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The impacts of extreme weather events on the Socioeconomics

- A case study in Southeast Asian region

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Methods of Advanced Data Engineering Summer 2024

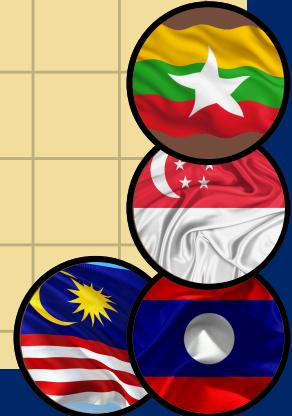


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1. Introduction

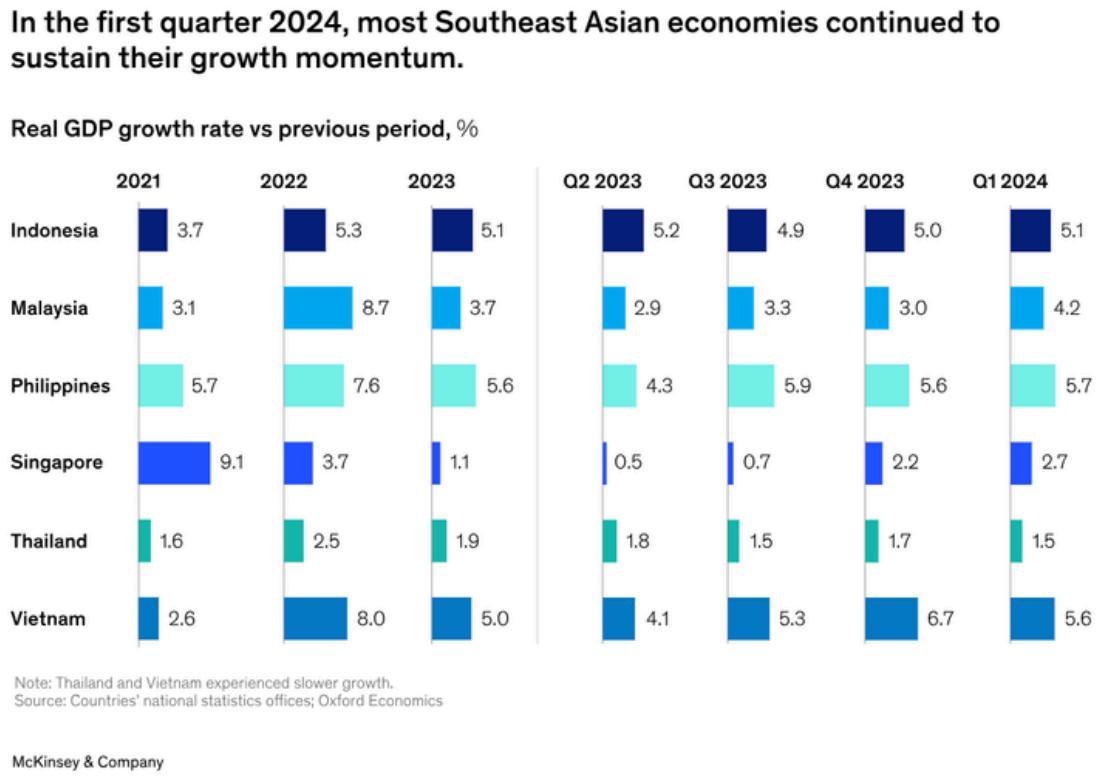
Nowadays, Southeast Asia has emerged as a region of significant development and economic success. However, it faces a prominent challenge: it is one of the world's most vulnerable to the impacts of climate change and natural disasters. Possible reasons:

- low-lying land susceptible to rising sea levels
- high frequency of floods and droughts
- large populations at risk
- limited community resilience



Objectives:

- Identify the countries most affected by extreme weather events
- Examine the impacts of extreme weather events on the socioeconomic



Source: <https://www.mckinsey.com/featured-insights/future-of-asia/southeast-asia-quarterly-economic-review>

Questions for the project

- 1. “What are the patterns in the occurrence of extreme weather events and the socioeconomic status of Southeast Asian countries?”**
- 2. “How do disaster risks impact the socioeconomic landscape of Southeast Asian countries?”**



2. Datasets

1. Southeast Asian extreme weather events

- Metadata URL: <https://data.opendvelopmentmekong.net/dataset/disaster-in-southeast-asia-from-1900-to-2021>
- Characteristics after transformation: 2738 rows and 26 columns
- Data Type: CSV
- License: [CC BY-SA 4.0 DEED License](#)

Derived from The International Disaster Database (EM-DAT), the dataset was refined to include a total of 2,738 extreme weather events in Southeast Asia from 1902 to 2021. It contains originally 52 standard attributes.

2. Southeast Asian socioeconomic indicators

- Metadata URL: <https://www.kaggle.com/datasets/mjshri23/life-expectancy-and-socio-economic-worldbank>
- Characteristics after transformation: 152 rows and 14 columns
- Data Type: CSV
- License: [World Bank Dataset Terms of Use](#)

This dataset includes 19 years data of multiple countries. It provides significant socioeconomic indicators and contains minimal missing values, playing a crucial role in addressing the given questions.

3. Southeast Asian disaster risk

- Metadata URL: <https://data.humdata.org/dataset/worldriskindex?>
- Data Type: CSV
- Characteristics after transformation: 264 rows and 9 columns
- License: [Creative Commons Attribution International](#)

The dataset was aggregated from World Risk Index (WRI) Meta Data. It integrates a country's physical exposure to extreme weather events with its societal vulnerability.

3. ETL Pipeline & Output

Extract: create 2 functions

`extract_csv_data`: download CSV dataset from website

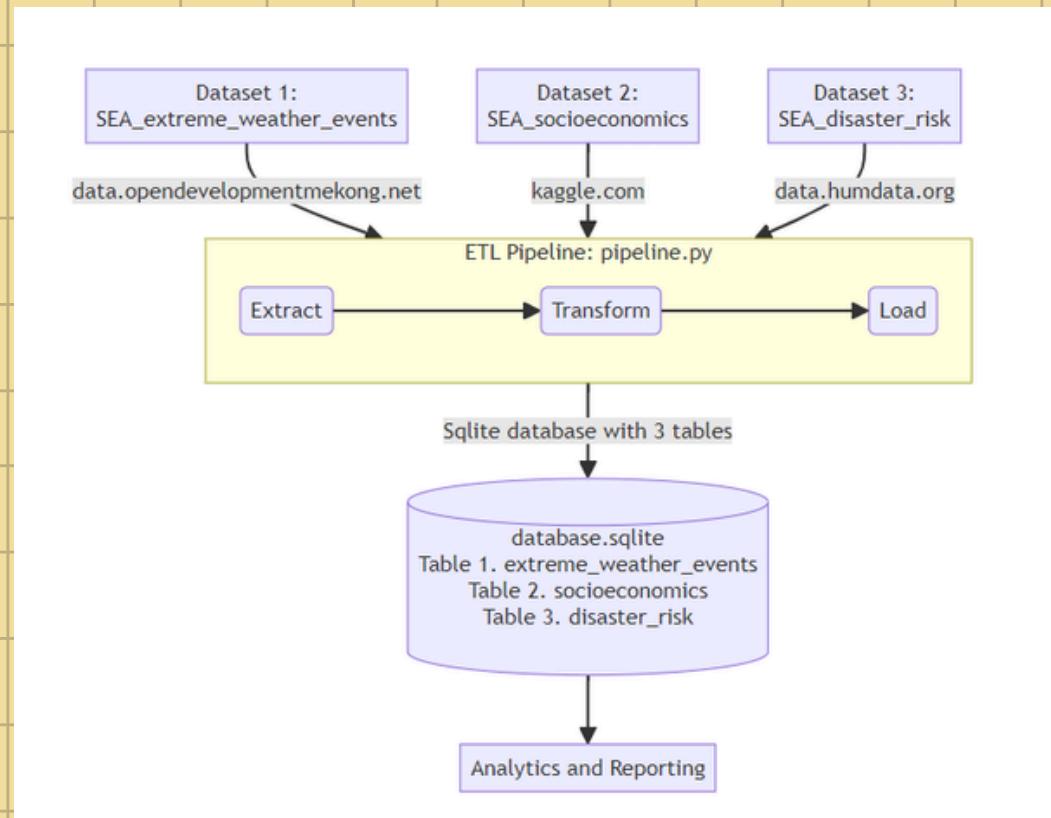
`extract_data_from_kaggle`: download zip file and extract from kaggle

Transform:

Rename columns name, drop and change columns, include only countries within Southeast Asia region, refill missing values

Load:

Load transformed datasets into a storage destination `database.sqlite`



Output Sqlite database

extreme_weather_events

```
1 import pandas as pd
2 import sqlite3
3 db_path = '../data/database.sqlite'
4 conn = sqlite3.connect(db_path)
5 cursor = conn.cursor()
6 df_events = pd.read_sql_query("SELECT * FROM extreme weather events", conn)
7 df_events.head()
```

	SELECT * FROM extreme_weather_events														Schema	Query Editor	Auto Reload	Find	Other Tools...	SQLite 3.46.0
	Year BIGINT ↑	Seq BIGINT	Disaster Group TEXT	Disaster Subgroup TEXT	Disaster Type TEXT	Disaster Subtype TEXT	Event Name TEXT	Country TEXT	Country Code TEXT	Location TEXT	Origin TEXT	Associated Dis TEXT	Appeal TEXT	Declaration TEXT	Aid Contribution FLOAT	Dis Mag Value FLOAT				
1	1902	5	Natural	Meteorological	Storm	Tropical cycl...	NULL	Myanmar	MMR	Rangoon	NULL	NULL	NULL	NULL	NULL	NULL				
2	1905	4	Natural	Meteorological	Storm	Tropical cycl...	NULL	Philippines	PHL	Central	NULL	NULL	NULL	NULL	NULL	NULL				
3	1909	2	Natural	Biological	Epidemic	Bacterial dis...	Bubonic	Indonesia	IDN	NULL	NULL	NULL	NULL	NULL	NULL	NULL				
4	1911	1	Natural	Geophysical	Volcanic activity	Ash fall	Mount Taal	Philippines	PHL	Manilla region	NULL	NULL	No	No	NULL	NULL				
5	1912	10	Natural	Meteorological	Storm	Tropical cycl...	NULL	Philippines	PHL	Cebu	NULL	NULL	NULL	NULL	NULL	NULL				
6	1913	27	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Sangihe Isl.	NULL	Tsunami/-	NULL	NULL	NULL	8.0				
7	1914	22	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Kepahyang, Ben...	NULL	Tsunami/-	NULL	NULL	NULL	8.0				
8	1917	3	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Bali	NULL	NULL	NULL	NULL	NULL	7.0				
9	1918	11	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Philippines	PHL	Mindanao, Sout...	NULL	Tsunami/-	NULL	NULL	NULL	8.0				
10	1919	1	Natural	Geophysical	Volcanic activity	Ash fall	Mt. Kelud	Indonesia	IDN	Small Island b...	NULL	NULL	No	No	NULL	NULL				
11	1923	4	Natural	Meteorological	Storm	Tropical cycl...	NULL	Myanmar	MMR	Maungdaw	NULL	NULL	NULL	NULL	NULL	NULL				
12	1924	7	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Wonosobo (Cent...	NULL	NULL	NULL	NULL	NULL	NULL				
13	1924	12	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Java	NULL	NULL	NULL	NULL	NULL	NULL				
14	1925	10	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Philippines	PHL	W. Luzo Isl.	NULL	Tsunami/-	NULL	NULL	NULL	7.0				
15	1926	5	Natural	Meteorological	Storm	Tropical cycl...	NULL	Myanmar	MMR	Arrakan	NULL	NULL	NULL	NULL	NULL	NULL				
16	1927	14	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Indonesia	IDN	Sulawesi, Dong...	NULL	Tsunami/-	NULL	NULL	NULL	6.0				
17	1928	12	Natural	Geophysical	Earthquake	Tsunami	NULL	Indonesia	IDN	Flores sea	Volac...	NULL	No	No	NULL	3.0				
18	1930	3	Natural	Geophysical	Volcanic activity	Ash fall	Mt. Merapi	Indonesia	IDN	Java Island	NULL	NULL	NULL	NULL	NULL	NULL				
19	1930	6	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Myanmar	MMR	Pegu, Rangoon	NULL	Tsunami/-	NULL	NULL	NULL	8.0				
20	1930	17	Natural	Geophysical	Earthquake	Ground moveme...	NULL	Myanmar	MMR	Nyauglebin, To...	NULL	NULL	NULL	NULL	NULL	7.0				

Output Sqlite database

socioeconomics

SELECT * FROM socioeconomics														SQLite 3.46.0
	Country TEXT	Country Code TEXT	IncomeGroup TEXT	Year BIGINT	Life Expectancy World Bank FLOAT	Prevalence of Undernourishment FLOAT	CO2 FLOAT	Health Expenditure % FLOAT	Education Expenditure % FLOAT	Unemployment FLOAT	Sanitation FLOAT	Injuries FLOAT	Communicable FLOAT	NonCommunicable FLOAT
1	Indonesia	IDN	Lower middle income	2001	66.037	19.2	302060.0	2.11850...	2.46003007...	6.07999992370...	58.92317706	6996569.3	30881627.35	41520804.67
2	Cambodia	KHM	Lower middle income	2001	59.335	23.6	2150.0	7.01192...	1.72221994...	1.03299999237...	58.92317706	575530.43	3831903.27	2432916.2
3	Myanmar	MMR	Lower middle income	2001	60.377	37.6	8350.0	2.14881...	4.60334491...	0.67400002479...	58.92317706	2642483.37	13438452.76	11950793.29
4	Malaysia	MYS	Upper middle income	2001	72.782	2.5	129460.0	2.67539...	7.48446989...	3.52999997138...	65.8615045	675010.81	1040202.68	3668019.93
5	Philippines	PHL	Lower middle income	2001	68.835	18.7	70480.0	2.84775...	2.92463994...	3.70000004768...	43.52262482	2887545.85	9955777.05	13181817.63
6	Singapore	SGP	High income	2001	78.25121951219...	18.0	42030.0	3.16302...	3.54249000...	3.75999999046...	100.0	84897.01	63745.56	602137.61
7	Thailand	THA	Upper middle income	2001	70.832	17.3	173160.0	3.02623...	4.81787014...	2.59999990463...	20.05491674	3853836.67	4314043.74	11879825.13
8	Vietnam	VNM	Lower middle income	2001	73.228	19.7	56720.0	4.51130...	3.73178005...	2.75999999046...	29.8515470025	2704748.48	5466480.61	12763734.45
9	Indonesia	IDN	Lower middle income	2002	66.321	19.1	305640.0146...	1.98062...	2.64568996...	6.59999990463...	39.648177265	6843320.92	30124966.45	42387112.22
10	Cambodia	KHM	Lower middle income	2002	60.283	21.2	2210.000038...	7.23566...	1.71121001...	1.09700000286...	49.4448075275	577266.37	3617795.69	2467339.87

disaster_risk

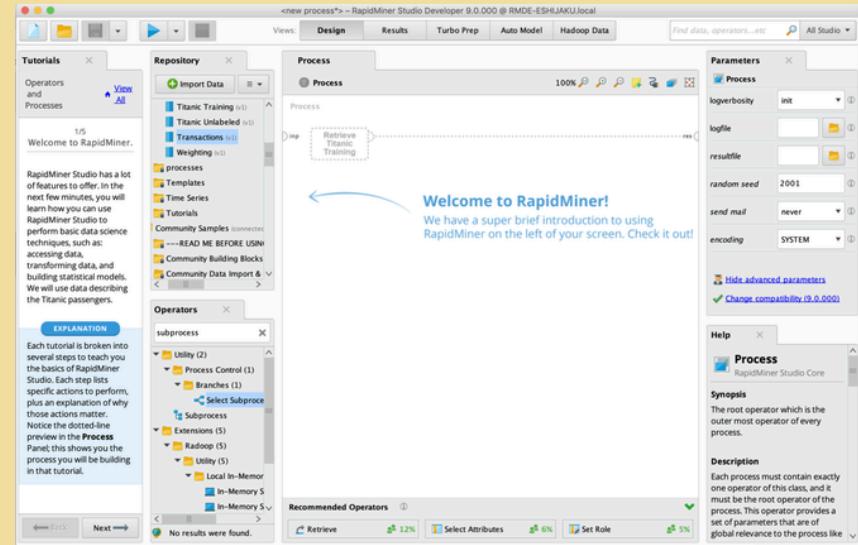
SELECT * FROM disaster_risk									SQLite 3.46.0
	Country TEXT	Country Code TEXT	Year BIGINT ↑	World Risk Index FLOAT	Exposure FLOAT	Vulnerability FLOAT	Susceptibility FLOAT	Lack of Coping Capabilities FLOAT	Lack of Adaptive Capabilities FLOAT
1	Brunei Darussalam	BRN	2000	1.35	0.33	5.55	5.68	2.45	12.26
2	Cambodia	KHM	2000	10.63	2.49	45.34	25.0	65.02	57.33
3	Indonesia	IDN	2000	41.63	39.31	44.09	29.26	56.61	51.73
4	Lao People's DR	LAO	2000	3.56	0.38	33.4	39.91	14.49	64.42
5	Malaysia	MYS	2000	13.05	8.56	19.89	22.63	9.95	34.94
6	Myanmar	MMR	2000	36.94	23.58	57.87	55.54	57.85	60.32
7	Philippines	PHL	2000	44.97	40.62	49.79	38.95	56.21	56.37
8	Singapore	SGP	2000	0.6	0.15	2.39	2.61	0.71	7.34
9	Thailand	THA	2000	22.84	13.79	37.84	43.74	47.48	26.08
10	Timor-Leste	TLS	2000	7.89	2.8	22.22	57.39	3.2	59.75

4. Data Analysis



seaborn

matplotlib



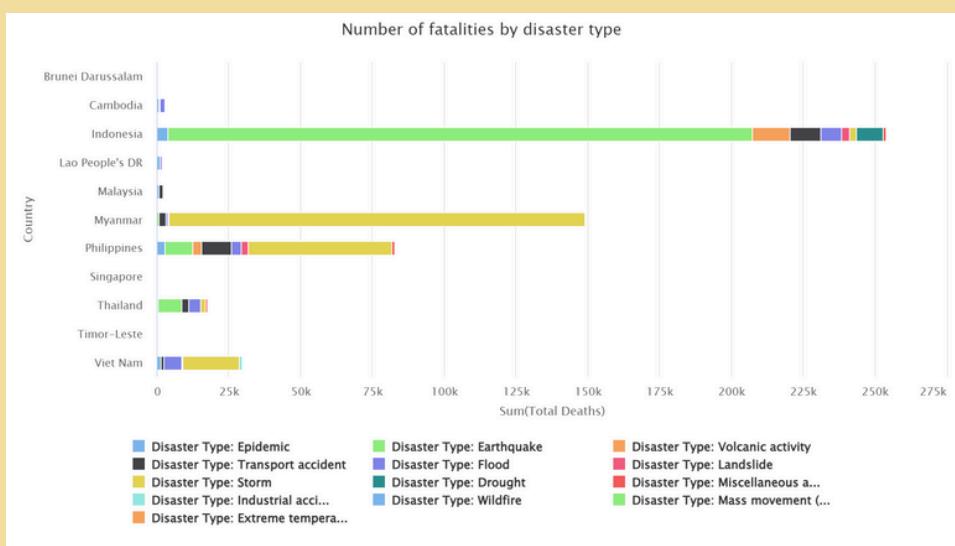
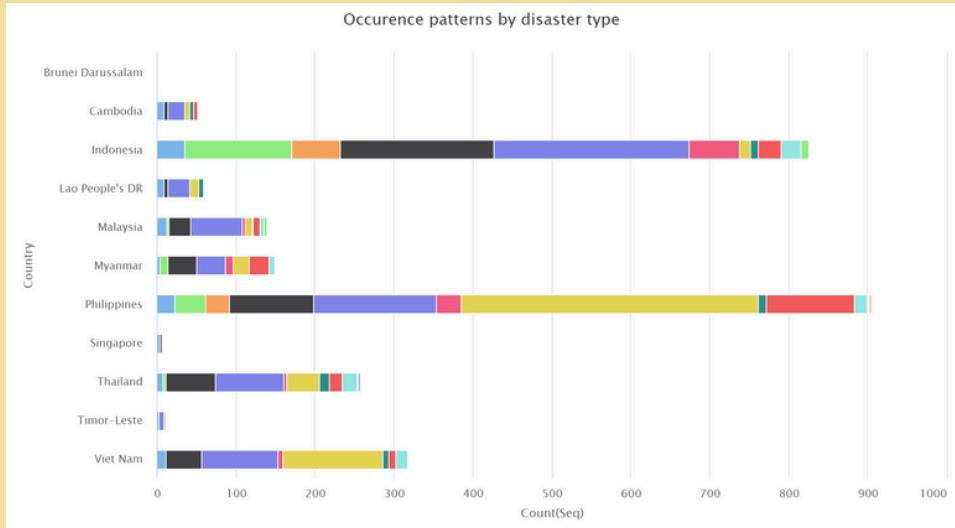
RAPIDMINER

Visualization technologies applied in the project

What are the patterns in the occurrence of extreme weather events and the socioeconomic status of Southeast Asian countries?

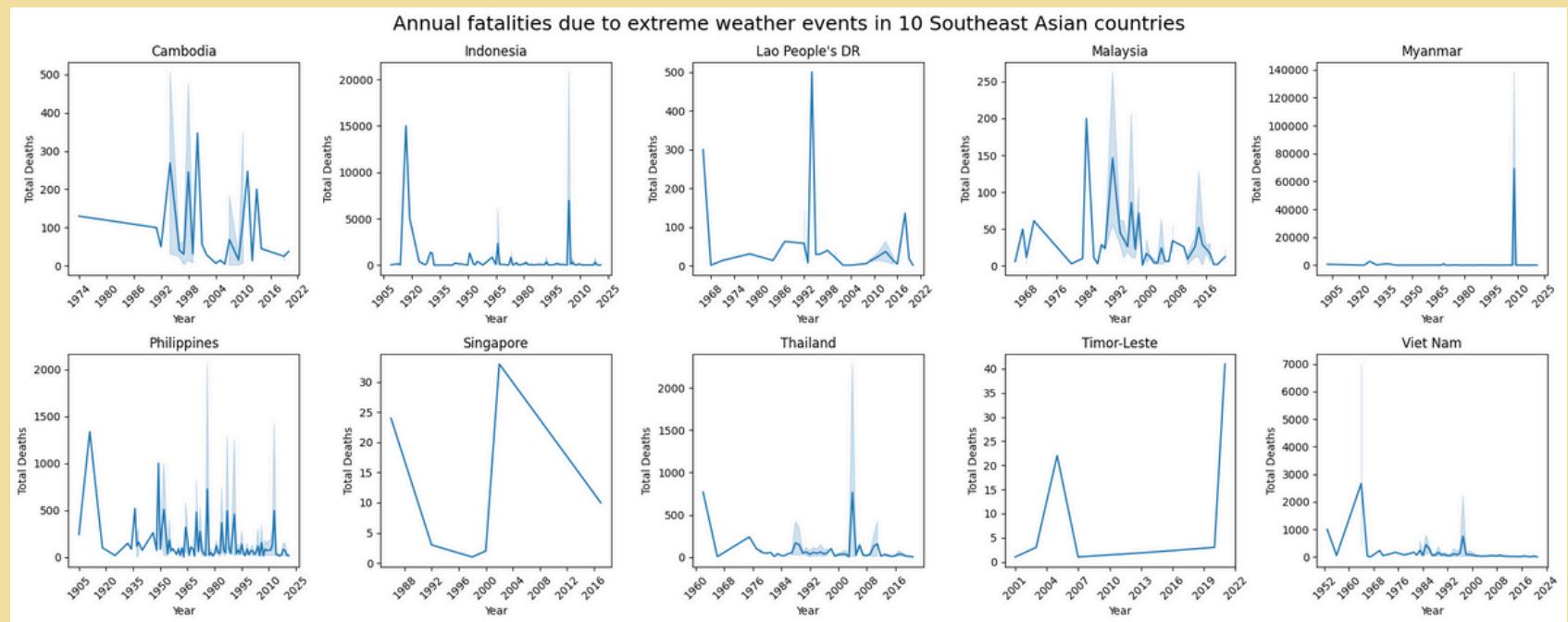
Key observations:

- Indonesia and the Philippines experienced the highest overall number of disaster occurrences
- Indonesia stands out with the highest overall number of total fatalities, primarily due to earthquakes and volcanic eruptions
- Myanmar is the second highest in total fatalities, mainly caused by storms, followed by the Philippines in the third place
- Singapore, Malaysia, Brunei, Timor-Leste have low numbers of fatalities
- Floods are the most common disaster type across most countries



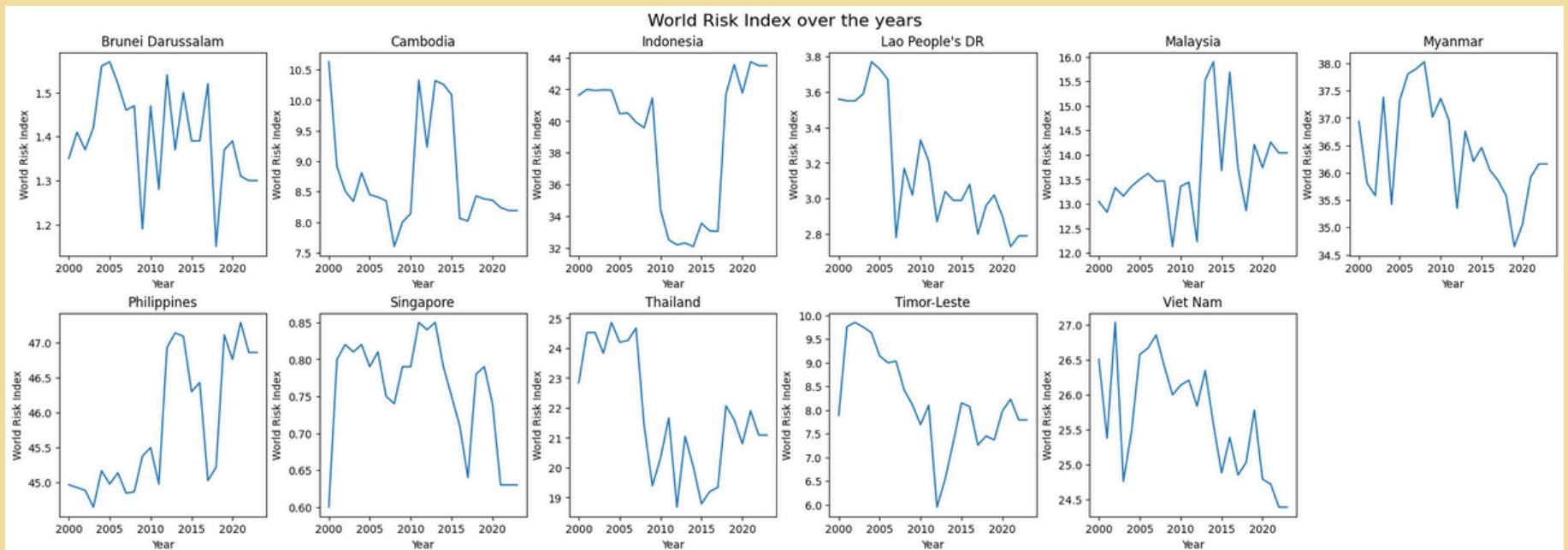
What are the patterns in the occurrence of extreme weather events and the socioeconomic status of Southeast Asian countries?

- Myanmar had the highest number of fatalities in 2010, mainly caused by storms
- Indonesia was the second highest in total fatalities in 2010, primarily due to earthquakes and volcanic eruptions



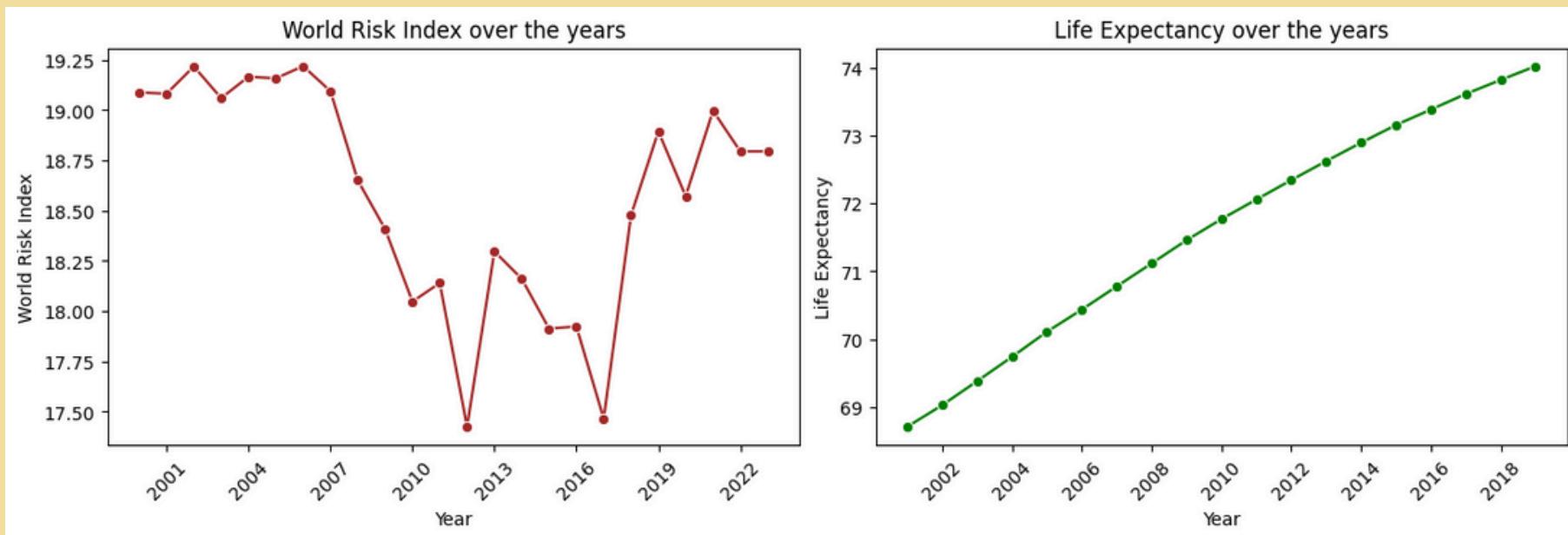
What are the patterns in the occurrence of extreme weather events and the socioeconomic status of Southeast Asian countries?

- Indonesia and the Philippines show the highest overall WRI, reflecting its vulnerability to natural hazards
- Singapore and Brunei with fewer disaster occurrences, maintain the two lowest WRI



How do disaster risks impact the socioeconomic landscape of Southeast Asian countries?

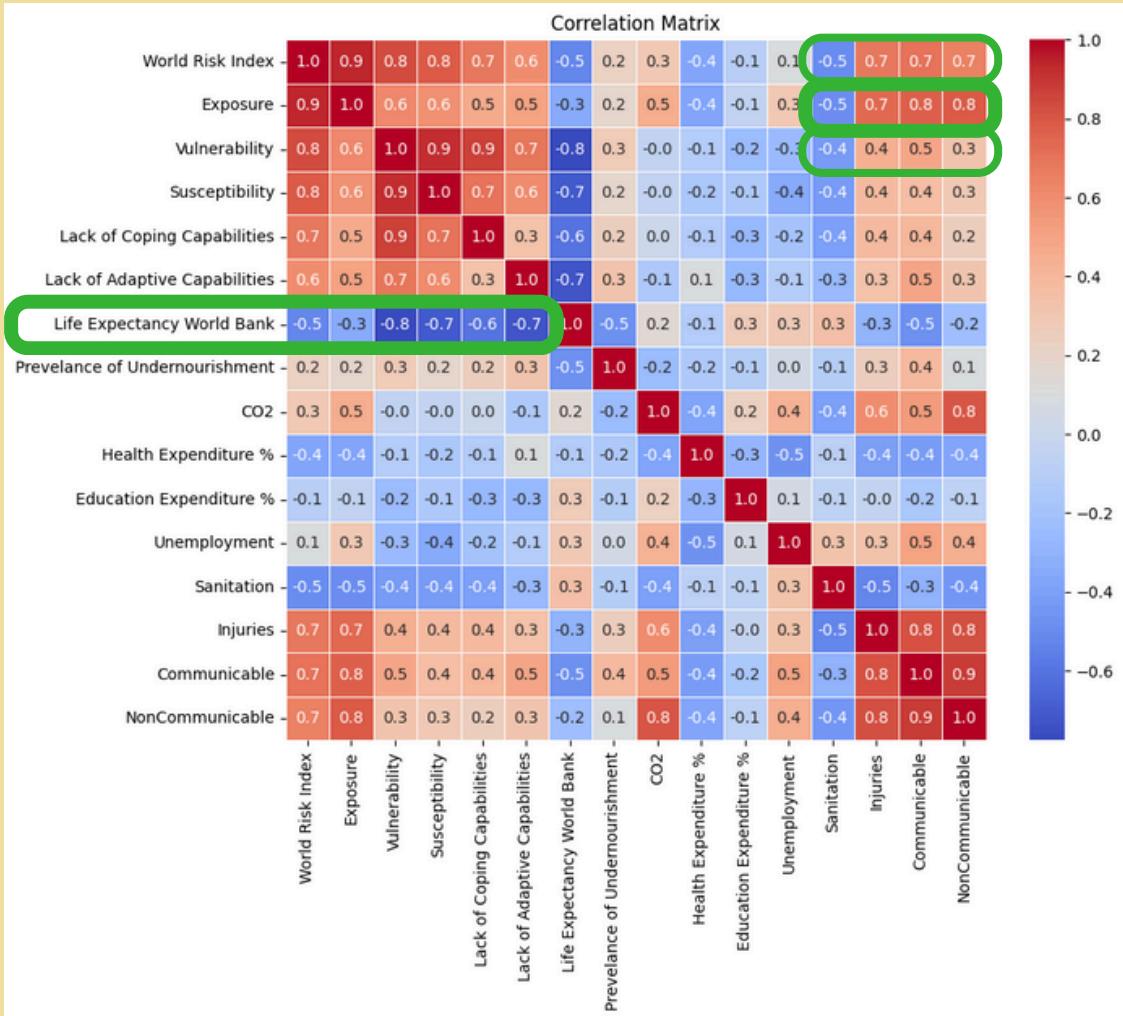
- The plots do not reveal a direct correlation between the World Risk Index and life expectancy. Despite fluctuations in WRI, life expectancy continues to rise steadily over the years
- Other factors, such as advancements in healthcare, sanitation, and living standards, should be considered other than WRI



Correlation between disaster risks and the socioeconomic landscape

Key observations:

- Life expectancy exhibits a negative correlation with the World Risk Index (-0.5) and its components: exposure (-0.3), vulnerability (-0.8), susceptibility (-0.7), lack of coping capabilities (-0.6), and lack of adaptive capacities (-0.7)
- Countries with higher disaster risks tend to have lower life expectancies
- The strong positive correlations between Exposure and Injuries (0.7) and Communicable Diseases (0.8) indicate a significant proportion of injuries which can be directly attributed to hazard exposure
- Disasters do directly cause NCDs like heart disease and cancer, but can worsen these conditions and increase the risk of developing them



NCDs: Non-communicable diseases

5. Conclusion

Overview

Unequal distribution in the region:

- Countries like Indonesia and the Philippines experience significantly higher disaster occurrences compared to others like Singapore, Brunei or Laos, probably due to economy and geographical location
- The need for tailored approaches to disaster risk reduction and policy management for these two vulnerable island countries

Reduce exposure to hazards:

- In Myanmar, a strong infrastructure as building storm-resistant housing should be considered to reduce damage and casualties

Prioritizing health and resilience:

- Correlation analysis shows relationships between disaster risks and investments in health and education
- Focus investments on these two while mitigating natural hazards can reduce WRI, exposure, and improve other socioeconomic indicators

Limitation

- Data completeness: in extreme weather events dataset, there are many missing values, which affects the accuracy of data analysis and visualization
- Data timeliness: the datasets cover limited timeframes



Topics for further research

- Different policy interventions for disaster risks and their potential unintended consequences to the socioeconomics
- The specific factors contributing to the variations in the World Risk Index and the detailed relationship between disaster risks and life expectancy
- The specific factors that contribute to extreme weather events in Southeast Asian region (economy, geography, location, education, government system, politics...)

Thank you for reading!