

PLANNING FOR GROUNDWATER RESOURCES IN RAJASTHAN DESERT — SOME SUGGESTIONS

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Since water is a burning problem of the Rajasthan Desert, efforts are being made for its exploration by several organisations on individual basis, and not on a coordinated level. As a result of this, the problem has not been solved fully. In the present paper, suggestions have been made, such as, establishment of Groundwater Archives, Research Centre on National level, framing and adopting of laws for regulating groundwater exploration and its rational utilization, coordinated and integrated approach by organisations engaged in development of groundwater etc.

INTRODUCTION

The scarcity of water is a conspicuous phenomenon of the arid region of the world, and such is the case of the Indian arid region. The agrarian, industrial and other developments of this region are very much dependent on water. This valuable resource impeded the developments, and this in turn perpetuated lack of opportunities and facilities for economic growth. The availability and assessment particularly replenishment and recovery of water are the pre-requisites for its scientific utilization on rational basis. As a matter of fact, groundwater assumes special importance in arid regions as in these parts surface water resources are scarcely found.

The hot arid zone of India covers an area of 317090 sq.km. leaving aside the cold arid zone which covers 703000 sq.km. These dry regions of the country account for 40% of the total food production. The arid zone of Rajasthan is the largest and covers 196150 sq.km. which is approximately 61.0% area of the total hot arid zone of the country. The region having a range of 100 to 500 mm rainfall has to support 7 million people and 14 million livestock, if not more.

It is needless to state that we are meeting today in this region where predominantly hot and dry climate prevails. The conditions are extremely tiring for men, animals and plants. Major part of the year possesses clear skies, extreme temperatures, low rainfall, high evaporation losses, severe droughts and poor and scanty vegetation. To make matters worse, the evaporation from the land, transpiration through the plants outstrips, the scanty and highly variable precipitation. The poor vegetation cover and the condition of the climate allow winds to blow with high speeds. At occasions, though rare, heavy downpours occur.

On the while, this arid tract is devoid of surface drainage channels except the Luni in the south eastern part and the Kanthi in the north-eastern part. These two

rivers are ephemeral in nature and flow in direct response to the precipitation. In the absence of perennial rivers i.e. snow fed river, which could act as perpetual/recharging source to the aquifers, the aquifers of this region are only dependent on annual precipitation. Moreover, this region is a big basin enclosed by the Aravallis on its eastern side and by the submerged ridges on its northern and western sides. As a result of this situation, there is also no groundwater flow and no chances of its replenishment from the high rainfall areas such as the Indo-Gangetic basin.

The irrigation practised in this tract is dependent on groundwater. Excluding the Ganganagar district where irrigation is done by canal irrigation and Pali district where only 14% area is irrigated by wells and rest by canals; in all other districts of western Rajasthan more than 90-100% of the total area is irrigated by groundwater resources. As such, it is more than necessary to undertake a project on the correct and scientific utilization of groundwater, so that at least manifestation of factors contributing to the extreme aridity can be brought under reasonable control.

Since the advent of Independence and the launching of the Five Year plans there has been a phenomenal rise in consciousness for the development of water resources in the country as a whole and in the arid and semi-arid lands in particular. It has, so far, not been possible, for a variety of reasons, to provide required amount of efforts to be paid in concentrated way to tackle this very important resource.

Geological studies of this region had been undertaken as early as 1879 but less attention was devoted to the hydrogeological aspects. Strides were made to study the groundwater resources of this region since 1950. A rough estimate of water resources of this region was first given in a paper contributed to the symposium on Rajasthan desert in 1952 organised by the National Institute of Sciences. Thereafter several papers have been presented on the various aspects of groundwater for this region at various symposiums, e.g. Symposium on Groundwater in India, organised by Geological Survey of India in 1963; Symposium on Problems of Indian Arid Zone, organised jointly by UNESCO and Ministry of Education, Government of India in 1964; Symposium on Groundwater Resources of Rajasthan, organised by the Indian Association of Hydrogeologists, 1966; Symposium on Groundwater Studies in Arid and Semi-arid Regions, organised by University of Roorkee in 1966; Symposium on Water Resources of India, organised by Indian Geo-Science Association in 1966; Symposium on Water Problem in Drought Areas of Bihar and Neighbouring States, organised by Indian Association of Hydrogeologists in 1967. Over and above, these various organisations like Geological Survey of India, Exploratory Tubewells Organisation, Rajasthan Groundwater Board, Defence Laboratory and Central Arid Zone Research Institute have brought out several unpublished or memiographed reports of their surveys and studies and various works in this field have published several papers in various scientific and professional journals. Broadly speaking over 400 reports and papers have so far been put out for this region.

POSSIBLE BOTTLENECKS

In spite of so much of survey and studies already carried out for this region, whose testimony is well evidenced from the number of publication, very little practical and

tangible solutions have been found out for the problem and it remains as alive as an eternal glowing flame. This clearly indicates that there are some lags in the way and type of studies undertaken for the region.

The principal reasons being lack of systematic approach towards the problem and to undertake exploitation programmes without considering their consequences and after-effects etc. The most commonly followed objectives of the organisations engaged in exploration are dig/drill wells and withdraw water whatsoever available under the garb of scientific exploitation. Most of these programmes are based on hit and miss method. Such an approach may look very attractive for the present moment and also give good achievements to keep their close up, but will have very serious and detrimental effects on the economic development of the region in longer run. Any plan which is formulated on a long range basis to meet the requirements of growing needs is always more beneficial in establishing a stabilized economy of a region. The principal objectives which ought to have been kept in mind before launching any extensive exploration and exploitation programmes are.

- (a) Much have been publicized for the various water potential zones of this region i.e. Lathi basin, Jalore area, Rampura-Mathania area, Borunda area etc., but very little achievements have been made in establishing the parameters of these aquifers, estimation of the existing reserves, annual recharge, existing draft, various losses i.e. evaporation, transpiration, leakage etc., losses and then try to work out a proper ground water management programme for these areas or basins. Even so, the economics of the tubewell irrigation for this tract has been practically ignored.
- (b) The inadequate number of hydrometereological observatories and stream gauging stations are another stumbling block for proper assessment of the resources.
- (c) Exploitation of groundwater is an individual right. Due to this and small size of land holdings the resources are not properly and profitably exploited, as it should have been under the proper groundwater management plans supported by legislation.
- (d) Moreover due to the traditional and conservative methods of groundwater exploitation and utilization followed in this region, sizable portion of the region having undulating topography and saline groundwater resources are left-unused.
- (e) Practically no attention is paid on the effects of major constructional works e.g. dam across the flow of the river canals etc., on the groundwater regime of the region. Such constructions have proved very hazardous for the area. The construction of Jawai Dam across the Jawai river has developed lowering of the water-table and salinity in the wells of the down stream areas as these aquifers are not adequately recharged every year. In the Gang Canal area, where the water table was originally over 40 metres is now within 10 metres and is still rising up due to canal irrigation. In the Rajasthan Canal area, where irrigation has been started only for the past 2-3 years the water table is rising with a rate of about 2 metres per year. The original water-table was over 40 metres. In the

Chambal area even before starting irrigation through canals water logging and salinity problems have developed.

- (f) Efforts are not made to use saline water for irrigation purposes.
- (g) With the start of excessive utilization of groundwater in the coastal areas of Kutch the possibilities of the encroachment of sea within a short period can also not be ruled out.
- (h) No attention is being paid to the rise of water level, pollution due to the uses of chemical detergents and reutilization of industrial waste and sewage water in the urban areas of the region under consideration.
- (i) Very little attention has been paid to the research aspect of the problem. Practically all efforts are being directed towards the exploration of the resources.
- (j) Within past 20 years of Independence sufficient stride could have been made and fruitful results achieved, but for want of coordination amongst the various organisations progress has been retarded. Broadly speaking, generally the efforts of all the organisations are mostly duplication of efforts i.e. any organisation or a person who is interested in taking up any advanced study in any area will have to start from the beginning and waste valuable time and money which could have been saved, if, the basic information collected by other organisations for that area are easily and freely available.

Keeping in view this alarming situation of groundwater resources some relevant and potential suggestions are made here for proper exploration, utilization and management of these precious resources.

SUGGESTIONS

Systematic groundwater studies are much time consuming and require sufficient financial resources. As such, if, coordinated efforts are made by all organisations engaged in the pursuit of groundwater resources then the problem could be solved much earlier and easier. The best way to achieve this would be:

- (a) *Groundwater Archives*: A groundwater Archives be established for this region which would have the following activities, which are :
 - (i) *Preservation of basic data* : All organisations working in this region should under obligation pass on the basic data collected by them to this Archives without waiting for the publication of the report, which takes considerable time. At the Archives the well for which the information has been sent should be properly located on a suitable scale map say 4" to a mile, or 8" to a mile numbered and all basic data i.e. lithological, hydrological, hydrogeochemical, utilization etc., preserved as card system. If need be samples of specially cores, be also preserved in a core log library.
 - (ii) The Archives should select wells on a grid system of suitable distance or say at the headquarters of each Panchyat, Patwari, Primary School and Post Office. The Sarpanch, the Patwari, School Head Master and the Post Master should under obligation send the depth to water measurements from a prefixed reference point and water samples thrice a year — say in the months of May/

June, September/October and January/February. These persons should be supplied with detailed cards and well rinsed romoline bottles with proper packing material every year for this purpose. In exchange the Archieves should give to these persons postal charges incurred and an annual gift or some honorarium. The Archieves should maintain the information on water level and analysis report. The analysis work should also be undertaken by a Archieves by selective sampling technique i.e. each water sample should be analysed for total dissolved solids, electrical conductivity, pH, dissolved oxygen and when a significant variation is noticed from its first analysis all cations and anions or at least Si, Na, K, Ca, Mg, Cl, SO₄, CO₃, HCO₃, be determined. Similarly the Archieves should also maintain records of rainfall and runoff data. This method of collection of data will be much economical than to employ regular staff. If need be, the concerned persons could be given training in measuring water level, recording rainfall and runoff.

- (iii) The Archives should maintain a library in which all published and unpublished reports on any groundwater investigations by all organisations; irrespective of the objective of the study be preserved. All organisations should under obligation send their reports to the Archieves.
- (iv) Periodically i.e. say every second or third year the basic data collected by the Archieves should be published.

(b) *Research Centre* : A regional research centre be established for hydrogeological, geohydrological, hydrometereological, hydrogeochemical, photohydrogeological and hydrogeophysical studies. This centre should work on the relationship of the surface and groundwater, courses of mineralization in groundwater, determination of various hydrological properties of various rock type under laboratory and field condition, establish the parameters of the various aquifers, work out the management programme with the help of various models; give predictions of the groundwater utilization and recharge, development of techniques for easy location of potential groundwater areas by various surface techniques suitable for this region, study the drilling problems and designs of wells and screens, work on the monitoring of water pollution, water logging and development of salinity in the region, problem of land subsidence and other crustal displacement caused by the excessive utilization of groundwater, and problem of saline water intrusion.

The second objective of this centre should be to standardize the field and laboratory techniques so that the data obtained by all organisations for their respective work are uniform. Such data will have better utilization for the benefit for all. Standardization is very essential in the measuring techniques, collection and preservation of water samples, working out yield of dugwell, chemical analysis of water. All these investigations involve factor of personal errors and generally there is no agreement in the results from the different sources. If all these are done by uniform precision and preserved at the Archives any organisation could use it without any personal bias and time of every worker and public exchequer will be saved to a great extent and the results of investigations will be available to the concerned for utilization much easily than the time now required.

The third aspect of this centre's work would be to prepare groundwater utilization atlas for this region say catchment-wise or Development Block-wise on suitable scale say one inch to a mile. The atlas should show the surface features with isohyets, soil types with its depth, mechanical properties of soil, configuration of basement topography, water table, permeability, discharge potential, depth and thickness of paying aquifer, irrigation quality of water etc. This will much help the planners, organisations engaged in exploration and exploitation programme and even to individuals to develop their groundwater resources.

The centre should also work on the development of irrigation devices and system with economics for various parts of this region. The irrigation quality norm should also be worked out by actual field trials for the utilization of saline water, introduction of better suited crops etc., to the water available on a particular area. The major portion of the regions is left unutilized, except during monsoon period for want of water. If saline water could be utilized and such crops etc., introduced which consume less water and can stand salinity the land could profitably be utilized for the economic development of the region.

The last and the most important objective of this centre should be to educate the people. Due to the lack of knowledge of various aspects of groundwater specially its sources, limitations, effect of excessive utilization or wastage any plan for groundwater resource development will not be successful. This could be best achieved by audio-visual methods. It is only after this that any plan on groundwater resource management could be fruitful.

(b) *Groundwater legislation*: Unlike mineral resources individual has the right to exploit water, without any restriction on location or quantity. It is due to this system that the resources are not being fully utilized for the economic growth of the region. Unless definite legislation is introduced on the optimum spacing and draft of wells for every area, ascertained by the above proposed research centre otherwise, the groundwater resources cannot be properly utilized. The size of the land holdings may come in way of introduction of such legislation but could be overcome if consolidation of land holdings is adopted or the groundwater is exploited on cooperative or community basis or the supply of water is made by the State Government on very nominal charges i.e. the charges to meet the operational cost which any farmer would have spent provided he had undertaken this work. This will be possible only if groundwater is put at par with minerals.

(d) *Coordination*: Due to lack of coordination between the various organisations very little progress in the field of groundwater has been made; in spite of the fact that several organisations are working in this area. It is very essential that the heads of the various organisations should meet frequently and work out programmes for a period of five years for their organisations after mutual consultation with each other and review the progress of the problems that crop in maintaining coordination every year. The scientific staff of all the organisations should meet at the research centre twice a year or at least once a year and have free exchange of idea by way of symposium or seminars or workshops. This practice would avoid wastage

of public funds, duplication of efforts and the assessment of the resources could be taken up with much faster speed in comparison to the achievements so far attained.

CONCLUSIONS

It is concluded that certain practical resolutions will be adopted by this gathering of scientists for solving the problems discussed by the authors so that groundwater studies could be profitably done for wholesome results.