Evaluation of Sustainable Urban Development Suitability in the Jingjinji Area using GIS Techniques

INTRODUCTION

Rapid economic and demographic changes in China have meant that urban expansion within the country has been taking place at an unprecedented scale. The World Bank, for example, estimates that the share of the urban population in China has increased from 23% of the overall population in 1985 to 31% in 1995, before rising sharply to 54% in 2014. The Jingjinji Area comprising the Beijing Metropolitan Area, the Tianjin Metropolitan Area and part of Hebei province is one of the largest economic regions in China. With a current combined population of approximately 130 million and spanning an area of 82, 000 square miles, the economic region would build on the strengths of each individual region: Beijing's political and economic resources, Tianjin's port access to the Bohai Sea, and Hebei's resources and technological developments.

While urban areas are important drivers of economic growth, unchecked development can also lead to environmental degradation, urban sprawl, pollution and an inefficient and sub-optimal use of energy, land and scarce resources. Sustainable urban development, as such, hinges upon balancing the need for economic and urban development but also minimizing the impact of urban growth on the environment and on people's health. Evaluating the suitability of different counties within the Jingjinj area for sustainable urban development is thus an urgent priority. In this project, I perform a land-use suitability analysis to map the advantages and disadvantages of urban development on the county level in the Jingjinji area, and ultimately locate counties that are most suitable for sustainable urban development in the future.
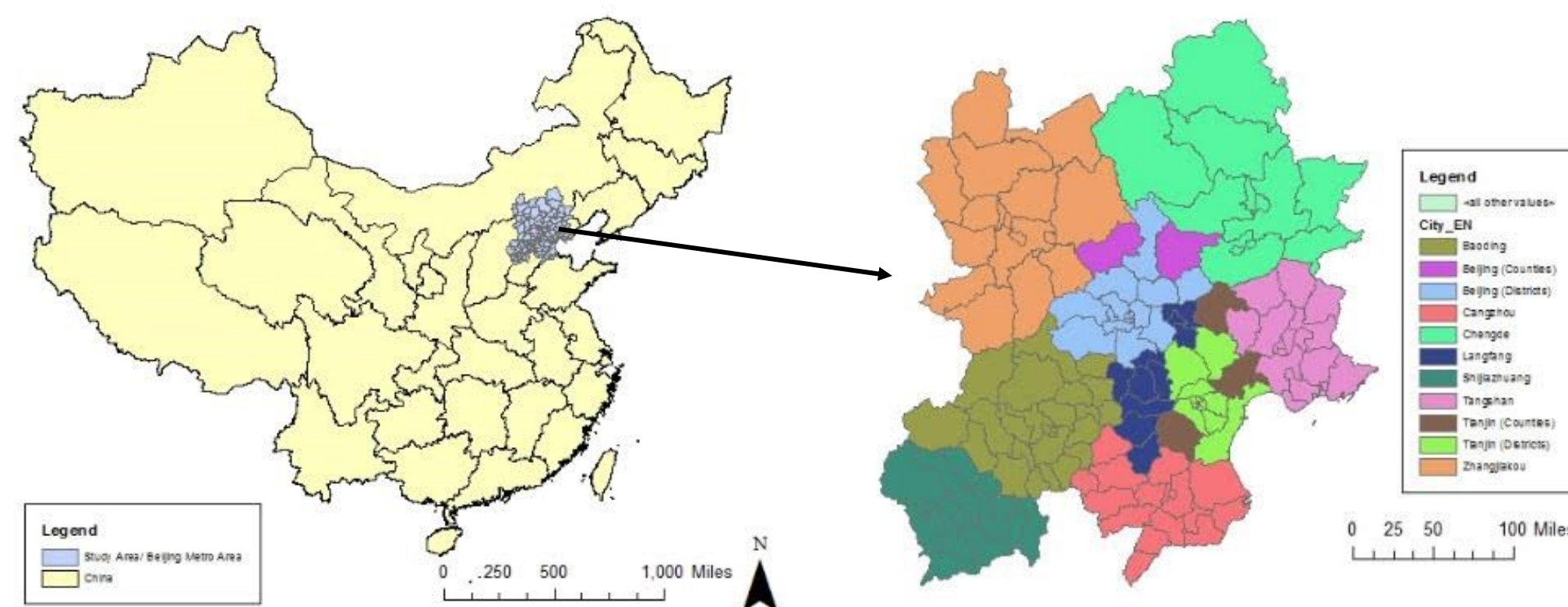
Figure 1: Map of China

Figure 2: Study Area

METHODOLOGY

The suitability for urban development is influenced by both environmental and socio-economic factors. An evaluation criteria system was set up containing 7 factors belonging to 2 categories, as expressed in Table 1: (1) environmental factors and (2) socio-economic development factors. All the parameters have been reclassified from a scale of 1 – 10, with 1 being the least suitable and 10 the most suitable. A weighted overlay was then performed with the weights expressed in Table 1.

Factors	Parameters	Weight
Environmental Factors	Slope	0.20
	Interpolation of CO2 emissions from power plants	0.10
	Interpolation of Water Quality, 2006	0.10
	Euclidean Distance to Conservation Points	0.05
Socio-Economic Development Factors	Railway Density [length of railway/ built-up area]	0.10
	Road Density [length of road/ built-up area]	0.15
	Change in population density in built-up areas, 2000—2010	0.30

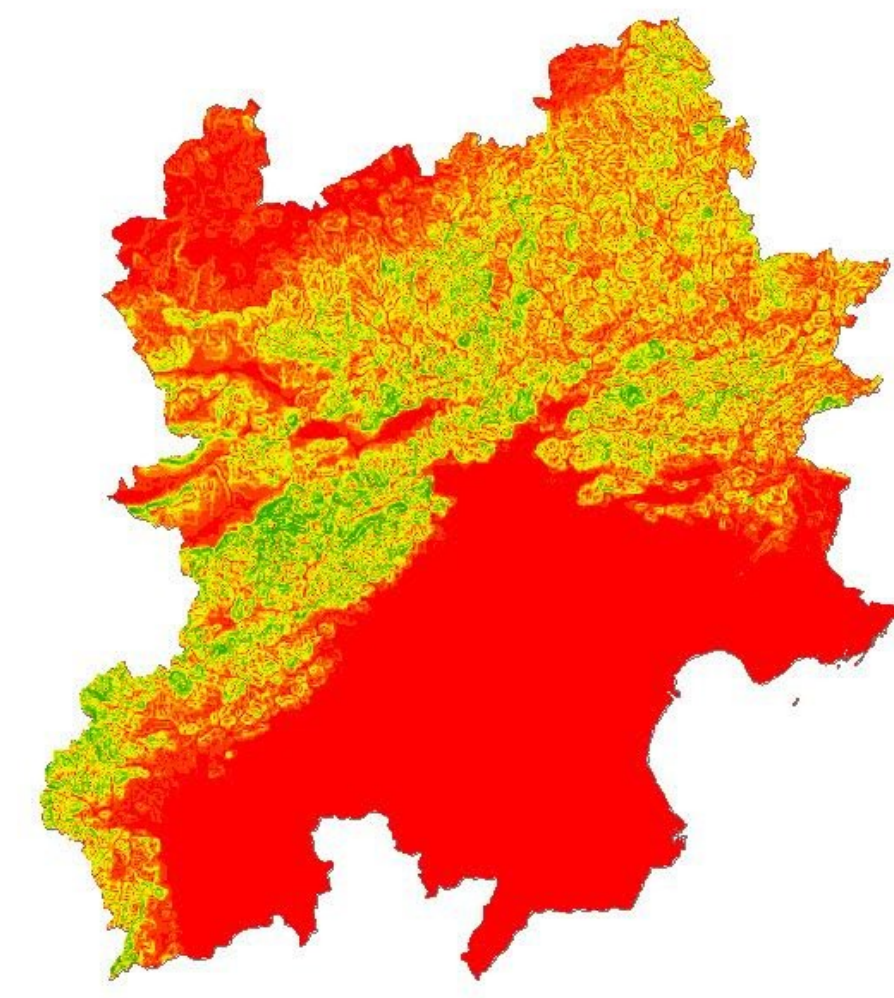Table 1: Weight Matrix for Sustainable Urban Development Suitability
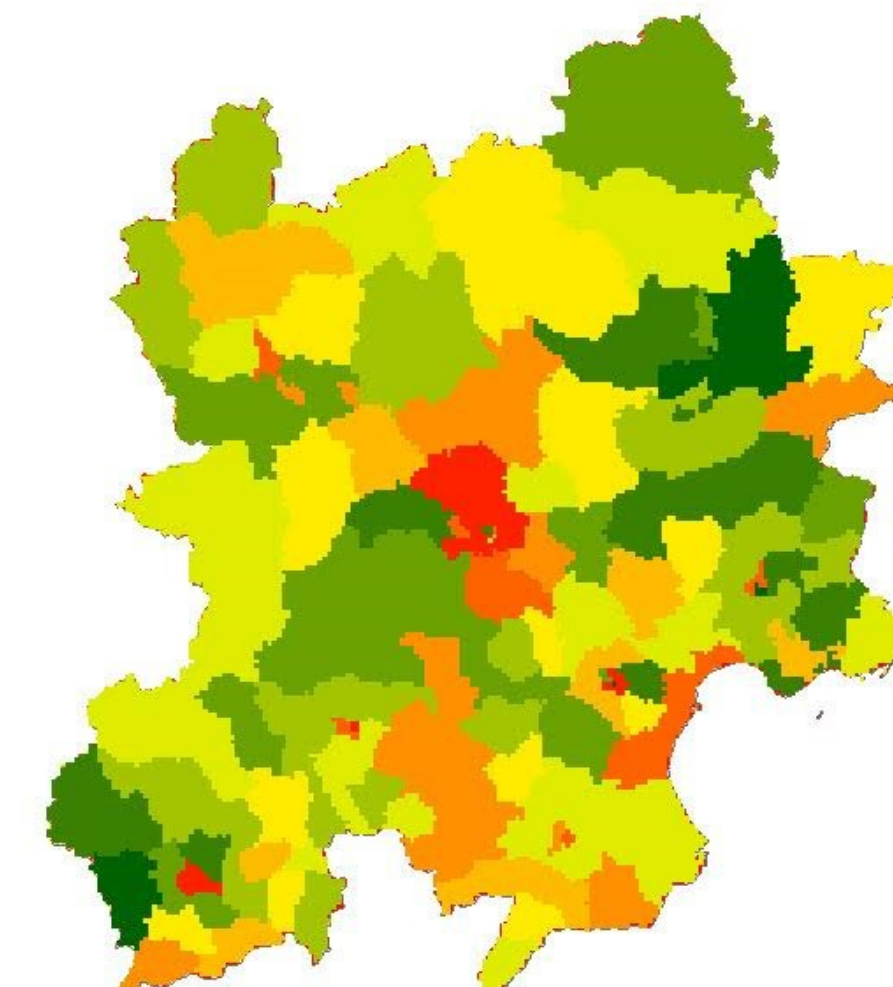
MAPS

Fig 3: Slope

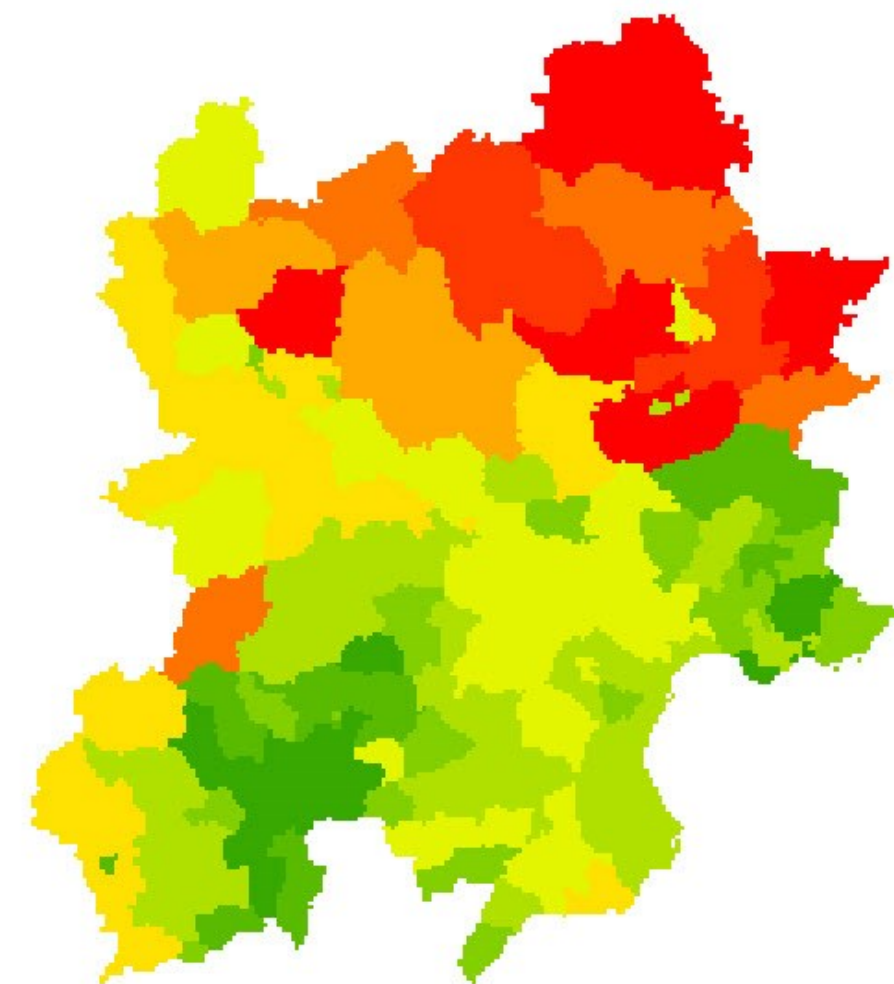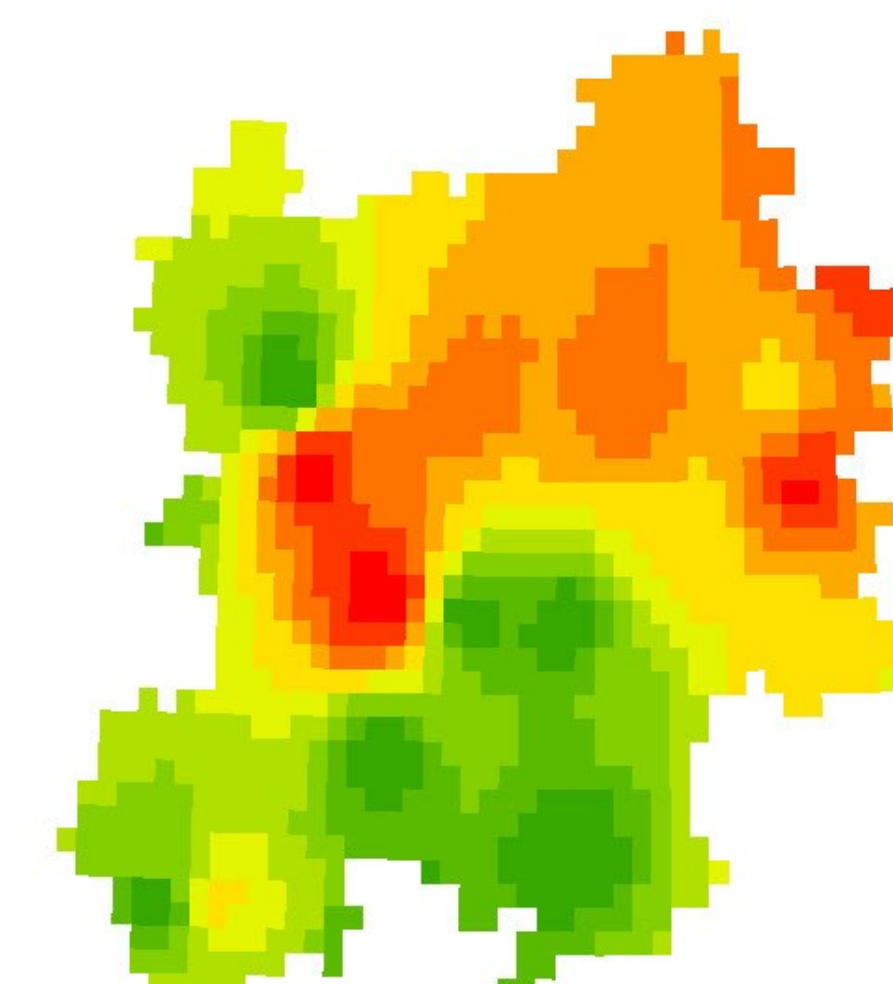Fig 4: Changes in Population Density/ Built-up Area, 2000-2010

Fig 5: Road density

Fig 6: Water quality
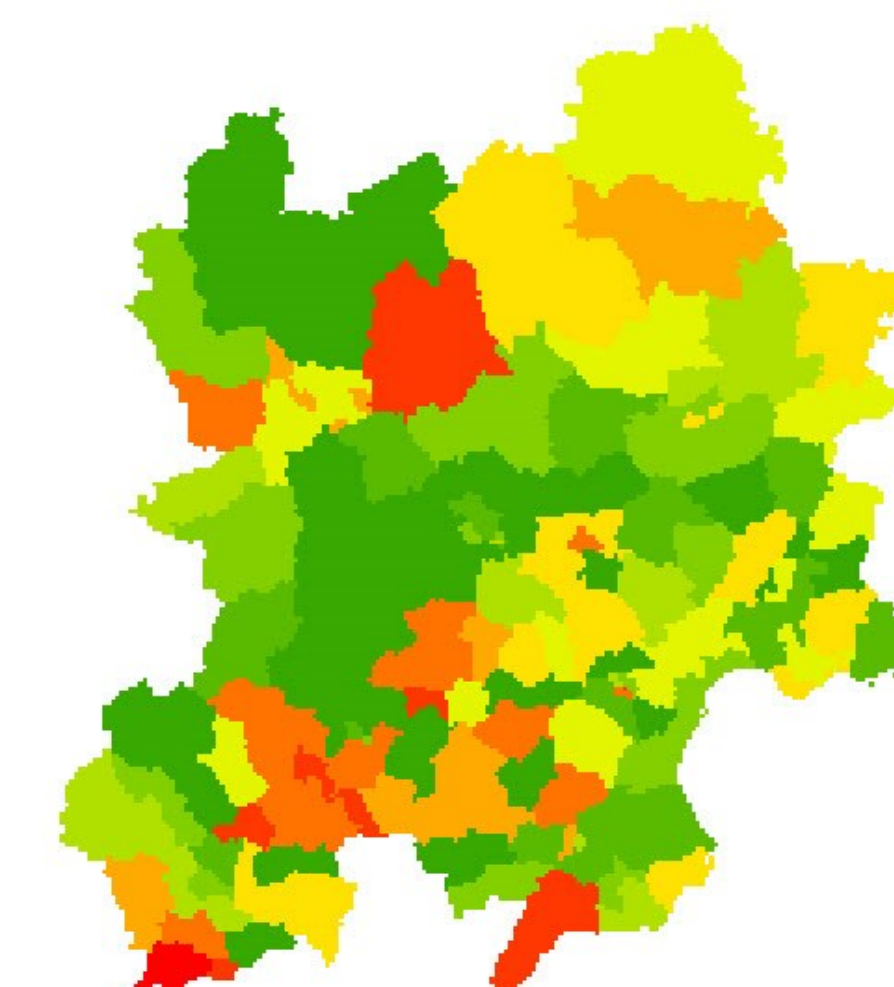
Fig 7: Rail density

Fig 8: CO2 emissions
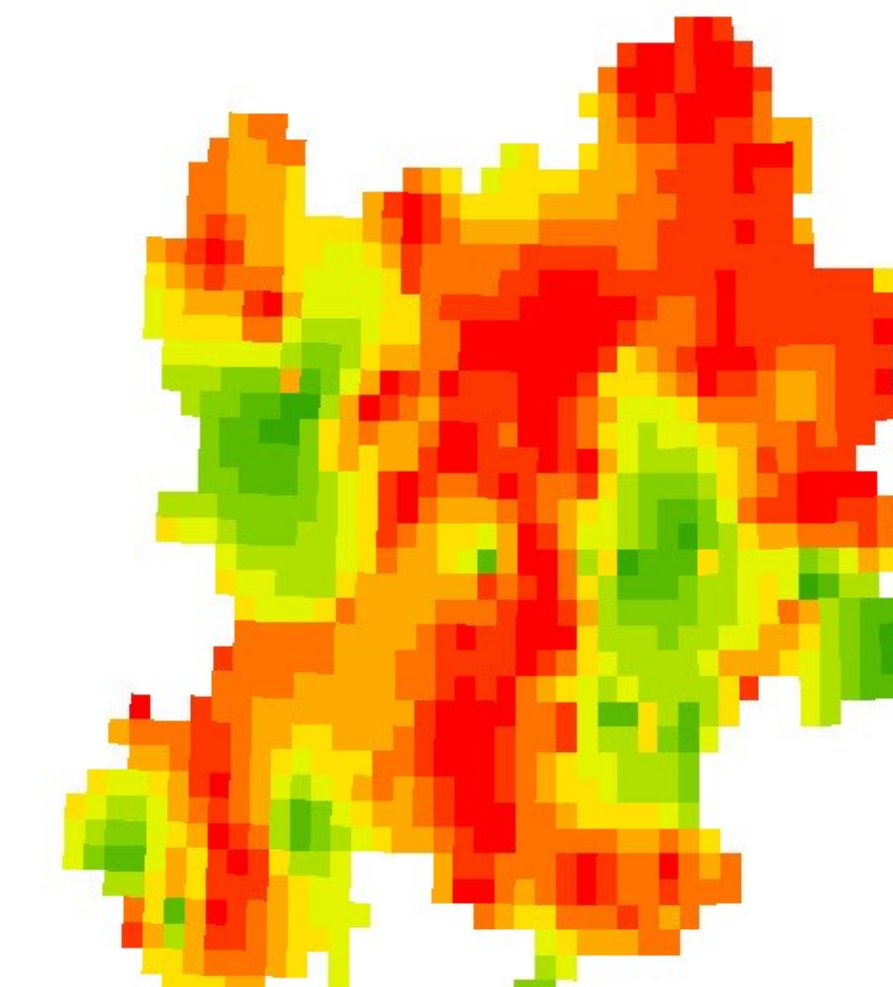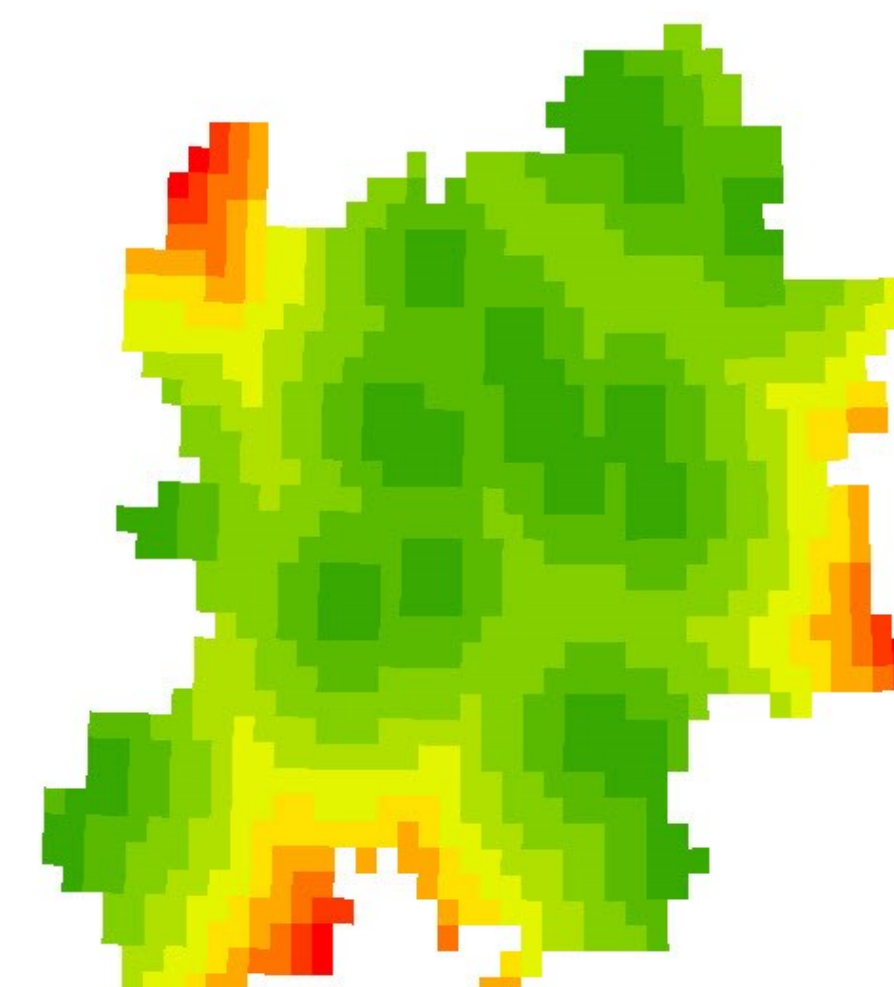
Fig 9: Distance from conservation points

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RESULTS AND ANALYSIS

The results from a weighted overlay shows that two counties in Chengde city in Hebei Province, Fengning Manchu Autonomous Country and Kuangcheng Manchu Autonomous County, are most suitable for new urban development, with scores of 7.31 and 8.27 respectively. In addition, the majority of the counties with suitability scores of above 5.5 are located in the North and in the West of the region. In contrast, counties around the Beijing Metropolitan Area and the Tianjin Metropolitan Area have low suitability scores, arguably because of existing high levels of urbanization that has consequently left the area with high levels of carbon dioxide emissions and low water quality. The mean suitability score is 4.25 out of a possible 10.
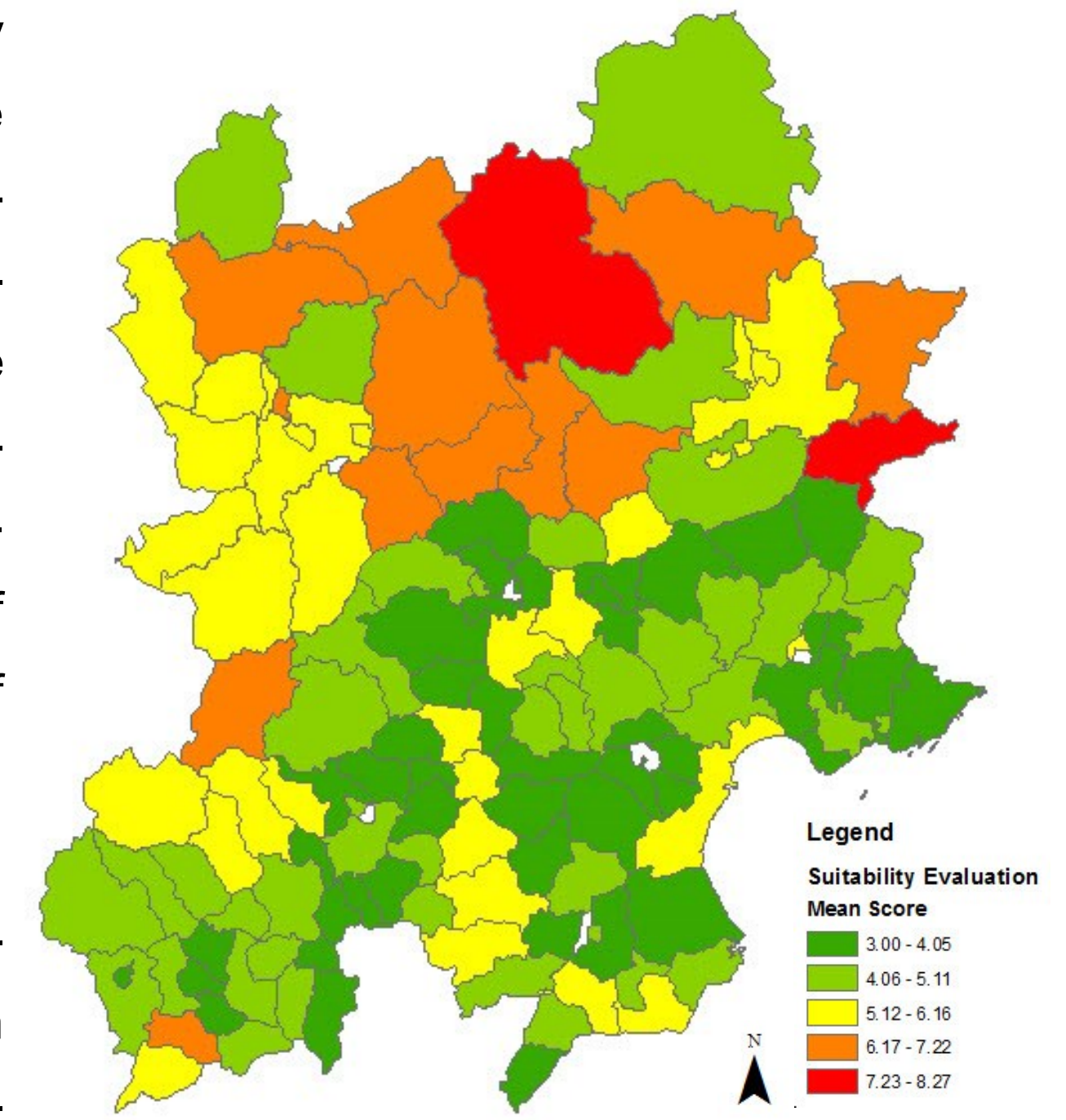
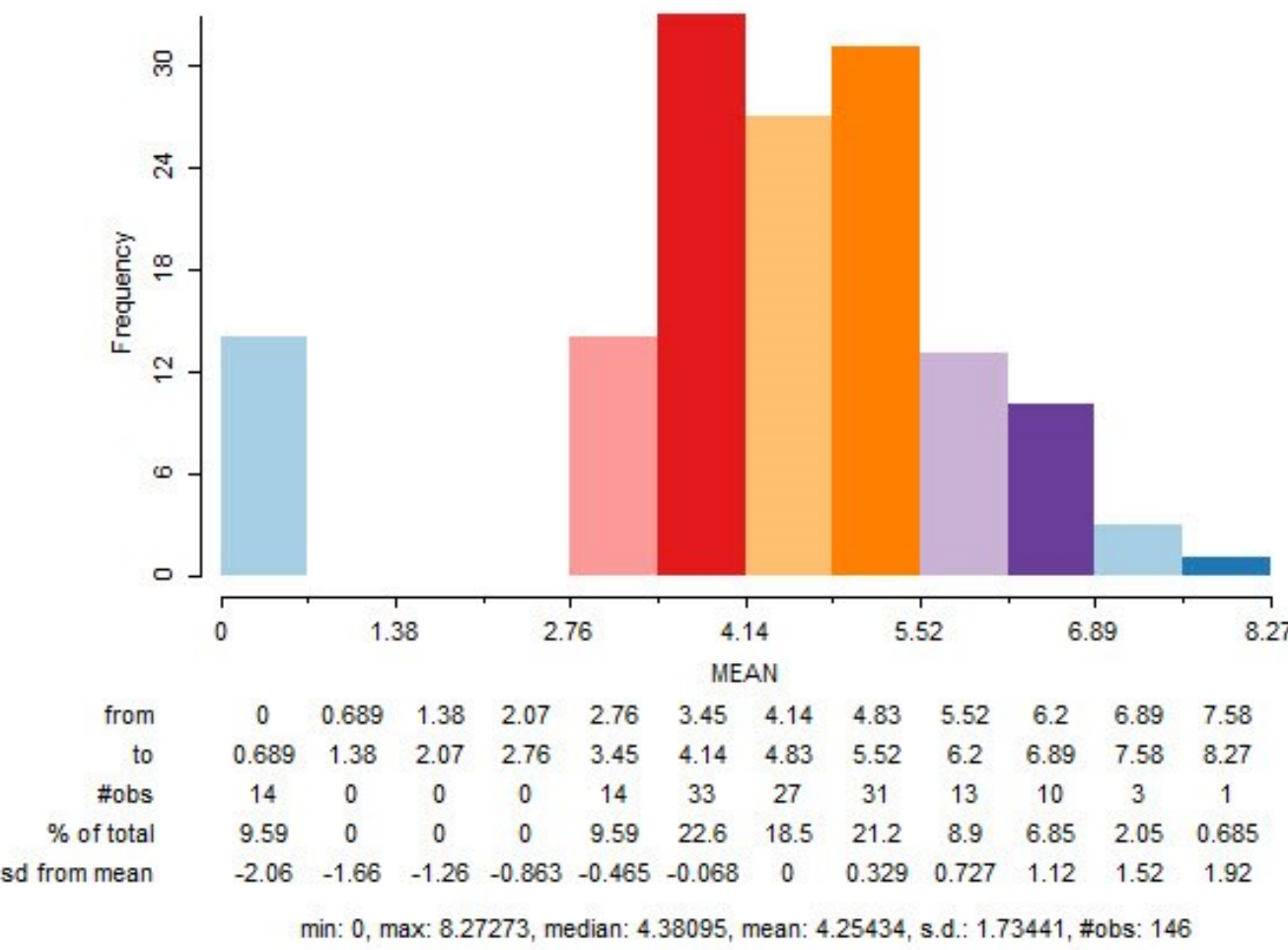Fig 10: Mean Suitability Index of county

from	0	0.689	1.38	2.07	2.76	3.45	4.14	4.83	5.52	6.2	6.89	7.58
to	0.689	1.38	2.07	2.76	3.45	4.14	4.83	5.52	6.2	6.89	7.58	8.27
#obs	14	0	0	0	14	33	27	31	13	10	3	1
% of total	9.59	0	0	0	9.59	22.6	18.5	21.2	8.9	6.85	2.05	0.685
sd from mean	-2.06	-1.66	-1.26	-0.863	-0.465	-0.068	0	0.329	0.727	1.12	1.52	1.92

min: 0, max: 8.27273, median: 4.38095, mean: 4.25434, s.d.: 1.73441, #obs: 146

Fig 11: Histogram of Mean Suitability Score by county

LIMITATIONS

- Additional factors that can be considered in the evaluation of suitability include land use data, precipitation, geomorphological types and river density

- In this project, road and rail density were calculated by dividing the length of rail and road by built up area in 2010. This is not reflective of road and rail density at the town or city level because some of the counties have very small built-up areas. Road and rail density can in future be calculated based on population size.

- While counties that have high carbon dioxide emissions and low water quality are classified as less suitable for urban development, identifying counties with low CO2 emissions and good water quality can in turn cause those counties to be in future less suitable.

SOURCES

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