

# Are we Heading Towards a Water Crisis?

## Plea for a better Management of Our Groundwater Resources

### *Warning Signals*

Nature has been issuing warning signals like steep decline in water table, stoppage of base flow in streams and drying up of a large number of open wells and drilled bore wells. These have been ignored and there is masterly inaction on the part of Central and State Governments, research institutions, captains of industry and well-to-do farmers in setting right the deterioration in the availability of the most precious among our natural resources – groundwater. Water underground till recently had remained a precious resource to be tapped in times of need when all other sources of water had failed. This is no longer the case. The reckless way in which loans are being granted to drill more and more number of wells, drill deeper and deeper into the ground and withdraw water without exercising any restraint for running industries, erecting swimming pools and for growing crops like sugarcane which require enormous quantities of water, shows gross abuse. Great damage has already been caused and any further abuse of this resource will result in a water crisis.

It is the fine dispensation of Nature that, unlike oil, groundwater is a resource which can be replenished year after year provided adequate measures are undertaken to assure sustainable yields. Formerly the drinking water requirement of rural India was met by the construction of tanks and wells by the people themselves who also took care to keep these structures in good repair. This earlier system of self-reliant economy has given place to abject dependence on government even to meet basic needs like drinking water. Tanks have been allowed to fill with silt and remain dry for most part of the year and with no source of recharge, wells are dry, land is bare, without vegetation and hill slopes degraded due to heavy soil erosion. Matters can be set right if timely action is taken. Tanks can be desilted, bunds erected, contour ditches dug, and land levelled. But there is no attempt at harnessing the inexhaustible human resource in

setting right the deterioration that has set in the exploitation of groundwater.

### *Groundwater – A Limited Resource*

Realisation that groundwater is a limited resource despite annual recharge and should be carefully guarded, to satisfy our needs during periods of drought and not allowed to be squandered, is yet to dawn in the minds of our people. Indiscriminate drilling of bore wells is not the answer to the problem of restoring sustainable yields.

In the type of meteorological conditions prevailing in India where rainfall is restricted to about three months in a year, major dams are not capable of storing more than 10 to 15% of the rain water that falls in their catchment area. The dams are usually full by about mid August and the considerable quantities of water flowing into the reservoirs during the next two months in the form of heavy spells of rain has to be released through large spill ways. Taking note of the pattern of rainfall, water conservation through numerous large and small ponds is a much better alternative for storing rainwater – it has to be stored where it falls – *in situ*.

Our ancestors had a clearer conception of water availability and the need for conservation. They had, through their own labour, constructed at every favourable point a chain of reservoirs called tanks, any overflow from one at a higher level being fed to another at lower level and so on all down the course of the stream. These storage tanks which were kept in constant repair by village communities through voluntary labour, are now in a state of decay.

### *Who Owns Groundwater?*

Water, like fresh air, is common to all but it is becoming a big business now. Enterprising individuals who are lucky enough to tap a copious supply of water in bore wells drilled within their property have claimed ownership of the water and have started supplying it

in tankers to communities who are prepared to pay for it. Heavy withdrawal of water from such centres has resulted in most of the bore-wells in the neighbourhood going dry. Yet Governments have failed to take action to put a stop to such unregulated trading in a basic need as water.

Who owns the water and how to regulate its use are important issues which the Central and State governments have to face. In the pre-British days forests, tanks, grazing land and land adjoining the village were properties belonging to the village community as a whole. In the colonial rule which followed thereafter, Governments have appropriated ownership of these assets and there does not appear to be any legal provision for making the local people partners in the exploitation of these resources.

In actual practice two different standards are adopted in managing surface and groundwater resources. Landowners claim ownership of water occurring below their land with liberty to sink as many wells as they choose. There is thus no limit to the quantity of water which can be exploited and this has led to gross abuse in the utilization of a precious resource.

So far as surface water is concerned, Government claims full ownership and private individuals and even village communities are not allowed to erect check dams for catching rain water. There have been cases in recent years where governments have threatened prosecution of non-governmental agencies for constructing check dams.

Pollution of water resources is taking place on a colossal scale with no one being held responsible for the degradation of these assets? How can we ensure better utilisation of our land and water resources are issues of great importance which must be debated and norms fixed for better management. Good quality water is becoming a rare commodity and pollution is spreading fast. Once groundwater becomes contaminated it will be almost impossible to restore its potability.

Our knowledge of groundwater resource is not adequate for regulating its exploitation. Water is mobile and difficult to manage. Ownership is hard to define. Educating public and community participation

in utilizing the resource appears to be the only effective way of exercising control.

### *Rain water Harvesting*

A large number of water ponds, each about a hectare in area, 8 to 10 m deep, having a catchment area of 30 to 40 acres is considered to be the best way for harnessing rain water on a regional basis. These will act as percolation tanks and will improve water levels in all the dug wells in the neighbourhood. On sloping ground excavation of contour ditches and erection of contour bunds to collect run-off will have the same effect and will greatly improve the region as a whole. A major aspect of rain water harvesting should therefore be the construction of farm ponds and the development of contour ditches and bunds to prevent rapid run-off.

In urban areas too, building laws should insist on collection of water from roof tops, making provision for collection and utilization for purposes other than drinking.

Tanks are an essential part of village life. Construction of tanks and their proper upkeep, helps in harnessing rain water and recharge the groundwater reservoir, making water available to dry land areas downstream by means of wells. Priority attention should therefore be given to desilting and restoring tanks to their old glory. Self-sufficiency in food has been realised through massive utilization of groundwater. The significance of this great achievement is yet to be realised.

M.S. Swaminathan, the noted agriculture expert states:

‘The first priority should be for water security. The greatest pay-off with limited investment will come from strengthening community water harvesting and management systems. Every drop of rain water will have to be harvested, stored and used conjunctively with groundwater wherever possible for raising high value but low water requiring crops’.

He has recommended revival of horticultural orchards as there are opportunities for organising horticultural estates based on low-cost greenhouses and drip and fertigation techniques (i.e. adding nutrients to irrigated water).

Isolated attempts at rain water harvesting will not produce results. A concrete plan of action has to be drawn and implemented, making it a mass movement for water harvesting.

#### *Wasteful use of Water*

Ownership of a three bed room flat in an upper class locality, each bedroom with an attached bathroom with luxury fittings, has become a status symbol among the new elite.

Drinking water requirement of an individual is about 10 litres/day whereas that required for flushing, bathing, washing clothes, gardening goes up to 1000 litres per day per person. Most citizens, in a city like Bangalore, use this amount of water without realizing the enormous expense involved in transporting it over a distance of 100 km, storing it, filtering it and pumping it to a height of 300 m. Only a fraction of this expense is passed on to the consumer. When filtered water is supplied at highly subsidized rates, who will exercise restraint in the use of such water supplied dirt cheap? The true value of the resource is never realized and no attempt made to use water sparingly.

A similar recklessness is revealed in the use of water for irrigation. There is no regulatory structures to control the supply of water and fields are literally flooded. Yields of as much as five tonnes per hectare have been achieved where supply of water is controlled through sprinklers and drip systems as against a yield of 1.5 tonnes per hectare in land accustomed to flood irrigation. This gives an idea of what can be achieved through controlled irrigation.

#### *Proper Pricing Policy for Water*

Governments have yet to adopt a proper pricing policy for water used for irrigation. Complete waiver of energy charges is detrimental leading to excessive irrigation, salinity and degradation of soil quality. This waiver has led to wasteful withdrawal of groundwater and steep decline in water table.

Hardly any attention is given to the conservation of water resources. While major dams have no doubt been constructed utilizing latest technology, conveyance of water remains primitive, with as much as 30 to 50% water being lost through percolation in

unlined canals. The alternative choice of conveying water through pipes and regulating the supply has not been considered and the wasteful practice of conveying water through canals continues.

An accurate quantitative estimate of resource availability and its utilization has yet to be attempted, most of the estimates being of an *ad hoc* nature. In the system of canal irrigation prevailing in the country, the quantity of water supplied to a field is not measured and there is in almost every case excessive application which has tended to ruin the quality of the soil.

The exact number of functioning bore-wells and the quantity of water extracted is not known and groundwater organizations have not made a reliable assessment of groundwater withdrawn for domestic, industrial and agricultural applications. Biggest culprits contributing to the steep decline in water table are the rich farmers who have taken to growing commercial crops like sugarcane. Misuse of a precious resource is continuing.

Latur in Maharashtra was the site of one of the worst earthquakes in recent history. Rehabilitation has cost over 1200 crores. Much of this money has been spent in drilling deep bore wells and indulging in excessive utilisation of groundwater. In 1985, Latur had only two sugar factories. Today there are seven units and several more under construction. This is nothing but gross misuse of a precious resource and has lowered the water table by as much as 200 m.

India is the second wettest country in the world and it has adequate water resources and the soils are good. There is glorious sunshine throughout the year and abundant manpower with inherited experience extending to thousands of years. Adoption of correct technology and avoiding wastage at all points can affect significant improvements.

A beginning can be made by insisting on registration of existing bore wells and keeping a record of the quantity pumped and energy consumed which can be checked. Power supply should be permitted only to registered bore wells.

#### *Priority to Drinking Water Needs*

In any wise management of water resources,

provision of drinking water should take precedence over all other requirements and the least priority should be for industrial purposes. The depletion of groundwater as revealed by declining water levels is largely the result of massive withdrawals by industries and affluent farmers for growing heavy water-consuming crops like sugarcane. Once this misuse of a precious resource is regulated, groundwater availability will automatically improve. Urgent action against misuse is necessary.

#### *Blue Print for Action*

Geological maps can be a source of valuable information on the occurrence of groundwater and its movement below ground. Cadastral maps showing individual land ownership are available for most parts of the country. If, on these maps, contours are drawn showing the direction of ground slope and other features like soil types, location of open wells and bore wells, depth to water table and such other details can be incorporated, it will go a long way in educating the farmer and make him better equipped for growing more food. Where well irrigation is practiced the extent of area irrigated can also be shown. Flat land suitable for irrigation, sloping land suitable for horticultural crops and hilly land suitable for afforestation should be represented in different colours and additional information can be added as and when it becomes available. All this information can be stored in a digital format in a computer. Such maps are easy to read and understood by individual farmers.

Going a step further, using remote sensing technique and satellite imagery, contour bunds, ditches and farm ponds can be shown. Existing tanks within the limits of the village, their extent, the amount of silt that has accumulated which requires to be removed with estimates of cost can be prepared.

Other information which can be gathered and shown in several inset maps are: rainfall pattern, fluctuation of water levels in wells, chemical analysis of soil types, availability of building material (rock, sand, gravel, clay, kankar), demarcation of groundwater recharge area, water quality, etc.

Farmers can be educated and their knowledge increased with self-help being assured as the whole

exercise is aimed at improving the quality of their life. Non-governmental organizations have an important role to play.

#### *Educating Public – Communicating Science*

The one opportunity for geologists to come into close contact with villagers and be of service to them is in the field of groundwater. At present earth science community is least prepared to communicate information and resolve the doubts about availability of groundwater and its wise management.

Geologists should not confine themselves to just teaching the subject at university level but develop the art of communicating and explaining measures necessary to solve the problems of water conservation and use more effectively.

Short courses must be organized to teach enthusiastic volunteers in communicating their knowledge to the rural public making good use of video cassettes.

Population pressure is increasing daily and improved standard of living is making fresh demands on limited availability of water resource. We are heading towards a major crisis and yet we find little attempt at scientific study of the water problem. Sporadic attempts are being made at recharging the aquifer system but this is an isolated action as water resource management is full of complexities. Most of our policies are oriented towards catering to the needs of the affluent in urban conglomerations and hardly any attention paid to the needs of the less affluent. Difficult issues lie ahead relating not only to water conservation but also to policy matters, property rights, and proper allocation of water among different states.

The agenda of work on water management is heavy and yet there is no attempt at collecting information on the extent of resource availability and formulating a long term plan for resource utilisation.

Water resource management through adoption of better practices should be a field of most advanced and practical research. Interdisciplinary teams of irrigation engineers, agriculturists, geologists and ecologists should start functioning to determine solutions and prevent the enormous wastage of water which is daily taking place.

Drip and sprinkler irrigation offers the best way of bringing immediate benefits of irrigation to arid and semi-arid tracts. There is greater need for concentrating attention on such programmes rather than on constructing large dams, raising endless controversies about rehabilitation of the dispossessed and water sharing. While irrigation practices are confined mainly to river valleys, development of the groundwater resource, on the other hand, can benefit land located far away from rivers.

Efforts of non-governmental organizations (NGOs) working at village level in constructing check dams, small tanks, and wells have transformed the landscape in several areas. Much of this work is carried out through voluntary effort and such efforts have to be multiplied with the active involvement of the beneficiaries.

Problems which are going to arise in the not very distant future in making available water for various needs can be best tackled by the establishment of 'Groundwater Sanctuaries' attached to research institutes.

#### *Groundwater Sanctuaries*

How to make a success of agriculture over 80 percent of the country which has no assured supply of water? How to conserve water received through rainfall restricted to some sixty rainy days in a year and make it available for domestic and irrigation needs throughout the year? How to make excess rain water percolate and recharge the groundwater reservoir? – These are important issues which have to be faced and practical solutions provided. If timely action is not initiated in formulating better water management strategies, water crisis is sure to overtake the country and all development will come to a grinding halt.

Groundwater has great many advantages over surface water. It is a manageable and more efficient source of irrigation than major and minor irrigation projects. It demands no heavy investment on storage and transport. It is available where it is needed. Land levelling and the construction of field channels are carried out by the farmer. There is no problem of water logging and no major water loss (amounting to

as much as 50% of the water released at head works) through evaporation and seepage.

These advantages make groundwater an important source of irrigation. Every care is needed to protect it and not allow it to get depleted.

Groundwater sanctuaries should be established and be equipped to keep actual record of rainfall and the flow generated at various intensities. Methods of catching and storing this rainfall both on the surface and underground should be demonstrated. Efficacy of different types of structures in intercepting rainfall and allowing it to seep underground as result of natural process as well as artificially injecting excess water to recharge groundwater reservoir should be demonstrated. Maintenance of accurate record of changes in water level in observation wells will provide necessary checks in evaluating the efficacy of the different practices adopted.

All aspects of rain water harvesting and water conservation should be tried. Scientists of all disciplines, pooling their research capabilities should be in a position to find solutions to problems of water availability and utilisation. 'Water is a crop, a resource to be cultivated, nurtured and harvested over long periods of time.'

The establishment of such sanctuaries within the premises of our research institutions will go a long way in evolving schemes of better land and water management. A complacent attitude will make the position worse. We earnestly hope that governments as well as people appreciate the magnitude of the problem and will be spurred into action.

There does not appear to be any plan of research in respect of wise management of water resources. Research should be focussed on understanding how water is transferred from the surface to the saturated zone below ground especially in the hard rock aquifers of south India? How does water move in fissured medium? What are the circumstances which enable storage and movement of large quantities of water in hard rock aquifers? We have to find answers to such questions. The process of aquifer recharge has to be better understood.

Scientific capabilities of all disciplines available in the country have to be harnessed in solving problems

of the countryside. Making available adequate quantities of water for drinking and agriculture will be the biggest challenge facing the country in the 21st century.

Attempts similar to the Regional Aquifer Analysis (RASA) programme of the United States should be launched in order to develop quantitative appraisals of the major groundwater systems of India. Computer simulation is to be attempted to develop an understanding of the natural undisturbed hydrologic system and the changes brought about in it by human activities and to provide a means of predicting the

regional effect of future pumping. Results of such studies should be presented and discussed at Symposia to be organised in different parts of the country on the geology, hydrology and geochemistry of each regional aquifer system.

I would like to end this note with a hymn from the Rig Veda composed some 6000 years ago. It reflects a deep understanding and synthesis of water in all its manifestations. It also reflects the fundamental role of water in human existence and survival and is really worthy of being committed to memory.

*yā āpo divyā, uta vā sravanti, khanitrimā, uta vā yāh swayamjāh  
samudrārtha, yāh śuṣayah pāvakāstā, Āpo deveeh iha mām avantu*

*yā āpo divyā* (those waters which have come from heaven), *uta vā sravanti* (or those which flow), *khanitrimā* (those which come from digging), *uta vā yāh swayamjāh* (or those which of their own accord ooze out as springs), *samudrārtha* (speeding towards the ocean), *yāh śuṣayah pāvakāstā* (those which are bright and pure), *Āpo deveeh iha mām avantu* (O Goddess, protect me) – (VII-49-2)

B.P. RADHAKRISHNA

I want all of us – institutions, political parties, industries, communities, families, individuals – at every level to take full responsibility for what is good or bad in our situation, for what we possess and that which we do not. This would mean that we stop blaming others for the circumstances we find ourselves in. Taking responsibility also means a willingness to exercise our ability to the fullest. This will make us worthy of enjoying the benefits that come with effort.

Abdul Kalam