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Climate Change-Induced Geoenvironmental Challenges in Faizabad City: A Case Study from 2010-2020

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ABSTRACT
The issue of environmental change is a pressing concern in the world today, impacting various aspects of human life. This study aims to assess environmental changes in Faizabad City, located in the Badakhshan Province at the northeast of Afghanistan. The study utilizes a combination of comperhinsive reviws, field observations, and laboratory analysis. Specifically, the study focuses on climate change and its environmental impact on Faizabad City, affecting both human and non-human elements of the ecosystem. By analyzing data from 2010 to 2020, including rainfall patterns, population growth, and temperature fluctuations from reputable local and global meteorological sources, the study highlights significant trends in environmental parameters. The findings indicate a population growth rate exceeding 2% and a temperature increase of 0.5°C during the specified timeframe, alongside fluctuating precipitation levels characterized by both decreases and increases. Consequently, the study concludes that Faizabad City experiences significant warming trends and excessive population growth, posing challenges to planned urban development and geomorphic integrity, thereby compromising its aesthetic appeal.

Keywords: Climate change, Environmental Geology, Geomorphology, Fossil Fuel

INTRODUCTION
Faizabad city located in the northeastern region of Afghanistan, serves as the capital of Badakhshan province. Renowned for its agreeable climate and captivating natural vistas, Faizabad has garnered widespread recognition as a prominent city within Afghanistan(Panjshiri, A. H., et al. 2018). However, the undeniable influence of global environmental change has not spared this city, leaving it significantly impacted. Consequently, this study places a considerable emphasis on the examination of environmental transformations specifically within the city of Faizabad over a span of ten years, recognizing the criticality of this subject matter (Sadiqi,1398).

In light of the significance attributed to this field of inquiry, a comprehensive exploration is imperative. The primary objective of study is to scrutinize the alterations in the geological and environmental landscape, specifically pertaining to climate change, within the city of Faizabad, situated in the Badakhshan province, during the period spanning from 2010 to 2020. The investigation at hand delves into the multifarious factors and underlying causes that exert influence upon the prevailing climate conditions. Furthermore, it endeavors to proffer viable recommendations aimed at mitigating the adverse consequences wrought by these transformations (Zaryab, M. Y. 1401; Sadiqi, A. 1398).

MATERIALS AND METHODS
This study accomplished in two steps; The first step provides comprehensive insights into Environmental Geology and climate change, while in the second step analyzed the collected data. The main objective was to investigate climate change and Environmental Geology in Faizabad City, Badakhshan province, from 2010 to 2020. This study employed fieldwork, laboratory analysis, and comperhinsive reviws. Pertinent information on population growth, urban development, water levels, and other environmental changes was gathered. In the laboratory phase, data on temperature variations and rainfall patterns in Faizabad from 2010 to 2020 were rigorously analyzed using Geographic Information System (GIS) software and Remote Sensing Technology. The research also utilized Cru Data, a reputable data source, to enhance the analysis.

RESULTS

The influence factor of climate change

Climate change presents a significant challenge in the modern era, encompassing various urgent issues such as floods, extreme temperature fluctuations, increased drought frequency, rising sea levels, melting Arctic glaciers, the spread of pests and plant diseases, and ozone layer depletion. These challenges have elevated climate change to a prominent global concern. When climatic changes occur within a particular region, it is referred to as climate change. Scientifically, climate change represents an unprecedented crisis, exerting a profound impact on global climate patterns (Ray, 2011). Factors influencing climate change are typically categorized into two groups.

Natural factors

Natural factors significantly contribute to climate change worldwide. These factors encompass phenomena such as Earth's circulation patterns and fluctuations in sunlight. It is essential to recognize that while these natural factors are influential, they do not present an immediate and severe threat.

Human *factors*

Human activities have become significant drivers of climate change, driven by technological advancements, increased use of fossil fuels, deforestation, poor construction practices, and manipulation of natural elements. These anthropogenic influences have played a crucial role in shaping current climate patterns, with certain factors assuming greater importance. The key factors contributing to climate change are well recognized at (Kaddo, 2016) works.

Examination of population changes in the Faizabad city

This study has established a clear link between population growth and environmental degradation, which varies depending on the socio-economic and political context as well as technological advancement. Recognizing the interdependence between population dynamics and the environment, particularly in terms of resource sustainability, is crucial. Consequently, population size can fluctuate due to various factors (Lutz, 2016). In the past decade, Faizabad's population has experienced significant growth rate, with a considerable portion of residents coming from outside the immediate area. This population influx can be attributed to factors such as inadequate healthcare facilities, limited educational opportunities, insufficient access to sustenance, and environmental geological changes. To support our findings, we obtained statistical data and official documents of Faizabad's population from the reputable Badakhshan statistical information office.

Table 1: Population Growth rate of Faizabad city

NO	Year	Male	Female	Total	Population Growth
1	2010	31026	30487	61547	0
2	2011	31705	31123	62823	2.03%
3	2012	32369	31765	64127	2.01%
4	2013	33031	32432	65456	2.01%
5	2014	33718	33093	66813	2.04%
6	2015	34416	34417	68198	2.03%
7	2016	35131	34481	69612	2.02%
8	2017	35859	35196	71055	2.03%
9	2018	36602	35920	72528	2.01%
10	2019	37361	36670	74031	2.03%
11	2020	38141	37436	77577	2.04%

Source: (Sadiqi,1398).

This study meticulously examined the climatic conditions in Faizabad, focusing on temperature variations over a decade. Temperature data from the reliable World Clime meteorological site were analyzed using GIS software. The outcomes were effectively visualized through maps and graphs. The findings indicate a sustained trend of increasing temperatures in Faizabad over the ten-year period, reflecting a worsening heat phenomenon in the city. The results reveal an average temperature rise of 0.5°C during this time span.

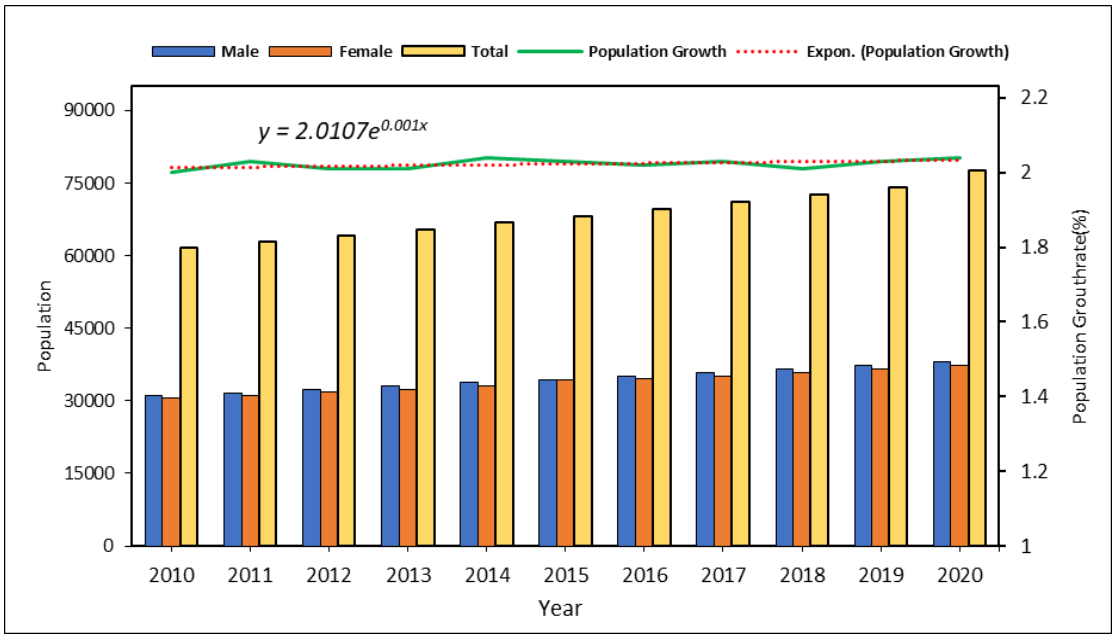

Figure 1. Population Growth and Growth rate of Badakhshan Provinces from 2010 since2020.

Rainfall

Humidity and rainfall are crucial climatic factors that directly affect the weather conditions in a region, operating on monthly and yearly time scales. Their interaction is closely linked to air pressure systems, topography, and the dynamics of cold and warm air fronts. Generally, areas with low-pressure systems tend to experience higher precipitation levels. However, the occurrence of rainfall in mountainous regions and associated weather complexities depend on the altitude of the mountain range. In elevated terrains, the cooler temperature of humid air leads to earlier saturation, resulting in increased precipitation and intricate meteorological phenomena.

The interaction of moisture and rainfall are also closely linked to air pressure systems, topographic features, and the dynamics of cold and warm air fronts. Typically, areas with low-pressure systems have higher precipitation levels. However, the occurrence of rainfall in mountainous regions and the associated weather complexities depend on the altitude of the mountains. This study thoroughly analyzed the rainfall patterns in Faizabad over a ten-year period using rainfall data from the reputable meteorological site, World Clim. The data was meticulously analyzed using GIS software and visualized through maps and graphs. The findings demonstrate the dynamic nature of rainfall in Faizabad over the specified time frame, showing fluctuations in both decreased and increased precipitation levels (**Figure 2**).

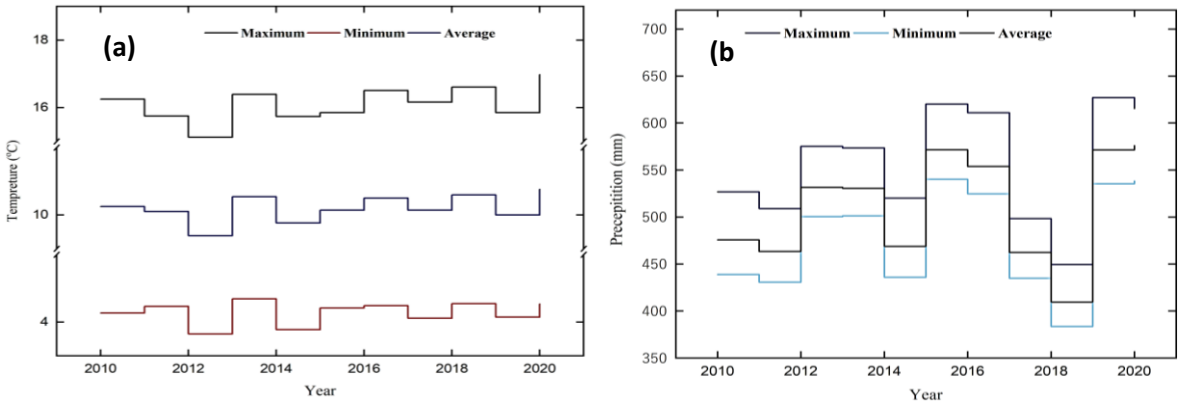

Figure 2. Climatic condition changes in Fayzabad city; (a) Tempretures change, (b) Rainfall changes.

Greenhouse gas increases

Increasing greenhouse gas emissions have become a paramount contributor to global warming, posing a critical challenge for both humanity and the environment. The release of carbon dioxide CO_2 from burning fossil fuels is the primary driver behind the Earth's rising temperatures. Faizabad, a charming town adorned by the Kokchah river, adds to the city's aesthetic appeal. However, the city's serene atmosphere is unfortunately tarnished by harmful practices, such as the indiscriminate use of fossil fuels and improper plastic disposal, leading to atmospheric contamination. This concerning reality is supported by an authoritative report from the Environmental Directorate of Badakhshan province.

DISCUSSION

The Faizabad city center of Badakhshan province, is one of the small cities in northeastern Afghanistan, surrounded by the mountains of the Hindu Kush, and the Kokchah passes through its center. It is one of the touristic areas of the Afghanistan for territorial and foreigner tourists. Since 1992, non-standard Construction on public and private properties in the Faizabad city began with the return of people from districts to the provincial capital, which continues to this day, although a regular urban planning process has not been implemented by the authorities. Such a behavior of people and the local government has caused the destruction of the environment and the beautiful geomorphology of the Faizabad city.

CONCLUSION

The city of Faizabad in Badakhshan Province has experienced environmental challenges, including climate change, urbanization, and unsustainable resource exploitation. These changes have had significant impacts on the region's ecosystem and population growth. From 2010 to 2020, Faizabad recorded a temperature increase of 0.5°C, contributing to the city's population growth. To preserve the environment and prevent ecosystem destruction and river pollution, coordination between authorities and experts is crucial in managing human activities in Faizabad. Implementing sustainable practices and regulating resource exploitation are essential steps in safeguarding the region's natural beauty.

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