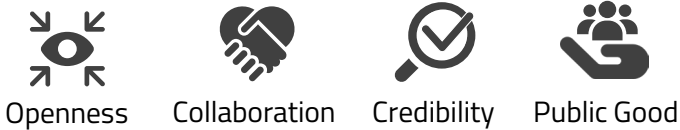


EARTHQUAKE VULNERABILITY AND SYSTEMIC RISK ASSESSMENT IN BANGLADESH

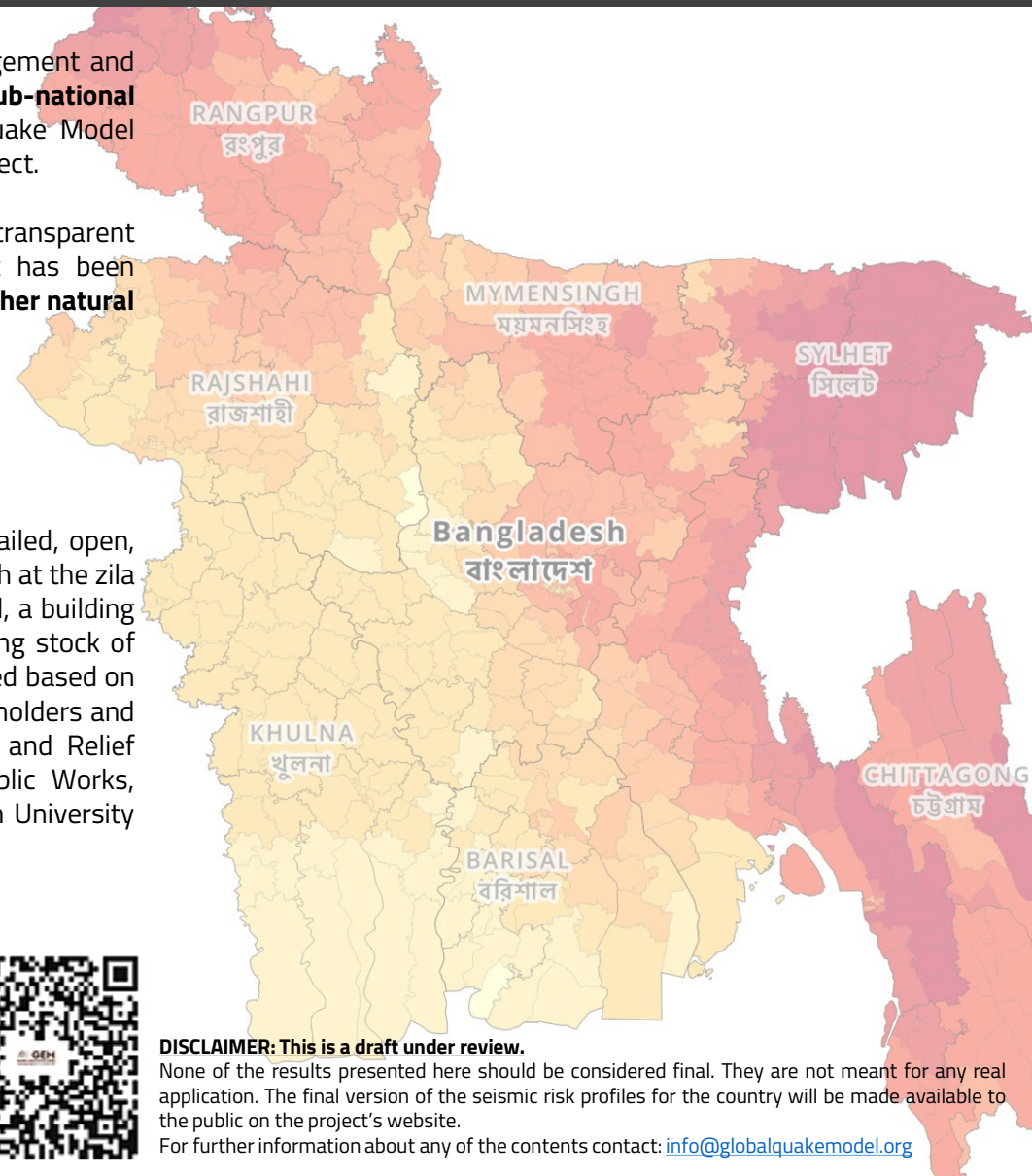
www.globalquakemodel.org/project/bangladesh

Following a specific support request made by the Ministry of Disaster Management and Relief (MoMDR) to the UN Office for Disaster Risk Reduction (UNDRR) for a **sub-national earthquake hazard and risk assessment in Bangladesh**, the Global Earthquake Model (GEM) Foundation was chosen to take the lead on the technical work for the project.

GEM is a non-profit, scientific, public-private partnership developing transparent earthquake risk assessment resources for worldwide risk management. It has been fostering collaborations for **a world that is more resilient to earthquakes and other natural hazards** for the past 15 years guided by four core values:



This booklet summarises the achievements of the project in developing a detailed, open, sub-national earthquake risk model and in evaluating seismic risk for Bangladesh at the zila and upazila levels. The risk model includes a probabilistic seismic hazard model, a building exposure model, and a seismic fragility and vulnerability model for the building stock of Bangladesh. Additionally, it incorporates critical scenarios for key cities, identified based on the results of the probabilistic risk assessment in consultation with local stakeholders and experts, overseen by a panel led by the Ministry of Disaster Management and Relief (MoMDR), including representatives from the Ministry of Housing and Public Works, Bangladesh Bureau of Statistics, Geological Survey of Bangladesh, Bangladesh University of Engineering and Technology, and University of Dhaka.



UNITED NATIONS
BANGLADESH



UNDRR

UN Office for Disaster Risk Reduction



GEM

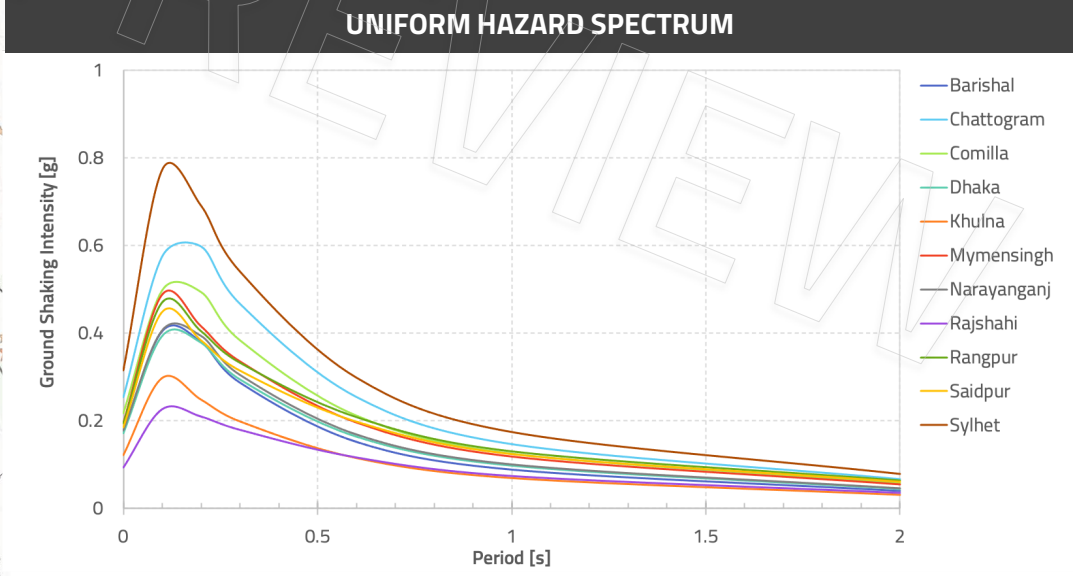
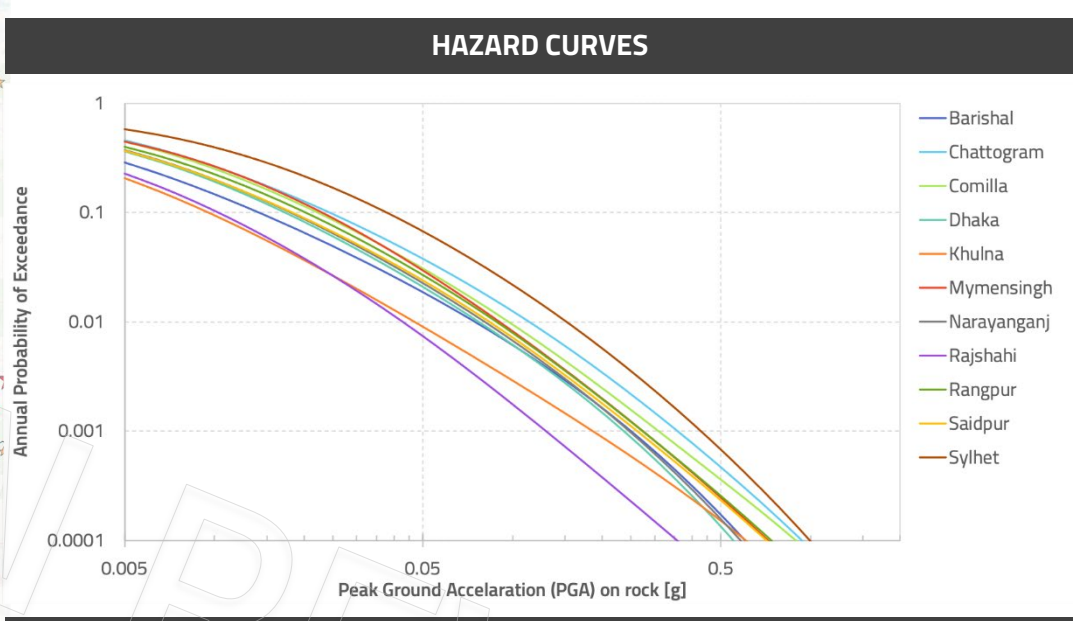
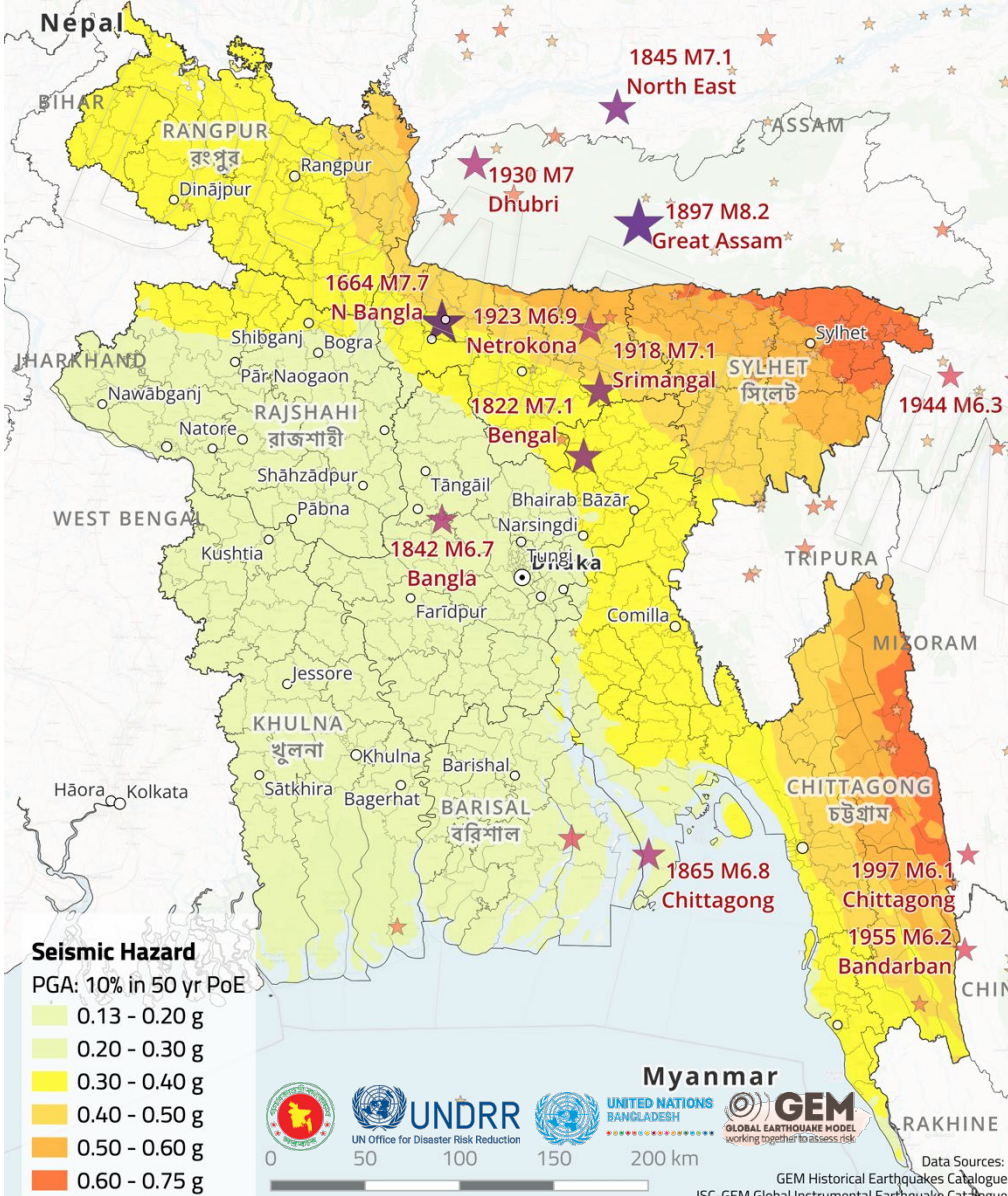
GLOBAL EARTHQUAKE MODEL
working together to assess risk



DISCLAIMER: This is a draft under review.

None of the results presented here should be considered final. They are not meant for any real application. The final version of the seismic risk profiles for the country will be made available to the public on the project's website.

For further information about any of the contents contact: info@globalquakemodel.org





গণপ্রজাতন্ত্রী বাংলাদেশ
REPUBLIC OF BANGLADESH
EXPOSURE MODEL



Population
170 Million



Residential
buildings
30.1 Million



Commercial
buildings
470,800



Industrial
buildings
101,100



Educational
buildings
260,000

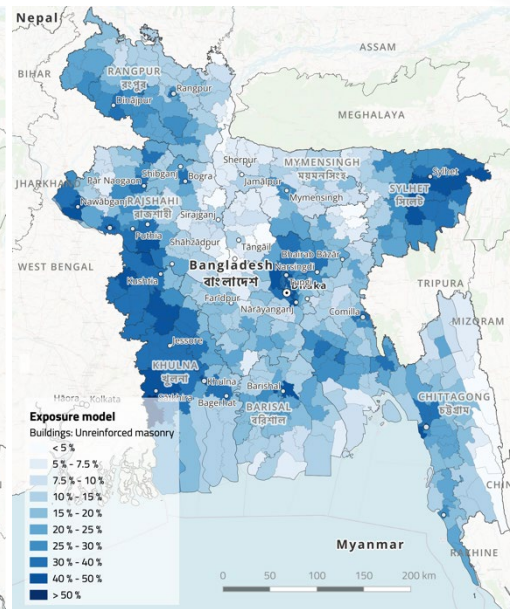
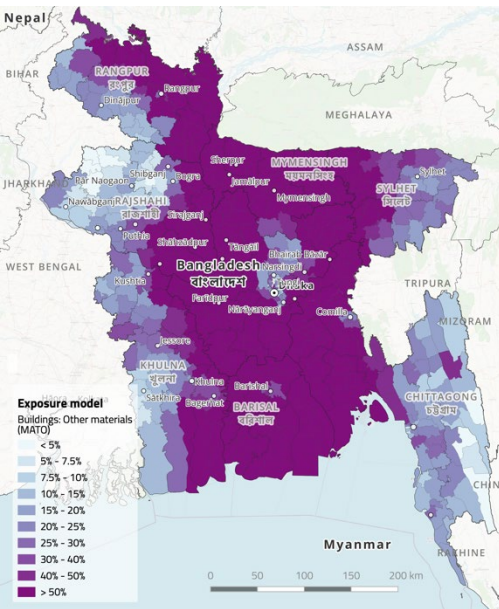
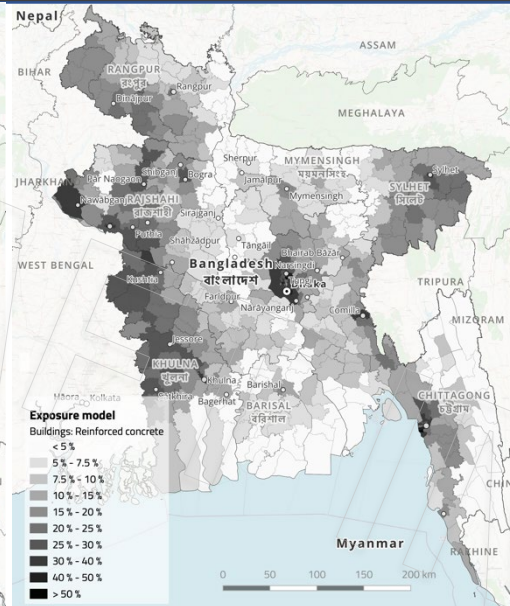
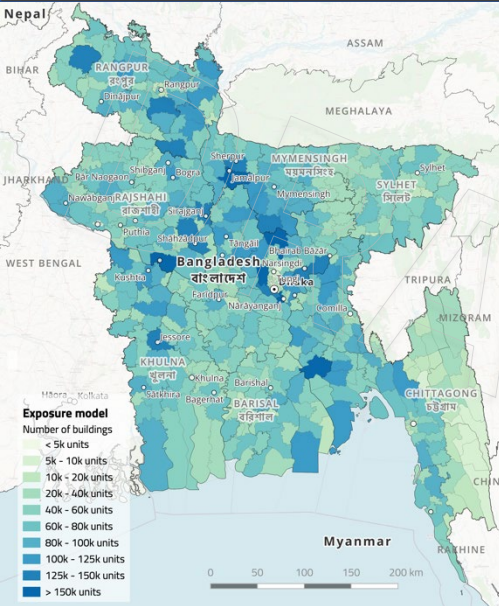


Healthcare
facilities
34,300



Exposed value
\$420 Billion USD

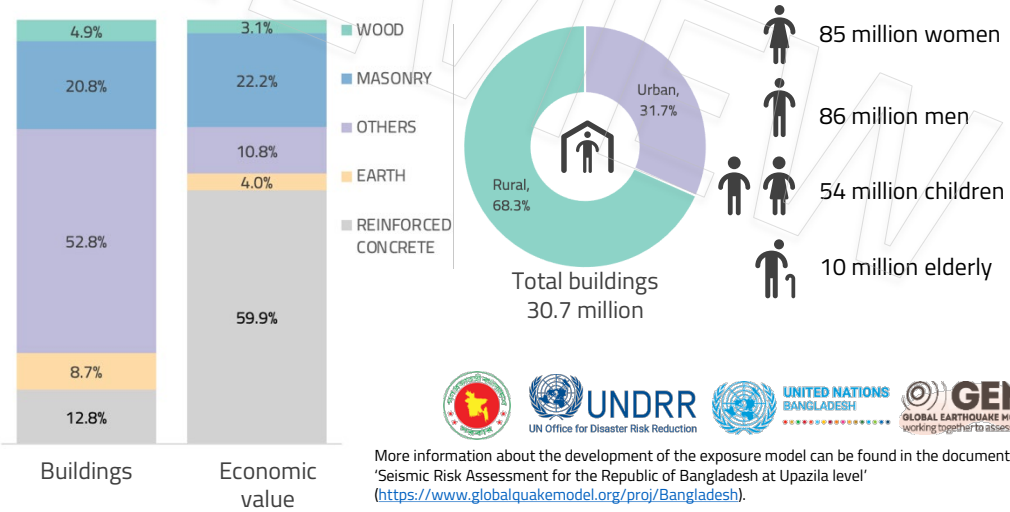
NATIONAL BUILDING INVENTORY



EXPOSURE MODEL FOR THE 15 MOST POPULATED ZILAS

Zila	Population (Thousand)	Building units (Thousands)	Economic value (Million USD)
Dhaka	14,274 (8.4%)	1,225 (4.0%)	68,723 (16.4%)
Chattogram	9,332 (5.5%)	1,258 (4.1%)	30,723 (7.3%)
Cumilla	6,432 (3.8%)	1,115 (3.6%)	12,994 (3.1%)
Mymensingh	6,105 (3.6%)	1,261 (4.1%)	12,236 (2.9%)
Gazipur	5,289 (3.1%)	703 (2.3%)	16,184 (3.9%)
Tangail	4,192 (2.5%)	901 (2.9%)	5,626 (1.3%)
Narayanganj	3,965 (2.3%)	562 (1.8%)	13,680 (3.3%)
Sylhet	3,953 (2.3%)	564 (1.8%)	9,089 (2.2%)
Bogura	3,884 (2.3%)	820 (2.7%)	10,806 (2.6%)
Noakhali	3,751 (2.2%)	698 (2.3%)	5,114 (1.2%)
Sirajganj	3,494 (2.1%)	771 (2.5%)	5,405 (1.3%)
Dinajpur	3,450 (2.0%)	653 (2.1%)	10,377 (2.5%)
Brahmanbaria	3,431 (2.0%)	582 (1.9%)	5,908 (1.4%)
Kishoreganj	3,386 (2.0%)	629 (2.0%)	4,561 (1.1%)
Rangpur	3,294 (1.9%)	731 (2.4%)	8,772 (2.1%)

BUILDING AND POPULATION CHARACTERISTICS



More information about the development of the exposure model can be found in the document 'Seismic Risk Assessment for the Republic of Bangladesh at Upazila level' (<https://www.globalquakemodel.org/proj/Bangladesh>).





গণপ্রজাতন্ত্রী বাংলাদেশ
 REPUBLIC OF BANGLADESH
 EARTHQUAKE SCENARIOS

NATIONAL BUILDING INVENTORY



Population
170 Million



Residential
buildings
30.1 Million



Commercial
buildings
470,800



Industrial
buildings
101,100



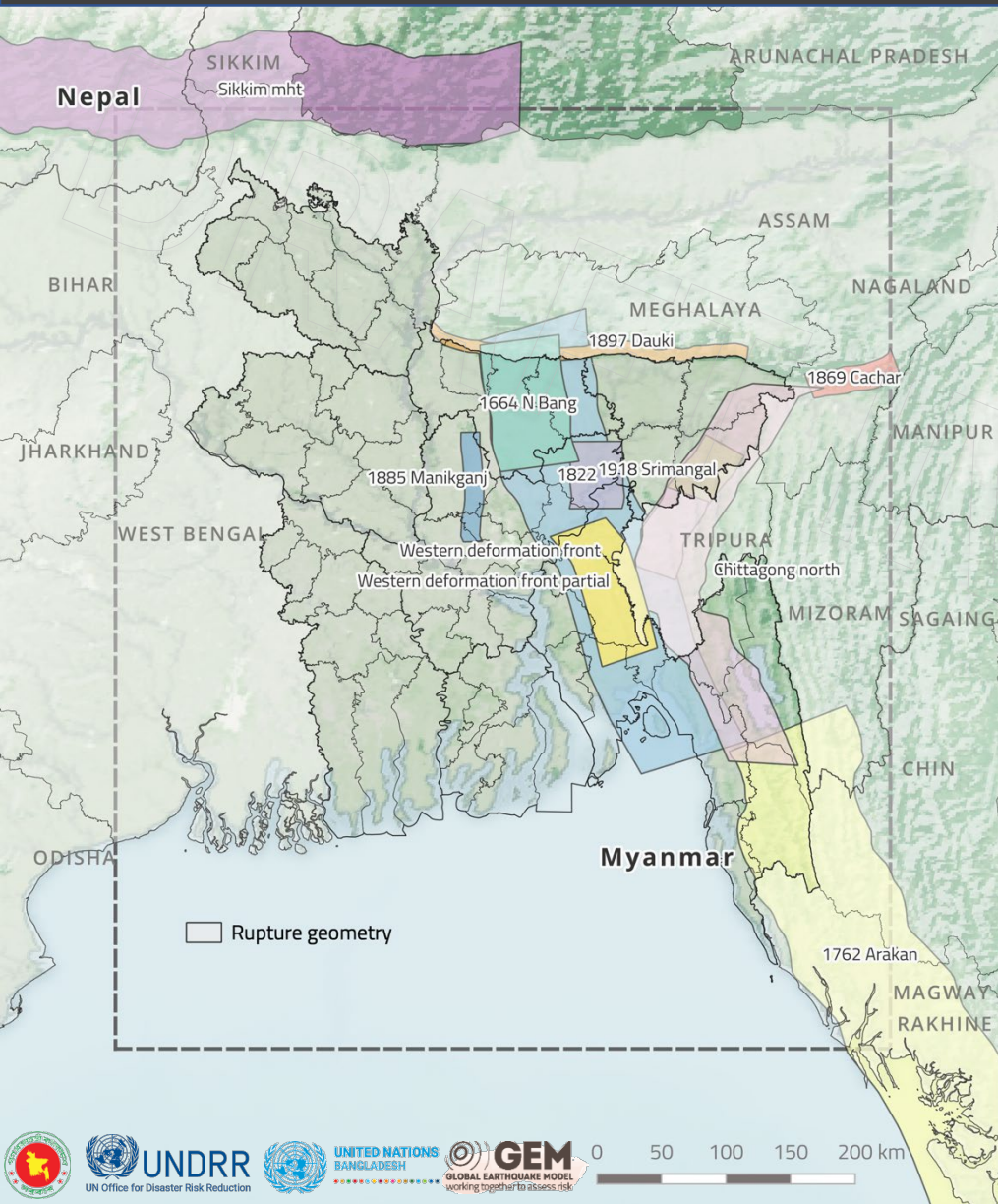
Educational
buildings
260,000



Healthcare
facilities
34,300



Exposed value
\$420 Billion USD



EARTHQUAKE SCENARIO IMPACT

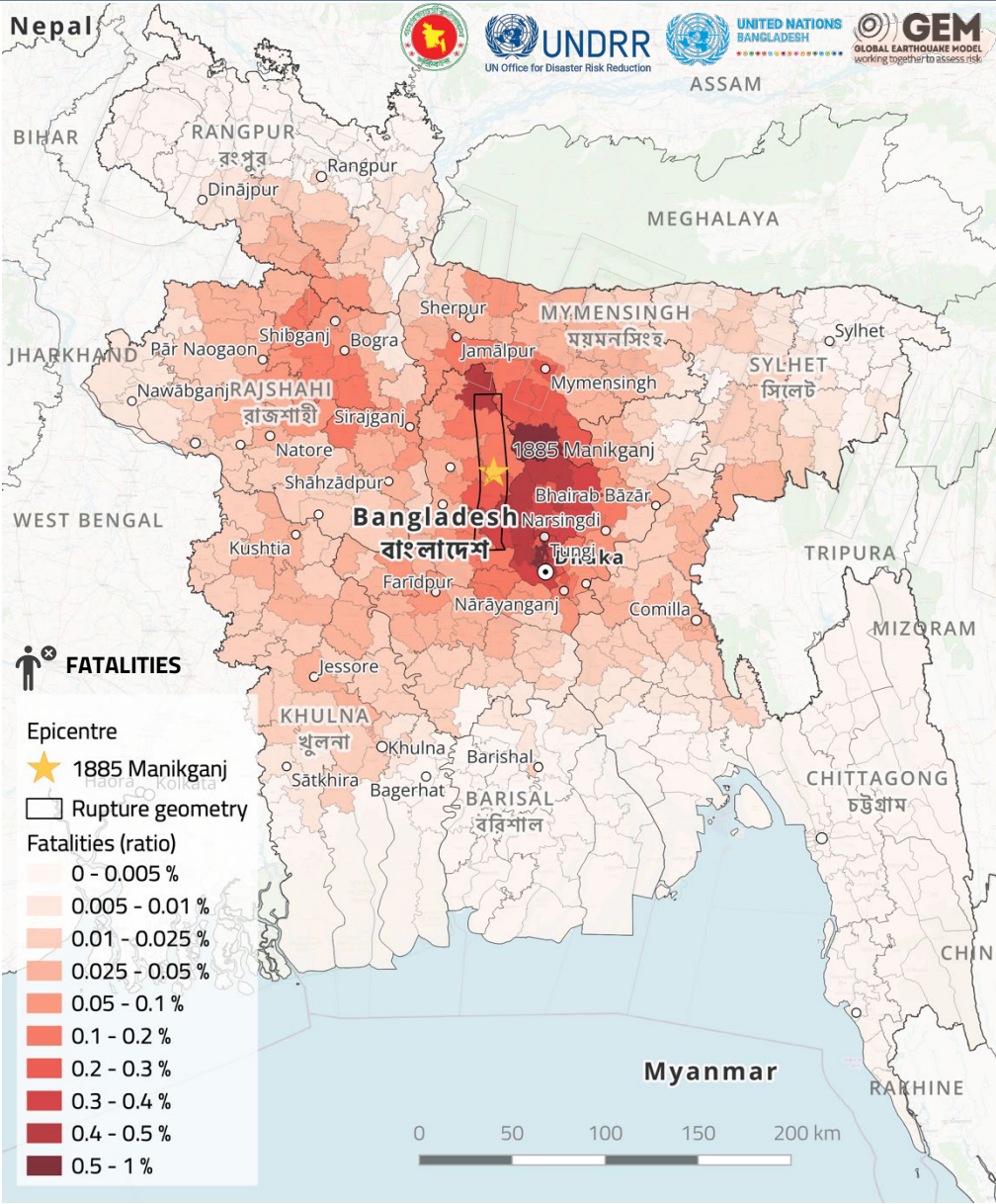
Earthquake scenario	Mw	Fatalities (Thousand)	Displaced population (Million)	Destroyed buildings (Thousand)	Economic losses (Million USD)
Western deformation front	8.5	557	45	4,306	188,007
Western deformation front partial	7.7	218	20	1,544	88,888
Chittagong north	8.2	185	16	1,442	62,163
1664 North Bangladesh	7.7	159	14	1,162	66,418
1885 Manikganj	7.2	130	12	811	59,584
1897 Dauki	8.7	128	11	1,032	48,340
1762 Arakan	8.5	87	7	661	25,520
Chittagong thrust smaller	7.25	64	6	438	29,569
1918 Srimangal	7.4	62	6	437	25,082
1822 Kishoreganj	7.1	37	4	290	16,529
Sikkim mht	8.5	13	2	150	8,347
1869 Cachar	7.3	5	1	40	3,531

Notes

- The earthquake scenarios selected include historical events as well as hypothetical events located in existing faults.
- The number of fatalities and number of displaced population assumes the occurrence of the event at night and that 100% of the population is located in residential buildings.
- The number of destroyed buildings includes the residential, industrial and commercial buildings that suffer complete damage due to ground shaking and is an indicator of physical vulnerability.
- The economic losses are only related with the physical damage of the residential, industrial and commercial buildings and their contents.
- More information about the assumptions of the seismic scenario analysis can be found in the document 'Seismic Risk Assessment for the Republic of Bangladesh at Upazila level' (<https://www.globalquakemodel.org/proj/Bangladesh>).

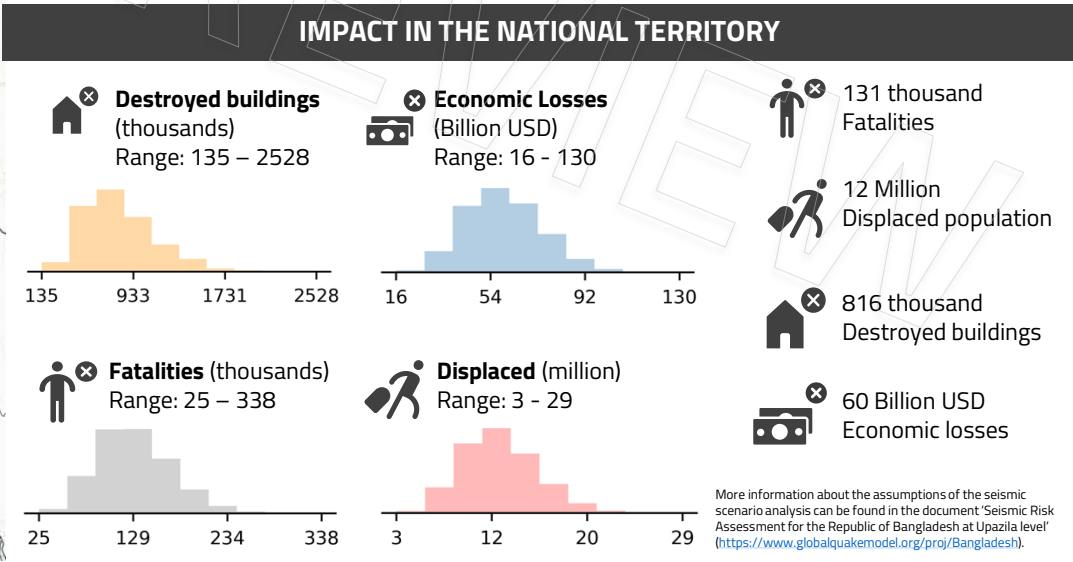


0 50 100 150 200 km

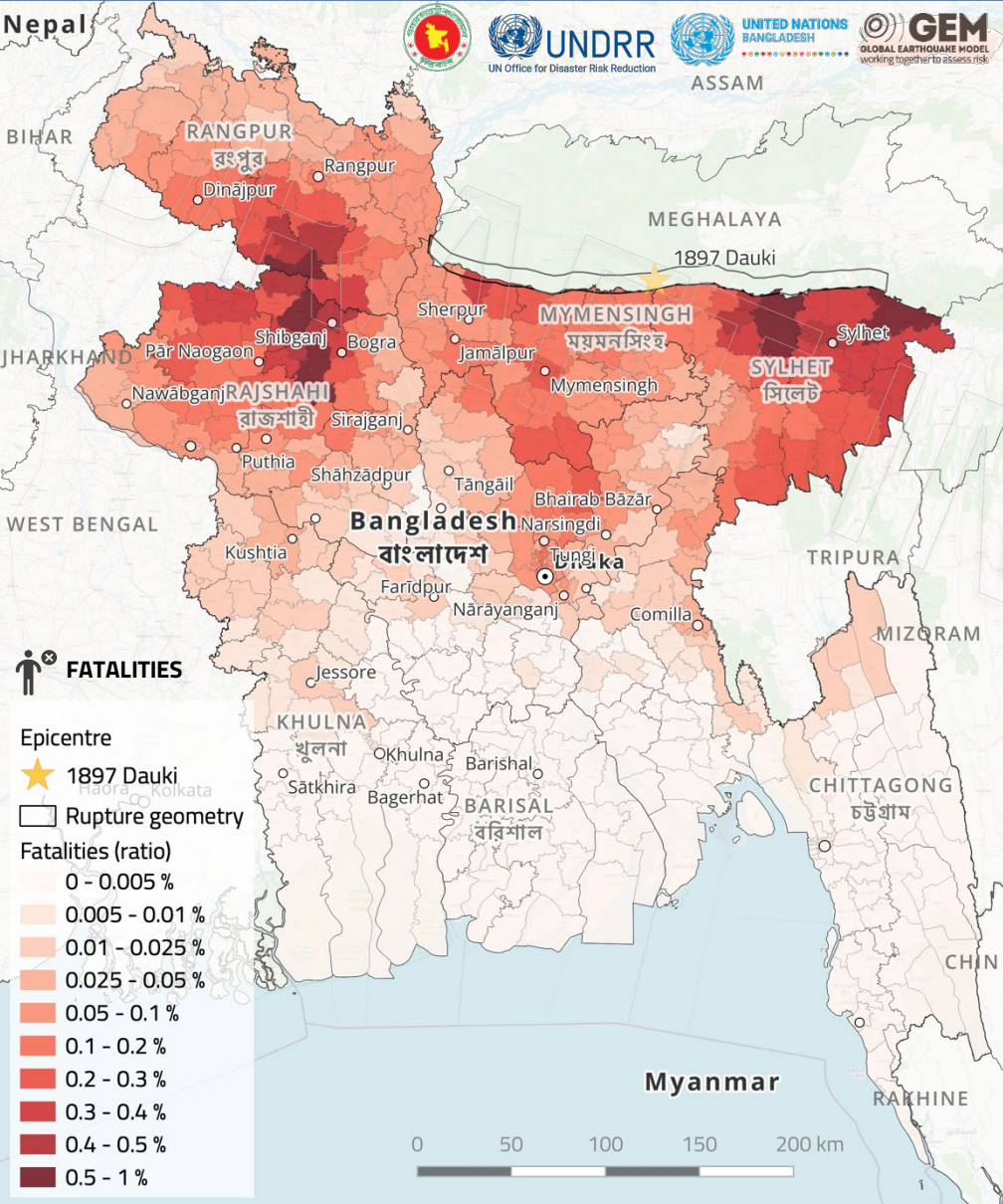


ZILAS AT HIGHEST RISK

Zila	Fatalities	Displaced population	Destroyed buildings	Economic losses (Million USD)
Dhaka	59,896	5,503,885	246,429	26,682
Gazipur	19,963	1,678,927	119,119	6,307
Mymensingh	10,643	785,019	83,466	3,678
Narayanganj	5,899	680,676	42,016	3,212
Tangail	5,707	442,363	52,857	2,093
Bogura	3,362	251,843	24,852	1,270
Narsingdi	1,876	186,126	16,019	789
Manikganj	1,842	188,542	21,150	884
Sirajganj	1,616	148,609	14,766	739
Jamalpur	1,488	154,640	15,964	799
Cumilla	1,404	193,370	11,435	1,019
Faridpur	975	129,761	10,172	566
Naogaon	953	76,965	6,924	467
Kishoreganj	864	112,634	8,347	501
Jashore	784	105,551	6,539	722

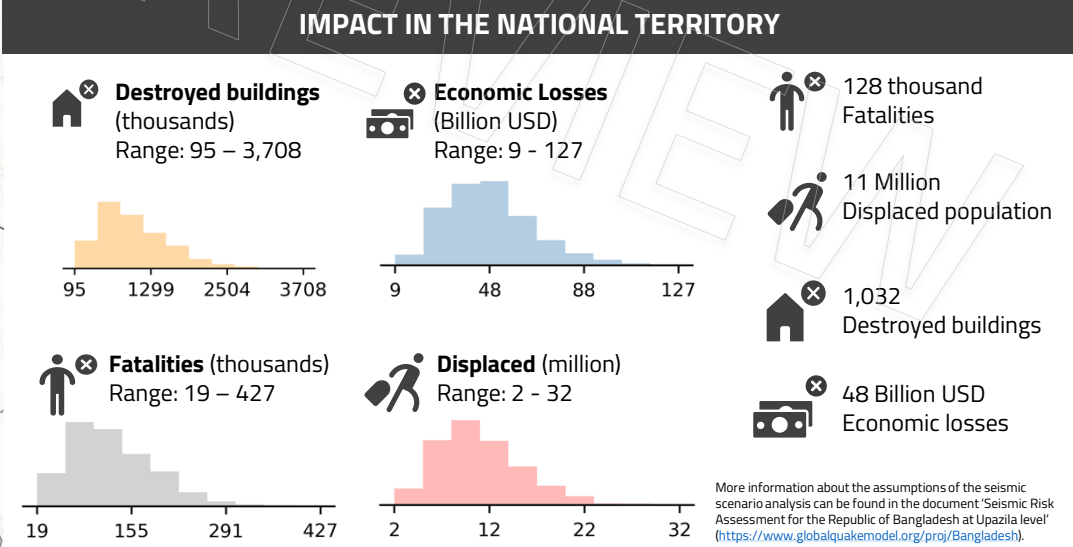


More information about the assumptions of the seismic scenario analysis can be found in the document 'Seismic Risk Assessment for the Republic of Bangladesh at Upazila level' (<https://www.globalquakemodel.org/proj/Bangladesh>).



ZILAS WITH HIGHEST RISK

Zila	Fatalities	Displaced population	Destroyed buildings	Economic losses (Million USD)
Sylhet	14,985	1,308,839	128,161	3,813
Dhaka	11,740	1,303,215	34,020	6,906
Bogura	10,666	645,765	78,527	2,826
Mymensingh	9,679	787,281	84,044	3,652
Sunamganj	8,602	578,469	66,863	1,510
Dinajpur	7,165	464,985	55,025	1,928
Naogaon	6,379	340,266	42,053	1,457
Gazipur	5,948	535,167	32,675	2,303
Rangpur	5,848	475,737	62,908	2,247
Moulvibazar	5,606	410,913	41,395	1,365
Gaibandha	4,520	391,004	55,293	1,739
Joypurhat	4,384	215,147	29,614	849
Habiganj	3,433	289,263	24,036	1,084
Netrakona	2,711	295,754	35,614	1,221
Rajshahi	2,385	192,650	17,612	1,012





গণপ্রজাতন্ত্রী বাংলাদেশ REPUBLIC OF BANGLADESH PROBABILISTIC SEISMIC RISK



Population
170 Million



Residential
buildings
30.1 Million



Commercial
buildings
470,800



Industrial
buildings
101,100



Educational
buildings
260,000

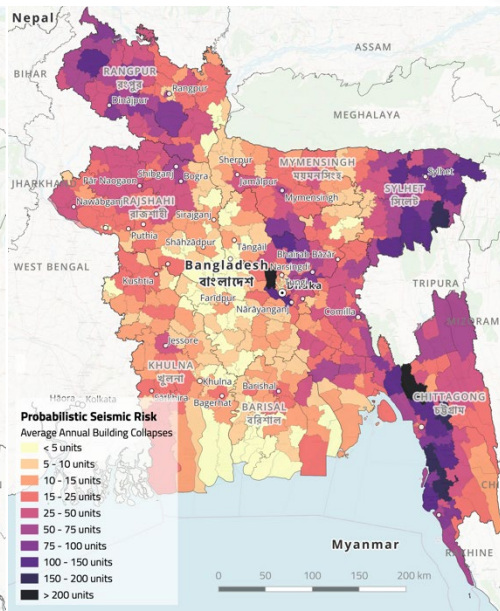
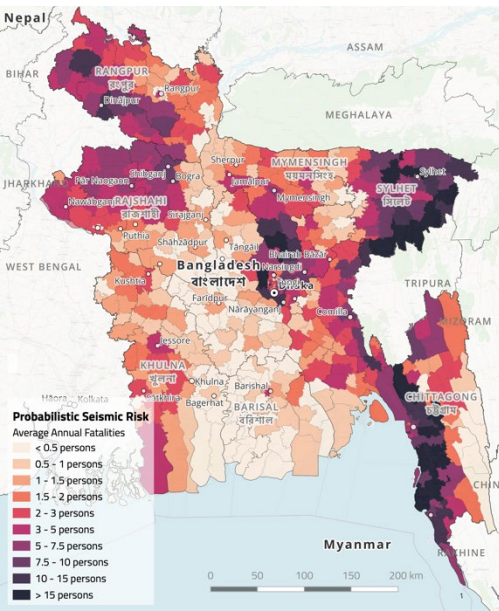
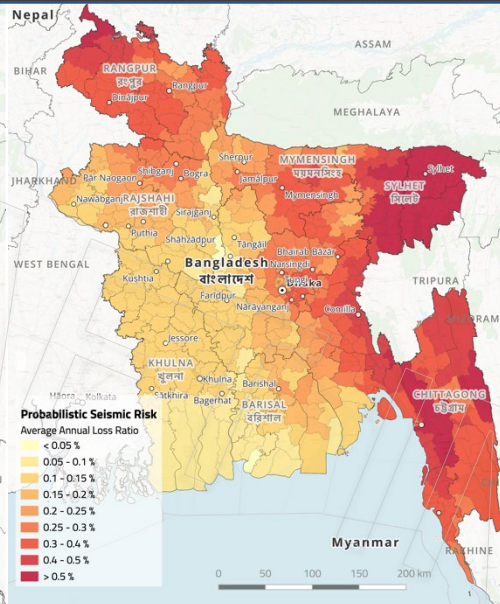
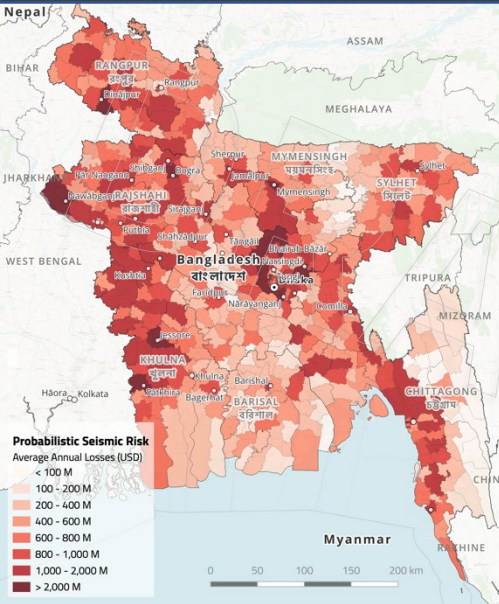


Healthcare
facilities
34,300



Exposed value
\$420 Billion USD

NATIONAL BUILDING INVENTORY



UPAZILAS WITH HIGHEST AVERAGE ANNUAL RISK

Upazila	Fatalities	Displaced population	Destroyed buildings	Economic losses (Million USD)
Fatikhari	33	2,233	226	7.76
Banshkhali	29	1,719	196	4.48
Savar	26	3,754	262	36.14
Rangunia	25	1,774	175	7.44
Maheshkhali	23	920	113	2.11
Lohagara	22	1,252	115	5.07
Kulaura	21	1,635	156	6.49
Chunarughat	20	1,139	115	4.63
Chakaria	20	1,801	185	5.21
Sreemangal	19	1,190	124	5.04
Kamalgarj	19	1,161	135	3.84
Patiya	19	1,573	148	6.18
Sreepur	18	1,375	113	8.25
Chhatak	17	1,362	117	4.81
Satkania	17	1,669	142	7.62

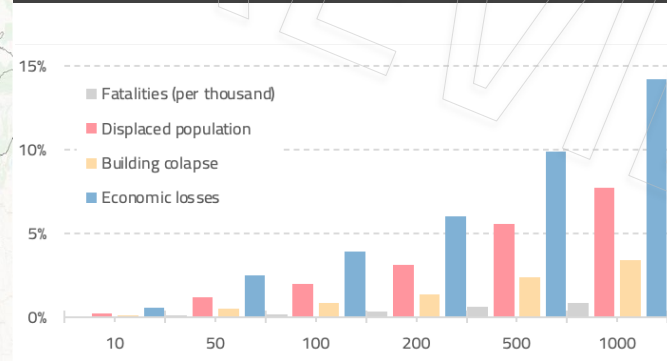
2 thousand Fatalities

207 thousand Displaced population

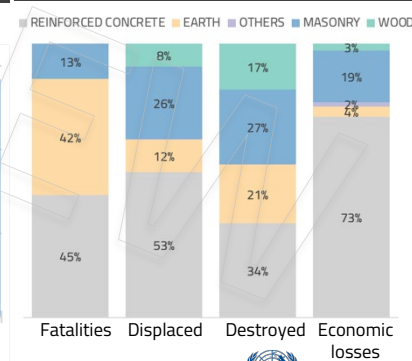
16 thousand Destroyed buildings

1,200 Million USD Economic losses

AGGREGATED LOSS CURVES



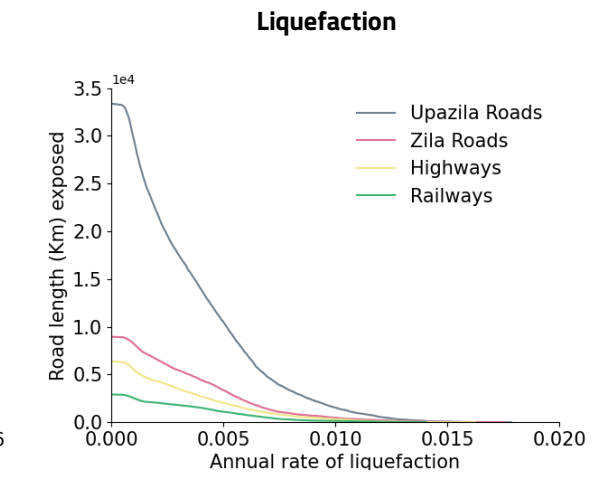
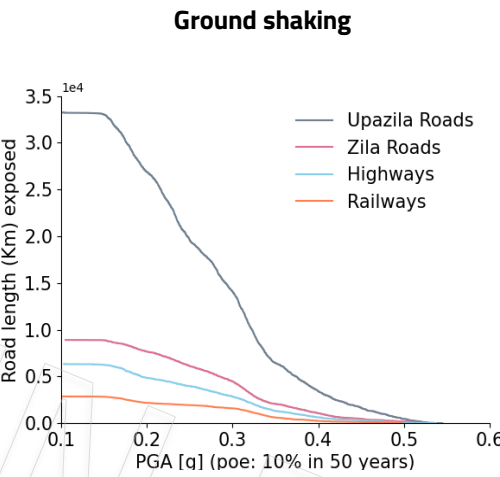
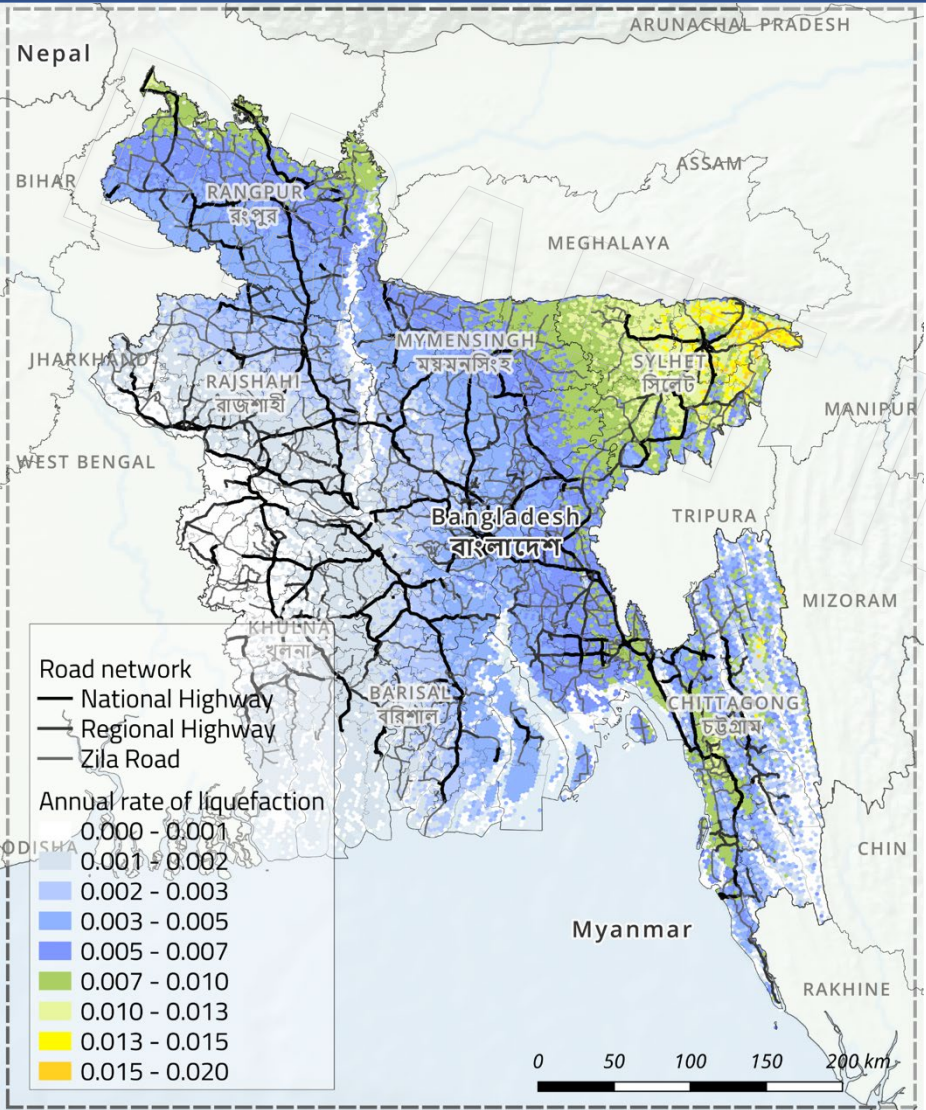
LOSS PER MATERIAL



Notes

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Division	Road network on ground shaking > 0.35g	Railway network on ground shaking > 0.35g	Road network in liquefaction areas	Railway network in liquefaction areas
Barisal	0 (0%)	0 (0%)	16534 (71%)	0 (0%)
Chittagong	13822 (29%)	62 (1.3%)	42167 (90%)	436 (92%)
Dhaka	1642 (4%)	0 (0%)	29156 (73%)	309 (62%)
Khulna	0 (0%)	0 (0%)	313 (0%)	0 (0%)
Mymensingh	10636 (55%)	124 (39%)	19177 (99%)	310 (99%)
Rajshahi	0 (0%)	0 (0%)	10172 (33%)	129 (29%)
Rangpur	6615 (21%)	152 (26%)	30084 (97%)	577 (99%)
Sylhet	14927 (97%)	265 (99%)	15125 (98%)	273 (99%)