University of BRISTOL

IHRR Seminar

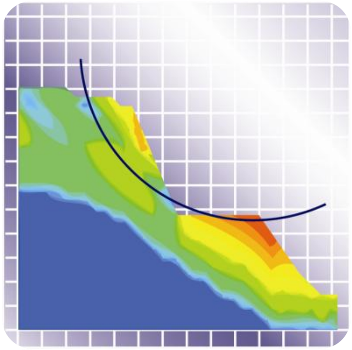
Delivering urban landslide risk reduction in developing countries

Dr Liz Holcombe

Overview

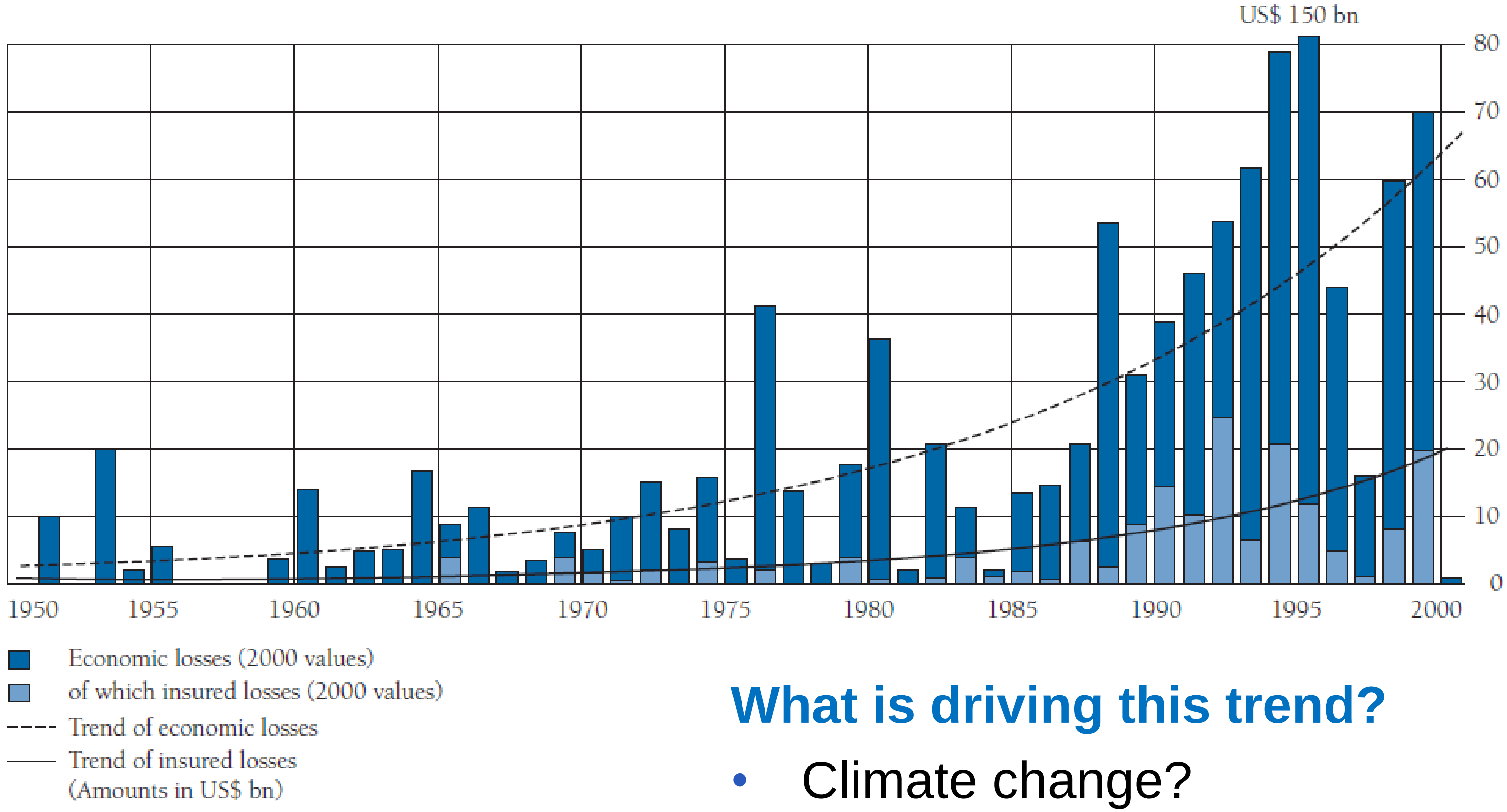
- Disaster risk: some challenges
- Urban landslide risk in humid tropical developing countries
- Management of Slope Stability in Communities
- Discussion on science-policy-practice gaps and bridges






Disaster Risk increasing (economic losses)

UNISDR, 2009

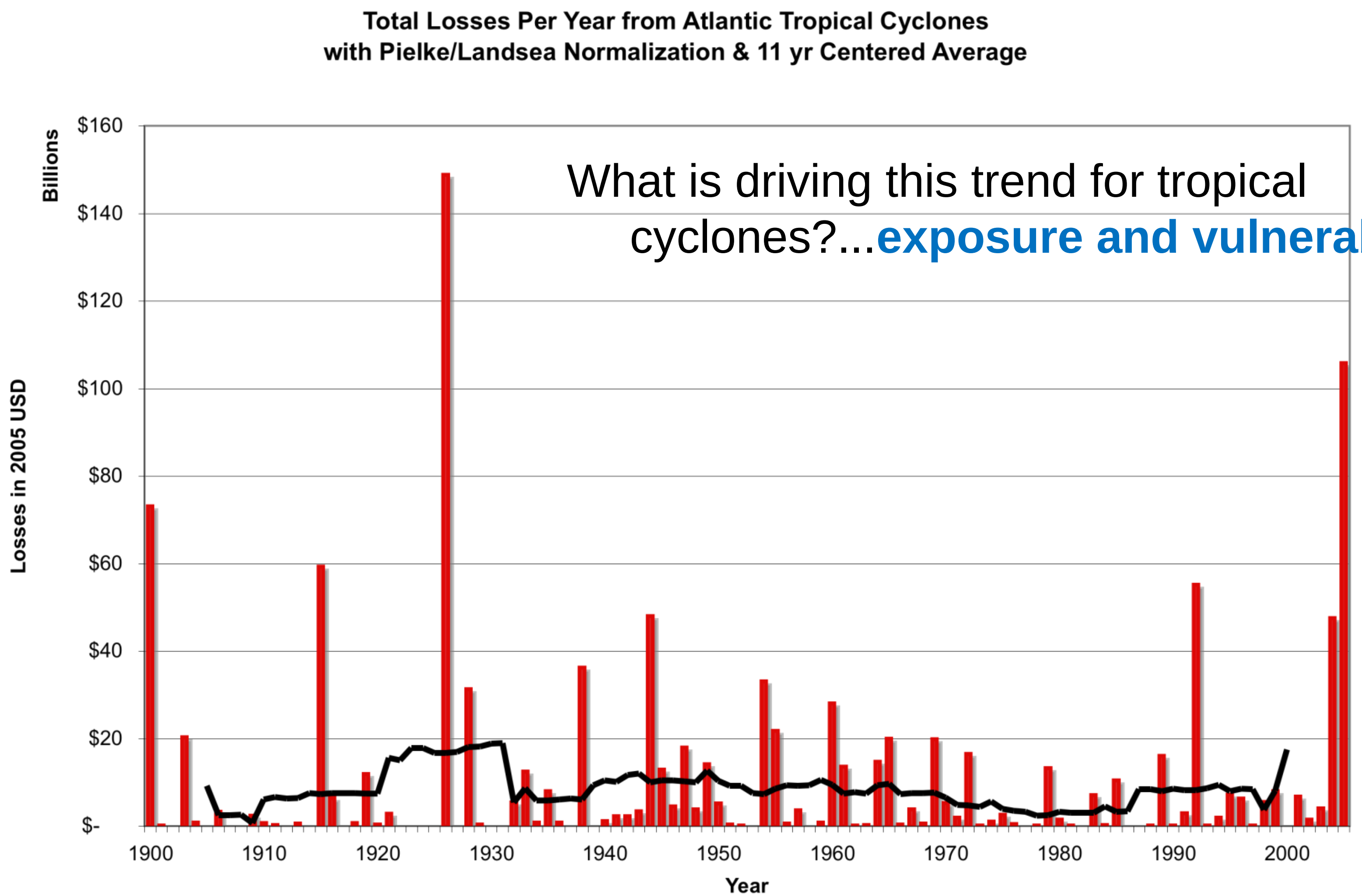


Source: Munich Re 2002.

What is driving this trend?

- Climate change?
- Population growth / urbanisation?
- Development / poverty?
- ...all of the above?

Identifying risk drivers for tropical cyclones



What is driving this trend for tropical cyclones?...**exposure and vulnerability**

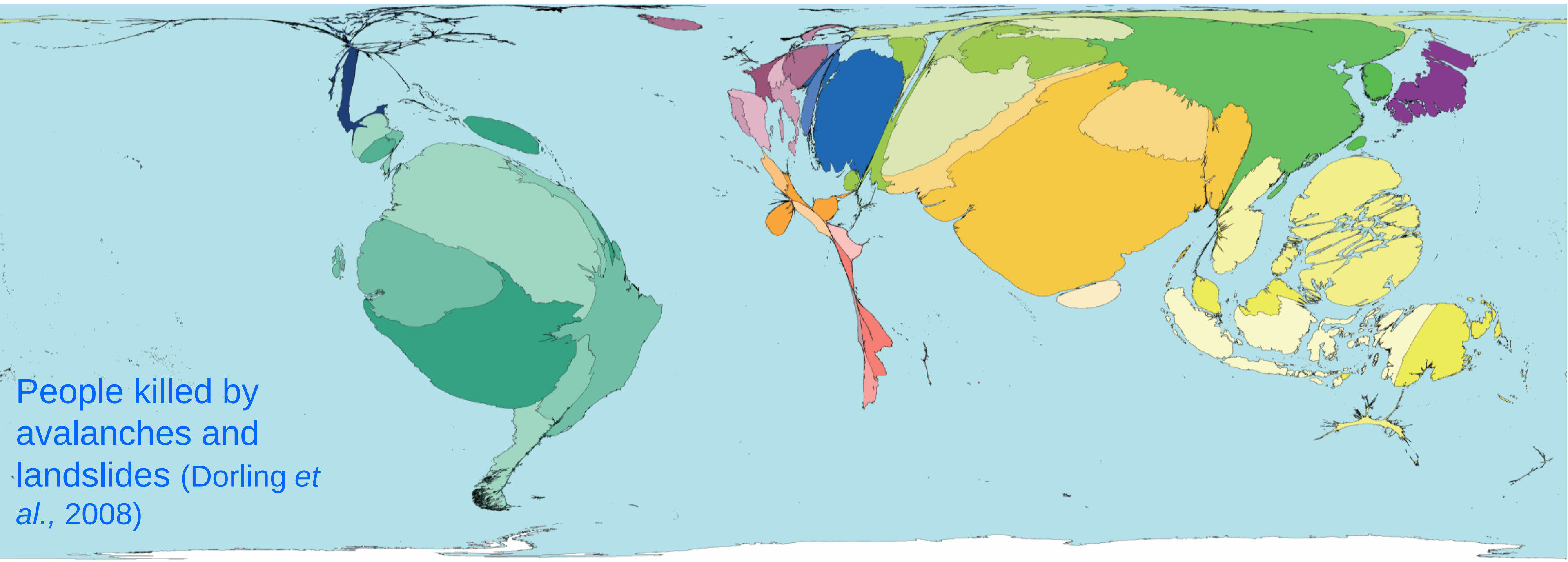
Challenge 1: policy and practice

- “...policy statements by all major agencies have **included risk reduction as a pre-condition** and an integrated aspect of sustainable development...

- …but when it comes to **practical implementation, very little has been done**, even when money is available” (UN-ISDR 2002, in Wamsler, 2006)

- “**Few examples of effective landslide hazard reduction measures**” (Wamsler, 2007)

Global landslide risk distribution

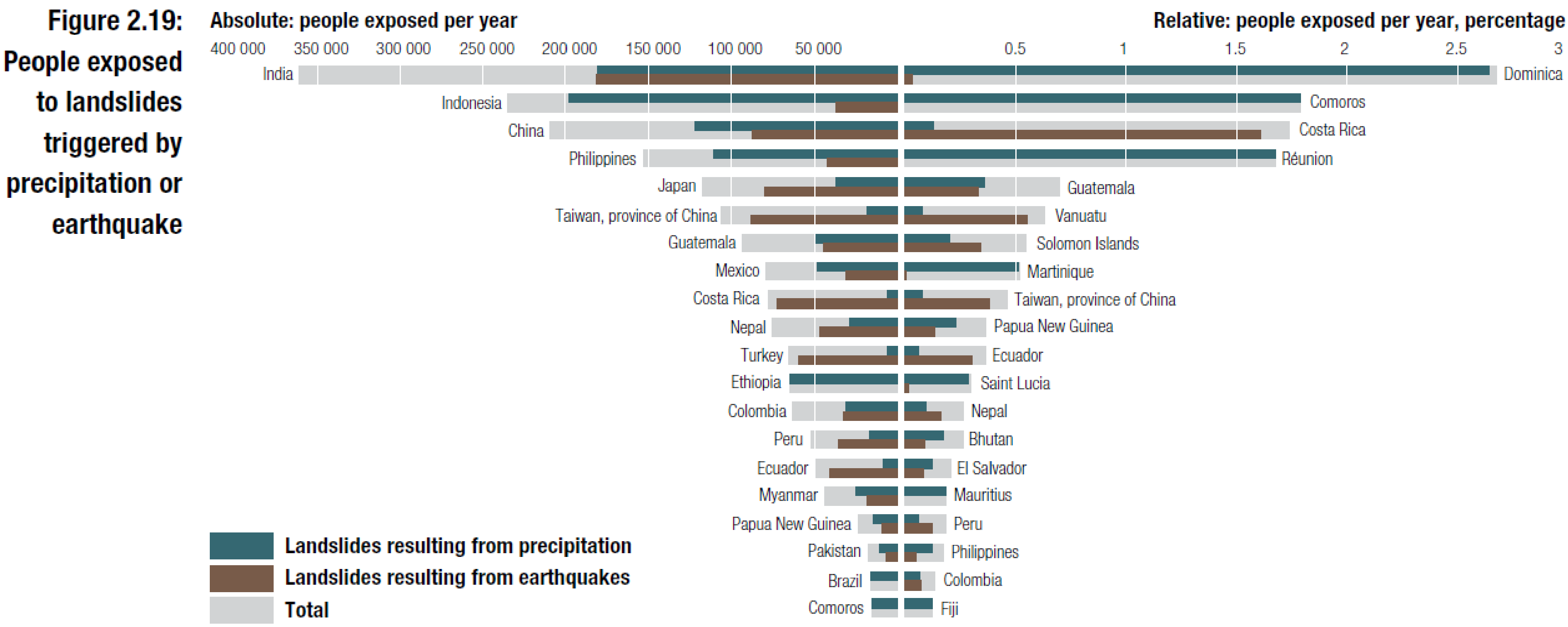


People killed by avalanches and landslides (Dorling *et al.*, 2008)

- Cost as the proportion of GDP per unit area of countries affected:

  40% of the global economic losses due to landslides are experienced in Central and South America and the Caribbean and **40%** in Asia.
- In 2005 the majority of fatal landslides were in urban areas (Petley, 2009)
- ...but landslide risk probably underestimated

Landslide risk distribution and **triggers**



South and South East Asia
Central and South America

Small Island Developing States (SIDS)

UNISDR, 2009

Challenge 2: science and practice

- In developed countries the science of landslide prediction and prevention has been advanced through complex or data-intensive modelling (Glade et al., 2005)

- Not easy to 'transfer' this science to developing countries "where knowledge [and data] base is often nonexistent or fragmentary" (UN, 2006)

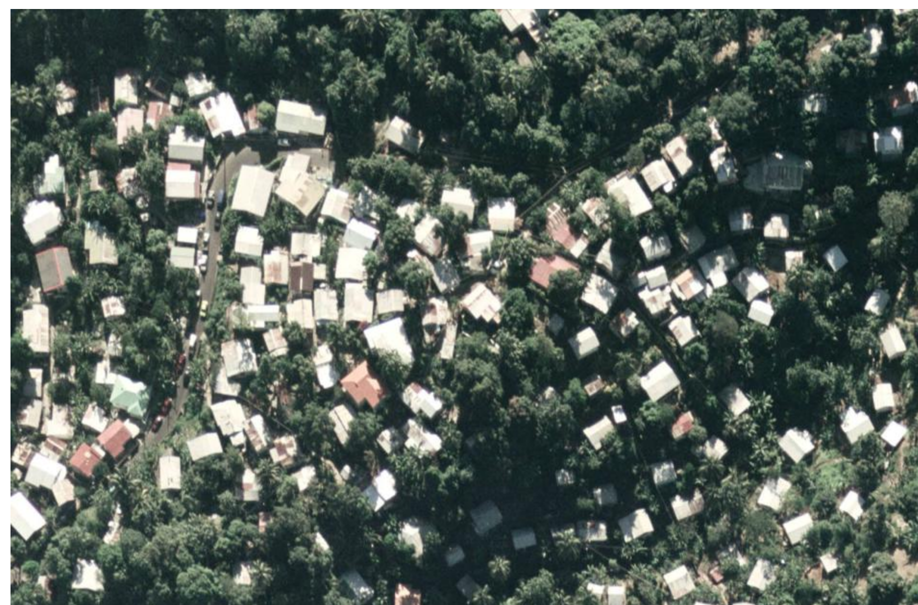
- The knowledge and practices identified at international and national scales "aren't trickling down fast enough" (Wisner, 2009).

- Reducing urban landslide risk in humid tropical developing countries

A growing issue

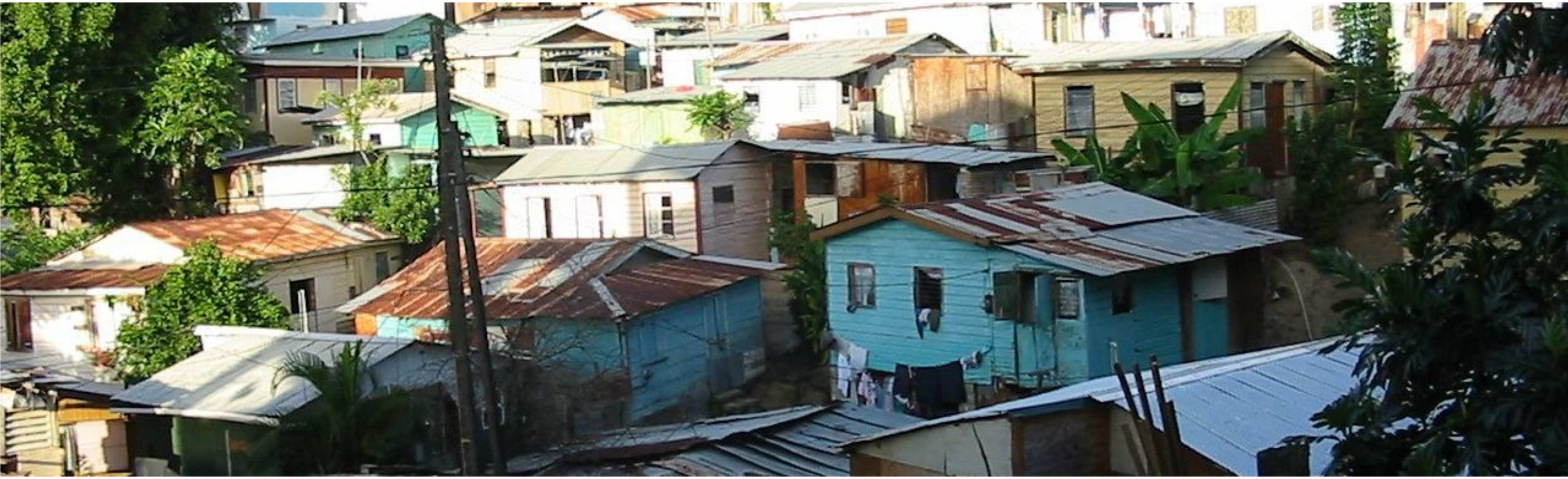
Landslide risk drivers: physical and human

Risk component	Humid tropical developing countries
Hazard	Rainfall-triggering, deep weathered soil profiles, anthropogenic influences (construction, agriculture, deforestation, mining...)
Exposure	Population growth, migration to urban areas, unplanned settlements on landslide prone slopes...
Vulnerability	Poverty, easily damaged houses, low resilience to shocks...



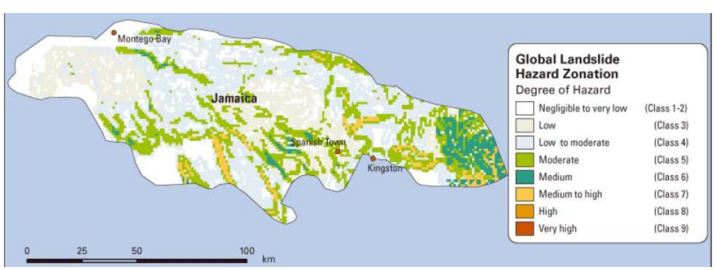
Unauthorised (unplanned) housing

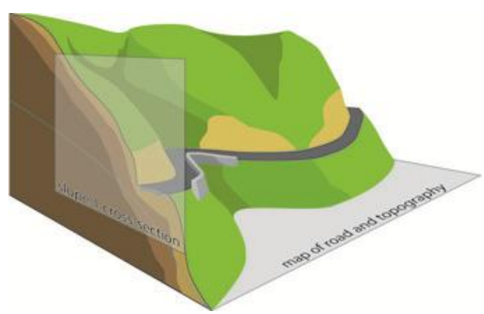
Country type (income)	Low	Lower middle	Upper middle	High
Owner occupancy %	33	59	57	59
Unauthorised housing %	64	27	9	0
Squatter Housing %	17	16	4	0

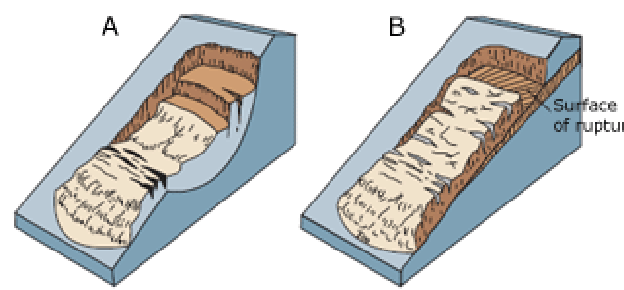


Understanding the physical hazard drivers

Understand	Our approach
Underlying landslide susceptibility processes	Understanding **local factors** is key (1-30m scale): Slope angle Material type (weathered materials) Drainage and topography effects Surface water infiltration Human activity (cut/fill, loading, adding water, vegetation)
Triggering mechanism	**Rainfall** and surface water infiltration
Type of landslide	**Rotational and translational** slides Weathered materials **(soils)**

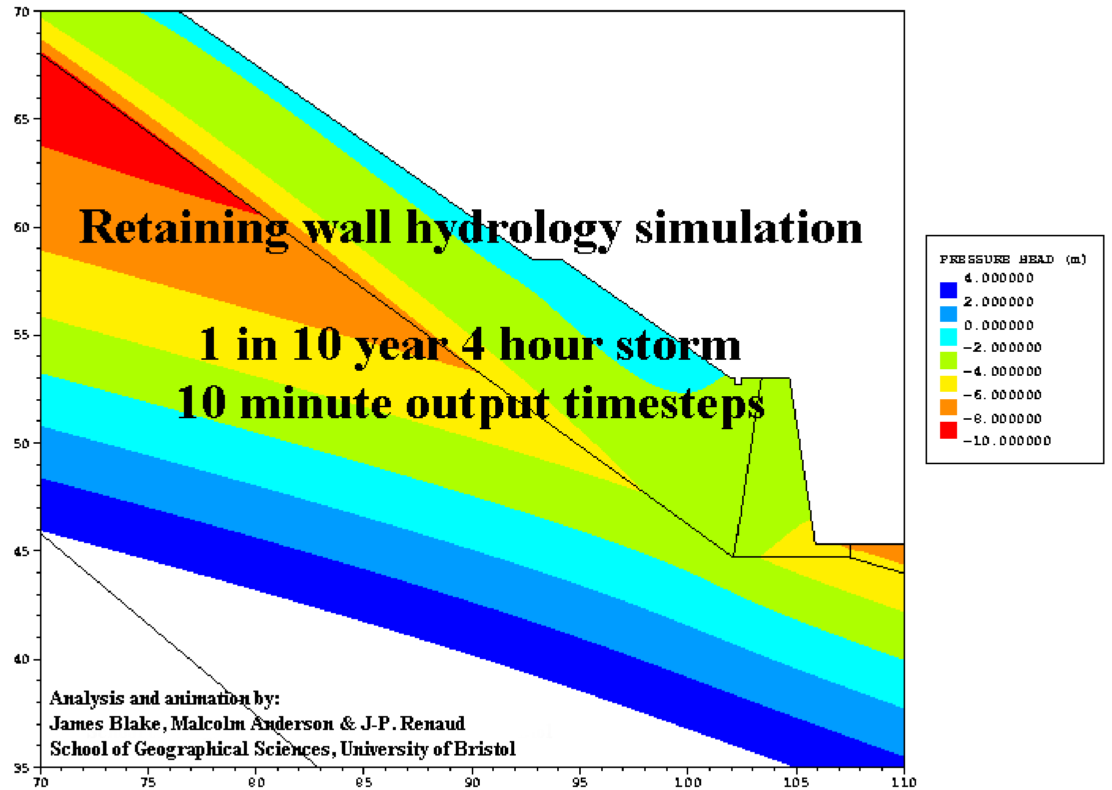


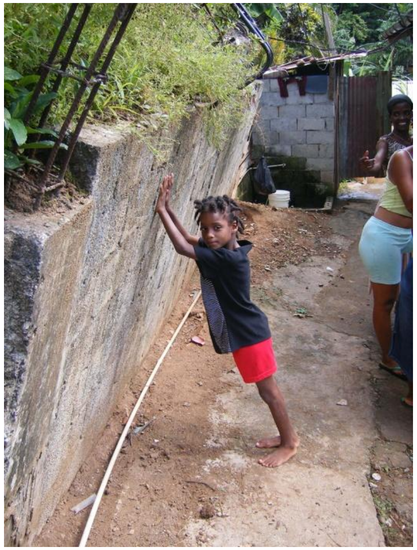




Rotational landslide Translational landslide

Local slope stabilisation practices





Local slope management issues: drainage

Impact of urban water supply

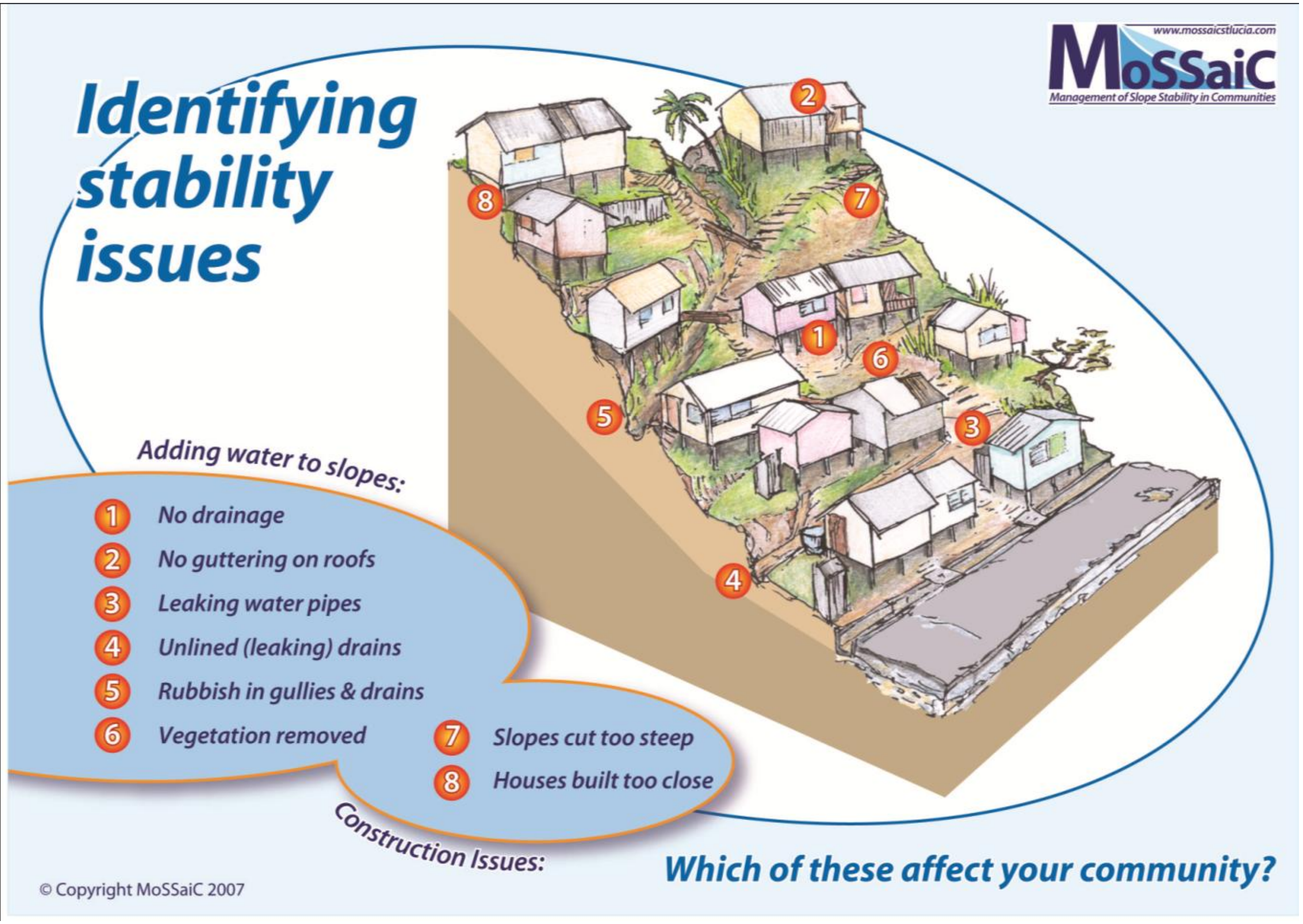
Estimate soil saturated:

14 days per month

But, roof guttering + proper surface drainage reduce the level of soil saturation to…

…1 day per month

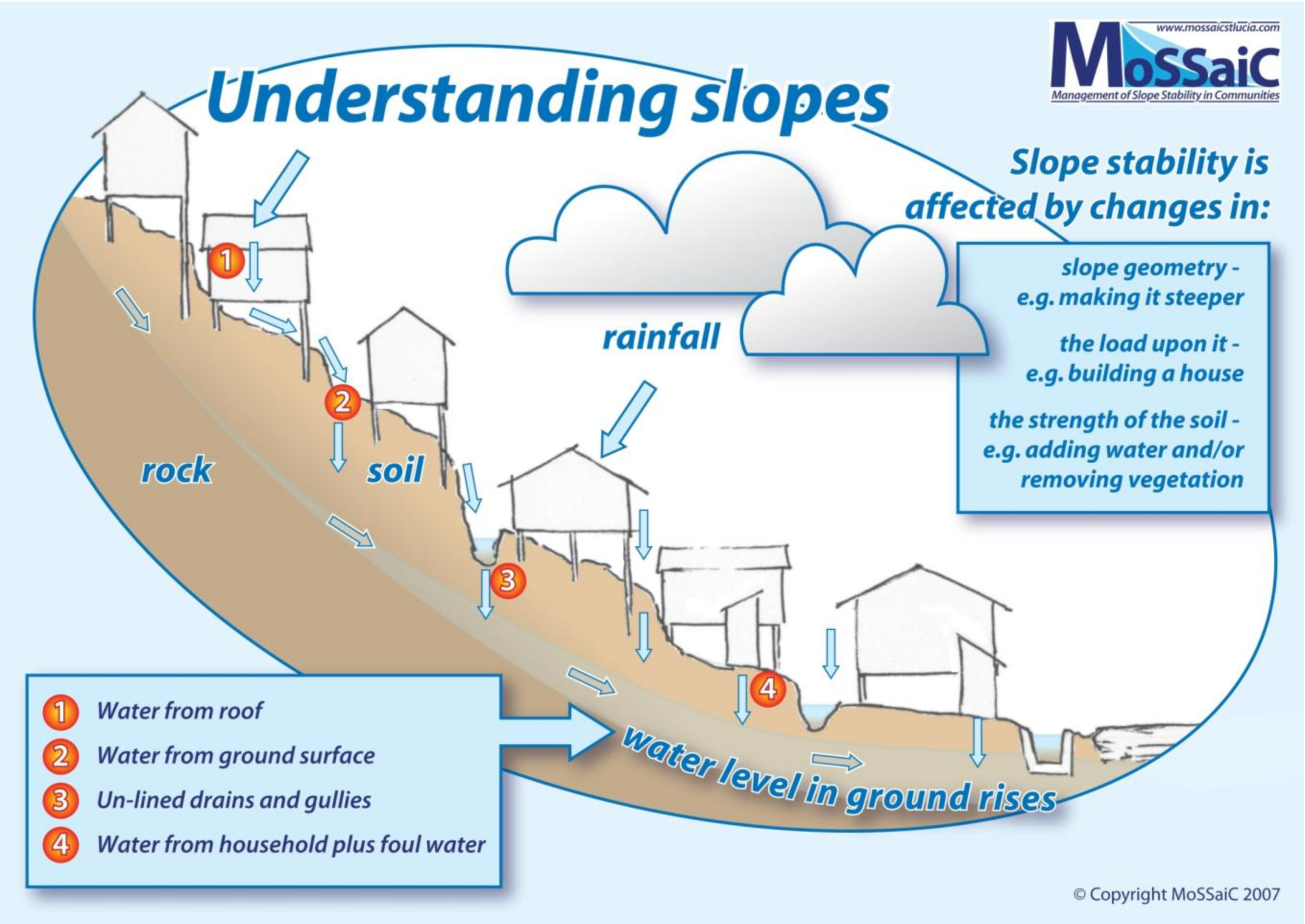
Local **knowledge**: mapping slope features

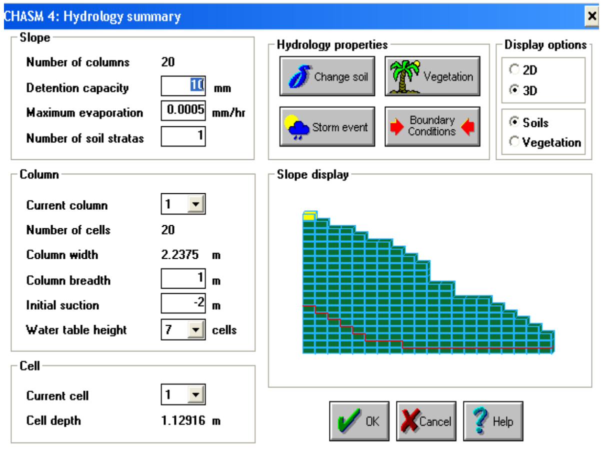


Map past landslides, instability indicators, drainage, soils and topography

Discuss slope processes with Government team and residents

Using **science** to understand slopes

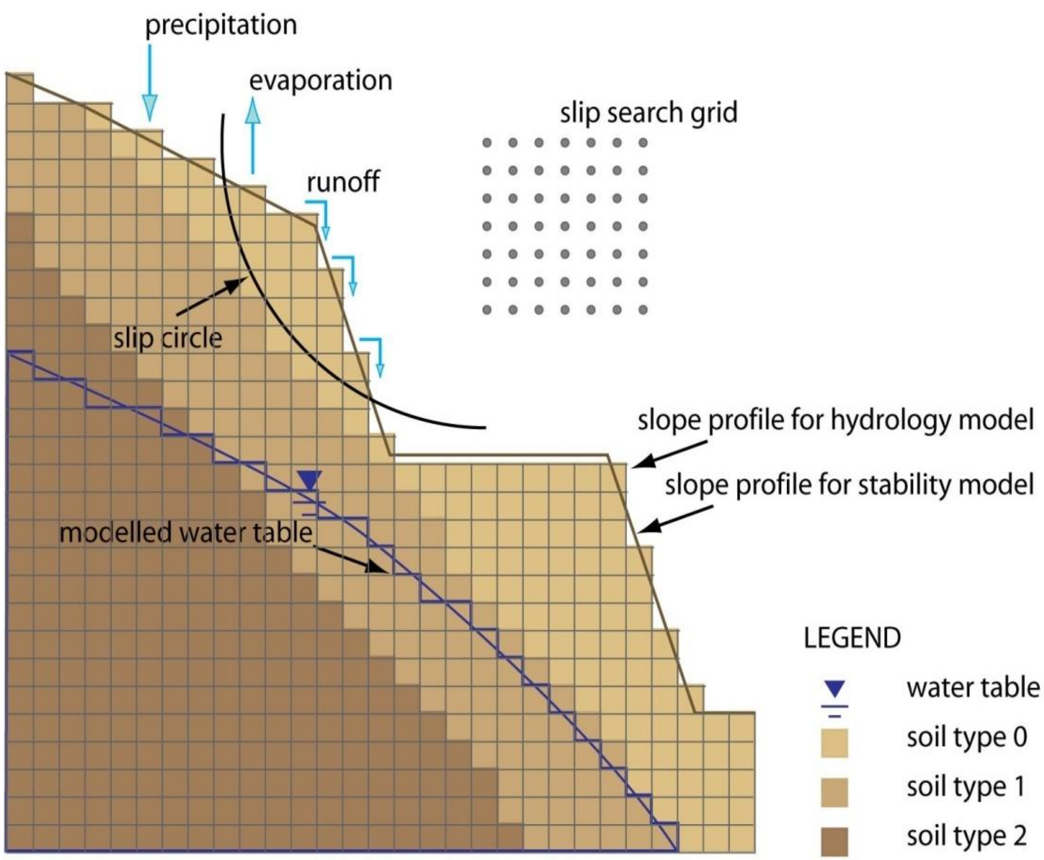


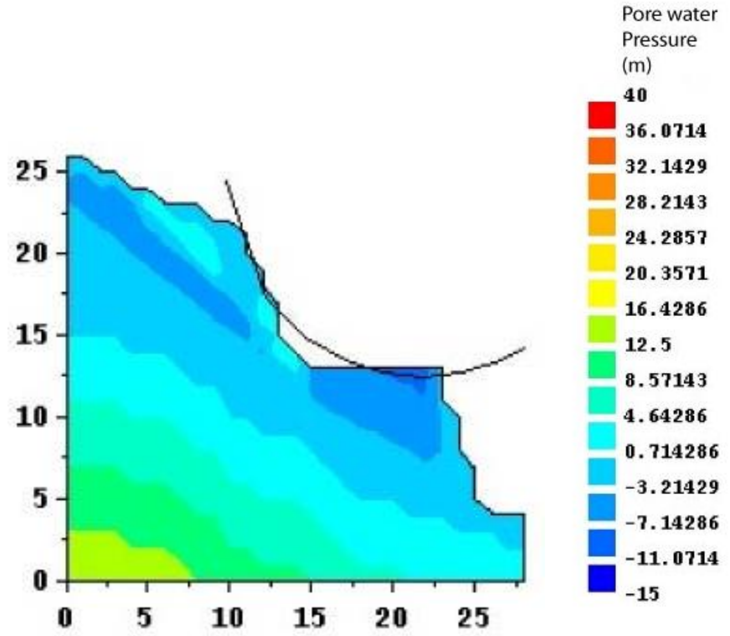


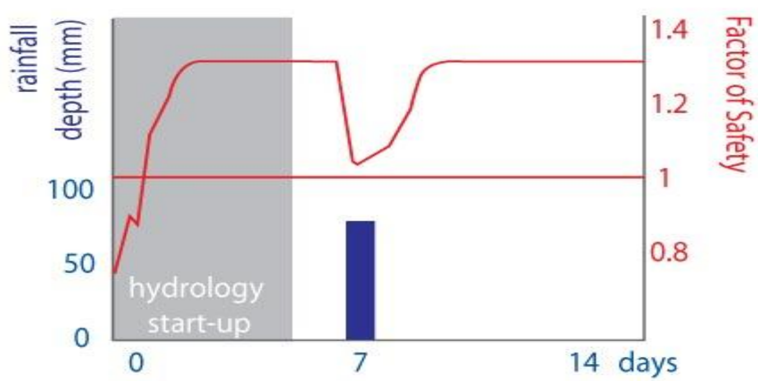
Use local and expert knowledge to **identify potential landslide drivers**

Confirm using scientific methods (e.g. slope stability models)

Combined Stability and Hydrology Model CHASM







Developing appropriate solutions

SAINT LUCIA SECOND DISASTER MANAGEMENT PROJECT (SDMP)

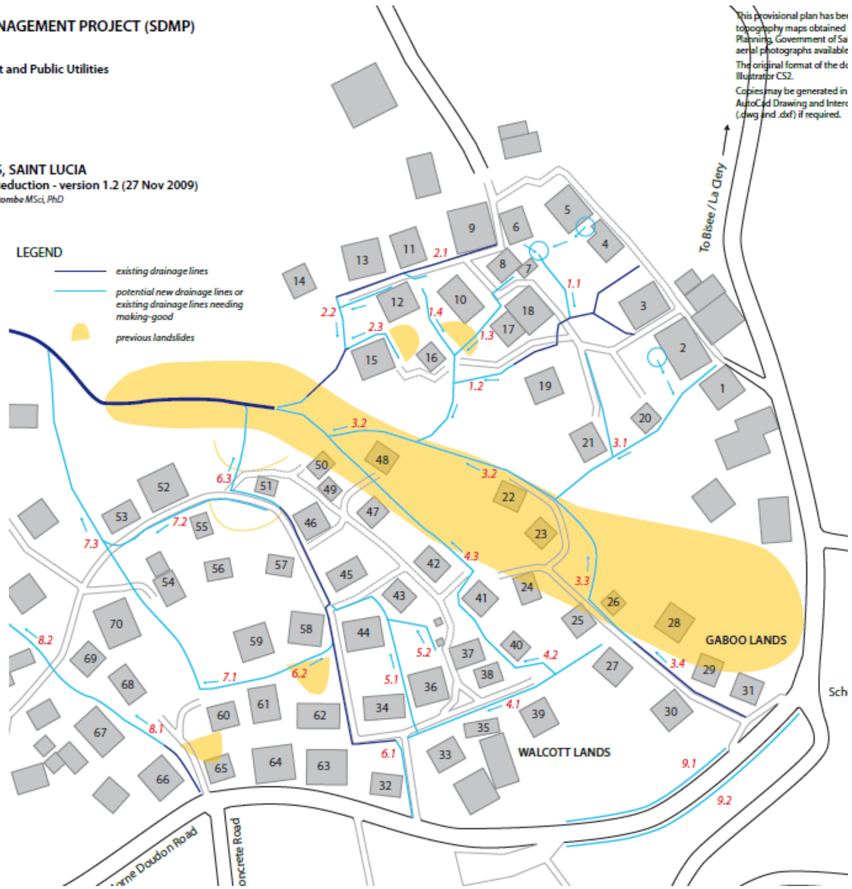
GOVERNMENT OF SAINT LUCIA
Ministry of Communications, Works, Transport and Public Utilities
(MCWT&PU)

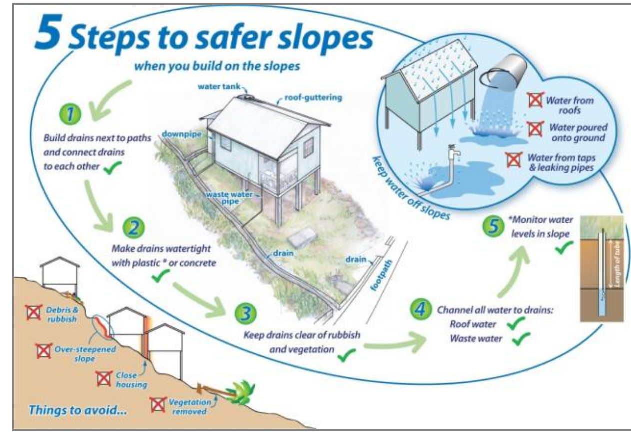
WORLD BANK

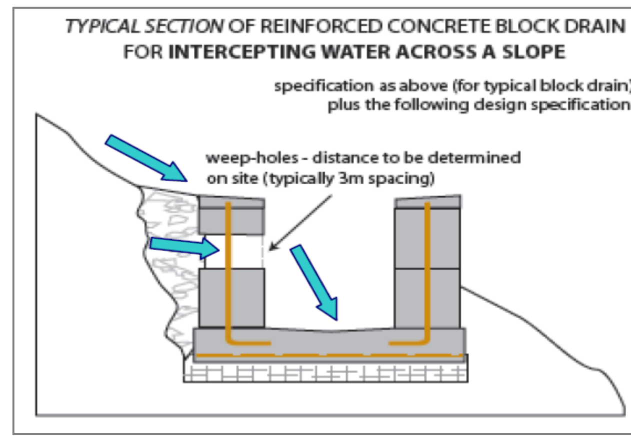
MORNE DOUDON / LA PENSEE, CASTRIES, SAINT LUCIA
Provisional Drainage Plan for Landslide Risk Reduction - version 1.2 (27 Nov 2009)
Prof. M.G. Anderson PhD, DSc, FICE, CEng, A.M.ASCE, Dr E.A.Holcombe MSci, PhD

PROVISIONAL LIST OF WORKS

	Item	Approx. Length (m)
	DRAINAGE GROUP 1	
1.1	intercept drain joining with SSDF drain	~25m
1.2	make good SSDF drain and continue to join drain 3.2	~60m
1.3	secondary drain to capture runoff and household water	~37m
1.4	minor intercept drain to capture surface runoff	~15m
	DRAINAGE GROUP 2	
2.1	make-good path drain	~42m
2.2	connections to existing concrete drain	~30m
2.3	extend existing concrete drain behind house	~10m
	DRAINAGE GROUP 3	
3.1	new drains (including pipe-connection from house 2)	
3.2	new drain (along existing drainage route)	
3.3	new drain intercept drain to connect footpath drain to 3.2	
3.4	make-good path drain	
	DRAINAGE GROUP 4	
4.1	new intercept drain above concrete path	
4.2	make-good existing drain and re-route to avoid house 41	
4.3	new drain along existing drainage channel (connect to 3.2)	
	DRAINAGE GROUP 5	
5.1	make-good existing drain and extend to connect to 4.1	
5.2	make-good and extend to collect bathroom water	
	DRAINAGE GROUP 6	
6.1	make-good path drain	
6.2	extend intercept drain across slope towards house 60	
6.3	repair bridge and drain, and extend drain to ravine	
	DRAINAGE GROUP 7	
7.1	new intercept and downslope drain	
7.2	make-good and extend footpath drain to intercept water	
7.3	make-good existing channel to ravine	
	DRAIN 8	
8.1	make-good culvert from road to bridge (prevent leakage)	
8.2	make-good culvert from footpath bridge to ravine	
	ROAD DRAIN 9	







Surface drainage network designed – appropriate **hazard reduction measures**

Government and residents work together to **agree the plan**

Posters and show homes promote **good slope management practices**

Delivering landslide hazard reduction measures on the ground

Funding from **Government / donor agency**

Local engineers supervise works

Contractors and workers employed from the **community**

Indicators of effectiveness

The 12 communities **withstood a 1 in 500 year rainfall** event (600mm, 24 hours)

Calculated **benefit-cost ratio of 2.7:1** (including indirect community benefits)

Cost to Government of **~2% of the potential community-relocation costs**

Management of Slope Stability in Communities

MoSSaiC premises

- Disaster risk mitigation pays, and **landslide hazards can *often* be reduced** in vulnerable communities.
- Engaging existing **government expertise** for implementing risk reduction measures can build capacity, embed good practice, and change policy.
- Ensuring **community engagement** from start to finish can establish ownership of solutions.

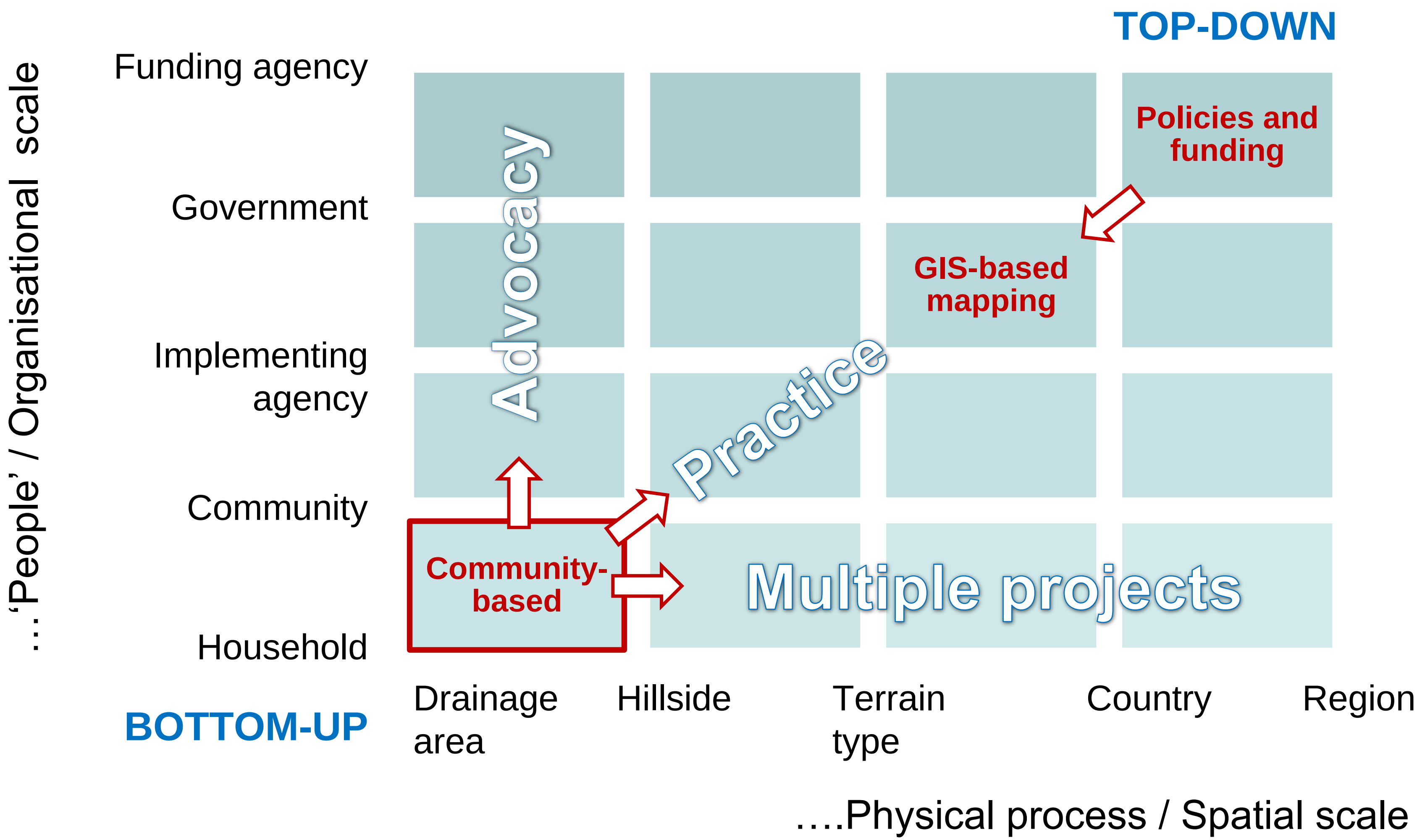
Three foundations for sustainable landslide risk reduction

- Community-based
- Science based
- Evidence based

The MoSSaiC approach and the science-practice-policy challenges

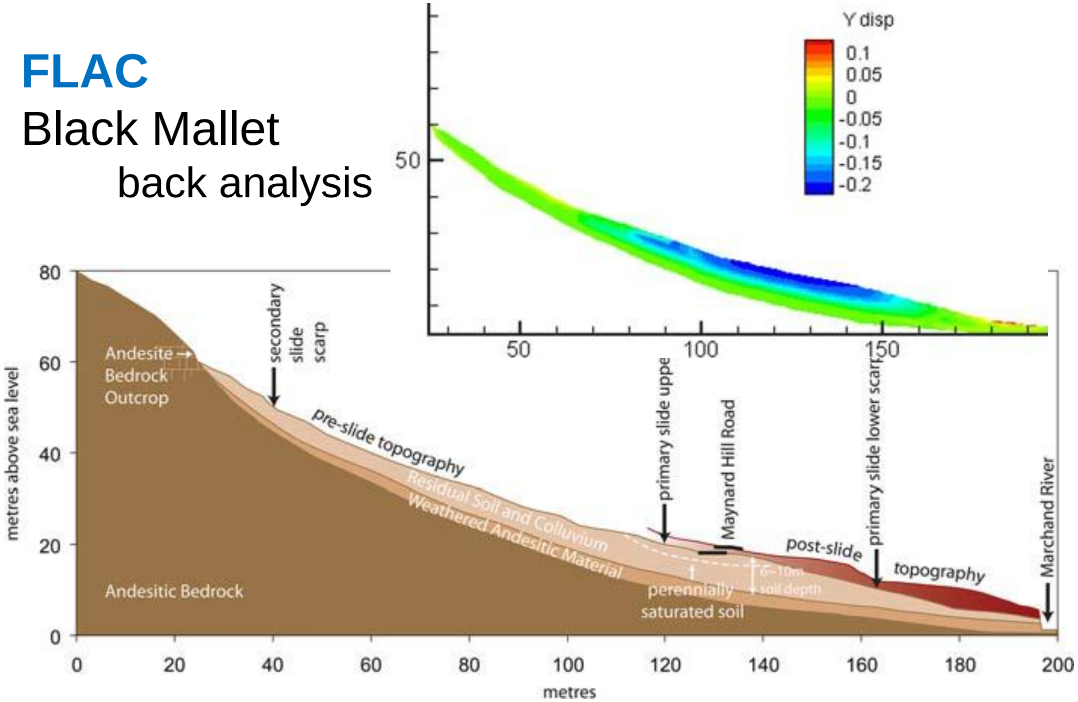
- Community-based
- Science based
- Evidence based

Overcoming scale issues

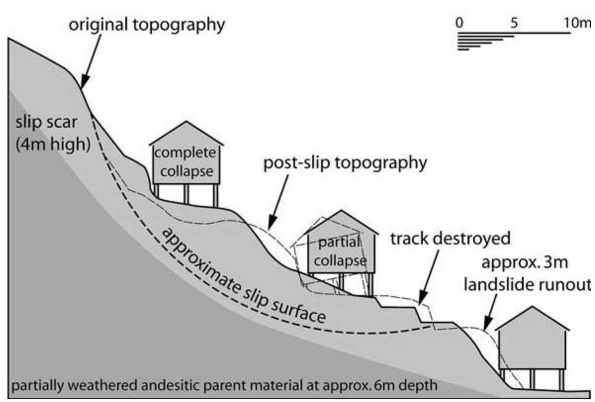


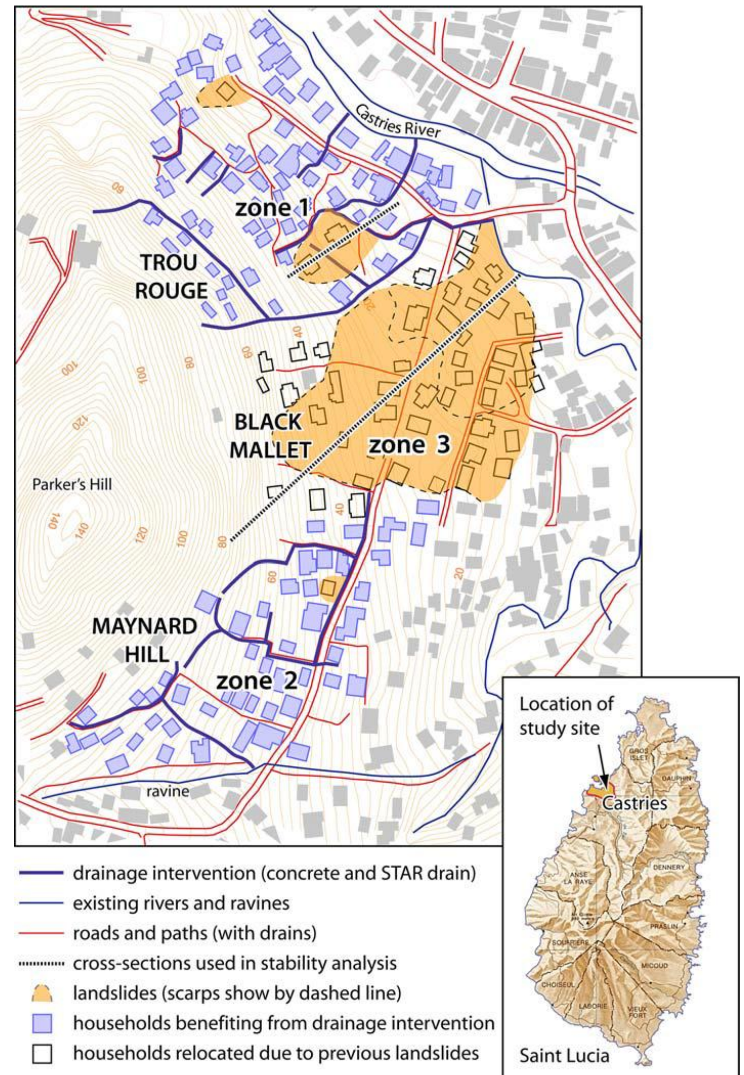
Identifying hazard drivers

FLAC
Black Mallet
back analysis



CHASM
Trou Rouge
Before, F = 0.99
After, F = 1.12





Action into knowledge (and vice versa)

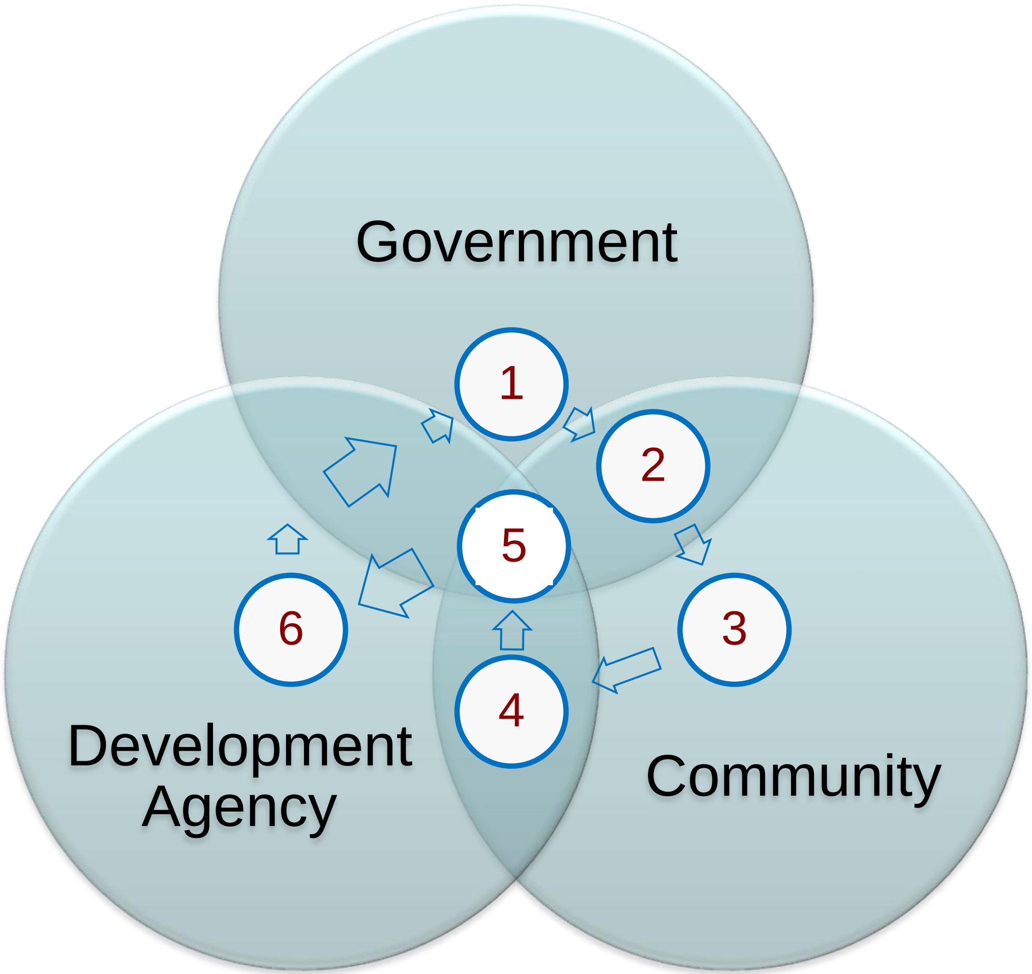
- **Actions**
  mapping / team-building / management / design / construction
- **Expertise and knowledge**
  local knowledge / engineering / science / social science
- **Participants**
  residents / technical teams / decision-makers / researchers



From awareness to adoption

Steps	MoSSaiC
Awareness of the problem	Risk perception: landslide risk accumulation
Interest in specific problem	Risk perception: urban landslide hazard reduction
Knowledge / comprehension of how to change the situation	Understanding the MoSSaiC vision, science and project steps
Attitude affecting tendency to accept and adopt an innovation	Acceptance by communities and government (decision to fund projects with a country)
Legitimisation within local norms and context	Adaption of MoSSaiC at community and government levels
Practice putting knowledge into action before adoption	Delivery of landslide hazard reduction measures on the ground
...leading to adoption of the new approach (behavioural change)	Improved landslide risk reduction and slope management practices within communities and government...and international development agencies

Strategic incrementalism



Advocating ex-ante risk reduction

	Reduce landslide hazard	Reduce exposure to landslides	Reduce vulnerability to landslides
Typical ex-ante mitigation measures	**Slope stabilisation measures** Control slope usage	Debris control measures Planning controls	Increase building reliability Increase community awareness and resilience
Landslide		Early warning and evacuation	Early warning and evacuation
Typical ex-post response, relief and recovery	Slope stabilisation measures Control slope usage	Relocation	Search and rescue Insurance Building back better

Questions and discussion

- Other landslide hazard reduction approaches?
- Similar approaches to other hazards?
- Addressing hazard *and* vulnerability?
- Bridging the gaps:
  - Science – Social science
  - Science – Practice – Policy
  - Top-down – Bottom-up approaches
  - Uncertainty – Knowledge – Action