International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Water Conservation

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Abstract
'Water is elixir of life' said Sir. Chandrasekhara Venkata Raman. Out of the three basic necessities of life namely air, water and food, water is the most disputed one. It is not for nothing world statesmen say that the future wars will be fought for water. It is very interesting to look at our Globe and understand how the nature is trying to help us sustain our life. The air envelopes us and we have no problem in taking the required air into our body. Water is available to us in our water bodies and they are routinely replenished in the purest form by precipitation. We get food naturally on land and in water but we have intervened here tremendously to produce sufficient to cope up with the population but without adequately following the nature's laws. Though the nature's wealth is constant, the case of water is unique unlike air or food. In this paper we will deal with water availability and the dire necessity of its conservation.

History of water

Some 70% of the earth's surface is water, but most of that is in ocean. By volume, only 3% of all water on earth is fresh-water, and most of this is largely unavailable. About three-quarters of all freshwater is locked away in the form of ice caps and glaciers located in polar areas far removed from most human habitation; only about 1% is available surface freshwater. But of this one percent of the world's total supply of water only one-hundredth is considered easily accessible for human use.

Global per capita figures on water availability give an exaggerated idea. But the world's available freshwater supply is not distributed evenly around the globe, throughout the seasons, or from year to year. In some cases water is neither where we want it nor in sufficient quantities. In other cases we have too much water, in the wrong place, at the wrong time. In fact we "live under the tyranny of the water cycle,"

The Water Cycle (The Hydrological Cycle)

The Water (Hydrological cycle)

The earth's hydrological cycle acts like a giant water pump that continually transfers freshwater from the oceans to the land and back again. In this solar-driven cycle, water evaporates from the earth's surface into the atmosphere and is returned as rain or snow. Part of this precipitation evaporates back into the atmosphere. Another part flows into streams, rivers, and lakes, commencing a journey back to the sea. Still another part sinks into the soil and becomes soil moisture or groundwater. Plants incorporate soil moisture into their tissues and release it into the atmosphere in the process of evapo-transpiration. Much of the groundwater eventually works its way back into the flow of surface waters.

There is a lot of water on Earth. Approximately **1260 million trillion litres (1260 billion cubic kilometres)** can be found in our globe. This water is in a **constant cycle** -- it evaporates from the ocean, travels through the air, rains down on the land and then flows back to the ocean. The oceans are huge.

About 70 percent of the planet is covered in ocean, and the average depth of the ocean is well over 1,000 meters. 98 percent of the water (1235 billion cubic kilometers of water) on the planet is in the oceans, and therefore is unusable for drinking because of the salt. About 2 percent of the planet's water (25 billion cubic kilometers of water) is fresh, but 1.6 percent of the planet's water is locked up in the polar ice caps and glaciers. Another 0.36 percent is found underground in aquifers and wells. Only about 0.036 percent of the planet's total water supply is found in lakes and rivers. That's still thousands of trillions of litres, but it's a very small amount compared to all the water available.

The vast bulk of the water on Earth is regarded as **saline** or **salt water**, with an average salinity of 3.5 ppm, though this varies slightly according to the amount of runoff received from surrounding land. In all, oceanic water, saline water from marginal seas, and water from saline closed lakes amounts to over 98% of the water on Earth. The remainder of the Earth's water constitutes the planet's **fresh water** resource. Typically, fresh water is defined as water with a salinity of **less than 1 percent that of the oceans** - i.e. below around 0.035ppm. Water with salinity between this level and 1ppm is typically referred to as **marginal water** because it is marginal for many uses by humans and animals. The earth’s fresh water distribution is very uneven. Let us just understand how it is

- **Ice caps and glaciers** **- 68.7%, of which**
  - Antarctic ice cap - 90%,
  - Greenland ice cap - 9%
  - Other glaciers - <1%,
- **Surface water** **- 0.3%, of which**
  - Freshwater lakes - 87%
  - Swamps - 11%
  - Rivers - 2%
- **Groundwater** **- 30.1%**
- **Ground ice and permafrost** **- 0.86%**
- **Atmosphere** **- 0.04**

Quantifying, in this world only 12,500 to 14,000 cubic kilometers of water is considered available for human use on an annual basis. On the basis of recent assessment only about 9,000 cubic meters of fresh water is available per person per year (1cubic meter equals 1,000 liters). By the year 2025 global per capita availability of fresh water is projected to drop to 5,100 cubic meters per person as another 2 billion people join the world's population. Even then, this amount would be enough to meet human needs if it were distributed equally among the world's population. That is where water conservation and equitable distribution gains prime importance.

Water Resources in India – an overview

The total geographical area of land in India is 329 (exactly 328.762) million hectares which is 2.45% of the global land area. The total arable land is 165.3 million hectares which is about 50.2% of total geographical area against the corresponding global figure of 10.2%. India possesses 4% of the total average annual runoff in the rivers of the world. The per capita water availability of natural runoff is at least 956 cubic metres per year.

The utilizable surface water potential of the country has been estimated to be 1869 cubic km. But the amount of water that can be actually put to beneficial use is much less due to severe limitations imposed by physiography, topography, inter-state issues and the present state of technology to harness water resources economically. The recent estimates made by the Central Water Commission indicate that the water resources utilizable through surface structures are about 690 cubic km.only (about 36% of the total). Ground water is another important source of water. Quantum of water which can be extracted economically from the ground water aquifers every year is generally reckoned as ground water potential. The preliminary estimates made by the Central Ground Water Board indicate that the utilizable ground water is about 432 cubic km. Thus, total utilizable water resource is estimated to be 1122 cubic km.

Water Resources of Kerala - an overview

Kerala State is situated in the humid tropics with two predominant rainy seasons caused by south-west monsoon (June-August) and north- east monsoon (September - December). On an average, the State receives 3000 mm annual rainfall, of which 65% is obtained during the south-west monsoon, 20% during the north-east monsoon and the remaining during the so called summer (January-May). The rainfall varies not only in time but also in duration.

For example, while Wayanad and Idukki areas receive 5000mm of average annual rainfall, Palakkad and certain areas on the eastern side of the Ghats receive only 2500mm. There are some areas in Attappady valley with only 600mm average annual rainfall. Generally the high ranges receive more rainfall than the other zones, mainly due the influence of hills. Areas on the eastern side of the Western Ghats have less rainfall and are rightly called ‘rain shadow areas’. The rainfall in regions close to the gaps, such as Palakkad, is also comparatively less due to the escape of the moisture-laden clouds through gaps. Usually the south-west monsoon is more vigorous in the northern part of Kerala and the north-east monsoon in the southern part and also in the basins of east flowing rivers of Kerala. While the seasonal distribution of rainfall depends on the monsoon winds to a great extent while the spatial distribution depends on the configuration of land especially the undulating topography of the Ghats. The flora and fauna of Kerala very much depend on the rainfall pattern and availability of water either as direct rainfall or as stream flow, soil moisture and ground water.

There are 44 rivers in Kerala of lengths more than 15 kilometers; 41 of them flow towards the west and the remaining 3 flow towards east. Most of these rivers are transitory because the only input of water is from rainfall mainly during the monsoons. It is important to note that these rivers are short and their basin areas are comparatively very small. The annual discharge from all the rivers of Kerala is estimated to be around 78000 million cubic meters of which 70000 million cubic meters is the contribution from the sub-basins in Kerala. It is worthwhile to note in this context that a single river like Godavari in the Andhra Pradesh has an average annual discharge of 105000 million cubic meters. The utilizable surface water is estimated at around 40,000 million cubic meters. The ground water potential of the State is estimated to be around 8000 million cubic meters of which more than 1000 million cubic meters is the present draft. However there are diverse views even on the calculation of utilizable potential. There are more than 6 million open wells in the State. Apart from these sources, there are several traditional sources like springs in the high lands and the tanks in the midland and the low land areas. The ‘surangams’ are the so called horizontal wells are popular in Kasaragod and even pockets of Kannur district. Wet lands such as Sasthamkottah in the low land belt of Kollam, Vellayani in the midland belt of Thiruvananthapuram and Pookot in the highland belt of Wayanad are potential sources of fresh water in the respective areas of the State. It is worthwhile to note that the transpiration from the natural plants and tees of uncultivated areas is estimated to be very high in Kerala.

Water Conservation

Why water should be conserved?

When we speak of water conservation here, we speak of fresh water conservation free from pollution intended primarily for human use such as drinking, domestic uses, industrial uses, agricultural uses and last but not least tourism uses.

A step to conserve water is the step to secure the future. The most essential among all the natural resources on earth is water. A drop of water is worth more than a sack of gold for a thirsty man. If each one of us makes efforts to save water today, it will save us later. Water conservation is the most effective and environmentally sound method to fight global warming and desertification. Water conservation is what that can reduce the scarcity of water. It aims to improve the efficiency of use of water, maintain and develop ground water storage, and reduce losses and waste.

The issue of water conservation is not about “saving” water—it is about having enough clean water at any given time and place to meet our needs.

Conservation is defined as “The wise use of the earth and its resources for the lasting good of men.” The conservation of our water resources depends on our wise use of these resources. Such wise use, without a doubt, begins at home and in our community. As we attempt to meet the water use needs of a growing population, issues of water quality and quantity will gain increasing significance in years to come. We cannot afford to take our water resources for granted. Droughts, for example, are natural occurrences that can cause water shortages. But human activities can cause water availability problems as well. Contaminating the natural waters with industrial, sewage or any such pollution will cause great damage to them. Contaminating ground water is all the more dangerous as once ground water becomes contaminated, it can take years or decades for it to clean itself naturally.

Over the years the rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts) water. Water conservation has become the need of the day. The idea of ground water recharging by harvesting rainwater is gaining importance in many cities. In the forests, water seeps gently into the ground as vegetation breaks the fall. This groundwater in turn feeds wells, lakes, and rivers. Protecting forests means protecting water 'catchments'. In ancient India, people believed that forests were the 'mothers' of rivers and worshipped the sources of these water bodies.

Some ancient Indian methods of water conservation

Just for nostalgia let us recapitulate some water conservation actions that our ancient people did. They might also give some ideas for us in our endeavors.

- A very good example is the well-planned city of Dhaulagiri, on Khadir Bet, a low plateau in the Rann in Gujarat. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the Western Ghats. A large number of tanks were cut in the rocks to provide drinking water to tradesmen who used to travel along this ancient trade route.
- Each fort in the area had its own water harvesting and storage system in the form of rock-cut cisterns, ponds, tanks and wells that are still in use today. A large number of forts like Raigad had tanks that supplied water.
- In ancient times, houses in parts of western Rajasthan were built so that each had a rooftop water harvesting system. Rainwater from these rooftops was directed into underground tanks. This system can be seen even today in all the forts, palaces and houses of the region.

- Underground baked earthen pipes and tunnels to maintain the flow of water and to transport it to distant places, are still functional at Bijapur in Karnataka Burhanpur in Madhya Pradesh, Golconda, and Aurangabad in Maharashtra.
- The tank canal irrigation system that prevailed in the Tamilnadu/Andhra Pradesh/Karnataka areas (old Madras presidency) inherited from the old Chola / Pandya Sangam period was connecting rivers and streams and developing irrigation Eries, Kulams and Ooranies was an excellent system of developing ground water and assisting cultivation all year around.
- Ancient period: In Tamil Nadu, rainwater was stored in public spaces separately for drinking and bathing purposes, which were called as Ooranies. Percolation tanks or ponds were also made for the purpose of recharge irrigation.
- Pre-independence era**:** Rainwater harvesting structures existed in low rainfall areas of Rajasthan; harvesting springs in hilly areas and mountainous regions; percolation ponds and tanks in Southern India.
- Villages in Thar Desert had an ingenious system of rainwater harvesting known as *kund* or *kundis* i.e. covered underground water tank.
- In Spiti valley of Himachal Pradesh, *kul* (diversion channels) irrigation is utilised to carry water from the glaciers to the village.
- Havelis in Jodhpur and Jaisalmer channel every drop of water into a container – usually under the courtyard, to store rainwater.
- The Viceregal lodge in Shimla, of 1880s, channels every drop of water from the roof of the building into two large tanks – one under the main front garden and the second next to the council chamber.
- The Indus Valley Civilization, that flourished along the banks of the river Indus and other parts of western and northern India about 5,000 years ago, had one of the most sophisticated urban water supply and sewerage systems in the world. They collected rain water as also built canals to bring water to use in the urban areas.

Threats to water resources

1. Deforestation

Large-scale deforestation around the watersheds and introduction of plantation crops in highlands replacing the natural vegetation reduced the storage capacity of soil and resulted in surface soil erosion in watersheds and sedimentation in rivers. This affected summer flow in rivers and some of the once perennial rivers and rivulets became seasonal in the last few decades.

2. Sand Quarrying and River Bank Agriculture

Sand quarrying in rivers and watersheds are killing the rivers. Such activities lead to bank erosion, lowering of water table and create several environmental problems. Ground water level in the watersheds depletes due to this. Agricultural practices in the riverbanks (and also inside the dry riverbeds) during non-rainy months also add to bank erosion and sedimentation in rivers.

3. Degradation of Water Resources

All the 44 rivers in Kerala are highly polluted by untreated domestic and industrial wastes and pesticides and fertilizers from the agriculture. Most of the industries are near the thickly populated riversides, often near cities and towns. There is no efficient water treatment system in industries and cities. Pollution level in some of the sites is far above permissible limits.

4. Land Reclamation and Construction

Sand filling of ponds, farmlands, wetlands and other water bodies affects natural water flow and groundwater recharge. Construction of new roads and buildings has blocked many canals, which were important for navigation and freshwater. Vast areas of wetlands and paddy fields have been converted into settlement and industrial areas in the post-independent era.

5. Increasing Urbanization

Shrinking areas of paddy fields, reduced agricultural and connected operations, new system of education which doesn't give practical applications of what one learns, reduced rural employment avenues, higher wages promotes more urbanization. Most of the people diverted from traditional jobs which were mainly caste-based as there was low demand. Cities in Kerala are not well planned to accommodate large population migration and therefore water supply becomes inadequate and often breaks down. Providing water in sufficient quantity and in time increasingly becomes a problem. Competition in suburban areas where there are more settlements of the poor leads to conflicts. Population increases domestic waste. Domestic wastes often block drainage channels and waterways. Water pollution not only affects availability of safe water, but also creates health issues.

6. Overdraft and Misuse

Overdraft, careless use and improper maintenance of delivery system contribute much to the water scarcity. Domestic drinking water used for gardening and even washing vehicles in big households consume several times the water needed for sustaining the life of a poor family. Number of deep bore wells is terribly increasing. Overdraft of groundwater has invited salinity intrusion far inland in certain locations in coastal areas. There is no way of accounting the theft and illegal use of water.

7. Lack of public interest

Public interest is not only not cultivated in vital issues but oriented towards non-issues by intelligent vested interests as can be very well understood from media presentations. Public interest is highly negative.

8. Inefficiency in Planning and Management

Government machinery is very slow and there is a lack of cooperation among the different departments involved in project implementation. This causes unnecessary delays in project completion. Government at all levels lack vision and foresight. All decisions generally are adhoc.

Why Water is Scarce?

- Lack of concern about the value of water
- Available sources of water tapped already
- Unscientific interventions in the natural water harvesting facilities
- Increase in water requirements due to increase in population
- Increase in water requirement due to change in life style
- Contamination of available water sources due to increase in human activities and
- indiscriminate dumping of Industrial waste
- Ignoring the well being of the poorer countries by developed countries
- Industrial development
- Human needs and desire for higher standards of living
- Expansion of agricultural activity

- Delay in project initiation time and implementation time due to increasing social, Political and environmental concerns

Water Harvesting

As we have understood the water is made available to us by nature on a systematic routine due to various climatological, geographical and geological phenomena. The habitations existed and continue to exist near water courses. In the present day due to technological development water is also brought to where habitations are positioned due to current concerns. Therefore there is human intervention in water's natural existence and device. And as such we need to look into various aspects of water harvesting by understanding and assisting the nature in conserving water for human use as it is a vital necessity of life. As we know precipitation i.e. rain or snow is the only factor assisting water conservation. Some methods of harnessing water are noted below.

Dams across rivers: Across rivers and streams we build these water retaining structures. They are constructed across big and medium sized rivers. Sometimes they are only for purposes of irrigation and sometimes they are built for both irrigation and power generation. They also control floods. They conserve water. The canals from the dams not only take water to fields for cultivation but on the way they assist in developing ground water. At times they cause water logging in the soil. However appropriately constructed dams when controlled and maintained properly go a great way in assisting in the conservation of water.

Check dams: The main function of the check dam is to impede the soil and water removed from the watershed. This structure is built across a stream, of shallow height and preferably done with local materials. It holds water as well as easily allows water to flow over when there is more inflow. A little water is also stored above the dam. This water recharges the groundwater.

Percolation Ponds: The percolation pond is a multipurpose conservation structure depending on its location and size. It stores water for livestock and recharges the groundwater. It is constructed by excavating a depression, forming a small reservoir or by constructing an embankment in a natural ravine or gully to form an impounded type of reservoir.

Irrigation Tanks: The main function of this storage structure is irrigating crops. It is constructed below the above-mentioned structures in a watershed. In Tamil Nadu, India, each tank irrigates from 10 to 5 000 hectares. In south India, there are about 2,000 000 tanks, irrigating about 3.5 million hectares. Earthen bunds are reinforced with masonry to collect and store rainwater for irrigation.

Water bodies: Lakes, tanks and ponds have immense potential to store rainwater. The harvested rainwater can not only be used to meet water requirements but also to recharge groundwater aquifers.

Rainwater harvesting

As we already stated rain is naturally harvested in the naturally existing water bodies. When we assist harvesting the following things take place

- Increases water availability
- Checks the declining water table
- It is environmentally friendly
- Improves the quality of groundwater through the dilution of fluoride, nitrate, and salinity
- Prevents soil erosion and flooding especially in urban areas

There are various sectors where rainwater is harvested. Let us look into them.

Agriculture

Conservation of water in the agricultural sector is essential since water is necessary for the growth of plants and crops. A depleting water table and a rise in salinity due to over use of chemical fertilizers and pesticides have made matters serious. Various methods of water harvesting and recharging have been and are being applied all over the world to tackle the problem. In areas where rainfall is low and water is scarce, the local people have used simple techniques that are suited to their region and reduce the demand for water. In deciding which techniques to use to make more efficient use of the available water, it is important to consider how crops receive or lose water. Crops receive water through rainfall, irrigation and stored soil water. They lose it through run off, evaporation and drainage. Some key principles on effective water management are:

1. Use rainwater effectively.
2. Make effective use of soil water reserves.
3. Take measures to avoid run off
4. Avoid wasting water through evaporation
5. Reduce water losses through drainage
6. Plan your irrigation

Some methods that are adopted in agriculture sector are mentioned briefly below.

1. Contour farming

Contour farming refers to field activities such as ploughing and furrowing that are carried out along contours rather than up and down the slope. These are done to slow down the water velocity so that water percolates into the soil and gets retained. The various methods are as follows.

a. Contour Ploughing b. Contour Furrows c. Bench Terraces d. Grass Strips e. Stone Lines f. Retention Ditches

2. Planting pits

Planting pits are a very simple form of free standing water harvesting structure that is easy to construct. They consist of small pits in which individual or small groups of plants are sown. The pits catch run off and concentrate soil moisture around the roots.

3. Earth basins

Earth basins are designed to collect and hold rainfall and are easy to construct by hand. They are square or diamond shaped basins with earth ridges on all sides. Runoff water is channeled to the lowest point and stored in an infiltration pit.

4. Semicircular bunds

Semi-circular bunds are earth bunds formed in U-shapes on a slope. The uppermost tips of the U lie on a contour so that run off is collected in the lowest section of the U. A shallow pit is sometimes also dug in this section to help concentrate moisture.

5. Cover crops / green manures

Cover crops are grown to protect the soil from leaching, erosion and to improve soil fertility. They build up organic matter in the soil, improve soil structure, suppress weed growth and increase soil fertility through nitrogen fixation. They also, reduce fluctuations in temperature and improve soil moisture.

6. Mulching

Mulching means covering the soil between crop rows or around trees with a layer of loose material such as dry grass, straw, crop residues, leaves, manure or compost. This helps to retain soil moisture by limiting evaporation, suppressing weed growth and enhancing soil structure, reducing runoff, protecting the soil from splash erosion and limiting the formation of crust. In addition, mulching reduces fluctuations in soil temperature which improves conditions for micro-organisms

7. Drip irrigation

Drip irrigation can conserve water especially when used in conjunction with roof top harvesting. The principle is very simple: water seeps slowly out of small holes in a pipe on the soil surface. Holes are normally located close to plants so that the water is targeted directly to the root zone

8. Conservation tillage

Conservation tillage refers to a type of agriculture where soil cultivation is kept to a minimum. It aims to reduce the negative effects of conventional tillage such as soil compaction, formation of pans, disturbance of soil fauna and moisture loss. The two main features that distinguish conservation tillage systems from conventional tillage systems are minimum cultivations and permanent soil cover.

9. Water harvesting from external catchment.

Water harvesting from external catchments involves diverting runoff water from an area that is not cropped to the area where crops are grown. Water is stored in a simple reservoir structure and can be applied to the crops when it is needed. The flow of water from the reservoir into the cropped area can be controlled using tied bunds that can be built up or dismantled as required. This technique is a much larger scale operation than the others.

10. Roof top harvesting of rain

Roof top harvesting of rain is a simple technique that can store large amounts of water from the rainy season for later use in the dry season. Although frequently used for domestic use, the stored water can also be used for small scale growing of high value horticultural crops which can be particularly drought sensitive. It works well in conjunction with drip irrigation described above. The technique is simple - run off from sloping roofs is collected in plastic gutters then diverted through a down pipe into a storage tank.

Rainwater harvesting in urban areas

In urban areas, the construction of houses, footpaths and roads has left little exposed earth for water to soak in. In parts of the rural areas of India, flood water quickly flows to the rivers, which then dry up soon after the rains stop. If this water can be held back, it can seep into the ground and recharge the groundwater supply.

This has become a very popular method of conserving water especially in the urban areas. Rainwater harvesting essentially means collecting rainwater on the roofs of building and storing it underground for later use. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply. Rainwater harvesting and artificial recharging are becoming very important issues. It is essential to stop the decline in groundwater levels, arrest sea-water ingress, i.e. prevent sea-water from moving landward, and conserve surface water run-off during the rainy season.

Town planners and civic authority in many cities in India are introducing bylaws making rainwater harvesting compulsory in all new structures. No water or sewage connection would be given if a new building did not have provisions for rainwater harvesting. Such rules should also be implemented in all the other cities to ensure a rise in the groundwater level.

Realizing the importance of recharging groundwater, the CGWB (Central Ground Water Board) is taking steps to encourage it through rainwater harvesting in the capital and elsewhere. A number of government buildings have been asked to go in for water harvesting in Delhi and other cities of India.

Rainwater harvesting stories of success and failures:

1. Once Cherrapunji was famous because it received the largest volume of rainfall in the world. It still does but ironically, experiences acute water shortages. This is mainly the result of extensive deforestation and because proper methods of conserving rainwater are not used. There has been extensive soil erosion and often, despite the heavy rainfall and its location in the green hills of Meghalaya, one can see stretches of hillside devoid of trees and greenery. People have to walk long distances to collect water.
2. In the area surrounding the River Ruparel in Rajasthan, the story is different - this is an example of proper water conservation. The site does not receive even half the rainfall received by Cherrapunji, but proper management and conservation have meant that more water is available than in Cherrapunji. The water level in the river began declining due to extensive deforestation and agricultural activities along the banks and, by the 1980s, a drought-like situation began to spread. Under the guidance of some non-government organizations, the women living in the area were encouraged to take the initiative in building johads (round ponds) and dams to hold back rainwater. Gradually, water began coming back as proper methods of conserving and harvesting rainwater were followed. The revival of the river has transformed the ecology of the place and the lives of the people living along its banks. Their relationship with their natural environment has been strengthened. It has proved that humankind is not the master of the environment, but a part of it. If human beings put in an effort, the damage caused by us can be undone.
3. The severe drought in late eighties and nineties devastated Chennai city. Bore wells were extensively dug; but soon due to sea water ingression they turned brackish. Under the leadership of Ms. Jayalalitha rainwater harvesting was extensively done in all roads by digging pits and all houses were forced to make rainwater harvesting pits. Now the story is that the bore wells have water and the quality is greatly improved.
4. In Gandhigram, a coastal village in Kutch district, the villagers had been facing a drinking water crisis for the past 10 to 12 years. The groundwater table had fallen below the sea level due to over-extraction and the seawater had seeped into the ground water aquifers. The villagers formed a village development group, Gram Vikas Mandal. The Mandal took a loan from the bank and the villagers contributed voluntary labor (Shramdan). A check dam was built on a nearby seasonal river, which flowed past the village. Apart from the dam, the villagers also undertook a micro-watershed project. Due to these water retention structures, the villagers now have sufficient drinking water, and 400 hectares of land, which earlier lay barren, has come under irrigation.

The future for India on the water front?

India's future can be bright or dismal depending on our action. We can shape our water future by having a clear policy. A holistic policy has not been in place for various reasons. Primarily because we have looked at these issues in a compartmentalized way. The Ministry of Water Resources looks after water; the Ministry of Agriculture looks after agriculture and disaster management; the Ministry of Power looks after hydro-electric power; the Ministry of Environment and Forests is in charge of climate change and climate convention; and the Indian Meteorological Department is under the Department of Science and Technology. Wherever land, water, flora, fauna and human beings are involved, issues cannot be compartmentalized. Different issues need to be addressed in conjunction with one another and not in isolation.

There is a need to develop a series of technical resource centres on monsoon management within a university or an institution. These centres can be synthesizers and not original researchers. They can put together research works from different agencies or departments and work out monsoon management strategies that are location specific, based on computer simulation models.

CONCLUSIONS AND SUGGESTIONS

For the people of Kerala need in water are fast increasing, whereas the resources are fast depleting. Management and conservation of water resources are being made more and more difficult and complicated.

What Kerala needs is an appropriate water policy at the state level and in agreement with the national water policy of India.

Water development projects shall be completed time bound.

People shall be trained to spread awareness in local level water conservation such as rainwater harvesting and enhancement of groundwater recharge.

Cleaning of public wells, ponds, afforestation must be encouraged.

Traditional methods of water conservation and agriculture are to be revived and initiated from the domestic level.

It may not be possible to revive the already destroyed water conserving facility such as tanks, ponds, paddy fields; but the existing ones can be saved and improved. Further destruction can be stopped.

Such methods are environment friendly and involve nominal expenditure and capable of solving problems associated with regional water scarcities.

Modern methods shall be brought in. Reclamation of water from waste water generated in such projects must be encouraged and water resources augmented.

The State needs a leadership with understanding, strong, enlightened and impartial political will to implement the people's need of long time redressel of the instabilities in the water front.

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