AJSS, Vol .1, No.1, Mar-Aug 2002, pp 49 - 56

RAINWATER HARVESTING IN INDIA

Dr.Rekha Jagannath*

Abstract

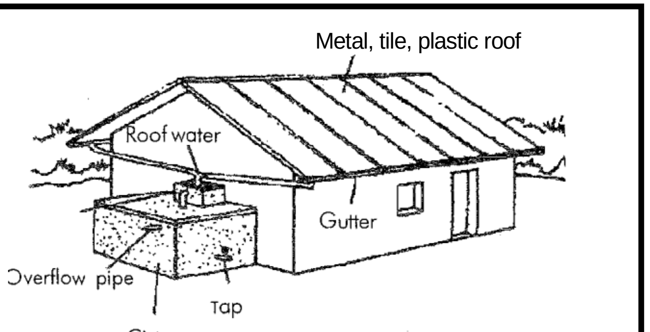
The objective of this article *is* to provide awareness into the process of rainwater *harvesting so as* to make people proactive *in conserving* fast *depleting* water resources through *this technique, which has been used in* India from *time immemorial, but is* now forgotten *behind the insignia* of modernisation. The article *highlights the* benefits of rainwater *harvesting such* as: provision *of* an economical water conservation measure, reduction of *the burden on* other sources of *water, provision* for agriculture *when* there *is* no rainfall, *alternative* and cleaner *source* of *drinking* water, *prevention* of top soil erosion, reduction of the possibility of *floods,* improved plant growth, greater *responsiveness* of water provision, and connection of water *supply* to *natural* water cycle. *It* also *gives* information *regarding the* rainwater *harvesting* practices *in* some countries abroad for *further* comparison *and* research into those practices *by* those who feel interested. Details of *different techniques* of rainwater *harvesting* are furnished so as to inculcate *interest in the* process. *Calculation of rainwater harvesting* potential is also discussed *for* estimating *the* possible benefits. How far India *has moved in this* direction is briefed for those who *would* want to *bring* about changes connected to *their micro set up* or policy *making* at macro level. The article is an endeavour to give a factual *picture of rainwater harvesting in* India, with the hope that it would inspire *more* popular implementation of *this futuristic* source of water conservation.

" Prof. (Dr.) Rekha Jagannath *teaches Economics at Christ* College, Bangalore. E-mail: *rekjag@hotmail.com*

Economic development is a beautiful macro economic process in which persistent economic growth conceives improvement in the standard of living of the people at large. This great process is the function of both physical inputs and certain mental traits. Among the physical factors, water is a fundamental factor providing for biological existence, domestic cleansing, waste disposal agriculture, power generation, transport and industrial use.

From ancient times, water is preserved for various reasons. Now it is imperative to conserve water, both potable and non-potable, as it is fast depleting. There is also need to prevent wastage of water, replenish lost water, reduce the cost of providing water and avoid its periodical scarcity. There is also visible over-exploitation of water and environmental stress. Pollution has almost destroyed aquatic flora and fauna. It is also posing a serious threat to human life.

In most populous parts of the world, it is observed that there is scarcity of water that obstructs even accepted levels of food production from irrigated agriculture. It is also difficult to meet perennial water needs for domestic and environmental purposes. A study by the Colombo based 'International Water Management Institute' (IWMI) expressed concern over the depleting water resources and the situation in the 1990s and the first quarter of 2000 pertaining to the semi-arid zone of Asia. The study was based on the water supply and demand for water in 118 countries of the world.



Roof catchment

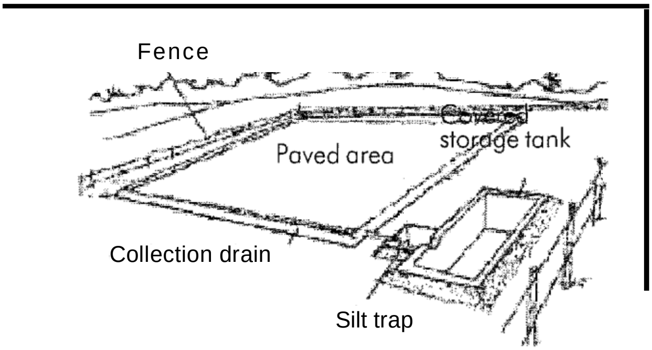
In another study by 'United Nations Environment Programme', about 1/5th of the world's population lacks access to safe drinking water. About 1 /3rd of the world's population now lives under moderate or high water-stressed conditions where water consumption is more than 10% of the fresh water supply. There is urgent need for action to maintain the health of our water systems.

Supply of subsidised electricity has benefited the rural and the urban affluent and led to over-exploitation of water. The sufferers are the rural poor as they are economically the most vulnerable. Water scarcity imposes greater burden on them to procure water. So also in case of water-borne diseases, the economic burden borne by the poor is much greater than that borne by those who can afford it. The point is that it is necessary to recognise the economic value of water to the masses and adopt the most feasible water management projects that make the masses the stake-holders in the process. It is therefore very necessary that the masses understand the water management process. Hence there is need to revive traditional methods of rejuvenating and conserving water resources practiced in ancient and medieval times. One such proven techniques of water management that has now become obscure with growth of science and technology that needs revival, is rainwater harvesting.

Nature takes its own measures of refilling ground water through rainfall that infiltrates into the soil layers. Urbanisation exposes the soil to recharge very often, reducing the natural recharge capacity of the soil. There is already too much of groundwater development activity and therefore any further underground water development measure is not suggestible. But tapping natural groundwater potential for use during emergency without disturbing hydraulic equilibrium provides for sustainable economic development. It is also found that the plants grow healthier and faster with rainwater. Thus it helps sustainable agriculture in a country like India where 66% of the population depends on agriculture.

Most of the countries of the world have been practising several methods of rainwater harvesting. Most prominent of them are the USA, Canada, Austria, New Zealand, Africa, Israel, China, Ceylon and Thailand. India in particular has adopted rainwater harvesting for thousands of years although nature benedicts India to be one of the wettest countries of the world. Now rainwater harvesting is even more urgently necessary because of irregular water supply, seasonally and regionally. Increased developmental needs as well as increasing population stress the need for it too.

Rain -water harvesting, in simple words, refers to catching water where it falls. In other words it means collecting and conserving rainwater runoff wherever it falls, for beneficial use. It also involves such water being kept clean and not allowing polluting activities to take place near the area of rainwater harvesting. Choosing the method of rainwater harvesting requires an understanding of the process of hydraulic cycle. Circulation of water around the earth in various forms is termed as hydraulic cycle. Evaporation of water from the earth is due to heating of water through sunlight. Water comes back to earth in the form of rainfall, snowfall, dew and hail. With higher temperature of air mass, more water vapour can be carried. Cooling of air masses causes change of water vapour into liquid droplets that fall due to their own weight.



Paved ground catchment

The greatest proportion of air moisture is from the evaporation of water from oceans, open bodies of water and ground. Water is also generated when plants transpire. The surface water in the form of rivers, lakes and oceans runs over land and becomes groundwater. Harvesting water on earth's surface may be done before it evaporates. Factors that determine the exact method of rainwater harvesting depend on 1) purpose for which the water is to be harvested 2) soil properties 3) land slope 4) construction costs 5) volume, intensity and direction of rainfall, and 6) social factors such as land tenure and water use practices. Some of the devices used for rainwater harvesting in agriculture are discussed below.

Terraces are useful in harvesting surface runoff for cultivating wet crops. Gabions

constructed of wire mesh designed like a cage are popular in Africa.

Gabions are filled with rocks and placed across small valleys to ad as barrages to obstruct runoff. Runoff water collected behind the barrage seeps into the ground conceiving high soil moisture. This facilitates farmers to plant crops behind the barrage after the rainy season.

Large jars made of Ferro cements are used in Thailand to harvest rainwater from the roofs. These catchment devices may provide a family with enough drinking water through the dry season.

Small ponds provide opportunities for diversification of agriculture. They are useful in harvesting runoff water in rural areas for small-scale irrigation, household uses, livestock watering and aquaculture. Ponds properly built and well managed have a long life.

Runoff water from a large area is mobilised into a small basin towards micro-catchment farming where fruit trees and other crops are grown.

Watershed to direct and concentrate runoff water into a specified area is a modification of micro-catchment farming. Ditches of low stonewalls constructed on land contours channelise water to the point of use.

Some rainwater seeps into the soil for the plants to absorb it through their roots: Rainwater harvesting through structures like Gabions and ponds enhances the proportion of water available to the plants. Water that infiltrates into deeper layers beyond the reach of the roots of the plants is called 'groundwater'. Groundwater is dispersed among particles of soil, sand, gravel, or rock and may not be harvestable. Soil type and moisture content determine the rate and volume of soil infiltration. This varies from a fraction of a centimetre to several centimetres per hour. Ultimately, water may reach porous soil layers saturated with water called the aquifers. Water is usually drawn from the aquifers by pumping or lifting from the wells. The top layer of saturation in the aquifer is called the 'water table'. Bore-wells or dug wells are constructed into this zone before water is drawn from the aquifer.

Aquifers get depleted if water is drawn from, faster than the rate of recharge. If this happens, wells go dry. Hence they are often dug deeper as a temporary remedy. Aquifers are recharged as rainwater infiltrates into the water table. If a depleted aquifer is not recharged, it only worsens the problem. Slow runoff rate encourages infiltration into aquifers and fast runoff rate decreases infiltration just as in the case of deforestation. Many rainwater harvesting practices reduce runoff rate and accumulate water in the aquifers.

Spring water that seeps in may be harvested and also be a good source of drinking water. Water that is perched above rock or clay layer on the hillside flows from the hillside as spring. These water bodies dry up if the watershed area is cleared off vegetation. Drying up of the springs could be prevented by building water-harvesting structures on the watershed to collect rainwater and increase inflow into the aquifers. Such rainwater harvesting measure assists in maintaining enough water supplies to the rural areas.

In hill top villages, there are several alternatives such as drilling, digging wells, impounding water by *nala* dams and excavating. These are adopted in the frontier region and Maharashtra area of India. However, underground tanks are popular here.

Due to increasing demand for water and fast depleting surface water, groundwater exploitation is inevitable in urban areas. But even groundwater potential is depleting due to over-exploitation caused by increased urbanisation. So there is need for concentrated efforts to recharge groundwater through least expensive eco-friendly 'rainwater harvesting' measures by both Government and non -Government Organisations. Some of them are briefed below.

Artificial recharge is the process of promotion of seepage of rainwater into the artificial formation through some deliberately planned methods. Some of the suggested methods are water-spreading, recharge through pits, trenches, bore-wells, shafts and directly diverting rainwater into the existing wells. The choice out of these methods and the extent of success of the method depends on the local water conditions, condition of the earth and water use.

Direct recharge through wells involves connection of rainwater through a sump to the underground waterbed. These wells could be used both as production wells and recharge wells. With this method more roof top rainwater could be efficiently utilised. There is high rate of recharge through this method. Groundwater could be conserved for use during the days when there is no rainfall.

In urban areas the availability of roof top rainwater is so high that if diverted to proper use, it will increase groundwater reservoir and also reduce the water scarcity in urban areas. Normally rainwater is left to flow into the drains. Instead of this, rainwater outlets could be connected through a pipe to a storage tank and let into gravel-filled trenches, pits or existing open wells or bore wells to be used as recharge points. This method is simple, less expensive and, if followed at micro levels by all households, will help improve groundwater capacity of the area very effectively. Depending on the area and the construction of the house, different structures can be adopted for groundwater recharge through this method.

Deep pits have to be dug away from the building foundation where the soil is more pervious. These pits must be filled with pebbles in the first layer, gravel in the next and sand for better percolation. Top sand layer has to be cleaned once in two years to remove the accumulated silt to restore percolation. Pits are recommended to be of 1.0m diameter and 2 to 3m depth.

Rainwater could be let into recharge structures taken up in the vacant areas, parks, playgrounds, street corners, and pavements. Pavements could be used to recharge groundwater and to collect road runoff. A trench for infiltration of 0.5m width and 1.5m depth filled with porous material and large perforated pipe to distribute storm runoff speedily and to hold more water, serves as the best recharge facility. Along the street corners and wherever feasible, infiltration pits of 1 m diameter and 2 to 3 m depth can also be taken up and connected to the trench to accommodate more storm run off for recharge.

How much of rainwater can be harvested is theoretically calculated. The quantity of rainwater received over an area is called rainwater endowment of that area. The amount that could be effectively harvested out of that is called the water harvesting potential:

Water harvesting potential = Rainfall (mm) x Collection efficiency

Collection efficiency considers the fact that all the rainwater falling above an area cannot be harvested. A significant proportion of it escapes collection due to evaporation, spillage, etc. Runoff coefficient and first flush wastage are accounted when collection efficiency is estimated.

Water harvesting potential improves with the improvement in collection efficiency and reduction in runoff coefficient and reduction in first flush wastage. It is found that normally water is 4 to 5 times the potable water requirement of a family of 4 people.

Most of the above-mentioned methods are to be undertaken by either the

Government or the Non-Government Organisations. For households, rainwater harvesting is mainly through roof catchments or ground catchments. Roof catchments have the advantage that they are near the users, if roof is suitable for this purpose. Groundwater catchments are costly to construct and they have to be carefully maintained. They also require large plots of land that may not always be available in urban areas and hilly regions. But ground catchment provides good quality of water for community use. These ground catchments are either connected to underground tanks (very popular in arid and semi-arid areas, particularly in Africa) or a connected tank above the ground level as the environment provides.

In all the above measures at the macro level, 'Central groundwater Board' is trying area-based projects for implementing rainwater harvesting. It is assisted by the connected State Governments and Non-Government Organisations in rejuvenating ancient and medieval rainwater harvesting measures in the form of tanks, ponds, lakes and dams. Laudable attempts have been made in this direction in Rajasthan, Maharashtra, Tamilnadu, Delhi and Andhra Pradesh. In Delhi, Coimbatore and Hyderabad, rainwater harvesting is made compulsory for all buildings that are to be constructed. But there is need to make rainwater harvesting compulsory at both macro and micro levels at the present juncture to replenish diminishing water resources in the most sustainable, cost effective and effective way, both in India and in rest of the world.