

## Man-made drought and the looming water crisis

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Despite distress signals of scarcity, it is reassuring to realize that the plains of India receive, on an average, 1170 mm of rainfall compared to the world average of just 870 mm. In fact, India is the second wettest country in the world! We are therefore not badly off so far as water resources are concerned. Our land area being 320 million hectares the total amount of water received by rainfall on this land every year is estimated to be 370 million hectare metres. This is a huge quantity no doubt and should not cause undue worry. But this gift which nature has bestowed on us has certain serious limitations. Over 80% of this annual rainfall is seasonal, being confined to the monsoon months of June–September and restricted to 30–60 days during that season. Moreover, this rainfall also occurs in heavy spells of short duration of an hour or less, causing the water to just run-off without allowing it time to percolate.

These limitations of the Indian monsoon rainfall dictate what practices have to be adopted for conserving the water and making it available when needed; and the only logical method which suggests itself is to collect and store rainwater where it falls. This is what rainwater harvesting really means. Deep ploughing of land and the formation of furrows in agricultural land is rainwater harvesting in its simplest form. The erection of check dams, contour bunds and excavation of contour ditches across gently sloping ground are other effective ways of arresting the rapid surface flow of rain water.

### Water harvesting – a time-tested technique

Our forefathers had a clear conception of the above characteristics of the Indian monsoon rainfall and in their wisdom constructed numerous water-harvesting structures in different states of India. In the southern states of Andhra Pradesh, Karnataka and Tamil Nadu, numerous tanks were constructed by erecting bunds across the courses of rivulets to collect rainwater. These tanks not only provided

water for irrigation, but allowed it to seep underground and become available to farmers in non-rainy months through large-diameter open wells sunk in lower sections of the valley. Such works were undertaken not by State agencies, but by local leadership. In recent years there is a tendency to discredit ancient practices in favour of grandiose schemes of constructing major dams and interlinking of rivers involving thousands of crores of rupees, uprooting in the process, large sections of the population. In this connection I am tempted to recapitulate the words of Bankim Chandra Chatterjee, the greatest nationalist and novelist which Bengal has produced: 'Do not lose your reverence for the past; it is on the past that you must plant your foot firmly if you wish to mount high in the future. You are not a race of savages who have no past to remember. . . . You cannot annihilate in a day a past national existence which has survived the annihilation of hundreds of empires, of hundred systems of religion. . . . I have to make my warning emphatic because the general tendency is to decry your past history, to call for its virtual erasure from your memory and lead you in the opposite direction'.

Tanks are an essential part of our village life and have a major role to play in conserving water resources. They have, however, been sadly neglected and their utility has been completely lost. First priority should therefore be given to desilting of existing tanks to make them functional. Every drop of rainwater should be harvested and used conjunctively with groundwater wherever possible, for raising high value but low water requiring crops. Revival of horticultural orchards and estates and adoption of drip and sprinkler irrigation methods should become common practice and all wastage of water avoided.

Pisharoty, the noted Indian meteorologist of yesteryears, had another practical suggestion: In land which is lying fallow for various reasons, he advocated excavation of farm ponds, a hectare (about 2.5 acres) in extent and to a depth of 8 to 10 m. Such ponds could have a catchment area of 30 to 40 acres and a storage capacity of about 80,000 cubic metres of

water. Excavation of such ponds has not been tried so far, but it is desirable to have one or two such ponds in each village as these would also function as percolation tanks and recharge the groundwater reservoir.

Doubts have recently been expressed and widely publicized that intensive rain-water harvesting will disrupt the hydrological cycle. There is no ground for entertaining any such doubts. Increased seepage of rainfall through simple harvesting methods will maintain groundwater levels and surplus unutilized water escapes to the lower sections of the valley, contributing to summer flow in rivulets and rivers. It is only when the utilization of groundwater is far in excess of the annual recharge that the normal pattern of flow is reversed; water levels in wells get lowered, and streams go dry, creating drought conditions. River Palar is dry not because of construction of tanks in the upper reaches, but because of unprincipled and uncontrolled withdrawal of groundwater for growing crops like sugarcane and paddy all the year round. Construction of earthen dams checks sediment transport, effectively preventing soil erosion.

There is reason to believe that formerly India had a good water-management system, with authority vested in the local community. Traditional methods were unfortunately scrapped by the colonial administration which was interested only in collecting revenue and people's participation in the management of resources was removed. The merits of the indigenous system have yet to be recognized and active steps taken to improve the system with the aid of modern technology.

### Subsurface conditions in Peninsular India

A good part of south India is covered by hard rocks which, on the face of it, appears to be unsuitable for groundwater storage and development. In most places, however, hard rock is weathered and decomposed and can hold an appreciable quantity of groundwater as is evidenced by the innumerable open wells across the country. Catching rainwater where it falls and storing it in tanks helps in recharging the

wells and making available water throughout the year. Storage of water underground protects it from the twin evils of pollution and evaporation and every effort at recharging the groundwater reservoir should therefore be welcome.

A new field of activity of tapping groundwater by means of borewells has been allowed to grow unchecked. Highly fractured rocks at depth do hold considerable quantity of water under pressure. Powerful pumps are able to suck this water with the result that there has been a boom in borewell drilling and indiscriminate pumping. The fact that the water encountered in borewells is not the result of direct seepage of rainfall from above but represents water accumulated over a long period extending to hundreds of years has not been realized. Uncontrolled pumping without any immediate source of recharge has dried up most borewells. Now the effort is directed towards drilling deeper wells with the result that not only the weathered pervious layer, but the deep layer with water-bearing fissures has been sucked completely dry. There is no physical means of recharging this zone, for water will take hundreds of years to reach these depths. Through bad management a resource of great value to the community has been ruined.

### **Dangers inherent in overexploitation of groundwater**

In spite of repeated warnings no action has been taken by the authorities concerned to put an end to the drilling of deep borewells and ban commercial exploitation of a resource which is to be held in trust for the community. The results of this policy are evident in Kerala, the wettest and greenest part of our country. Paddy fields are converted into concrete jungles, rivers and rivulets are choked with silt and weed. Groundwater exploration rights have been given to multinational companies for exploitation. Worst drought conditions have overtaken this lush green land. Even a river like Bharatpuzha is dry. Similar fate will overtake the rest of the Peninsular rivers. Summer flow in major rivers like the Tungabhadra and Kaveri is greatly reduced because of indiscriminate exploitation of groundwater.

### **Threats posed by metropolitan cities**

Our fast-growing cities have become major consumers of water. All large tanks with-

in hundred kilometres of the city have become victims of the rapacious demands of city-dwellers, specially those occupying multi-storey mansions. Not satisfied with water transported from great distance and supplied at highly subsidized rates, their greed has been directed to tapping groundwater (see *The Hindu*, 30 March 2004, on the sinking of deep borewells in the beds of Gaddam-Paravanuru river beds for effecting water supply to Chennai at a cost of Rs 49 crores). Every multi-storey complex in Bangalore metropolitan city has dozens of deep borewells pumping water day and night, leading to a severe depression in the water table and the drying up of a large number of shallow borewells catering to the need of middle class and slum dwellers. Having exhausted the resources available within city limits, the authorities want to tap groundwater from well fields 200 km away!

The evil consequences of sucking dry the water-bearing zone below ground is not immediately apparent. If continued unchecked, this practice will lead to desertification.

Multinational companies, anticipating the critical shortage of water, are already flooding the market with water in attractive plastic bottles. For want of any alternative supply, public are forced to buy this water paying as much as Rs 15 per litre. Private land owners have started exploiting the water-scarcity situation. Those who are lucky to strike groundwater in deep borewells have started selling water in tankers. It is common sight to see tankers lining up in front of the palatial residences of these water lords.

Governmental agencies like the Central and State Groundwater Boards have taken no action to prevent this overexploitation which is going on unchecked.

### **Need for urgent action**

A. B. Vajpayee, former Prime Minister of India, recently declared while inaugurating the celebrations to mark the 125 years of *The Hindu*:

‘A newspaper should be a voice of the voiceless. It should be the hope of the hopeless. But this is not always the case. The common man is invisible in the pages of the glossy newspapers and magazines’.

Should this merely end in rhetoric or be followed up by positive action aimed at looking after the water needs of the

poor. Availability of safe drinking water is nobody's business. Groundwater resources which could have come to our aid when surface-water resources have dried because of drought, have been ruined through reckless overexploitation.

The only hope is for the local community, realizing the gravity of the situation, to act and come forward to protect its resources. There have been several instances where spectacular results have been obtained through cooperative effort at rainwater harvesting and controlled irrigation. The sense should dawn that ‘our resource utilization should ensure a modest life for all rather than luxury living for a few’.

These factors are being stressed in order to emphasize the need for rainwater harvesting and utilization of the resource to the extent to which it gets replenished annually. Sustainability in making available a vital resource to the largest number and not just to the affluent few with their luxuriant lifestyles is what is badly needed. A mass campaign has to be initiated not only for water harvesting but conserving the resource to maximum benefit.

### **Suggested course of action**

A few suggestions as to what could be done in addition to promoting rainwater harvesting may not be inappropriate.

It should be recognized that fissured hard-rock aquifers are making substantial contribution to the nation's water supply. There is, however, no clear conception as to how water has penetrated rocks of near-zero permeability to depths of 200–300 m and is contributing substantially in wells drilled to these depths. Direct overhead rainfall is not the source. Where is the source for this water and how much time has it taken to accumulate? Satisfactory answers to these questions are not forthcoming. Understanding the undisturbed hydrological system represented by the hard rock aquifer and monitoring the changes brought about at different scales of pumping should form a most absorbing topic of relevant research. The effect of heavy groundwater withdrawals on the diminishing summer flow of rivers should be quantified and limits prescribed on pumping to assure a minimum flow of water in streams.

Surface storage of water in major dams and transport of water through open canals is most wasteful, as nearly 50% of the water is lost through evaporation and

seepage. There should be a shift in emphasis to storing water in large underground reservoirs and effecting supplies of measured quantities through pipes. Adoption of drip and sprinkler irrigation should become common practice and farmers should be educated in simple techniques of measurement of soil moisture and the application of only the right quantity of water at the right time. Flooding fields with water and using groundwater for growing crops like sugarcane and paddy should be strictly prohibited.

Agricultural research should focus on evolving new strains which can assure maximum yields with the least amount of water. Our food habits should change – *ragi* and *jola* require minimum quantity of water and should be the staple grains, replacing rice and wheat to a large extent.

Desalination of sea water and recycling of once used water should be under-

taken with greater urgency and maximum financial assistance made available for such projects.

Defecation and the disposal of human waste is a subject which has not engaged the attention of our researchers despite the fact that enormous amounts are being spent on building top-class toilets with glamorous fittings in all the new constructions coming up in our cities. No one seems to be giving a thought to reducing the quantity of water used for flushing toilets, in which literally millions and millions of litres of water are being misused daily. If this use of treated water can be reduced by 50%, pressure on water resources will be greatly reduced and pollution brought well under control. The ideal solution would be to eliminate water used in flushing process by replacing it with other techniques and devices. The adoption of a cheap envi-

ronment-friendly system of handling human waste is far more important than sending man to the moon.

Those who succeed in finding real solutions to some of these problems and add to our resource of usable water should be considered as benefactors of mankind and be the recipients of the highest awards that the nation can bestow. The 22 of March is the World Water Day. It is time that government takes its responsibilities seriously and accords the highest priority to provision of clean drinking water and better sanitation systems, specially sanitation, requiring less water, which does not appear to be on its agenda despite the pressing, indeed urgent, need to conserve water supplies.

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## FROM THE ARCHIVES



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The National Chemical Laboratory.—A scheme for the establishment of a National Chemical Laboratory for India after the war has been drawn up by a committee of the Council of Scientific and Industrial Research. The Laboratory is intended to specialise in industrial research and develop new processes up to the pilot plant stage.

“The proposed National Chemical Laboratory in India is expected to follow, more or less, the lines which have been accepted for the chemical research laboratories in Teddington (London), although the technical nature of our problems may be somewhat different owing to our special needs.

“It has to be borne in mind that while fundamental problems in various branches of chemistry will be promoted and encouraged as no new industrial work of any importance is possible without the researchers being engaged in increasing

the bounds of fundamental knowledge, greater emphasis will be laid in this Laboratory on industrial research and the development of new processes up to the pilot plant stage, so that the chemical industry and other industries requiring the aid of chemical research in general will benefit from the investigations carried out in this Laboratory.

“In India such facilities for research work up to the pilot plant stage are rarely available and such scientific research as had been carried out so far has not been so convincing to industrialists and the would-be manufacturers as it might have been if the success of a process had been demonstrated on a large scale.

“This aspect of the question will distinguish the National Chemical Laboratory from the rest of the laboratories either in the universities or in any technical institution run privately, or under semi-Government control. It will maintain the closest co-operation with existing institutions, particularly as the National Laboratory will be able to initiate those ambitious investigations which are not carried out in university laboratories either for want of funds or for the reason that the problems have a predominantly industrial bias.”

It is proposed that the Laboratory should, at present, provide accommodation and facilities for the following main branches of chemistry: Inorganic Chemistry, in-

cluding analytical investigations; Organic Chemistry, including drugs and chemotherapy; Physical Chemistry, including high-pressure technique and electro-chemistry; Bio-Chemistry, including biological products and chemical engineering.

With a proper co-ordination of the activities of these sections, it will be possible, the report states, to deal with new raw materials and problems relating to a number of industries, such as heavy chemicals (acids, alkali, salts, etc.); minerals, particularly from the analytical standpoint, and such industries as the non-metal industries: fertilisers, organic and inorganic chemicals, including solvents, pharmaceuticals and food: fermentation and biological products; resins and plastics; paints, pigments, lacquers and varnishes; oils, fats, soaps and lubricants; essential oils, rubber, petroleum, high-pressure research and electro-chemical industries.

The workshops and pilot plant equipment suggested for the Laboratory ought to enable the Laboratory to undertake, ordinarily, any type of industrial research.

Public opinion on the tentative scheme is invited. Scientists and scientific bodies and commercial men and commercial bodies interested in the proposals will be supplied with copies of the scheme, on request, by the Director of Scientific and Industrial Research, University Buildings, Delhi.