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How Data Science Can Help Prevent Collapse

Jared Diamond believes "...environmental damage, climate change, hostile neighbors, and friendly trade partners, [and] the society's responses to its environmental problems—always proves significant" in a society's collapse (Diamond). It is a bold claim, but it is rather understandable. Each factor is vital to explore and discover ways we as a society can do to help mitigate collapse. In order to do this, one can investigate using data science. Data is everywhere and data science is a powerful tool to provide insight and the meaning of various problems. Countries like Pakistan suffer countless years of climate change and with the help of data science, we can try to find and investigate a solution to help the country's troubles they face towards climate change.

First, what is climate change? According to NASA, "climate change is a change in the usual weather found in a place" (Dunbar). This can be anywhere from droughts, rising sea levels, a sudden change of cold to hot weather, floods, storms, etc. These problems can also be accompanied by the other four factors of collapse. For example, environmental damage such as deforestation, "...is responsible for as much as 10 percent of all global warming emissions [because]... when trees are cut down and burned or simply allowed to rot, that carbon is released into the air as carbon dioxide" (Kessler). In return, increases the temperature of the Earth which can have a negative impact on our environment and lead to irreversible damage. Then a snowball effect of the collapse of a society where an increase in temperature can deprive them of a natural resource that helps them to survive or use as trade. If they have no resources, it would be difficult for them to defend from hostile neighbors. In addition, if they are not able to trade, they can lose

support from friendly neighbors and the society may not know how to respond properly to these problems. Climate change can be dangerous and the downfall to a society.

Home of 231 million people, Pakistan is a country located in Southern Asia. The country's climate varies as it is usually hot and dry along the coast of the Arabian Sea and more cold up north towards the Himalayas. With the contrast of the weather, Pakistan is suffering from climate change. Specifically up north, all throughout history, Pakistan has had to endure huge amounts of rainfall and floods. Pakistan goes through a season of monsoons which are said to be record breaking, receiving "...more than 3 times its usual rainfall in August, making it the wettest August since 1961" (World Weather Attribution). Monsoons occur in Pakistan because the hot temperatures during the summer pull in cool, moist air from the Indian Ocean, resulting in heavy precipitation. Although heavy rain sounds harmless, it has many negative impacts.

In recent years, the amount of precipitation Pakistan experiences seems to be growing larger and larger with no point of return. They are faced with intense floods and landslides resulting in damaged crops, infrastructure, and unfortunately taking the lives of many people. For weeks in summer of 2010, Pakistan endured some of the worst rain and flooding that totaled "...70 percent above normal in July and 102 percent above normal in August" (Scott). 20 million people were affected where nearly 2 thousand citizens passed away, 2 million homes destroyed, and 200 thousand livestock lost all of which cost Pakistan 12.9 billion dollars in damage and repairs. 12 years later in 2022, just last year, Pakistan was yet again hit by arguably their worst monsoon in history. This monsoon affected 33 million people where 1.2 thousand citizens passed away, destroying 300 thousand homes, and over 700 thousand livestock which cost Pakistan over 10 billion dollars in damage and repairs. To top it all off, the aftermath of the heavy floods caused by the monsoons emerged "...waterborne diseases such as cholera [which plagued the]

survivors…" (Scott). Heavy rainfall causes flooding which provides a perfect living condition for mosquitos who are known to carry diseases. The impacts of heavy rainfall caused by climate change turns out to have major consequences to a society. Health related deaths include "...allergic chest infections, asthma, chronic obstructive lung disease, pneumonia, and the flu" (Manzoor). It is evident that climate change of Diamond's five factors of collapse is ruthless towards Pakistan by taking away the lives of many people and negatively affecting the economy.

To prevent Pakistan's societal collapse, data science, which is "the practice of working with data to generate valuable [knowledge and understanding to] solve real-world problems", can be used to provide insight (Tarshizi). One way is by predicting future outcomes using data science. What the process of data science entails is defining the problem, collecting data, exploratory data analysis, modeling, evaluation, deployment, and monitoring and maintenance. Within this process there is machine learning where "...computer models are used to draw conclusions from complex datasets [and the] models are usually designed for research that would be impractical or excessively laborious to carry out with conventional analysis" (Beardmore). Which in short, can help predict future outcomes of climate change.

The process is intensive. First we would need to define the problem. In this case, can we predict the amount of future rainfall for Pakistan? To start answering, we would need to collect data. One way to attack this problem is by looking at Pakistan's recorded history of rainfall such as how much it rained in a month and year. Once the data is collected, a data scientist would have to perform exploratory data analysis which is a crucial part of the process. This allows the team working to understand the data, trends, distributions, and identify unusual statistics of the data collected of rainfall. This will then help them brainstorm different types of models to undergo a machine learning algorithm to start visualizing how to predict rainfall. Since rainfall is

the output variable to be predicted, data scientists can use a linear regression model which "...is a supervised learning algorithm that compares input (X) and output (Y) variables based on labeled data [which is] used for finding the relationship between the two variables and predicting future results based on past relationships" (Master's in Data Science). Once it goes through the algorithm, the next step is to test the validity of the model. If everything looks right, the model can be safely used to accurately predict future rainfall and present the findings.

Since we are able to predict something so complex, it describes another of Diamond's five factors of collapse which is societal response. If the model predicts an abnormally high amount of rainfall, Pakistan could assume it is caused by a monsoon and react accordingly. For example, in the 2022 monsoon, Pakistan funded "$245 million… from the government's own resources and contributions by private citizens and international donors, [to support] 2.2 million households and hundreds of thousands of tents, food, water, and medicines were distributed to the displaced [which was then] revised up to $816 million after additional international commitments" (Nabi). The response was not directly caused by data science, but it is something that the government could start to organize early with the results.

Pakistan could go through two other factors of collapse, however empathy is shown towards Pakistan where they have friendly neighbors. Many donations are being sent to help provide assistance in the repairs and medical assistance. Notably the United Nations International Children's Emergency Fund "...is doing everything it can to support children and families affected and protect them from the ongoing dangers of waterborne diseases, malnutrition and protection risks. UNICEF is on the ground with partners, delivering life-saving medical and other emergency supplies to support children and women affected by the floods. They have

funded up to around 173.5 million dollars towards the affected people which is an immense amount of help.

Pakistan goes through the climate change factor of collapse. The country suffers from years of intense climate change such as monsoons which cause heavy rainfall, floods, and landslides. This negatively affects the society as the monsoons destroy peoples homes and livestock needed to survive, brings death to the population, and creates water borne diseases that give people agonizing pain. Luckily, friendly neighbors assist in the revival of Pakistan providing large amounts of money to help bring medical assistance to people plagued by the illnesses caused by the monsoon. Data science can act as a powerful tool and there is more than one way for data scientists to tackle Pakistan's problem with climate change to aid society's response to rainfall. Machine learning algorithms can predict future outcomes and the government can use this information to take action early. This will not solve all of Pakistan's problems, but it contributes to finding the solutions of solving their climate change issues.

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