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Rural Empowerment through Revival of Traditional Techniques of Water Harvesting in Arid Region: A Geographical Study of Bikaner District (Rajasthan)

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Abstract

Rural development is one of the most formidable and fundamental concern of development efforts in India since two-third of the population is inhabitated in the rural areas. It requires changes in social, economical, technological, natural and political components. Thus, it means development of the rural areas in such a way that each component of rural life changes in a desired direction and in sympathy with the other components.

The art and science of collecting rainwater is very old in India and it was devised to make the optimum use of the available water. Generally, the word 'traditional techniques' is taken to mean old fashioned and to some extent backward and obsolete. But after 1990, many people, voluntary organizations and to some extent even the administration realized for the first time due to frequent famines that even those techniques which were considered obsolete could be of use in times of crisis. Therefore, it is needed that our old techniques of water harvesting should be revived to meet out freshwater requirements adequately and sustainably. Our aim and in fact, our responsibility is to revive and modernize this traditional method which holds the key to our water future.

Keywords: Rural Development, Traditional Techniques, Adequately and Sustainably, Revive and Modernize.

Introduction

The traditional techniques are totally based on local needs and surroundings, prepared from locally available resources and skill handed down from generation to generation. These indigenous technologies are in a way totally self sustained. They do not require any specific skill, technology, management, spare parts and fuel that need to be brought in from outside. A special feature of any traditional technique of water harvesting is that it is based on the environment of that area and it knows how to perpetuate itself (Ray, Sunil and Bijarnia, 2006).

In the context of arid region of Rajasthan, use of traditional methods to tap the flow of surface water, as well as groundwater, through structures such as *tanka, kundi, kuin, bawri* (step-wells), *talab, bera* (small wells) etc. are being practiced since ancient times. In the desert, people build unique underground structures of various shapes and sizes to collect rainwater for drinking purposes. These structures are constructed in a variety of places like courtyards, in front of houses and temples, in open agricultural fields, barren lands etc. These are built both for individual households as well as for village communities using locally available materials.

The increasing demographic pressure and societal advancement have resulted acute shortage of water for drinking, agriculture and for industrial purposes (Biswas, Asit K., Jellani, Mohd. and Glenn Slout, 1993). This problem is more severe in the arid district of Bikaner which is characterized by low and erratic rainfall, higher evaporation rate and low ground water potential. Therefore, the first and foremost need for today is to create awareness amongst the people for revival of old water harvesting structures.

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Objective

To evaluate the significance of traditional techniques of water harvesting to mitigate rural water requirement in the arid region.

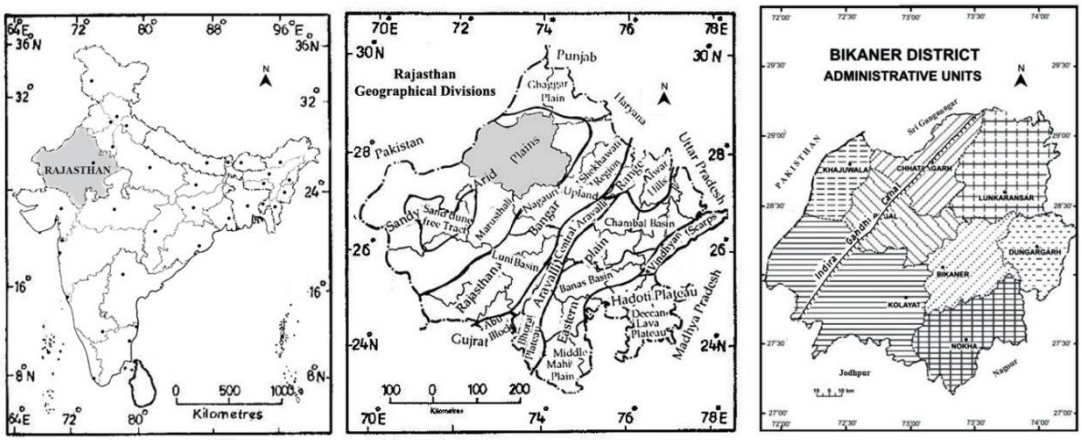
Hypothesis

1. The increasing pressure of population and livestock, expansion of agricultural activities, extraction of groundwater to irrigate water intensive crops, supply of drinking water by government are some of the factors responsible for extinction of traditional structure of water harvesting.
2. Inadequate supply of water for drinking and irrigation, and gradual decrease in groundwater level are the factors initiating revival of traditional techniques of water conservation.

Study Area

Bikaner district spreads over an area of 30289.62 sq km lying in the north-western part of Rajasthan, located between 27°11' and 29°03' north latitudes and 71°54' and 74° 12' east longitudes (fig 1). It is bounded by Sriganganagar district in the north, Churu and Sriganganagar districts in the north and north-east, Jaisalmer district and Pakistan in the west, and Nagaur and Jodhpur districts in the south and south-east respectively. It has extreme climate with a hot, dry and long summer, a cold winter and a short monsoon.

Fig 1: Location Map of Study Area



Source: GSI and District Gazetteer, Bikaner

Methodology

The primary data have been collected from five respondents each from 23 sample villages of Bikaner and Nokha tehsils by considering their availability and quality of ground water, irrigation facilities, location of settlement etc. through schedule-cum- interview method whereas the secondary data have been gathered from concerned departments. The colleted data and information have been tabulated and analyzed to conclude the findings, and presented through maps.

Factors Influencing Water Resources

Climate

The study area has a dry climate with large variations of temperature and scanty rainfall. Hot winds blow in summer, sweeping away and creating new sand dunes. Summers are very hot and dry. Days are very hot with scorching sun. Sometimes maximum temperature of day time reaches up to 49°C in the month of May and June. The mean maximum temperature remains between 31-42°C during summers. Winters are severe and sometimes the temperature touches to freezing point due to cold wave coming from Lower Himalayas. The mean temperature of this season ranges 14-16°C (Sharma, H.S. and Sharma, M.L., 2002).

The western disturbance occurs from November to May cause rainfall during winter which is popularly known as *mawat*. Normal annual rainfall in the district is 23.37 cm and the average humidity is 45 per cent. The rainfall is irregular and uncertain. The study area is influenced by cold wave during winter and warm winds (*loo*) in summer.

Droughts and Famines

Droughts are very common in the study area. The frequency of droughts remained 50 per cent during the period of 1901-2007. Among these droughts 7-15 per cent were very severe droughts. There have been hard droughts during 1999-2005. The frequency of droughts causes very heavy loss to crops and livestock. The study area has faced 4 very hard, 11 hard, 23 normal and 9 light droughts during last century.

Status of Groundwater

There are three stages of groundwater availability in Bikaner district. The district was under safe zone in groundwater till 1998 (GWD, Rajasthan, 2007). But as the exploitation of groundwater increased with the growing number of public and field tube-wells since last 25 years, the district has reached in critical and very critical stage. The exploitation of groundwater for irrigation and adoption of commercial and water intensive crops has put Nokha and Bikaner tehsils in very critical zone while Dungargrah has reached in critical zone (2007). The other tehsils like Kolayat and Lunkaranser have saline water which is not suitable for cultivation. Therefore, they are in the safe zone of the groundwater. The remaining three tehsils i.e. Chhatargrah, Khajuwala and Pugal have canal irrigation with brackish groundwater.

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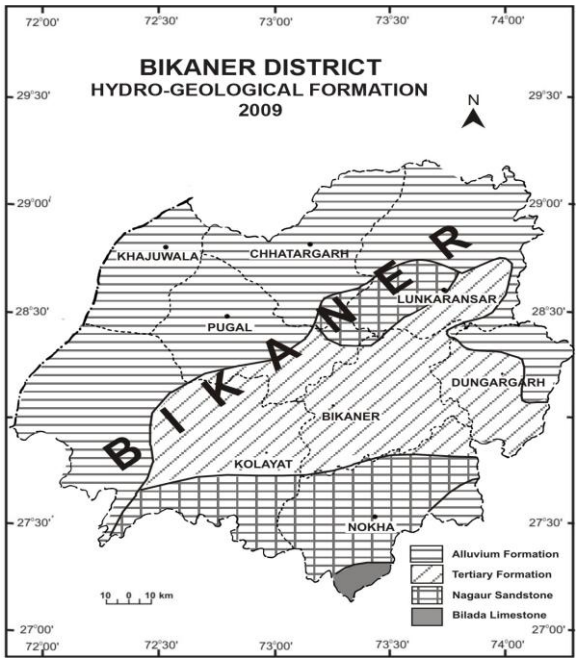

Hydro-Geological Formation

The district is divided into four hydro-geological formations- Alluvium, Tertiary, Nagaur and Bilada (Groundwater Assessment Report, 2003). The western parts along the Indira Gandhi Canal comprising Khajuwala, Pugal, Chhatargarh and western parts of Lunkaransar and Kolayat tehsils have alluvium formation. It is a good aquifer but has saline water which is not suitable for drinking and irrigation. The depth of water is 10-40 m while Kolayat, Bikaner, Dungargarh and south of Lunkaransar tehsils have tertiary formation. It is a potable water belt and has good quality of water with 40-130 m deep water table (fig 2). The dominance of Nagaur and Bilada formations is in the south-eastern parts of Bikaner district having normal potable with some pockets of saline water. The depth of water table ranges 90-130 m. Here the water level is decreasing 3-4 ft annually which shall create water crisis in the coming years.

Population, Livestock and Water Demand

The study area has higher population growth rate than Rajasthan State and country as well since 1961. During 2001-2011 decade, it remained 34.13% in Bikaner where as 21.41% in Rajasthan and 18.62% in India (table 1). The population growth rate has been higher since 1971 due to availability of water through Indira Gandhi Canal, and expansion of medical and transport facilities. The livestock population has also increased by two and half times since last 50 years from 10.45 lac in 1961 to 26.50 lac in 2012. In the same way, water demand has also increased from 310.8 lac lt/day in 1961 to 1420.5 lac lt/day in 2011 (GWD, 2011). It has further accelerated the extraction of ground water in the study area.

Table 1
Bikaner District- Population, Animal Wealth and Water Demand

Year	Bikaner (lac)	% Growth	Raj. % Growth	India % Growth	Year	Animals (lac)	Water demand (lac litre/day)
1961	4.44	25.56	26.20	21.64	1961	10.45	310.8
1971	5.73	28.98	27.83	24.80	1972	8.98	401.1
1981	8.49	48.09	32.97	24.66	1988	16.93	594.3
1991	12.11	42.70	28.44	23.86	1997	25.31	847.7
2001	19.01	56.96	28.33	21.34	2003	24.35	1330.7
2011	23.50	34.13	21.41	18.62	2012	26.50	1420.5

Source: Census of India, 2011 and Annual Report of Animal Husbandry Department, GOR.

Traditional Techniques of Rainwater Harvesting

Tanka

This is the most prevalent rainwater harvesting structure in the study area and is a local term for an underground cistern. It is a small circular or square underground tank constructed with lime mortar or cement plaster. It is constructed normally on fallow ground where surface runoff can be diverted to the structure by creating a clean catchment all around. It is constructed in different sizes depending upon water requirement. This system of water harvesting is highly economic as compared with hauling of water from long distances. In general a village lady spent minimum half a day in hauling 20 lt water from a water point located few kilometers from the settlement.

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Kuin

It is a very small well used to conserve rainwater in the arid region of Rajasthan. However, unlike well, it is not linked to groundwater. A *kuin* is a very narrow, shallow, vertical and cylindrical structure. They serve to slowly convert the moisture in the sand into water. It is a little difficult to understand the system, but we must not forget that, for centuries, people have been using this technique with great ease. In a very slow process, the *kuin* converts the conserved moisture of the sand to water and is employed particularly in those areas where ground water is saline and no other source of drinking water is available. Saline ground water is commonly found in all those areas where a hard stratum of gypsum or chalk exists. *Kuins* are mainly constructed on such hard strata to check the percolation of rainwater.

Kund

Older communities in desert settlements used the roofs of their houses and courtyards to serve the same purpose as the catchment areas of the ponds to collect rainwater on the rooftop and courtyard of the house. These are called *kunds* or *tankas*. Rainwater collected in this way assumes greater significance when it is realized that ground water in some areas is saline and unfit for drinking.

Almost every rooftop has a gentle slope so that water can flow from here into a pipe and through that to an underground tank. The pipe has a provision for straining out dirt and grains of sand. The size of the underground storage tank depends on the average quantity of rainfall in that area. Normally the capacity of these tanks varies from 50,000-500,000 lt.

Talab

It is the name given to big pond or tank generally found in cities or towns. In the city of Bikaner itself, there were eight *talabs* since 1985 but today most of them are non-functional and abandoned. The functional ones are also having problem of reduction in runoff water from their respective catchments due to urbanization and unchecked encroachment. If the existing *talabs* are renovated and maintained properly, water scarcity problem in cities, towns and villages may be minimized substantially. Sansolao, Harshalao, Devikundsagar, Kalyansagar, Surajnath talai, Navalpuri talai and Shivbari talab are the important ponds of Bikaner city.

These larger sized ponds intercept water from the local catchment and store it for optimum utilization. Such structures not only reduce the erosive velocity of runoff but also prevent the gullies from further enlargement. The water retained on the upstream side or behind the structure can be used for lift irrigation and as drinking water for people, as well as for cattle and other animals.

Bawri

This type of structures were constructed to mitigate drinking water supply, particularly in cities and towns. The bawri (step-well) was simply made pucca providing pully to draw the water through rope and bucket. These are often example of beautiful mansions and many of them carry the name of either important social or royal personalities or the holy sites.

It has been seen that in general ground water aquifers of *bawri* and step-well were essentially sweet water aquifer and not saline. These systems used to get very regular heavy recharge every year to meet the society's requirement. Thus, the site selections for these essentially must have been based on sound scientific line of exploring ground water with high and regular recharge source of high quality water.

Outcome of the Study

Reasons of Extinction

The sample households of Bikaner district both in rural and urban areas responded that there are many factors behind the extinction of traditional water harvesting structures. The main factors are Shrinkage of catchment 98 (28.4%), expansion of agriculture and industrial activities 71 (20.57%),

increase in settlement 68 (19.71%), government supply 56 (16.23%), change in life style and economic status 32 (9.27%) and negligence of old structures 20 (5.79%).

The rural and urban respondents answered that *tanka, kuin, bawri, talai, khadin* etc. were the main sources of water storage of monsoon rains and were kept clean to supply water throughout the year. The aged respondents of both rural and urban areas complained about the government policy and encroachment of *agors* of water structures. They have also replied that the consumption-ratio of water has increased due to economic and social improvement. They strongly recommended 267 (77.39%) that the old structures should be revived by the government for the proper utilization of water and efficient supply for the increasing population and livestock.

The respondents 289 (83.76%) have also replied that *kundi* and *tanka* are essential for storing water in every household but these small structures are used to store tap water only. Even today, there are many *kuin, bawri, talai, talab, tanka* etc. in every village and at temples and palaces in Bikaner district. But their catchment areas (*agor*) have been shrinking due to population pressure in the form of encroachments, increasing settlements, agriculture and industrial activities.

Revival of Traditional Techniques

The respondents of the study area replied about the revival and construction of traditional water structures and gave many suggestions. Most of them (54.35%) have stressed on removal of encroachment on *agor* (catchment) that may be by government or individual. It is the main reason for low amount of rainwater supply. There were large areas under *agors* of *talab, talai, bawri, tanka* etc. in the study area which are either encroached for agriculture or for settlement, construction of government buildings, allocation of land to landless farmers etc. Secondly, these old structures should be maintained and they should be cleaned and dug well before onset of monsoon rain 129 (37.39%). Therefore, the *agor* area should be demarcated and fenced well and the stored water should optimally be used. Construction of new water structures 57 (16.52%), model village development 21 (6.08%), control over population and livestock 68 (19.71%), motivation to re-cyclic use of water 27 (7.82%), adoption of rainfed crops 31 (8.98%), rational supply of water 14 (4.05) are the main suggestions for revival of traditional methods of water harvesting in this arid and semi-arid district.

It is also replied that the rural development and self dependence is possible by adoption of these locally available techniques of water conservation. When the respondents have been asked who should take responsibility for care of this age old technique, the majority 266 (77.1%) of them replied that the government should take care of these water structures with the local participation.

Conclusion

In The Rural Areas Of The Arid Region, Water Conservation Has Become A Necessity For The Proper Management And Conservation Of Natural Resources Otherwise There Will Be A Great Problem For Planners And Executives To Meet Out The Increasing Demand Of Water. The Unplanned Land-Use, Cropping Pattern And Present Irrigation Techniques Are Not Ecologically Suitable For The Study Area. Therefore, Water Harvesting Is Indispensable Technique For The Safety Of Water Resources. The Old Water Structures Which Have Been Earlier Demolished And Encroached, Are To Be Revived And The Traditional Techniques Of Rainwater Harvesting Should Be Adopted Essentially At Both Household And Field Level. A Mass Movement Is To Be Taken Up At Government, Media And Community Level For The Revival Of The Traditional Techniques Of Water Harvesting In The Study Area.

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