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Cost benefit analysis of flood risk in the area of Thrace in Greece

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Abstract: Cost-benefit analysis can significantly aid the decision-making process for flood risk reduction and mitigation. Decision-makers can use it to weigh the expenses of various flood mitigation strategies against their possible upside in terms of lowering the risk of losses and damage. Decisions regarding how to allocate resources for flood risk management can be made more intelligently with the use of this information by policymakers and stakeholders. During severe rainfall or snowfall, these rivers are prone to flooding, which can harm structures such as homes, businesses, and infrastructure, have negative impacts to land uses and as a result they can cause high opportunity costs. Flooding in the Thrace region can have indirect and direct expenses, including property damage and lost commercial activity. These costs can include communication breakdowns and higher insurance rates. The predicted total economic losses from erosion for all of Greece are €356 million and €649 million for a 0.5- and 1-meter sea level increase, respectively.

Keywords: Cost-benefit analysis, Flood risk, Thrace.

1. Introduction

The daily activities of locals might be severely disrupted by flooding, including access to basic services, communication, and transportation (European Investment Bank, 2019). Floods have the potential to seriously harm the environment, notably by destroying habitats, eroding land, and contaminating streams (European Investment Bank, 2019). Floods can harm all productive activities such farmland and crops, reducing agricultural output and raising food prices, manufacture and tourism. Floods in regions with historical or cultural significance can harm or destroy significant landmarks and artifacts, causing a loss of cultural heritage and possibly having an adverse effect on tourism and local economy.

The decline in property prices in the Thrace region is one of the major effects of flooding. Floods can seriously harm homes, structures, and infrastructure, which lowers the value of real estate in the impacted areas. Overflooding can cause severe property damage, which lowers the property's worth (Ismail et al, 2019). Floods in the Thrace region can disrupt corporate activities, which economically impacts nearby companies and the neighborhood. Natural catastrophes can directly damage or obstruct the factors of production-labor and physical capital (Sun, et al., 2022). Communication costs may greatly impact how flooding affects Greece, notably the Thrace region.

Greece has widespread floods in the wider Evros River basin. In addition to intense snowfall in the mountains and violent south winds in offshore and onshore locations, they experience significant rainfall, storms, and snowfall. The tragedy damaged more than 60% of the road system in Epirus. Some of Greece's cultural heritage sites suffer severely destroyed, which can be washed away by the surging waters of the Arachthos River (European Commission, 2015). Other devastated structures included private residences, retail establishments, and farms.

Costs associated with protection and flood protection are significant factors in minimizing the effects of floods in Greece. Over four years, the new program sponsored ten flood prevention projects. In order to lessen the risk of future flooding in Greek cities that are most susceptible to flooding, river embankments are raised, river channels are deepened, stormwater drainage has improved, and

floodwater retention is increased (European Commission, 2015). In Thrace, flooding can occasionally play a significant part in a region's cultural and historical legacy and can be appreciated as a natural phenomenon (European Commission, 2015).

Flooding can be advantageous in the instance of the Evros River, which forms a natural border between Greece and Turkey, by aiding in the protection of the borderline. The river is a natural barrier, and flooding may make it harder for anyone to cross the border without authorization (Poulos et al., 2022). However, it is crucial to remember that the enormous expenses involved with floodings, such as property damage, casualties, and economic effects, outweigh these potential benefits. The major land uses near Evros River are agricultural but the socioeconomic impacts affect all the settlements in the region unit of Evros. A comprehensive strategy that weighs the advantages and disadvantages of various solutions was necessary to manage flood risk in the Thrace region. While maximizing the potential benefits for the area, effective flood risk management can help reduce the costs of floods. The cost-benefit analysis findings may be used to guide policy choices about flood management and prevention in the Thrace region, such as choosing affordable flood protection options or allocating funds for emergency response and recovery efforts.

2. Flood Risks in Thrace

Cost benefit analysis is possible through thorough analysis of potential sources and effects of flooding along Thrace region in Greece. Assessment of data on flood and population density and infrastructural vulnerability as well as economic activities in the area affected by these floods. The study by Chalmoukis (2023) assess coastal vulnerability by considering the impacts of storm-induced phenomena in relation to the coast of Thrace. The report further indicates that erosion and inundation are the common impacts in this region and have significant potential in causing more effects to the increased urbanization and migration to the coastal regions. Research has indicated about 70% increase in the population low-elevated coastal regions, especially along the Mediterranean Sea with an estimation of 572 million people by 2030 (Chalmoukis, 2023). The population increase poses more challenges with the climate changes experienced across the world that are expected to cause extreme storms and rise of sea level. Consequently, more people are likely to prone to severe flood risks due to erosion, inundation and other forms of land degradation.

A flood is among the most destructive natural peril that has affected many people across the world in the past due to effects associated with climate change. Research has indicated that approximately 250 million of people across the world are affected by floods and billions of monies is lost every year in losses every year (Skouloudis et al., 2022). Such environmental disturbances and abrupt changes cause disruption of businesses in flood-prone areas through damage of crucial assets, interruption of operations. The changes lead to increased costs which have more profound negative effects on labor, capital, revenue and overall decline in economic growth.

The assessment of impacts of floods on business was carried using small and medium-sized enterprises (SMEs) located within flood-prone areas in Greece indicates that the owners of SMEs have not adequately invested in resilient capacity building to prepare for future floods (Skouloudis et al., 2022). Therefore, there is need for institutional support to promote and nurture resilience and develop anticipatory prevention mechanisms in SMEs. The report further suggests that SMEs should formulate approaches to develop a proactive culture to foster risk awareness and incorporate employees in resilient-building mechanisms. These approaches would reduce the potential risks and increase the profit margin due to prevention of losses and damages resulting from these floods in future.

The global floods report has indicated that about 2800 cases of major case have occurred globally resulting to losses exceeding 538 billion USD (Beltrán et al., 2018). Thus, because of these effects, combating floods through allocation of resources in floods prevention strategies to save on cost associated with flood losses. Beltrán et al. (2018) explores the various empirical studies to find the best estimates on the extent of price discount suffered by the properties located along floodplains. The research indicates that properties located in this area are likely to command higher prices. For instance, the empirical data shows about -4.6% price discount in for the inland flooding within 100 years. This figure underscores the importance of investing in flood relief projects because the ultimate benefits

outweigh the costs associated with the damages and losses. The results from this study can be used to inform decisions in development of policies to manage the impacts of floods along the Thrace and other places along the coastal areas.

Greece is one of the mostly affected area posing a significant danger along the Mediterranean region due to the increasing population towards coastal area and along river deltas. The study by Diakakis et al. (2012) examined the flooding phenomena in Greece over the last 130 years to demonstrate the distribution of flood events and victims. According to this data, Greece has recorded approximately 545 flooding events and about 686 human casualties and general property damage across the country. Besides, the study indicated that the urban environments are at higher risk of flooding than rural and mountainous areas. Therefore, Thrace being along the low-level coastal region has suffered a lot of such losses over that period.

Greece has suffered unprecedented economic impacts from the "Daniel" storm caused by heavy rainfall of approximately 15% especially in Thessaly plain (Karakatsani, 2023). The floods resulted to massive destruction of infrastructure, residences and significant impacts on agriculture that negatively affected the country's economy. According to Greek authorities, this storm was estimated at 700 tons per acre, resulting to massive flooding, destruction of public infrastructure, properties and agriculture (Karakatsani, 2023). Thessaly plain is the major agricultural basket in Greece as it account for more than 22% of country's agricultural production. The occurrence of these floods in Greece have affected not only Thessaly plain but also had effects on the areas along the coast. The economic impacts associated with such floods include the loss associated with destruction of essential infrastructure such as transport that support various agricultural activities. Besides, due to the massive destruction of agricultural products, many families are likely to suffer from lack of food and other basic services. Furthermore, the floods may result to displacement of people from their residents, thus disrupting their normal economic productivity. Therefore, the many areas in Greece not only Thrace have experienced significant impacts of floods and it is evident that developing resilience and preventive strategies is crucial to mitigate the future effects of such disasters.

Floods have caused loses across all sectors including destruction of roads, bridges as experienced in September 2023 where heavy torrents were experienced in Bulgaria, Greece and Turkey. Within a span of one day and night in Kirklareli province, three lives were lost and other three people went missing (Buyuk & Todorov, 2023). Besides, in Istanbul two lives were reported lost and about 12 other people were injured within Kucukcekmece and Basaksehir districts. Due to this effect, it was approximated that about 15,000 Turkish lira equivalent to 500 euros would be used as compensation to the families and households affected by floods (Buyuk & Todorov, 2023). The storm also halted the summer tourist season in Bulgaria where about 4,000 people have been affected by the floods. Therefore, this analysis reflects the common phenomenon within Thrace region where the countries are losing not only resources but lives to floods. Besides, the loss of lives and property has significant economic implications because much of the money is spent on compensation, reconstruction and repair of infrastructure. Additionally, a lot of resources are lost to alteration of productive operations like tourism, agriculture and even industries to some extent due to power breakdowns commonly experienced during these scenarios.

3. Conclusion

The flood risks in Thrace Region have caused significant challenges and require comprehensive approaches to address and mitigate the effects and the potential losses and damages. Through an extensive of this phenomenon in this region and cost-benefit analysis, it is evident that the impacts of floods are multifaceted due to economic, environmental and social effects. Floods in Thrace have caused damage of property, loss of lives, alteration of economic activities and also loss of cultural heritage. Additionally, the financial effects from floods goes beyond repair costs to long-term economic implications such as depreciation of property, disruption of business operations and more insurance rates due to increased risk factor. Furthermore, the floods have resulted to increased environmental impacts including land erosion and destruction of habitats, which further exacerbates the overall flooding costs.

Prevention and mitigation of flood impacts will reduce the vulnerability of this area to flood risks. Some of the remedies to address this issue and reduce vulnerability may include raising embankments, establishing early warning mechanisms, improve drainage systems. These approaches would minimize the potential damages and overall losses from floods. The insight acquired from various literatures and analysis; flooding events may have strategic advantages like Evros River that serves as a natural boarder among other strategic advantages. However, the cost and other negative implications outweigh the potential benefits of floods. Therefore, the cost of flooding events are more than the benefits; hence appropriate flood risk management mechanisms are key in safeguarding Thrace region, which is floods prone to prevent and mitigate the impacts.

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