How can Integrated Assessment Better Inform Climate Risk Management?

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Focus on tools for prioritization and the role of governance

Making Fiji Resilient

The Climate and Disaster Vulnerability Assessment for the Republic of Fiji

WORLD BANK GROUP
Climate Change

GFDRR
Global Facility for Disaster Reduction and Recovery

ACP-EU Natural Disaster Risk Reduction Program

An initiative of the African, Caribbean and Pacific Group, funded by the European Union and managed by GFDRR

An adaptation plan with 125 interventions in 5 priority areas

1. Inclusive and resilient cities
2. Improving infrastructure services
3. Climate smart agriculture and fisheries
4. Conserving ecosystems and the local environment
5. Building socioeconomic resilience

Costs of building resilience and adaptation

- Resilience and adaptation needs total F$9.3 billion, including F$5 billion in new projects, plus recurrent costs

	INVESTMENT NEEDS (million F$)			RECURRENT COSTS (million F$)		
Sector	**Planned**	**New**	**Total**	**Planned**	**New**	**Total**
Housing/land use	63	152	215			
Hazard Management	n.a.	2,106	2,106			
Transport	3,098	1,591	4,689			
Energy	271	175	446			
Water	685	447	1,132		175-440	
Health/education	5	568	573			
Environment	55	22	77			
Agriculture	11	3	14			
Fisheries	6	14	20			
Social Protection				47	4	51
GRAND TOTAL	**4,194**	**5,078**	**9,272**			**226-491**

LIFELINES

The Resilient Infrastructure Opportunity

Resilient infrastructure?

Resilient infrastructure?

Resilience of infrastructure *assets*

Resilient infrastructure is less costly to maintain and repair

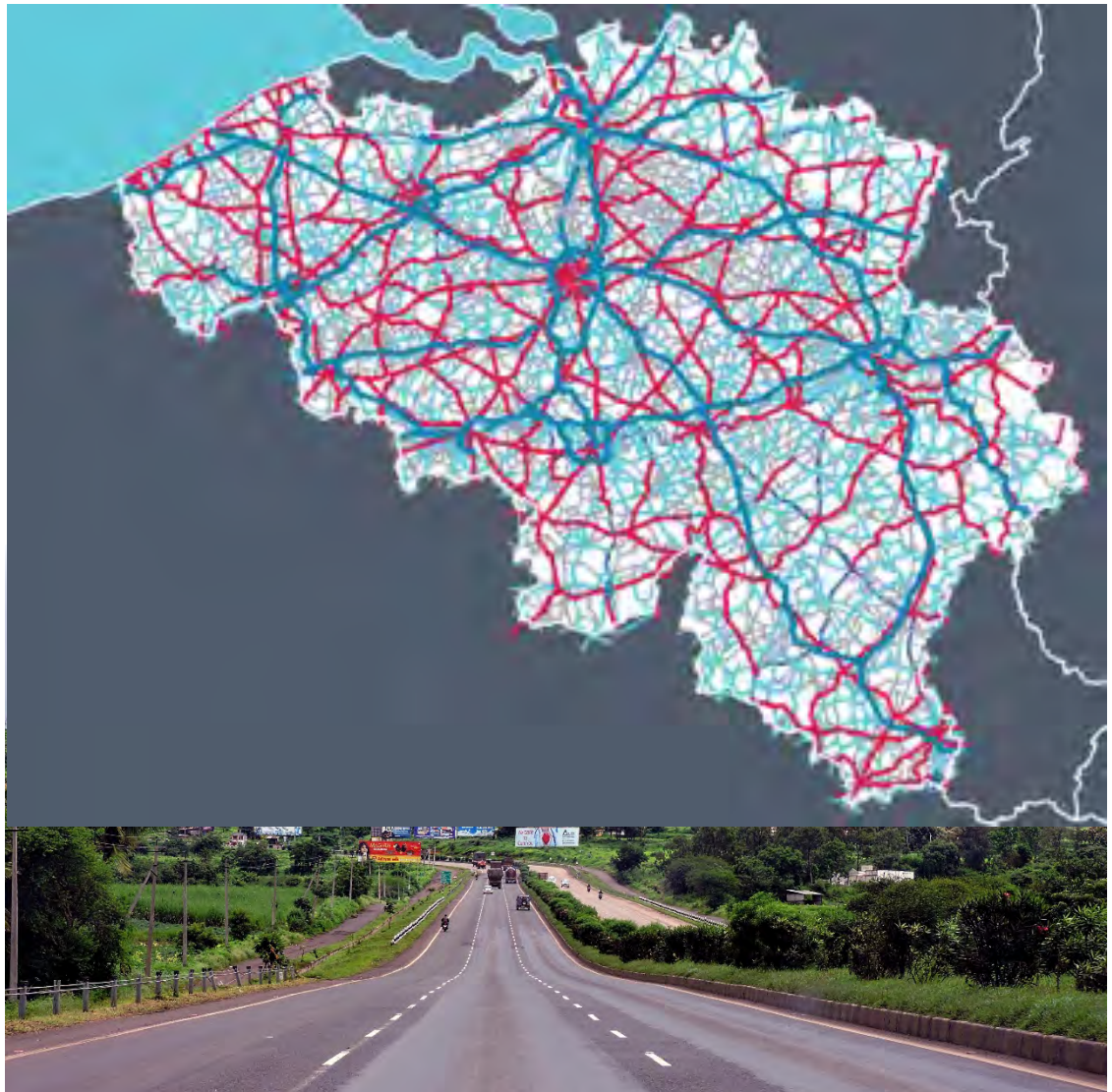
Resilient infrastructure?

Resilience of infrastructure *services*

Resilient infrastructure provides more reliable services

Resilience of infrastructure *assets*

Resilient infrastructure is less costly to maintain and repair



Resilient infrastructure?

Resilience of infrastructure *users*

Resilient infrastructure makes people better able to cope with and recover from shocks

Resilience of infrastructure *services*

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Resilience of infrastructure *assets*

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Resilient infrastructure?

Quality infrastructure

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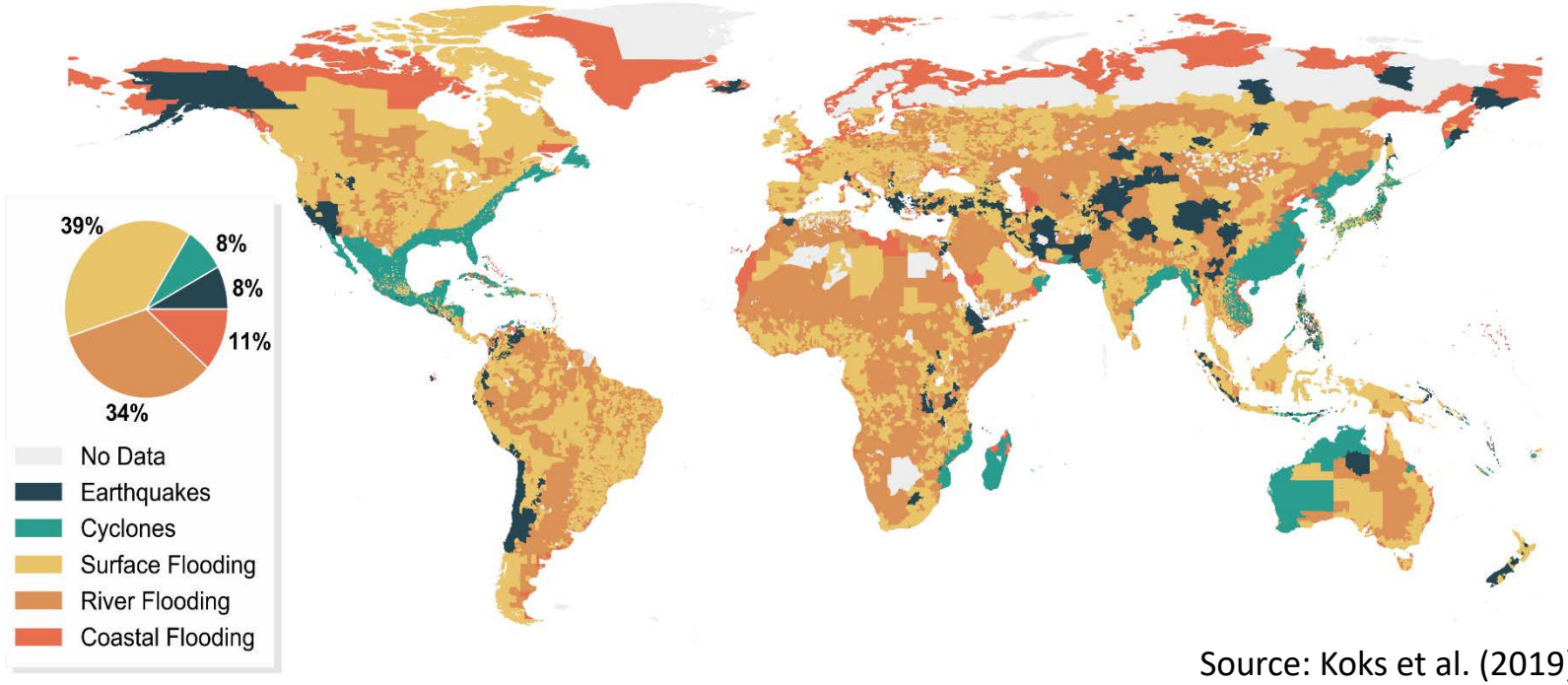
Damages and repair costs are significant…



Source: Koks et al. (2019) and Nicolas et al (2019)

Global annual damages to transport and power generation

$30 billion per year

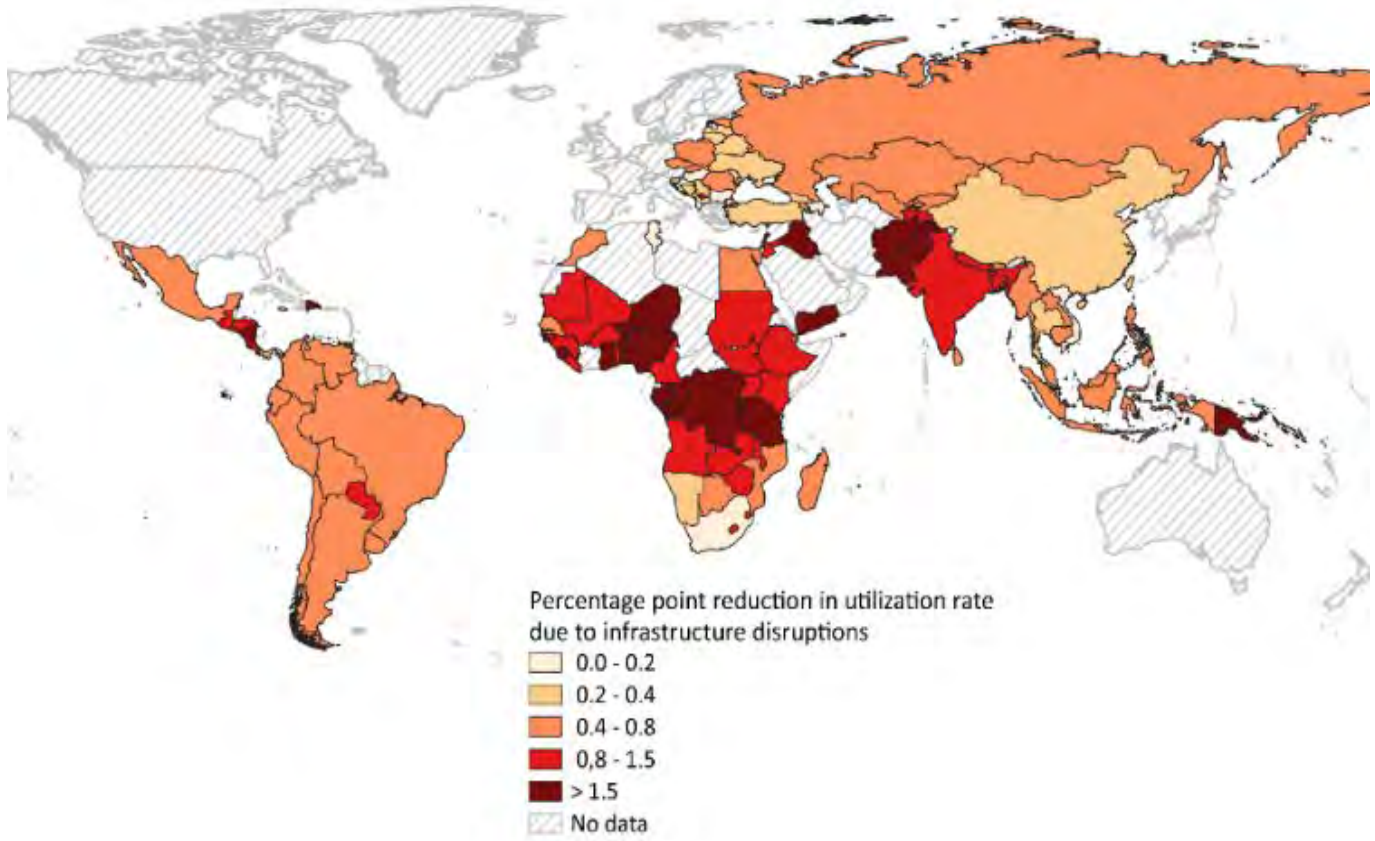
Damages in low- and middle-income countries

$18 billion per year

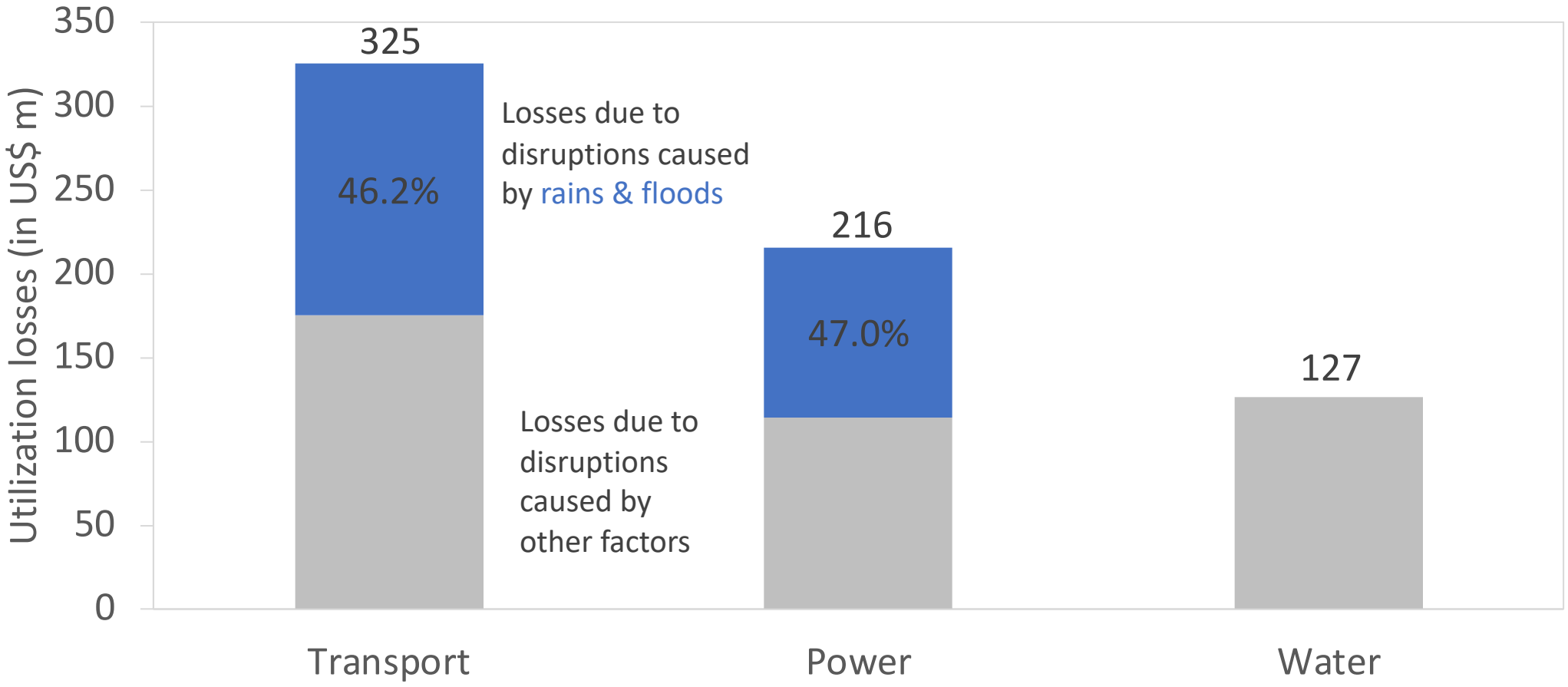
… but repairs are only part of the problem.

Altogether, infrastructure disruptions impose costs **between $391 and $647 billion a year** on households and firms in developing countries.

- **Firms**
  - **Reduced utilization rate ($151b)**
  - **Lost sales ($82b)**
  - **Self-generation costs ($65b)**
  - Increased inventories
  - More expensive localization choices
  - Higher barriers for entry of new firms
  - Less competition and innovation
  - Labor-biased technologies
- **Household**
  - **Willingness-to-pay ($90b to $343b)**
  - **Health expenditures ($3 to $6b)**
  - Income impact and gender implications



What fraction is caused by natural hazards?
Zoom on Tanzania



Total: $640 million per year, or 1.8 percent of GDP

Weather-related: $250 million, or 0.7 percent of GDP

What are the solutions?


Quality infrastructure
Resilience of infrastructure *users*
Resilient infrastructure makes people better able to cope with and recover from shocks
Resilience of infrastructure *services*
Resilient infrastructure provides more reliable services
Resilience of infrastructure *assets*
Resilient infrastructure is less costly to maintain and repair

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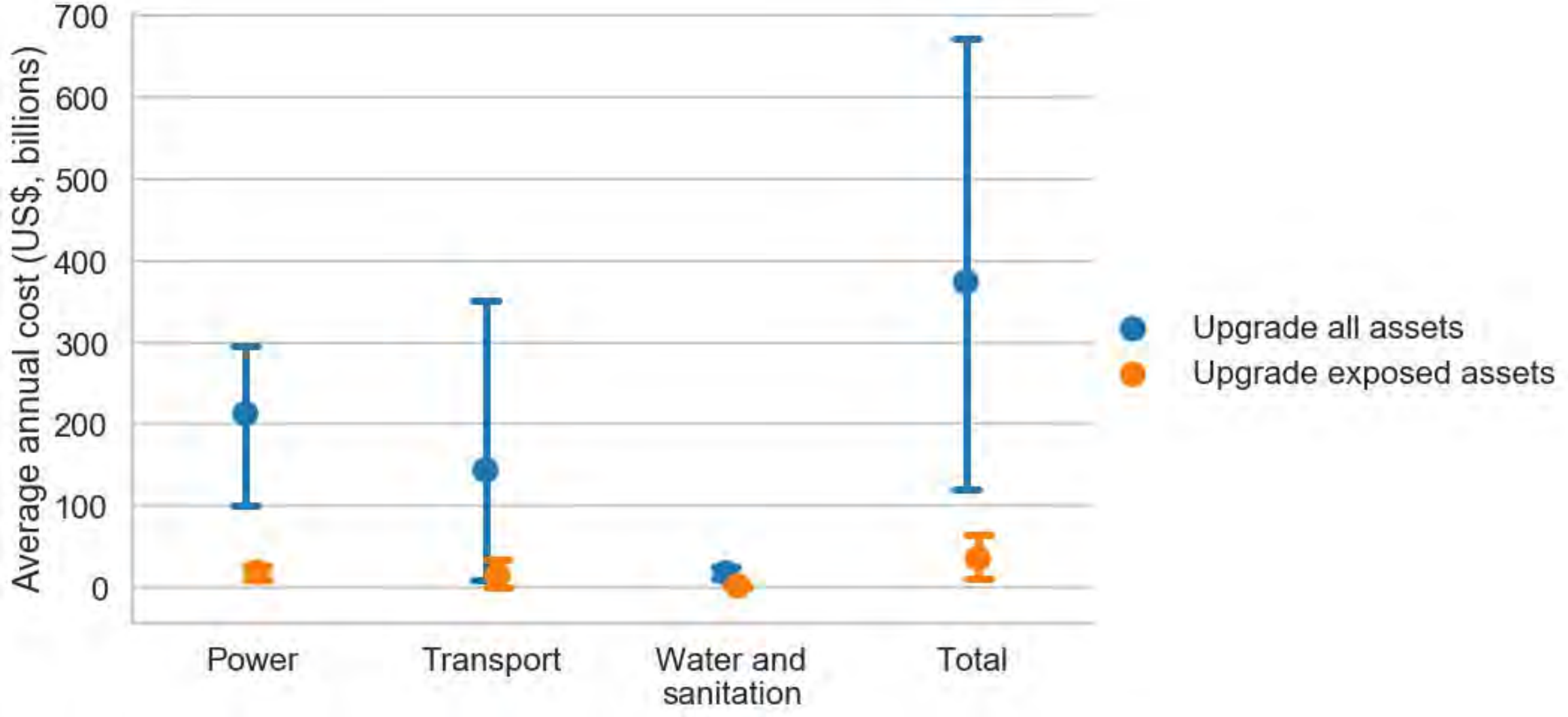
Starting from engineering options

	Natural hazard			Critical system/component		Damage probability		Incremental cost (including quality control)
Type	Hazard	Intensity	Component	Engineering improvement	Quality improvement	Baseline	Improved	
Urban (roadway) bridges	EQ motion	Mw 7 PGA 0.4g	Bridge superstructure, abutments, footings	Use CA or Japan seismic design, columns as fuse	Construction inspection, testing, qualify contractors	0.35	0.04	0.2
	Liquefaction	PGD 250 mm	Bridge foundation	H pile or prestressed pile foundation	Geotechnical testing, construction inspection	0.4	0.1	0.3
	Wind	Small events	Connection of diaphragms to steel girders	Reduce dissertation-induced fatigue cracking, redundant nonfracture critical design	Inspection of welded connections, reduce section loss by corrosion prevention	0.1	0.03	0.05
	Flood	Large events	Pier and abutment foundations	Mitigation of local scour, use rocks or pier walls	Regular inspection, construction quality control	0.03	0.02	0.01
	Landslide	N/A						
Unpaved tertiary roads	EQ motion	Mw 7 PGA 0.4g	Road surface and underlying material	Provide seismic reinforcement, compact the underlying material	Use earthquake-resistant foundations	0.1	0.05	0.1
	Liquefaction	Large PGD: more than 0.3 m	Road surface and underlying material	Provide reinforcement against large ground displacement	Soil improvement, avoid areas vulnerable to liquefaction	0.1	0.05	0.05
	Wind	N/A						
	Flood	Large floods	Road surface	Provide barriers, improve drainage	Maintain the roads	0.1	0.05	0.03
	Landslide	ND	Road surface	Add retaining wall, stabilize slope, shotcrete, soil nails	Construction monitoring	0.2	0.02	0.05

Source: Miyamoto International (2019)

With the right data, strengthening assets would cost between $11 and $65 billion per year – 3 percent of total needs



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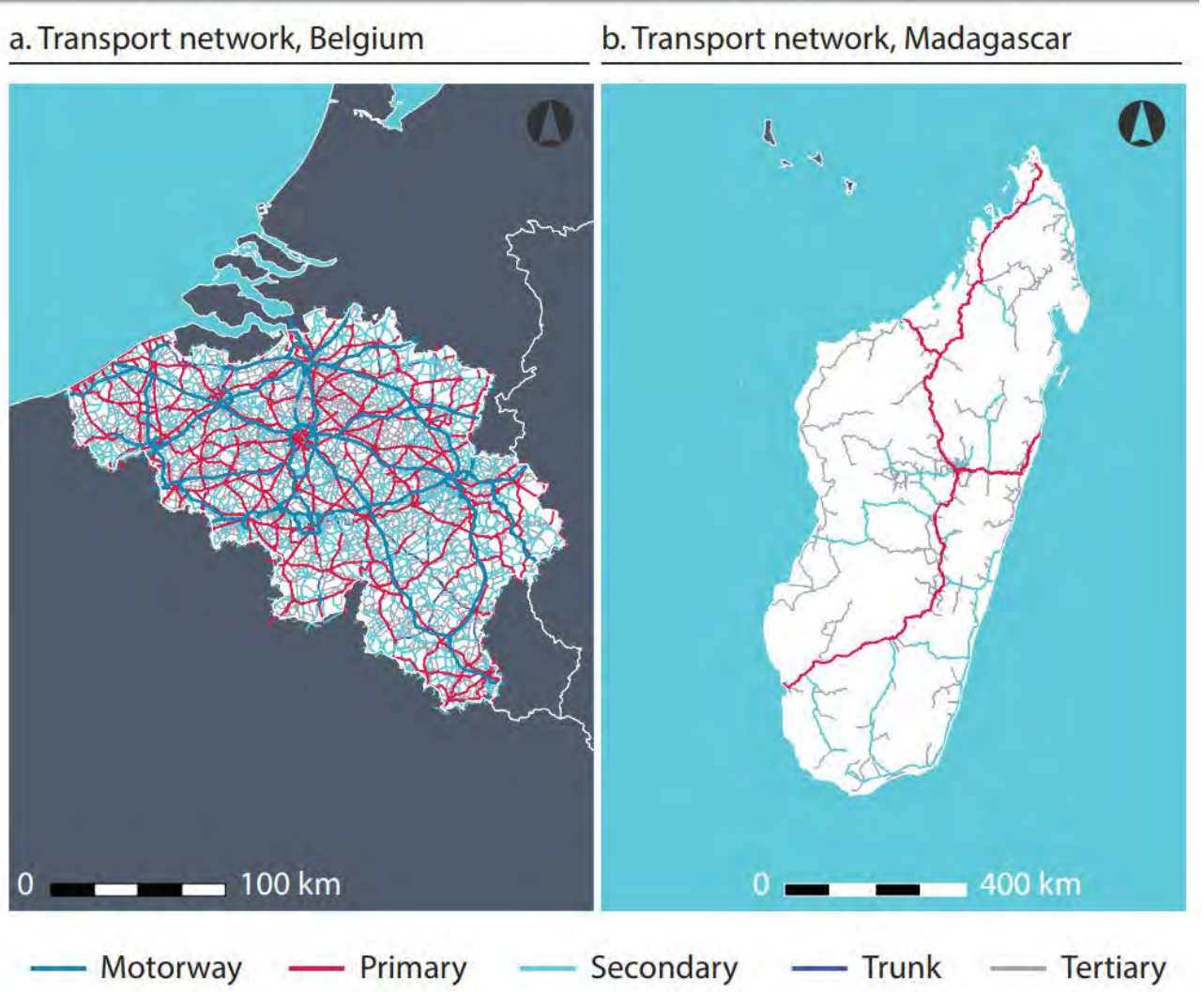
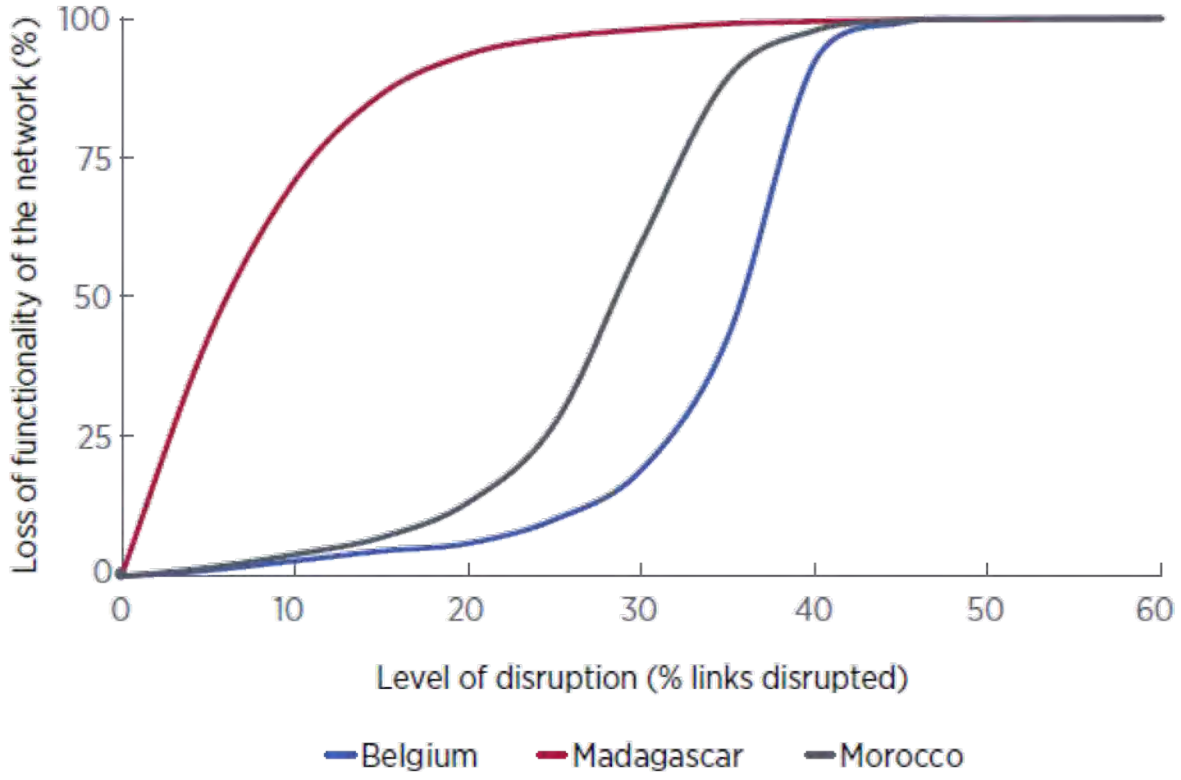
Asset and system vulnerabilities can be very different

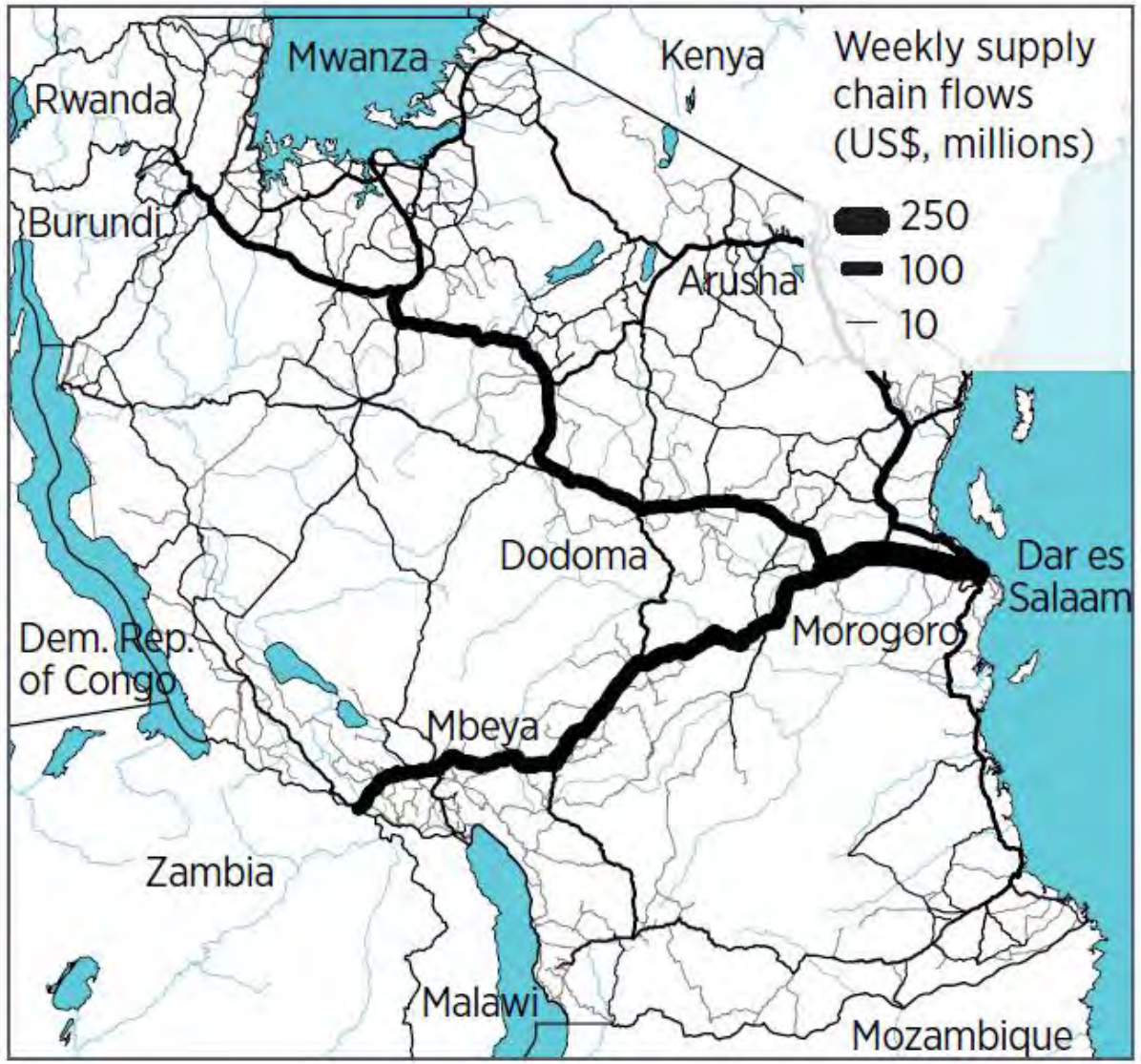


Examples of functionality loss in a transport system as a function of the percentage of links disrupted

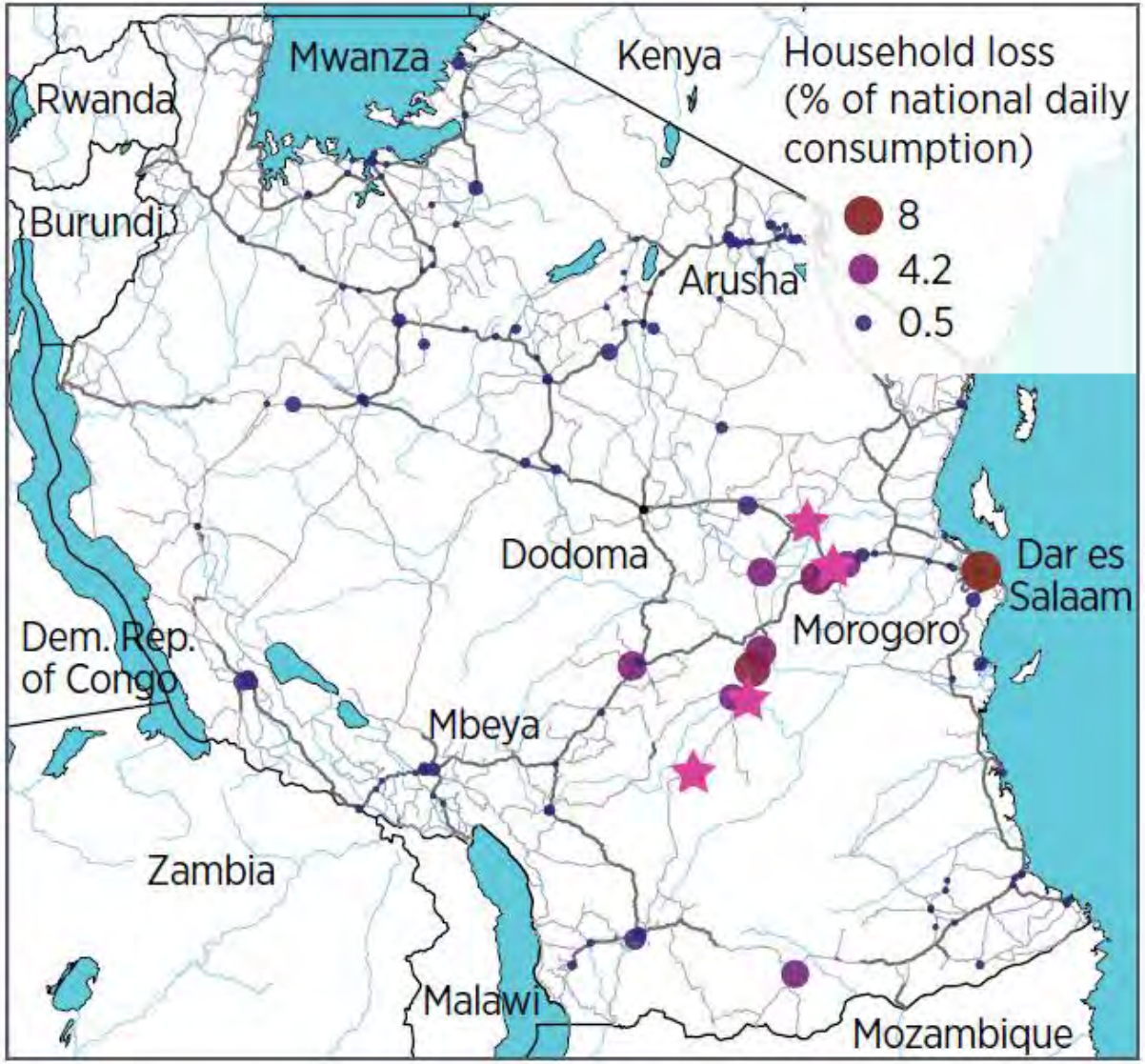


Direct impacts and final consequences can be very different

a. Weekly supply chain flows

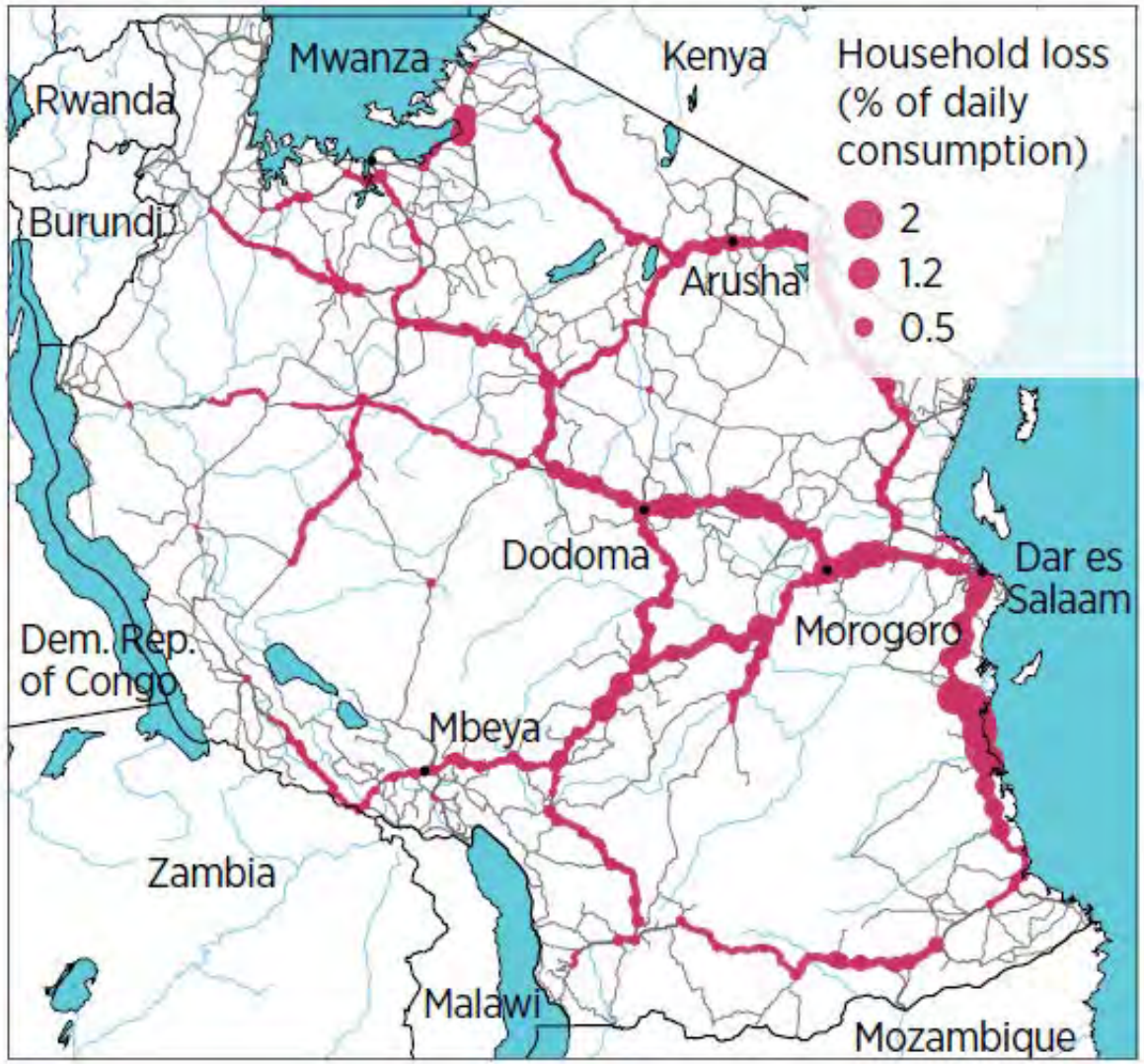


b. Household losses

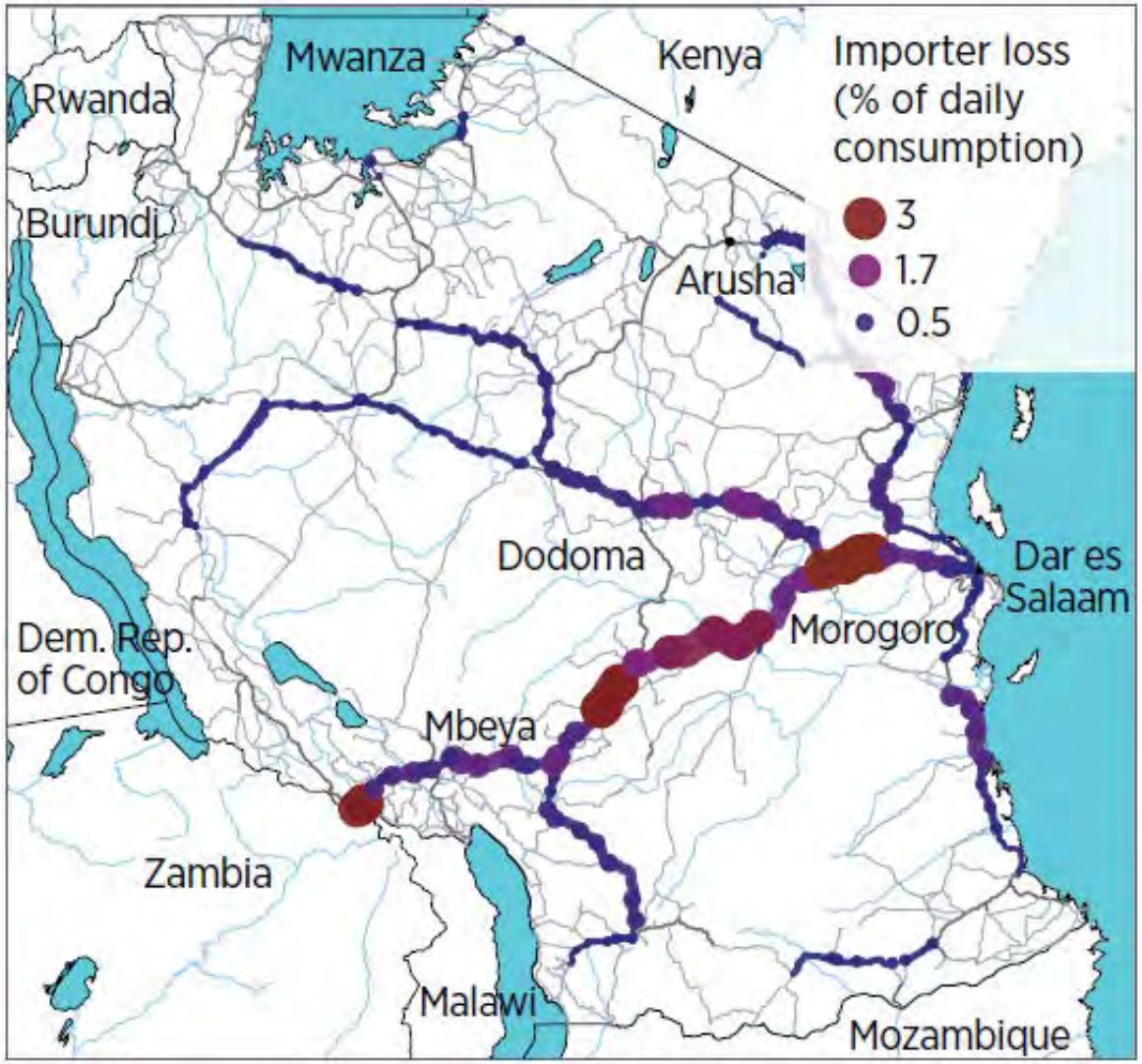


Priorities for action are network-dependent

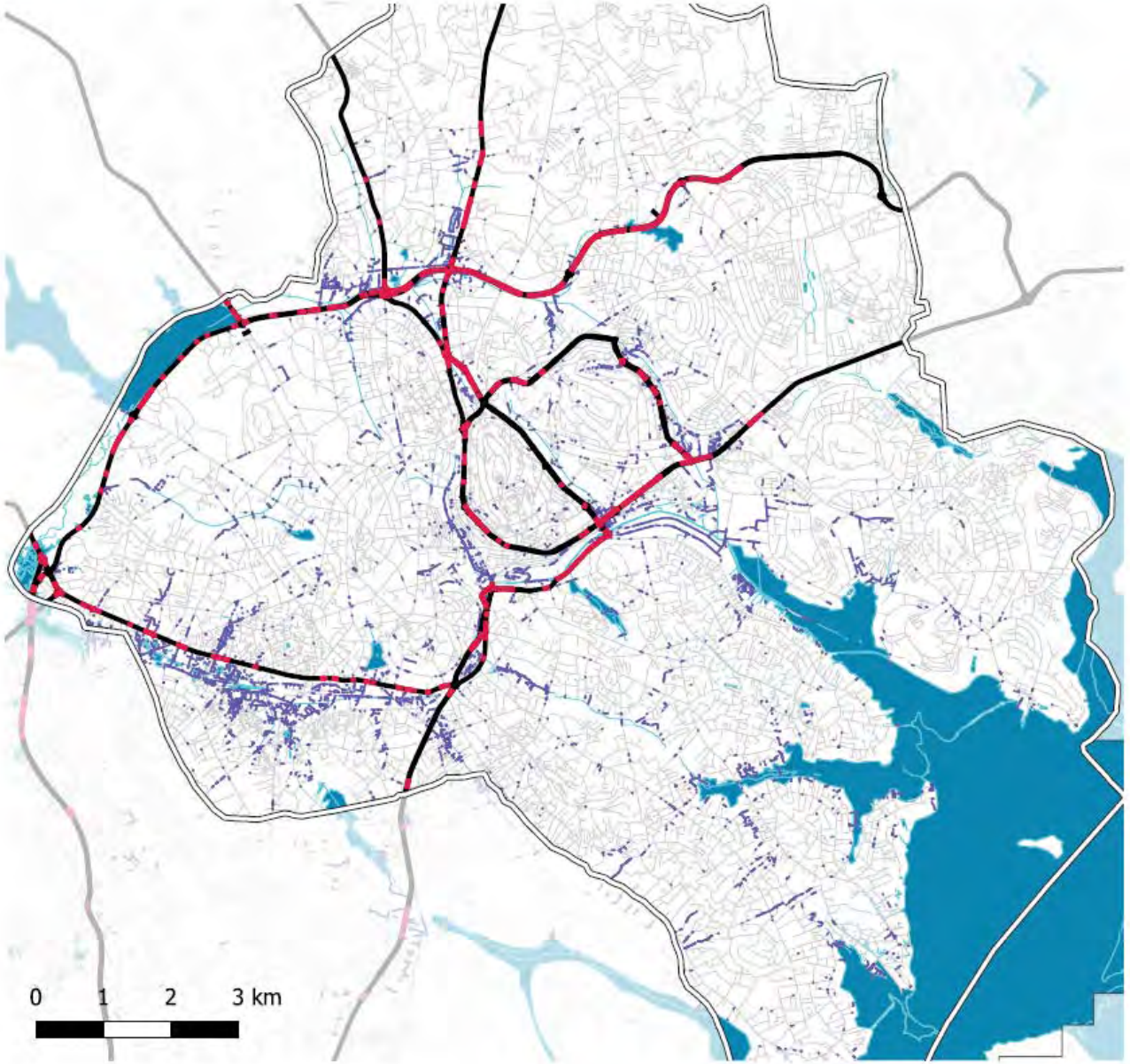
b. Food products consumed by households

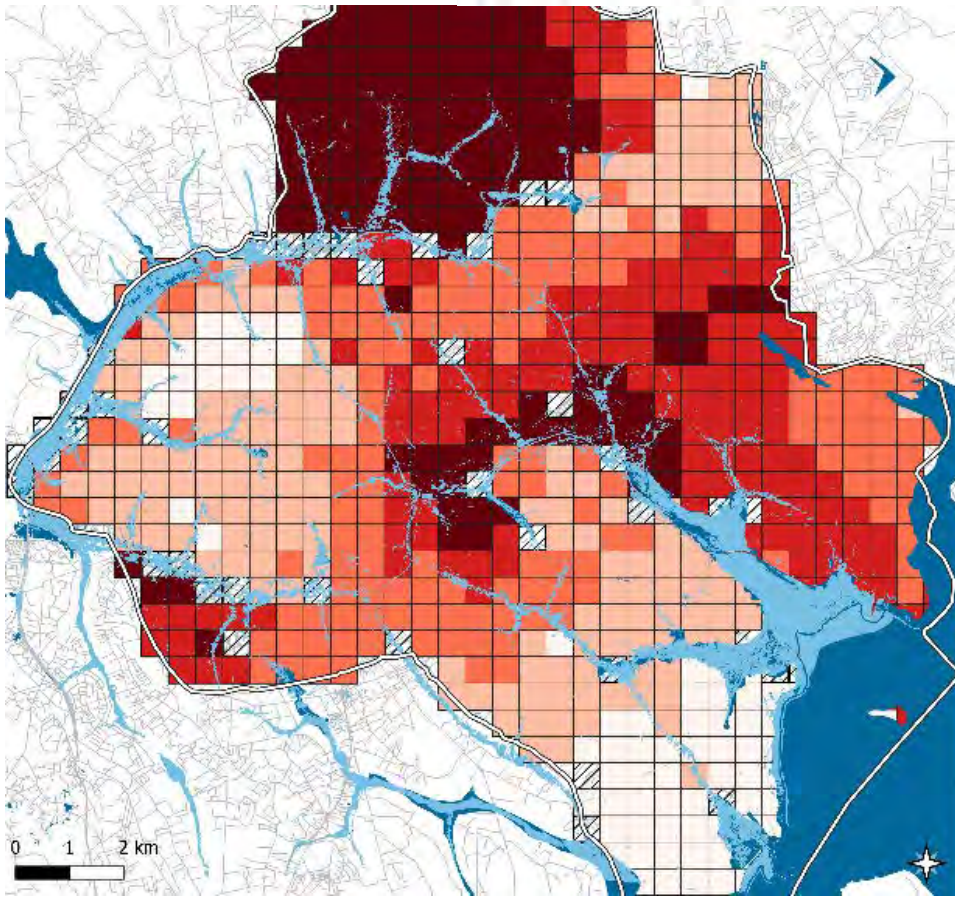


d. Exports

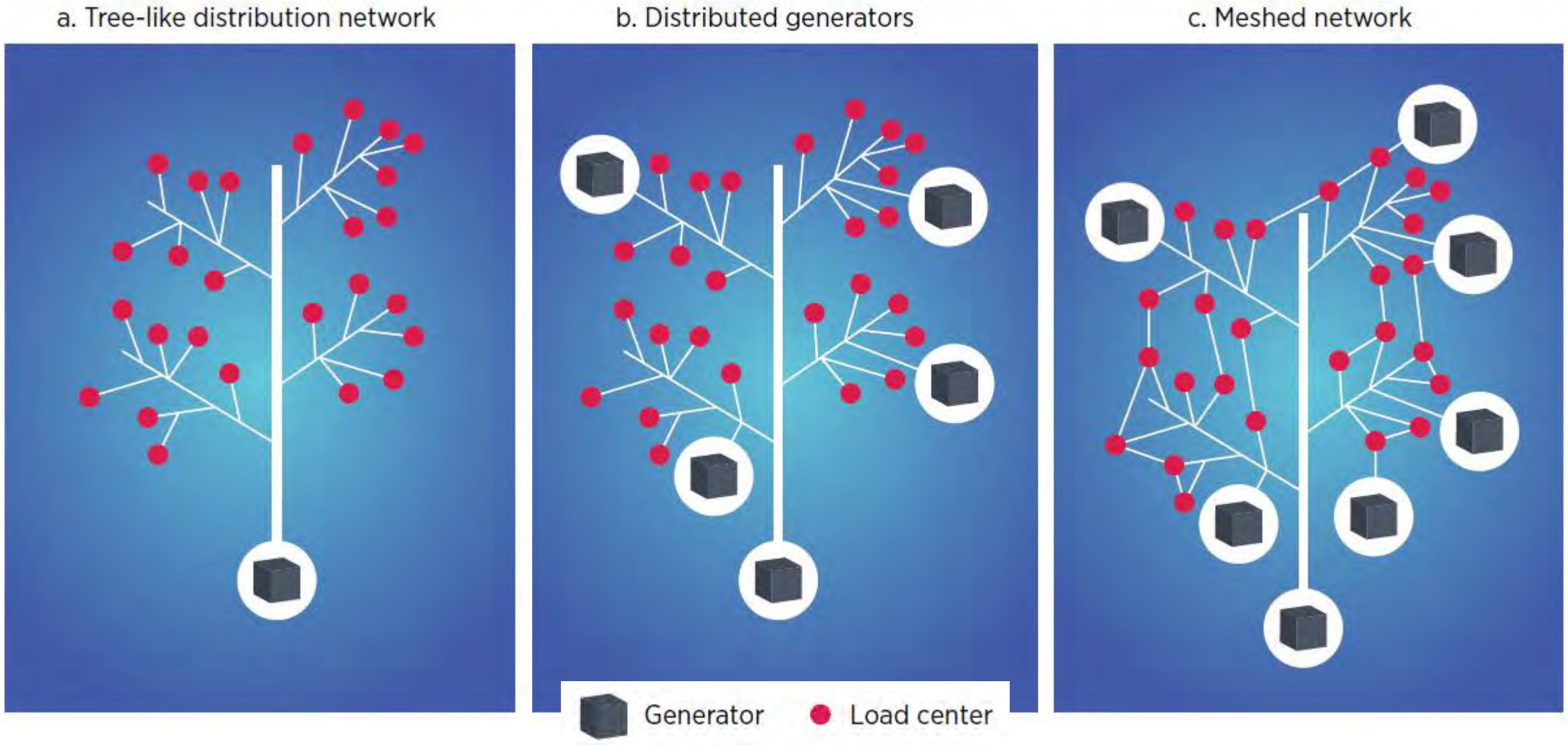


MAP 4.4 Flooded segments of the road network (50-year return period), Inner Kampala





Redundancy and decentralized systems
Example from the power grid



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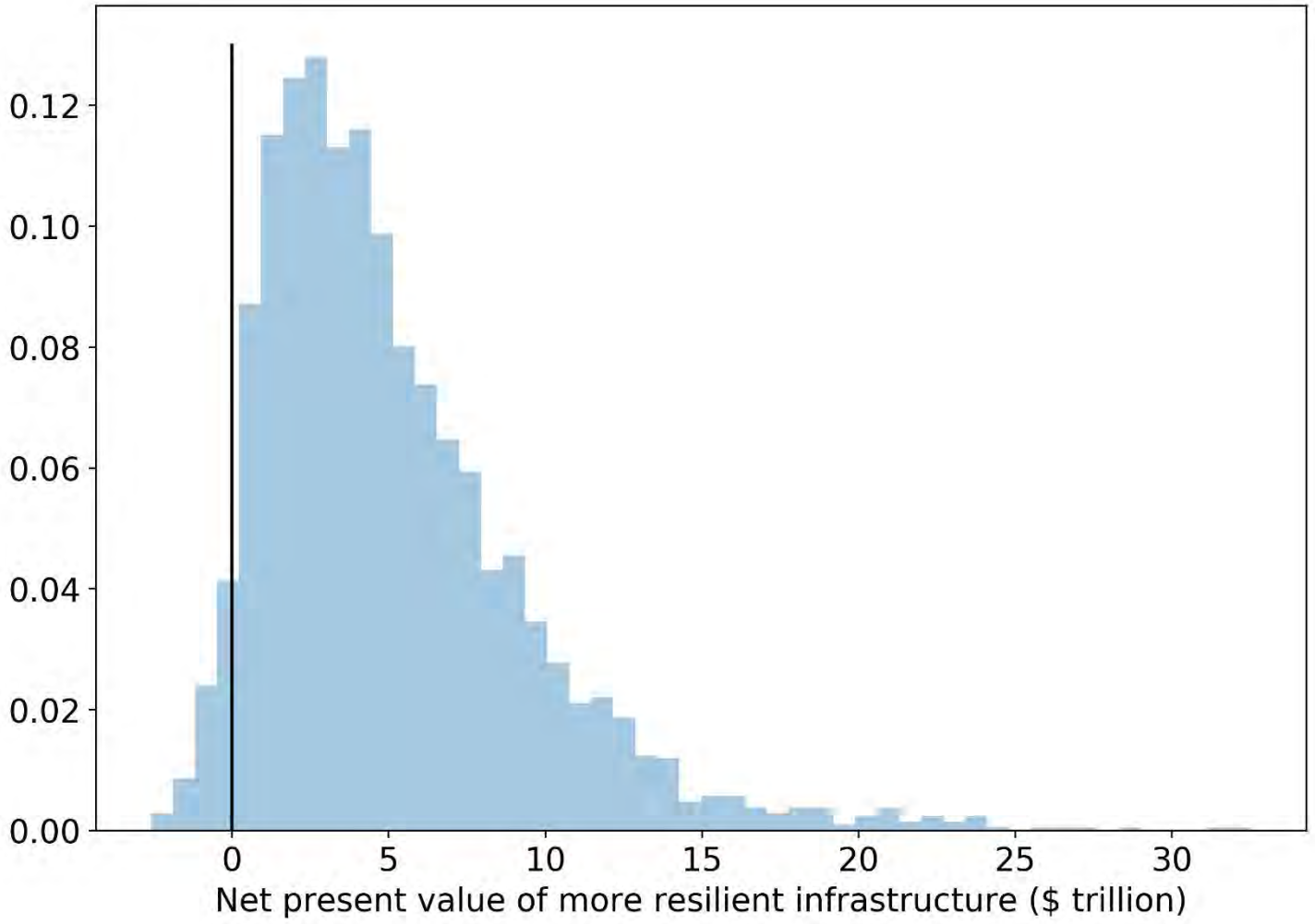
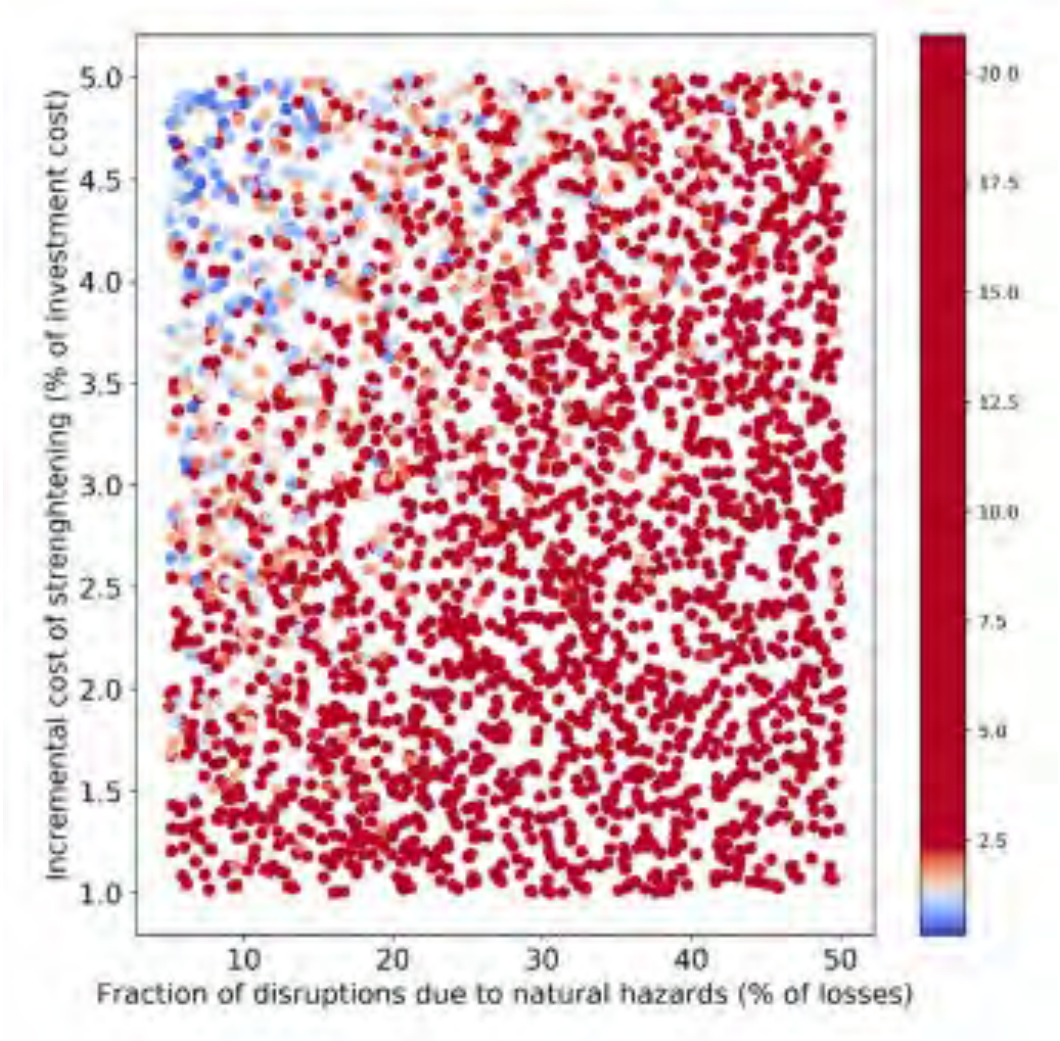
Opportunities for cheaper resilience by making users better able to manage disruptions

Altogether: Investing in resilience is sound, profitable, and urgent, if investments are well targeted



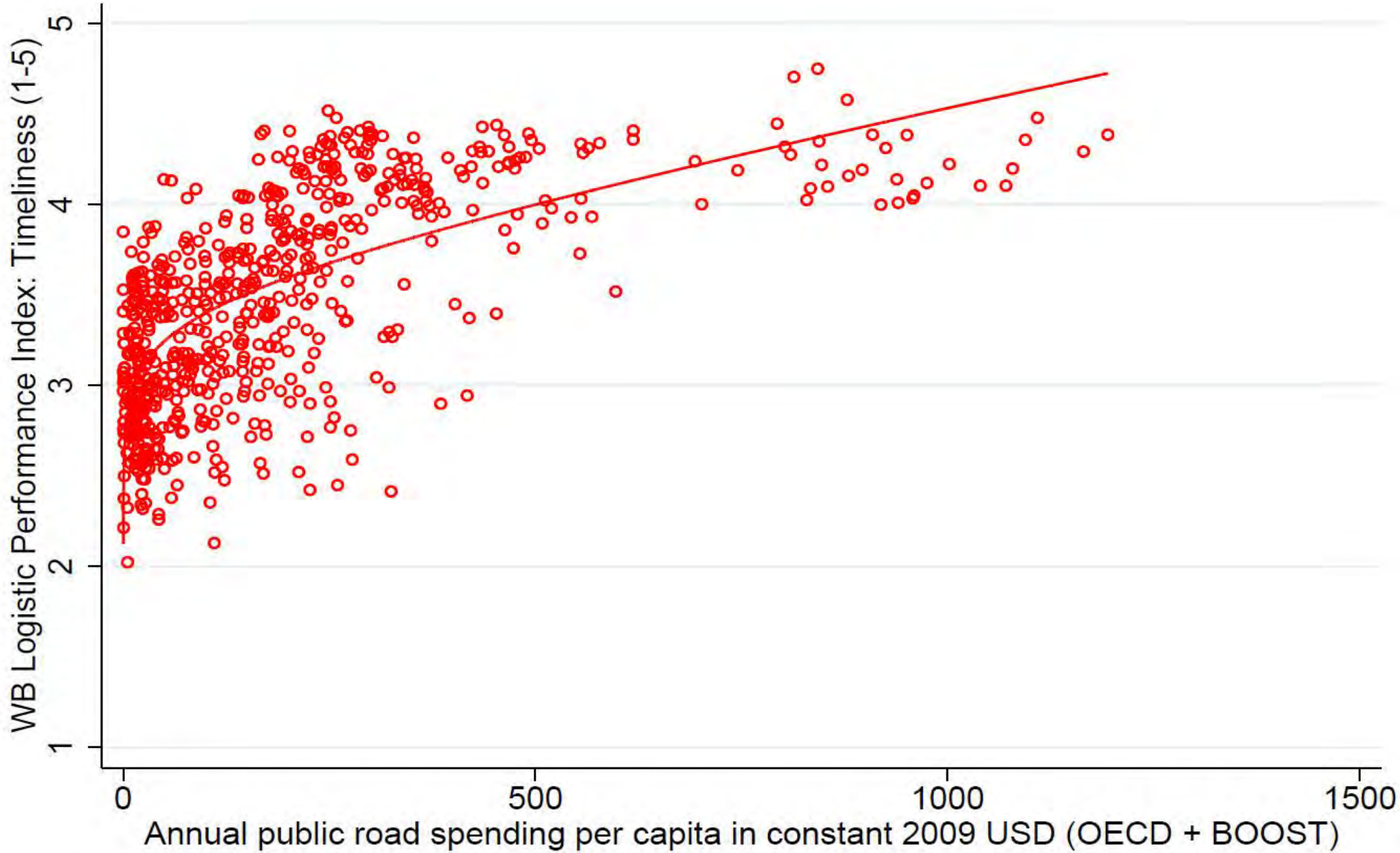
- **Sound**: beneficial in 96 percent of the scenarios

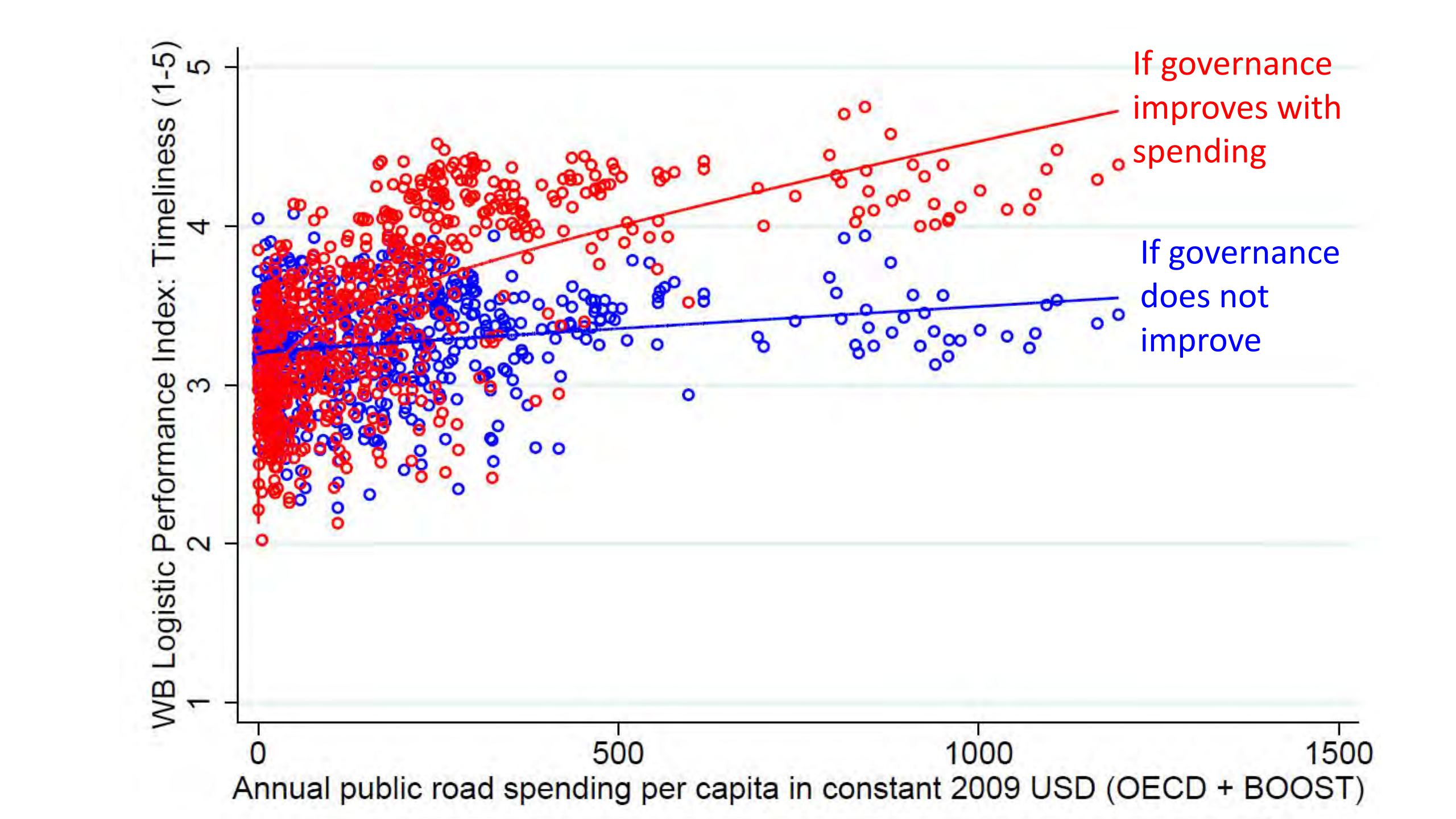
Altogether: Investing in resilience is sound, profitable, and urgent, if investments are well targeted



- **Sound**: beneficial in 96 percent of the scenarios
- **Profitable**: the net benefits from investing in more resilience in infrastructure is $4.2 trillion, over the lifetime of new assets
- **Urgent**: Median cost of one decade of inaction is $1 trillion
- **Climate change** doubles the value of resilience

What about governance?


WB Logistic Performance Index: Timeliness (1-5)
1
2
3
4
5
0
500
1000
1500
Annual public road spending per capita in constant 2009 USD (OECD + BOOST)


If governance improves with spending
If governance does not improve
WB Logistic Performance Index: Timeliness (1-5)
1
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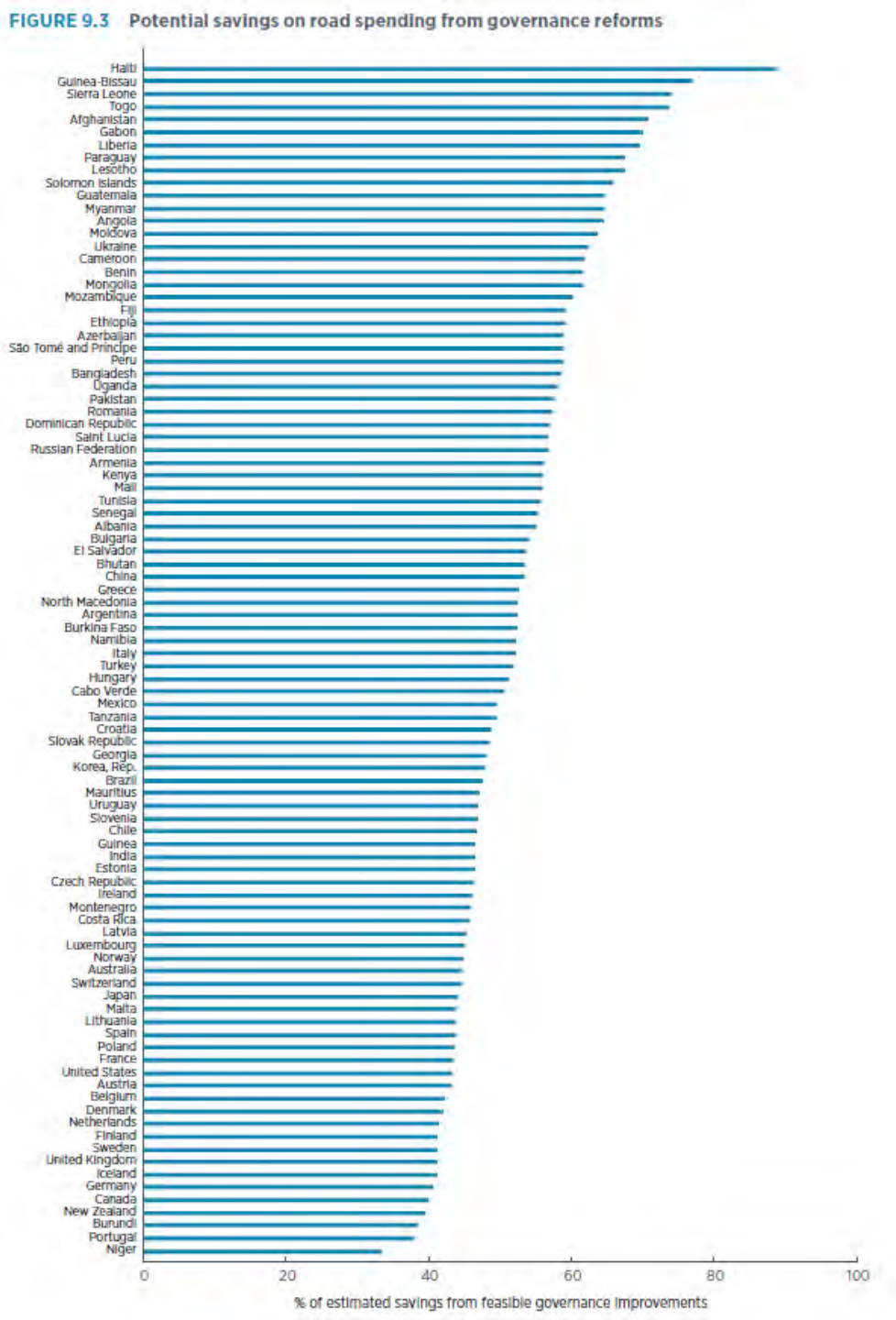
Annual public road spending per capita in constant 2009 USD (OECD + BOOST)

What does the “cost of adaptation” mean?



A menu of actions for countries to build their strategy

Recommendation	Actions
1: Get the basics right	1.1: Introduce and enforce regulations, construction codes, and procurement rules 1.2: Create systems for appropriate infrastructure operation, maintenance, and postincident response 1.3: Provide appropriate funding and financing for infrastructure planning, construction, and maintenance
2: Build institutions for resilience	2.1: Implement a whole-of-government approach to resilient infrastructure, building on existing regulatory systems 2.2: Identify critical infrastructure and define acceptable and intolerable risk levels 2.3: Ensure equitable access to resilient infrastructure
3: Create regulations and incentives for resilience	3.1: Consider resilience objectives in master plans, standards, and regulations and adjust them regularly to account for climate change 3.2: Create economic incentives for service providers to offer resilient infrastructure assets and services 3.3: Ensure that infrastructure regulations are consistent with risk-informed land use plans and guide development toward safer areas
4: Improve decision making	4.1: Invest in freely accessible natural hazard and climate change data 4.2: Make robust decisions and minimize the potential for regret and catastrophic failures 4.3: Build the skills needed to use data and models and mobilize the know-how of the private sector
5: Provide financing	5.1: Provide adequate funding to include risk assessments in master plans and early project design 5.2: Develop a government-wide financial protection strategy and contingency plans 5.3: Promote transparency to better inform investors and decision makers