TAPI: A pipeline to South Asia's peace and prosperity

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Projection: Equidistant_Conic

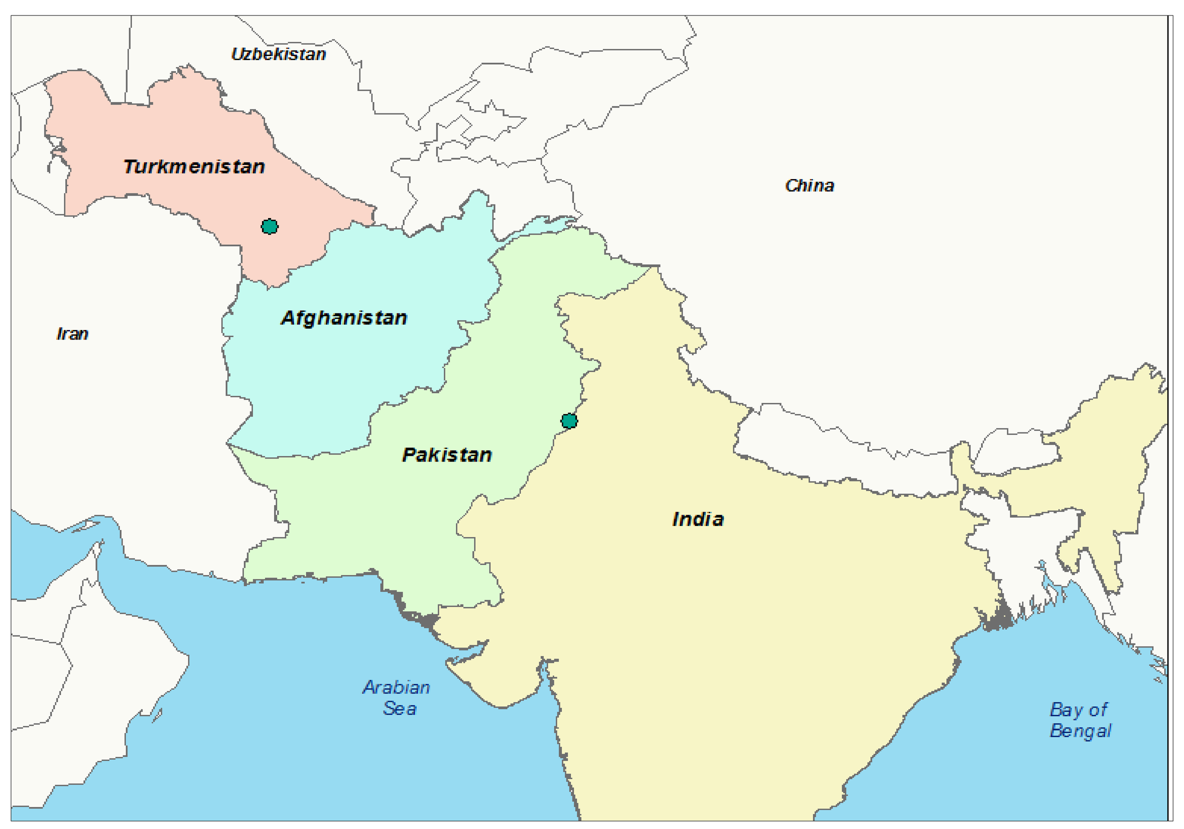
BACKGROUND

India's economic growth, as well as its energy usage, are both projected to be on the rise. According to BP's projection for 2035, India will be responsible for 9 % of world energy consumption while its share in global production will be 5 %. In 2015, India's natural gas production was about 30 bcm while consumption stood at 50 bcm. Imports in the form of liquefied natural gas (LNG) were around 21 bcm in 2015. Gas imports are projected to quadruple by 2040, reaching 100 bcm.

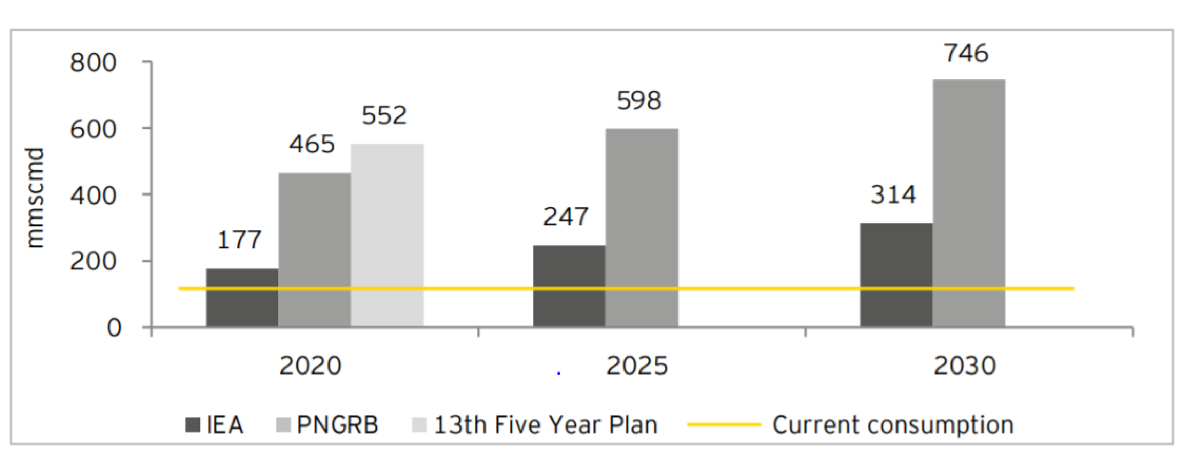
This growing energy deficit explains the Indian government's interest in TAPI (Turkmenistan-Afghanistan-Pakistan-India pipeline). In India, the internal network of gas pipelines is not interconnected because of the country federalization. Even if the regasification plants projects succeed, massive investments are needed to serve the Punjab region of India. This region will be directly served by the TAPI in Fazilka. The start and end points are highlighted in the map using a green dot.

Source: Galkynysh gas fields, Turkmenistan

Destination: Fazilka, Punjab, India



Multiple estimates show Increasing Natural Gas Demand in Indi through 2030.



Source: IEA World Energy Outlook 2015, PNGRB Vision 2030, 13th Five Year Plan source through Petroleum Planning and Analysis Cell website

PIPELINE ROUTING

Pipelines are the most efficient, cost effective and environmentally friendly method used for the transportation of natural gas. The use of pipelines helps to minimize cost, pollution, spill and highway congestion. Careful planning and management of the pipeline route can save on cost, time and operating expenses to facilitate longer operational life. A major objective in selecting a pipeline route is to ensure the chosen route has the highest utility to the public, in addition to minimizing harmful impacts to people and the natural environment. This project will explore GIS based methodology to determine the combined suitability of trans-national gas pipeline route between Turkmenistan and India. Given the security concerns in this region, a multi-criteria evaluation is imperative. Three criteria will be used - Construction, Environmental and Security.

METHODOLOGY

The following steps have to be taken to generate the a cost raster for TAPI:

1. Rasterization of vector layers
2. Reclassification
3. Equal weighting of routing criteria
4. Generation Suitability Map

The most important part of this method is the cost surface The cost surface has been generated by combining all the thematic costs of laying the pipeline on a given terrain by a system of equal weighting.

This is consistent with the basic problem as the pipeline routing is a compromise between the minimum (straight line) distance from source to destination and the physical conditions existing above and below ground.

Cost Raster Level 1 = Population Density + Rainfall + Conflict Density + Elevation

Cost Raster Level 2 = Cost Raster Level 1 * Airport areas * Disputed Territories * Land Cover * Existing Pipelines. The multiplied rasters are all binary.

ANALYSIS

The purpose of suitability analysis is to find optimal locations for developing a natural gas pipeline route, TAPI. This analysis helps in finding a general location and further field work can be done later to determine the optimal conditions.

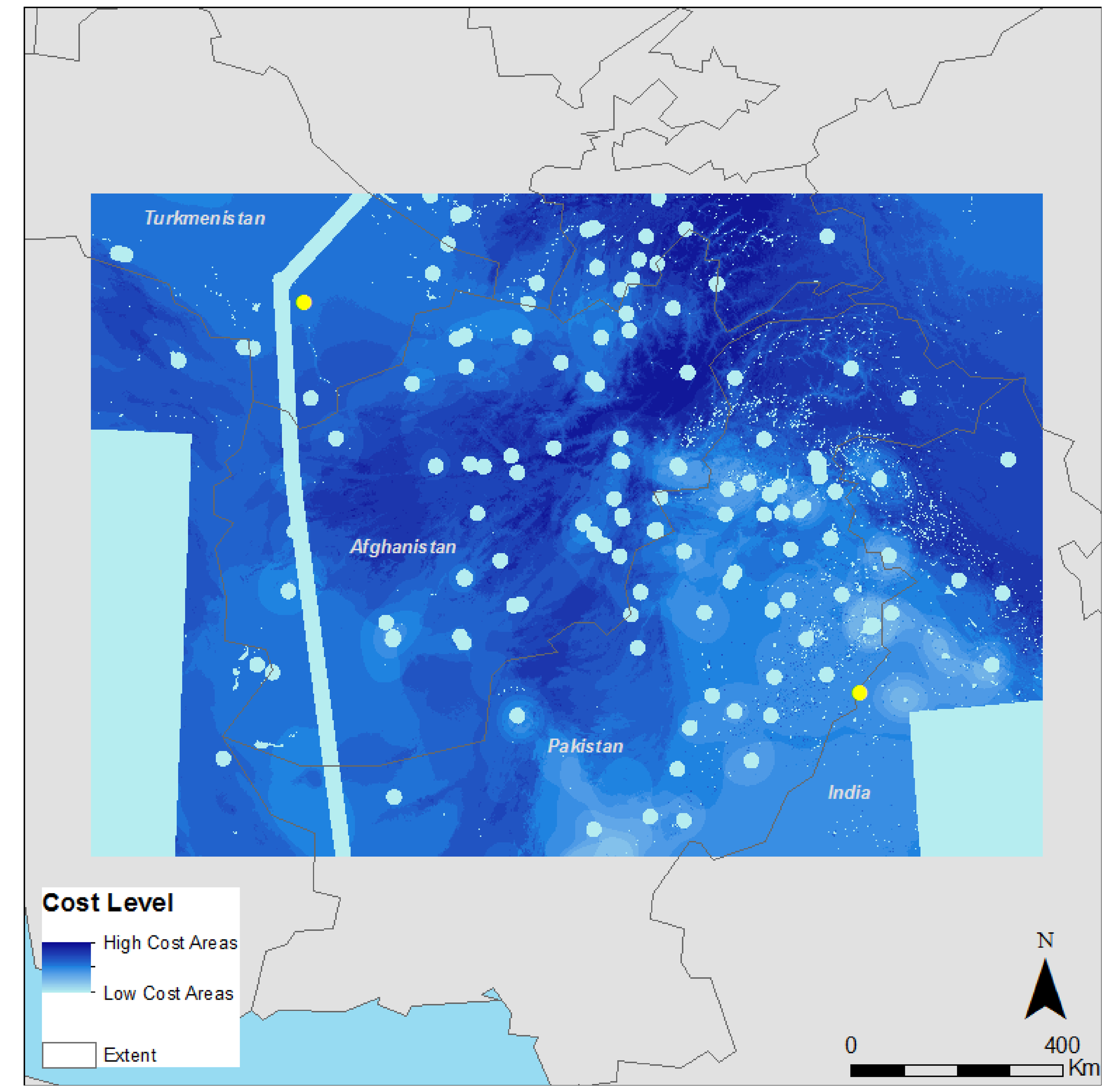
Overall, there are medium to high suitability areas in the region that can facilitate the development of the pipeline, at a lower cost structure. Areas with highest cost are concentrated in a few pockets. These areas don't receive very high rainfall, which is a favorable factor in the construction of a pipeline. Conflict hotspots are concentrated near the border areas, which is to be expected.

Overall, the economics of the project are encouraging, however, this region faces a high level of uncertainty and security concerns. Therefore, the key to this project is to use it to stabilize the region. However, this is a high risk task and the level of investment for a trans-national pipeline like TAPI is about $10 billion USD.

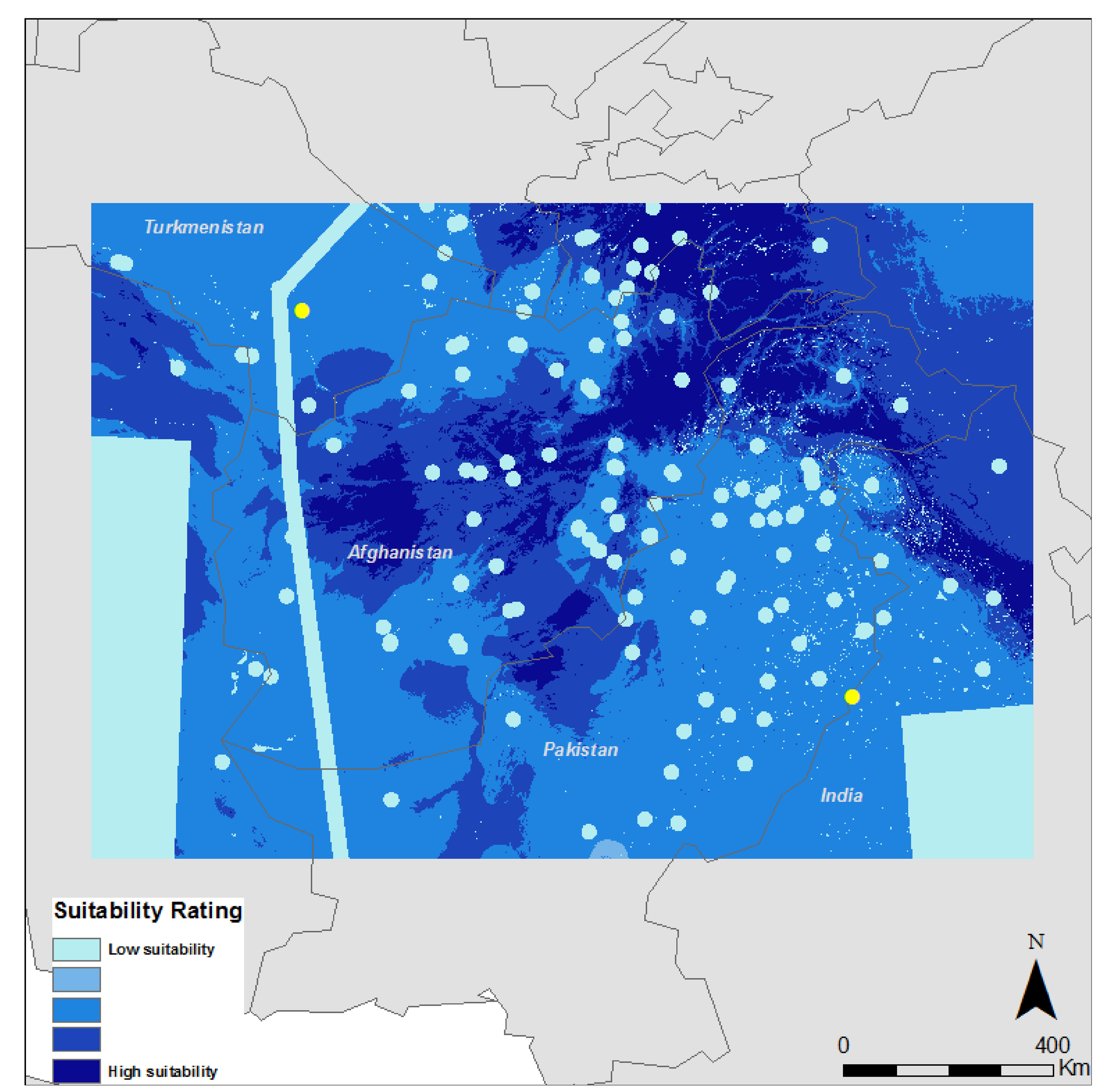
FURTHER RESEARCH

Major limitations of this analysis are— the quality of free-to-use data available and the subjectivity of weights for suitability analysis.Therefore, this analysis can be taken further by weighting each criteria differently and using the Least Cost Path functionality in GIS to find an optimal pipeline route.

Cost Surface for TAPI pipeline project, 2018



Suitability Map for TAPI pipeline project, 2018

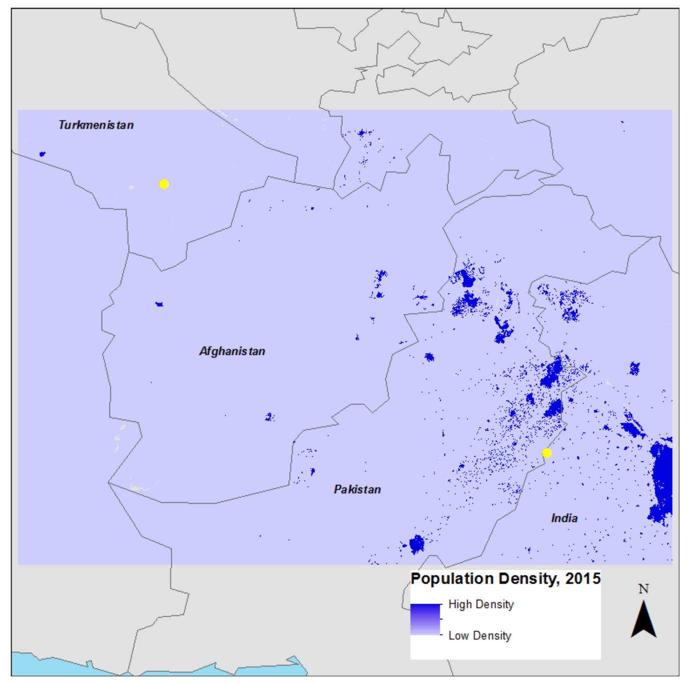


SOURCES

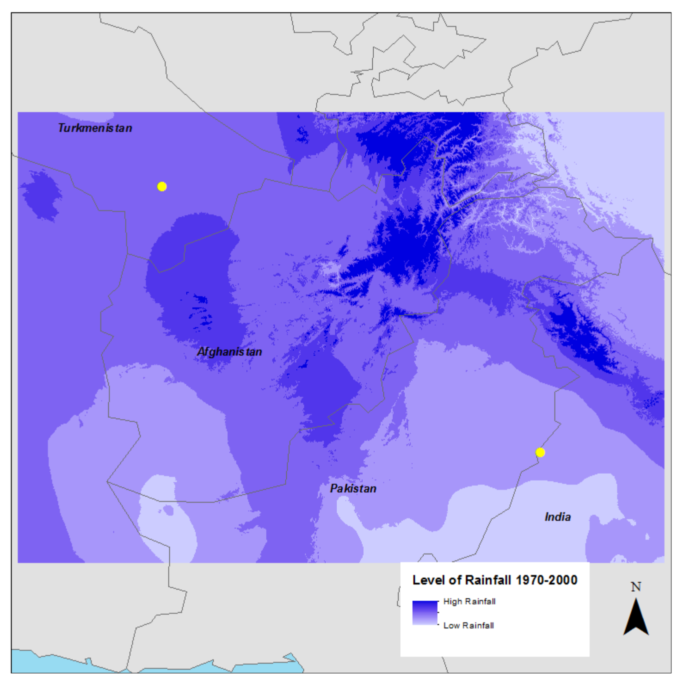
USGS, NASA, CIAT, Global Land Cover Facility, Environmental Systems Research Institute, Harvard University, Worldpop, WFP Geonode, Openstreetmap, ACLED Project, Humanitarian Data Exchange, ESRI, ADB and Reuters.

Rasters used to create first level of cost surface

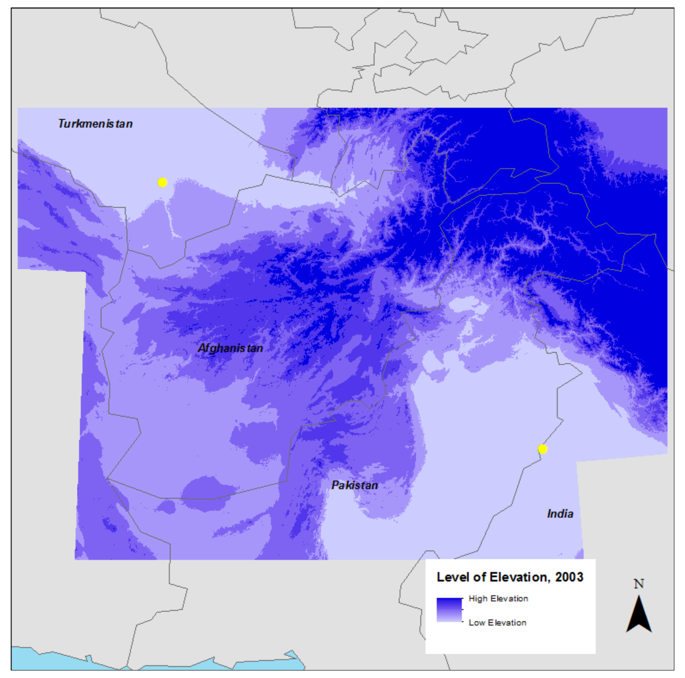
Adjusted Population Density, TAPI region, 2015



Level of Rainfall, TAPI region, 1970-2000



Adjusted Level of Elevation, TAPI region, 2003



Conflict Hotspots, TAPI region, 2016 - 2018