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Water Resource Management

A study of the World's first man - made river links, river diversion and micro watershed of Udaipur basin

Narpat Singh Rathore*



Keywords: Basin, Diversion, Girwa, Lake Interlink, Maharana, Mewar, Micro - watershed, River link, Sagar, Talab, Ubeshwar, Udaipur

Abstract

Geographically Udaipur basin is located along the great Indian water divide line at the confluence of four rivers viz. Ahar, Morwani, Amarjok and Kotra (Sisarma) that flow through the well defined Girwa region along eastern slopes of south central Aravalis, one of the oldest mountain ranges of the world. The city of Udaipur in southern Rajasthan has evolved a network of eight man made lakes: Dudh Talai, Pichola, Kumharia Talab, Fateh Sagar, Goverdhan Sagar, Rang Sagar, Swaroop Sagar and Amar Kund have been evolved at Udaipur City since the 14th Century. All these eight lakes / ponds are interlinked with each other. They are the outcome of the vision and foresightedness of the ruling Maharanas of the erstwhile State of Mewar. **Rana Lakha** constructed the Lake Pichola in the year 1382-85 across Kotra (Sisarma) River. This concept was carried forward by other Maharanas, who constructed Udai Sagar, Kumharia Talab, Goverdhan Sagar, Rang Sagar, Swaroop Sagar and Fateh Sagar as micro watershed units. Maharanas of Mewar are credited with the first ever attempt of river diversion and river linkage in Udaipur Basin. Mewar is also credited with the first ever attempt to Link River in Udaipur basin. Maharana Fateh Singh, inaugurated the River Link project on 13th August, 1890. Under this project the water of Ahar river was diverted to feed Fateh Sagar. A dam was constructed across Ahar river 6 km northwest of Udaipur city near village Chikalwas and a link canal 'Ahar - Morvani River Link Channel' (Chikalwas Feeder) was constructed to divert the surplus monsoon water of Ahar river into Fateh Sagar. Thus Maharana Fateh Singh can be considered as the father of river linkage not only in India but also throughout the world. The Maharanas of Mewar thus presented a unique example of water conservation and management in Udaipur basin throughout the world.



Rana Lakha
A.D. 1382 - 1421

Study Area

The study area, Udaipur Basin lies between 73°36'51"E to 73°49'46"E longitude and 24°28'49" to 24°42'56" North latitude. It is a saucer shaped basin 22 kms wide from East to West and 24 kms long from North to South. It is wider in the South and tapers northwards. Its average height is 577 meters above the mean sea level. The Tropic of Cancer lies 122 kms to the south of the study area. Udaipur City popularly known, as the City of Lakes or Venice of the East is a picturesque city located in the south of Rajasthan and in north-western India. Founded by **Rana Udai Singh II** in A.D. 1553. Udaipur is one of the most majestic and historical city with rich cultural heritage and diversity.



Rana Udai Singh II
A.D. 1537 - 1572

The lakes of Udaipur are its invaluable natural assets developed by the Maharanas of Mewar in the past. These are the lifelines of Udaipur basin, not only serving its varied needs for the past six centuries but are also responsible for bringing Udaipur on the tourist map of the world as City of Lakes. This research paper attempts to highlight how River Linkages, River Diversion and Lake Inter-Linkages have taken place in the past, for more than six centuries.

Objective

- (1) To recognize the contribution made by the Maharanas of Mewar in the management and conservation of water resources in Udaipur basin.
- (2) To present the historical fact about the river linkage, diversion and watershed management.
- (3) To review one of the world's oldest water conservation and management system available in a basin.

Materials and Methods

The present study has been undertaken with the help of Survey of India topo-sheets on scale 1:25000 and 1:50000 surveyed in the years 1932-35, 1959-60, 1967-72 and 1973. Satellite images of varying resolutions for different years viz. Land Sat MSS data of 3rd March 1975 with 80 meters resolution, IRS data of LISS I of 18th February 1996 with 72.5 meters resolution IRS data of LISS III of 8th February 2004 with 23.5 meters resolution and IRS data of LISS-IV of 7th June 2004 and 2006 with 5.6 meters resolution and satellite imageries of Google Earth of 2007 and 2008 with one meter resolution have been used. Besides these Geological Survey of India Map 1997 depicting litho logical formation of the region has also been used. Ground truths have been verified through field survey.

For this study three broad methods have been used viz. the visual interpretation of remotely sensed data, mathematical analysis and field survey for verification of ground truth. The satellite data have been geo referenced. Catchment boundaries have been overlaid. Geological Map has been referred for litho logical composition of the entire basin and a composite picture has been arrived at for analysis including lineaments, drainage, settlements and roads.

Geographical Background of the Study Area

The Udaipur basin is a saucer shaped basin in form of a valley surrounded by the Aravali hill ranges which girdle it from all sides, locally called 'Girwa' means a girdle of hills. Udaipur basin, is largely dominated by Aravali and post Aravali geological systems with pyrite and schist as dominant rock types. The main city area lies on soft and cleaved metamorphic rocks of pyrite, schist and metagraywacke. The rocks of upper catchment area are composed of pyrite, schist, basic volcanic, and pyroclastics with enclaves of met conglomerate and marble.

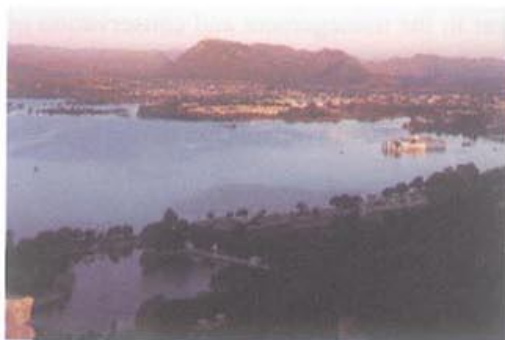
Traces of limestone, lineaments and granite are found in the west along Sisarma River. The satellite image (IRS P6) of February 2004 depicts three prominent sets of lineaments, trending NE-SW, NW-SE and EW directions around Udaipur City. These lineaments represent fracture zones in the area. The lineaments control the drainage and act as conduits for water recharge of the lakes in the basin. There are however no faults and folds in the Udaipur lakes to cause any underground seepage from the lakes.

The region is drained by Ahar river and its tributaries. This is the only major river that flows through this region. It originates from the hills of Gogunda lying in the north west of Udaipur City, flows for a distance of 30 kms and joins Uda Sagar in the East. It is joined by numerous tributaries and sub-tributaries. Sisarma River along with its important tributaries Amarjok and Kotra drain into Lake Pichola in Udaipur City. The Ahar river and its tributaries are seasonal in nature, they flow only during the rainy season and remain dry for the rest of the period. Ahar river lies at the centre and its tributaries form dendrite pattern. India's principal water divide passes over 610 meters contour towards west and south of Udaipur Basin.

Climatically, Udaipur basin is transitional between semi-arid region in the north and sub-humid region in the south. It receives 65 cms. average annual rainfall. Bulk of it is received during the rainy season from the south west monsoon. Winters are dry with mild temperature and occasional cold waves. The nature of rainfall in the basin is highly erratic and uncertain. There is high variability in the amount of rainfall received. Consequently occurrences of droughts coupled with rainfall are a characteristic feature of the basin.

Keeping in view the above climatic conditions and limited natural water resources the erstwhile rulers the Maharanas of Mewar constructed several lakes / ponds in the Udaipur basin to overcome the problems of availability of water for the local population. The eight lakes of the Udaipur city are interconnected and are the principal sources of water for the residents of the basin (Fig. 1). In the Udaipur basin eight lakes link channel are existing; Goverdhan Sagar - Pichola Link Channel, Pichola - Doodh Talai Link Channel, Pichola - Amarkund Link Channel, Pichola - Kumharia Talab Link Channel, Kumharia Talab - Rang Sagar Link Channel, Amar Kund - Rang Sagar Link Channel, Rang Sagar - Swaroop Sagar Link Channel and Swaroop Sagar - Fateh Sagar Link Channel.

Interconnected Lakes



Lake Pichola - It is one of the oldest amongst all the city lakes. It was constructed 600 years ago, between A.D. 1382 to 1385 by Rana Lakha. This lake is situated in the southwestern part of the city at 73°40'E longitude and 24°34'N. latitude. It derives its name from the village of 'Picholi'. It accounts for a total water body area around 6.96 sq. kilometers and has gross, live and dead capacities of 483,318 and 165 mcft, respectively. The lake has a maximum depth of 10.5 meters. It is interconnected with Goverdhan Sagar, Amar Kund and Kumharia Talab.



Rang Sagar - It was constructed in 1668 by **Rana Raj Singh I**. It is 700 meters long and 245 meters wide. It has a maximum depth of 7 meters. It acts as a link channel between Lake Pichola towards south and Swaroop Sagar and Fateh Sagar in the north. Its water holding capacity is 1000 mcft. Rang Sagar is interconnected with Amar Kund and Kumharia Talab.



Rana Raj Singh I
A.D. 1653 - 1680



Swaroop Sagar - It is a pear shaped lake which was constructed by **Maharana Swaroop Singh** in the year 1858. Its gross capacity is 427 mcft. Its live and dead capacity is 247 mcft and 180 mcft respectively. Its total area is 4.00 square kilometers and has a maximum depth of 13.4 meters. It is interconnected with Rang Sagar and Fateh Sagar.



Maharana Swaroop Singh
A.D. 1842 - 1861



Fateh Sagar - Fateh Sagar is another principal lake of the city. The Lake is situated at 24°35' N. latitude and 73°37'E. longitude at 578 meters altitude (m.s.l.) in the north western side of the city. This pear shaped and medium sized lake was first constructed by **Rana Jai Singh** in A.D. 1680. It was renovated in A.D. 1889 by **Maharana Fateh Singh**. The foundation stone of the present dam was laid by Duke of Connaught who was visiting Udaipur at that time. The lake is 720 meters long, about 100 meters wide and rises nearly 40 meters from the ground level towards east (Sahelion-ki-Bari).



Rana Jai Singh
A.D. 1680 - 1698

Fateh Sagar stretches 2.6 kms in north-south and 1.8 kms in east-west directions, covering total water spread of nearly 5 sq. kms. and maximum depth of 12 meters. It commands a total catchment area of about 41 sq. kms. Its gross, live and dead capacity is 427.60, 247.60 and 180-mcft water, evidently lower than that of Pichola. Fateh Sagar is connected with Swaroop Sagar by a link channel and also connected with Ahar river by a link channel i.e., 'Chikalwas Feeder'.

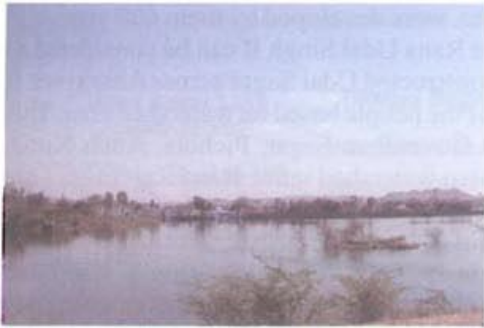


Maharana Fateh Singh
A.D. 1884 - 1930

Amar Kund - It is situated between Lake Pichola and Rang Sagar, constructed by the Prime Minister of Mewar, Shri Amar Chand Barwa in the year 1874. Later on Maharana Sajjan Singh merged this lake into Pichola, now it is deemed as a part of Lake Pichola. Amar Kund is interconnected with Lake Pichola and Rang Sagar by a link channel.



Doodh Talai - Smallest Lake in the lake region of Udaipur Basin. It was constructed by a nomadic 'Banjara' sometime between year 1375 to 1385. The nomadic Banjara used it for his cattle. The villagers of the Picholi also used the water of Doodh Talai during summers. It was the first water body constructed in the Udaipur Basin more than six hundred year ago. The Doodh Talai is interconnected with Lake Pichola through a link channel.



Goverdhan Sagar - This lake is situated to the south of Lake Pichola at 74042' East longitude and 24034' North latitude. Constructed in the year 1855 by Maharana Swaroop Singh. Its gross catchment area is 2.5 sq. kms and its live capacity is 9 mcft. It is connected with Lake Pichola through a link channel.

Kumharla Talab - It was constructed in the year 1559-61 by Rana Udai Singh II at the time of laying the foundation of Udaipur City Palace, it is made of earthenware and bricks. It is also interconnected with Lake Pichola and Rang Sagar.



Contribution of Mewar in Interlinking Rivers and Lakes: shown through Google Satellite images

Results and Discussions

All the eight lakes / ponds are man-made and interconnected with each other. They are the outcome of the vision and foresightedness of the Maharanas of the Mewar. In fact the establishment of Udaipur city itself was due to the strategic thinking of its founder, Rana Udai Singh II who founded the city in the girdles of the Aravali to safeguard his subjects and dynasty from the continued attacks of the invaders. Taking into account the sub humid and semi arid conditions of the Mewar state, 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. These lakes have been catering to the needs of this city for the past six centuries. They are an engineering marvel, developed and designed in such a manner that even though they are located at different elevations from mean sea level with varying depths, their water level becomes uniform when completely filled up. They are inter-linked with each other so that as one lake gets filled up the surplus water gets

transferred into the other lakes automatically. Thus they exhibit a unique example of water conservation and management. The World's First Man- Made Micro Watershed, River Diversion and River Links has taken place in Udaipur basin between six hundred to one hundred eighteen year ago.

The custodians 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 custodians of the state undertook development of infrastructural facilities even in most pressing and demanding situations for the overall progress of the region. The concept of watershed management, river diversion and river linkage is basically concept of Mewar which was derived by the Maharanas of Mewar. 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 water in the region. Some of the present conservation methods viz. watershed management, river inter-linkage, river diversion, lake inter-linkage etc. were developed by them 600 years ago that speaks volumes of their water management acumen. For instance Rana Udai Singh II can be considered as the pioneer of watershed area planning. For it was he, who in 1562 constructed Uda Sagar across Ahar river. It was the first ever attempt in the world to improve the living standard of the people based on watershed area. This concept was carried forward by other Maharanas who constructed Goverdhan Sagar, Pichola, Amar Kund, Kumharia Talab, Rang Sagar, Swaroop Sagar and Fateh Sagar as Micro watershed units. Rana Raj Singh I got the waters of Ubeshwar river diverted to Jana Sagar through Morwani river. Prior to this the Ubeshwar river fell into Chota Madar lake. Rana Raj Singh I, can be considered the father of river diversion in the world. Ministry of Agriculture, Govt. of India, later adopted this concept of watershed in 1974 for the conservation of water and soil. This is now the smallest unit of development in India. Mewar is also credited with the first ever attempt to link rivers in Udaipur Basin. Maharana Fateh Singh inaugurated this project on 13th August 1890. Under this project the water of Ahar river was diverted to feed Fateh Sagar Lake. A dam was constructed across Ahar river 6 kms. Northwest of Udaipur near Chikalwas village and a feeder canal called 'Chikalwas Feeder' was constructed to divert the surplus rain water of Ahar river towards Fateh Sagar. The Chikalwas Feeder is actually River Link Channel between Ahar and Morwani River. This is the first example of River Linkage throughout the world. Maharana Fateh Singh, thus can be considered as the father of River Linkage.



Shriji Arvind Singh Mewar
A.D. 1984

The Maharana of Mewar Charitable Foundation has undertaken a comprehensive research project on rivers under the guidance of **Shriji Arvind Singh Mewar**, Chairman and Managing Trustee. The project includes strategies for the preservation and sustenance of Udaipur's natural heritage: specifically the lake network of Udaipur basin in South Rajasthan. This network of lakes is an example of natural resources conservation including watershed management.

Presently these lakes, the lifelines of Udaipur City 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.

Conclusion

The lakes in Udaipur are the lifelines of the city for the past six centuries and will continue to remain so even in the future. The major economic activity of the city is tourism which depends upon these lakes. Consequently their sustenance is imperative in the interest of the basin. The measures suggested above and the model of Lake inter-linkage, river diversion and river inter-linkage developed by the Maharanas of Mewar need to be emulated for the preservation of these lakes.

The model of water accumulation, conservation and management developed by the Maharanas of Mewar in the Udaipur Basin in the past six centuries can thus be adopted in the country for effective water management. Through river diversion and river inter-linkage as envisaged and developed by the rulers of Mewar in Udaipur Basin the surplus rain water in different parts of the country can be diverted to the water deficient dry areas. About 350 years ago Rana Raj Singh I made the first ever successful attempt in the world to divert river water when he got the water of Ubeshwar River diverted to Morwani River by getting a Check Dam Wall constructed near village Dhar. Prior to it Ubeshwar river used to flow into Chotta Madar lake. Similarly Maharana Fateh Singh on 13 August 1890 got the surplus water of Ahar river diverted to Fateh Sagar through the construction of Chikalwas Feeder Canal. The custodians of Mewar have thus set a unique example before the world, of water conservation and management by constructing eight lakes / ponds in Udaipur City and interlinking them.

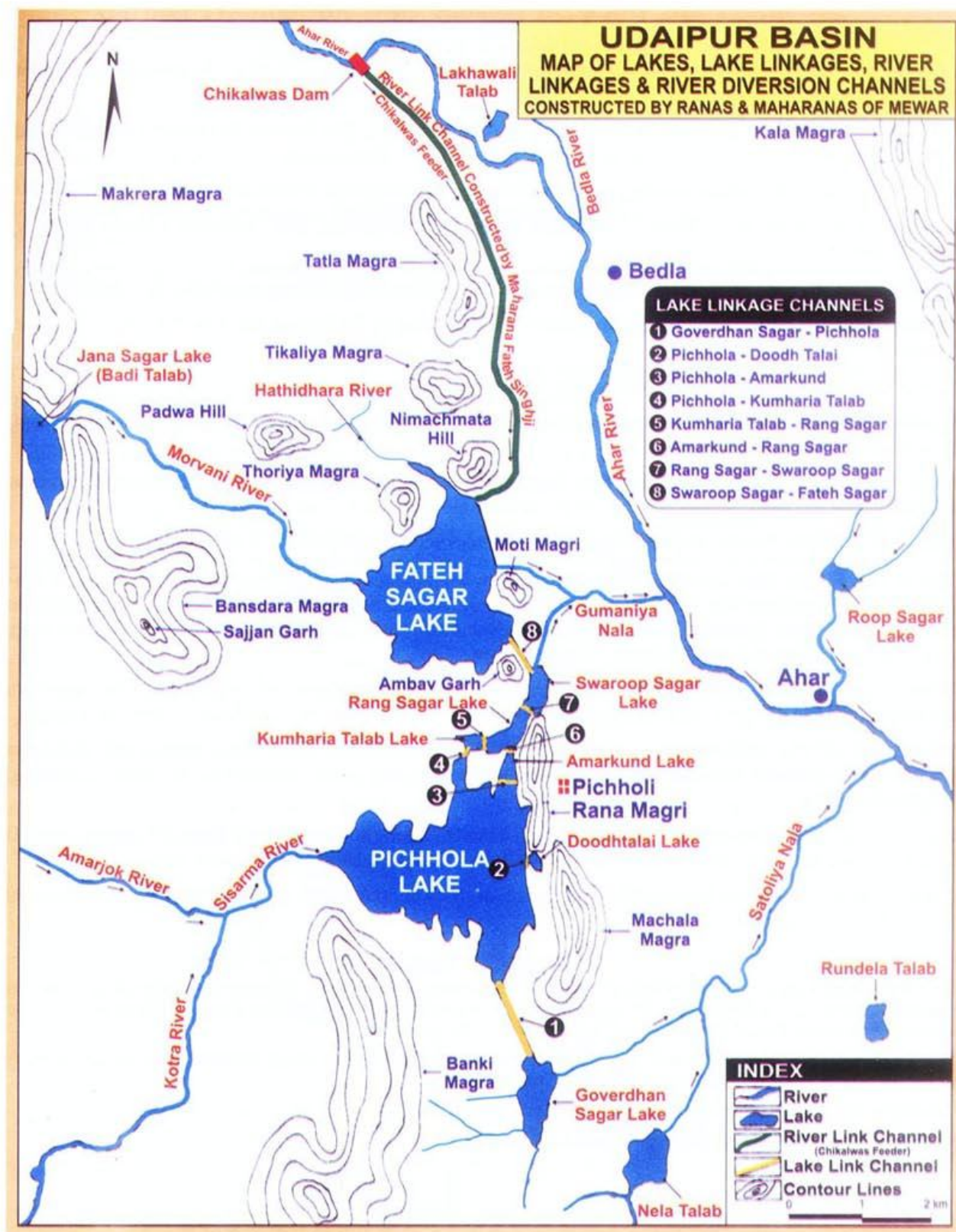


Fig. 1

Source: Dr. Narpal Singh Rathore, Associate Professor and Head, Department of Geography, University College of Social Science & Humanities, Mohan Lal Sukhadia University, Udaipur 313001, Rajasthan, India and Resource Person of Maharana of Mewar Charitable Foundation, The City Palace Complex, Udaipur 313001, Rajasthan, India

References

- Agarwal, B.D. (1979). Rajasthan District Gazetteers, Udaipur. Directorate of District Gazetteers, Government of Rajasthan, Jaipur.
- Erskine, K.D. (1992). Rajputana Gazetteers, Vol. II-A & Vol. II-B, The Mewar Residency, Vintage Book, Gurgaon, Haryana.
- GIS, (2000). Atlas of Rajasthan, Geology and Minerals, Geological Survey of India, Jaipur (Raj.) India.
- Haqiqat Bahida (1890). Daily Diary of Maharana Fateh Singh of Mewar, 24th December 1884 to 24th May, 1930, Rajasthan.
- Ojjha Gauri Shankar, Hira Chand (1928). History of Udaipur State (In Hindi language) Vol.-I & II, Jodhpur.
- Purohit, Devnath (1930). Udaipur - Sachitra (Mewar). Published by Sri Bhupal Mudran Mudranaly, Udaipur, Rajasthan.
- Purohit, Devnath (1938). History of Mewar. The Times of India Press, Bombay.
- Rajasthan Government, (1997). Discover Rajasthan, Department Tourism, Art & Culture, Govt. of Rajasthan, Jaipur (Raj.) India.
- Ranawat, I.S. (2004). Water Resources of Rajasthan (In Hindi language), Chirag Publication, Udaipur Rajasthan.
- Rathore, N.S. (1992). Natural Resources Base Development Scientific Publishers, Jodhpur (Raj.) India.
- Rathore, N.S. (2000). Identification and Mapping of New Maruganga channel in Northwest India of Indian Sub-Continent. Proceeding of the 21st Asian Conference on Remote Sensing. Chinese Taipei Society of Photo geometry and Remote Sensing, Centre for Space and Remote Sensing Research of National Central University and Asian Association of Remote Sensing, Taipei, Taiwan.
- Rathore, N.S. (2001). Udaipur the City of Sun-Rise, Souvenir, Thirteenth Annual Conference of the Rajasthan Ganita Parishad and Symposium, Department of Mathematics & Statistics, M.L. Sukhadia University, Udaipur.
- Rathore, N.S. (2002). Deforestation in Great Aravalli Mountain region of India. Proceeding of the 23rd Asian Conference on Remote Sensing, Royal Survey Department and Asian Association of Remote Sensing, Kathmandu, Nepal.
- Sharma, G.N. (1992,1994 &1995). Haqiqat Bahida - 7 to 16, H.I.H. Maharana Fateh Singh of Udaipur, Vol I, II & III, Maharana Mewar Research Institute, The City Palace Complex, Udaipur, Rajasthan, India.
- Shore, R. (1909). Medico-Topographical Account of Mewar, published by Superintendent Government Printing, Calcutta, India.

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Compilation: Mr. Bhupendra Singh Auwa, Deputy Secretary MMCF - Administration and Dr. Mayank Gupta, Deputy Secretary MMCF - Development, Maharana of Mewar Charitable Foundation, Udaipur

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