Climate and Disaster Risk Management for Health Systems Global Program

Climate and Disaster Risk Management for Health Systems:

A Data-Driven Artificial Intelligence Approach

GFDRR
Administered by THE WORLD BANK
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Saxa 7

Emily Elwood

Paul Sweda

Shannon Le

Mabel B. Davila

Jacob Beall

Pablo Vega

Agenda

- Project Overview
- Methodology
- Results
- Key Takeaways

Project Overview

Target Country: Colombia

Sponsoring Organization: The World Bank

Context

Earthquakes pose worldwide threats to:

- Public Health
- Infrastructure
- Recovery

Objective

Analyze and identify municipalities with the highest predicted risk to healthcare system impacts following seismic events.

Output

Develop an AI-powered risk index and simulation model to understand which interventions should be prioritized in which municipalities to most effectively mitigate risk.

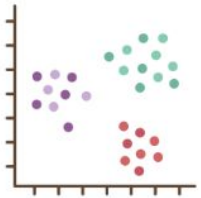
Methodology

Population Data

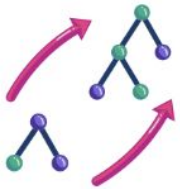
Risk Index Generation

Potential Influential Variables

- Demographics
- Housing materials
- Public utilities
- Social programs and services



K-means Clustering



Gradient Boosting

Predicted Risk Score

Intervention Simulation Tool

Data Preparation

Clean Data	Missing values	Translation	Feature Engineering	Outliers	Standardization	Scaling
• Column Names • Data Types	• Removal of Columns - 90% Missing Values	• Spanish Language Conversion	• External Sources Needed Custom Feature Engineering • *E.g. 4W - Who, What, Where, When dataset*	• Kept Outliers as Real-World Indicators	• GFDRR Preprocessing Required Standardization Of Datasets from Various Sources • *E.g. ADMN Code matching*	• GFDRR Preprocessing Framework provided Min-Max Normalization

Top Influential Features

Explainability methods to determine variable importance:

1. Permutation Feature Importance
2. Partial Dependence Plots (PDPs)

Top Six features with strongest influence on Risk Score:


Access to safe sanitation and drinking water


Access to electricity

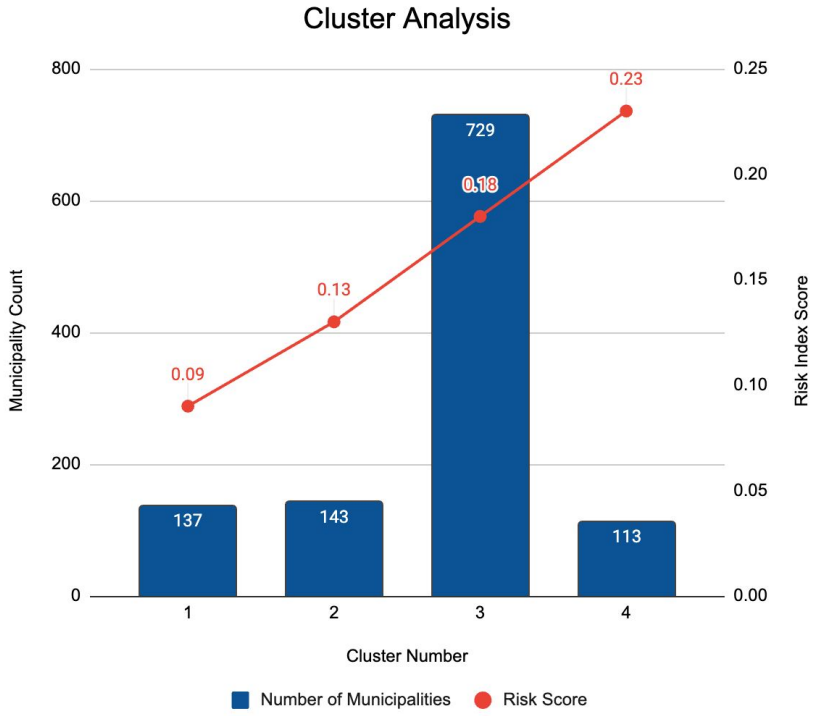

Requirement of health resources

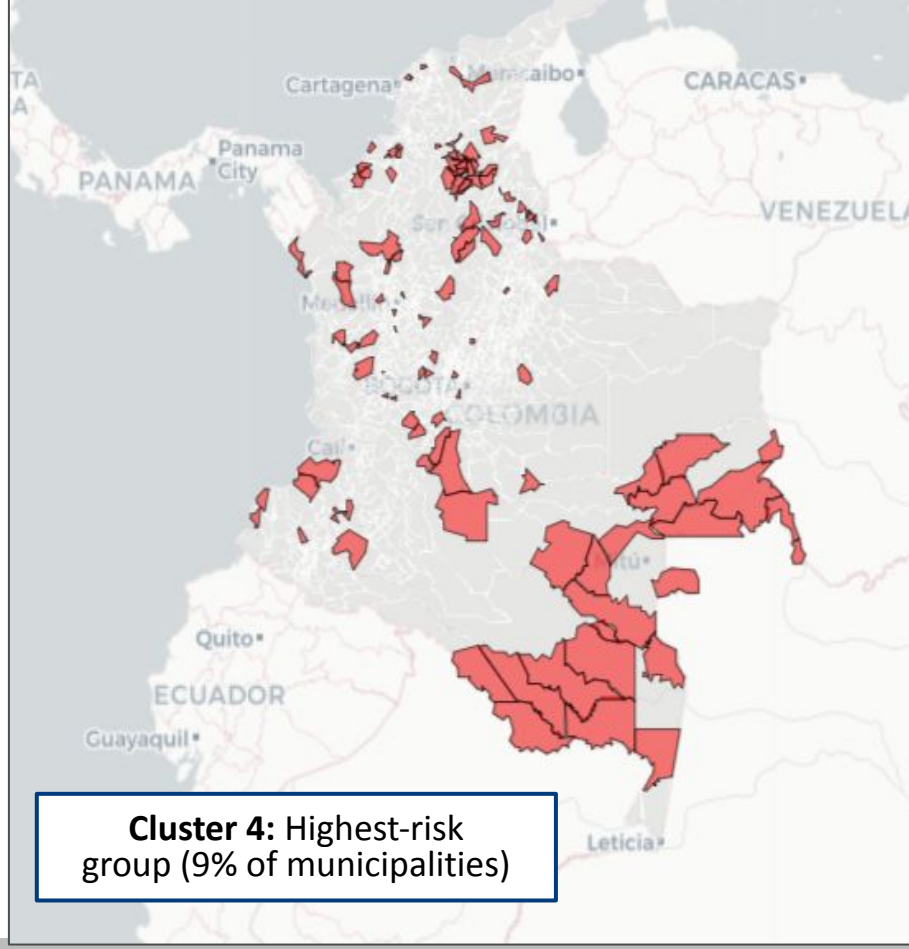

Requirement of protection resources


Total beneficiaries of socioeconomic support


Municipalities making efforts to remove land mines

Risk Index Results

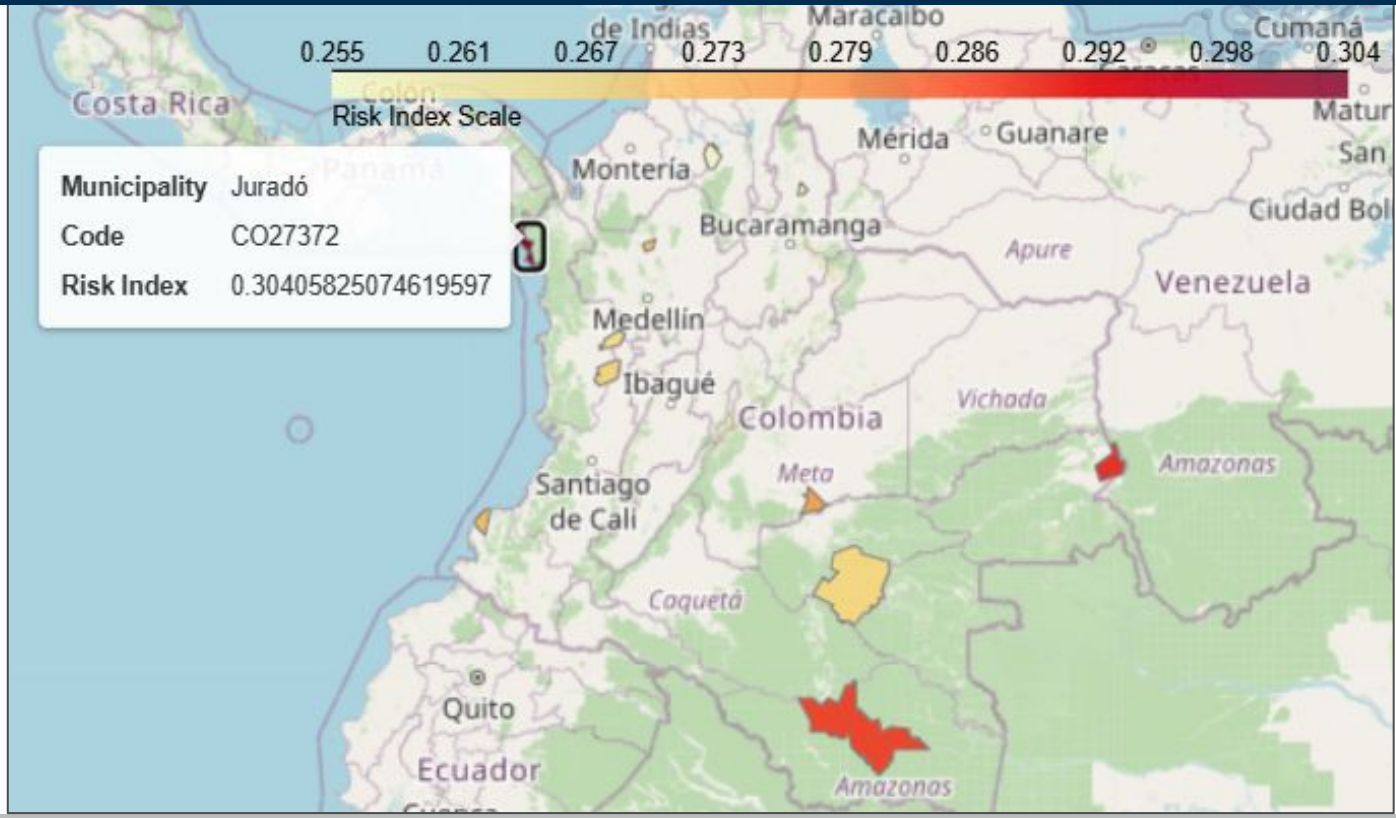




Cluster 4: Highest-risk group (9% of municipalities)

Targeted Municipalities

- Cluster 4 was narrowed down by filtering for above-average values of high-importance features (healthcare need and protection need).
- Final group contained 11 municipalities with Juradó being the highest-risk overall.

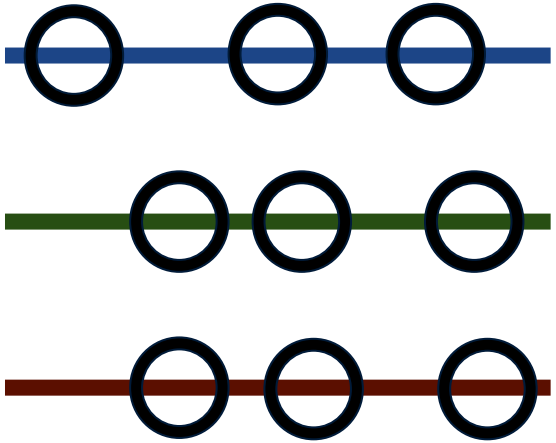


Intervention Simulation Tool

Access to Electricity

Healthcare Needs

Protection Needs

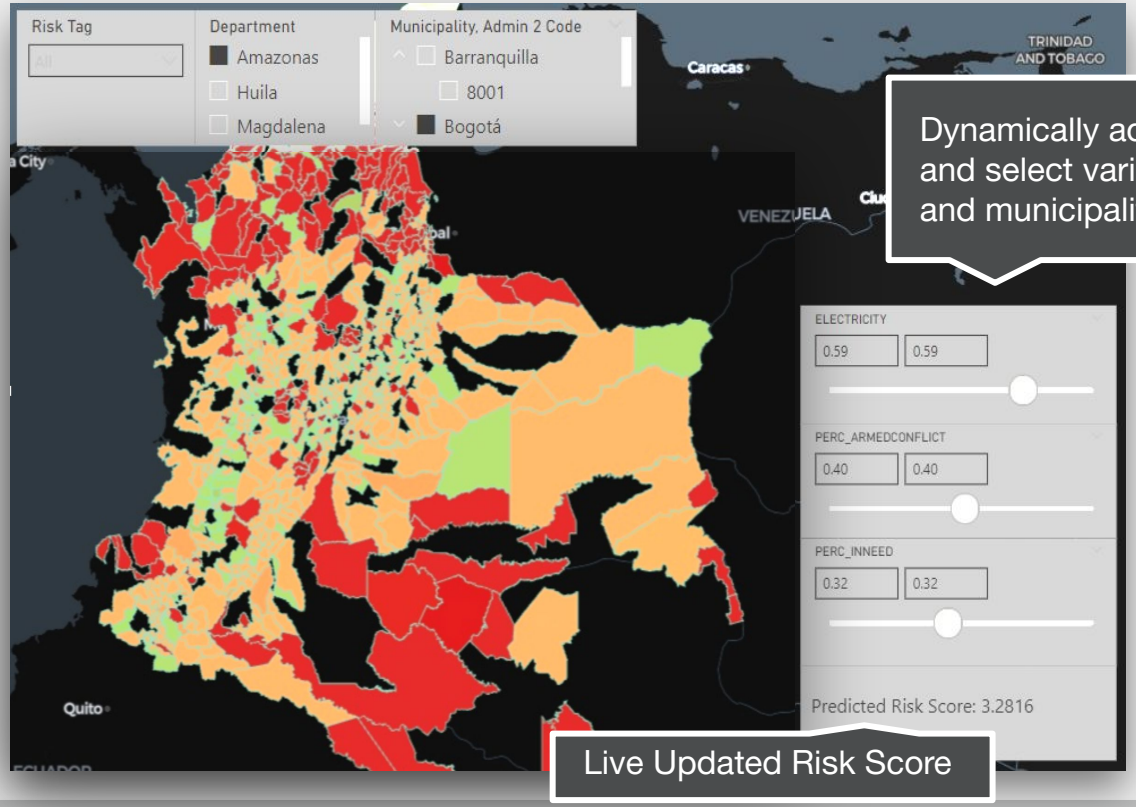


Risk Score: **0.2**

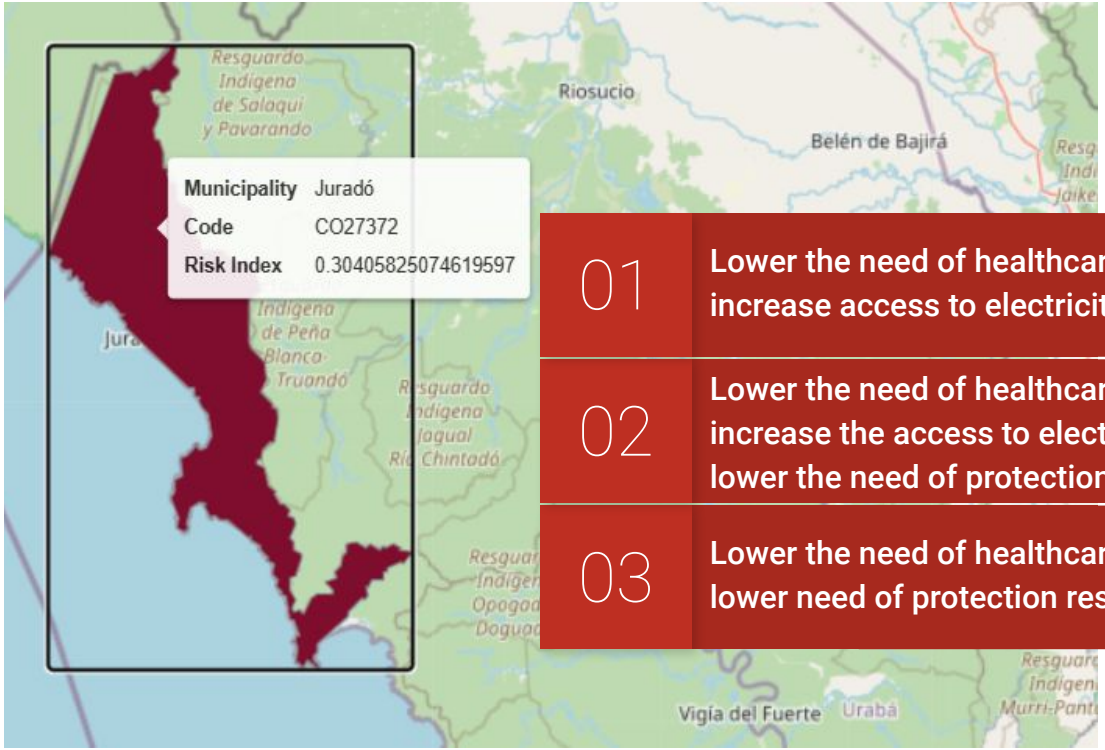
Utility of a Dashboard

Sample Software: Kepler

- Impute **on-the-spot adjustments** to the model variables.
- Propose **investments** in infrastructure and workshopping **solutions.**
- Demonstrate **efficacy** by showing the expected impact to variables and the **projected risk score.**



Intervention Scenarios for Juradó



Original Risk Index: 0.3040

01	Lower the need of healthcare resources by 40%, increase access to electricity by 20%	**Scenario 1 Risk Score: 0.2574**
02	Lower the need of healthcare resources by 40%, increase the access to electricity by 20%, and lower the need of protection resources by 10%	**Scenario 2 Risk Score: 0.2392**
03	Lower the need of healthcare resources by 40%, lower need of protection resources by 10%	**Scenario 3 Risk Score: 0.2576**

Top 5 Highest-Risk Municipalities

Municipalities:

- Mosquera, Nariño
- Jurado, Chocó
- Puerto Concordia, Meta
- Cacahual, Guainía
- Puerto Santander, Amazonas

Collective Issues:

- Proximity to fault lines
- Landmines
- Structural Integrity
- Population Impact
- Health and Safety

Interventions:

- Protection programs
- Electrification
- Emergency Preparedness
- Housing Projects
- Social Services
- Power Grids
- Natural Gas Systems

Alcaldía de Mosquera - Nariño. "Child with Police." Facebook, 2024, https://www.facebook.com/100808092066 34/photos/528754606494842/?_rdr.

Recommendations and Next Steps

- **Integrated Programs:** Bundle interventions (e.g., child protection, emergency preparedness) to create comprehensive solutions.
- **Data-Driven Decisions:** Leverage simulation tool and optimize dashboard to guide interventions specific to each area's unique vulnerabilities.
- **Expand Investigations:** Analyze non-linear relationships and variable interactions to uncover additional potential risk indicators.
- **Cost Analysis:** Conduct a people-focused financial evaluation to understand which interventions will have the greatest return on investment.

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Thank You