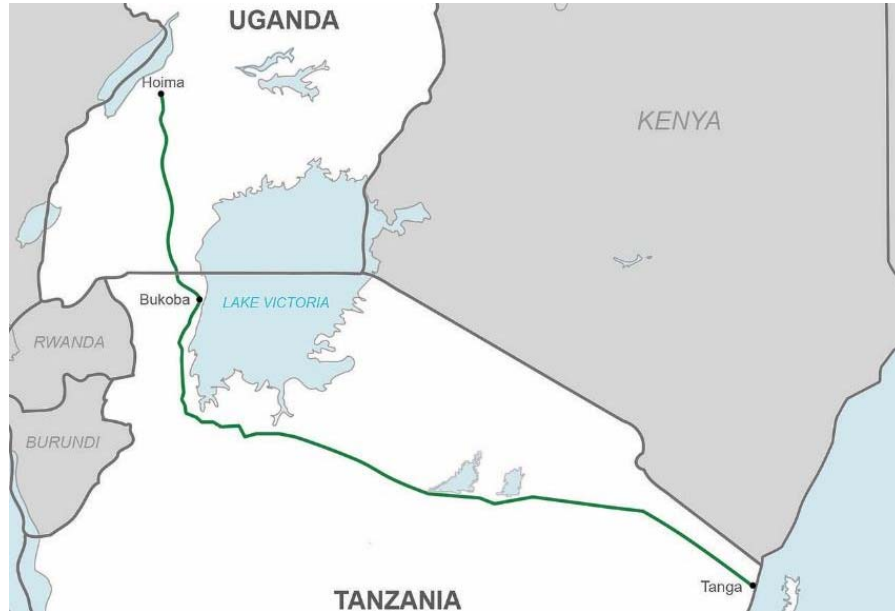


Defining routing of the oil export pipeline UTCOP.

The authorities in Tanzania and Uganda are planning to build a 24-inch crude oil pipeline (UTCOP¹) that will transport 216,000 barrels of oil per day (stb/d) from Uganda's oil fields in Hoima (coordinates: 1.416667, 31.083333) to the port of Tanga (-5.066, 39.105556), in Tanzania, for further export using tankers.



The pipeline will follow the Earth's surface and cross a big part of the Ugandan and Tanzanian territory. This pipeline is very strategic for facilitating the export of oil to the market and reducing CO₂ emissions of oil transportation that is currently performed by trucking.

You are in the pipeline design team. Your main task is to propose the best pipeline path considering the following:

- Pipeline length should be minimum to reduce costs and environmental impact and pressure drop.
- The pipeline should not traverse big water bodies, such as lakes or wide rivers
- The pipeline should not traverse major cities.
- The pipeline should not traverse tall mountains or require building tunnels.
- The pipeline should not traverse protected areas such as national parks.
- The pipeline should not traverse war or guerrilla zones.

Additionally, you are required to provide the following:

- Estimates on pipeline length, cost and pressure drop
- Make a 2D color plot showing the elevation as a function of latitude and longitude for the area where the pipeline will be placed
- Plot the pipeline trajectory on a map, showing the continent's shoreline, and the start and end point.

Useful data:

- The cost of the pipeline is 2.4 million USD per km.
- The pressure drop (DP in bar) is a function of the pipeline length, $DP = 0.262 * L$. (with L in km)

¹ https://en.wikipedia.org/wiki/Uganda%E2%80%93Tanzania_Crude_Oil_Pipeline