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Unit



Adaptation to climate change (CCA) in low to middle income countries

Results of an evidence gap map

Kevin Moull

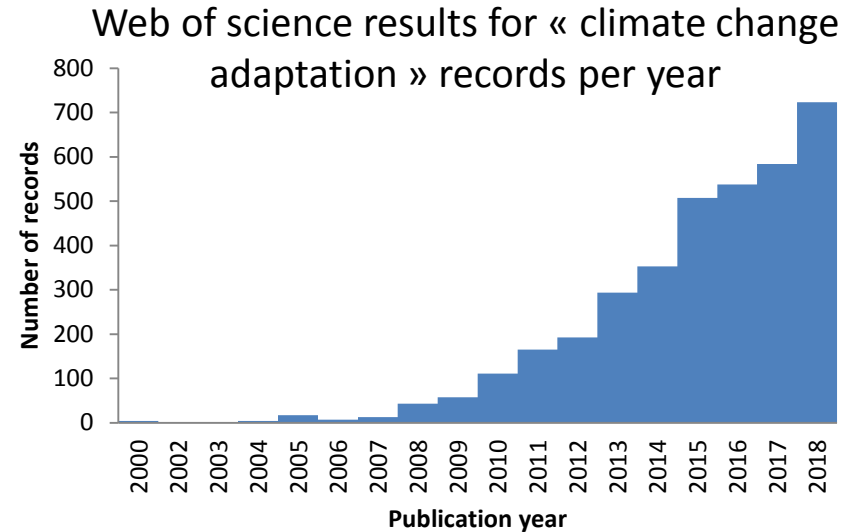
German Institute for Development Evaluation (DEval)

Authors: Doswald, N., Sanchez Torrente, L., Reumann, A., Moull, K., Rocio Perez, J.J., Köngeter, A., Fernández de Velasco, G., Leppert, G. & Puri, J.


Introduction

- Rising emphasis of CCA in **development cooperation**

- Growing **peer-reviewed literature** on CCA



- Important to evaluate which interventions are **effective** for adapting to the impacts of climate change

- **Lack** of comprehensive and systematic synthesis of CCA evidence  **Evidence Gap Map**

Research question of the EGM

What is the state of the evidence base regarding the **ability** of **climate change adaptation (CCA) interventions** to help **people in low to middle income countries adapt to the impacts of climate change?**

POPULATION	INTERVENTION	COMPARATOR	OUTCOME
Human individuals, groups, communities, institutions, systems and sectors (water, infrastructure, agriculture, forestry, fishing, health) in low to middle income countries.	Those that aim to adjust, reduce, stop or make use of the benefits of an impact from a direct change in climate or a climatic hazard.	No adaptation intervention, different levels of intervention or comparison of different interventions.	Human adaptation to climate change, variability, extremes or other natural hazards that could be linked to climate.

Methods

- **Study types:** impact evaluations, systematic reviews
 - experimental, quasi-experimental, non-experimental studies
- **Filters:**
 - country: low to middle income countries
 - language: English (title, abstract, and body)
 - publication year: 2007-2018
 - publication type: peer-reviewed, grey literature
- **Sources:** Web of Science, Scopus, 3ie, CEE, websites
- **EGM framework:** based on AR4 (2007) and AR5 (2014) adaptation frameworks by IPCC
- **Systematic map protocol:** inclusion/exclusion criteria

EGM Framework

Outcomes

Uptake	Shocks and stressors		Adaptive capacity		Enabling Environment		
Adoption	Decreased Exposure	Decreased Impacts/Risks	Social benefits	Economic benefits	Environmental systems	Socio-economic systems	Institutional systems
	Population affected by extreme weather events	Proactive and reactive risk management; climate related illness; deaths; food security	Skills acquired, access, awareness	Livelihood diversification, productivity gains, access	Area protected, ecological services improved	Social capital enhanced, overall poverty measurements	Policy changes, regulations approved, institutional reform

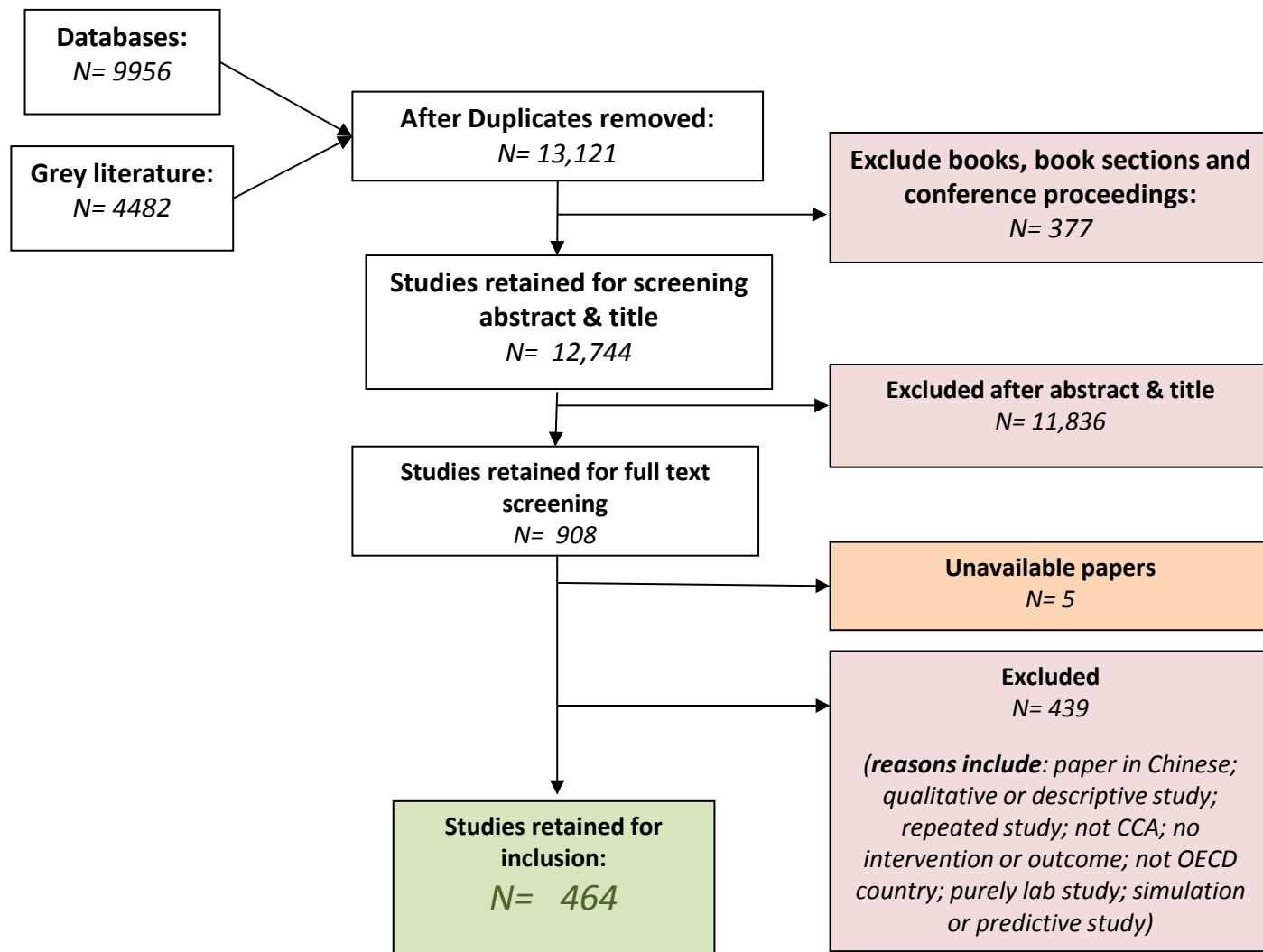
Interventions

Nature-Based Options
Built Infrastructure / Structural
Technological Options
Informational/ Research
Institutional/ Planning/ Policy/ Laws/ Regulations
Financial/ Market Mechanisms
Social/ Behavioural

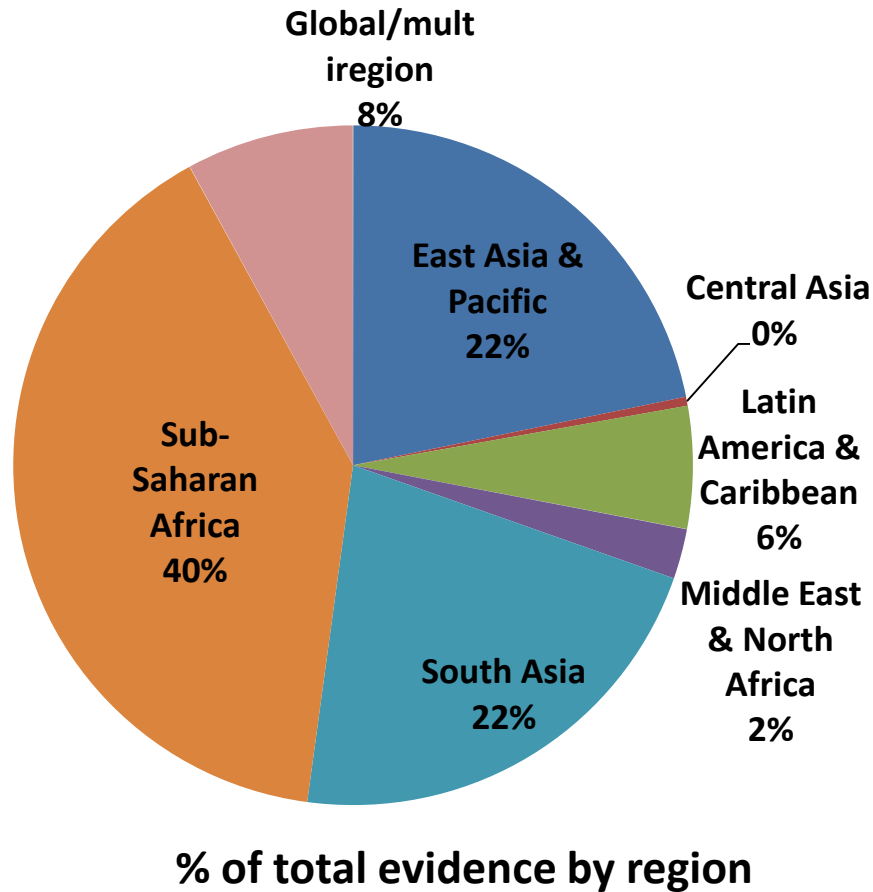
Sectors

- Water
- Built environment & Land-use
- Agriculture, Forestry & Fishing
- Society, Economy and Health

Systematic literature review: inclusion/exclusion

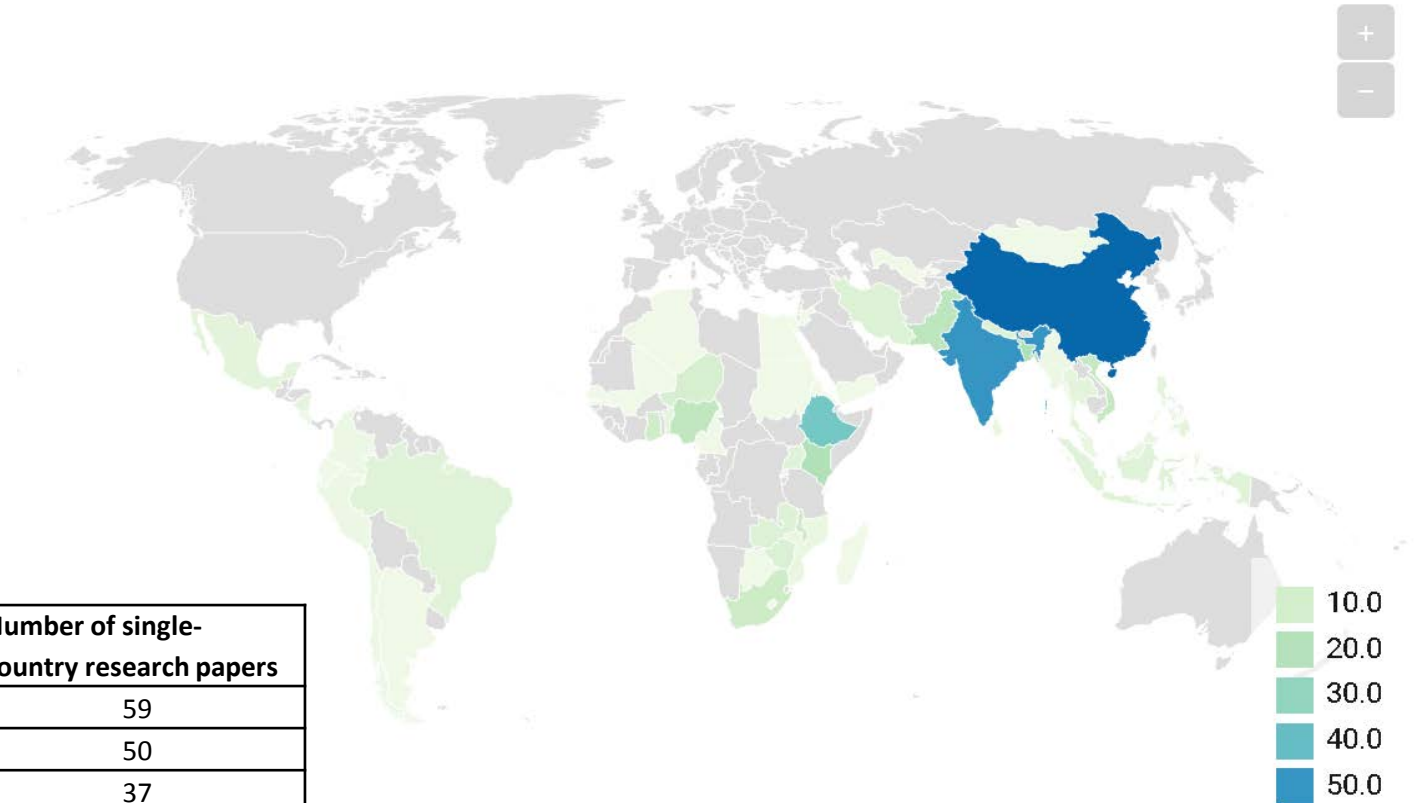


Results: CCA evidence by region



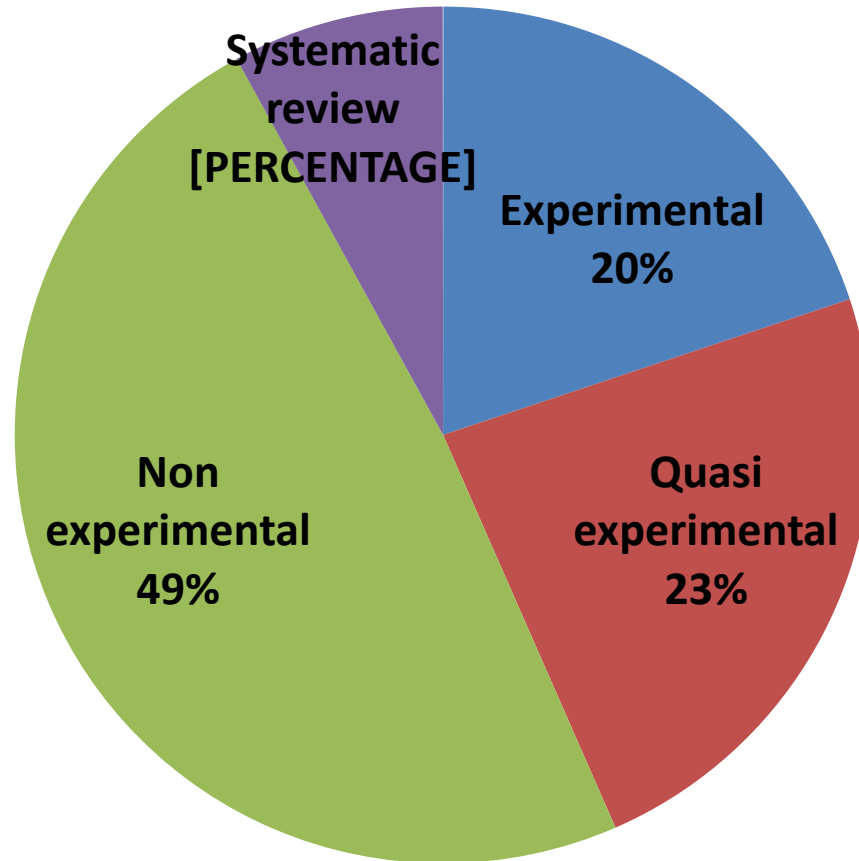
- Sub-Saharan Africa: drought and food security
- Asia and Pacific: disaster risk reduction and food security
- Latin America: little evidence is probably due to methods

Results: CCA evidence by country

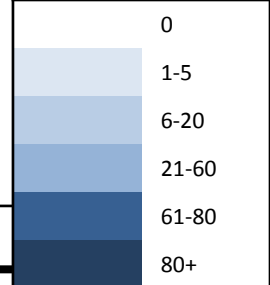


Country	Number of single-country research papers
China	59
India	50
Ethiopia	37
Bangladesh	22
Kenya	21
Pakistan	17
Nigeria	16
Vietnam	14
Malawi	12
South Africa	12

Results: CCA evidence by study type



Results: CCA evidence gap map



Climate change adaptation		Uptake	Shocks and stressors		Adaptive capacity		Enabling environment		
SECTORS	INTERVENTION/OUTCOMES	Adoption	Decreased Exposure	Decreased Impacts/Risks	Social benefits	Economic benefits	Environmental systems	Socioeconomic systems	Institutional systems
	Example specific outcomes indicators		Population affected by extreme weather events	Proactive and reactive risk management; climate related illness; deaths; food security	Skills acquired, access, awareness	Livelihood diversification, productivity gains, access	Area protected, ecological services improved	Social capital enhanced, overall poverty measurements	Policy changes, regulations approved, institutional reform
Water	Nature-Based Options				1	3	3		
	Built Infrastructure / Structural	1	1	11	2	9	3	2	
	Technological Options			1		1	1		
	Informational/ Educational	2		3		1	1		
	Institutional/ Planning/ Policy/ Laws/ Regulations	1		3	1	2			
	Financial/ Market Mechanisms	1		1			2		
	Social/Behavioural	1		1	1	1	1		
Land-use and Built Environment	Nature-Based Options	1	14	4	1	3	2	1	
	Built Infrastructure / Structural	3	4	4		5	3	1	
	Technological Options			1			3		
	Informational/ Educational	3		4	1		3		
	Institutional/ Planning/ Policy/ Laws/ Regulations	2	3	2	1	4	4	2	2
	Financial/ Market Mechanisms	2		2	1		2		
	Social/Behavioural	1	1	5	3	2	2	1	
Forestry, Fishing and Agriculture	Nature-Based Options	3	2	29	2	105	34	8	
	Built Infrastructure / Structural]		5	1	9	1		
	Technological Options	7	2	19	2	101	16	6	
	Informational/ Educational	77	1	8	9	19	5	5	
	Institutional/ Planning/ Policy/ Laws/ Regulations	14		3	1	5		3	
	Financial/ Market Mechanisms	44	2	6	4	15	4	6	
	Social/Behavioural	36		5	3	19	4	3	
Society, Economy and Health	Nature-Based Options	1		3	1				
	Built Infrastructure / Structural	1		9		3			
	Technological Options			8				1	
	Informational/ Educational	9	3	11	8	2		1	
	Institutional/ Planning/ Policy/ Laws/ Regulations	2	1	14		4		2	2
	Financial/ Market Mechanisms	5	1	26	1	14	1	5	1
	Social/Behavioural	13	2	25	5	17	1	6	3

EVIDENCE GAP MAP		Uptake				Shocks and Stressors				Adaptive Capacity				Enabling Environment																			
SECTORS	Intervention type/outcome category	Adoption				Decreased exposure				Decreased Impacts/risks				Social benefits				Economic benefits				Environmental systems				Socioeconomic systems				Institutional systems			
	Study Design	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S	Ex	Q	N	S
Water	Nature-Based Options														1				2	1		2	1										
	Built Infrastructure / Structural			1				1			3	8			2				4	5		1	1	1		1		1					
	Technological Options										1							1					1										
	Informational/ Educational			2						1	1		1							1			1										
	Institutional/ Planning/ Policy/Laws/			1							1		2		1				2														
	Financial/ Market Mechanisms			1									1										2										
	Social/Behavioural			1									1			1				1			1										
Land-use and Built Environment	Nature-Based Options		1			4	1	4	5		1	2	1		1			2	1		1		1			1							
	Built Infrastructure / Structural			2	1	2		1	1		1	3						1		4			1	1	1			1					
	Technological Options											1										2	1										
	Informational/ Educational			3							1	3				1							3										
	Institutional/ Planning/ Policy/Laws/			1	1		2	1					2					1		2	2		2	1	1			1	1				
	Financial/ Market Mechanisms			1	1								2				1						2										
	Social/Behavioural		1					1		1		1	4		1	2			2			2		2			1						
Forestry, Fishing and Agriculture	Nature-Based Options		1	2		1	1			14	13	2		2			35	33	29	9	20	4	6	4		3	4	1					
	Built Infrastructure / Structural		3	8						2	2	1		1			2	2	4	1	1												
	Technological Options		3	4		1	1			1	8	9	1				33	30	34	4	12	3			1		4	2					
	Informational/ Educational		16	59	2		1				3	1	4			2	7		1	10	7	1	1	1	2	1		2	2	1			
	Institutional/ Planning/ Policy/Laws/		6	8							1	2						2	3								1	2					
	Financial/ Market Mechanisms	1	7	36			2				1	5			1	3		1	8	4	2		1	2	1		3	2	1				
	Social/Behavioural	1	6	29									5				3		1	6	11	1		1	2		2	1					
Society, Economy and Health	Nature-Based Options			1						1		1	1			1																	
	Built Infrastructure / Structural			1							4	5						1	2														
	Technological Options										1	5	2														1						
	Informational/ Educational	4	2	3				3		2	5	4			4	3			1	1					1								
	Institutional/ Planning/ Policy/Laws/		1	1				1			4	8	2						2	2							1	1					
	Financial/ Market Mechanisms	1		4				1		5	6	14	1						5	7	2			1		1		3	1			1	
	Social/Behavioural	2	3	8				2		2	5	13	5			2	1	2		3	13	1			1		1	2	2	1		1	

Observations: Agriculture



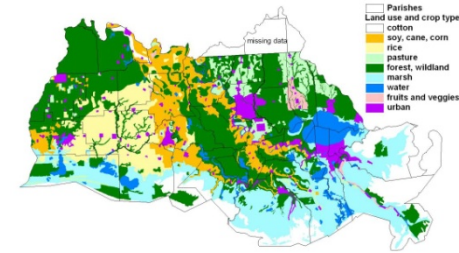
- **Quantity:** Most populated in the EGM (but no Fisheries and hardly any Forestry): 295 articles
- **Interventions:** NbS, Technological, Information, Behaviour sustainable agriculture, drought tolerant species, fertilizer/irrigation, extension services
- **Outcomes:** Economic benefits, Uptake, Impacts, Environment
- **Design:** EX 23% (67); QE: 25% (73); NE: 48% (143); SR: 4% (12)
- **Interpretation:** important area of research and policy. Much on adoption studies
- **Recommendations:** SR or MA of adoption studies

Observations: Society, Economy and Health



- **Quantity:** 2nd most populated in the EGM: 112 articles
- **Interventions:** Behaviour, Financial, Information, Planning livelihoods (Society), insurance or cash transfers (Economy) and Health interventions, particularly malaria or dealing with post-traumatic stress, Governance
- **Outcomes:** Impacts, Economic benefits, Uptake
- **Design:** Ex 11% (12); QE: 26% (29); NE: 50% (56); SR: 13% (15)
- **Interpretation:** broad sector; qualitative studies potentially more useful
- **Recommendations:** SR of qualitative studies

Observations: Land use and Built Environment Sector



- **Quantity:** 2nd least evidence in the EGM: 54 articles
- **Interventions:** NbS, Structural, Planning, Behaviour green infrastructure (especially in urban areas), grey infrastructure, early warning systems, land use and management, land use policy and regulations
- **Outcomes:** Impacts, Exposure, Environment, Economic benefits
- **Design:** EX 15% (8); QE: 19% (10); NE: 50% (27); SR: 17% (9)
- **Interpretation:** often ex-ante modelling studies but IE are feasible
- **Recommendations:** SR of ex-ante studies and more IE studies undertaken

Observations: Water Sector



- **Quantity:** least evidence in the EGM: 39 articles
- **Interventions:** Structural, NbS, Information, Planning watershed development, water-saving/collecting mechanisms and access to water
- **Outcomes:** Impacts, Economic benefits, Environmental systems
- **Design:** EX 15% (6); QE: 33% (13); NE: 46% (18); SR: 5% (2)
- **Interpretation:** often ex-ante modelling studies but IE are feasible
- **Recommendations:** SR of ex-ante studies and more IE studies undertaken

Conclusions

Evidence gaps in EGM:

- **Regional:** Studies in Latin America
- **Sectors:** Water, built environment
- **Interventions:** depends on sector, institutional
- **Outcomes:** exposure, enabling environment

Concentration of evidence in EGM:

- **Regional:** Studies in Sub Saharan Africa
- **Sectors:** Agriculture
- **Interventions:** Conservation agriculture, irrigation and fertiliser, types of crops, extension services
- **Outcomes:** adoption, economic benefits (yield, income)

Implications

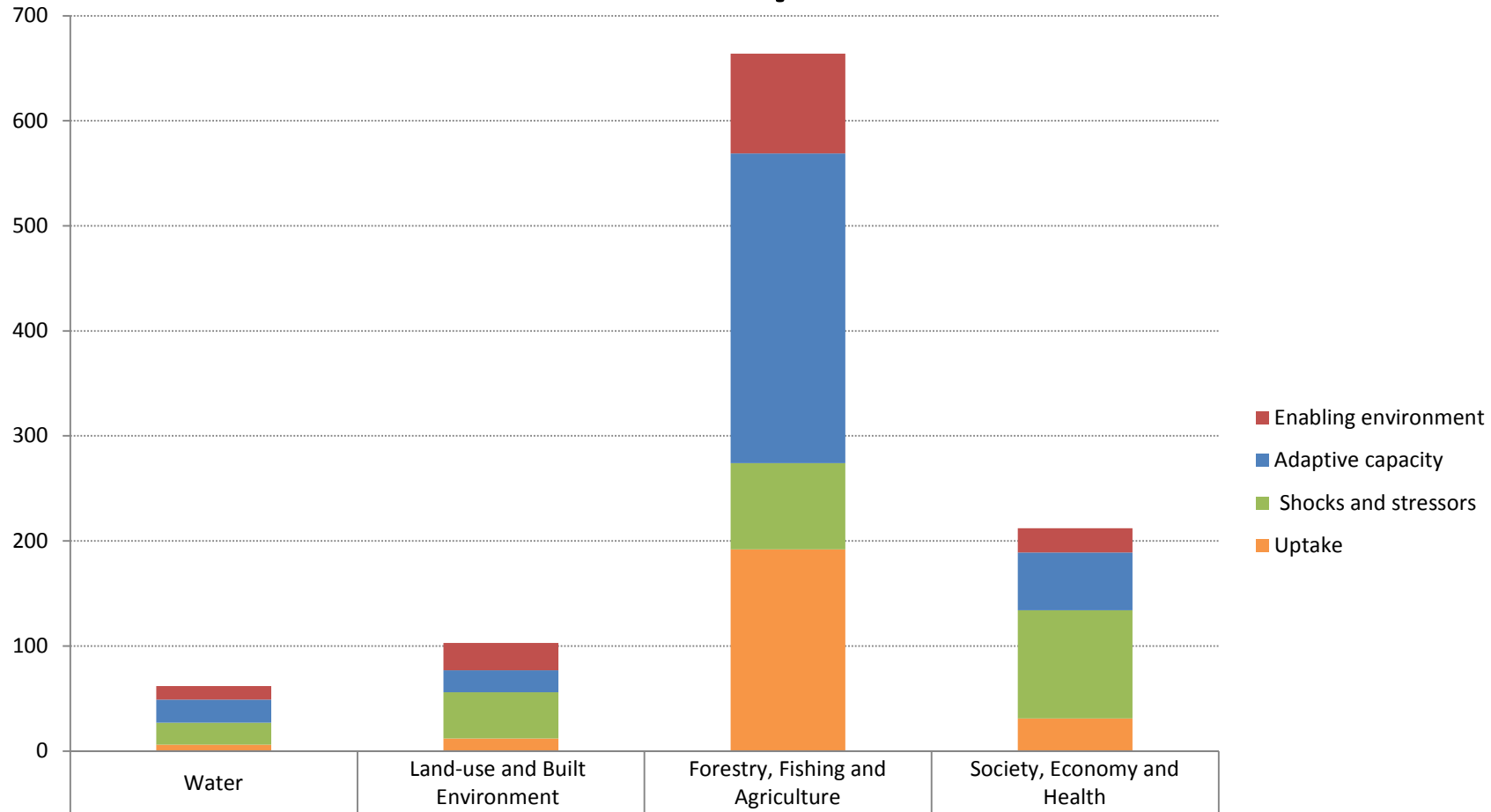
- More impact evaluations in CCA are required
 - Many CCA interventions lack impact evaluations
 - Water sector
 - Enabling environments
- Meta-analyses should be done to measure effect size of particular intervention/outcome cells of the EGM

Any questions?



Discussion

Results: Sectors/outcomes

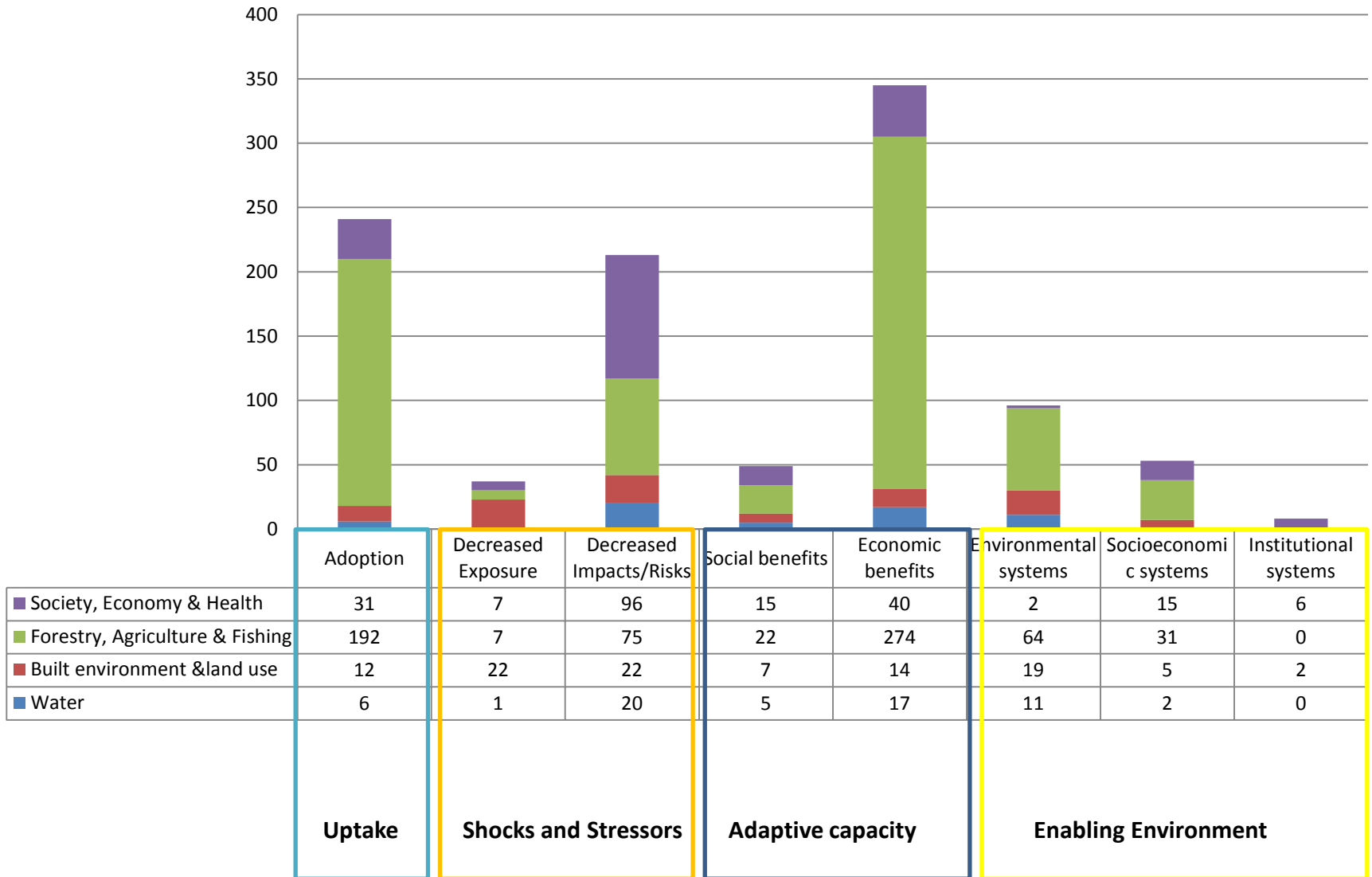


	Water	Land-use and Built Environment	Forestry, Fishing and Agriculture	Society, Economy and Health
Enabling environment	13	26	95	23
Adaptive capacity	22	21	295	55
Shocks and stressors	21	44	82	103
Uptake	6	12	192	31

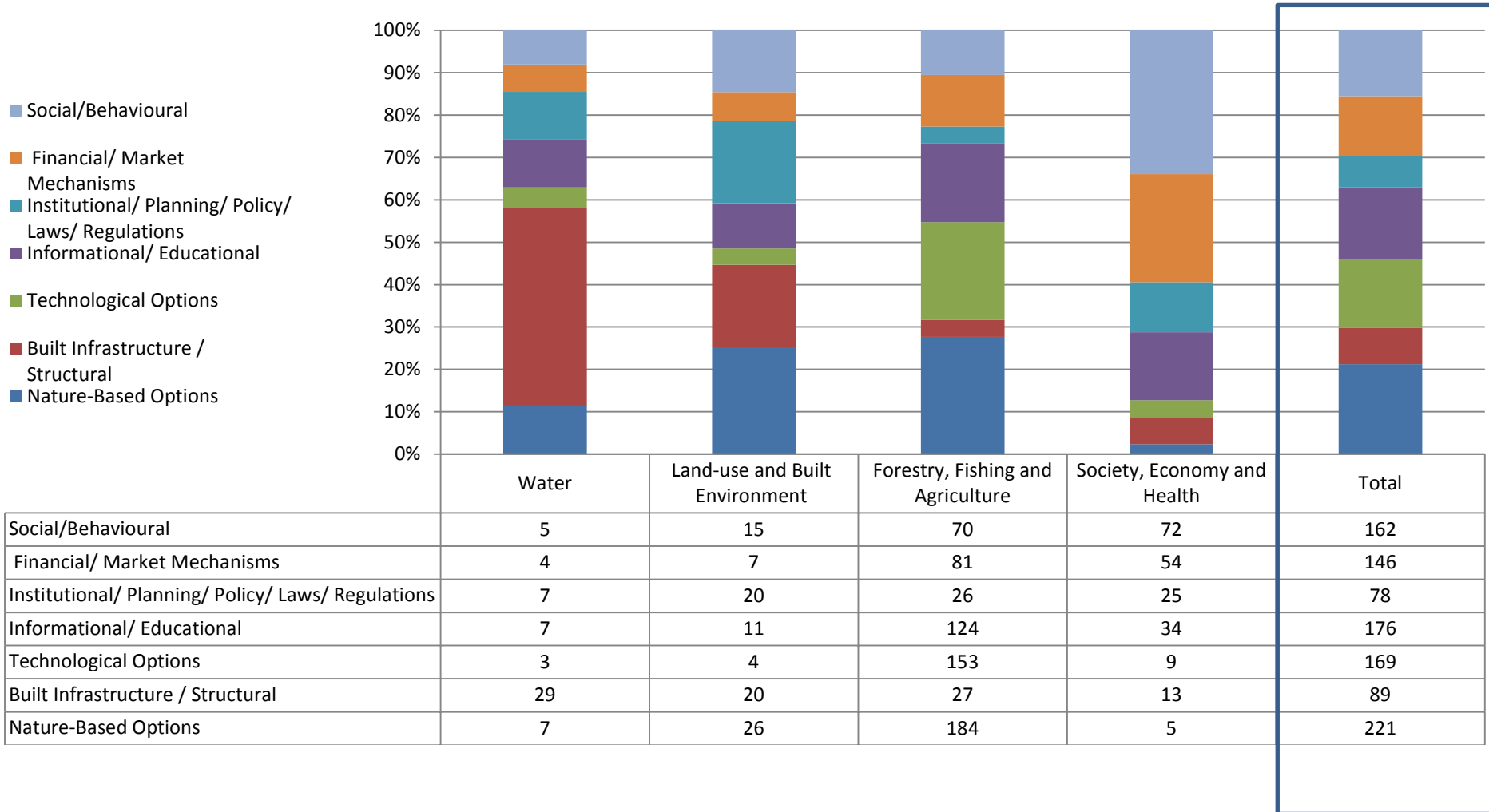
Highest concentration of studies: Agricultural sector (295 articles/ 664 pieces of evidence)

Lowest concentration of studies: Water sector (39 articles/62 pieces of evidence)

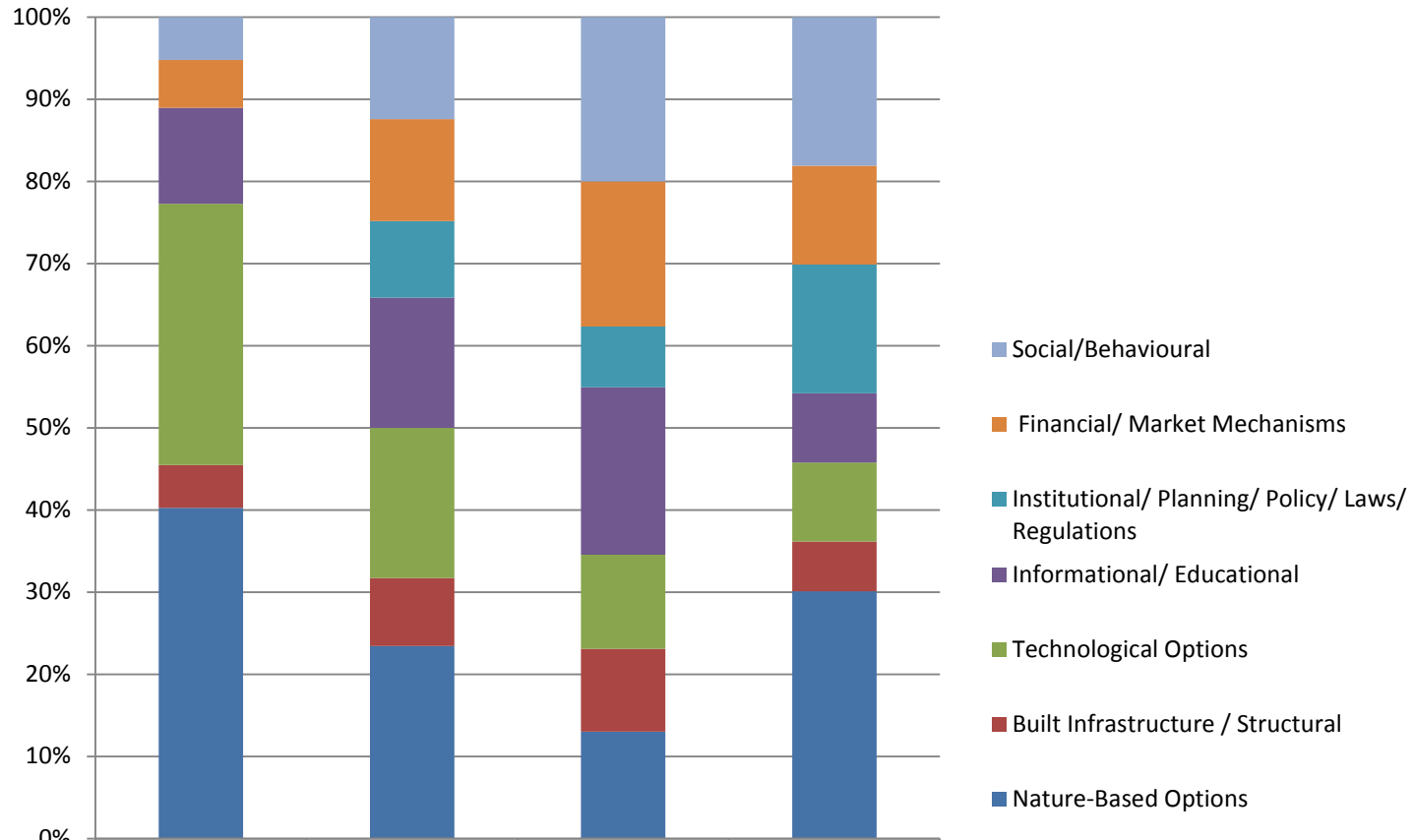
Results: Outcomes per sector



Results: interventions per sector

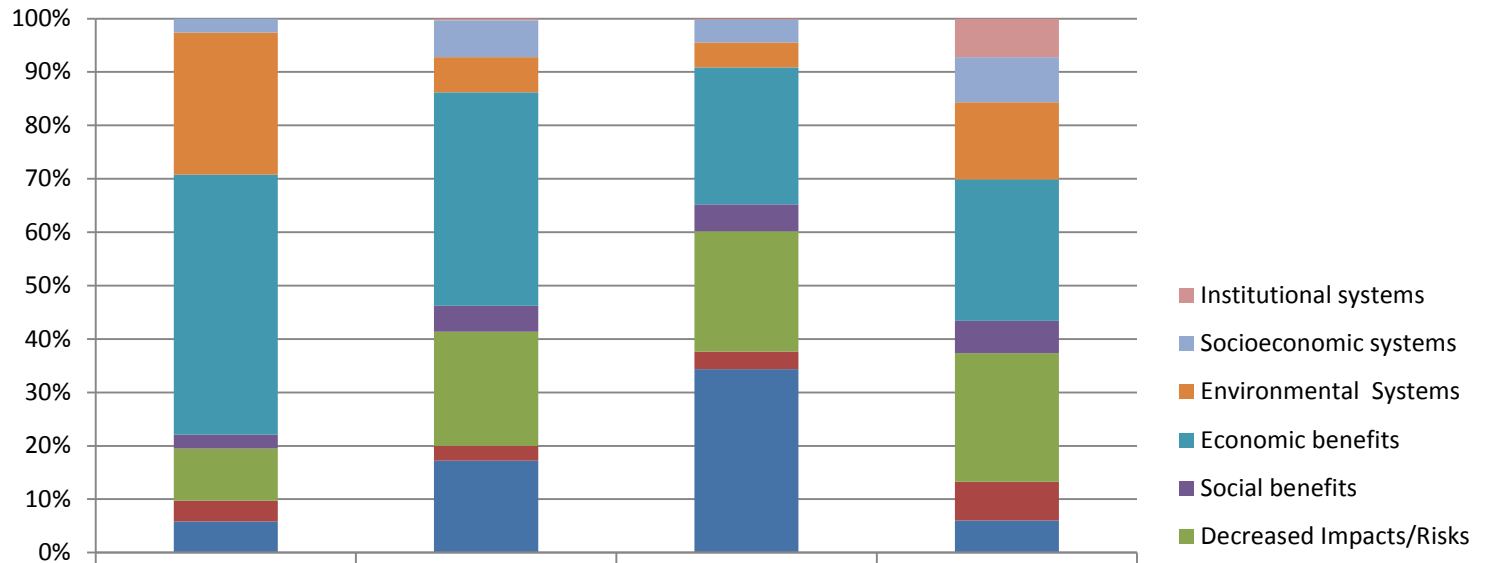


Study type by intervention



	Experimental	Quasi-experimental	Non-experimental	Systematic review
Social/Behavioural	8	36	103	15
Financial/ Market Mechanisms	9	36	91	10
Institutional/ Planning/ Policy/ Laws/ Regulations		27	38	13
Informational/ Educational	18	46	105	7
Technological Options	49	53	59	8
Built Infrastructure / Structural	8	24	52	5
Nature-Based Options	62	68	67	25

Study type by outcome



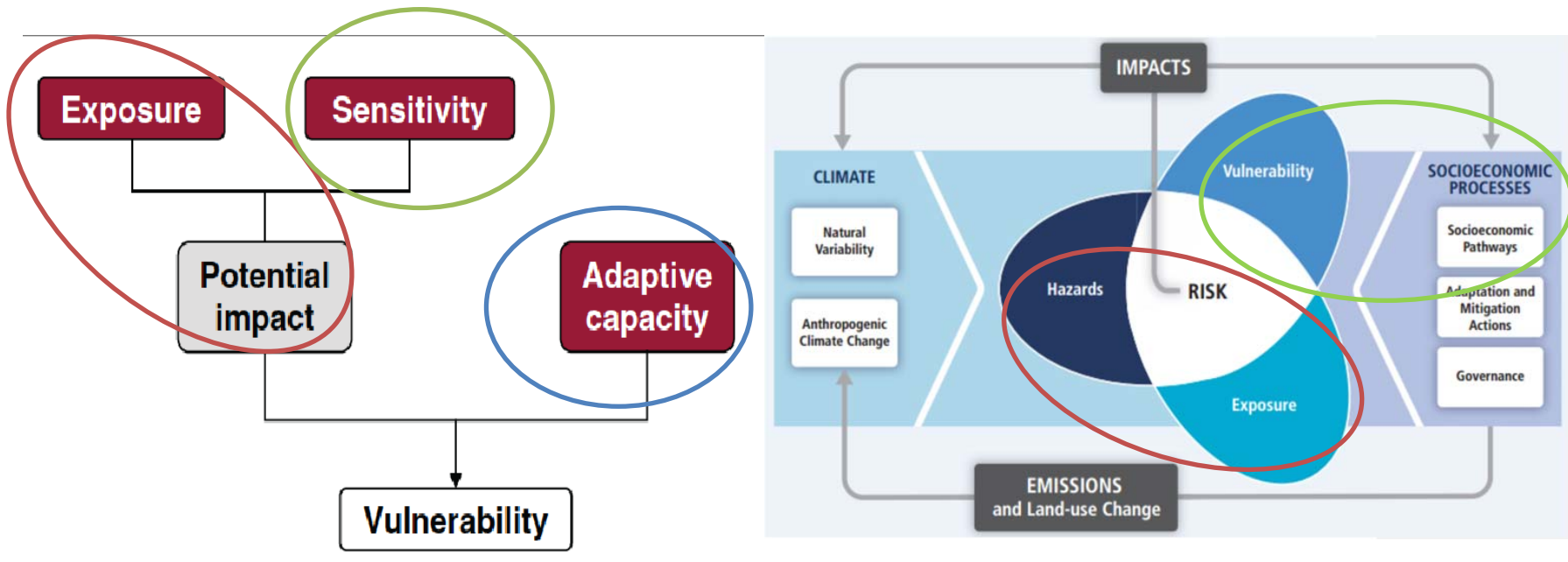
	Experimental	Quasi-experimental	Non-experimental	Systematic review
Institutional systems		1	1	6
Socioeconomic systems	4	20	22	7
Environmental Systems	41	19	24	12
Economic benefits	75	116	132	22
Social benefits	4	14	26	5
Decreased Impacts/Risks	15	62	116	20
Decreased Exposure	6	8	17	6
Uptake	9	50	177	5

Sector	Instrument type	Interventions
Water	Nature-Based Options	Wetland restoration; water conservation; river restoration; nature weirs; integrated water management; watershed management
	Built Infrastructure / Structural	Dams; dykes; weirs; drainage systems; wells
	Technological Options	Desalinisation technology
	Informational/ Educational	Water conservation education; Flood information; early warning systems
	Institutional/ Planning/ Policy/ Laws/ Regulations	Water policies, regulations
	Financial/ Market Mechanisms	Payment for ecosystem services; water payment; insurance for flooding
	Social/Behavioural	Migration due to floods/drought; social support due to floods/drought
Land-use and Built Environment	Nature-Based Options	Restoration; conservation; sustainable management; mangroves, sand dunes or marshes for coastal protection; integrated coastal zone management; green roofs/walls; green infrastructure; green and blue space in cities
	Built Infrastructure / Structural	Sea walls; hazard proof buildings; insulation for buildings
	Technological Options	Air-conditioning; cooling systems
	Informational/ Educational	Sustainable management trainings; coastal early warning
	Institutional/ Planning/ Policy/ Laws/ Regulations	Zoning; land use plans; regulations and standards for buildings; government & NGO input
	Financial/ Market Mechanisms	Payment for ecosystem services
	Social/ Behavioural	Support groups; migration from coastal areas
Forestry, Fishing and Agriculture	Nature-Based Options	Intercropping, conservation agriculture, changing planting dates; agroforestry; conservation tillage, bunds, traditional seeds/varieties; rain-fed irrigation; crop rotation; sustainable forestry and fishing
	Built Infrastructure / Structural	Seed banks; windshelters
	Technological Options	Drought-tolerant varieties, GMO, irrigation, fertilizer
	Informational/ Educational	Extension services; trainings; information; early warning
	Institutional/ Planning/ Policy/ Laws/ Regulations	Agricultural laws; NGO/government programs
	Financial/ Market Mechanisms	Weather insurance; credit; subsidies
	Social/ Behavioural	Cooperatives; informal groups
Society, Economy and Health	Nature-Based Options	Nature management for vector control; nature-based/ecological livelihood diversification
	Built Infrastructure / Structural	shelters for disasters
	Technological Options	Bednets, etc. for mosquitos; early warning technology/mapping
	Informational/ Educational	Health related information/education; financial information
	Institutional/ Planning/ Policy/ Laws/ Regulations	Vulnerability reducing programs; DRR laws and regulations vaccination programs, essential public health services, enhanced emergency medical services
	Financial/ Market Mechanisms	Cash transfers, credit, microcredit,
	Social/ Behavioural	Psychotherapies; livelihood diversification, Household preparation & evacuation planning reliance on social networks, social safety nets & social protection, food banks & distribution of food surplus; governance programs

Framework: Definitions & Concept

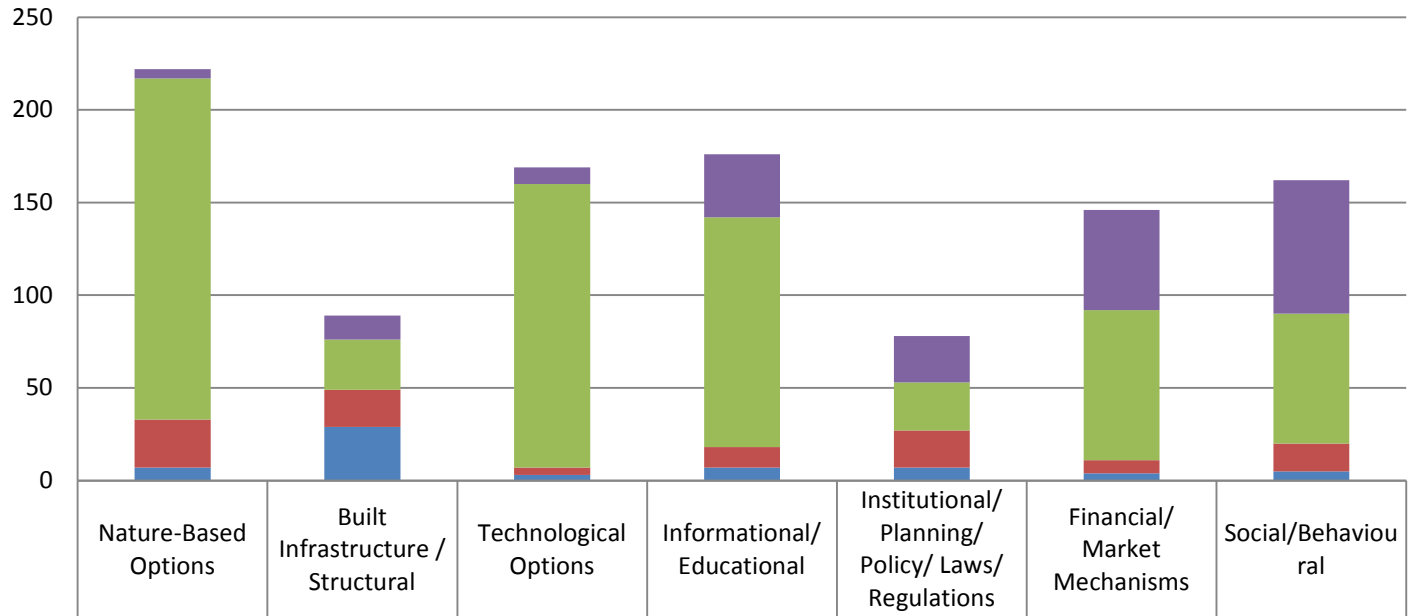
Climate Change Adaptation (CCA) is the process of "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"

(UNFCCC 2018)



Exposure; impact from hazards; adaptive capacity; enabling environment

Results: interventions per sector



	Nature-Based Options	Built Infrastructure / Structural	Technological Options	Informational/Educational	Institutional/ Planning/ Policy/ Laws/ Regulations	Financial/ Market Mechanisms	Social/Behavioural
■ Society, Economy & Health	5	13	9	34	25	54	72
■ Agriculture, Forestry & Fisiing	184	27	153	124	26	81	70
■ Built Environment & land use	26	20	4	11	20	7	15
■ Water	7	29	3	7	7	4	5