Department of Statistics, Middle East Technical University (METU)

Impact of Flood Disasters in Türkiye

A Brief Analysis for Flood Hazards and Disasters between 2000&2024 in Türkiye

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Abstract

This study conducts an analysis for flood disasters in Türkiye recorded between 2000 and 2024. In this study, this recorded flood events investigated by some statistical methods such as Exploratory Data Analysis and Hypothesis Testing techniques to investigate dispersion of flood events in Türkiye over their impacts, seasonality, regionality, and patterns by years. Investigated data of this study contains total of 37 records for flood disasters provided by EM-DAT database. This study found that the amount of recorded floods have no clear increasing or decreasing pattern by time even there are some specific years that larger number of recorded floods. In Black Sea region number and magnitude of floods are more than other regions. Flood events in Türkiye observed mostly at summer season, especially in Blacks Sea region. Most observed flood types in Türkiye are riverine and flash floods. This study has shown that every year approximately 20 people dies and 7831 people affects by flood on average. Total amount of economic impact of these recorded floods in Türkiye for 25 years is higher than 2 billons of USD.

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1 Introduction and Aim

1.1 Motivation & Research Problem

Türkiye is a disaster-prone country exposed to many natural hazards. due to its geographical location, climatic diversity, and topographical features.

In addition to disasters such as earthquakes, landslides, and droughts, floods are among the most prominent types of disasters in Türkiye, both because of their frequency and the economic and social impacts they create. Climate change, rapid and unplanned urbanization, changes in land use, and inadequate infrastructure increase the impact of floods, turning them into devastating disasters. Therefore, floods should be considered not only as a physical natural event but also as a risk area directly related to the social structure and the built-in environment.

Türkiye’s diverse climate and geographical characteristics lead to variations in flood events across regions and seasons. This necessitates the accurate analysis of flood-related risks and the development of effective risk reduction strategies. However, to create such strategies, a data-driven examination of the temporal and spatial distribution of flood events is required.

This project aims to reveal the fundamental patterns of flood risk by analyzing flood events in Türkiye based on years, regions, and seasons.
Additionally, the study examines how Türkiye’s resilience to floods has changed over time, and evaluates the impact of implemented policies and infrastructure investments on flood-related economic and social losses.

The research questions addressed within this scope focus on understanding the vulnerabilities that play a role in transforming floods from a hazard into a devastating disaster.
The selected research questions are important not only for revealing the spatial and temporal dimensions of flood risk, but also for evaluating the effectiveness of existing risk reduction policies. The aim is for the findings to contribute to disaster management practices, risk-based insurance approaches, and long-term planning processes.

1.2 Aim of The Study

Aim of this study is analysis of distribution of the floods disaster according to region, seasons and the years between 2000 & 2024 in Türkiye. Furthermore, study aims to evaluate the change in Türkiye's resilience to flood disaster over time by analyzing the changes in the number of deaths and injuries caused by flood. In this context, the health impacts of disasters are examined, and the potential effects of improvements in disaster management, early warning systems. Afterwords, response capacity on human losses are criticized.

In the lights of the findings, the aim is to increase social and corporate awareness of flood disasters in our country, to guide resource management based on scientific evidence, and to contribute to making Türkiye a vulnerable country by considering the fact that it is a disaster-prone country. Furthermore, the study aims to develop solutions for reducing flood risks and to shed light on potential collaborations with official institutions such as the United Nations Office for Disaster Risk Reduction (UNDRR) and the Disaster and Emergency Management Presidency (AFAD). Sharing the study findings in accordance with open science principles to contribute to knowledge production and policy development processes at national and international levels is also among the main objectives.

2 Literature Review

Hydrological risk management in the Republic of Türkiye demands an all-encompassing perspective on natural hazards as well as human systems. The following section lays down the principles of Disaster Risk Management from global sources such as UNDRR, CODATA, and Sendai Framework.

2.1 Taxonomy of Disaster: Definitions and Triggers

According to the UNDRR (United Nations Office for Disaster Risk Reduction) & AFAD (Afet Terimleri Sözlüğü), the point where a natural disaster becomes a disaster is not dependent on the event but on human reactions to the event.
Hazard (Tehlike): "Hazard is considered as a situation, process, or phenomenon which has the potential to result in loss of life, injury, damage to property, or depletion of natural resources." With respect to our dataset, Heavy Rains function as a hazard.
Disaster (Afet): As stated above in this course, disaster occurs where there is unpreparedness, unpreparedness or lack of exercise/drills, or without mitigation as its vehicle and when hazards are realized in an at-risk environment characterized by unavailability of the four pillars of disaster risk management, entailing the conversion of hydrologic risk into disaster or catastrophe.
Catastrophe: Although "disaster" is a very general term, Catastrophe describes events with such extreme effects that these events exceed not only local but also state capacity to respond to them. Using data from EM-DATA for Türkiye, the flood peaks observed in 2021 and 2023 are used as examples for catastrophes, which exceeded state capacity due to the intensity of the effects felt.

2.2 The Core Equation of Risk: The Mathematical Framework

To proceed from descriptive to quantitative work, we need to state and apply the basic DRM formula:

$$Risk = \frac{Hazard\ x\ Vulnerability}{Capacity}$$

Vulnerability (Social, Economic, Physical): This refers to the level of exposure or susceptibility to risk. These are classified by our analysis into Physical Vulnerability (for instance, Black Sea settlements in the Black Sea riverbeds), Economic Vulnerability (lack of insurance), and Social Vulnerability (Total Affected population).

Capacity & The Investment Principle: Capacity refers to attributes or resources to manage risk. The strategic mantra of modern DRM thus is: "Invest Before: Capacity Up, Risk Down." Moving from a state of vulnerability to Resilience actually needs to be done way in advance through capital and social investment before the event.

2.3 Actuarial Perspectives: The Human Factor in Risk

The concept of risk in actuarial sciences doesn't only present itself as a physical probability, but it also becomes a behavioural variable. Among the two most impacting behavioural hazards that have an important interaction with financial outcomes, both observed in Türkiye, are:

Moral Hazard: Excessive risk undertaken by individual or institutional parties, knowing that the state or a third party will cover the Ex-post damages. This dissuades locals from investing in mitigation measures.

Moral Hazard: An attitude of fatalism or defeatism-"It is just fate"-that inhibits the adoption of Ex-ante mitigation strategies or the purchase of insurance. When citizens believe preparation is futile, the system's Capacity remains low, mathematically ensuring that the Risk remains high.

2.4 Impact Assessment: Tangible and Intangible Loss

The effects of a disaster are categorized in two dimensions depending on the measurability of such effects:

Tangible Losses: The losses incurred and accounted for in terms of Total Damage and Reconstruction Costs, which are columns found in the table. They are assets whose value can and should be quantified in dollars and cents, expressed in physical terms.

Intangible Losses: Non-financial effects such as psychological shock, loss of identity within a community, and impacts on education. Although more challenging to analyze in numerical values, such effects are included in the No. Injured and Total Affected numbers.

2.5 Global Frameworks for Resistance

The history of DRM has a path studded with worldwide milestones, which are sometimes based on lessons from high-risk areas such as Japan (Pacific Ring of Fire):

Yokohama Strategy (1994): The first move from response to prevention, which declared that "prevention is better than cure."
Hyogo Framework for Action (HFA 2005-2015): Emphasized the development of global resilience and integrating disaster risks into sustainable development.
Sendai Framework on DRR (2015-2030): The present gold standard is centered on Build Back Better (BBB). BBB means that the reconstruction stage is the best time to enhance capacity instead of merely replacing what is lost.
The "Seven" Dimensions of Resilience: Resilience is described as "the capacity of absorbance of a shock effect." Founded on the model of perseverance shown by leaders such as Mandela or Gandhi in the face of overwhelming odds, its purpose is to ensure that if a risk is "too much" (The Seven), the system will adapt successfully.

2.6 Scientific Standards and Monitoring

Effective DRM analysis needs to conform to the standards of global data, such that data can serve as a predictive instrument:
CODATA & International Science Council (ISC): This body encourages the harmonization of data on disasters for enhanced modeling. Adherence to the CODATA guidelines enables our assessment to set a sound benchmark for risk reduction.
MGM FLASH System: The MGM Flash Flood Guidance System in Türkiye functions as a Capacity multiplier that fills the space between Hazard and Response.

3 Methodology/Design

This study followed a data-based analysis process to examine the temporal, spatial, and seasonal distribution of flood events in Türkiye and to analyze the change in the country's resilience to floods over time. Following the data collection phase, the data were organized for analysis, and a systematic method focusing on the research questions was applied. The analysis process included data cleaning, exploratory data analysis, and statistical evaluation steps; various visualization techniques were used to present the findings clearly and understandably.

3.1 Data Source and Preparation

The data used in this study were obtained from the EM-DAT (Emergency Events Database), an international disaster database. The analysis was limited to flood events that occurred in Türkiye between 2000 and 2024. In line with the scope of the study, variables such as year, region, season, number of events, loss of life, and economic damage were considered for each flood event. The season variable was derived using the event dates (months), and each event was assigned to the relevant seasonal category. To perform spatial analyses, data were classified by region (e.g., Marmara, Black Sea, Mediterranean, etc.), and cities were also classified by region. The NumPy library was used for data processing and basic calculations at this stage. This stage ensured that the data was consistent and reliable for analysis.

3.2 Methods of Analysis

3.2.1 Exploratory Data Analysis (EDA)

To answer the research questions, exploratory data analysis (EDA) was applied first. At this stage, the distribution of flood events by year, region, and season was examined. Basic indicators such as the number of floods per region, flood intensity by season, and the seasonal distribution of total economic damages were analyzed to reveal the basic patterns of flood risk. In addition, the change in the number of flood events over the years was examined; heatmap was used to evaluate regional and seasonal variables together. These visualizations allowed for a clearer understanding of the flood risk concentrated in specific regions and periods.

3.2.2 Statistical Analysis and Resilience Assessment

In addition to exploratory analyses, statistical analyses were applied to assess the change in the effects of flood events. To examine the change in Türkiye's resilience to floods over time, the death rate per flood was analyzed on a yearly basis. This indicator aims to quantitatively evaluate the possible effects of increased awareness, infrastructure improvements, and disaster management practices over the years on the destructive effects of floods.

The change in the death/flood ratio over the years was visualized through line graphs, and the possible effects of this change on the country's resilience to disasters were interpreted. This analysis aims to reveal the extent to which the measures taken can limit these events from becoming a disaster, even though flood events are an unavoidable hazard.

3.2.3 Visualization and Tools

All data analysis and visualization processes were performed using the Python programming language. Pandas and NumPy were used for data processing and numerical calculations, while matplotlib and seaborn libraries were used for visualization. These tools have made it possible to visually present the temporal, spatial, and seasonal distributions of flood events, and to make the findings more understandable and interpretable.

4 Results and Findings

4.1 Frequency Analysis of Temporal Trends and Seasonality

The spread of 37 individual records of flood disasters in Türkiye between 2000 and 2024 has no clear increasing or decreasing pattern over years. To better understanding for trend by years graph below (Figure 1) can be examined.

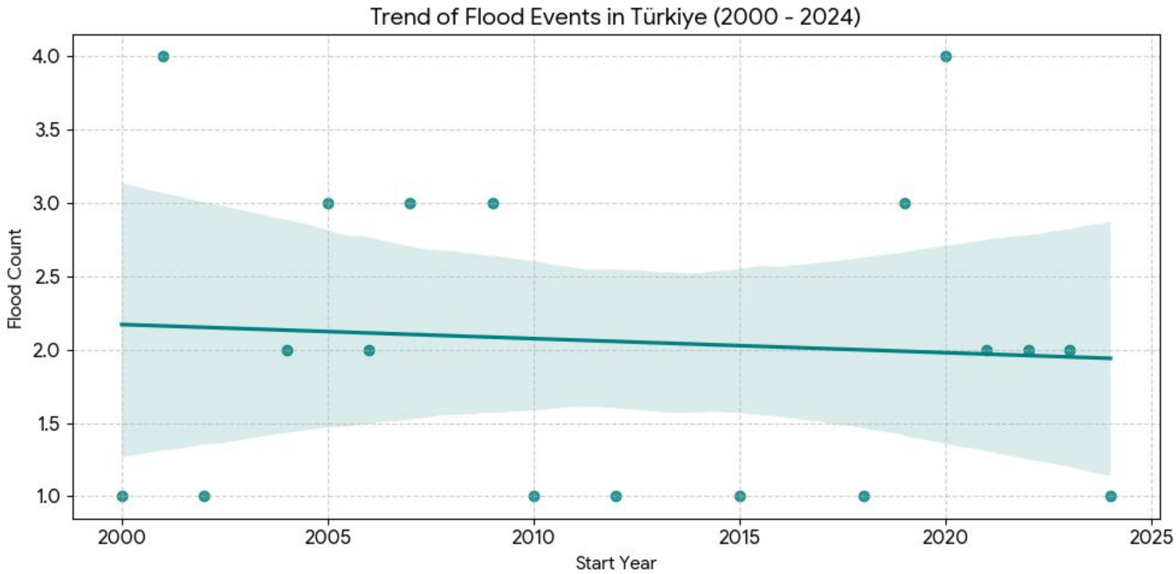

Figure 1 – Trend of Flood Events in Türkiye (2020-2024)

Time-series trend analysis reveals that flood events do not show a clear upward or downward trend over the years, but rather that the number of events fluctuates from year to year. This situation highlights the continuity of flood risk and emphasizes the importance of long-term risk management strategies rather than short-term trends.

In order to support these initial findings with some generalizable rules, Hypothesis Testing approach for Regression is used to find statistically signicant evidences for there is no pattern by years as observed from line graph for trend.

The regression analysis revealed that the p-value representing the relationship between flood frequency over the years was calculated as 0.767. Since it is greater than the specified significance level of α = 0.05, the H_0 hypothesis cannot be rejected. This proves that there is no statistically significant increase or decrease trend in the number of flood events in Türkiye between 2000 and 2024. The very low R^2 value (0.006) indicates that the time factor is insufficient to explain the change in flood frequency and that fluctuations in the number of events are due to random or other meteorological factors rather than time.

One another essential element of frequency analysis for this research's interest is change of seasonality for floods in Türkiye.

The number of flood incidents by seasons in Türkiye (2020-2024) is shown below (Figure 1).

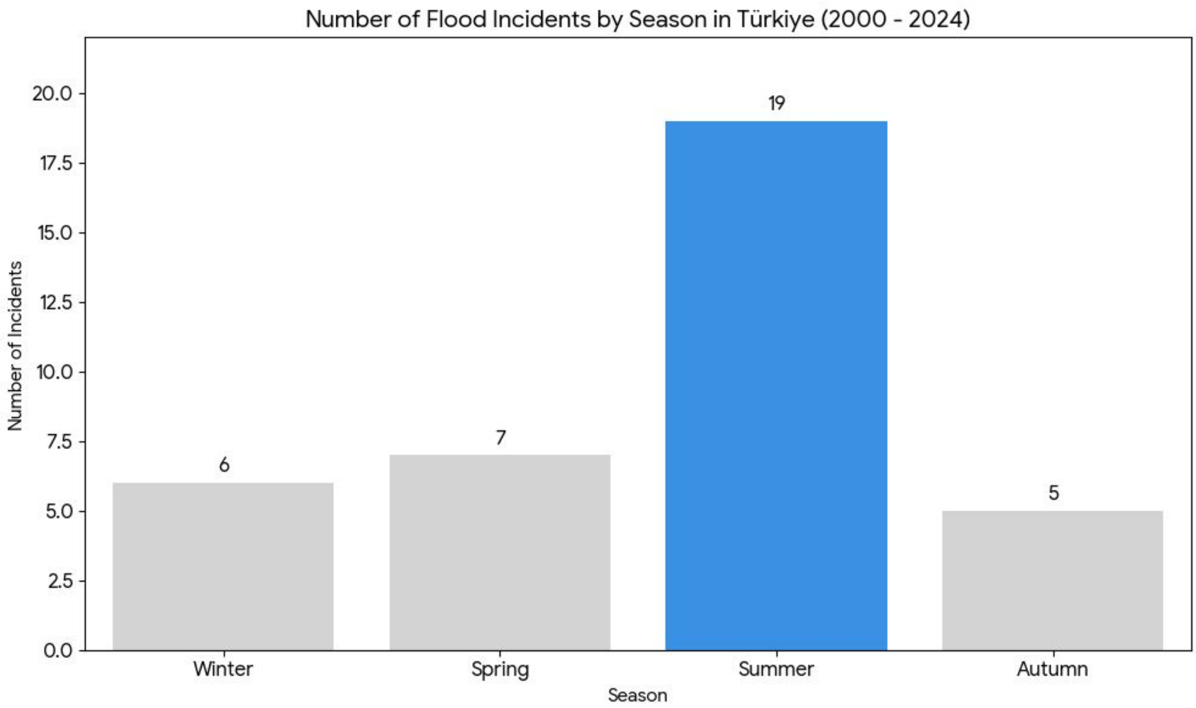

Figure 2 – Number of Flood Incidents by Season in Türkiye (2020-2024)

The graph shows that flood events occur most frequently during the summer season. This suggests that sudden floods, particularly those associated with short-term and intense rainfall, are more common during the summer months.
While spring and winter seasons also account for a significant proportion, relatively fewer flood events have been recorded during the autumn period. The seasonal distribution indicates that early warning systems need to be strengthened, especially during the summer months.,

To validate these initial findings, statsistically significancy is checked by chi-square (χ^2) Goodness-of-fit test hypothesis testing approach.

The Chi-Square test conducted to examine the seasonal frequency of floods yielded a p-value of 0.0030. At the significance level of $\alpha = 0.05$, the H_0 hypothesis was strongly rejected. This finding proves that flood events in Türkiye are not uniformly distributed seasonally, but rather are concentrated in a specific season. The fact that more than 50% of the total events (19/37) occurred in the summer season statistically confirms that Türkiye's flood characteristics are largely dominated by severe convective rainfall and flash floods during the summer months.

4.2 The Subtypes of Flood Disasters in Türkiye

It is possible to observe 5 different subptypes of flood disasters in Türkiye according to the 37 EM-DAT records between 2020-2024. The frequency and spread of this 5 subtypes is shown by bar plot below (Figure 3).

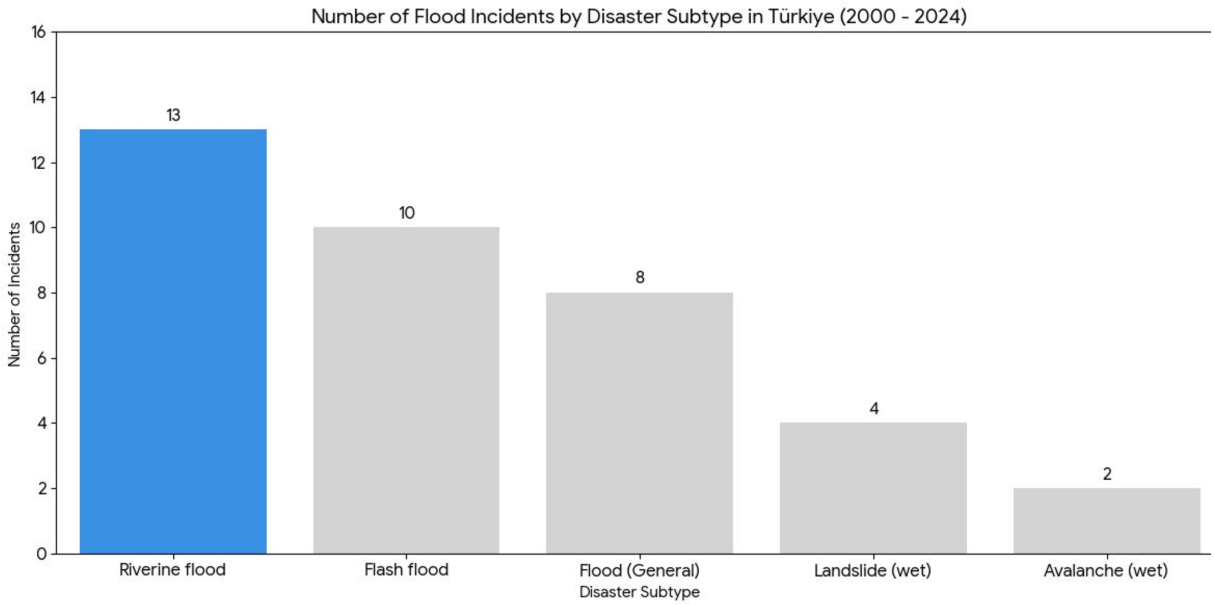

Figure 3 – Number of Flood Incidents by Disaster Subtype in Türkiye (2020-2024)

This graph shows that the vast majority of flood disasters in Türkiye occur in the form of riverine floods and flash floods. The fact that riverine floods are the most common type of disaster highlights the importance of watershed management, riverbeds, and infrastructure planning. Although less common, secondary disaster types such as landslides and wet avalanches also point to the chain reaction effects of flood events.

4.3 Regional Differences in Flood Impacts

Regionality is one another crucial interest of aim of this study. The figure below (1) shows that how the dispersion of recorded 37 individual flood disasters over 7 geographical regions of Türkiye.

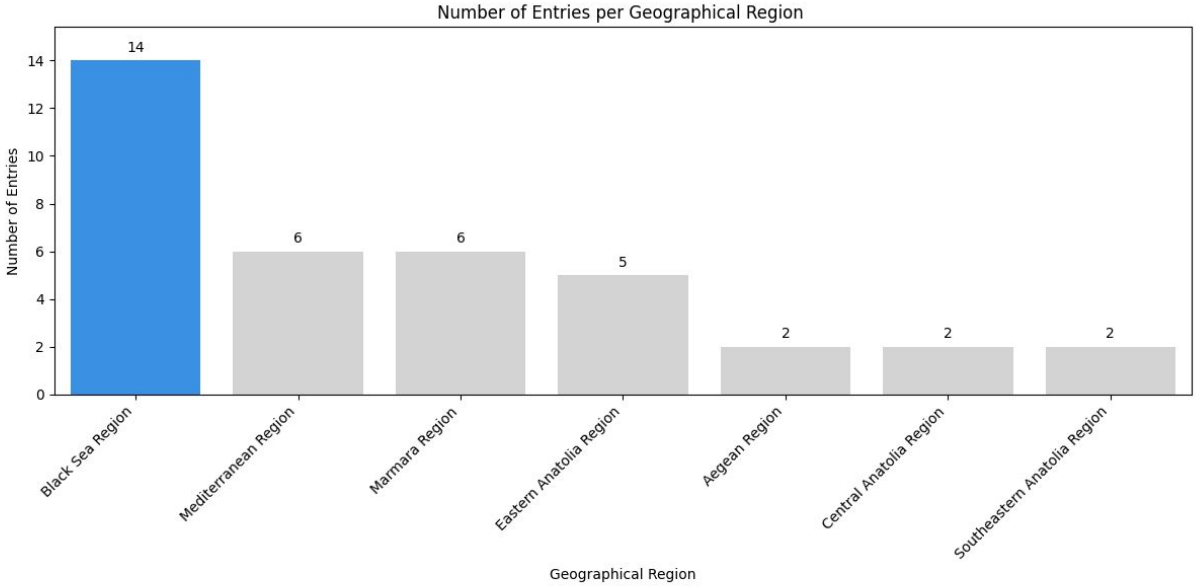

Figure 4 – Number of Flood Incidents by Geographical Regions in Türkiye (2020-2024)

When flood numbers are examined by region, it is evident that the Black Sea Region is by far the region most affected by floods. The Mediterranean and Marmara regions show a moderate level of risk, while lower numbers have been observed in the Central Anatolia, Aegean, and Southeastern Anatolia regions. This distribution reveals that flood risk in Türkiye is spatially concentrated and highlights the need for region-specific measures.

To validate these initial findings that number of flood incidents change by geographical regions, statsistically significancy is checked by chi-square (χ^2) Goodness-of-fit test hypothesis testing approach.

The p-value obtained from the Chi-Square Goodness-of-Fit Test is 0.0021, which is much smaller than the significance level of α = 0.05. Based on this result, the H_0 hypothesis is strongly rejected. The distribution of flood disasters in Türkiye across geographical regions is not random but shows a statistically significant difference. In particular, the Black Sea

Region has been identified as a 'hotspot' area with the highest frequency of flood risk, experiencing approximately three times (14) the expected number of events (5.29).

To investigate whether there is a pattern across number of floods, geographical regions and seasons heatmap below (Figure 5) can be examined.

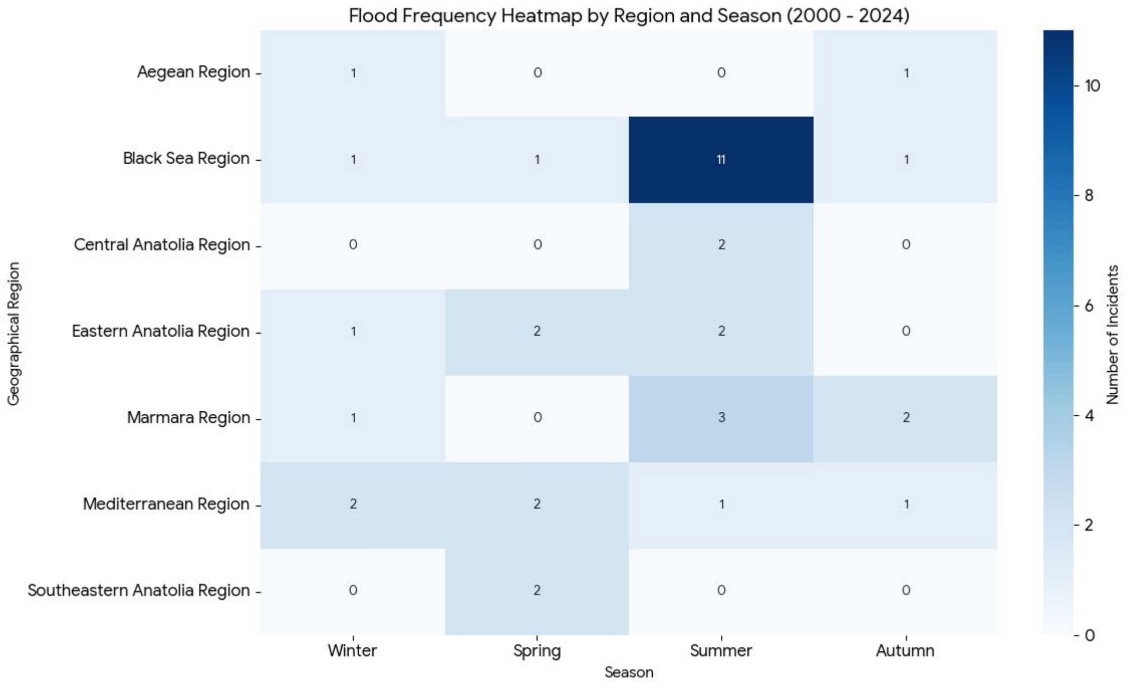

Figure 5 – Flood Frequency Heatmap by Region and Season in Türkiye (2020-2024)

The heat map shows that flood events are not evenly distributed both regionally and seasonally. Flood events concentrated particularly in the summer season in the Black Sea Region are noteworthy. In the Mediterranean and Eastern Anatolia regions, relatively more flood events are observed in the spring and winter seasons. These findings indicate that flood risk in Turkey is largely related to regional climate conditions and seasonal rainfall patterns.

4.4 Economic & Social Impact of Floods in Türkiye

Floods have significant impact on economy and sociology of countries like other disasters. Particularly, countries with lower resilience due to not being developed from disaster risk management perspective encounter with higher social and economic impacts of flood and other disasters. The figure below (Figure 6) shows that how the number of death people per one flood changed over years.

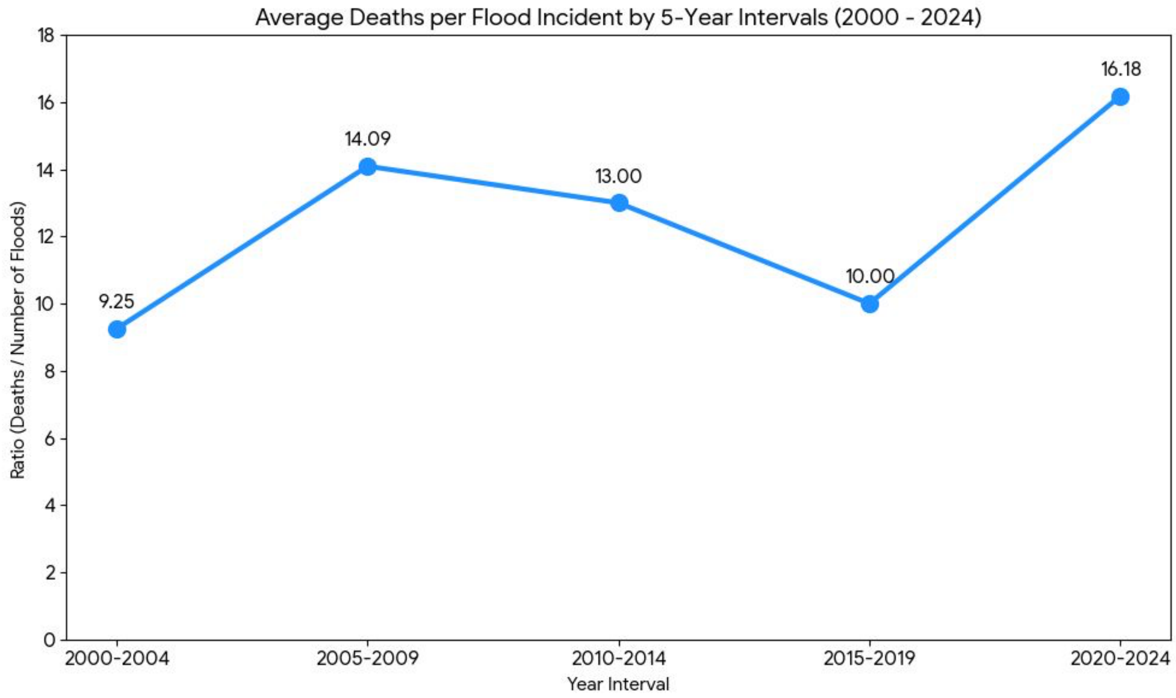

Figure 6 – Average Deaths per Flood Incident by 5-year Intervals in Türkiye (2020-2024)

The relative decrease in the average number of deaths per flood observed between 2015 and 2019 coincides with the development of early warning capabilities for flash floods in Turkey during the same period. The Black Sea and Middle East Flash Flood Early Warning System, implemented in collaboration with the World Meteorological Organization (WMO), was launched in 2010 and became operational in 2013 (Bacanlı et al., 2013). The system aims to strengthen early warning and risk communication, particularly in areas with high flash flood risk, through the integration of radar, satellite, and hydrological models. While findings suggest that early warning systems may have contributed to reducing loss of life, the renewed increase in mortality rates during the 2020–2024 period indicates that these systemsalone are insufficient and that disaster resilience must be addressed through a multidimensional approach.

To check statatistically significance of this findings on change of number of death people per flood by years, Analysis of Variance (ANOVA) approach on hyptothesis testing with checked necessary assumptions (instead of death number logarithm used to satisfy normality assumption) is used.

The variance analysis (ANOVA) resulted in a p-value of 0.953. At a significance level of α = 0.05, the H_0 hypothesis that $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$ The average number of lives lost per flood (fatality rate) in Turkey is statistically constant over 5-year periods between 2000 and 2024. Time has no significant effect on the severity of floods cannot be rejected. Although a graphical increase (16.18) is observed in the recent period (2020-2024), this difference is not statistically significant. The main reason for this is the high variance within flood events themselves (resistant error). In other words, the fact that some floods cause very few casualties while others cause many (high standard deviation) obscures the average difference between periods.

Economic impact of floods is not directly related with number of floods or magnitudes of floods, the flood affected area if being more industrialized or having a larger population can change the economic impact more than directly flood related factors. The figure below (Figure 7) shows that how total economic impact of floods changes by geographical regions of Türkiye.

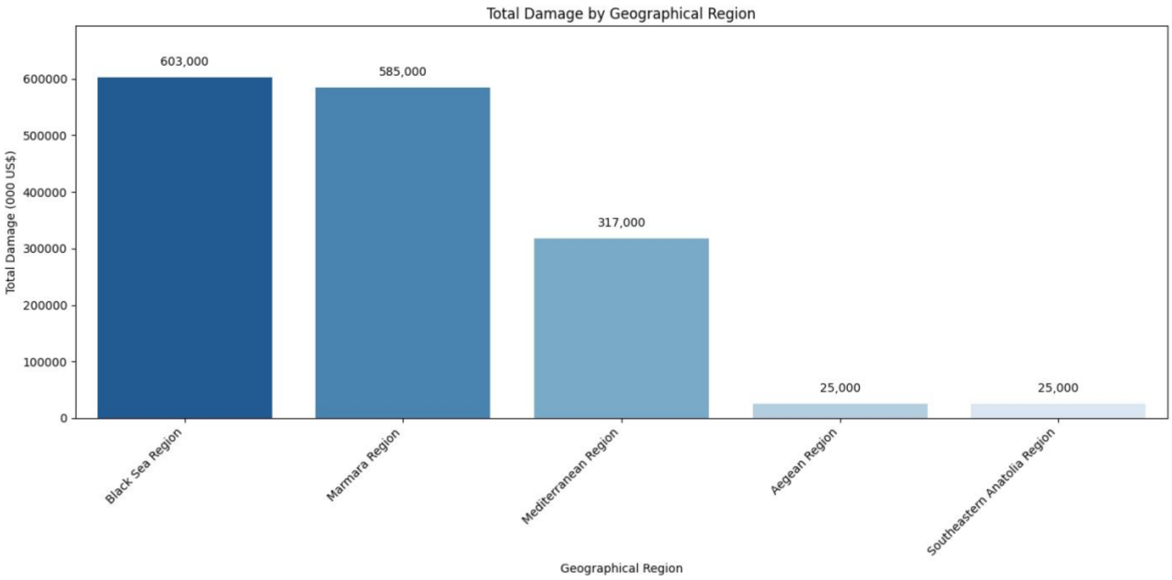

Figure 7 – Total Damage of Floods by Geograpgical Region

In terms of total economic damage, the Black Sea and Marmara regions stand out significantly compared to other regions. Even we have seen that number of recorded flood incident in Marmara was very less than Black Sea region, this situation demonstrates that the dense population, industrial activities, and infrastructure density in these regions amplify the economic impacts of flood disasters. Lower damage amounts have been observed in the Aegean and Southeastern Anatolia regions; however, this does not mean that the risk is low.

5 Conclusion

There is no clear evidence of an increasing or decreasing trend in the number of flood events recorded over the 25-year period, although there are some specific years that show more flood events than others (I. E., than normal). The results also showed that in average, there are 20 deaths and 7831 people affected and more than 2 billion of USD economic losses from flood-related disasters each year in Türkiye.

The research conducted a thorough and complete empirical assessment about flood disasters in Türkiye between 2000 and 2024 using data derived from the EM-DAT database and it has looked at a total of 37 flood events recorded there. In addition, the research has highlighted different trends about flood risk and resilience development in terms of those experienced over time through exploratory data analysis and hypothesis testing techniques.

Regional and seasonal analysis identified several susceptible regions, but specifically, vulnerability has been noted to a large extent within the Black Sea region. This region experiences the largest number of flood occurrences and greatest flood magnitudes, which are generally of flood type river or flash flood. Moreover, flood occurrences have been most often observed to happen during summer season, specifically within the geographical region of Black Sea.

The measurement of the-resilience of Turkey reveals that while floods remain an inevitable risk, it is human systems that critically condition the transformation of floods from “disaster” to “catastrophe.” The research made use of the death per flood ratio to objectively appraise progress on disaster management and warning systems. Though expenditures on systems such as MGM Flash Flood Guidance have been capacity multipliers, issues of moral hazard insurance and behavioral effects due to fatalism have been hampering the adoption of ex-ante instruments for mitigation.

Based on the findings, it can be concluded that flood risk in Türkiye is not an environment-dependent phenomenon but is associated with various factors that interact with each other such as hazard, vulnerability, and capacity. To upgrade from a position of vulnerability to that of resilience, it is essential to continue to invest in capacity development actions prior to the occurrence of events, following the "Build Back Better" philosophy, as contained in the Sendai Framework. In this regard, the research work presents a scientific basis not only for practices in a disaster management system but also in risk insurance.

6 Further Research Opportunities and Potential Extensions

This study represents a basic assessment of flood consequences in Türkiye but leaves several paths to deeper investigation in order to further improve the accuracy of risk modeling and efficiency of disaster mitigation strategies.

6.1 Integrating Real-Time Meteorological Data

Another critical direction is based on the fact that this study uses only the recorded history (the EM-DAT database), while future studies will be able to use high resolution real time data provided by the MGM Flash Flood Guidance System to link specific thresholds of rainfall with actual results of disasters and make more accurate and regional early warning thresholds.

6.2 Socio-Economic and Infrastructure Impact Analysis

Future revisions will expand "Tangible Losses" (economic loss in USD terms) to "Intangible Losses, " comprising:

I. Infrastructure Resilience - exploring the relationship between the drainage ability of urban systems and the size of the flood in increasingly urbanized provinces and

II. Vulnerability Mapping - using GIS (Geographic Information Systems) mapping for social vulnerabilities at a district level to identify the population with the least "Ability" to deal with shock impacts.

6.3 Evaluating the Effectiveness of Risk-Based Insurance

Therefore, further empirical analysis about the coverage and the efficiency of the flood insurance in a risky area like the Black Sea Region is required to study the "moral hazard" and "fatalism" ideas proposed by this research. A comparative analysis could help to understand if obligatory insurance systems can shift the interest on ex ante disaster preparedness instead of ex post state help.

6.4 Climate Change Projection Modeling

Another goal is to predict future flood risk and, since climate change plays an important role in shaping the flood intensities, the models of the future flood risk should interact with some climate models (e. G., CMIP6) to include the impact of changing precipitation patterns representing 50 years of changes to the "Hazard" part of the flood-risk equation for riverine/flash floods.

6.5 Collaborative Policy Frameworks

Future studies might look at how the concept "Build Back Better" can be operationally integrated into national disaster response plans. The AFAD could also outline how national data collection can be harmonized to comply with the global scientific standard like CODATA, by investigating possible partnerships with global organizations like UNDRR.

References

Altunci, Y., & Aytekin, A. (2024). *Analysis of flood disasters in Turkey and their effects on health*. ResearchGate. https://www.researchgate.net/publication/381451631_Analysis_of_Flood_Disasters_in_Turkey_and_Their_Effects_on_Health

Bulut, İ., & Tanrıkulu, S. (2019). Türkiye'de sel ve taşkınların coğrafi dağılışı [Geographical distribution of floods and overflows in Turkey]. *Doğu Coğrafya Dergisi, 24*(42), 143-162. https://dergipark.org.tr/en/download/article-file/787831

Centre for Research on the Epidemiology of Disasters. (2024). *EM-DAT: The international disaster database*. Université Catholique de Louvain. https://www.emdat.be

Meteoroloji Genel Müdürlüğü. (n.d.). *Türkiye'de ani taşkın erken uyarı sistemi çalışmaları* [Studies on flash flood early warning systems in Türkiye]. T.C. Çevre Şehircilik ve İklim Değişikliği Bakanlığı. https://www.mgm.gov.tr/files/genel/makale/anitaskin-erken.pdf

OECD. (2016). *Financial management of flood risk*. OECD Publishing. https://doi.org/10.1787/9789264257689-en