

# Detailed estimates from the Vietnam multisectoral risk assessment: Technical annex to *Resilient Shores*

*Sophie De Vries Robbé, Jun Rentschler, Johannes Braese*

This technical annex offers a detailed breakdown of the results of the national risk assessment, conducted in Part I of the *Resilient Shores* report. In particular, the results cover following scope:

**People:** Section 1 presents detailed results for the number of people exposed in built up areas on Vietnam's coastal provinces.

**Sectors:**

- Section 2 provides estimates of the risk to four key economic sectors (agriculture, aquaculture, tourism and industry)
- Section 3 provides detailed estimates for hazard exposure of public services (schools and hospitals)
- Section 4 presents detailed estimates for hazard exposure of lifeline infrastructure systems (the transport network, electrical infrastructure and power plants).

**Provinces:** The results are from all of Vietnam's 28 coastal provinces for every sector except transport, which only covers provinces north of Ba Ria Vung-Tau, and aquaculture, which only covers the Red River and Mekong Delta Regions.

**Hazards:** This annex presents estimates for coastal and riverine flooding, and five different hazard intensities: 5, 20/25, 50, 100, 250 and 500-year return periods. For data availability reasons, a 25-year return period is used for coastal flooding, whereas for riverine floods, a 20-year return period has been employed. Results for other hazards are presented in the main report.

**Exposure estimates** are presented as:

- Physical units (for example, hectares of agricultural area or number of assets) both in relative and absolute terms
- Economic units (for example, \$ or number of jobs exposed), both in relative and absolute terms.

All estimates have been obtained based on the methodology described in the technical background paper (Braese et al. 2020). The authors can be contacted at [sdevriesrobbe@worldbank.org](mailto:sdevriesrobbe@worldbank.org) (Sophie De Vries Robbé) and [jrentschler@worldbank.org](mailto:jrentschler@worldbank.org) (Jun Rentschler).

# 1 People in harm's way

Table A1.1. People exposed to the risk of being flooded by more than 25cm coastal flood

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	18	1	287	23	430	35	502	40	560	45	604	49
Hai Phong City	0	0	262	13	1,225	61	1,575	79	1,784	89	1,851	93
Thai Binh	0	0	142	8	1,670	93	1,755	98	1,783	100	1,788	100
Nam Dinh	0	0	272	15	1,445	78	1,739	94	1,804	97	1,829	99
Ninh Binh	3	0	168	18	544	57	659	69	727	76	754	78
Thanh Hoa	5	0	114	3	398	11	673	19	1,018	29	1,240	35
Nghe An	3	0	78	2	176	6	391	12	719	23	1,031	33
Ha Tinh	1	0	40	3	110	9	179	14	278	22	355	28
Quang Binh	0	0	7	1	13	1	20	2	34	4	49	6
Quang Tri	0	0	1	0	4	1	6	1	9	1	14	2
Thua Thien-Hue	1	0	5	0	8	1	12	1	19	2	32	3
Da Nang City	1	0	13	1	18	2	26	2	40	4	59	6
Quang Nam	1	0	7	0	10	1	11	1	13	1	18	1
Quang Ngai	1	0	6	0	8	1	9	1	9	1	10	1
Binh Dinh	1	0	6	0	7	0	10	1	10	1	12	1
Phu Yen	1	0	3	0	4	0	5	1	6	1	6	1
Khanh Hoa	3	0	12	1	17	1	19	2	19	2	22	2
Ninh Thuan	0	0	2	0	4	1	6	1	7	1	7	1
Binh Thuan	2	0	14	1	19	2	23	2	33	3	41	3
Ba Ria-Vung Tau	4	0	48	4	89	8	131	12	176	16	213	19
Ho Chi Minh City	8	0	192	2	730	9	1,345	16	2,479	29	3,208	38
Tien Giang	0	0	54	3	154	9	649	37	1,101	63	1,418	81
Ben Tre	44	3	372	29	514	41	705	56	900	71	1,016	80
Tra Vinh	10	1	150	14	285	27	415	40	576	55	687	66
Soc Trang	7	1	88	7	209	16	296	23	374	28	492	37
Bac Lieu	3	0	62	7	310	35	551	62	743	83	832	93
Ca Mau	1	0	12	1	36	3	79	6	219	18	464	38
Kien Giang	1	0	9	0	27	2	55	3	215	12	385	21
<b>Total coastal</b>	<b>119</b>	<b>0</b>	<b>2,427</b>	<b>6</b>	<b>8,463</b>	<b>18</b>	<b>11,844</b>	<b>25</b>	<b>15,658</b>	<b>31</b>	<b>18,435</b>	<b>36</b>

Data sources: General Statistics Office of Vietnam (population data 2017)<sup>1</sup> and Braese et al. 2020 (coastal flood maps). Note: a) People exposed in thousands; b) Share of built-up area exposed (%)

**Table A1.2. People exposed to the risk of being flooded by more than 25cm riverine flood**

Return period	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
	a	b	a	b	a	b	a	b	a	b	a	b
<b>Province</b>												
Quang Ninh	0	0	42	3	122	10	157	13	205	17	243	20
Hai Phong City	0	0	0	0	0	0	0	0	35	2	999	50
Thai Binh	0	0	0	0	0	0	0	0	87	5	1,756	98
Nam Dinh	0	0	0	0	0	0	0	0	86	5	1,764	95
Ninh Binh	0	0	0	0	0	0	0	0	34	4	723	75
Thanh Hoa	0	0	0	0	47	1	1,280	36	1,694	48	1,951	55
Nghe An	0	0	0	0	17	1	508	16	734	23	873	28
Ha Tinh	0	0	0	0	8	1	192	15	234	18	287	23
Quang Binh	0	0	49	6	66	8	80	9	103	12	130	15
Quang Tri	0	0	27	4	38	6	47	7	60	10	73	12
Thua Thien-Hue	0	0	92	8	127	11	155	13	197	17	230	20
Da Nang City	0	0	38	4	79	7	183	17	285	27	349	33
Quang Nam	0	0	155	10	203	14	239	16	286	19	334	22
Quang Ngai	0	0	147	12	211	17	261	21	365	29	433	34
Binh Dinh	0	0	155	10	221	14	277	18	340	22	396	26
Phu Yen	0	0	73	8	97	11	114	13	138	15	161	18
Khanh Hoa	0	0	94	8	153	13	193	16	248	20	290	24
Ninh Thuan	0	0	45	7	67	11	84	14	111	18	135	22
Binh Thuan	0	0	84	7	133	11	172	14	226	18	269	22
Ba Ria-Vung Tau	0	0	30	3	52	5	72	7	97	9	117	11
Ho Chi Minh City	0	0	0	0	0	0	86	1	2,194	26	2,536	30
Tien Giang	0	0	1	0	57	3	101	6	235	13	480	27
Ben Tre	0	0	1	0	62	5	117	9	187	15	250	20
Tra Vinh	0	0	2	0	82	8	127	12	218	21	322	31
Soc Trang	0	0	2	0	84	6	118	9	181	14	255	19
Bac Lieu	0	0	1	0	50	6	71	8	96	11	127	14
Ca Mau	0	0	2	0	64	5	96	8	135	11	179	15
Kien Giang	0	0	3	0	106	6	171	10	253	14	331	18
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>1,043</b>	<b>3</b>	<b>2,149</b>	<b>6</b>	<b>4,904</b>	<b>11</b>	<b>9,065</b>	<b>17</b>	<b>15,993</b>	<b>31</b>

Data sources: General Statistics Office of Vietnam (population data 2017)<sup>[1]</sup> and Fathom (riverine flood maps).<sup>2</sup> Note: a) People exposed in thousands; b) Share of built-up area exposed (%)

## 2 Natural hazards threaten key sectors of Vietnam's coastal economy

### 2.1 The agriculture sector

#### 2.1.1 Exposure estimates

**Table A2.1. Agricultural area exposed to coastal flood risk**

Return period	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	1	19	16	27	23	32	28	36	31	39	33
Hai Phong City	0	0	23	24	87	89	93	95	95	96	95	97
Thai Binh	0	0	17	9	177	97	179	98	180	99	181	99
Nam Dinh	0	0	45	26	169	96	175	99	175	99	176	99
Ninh Binh	1	1	31	26	74	62	80	66	83	69	85	71
Thanh Hoa	1	0	21	4	65	13	87	17	109	22	121	24
Nghe An	0	0	23	3	41	5	63	8	85	11	99	13
Ha Tinh	0	0	17	6	40	14	62	22	84	30	97	34
Quang Binh	0	0	7	4	14	8	23	14	33	19	38	22
Quang Tri	0	0	1	0	3	1	7	3	13	6	20	9
Thua Thien-Hue	0	0	4	3	9	7	15	12	22	17	29	21
Da Nang City	0	0	0	1	0	1	1	2	1	3	1	5
Quang Nam	0	0	1	0	1	0	1	0	2	1	2	1
Quang Ngai	0	0	1	0	2	0	2	1	3	1	3	1
Binh Dinh	0	0	1	0	1	0	1	1	1	1	1	1
Phu Yen	0	0	0	0	1	1	1	1	1	1	1	1
Khanh Hoa	0	0	1	1	2	1	2	2	2	2	2	2
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	1	0	1	0	1	0
Ba Ria-Vung Tau	0	0	1	2	1	4	2	7	3	9	3	12
Ho Chi Minh City	0	0	4	9	19	38	31	62	42	85	45	90
Tien Giang	0	0	10	3	45	15	187	65	261	90	279	97
Ben Tre	7	3	66	28	95	41	135	58	184	79	206	88
Tra Vinh	2	1	54	24	109	49	150	68	183	83	197	89
Soc Trang	1	0	10	3	26	8	60	18	132	41	218	67
Bac Lieu	0	0	7	6	51	46	97	88	109	99	110	100
Ca Mau	0	0	1	2	7	9	25	33	51	66	64	81
Kien Giang	0	0	1	0	13	3	43	9	134	29	195	43
<b>Total coastal</b>	<b>17</b>	<b>0</b>	<b>367</b>	<b>6</b>	<b>1,077</b>	<b>18</b>	<b>1,554</b>	<b>26</b>	<b>2,024</b>	<b>33</b>	<b>2,310</b>	<b>38</b>

Data sources: JAXA EORC 2018 (land use maps) and Braese et al. 2020 (coastal flood maps). Note: a) Number of hectares in thousands; b) Share of total (%)

Table A2.2. Agricultural area exposed to riverine flood risk

Return period	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	6	5	16	13	19	17	24	20	27	24
Hai Phong City	0	0	0	0	0	0	0	0	3	3	69	70
Thai Binh	0	0	0	0	0	0	0	0	9	5	178	98
Nam Dinh	0	0	0	0	0	0	0	0	8	5	167	95
Ninh Binh	0	0	0	0	0	0	0	0	4	3	81	68
Thanh Hoa	0	0	0	0	7	1	172	34	220	44	244	49
Nghe An	0	0	0	0	6	1	139	19	176	24	201	27
Ha Tinh	0	0	0	0	3	1	67	24	84	30	101	36
Quang Binh	0	0	27	16	38	22	48	28	61	36	68	39
Quang Tri	0	0	23	10	34	14	43	18	54	23	63	27
Thua Thien-Hue	0	0	23	17	33	25	41	30	50	37	56	42
Da Nang City	0	0	3	11	6	20	8	28	10	34	11	39
Quang Nam	0	0	44	16	60	22	69	25	79	29	88	32
Quang Ngai	0	0	32	10	44	13	53	16	65	20	76	24
Binh Dinh	0	0	25	15	34	20	41	24	48	29	53	32
Phu Yen	0	0	12	10	17	15	21	18	25	21	30	25
Khanh Hoa	0	0	17	14	24	20	28	24	34	28	38	32
Ninh Thuan	0	0	9	9	15	14	20	19	25	25	29	29
Binh Thuan	0	0	34	9	53	14	65	17	81	21	94	25
Ba Ria-Vung Tau	0	0	3	11	5	17	6	22	8	28	9	32
Ho Chi Minh City	0	0	0	0	0	0	1	1	18	36	22	44
Tien Giang	0	0	0	0	6	2	13	4	45	15	96	33
Ben Tre	0	0	0	0	9	4	22	9	44	19	62	26
Tra Vinh	0	0	0	0	14	6	24	11	64	29	108	49
Soc Trang	0	0	0	0	12	4	19	6	47	15	80	25
Bac Lieu	0	0	0	0	2	2	3	3	5	5	9	9
Ca Mau	0	0	0	0	2	2	4	5	7	8	10	13
Kien Giang	0	0	1	0	52	11	88	19	143	31	190	42
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>259</b>	<b>4</b>	<b>488</b>	<b>8</b>	<b>1,013</b>	<b>17</b>	<b>1,441</b>	<b>24</b>	<b>2,263</b>	<b>37</b>

Data sources: JAXA EORC 2018 (land use maps) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Number of hectares in thousands; b) Share of total (%)

**Table A2.3. Rice area exposed to coastal flood risk**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	2	15	29	22	42	25	48	27	52	29	55
Hai Phong City	0	0	19	27	67	96	69	99	70	99	70	99
Thai Binh	0	0	14	10	147	99	148	99	148	99	148	99
Nam Dinh	0	0	38	27	140	97	142	99	143	99	143	99
Ninh Binh	1	2	27	37	62	86	66	90	67	93	68	94
Thanh Hoa	1	1	17	11	53	33	70	43	84	52	91	57
Nghe An	0	0	17	14	30	24	46	36	59	47	65	52
Ha Tinh	0	0	14	13	33	31	51	48	66	63	74	70
Quang Binh	0	0	6	12	13	24	21	38	29	52	33	59
Quang Tri	0	0	1	1	3	7	6	14	11	26	17	39
Thua Thien-Hue	0	1	4	9	8	19	14	32	20	45	24	55
Da Nang City	0	0	0	0	0	1	0	1	0	3	0	5
Quang Nam	0	0	0	0	0	0	0	0	1	1	1	1
Quang Ngai	0	0	1	1	1	1	1	2	2	2	2	3
Binh Dinh	0	0	0	1	1	1	1	1	1	1	1	1
Phu Yen	0	0	0	0	1	1	1	1	1	1	1	1
Khanh Hoa	0	1	1	2	1	3	2	4	2	4	2	4
Ninh Thuan	0	0	0	0	0	0	0	0	0	1	0	1
Binh Thuan	0	0	0	0	0	0	0	0	0	1	1	1
Ba Ria-Vung Tau	0	0	1	4	1	8	2	13	2	19	3	24
Ho Chi Minh City	0	1	1	20	4	50	4	59	5	65	5	67
Tien Giang	0	0	2	3	8	12	39	58	65	98	67	100
Ben Tre	1	13	7	85	7	93	8	98	8	100	8	100
Tra Vinh	1	2	30	40	57	75	70	92	74	98	75	99
Soc Trang	0	0	4	2	12	7	37	20	93	49	154	82
Bac Lieu	0	0	4	5	36	45	71	90	79	99	79	100
Ca Mau	0	0	1	2	6	11	23	43	44	81	51	93
Kien Giang	0	0	1	0	12	3	40	10	120	30	175	44
<b>Total coastal</b>	<b>8</b>	<b>23</b>	<b>228</b>	<b>10</b>	<b>726</b>	<b>30</b>	<b>957</b>	<b>40</b>	<b>1,220</b>	<b>51</b>	<b>1,386</b>	<b>58</b>

Data sources: JAXA EORC 2018 (land use maps) and Braese et al. 2020 (coastal flood maps). Note: a) Number of hectares in thousands; b) Share of total (%)

Table A2.4. Rice area exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	3	5	8	16	10	20	13	25	15	29
Hai Phong City	0	0	0	0	0	0	0	0	2	3	56	79
Thai Binh	0	0	0	0	0	0	0	0	7	5	146	99
Nam Dinh	0	0	0	0	0	0	0	0	7	5	135	94
Ninh Binh	0	0	0	0	0	0	0	0	3	4	65	90
Thanh Hoa	0	0	0	0	3	2	88	55	117	73	130	81
Nghe An	0	0	0	0	2	2	52	41	68	54	77	61
Ha Tinh	0	0	0	0	1	1	35	33	44	42	55	52
Quang Binh	0	0	12	21	18	33	26	46	35	62	38	68
Quang Tri	0	0	8	19	14	33	19	44	24	56	29	66
Thua Thien-Hue	0	0	13	29	19	44	24	53	28	63	31	69
Da Nang City	0	0	1	22	3	40	3	49	4	56	4	60
Quang Nam	0	0	20	23	28	32	32	37	36	42	40	46
Quang Ngai	0	0	13	17	18	24	21	29	26	36	31	41
Binh Dinh	0	0	19	22	27	30	31	36	37	42	41	47
Phu Yen	0	0	11	12	16	17	19	20	23	25	27	29
Khanh Hoa	0	0	10	23	15	32	17	38	20	44	22	48
Ninh Thuan	0	0	4	14	7	25	10	33	12	43	14	50
Binh Thuan	0	0	14	21	22	33	27	40	33	49	37	56
Ba Ria-Vung Tau	0	0	2	19	3	29	5	37	6	49	7	55
Ho Chi Minh City	0	0	0	0	0	0	0	3	5	67	5	70
Tien Giang	0	0	0	0	1	2	2	3	5	7	26	38
Ben Tre	0	0	0	0	0	2	0	4	1	9	1	13
Tra Vinh	0	0	0	0	6	8	10	14	28	37	43	57
Soc Trang	0	0	0	0	8	4	13	7	31	16	53	28
Bac Lieu	0	0	0	0	1	2	2	3	4	5	8	10
Ca Mau	0	0	0	0	1	2	2	5	5	9	7	13
Kien Giang	0	0	1	0	48	12	80	20	130	33	174	44
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>132</b>	<b>5</b>	<b>270</b>	<b>11</b>	<b>529</b>	<b>22</b>	<b>753</b>	<b>31</b>	<b>1,316</b>	<b>55</b>

Data sources: JAXA EORC 2018 (land use maps) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Number of hectares in thousands; b) Share of total (%)

## 2.1.2 Economic impact of exposure to flooding

**Table A2.5. Economic impact of coastal flood risk on the agriculture sector**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	1	13	19	19	27	22	32	25	36	27	39
Hai Phong City	0	0	16	23	61	87	65	93	66	95	66	95
Thai Binh	0	0	12	17	123	177	124	179	125	180	126	181
Nam Dinh	0	0	32	45	118	169	121	175	122	175	122	176
Ninh Binh	1	1	22	31	51	74	55	80	58	83	59	85
Thanh Hoa	1	1	14	21	45	65	61	87	76	109	84	121
Nghe An	0	0	16	23	28	41	44	63	59	85	69	99
Ha Tinh	0	0	12	17	28	40	43	62	59	84	68	97
Quang Binh	0	0	5	7	10	14	16	23	23	33	26	38
Quang Tri	0	0	1	1	2	3	5	7	9	13	14	20
Thua Thien-Hue	0	0	3	4	6	9	11	15	16	22	20	29
Da Nang City	0	0	0	0	0	0	0	1	1	1	1	1
Quang Nam	0	0	0	1	1	1	1	1	1	2	2	2
Quang Ngai	0	0	1	1	1	2	1	2	2	3	2	3
Binh Dinh	0	0	0	1	0	1	1	1	1	1	1	1
Phu Yen	0	0	0	0	0	1	0	1	1	1	1	1
Khanh Hoa	0	0	1	1	1	2	1	2	1	2	2	2
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	0	1	1	1	1	1
Ba Ria-Vung Tau	0	0	0	1	1	1	1	2	2	3	2	3
Ho Chi Minh City	0	0	3	4	13	19	22	31	29	42	31	45
Tien Giang	0	0	7	10	31	45	130	187	182	261	194	279
Ben Tre	5	7	46	66	66	95	94	135	128	184	143	206
Tra Vinh	2	2	37	54	76	109	105	150	127	183	137	197
Soc Trang	1	1	7	10	18	26	42	60	92	132	152	218
Bac Lieu	0	0	5	7	35	51	67	97	76	109	77	110
Ca Mau	0	0	1	1	5	7	18	25	36	51	44	64
Kien Giang	0	0	1	1	9	13	30	43	93	134	136	195
<b>Total coastal</b>	<b>12</b>	<b>17</b>	<b>255</b>	<b>367</b>	<b>749</b>	<b>1,077</b>	<b>1,081</b>	<b>1,554</b>	<b>1,408</b>	<b>2,024</b>	<b>1,607</b>	<b>2,310</b>

Data sources: JAXA EORC 2018 (land use maps), Braese et al. 2020 (coastal flood maps), and World Bank<sup>3</sup> and General Statistics Office of Vietnam<sup>4</sup> (economic indicators).

Note: a) GDP at risk (\$, millions); b) Jobs at risk (thousands)



**Table A2.6. Economic impact of riverine flooding on the agriculture sector**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	4	6	11	16	13	19	16	24	19	27
Hai Phong City	0	0	0	0	0	0	0	0	2	3	48	69
Thai Binh	0	0	0	0	0	0	0	0	6	9	124	178
Nam Dinh	0	0	0	0	0	0	0	0	6	8	116	167
Ninh Binh	0	0	0	0	0	0	0	0	3	4	56	81
Thanh Hoa	0	0	0	0	5	7	120	172	153	220	170	244
Nghe An	0	0	0	0	4	6	97	139	123	176	140	201
Ha Tinh	0	0	0	0	2	3	47	67	58	84	70	101
Quang Binh	0	0	19	27	26	38	34	48	42	61	47	68
Quang Tri	0	0	16	23	24	34	30	43	38	54	44	63
Thua Thien-Hue	0	0	16	23	23	33	28	41	35	50	39	56
Da Nang City	0	0	2	3	4	6	5	8	7	10	8	11
Quang Nam	0	0	31	44	42	60	48	69	55	79	61	88
Quang Ngai	0	0	22	32	30	44	37	53	45	65	53	76
Binh Dinh	0	0	17	25	24	34	28	41	33	48	37	53
Phu Yen	0	0	8	12	12	17	14	21	18	25	21	30
Khanh Hoa	0	0	12	17	17	24	20	28	24	34	26	38
Ninh Thuan	0	0	6	9	10	15	14	20	18	25	20	29
Binh Thuan	0	0	24	34	37	53	45	65	57	81	66	94
Ba Ria-Vung Tau	0	0	2	3	3	5	4	6	6	8	6	9
Ho Chi Minh City	0	0	0	0	0	0	0	1	12	18	15	22
Tien Giang	0	0	0	0	4	6	9	13	31	45	67	96
Ben Tre	0	0	0	0	6	9	15	22	31	44	43	62
Tra Vinh	0	0	0	0	10	14	17	24	44	64	75	108
Soc Trang	0	0	0	0	9	12	13	19	33	47	56	80
Bac Lieu	0	0	0	0	1	2	2	3	4	5	7	9
Ca Mau	0	0	0	0	1	2	2	4	5	7	7	10
Kien Giang	0	0	0	1	36	52	61	88	99	143	133	190
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>180</b>	<b>259</b>	<b>340</b>	<b>488</b>	<b>705</b>	<b>1,013</b>	<b>1,002</b>	<b>1,441</b>	<b>1,574</b>	<b>2,263</b>

Data sources: JAXA EORC 2018 (land use maps), Fathom (riverine flood maps),<sup>2</sup> and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) GDP at risk (\$, millions); b) Jobs at risk (thousands)

**Table A2.7. Economic impacts of coastal flood risk on the rice sector**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	1	3	7	5	10	6	12	6	13	7	14
Hai Phong City	0	0	7	12	25	42	26	43	26	43	26	43
Thai Binh	0	0	6	9	57	94	57	95	57	95	57	95
Nam Dinh	0	0	14	24	50	88	51	90	51	90	51	90
Ninh Binh	0	1	10	17	23	40	24	42	25	43	25	44
Thanh Hoa	1	1	10	16	30	50	39	65	46	78	50	85
Nghe An	0	0	8	15	15	27	22	41	29	53	32	59
Ha Tinh	0	0	4	8	8	19	13	30	17	39	19	44
Quang Binh	0	0	2	4	4	8	7	13	9	17	10	20
Quang Tri	0	0	0	0	1	2	2	4	4	8	6	12
Thua Thien-Hue	0	0	2	3	4	6	6	10	9	15	11	18
Da Nang City	0	0	0	0	0	0	0	0	0	0	0	0
Quang Nam	0	0	0	0	0	0	0	0	0	0	0	1
Quang Ngai	0	0	0	0	0	1	0	1	1	1	1	1
Binh Dinh	0	0	0	0	0	0	0	1	0	1	0	1
Phu Yen	0	0	0	0	0	0	0	0	0	0	0	0
Khanh Hoa	0	0	0	1	0	1	1	1	1	1	1	1
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	0	0	0	0	0	1
Ba Ria-Vung Tau	0	0	0	1	1	1	1	2	1	3	2	4
Ho Chi Minh City	0	0	1	2	3	6	3	7	3	7	4	8
Tien Giang	0	0	2	3	9	15	44	74	74	123	76	126
Ben Tre	2	4	12	28	13	31	13	32	14	33	14	33
Tra Vinh	1	2	28	53	52	99	64	122	68	129	69	131
Soc Trang	0	0	3	5	8	14	25	42	63	103	105	171
Bac Lieu	0	0	3	6	29	49	58	97	64	108	65	108
Ca Mau	0	0	1	2	3	7	12	29	22	55	25	63
Kien Giang	0	0	0	1	7	13	25	44	75	134	110	196
<b>Total coastal</b>	<b>5</b>	<b>11</b>	<b>117</b>	<b>219</b>	<b>348</b>	<b>624</b>	<b>500</b>	<b>897</b>	<b>666</b>	<b>1,194</b>	<b>765</b>	<b>1,366</b>

Data sources: JAXA EORC 2018 (land use maps), Braese et al. 2020 (coastal flood maps) and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) Export value at risk (\$, millions); b) Jobs at risk (thousands)

**Table A2.8. Economic impacts of riverine flood risk on the rice sector**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	1	1	2	4	2	5	3	6	3	7
Hai Phong City	0	0	0	0	0	0	0	0	1	1	21	34
Thai Binh	0	0	0	0	0	0	0	0	3	5	56	94
Nam Dinh	0	0	0	0	0	0	0	0	2	4	48	85
Ninh Binh	0	0	0	0	0	0	0	0	1	2	24	42
Thanh Hoa	0	0	0	0	2	3	49	83	65	109	72	121
Nghe An	0	0	0	0	1	2	25	46	33	61	38	69
Ha Tinh	0	0	0	0	0	1	9	20	11	26	14	32
Quang Binh	0	0	4	7	6	11	8	15	11	21	12	23
Quang Tri	0	0	3	6	5	10	6	13	8	17	10	20
Thua Thien-Hue	0	0	6	10	9	14	10	17	12	21	14	23
Da Nang City	0	0	0	1	1	1	1	2	1	2	1	2
Quang Nam	0	0	7	12	9	17	10	19	12	22	13	24
Quang Ngai	0	0	5	8	6	11	8	13	10	16	11	19
Binh Dinh	0	0	9	14	12	19	15	23	17	27	19	30
Phu Yen	0	0	3	4	4	6	5	7	6	8	7	10
Khanh Hoa	0	0	4	6	5	9	6	11	7	12	7	14
Ninh Thuan	0	0	2	4	4	7	6	10	7	13	8	14
Binh Thuan	0	0	9	15	14	24	17	30	22	37	25	42
Ba Ria-Vung Tau	0	0	1	3	2	4	3	6	4	7	4	8
Ho Chi Minh City	0	0	0	0	0	0	0	0	4	8	4	8
Tien Giang	0	0	0	0	1	2	2	4	5	9	29	49
Ben Tre	0	0	0	0	0	1	1	1	1	3	2	4
Tra Vinh	0	0	0	0	5	10	10	18	26	49	39	75
Soc Trang	0	0	0	0	5	9	9	14	21	34	36	59
Bac Lieu	0	0	0	0	1	2	2	3	3	6	6	10
Ca Mau	0	0	0	0	1	2	1	3	2	6	4	9
Kien Giang	0	0	0	1	30	54	50	90	82	146	109	195
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>53</b>	<b>92</b>	<b>126</b>	<b>223</b>	<b>255</b>	<b>454</b>	<b>379</b>	<b>676</b>	<b>636</b>	<b>1,122</b>

Data sources: JAXA EORC 2018 (land use maps), Fathom (riverine flood maps) and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) Export value at risk (\$, millions); b) Jobs at risk (thousands)

## 2.2 The aquaculture sector

### 2.2.1 Exposure estimates

**Table A2.9. Aquaculture exposure to coastal flood risk**

Return period:		1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
<b>Delta</b>	<b>Province</b>	a	b	a	b	a	b	a	b	a	b	a	b
<i>Red</i>	Hai Phong City	0	0	15,522	23	55,430	84	57,463	87	58,267	88	58,625	89
<i>River</i>	Thai Binh	0	0	2,443	9	25,087	92	25,369	93	25,446	93	25,453	93
<i>Delta</i>	Nam Dinh	0	0	10,221	26	36,640	92	37,718	95	38,057	96	38,155	96
	Ninh Binh	1,267	2	20,242	33	45,029	74	47,250	77	48,618	79	49,203	80
<i>Mekong</i>	Tien Giang	0	0	1,831	16	3,906	34	9,501	82	10,553	91	10,871	94
<i>River</i>	Ben Tre	4,716	10	34,245	70	41,035	84	45,620	93	47,127	96	47,384	97
<i>Delta</i>	Tra Vinh	1,345	4	15,976	51	24,309	77	28,038	89	30,045	95	30,574	97
	Soc Trang	934	2	10,708	17	24,614	40	35,080	57	44,296	72	51,847	84
	Bac Lieu	3,063	2	60,754	37	154,253	93	164,090	99	165,645	100	166,017	100
	Ca Mau	646	0	11,430	3	43,075	12	141,276	39	261,476	73	308,154	86
	Kien Giang	41	0	1,653	1	21,872	17	54,984	42	106,928	82	120,022	92
Total Red River Delta		1,389	1	48,599	22	162,372	72	167,987	75	170,580	76	171,629	76
Total Mekong River Delta		10,912	1	136,795	17	313,282	38	478,847	58	666,362	81	735,180	89
<b>Total coastal provinces</b>		<b>12,301</b>	<b>1</b>	<b>185,394</b>	<b>18</b>	<b>475,654</b>	<b>45</b>	<b>646,834</b>	<b>62</b>	<b>836,942</b>	<b>80</b>	<b>906,809</b>	<b>87</b>

Data sources: JAXA EORC 2018 (land use maps) and Braese et al. 2020 (coastal flood maps). Note: a) Ponds exposed; b) Share of total (%)

**Table A2.10. Aquaculture exposure to riverine flood risk**

Return period:		1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
<b>Delta</b>	<b>Province</b>	a	b	a	b	a	b	a	b	a	b	a	b
<i>Red River</i>	Hai Phong City	0	0	0	0	0	0	0	0	2,356	4	52,203	79
<i>Delta</i>	Thai Binh	0	0	0	0	0	0	0	0	1,333	5	27,072	99
	Nam Dinh	0	0	0	0	0	0	0	0	1,867	5	38,490	97
	Ninh Binh	0	0	0	0	0	0	0	0	2,270	4	47,365	77
<i>Mekong</i>	Tien Giang	764	7	1,470	13	3,169	27	7,176	62	8,141	71	8,857	77
<i>River</i>	Ben Tre	3,718	8	6,967	14	14,650	30	32,763	67	36,103	74	38,382	78
<i>Delta</i>	Tra Vinh	1,849	6	4,452	14	9,566	30	21,325	68	23,555	75	25,142	80
	Soc Trang	4,930	8	9,073	15	18,720	30	41,555	67	45,604	74	48,539	79
	Bac Lieu	12,883	8	28,907	17	60,495	36	132,605	80	143,148	86	149,978	90
	Ca Mau	26,638	7	61,746	17	129,620	36	284,657	79	307,412	85	322,307	89
	Kien Giang	0	0	0	0	0	0	0	0	0	0	11,705	85
Total Red River Delta		12,777	6	18,954	8	22,297	10	23,590	10	35,032	16	195,023	87
Total Mekong River Delta		61,129	7	123,181	15	246,846	30	530,746	65	574,674	70	715,661	87
<b>Total coastal provinces</b>		<b>73,906</b>	<b>7</b>	<b>142,135</b>	<b>14</b>	<b>269,143</b>	<b>26</b>	<b>554,336</b>	<b>53</b>	<b>609,706</b>	<b>58</b>	<b>910,684</b>	<b>87</b>

Data sources: JAXA EORC 2018 (land use maps) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Ponds exposed; b) Share of total (%)

## 2.2.2 Economic impact of exposure to flooding

**Table A2.11. Economic impact of coastal flood risk on the aquaculture sector in the two main river delta regions**

Return period:		1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
<b>Delta</b>	<b>Province</b>	a	b	a	b	a	b	a	b	a	b	a	b
<i>Red River Delta</i>	Hai Phong City	0	0	11	14	41	49	42	51	43	52	43	52
	Thai Binh	0	0	11	13	114	138	115	140	116	140	116	140
	Nam Dinh	0	0	20	24	71	86	73	89	74	89	74	90
	Ninh Binh	1	1	9	11	20	25	21	26	22	27	22	27
<i>Mekong River Delta</i>	Tien Giang	0	0	25	30	54	65	130	158	145	175	149	180
	Ben Tre	25	30	180	218	216	261	240	290	248	300	249	302
	Tra Vinh	5	6	56	68	86	104	99	120	106	128	108	131
	Soc Trang	3	3	32	39	74	89	105	127	133	161	155	188
	Bac Lieu	4	5	74	90	188	228	200	243	202	245	203	246
	Ca Mau	1	1	10	12	37	44	120	145	222	269	261	317
	Kien Giang	0	0	3	3	35	42	87	106	169	205	190	230
<b>Total Red River Delta</b>		<b>2</b>	<b>1</b>	<b>71</b>	<b>63</b>	<b>238</b>	<b>299</b>	<b>246</b>	<b>306</b>	<b>250</b>	<b>309</b>	<b>252</b>	<b>310</b>
<b>Total Mekong River Delta</b>		<b>19</b>	<b>45</b>	<b>241</b>	<b>461</b>	<b>551</b>	<b>834</b>	<b>842</b>	<b>1,189</b>	<b>1,172</b>	<b>1,484</b>	<b>1,293</b>	<b>1,594</b>
<b>Total coastal provinces</b>		<b>21</b>	<b>46</b>	<b>314</b>	<b>523</b>	<b>806</b>	<b>1,133</b>	<b>1,097</b>	<b>1,495</b>	<b>1,419</b>	<b>1,792</b>	<b>1,538</b>	<b>1,904</b>

Data sources: JAXA EORC 2018 (land use maps), Braese et al. 2020 (coastal flood maps) and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) Production at risk (tons, thousands); b) GDP at risk (\$, millions).

Table A2.12. Economic impact of riverine flood risk on the aquaculture sector in the two main river delta regions

Return period:		1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Delta	Province	a	b	a	b	a	b	a	b	a	b	a	b
Red	Hai Phong City	0	0	0	0	0	0	0	0	2	2	38	47
River	Thai Binh	0	0	0	0	0	0	0	0	6	7	123	149
Delta	Nam Dinh	0	0	0	0	0	0	0	0	4	4	75	90
	Ninh Binh	0	0	0	0	0	0	0	0	1	1	22	26
Mekong	Tien Giang	10	13	20	24	43	53	98	119	112	135	121	147
River	Ben Tre	20	24	37	44	77	93	172	209	190	230	202	244
Delta	Tra Vinh	7	8	16	19	34	41	75	91	83	101	89	107
	Soc Trang	15	18	27	33	56	68	124	151	137	165	145	176
	Bac Lieu	16	19	35	43	74	90	162	196	175	212	183	222
	Ca Mau	23	27	52	63	110	133	241	293	261	316	273	331
	Kien Giang	0	0	0	0	0	0	0	0	0	0	177	214
Total Red River Delta		19	26	28	39	33	46	35	48	51	71	286	374
Total Mekong River Delta		107	130	217	249	434	499	933	1,080	1,010	1,181	1,258	1,464
<b>Total coastal provinces</b>		<b>125</b>	<b>156</b>	<b>241</b>	<b>288</b>	<b>456</b>	<b>545</b>	<b>940</b>	<b>1,129</b>	<b>1,034</b>	<b>1,252</b>	<b>1,544</b>	<b>1,838</b>

Data sources: JAXA EORC 2018 (land use maps), Fathom (riverine flood maps)<sup>[2]</sup> and World Bank and General Statistics Office of Vietnam (economic indicators). Note: a) Production at risk (tons, thousands); b) GDP at risk (\$, millions).

Table A2.13. Aquaculture jobs at risk

Return period:		1-in-5		1-in20/25*		1-in-50		1-in-100		1-in250		1-in500	
<b>Delta</b>	<b>Province</b>	a	b	a	b	a	b	a	b	a	b	a	b
<i>Red</i>	Hai Phong City	0	0	9	0	31	0	32	0	33	1	33	30
<i>River</i>	Thai Binh	0	0	9	0	88	0	89	0	89	5	89	95
<i>Delta</i>	Nam Dinh	0	0	15	0	55	0	56	0	57	3	57	57
	Ninh Binh	0	0	7	0	16	0	17	0	17	1	17	17
<i>Mekong</i>	Tien Giang	0	8	19	15	41	33	100	76	111	86	115	93
<i>River</i>	Ben Tre	19	15	138	28	166	59	184	132	190	146	191	155
<i>Delta</i>	Tra Vinh	4	5	43	12	66	26	76	58	81	64	83	68
	Soc Trang	2	11	25	21	57	43	81	96	102	105	119	112
	Bac Lieu	3	12	57	27	145	57	154	125	156	134	156	141
	Ca Mau	0	17	7	40	28	85	92	186	171	201	201	210
	Kien Giang	0	0	2	0	27	0	67	0	130	0	146	136
Total Red River Delta		1	17	40	25	190	29	194	31	196	45	197	237
Total Mekong River Delta		28	82	292	158	529	317	755	686	942	750	1,012	930
<b>Total coastal provinces</b>		<b>29</b>	<b>99</b>	<b>332</b>	<b>183</b>	<b>719</b>	<b>346</b>	<b>949</b>	<b>716</b>	<b>1,138</b>	<b>795</b>	<b>1,208</b>	<b>1,167</b>

Data sources: JAXA EORC 2018 (land use maps); Braese et al. 2020 (coastal flood maps), Fathom (riverine flood maps),<sup>2</sup> and World Bank and General Statistics Office of Vietnam (economic indicators). Note: a) Coastal flood risk; b) Riverine flood risk. \*For riverine flood risk a return period of 1-in-20 has been used, for coastal flooding this is 1-in-25.



## 2.3 The tourism sector

### 2.3.1 Exposure estimates

**Table A2.14. Hotels exposed to coastal flood risk**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	5	5	50	54	65	71	67	73	72	78	75	82
Hai Phong City	0	0	13	8	59	37	68	43	71	44	96	60
Thai Binh	0	0	1	11	9	100	9	100	9	100	9	100
Nam Dinh	0	0	1	13	5	63	7	88	8	100	8	100
Ninh Binh	7	5	56	36	137	89	141	92	149	97	150	97
Thanh Hoa	1	1	7	9	22	29	25	32	33	43	35	45
Nghe An	1	2	9	14	11	17	17	26	25	38	29	45
Ha Tinh	0	0	2	6	7	20	10	29	11	31	12	34
Quang Binh	2	2	28	22	43	34	48	38	63	49	93	73
Quang Tri	0	0	2	4	4	8	4	8	6	11	7	13
Thua Thien-Hue	8	4	45	25	49	27	56	31	65	36	70	39
Da Nang City	3	2	16	8	32	16	35	18	37	19	49	25
Quang Nam	6	2	44	14	53	17	55	18	63	21	63	21
Quang Ngai	0	0	1	2	2	5	3	7	3	7	3	7
Binh Dinh	0	0	2	2	2	2	3	3	3	3	3	3
Phu Yen	1	2	2	4	3	6	3	6	3	6	3	6
Khanh Hoa	4	1	17	6	21	8	21	8	21	8	21	8
Ninh Thuan	0	0	2	8	5	21	5	21	5	21	6	25
Binh Thuan	6	3	31	15	43	21	49	24	58	28	72	35
Ba Ria-Vung Tau	5	3	43	28	59	38	69	45	73	47	81	53
Ho Chi Minh City	2	0	34	5	88	13	110	16	137	20	158	23
Tien Giang	0	0	3	8	7	19	27	75	29	81	35	97
Ben Tre	1	4	8	35	9	39	17	74	20	87	22	96
Tra Vinh	0	0	4	40	6	60	6	60	7	70	7	70
Soc Trang	0	0	0	0	0	0	0	0	0	0	0	0
Bac Lieu	0	0	0	0	1	100	1	100	1	100	1	100
Ca Mau	0	0	0	0	1	7	2	13	6	40	7	47
Kien Giang	2	1	30	14	70	33	79	37	92	43	106	50
<b>Total coastal</b>	<b>54</b>	<b>2</b>	<b>451</b>	<b>14</b>	<b>813</b>	<b>25</b>	<b>937</b>	<b>28</b>	<b>1,070</b>	<b>32</b>	<b>1,221</b>	<b>37</b>

Data sources: Open Street Map (hotel locations) and Braese et al. 2020 (coastal flood maps). Note: a) Number of hotels exposed to flooding; b) Share of total (%)

Table A2.15 Hotels exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	24	26	62	67	65	71	68	74	78	85
Hai Phong City	0	0	0	0	0	0	0	0	6	4	143	89
Thai Binh	0	0	0	0	0	0	0	0	0	0	9	100
Nam Dinh	0	0	0	0	0	0	0	0	0	0	8	100
Ninh Binh	0	0	0	0	0	0	0	0	7	5	147	95
Thanh Hoa	0	0	0	0	3	4	67	87	68	88	68	88
Nghe An	0	0	0	0	2	3	50	77	57	88	57	88
Ha Tinh	0	0	0	0	1	3	31	89	33	94	34	97
Quang Binh	0	0	107	84	114	89	120	94	125	98	126	98
Quang Tri	0	0	28	53	29	55	32	60	33	62	35	66
Thua Thien-Hue	0	0	164	91	170	94	172	95	175	97	177	98
Da Nang City	0	0	78	40	91	46	116	59	136	69	149	76
Quang Nam	0	0	131	43	185	61	205	67	235	77	257	84
Quang Ngai	0	0	28	68	33	80	36	88	38	93	39	95
Binh Dinh	0	0	47	55	68	79	76	88	77	90	79	92
Phu Yen	0	0	24	46	40	77	42	81	43	83	44	85
Khanh Hoa	0	0	75	27	124	45	135	49	157	57	215	78
Ninh Thuan	0	0	22	92	23	96	23	96	24	100	24	100
Binh Thuan	0	0	156	75	170	82	175	85	183	88	191	92
Ba Ria-Vung Tau	0	0	97	63	107	69	111	72	118	77	128	83
Ho Chi Minh City	0	0	0	0	0	0	24	3	549	78	630	90
Tien Giang	0	0	1	3	31	86	33	92	36	100	36	100
Ben Tre	0	0	1	4	22	96	23	100	23	100	23	100
Tra Vinh	0	0	0	0	6	60	7	70	7	70	10	100
Soc Trang	0	0	0	0	2	40	5	100	5	100	5	100
Bac Lieu	0	0	0	0	1	100	1	100	1	100	1	100
Ca Mau	0	0	0	0	9	60	12	80	14	93	15	100
Kien Giang	0	0	7	3	158	74	166	78	171	80	175	82
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>990</b>	<b>30</b>	<b>1,451</b>	<b>44</b>	<b>1,727</b>	<b>52</b>	<b>2,389</b>	<b>72</b>	<b>2,903</b>	<b>88</b>

Data sources: Open Street Map (hotel locations) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Number of hotels exposed to flooding; b) Share of total (%)

## 2.3.2 Economic impact of exposure to flooding

**Table A2.16. Economic impact of coastal flood exposure on the tourism sector**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	15	2	146	22	189	28	195	29	210	31	218	33
Hai Phong City	0	0	38	6	172	26	198	30	207	31	280	42
Thai Binh	0	0	3	0	26	4	26	4	26	4	26	4
Nam Dinh	0	0	3	0	15	2	20	3	23	3	23	3
Ninh Binh	20	3	163	24	399	60	411	61	434	65	437	65
Thanh Hoa	3	0	20	3	64	10	73	11	96	14	102	15
Nghe An	3	0	26	4	32	5	50	7	73	11	84	13
Ha Tinh	0	0	6	1	20	3	29	4	32	5	35	5
Quang Binh	6	1	82	12	125	19	140	21	183	27	271	41
Quang Tri	0	0	6	1	12	2	12	2	17	3	20	3
Thua Thien-Hue	23	3	131	20	143	21	163	24	189	28	204	31
Da Nang City	9	1	47	7	93	14	102	15	108	16	143	21
Quang Nam	17	3	128	19	154	23	160	24	183	27	183	27
Quang Ngai	0	0	3	0	6	1	9	1	9	1	9	1
Binh Dinh	0	0	6	1	6	1	9	1	9	1	9	1
Phu Yen	3	0	6	1	9	1	9	1	9	1	9	1
Khanh Hoa	12	2	50	7	61	9	61	9	61	9	61	9
Ninh Thuan	0	0	6	1	15	2	15	2	15	2	17	3
Binh Thuan	17	3	90	14	125	19	143	21	169	25	210	31
Ba Ria-Vung Tau	15	2	125	19	172	26	201	30	213	32	236	35
Ho Chi Minh City	6	1	99	15	256	38	320	48	399	60	460	69
Tien Giang	0	0	9	1	20	3	79	12	84	13	102	15
Ben Tre	3	0	23	3	26	4	50	7	58	9	64	10
Tra Vinh	0	0	12	2	17	3	17	3	20	3	20	3
Soc Trang	0	0	0	0	0	0	0	0	0	0	0	0
Bac Lieu	0	0	0	0	3	0	3	0	3	0	3	0
Ca Mau	0	0	0	0	3	0	6	1	17	3	20	3
Kien Giang	6	1	87	13	204	31	230	34	268	40	309	46
<b>Total coastal</b>	<b>157</b>	<b>24</b>	<b>1,313</b>	<b>197</b>	<b>2,368</b>	<b>355</b>	<b>2,729</b>	<b>409</b>	<b>3,116</b>	<b>467</b>	<b>3,556</b>	<b>532</b>

Data sources: Open Street Map (hotel locations), Braese et al. 2020 (coastal flood maps), and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) GDP at risk (\$, millions); b) Jobs at risk (thousands).

**Table A2.17. Economic impact of riverine flood exposure on the tourism sector**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	70	10	181	27	189	28	198	30	227	34
Hai Phong City	0	0	0	0	0	0	0	0	17	3	416	62
Thai Binh	0	0	0	0	0	0	0	0	0	0	26	4
Nam Dinh	0	0	0	0	0	0	0	0	0	0	23	3
Ninh Binh	0	0	0	0	0	0	0	0	20	3	428	64
Thanh Hoa	0	0	0	0	9	1	195	29	198	30	198	30
Nghe An	0	0	0	0	6	1	146	22	166	25	166	25
Ha Tinh	0	0	0	0	3	0	90	14	96	14	99	15
Quang Binh	0	0	312	47	332	50	349	52	364	55	367	55
Quang Tri	0	0	82	12	84	13	93	14	96	14	102	15
Thua Thien-Hue	0	0	478	72	495	74	501	75	510	76	515	77
Da Nang City	0	0	227	34	265	40	338	51	396	59	434	65
Quang Nam	0	0	381	57	539	81	597	89	684	102	748	112
Quang Ngai	0	0	82	12	96	14	105	16	111	17	114	17
Binh Dinh	0	0	137	20	198	30	221	33	224	34	230	34
Phu Yen	0	0	70	10	116	17	122	18	125	19	128	19
Khanh Hoa	0	0	218	33	361	54	393	59	457	68	626	94
Ninh Thuan	0	0	64	10	67	10	67	10	70	10	70	10
Binh Thuan	0	0	454	68	495	74	510	76	533	80	556	83
Ba Ria-Vung Tau	0	0	282	42	312	47	323	48	344	51	373	56
Ho Chi Minh City	0	0	0	0	0	0	70	10	1,599	239	1,835	275
Tien Giang	0	0	3	0	90	14	96	14	105	16	105	16
Ben Tre	0	0	3	0	64	10	67	10	67	10	67	10
Tra Vinh	0	0	0	0	17	3	20	3	20	3	29	4
Soc Trang	0	0	0	0	6	1	15	2	15	2	15	2
Bac Lieu	0	0	0	0	3	0	3	0	3	0	3	0
Ca Mau	0	0	0	0	26	4	35	5	41	6	44	7
Kien Giang	0	0	20	3	460	69	483	72	498	75	510	76
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>2,883</b>	<b>432</b>	<b>4,225</b>	<b>633</b>	<b>5,029</b>	<b>753</b>	<b>6,957</b>	<b>1,042</b>	<b>8,454</b>	<b>1,266</b>

Data sources: Open Street Map (hotel locations), Fathom (riverine flood maps),<sup>[2]</sup> and World Bank and General Statistics Office of Vietnam (economic indicators).

Note: a) GDP at risk (\$, millions); b) Jobs at risk (thousands).

## 2.4 The industry sector

### 2.4.1 Exposure estimates

**Table A2.18. Industrial zones exposed to coastal flood risk**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	11	6	67	7	78	8	89	8	89	8	89
Hai Phong City	0	0	1	25	4	100	4	100	4	100	4	100
Thai Binh	0	0	0	0	5	100	5	100	5	100	5	100
Nam Dinh	0	0	1	25	4	100	4	100	4	100	4	100
Ninh Binh	0	0	2	40	4	80	4	80	4	80	4	80
Thanh Hoa	0	0	1	25	3	75	3	75	3	75	3	75
Nghe An	0	0	0	0	0	0	1	100	1	100	1	100
Ha Tinh	0	0	0	0	1	100	1	100	1	100	1	100
Quang Binh	0	0	0	0	0	0	0	0	0	0	0	0
Quang Tri	0	0	0	0	0	0	0	0	1	50	1	50
Thua Thien-Hue	0	0	0	0	0	0	0	0	0	0	1	11
Da Nang City	0	0	0	0	0	0	0	0	0	0	0	0
Quang Nam	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ngai	0	0	0	0	0	0	0	0	0	0	0	0
Binh Dinh	0	0	0	0	0	0	0	0	0	0	0	0
Phu Yen	0	0	0	0	0	0	0	0	0	0	0	0
Khanh Hoa	0	0	0	0	0	0	0	0	0	0	0	0
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Ba Ria-Vung Tau	0	0	2	14	2	14	2	14	2	14	2	14
Ho Chi Minh City	0	0	3	12	11	44	15	60	17	68	19	76
Tien Giang	0	0	0	0	2	67	3	100	3	100	3	100
Ben Tre	0	0	2	100	2	100	2	100	2	100	2	100
Tra Vinh	0	0	1	50	1	50	1	50	1	50	1	50
Soc Trang	0	0	0	0	1	50	2	100	2	100	2	100
Bac Lieu	0	0	0	0	1	100	1	100	1	100	1	100
Ca Mau	0	0	0	0	1	50	2	100	2	100	2	100
Kien Giang	0	0	0	0	0	0	0	0	1	50	1	50
<b>Total coastal</b>	<b>1</b>	<b>1</b>	<b>19</b>	<b>15</b>	<b>49</b>	<b>39</b>	<b>58</b>	<b>46</b>	<b>62</b>	<b>49</b>	<b>65</b>	<b>51</b>

Data sources: World Bank 2020 (Industrial zones locations) and Braese et al. 2020 (coastal flood maps). Note: a) Number exposed; b) Share of total (%)

**Table A2.19. Industrial zones exposed to riverine flood risk**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	4	44	7	78	8	89	8	89	9	100
Hai Phong City	0	0	0	0	0	0	0	0	0	0	4	100
Thai Binh	0	0	0	0	0	0	0	0	0	0	5	100
Nam Dinh	0	0	0	0	0	0	0	0	0	0	4	100
Ninh Binh	0	0	0	0	0	0	0	0	0	0	4	80
Thanh Hoa	0	0	0	0	0	0	4	100	4	100	4	100
Nghe An	0	0	0	0	0	0	1	100	1	100	1	100
Ha Tinh	0	0	0	0	0	0	1	100	1	100	1	100
Quang Binh	0	0	0	0	1	33	1	33	1	33	1	33
Quang Tri	0	0	1	50	1	50	1	50	1	50	1	50
Thua Thien-Hue	0	0	7	78	7	78	7	78	8	89	8	89
Da Nang City	0	0	0	0	0	0	2	40	2	40	3	60
Quang Nam	0	0	1	50	2	100	2	100	2	100	2	100
Quang Ngai	0	0	1	50	2	100	2	100	2	100	2	100
Binh Dinh	0	0	2	50	2	50	2	50	3	75	4	100
Phu Yen	0	0	2	67	2	67	2	67	2	67	2	67
Khanh Hoa	0	0	0	0	0	0	0	0	1	100	1	100
Ninh Thuan	0	0	2	67	3	100	3	100	3	100	3	100
Binh Thuan	0	0	3	43	5	71	6	86	6	86	6	86
Ba Ria-Vung Tau	0	0	8	57	9	64	9	64	9	64	10	71
Ho Chi Minh City	0	0	0	0	0	0	1	4	22	88	23	92
Tien Giang	0	0	0	0	1	33	2	67	3	100	3	100
Ben Tre	0	0	0	0	2	100	2	100	2	100	2	100
Tra Vinh	0	0	0	0	2	100	2	100	2	100	2	100
Soc Trang	0	0	0	0	2	100	2	100	2	100	2	100
Bac Lieu	0	0	0	0	1	100	1	100	1	100	1	100
Ca Mau	0	0	0	0	2	100	2	100	2	100	2	100
Kien Giang	0	0	0	0	2	100	2	100	2	100	2	100
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>31</b>	<b>24</b>	<b>53</b>	<b>42</b>	<b>65</b>	<b>51</b>	<b>90</b>	<b>71</b>	<b>112</b>	<b>88</b>

Data sources: World Bank 2020 (industrial zone locations) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Number exposed; b) Share of total (%)

## 2.4.2 Economic impact of exposure to flooding

**Table A2.20. Economic impact of coastal flood exposure to the industry sector**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250	
Province	a	b	a	b	a	b	a	b	a	b
Quang Ninh	30	3	82	16	107	19	133	21	171	21
Hai Phong City	22	0	56	9	71	36	86	36	110	36
Thai Binh	2	0	6	0	8	52	10	52	14	52
Nam Dinh	2	0	8	8	13	33	16	33	21	33
Ninh Binh	3	0	14	15	20	29	28	29	37	29
Thanh Hoa	4	0	48	15	64	44	91	44	121	44
Nghe An	2	0	18	0	61	0	81	7	115	7
Ha Tinh	5	0	43	0	81	1	115	1	152	1
Quang Binh	1	0	5	0	8	0	11	0	18	0
Quang Tri	0	0	1	0	1	0	2	0	3	2
Thua Thien-Hue	1	0	5	0	8	0	11	0	16	0
Da Nang City	6	0	22	0	34	0	47	0	70	0
Quang Nam	1	0	7	0	19	0	27	0	39	0
Quang Ngai	3	0	16	0	24	0	40	0	65	0
Binh Dinh	3	0	14	0	19	0	29	0	41	0
Phu Yen	0	0	2	0	2	0	4	0	5	0
Khanh Hoa	1	0	5	0	8	0	11	0	16	0
Ninh Thuan	0	0	1	0	2	0	2	0	4	0
Binh Thuan	0	0	2	0	4	0	7	0	9	0
Ba Ria-Vung Tau	1	0	15	8	27	8	43	8	80	8
Ho Chi Minh City	0	0	18	35	48	128	93	174	146	198
Tien Giang	0	0	1	0	2	55	4	83	6	83
Ben Tre	0	0	0	34	1	34	1	34	2	34
Tra Vinh	0	0	0	7	1	7	1	7	2	7
Soc Trang	0	0	0	0	1	4	1	8	2	8
Bac Lieu	0	0	0	0	0	2	0	2	1	2
Ca Mau	0	0	0	0	1	1	1	1	2	1
Kien Giang	0	0	0	0	1	0	1	0	2	3
<b>Total coastal</b>	<b>87</b>	<b>3</b>	<b>390</b>	<b>146</b>	<b>636</b>	<b>452</b>	<b>898</b>	<b>541</b>	<b>1,269</b>	<b>569</b>

Data sources: World Bank DRFI Program 2019. Note: a) Probable maximum losses (\$, millions); b) Jobs at risk (thousands)

**Table A2.21. Economic impact of riverine flood exposure to the industry sector**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250	
Province	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	0	3	11	7	19	15	21	59	21
Hai Phong City	0	0	3	0	5	0	9	0	16	0
Thai Binh	0	0	0	0	1	0	2	0	5	0
Nam Dinh	0	0	15	0	20	0	24	0	29	0
Ninh Binh	1	0	21	0	31	0	41	0	52	0
Thanh Hoa	2	0	72	0	102	0	140	59	188	59
Nghe An	2	0	86	0	122	0	151	7	187	7
Ha Tinh	2	0	104	0	140	0	183	1	231	1
Quang Binh	0	0	14	0	23	1	31	1	44	1
Quang Tri	0	0	1	2	2	2	2	2	3	2
Thua Thien-Hue	0	0	10	13	15	13	19	13	25	15
Da Nang City	1	0	20	0	32	0	44	24	57	24
Quang Nam	0	0	31	11	40	23	49	23	59	23
Quang Ngai	0	0	2	8	4	15	5	15	8	15
Binh Dinh	0	0	6	7	8	7	10	7	13	11
Phu Yen	0	0	0	2	1	2	1	2	1	2
Khanh Hoa	0	0	9	0	11	0	13	0	16	12
Ninh Thuan	0	0	2	1	2	2	3	2	3	2
Binh Thuan	0	0	6	4	10	7	14	8	21	8
Ba Ria-Vung Tau	0	0	0	30	1	34	2	34	3	34
Ho Chi Minh City	2	0	128	0	179	0	226	12	282	256
Tien Giang	0	0	1	0	1	28	2	55	2	83
Ben Tre	0	0	0	0	0	34	0	34	0	34
Tra Vinh	0	0	0	0	0	13	0	13	0	13
Soc Trang	0	0	0	0	1	8	1	8	1	8
Bac Lieu	0	0	0	0	0	2	0	2	0	2
Ca Mau	0	0	0	0	0	1	1	1	4	1
Kien Giang	0	0	1	0	1	6	0	6	2	6
<b>Total coastal</b>	<b>12</b>	<b>0</b>	<b>537</b>	<b>90</b>	<b>759</b>	<b>216</b>	<b>988</b>	<b>351</b>	<b>1,313</b>	<b>641</b>

Data sources: World Bank DRFI Program 2019. Note: a) Probable maximum losses (\$, millions); b) Jobs at risk (thousands)



### 3 Natural hazards threaten essential public services

#### 3.1 Health care facilities

**Table A3.1. Health care facilities exposed to coastal flood risk**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	0	0	0	0	0	0	0	0	0	0
Hai Phong City	0	0	6	11	31	58	34	64	37	70	42	79
Thai Binh	0	0	2	7	26	96	26	96	26	96	26	96
Nam Dinh	0	0	4	20	17	85	17	85	17	85	20	100
Ninh Binh	0	0	4	20	11	55	12	60	14	70	17	85
Thanh Hoa	0	0	2	3	7	11	14	22	21	32	22	34
Nghe An	0	0	3	7	3	7	6	15	9	22	14	34
Ha Tinh	0	0	3	10	9	30	9	30	14	47	18	60
Quang Binh	0	0	1	5	4	21	6	32	8	42	9	47
Quang Tri	0	0	0	0	2	13	3	20	3	20	3	20
Thua Thien-Hue	0	0	2	10	2	10	2	10	3	14	4	19
Da Nang City	0	0	0	0	0	0	0	0	1	4	1	4
Quang Nam	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ngai	0	0	0	0	0	0	0	0	0	0	0	0
Binh Dinh	0	0	1	5	1	5	1	5	1	5	1	5
Phu Yen	0	0	1	6	1	6	1	6	1	6	1	6
Khanh Hoa	1	5	3	14	4	18	4	18	4	18	4	18
Ninh Thuan	0	0	0	0	1	7	1	7	1	7	1	7
Binh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Ba Ria-Vung Tau	0	0	1	8	1	8	1	8	1	8	1	8
Ho Chi Minh City	0	0	4	4	11	11	15	15	16	16	17	17
Tien Giang	0	0	1	5	2	10	8	38	13	62	16	76
Ben Tre	0	0	2	10	4	20	9	45	14	70	16	80
Tra Vinh	0	0	2	10	3	14	5	24	9	43	12	57
Soc Trang	0	0	0	0	3	17	3	17	7	39	10	56
Bac Lieu	0	0	2	13	9	56	11	69	14	88	14	88
Ca Mau	0	0	1	5	4	19	6	29	10	48	11	52
Kien Giang	0	0	0	0	3	16	4	21	6	32	8	42
<b>Total coastal</b>	<b>1</b>	<b>0</b>	<b>45</b>	<b>6</b>	<b>159</b>	<b>21</b>	<b>198</b>	<b>26</b>	<b>250</b>	<b>33</b>	<b>288</b>	<b>38</b>

Data sources: Government of Vietnam et al. 2019 (health care facility locations), Braese et al. 2020 (coastal flood maps). Note: a) Number exposed; b) Share of total (%).

**Table A3.2. Health care facilities exposed to riverine flood risk**

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	8	31	19	73	20	77	22	85	23	88
Hai Phong City	0	0	0	0	0	0	0	0	2	4	39	74
Thai Binh	0	0	0	0	0	0	0	0	1	4	27	100
Nam Dinh	0	0	0	0	0	0	0	0	1	5	20	100
Ninh Binh	0	0	0	0	0	0	0	0	1	5	18	90
Thanh Hoa	0	0	0	0	2	3	51	78	56	86	56	86
Nghe An	0	0	0	0	1	2	29	71	32	78	33	80
Ha Tinh	0	0	0	0	1	3	22	73	25	83	26	87
Quang Binh	0	0	12	63	14	74	14	74	14	74	16	84
Quang Tri	0	0	9	60	10	67	12	80	12	80	13	87
Thua Thien-Hue	0	0	13	62	15	71	16	76	16	76	16	76
Da Nang City	0	0	0	0	2	9	6	26	7	30	12	52
Quang Nam	0	0	10	36	15	54	21	75	22	79	22	79
Quang Ngai	0	0	10	48	14	67	15	71	17	81	17	81
Binh Dinh	0	0	7	32	11	50	14	64	17	77	18	82
Phu Yen	0	0	3	19	4	25	4	25	5	31	6	38
Khanh Hoa	0	0	12	55	12	55	12	55	13	59	16	73
Ninh Thuan	0	0	8	53	8	53	9	60	11	73	11	73
Binh Thuan	0	0	7	39	10	56	12	67	13	72	14	78
Ba Ria-Vung Tau	0	0	8	62	8	62	9	69	10	77	10	77
Ho Chi Minh City	0	0	0	0	0	0	2	2	63	64	72	73
Tien Giang	0	0	0	0	12	57	15	71	18	86	19	90
Ben Tre	0	0	1	5	14	70	16	80	16	80	19	95
Tra Vinh	0	0	1	5	17	81	18	86	18	86	19	90
Soc Trang	0	0	0	0	15	83	16	89	17	94	17	94
Bac Lieu	0	0	1	6	13	81	14	88	15	94	16	100
Ca Mau	0	0	0	0	13	62	13	62	18	86	18	86
Kien Giang	0	0	1	5	14	74	16	84	17	89	17	89
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>111</b>	<b>15</b>	<b>244</b>	<b>33</b>	<b>376</b>	<b>50</b>	<b>479</b>	<b>64</b>	<b>610</b>	<b>81</b>

Data sources: Government of Vietnam et al. 2019 (health care facility locations), Fathom (riverine flood maps).<sup>2</sup> Note: a) Number exposed; b) Share of total (%).

### 3.2 Schools

Table A3.3. Schools exposed to coastal flood risk

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	0	0	0	0	1	50	1	50	2	100
Hai Phong City	0	0	1	2	4	7	8	14	10	17	16	28
Thai Binh	0	0	0	0	1	14	2	29	2	29	2	29
Nam Dinh	0	0	0	0	0	0	0	0	0	0	0	0
Ninh Binh	0	0	0	0	1	11	1	11	1	11	2	22
Thanh Hoa	0	0	0	0	0	0	0	0	0	0	0	0
Nghe An	0	0	0	0	0	0	0	0	0	0	0	0
Ha Tinh	0	0	0	0	0	0	0	0	1	14	1	14
Quang Binh	0	0	0	0	0	0	0	0	0	0	0	0
Quang Tri*	0	0	0	0	0	0	0	0	0	0	0	0
Thua Thien-Hue	0	0	1	6	1	6	1	6	1	6	1	6
Da Nang City	0	0	0	0	2	5	3	8	4	11	5	13
Quang Nam	0	0	0	0	0	0	0	0	1	10	1	10
Quang Ngai	0	0	2	40	2	40	2	40	2	40	2	40
Binh Dinh	0	0	1	3	3	10	3	10	3	10	3	10
Phu Yen	0	0	2	29	2	29	2	29	2	29	2	29
Khanh Hoa	0	0	3	9	4	13	5	16	6	19	6	19
Ninh Thuan	0	0	2	10	5	25	6	30	7	35	7	35
Binh Thuan	0	0	1	3	3	9	3	9	3	9	6	18
Ba Ria-Vung Tau	0	0	2	7	2	7	3	11	4	15	6	22
Ho Chi Minh City	0	0	6	1	23	5	43	9	60	12	69	14
Tien Giang	0	0	0	0	0	0	0	0	0	0	1	17
Ben Tre	0	0	3	23	4	31	4	31	5	38	5	38
Tra Vinh*	0	0	0	0	0	0	0	0	0	0	0	0
Soc Trang	0	0	0	0	0	0	0	0	0	0	0	0
Bac Lieu*	0	0	0	0	0	0	0	0	0	0	0	0
Ca Mau	0	0	0	0	1	25	2	50	2	50	2	50
Kien Giang	0	0	1	10	2	20	2	20	3	30	3	30
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>25</b>	<b>3</b>	<b>60</b>	<b>7</b>	<b>91</b>	<b>11</b>	<b>118</b>	<b>14</b>	<b>142</b>	<b>16</b>

Data sources: Open Street map 2019 (school locations), Braese et al. 2020 (coastal flood maps). Note: a) Number exposed; b) Share of total (%).

Table A3.4. Schools exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	0	0	1	50	1	50	2	100	2	100
Hai Phong City	0	0	0	0	0	0	0	0	2	3	44	76
Thai Binh	0	0	0	0	0	0	0	0	0	0	5	71
Nam Dinh	0	0	0	0	0	0	0	0	0	0	10	100
Ninh Binh	0	0	0	0	0	0	0	0	0	0	8	89
Thanh Hoa	0	0	0	0	0	0	1	100	1	100	1	100
Nghe An	0	0	0	0	0	0	2	33	5	83	5	83
Ha Tinh	0	0	0	0	0	0	3	43	3	43	5	71
Quang Binh	0	0	2	67	2	67	3	100	3	100	3	100
Quang Tri*	0	0	0	0	0	0	0	0	0	0	0	0
Thua Thien-Hue	0	0	5	29	8	47	11	65	14	82	16	94
Da Nang City	0	0	7	18	13	34	21	55	26	68	30	79
Quang Nam	0	0	1	10	3	30	7	70	9	90	10	100
Quang Ngai	0	0	2	40	4	80	4	80	4	80	5	100
Binh Dinh	0	0	13	42	18	58	20	65	24	77	27	87
Phu Yen	0	0	4	57	4	57	5	71	7	100	7	100
Khanh Hoa	0	0	9	28	14	44	16	50	23	72	25	78
Ninh Thuan	0	0	10	50	14	70	16	80	19	95	19	95
Binh Thuan	0	0	18	55	24	73	25	76	30	91	31	94
Ba Ria-Vung Tau	0	0	13	48	16	59	19	70	20	74	23	85
Ho Chi Minh City	0	0	0	0	0	0	18	4	396	78	426	84
Tien Giang	0	0	0	0	0	0	1	17	2	33	2	33
Ben Tre	0	0	0	0	9	69	11	85	12	92	12	92
Tra Vinh*	0	0	0	0	0	0	0	0	0	0	0	0
Soc Trang	0	0	0	0	1	33	1	33	1	33	1	33
Bac Lieu*	0	0	0	0	0	0	0	0	0	0	0	0
Ca Mau	0	0	0	0	0	0	1	25	1	25	3	75
Kien Giang	0	0	0	0	5	50	6	60	8	80	9	90
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>84</b>	<b>10</b>	<b>136</b>	<b>16</b>	<b>192</b>	<b>22</b>	<b>612</b>	<b>71</b>	<b>729</b>	<b>84</b>

Data sources: Open Street map 2019 (school locations) and Fathom (riverine flood maps).<sup>2</sup> Note: a) Number exposed; b) Share of total (%).

## 4 Lifeline infrastructure systems are highly exposed to natural hazards

### 4.1 The transport network

#### 4.1.1 Exposure estimates

**Table A4.1. Road network exposed to typhoon risk, in provinces north of Ba Ria Vung-Tau**

Beaufort scale:	Level 13		Level 14		Level 15		Level 16	
Province	a	b	a	b	a	b	a	b
Quang Ninh	41	11	49	13	62	17	112	30
Hai Phong City	35	10	36	10	37	10	64	18
Thai Binh	19	1	24	2	79	5	35	2
Nam Dinh	16	1	59	5	56	5	34	3
Ninh Binh	5	0	3	0	3	0	12	1
Thanh Hoa	5	1	28	4	39	5	51	7
Nghe An	47	6	42	5	48	6	60	8
Ha Tinh	20	1	23	2	24	2	24	2
Quang Binh	52	12	65	15	62	14	82	19
Quang Tri	43	8	61	12	64	12	68	13
Thua Thien-Hue	62	7	72	8	84	9	90	10
Da Nang City	24	2	19	2	23	2	19	2
Quang Nam	17	1	17	1	18	1	19	1
Quang Ngai	36	8	27	6	28	6	29	7
Binh Dinh	12	2	15	3	17	3	18	3
Phu Yen	14	1	22	2	23	2	34	3
Khanh Hoa	14	4	13	4	26	8	23	7
Ninh Thuan	6	1	6	1	7	1	7	1
Binh Thuan	0	0	0	0	0	0	0	0
<b>Total coastal</b>	<b>1</b>	<b>0</b>	<b>45</b>	<b>6</b>	<b>159</b>	<b>21</b>	<b>198</b>	<b>26</b>

*Data source:* Based on Pant et al 2019. *Note:* a) Length exposed (km); b) Share of total (%). Typhoon intensity is determined by wind speeds based on the Beaufort scale, where Level 13 = 134–149 kilometers per hour (km/h); Level 14 = 150–166km/h; Level 15 = 167–183km/h; and Level 16 = 184–201km/h. Only areas with flood depths of over one meter were considered in the analysis

Table A4.2. Road network exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	0	0	0	0	35	9	37	10	37	10
Hai Phong City	0	0	0	0	0	0	0	0	0	0	0	0
Thai Binh	0	0	0	0	0	0	4	0	4	0	8	1
Nam Dinh	0	0	0	0	0	0	20	2	25	2	37	3
Ninh Binh	0	0	0	0	0	0	0	0	0	0	0	0
Thanh Hoa	0	0	11	1	14	2	47	7	48	7	64	9
Nghe An	0	0	1	0	1	0	47	6	63	8	68	9
Ha Tinh	0	0	0	0	0	0	0	0	9	1	10	1
Quang Binh	0	0	0	0	17	4	18	4	18	4	31	7
Quang Tri	0	0	0	0	0	0	0	0	0	0	10	2
Thua Thien-Hue	0	0	6	1	6	1	10	1	10	1	29	3
Da Nang City	0	0	18	2	19	2	22	2	22	2	22	2
Quang Nam	2	0	40	2	46	3	67	4	66	4	80	5
Quang Ngai	0	0	19	4	19	4	19	4	20	5	22	5
Binh Dinh	0	0	0	0	0	0	3	0	4	1	52	9
Phu Yen	0	0	0	0	0	0	13	1	20	2	21	2
Khanh Hoa	0	0	0	0	0	0	4	1	4	1	4	1
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Ba Ria-Vung Tau	0	0	0	0	0	0	0	0	0	0	0	0
Ho Chi Minh City	0	0	7	1	18	3	30	5	30	5	62	10
Tien Giang	0	0	7	1	18	3	30	5	62	10	35	6
Ben Tre	0	0	1	0	1	0	1	0	1	0	3	0
Tra Vinh	0	0	0	0	1	0	1	0	25	3	25	3
Soc Trang	0	0	0	0	0	0	0	0	11	1	11	1
Bac Lieu	0	0	0	0	0	0	0	0	0	0	0	0
Ca Mau	0	0	0	0	0	0	0	0	0	0	0	0
Kien Giang	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total coastal</b>	<b>2</b>	<b>0</b>	<b>110</b>	<b>1</b>	<b>161</b>	<b>1</b>	<b>370</b>	<b>2</b>	<b>481</b>	<b>2</b>	<b>631</b>	<b>3</b>

Data source: Based on Pant et al. 2019. Note: a) Length exposed (km); b) Share of total (%).

#### 4.1.2 Economic impact of exposure to flooding

**Table A4.3. Potential direct damages (\$, millions)**

Return period:	1-in-5		1-in-20/25*		1-in-50		1-in-100		1-in-250	
Province	a	b	a	b	a	b	a	b	a	b
Quang Ninh	1	0	4	6	7	7	9	9	13	11
Hai Phong City	1	0	3	23	4	26	5	30	7	40
Thai Binh	0	0	1	4	3	7	5	9	8	12
Nam Dinh	0	0	1	19	13	20	15	22	17	24
Ninh Binh	0	0	1	9	6	11	8	13	10	15
Thanh Hoa	1	0	35	47	38	51	41	55	47	83
Nghe An	2	0	37	67	52	74	57	80	66	116
Ha Tinh	1	0	22	21	27	30	29	34	33	38
Quang Binh	0	0	5	14	11	18	15	21	20	25
Quang Tri	0	0	3	13	6	14	10	16	12	21
Thua Thien-Hue	1	0	7	18	13	20	17	22	22	33
Da Nang City	1	0	9	20	13	23	20	24	32	32
Quang Nam	1	0	12	24	19	25	21	27	32	42
Quang Ngai	0	0	5	13	10	15	12	17	19	21
Binh Dinh	0	0	12	15	14	18	16	20	19	25
Phu Yen	0	0	2	2	2	3	3	4	5	5
Khanh Hoa	0	0	2	13	10	14	11	15	13	23
Ninh Thuan	0	0	0	7	5	8	6	9	7	9
Binh Thuan	0	0	1	10	6	11	8	13	9	18
Ba Ria-Vung Tau	0	0	2	1	3	1	5	2	8	2
Ho Chi Minh City	0	0	5	63	18	82	36	98	51	114
Tien Giang	0	0	2	4	3	4	4	5	7	7
Ben Tre	0	0	1	1	2	1	3	1	6	2
Tra Vinh	0	0	1	1	1	1	2	2	3	2
Soc Trang	0	0	2	2	2	3	3	3	4	4
Bac Lieu	0	0	0	2	1	2	2	3	2	3
Ca Mau	0	0	0	1	0	1	1	1	1	1
Kien Giang	0	0	0	7	7	9	8	11	9	12
<b>Total coastal</b>	<b>10</b>	<b>0</b>	<b>175</b>	<b>427</b>	<b>296</b>	<b>502</b>	<b>371</b>	<b>564</b>	<b>481</b>	<b>740</b>

Data source: Based on World Bank DRFI Program 2019. Note: a) Coastal flood risk; b) Riverine flood risk. Note: a) Coastal flood risk; b) Riverine flood risk. \*For riverine flood risk a return period of 1-in-20 has been used, for coastal flooding this is 1-in-25.

## 4.2 The energy system

### 4.2.1 Exposure estimates

**Table A4.4. Electrical substations exposed to coastal flooding**

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	5	18	6	21	7	25	7	25	7	25
Hai Phong City	0	0	2	18	11	100	11	100	11	100	11	100
Thai Binh	0	0	1	14	7	100	7	100	7	100	7	100
Nam Dinh	0	0	2	40	5	100	5	100	5	100	5	100
Ninh Binh	0	0	3	21	7	50	8	57	8	57	8	57
Thanh Hoa	0	0	0	0	1	5	2	9	3	14	4	18
Nghe An	0	0	3	15	3	15	4	20	5	25	5	25
Ha Tinh	0	0	1	13	2	25	4	50	4	50	4	50
Quang Binh	0	0	1	10	1	10	1	10	1	10	1	10
Quang Tri	0	0	0	0	0	0	1	9	1	9	1	9
Thua Thien-Hue	0	0	0	0	0	0	1	8	2	17	3	25
Da Nang City	0	0	0	0	0	0	1	8	1	8	1	8
Quang Nam	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ngai	0	0	0	0	0	0	1	13	1	13	1	13
Binh Dinh	0	0	1	8	1	8	1	8	1	8	2	15
Phu Yen	0	0	0	0	0	0	0	0	0	0	0	0
Khanh Hoa	0	0	0	0	0	0	0	0	0	0	0	0
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Ba Ria-Vung Tau	0	0	2	9	2	9	3	14	3	14	3	14
Ho Chi Minh City	1	1	12	17	29	41	33	46	37	52	39	55
Tien Giang	0	0	1	11	4	44	8	89	8	89	8	89
Ben Tre	1	17	3	50	3	50	4	67	5	83	5	83
Tra Vinh	0	0	2	40	3	60	5	100	5	100	5	100
Soc Trang	0	0	2	22	3	33	5	56	5	56	8	89
Bac Lieu	0	0	1	20	4	80	5	100	5	100	5	100
Ca Mau	0	0	0	0	3	38	6	75	8	100	8	100
Kien Giang	0	0	0	0	1	7	3	20	9	60	11	73
<b>Total coastal</b>	<b>2</b>	<b>1</b>	<b>42</b>	<b>11</b>	<b>96</b>	<b>25</b>	<b>126</b>	<b>33</b>	<b>142</b>	<b>37</b>	<b>152</b>	<b>40</b>

Data sources: Global Energy Observatory et. al 2019 (electrical substation locations), Braese et al. 2020 (coastal flood maps). Note: a) Number exposed; b) Share of total (%)



Table A4.5. Electrical substations exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	4	14	10	36	10	36	12	43	13	46
Hai Phong City	0	0	0	0	0	0	0	0	0	0	9	82
Thai Binh	0	0	0	0	0	0	0	0	0	0	7	100
Nam Dinh	0	0	0	0	0	0	0	0	0	0	5	100
Ninh Binh	0	0	0	0	0	0	0	0	0	0	9	64
Thanh Hoa	0	0	0	0	1	5	13	59	13	59	15	68
Nghe An	0	0	0	0	0	0	10	50	10	50	10	50
Ha Tinh	0	0	0	0	0	0	5	63	6	75	6	75
Quang Binh	0	0	3	30	4	40	5	50	5	50	5	50
Quang Tri	0	0	4	36	4	36	4	36	5	45	5	45
Thua Thien-Hue	0	0	3	25	4	33	4	33	7	58	7	58
Da Nang City	0	0	5	42	5	42	6	50	6	50	6	50
Quang Nam	0	0	5	33	6	40	6	40	6	40	8	53
Quang Ngai	0	0	3	38	3	38	3	38	4	50	5	63
Binh Dinh	0	0	9	69	10	77	11	85	11	85	11	85
Phu Yen	0	0	1	14	1	14	1	14	1	14	1	14
Khanh Hoa	0	0	3	27	3	27	6	55	6	55	6	55
Ninh Thuan	0	0	3	43	3	43	3	43	3	43	4	57
Binh Thuan	0	0	10	77	10	77	11	85	11	85	12	92
Ba Ria-Vung Tau	0	0	11	50	13	59	13	59	15	68	16	73
Ho Chi Minh City	0	0	0	0	0	0	3	4	60	85	63	89
Tien Giang	0	0	0	0	8	89	8	89	9	100	9	100
Ben Tre	0	0	0	0	5	83	5	83	5	83	5	83
Tra Vinh	0	0	0	0	4	80	5	100	5	100	5	100
Soc Trang	0	0	0	0	7	78	8	89	9	100	9	100
Bac Lieu	0	0	0	0	5	100	5	100	5	100	5	100
Ca Mau	0	0	0	0	7	88	8	100	8	100	8	100
Kien Giang	0	0	1	7	12	80	12	80	12	80	14	93
<b>Total coastal</b>	<b>0</b>	<b>0</b>	<b>65</b>	<b>17</b>	<b>125</b>	<b>33</b>	<b>165</b>	<b>43</b>	<b>234</b>	<b>61</b>	<b>278</b>	<b>72</b>

Data sources: Global Energy Observatory et al. 2019 (electrical substation locations), Fathom (riverine flood maps).<sup>2</sup> Note: a) Number exposed; b) Share of total (%)

Table A4.6. Power plants exposed to coastal flood risk

Return period:	1-in-5		1-in-25		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	2	50	3	75	3	75	3	75	3	75
Hai Phong City	0	0	1	50	2	100	2	100	2	100	2	100
Ninh Binh	0	0	0	0	0	0	1	100	1	100	1	100
Thanh Hoa	0	0	0	0	1	25	1	25	1	25	1	25
Nghe An	0	0	0	0	0	0	0	0	0	0	0	0
Ha Tinh	0	0	1	20	1	20	1	20	1	20	1	20
Quang Binh	0	0	0	0	0	0	0	0	0	0	0	0
Thua Thien-Hue	0	0	0	0	0	0	0	0	0	0	0	0
Quang Nam	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ngai	0	0	0	0	0	0	0	0	0	0	0	0
Binh Dinh	0	0	1	20	1	20	1	20	1	20	1	20
Phu Yen	0	0	0	0	0	0	0	0	0	0	0	0
Khanh Hoa	0	0	0	0	0	0	0	0	0	0	0	0
Ninh Thuan	0	0	0	0	0	0	0	0	0	0	0	0
Binh Thuan	0	0	1	20	1	20	1	20	1	20	1	20
Ba Ria-Vung Tau	0	0	2	33	2	33	2	33	2	33	2	33
Ho Chi Minh City	0	0	0	0	1	50	1	50	1	50	1	50
Tra Vinh	0	0	2	100	2	100	2	100	2	100	2	100
Bac Lieu	0	0	0	0	1	100	1	100	1	100	1	100
Ca Mau	0	0	0	0	0	0	1	100	1	100	1	100
<b>Total</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>14</b>	<b>15</b>	<b>21</b>	<b>17</b>	<b>23</b>	<b>17</b>	<b>23</b>	<b>17</b>	<b>23</b>

Data sources: Global Energy Observatory et al. 2019 (power plant locations), Braese et al. 2020 (coastal flood maps). Note: a) Total exposed; b) Share of total (%).

Table A4.7. Power plants exposed to riverine flood risk

Return period:	1-in-5		1-in-20		1-in-50		1-in-100		1-in-250		1-in-500	
Province	a	b	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	0	0	2	1	4	4	4	4	4	4
Hai Phong City	0	0	0	0	0	0	0	0	0	0	2	2
Ninh Binh	0	0	0	0	0	0	0	0	0	0	1	1
Thanh Hoa	0	0	0	0	0	0	2	1	2	1	2	1
Nghe An	0	0	0	0	0	0	3	2	3	2	3	2
Ha Tinh	0	0	0	0	0	0	4	3	4	3	4	3
Quang Binh	0	0	0	0	0	0	0	0	0	0	1	1
Thua Thien-Hue	0	0	3	2	3	2	3	2	3	2	3	2
Quang Nam	0	0	10	8	10	8	11	9	11	9	11	9
Quang Ngai	0	0	1	0	3	3	3	3	3	3	3	3
Binh Dinh	0	0	2	1	2	1	3	2	3	2	4	3
Phu Yen	0	0	2	1	2	1	2	1	3	3	3	3
Khanh Hoa	0	0	2	2	2	2	2	2	2	2	2	2
Ninh Thuan	0	0	3	3	3	3	3	3	3	3	3	3
Binh Thuan	0	0	3	2	3	2	3	2	3	2	3	2
Ba Ria-Vung Tau	0	0	2	1	5	4	5	4	5	4	5	4
Ho Chi Minh City	0	0	0	0	0	0	0	0	1	1	2	2
Tra Vinh	0	0	0	0	2	2	2	2	2	2	2	2
Bac Lieu	0	0	0	0	1	1	1	1	1	1	1	1
Ca Mau	0	0	0	0	1	1	1	1	1	1	1	1
<b>Total</b>	<b>0</b>	<b>0</b>	<b>28</b>	<b>11</b>	<b>39</b>	<b>21</b>	<b>52</b>	<b>37</b>	<b>54</b>	<b>40</b>	<b>60</b>	<b>49</b>

Data sources: Global Energy Observatory et al. 2019 (power plant locations), Fathom (riverine flood maps).<sup>2</sup> Note: a) Total exposed; b) Share of total (%).

## 4.2.2 Economic impact of exposure to flooding

**Table A4.8. Potential direct damages of flood exposure to the power sector**

Return period:	1-in-5		1-in-20/25*		1-in-50		1-in-100		1-in-250	
Province	a	b	a	b	a	b	a	b	a	b
Quang Ninh	0	0	1	1	2	2	2	2	3	2
Hai Phong City	0	0	1	5	1	5	1	6	1	8
Thai Binh	0	0	0	0	0	0	0	0	0	0
Nam Dinh	0	0	0	0	0	0	0	0	0	0
Ninh Binh	0	0	0	1	1	1	1	1	1	2
Thanh Hoa	0	0	7	10	8	11	9	12	10	18
Nghe An	0	0	6	11	9	12	9	13	11	19
Ha Tinh	0	0	6	5	7	8	8	9	8	10
Quang Binh	0	0	1	3	2	4	3	4	4	5
Quang Tri	0	0	1	2	1	3	2	3	2	4
Thua Thien-Hue	0	0	1	4	3	4	3	4	4	7
Da Nang City	0	0	1	2	2	3	2	3	4	4
Quang Nam	0	0	2	5	4	5	4	5	6	8
Quang Ngai	0	0	1	1	1	2	1	2	2	2
Binh Dinh	0	0	0	0	0	0	0	1	0	1
Phu Yen	0	0	0	0	0	0	0	0	1	1
Khanh Hoa	0	0	0	0	0	0	0	0	0	0
Ninh Thuan	0	0	0	1	1	1	1	1	1	1
Binh Thuan	0	0	0	2	1	3	2	3	2	4
Ba Ria-Vung Tau	0	0	0	0	0	0	1	0	1	0
Ho Chi Minh City	0	0	1	16	4	21	9	25	13	29
Tien Giang	0	0	0	0	0	0	0	0	1	1
Ben Tre	0	0	0	0	0	0	0	0	0	0
Tra Vinh	0	0	0	0	0	0	0	0	0	0
Soc Trang	0	0	0	0	0	0	0	0	0	0
Bac Lieu	0	0	0	0	0	0	0	0	0	0
Ca Mau	0	0	0	1	1	1	1	2	2	2
Kien Giang	0	0	0	0	0	0	0	0	0	0
<b>Total coastal</b>	<b>0</b>	<b>2</b>	<b>25</b>	<b>30</b>	<b>72</b>	<b>47</b>	<b>86</b>	<b>60</b>	<b>97</b>	<b>78</b>

Data source: Based on World Bank DRFI Program, 2019. Note: a) Coastal flood risk; b) Riverine flood risk. \*For riverine flood risk a return period of 1-in-20 has been used, for coastal flooding this is 1-in-25. Direct damage estimates are based on potential damages to power plants and transmission lines.

## References

- Braese, J, de Vries Robbé, S and Rentschler, J. 2020. *Technical Background Paper: A Multisectoral Risk Assessment for Coastal Vietnam*. World Bank Group.
- Global Energy Observatory, Google, KTH Royal Institute of Technology in Stockholm, Enipedia and World Resources Institute. 2019. *Global Power Plant Database*. Published on Resource Watch and Google Earth Engine. <https://tinyurl.com/w8l32z2>
- WHO, World Bank and Government of Vietnam. 2019. Vietnam Health Facility Database. Work in progress.
- JAXA EORC. (2018). High-Resolution Land Use and Land Cover Map of the Southern Region of Vietnam. Version 18.09. Japan Aerospace Exploration Agency Earth Observation Research Center.
- Pant, R, Koks, E E, Russell, T, Schoenmakers, R and Hall, J W (2019). *Analysis and Development of Model for Addressing Climate Change/Disaster Risks in Multi-modal Transport Networks in Vietnam*. Oxford, UK.
- World Bank. (2020). *Vietnam: Urbanization Review. Shifting the GEAR: Putting Vietnam's Urbanization onto an Efficient, Inclusive, and Resilient pathway*.
- World Bank DRFI Program. (2019). *Vietnam Country Risk Assessment*. Washington, DC.

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<sup>1</sup> Information retrieved from General Statistics Office of Vietnam, <https://tinyurl.com/tq3s66s>

<sup>2</sup> Information from Fathom Global, <https://tinyurl.com/sfzgo7z>

<sup>3</sup> Information from World Bank Open Data, <https://data.worldbank.org/>

<sup>4</sup> Information retrieved from General Statistics Office of Vietnam, <https://www.gso.gov.vn/>