

## **A Historical Perspective of the Development of Rain Water Harvesting Techniques in the Mewar Region, Udaipur, Rajasthan, India**

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**Abstract:** Water is an essential resource for our existence. However its availability is not only limited but also very unevenly distributed world over. The largest brunt of its scarcity is experienced in the semi arid and arid regions of the world. Consequently the people of these regions have, from times immemorial, been practicing techniques of rain water conservation and management. Rajasthan is the largest state of India area wise however it has only one percent of the total water resources of the country. Rain water conservation and management techniques have been in practice in the different parts of the state from time immemorial. The present study is concentrated on the water conservation and water management practices developed during the reigns of the various Rawals, Ranas and Maharanas of the Mewar State, Rajasthan. The study area includes Banswara, Bhilwara, Chittorgarh, Dungarpur, Rajsamand, Pratapgarh and Udaipur Districts. The present research paper is an attempt to study and highlight the various scientific techniques and methods adopted for the conservation and management of rain water.

**Key words:** Ahar · Bhela · Genda · Hameda · Roof water harvesting · River diversion · River Linkage

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### **INTRODUCTION**

The availability of water is not only limited but also very unevenly distributed world over. The largest brunt of its scarcity is experienced in the arid and semi arid regions of the world. The people of these regions have, from times immemorial, been practicing techniques of rain water conservation and management. India is a land of physical diversities. On the one hand there are the Western Ghats in the West and the North Eastern states that are extremely humid and on the other hand are the arid and the semi arid regions including the leeward side of the western ghats in the Deccan plateau and the desert state of Rajasthan where the climatic conditions range from sub-humid, semi arid to arid climatic conditions.

Rajasthan is the largest state of India area wise however it has only one percent of the total water resources of the country. Water conservation and management techniques have been in practice in the different parts of the state from time immemorial. The present study is concentrated on the rain water conservation and water management practices in Mewar

Region of South Rajasthan. Mewar Region is a prominent area located to the south of the Great Indian Desert of Rajasthan, India. The region has a very picturesque landscape dotted by the mighty Aravalli folded mountains, the oldest in the world, dissected plateaus, lakes (man made) and valleys with a rich bonanza of cultural heritage that make it a tourist's paradise world over. Climatically the region is transitional between sub-humid in south-east to semi-arid in north, north-west. Owing to the semi-arid conditions the rulers and people of Mewar have always been sensitive towards rainwater conservation and management from very ancient times.

**Study area:** The region under study comprises 53 tehsils distributed in the seven districts of Banswara, Bhilwara, Chittorgarh, Dungarpur, Rajsamand, Pratapgarh and Udaipur, located between 23°1' 10"N to 26° 1' 5"N latitude and 73° 1'10"E to 75° 48' 30"E Longitude with the tropic of cancer passing through the south of the town of Banswara.

The eastern boundary of the Mewar region is formed by Jhabua, Ratlam Mandsaur and Neemuch districts of Madhya Pradesh. Sabarkantha and Panchmahal districts

of the state of Gujarat form its southern boundary. The western boundary is formed by Sirohi & Pali and Ajmer, Tonk, Bundi and Kota districts form its northern boundary. Its total geographical area is approximately 46660 km<sup>2</sup> which is 14.25 % of the Rajasthan state and 1.44 % of India's total area respectively.

**Physical Landscape:** Topographically the Mewar region is par excellence a region of hills and dales, though frequency of occurrence and altitudes of the hills decline in a west to east direction, merging into the northern high plain of Banas and low plains of Mahi in the south. The hills reappear in the eastern periphery of the region, though with subdued heights compared to the northern parts, here the hills area is lower as well as more scattered and dispersed. The region characteristically comprises of one of the most ancient hill – systems in the world, in the form of Aravallis. Physiographically the region could be divided into the following sub-regions (1) the western high hills (2) the eastern low hills and scarps (3) the central part of Mewar (4) the low Mahi plain in the south and finally the (5) the high Banas plain in the north.

**Drainage System:** A unique drainage system is controlled by the local relief and physiography in this region. It can be divided into three sub systems, the largest being that of Banas in the north and east belonging to the Ganga-Yamuna Chambal or Bay of Bengal system; Mahi in the south and Sabarmati in south-west belonging to the Arabian system. The characteristic relief pattern has determined the layout of the national water divide which passes through the study region, first in a north-south direction following the Aravalli ridges through the picturesque Udaipur City and then moves eastward up to the Neemuch town in the adjoining state of Madhya Pradesh. It is of interest to note here that this is not only a water divide but also an ethnic one, a frontier between the tribal and non-tribal tracts. The rivers of Mewar are largely non- perennial, yet with a moderate amount of annual rainfall.

**Climatic Conditions:** The climate of the region is of the transitional type, between the sub-humid Malwa and semi arid western slope and foothills of the Aravallis. Relief and altitude of land and surface configuration, interior location, presence of water bodies affect the climate of the region which is moderate and generally free from extremes of temperature except in the northern high plain area.

**Temperature Conditions:** For the region as a whole, the annual range of temperature varies from a maximum of 23.10° C. in January and 37.43°C in May. The mean temperatures range for January and May are 17.13°C to 34.36°C, respectively. As could be expected, the summer is more prolonged and prevails for nearly six months between the months of April and September when the temperature is normally above 30°C. i.e. little higher than that of June. The highland areas of Mewar particularly the Bhorat plateau with Gogunda and Kumbhalgarh remains comparatively cooler even in the summer season. Temperatures start rising right from March and start declining from July onward with the onset of rains, after reaching the peak in May and June as mentioned earlier.

**Rainfall Conditions:** Rainfall in the region is characterized by moderate amount, seasonality, limited number of rainy days but with a larger number of cloudy days, variability in terms of time and space, uncertainty and unreliability again regarding time, space and amount. The average annual amount of rainfall of Mewar declines from east to west or more particularly from south-east to north west; i.e. from about 105 cm in the Kushalgarh tehsil of Banswara district to less than 55 cm over a large tract in the west along the Aravalli ranges from Bhim to Kherwara tehsils, altitude being an ineffective factor.

The orientation of isohyets is interesting, being longitudinal and having a tendency to protrude locally towards west, particularly the one extending from Malwa to the interior, utilising the narrow valleys of rivers Jhakhm, Mahi and Som flanking the southern hill mass. A similar protrusion through over a limited area, lies northward round the hills of Chittorgarh. As per localities, the lowest average annual amount of rainfall is recorded at Rajsamand, being 48.888 cm and the highest of 106.35 cm being recorded at Kushalgarh, followed by Banswar, 99.02 cm, Chittorgarh 86.91 cm, Garhi, 81.14 cm, Pratapgarh 80.04 cm, Jahazpur, 77.24 cm, Bhilwara 68.81 cm, Udaipur 65.15 cm, Kelwara 62.50 cm and Bhim in the north-western extreme having only 55.93 cm. In terms of districts, while Banswara is the rainiest, Dungarpur and a large part of Udaipur are the least rainy.

**Geology:** Geologically speaking the region comprises one of the most ancient rock system, rich in a variety of minerals, including lead and zinc. The region forms a part of the ancient stable block displaying rock system ranging from the Achaean to the Proterozoic. The formations,

however, belong to the Aravallis and the Vindhya, separated by the Great Boundary Fault. Outcrops of Bundelkhand, gneiss the oldest geological formation as per geological sequence in the world appear both in the east as well as west of the Aravallis and cover a large part of Mewar. It is mostly granite in composition with quartz and some ferro-magnesium minerals. It is also traversed by veins of aplitic, micro-granite, quartz and dykes of dolerite. The Banded Gneissic complex is found in south-central Mewar. These are metamorphic rocks and they were originally sedimentary rocks.

The Aravalli mountain system, which is among the oldest in the world, dominates the physical landscape of Mewar. It covers the central part of the region, extending from western part of Banswara district, whole of Dungarpur district, up to north-eastern part of Bhilwara district and in between in a narrow belt in the central part of Chittorgarh district. The Vindhyan system consisting modest of sedimentary formations like sandstones, limestone and shales of immense thickness and belonging to the Paleozoic era are confined to the eastern fringe of Chittorgarh district. The Deccan trap of Cretaceous period is another important geological formation over laid on pre-Aravalli gneiss, Aravallis and Vindhya. This system extends in a broad belt from the eastern part of the Banswara districts and southern part of the Chittorgarh district.

#### **MATERIALS AND METHODS**

The present study has been undertaken with the help of Survey of India topo-sheets of scale 1:25,000, 1:50,000, 1:1,25,000 and 1:2,50,000 surveyed in 1959-60, 1967-72 and 1973 respectively. Satellite images of varying resolutions for different years viz. Landsat MSS data of 3<sup>rd</sup> March, 1975 with 80 meters resolution, IRS data of LISS I of 18<sup>th</sup> February, 1996 with 72.5 meters resolution, IRS data of LISS III of 8<sup>th</sup> February 2004 with 23.5 meters resolution and IRS data of LISS-IV of 7<sup>th</sup> June, 2004 and 2006 with 5.6 meters resolution and Google Earth Satellite picture of the year 2007-2008 and 2009-2010 have been used. Besides this Geological Survey of India Map 1997 depicting lithological formation of the region has also been used. Ground truths have been verified through field survey. The visual interpretation of remotely sensed data has been verified by the ground truth. The satellite data have been geo referenced.

#### **DISCUSSION**

Owing to the peculiar climatic conditions of the region and taking into consideration the sub humid and semi-arid conditions of the Mewar region the rulers of the Mewar state were quite sensitive towards the development of various measures to conserve and manage scarce water. The most prominent was the development of several man made lakes that are the lifeline of the Mewar region even today, serving the varied needs of the local population. Fig.1 shows the contribution of rulers of Mewar since 566 A.D. in Water Resource Management in Mewar Region.

The lakes of Udaipur basin include Fateh Sagar, Pichola, Goverdhan Sagar, Jana Sagar, Nela Talab, Kumharia Talab, Swaroop Sagar, Rang Sagar, Amar Kund and Doodh Talai built by ruler of Mewar in different time. They are the outcome of the vision and foresightedness of the Maharanas of the Mewar State. In fact the establishment of Udaipur city itself was due to the strategic thinking of its founder, Maharana Udai Singh II who founded the city in the girdles of the Aravalli to safeguard his subjects and dynasty from the continued attacks of the Muslim rulers. Recognizing the need for water, the Maharanas of Mewar developed these lakes to fulfill the needs of the common man and also have water supply throughout the year even after the monsoons during the dry season.

The lakes of Udaipur basin have been catering to the needs of this city for the past 6 centuries. They are an engineering marvel, developed and designed in such a manner that even though they are located at different elevation from mean sea level with varying depths, their water level becomes uniform when completely filled. They are inter-linked (Fig.2) with each other so that as one lake gets filled up the surplus water gets transferred into the other lakes. Thus they exhibit a unique example of rain water conservation and management.

**The Following Few Major Lakes Are Having Importance in Modern Period Throughout the World:** Rajsamand (Rajsanudra) Lake: It was constructed between 1662 to 1676 A.D. by Maharana Raj Singh I across the River Gomati, Kelwa and Tali. The reason for the lake was to provide employment for victims of widespread drought and famine in year 1661 and to provide canal irrigation to local farmers. Rajsamand lake is the oldest known systematic relief work in Rajasthan. With a circumference



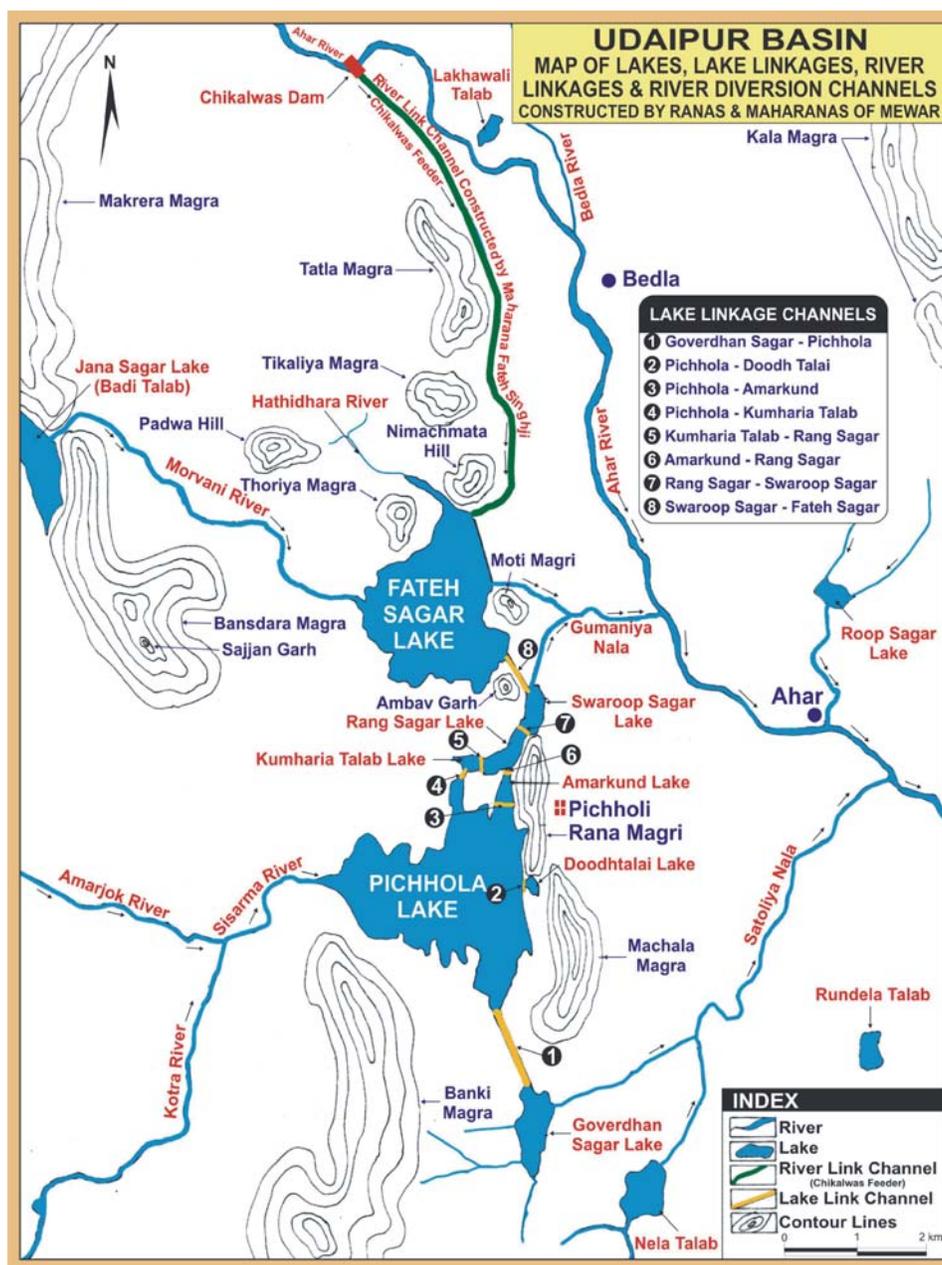


Fig. 2:

**Jaisamand Lake:** This lake is India's largest man-made lake situated 50 km south of Udaipur. Its often-used, nickname is 'ocean of victory' (Samand meaning 'ocean') and is also known a Dhebar lake, a dhebar being a catchment area. During the reign of Maharana Jai Singh (A.D. 1680-1698), there was a great need for water for cultivation in the southern corner of Mewar so that Jaisamand lake (Fig.3) was constructed on Gomati River. This Lake, covers an area of 50km<sup>2</sup>. and has a

circumference of nearly 90 km. It is 15km. long and breadth varies from 1.5kms to 10kms wide and reaches a depth of 30 m. It holds about 560 million cubic metres of water, with a catchment area of 1787 sq. km. and its western hills having considerable elevation. The lake generally remains full, except in periods of extended drought when its level becomes dangerously low. The dam itself measures 330 m. in length and 35 m. in height. The lake has seven natural islands, the largest being Baba Island, which is inhabited

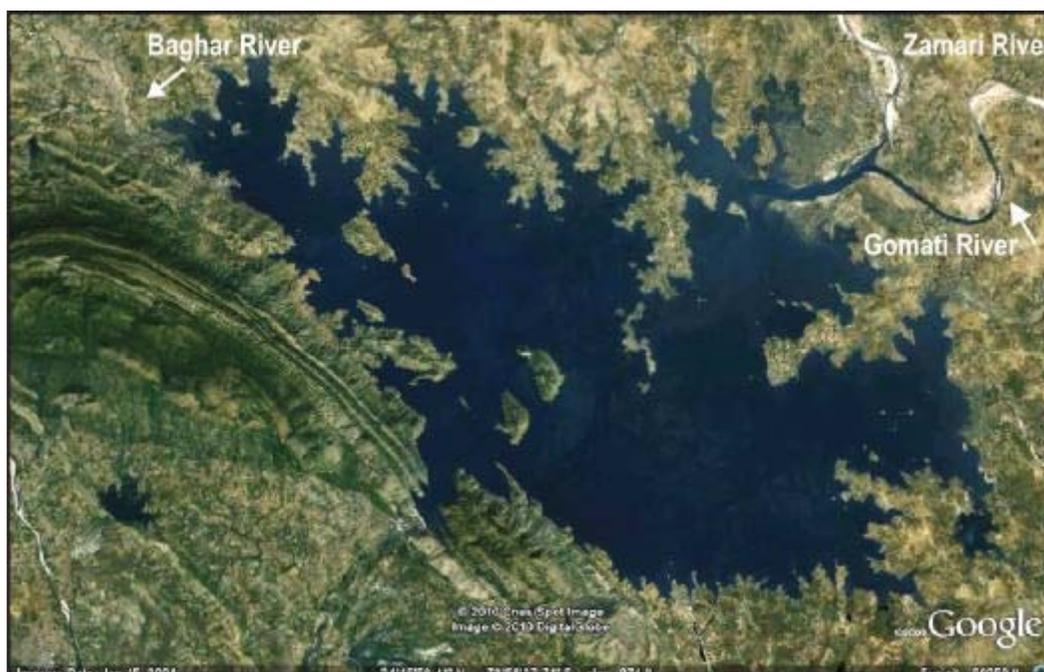


Fig. 3: Jaisamand Lake - Second Largest Man-made Lake in World

by Bhil and other tribal people. Until the building of the Aswan Dam in Egypt, Jaisamand Lake remained the largest artificial lake in the world.

Maharana Jai Singh laid the foundation stone of this dam in 1667. This is one of the largest man made fresh water lakes in the world. Nine rivers and 99 rivulets fall in this lake. The major rivers include Gomati, Zamari, Ruparel and Baghar. With the construction of the dam Chigoda, Namla, Batwada, Gamadi, Semal, Kotra, Ghati, Sanghawali and Saelab villages got inundated in the dam water. The remnants of these villages are visible when the water in the dam lowers. The people of these villages were rehabilitated in the near by high ground areas.

There are seven islands in the lake. Of these two are inhabited by the local tribal population. These villagers use country made boats for transportation called Bhela in local language to come across the lake together with their animals. Similarly small boats locally called Genda and Hamedra are also used. Bhela is constructed by tightly knitting together bamboos, where as Genda is made from grass and Hamedra from flat wood.

The people displaced due to the construction of this dam were rehabilitated in a very scientific manner and carefully chalked out plan that has acclaimed world wide distinction and recognition. This rehabilitation plan was the brain child of Maharana Jai Singh. The need for

rain water conservation and management in Mewar is the outcome of the recurring drought and famine in this region. The earliest recorded famine in the region is the A.D. 1662 famine thereafter similar drought and famine conditions have been experienced in 1812-13, 1833-34, 1888 and 1899 respectively. This inspired the rulers of Mewar to adopt various techniques to harvest rain water.

The rulers of Mewar were always sensitive to the needs of the common man. They were guided by the philosophy of "*Maximization of common man's welfare*". Consequently Mewar State was such a state where developmental activities were carried out unhindered even at the time of war besides natural calamities. The rulers of the state undertook development of infrastructural facilities even in the most pressing and demanding situations for the overall progress of the region.

**Udai Sagar Lake:** For instance Maharana Udai Singh II can be considered as the father of water shed area planning. For it was he, who in 1562 got constructed Udai Sagar Lake (Fig. 4) across Ahar River. It was the first ever attempt in the world to improve the living standard of the people based on water shed area. This concept was carried forward by the other Maharanas who got constructed Goverdhan Sagar, Pichola, Amar Kund, Kumharia Talab, Rang Sagar, Swaroop Sagar and

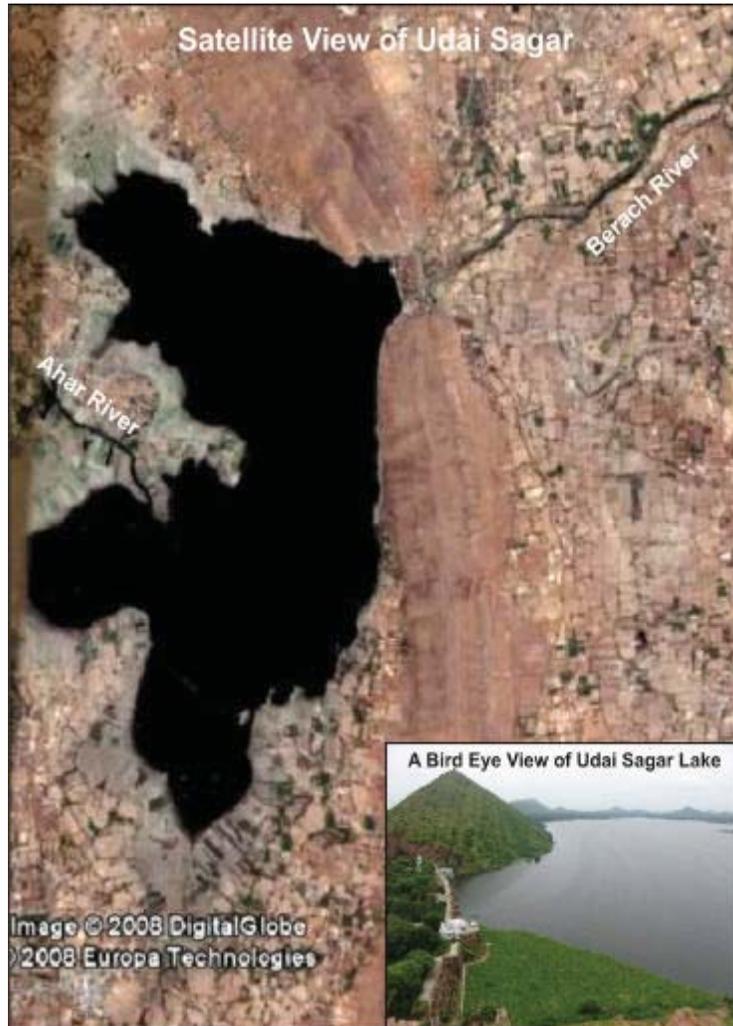


Fig. 4 Udai Sagar Lake

Fateh Sagar as Micro water shed units. Ministry of Agriculture, Government of India, later adopted this concept of water shed in 1974 for the conservation of water and soil. This is now the smallest unit of development.

The Maharanas of Mewar were fully aware of the importance of water management hence they encouraged development of such schemes that could lead to conservation of rain water in the region. Some of the present conservation methods viz. water shed management, river inter-linkage, river diversion, lake inter-linkage etc. were developed by them 500 years ago that speaks volumes of their water management acumen.

Mewar is also credited with the first ever attempt to link rivers in Udaipur Basin. Maharana Fateh Singhji inaugurated this project on 13th August 1890. Under this

project the rain water of Ahar River was diverted to feed Fatehsagar Lake. A dam was constructed across Ahar River 6 kms. Northwest of Udaipur city near Chikalwas village and a feeder canal called “Chikalwas Feeder” was constructed to divert the surplus rainwater of Ahar River towards Fatehsagar Lake. Maharana Fateh Singhji thus can be considered as the father of River Linkage in modern period. Owing to the semi-arid conditions the rulers and people of Mewar have always been sensitive towards water conservation and management from very ancient times.

Rain water conservation, accumulation and management practices in this region have been in vogue since 4500 to 6500 years before present till the modern times, the example of which is found in the Ahar Civilization. Reminisces of 4500 -6500 year old water



Fig. 5: Ring Well, Ahar Civilization (4500-6500 Years Old)

harvesting system called Ring Well system (Fig. 5) belonging to the Ahar Civilization has been preserved by the Department of Archeology, Government of India at Udaipur City. Actually Ring Well System was used for recycling of polluted domestic water which was reused for recharging underground water through mud pipes covered with stone walls to protect or after purification, clean domestic water was left into Ahar River which is flowing just near to the Ahar Civilization site.

IN the Mewar the roof Water Harvesting was for the first time practiced in the world at Kumbhalgarh Fort located 90 kms to the north - west of Udaipur City during 2<sup>nd</sup> century A.D., the traces of which are still found in the fort. Similarly Roof Water Harvesting was also practiced in the Chittorgarh Fort located 130 kms east of Udaipur City.

About 340 years (1670-1685) ago Maharana Raj Singhji I made the first ever successful attempt in the world to divert the water of Ubeshwar river to the Janna Sagar Lake (Bari Talav) through the Morvani river in medieval period. Prior to this the Ubeshwar river fell into the Chota Madar reservoir. For this diversion of Ubeshwar river rain water towards the Morvani river he constructed a Check Dam Wall near Dhar village 18 Kms. away from west of Udaipur city, which still exists.

The rulers of Mewar are also credited for evolving for the first time the concepts of multipurpose river valley project, river diversion, river linkage and development of man made lakes for the optimum utilization of rain water. The first river multipurpose valley project in the world was evolved with the construction of Jaisamand Lake during the 17th century in this region, likewise Ubeshwar river located 20 kms west of Udaipur was diverted towards Morvani River during 18th century.

In the 19th century the first ever attempt at river linkage was made in Udaipur basin, the Chikalwas feeder was constructed to divert the surplus monsoon rain water of Ahar river towards Fateh Sagar Lake. The incredible rain water conservation, preservation and management system which was developed by the former rulers of Mewar have been verified by historical records of the ancient, medieval and modern period, satellite imageries, survey of Indian topographical maps and sheets and extensive field survey.

## CONCLUSIONS

From the above discussion it is crystal clear that rain water management and conservation techniques developed by the rulers of Mewar were quite ahead of

their times. In an era when there were no sophisticated techniques and technical know how as prevalent today creating such engineering marvels is indeed highly appreciable. Their feasibility can be gauged from the fact that these lakes and water bodies continue to serve the needs of the growing population of the region unabated for the past many centuries. These measures developed at the behest of the rulers of Mewar Region, if emulated can help in the sustenance and availability of water, particularly in the water scarce regions of the world.

Presently the water bodies, reservoir, lakes, talab and small tanks of Mewar and particularly the Udaipur basin are facing a continuous threat to their environment. The major factors responsible for it include: population explosion, massive urbanization, encroachment in and around lake beds and river catchment areas, construction of anicuts and check dams, mining activities and deforestation in the hills around lake region and river catchment areas, silting and soil erosion, problem of water pollution bathing and washing activities, problems of sewage and domestic waste. The problem of floating weeds, Industrial pollutants and Water borne diseases.

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