Feasibility Study of Proposed Interlinking between Ozat and Mahuvanti Rivers: A Review Paper

Nevil K. Trambadia[1], Vinodkumar M. Patel[2], Manoj J. Gundalia[3]
[1,2,3]*Civil Engineering Department, Gujarat Technological University*
[1]*Ph.D. Scholar, Civil Engineering Department, Gujarat Technological University*
[2]*Ph.D. Supervisor, Civil Engineering Department, Gujarat Technological University*
[3]*Ph.D.Co- Supervisor, Department of Civil Engineering, Uka Tarsadia University*
[1]patel.nil26@gmail.com
[2]vmpatel33@gmail.com
[3]mjgundalia@gmail.com

***Abstract*— According to the National Water Policy, water is a prime natural resource for human being and a precious national asset. Nowadays, it is hard to find freshwater due to growth in population, agricultural and industrial activities, and contamination of water resources. The rapid growth in the demand of freshwater driven by growth in the global population and of the economies, has led to this natural resource becoming scarce in many parts of the world. As a result, the ratio between the number of people and the available water resource is worsening day by day. Water being a finite resource, emphasis is required to be given on its conservation (saving). There are many ways of conserving water and one of the important methods is interlinking of small rivers. The interlinking of rivers (ILR) programme is a major endeavour to create additional storage facilities and transfer water from water-surplus regions to more drought-prone areas through inter-basin transfers. Ozat and Madhuvanti are the small rivers of Saurashtra region of Gujarat state. Both the rivers run closely parallel in about 10 Kms and hence, interlinking is possible between them.**

***Keywords*— Hydrology, River Interlinking, Submergence Analysis, GIS, RS**

I. INTRODUCTION

By 2020, the global population is projected to touch 7.9 billion, which is 50 percent larger than that in 1990 (Dyson, 1996). Because of this rapidly growing human population, the world may see more than a six fold increase in the number of people living in conditions of water stress - from 470 million today to 3 billion in 2025 (Postel, 1999).There are many ways to conserve this finite resource however, we must explore the best possible ways at local and regional levels. Interlinking of two water bodies is one of such methods for any area.The idea of linking the rivers of India has its roots in the thoughts of Visveswarya, the stalwart engineer of yesteryears. The idea was further extended by K L Rao, the legendary irrigation minister of India (Rao, 1975), and Captain Dastur, a pilot. Several rivers have been linked in the past in India as well as the world over in order to divert excessive water in order to save the flooding and inundation of the low lying areas of the river spread. These links have been establishes through various means viz., through pipe lines, canals and tunnels. Near Chail (Himachal Pradesh) 13.11 Km long tunnel has been constructed under Beas Sutlej Link project for diversion of Beas water. Considerable water can be transferred from one river to another river by such links. Similar effort is required comparatively at a smaller scale in semi-arid region of Saurashtra area. It has therefore, been realized to find out the ways and means to link two small rivers one is devastating the area and bringing a flood like situation whereas the other is mostly remaining dry.

Junagadh district is the sixth largest district of Gujarat state. It falls between 20o 44' North latitudes and 69o 40' and 71o 5' East longitudes. Girnar and Barda hills represent the hilly region of the district. Bhadar, Uben, Hiran, Ozat, Machchhundri, Madhuvanti, Somat, Sarbali, Raval, Shingavada are some of the important rivers of the district. The district has radial and dendritic type of drainage pattern. The average annual rainfall of last decade is 744mm. Ground water condition varies with the lithological characteristics of the geological formations. Ground water development of Junagadh district is shown in **Figure 1.** Limestone is deposited in the coastal area. Due to proximity of the seacoast, ground water quality is brackish to saline. Generally, depth of wells ranges from 10 to 25 meters depth below ground level and depth of bores ranges from 50 to 100 meters below ground level. The average yield in the wells / bores is approximately 50 to 400 LPM. Occurrence of ground water in the Gaj beds in confined within the limestone. Alluvial deposits occur in Ghed area which has inherent salinity. The district is facing problem of deterioration in ground water quality. The coastal areas are heavily affected by salt water intrusion. Excessive fluoride content problem is also noticed in many villages of Junagadh, Manavadar, Mangrol, Una, Kodinar, Keshod and Veraval talukas of the district. Deeper aquifers of trap formation in Junagadh, Vanthali, Maliya, Keshod, Manavadar and Una talukas yield brackish to saline water. Due to problem of insufficient yield and non-potable ground water, the most of the villages are getting drinking water from various Regional water supply schemes with sources as reservoirs.

II. NEED OF STUDY

While considering a representative area like district of Junagadh in Saurashtra, Ozat river creates a havoc like situation due to limited carrying capacity compared to rains received by it during rainy season with a greater frequency. The amount of water inundates the Ghed area with the fury of flood. Distraction of local transportation completely obstruct the natural contacts to give connectivity in area for making it accessible for distributing required food and other primary needs. In case some measures are taken to divert the flood water so received, the local population is saved from the loss they incur in terms of washing away of top soil of the fertile fields, loss of crops, washing out of homes and animals and loss of human life. For example the economy of one of the villages like Shapur situated on bank of Ozat was almost destroyed after the flooding of June 22, 1983. Indian Prime Minister Mrs. Indira Gandhi was rushed to Shapur and was much shocked after seeing villagers' loss of homes, business and crops ("http://en.wikipedia.org/wiki/Shapur_Sorath").

III. STUDY AREA

Proposed site is selected based on field survey. The rivers Ozat and Madhuvanti running parallel and average distance is nearby 10km. In these both Rivers the Ozat River is Surplus basin which needs to transfer into water deficit Basin of Madhuvanti River. Our proposed site is selected for interlinking of both rivers near Nana kajaliyana village because this point is nearest of for both rivers. During the peak flood condition the downstream area of Ozat River is submerged at every season of monsoon. The estuary area of Ozat River is submerged due to low laying condition and some of regular human activities get affected during these days. There are many people witnessed for the flood. Nearby 300 villages of Ghed region get submerged and also transportation get affected and disconnect from other nearby areas. The work of this interlinking is only to save the life of human do needful as possible by applying civil engineering push ups.

IV. LITERATURE REVIEW

In the above river interlinking works, the some literature reviews has been analysed for future work and reliable study to getting good outcomes as well as submergence analysis of downstream area of Ghed Region.

1. Vyas, Sunil Kumar, et al. (2016)

Annual surplus water of about 1437 MCM in the river Chambal is going waste and ultimate ly reaches to sea after creating flood situations in various places in India including Rajasthan, while on the other hand 1077 MCM water is a requirement in the four other basins in Rajasthan i.e.Banas, Banganga, Gambhir and Parbati at 75% dependability. Interlinking and water transfer from Chambal to these four river basins is the prime solution for which 372 km link channel including 9 km tunnel of design capacity of 300 cumec with 64 m lift is required.

2. Avtar Ram, et al. (2011)

Ken–Betwa river link is one of the pilot projects of the Inter Linking of Rivers program of Government of India in Bundelkhand Region. The integrated thematic maps were used for hazard zonation. This is based on categorizing the different hydrological and geomorphological processes influencing the inundation and erosion intensity. Result shows that the southern part of the study area which lies in Panna district of Madhya Pradesh, India, is more vulnerable than the other areas.

3. Goparaju, Laxmi, Firoz Ahmad, and Himanshu Thakkar (2017)

This study has analysed the Landsat 8 OLI data (December 2016) to delineate the various land use/land cover classes of the area which will be submerged by the proposed Daudhan/Greater Gangau Dam, which is part of the proposed Ken Betwa River Link Project (in the Madhya Pradesh state of India) and also the area likely to be submerged in the Panna Tiger Reserve (PTR). Geospatial technology helps in studying the overall spatial view of the proposed submergence area and the visualization gives a clear picture of the likely scenario in the future. It would assist in decision making and mitigation measures.

4. Patel Akruti K., N. P. Singh, and Indra Prakash (2015)

In Bhavnagar district (India) the Shetrunji dam was built for irrigation on river Shetrunji.The surplus water availability in the dam is high as dam overflows quite often .Water deficiency analysis is also done on the basis of yearly availability of water in the Dhatarwadi II dam, Rajula Taluka, Amreli district (India) .Dhatarwadi dam was constructed on Dhatarwadi river.So surplus water diversion is possible through canal to feed the dam having deficiency of water. The present study is to deal with the surplus water diversion via canal along with consideration of various ground features, contours and slope of the study area using GIS and Remote Sensing. Location of canal falls and location of cross drainage work is also presented in the present study.

5. Kanjani Heena, et al. (2016)

The present study deals with the surplus water diversion via canal from Kadana Dam to Watrak Dam, Gujarat. The study area includes two districts namely Panchmahal and Sabarkantha of north-east Gujarat. For interlinking, consideration of various ground features, contours and slope of the study area is done using GIS and Remote Sensing. The data obtained from thematic maps are integrated that helps in planning of alignment of canal. Selection of alignment for a canal is critical in terms of cost and execution time. Several alignments may be possible between the source and destination of a canal, but command area and alignment possible with minimum cutting and filling works based on topography is finalized. Further construction of civil engineering structures are identified to design the new interlink canal from Kadana Dam to Watrak Dam.

6. Chandrashekar H., et al. (2015)

Detailed morphometric analysis was carried out using ARC- GIS for Manchanabele reservoir catchment and Nellegudde reservoir catchment of Arkavati river system. Arkavati River is the tributary of river Cauvery which covers a catchment area of 4038 sqkm. Manchanabele Reservoir and Nelligudde Reservoir is constructed across river Arkavati. Manchanabele Reservoir has an independent catchment of 152.99sq km and Nelligudde reservoir has an independent catchment of 66.64 sq km. The results of the morphometric analysis reveal that Manchanabele catchment is less elongated with high erosion and peak flow. It has a strong relief and steep ground.

7. Jiang Yan. (2011)

The study has put forward a water pollution management model as a GIS tool in the long-term water projects regulating process and pollution control plan for the Huaihe River Basin in China. Based on algorithms provided in the GIS foundational software such as shortest path analysis, connectivity component analysis, upstream/downstream trace and buffer analysis, we built an algorithm library including water projects regulating-oriented algorithms for upstream/downstream tracking of water pollution.

8. Khalfallah C. Ben, and S. Saidi (2018).

The floods have become a scourge in recent years (Floods of, 2003, 2006, 2009, 2011, and 2012), increasingly frequent and devastating. Tunisia does not escape flooding problems. The analysis of the results shows a good correlation between simulated parameters and those measured. There is a flood of the river exceeding 240m3/s (DGRE, 2015) and more flowing sections are observed in the future simulations; for return periods of 10yr, 20yr and 50yr.

9. Fernandez Paz, et al. (2018)

This article presents analyses of soil and environmental information for the Darro River basin (Granada-Spain) preliminary to its hydrological and forestry restoration. These analyses were carried out using a geographical information system (GIS) and employing a new procedure that adapts hydrological forest-restoration methods. According to the results, river authorities have included several measures in the restoration project aimed at reducing the erosion and helping to recover the environmental value of this river basin and to include it in recreation possibilities for the community of Granada. The presented analytical approach, designed by the authors, would be useful as a tool for environmental restoration in other small Mediterranean river basins.

10. Patel Dhruvesh P., and Prashant K. Srivastava. (2013)

This study, integration of the satellite and GIS datasets are carried out to prepare the flood zonation mapping of Surat district, Gujarat, India. Overall analysis indicates that more than 90 – 95% of the area would be submerged if the flood of the same frequency happened over this flood plain in the near future. To mitigate the floods hazards, various remedial measures are suggested to lower the degree of danger owing to future flood events.

11. Bai Jie et al. (2011)

Inland lakes are major surface water resource in arid regions of Central Asia. The area changes in these lakes have been proved to be the results of regional climate changes and recent human activities. This study aimed at investigating the area variations of the nine major lakes in Central Asia over the last 30 years. According to comprehensive analyses, different types of inland lakes presented different trends of area changes under the background of global warming effects in Central Asia, which showed that the Increased human activities had broken the balance of water cycles in this region.

12. Choudhary Komal, Mukesh Singh Boori, and Alexander Kupriyanov.(2017)

The present study illustrates the spatial-temporal dynamics of Land use/cover change in Astrakhan city, Russia. Landsat satellite imageries of three different time periods of 2000, 2007 and 2015 were acquired by earth explorer website and quantify the changes in the Astrakhan. The result shows extensive vegetation degradation and water logging in different parts of the study area.

13. Bharathkumar L., and M. A. Mohammed-Aslam.(2015)

The study area Tumkur taluka is located in southern part of Karnataka and belonging semi-arid climatic condition. The cropping pattern includes majorly coconut plantation, Arecanut plantation, Banana plantation, Ragi, Wheat, Maize, Jowar and other crops. Our suitability crop modelling map will minimize the maintenance of ground water. Suitability crop pattern map includes high income and yield to farmers within less maintenance and less water usage with respect to the climatic conditions.

14. Singh Kanwar Vivek, et al.(2015)

The rule-based classification algorithms were used for differentiating waterlogged areas from other ground features using Resourcesat-2 AWiFS satellite imagery (Indian Remote Sensing Satellite with spatial resolution of 56 m). Two spectral indices normalized difference water index (NDWI) and modified normalized difference water index (MNDWI) were used for extracting waterlogged areas in Sri Muktsar Sahib District of Punjab, India. These results suggest that MNDWI can be used to better delineate water features mixed with vegetation compared to NDWI.

15. Othman Arsalan A., et al.(2014)

This study aims to assess the potential of several ancillary input data for the improvement of unsupervised land cover change detection in arid environments. The study area is located in Central Iraq where desertification has been observed. We show that such an approach allows a robust and low-cost alternative for preliminary and large-scale assessments. This study shows that desertification has increased in the study area since 1990.

16. Boori M. S., et al. (2016)

Monitoring of land use/cover change is very important for sustainable development planning study. This research work is to understand natural and environmental vulnerability situation and its cause such as intensity, distribution and socio-economic effect in the Indigirka River basin, Eastern Siberia, Russia based on remote sensing and Geographical Information System (GIS) techniques. Resulted vulnerability classified into five levels: low, sensible, moderate, high and extreme vulnerability by mean of cluster principal. The natural vulnerability maximum area covered by moderate (29.84%) and sensible (38.61%) vulnerability and environmental vulnerability concentrated by moderate (49.30%) vulnerability. So study area has at medial level vulnerability. This study is helpful for decision making for eco-environmental recovering and re-building as well as predicting the future development.

17. Everard, Mark.(2019)

The need to adapt human resource demands to the renewable capacities of ecosystems is widely acknowledged and has been transposed into multiple international and national commitments and strategies. This need is intensified by the contemporary full world and increasing human numbers, urbanisation and climate change. It also provides insights into means to mitigate and sustainably hybridise qualitatively differing water management approaches to safeguard, and ideally to rebuild where degraded, the capacities of catchments to meet human needs on an enduring and equitable basis.

V. Concluding Remarks

1. River interlinking is possible for small rivers to balance the surplus and deficit basins.
2. Catchment drainage map, slope map and contour map using GIS are reliable for prediction of interlinking path detection.
3. GIS data sets are useful for morphometry analysis as well as in preparing various hydrological maps.
4. Recent research indicates that Landsat 7 and Landsat 8 are provided reliable data for remote sensing.
5. Crop selection and cropping pattern analysis would efficiently carried out using RS and GIS tools.
6. NDWI and MNDWI technic along with RS would effectively be detected water body status.
7. RS data and GIS software are effectively used to identify forest restoration and land use land cover change.
8. Appropriate interlinking structure is suggested based on field survey.

References

[1] Vyas, Sunil Kumar, et al. "Interlinking feasibility of five river basins of Rajasthan in India." *Perspectives in Science* 8 (2016): 83-86.

[2] Avtar, Ram, et al. "Identification of erosional and inundation hazard zones in Ken–Betwa river linking area, India, using remote sensing and GIS." *Environmental monitoring and assessment* 182.1-4 (2011): 341-360.

[3] Goparaju, Laxmi, Firoz Ahmad, and Himanshu Thakkar. "Submergence analysis of the proposed Ken Betwa Dam (Madhya Pradesh) India, using geospatial technology in Environmental Impact Assessments." *Environmental & Socio-economic Studies* 5.4 (2017): 18-28.

[4] Patel, Akruti K., N. P. Singh, and Indra Prakash. "Planning of River Inter-Linking Canal System between Shetrunji River and Dhatarwadi River, Saurashtra, India, using Remote Sensing and GIS." *IJSTE-International Journal of Science Technology & Engineering* (2015).

[5] Kanjani, Heena, et al. "Selection of Inter-Linking Canal Alignment from Kadana Dam to Watrak Dam, Gujarat, using Remote Sensing and GIS." *IJSTE-International Journal of Science Technology & Engineering* 2.11 (2016).

[6] Chandrashekar, H., et al. "GIS–based morphometric analysis of two reservoir catchments of Arkavati River, Ramanagaram District, Karnataka." *Aquatic Procedia* 4 (2015): 1345-1353.

[7] Jiang, Yan. "GIS stream network analysis for Huaihe River basin of China." *Procedia Environmental Sciences* 10 (2011): 1553-1558.

[8] Khalfallah, C. Ben, and S. Saidi. "Spatiotemporal floodplain mapping and prediction using HEC-RAS-GIS tools: Case of the Mejerda river, Tunisia." *Journal of African Earth Sciences*142 (2018): 44-51.

[9] Fernandez, Paz, et al. "GIS environmental information analysis of the Darro River basin as the key for the management and hydrological forest restoration." *Science of the Total Environment* 613 (2018): 1154-1164.

[10] Patel, Dhruvesh P., and Prashant K. Srivastava. "Flood hazards mitigation analysis using remote sensing and GIS: correspondence with town planning scheme." *Water resources management* 27.7 (2013): 2353-2368.

[11] Bai, Jie, et al. "Changes in the area of inland lakes in arid regions of central Asia during the past 30 years." *Environmental monitoring and assessment* 178.1-4 (2011): 247-256.

[12] Choudhary, Komal, Mukesh Singh Boori, and Alexander Kupriyanov. "Landscape analysis through remote sensing and GIS techniques: A case study of Astrakhan, Russia." *Eighth International Conference on Graphic and Image Processing (ICGIP 2016)*. Vol. 10225. International Society for Optics and Photonics, 2017.

[13] Bharathkumar, L., and M. A. Mohammed-Aslam. "Crop pattern mapping of tumkur taluk using NDVI technique: a remote sensing and GIS approach." *Aquatic Procedia* 4 (2015): 1397-1404.
[14] Singh, Kanwar Vivek, et al. "Evaluation of NDWI and MNDWI for assessment of waterlogging by integrating digital elevation model and groundwater level." *Geocarto International* 30.6 (2015): 650-661.
[15] Othman, Arsalan A., et al. "Environmental change detection in the central part of Iraq using remote sensing data and GIS." *Arabian Journal of Geosciences* 7.3 (2014): 1017-1028.
[16] Boori, M. S., et al. "Land use/cover change detection and vulnerability assessment in Indigirka river basin, eastern Siberia, Russia." *Imnage Processing, Geoinformatics and Information Security* 1638 (2016): 270-283.
[17] Everard, Mark. "A socio-ecological framework supporting catchment-scale water resource stewardship." *Environmental science & policy* 91 (2019): 50-59.