

Supplementary Material

Supplementary Table 1. References used to support causal loop diagram of effect of natural hazards and land-use change on rice production. References are listed under Supplementary References.

	Variable A	Variable B	Relationship	Location	References	Number of references	% of references
1	Human development	Dikes	positive	Mekong River Delta	12 14 16 15 41 71 89 90	8	9%
				Red River Delta	77	1	1%
				Both deltas		0	0%
2	Dikes	Irrigation	positive	Mekong River Delta	14 41 71 101	4	4%
				Red River Delta	77	1	1%
				Both deltas		0	0%
3	Irrigation	Water supply	positive	Mekong River Delta	14 41 71 101	4	4%
				Red River Delta	77	1	1%
				Both deltas		0	0%
4	Water Supply	Rice growing area	positive	Mekong River Delta	1 14 41 63 71 78 101	7	7%
				Red River Delta	96	1	1%
				Both Deltas		0	0%
5	Dikes	Flooding	uncertain	Mekong River Delta	14 34 35 37 41 47 48 62 89 90	10	11%
				Red River Delta	33 54 58 77	4	4%
				Both Deltas		0	0%
6	Flooding	Fertile Alluvium	positive	Mekong River Delta	14 15 16 18 36 37 41 62 71 88 89 90	12	13%
				Red River Delta		0	0%
				Both Deltas		0	0%
7	Flooding	Rice growing area	uncertain	Mekong River Delta	14 15 16 18 25 41 47 62 71 78 89	11	12%
				Red River Delta	54 58 61	3	3%
				Both Deltas		0	0%

8	Fertile Alluvium	Rice yield	positive	Mekong River Delta	14 15 16 41 62 71 88 89	8	9%
				Red River Delta		0	0%
				Both Deltas		0	0%
9	Fertile Alluvium	delta size	positive	Mekong River Delta	14 15 16 36	4	4%
				Red River Delta		0	0%
				Both Deltas		0	0%
10	Human Development	Sand mining	positive	Mekong River Delta	3 8 11 12 41 49 78 81	8	9%
				Red River Delta	17 97	2	2%
				Both Deltas		0	0%
11	Sand mining	Sediment	negative	Mekong River Delta	3 8 11 12 41 49 78 81	8	9%
				Red River Delta	97	1	1%
				Both Deltas		0	0%
12	Sediment	Delta size	positive	Mekong River Delta	3 8 15 16 40 41 49 78 79 81	10	11%
				Red River Delta	24	1	1%
				Both Deltas		0	0%
13	Sediment	Land subsidence	negative	Mekong River Delta	3 8 41 78 79	5	5%
				Red River Delta		0	0%
				Both Deltas		0	0%
14	Land subsidence	Delta size	negative	Mekong River Delta	3 8 41 78 79	5	5%
				Red River Delta		0	0%
				Both Deltas		0	0%
15	Delta size	saltwater intrusion	negative	Mekong River Delta	43 69	2	2%
				Red River Delta		0	0%
				Both Deltas		0	0%
16	Delta size	Rice growing area	positive	Mekong River Delta	41 79	2	2%
				Red River Delta		0	0%
				Both Deltas		0	0%
17	Rice growing area	Rice yield per ha	positive	Mekong River Delta	30	1	1%
				Red River Delta		0	0%

				Both Deltas		0	0%
18	Human development	Dams	positive	Mekong River Delta	2 3 8 9 12 31 40 41 43 51	15	16%
					52 69 78 79 81		
				Red River Delta	21 24 46 50 86 97	6	6%
				Both Deltas		0	0%
19	Dams	Sediment	negative	Mekong River Delta	2 3 8 9 12 18 31 40 41 43	17	18%
					49 51 56 69 78 79 81		
				Red River Delta	21 24 46 50 87 98	6	6%
				Both Deltas		0	0%
20	Dams	Water supply	uncertain	Mekong River Delta	2 9 18 20 41 43 51 52 69 78	10	11%
				Red River Delta	46 87 98	3	3%
				Both Deltas		0	0%
21	Water supply	Saltwater intrusion	negative	Mekong River Delta	1 9 30 42 63 67 68 69 71 72	12	13%
					78 95		
				Red River Delta	38 65 97	3	3%
				Both Deltas	32	1	1%
22	Saltwater intrusion	Rice growing area	negative	Mekong River Delta	1 9 30 42 63 67 68 69 71 72	13	14%
					78 92 95		
				Red River Delta	38 54 65	3	3%
				Both Deltas	87	1	1%
23	Human development	Groundwater extraction	positive	Mekong River Delta	3 8 26 27 41 49 59 60 78 80	11	12%
					81		
				Red River Delta	100	1	1%
				Both Deltas		0	0%
24	Groundwater extraction	Land subsidence	positive	Mekong River Delta	3 8 26 27 41 49 59 60 80 81	10	11%
				Red River Delta		0	0%
				Both Deltas		0	0%
25	Land subsidence	Saltwater intrusion	positive	Mekong River Delta	3 26 41 80 81	5	5%
				Red River Delta		0	0%

				Both Deltas			0	0%
26	Groundwater extraction	Water supply	positive	Mekong River Delta	3 26 41 59 60 80 81		7	7%
				Red River Delta	100		1	1%
				Both Deltas	53		1	1%
27	Groundwater extraction	Arsenic contamination	positive	Mekong River Delta	26 27 44		3	3%
				Red River Delta	73 100		2	2%
				Both Deltas	7 29 53 76		4	4%
28	Arsenic contamination	Rice quality	negative	Mekong River Delta	44		1	1%
				Red River Delta	74		1	1%
				Both Deltas	29 76		2	2%
29	Typhoon intensity	Rain	positive	Mekong River Delta	62		1	1%
				Red River Delta	24 61		2	2%
				Both Deltas	66		1	1%
30	Rain	Water supply	positive	Mekong River Delta	1		1	1%
				Red River Delta	96 97		2	2%
				Both Deltas			0	0%
31	Rain	Flooding	positive	Mekong River Delta	62		1	1%
				Red River Delta	24 61		2	2%
				Both Deltas	66 87		2	2%
32	Typhoon intensity	Storm surge	positive	Mekong River Delta	28 84 85 86		4	4%
				Red River Delta	54 61		2	2%
				Both Deltas	13		1	1%
33	Storm surge	Flooding	positive	Mekong River Delta	84 85		2	2%
				Red River Delta	54 61		2	2%
				Both Deltas	13 87		2	2%
34	Typhoon intensity	Wind speed	positive	Mekong River Delta	28 84		2	2%
				Red River Delta	61		1	1%
				Both Deltas			0	0%
35	Wind speed	Rice yield per ha	negative	Mekong River Delta	28		1	1%

				Red River Delta		0	0%
				Both Deltas		0	0%
36	Typhoon	Sediment	positive	Mekong River Delta	22	1	1%
				Red River Delta		0	0%
				Both Deltas		0	0%
37	Drought	Rain	negative	Mekong River Delta	1 9 30 63 67 68 71	7	7%
				Red River Delta	96 97	2	2%
				Both Deltas	72	1	1%
38	Human Development	Agrochemical use	positive	Mekong River Delta	4 5 6 19 82	5	5%
				Red River Delta	57 91	2	2%
				Both Deltas	70	1	1%
39	Agrochemical use	Pests and diseases	uncertain	Mekong River Delta	4 5 6 19 39 81 82 94	7	7%
				Red River Delta	57 91	2	2%
				Both Deltas	70	0	0%
40	Pests and diseases	Rice growing area	negative	Mekong River Delta	4 5 6 19 39 64 75 82 94	9	10%
				Red River Delta	57 91	2	2%
				Both Deltas	70	0	0%

Supplementary Table 2. References used to support causal loop diagram of effect of climate change on natural hazards and land-use change on rice production. References are listed under Supplementary References.

	Variable A	Variable B	Relationship	Location	References	Number of references	% of references
1	Climate change	Temperature	positive	Mekong River Delta	18 41 55 62 78 83 92 93	8	26%
				Red River Delta	61 65	2	6%
				Both deltas	45	1	3%
2	Temperature	Ice melt/thermal expansion	positive	Mekong River Delta	78	1	3%
				Red River Delta		0	0%
				Both deltas		0	0%
3	Ice melt	Sea level	positive	Mekong River Delta	78	1	3%
				Red River Delta		0	0%
				Both deltas		0	0%
4	Sea level	Flooding	positive	Mekong River Delta	2 18 20 23 47 83 92 99	8	26%
				Red River Delta	61	1	3%
				Both deltas	10 32 87	3	10%
5	Flooding	Rice growing area	negative	Mekong River Delta	23 78 83 99	4	13%
				Red River Delta	61	1	3%
				Both deltas	32 45	2	6%
6	Sea level	Storm surge	positive	Mekong River Delta		0	0%
				Red River Delta	61	1	3%
				Both deltas	32	1	3%
7	Storm surge	Flooding	positive	Mekong River Delta	84 85	2	6%
				Red River Delta	61	1	3%
				Both deltas		0	0%
8	Flooding	Erosion	positive	Mekong River Delta		0	0%
				Red River Delta	61	1	3%
				Both deltas	10 45	2	6%
9	Erosion	Rice growing area	negative	Mekong River Delta		0	0%
				Red River Delta	61	1	3%

				Both deltas	10		1	3%
10	Rice growing area	Rice yield per ha	positive	Mekong River Delta	30		1	3%
				Red River Delta			0	0%
				Both deltas			0	0%
11	Sea level	Saltwater intrusion	positive	Mekong River Delta	2 9 18 62 83 92 93		7	23%
				Red River Delta	61 65		2	6%
				Both deltas	10 32 45 87		4	13%
12	Saltwater intrusion	Water supply	negative	Mekong River Delta	68 83		2	6%
				Red River Delta			0	0%
				Both deltas	10 32		2	6%
13	Water supply	Rice growing area	negative	Mekong River Delta	30 93		2	6%
				Red River Delta	65		1	3%
				Both deltas	32		1	3%
14	Water supply	Saltwater intrusion	negative	Mekong River Delta	68		1	3%
				Red River Delta	65		1	3%
				Both deltas	10		1	3%
15	Temperature	Rice yield	uncertain	Mekong River Delta	18 68		2	6%
				Red River Delta			0	0%
				Both deltas			0	0%
16	Climate change	Typhoon intensity	positive	Mekong River Delta	62 83 84		3	10%
				Red River Delta	61		1	3%
				Both deltas	13		1	3%
17	Temperature	Typhoon intensity	positive	Mekong River Delta	28 84		2	6%
				Red River Delta			0	0%
				Both deltas			0	0%
18	Typhoon intensity	Storm surge	positive	Mekong River Delta	28 84		2	6%
				Red River Delta	61		1	3%
				Both deltas			0	0%
19	Typhoon intensity	Wind speed	positive	Mekong River Delta	28 62 84		3	10%

				Red River Delta		0	0%
				Both deltas		0	0%
20	Wind speed	Rice yield per ha	negative	Mekong River Delta	28	1	3%
				Red River Delta		0	0%
				Both deltas		0	0%
21	Typhoon intensity	Rain	positive	Mekong River Delta	62	1	3%
				Red River Delta		0	0%
				Both deltas		0	0%
22	Rain	Flooding	positive	Mekong River Delta	23 62	2	6%
				Red River Delta	58	1	3%
				Both deltas	66	1	3%
23	Climate change	Drought	positive	Mekong River Delta	30 83	2	6%
				Red River Delta		0	0%
				Both deltas	13	1	3%
24	Drought	Rain	negative	Mekong River Delta	30 68	2	6%
				Red River Delta		0	0%
				Both deltas		0	0%
25	Rain	Water supply	positive	Mekong River Delta	1 68	2	6%
				Red River Delta	96	1	3%
				Both deltas		0	0%
26	Climate change	Rain	uncertain	Mekong River Delta	55	1	3%
				Red River Delta	58 61	2	6%
				Both deltas	45	1	3%
27	Climate change	Pests and diseases	uncertain	Mekong River Delta	82	1	3%
				Red River Delta		0	0%
				Both deltas		0	0%

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