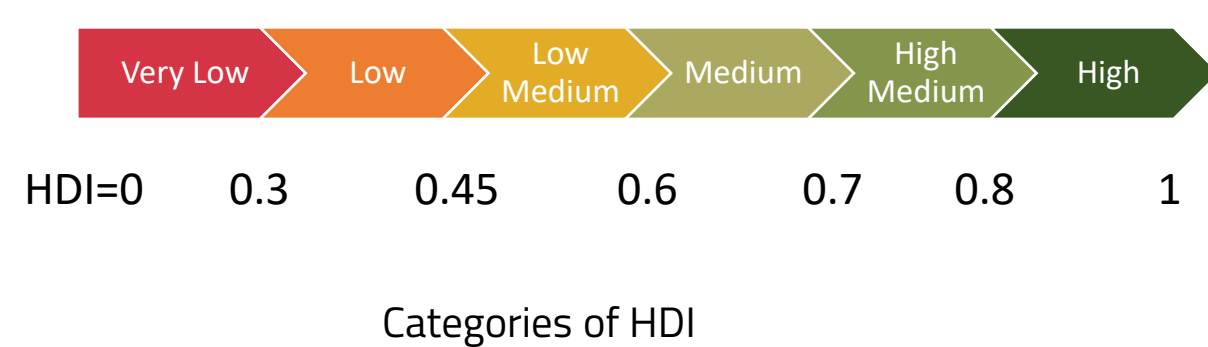# Flood Hazard and Human Development in Pakistan

MGA 60710 Geographical Information Systems
Mehak Anjum Siddiquei

Introduction

In Pakistan almost every year rains in the Monsoon season lead to flooding. The flooding makes the land near the rivers more fertile and having a sizeable agricultural industry, it would seem that a large population would reside in these areas. However, there are other factors as well which people consider when deciding where to live such as educational opportunities, health facilities, infrastructure and overall standard of living. A good measure of development along these lines is offered by the Human Development Index produced by the United Nations Development Program (UNDP).

HDI measures development along three aspects; education, health and standard of living and uses different indicators such as average years of schooling, satisfaction with health facilities and immunization rate, to measure these. It aims to measure the development of a country through the prosperity of the people as opposed to considering wealth only. The index ranges from 0 to 1, 0 being the least developed and 1 being the most developed. The score is categorized into 6 categories of development as shown in the chart below.

Development in Pakistan varies across the four provinces and even within the provinces the level of development varies along districts. There are many factors which affect the level of development of an area natural hazards is just one of them. Other such as natural resources, topography, investment and even historical factors such as colonial history can explain the differing levels of development.

| Very Low | Low | Low Medium | Medium | High Medium | High |

HDI=0   0.3   0.45   0.6   0.7   0.8   1

Categories of HDI

Research Question

The aim of this research is to investigate the impact of flood hazard on human development in Pakistan, if there is any. Moreover, the study looks at distribution of population to asses where most people reside. Overall, the variation is investigated within provinces at the district level.

Hypothesis 1: The hypothesis is that a large proportion of people will be living in areas prone to flooding since these tend to be more fertile and so the large number of people part of the agriculture sector would be living in these areas.

Hypothesis 2: The second hypothesis is that areas more prone to flooding will tend to have a lower level of human development as flooding can disrupt daily life .
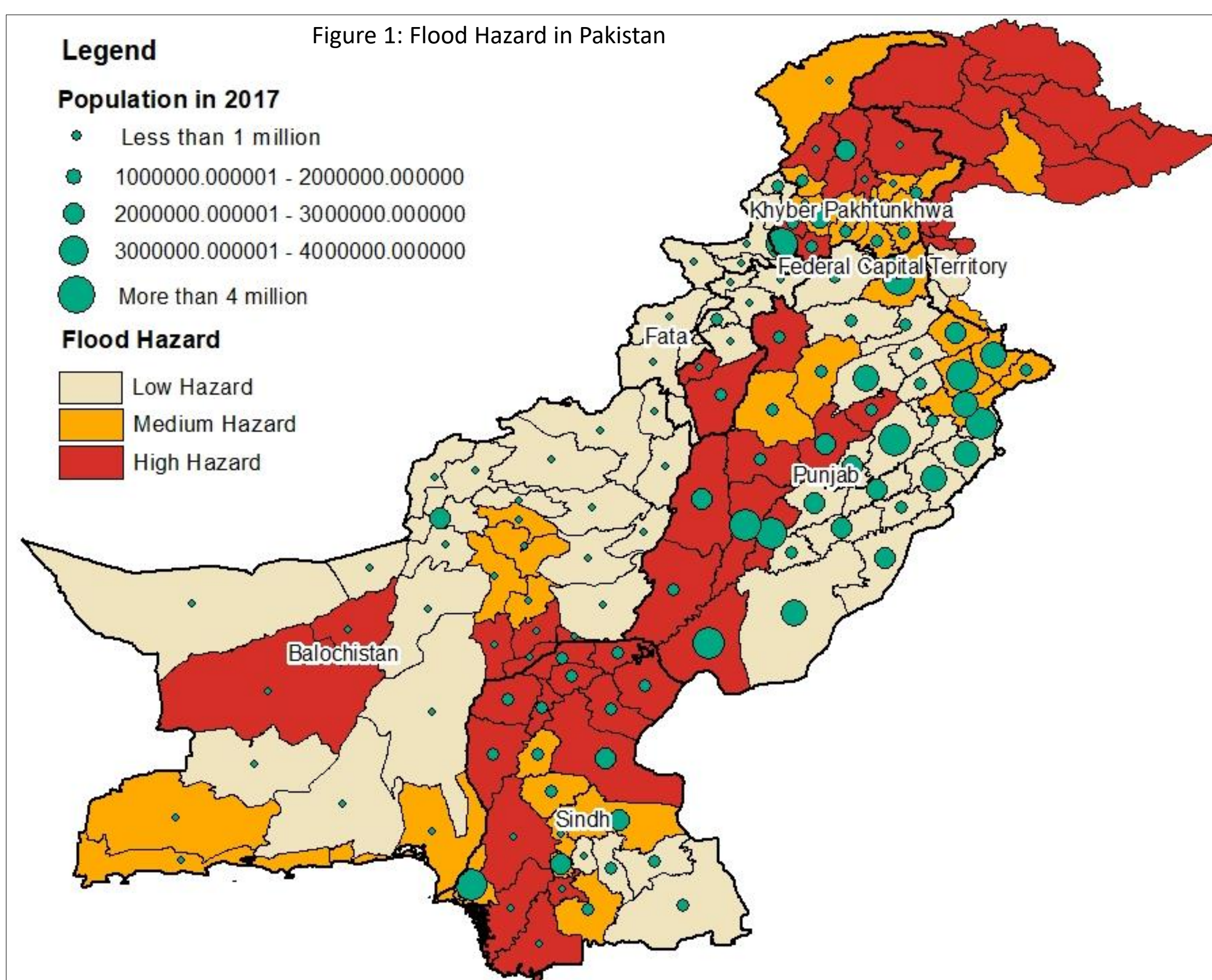
Given that different factors impact development in an area, the causal mechanisms are not explored in this research and are beyond the scope of the project. The focus is only on identifying trends, if there are any.
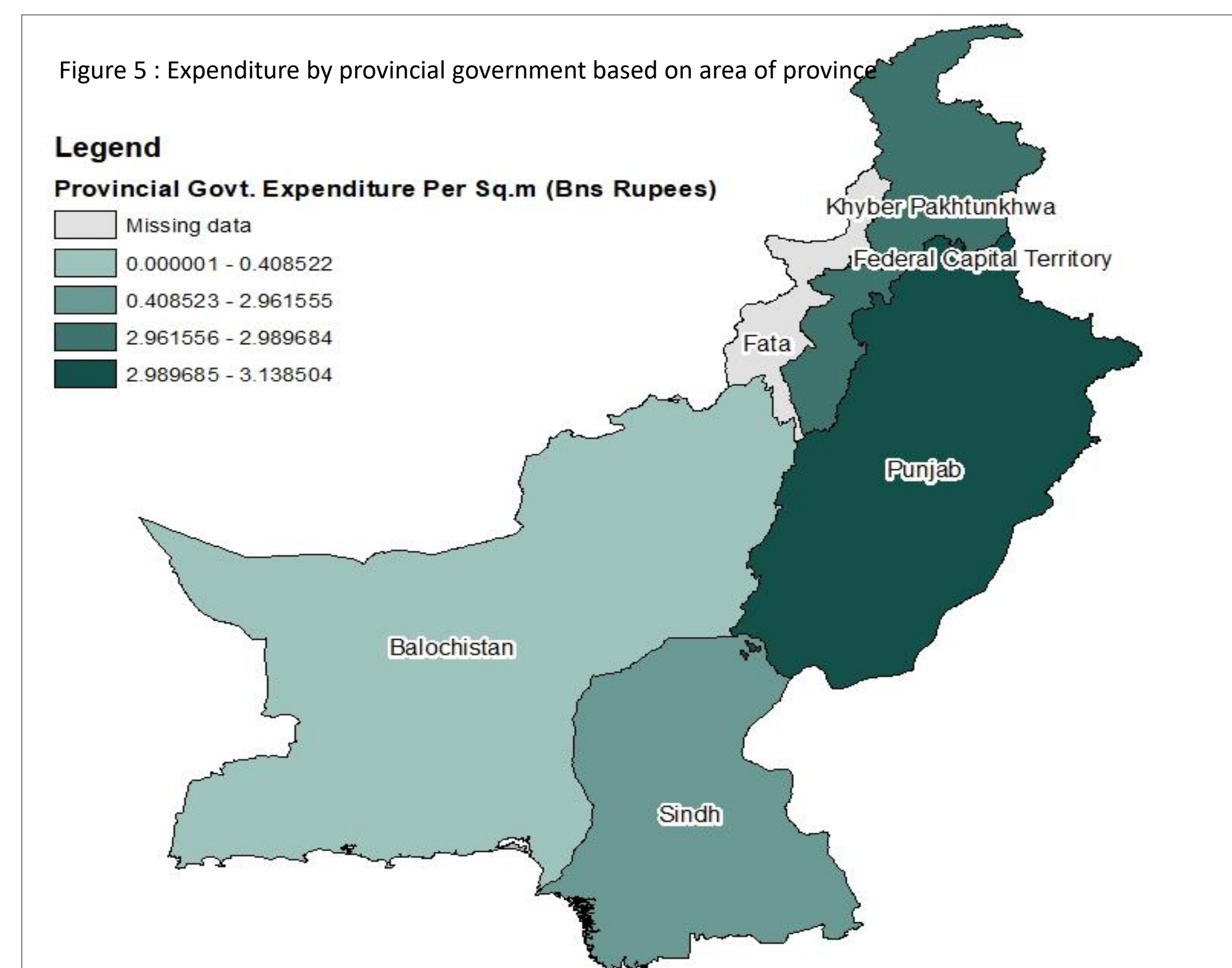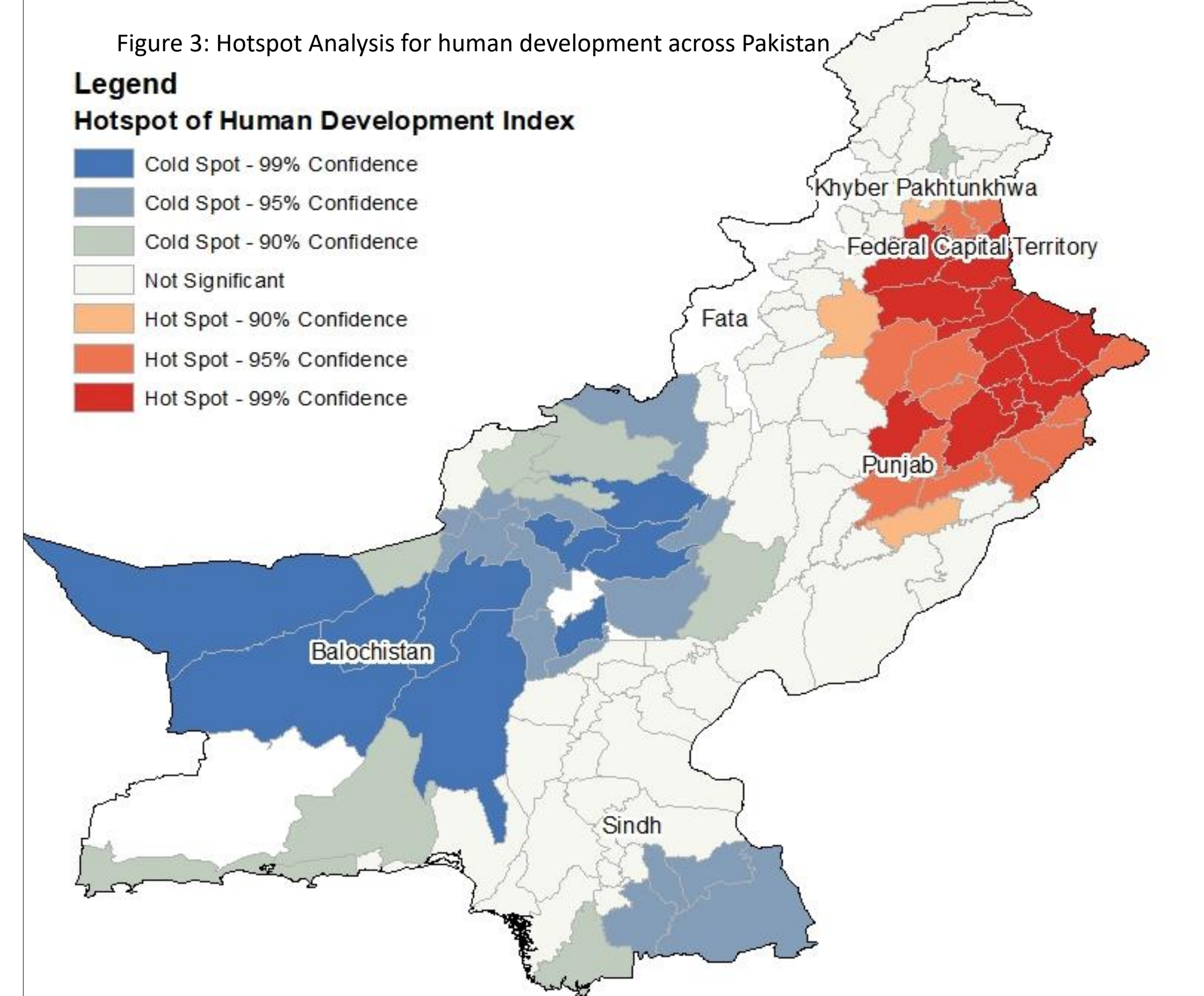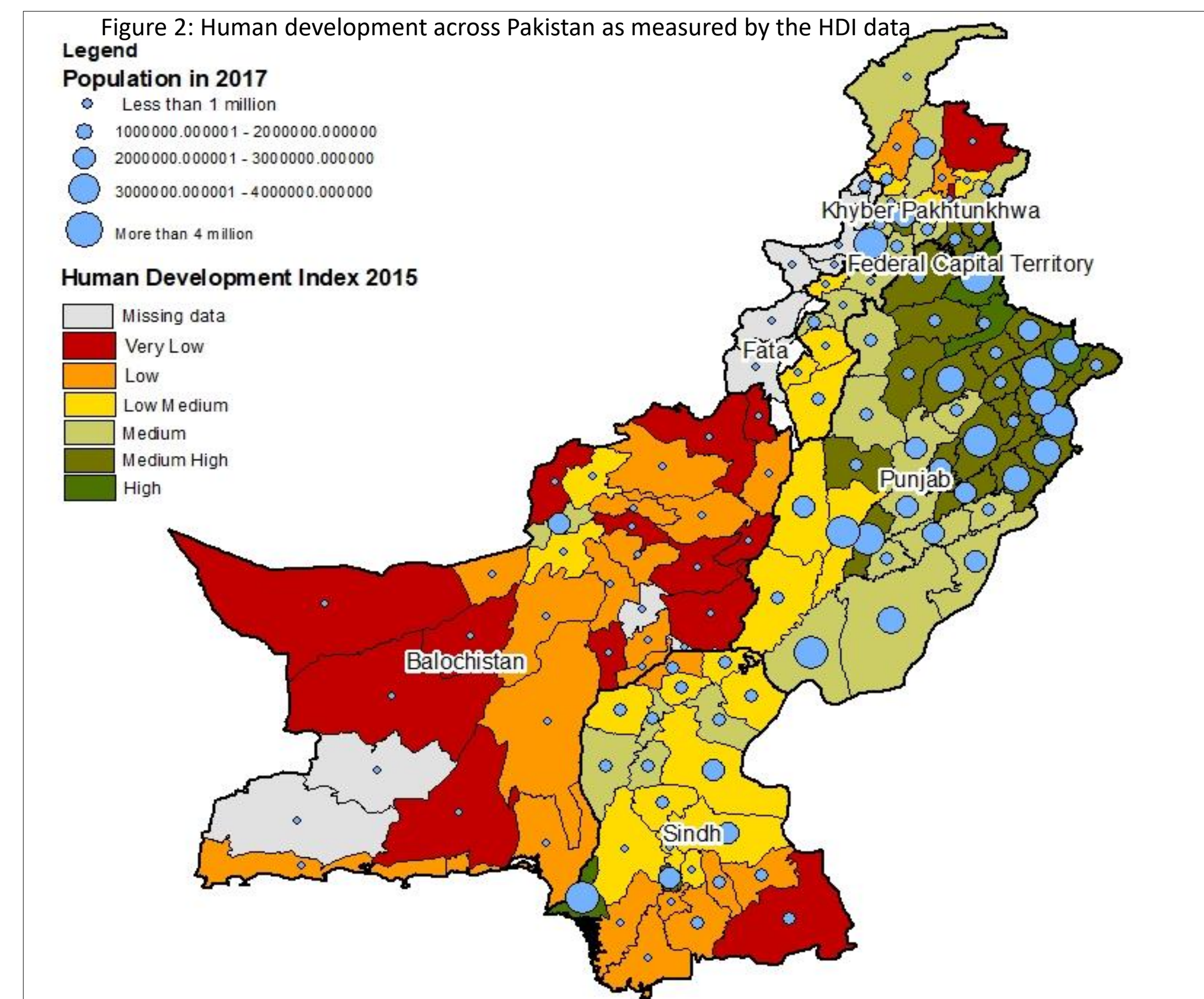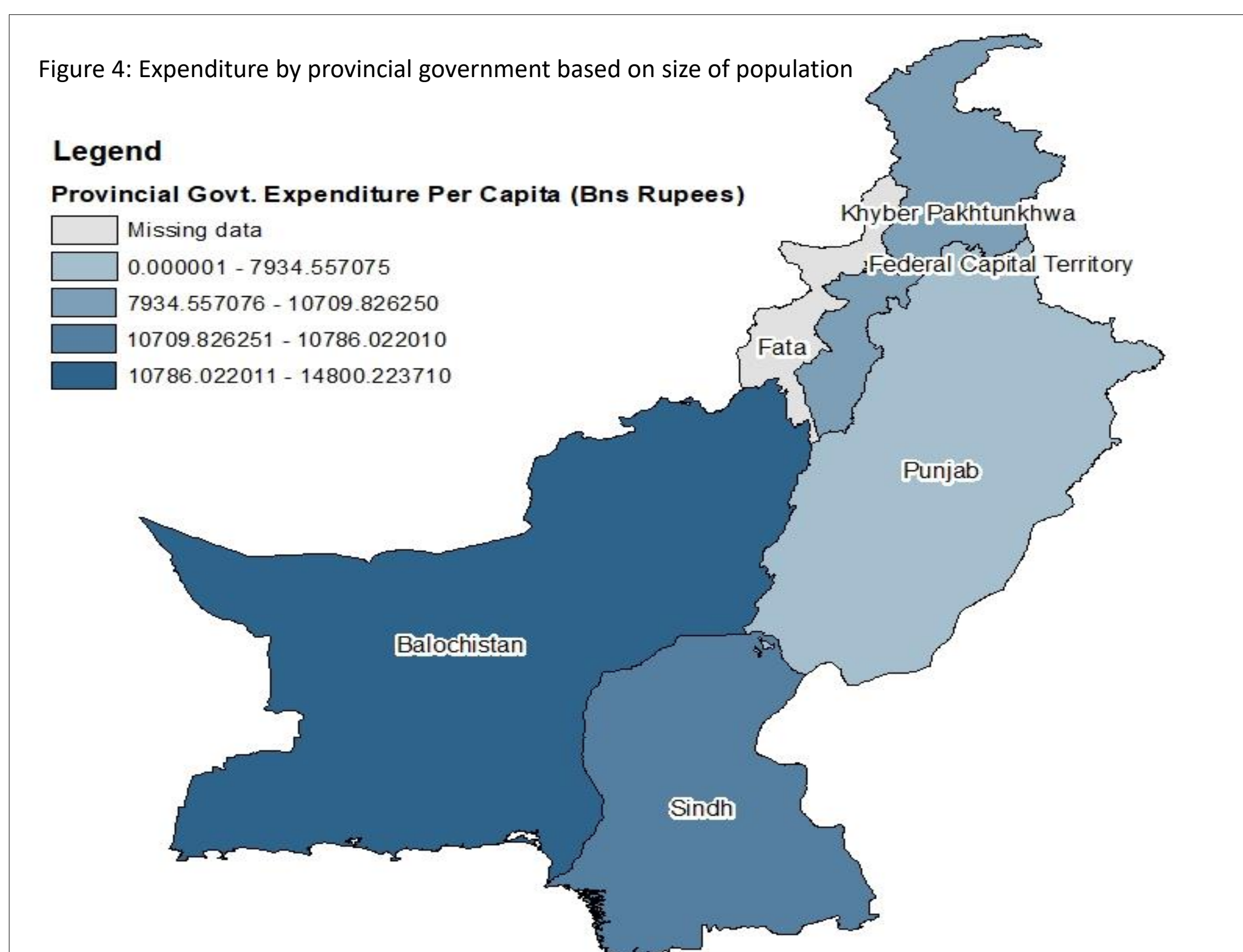
Data & Methodology

Data:
The analysis is conducted for the year 2015 since the flood hazard data available is covered till 2015 and the latest HDI data published in 2017, is for 2015 as well. The last census conducted in Pakistan was in 2017 after the one conducted in 1998 so data for 2015 is not available. However, the data for 2017 will help to provide an estimate of what the census population looked like in 2015 and what the distribution of the population looked like in the districts. For this reason, I will focus more on comparing the proportion of people rather than the number of people living in the different districts. The flood hazard variable is categorical, ranking areas as having low, medium and high risk of flooding. The measure is constructed based on the number of flooding events between 1950 and 2015 by WFPGeoNode. Lastly, data for expenditures by provincial governments is obtained for the year 2015 to investigate one possible reason for different levels of development. While the flood hazard data is available for all of Pakistan, the HDI and expenditure data does not include Azad Jammu and Kashmir (AJK) since it is a self-governing territory.

Methodology:
Choropleth maps are made for the flood hazard in districts to find which areas have a high flood hazard, for the HDI data to assess how flood hazard and development are related and lastly, for expenditure by the provincial government to determine which provinces get more resources from the government budget. Point data for the population through centroids is represented by graduated symbols.
Hotspot analysis is conducted to highlight the areas with high and low levels of development.

Results

Figure 1: Flood Hazard in Pakistan

Legend
Population in 2017
- Less than 1 million
- 1000000.000000 – 2000000.000000
- 2000000.000001 – 3000000.000000
- 3000000.000001 – 4000000.000000
- More than 4 million

Flood Hazard
- Low Hazard
- Medium Hazard
- High Hazard

Figure 2: Human development across Pakistan as measured by the HDI data

Legend
Population in 2017
- Less than 1 million
- 1000000.000001 – 2000000.000000
- 2000000.000001 – 3000000.000000
- 3000000.000001 – 4000000.000000
- More than 4 million

Human Development Index 2015
- Missing data
- Very Low
- Low
- Low Medium
- Medium
- Medium High
- High

- Figure 1 shows that the high flood risk areas are in AJK, western and southern Punjab, northern Khyber Pakhtunkhwa (KPK) most of Sindh and south–west Balochistan. Punjab is the most populous of the provinces and it seems that most of the population does reside in the medium and high flood hazard areas. This means that the first hypothesis is unlikely to be rejected and is true.

- The second figure shows the HDI data for different districts. Most of Punjab has medium, medium high and high levels of HDI, Sindh has comparatively higher development in the center of the province while the coastal areas have low or very low levels of HDI, Balochistan has mostly very low levels of HDI and KPK has medium and medium high levels of development. It seems that data might reject the second hypothesis since with the exception of Balochistan, high flood hazard areas tend to have higher levels of development.

- To find if development is clustered, hotspot analysis is used to find hot and cold spots of development and Figure 3 shows that high human development is clustered in northern Punjab, the capital territory Islamabad and some parts of KPK while low levels of development are clustered in Balochistan. Does this imply that flood hazard is good for development ? Clearly, there is more to this pattern than can be concluded with a spatial analysis of the data at hand only. There are many reasons why development remains unequal across provinces in Pakistan. This analysis explores only one of these which is the amount spent by the provincial government in these areas.

Figure 3: Hotspot Analysis for human development across Pakistan

Legend
Hotspot of Human Development Index
- Cold Spot - 99% Confidence
- Cold Spot - 95% Confidence
- Cold Spot - 90% Confidence
- Not Significant
- Hot Spot - 90% Confidence
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence

Figure 4: Expenditure by provincial government based on size of population

Legend
Provincial Govt. Expenditure Per Capita (Bns Rupees)
- Missing data
- 0.000001 – 7934.557075
- 7934.557076 – 10709.826250
- 10709.826251 – 10786.022010
- 10786.022011 – 14800.223710

Figure 5 : Expenditure by provincial government based on area of province

Legend
Provincial Govt. Expenditure Per Sq.m (Bns Rupees)
- Missing data
- 0.000001 – 0.408522
- 0.408523 – 2.961555
- 2.961556 – 2.989684
- 2.989685 – 3.138504

Results (Continued)

- Figure 4 shows that Balochistan spends the most in terms of per capita resources followed by Sindh, KPK and Punjab. However, Figure 5 tells a different story where expenditure per square mile is mapped. For this, area of the province polygons was calculated and total expenditure was normalized by this. The two graphs show that while Balochistan gets more money for its population, it gets less money given its size. This might be one of the reasons the province remains largely underdeveloped and resultantly experiences very lower levels of human development.

Conclusion

- The spatial analysis in this study helps to shed light on the unequal state of development in Pakistan. Geographical mapping of data shows that a large proportion of the population resides in the medium and high flood hazard areas. The maps also show that most of these high hazard areas in two provinces, KPK and Punjab, are fairly developed while coastal areas of Sindh and almost all of Balochistan has low levels of human development. This makes the first hypothesis unlikely to be rejected while the second hypothesis may be rejected.

- Hotspot analysis confirms that development extremes are indeed clustered in provinces. Punjab has high development while Balochistan has lower levels of human development.

- An investigation into one possible reason for this disparity shows that while Balochistan receives the highest per capita expenditure by the provincial government, it is Punjab that receives the most expenditure by the provincial government given the area of provinces. This means that Balochistan has fewer resources which would restrict the level of human development in the province.

- This also provides insight intoa possible reason for low population of Balochistan.

Policy Recommendations:

- There is a need to devote more resources to the Balochistan province so that the level of human development rises for its current population.

- People may have settled in high flood hazard areas due to agriculture but as the structure of the economy changes over time this will become less relevant and if other provinces do not develop then most population will be concentrated in a few provinces putting pressure on resources there. Opportunities should be created in Balochistan which will help to diversify the economy.

Data Sources

- Shapefiles for administrative level 2 (districts) boundaries and provincial boundaries are available on the Humanitarian Data Exchange (HDX) website.
- Population census data is published on the Pakistan Bureau of Statistics (PBS) website.
- HDI data is available in the country report published by UNDP.
- The flood hazard data is available as a shapefile on WFPGeoNode website.
- The provincial expenditure data is available in the annual reports published by the State Bank of Pakistan.