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SELECTION OF CANAL ALIGNMENT FOR THE INTERLINKING OF DAMANGANGA (EKADARE) AND GODAVARI VALLEY USING QGIS

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Abstract - Water scarcity is the major issue faced by the world and it is rapidly rising in India. To overcome this problem many methods have been adopted, interlinking of rivers is one of them. Connecting the rivers with the help of canals and reservoirs is called interlinking. In India, National Water Development Agency (NWDA) have proposed various links for this purpose. Amongst these link Daman Ganga (Ekadare) - Godavari Valley link is selected and 4 alignments are proposed considering various factors. QGIS software is used for this project.

Keywords: Water, interlinking, rivers, canal, alignment, QGIS.

1. INTRODUCTION

Water scarcity is a major issue that is rising very rapidly in India. India being water stressed nation, is standing on the brink of an acute water crisis. The solutions proposed to solve the water scarcity problems are rainwater harvesting, water conservation, waste water recycling and much more. The one of the major solution to solve this problem is inter linking of rivers which was introduced in the year 1982 in India. The Interlinking of Rivers is the concept of connecting the rivers of the country by networks of reservoirs and canals. Through interlinking, water can be transferred from elevated surplus areas to low-lying deficit areas. Interlinking of rivers consists of multifaceted data on agrarian, environmental, hydrogeological, political and socio-economic aspects. Data is derived from a variety of sources, including remote sensing photos, aerial photography, paper maps, and field data. For easy retrieval, analysis, effective planning and execution and decision making on such complex project issues, the data and information related to it should be stored in digital form at one place.

1.1 Literature review

Akruti K Patel et.al, (2015): They proposed the planning of interlinking of River Shetrunji and River Dhatarwadi by a canal using Remote Sensing and GIS. The slope map and contour map were prepared with the help of ARC GIS software. The canal alignment is planned based on the data acquired in such a way that the surplus water from Shetrunji Dam flows to the Dhatarwadi Dam by gravity level passing through the three talukas. Three cross drainage works are required because the canal crosses the natural streams of the Bagad River, Malan River, and Zolapur River.

Heena K Kanjani et.al, (2016): She conducted a case study to propose the interlinking canal alignment from Kandana Dam to Watrak Dam which is located in the northern part of Gujarat using Remote Sensing and Geographical Information System (GIS). The satellite image data and geo spatial data were obtained from the BISAG and thematic layers were made using visual interpretation technique of ARC GIS. Three alignment of canals were proposed based on the I.S. code of lined canal. Considering economy, suitability and land use requirement that is based on GIS study; approximately 38 km length of interlink canal has been proposed. The water through the canal will flow with the help of gravity passing through loamy soil.

Anupriya et.al, (2018): Using GIS and Open Source Maps, they investigated the Vidarbha region (OSM). The topography characteristics and potential of water storage capacity with water shading of the Vidarbha region were analysed using Q GIS 2.14.12 with grass 7.2.0 and Cgiar-csi. The softwares were used to create the various data needed for the linkage. Examining such an environmental issue with software proves to be a significant step in the right direction.

1.2 Objectives

a) The core objective of the project is to analyze the most suitable path for interlinking of Damanganga River and Gangapur Reservoir using the QGIS software.

b) To find out the proposed location of dam near Ekadare.
c) To divert the surplus water using canal, ducts and drains to increase the area under irrigation.

2. METHODOLOGY

2.1 Study area

NWDA has carried out studies and proposed diversion of surplus water available at dependable yield of Damanganga basin upto proposed Ekadare dam site to existing Gangapur reservoir in Godavari Valley.

Damanganga: The Daman Ganga originates in the Sahyadri hills near Ambegaon village in the Dindori taluka of Maharashtra's Nasik district. Major part of the river lies in Maharashtra. It is 131.30 km long from point of origin to the Arabian Sea. 20°19′N, 72°50′E are the coordinates. Dawn, Shrimat, Val, Rayte, Lendi, Vagh, and Dudhni are important tributaries of the Damanganga River.

Godavari Valley: The Upper Godavari sub-basin, which lies between 18°42' and 20°28' north latitude and 73°26' to 77°46' east longitude, includes the Godavari's reach from its source to its convergence with the Manjra River but excludes the Pravara, Purna, and Manjra rivers' catchment areas. The river flows through Nashik district, eventually reaching the Gangapur Reservoir, which was created by a dam of the same name, and subsequently the Kashyapi Dam. The Kashyapi dam rises 41.75 m above the lowest foundation. The gross storage capacity is 0.05269 km3 and the volume content is 0.05174 km3.

2.2 Flowchart

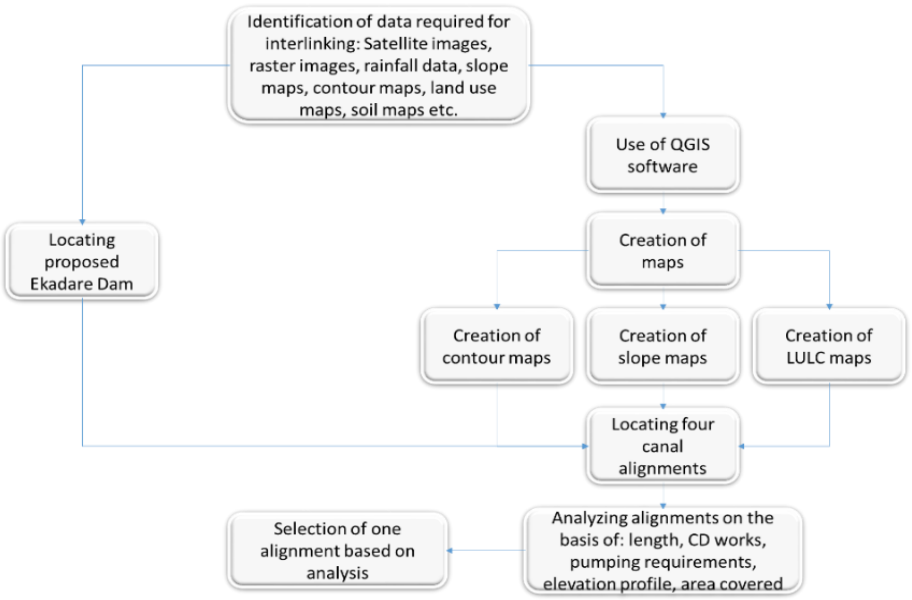

Fig -1: Methodology Flowchart

Figure 1 gives the flowchart on methodology used in the study.

2.3 Proposed Ekadare Dam:

It is proposed to build a new dam on the Damanganga River near Ekadare village in Nashik district to divert excess water to the Kashyapi Dam via a canal. The proposed Ekadare Dam is located at 20°11′24″ N, 73°32′20″ E. The dam was chosen for this location based on the following criteria:

1. The presence of a suitable foundation.
2. Minimum length of the dam, which came out to be 320 m using Google Earth Pro Software.

3. It should not be too far from the Kashyapi dam, as this will lengthen the interlink and increase the project's cost.
Catchment Area: 182 km

2.4 Creation of Maps Using QGIS Software:

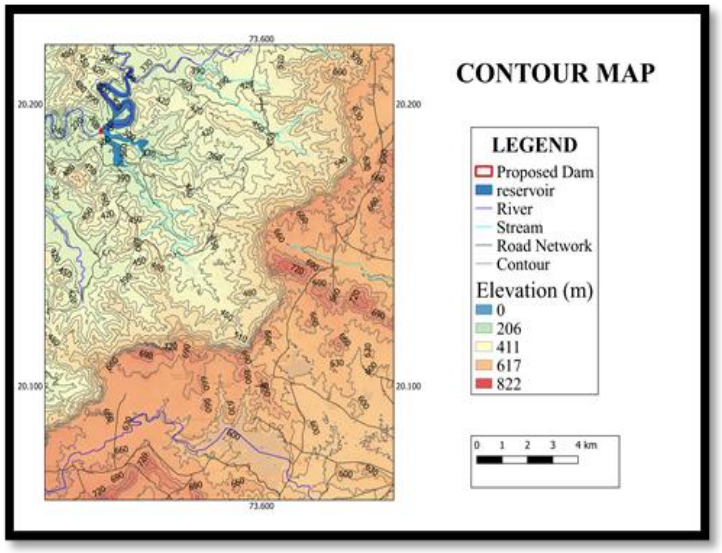

Fig -2: Contour Map

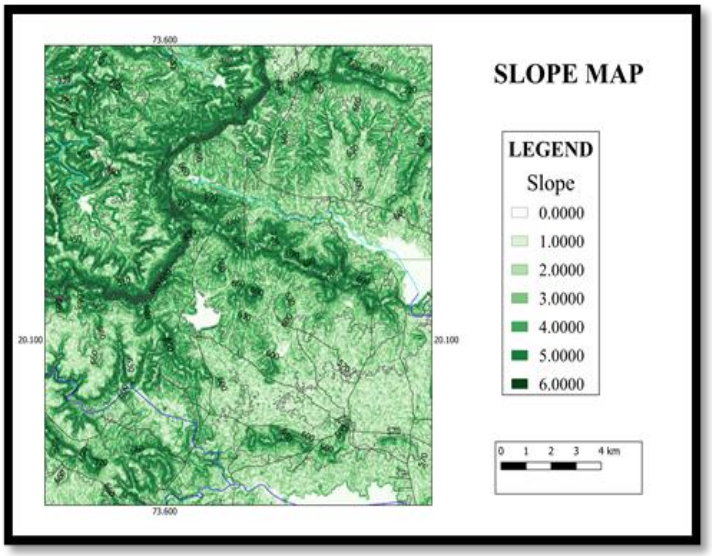

Fig -3: Slope Map

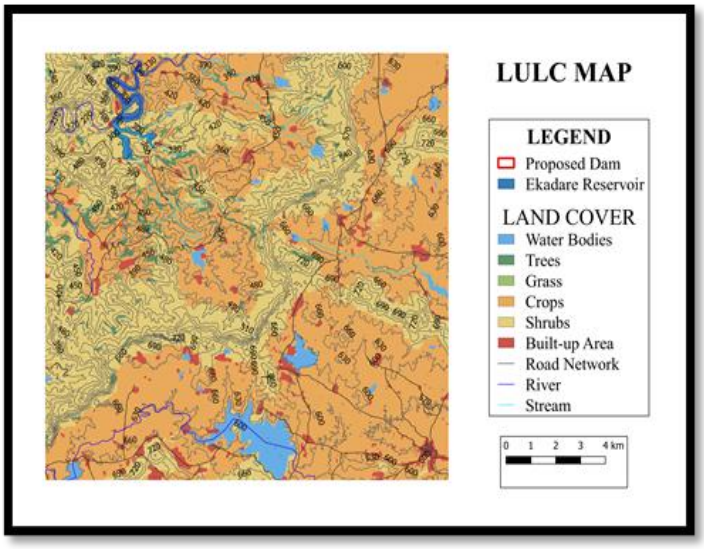

Fig -4: LULC Map.

2.4 Alignments

Some of the basic requirements for canal alignment were as follows:
1. The canal alignments were chosen in such a way that water flowed primarily through gravity, with as little pumping as feasible.
2. Landuse land cover maps were used to identify and avoid built-up regions.
3. The alignments provided run through the most of the open land possible.
4. The majority of the time, road and river networks were avoided so that cross drainage work would be minimal.
The four canal alignments are investigated based on geology, hydrology, and land use, with the most suitable alignment chosen based on topographic circumstances and meeting the canal alignment criteria.
Figure 2 shows contour map, slope map and LULC map that are used for passing the alignments.

2.4.1 Canal Alignment 1:

Between Ekadare Dam and Kashyapi Dam, a canal alignment was suggested. The canal runs from the proposed Ekadare Reservoir's left bank to a sump at RD 4.7 km, FSL 550 m, and a lift of 170 m. Then it flows up to RD 6.7 km by gravity. The link then takes off from the sump at FSL 540 m, pumping through a pipe line to a sump at RD 7.9 km, FSL 715 m, with a lift of 175 m. The canal runs from a sump at RD 7.9 km through a tunnel to RD 12.7 km on the upper bank of Kashyapi Reservoir, with an FSL of 715 m. In the tunnel, water flows due to gravity. The canal is 12.7 km long in total. The total lifting head is 345 m. Shingdari, Cholmukh, Kulwandi, Shivaji Nagar, Holdar Nagar, and Kashyapnagar are among the villages served by the link. It crosses a major road at a distance of 3.58 km, necessitating the construction of an overbridge. Only one cross drainage work is required in this case. This alignment has the shortest length of the four proposed alignments. Figure 5 shows canal alignment 1.

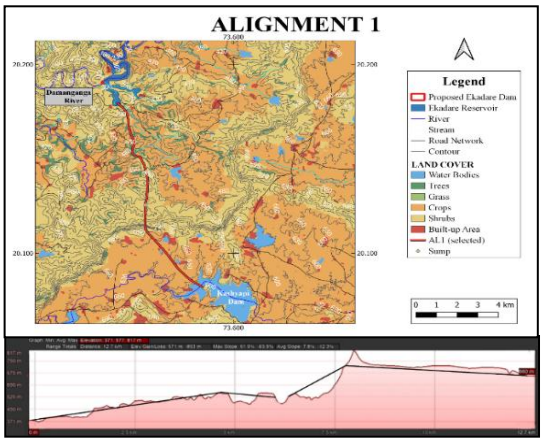

Fig-5: Alignment 1

2.4.2 Canal Alignment 2:

The alignment runs from the proposed Ekadare Reservoir's lower right bank to a sump at RD 5.15 km at FSL 510 m with a lift of 140 m. Then it flows up to RD 8.15 km due to gravity. The link then takes off from the sump at FSL 490 m by pumping through a pipe line to a sump at RD 9.7 km at FSL 700 m with a lift of 210 m. The canal starts with an FSL of 700 m from a sump at RD 9.7 km and continues through a tunnel to RD 13.2 km on the upper bank of Kashyapi Reservoir. In the tunnel, water flows due to gravity. The canal is 13.2 kilometres long in total. A total of 350 m of lifting head is available. Ruipetha, Murmuti, Fanaspada, Pate, Donwade, Umbardahad, Vaishnavnagar, and Indiranagar are the villages covered by this link. It crosses five roads at distances of 1.16 kilometres, 5.24 kilometres, 5.94 kilometres, 7.82 kilometres, and 10.7 kilometres, respectively, and thus over bridges must be provided at those points. At a chainage of 5.43 kilometres, it crosses a stream, necessitating cross drainage work. It is the second shortest of the four alignments. In comparison to other alignments, it necessitates more cross drainages. Figure 6 shows canal alignment 2.

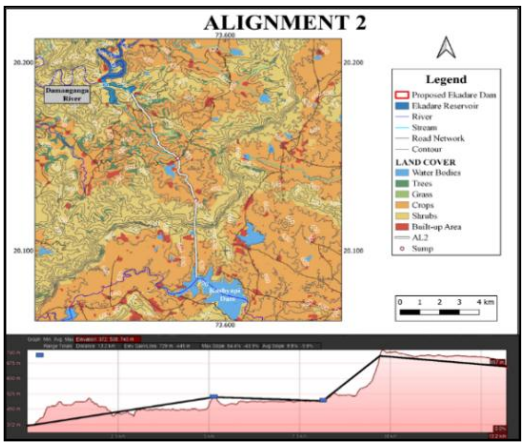

Fig-6: Alignment 2

2.4.3 Canal Alignment 3:

The alignment runs from the proposed Ekadare Reservoir's lower right bank to a sump at RD 2.6 km, FSL 404 m, with a 34 m lift. The link then starts pumping to a sump at RD 4.8 km, which is at FSL 486 metres. It's an 82-meter lift. The link then ascends through a pipe line from sump at RD 4.8 km to a sump at RD 6.1 km at FSL 681 m, with a lift of 195 m. The canal, then runs with an FSL of 681 m from a sump at RD 6.1 km to RD 9.2 km through tunnel. In the tunnel, the water flows by gravity. The canal then takes off from RD 9.2 km at FSL 673 m to RD 18.6 km at FSL 635 m through gravity. The canal is 18.6 kilometres long in

total. The total lifting head is 311 m. Thus at three points, pumping is required. Dolharmal, Kohor, Ladachi, Sadgaon, and Dhondegaon are the villages covered by this link. It crosses eight roads at distances of 1.6 km, 3.3 km , 4.6 km, 9.48 km, 12.5 km, 13.86 km, 14.45 km, 15.37 km, and 17.9 km, respectively, and thus over bridges must be provided at those points. It crosses the stream at a distance of 2.4 km, necessitating cross drainage work. Thus at nine different locations, cross drainage work is required. Figure 7 shows canal alignment 3.

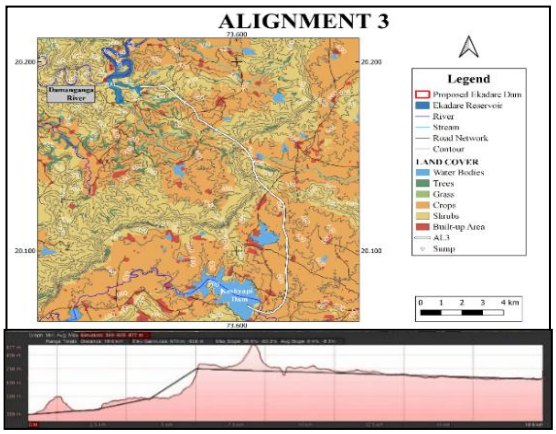

Fig-7: Alignment 3

2.4.4 Canal Alignment 4:

The alignment runs from the proposed Ekadare Reservoir's lower right bank to a sump at RD 4.2 km at FSL 515 m with a lift of 145 m. Then it flows up to RD 10.2 km due to gravity. The link then takes off from the sump at FSL 505 m, pumping through a pipe line to a sump at RD 11.9 km, FSL 720 m, with a lift of 215 m. The canal runs from a sump at RD 11.9 km through a tunnel to RD 15.2 km on the upper bank of Kashyapi Reservoir, with an FSL of 720 metres to 660 m, respectively. In the tunnel, water flows due to gravity. The canal is 15.2 km long in total. The total lifting head length is 360 m. Dolharma, Ruipetha, Fanaspada, Pate, Donwade, Vaishnavnagar, and Indiranagar are the villages covered by this link. It crosses six roads at distances of 1.7 km, 3.5 km, 5.32 km, 7.79 km, 9.14 km, and 12.82 km, respectively, and thus over bridges must be provided at those points. The amount of arable land covered is greater but the requirement of cross drainage work is more. Figure 8 shows canal alignment 4.

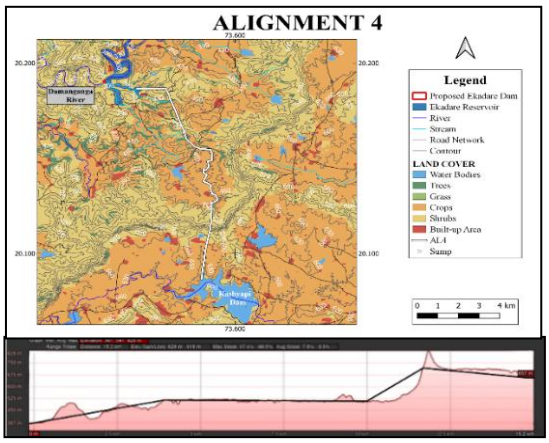

Fig-8: Alignment 4

3. Results

Table-1: Comparison of Alignments

Alignment	Length	Image	Remarks
1	12.7 km		• Shortest link • Only one cross drainage work is required. • Covers significant cultivable area • Two stage pumping is required with total lift of 345 m. • Total Gravity flow- 6.8 km (53%) • Tunnel Length- 4.8 km.
2	13.2 km		• Second shortest link. • Cross drainage work is required at six locations. • Covers more cultivable area • Two stage pumping is required with total lift of 350 m. • Total Gravity flow- 6.5 km(49%) • Tunnel Length- 3.5 km.
3	18.6 km		• Longest link. • Cross drainage work is required at nine locations. • Three stage pumping is required with total lift of 311 m • Total Gravity flow- 12.5 km (67%) • Tunnel Length- 3.1 km.
4	15.2 km		• Cross drainage work is required at six locations • Covers more cultivable area • Two stage pumping is required with total lift of 360 m. • Total Gravity flow- 9.5 km(62.5%) • Tunnel Length- 3.3 km.

A comparison of all four alignments is shown in the table. It shows the length of the alignments, the number of cross drainage works necessary, the amount of pumping required, total gravity flow, and tunnel length. Alignment 1 is the shortest whereas alignment 3 is the longest.

4. Conclusion

The analysis of maps such as slope maps, contour maps, land use land cover maps of the area between the proposed Ekadare dam and the Kashyapi dam led to the selection of a suitable interlinking canal to carry surplus water from the Ekadare dam to the Kashyapi dam. Based on the GIS study, various alternative proposals were considered, taking into account length, suitability, pumping, and land use requirements. Civil engineering structures such as roads, bridges, and other structures were taken into account when choosing canal alignment streams. The alignment 1 has been chosen as the most suitable based on the tabulated data in result table, as it is the shortest link (12.7 km) and has the lowest CD works with two stage pumping and a total lift of 345 m.

4.1 Scope for future studies

a) The project can be used as a base for cost estimation which will include the cost of Dam construction, Canal construction, Pumping Station and sump construction, Cost of Cutting & Filling of Earthwork, Cost of Pumping. The results may vary depending on the cost analysis and cost-benefit ratio, and the chosen alignment can be changed.

b) Design of Tunnel,

c) Design of Canal,

d) Design of Pipeline.

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