

Post-Disaster Reconstruction in Puerto Rico

CP 4813: Sustainable Development Planning | CP 4813: Puerto Rico Planning Studio Project | CP 6053: Applied Planning Studio (Urban Design)

Background

Puerto Rico, an unincorporated territory of the United States, faces a unique challenge to post-disaster recovery and reconstruction. As an island in the Caribbean, it is routinely hit by hurricanes and far from mainland support. Puerto Rico is also facing a debt crisis and austerity measures, which started in 2014, that left the government financially ill-equipped to prepare for and respond to disasters. Of its 3.2 million residents, more than 40 percent live below the poverty line and one-third live in rental-occupied units. Natural disasters test these vulnerabilities. From late December 2019 to July 2020, a series of earthquakes impacted Puerto Rico, with the largest earthquake registering at a 6.4 on the Richter scale on January 7, 2020. Two years later, Hurricane Fiona brought excessive rainfall to the island, triggering mudslides and flooding. A combination of public assistance and private investment was sent to Puerto Rico to respond to these disasters, although its impact is still up for debate.

Name of All Participants

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Abstract

This planning studio project focuses on post-disaster response and recovery in Puerto Rico in the aftermath of the 2020 earthquakes and Hurricane Fiona in 2022. How did the natural disasters impact Puerto Rico and how have public and private initiatives assisted in its recovery? This project analyzes the equitable distribution of reconstruction funds and recovery interventions across Puerto Rico by evaluating socio-economic and environmental vulnerabilities, public reconstruction resources, and private reconstruction resources. Each component of the project follows a structured timeline encompassing background research, preliminary analysis, fieldwork, and final deliverable preparation.

Vulnerability & Damage G 1

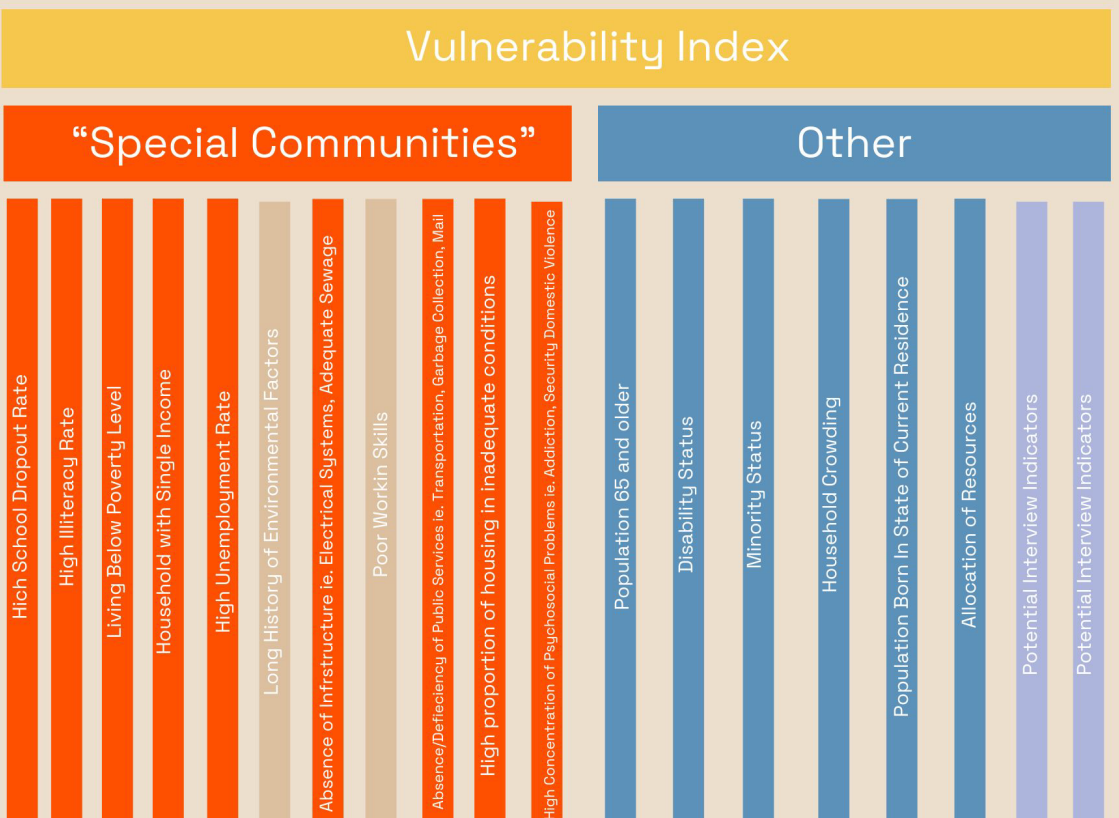
Abstract

Group 1, focusing on vulnerability and damage, is tasked with 1) reindexing vulnerability on the island and 2) assessing damage and hazard risk and creating GIS mapping for both in regards specifically to Hurricane Fiona and the 2020 Earthquakes in Puerto Rico. We are creating a GIS map of vulnerability based on indicators that expand on past vulnerability research through holistic analysis as well as account for the past disasters and the disaster colonialism impact on vulnerability. Using the methodology outlined by Lamba-Nieves & Santiago-Bartolomei (2023) we are using multiple datasets, namely the FEMA datasets on damage, hazards, and vulnerability, which must be cleaned and expanded upon before use. The final product will be an overlay of GIS maps that show vulnerability (socioeconomic factors, environmental factors), housing damages as the specific form of damages, and hazard risk (precipitation + wind speed and proximity to epicenter respectively).

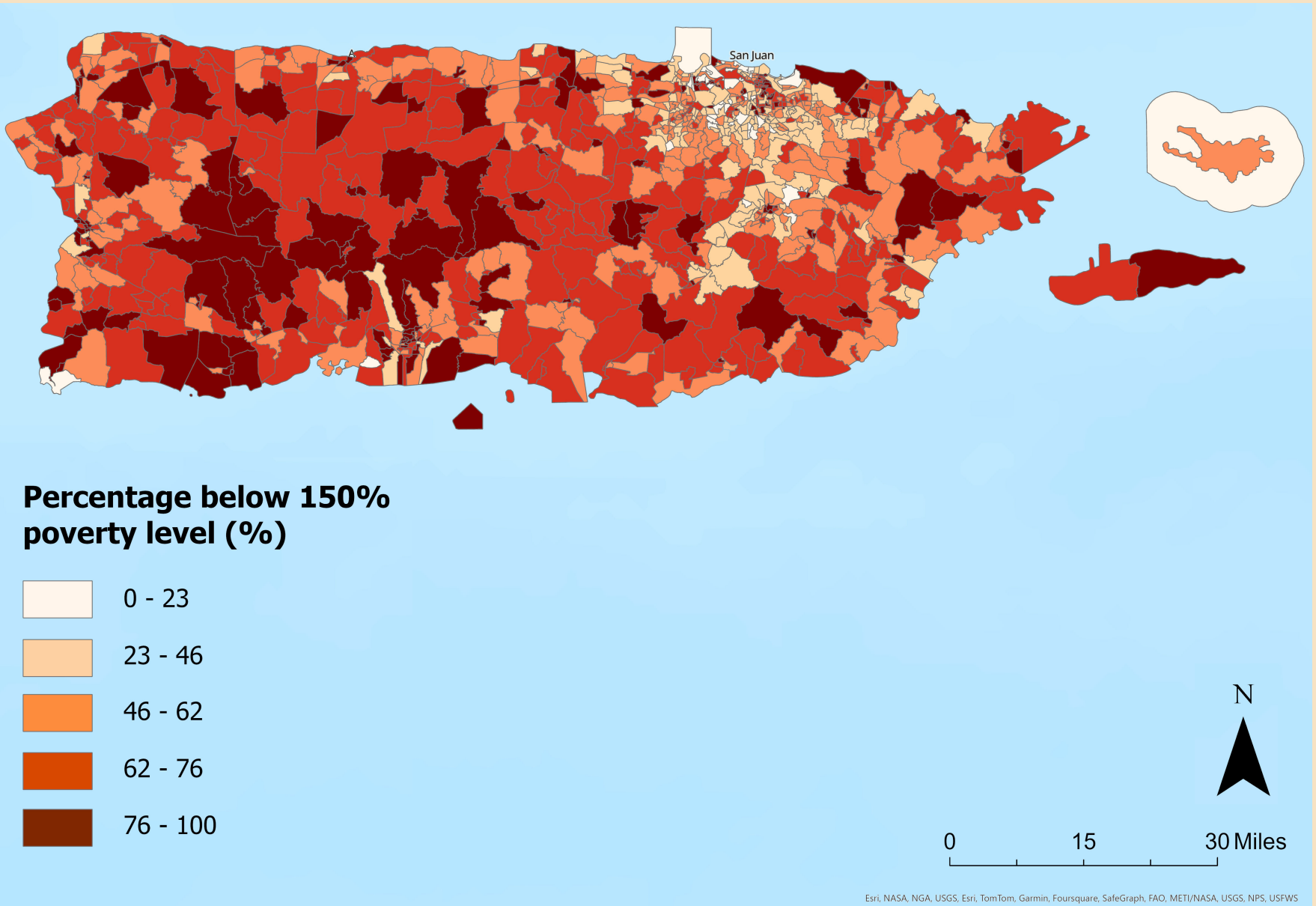
Preliminary Findings

To be well-positioned to create our index of vulnerability and maps, we first reviewed 40 sources related to the definition of vulnerability & the contribution of different vulnerability indicators to the overall vulnerability of the community. After our literature review, we went back and identified several vulnerability indexes like the CDC Social Vulnerability Index and the EPA EJScreen Environmental Justice Index in order to identify which features of pre-existing indexes we thought would work well or need improvement in the context of Puerto Rico. Moving into quantitative analysis, we have begun cleaning datasets for use in future mappings, and already generated a map of housing damage for the two recent hazards, using financial impact as a direct indicator for magnitude of damage.

Our framework for creating a vulnerability index, supplementing the "Special Communities" outlined by Deepak Lamba-Nieves & Raúl Santiago-Bartolomei (2023) with other factors to create a holistic index of a community's vulnerability.



Map showing the percentage of persons below 150% poverty level at census tract level. This is an example of what one layer on our final vulnerability map might look like.



Public Reconstruction G 2

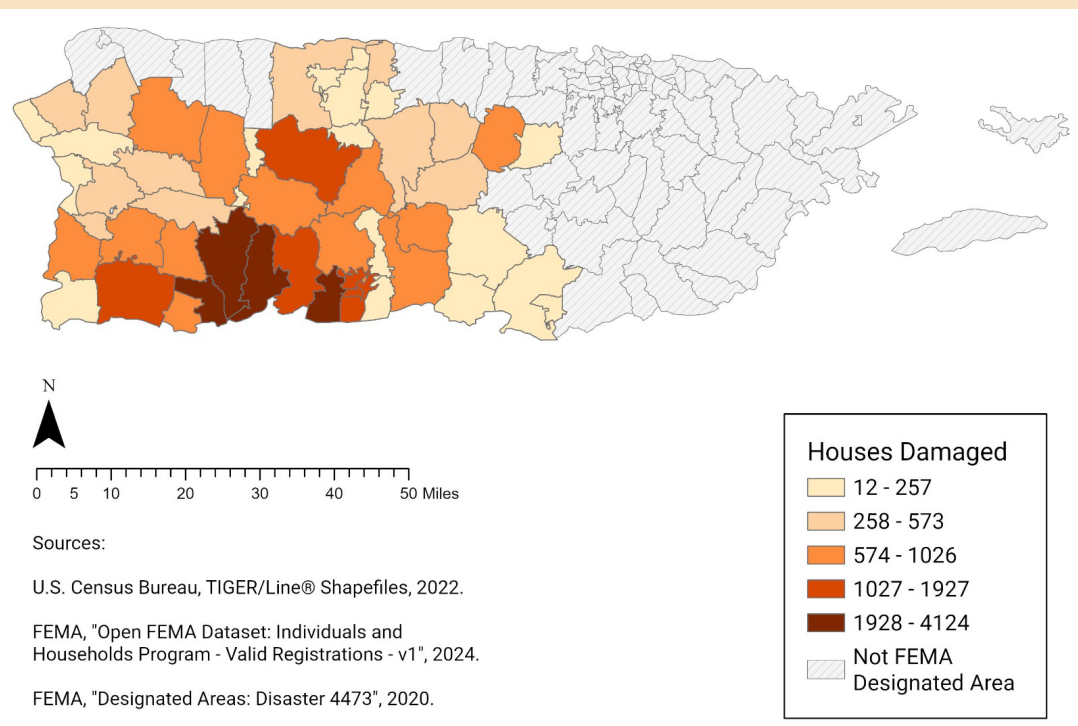
Abstract

How was allocation of FEMA housing relief aid stratified among certain factors – such as poverty, residential tenure status, and geographic vulnerability – after Hurricane Fiona and the earthquakes in Puerto Rico? Puerto Rico's post-disaster reconstruction efforts rely on a combination of federal funding sources, including FEMA's Individual Assistance (IA) program for housing and rental aid. FEMA's IA Program offers essential assistance in the initial months in the aftermath of a disaster, addressing basic needs and most pressing reconstruction problems. However, there are many concerns that FEMA's IA application, inspection, and approval process excludes vulnerable communities. For this reason, we will interview actors in the recovery process to fill in gaps that quantitative data may have.

Preliminary Findings

In our preliminary analysis, we found that foundation damage was the most prevalent kind of structural harm that affected residential units in Puerto Rico following the earthquakes, whereas flood damage was most prevalent following hurricane Fiona. According to our analysis of 5-year ACS data from the U.S. Census Bureau, Puerto Rico's social demographics, such as population, poverty rate, number of housing units, mean household size, and percent of units that are owner or renter occupied, did not change much between the two disasters. According to FEMA data of the Individuals and Households Program (IHP), 37,553 homes were damaged and \$83,537,924 in financial aid was disbursed for the 2020 earthquakes and 741,025 homes were damaged and \$648,750,565 in financial aid was disbursed for Hurricane Irma in 2022.

Map 1 (Earthquake): Number of houses damaged after the 2020 Earthquakes (Disaster 4473) by zip code, according to FEMA Individual Assistance registration data.



Map 2 (Hurricane): Number of houses damaged after Hurricane Fiona (Disaster 4671) in 2022 by zip code, according to FEMA Individual Assistance registration data.

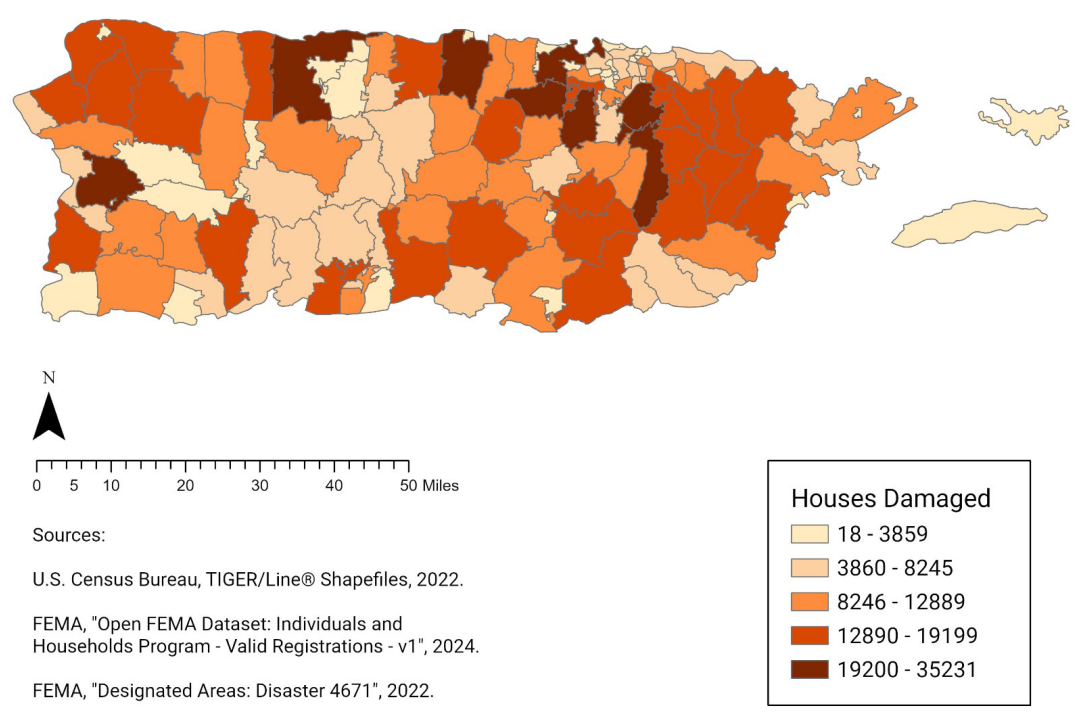


Table 2: Housing Damages in Puerto Rico - Earthquakes	
Metric	Value
Occupied housing units in Puerto Rico	1205749
Homes with damages	37553
Percent of damaged homes	3%
Aggregate damage	\$83537924
Average home damage	\$2225
Total homes destroyed	294
Total homes with flood damage	2
Total homes with roof damage	2348
Total homes with foundation damage	20147

Table 2: Housing Damages in Puerto Rico - Hurricane Fiona	
Metric	Value
Occupied housing units in Puerto Rico	1219658
Homes with damages	741065
Percent of damaged homes	61%
Aggregate damage	\$648750565
Average home damage	\$875
Total homes destroyed	36
Total homes with flood damage	7579
Total homes with roof damage	0
Total homes with foundation damage	0

Private Reconstruction G 3

Abstract

This project aims to determine the process of private reconstruction in Puerto Rico following the natural disasters. There is a focus particularly on data from the Permit Management Office in Puerto Rico. There is also a focus on interviewing different people across various industries in Puerto Rico such as engineers, municipal workers, gestores (intermediaries in the permitting process), and architects. Maps and charts highlighting the trends and distribution of privately funded reconstruction resources throughout Puerto Rico 1 year after Hurricanes Maria and Irma in 2017, the Earthquakes of 2019, and Hurricane Fiona in 2022 will be generated. Finally, a narrative of on-the-ground reconstruction and patterns in the construction industry will be produced.

Preliminary Findings

Various trends can be seen from working with the data. For example, the mean estimated cost for an urban project is \$371,203.5 compared to \$116,535.7 for rural ones. Permits filed by a permitting assistant had a lower mean duration and cost of 51.61 days and \$197,899.5, respectively, while those without a permitting assistant had a mean duration of 119.61 days and a mean cost of \$273,397.5. Finally, permits filed by a corporate owner had a higher mean estimated cost of \$765,994.7, while those not filed by a corporate owner had a mean estimated cost of \$168,988.8. Note that while generating all the above statistics, only private projects and permits were considered. Looking at another data set, from the Puerto Rico planning board, it becomes evident that there was an increase in private funding roughly one year after each of the major disasters. From the brief interviews that have been conducted, much information has been shared on how residents of the island think about construction and the culture that surrounds it.

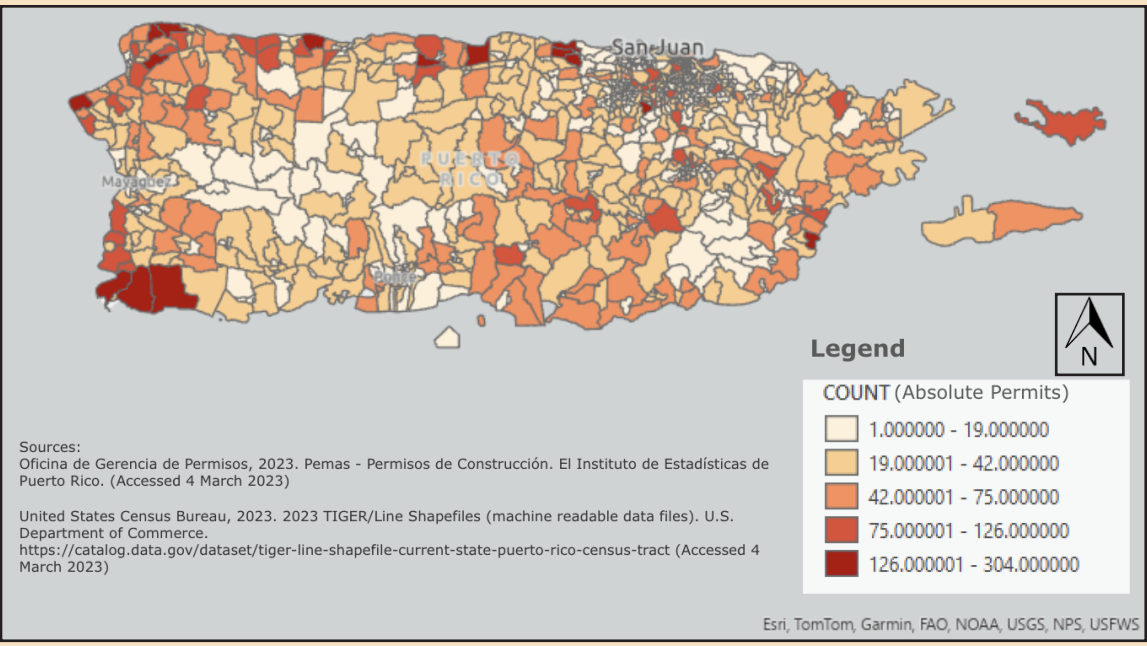
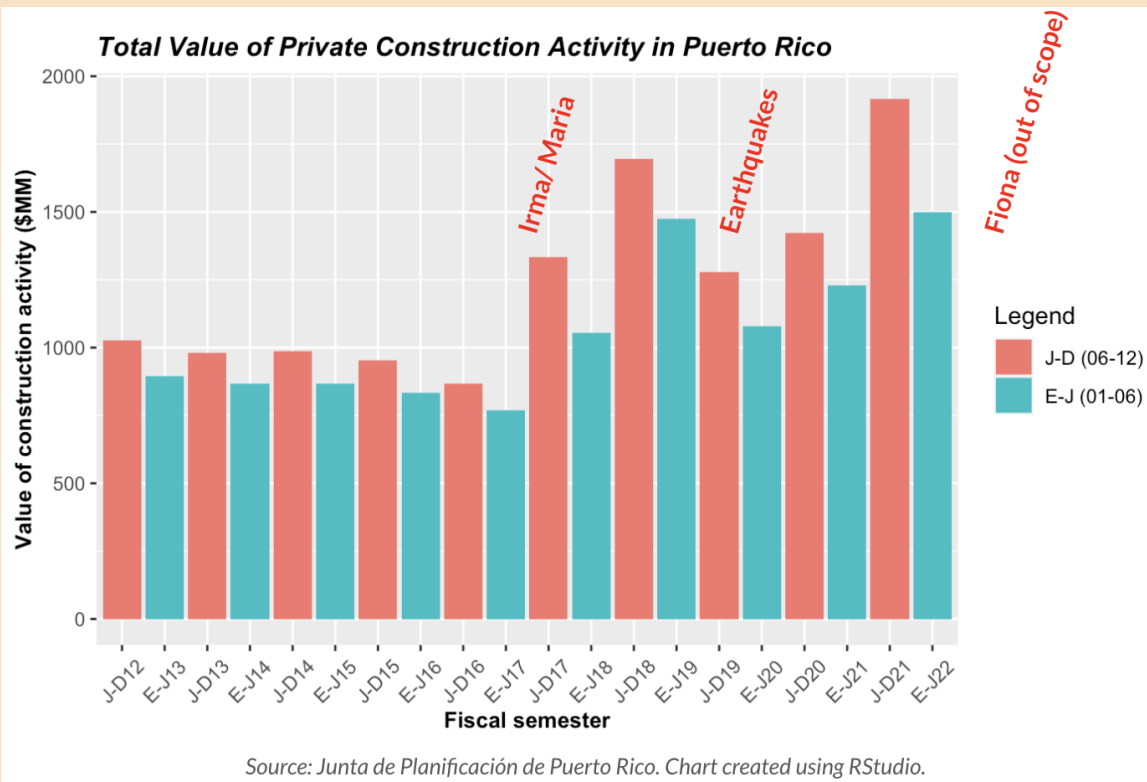


Chart on the left shows the total value of private construction activity in Puerto Rico from late 2012 to early 2022, broken down by six-month periods. Following hurricanes Irma/Maria, and the 2020 earthquakes, construction activity initially dipped, but then experienced a significant rise about a year later, likely due to reconstruction efforts.

Maps below describe the distribution of privately funded construction projects in Puerto Rico from Hurricane Irma's landfall on September 6, 2017-November 2023. Public projects with private contracting and public-private partnership projects were included. Private reconstruction has been mostly concentrated in coastal regions, which typically constitute higher populations and tourism.

