

Global Climate Impact Analysis Using Tableau

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Abstract- Climate change has become one of the most significant global challenges of the 21st century, causing severe environmental and economic consequences worldwide. Extreme climate events such as floods, hurricanes, wildfires, droughts, and heatwaves have increased in both frequency and intensity, resulting in substantial financial losses across various sectors, including agriculture, infrastructure, industry, and public services. This study presents a comprehensive analysis of global climate events and their economic impacts using data visualization techniques. The dataset used in this research covers climate-related events occurring between 2020 and 2025 and includes information on event types, affected regions, occurrence dates, and estimated economic losses. The primary objective of this work is to transform complex climate data into meaningful visual representations that facilitate better understanding and interpretation. Tableau was employed as the main visualization tool to create interactive dashboards, bar charts, line graphs, heat maps, highlight tables, and geographic maps. Data preprocessing techniques, including cleaning, filtering, sorting, grouping, and aggregation, were applied to ensure accurate analysis. Time-series visualizations were used to identify trends in climate events and economic damages over the study period, while geographic visualizations highlighted regional variations in climate-related losses. The results reveal significant differences in the economic impacts of various climate events across regions and years, enabling the identification of highly vulnerable areas and the most damaging event categories. The interactive dashboards further support comparative analysis and enhance decision-making capabilities. This study demonstrates the effectiveness of data visualization in communicating complex climate information and provides valuable insights for policymakers, researchers, and stakeholders. The findings emphasize the growing economic burden of climate change and the importance of adopting sustainable strategies, risk mitigation measures, and improved disaster preparedness to reduce future impacts.

Keywords – Climate Change, Data Visualization, Economic Impact, Tableau, Global Climate Events, Interactive Dashboard, Environmental Analytics, Climate Risk Assessment.

I. INTRODUCTION

In the 21st century, climate change has emerged as one of the most pressing global challenges, significantly impacting both the environment and the economy. The increasing frequency and intensity of climate-related events such as floods, hurricanes, wildfires, droughts, and heatwaves have drawn worldwide attention. These events not only cause loss of life and environmental damage but also lead to severe economic disruptions, affecting agriculture, infrastructure, industries, and overall national development. As a result, analyzing and understanding these impacts has become essential for governments, organizations, and researchers.

With the rapid growth of data generation, large volumes of information related to climate events are now available. However, raw data in its original form can be complex,

unstructured, and difficult to interpret. This is where data visualization plays a crucial role. Data visualization is the graphical representation of data using charts, graphs, maps, and dashboards, which helps in simplifying complex datasets and presenting them in a clear and meaningful way. It enables users to quickly identify patterns, trends, and relationships that might not be easily noticeable through traditional data analysis methods.

This lab focuses on the visualization and analysis of a dataset that represents global climate events and their economic impact over the period from 2020 to 2025. The dataset includes various attributes such as types of climate events, affected regions or countries, financial losses, and possibly other related factors. By applying different visualization techniques, this study aims to uncover valuable insights, such as identifying the most affected regions, understanding which types of events cause the

highest economic damage, and analyzing how these events have evolved over time.

Furthermore, this project highlights the importance of visual analytics in decision-making. Effective visualizations not only make data more accessible but also support policymakers and stakeholders in planning mitigation strategies, allocating resources, and improving disaster preparedness. It also raises awareness about the growing economic burden of climate change and emphasizes the need for sustainable practices and proactive measures.

In conclusion, this data visualization lab demonstrates how transforming raw data into visual formats can enhance understanding and communication of complex global issues. By exploring climate event data through visualization tools, we gain deeper insights into their economic impact, ultimately contributing to informed decisions and a better understanding of the challenges posed by climate change.

II. LITERATURE SURVEY

Ikegwu, et al., explained how big data analytics is used to model and combat climate change [1]. It discussed tools such as Hadoop, HDFS, MapReduce, YARN, Apache Spark, Google BigTable, Mahout, and Apache Flume to manage large climate datasets collected from satellites, simulations, and environmental records. The study highlights challenges like storage limitations, scalability issues, and real time processing difficulties. It mainly focuses on how distributed computing frameworks improve climate prediction and support better decision making. Unlike older research, this study emphasizes modern big data technologies rather than traditional climate models or policy based analysis.

Girvetz, et al, introduces the Climate Wizard, a web based climate analysis tool [2]. It uses ArcGIS, R software, the CRU TS 2.1 dataset from 1901 to 2002, and 16 General Circulation Model projections for 2070 to 2099 to analyze temperature and precipitation trends. The tool applies statistical trend analysis and anomaly analysis to support planning and decision making. Unlike traditional climate modeling studies, this research focuses on providing an accessible online platform that allows non experts to analyze climate data easily.

Robock, et al, discusses how General Circulation Models are used to create climate change scenarios [3]. It explains the limitation of coarse grid resolution around 500 km and suggests combining model outputs with observed regional climate data to improve accuracy. The study also identifies major uncertainty sources such as solar variability and internal climate variability. Unlike recent big data research, this paper focuses on improving climate scenario generation methods for impact analysis rather than data infrastructure or economic policy evaluation.

Ahmadalipour, et al, evaluates 20 CMIP5 Global Climate Models (GCMs) for the Columbia River Basin (USA) during 1970–2000 [4]. Published in 2015 by Ali Ahmadalipour and co-authors from Portland State University, it used statistical tools such as Mean, Standard Deviation, Mann–Kendall Test, Kolmogorov–Smirnov Test, Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Canonical Correlation Analysis (CCA), and Cluster Analysis. The study analyzed temperature and precipitation at daily, monthly, and seasonal scales before bias correction. It differs from others because it ranks climate models using a multi-criteria statistical approach to select the most reliable GCMs for regional impact studies.

Ruane, Alex C., et al, In 2013, published this study in Global Environmental Change [5]. The research assessed climate change impacts on rice (aman, boro, aus) and wheat production across 16 sub-regions of Bangladesh for the 2040–2069 period. The study used outputs from CMIP3 Global Climate Models and applied CERES crop models (DSSAT framework), the MIKE BASIN hydrologic model for river floods, and the MIKE21 two-dimensional estuary model for sea-level rise. It analyzed temperature, precipitation, CO₂ concentration, floods, and coastal inundation both separately and together. Results showed temperature increases reduce yields, while CO₂ fertilization increases yields, but sea-level rise severely affects southern regions. This study is different because it uses a multi-factor integrated modeling framework combining crop, hydrological, and coastal models.

Joel Smith, et al, published research to estimate global economic damages from climate change [6]. It uses increase in global mean temperature as the main indicator and analyzes how damages change with rising temperature. The survey covers sectors such as sea level rise, agriculture, water resources, health, energy, ecosystems, forestry, and biodiversity. Results show that impacts differ across sectors, with stronger adverse effects beyond about 3 to 4 degree Celsius warming, although uncertainties remain. Unlike replication based statistical studies, this paper mainly synthesizes sector wise impact research to understand the overall damage trend with increasing temperature

Richard S. J. Tol, et al, published a survey-based study in 2017 to review and replicate earlier global economic damage estimates of climate change [7]. It compiles 36 usable estimates from 27 studies and applies statistical regression techniques, particularly a median quadratic weighted regression, to estimate the climate damage function. The analysis shows that global income losses are approximately –2.04% at 3°C warming and –8.16% at 6°C warming after adjusting for unquantified damages. The study also investigates the presence of sharp thresholds but finds no strong statistical evidence for sudden discontinuities in damage patterns. Unlike earlier surveys, this research emphasizes replication accuracy,

correction of previous errors, and rigorous statistical validation of global damage estimates.

Thomas W. Hertel, et al., conducted a 2010 study from the Kiel Institute for the World Economy examining the impacts of climate change on global agriculture [8]. Using a computable general equilibrium model, it considers IPCC SRES A1B and A2 scenarios for the 2020s and 2050s, incorporating variables such as temperature, precipitation, river flow, and CO₂ fertilization. The analysis distinguishes between rainfed and irrigated agriculture and treats water as a key production factor. Findings indicate declines in global food production, GDP, and overall welfare, along with increasing food prices. Unlike other studies, this research links climate impacts with international trade and economic competitiveness through a global modeling framework.

Mike Hulme, et al., developed standardized global climate scenarios for impact assessments in 1999 [9]. Using coupled ocean-atmosphere General Circulation Models under a 1% annual greenhouse gas increase scenario, projections were generated for the 2020s, 2050s, and 2080s relative to a historical baseline. The study includes variables such as temperature, precipitation, sea-level rise, and CO₂ concentrations, with data prepared at fine spatial resolution for global land areas. Unlike impact-focused studies, this work primarily provides consistent climate scenarios to support a wide range of applications, including ecosystems, agriculture, water resources, health, and coastal systems.

Wilby, R. L., and colleagues discussed inconsistencies between global climate models and climate impact research [10]. The study highlights that many impact studies rely on coarse-resolution climate models, which limits their regional accuracy and ability to represent local variations. Issues such as scale mismatch, parameterization of sub-grid processes, and inadequate representation of local climates are discussed. It proposes downscaling techniques and improved coordination between climate modelers and impact researchers. Unlike economic or statistical analyses, this work focuses on methodological challenges and improving the integration between global models and local impact studies.

III. MATERIALS AND METHODS

The materials used in this study include a dataset representing global climate events and their economic impacts for the period 2020 to 2025. The dataset contains information such as types of climate events (floods, hurricanes, wildfires, droughts, and heatwaves), affected regions or countries, dates of occurrence, and estimated economic losses.

In addition to the dataset, the study utilizes a computer system with sufficient processing capability to handle data analysis tasks. Software tools such as Python programming language

and its associated libraries (Pandas, NumPy, Matplotlib, and Seaborn) are used for data handling and visualization. A development environment such as Jupyter Notebook or Google Colab is employed to execute the analysis.

Optional visualization tools like Tableau or Power BI may also be used to create interactive dashboards for better representation of the data.

In this project, Tableau (Tableau Public/Desktop) was used as the primary tool for data visualization and analysis. A standard computer system was used to process the dataset and generate various visual representations such as charts, heat maps, and tables.

Initially, the collected dataset was carefully cleaned and organized by handling missing values and correcting any inconsistencies. After preprocessing, the dataset was imported into Tableau for further analysis. Different analytical techniques such as aggregation (SUM and AVG), filtering, sorting, and grouping were applied to explore the data effectively.

Various types of visualizations including bar charts, line graphs, heat maps, highlight tables, and geographic maps were created to represent the data in a clear and meaningful way. Time-series analysis was performed using the date attribute to study the trends in gold prices and supply over the years.

Additionally, interactive dashboards were designed where multiple charts were connected using highlighting and filtering actions. This allowed better comparison, where selecting a data point in one chart automatically highlights related information in other charts.

Finally, the visualizations were analyzed to identify patterns, relationships, and key insights regarding gold price variations and supply distribution across different countries.

IV. ANALYSIS AND DISCUSSIONS

The visualizations reveal substantial differences in the human and economic impacts of climate events across countries and disaster types. India and China recorded the highest affected populations, indicating greater exposure to climate-related risks. Heatwaves, droughts, and landslides emerged as major contributors to injury counts, highlighting their significant effects on public health and safety. Temporal analysis shows notable fluctuations in injuries throughout the year, with peak impacts occurring during specific months. Furthermore, the choropleth map demonstrates that economic losses are unevenly distributed across regions, emphasizing the varying vulnerability of national economies. Overall, the findings underscore the growing consequences of climate change and the importance of effective disaster management, adaptation policies, and sustainable development strategies.

Table 1. Country-wise Comparison of Affected Population (Cross Tab)

Country VS Sum(Affected population)

Country	Sum(Affected population)
Bangladesh	8,96,44,403
Brazil	11,85,59,459
China	39,64,35,185
India	78,44,10,559
Indonesia	10,59,07,079
Japan	8,01,81,165
Nigeria	7,79,77,140
Pakistan	9,18,82,471
Russia	6,35,25,457
United States	14,16,75,560

Description:

This cross-tab presents the total population affected by climate events across different countries. The results indicate that India recorded the highest affected population, followed by China and the United States. The variation across countries highlights differences in climate vulnerability, population density, and exposure to extreme weather events. These findings help identify regions requiring stronger disaster preparedness and mitigation strategies.

Table 2. Disaster Type-wise Comparison of Injuries (Cross Tab)

Event Type VS Sum(Injuries)

Event Type	Sum(Injuries)
Cold Wave	12,423
Drought	13,094
Earthquake	3,922
Flood	11,934
Hailstorm	12,452
Heatwave	14,262
Hurricane	3,342
Landslide	13,615
Tornado	12,480
Tsunami	3,536
Volcanic Eruption	3,941
Wildfire	12,684

Description:

This table compares climate disaster types based on the total number of injuries reported. The results show that heatwaves, landslides, and droughts caused the highest injury counts, while hurricanes, tsunamis, and earthquakes resulted in comparatively fewer injuries. The analysis highlights the

varying severity of different climate events and their impact on public safety.

Country VS Sum(Affected Population)



Fig. 1. Heat Map of Country-wise Affected Population

Description:

This heat map visualizes the affected population across different countries using color intensity. Countries represented with darker shades experienced a greater number of affected individuals, indicating higher disaster impact. India and China show relatively stronger intensities, reflecting their significant exposure to climate-related events. The visualization enables quick identification of high-risk regions.

Country VS Sum(Injuries)

Country	Sum(Injuries)
Bangladesh	1,618
Brazil	2,150
China	1,922
India	2,112
Indonesia	2,348
Japan	2,941
Nigeria	1,951
Pakistan	3,071
Russia	2,684
United States	1,718

Fig. 2. Highlight Table of Country-wise Injuries

Description:

This highlight table displays the total number of injuries caused by climate disasters across various countries. Darker color shades indicate higher injury counts, allowing easy comparison of disaster severity among nations. The results reveal that Pakistan, Japan, and Russia experienced relatively higher injury levels compared to other countries in the dataset.

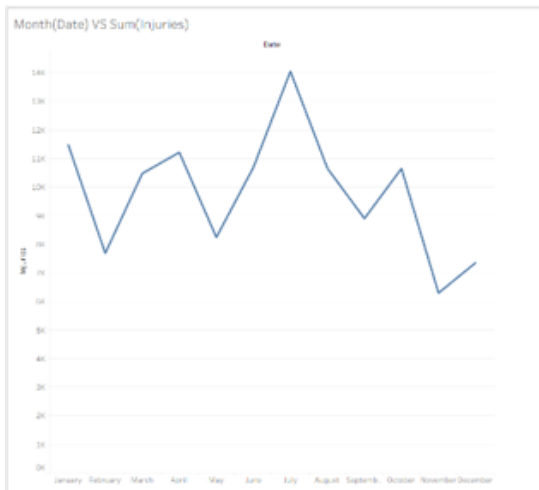


Fig. 3. Monthly Trend of Injuries (Line Chart)

Description:

This line chart illustrates the monthly trend of injuries caused by climate-related events. The graph shows noticeable fluctuations throughout the year, with the highest number of injuries recorded during July and lower values observed in February and November. These variations indicate seasonal differences in climate disaster intensity and their associated human impacts.

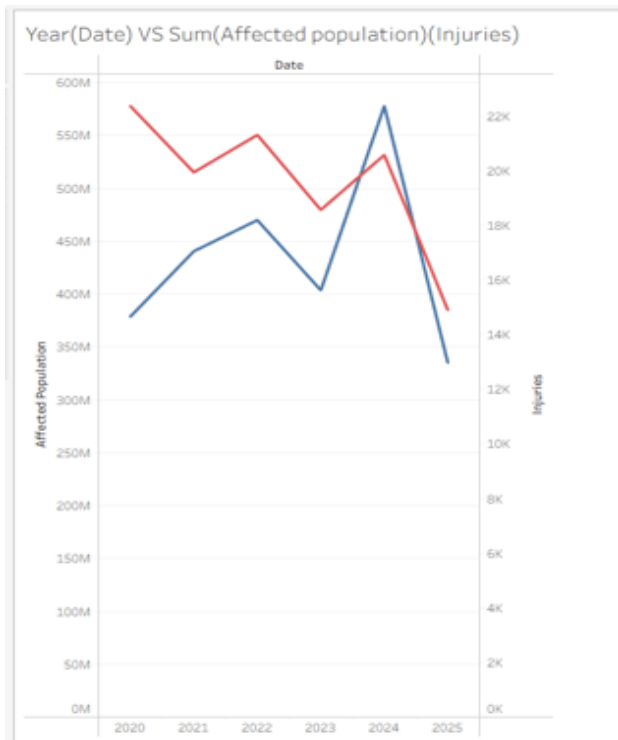


Fig. 4. Comparison of Affected Population and Injuries Over Time (Dual Axis Chart)

Description:

This dual-axis chart compares affected population and injury counts from 2020 to 2025. The results indicate that both variables exhibit fluctuations over time, with a significant peak observed in 2024. The visualization highlights the relationship between population exposure and disaster severity, providing insights into the overall human impact of climate events.

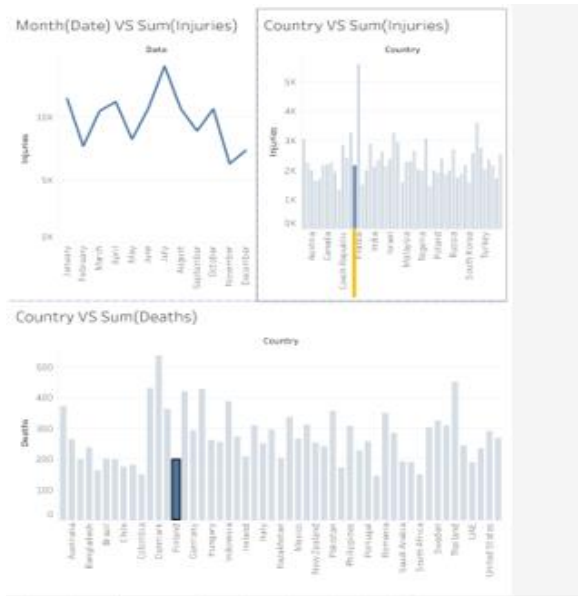


Fig. 5. Climate Disaster Impact Dashboard

Description:

This dashboard integrates multiple visualizations to provide a comprehensive overview of climate disaster impacts. It combines monthly injury trends, country-wise injury comparisons, and death statistics within a single interactive interface. The dashboard facilitates effective exploration of patterns, supports comparative analysis, and helps identify regions experiencing severe climate-related consequences.

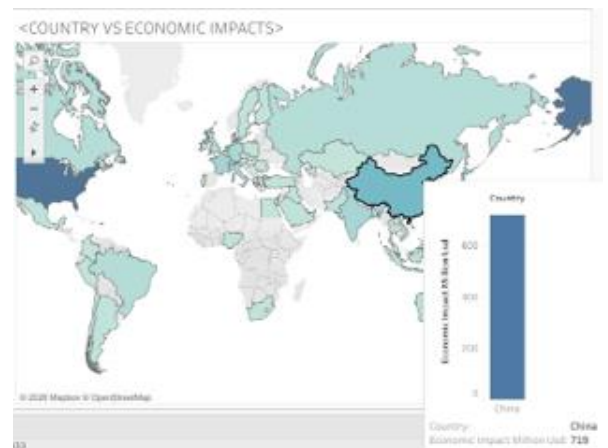


Fig. 6. Choropleth Map of Economic Impact by Country

Description:

This choropleth map illustrates the economic impact of climate events across different countries. Darker shades represent higher economic losses, while lighter shades indicate lower levels of financial damage. The results reveal significant regional differences in economic vulnerability, enabling the identification of countries that experience greater financial burdens due to climate-related disasters.

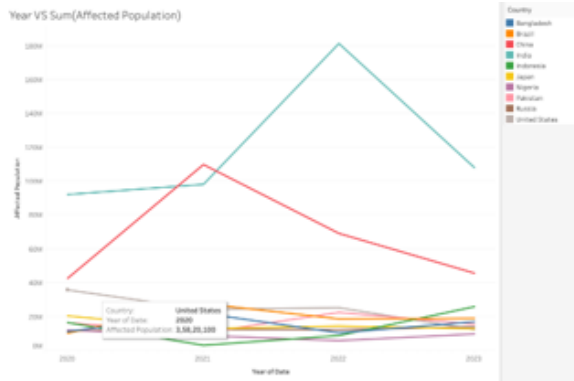


Fig. 7. Timeline Analysis of Climate Impacts Across Countries

Description:

This timeline chart presents year-wise changes in climate disaster impacts across different countries. The visualization helps identify trends, fluctuations, and growth patterns over time. Variations in the lines indicate differences in disaster severity and affected populations, enabling comparison of climate impacts among countries throughout the study period.

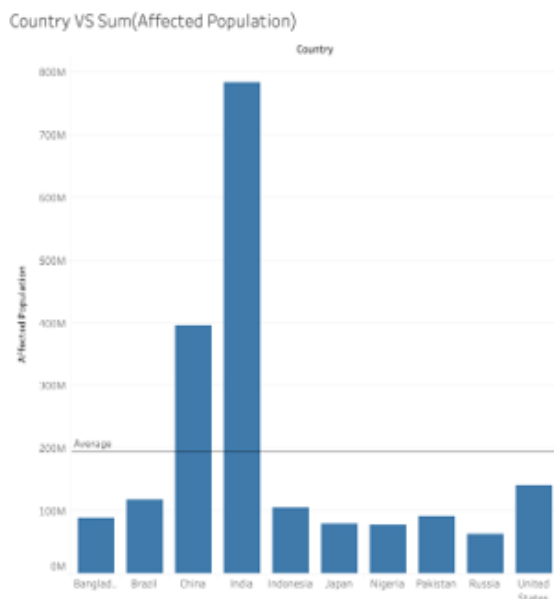


Fig. 8. Baseline Comparison of Country-wise Affected Population

Description:

This chart compares the affected population across different countries against a baseline value. The visualization highlights countries with relatively higher or lower disaster impacts and helps identify regions that experience significant climate-related disruptions. The comparison provides a clear understanding of relative vulnerability among nations.

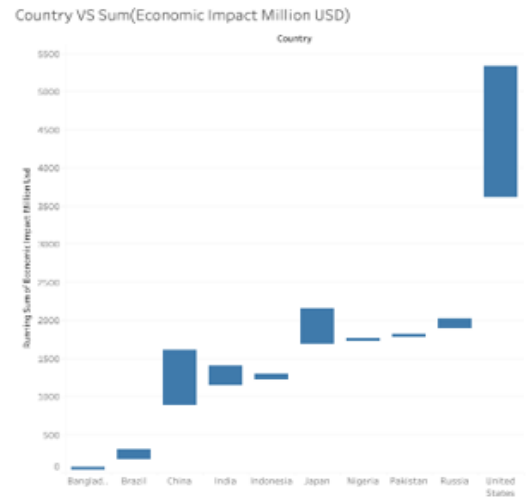


Fig. 9. Waterfall Chart of Economic Impact Distribution by Country

Description:

This waterfall chart illustrates the cumulative contribution of different countries to the overall economic losses caused by climate events. Each bar represents the incremental increase or decrease in economic impact contributed by a country. The visualization helps identify major contributors to global climate-related financial losses and understand the distribution of economic burden.

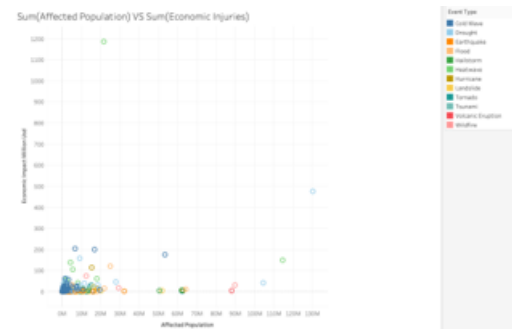


Fig. 10. Scatter Plot of Severity vs Economic Impact

Description:

This scatter plot analyzes the relationship between disaster severity and economic impact. Each point represents an individual climate event, where higher severity levels generally correspond to greater economic losses. The visualization helps

identify patterns, correlations, and outlier events with exceptionally high impacts.



Fig. 11. Bubble Chart of Country-wise Climate Impact

Description:

This bubble chart visualizes climate disaster impacts across countries using bubble size and position. Larger bubbles represent higher affected populations or economic losses, enabling quick identification of countries experiencing the greatest climate-related consequences. The chart provides an effective comparative analysis of disaster impacts across regions.



Fig. 12. Tree Map of Economic Losses by Disaster Type

Description:

This treemap displays the distribution of economic losses among different climate disaster types. Larger rectangles indicate disaster categories contributing greater financial damage. The visualization provides an intuitive overview of which climate events impose the highest economic burden on affected regions.



Fig. 13. Geographic Map of Global Climate Events

Description:

This geographic map illustrates the spatial distribution of climate events across different countries and regions. The visualization highlights areas experiencing frequent or severe disasters and enables geographical comparison of climate impacts. It assists in identifying regions that are particularly vulnerable to climate-related risks.

V. CONCLUSION

Climate change continues to pose significant environmental, social, and economic challenges across the globe. This study utilized data visualization techniques to analyze the impact of climate-related disasters on affected populations, injuries, deaths, and economic losses across different countries and time periods. By transforming complex climate datasets into meaningful visual representations, valuable insights were obtained regarding the distribution and severity of climate disaster impacts.

The analysis revealed considerable variations in disaster impacts among countries, with some regions experiencing significantly higher affected populations and injury counts than others. Disaster types such as heatwaves, droughts, and landslides were found to contribute substantially to human casualties, while economic losses varied considerably across nations. Time-series visualizations further highlighted fluctuations in disaster impacts over different months and years, indicating changing patterns in climate-related risks.

The use of Tableau dashboards, heat maps, highlight tables, cross-tab analyses, line charts, and choropleth maps enabled effective exploration of trends, comparisons, and relationships within the dataset. These visualizations enhanced understanding of climate impacts and supported data-driven interpretation of global disaster patterns.

Overall, the study demonstrates the importance of data visualization as a powerful tool for climate impact analysis. The findings can assist policymakers, researchers, and disaster management authorities in identifying vulnerable regions, improving preparedness strategies, allocating resources efficiently, and developing sustainable adaptation measures. As climate change continues to intensify, the integration of visual analytics with climate data will play an increasingly important role in supporting informed decision-making and reducing future risks.

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