

The Impact of Green Riyadh Project on Temperature

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Abstract—Kingdom of Saudi Arabia and its capital, Riyadh, are undergoing huge mega-projects. Of them, are The Middle East Green Initiative (regionally) and the Green Riyadh Project (specifically for the capital). In this research, we rely on Geographic Information Systems (GIS) to study the impact of Green Riyadh Project on surface temperature of Riyadh City. We have found a very small effect of trees on temperature (each increase in one unit of trees decreases temperature by 1%).

Keywords— GIS, Surface temperature, QGIS, Green Riyadh.

1. INTRODUCTION

The Green Riyadh project is one of the most important and distinguished environmental projects, as it is one of the largest and ambitious afforestation projects in the world, and one of the four current major Riyadh projects (Diriyah, Qiddiya and ROSHN) that are in line with the 2030 vision of the Kingdom of Saudi Arabia. Green Riyadh aims to “increase the public open spaces per capita in the city and enhance livability” [1] by planting trees, developing more parks and preserving and maintaining existing ones. It was launched on 2019 to “promote Riyadh’s position among the world’s top 100 most livable cities” [2].

Green spaces “play a crucial role in mitigating climate change as well as climate management in cities” [3]. Over the last fifty years, temperature increased by almost 4 degrees in Saudi Arabia [4] and it expected to expedite in coming years [5]. Thus, initiatives are needed slowdown the increase. More importantly, evaluation is needed to gauge the impact of such initiatives. The study area of this work is presented in figure 1.

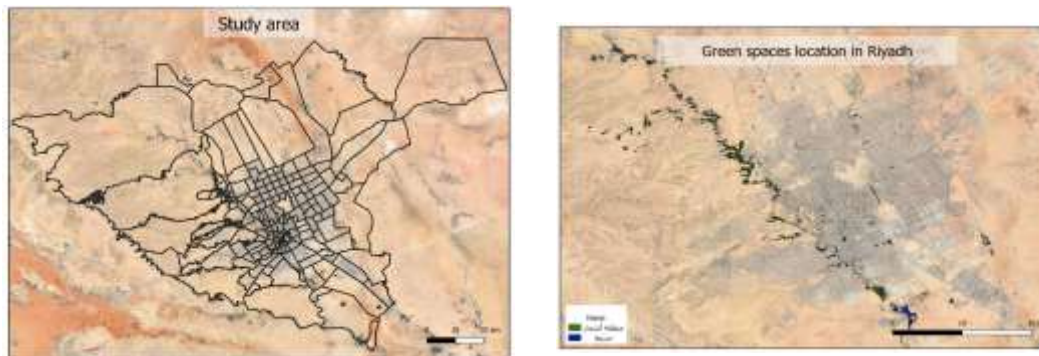


Figure 1. Study Area

2. DATA

The data used was obtained from fellow researchers and via satellite imagery. It included (temperature, elevation, green space location and green space type). The following steps were performed to preprocess the data.

1- Resampling raster (temperature and elevation) layers to have better resolution.

The highest raster resolution we found was 30s ~ 1 km², and we want to increase this resolution so that we can deal with the curved border and small parks. So we resampled the raster data (Temperature and Elevation) to increase the resolution from ~1 km² to ~0.007569 km² Using SAGA tool (shown in figure 2).

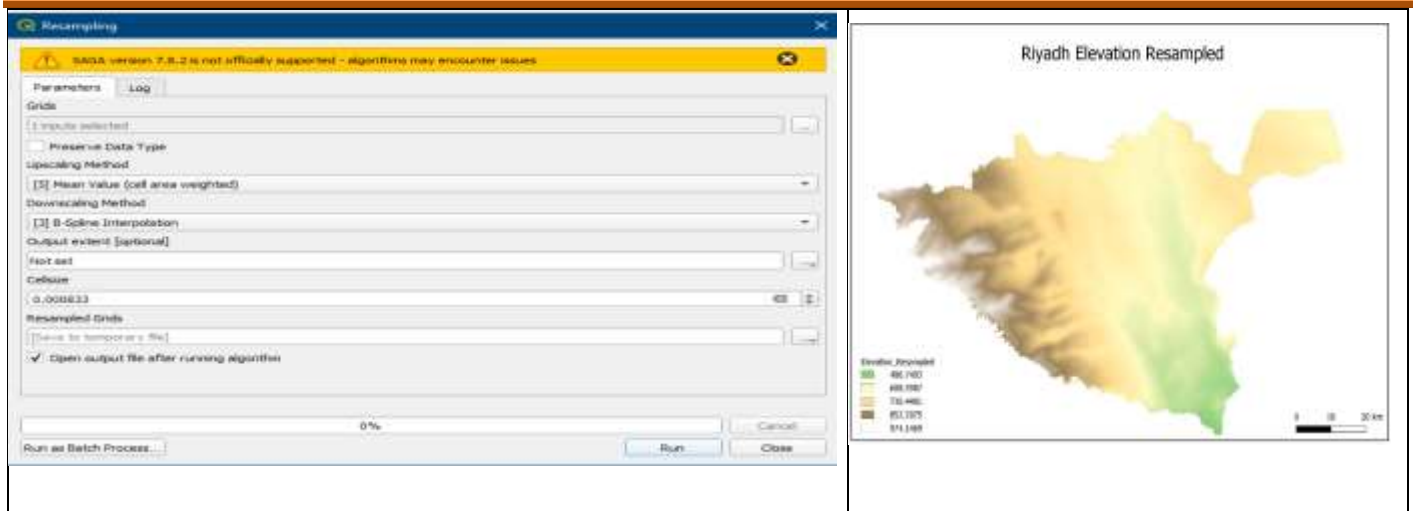


Figure 2. Resampling from SAGA

2- Convert raster layer (temperature and elevation) to vector layer (polygonize using GDAL tool as shown in figure 3).

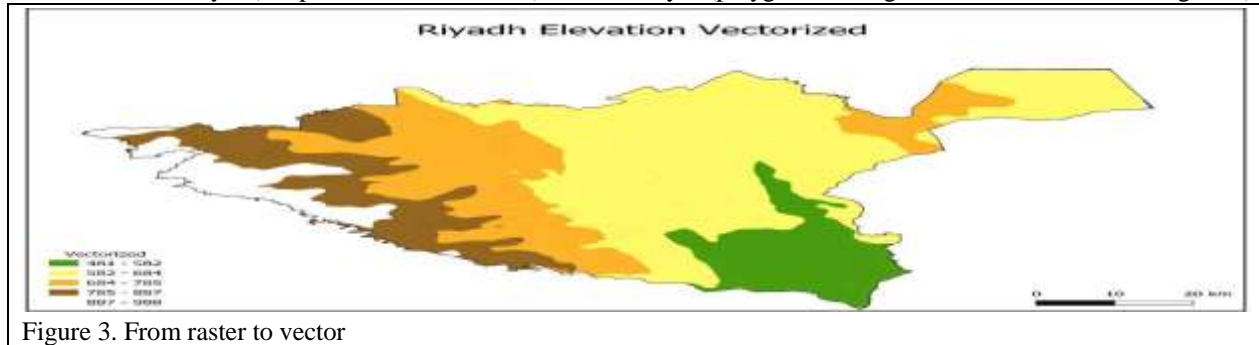


Figure 3. From raster to vector

- 3- Merge the new temperature and elevation vector layer into one layer (using join attributes by nearest function from QGIS software).
- 4- Add green space and tree fields to the layer (using clip vector by mask layer function in QGIS).
- 5- Clip locations that represent green spaces to add GS and Tree fields into it with 1 value to GS and 1 value if the location is “أشجار منطقة”.
- 6- Clip locations that do not represent green spaces to add GS and Tree fields into it with 0 value for both fields.
- 7- Merge the vector layers.

Figure 4 shows the file data after all the preparation steps have been performed. It includes TempINC*10: temperature in kalvin * 10, name: green space name, TempINC: temperature in Celsius, NEIGHBORH_: Neighborhood name, GS: If GS = 1 else = 0, Elevation: Elevation in meters and Tree: if Tree = 1 else = 0.

FID	name	BEIGHORH	Elevation	TempINC	GS	Tree
1	منطقة النور	1801	753	3140	41.6300000000000	1
2	منطقة النور	1801	751	3140	41.6300000000000	1
3	منطقة النور	1801	750	3140	41.6300000000000	1
4	منطقة النور	1801	749	3140	41.6300000000000	1
5	منطقة النور	1801	749	3140	41.75	1
6	منطقة النور	1801	745	3140	41.6300000000000	1
7	منطقة النور	1801	745	3140	41.75	1
8	منطقة النور	1801	749	3140	41.6300000000000	1
9	منطقة النور	1801	749	3140	41.6300000000000	1
10	منطقة النور	1801	748	3140	41.75	1
11	منطقة النور	1801	747	3140	41.6300000000000	1
12	منطقة النور	1801	747	3140	41.75	1
13	منطقة النور	1801	748	3140	41.75	1
14	منطقة النور	1801	745	3140	41.75	1

Figure 4. After merging all data.

3. ANALYSIS

Using ESRI ArcGIS Pro we ran a Generalized Linear Regression (GLR) on our data with ‘TempINC’ as the Dependent variable and Elevation, area, GS, and Tree as the independent variables. The results are shown in figure 5.

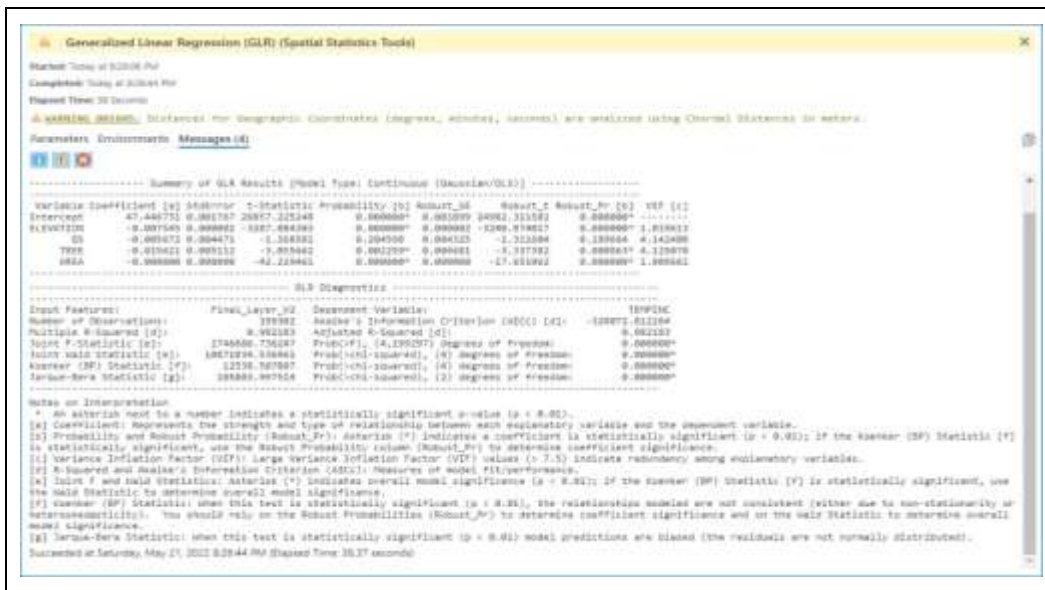


Figure 5. Results of GLR test.

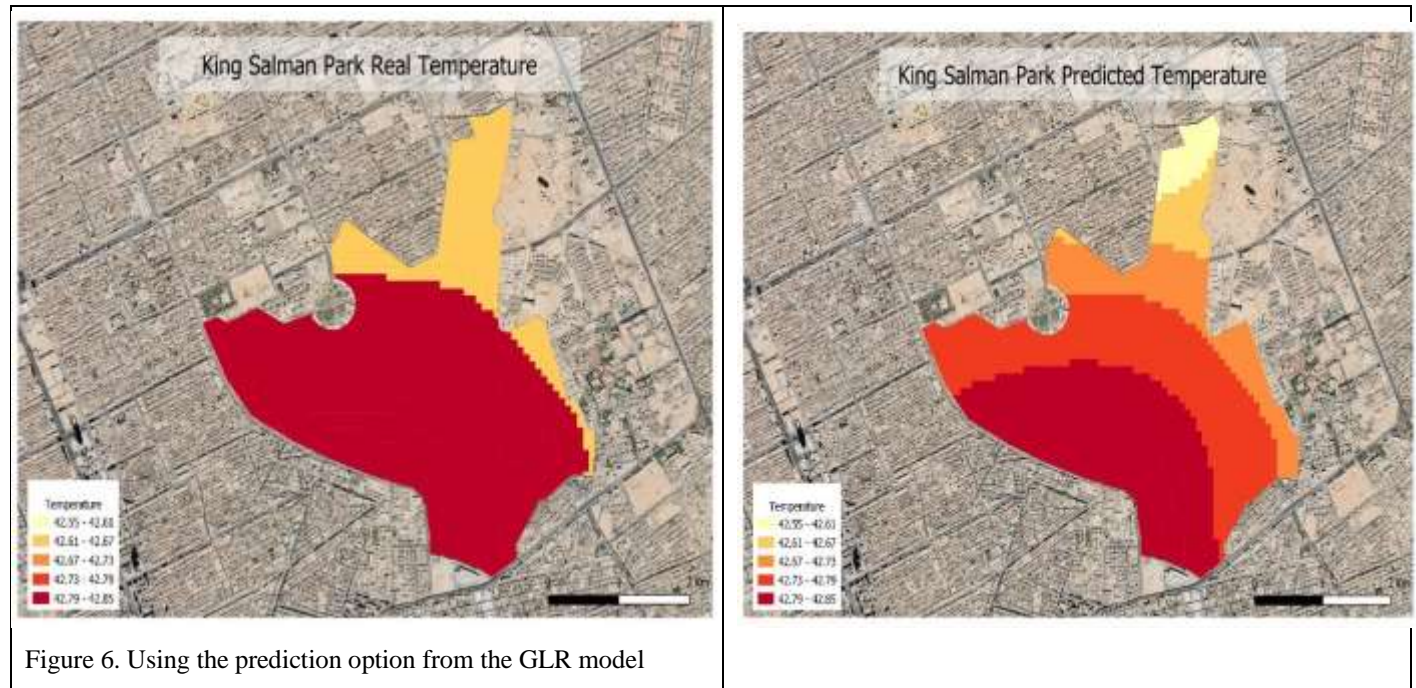
The results in figure 5 show that area has no effect on the temperature. More importantly, the existence of green space (a park) had no statistically significant effect on temperature. This could be interpreted by the fact the some parks in Riyadh are not totally planted by green grass and trees instead sand is used to cover playgrounds and stones are used to pave walkways. However, one unit increase in trees significantly decrease temperature by 2%. One unit increase in elevation significantly decrease temperature by 1%.

If area is excluded from the model, the following formula is obtained to predict temperature in Riyadh.

$$T = 47.44 - 0.0075 \times e - 0.0042 \times g - 0.016 \times t$$

T = temperature, e = elevation, g = Green Space, t = Tree

This model was used to predict the effect of King Salman Park (one of the largest parks to be built in Riyadh and the world [6]) on surrounding temperature. Again from the geoprocessing toolbar in ArcGIS Pro, the model was run with the prediction options. The results are shown in Figure 6.



4. CONCLUSION

This work has found that there is a relationship between trees and temperature. Although that the effect is quite small, we think this is because the data we used which was data for 1 km² is not good for this study and we think the real effect is bigger than this. To improve this study better data is needed for temperature and elevation. Most importantly green space data needs to contain tree types (maybe some trees like Palm trees does not have a big effect on temperate so it should be separated from other types).

5. REFERENCES

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- [6] <https://www.rcrc.gov.sa/en/projects/king-salman-park-project>