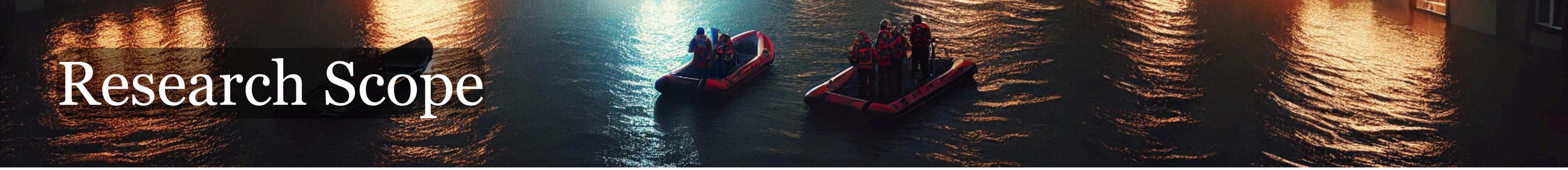
BUSINESS CHALLENGE II

GROUP 8

Introduction

Context:

- Flood hazards pose a significant risk to critical infrastructure, causing economic losses, functional disruptions, and long-term structural damage.
- With climate change, extreme events have intensified and become more frequent over the past decades.
- Infrastructure resilience is an increasingly growing concern for governments and other key stakeholders.
- This study seeks to help Eoliann improve its climate risk predictive modeling, by providing a comprehensive analysis of flood hazards in Italy and Germany.



Research Scope

The analysis investigates flood hazards in Italy for 2023 and 2024 and in 2024 for Germany. This report shows:

- Impact of the floods on different infrastructures.
- Patterns of damage as it varies between Italy and Germany.
- Key physical and socio-economic factors that drive flood damage.
- Use of land valuation in approximation of the willingness to pay (WTP).

Justification of the Study

Why Floods?

- Flooding is among the most frequent and costly climate threats, causing infrastructure damage and economic disruption.

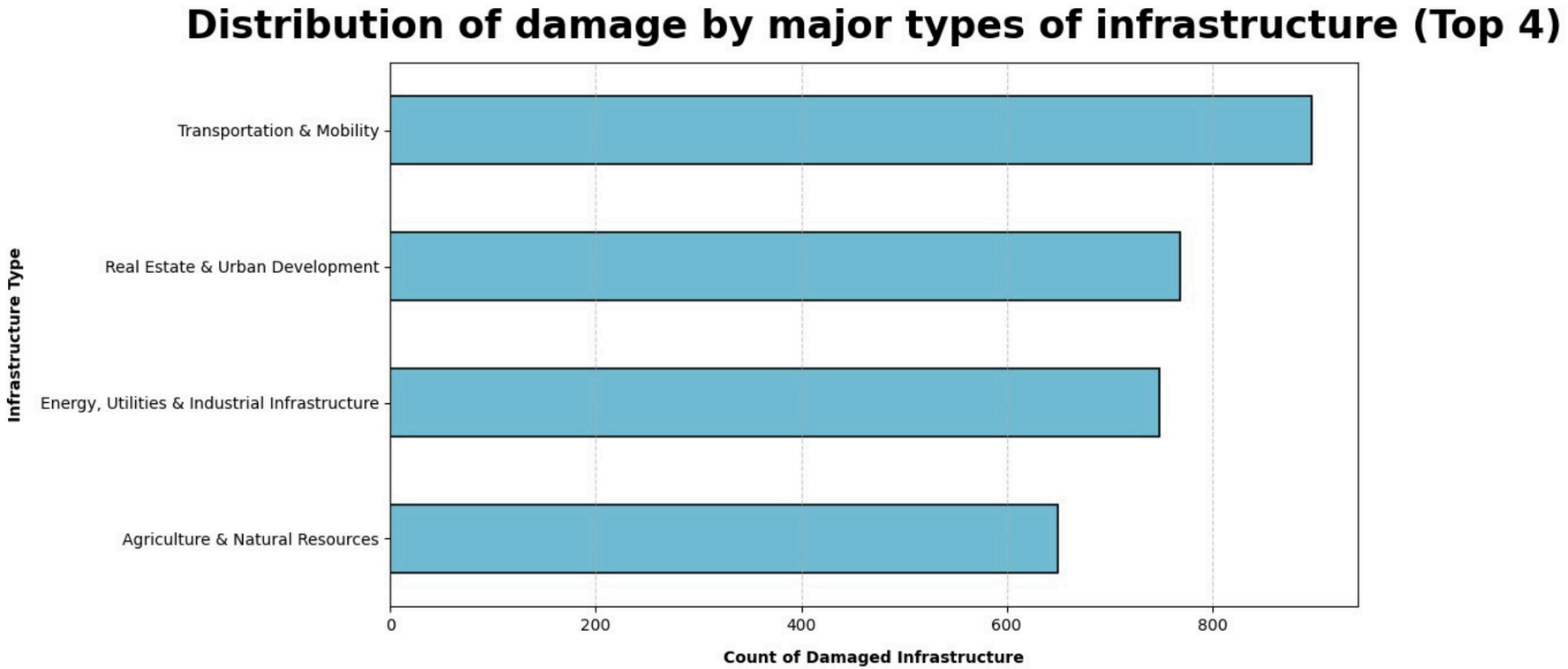
- Events like Ahr Valley (2021), Emilia-Romagna (2023), and Southern Germany (2024) demonstrate rising risks due to climate change, urbanization, and extreme rainfall.

Methodology:

Our approach considers data driven research with analysis in Python to assess flood impact across four key infrastructure sectors:

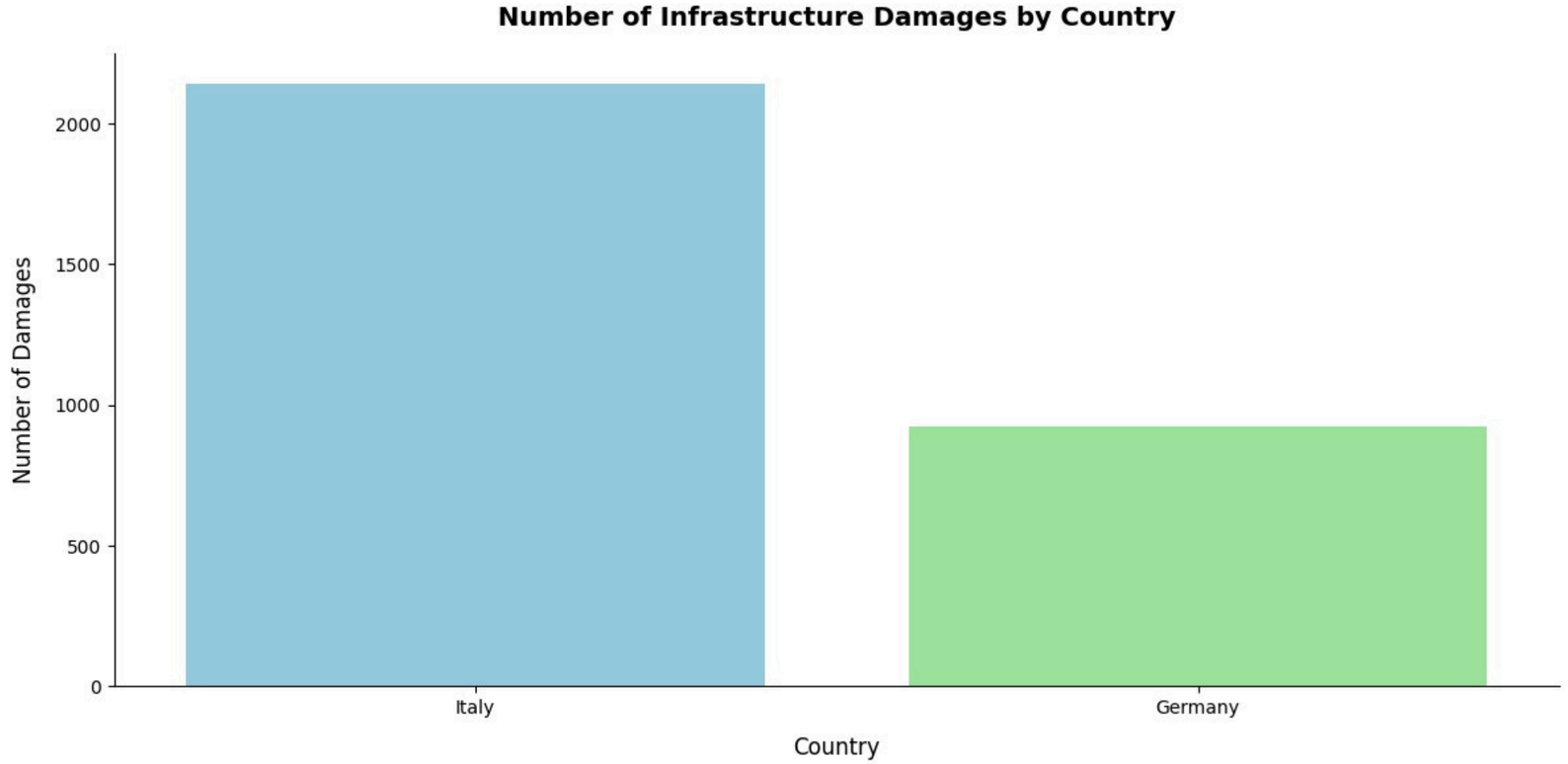
- Agriculture & Natural Resources.
- Energy, Utilities & Industrial Infrastructure.
- Real Estate & Urban Development.
- Transportation & Mobility.

Impact of Flood Damage on Key Infrastructure Sectors



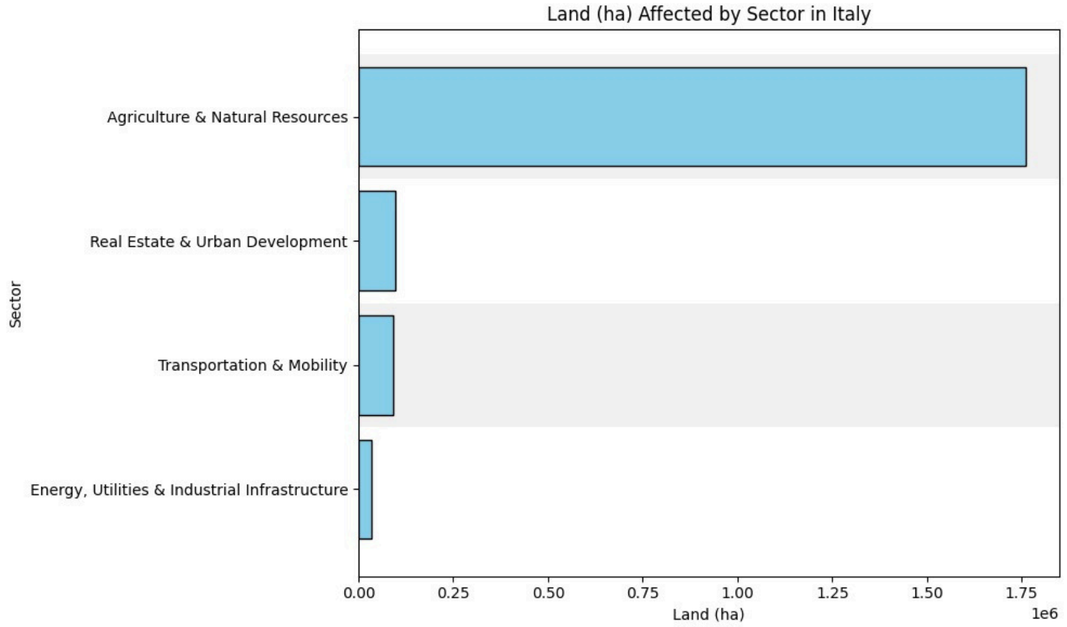
Floods severely impact critical infrastructure, with transport networks most affected. The widespread damage highlights the urgent need for resilience investments, better urban planning, and flood mitigation strategies to protect infrastructure and economic stability.

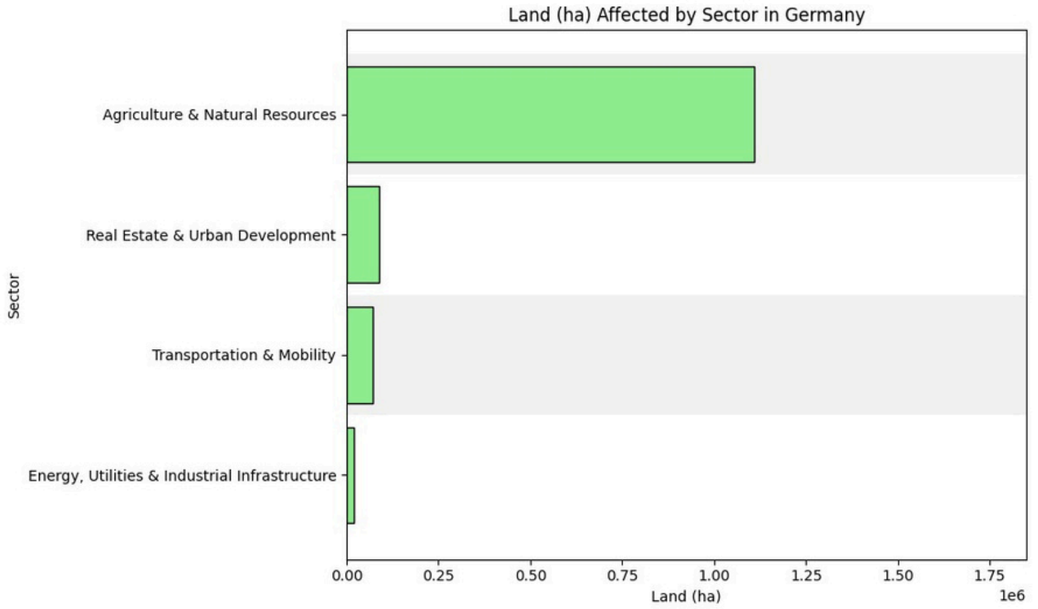
Comparison of Infrastructure Damage from Flooding in Italy and Germany



Italy saw significantly more infrastructure damage than Germany, likely due to urban planning challenges, climate exposure, and resilience disparities. The contrast underscores the need for targeted flood mitigation efforts, especially in high-risk areas.

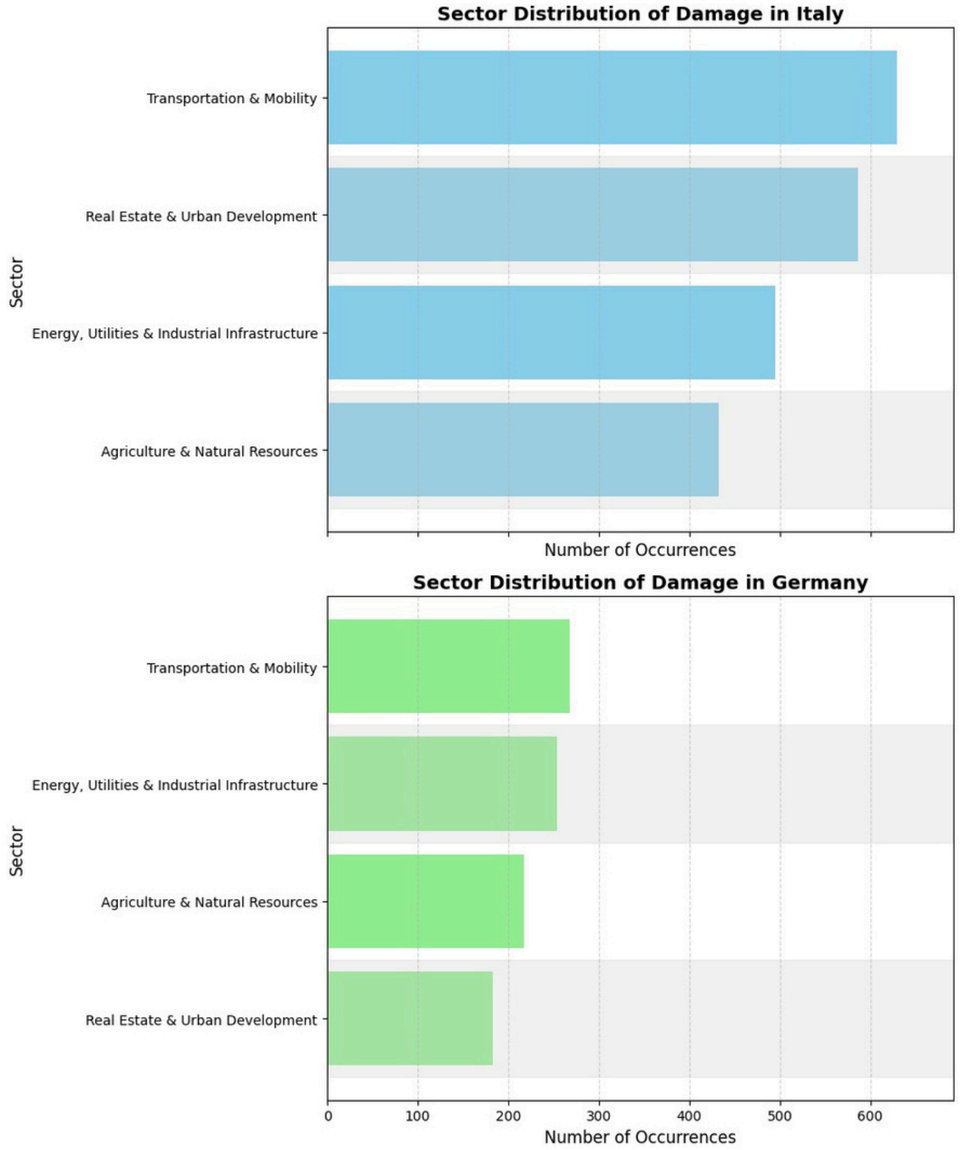
Land Area Affected by Flooding in Italy and Germany





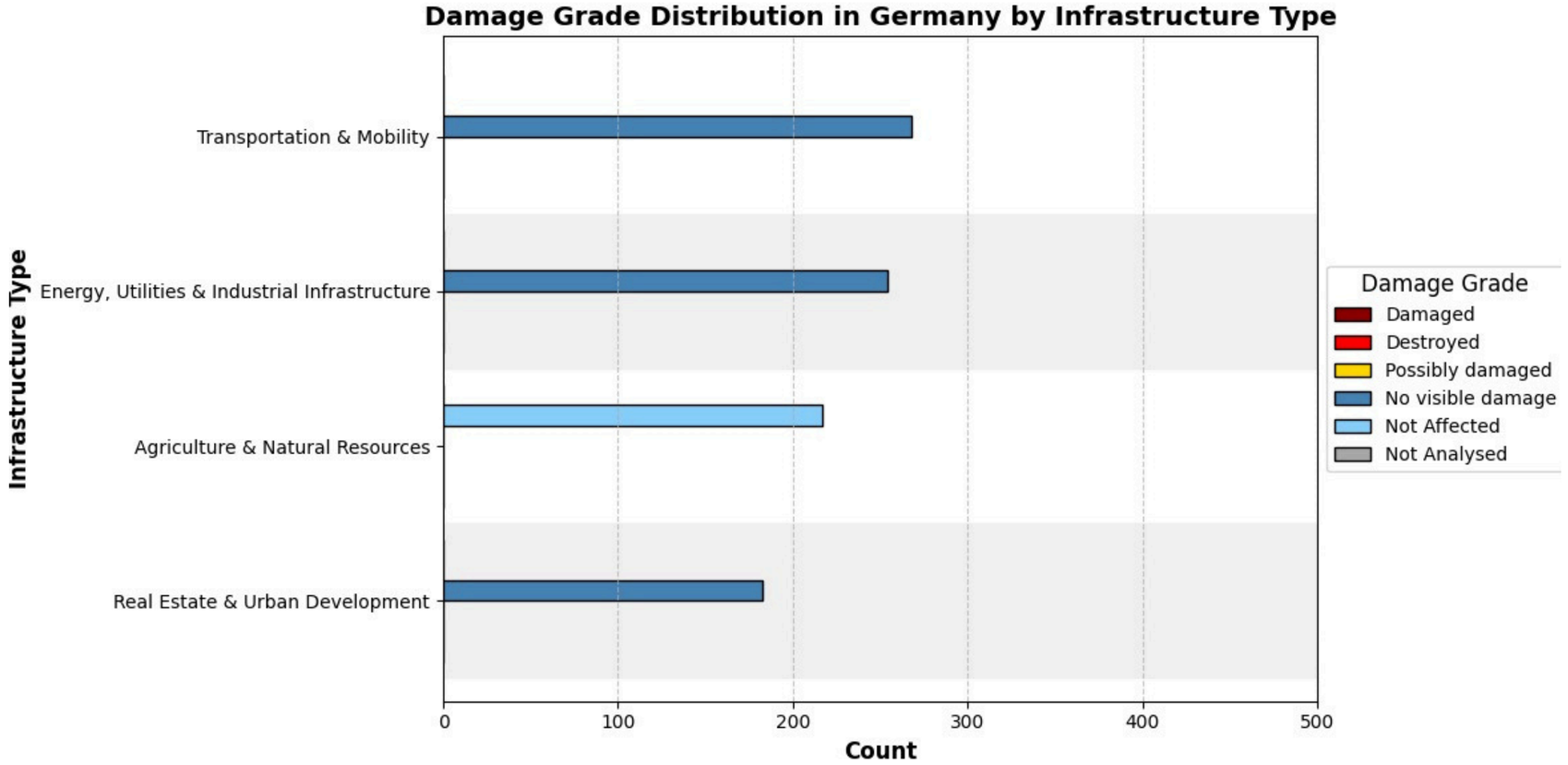
Flooding affected agricultural land the most, with Italy experiencing a greater overall impact than Germany. Other sectors, including real estate, transportation, and energy, saw relatively smaller affected areas. These results emphasize the need for targeted flood mitigation, especially for agricultural land.

Sectoral Comparison of Flood



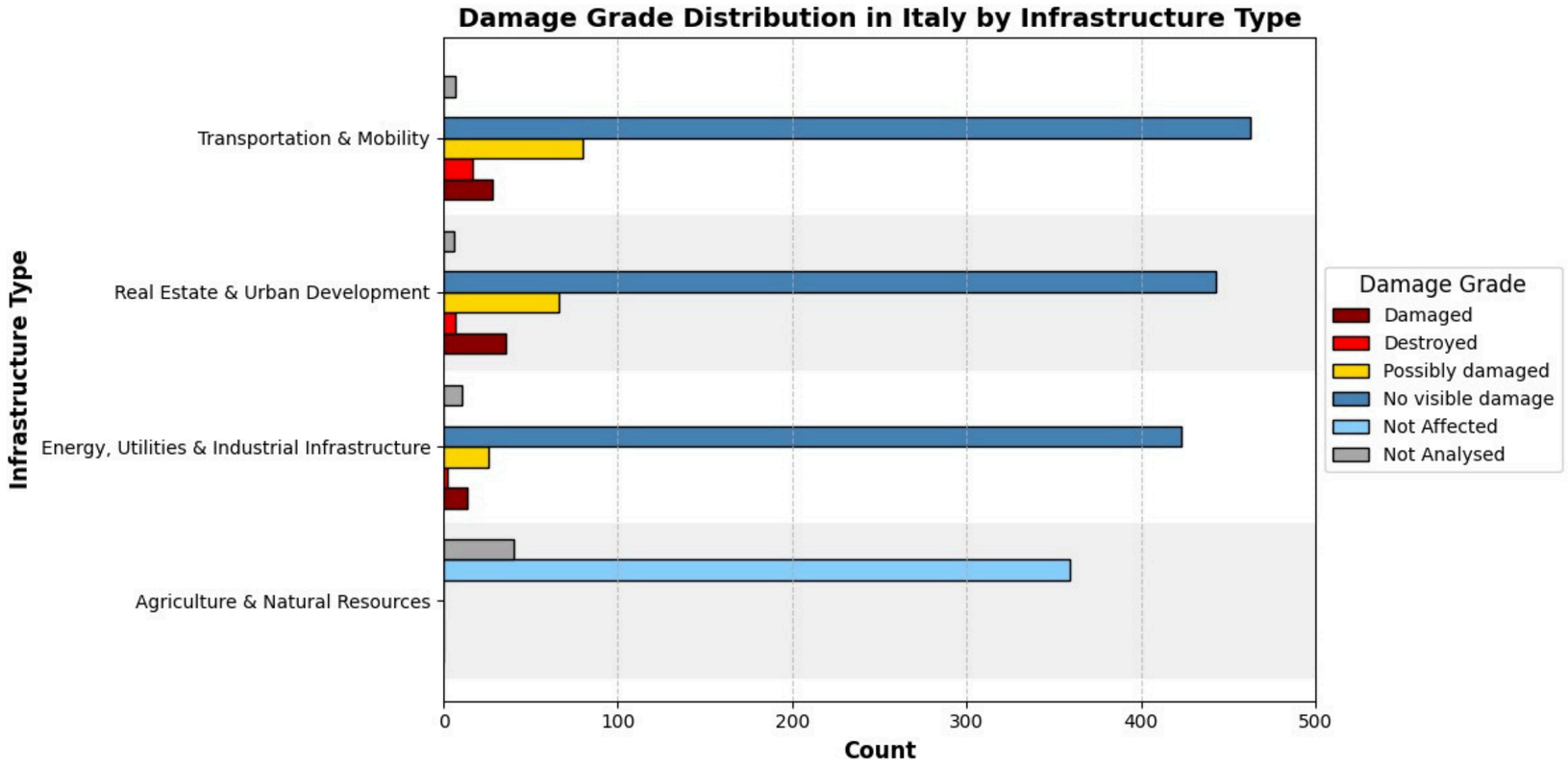
- Italy's Transportation & Mobility sector saw the highest flood damage, followed by Real Estate & Energy Infrastructure.
- In Germany, damage levels were lower, with Agriculture & Transportation most affected.
- These findings highlight the need for enhanced resilience strategies, particularly in high-risk sectors.

Damage Grade Distribution Across Infrastructure in Germany



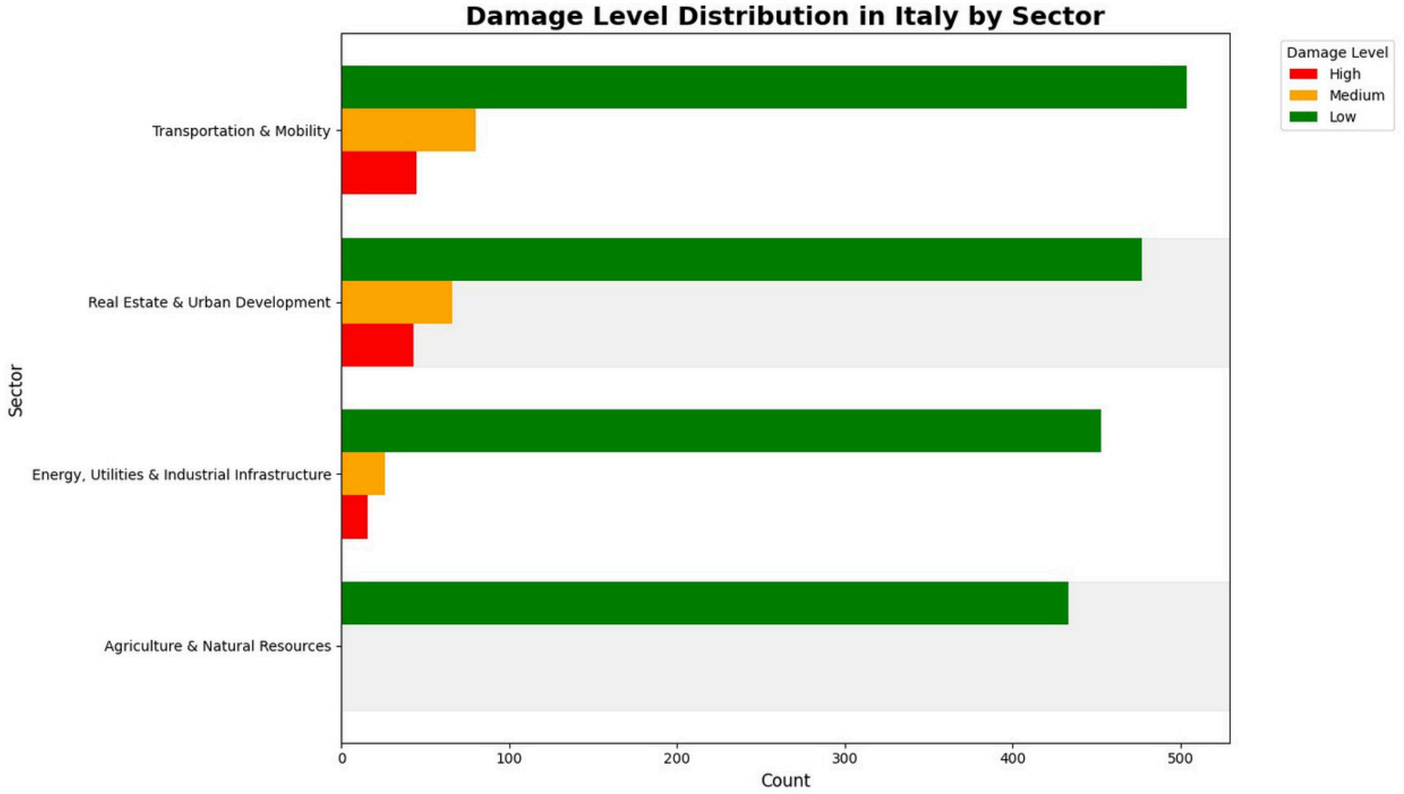
Floods in Germany heavily impacted transportation & energy infrastructure, followed by real estate & agriculture. The classification shows a mix of affected but not completely destroyed structures, emphasizing the need for resilience investments in critical infrastructure.

Flood Damage Grade Distribution Across Infrastructure in Italy

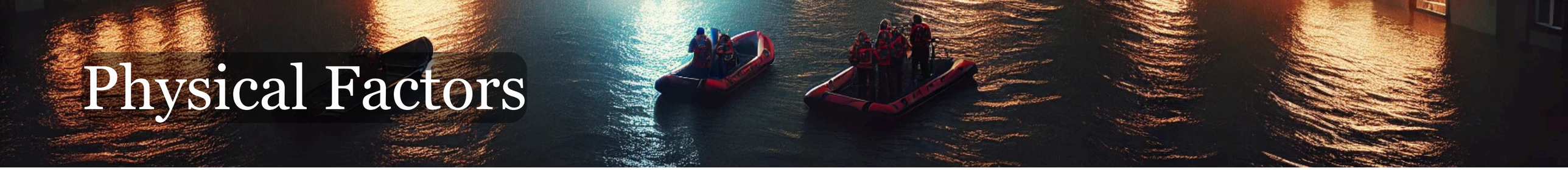


Flood damage in Italy was severe across all sectors, with Transportation & Mobility most affected. More infrastructure experienced visible damage or destruction compared to Germany, highlighting the need for improved flood resilience, particularly in urban and transport systems.

Infrastructure Damage Levels in Italy by Sector



While low damage dominates, high and medium damage levels are concentrated in transport and energy sectors, highlighting their vulnerability to floods. Strengthening resilience in these sectors is crucial for reducing future flood impacts.



Physical Factors

Mapped across 12 infrastructure types using European resilience reports & flood protection guidelines.

Building Material

- Resilient (Concrete, Steel) → Better flood resistance (e.g., bridges, tunnels, modern buildings).
- Vulnerable (Wood, Soil, Plastic) → Higher flood susceptibility (e.g., agricultural fields, older buildings).

Year of Construction

- Post-2000 → Stronger flood protection (reinforced drainage, elevation, waterproofing).
- Pre-2000 → Higher risk due to outdated flood defenses.

Structural Design

- Elevated, drained, reinforced → Less damage (e.g., bridges, modern industrial sites).
- Flat, undrained, low-lying → Severe flood damage (e.g., roads, traditional buildings).

Socio-Economic Factors

Mapped across 12 infrastructure types using economic reports & flood resilience studies.

Economic Development & Income Levels

- Wealthier sectors (Industry, Energy) invest in flood resilience & recovery (e.g., insured power plants).
- Less affluent sectors (Agriculture, Small Businesses) suffer higher losses, relying on government aid.

Insurance Coverage & Public Funding

- Well-insured assets (Power plants, Hotels) recover faster due to financial support.
- Underinsured assets (Retail, Farmland) face longer recovery times, increasing economic impact.

Government Policies & Investment

- Public investment in flood protection (e.g., roads, bridges) lowers damage risks.
- Poor land-use planning (urban floodplain expansion) raises vulnerability (e.g., Emilia-Romagna 2024 floods).

Willingness To Pay

Insurance Market Trends: A Key Factor

Germany: Flood insurance premiums in high-risk areas rose by 15%

Some insurers now require flood protection

Higher financial pressure = Higher WTP for resilience investments.

Government disaster relief reduces urgency for private investment.

Lower financial pressure = Lower WTP for flood resilience.

Land Value & Functional Use: Higher vs. Lower WTP

High-Value, High-Use Properties → Higher WTP

Low-Value, Passive-Use Land → Lower WTP

Willingness To Pay

Financial Exposure & WTP

High-Risk Sectors → Higher WTP

Highways in Bavaria (2024 Floods): 120 km damaged (€2B repair cost).

Low-Risk Sectors → Lower WTP

Vineyards in Po Valley (€1.50/m² land value).

Prevention: €50K/hectare (irrigation).

Conclusions and recomendations

Flood Hazards and Infrastructure Resilience in Germany & Italy

- Flooding poses a major threat to infrastructure in Germany and Italy, with impacts varying across sectors.
- High-risk assets like highways, agricultural land, and non-residential buildings are more vulnerable, while reinforced structures (e.g., bridges, elevated highways) exhibit greater resilience.
- This analysis supports Eoliann's efforts in climate risk modeling and data-driven flood mitigation strategies for policymakers, insurers, and infrastructure owners.

Recommendations

- Incorporate Infrastructure-Specific Resilience Scores.
- Use historical flood data for improved risk assessment.
- Develop an Economic Risk Indicator (WTP).
- Support Policy & Investment Prioritization.

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