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Map of Earthquake Risk in Istanbul as a Factor of Socioeconomic Status

Introduction

Turkey is an earthquake country that faces the challenge of existing over active fault lines and always living temporally between earthquakes. These challenges are only exacerbated in Turkey's largest metropolitan area, Istanbul. Istanbul has suffered a major earthquake in 1999, amounting to major losses in life and capital. This paper begins with a brief overview of how the city's earthquake policy has developed in the twenty years that followed, and how the options currently available for earthquake prevention create precarious social and economic situations for the communities who are most exposed to disaster via earthquake. It then details my attempt to map out which communities face the largest earthquake risk by cross-referencing levels of earthquake hazard in the city with population density and socioeconomic status. Although the methodology demands further revision and refinement, as well as consultations with experts in seismology and sociology, the map ends up highlighting the communities that should be prioritized with regards to earthquake safety— preferably by more equitable means than the government's current policies.

Istanbul and Earthquakes — A Recent History

Istanbul is situated about 20 kilometers (12.4 miles) north of the Northern Anatolian Fault Line, which passes by the Marmara Sea. The city has experienced two major earthquakes of magnitudes above 7 in the Richter scale in the last two hundred years, in 1894 and 1999.

According to a 2000 assessment by Ozerdem and Barakat, the 1999 Marmara Earthquake caused 17,127 deaths, 43,953 hospitalizations and monetary loss estimated to be between US$9—13 billion, with nearly the same amount of economic loss as industry in the area ground to a halt.[1]

It is important to note that the epicenter of the earthquake was not directly on Istanbul, but rather on the neighboring province of Izmit. In 2000, Parsons et al. suggested that the tectonic shifts caused by this earthquake has increased the chances of an earthquake occurring closer to Istanbul, and estimated that there is a 32 ± 12% probability of a strong earthquake occurring in the area within the next decade, and a 62 ± 15% probability of one occurring in the next 30 years.[2]

Earthquakes and Urbanization Policy

By far the most significant policy response in the twenty years that followed the Marmara Earthquake has been the Justice and Development Party's (*Adalet ve Kalkinma Partisi, AKP*) so-called "urban transformation" policy. In their study, "Urban Transformation in Istanbul", Torus and Yonet interpret the new wave of urban transformation under the AKP regime as a direct response to the 1999 earthquake.[3]

The efficacy of this policy in terms of earthquake mitigation is questionable, however. Ekrem Imamoglu, the mayor of Istanbul, has denoted that urbanization in Istanbul has not been successful in integrating widespread earthquake mitigation efforts, projecting that an earthquake of

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[1] Alparslan Ozerdem and Sultan Barakat, "After the Marmara Earthquake: Lessons for Avoiding Short Cuts to Disasters," *Third World Quarterly* 21 No.3 (2000), 425

[2] Tom Parsons et al. "Heightened Odds of Large Earthquakes Near Istanbul: An Interaction- Based Probability Calculation," *Science* 288 (2000), 661

[3] Belinda Torus and Neslihan Aydin Yonet, "Urban Transformation in Istanbul", *Archi-Cultural Interactions through the Silk Road: 4th International Conference, Mukogawa Women's University* (2016), 126

a similar magnitude to the 1999 earthquake could cause 22.6% of buildings in the city to collapse, causing massive infrastructural damage, as well as over US$20 billion in economic losses.[4]

The consequences of urban transformation can be better understood under the lens of gentrification. The policy involves two distinct processes. The first is the selective demolishing and renovation of individual buildings that do not adhere to regulations. The second involves larger scale renovation projects of entire neighborhoods. It is important to note that while both of these processes are state-led, their actual implementations are often delegated to private bodies, leading to inconsistencies execution and consequences.

In their case study of two individual building transformations, Torus and Yonet have found that as a result, it tends that "the life quality decreases while the rant and number of habitants increase."[5] In addition, in cases where the constructors do not find building in the district profitable, the habitants of the transformed building need to pay for the reconstruction.[6] This theme of earthquake safety having a price for homeowners extends to the government-enforced Compulsory Earthquake Insurance (DASK), which operates through a public-private body and funds itself through international cat bonds.[7]

For neighborhoods of lower socioeconomic status, individual initiatives are replaced with large-scale renovations of the entire neighborhood. Calling the process "state-led gentrification"[8], Tolga Islam and Bahar Sakizlioglu have observed two of these projects, finding that they often

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[4] "İBB Başkanı İmamoğlu: Deprem Seferberliğini Başlatıyoruz," Cumhuriyet Türkiye Haberleri, October 14, 2019, http://www.cumhuriyet.com.tr/haber/turkiye/1628242/iBB_Baskani_imamoglu__Deprem_seferberligini_baslatiyoruz.html.

[5] Torus and Yonet, "Urban Transformation in Istanbul", 129.

[6] Ibid., 129.

[7] D. Graham Burnett, "The Bonds of Catastrophe: Betting on Disaster", CABINET, http://cabinetmagazine.org/issues/57/burnett.php.

[8] Tolga Islam and Bahar Saklizlioglu, "The making of, and resistance to, state-led gentrification in Istanbul, Turkey", *Global Gentrifications: Uneven development and displacement*. Bristol University Press, Policy Press (2015), 250

involve the aggregation of property rights under local administrators[9] and the sudden and forced displacement and relocation of residents, which they found hinders economic prosperity and sense of community in the neighborhoods.[10]

All of these lend to a situation where the notion of establishing earthquake safety is tied to the generation of social and economic precarity. Working class neighborhoods, disadvantaged communities, and communities of lower socioeconomic status in general —which are more economically prone to earthquake disaster[11]— often have even less of a choice in this matter, and face a massive upheaval of their lives without a guarantee of a better quality of life, or even guaranteed earthquake mitigation.

Mapping Earthquake Risk as a factor of Socioeconomic Status

In traditional studies in the area, earthquake risk is defined as "the harm or losses that are likely to result from exposure to seismic hazards", usually measured in terms of expected casualties and direct/indirect economic losses.[12] Policies that result from economically guided risk assessments appear not to take their own social consequences into account. As a result, communities that would be worst affected by earthquakes face further precarity from attempts to mitigate their damage.

Within this context, I have created a speculative map that assesses the earthquake risk of each municipality in Istanbul as a factor of its socioeconomic status, which aims to highlight the

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[9] Islam and Sakizlioglu, "The making of, and resistance to, state-led gentrification in Istanbul, Turkey", 250.

[10] Ibid., 251.

[11] SAMSHA, "Greater Impact: How Disasters Affect People of Low Socioeconomic Status", *Disaster Technical Assistance Center Supplemental Research Bulletin* (2017), 3.

[12] "Your Earthquake Risk," Your Earthquake Risk | FEMA.gov. Accessed November 1, 2019. https://www.fema.gov/your-earthquake-risk.

communities that are either at risk of facing the aforementioned dilemma in the future, or are facing it in the present.

Methodology

Models of measuring earthquake risk vary highly. For the sake of this project, a rudimentary formula was developed out of FEMA's definition of seismic risk[13], which takes three factors into account: *Seismic hazard.* Seismic hazard is defined as a "source of potential harm or loss during earthquakes,"[14] which include natural occurrences like landslides and tsunamis, as well as human-made hazards such as vulnerable buildings. For the sake of this study, I used an earthquake hazard map of Istanbul's municipalities, created in 2014 by Karaman and Erdem[15], which assigns an earthquake hazard score on a 5-point scale to each municipality. *Exposure.* Exposure refers to the number of people present in stricken areas, and increases when earthquake zones become densely populated and urbanized. This map takes the population density of each municipality into account for calculations of exposure. *Vulnerability.* As mentioned above, vulnerability is often defined as a "vulnerability of property", rather than a vulnerability of community. As such, this map calculates this value through an index of Istanbul's socioeconomic status index on a neighborhood basis[16], which takes in factors such as economic access, income gap, access to education, infrastructure and transportation, among others, and grades each neighborhood and larger municipality in a scale of 0 to 100.

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[13] "Your Earthquake Risk," Your Earthquake Risk | FEMA.gov. Accessed November 1, 2019. https://www.fema.gov/your-earthquake-risk.

[14] Ibid.

[15] Himmet Karaman and Turan Erden, "Net Earthquake Hazard and Elements at Risk (NEaR) Map Creation for City of Istanbul via Spatial Multi-Criteria Decision Analysis," *Natural Hazards 73,* No.2 (2014): 703

[16] "Mahallem Istanbul Sosyoekonomik Gelismislik Endeksi," Mahallem Istanbul. Accessed November 1, 2019. http://www.mahallemistanbul.com/MahallemSEGE_/.

Out of these three factors, the following basic formula was established:

Risk = Hazard x Population Density x (1 / Socioeconomic Status Index)

The resulting number for each municipality was then mapped into a range of 0 to 100, and visualized over a map of Istanbul's municipalities. Maps depicting how each municipality fares with the individual variables of the formula were also included in the project.

Results and Conclusion

The map highlights municipalities such as Bagcilar, Bahcelievler, Bayrampasa, Esenler, Gaziosmanpasa, Fatih, and Zeytinburnu as those facing the most earthquake risk under this model. These municipalities have a hazard score of 3 out of 5, or higher, and are also among those that have faced large amounts of urban development, gentrification and sprawl under the AKP government's policies, and tend to have a higher population density in contrast to the rest of the city, while also scoring lower on the socioeconomic status index.

In the aftermath of two earthquakes with respective magnitudes of 5.4 and 5.6, which occurred in September 2019, the prospect of earthquake safety has the potential to re-enter the Turkish national dialogue. In such an event, this study suggests that these municipalities be targeted with more progressive earthquake mitigation policies, that should seek to reinforce and empower communities, rather than disenfranchise and dislocate them.

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