

Soil Conservation Section of Tamil Nadu has made the following recommendations regarding the spacing of trenches.

	Percentage of Slope	Vertical Gap (in cm)
Light Slope	5 to 10	13.5 to 19.5
Medium Slope	10 to 25	6 to 13.5
High Slope	above 25	1.25

In areas having more than 33 per cent slope, Tamil Nadu Agriculture Department discourages farming. Hence there is no recommendation for slopes above 33 per cent. Planting perennial trees with taproots is the best-suited method for such areas. Disturbing the soil for construction of trenches etc is risky as it might induce landslide.

In Kerala State due to population pressure, people are compelled to cultivate in areas having slopes above 33 per cent. Many problems like landslides frequent in districts like Idukki and Thiruvananthapuram.

There is a thumb rule for measurements of staggered trenches. Let us assume that the spot has 10-12 per cent slopes. The suggested measurements are 3 metres length, 60-cm breadth and a depth of 75-cm. (10ft x2 ft x 2.5 ft) The vertical height between the rows of trenches is 3 metres. In one-hectare land, 335 such staggered trenches can be dug. While digging trenches, if there are shrubs or patch of plants in between, you can avoid that area from trenching; this patch of plants will grow faster and take care of soil and water conservation work.

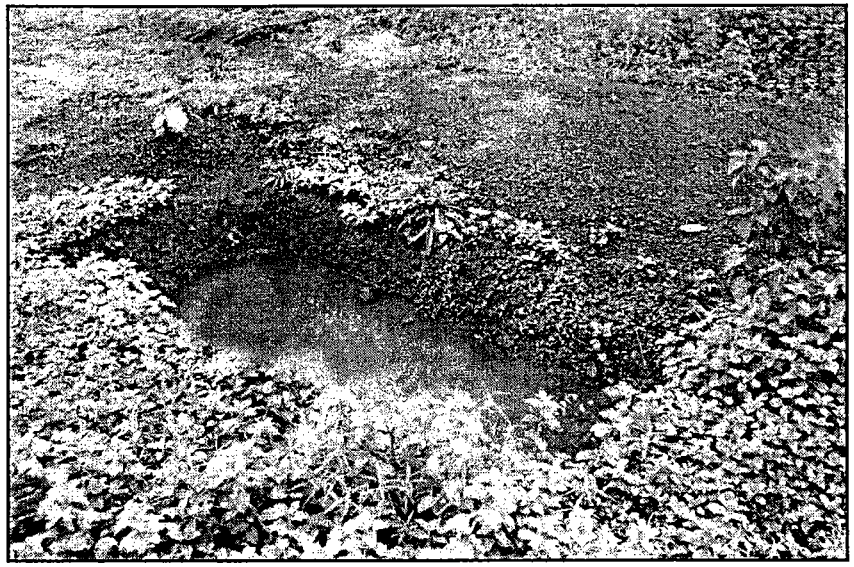
Suppose you have to dig about 300 to 400 cubic metres of soil in a hectare. One labourer can dig out 3 cubic metre soil per day at an average. Thus, to finish the whole job, about 100-man days work is necessary. You can work out the total labour as per the prevailing rates of labour in your area. This again, is a broad calculation. Work output will vary depending on the structure of the soil.

Infiltration pits

Digging infiltration pits was in vogue in coffee estates since the time of British rule in the country. In between two rows of the crop, these pits are dug. Generally it is 5 feet long, 1.5 feet deep and wide. As the pit goes deep, the length is reduced. This is to avoid soil from sliding inside. Pits are always taken on contour lines, across the slope. Like staggered pits, a pit in the second row that lies below the first catches the run-off from untreated area of the first row. Once in two years, silt, the dry leaves etc are cleared from the pit and put to plants. This is good manure.

Saucer Bunds

Saucer bund is a structure similar to infiltration pit. The difference lies in the shape. This one is circular. The main intention of digging



Infiltration Pit

saucer bunds is to provide moisture to the newly planted sapling especially in dry areas.

In level lands, soil is dug from a 1.5 feet diameter area. Using the loose soil obtained, a bund of 30-40-cm is raised on the edge of the circle. Saplings are planted in the centre.

In slopes, saucers are dug on contour lines. Soil from the lower half is used to create the bund. Bunds are raised on the lower side, in a semi-circular shape. As a result, in the lower side, a depression is formed. The plant has to be positioned slightly above the depression. Even if the pit contains full water, roots of the plant should not get submerged in it.

Such a pit can hold 40 - 50 liters of water. Imagine you are planting 1000 - 1250 plants in an acre in a spacing of 2 x 2 metre. The saucer pits alone can take care of good rain harvesting. But in heavy rainfall areas, instead of saucer bunds, it is better to go for infiltration pits.

Dr. A.N. Yellappa Reddy, an efficient conservator of forests popularised the saucer pits in Sirsi region of Karnataka. Because of this, farmers there call the pit as 'Reddy Bharav' (Reddy pit). Saucer pit looks like a saucer in plain areas and like a half moon in slopes. It can serve for 3-4 years. In heavy rainfall areas, if you plant trees

Saucer Bunds

during the first rains, saucer pits can be dug after the heavy rains are over. This will prevent the soil erosion from the newly dug pits.

Side Pits

In the initial stages of understanding rain harvesting, many people assume that digging infiltration pits in drainage channels is a good idea. But, in reality, it is a faulty step. These channels, along with a lot of run-off, carry considerable amount of silt too. The slit gets deposited in the infiltration pit in a very faster rate. More silt means lesser and lesser infiltration. The pit finally turns useless.

With a slight modification in selecting the spot, you can avoid the silt and can harvest good amount of water too. Take a small branch from the drainage channel and dig a pit on its side (may be vertically to that or parallel or in any convenient angle). If need be, you can dig an outlet from the infiltration pit to send the overflowing water outside. This outlet can be again connected to the drainage channel.Also, if there is a necessity, you can put a small bund across the drainage channel to divert some water to the infiltration pit.

This is not a textbook technique, but is very useful one. This way, you can take a series of water so as to drive all the run-off into the sub-soil in your own land.

Terracing

In slopes above 30 per cent, terracing (bench terrace) is a suggested soil and water conservation method. When you have pressure of land, terracing becomes unavoidable. If you are raising a crop that will

pay back the heavy investment on terracing, it is fine. Otherwise, it is an expensive method.

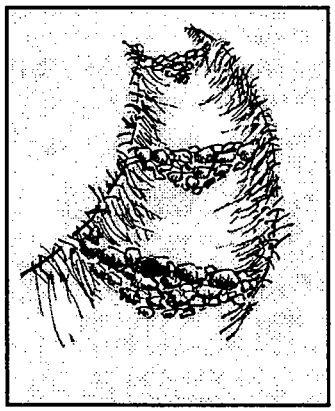
Terracing has been in practice in the country in hilly regions from time immemorial. For rubber plantations, terracing is being recommended. Instead of going for a few big steps by keeping the vertical distance between terraces higher, it is advisable to have more terraces with less vertical gap. Terracing checks the soil erosion and percolates the run-off. However, in places of heavy rainfall, inward sloping terraces give a better result.

Wherever rubber is planted in denuded hills the water-bodies downhill show an increase in water level. This is mainly because of terracing.

Gully Plugs

In some of the area areas where no treatment is done, the run-off creates gullies. To check further erosion and to improve the land, gully plugs are useful.

Depending on the speed and quantity of run-off, the gap between the gully plugs has to be decided. Stones are ideal for plugging gullies. In low rainfall areas, twigs can be used to construct plugs.



Gully Plugging

Percolation Tank

If you store water in an earthen tank at a higher elevation, it helps the water-bodies down below. The water percolated from the tank keeps feeding these water-bodies for a long time.

The dying traditional water harvesting system called *madaka* of Coastal Karnataka is a good example for percolation tank. *Johads* of Rajasthan are similar structures.

If there are natural depressions, failed or dry wells/tanks etc at the upper ridges in your farmland, you can convert them into a percolation structure. Just divert the run off to these depressions. It might dry in a few months. But by that time it would finish the job expected of it.

Check-dams

Purpose of check-dams is to stop the flow of water from rivers and rivulets to sea. Our ancestors used to construct temporary check-dams every year. Different kinds of local materials like stones, twigs, earth, tree-trunks etc are used in the construction. A series of check-dams constructed at the right time can increase the period of water-flow in a river.

Let us see what happens when a check-dam is constructed water level in the stream raises. Levels of water bodies in the surrounding areas also increase. As a result, a considerable portion of the soil on either side of the river, which was not getting water earlier, now gets recharged with water. Water level in the river goes on declining as summer concepts. At that time, the land from both the sides started draining a portion of water to the river by gravitational force. It is this process that increases the water flow in the river.

This temporary check-dam using stones and mud is constructed every year by farmers of kerala

Many people believe that a check-dam benefits the near by areas of both the sides and on lower side only. But the water sources in the near by-elevated places also show an increase. As long as there is

water in the check-dam, it does not allow the water level in the wells situated at higher elevations to drop steeply. Not only a check-dam any water-body in a lower level this way supports the water level in a water-body situated in the nearby higher places. There are instances of check-dams benefiting other water-bodies around a vicinity of 50 metres to 5 - 6 Km.

If you are to draw an aerial view of the area thus benefited, it will like a circle, around the check-dam. Nowadays, several innovations are taking place in the construction of check-dams. Polythene bags filled with river sand are used in some parts of Kerala. When you have good manpower and less of financial resources, these Sandbag check-dams are ideal. As such this type has become popular in people's planning activities in Kerala. Though the technique is yet to be standardised, it has many advantages over the traditional type of check-dams.

Using Termite Hills

Termite hills have several underground tunnels dug out in different directions. One or two of them usually touches the water table. It is by this way they bring droplets of water on their mouthparts for mound construction. Based on this fact, series of termite mounds are taken as indicators for water divining by some people.

If you carefully search in your land, you can notice some abandoned termite mounds. Just dig the spot and increase the storage area. If you have crystal clear water (like roof-water) available, you can directly feed it, If not, if you intend to use run-off, better strain it with the help of a filtering pit filled with filtering media like pebbles, gravel and sand. This is to avoid the silts blocking the termite tunnels in the long run. Termite mound can intake a very large amount of water and can infiltrate it to a very large area of the sub-soil in a short time. A farmer from Kasaragod diverted the run-off to a termite hill situated near his house. In the very next season, his well that had a track record of drying in summer-end was containing good amount of water.

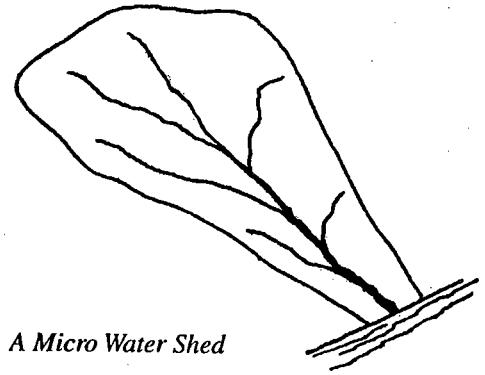
SOIL AND WATER
CONSERVATION IN WATERSHEDS

Soil and Water conservation in rural area is taken up not on ward or village basis. The widely unit is a watershed.

Watershed

The term watershed has derived from a German word, *Wasseshlede* meaning dividing lines. The piece of land wherefrom all the rainwater drains out to a common outlet is called a watershed. If you carefully observe, you can identify the borders of watershed. From inside the border, the rainwater flows to the common outlet. From the outsides of this border, the rainwater flows to another drainage line.

Water is the common property for all the families or landowners in a watershed. If it is scarce, it is their common problem. Generally, the geographic status, soil condition, farming practices etc are almost similar in a watershed. Identifying the borders of a watershed is easy- at any time. For these reasons, soil and water conservation measures are now taken up on watershed basis. However, a watershed development project covers other social, occupational and agricultural and forests development aspects also apart from the fundamental work of soil and water conservation. Though it is an integrated development



A Micro Water Shed

project, generally people take it more as a rain harvesting project because the ups and downs of water is generally very obvious.

In other words, the basic objective of Watershed Development (WD) is to stop soil erosion and run-off. By harvesting the rain, slowly the groundwater level is made to rise. Generally, WD requires recurring work of maintenance of rain harvesting structure in the following years. Once both the natural sources are taken care, it is time to build up forest cover either by forest regeneration or by planting trees. Then the question of proper and equitable use of enhanced natural resources arises. Activities like agriculture, animal husbandry, horticulture etc get more scope if properly handled with people's participation.

WD is a task that calls for community action. Before the execution of the work, education has to be imparted to all the local people about its importance. Water is the common property that is interlinked beneath the revenue borders of all the families' lands. Success lies in the level of peoples participation it ropes in. If majority of the people take part in harvesting rain, in the maintenance of RWH structures and judicious use of water, the success of the project will be the highest.

If farmer A belonging to a watershed takes up RWH measures, apart of the benefit will go to his neighbours too. Similarly if they also harvest rain, A would get some benefit. Once the groundwater table comes up, all of the landowners reap its fruits.

In an undulating topography consisting of hills and valleys, the upper ridges (hilltops) have the highest scope for percolating rain. In low-lying areas, water percolation is the least. This does not mean that people living in lower ridges have to sit idle. Keeping this limitation in mind, they have to select the suitable methods that will

give better results.

The RWH work done at the higher elevations, in addition to benefiting that particular area, will benefits the lands lying immediately below also. Similarly, if water table is raised in lower areas, that will improve the after availability in the middle and upper ridges of that watershed.

While treating the watershed, that is, when implementing soil and water conservation measures, it is advised to start from top and proceed towards the bottom. Imagine you are doing the work in monsoon. If you follow the 'top to bottom' principle, whatever structures you do remains intact; It does not get washed off with water. Instead, if you start work from bottom and proceed to the top, the run-off from the upper untreated area would cause considerable damage to your structures. In 'top to bottom' approach, you can take up work in phased manner according to availability of resources.

Imagine two adjacent watersheds. You treat one of them. As a result, water resources will increase there. But the adjacent untreated watershed might not register any increase in water level. Contraries to this, think of two neighboring watersheds one above the other. Here, if you treat the upper one, the lower will also have better results.

Let us assume that a farmer has 15 acres of lands spread over two adjoining watersheds - L and M. Out of this, 12 acres are in watershed L and another 3 acres in the watershed M. In such a situation, if watershed L is treated, the water level in the tank in watershed M need not necessarily improve. If the farmer wants to improve the water resource in this tank, he has to inspire his neighbors in watershed M to implement soil and water conservation measures.

Soil erosion in any area is dependent on the following aspects.

Rainfall rate

* Soil factor
* Length of the slope
* Degree of the slope
* Crop factor
* Practices of cultivation

There are many methods of soil and water conservation and rainwater harvesting. A method that is very successful in one area need not be that successful another area too. One has to select methods

that will suit to his geographic conditions. Selection of the method has to be done depending on many factors in your site. Following are some of the key factors that have to be taken into consideration.

* Number of rainy days
* Maximum rain in a day
* Boundaries of the watershed
* Degree of the slope
* Soil type
* Depth of the soil
* Where the water-bodies are situated
* Whether there is any agricultural improvement
* Methods of cultivation
* Irrigation requirement
* Plans for extension of farming

Measuring the Slope

Generally, degree of the slope is measured in percentage. To measure this, take a stick of about 3-m length. Tie a long rope to its one end. Let the rope have more length, say, and 10 - 12 metres. Take this implement to the area where you want to measure the slope. Have an assistant with you.

Hold the stick vertically. Let the end tied with rope is at top. Now, ask your assistant to hold the rope in a horizontal line, touching the ground, as shown in the picture. Measure the length of the rope from the stick end upto the point where it has touched the land. Length of the stick (A) is 3 metres. Assume that the measured length of the rope (U) is 12 metres.

Percentage of the slope is: U/ A x 100

In the above instance, 3/12 x 100 = 25 = 25%

'A' Frame

This simple implement, because of its resemblance to the English letter A, is popularly known as 'A' frame.

Materials Required: Two metre long reapers - 2, One metre long reaper - 1, One rope, stone, iron nails.

Drive a nail keeping the ends of the two metre long reapers side by side like the two arms of the letter A. Now keep the one metre

A frame

long reaper exactly horizontally and fix it with nails.

Tie one end of the rope to the point where the two arms of A meet at the top. Allow the lower end of the rope to hang down the horizontal arm. Tie a small stone to the free end of the rope. Let the stone swing freely; it should not touch the ground when the frame is kept in a vertical position.

Now, keep the 'A' frame erect on a cement floor. The stone oscillates for a while and stops at a point. Mark the point where rope touches the horizontal arm. Keep the 'A' frame in such a way that the position of both the long arms gets interchanged. Mark the corresponding point also. If the frame is correct, then both the points you mark will overleap. If not, if there are two separate points, mark the third point - at the centre of the two. This is the level point mark you have to watch in future.

Two persons are required to work with the 'A' frame. You need some wooden pegs of say, one one-foot height for marking the points. At the spot where you want to measure the contour line, keep one leg of the 'A' frame. Keep the other edge where your mind says the contour line will be, check whether the rope touches the level mark; if not, change the position of the second leg till the rope touches level mark. Now the points where the legs touch the land are in contour line. Drive the pegs on these points. Repeat the process till the line is marked for the required length.

The line joining all your peg-marks may be slightly curved; you can make slight adjustments here and there. But remember the contour line will not be like a straight line marked on paper. This is because of the presence of ups and downs in the measured area.

Tube level

If you want to measure contour line for very long or in a very big

land, 'A' frame might prove to be cumbersome. In that case, you can make use of tube level or dumpy level.

Take a transparent polythene pipe of one centimetre diameter. Length may be about 10 metres. Tie the ends of the pipe to two wooden sticks of two metres each as shown in the picture. Now, carefully fill up water inside the pipe. If there are any air bubbles stuck amidst the water, drive them away. Keep both the sticks on a cement floor and mark the water levels in both the sticks with the help of paint. If these marks are at the eye-level, it is convenient.

To use water level, you need three people. Ask one assistant to hold the first stick near the spot where you intend to measure the contour line. Let another person hold the second stick slightly away, where you think the contour line passes. Place the second stick slightly at upper or lower place till the water level and mark coincides. Mark the points with peg and repeat the process.

If you attach thin iron rods, of say 4 inches in length, to the bottoms of both the sticks of water level, you can make do with two or even with a single person. With the help of rods, you can drive the sticks into the soil and make it self standing. Care must be taken that each time you drive the stick, you should see the whole portion containing iron part should go into the soil.

ROOFWATER HARVESTING

In fact, Roof Water Harvesting has been in practice since centuries in Gujarath and Rajasthan. During the time of construction of the house, they used to reserve an underground room for the storage of rainwater. This specially constructed room is called *tanka* or *taka*.

According to an estimate, in Ahmedabad, there are about 10,000 houses having a *tanka* of 25,000 litres capacity. Unfortunately, with the availability of pipe water, the *tanka* system began to be discarded. Now, with the ever-increasing water shortage, there is a new interest to revive this system. In Dwaraka, a coastal town of Gujarath, most of the houses still use the *tankas*. This is because the water available here all around is saline.

For a city dweller, terrace or roof of his house is his catchment. Considerable quantity of rain falls on this. If it is properly filtered and collected, it can be a supplementary source of water for his domestic use, The method of utilising the rain that falls on roof is called Roof Water Harvesting.

There are two main methods of Roof Water Harvesting. In areas where there is no other possibility of getting water in summer,

Harvesting rain from roof tops

harvested rain can be stored in tanks in advance for direct use. The tank may be above ground or underground. However, rainwater from thatched roofs has to be avoided for the reasons of hygiene. If water has to be collected from such house, the roof has to be replaced by tile or cement. RCC, ferrocement or plastic tanks are used for storage. Maintenance measures like cleaning and disinfecting are necessary to ensure the quality of stored water. This method needs higher expenditure, mainly for the construction of tanks.

Another method is to use the harvested rain from the roof to recharge groundwater. Recharging can be done in many ways - by infiltration pits and trenches or through dug well, recharge well or bore-wells. If you have a dug-well or bore-well in your compound, there is every likelihood that the water level in the well will increase. The basic objective of rain harvesting in this method is top increase of declining water table. Even if you do not have any well in your premises, in the social interest, you can take up recharging.

Whatever may be the method of conserving roof-water you follow, it has another advantage too. By harvesting the rain, you are checking the floods on the road.

One question will naturally raise at this stage. "What method should I follow? Whether to store roof-water or to use it for recharge?"

Answer to this question lies in the extent of water crisis that you have. If you have difficulty to get safe and clean drinking water during summer end, it is advisable to go for the storage method. In areas of hard water, one can have sweet potable water throughout the year, if you can construct a tank of the required size to supply you the adequate amount of drinking water.

Another question asked in the context of storage method of roof-water harvesting is about the size of the tank that is required. Generally, the size is decided on the water requirement of the concerned family. In drought-prone areas, rain stored in tanks is used only for drinking and cooking. The size is also dependent on the local rainfall pattern. One has to study the rainfall records to see how the total rainfall is spread throughout the year. Quantity of rain that falls in monsoon and non-monsoon period is also important. If you have rains in 8 months a year, you can manage with a smaller tank. Because the dry months are less in this case, the tank is sure to be refilled in the next rains that might not be very long. In monsoon, you can liberally use water from the tank as it gets refilled off and on.

The surplus rainwater, if any, after filling your tank can be used to recharge directly through the soil or via bore-well or dug-well if you have one. As the harvested rainwater has less TDS (Total Dissolved Salts) it remains sweet and is preferred for drinking and cooking in areas containing hard water. In many areas, lab analysis of harvested water has shown that it is of a high quality when compared to the bore-well water or tap water that generally contain contaminants or more dissolved salts.

One another question frequently asked about the storage method of rainwater is this: "Doesn't the water get spoiled?"

There are certain precautionary measures to be taken. The catchment area, the roof or terrace, should be clean. If bird droppings or dry leaves keep falling on your roof, it is not advisable to harvest water from there for storage. Terrace has to be washed prior to the monsoon or during the first rains. Before storing, the water has to be filtered properly by using a mesh and sand filters. There should not be any suspending material or silt in the water.

If water has to be stored for long, chlorination is advised. About 1 gram of bleaching powder (about 1/4th teaspoon) can be mixed with 200 litres of water. All these precautionary measures not withstanding, it is always advised to boil the water before drinking. Boiling for 10 to 20 minutes is enough to remove all the biological contamination.

Sunrays promote the growth of algae. Storage tanks should be kept completely closed. There should not be any hole or opening which might permit entry of rats, mosquitoes or cockroaches etc. Fine mesh has to be tied around the air-vent too.

Generally, the quality of stored water is dependent on the quality of rainwater that is put inside the tank. As such, in industrial areas where lot of chemical vapours might be mixed with the air, harvesting roof water has to be avoided. If the soil is suspected to contain chemical residues, recharging might do more harms than good. So is the case where drainage gets mixed with the soil.

Chennai is in the forefront of roof-water harvesting in the country. In Chennai, the Metropolitan Water Supply and Sewerage Board is appealing the citizens to percolate all the water that falls on their respective compounds. For this purpose, in addition to releasing prominent advertisements in leading dailies, it conducts training classes regularly. Alacrity Foundation is a building firm that has been trying to create awareness about water in this drought-hit megacity. They have been freely distributing an informative booklet on water conservation to interested Chennaites. All the buildings Alacrity Foundation has constructed have Roof-water harvesting arrangements. Now they are experimenting with recycling of grey water. Rajparis Constructions is another building firm that is spreading the concept with great zeal.

Chennai Metropolitan Water Supply and Sewerage Board regularly conducts training classes on roof-water harvesting. National Rainwater Harvesters' Network organised by the Centre for Science and Environment (CSE) has opened a Tamil Nadu branch. It has employed a network associate to co-ordinate the efforts of different persons and groups in the state.

Aizwal, Capital City of Mizoram has classic example of Roof-Water Harvesting. Since tap water supply is not practical in this hilly tract, Government is giving subsidy for roof water harvesting. More

than 25,000 houses have been harvesting roof-water and have been utilising the same throughout the year. Mizoram's rainfall that is spread out throughout the year has come as a blessing for the local people.

The CSE headquarters at New Delhi has a unit that gives professional advice on Roof-Water Harvesting for the house-owners and industries. According to Vishwanath of Rainwater Club Bangalore, more and more industries are showing interest in catching rain. Those who have implemented Roof-Water Harvesting are able to recover the expenses in 4 to 5 years.

At Chellanam, a coastal panchayat of Kerala, the local people developed a very low cost method of Roof-Water Harvesting. This novel method does not require any tank to be constructed. If sweet water is slowly released on saline water, the former stands as a separate layer on top of the former. This is because of the lower specific gravity of sweet water as compared to the saline water. Based on this scientific fact, the people at Chellanam have standardised a method that costs only about 2,500 to 4,000 rupees. The local panchayat gives 50 per cent subsidy. This method has spread to more than 250 hours in a short span of two years. It is been noted that this method will work only at coastal belts where water table is shallow and the water saline. We have similar areas in the coasts of Tamil Nadu, Gujarath etc. Chellanam model will have application in these belts.

Chennai, Jaipur, Hyderabad and part of New Delhi have already passed regulations to make roof-water harvesting mandatory for newly constructed houses above certain size.

WHY IN-SITU WATER HARVESTING IS SUITABLE TO US?

Based on the point, at which you harvest the rain, it is classified into two methods: the in-situ method and ex-situ method.

In people oriented watershed development programmes, a golden rule of rain harvesting is universally accepted. It is catch rain where it falls. The methods of percolating the rain at the point of its fall itself is called in-situ water harvesting. Infiltration pits, contour bunds and trenches, terracing and planting trees are some of the examples.

In this way, you are trapping the raindrops before they travel and attain speed. That is why it is easier and affordable. You need not bring any material from outside nor consult an expert.

Compared to this, the ex-situ rain harvesting, that is, catching rain after it travels, as run-off from the point of its fall is pretty expensive. By then, the run-off attains speed and quantity. You might require inputs from cities like cement and steel and have to take professional advice from engineers. All these make it above the reach of common

man. Check-dams, percolation tanks etc come under this category.

If you adopt in-situ measures, rain harvesting is possible to a good extent without government subsidy. With the exceptions of districts like Idukki (Kerala), Kodagu (Karnataka) and certain parts of north east region which consist steep hills and valleys, in almost all other areas, common men themselves can execute many rain harvesting measures without external help provided there is good planning and people's participation.

Imagine a poor villager, say a headload worker living in the city. Assume that he has a dug-well in his premises, which dries for a fortnight or a month. In all likelihood, by adopting some in-situ methods, he can successfully keep away the water crisis. The man hours required to carry out the physical work is surprisingly low. Probably, to submit a subsidy application to a Government office and to pursue it, he might need more time. If he can put in the same energy in his compound, say to dig a few infiltration pits at the right spot and way, the job will be over. A little on the spot guidance by a Non-Governmental Organisation or an RWH activist might be essential.

Unfortunately, our departments concerned with Soil and Water Conservation are failing to project the advantages of catching rain where it falls. That is one of the reasons for the spread of a wrong notion that Soil and Water Conservation is impossible sans Government subsidy. Most of the people are worried about the expenditure, which they assume would be very high. True, there are a few methods and geographic conditions that necessitate the helping hand of subsidy. But, by and large, any Tom, Dick and Harry can certainly carry out a good extent of work all by themselves. That is the advantage catching rain where it falls.

SUCCESS STORIES

GOOD-BYE TO
MUNICIPAL WATER SUPPLY

"It is only a matter of time when our well water will prove to be 100 per cent potable"
R. Ramani

Have a look at the performance record of municipal tap water supply at Korattur, a Suburb of Chennai. Supply started in 1978; stopped in 84; resumed in 1996; stopped in 2000. Now taps are there, water is not!

R. Ramani, a resident of Korattur since quarter century, is least bothered about the erratic public water distribution. In the last 12 years, he has not used a single drop of municipal water, nor has he spent a rupee for private tankers. He depended on a democratic, dependent and decentralised water supply system called rain.

Story goes back to 1976, when Ramani constructed a house at Korattur. At that time there was no municipal water supply. He had an open well dug. The 20 feet deep well had good sweet water at 15 feet.

Year by year, the water level went down. Well had to be deepened. In the drought year of 1983, it dried up completely. Further deepening was the only way out. At 30 feet depth, the well started giving brackish, hard and salty water. Yet times, it emitted a stinking smell too.

At that time, the municipal tap was there, but supply was not. Poor Ramani had no other alternative but to consume the low quality water boiling. This mental torture prompted Ramani to rake up his brain for finding out a permanent solution for the water crisis. With decade long research and development, he was convinced that the rain had the answer.

The gentleman, after his retirement from the job has begun a trust to guide people in rain harvesting. His is one of the outstanding success stories of RWH not only in Chennai, but also in the whole country.

Ramani's house has 1,100 square feet of terrace area. It is covered by Mangalore terrace tiles and is cleanly maintained. 600 square feet is used for harvesting the rain. The water of first rain is used for washing the terrace. If rain is forecasted, he uses well water for this job. Rainwater falling on the terrace is first collected in an open tank called as CCT (Collection-cum-Treatment) tank. This tank is at the sunshade level.

After treatment with alum, this water is pumped to the 32,500-litre storage tank situated at the top of the terrace. Adjacent to the CCT is another small rainwater storage tank (500 lit) that also stores treated water. As such, Ramani's total rainwater storage capacity is 3,000 litres.

During the beginning of the monsoon, the first 3,000 litres is treated and stored. The remaining rainwater is released to the open well. This step, apart from improving the quality of the well water, recharges the groundwater too. Thereafter, as long as monsoon is there, the rain is collected, treated and either used carefully or is recharged.

Judging by the past rain records, when he feels that it might be the last rain, Ramani started using great restraint in using the harvested

water. The 3,000 litres stored is used only for the prime need, that is, drinking and cooking.

By repeated recharging with rainwater, the 100 per cent brackish water of his well in 1991 has now turn 95 per cent potable. Now he is freely using it for drinking.

Tamil Nadu Government had declared the summer of 2001 as drought year. When most of his neighbor's wells had dried, Ramani's well was having 6 feet water during May-June. In normal years, it contains double the amount of this.

His own crisis has made Ramani to study deeply about overall groundwater scenario and how best rain can be utilised. His dug-well was giving good, potable water in 1976. Initially the well was 20 feet deep and water was at 15. Ramani analyses the reason behind the presence of ample sweet water then as follows:

- Population of the area was not so thick as it became now.
- Nearby Korattur *Eri* (Tank like water-body) used to have considerable water. It is catchment area was not encroached by house-dwellers.
- Surplus water of Ambattur *Eri* used to flow into Korattur *Eri*.

But the corrupt bureaucrat-politician nexus made way for encroachment in Korattur *Eri* catchment Even parts of the *eri* was used to build houses. These families did not want water to be stagnant in their colonies. So, they broke open tank bunds, check-dams etc. The consequence of this is that entire rainwater now flows to the storm water canal, making considerable part of the *eri* dry.

The wells that were once yielding sweet water at 20 feet have gone dry in eighties. All the residents had no other way to deepen the wells to 25 to 28 feet. This also went dry in the unprecedented drought of 1983. The wells were deepened by another 2-3 feet by lowering cement rings. At 30 feet, most of the open wells started oozing salt water, spoiling its potability. Such problems prevailed not only in Korattur, but in parts of Ambattur, Avadi and Virugambakkam areas also.

Ramani had served the Oil and Natural Gas Commission for 35 years and retired as its Deputy Manager in 1999. He now devotes his full time for the popularisation of RWH through his Ramadies Trust.

So far, he has executed RWH system in 60 houses. More than 100 families have utilised his guidance. He is also an active member of the Tamil Nadu unit of National Rain Harvesters.

DEAD WELL GETS REVIVED

"Lifting water from land is like taking a loan from the bank. Like you repay the loan, you have to recharge the water. For the inputs like fertile soil and green manure you take from the nature, you have to grow forest in return" **HG Lakshminarayana Bhat**

Sorab lies in the transitional zone of Karnataka. It's sandwiched between the rain-rich Malnad (Western Ghats) and the Deccan Plateau with scanty showers. Average rainfall here does not exceed 2000 mm.

HG Lakshminarayana Bhat belongs to a farming family. He is Junior Engineer at the State Electricity Board Office. He has a two acres hilly land, slightly away from his house. The barren land has

Lakshminarayana uses a manual rope and washer pump to lift water

no land cover. With a small slope, the soil-type is laterite.

In 1995, Bhats decided to develop the land. Water source has to be found out. Water diviners suggested him to dig a well. They said, there would be enough water at 25 feet depth.

A contractor was hired for the job. At 25 feet, there was only a bucketful of water. Digging continued upto 30 feet. No considerable improvement. Only 8 to 12 inches of water layer got collected. Not enough to draw in a bucket. In the meantime, walls of the well had started collapsing. Cement rings had to be lowered down to give strength to walls. Seeing no hopes of getting water, this reinforcement was stopped halfway.

Lakshminarayana Bhat's wife and other family members suggested him to abandon this well and to have a new one dug. But Bhat had something else in mind. He had read about Anna Hazare's story of rain harvesting. Why not implement that principle here?

Next year, he had had continuous contour trenches dug starting from top of his land, one and half feet breadth, same depth. A gap of 60 -70 feet was given between the trenches. It required 30 man-days and an expenditure of 1,100 rupees.

In the next year itself, there was visible improvement. The land in

between trenches showed a higher degree of moisture content in summer. Fruit plants and coconut saplings planted in the previous year started picking up.

In the third year, the well registered 10-12 feet of water in the summer. Soil erosion stopped completely as grass had formed a thick mat over the topsoil.

Though Lakshminarayana is a Junior Engineer in State Electricity Board, he did not go for an electricity pump set. Instead, he installed a rope-n-washer pump that works on manpower.

Everyday morning himself and wife would lift water from the well and manually irrigate the tree crops. Farm labourers in the neighbourhood were permitted to draw water from this well. Daily uptake of water goes upto 900 to 1000 litres.

Now there are about 200 to 220 horticulture plants. Dry leaves & grass is cut and put as thick mulch around the plant bottom. Each plant is given 1.5 litres of water everyday. Coconut trees are provided with 25-30 litres.

FROM A LAUGHING
STOCK TO A MODEL

"At an average cost of 5,000 rupees per acre, so far I have spent 75,000 rupees for rain harvesting alone for about 1000 man-days. There are people who believe that with this much of expenditure, one could have a bore-well dug instead. But the moot question is how far the bore-well water can be believed?" **Richard Rebello**

Richard Rebello is a retired lecturer residing at Kalyanpur, Karnataka. A decade ago, people were mocking at him, calling him crazy. The very same people today seek his advice in harvesting rainwater. It is the present water status in his farm at Heroor, which has changed the public opinion.

The 35-acre farm in question is situated in the highest elevation of

that area. In this laterite hillock, topsoil is very shallow, measuring only a couple of feet in many patches. Because of scant land cover, the soil was under continuous erosion. In the first look, any farmer would say that nothing could be grown here except cashew.

The farm had only one water source, a dug-well. After March, water level used to go down considerably. It was hardly sufficient for drinking- for men and cattle. Plants had to dry in summer.

A gentleman had bought the farm in seventies. With a dream to improve it, he had heavily borrowed from banks and planted 135 coconut saplings but could not irrigate it for more than 2-3 months. The bank interest grew, plants started stunting. There was no way he could bring down the deficit.

Finally, in frustration, he decided to sell the land. Richard Rebello knew this farmer. He offered to help. Unfortunately, there were no takers. Those who visited feared for single reason, lack of water. Rebello took lot of pains, but did not succeed. Finally, as if in a whiff, he himself quoted a price. The tired seller agreed to that offer. That is how Richard came to possess this farm.

First thing Rebello did after buying the land was to try for more water. He had had dug two more wells, but in vain. Coconut plants started withering. He announced that if somebody were interested in these plants, he would give it free. But nobody came forward.

His conscience did not permit him to cut the coconut plants. Next thing he did is to search for relevant information to protect his farm. Rebello traveled widely in search of suitable technologies. To Moodabidri and many other parts of then Dakshina Kannada District. Around Kollur, there are many rubber farmers. They are settlers from neighboring Kerala. The trips were not unproductive. There was a lesson or two with each farmer.

Mulching was one idea. The coconut tree basins were broadened. Ample green manure, dry leaves, organic waste and organic manure were filled in the basin during monsoon. Organic materials kept the moisture for long. Slowly the coconut trees started Picking up.

By this time, Richard came to know about the concept of Rainwater Harvesting. A good amount of success had been achieved at TB Sanatorium, Moodabidri. From 1995 onwards, these methods were

tried at Rebeilo farm too.

It was a step-by-step work. Mainly contour trenches and check-dams. There are a few streams in the farm, which flow only during monsoon. By using locally available materials like stones and soil, a series of check-dams were erected. Staggered trenching was done extensively wherever there was run-off.

Results were positive. In 1998, his 3 HP motor could get tow hours of water even in May. For the first time after planting, coconut trees got continuous irrigation. A micro-irrigation system called spray-jet was installed to save the water.

By 2000, about half of the farm was treated, meaning, rain harvesting arrangements were made. Different methods were used such as infiltration pits, trenches and check-dams. Trenches dug in the initial years got filled up with topsoil and dry leaves in 2-3 years. Rebello plants pineapple, yam and other vegetable plants in this fertile soil.

Year by year water has been improving. So are the crops. Coconut population has risen to 185. Apart from this, with 750 vanilla plants, pepper, pineapple, turmeric, tapioca, and 9000 broiler chicken, 25 cattle - the farm has more production in pipeline. Richard is confident of making his farm water sustainable in the near future.

Now his abandoned well also has some water. In rainy season, under-current of water is seen flowing downwards. To tap this, he had dug a big well of 20 feet diameter and 40 feet depth.

In 1999, the farm produced 20,000 coconuts. An average of more than 100 bits per year- a yield statistics any farmer will envy.

Today Rebello's farm gets visitors from far away places. Watershed Development Department invites his for guest lectures. " All said and done", points Out Rebello with a mischievous smile, "many visitors give all the credit for the farm improvement not to the harvested rain, but to the poultry manure produced here."

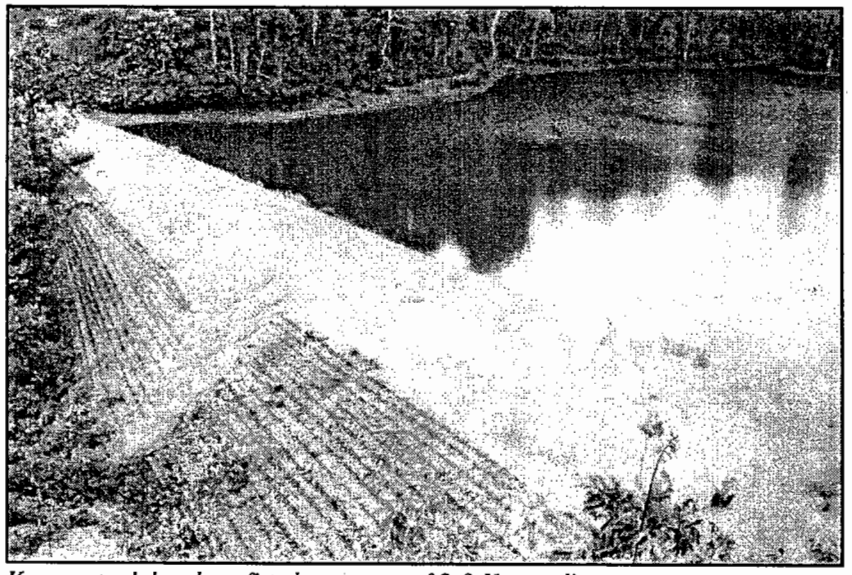
Looking back, anybody else in his shoes, finding no way to improve the water source, would have sold the land for a throw-away price and fled away. There may be many farmers who produce their own manure without any external input. But, how many farmers we have like Richard Rebello who meet lions-share of their water requirements by rain harvesting?

KANAVU TANK-
INSURANCE Vs SCARCITY

Elders in Coastal districts of Kerala and Karnataka can not forget year 1983. It was an year of unpredictable drought.

Digging of bore-wells suddenly took and upward trend. The drought had come to stay. The water table started falling year after year. Today, in Dakshina Kannada District of Karnataka, there are villages where even half an acre areca nut garden requires digging of a bore-well. Farmers who can successfully irrigate their gardens sans bore-well support are growing lesser and lesser in number.

This being reality, if someone from this district claims that he has a 35 acre areca nut farm that is irrigated by tank water, do you believe him? Further, what if he says that he is not worried even if the monsoon gets delayed by a month?



Kanavu tank has benefitted an area of 2-3 Km. radius

Come to Sullia Taluk. Kanavu Gopalakrishna Bhat and younger brother Thirumaleshwara Bhat are these lucky farmers. On the topmost portion of their land is a huge earthen tank. It covers an area of three and half acres. It is the key of Kanavu's success.

Irrigation starts by December 15th. Tank has an outlet pipe of 4 inches fitted with a gate-valve. This gate-valve is not opened during the beginning of irrigation. Below the big tank, there are several seepage tanks at different levels. Purpose of these tanks is to catch the seepage water from the big tank. The big tank is in such a height that running sprinkler jets in areca garden, gravity force is sufficient.

In the beginning two months, water from the seepage tanks is enough for irrigation. Only by February 15th, the gate-valve needs to be opened.

Inside the gardens, there are earthen check-bunds in all the drainage channels. Each check-bund has an exit pipe. The seepage water gets checked by these bunds. Once in a fortnight or so, this water stock is released out. The released water flows to the see page tank that exists below. From there, through pumpset it is used for irrigation.

The big tank is the result of foresight of the late Baja Narasimha Bhat, father of these two brothers. Decades ago, there was a paddy

field in this place. Above that, on all the three sides is a thick patch of trees, in Bhat's private land. Still above is the Government reserve forest. As a result of all these, there was a perennial water source at a corner of the paddy field Bhat build an earthen bund on the open side of the field - to create a reservoir of water. His ambition was to have gravity irrigation to most of his lands. Year by year, the bund was heightened. The forest above was kept intact. On seeing the water seeping below, he had a series of seepage tanks dug. In whole, it was a very scientific management. Forest to percolate rainwater and to prevent silting; utilisation of seepage water to maximum extent and checking water inside the garden in many stages.

Though Narasimha Bhat had his land in mind when he constructed the big tank, he was unknowingly insuring the whole hamlet against water scarcity - by this act. This because the spot of the big tank happens to be the highest in the vicinity, it acts as a percolation tank. An area of bout 3-Km radius is benefited by the Kanavu tank.

At Kunjady, 3 Kilometres away, where second crop of paddy could not be grown earlier for want of water, there is no problem now. Recalls Kunhanna, a farm labourer, "as the tank bund was being raised year after year decades ago, increase in water level in the neighborhood was a talk of the village"

So much so that Odiyappa Gowda, a nearby farmer today grows areca nut without irrigation; a rare achievement in the district. Pathaje, Balandoor, Thotadhamoole and Abila are the other hamlets, which are benefited. In the last decade about 20-30 bore-wells were dug here. None of them is a total failure. Some villagers point out that about 200 acres of land surrounding Kanavu tank might have been benefited by it indirectly.

Bhats Consciously protect their part of the forest. No trees are cut from there. Neither they collect green manure or dry leaves. Says Thirumaleshwara. "The benefit is that there is no silting. If silt gets accumulated from top, do you think it is possible to desalt it often?' Though the Kanavu tank was not built as a part of watershed development activity, it has benefited hundreds of families in a big way. The results are more than what a Government watershed project with an expenditure of 20 to 30 lakh rupees would have shown.

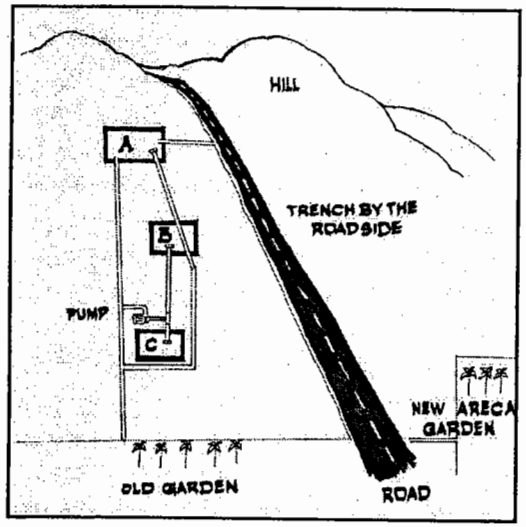
MANAGEMENT CHANGES
SAVE HIS FARM

Siddhamoole is a small in Dakshina Kannada District of Karnataka. Subrahmanya Bhat, a local areca nut grower has his farm by the main roadside. Bhat has two acres of areca nut. Above the garden is the sloppy hill where three earthen tanks are situated at different elevations. These tanks provide water for irrigation.

Tank A is at a very high elevation. Fifty metres below this is tank B. From here, about 40 metres away, vertically about ten feet below lies tank C.

For irrigation purpose, water freely flows by gravity principle to the garden from tank A and B. A 3 HP pump was fitted to tank C to facilitate use of water from this source too for sprinkler irrigation.

A few years ago water turned scarce during summer. Tank A has



good perennial source. Even in December it gets an input of one inch. The tank was deepened. It is side bunds were raised. All the three tanks were interconnected with pipeline, which in turn was connected to pump.

Tank B had a lot of water. Even during the irrigation time, considerable water used to overflow. After seeing this, a new idea flashed to Subrahmanya Bhat. Starting from December, water was pumped from tank B to tank A for a couple of hours. Because of this, tank A used to be always full.

In between tank C was also deepened. New areca garden was raised on a 1.5-acre plot on the other side of the main road. Tank B does not have much water source. Overflow from tank A keeps it full.

A fortnight after the monsoon stops, Bhat starts pumping water from tank C to tank A. Usually this is done during nights. The idea is to refill the tank A by the water that goes waste from tank C by way of overflow. Both the tanks at the upper level - tank A & B - are kept full as late as possible by pumping water from the lower tank-tank C.

Areca garden has 106 sprinkler jet points. Out of this from 60 points, sprinkling is done by gravitation force. In the beginning, water from lower tanks is used for irrigation. Only on rare occasions tank A is used. Bhat gives first priority to maintain the water level in this tank to full.

As a result, a lot of water gets into the surrounding soil. This percolated water keeps oozes into the tanks at lower level, never leaving it to dry. Thus the lower tanks are able to irrigate for a longer time. By employing this change in management practice, Subrahmanya

Bhat is able to irrigate his entire garden without stress. Moreover, he did not have to go for a bore-well source, like his neighboring farmers.

Principle : If you have an earthen tank at a higher elevation with a perennial water source, do not start using this water in the beginning. Maintain the level as late as possible. As long as this tank holds water, it keeps feeding the same to the water bodies at lower levels. On the other hand, if you start using water from higher level tanks in the beginning itself, you are deprived of the benefit of recharge that this water body would have done for more time. If you like to apply this principle, look for any natural depression abandoned well etc. in the higher elevation of your land. Make arrangements to hold run-off water there. Let it remain there as long as it can. This will boost the water sources down below.

REVIVAL OF MADAKA

Surprise was in store when Monappa Karkera returned home one November evening a few years ago. An unusual sound of flowing water raised his eyebrows. On checking, he was excited to learn that his bore-well was overflowing.

Just stones throw away from Monappa's house at Mundoor, Karnataka is a century old *madaka* - a traditional rain harvesting system. *Madakas*, unique to this area are on the verge of vanishing. This *madaka*, in good olden days, covered a couple of acres and was about the depth of two men. But due to silting the area the depth has now shrunk to half. Even now run-off from about fifty acres flows down to this natural depression.

Few years ago, Monappa had planned to raise a coconut garden

in this piece of land. Preparations were on. But he had second thoughts later. Why not retain the *madaka* as it is? How about making some minor repairs?

In 1988, he spent some money to strengthen the bund. In September, after most of the rains were over, exit vents of he *madaka* were plugged to facilitate storage of water. Subsequent rains filled it to the brim.

Two months after the *madaka* was full, the bore-well situated fifty metres away had overflowed! He had earlier measured the water level in his bore-well during monsoon. It was 40 feet below the ground.

Though the bund was repaired, because of the nature of the soil type (laterite), considerable seepage was there. This water used to flow down below through a channel that was carrying the rainwater earlier. It goes by the side of Monappa's areca nut garden situated at a lower elevation.

Monappa plans to put a series of small brushwood dams across this channel. This will raise the moisture in his garden. "Not only that", he points out, "that will permit me to delay the irrigation by one month. Theoretically, less you lift from your, groundwater reserves, better. This also is a measure of conservation."

Recalls an aged farmer, Pajimannu Ananthakrishna Rao (72), Whose farm is still below in this watershed, "that is a *madaka* in which many of our families had water rights in good old days. Forty years ago, it was irrigating ten acres of areca nut garden and an equal extent of paddy belonging to several farmers. Of course, for paddy, it provided irrigation support only for the first crop. Slowly the *madaka's* condition turned worse. The farm containing the *madaka* changed hands. Soil from the 5 cents houses that came up in its catchment got filled in its bed. Till recently, it was not holding any rainwater"

Now after an ad-hoc revival attempt by Monappa, there is hope among the farmers who live in the lower elevation. "If only it is properly desilted", hopes Rao," 35 acres of farms below that would certainly get indirect benefit. Water sources in these areas will get a boost and will not dry quickly as earlier"

Year after year, *madaka's* benefit is increasing, says Monappa. It

has started holding run-off water more a longer period. Last year it had water till January. Not only that, a small water source has started oozing into *madaka* for a still longer period. Now it is Monappa's ambition to convince the administration to take up the desilting work, which, he says, is above the reach of a single farmer.

MADAKA

Madakas are rainwater harvesting structures constructed by our ancestors in Kasaragod District (Kerala State) and Dakshina Kannada District (Karnataka State). This sort of RWH structure was associated with paddy cultivation.

Wherever there is a vast area in the foothills of a hill - having a huge catchment - in the form of a natural depression, madakas were constructed. Site selected was such that the depression opens to a huge catchment area. All the three sides have natural elevation. In such sites, people used to block the fourth direction with an earthen or earth-stone bund.

During monsoon, whatever run-off was there from the catchment used to collect in madaka. If there is an emergency, this stored water was used for supplementary irrigation for the second crop of paddy. It also acted as a percolation tank.

In the above two districts, there were hundreds of madakas decades age when paddy cultivation was popular. They supported paddy cultivation in thousands of acres. Now, with paddy cultivation turning unviable, madakas also are neglected. With increasing deforestation, construction of houses etc, most of the madakas are silted up or do not catch water at all.

It may be difficult to desilt all the yesteryear's madakas and put them to use. Nevertheless, in some places it can be rejuvenated. If the present generation understands the principle and importance of madakas, it is still possible to put this idea into use in several places. In its objective and methodology, madaka resembles johads of Rajasthan.

ROOF HAS THE SOLUTION

"It is advisable to harvest rain around the well instead of further deepening the well. This is a more sustainable way."

UKB Nambiar

UKB Nambiar, an ex-service man, lives in Kannur, Kerala. Every year, water level in his dug-well used to go down in summer. He had to fetch drinking water from nearby tap. For washing and bathing, the family had to go to his uncle's house.

Since the last 5-6 years, this 'summer crisis' has been solved. Now, his well has water enough to irrigate the coconut trees too. This was possible because of a simple method of rain harvesting called Roof Water Harvesting. For a city-dweller, his roof or terrace is his

catchment. Roof Water Harvesting catching the rain that falls on this 'hill'.

When UKB Nambiar was an officer in the Navy, he had to visit Canary Island. This tiny piece of land is situated to the north of Atlantic Ocean and west of Mediterranean Sea. Annual average rainfall here is less than 300-mm. All the houses in the island depend on harvested rain that is stored in the sumps. The islanders do not allow the raindrops to go to the sea.

Nambiar constructed his house in 1975. When the water problem grew acute, he was reminded of the method followed by the dwellers of Canary Island. In 1993, to reduce the heat from the terrace, tiles were covered on it. At that time, the terrace was made to slope to one side. Earlier, rainwater used to flow through PVC pipes in all the directions. This water later was being wasted as run-off.

Once the terrace was made sloped all the outflowing water flowed towards one point. From here it was conveyed out through a 4-inch PVC pipe. Whenever it rained, rainwater was rushed out as if from a pump. This falls to the bottom of a coconut tree. To Nambiar's surprise, all this water was absorbed by the tree basin without making a pit or taking any effort. Not a drop overflowed. He was surprised by the infiltration capacity of that spot. He even enquired with his neighbours whether there was a well here earlier that was subsequently filled.

Nambiar's terrace covers an area of 100 square metres. From many years he was putting coconut husks and leaves to the tree basin. The soil around, rich in organic material, had turned very lose. There are bunds on all sides of the basin. All these might have contributed to the high infiltration of water.

Earlier, water level was going down to one feet in May. Very next year (1995), it rose to 3 feets. There was a steady increase in the water lever over the passing years. The levels in subsequent years were 4 feets in 1996, 5 feets in 1997 and 6.5 feets in 1998.

Thereafter, the summer water level has been stabilised at that level. Total amount Nambiar had spent on the rain harvesting arrangement was only 700 rupees- for pipes. This is a onetime expenditure.

Just the side of Nambiar's house, slightly on a lower elevation is P. Narayanan's house. This well used to dry in summer since many

years. A few years ago, they had deepened their well. Still, in April, the well would dry up. Now, after Nambiar started rain harvesting, this well contains six feet water even in summer.

After his first experiment of catching rain has turned a success, Nambiar has started more. He takes a portion of the run-off from the lane in front of his house. A hole made in his compound wall brings the rainwater inside through a 4 inch stoneware pipe. This inflow is simply spread in a portion of his land. Though at a lower pace, it gets percolated there. Some amount of silt also enters his compound. This is scrapped periodically and put to his ornamental plants.

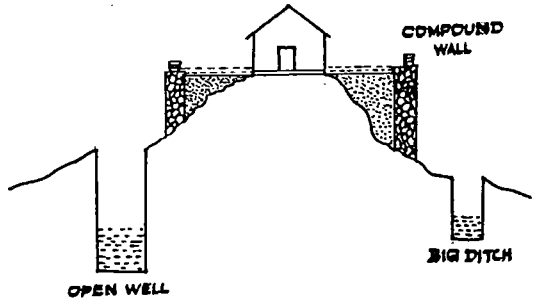
THRESHOLD SHOWS THE WAY

"What we want in this country is not big dams, but small water holding pits" **Thumpasseri James Mathew.**

Sometimes small incidents spark great inventions. In the recent past, a cement threshold was instrumental in making a Kerala farmer realise a simple method of rain harvesting.

Thumpasseri James Mathew is better known as Mathachan among his circle. A rubber grower from Quilon District, he had no expertise in water conservation.

Story goes back to 1960. Rubber is a rain-fed crop. It does not require irrigation. Yet, Mathew had water problem. The dug well, his only water source was drying up in February - March.



Mathachan's house is situated on the top of an egg-shaped hillock. The dug-well was slightly below. Once it turned dry, they had to get down the hillock and travel long distance to collect water for day-today use.

In fact, Mathachan had no idea whatsoever to improve his water source. For his good luck, it happened accidentally.

That year, he got his compound wall built around the house. To level the land, soil was transported from a lower spot. In front of the house, where steps were built, the enclosure was open.

Inside the compound wall, there was a heap of sand. During the monsoon this would have been washed off through the steps. To prevent this, Mathew constructed a barrier, a cement threshold of three inches high and three inches broad.

Unexpectedly, his well did not get dry next year. Mathew got excited, once he could co-relate the reason for this positive change. The threshold withheld a lot of rainwater that poured on the compound. Every time it rained, a layer of three-inch water in the half an acre plot would get blocked. Subsequently that would get into the sub-soil and groundwater. This part of Kerala gets about 110 days of rain.

Once the simple secret was known, Mathachan started extending the practice to the rest of his land. Contour trenches were dug in his 5.5 acres rubber plantation. Eight to twelve feet long, 2-3 feet broad and deep. Dry leaves, which earlier used to wash off with run-off now started settling in trenches. Activities of earthworms increased. So did the moisture content in the soil. Rubber trees looked greener when compared to neighboring plantations. In earlier years, during summer end Mathew's Rubber trees were not giving any yield. Now

they started yielding. Total yield of rubber rose to 200 Kilograms (dry) per acre.

In the years to come, instead of long trenches, he realised, small infiltration pits of the size of a cradle is convenient. This treatment extended to his entire rubber plantation. The hillock caught good amount of rain. Earlier, there was only one spring in the plot. Slowly more and more springs started emerging. Thumpassery Estate, in early eighties thus possessed many springs that do not dry even in summer.

Year 1983 is an unforgettable one for people of Coastal Kerala. It witnessed an unprecedented drought. To get drinking water, many people had to trek to far off places. Thumpasseri Estate that year served drinking water to a number of people in the village. This attracted the attention of media. *Malayala Manorama*, the leading Malayalam daily carried an in-depth feature on this unusual phenomenon. It focussed on the simple rain harvesting techniques adopted by Mathachan.

Mathew started sharing the newfound knowledge in a big way. He would spend from pocket and publish bulletins. Starting from the Prime Minister, to the MLAs, VIPs etc., he kept on sending please and his publications. But at that time, unfortunately there were not many takers for his ideas.

In 1985, he wrote a letter to the Rubber Board about the benefits of digging infiltration pits (*Neerkuzhi* in Malayalam). Rubber Board was not moved. But slowly they started realising the importance of catching rain. From 1993 onwards the Board is giving good publicity for infiltration pits. So much so that now a good number of rubber growers are following it.

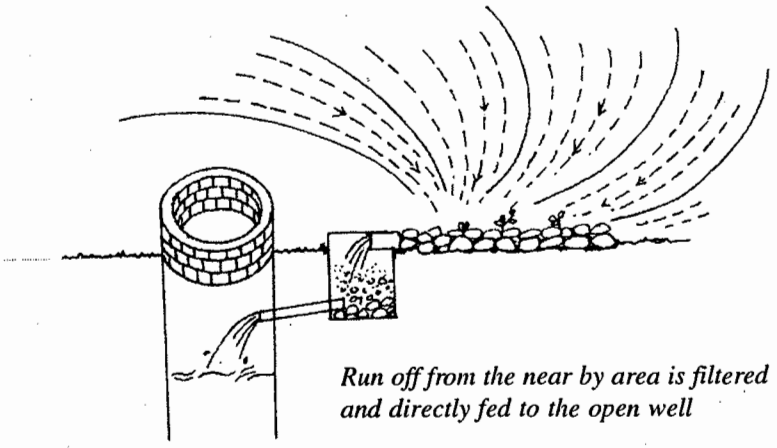
For the rest of his life, Mathew spent considerable time and money to popularise rain harvesting. Mathew breathed his last a couple of years ago. But he will be remembered as a visionary who wanted rain harvesting to be a decentralised people's movement in the country.

TOWARDS DEFEATING
THE DROUGHT

"For a moment, forget the Government. Do not ask what the Government has done to redress your water problem. Everybody needs water. Hence it is our problem, people's problem. Let us start helping ourselves. We ourselves should learn solving our problems."

Shamjibhai Antala

Saurashtra region of Gujarath resembles the shape of an inverted saucer. It is surrounded by sea from three sides. Nature has given Saurasthra a curse too. Rain fails very often. Monsoon season lasts for three months, July to September. Rainy days are meagre. In about 20-25 days, 300 to 500 mm rains falls here, that too, if the people are lucky.



Run off from the near by area is filtered and directly fed to the open well

Drought is a regular phenomenon. Mid eighties saw a worst drought of the century. Rainfall in between 1985 and 1987 was very scanty. "That was a terrible unprecedented drought the state has seen", recalls journalist Natwarsinh Chowhan. "People learnt to reuse the water even after bathing. Drinking water had to be brought in trains from 300-Km away. Thousands of families migrated to south Gujarath and elsewhere. Fodder was also supplied in trains from the neighboring states of Maharashtra and Madhya Pradesh. Those who had some green leaves could somehow save their cattle. Lesser fortunate ones ended up as carcasses by the roadside. None of us can forget that pathetic sight forever. Even if we recall those days, our body trembles."

Drought raises its ugly face once in 2-3 years. Saurashtra has six districts namely Rajkot, Jamnagar, Surendranagar, Junagadh, Bhavanagar and Amreli. Population of these 4,700 villages is one crore. Groundnut, cotton and millet are the main crops. A big asset of this area is its hard working farming community. If the rain is bountiful, nobody can prevent the Saurashtra farmer from raising a very good crop.

There is no perennial river in Saurashtra. Open wells are the main irrigation sources. Each one holds 3-4 lakh litres of water. Total number of irrigation wells is about seven lakhs. Farmers' inhabitations and agricultural fields are clearly separated. Water from irrigation wells is

not used for drinking.

During 1985-87 most of the wells dried up. Housewives had to walk kilometers together to organise their daily requirement of water. Luckily, in 1988 there were good showers. A new idea struck to a farmer, Ramjibhai Manjibhai of Dhoraji, a small town in Rajkot District. He diverted the entire the run-off of his land to the well. Neighbors pooh-poohed the idea warning him that his well would be filled up with silt. Ramjibhai was unmoved.

When all the neighbours' wells dried in next summer, Ramjibhai's had water. A local elder, Shamjibhai Antala, circulation manager of a local daily, was silently watching this entire goings on. The low cost method of Ramjibhai to harvest rain impressed him. Few days later, after discussion with friends, he improvised Ramjibhai's technique of wider application in the state.

A filter pit is sunk near the dug-well. Layers of stone, gravel and sand were filled one up on another. This arrangement is to filter the run-off before putting it to the well. An 8-9 inch cement pipe connects the filter pit to the well. Through this pipe the filtered water enters the well.

If there is a river nearby, with the help of pipes, floodwater is taken upto the filter pit through an underground pipeline. All the rivers get flooded at least four times a year. Where there is no river nearby, the run - off from the catchment is diverted to the filter pit. Farmers can adopt this method without any technical guidance. The arrangement costs anything from 750 Rupees to 1000 rupees. Once done, there is no recurring expenditure.

Shyamjibhai wanted to spread the idea to entire Saurashtra. Handbills were printed in thousands. In the evenings, he would visit villages and address groups of farmers. In the beginning, people made fun of him. When Antala pleaded that that it is for the benefit of the public, they suspected him for a Government employee.

Within a short time, he floated an organisation, Saurashtra Lok Manch (SLM). Water conservation was the main objective. SLM pooled its entire energy on creating awareness. As a first step, it appealed to all the religious leaders. The *swamijies* and priests were convinced about the relevance of SLM's mission.

Almost at that time, a social movement was picking up in this part of Gujarath, mass marriages. Fed up by the extravagance of traditional marriages, people were opting for mass marriages. For SLM, this was a god sent opportunity to sow the seeds of water conservation in the minds of thousands of people.

In all the mass marriages the SLM representatives used to take part. They would erect a *shamiana* and demonstrate a model of open-well recharge. In 1994-'95, 42 mass marriages were conducted in Saurashtra. Totally 2,000 couples entered into wedlock. Each function would draw anything from 20 to 25,000 villagers. As such that year the SLM message was spread to about eight lakh people. In Surath, there was a mammoth mass marriage, which tied holy knots between 350 pairs. 70,000 people attended this event. SLM did not leave a single opportunity like this to convince people about catching rain.

Slowly the farmers started responding. In 1992-'93, arrangements were made to recharge 3000 wells. Next year it rose to 10,000. Media report and mouth to mouth publicity spread the message. Within years, 3 lakh wells in Saurashtra were being recharged without any Government help.

Take the example of Mangalsinh Sodha, an influential farmer of Shekhpat Village, Jamnagar District. In his well, there was only two feet water in summer. From 1995 onwards, he started recharging with floodwater from the nearby river. In the first year itself, water level rose to 8 feet. Next year, it reached 20 feet. Now his annual income has increased by 20,000 rupees.

Gundsar village has 277 wells. Out of this 210 were recharged. Farmers could grow a new crop of groundnut. The additional income is estimated at 18 lakh rupees. According to a study, from the recharged water sources, in 5 lakh hectares of land, additional cultivation is done. This has brought an increase in farmers revenue to the tune of 150 Crore rupees.

How does this method work? The run-off or floodwater that gets into well gets accumulated there. By way of percolation, the water level gets down. By this time a portion of the soil inside the well absorbs water. This process is repeated 4 to 5 times. Slowly the water level inside the well raises. As and when the water is lifted, the

recharge soil from around oozes out water, maintaining the level for a longer time.

Excessive lifting of groundwater in the few decades has resulted in a serious decline in the water table. In open wells, it has gone down to 70-80 feet. Bore-wells have to go to a depth of 700 to 1000 feet. In coastal districts like Jamnagar, seawater has intruded inside. A stretch of land from 7 to 15-Km from the coast has rendered useless by saline intrusion.

In Jamnagar, Bhavnagar etc the municipal water supply is given only for half an hour per day. After Diwali, the same quota is reduced for alternate days. Families living in Raiya, Kalwad and other suburbs, which are outside the municipal limits of Rajkot City, have to spend 50 rupees per day in summer. They have to get water in tankers from outside. Their water bill totals to 15,000 rupees for three months! A litre of water sells here for anything from 60 paise to 1 rupee.

As a result, like villages, city dwellers are also severely affected by drought. SLM has been advocating roof water harvesting for urban houses. Rainwater from the terrace is filled into their domestic bore-wells with the help of a long hosepipe. The exercise needs only 250 to 500 rupees expenditure. This method is so popular in Rajkot today that nearly 7,000 houses have been following it.

The cheap and easy methods of rain harvesting adopted at Saurashtra have now spread to many states like Rajasthan, Orissa and Madhya Pradesh.

A CROREPATHI FORT

The phrase rainwater harvest might have come form oversees but the concept appears very much Indian. If you have any doubt, you have to study our ancient forts and Traditional Rain harvesting systems all over the country.

Come to Jaigath, 11Kilometres away from Jaipur of Rajasthan. This was constructed by the king, Maharaja Jaisingh II in 1726. Hence the Rajasthan capital came to be known as Jaipur.

On the north side of Jaigath fort, there is a range of mountains. Rainwater that falls on these mountains comes inside the fort through a specially build canal which is about 4-5 Kilometres in length. This canal is about 3-4 feet wide and 2 feet deep.

The first rains that carry floating particles etc are diverted to an open pond at the top of the fort. Only after the run-off turns clear, it is

let down to the storage area. At the storage area, there are totally three tanks. First one is open; rest two are closed from top. Clear water first enters the first tank and the overflow into the second. By the time water enters the third tank which is the biggest, it gets rid of all the sand particles etc which are left at the bottom of the first two tanks.

The third tank has a dimension of 130 ft x 150 ft x 40 ft. Bottom of the tank is made of copper and the walls are with lime coating. This is said to be a method to purify the stored water. The guides say that the total storage is 6 million gallon of water which is suffice for drinking for 10,000 people for full two years.

Even now rainwater is being harvested and the stored water which is clean and good is offered to the visitors. There are steps to get down the third tank.

Instead of catching the rain in a decentralised way, rulers of today are contemplating mammoth projects like diverting the river; success of which is suspect and sustainability of which is not asked! As far as huge projects have huge money, nobody bothers about cheaper, better alternatives.

(Info : K.Shyama Rao)

RIVERS REBORN

You might not have heard the names of these rivers of Rajasthan, viz. Arwari, Jahajwali, Sarsa, Ruparel and Bhagni-Teldeh. These rivulets are not big enough to have a place in India's map. But they have made world news!

Earlier they flowed only for a few months after the monsoon. None of them were perennial. Ruparel had turned seasonal three decades ago. Drying of Arwari has a history of six decades.

From year 1995 onwards, all these rivulets are flowing round the year. That has put a foundation for the economical and social rejuvenation of many a villages. Why only that, this development has given a facelift to scores of villages of this desert state.

In fact, there was no such precedence in the world. Nor is a mention of such an incident, river being revived by human efforts, there in the geology textbook. A confused senior scientist even wrote a letter

Dr. Rajendra Singh

suspecting that it is a hoax! Later, he was so moved that he took up extensive studies in the area.

What is the reason behind this visible change in a desert? There was no Government watershed project involving crores of rupees expenditure. Nor did the change come through on its own.

"We depended on the traditional knowledge bank of people", explains Dr. Rajendra Singh, the man behind the number one rain harvesting movement of the country. It is no wonder that he recently bagged the prestigious Magsaysay award for his achievement.

The unique aspect of the movement is that starting from planning, decision making and implementation upto maintenance, the whole process is shouldered by the local villagers through their representative body called *gramsabha*.

Story goes back to 1985. This ayurvedic doctor had a secure Government job. Just the year before, he was married. Over and above, he was a rich zamindar's son. At 28, this man had no reasons to complain about life. Or, so believed his near and dear ones.

But Rajendra Singh's idea of happiness differed with all others. He wanted to 'do something good' for the villagers. Do what? He had no idea. A feeling that he is off-track was silently disturbing him.

This discontent prompted him to take a 'strange' decision, coincidentally on *the Gandhi Jayanti* day. Wife Meenaji was away with her parents. Rajendra sold all the domestic appliances - TV, Fridge, Furniture etc. with bedding on one hand, a bag on the other and a group of four like-minded youngsters, he climbed a bus, with an undefined mission in mind. It is this act of his that earned him the title *nalayakh* (good for nothing) from none other than his father.

All the *nalayakhs* were not sure of their destination too. On an intuition, they boarded some village-bound bus. Concealing their confusion, when the conductor asked 'where to', they replied in a chorus, 'to the last stop'.

The bus took them to Kishori Village in Thanagazi Block. Villagers suspected bearded Rajendra and friends for terrorists. That was the time when the terrorist menace was at peak. It took quite some time for them to get a room for rent and settle in the village. Rajendra resumed his medical practice. Contacts grew.

At that time Kishori Village had a deserted look. Poverty was the main problem. Housewives had to spend most of the daytime in bringing water for their families from long distances. Another surprising fact was that all these villages were all women villages. No able-bodied male members were seen. Whoever could work migrated to nearby cities of Delhi, Surath, Ahmedabad, Agra etc in search of a living.

Aravali mountain range extends throughout Alwar District. In the early parts of the century, it was quite dense. In thirties, on the influence of British, king of Alwar terminated the community right on forests. Contractors clear felled the area.

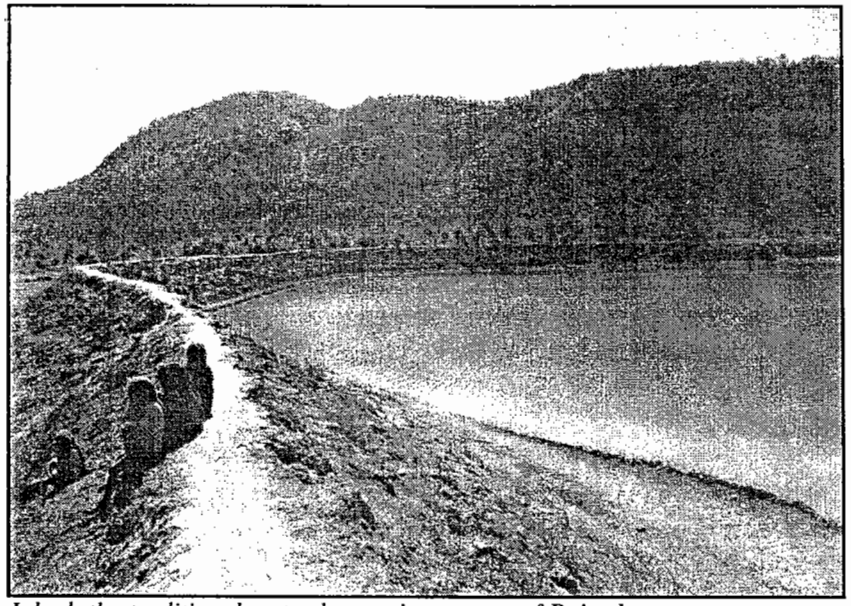
Once the forests were shaved, there was massive soil erosion. The water-bodies got silted up. Most of the rainfall turned into run-off in the absence of forest cover. Agriculture was no longer possible. By 1985 - '87, 80 percent of gents from Thanagazi Block had migrated in search of jobs.

The mission in front of Rajendra Singh and friends got a clear focus. Root problem of the area was soil, water and forest. "Till then we did not know in which direction to head", recalls Singh, "It was like plunging into the war without knowing who is the enemy".

An elderly villager of Gopalpur, Mangulal Patel had a piece of advice to these youth. "If you want to improve water resources, construct *johads*. You'll get results. Dry talk does not fetch you water".

That was an eye opener of Rajendra Singh and friends. By now they had formed an organisation - Tarun Bharath Sangh (TBS). But then, what is a *johad*? Many of the villagers did not know. About eight decades ago the tradition of constructing *johads* was alive in this region. Only handcounts of elders had practical knowledge of the same now.

Johad resembles *madakas* of Kasargod and Coastal Karnataka. They are constructed at a higher elevation, usually on the foothill of hillock where run-off from a vast area gets concentrated. The ideal



Johad, the traditional water harvesting system of Rajasthan

site will have natural slopes from all the three sides and a bottleneck at the front. A bund is raised by the community effort to block the bottleneck. *Johad*, apart from directly providing water for irrigation, also dubs as a percolation tank. It holds the run-off as long as it can. The uniqueness of *johads* is that it calls for community effort and benefits the whole community that is living in the lower elevation.

"Once I realised the importance of *johads*, the ego that the formal urban education had built in me crumbled", Rajendra reminisces now, "I was convinced that these villagers have their own solution for their problems. In Mangulal's words, I saw Gandhiji's concept of Grama Swaraj very clearly". TBS gave top priority for soil and water conservation. They were convinced that rejuvenation of *johads* would be the best way to revitalise these villages.

Mala Tolava is a village on Sariska Hills wherefrom River Ruparel originates. There were only two women in this village - Gyarsi and Phoola. Rest of the other able bodied men and women were out of the village insearch of jobs. A TBS volunteer who visited the village inspired the ladies to construct a *johad*. After a little persuasion, the women took interest and started working. Once in ten days, the TBS

The 'Reborn' Arvari Rivulet

volunteer would join them. In about four months, the *johad* was complete.

That year, after the monsoon, the new *johad* held water for only three months. The land absorbed most of the water. After a couple of years, *johad* started retaining water round the year. By that time, seeing the success of this, many villagers in down stream constructed new *johads*.

In 1985-86, two new *johads* came into existence; two were revived. By 1990, activities of TBS were talk of the village. Totally 116 rain harvesting structures including *johads* and small check-dams were constructed. After a decade of TBS' birth, by 1995, 150 villages gave birth to 1200 water retaining structures, mainly *johads*. Now this figure has raised to 3000 plus in about 700 villages.

When they started the work, Rajendra Singh and friends never dreamt that these rivulets would start flowing round the year. By 1995, five rivulets were ever flowing.

However, the 'rebirth' of rivers did not simply happen one fine morning. Take for example the case of Arwari Rivulet. It stretches

along 45 Kilometers. Catchment of this stream is 503 square kilometers. There are 201 rain-harvesting structures in the catchment. In 1990, the river flew only upto October. In 1991, it was alive even in January. In succeeding two seasons, the drying period shrunk to a month. 1995 saw the river flowing without a break.

With the raise in the water table, Alwar District slowly started regaining its past glory. Water was available in dug-wells till next monsoon. For the first time, women could spare time after finishing the duty of collection of water.

According to a study conducted in 36 villages, average increase in ground water level was six meters. It ranged from 2 feet to 20 feet in some areas. Thanagazi block that was declared as 'black zone' by NABARD was again listed under 'white zone'.

Villagers of Alwar who were pursuing petty jobs elsewhere slowly started returning to there native. Points out elderly women Prabha, "when water comes, all other things automatically follow".

Agriculture and productivity started increasing. Milk cake is a unique product of this belt. In 1985, there were 11shops selling this sweetmeat. Now it has raised to 100. Every year 20 tons of milk products are being sold. Production of milk has gone tenfold. Food grains also have recorded an equal increase.

"We act as a catalyst and never impose development on these villages", says a TBS activist. Now, in all, 650 villages in Alwar have *gramsabhas* that meet regularly. Twice a month or on no moon day. These are not the *gramsabhas* that are constituted under Panchayatraj Act. This is a more representative set up drawing one each member from all the families of the village. This *gramsabha* is a body formed by villagers. There is no leader or a committee to decide issues. Decisions are by majority.

TBS does not take a decision to construct a *johad* in any village. It inspires people to constitute a *gramsabha* where there is none earlier. *Gramsabha* has to take decision on any development. For *johads*, 25 per cent of the expenses have to be met by the villagers either in cash or by way of *shramadan*.

If *gramsabha* decides to go ahead with the construction of a *johad*, many issues have to be sorted out like the site which is most suitable for construction, the assessment of total run-of available, the size of

the *johad* etc. Generally *johad* is not constructed on somebody's farmland.

Planning for maintenance is done before the construction. There are three main areas: Annual maintenance, framing regulations for distribution of water and settlement or disputes, if any.

TBS pays money for the inputs that have to come from outside (Like trucks to transport soil, diesel, cement, brick, wages for the mason etc). Rest of the materials has to be organised by locals.

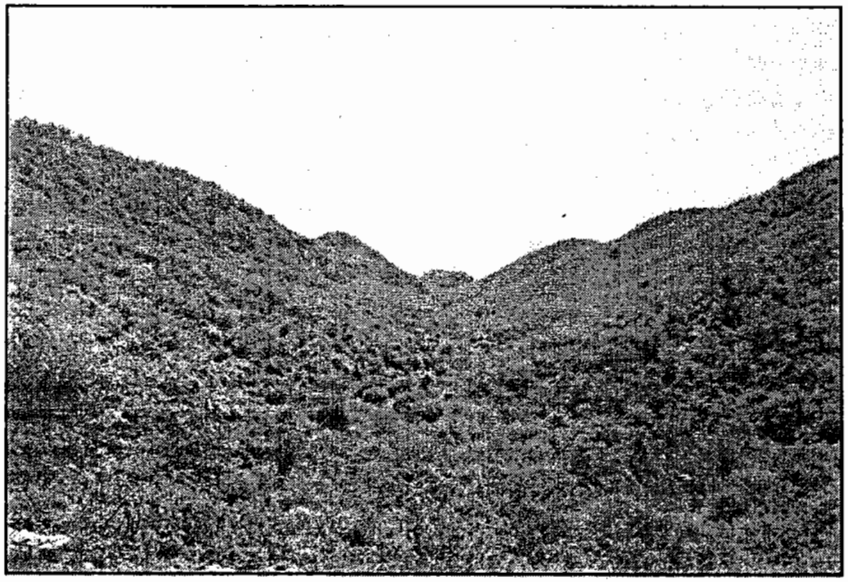
These days the economy of Alwar District has improved. In some areas, the locals come forward to meet a major share of the construction cost. For example, for *Gopala Johad* of Bhuj, which incurred an expenditure of 1, 90,510 rupees, locals contributed 90 per cent (1,76,000 rupees). In *Bhajak Nathatha Johad*, the villagers shouldered more than 50 per cent cost, 96497 rupees out of 1, 80,034 rupees.

It is notable that no engineer is called from the city for any of the civil works. G.D. Agarwal, a reputed engineer, has after a study of 36 villages has reported that each 100 rupee investments in *johads* have brought 400 rupees worth economic production. In 1995 -'96, when many of the Government built check-dams and other structures were damaged in floods, those constructed by the villagers remained intact. According to two professors of Kurukshethra University, the site selection, design and skill used to build *johads* by the villagers are very appropriate.

For conserving one cubic metre (1,000 ltr) of water, the villagers, through their *johads* spend anything from 20 paise to 3 rupees. For the 36 villages, the average of this is 95 paise. No engineering institution can build structures at this low cost.

Johads started showing more and more results in subsequent years. Many of the wells in the region stopped drying. But there was room for anxiety too. Along with the run-off, silt also started depositing in *johads*. This made the villagers to think again.

There was solution with the elders. When the forests were under people's ownership, there were many categories such as Kankad Bani, Rakhath Bani, Dev Aranya etc. There were specific rules attached to each category. For example, from Rakhath Bani, only during the drought years, if the villagers agree, trees and firewood could be

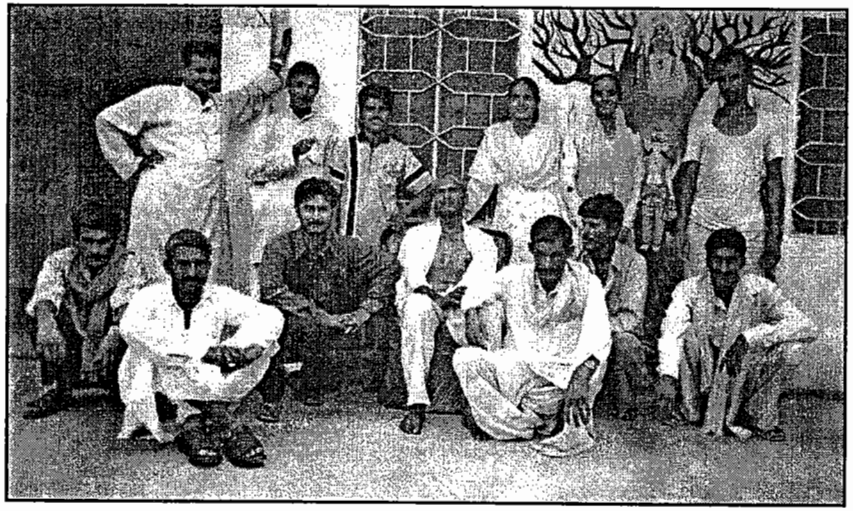


Rejuvenating forests in the basin of Arvari River

collected, only for personal use but not for sale.

If the forests are not regenerated, the villagers realised, the *johads* would eventually get filled up with silt. *Gramsabhas* took up the issue of forest regeneration. Whichever part of the hill has to be regenerated would be first protected form camels and grazing animals. Except fallen twigs and dry leaves nothing can be brought from the forest. If somebody wants to bring something, he should obtain prior permission from the *gramasabha*. Cutting trees without permission is a crime. It can attract a fine. If a person confesses his crime in *gramasabha*, he will be nominally fined. On the contrary, if he is caught red-handed by others, the penalty will be more.

Now most of the villagers at Alwar celebrate *Rakhibandhan* day as a forest day. That day, villagers tie the sacred thread to a tree and take oath to protect it from axe. Years ago, some of the villagers were expelled from the 'protected forest' by the forest department staff. This was because they had not paid bribes. The offended villagers of Bhavatha-Koylala took this as a challenge. They took steps to raise a protected forest of their own. Today this forest, Bhairudev Lok Vanyajivi Abhayaranya has many animals like tiger, deer etc.



The TBS Team

The Aravali mountain ranges need two third of forest cover to provide sustainability to the dependent areas. At one time it was reduced to 6 percent! Now slowly it has reached upto 40 percent. Entire villagers are now aware that *Jal-Jameen-Jungle* (water-soil-forest) is mutually dependent and all living animals are under the courtesy of these natural resources. India's biggest nature regeneration movement has now started extending its arms to issues like education, herbal medicine, women's banking etc.

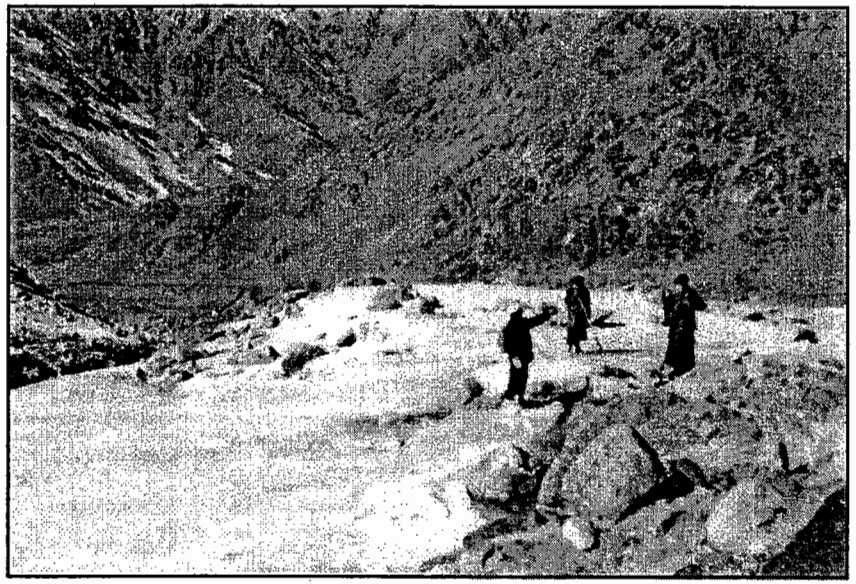
Dhanuva, 80, who was a headland worker at Delhi for decades, has now resettled in his dear village Bhavatha-Koylala. Says he, "we got freedom in 1995, when I was able to cultivate my land again." "With the return of *jal-jameen* and Jungle, the Desert State has regained its self-respect too. Migration rate has shrunk to a negligible level. There are a lot of stories of homecoming. Folk songs and the smell of *hukka* mark the twilight of these villages now. Gandhiji seems smiling from the framed portrait of his adorning the dust and smoke filled walls of these greening villages.

WORLD'S BIGGEST
ICE-MAKER

For outsiders, Ladakh is a picturesque mountain. Ask any locals, they will say, "Ours is a cursed land." Yes. Rain-God is angry at this beautiful piece of mountain. Ladakh is a rain-shadow area. It gets only 50-mm rain during the monsoon that stretches from May to July.

The region is characterised by high mountains. Altitude varies between 2900 to 5900 metres. This region of Himalayas is very harsh to live. Winter is long (Nov-March) with temperature sometimes dropping to minus 40 degree Celsius.

Its melting of snow that sustains life in Ladakh. Summer is very short. Agriculture season starts in April with the melting of snow in upper peaks. When the water reaches the fields down below, farmers



On a block of Manmade Ice

start sowing. Earlier sowing ensures better production. But usually the water reaches very late. As such, success of farming is always suspected.

Chewang Norphael (64), a retired engineer, has found a simple solution to this headache of farming community. He has evolved a novel technique to create artificial glaciers.

Coming from a middle class family of Leh, Norphael graduated from Amar Singh College in Srinagar. After completing the diploma course in civil engineering in 1960, he joined Government service as a civil engineer in Ladakh.

Travelling far and wide in the region his job include making Zings. Zings are small tanks fed by run-off from melting glacier. Slowly he developed great interest in the subject of water.

Working with farmers, Norphael identified their foremost need of developing a method, which will make water available in time. This, if possible, would have boosted the local economy.

While raking his brain in this direction, one day he made an interesting observation at Leh. Water flowing in the channels did not freeze, but that which passed through a thin iron pipe did. As the

pipes are made of metal and are very thin, they lose heat quite rapidly. Once this occurred to him, framework for a new technology was shaped in his engineering mind.

There are water streams or *nallahs* in the shadow area of the mountains. From the peak of the mountains, such *nallahs* exist 8 to 10 Km below. At a suitable site, a check-dam is built to divert water to the base of the mountain.

A very long diversion channel, say of 700 feet, is dug to which this water is diverted. In the bed of the channel, for every ten feet, a small, thin, half an inch diameter pipe is laid on the lower side. The whole idea of making the water to flow through pipe is to hasten the process of freezing. They are fixed in a steep gradient to prevent water from freezing inside.

Down below the diversion channel and parallel to it, series of stone bunds are constructed. This is to hold a big quantity of glacier. As more water seeps from the pipe, it pushes out the block, which is already artificially frozen. The new portion also freezes, continuing the cycle. Thus, a huge block of artificial glacier is formed.

The dry stone masonry bunds are built in a series. Between the bunds, a vertical gap of 20 to 100 feet is kept depending upon the nature of the slope. Generally the process of artificial freezing starts in November. Usually the temperature then will be minus 11 to minus 15 degree Celsius.

Melting of this artificial glacier starts very early because temperature raises here long before it does in peaks. The farmers get an early supply of water. The melting water is channeled to the fields. As the artificial glacier is located near the fields, the farmers can coincide with precision their sowing activities.

Norphael's first successful experiment was fifteen years ago. On community basis, he has created his first artificial glacier in village Umla. The whole village was benefited.

A typical artificial glacier would be about 600 feet long and 150 feet wide. It can collect about 60 lakh litres of water. According to Norphael, after the seepage and evaporation losses, about half of this water will reach the village fields, which are about four kilometers away. Farmers here mainly grow wheat, barley, peas and vegetables

like potato, turnip, cabbage, carrot and some leafy ones.

An artificial glacier would cost about 1,00,000 to 1,50,000 rupees (2000 to 3000 US $). So far Norphael has built five such glaciers. Another ten villages have plans to build such glaciers. Most of the expenses for the glaciers are for the manual labour. The bund construction calls for most of the labour. Usually 10-12 local villagers are employed. No special skill is required for the whole exercise except for the common sense and planning.

The conventional way of rain harvesting here is construction of water reservoirs with cement lining. "This works out to be ten times costlier than creation of artificial glaciers", points out Norphael," for example, if we construct artificial glacier to retain one cusec (103,66,000 cubic ft.) of water in the shape of ice, it costs 8000 to 9000 rupees. If we are to construct a reservoir for the same, it will cost 80,000 to 90,000 Rupees."

TINY TAIWAN
SHOWS THE WAY

The tiny island of Taiwan is better known for the electronic products being exported from that country. Giant electronic companies have opened up their branches there to exploit the availability of inexpensive labour.

In annual rainfall, Taiwan does not lag far behind. It has a rainfall that can make any other country jealous, an average of 2500-mm. This is 2.6 times the world average.

But Taiwan's topographic conditions come in the way of enjoying this water wealth. The island has so many mountainous regions that its rivers and streams flow very quickly. More than 70 per cent of Taiwan's rainwater flows out into the ocean or is lost through evaporation. As a result, the per capita water availability of a Taiwanian is reduced to a paltry figure of 4,348 cubic metres

(43,48,000 litres) as against the world average of 28,300 cubic metres. With one-seventh availability of water as compared to the world average, Taiwan is ranked as 18th country in the world in water shortage.

But then this country has realised its crisis very fast. Five years ago, to meet the challenges, it has opened a Water Resources Bureau (WRB) under its Ministry of Economic Affairs.

WRB has given priority to agricultural sector and has been giving subsidies for installing RWH systems for farming. Aluminium and Reinforced Concrete tanks are constructed for this purpose. More than 3,000 farmers are benefited from this project. These users have set up approximately 80,000 ton (One ton=1000 litres) capacity to collect nearly 3 million tons of water every year.

WRB has spread RWH very efficiently to some of the schools too. San-chi elementary school at Taipei County is a best example. Rainwater from roofs of all the buildings is collected in a storage tank. Capacity of the tank is 1,287 tons. This system now serves the need of toilet flushing for the school completely. In other words, the substitution ratio reaches 100 per cent.

In industrial sector, Chenghwa Picture Tubes (20,000 tons of rainwater collection per year) and among charity organisations, the Thu Chi Hospital and Tzu Chi Institute of Technology in Hualian of Eastern Taiwan (10,000 tons; work in progress for 50,000 tons utilisation) are some of the models for RWH systems, WRB has created. The Industrial Technology Research Institute harvests rain from its 375 square metre area roof. This is adequate for flushing toilets for 200 workers, for irrigating the garden etc. The substitution rate here is about 60 per cent.

However, the best example of RWH and its education in Taiwan lies with the Taipei zoo. It is the first successful example of rainwater utilised for the zoos of the world.

Taipei zoo spread over 164 hectare is located in Wen-Shang District known for 2,700-mm rainfall. The zoo houses about 3,000 animals. Number of visitors per year is half a crore. For the lawns, gardens, fountain, man made river, Hippopotamus Lake, lakes of other animals, toilet flushing and taps, the zoo requires 12 to 15 lakh tons of water per annum.

With the help of WRB, Taipei zoo has implemented RWH systems. The run-off coming from nearby hillocks is processed and stored in a 250-ton tank. This water is used to irrigate Eucalyptus trees and other plants, for filling the animal lakes and for flushing the toilets. Eucalyptus leaves are the food for the pet animals called Kola.

The administrative building of the zoo has a roof area of 5,000 square metres. All the water from the roof gets into a 500-ton tank. This tank provides additional supply for toilets and gardens. The handicraft section has 800 square metre roof whose water is stored in a 50-ton tank.

Taipei zoo has spent 14,000,000 NT $ (400,000 US$) on all these RWH arrangements. The Government has given 60 per cent subsidy for the same. Some of the systems are still under construction. The zoo was earlier spending 10 million NT$ per annum on municipal tap water.

In 1998, they spent NT$230,000 to replace the old type taps with an economy model. In the new type of tap, instead of gushing out, water spreads as a thin film. As a result of this change, the zoo could achieve savings of 40 per cent in the consumption of tap water. Formerly toilet flushes were releasing 9 litres of water on a single pressing. A new type of flush that works at two stages was introduced. This releases only 4.5 litres in the first stage. This change and utilisation of rainwater has brought down the usage of water in toilets by 60 per cent.

Apart from implementing some full pledged RWH systems, the zoo gives education to housewives and children in various ways. Brochures and colorful booklets are produced to teach rainwater harvesting to the public. One such attractive booklet, "Water, Rain down here" explains with ample colorful pictures the importance of water, how the zoo is successful in reducing the water consumption and in augmenting its water resources by RWH.

Zoo has set up 15 piggy banks (or rain-banks) at various spots. Rainwater from the roof is filtered and stored in colorful piggy banks. Says zoo director Yang-shanh-hsiung, "Rain-bank is a simple miniature rainwater catchment system. People have to recognise water resource as money value and save water like their savings money in the bank. We aim at drawing visitors' attention and curiosity in rain

harvesting. They can water the garden from rain-bank instead of municipal tap water. All these advantages are illustrated on walls and in pictures on boards".

Now, the harvested water amounts for 20-30 per cent of the total consumption in the zoo. That means 3,00,000 ton saved resulting in a net profit of 60 to 90,000 US dollars.

Over the years, Taipei zoo has turned to be an education centre for rain harvesting. There is a souvenir shop touching the entry and exit points of the zoo. It has some demonstrations of rainwater harvesting and messages of water conservation. After these were introduced, total water consumption in the souvenir shop has come down to 500 to 550 tons per day from 700 to 750 tons. A neat 30-35 per cent savings!

All the families that visit Taipei zoo can not escape from the education on water. While entering, each family is given a colorful folder on water conservation. Most of the programmes attached with the zoo never get completed without emphasising on the water issue. Apart from this, the zoo has a web site (http://www.zoo.gov.tw) that has a separate section on water conservation.

THAI JAR PROGRAMME

Thai Jar programme of Thailand Government remains as an unparalleled rain harvesting movement of the world. In a couple of years starting from 1985, the country constructed six million jars to harvest the rain for drinking purpose. This way, about 36 million people had minimum amount of good drinking water at their households. Probably no other developing country has been successful in providing clean and safe drinking water to majority of its population this way.

Based on the survey of 513 households done in 1985, the following conclusions were made.

* Storing rainwater is the best solution for the provision of drinking water.

* Each person needs 5 litres of water per day for drinking.

Jars for catching rainwater

* Average family size is 6 persons per family.

* In a year, there are 150 days during which water from jar has to be used.

* Jars of 2,000 litres capacity are adequate for these families.

Survey also revealed that roof areas of the houses varied from 50 to 150 square metres with an average size of 80 square metres. For a roof of 80 metres, only 25-mm rainfall is sufficient to fill up 2 cubic metre (2,000 ltr.) of water. Thailand has an average of 1000 mm of annual rainfall. As such even in relatively dry years, amount of rainfall during any one month of the rainy season is sufficient to supply drinking water through the dry season.

It is estimated that there are 6,00,000 households in rural Thailand. If 80 per cent of this number have to be provided with one jar, required total of jars is 48,000. A committee was set up with the target of providing 5 million jars. It was decided that year 1987 should meet the target when His Majesty, the King of Thailand celebrates his 60th birthday.

A national plan for drinking and domestic water was prepared. Though this plan was of five-year duration, 80 per cent target was fixed for the first two years. Committees were set up for technical development, training, public relations and promotion, fund

acquisition and monitoring the progress.

A construction manual was published. Tempos carrying the model of roof-water harvesting with a jar crisscrossed the country with stopovers at villages for small meetings. Government would supply cement and inputs plus training. Labour and cost of all the materials had to be borne by the consumers.

Masons were trained at district level. Strict specific instructions were given on the materials and method of construction of the jars. The monitoring and evaluation sub-committee kept a close watch on the progress of the programme.

In all the regions of Thailand, from April to October, they get good rains. November to March (150 days) is the dry period. In rainy season, they can go on consuming water from the jar liberally since there is a guarantee that it will get refilled soon. In October, they have to ensure that the jar remains full for use in the next five months. Southern zone is lucky to get good rains in November and December. This means, they will have the dry spell of only about 90 days.

Material cost for one jar of two cubic metre amounts in between 15 to 20 US dollars depending on the location where it is constructed. Each jar needs two man-days for the making.

To lend a helping hand to the villagers to help themselves, Thai Government set up a revolving fund. It works like this: Government will provide 10,000 baht as initial fund. Each household that participates in the project has to pay 400 bahts to the fund to cover the cost of materials. This amount is divided into four installments. A down payment of 100 bahts as initial installment has to be paid in the beginning. The other three installments may be paid in succeeding months. In several cases, credit for purchasing materials were obtained from local merchant, with officials serving as guarantors.

Training of villagers in jar construction technique was funded by Thai Government and conducted by the provincial universities. Each village sent two trainees to learn the construction method, operation and maintenance techniques. After their training, they had to teach this to others in the village. The idea was to have users involved in drinking water supply development so that they can acquire the skills and confidence to operate in future.

Apart from the Government contribution, considerable resources

were pooled from non-government and private sector. Three private cement companies donated 1,503 tons of cement.

There were incentives for implementation agencies too. The province where all the households were serviced by a jar was awarded the prestigious 'golden jar'. Mahasurakham Province was first to bag this award. Subsequently, Phayakaphumpisai, Nakhon Ratchasima Buriham and Phetchaburi Provinces also followed suit.

By 1986, a total of 1.3 million jars had been completed. By 1987, this figure rose to 2.9 million, providing drinking water to 46,75,000 households. Taking into account the large number of small capacity jars (about 14 million) that were made, the equivalent capacity totals to 5.7 million jars by 1987. This way, 80 per cent of the households were covered.

Thai Government spent 7.4 million US dollars for training the villagers in jar making technique, preparation of the construction manual, publicity etc. In addition to that, 13 million US dollars were provided as revolving fund for the villagers to borrow.

Thus, Thailand entered history as the first developing country to provide clean and safe drinking water for lions-share of its population.

CHINA : QUENCHING
THE THIRST OF 1.2 MILLION THROATS

If rainwater harvesting is a key for development for other countries, for people of Gansu Province in northwest China, it is a necessity for existence. Gansu is one of the driest and poorest regions of China. The total area is about 1,00,000 square kilometres.

Crisscross ravines, gullies and high altitude of the land makes any water distribution system or irrigation work impracticable here. Agriculture is mainly rain-fed. Annual rainfall is around 420-mm. Low and unfavourable distribution of rain causes frequent droughts and a very poor crop production.

History has it that in the last 14 centuries Gansu had suffered 634 droughts, almost once in two years. During the recent 41 years drought

has occurred 36 times, a frightening 90 percent.

Average production of crop is only one ton per hectare. In dry years, the yield does not pay for the seeds. Because of lack of water, cash crops are unthinkable. Most of the people in this region do not get sufficient drinking water since centuries. Government used to despatch water trucks from far away places. Annual income of a five-member family is as low as 250-300 US dollars. Water shortage, apart from being the root cause of poverty, at times threatened the human lives too.

The only hope for this province lies in rain. Local people had a tradition of rain harvesting since thousands of years. But the efficiency was dismally low; quantity of harvested rain was hardly sufficient for drinking.

In order to gear up the efficiency and to alleviate poverty, the Government entrusted a project to the Gansu Research Institute of Water Conservancy (GRIWAC) to develop a rain harvesting method to suit to local conditions.

GRIWAC, after extensive research, came up with a pilot project. It took four years for GRIWAC to complete the feasibility studies before actually implementing the pilot project. Thirty-three testing plots were set up to monitor the efficiency of the method in different rain-fed conditions. Based on the successful outcome of this study, the prestigious mega project was launched by the local Government in 1995.

Name of the project itself is catchy "121" (One-two-one). The Government supported each family to build one piece of water collecting field, two storage tanks and one land to plant cash crop. Hence this name. Objective was to provide the family with safe drinking water and to increase their agriculture production.

Considering the speed and coverage of the project, it can be well termed as one of the world's biggest water harvesting movement. In a couple of year's time, it solved the drinking water problem of 2,60,000 families with 1.2 million population and their 1.18 million livestock.

Rain harvesting is not a new concept for people of Gansu. They were catching water from threshing yards, roads etc. One of the methods used by the farmers is use of plastic sheets in fields. They

divide the field into four parts. Each year, one part is covered with plastic sheet to collect water for irrigating the other parts. In the subsequent years, other three parts would be used in turns. Polyethylene film with 0.01-mm thickness is used. This lasts for one year only.

In the beginning of the 121 or Rainwater Harvesting and Utilisation (RWHU) project, farmers were not confident that it would be beneficial to them. To impress upon them, pilot projects were implemented in some progressive minded farmers' houses. Of course, this had the concerned farmers' inputs too. After one year's demonstration, nearby farmers started taking interest.

The project was participatory in nature. Farmers had to contribute a larger part of the input. It included labour, local material and transportation. Government subsidised a small part, that of cement. According to a rough calculation, for the drinking water project for a 5 member family, total cost was about 124 US$. Subsidy from the Government was to the tune of 48 $ (40 per cent). For irrigation project, farmers had to shell out 80 per cent of the cost.

Although farmers shouldered 60-80 per cent of the whole project cost, the remaining part was still a large sum. To provide 1.2 million people with bare minimum drinking water this way, 12 million US dollars were needed for subsidy. Government could raise only 70 per cent of this amount. To fill up the shortage, a massive donation movement was mobilised by the Government and the media. There was good response. People from all walks of life, other provinces and municipalities together contributed 53.28 million yuans (6.6 million US$).

Because of the introduction of '121' project, farmers who have asphalt roads nearby considered themselves lucky. They could harvest rain from the road, bring it in open channels and store in underground cisterns. This water was subsequently pumped with hand-pumps for irrigation. Wherever asphalt roads were not present, mud roads, threshing yards etc are used for harvesting water.

In houses where roof area was not sufficient to produce enough water, the courtyard is lined with concrete slabs. 100 square metres of roof and concrete yard were found adequate for a five-member family in areas of 400 -mm rainfall.

The water cellars used for irrigation are usually underground and is bottle shaped. Its inner wall is pasted with 3 to 4 centimetre thick cement mortar to control seepage loss. Top and bottom of the cellar is built with concrete in arch shape. This was to support the overburden of water weight. In sandy areas, walls had to be in concrete. Storage capacity for drinking water ranged from 15 to 20 cubic metres. For irrigation purposes, 30 cubic metre storage is necessary for two applications in 1 mu land. (mu is a Chinese land unit equal to 1/15 of a hectare)

One of the methods to ensure efficient use of water is covering the field with plastic films. To increase soil moisture around the plant, the crop is planted in ditches between ridges. Ridges are covered with plastic film. During rains, most of the water will be concentrated in ditches. This method is followed in grain crops like wheat.

Thanks to the '121' project, villages of Gansu could get 10 lpd (litres per day) and animals 30 lpd in normal year. Though the quota is below normal, considering the local conditions, it is a sort of minimum guarantee. Earlier, on an average, each family had to spend 70 man-days per year to collect water from far away sources.

APPENDIX

"A DECADE IS SUFFICE TO DROUGHT-PROOF THE COUNTRY"

An Interview with Anil Agarwal

Centre for Science and Environment (CSE), the Delhi based NGO is in the forefront of popularising Rain harvesting in the country. It has published impressive publications like Dying Wisdom, Making Water Everybody's Business, Water links etc. It is striving hard to revive the Traditional Water Harvesting practices of the country. It floated National Rain harvesters Network and is bringing a very informative newsletter - Catch Water. Anil Agarwal, CSE Director strongly argues that Rain harvesting has to be a people's movement. Excerpts of an exclusive e-mail interview is given below:

? You assert that it is possible to drought-proof the country in a decade. To achieve this, what action plan from people and Government you envisage?

This work does not require more than a decade. I strongly advocate community-based rainwater harvesting. This is the tradition of our country. If rural people need technical advice for catching rain, that and the economic support as catalyst have to be provided by the Government. The harvested rainwater can be stored in surface water-bodies like tanks or can be used for groundwater recharging. Once if groundwater is recharged, it would be available in plenty during drought period also.

Government and people have to put a sort of joint effort. Some of the poor communities might not be able to spend for water harvesting structures. But it is also important that the Government should not provide for all the expenses. A portion of the whole expenditure of at the minimum, labour should come from rural communities. If not, the water harvesting structures will not have ownership.

Before constructing structures, organising local people is also important. Because, in laymen, deep thinking has to start about rain harvesting. Once the structures are made, then people have to shift their attention from harvesting to the maintenance of the structures. Cropping arrangement should be in such a way that the benefit should not go to only a selected people. Water use has to be done taking care to ensure that groundwater level does not fall once again.

? In our country, Rain harvesting *vidya* to suit any geographic condition is there. Leave alone politicians, even our mainstream media has failed to identify this and to project it in right perspective. Do you agree with this?

Throughout the world, in the last 100-150 years, in the issue of water management, two main paradigms can be noted. Communities had a role in the supply of water. That was taken over by the Government. With the advent of dam and bore-well technology, there was a shift from rain harvesting to its products like river water and ground water. This was the second paradigm. As such it is not surprising that they did not give attention to rain harvesting in our country too. As a result, our rainwater harvesting systems slowly declined. Especially wherever the Government was active in supply

of water. In Himalayas and northeastern region where the Government water supply could not reach, the tradition of rain harvesting is still in practice.

As such, it is not surprising that media did not give attention to RWH system. Media reflects only the discussions in the society, their exchange in issues and the wisdom the society might possess. Creating new knowledge is not its job. That has to be done by the other classes of the society. When we look up the issue of RWH and document the tradition prevailing in different parts of the society, media has given us tremendous support in publicising that concept.

? Common men, by adopting Government location- specific in-situ methods, can achieve good success in Rain harvesting, sans subsidy. This aspect is proved by movements headed by Tarun Bharat Sangh, Alwar, Saurashtra Lok Manch, Gujarath etc. Even then, our Government and bureaucrats are not ready to acknowledge the *Janshakthi* and to take it to confidence. How do you analyse this mental block?

It is true that since the last 15-20 years few groups in the country are trying to control human activities negatively affecting environment. Starting from the field of rain harvesting they are working in the fields like agriculture, animal husbandry and forest management. For a long time our Governments did not try to learn lessons from their efforts. A good example by a State Government can be seen in Madhya Pradesh. It is a watershed programme with people's participation. In four years, it has spread to 8000 villages. The inspiration was given by Digvijay Singh. He got this idea from Anna Hazare of Ralegaon Siddi. When he assumed the charge of Chief Minister, Singh spread the programme throughout the state. After the drought of 1999-2000, the media breeze touched the sleeping politicians. Media projected very effectively that rain harvesting is the solution for this problem. After that, many state Governments have started implementing RWH in a big way, especially in urban level, Delhi Government and in rural level, Governments of Andhra and Madhya Pradesh and Gujarath. Andhra and Gujarath have taken RWH very seriously. In three months, 10,000 check-dams are constructed in Gujarath.

? You advocate revival of Traditional Water Harvesting system.

Some, like tanks, are already lost. To what extent revision of System is possible and is practical?

Systems like tanks never get destroyed. What can happen is in the channels and its storage area, silt might get accumulated. The catchment that supplies water might get declined. If we are to rejuvenate this, then we have to bring the tank, the channels and the catchment to their state of yesteryears. Andhra Pradesh and Madhya Pradesh Governments have taken up tank rejuvenation programme in a big way. In Tamil Nadu, a NGO by name PRADAN is organising a federation of tank committees and is helping in the rejuvenation of tanks.

According to the report of the National Committee on Integrated Water Resources Development, if the loss of storage capacity due to the decline of tanks in the whole country is valued in terms of capital loss, it will come to 5,000 crore rupees. This is a fact that we definitely have to take into account. It is not sufficient if we think about constructing newer and newer water harvesting structures; we have to give due attention to rejuvenating our traditional structures as well.

? Long back, Central Government has drawn a Model Groundwater Conservation Bill and has sent to all states for adopting. States like Kerala are reportedly considering making it into an act. Thinkers who have studied the draft, point out that, instead of conserving ground water, the bill will conserve bureaucrats' vested interest. Do you think ground water can be conserved by stringent legislation?

Since that draft contained lot of bureaucratic methods, I agree that it is not practical. For example, according to that, there has to be a bore-well inspector. He has to visit the site and decide whether one could have a bore-well or not. This sort of process is totally impractical because that requires a lot of bureaucrats. There is no guarantee that the officer would be sincere.

We have seen that communities are highly concerned about the groundwater. There are examples where local people have formulated a crop pattern in which more people share groundwater. Main reason behind this awakening is that they have already been harvesting rainwater and have a feeling of ownership of the water resources.

That is why, in my opinion, we do not need to have any law that would strengthen the bureaucracy. What is needed is a programme and law that will facilitate the local communities to manage their water and other natural resources. Let the community decide and frame its own rules as to who can possess a bore-well and how much water can extracted from that source.

This is what Madhya Pradesh Government intends to do. In areas where watershed programme is successfully implemented, they plan to bring a legislation that would empower the watershed committee to control the water usage. On my suggestion, sometime ago, in Arwari watershed of Alwar, Tarun Bharath Sangh had organised an Arwari Parliament about managing the water resources of that watershed area. One rule the Arwari Parliament had framed is that the use of groundwater should not be too much; excessive use would dry up the now overflowing Arwari River that was flowing only for six months till recently. Communities that have initiated efforts regarding water management have shown sense in this matter. Laws should be in such a way that they rejuvenate the communities efforts to manage their water resources. In regard to water, self-management as advocated by the *Gram-Swaraj* concept of Gandhiji is the best.

Expressing fears on Government's 'target-oriented', hasty RWH projects, you had commented that " Water Harvesting can easily turn Money Harvesting futile exercise". Would you please elaborate?

Government's approach is always centered on annual plan and has a fixed target. Money always comes late, and then it has to be spent in a hurry-bury. Contractors are fixed and are asked to construct several structures. In the constructions of structures, lot of money harvesting takes place. That is why 'rain harvesting project' converting into 'money harvesting project' is very easy. We are asserting that unless local people are organised, construction of structures should not begin. Communities have to be organised for construction and maintenance of structures long before actual work starts. In other words, Government has to spend one or two years to organise the locals and has to arrive at majority opinion regarding the problem and its solution. Only after this is done, financial aid has to flow to the communities for implementation. But then, this methodology is

not conducive for Government's usual style. Watershed Development project at Madhya Pradesh has shown that if the Government is serious, this method of organising local people earlier is possible. In Gujarath lots of check-dams are being constructed in a hurry making financial profits to the Government. It is very essential to prevent rain harvesting from turning to money harvesting schemes. Otherwise, the whole process might get bad name. In departments concerned with water, there are many officials who are not for rain harvesting. Money harvesting strengthens such people. It is unfortunate.

? You have rightly pointed out that RWH can become a starting point for poverty eradication as in Alwar, Ralegaon Siddi etc. There is one more important point: Checking urban migration. Your comments, please.

There are many studies in the respective villages where RWH has eradicated poverty. All these studies have noted that migration as a result of economic crisis has considerably reduced in these villages. People were able to lead life pursuing their professions in their own native places. They need not go to cities desperately searching for jobs. Such a development is seen in Ralegaon Siddi, Alwar and many other villages. In a study conducted by Kanchan Chopra and others of Institute of Economic Growth, such a positive development has happened in many areas, some of them not well known.

? CSE has remarkably pioneered attempts to promote RWH in the country and is pursuing it with a missionary zeal. Of late, there is a sudden interest in the subject, especially from people in power. How do you view this? Is the country on its way towards drought-proofing?

Government waking up all of a sudden in regard to rain harvesting has definitely brought happiness to us. Starting from the Prime Minister, City and Rural Development Minister, all have started talking about water recharging. So are some of the State Governments. We have to give considerable credit for this to the media. During the time of drought they have encouraged us and have built pressure on the Government to take all possible remedial measures. One main concern now is about the speed with which the State and the Central Governments intend to work. We strongly believe that only if local people are socially organised, you can get success in the mission.

This is such a task for which if you channels the 'natural investment' only it might be insufficient. You have to channelise the social investment' that the economic experts define. This means, the co-operative and working capacity of a group for a common cause.

Water is an unusual resource. It has the capacity to unite people as well as to divide them. It can take you upto a war. According to an environment history book of Netherlands, water management is in the root of their democratic tradition. Since that country is below the sea level, for water management, their whole community has to co-operate. Even in India, it was like this in good olden days. We have to bring it back to implementation. Favour to the system of Panchayat Raj institution and community based water management are subjects with mutual connection.

Addresses of some of the Rain harvesters figuring in this book:

Lakshminarayana Bhat HG
S/o B.Ganesh Bhat
B. Dodderi Post, Sorab Taluk, Shimoga Dt
Karnataka

Richard Rebello
Maria, Post Santhekatte
Udupi 576125

Gopalakrishna Bhat
Kanavu, Post peruvaje, Sullya Taluk
Karnataka

Subrahmanya Bhat
Siddamoole, Post Perlampady, Sullya Taluk
Karnataka

UKB Nambiar
Ashwathi, Thaze Chovva
Kannur,Kerala

Rajarama Sharma
Palaneeru, Nalka, Post perla 671552, Kerala
Monappa Karkera, Post Mundoon, Via Darbe
DKDt., Karnataka

Vishwanath
Rainwater Club, 264, 6th Main Road
6th Block, BEL Layout
Vidyaranyapura 560097

Shyamjinhai Antala
Ram-Krupa, Opp : Bus stand, Dhoraji 360 410
Gujarath

Ramani R
Ramadies Chritable Trust, 5(1050) 41st Street
TNHB Colony, Korathur, Chennai 600 080

Tarun Bharat Sangh (TBS)
Beekampura -Kishori
Thanagazi, Alwar 301022
Rajasthan

Addresses of Institutions and a few individuals who have implemented RWH

Institutions :

Centre for Science and Environment(CSE)
41, Tughlalkabad Institutional Area
New Delhi - 110 062.

RUCHI
Technology complex
Bandh, Bhaguri, Solan 173 233
Himachal Predesh

Gram Vikas Navyuvak Mandal Laporiya (GVNML)
Laporiya Village, Via-Dudu,
Jaipur Dt, Rajasthan 303 008.

CECODECON
Agro Action, Development Centre
Shilki Dungri, Chaksu 303 901
Jaipur Dt, Rajasthan

Watershed Organisation Trust (WOTR)
Paryavaran, Behind Market Yard, Ahmednagar 414 001
Maharashtra

Gram Gaurav Pratisthan
PO Box No. 1202
67, Hadapsar Industrial Estate
Pune 411 013, Maharashtra.

Bochanaswami SA Public Charitable Trust
Shri A Swaminarayan Centre
Shahibaug, Ahmedabad - 380 004
Gujarath.

Saurashtra Jaladhara Trust
Gharda Tehsil, Bhavnagar, Gujarath

Malanadu Development Society (MDS)
Kanjirapally, Kottayam Dt, Kerala.

Peermade Development Society (PDS)
Peermade, Idukki Dt, Kerala.

BAIF
Kamadhenu, PB No 3, Sharadanagar
Tiptur Hassan Road,
Tiptur 572 202, Karnataka

DHAN
18, Pillaiyar Koil street,
SS Colony, Madurai 626 010
Tamilnadu

Tamilnadu Water Supply & Drainage Board (TWAD)
31, Kamarajar Salai, Chepauk, Chennai - 600 005

Chennai Metro Water
No.1, Pumping Station Road,
Chintadripet, Chennai - 600 002

Rainwater club
264, 6th Main Road, 6th Block, BEL Layout,
Vidyaranyapura - 560 097

Alacrity Foundations Pvt. Ltd
Atandra, 25 (Old No 15), Tirumalai road,
T-nagar, Chennai - 600 017

KRG Rainharvesting company
AA-98, Anna Nagar, Chennai - 600 040.

Annamalai Refforestation Society
PB No.5, 288, ROA Colony, Sri Ramanarasam Post,
Thiruvannamalai- 606 603, Tamilnadu.

Palmyra
Centre for Ecological Land use & Rural Development
Auroville-Aurobrindavan 605 101
Villupuram Dt, Tamilnadu.

Individuals

Prof. Dinesh Baishya
Sangeeta, Ananda Nagar,
6th Mile, Guwahati 781 022,
Assam.

Hardevsingh Jadeja
Raj-samadhiyala, Rajkot Dt,
Gujarath 360 020.

Anjaneyalu R.
1-4-27/72/92, Padmashali Colony,
Kavadiguda, Hyderabad - 80.

Dr. Sekhar Raghavan
D-15, Bayview Apartments, Kalakshetra Colony, Besant Nagar,
Chennai - 600 090

Jeyakumar R.
Rajparis Civil Constructions Ltd, Raj Court
162-B, Greams Land, Thousand Lights
Chennai - 600 006.

MN Mitra
TRY Charitable Trust
Flat No.22, Temple View Apartments, Dr. Vasu Dev Nagar Extn.,
Thiruvanniyur, Chenneai - 600 041.

Jayasudha
New 35, Old 16, Sriram Colony,
Abhiramapuram, Chennai - 600 018.

DV Subramanian
Krishna Kutir, 18(N) Justice Sundaram Road
Mylapore, Chennai - 600 004.

SV Krishnan
Raagasudha, Old No.85/2, New No.16,
Luz Avenue, Mylapore, Chennai - 600 004.

Dr. D. Chamdrashekhara Chowta
Sam ruddhi Charitable Society,
Miyapadavan, Via Manjeshwar,
Kasargod 671 323

Manoj Samuel
Technical Trainer, KVK, CPCRI Campus, Kasargod

Terry Thomas
Agrocrat, Peruvayal Post,
Calicut - 673 024, Kerala.

Krishnanath Pai
Secretary, Kannur Water Conservation society,
Anugraha, Behind Deepika Press,
Pallikunnu, Kannur - 670 004.

Winny D'Souza
Sweety Cottage, NGO's Colony,
Ajjarakad, Udupi - 576 101, Karnataka

Mohan Das
Airbail, Siddapura - 576 229, Kundapura Tq,
Udupi dt., karnataka.

Some Web-sites on Rain Water Harvesting

www.cseindia.org
www.rainwaterclub.org
www.twadboard.com
www.aboutrainwaterharvesting.com
www.rainwaterharvesting.com
www.WOTR.org
www.ci.austin.tx.us/watercon/rainwater.html
www.ms2.pccu.edu.tw/-g8710704
www.geocities.com/rainforest/canopy/4805

E-magazines & Newsletters etc

http://akash-ganga-rwh.com/RWH/AkashGangaNewsLetter.html
http://www.watermagazine.com
Discussion Group :
http://groups.yahoo.com/group/akashgangachennai/

For Futher Reading:

A Water Harvesting Manual for Urban Areas, CSE
Dying wisdom, Edited by Anil Agarwal and SunitaNaraian, CSE
Making Water Everybody's Business, Edited by Anil Agarwal, Sunita Narain & Indira Khanna CSE
Waterlinks-2, Water Harvesters Directory, CSE.
Catch Water, monthly bulletin of National Water Harvesters Network, CSE
Handbook of Rainwater Harvesting published by Rajiv Gandhi National Drinking Water Mission,
Rainwater Harvesting Technology for drinking purpose published by Structural Engineering Research Centre,
The Promotion of Community Self Reliance by Dr.Margaret Khalakhina, Oxfam India
Rejuvenating the Ruparel by Vir Singh, Tarun Bhasat Sangh
Story of a Rivulet Aravari by Jashbhai Pate,lTarun Bharat Sangh,
Ripples of the Society, Gandhi peace Foundation
Rajasthan Ki Rajath Boomdein (Hindi) by Anupam Mishra, Gandhi Peace Foundation
Aaj Bhee Khaden Hain Taalaab (Hindi) by Anupam Mishra, Gandhi Peace Foundation
The Good society by Ganesh Pangare & Vasudha Lokur, INTACH
From Poverty to Plenty by Ganesh & Vasudha Paugare, INTACH
Water management in Homes & Villages by Dr. Felix Ryan, Ryan foundation
Rain water catchment systems for Domestic supply. Designe, construction and Implementation by John gould and Nissen-Petersan, ITDG, UK.

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