Department of Geography & Geology

Analysis of Proposed Nicaragua Canal: Including Environmental Impacts & Alternate Routes

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Environmental GIS

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Introduction

The primary goal of this study is to discover if the proposed Nicaraguan canal is the most economically and environmentally viable option for a second transcontinental canal in Central America. The current favored route is approximately 278 kilometers long and cuts through a large portion of Nicaragua, including Lake Nicaragua the largest freshwater source for the country, which raises environmental concerns, shown in fig. 1. The new canal is being built to bypass the existing Panama canal and the proposed canal will shorten the distance from Los Angeles to New York by around 800 kilometers. The aim of this project is to explore alternative routes to the proposed canal, while looking for a route with less environmental impact.

Study Area

The study area for this project is Central America. With a focus on Nicaragua, Costa Rica, and Panama. Our proposed routes run through both Nicaragua and Costa Rica. End points for possible routes were chosen based on general distance, in an effort to lower overall cost and potentially reduce environmental impact.

Source: http://welldonestuff.com/panama-canal/

Methodology

1. Acquired four SRTM tiles for Central America from The CGIAR Consortium for Spatial Information
2. Mosaicked tiles together to create one digital elevation model (DEM) fig. 2
3. Crated a feature class polygon to extract relevant data and remove excess data from the DEM
4. Acquired the position of the proposed Nicaraguan canal from online sources
5. Acquired land use land cover (LULC) data for the world from the Global Land Cover Facility
6. Clipped the LULC data by the same polygon used to clip the DEM
7. Calculated slope from the mosaicked SRTM tiles
8. Reclassified slope for cost path analysis
9. Reclassified LULC for cost path analysis, two different reclassification scenarios were done fig. 4 & fig. 5
10. Used the "plus" tool to add reclassified slope and LULC together to create a unified cost layer.
11. Created two sets of start and end points with the "create feature class" tool.
12. Joined feature classes to polygon to give data two feature classes.
13. Ran cost direction on study area fig. 6
14. Ran cost distance on first start point
15. Ran cost path on first end point
16. Ran cost distance on second start point fig. 7
17. Ran cost path on second end point.
18. Reclassified slope and LULC to give water a high priority.
19. Repeated steps thirteen through sixteen for the remaining routes.
20. Comparative analysis of cost paths

Source: http://www.seattleglobalist.com/

Data

Fig. 1 Location of the proposed canal route in Nicaragua and the location of the Panama canal

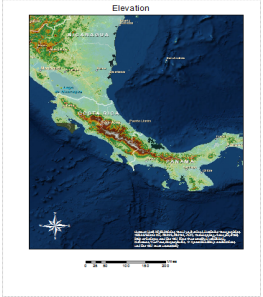

Fig. 2 Digital Elevation Model Created from SRTM tiles

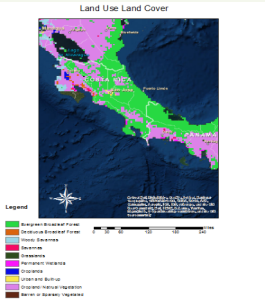

Fig. 3 Land use land cover data for the study area

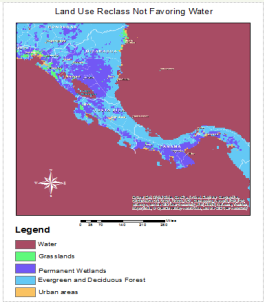

Fig. 4 Reclassified land use and land cover, water given a low priority

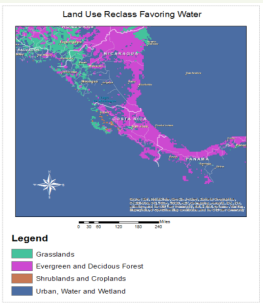

Fig. 5 Reclassified land use and land cover, water given a high priority

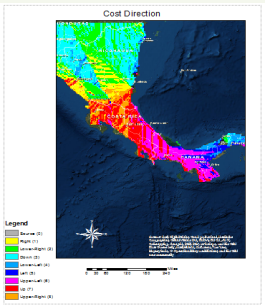

Fig. 6 Cost direction used in cost path analysis

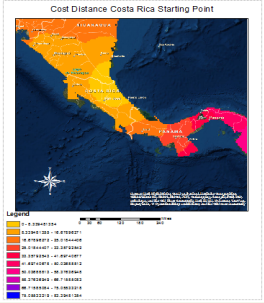

Fig. 7 Cost distance used in cost path analysis

Fig. 8 Locations of derived canals with water given a low priority in analysis

Fig. 9 Locations of derived canals with water given a high priority in analysis

References

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Jarvis A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled seamless SRTM data V4, International Centre for Tropical Agriculture (CIAT), available from http://srtm.csi.cgiar.org.

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Results

There were two different scenarios used to complete the cost analysis of the proposed canals. One giving water a high priority in an effort to avoid Lake Nicaragua and other freshwater sources, and one giving water a low priority. After completing the two different scenarios for the cost path, one that heavily favored routes that cut through water and one that heavily discouraged routes that cut through water. The distances were examined in order to find the least expensive route based on prices given in the updated construction of the Suez Canal, which is taking place currently and began in August 2014. The data from the Suez Canal offered a baseline of roughly $112 million per kilometer, which was later used when determining basic costs of each route. When giving water a higher priority the route distances were as follows; 163 Km for the route in Costa Rica and 256 Km for the route found in Nicaragua. When giving water a low priority the route distances were as follows; 175 Km for the route in Costa Rica and 257 Km for the route in Nicaragua. All of these distances were lower than the currently proposed Nicaraguan route, which is roughly 278 Km.

Source: http://www.ipsnews.net/2014/08/nicaragua-pins-hopes-for-progress-on-grand-canal/

Conclusions

With the use of GIS analysis tools, several alternative routes for a second transoceanic canal were found and studied. The two scenarios, with water priority as the variable, were used in the analysis. A comparison of these routes is shown in fig. 6. There was however, an issue when attempting to avoid water, especially in Nicaragua. Both routes after analysis were shown to run through Lake Nicaragua regardless of the importance given to water, this is due to the steep topography of the area surrounding the lake making other routes more costly shown in fig. 11. The final products showed that when using the end points given by the proposed Nicaraguan canal, it is not feasible to avoid cutting through Lake Nicaragua. Lake Nicaragua is the largest lake in Central America, with the proposed route there is the potential for extreme environmental consequences. This lead to the search for different potential routes outside of Nicaragua. After running our analysis on the routes we feel that the Costa Rican route with water given high importance is the better option. This route is not only shorter, it also does not cut through any bodies of water or large areas of wetlands. The price of this route at $18,256,000,000 is significantly less than the proposed $31,136,000,000 when looking at the price of cutting the canal alone, this is a savings of $12,880,000,000. Further analysis will need to be done on property values and other unforeseen costs to determine a true price, however, the Costa Rican route still appears to be the best option.

Fig. 10 A comparison of canal routes with water given both high and low priority

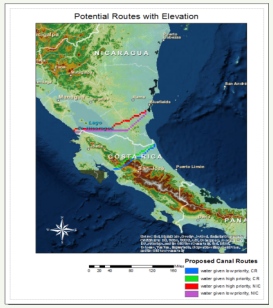

Fig. 11 Locations of the derived canals with digital elevation shown