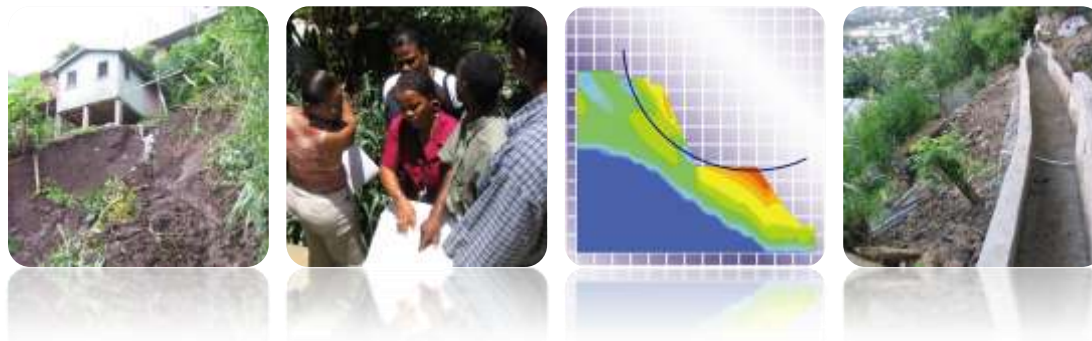


Community based landslide risk reduction: evidence and challenges



Prof. Malcolm G Anderson



Cooperative Governance
Traditional Affairs





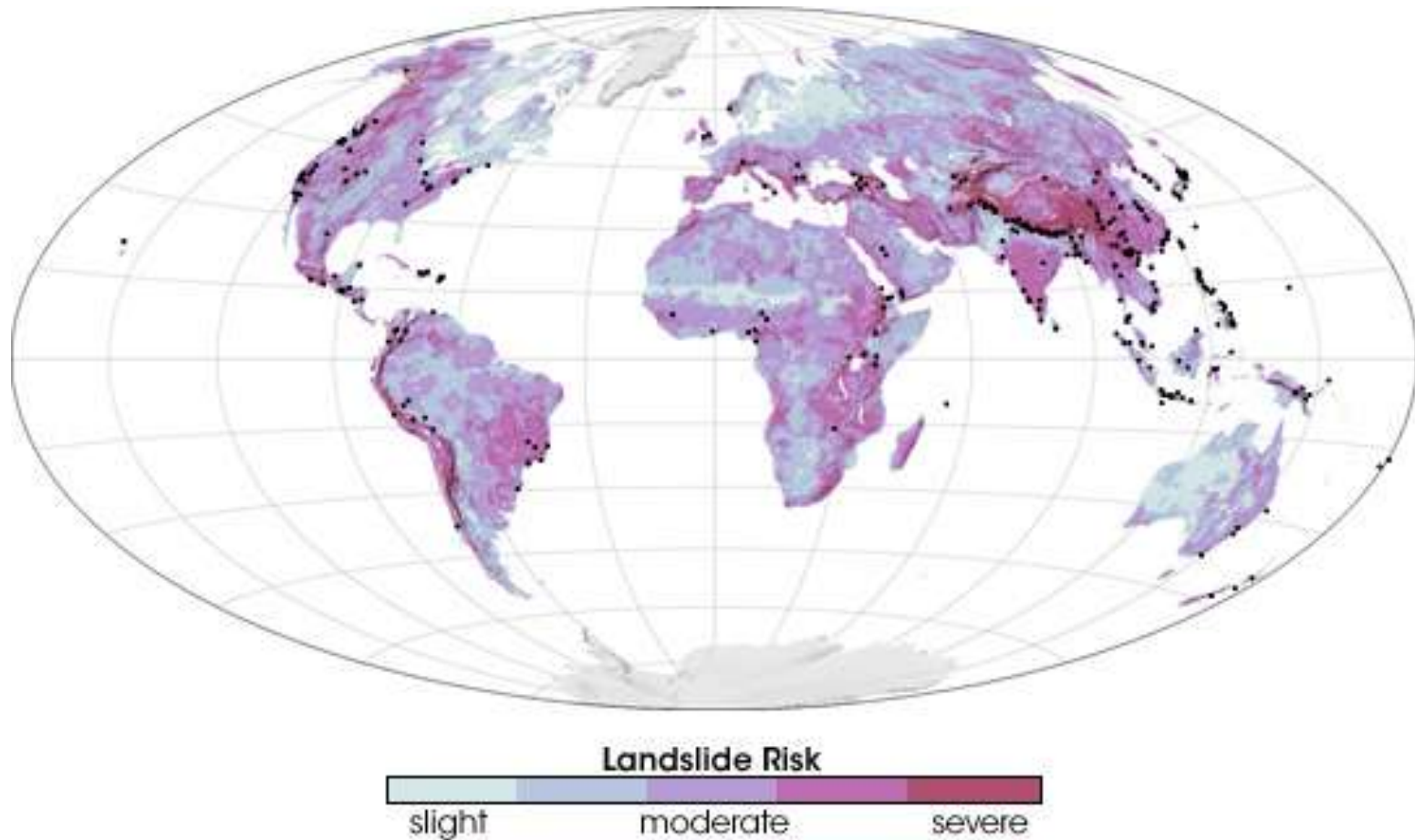
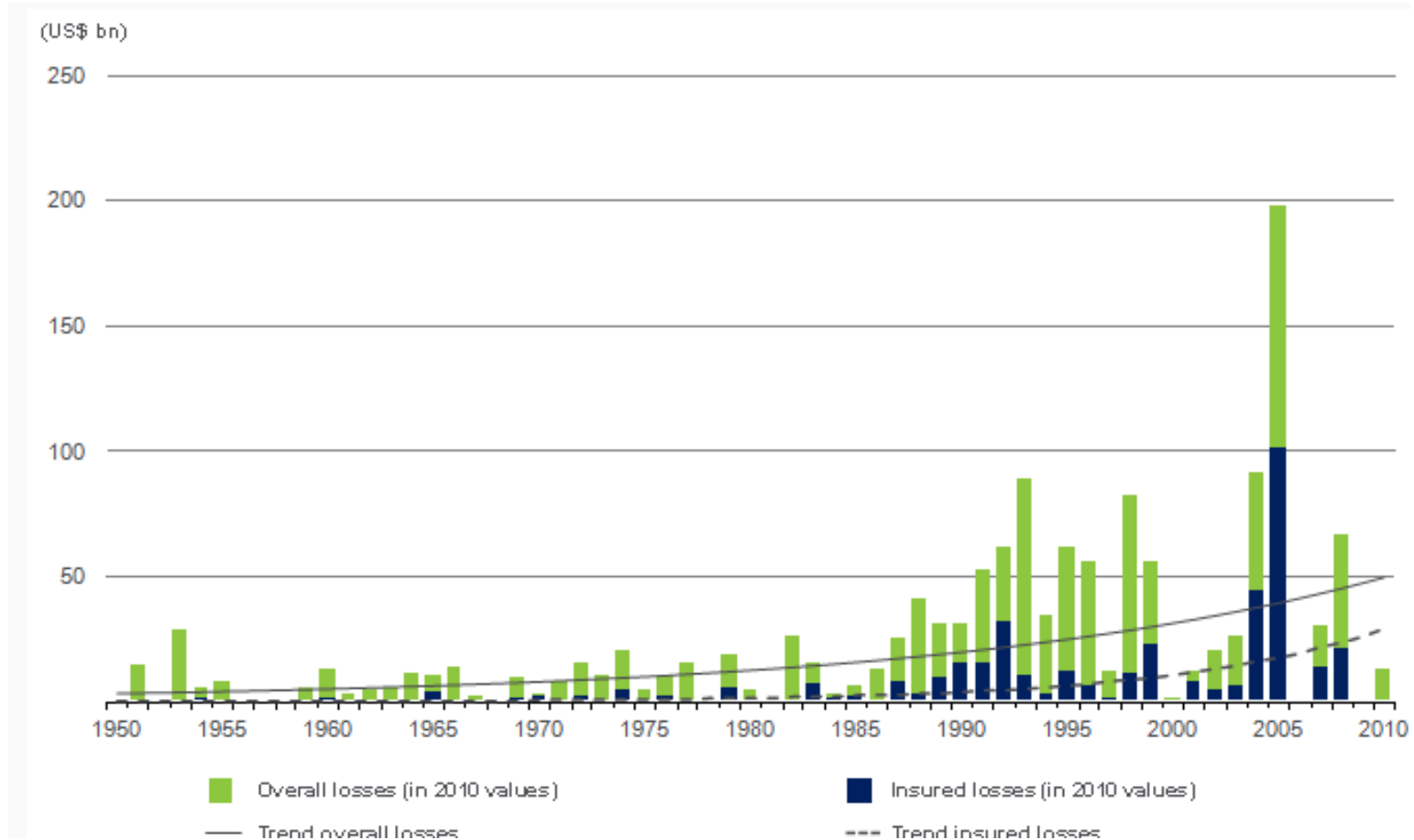


Image courtesy NASA

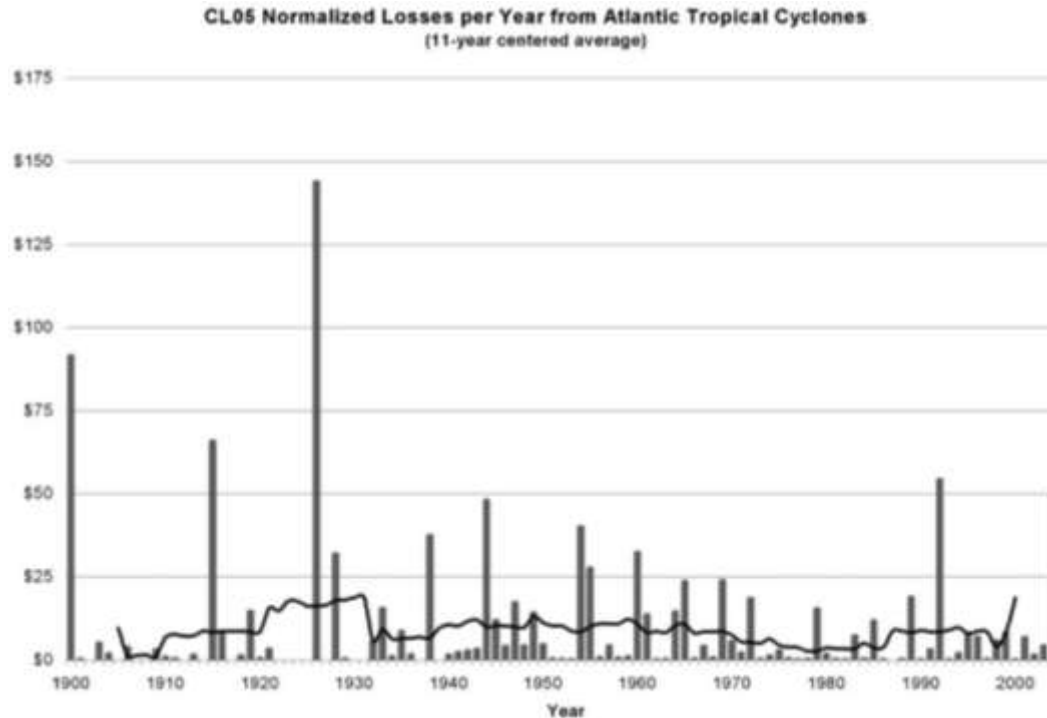
- ‘risk mitigation pays’
 - *but too few Cost Benefit Analyses to confirm this* (Twigg 2004)
- ‘economic losses due to risk are increasing’
 - *but normalised data shows no trend* (Pielke et al 2008)
- ‘providing the public with information on hazards encourages preparation’
 - *an unfounded assumption* (Paton 2003)
- ‘future context is today’s world, with modest variations’
 - *scenario modelling suggests otherwise* (Mahmoud et al. 2009)



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...but normalisation tells us...

Global risks



(After Pielke *et al* 2008)

...that what matters is

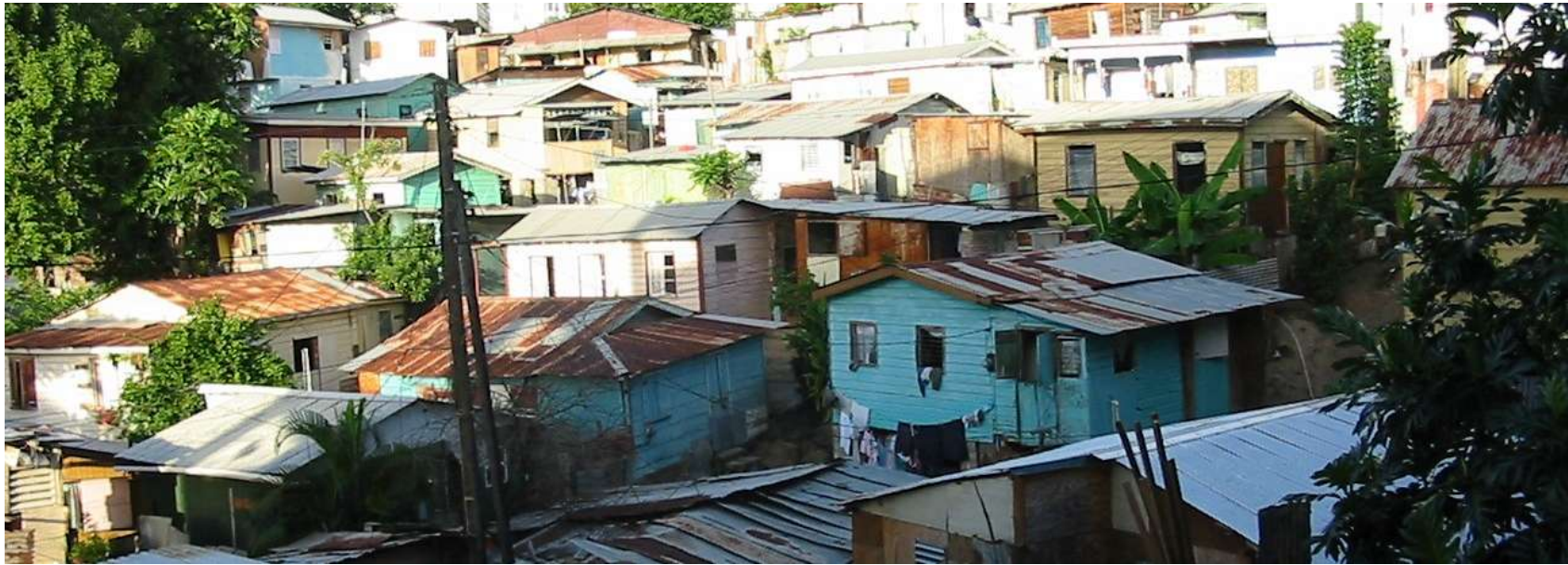
what we build,

where we build

and how we build

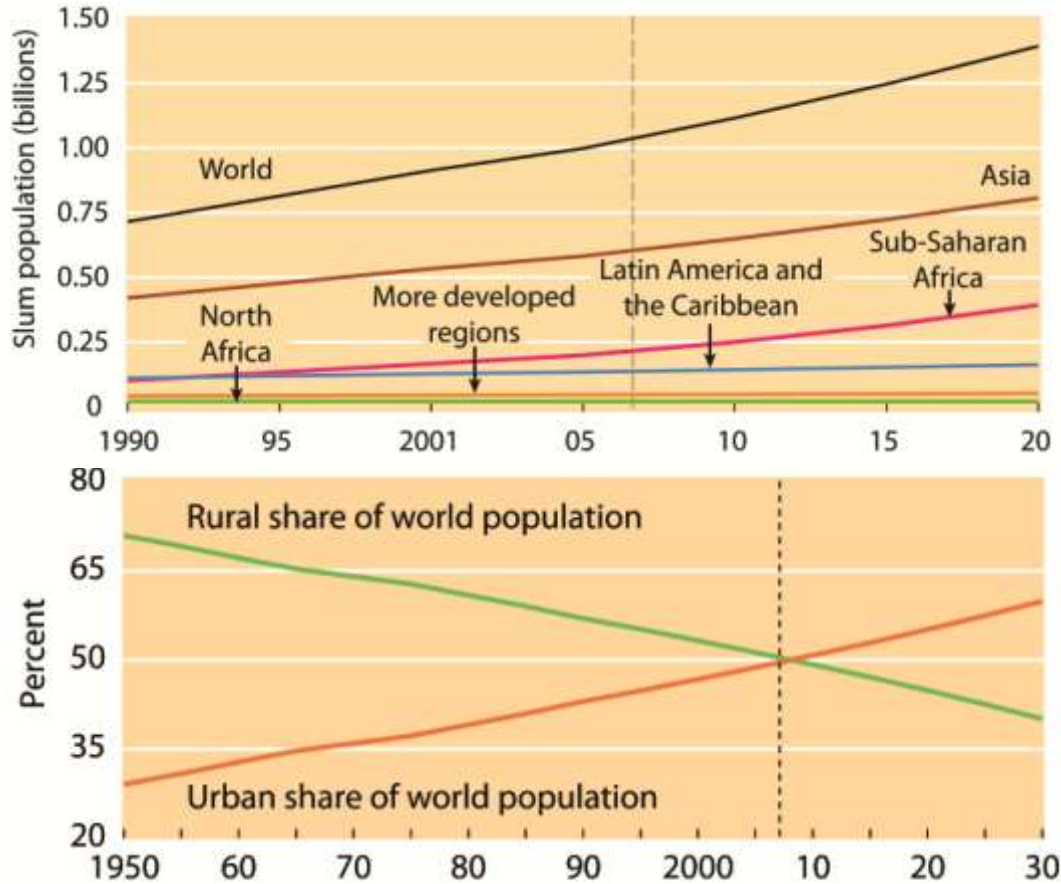
Drivers increasing landslide risk in developing countries	Potential emerging risks		
	Scarcity of detailed evidence that mitigation works	Challenges to adopting mitigation	Scarcity of implementation standards
<p>Lack of regulation and zonation methodologies - not at the scale of the triggering process <i>(Coburn and Maynard, 2009)</i></p> <p>Population and urban growth <i>(Twigg, 2004)</i></p> <p>On-ground-delivery of mitigation very limited <i>(Wamsler, 2007)</i></p> <p>Reductionist risk modelling and uncertainty <i>(Kunreuther and Useem, 2009)</i></p>	<p>Evidence of mitigation impact is rarely substantive. <i>(Benson and Twigg, 2004)</i></p> <p>Holistic uncertainty needed in models that purport to indicate stability improvements <i>(Rubio et al, 2004).</i></p> <p>Cost benefit analysis requires detailed survey work that is rarely undertaken <i>(Holcombe et al, 2011)</i></p>	<p>Samaritan's dilemma <i>(Raschky and Schwindt, 2009)</i></p> <p>Political agandas can exhibit instability <i>(Prater & Londell, 2000)</i></p> <p>Community residents need to be seen as both 'cause and solution' <i>(World Bank, 2010)</i></p>	<p>Communication gap between science and practice <i>(Malamud and Petley, 2009)</i></p> <p>Community contracting standards are rarely defined <i>(Sohail and Baldwin, 2004)</i></p> <p>Monitor implementation process. <i>(NASA, 2011)</i></p> <p><i>(Source: Anderson et al, 2012)</i></p>

“Over the last three decades policy statements by all major agencies have included risk reduction as a pre-condition and an integrated aspect of sustainable development...” UN



“...but when it comes to practical implementation, very little has been done, even when money is available”

Global risks



Source: United Nations Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2006 Revision (2007)

Not uncommon for one expert to say that there is little to be concerned about...

...whilst another expert will say the same risk is of major significance

(Kunreuther)



Source: Anderson & Holcombe

“We're still to some extent sleepwalking our way into disasters for the future which we know are going to happen,

...and not enough is being done to mitigate the damage”

(Holmes, Under-Secretary-General for Humanitarian Affairs, UNEP. 2009).



Uses existing within-country capacity to reduce urban landslide hazard

Identifies hazard drivers to justify interventions

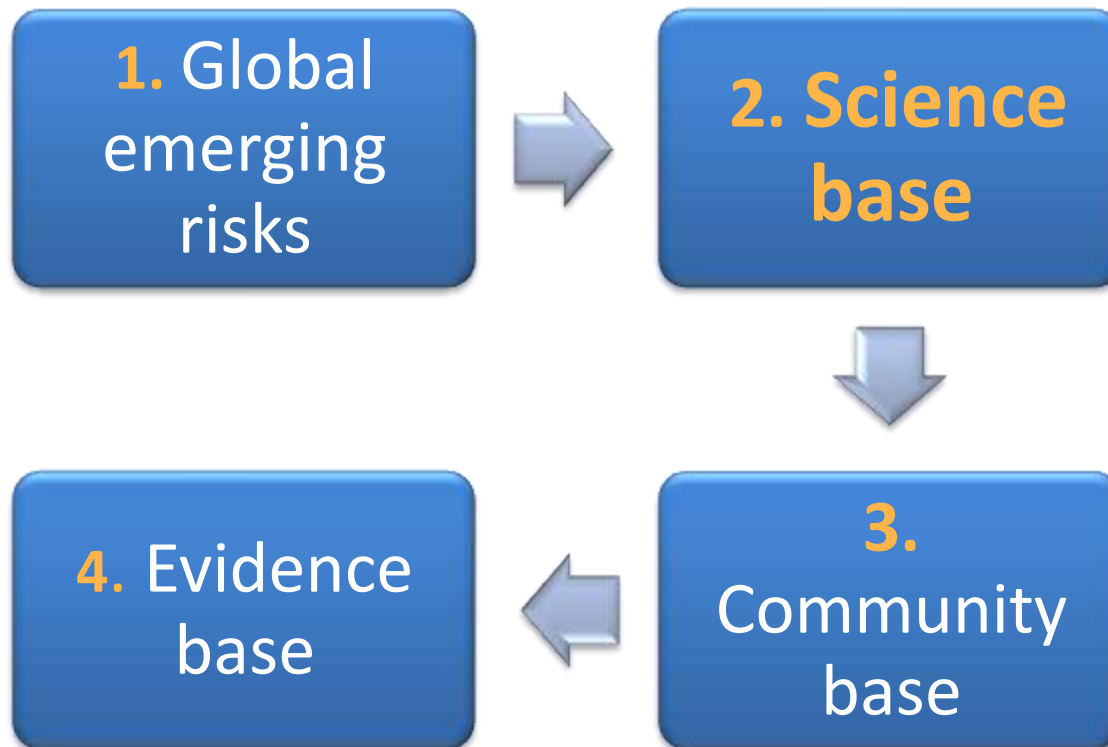
Community residents engaged throughout

Delivers landslide hazard reduction on the ground

Stresses importance of site supervision

Encourages behavioural change

Promotes evidence-base for landslide hazard reduction





Reduce the exposure to landslides
avoid the landslide hazard



Reduce the landslide hazard (likelihood)
good slope management practices, engineering
measures



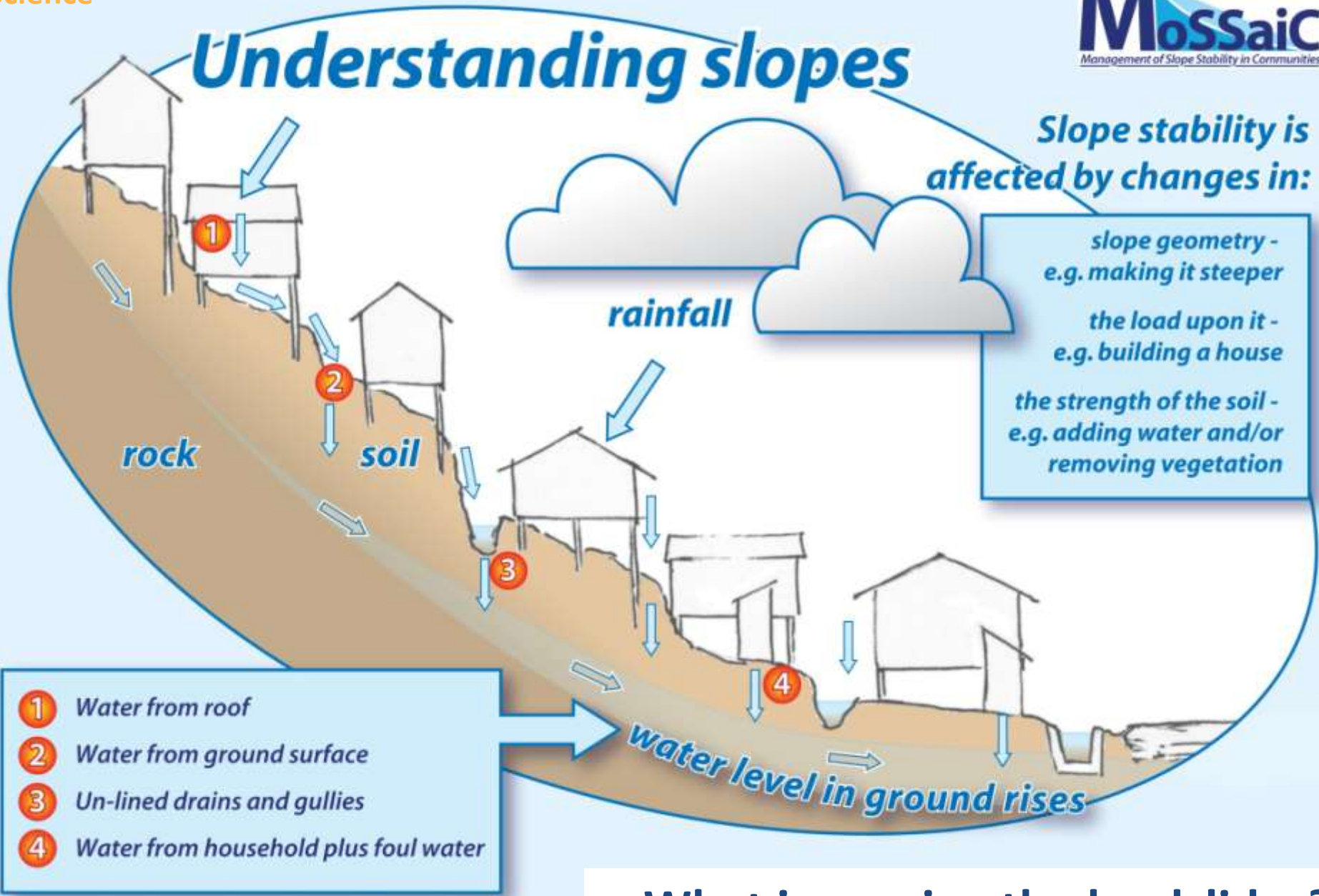
Reduce the vulnerability
communicating the risk, community warning, response
and recovery plans...



Understanding slopes

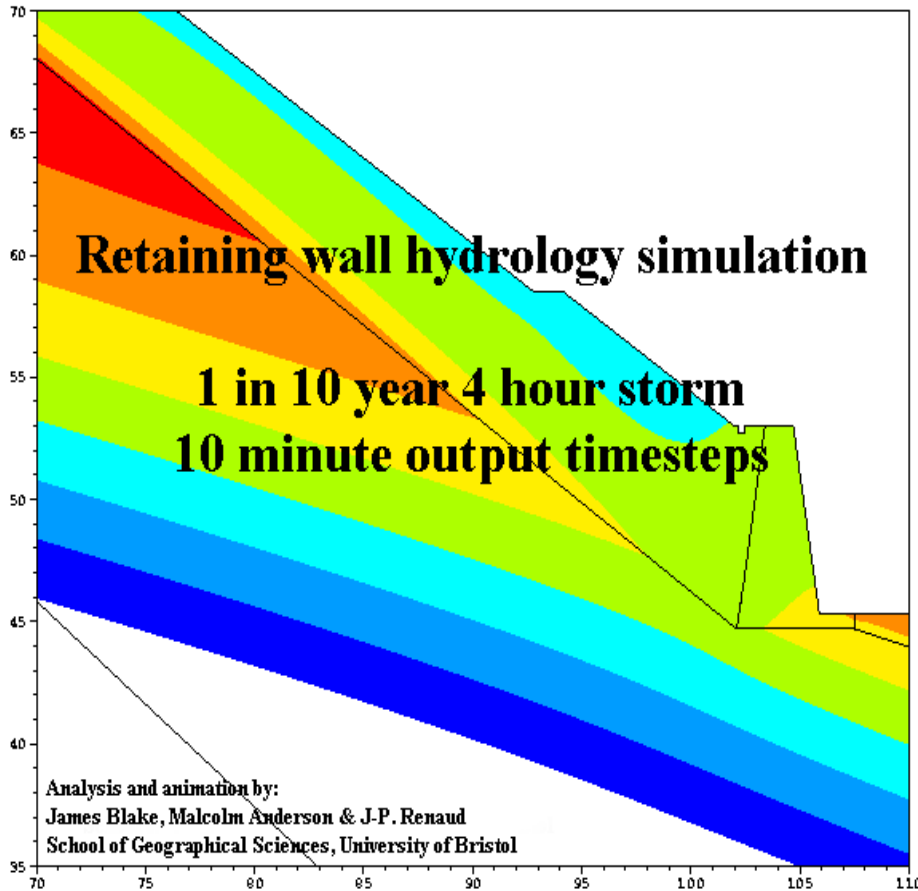
Slope stability is affected by changes in:

- slope geometry - e.g. making it steeper
- the load upon it - e.g. building a house
- the strength of the soil - e.g. adding water and/or removing vegetation



- 1 Water from roof
- 2 Water from ground surface
- 3 Un-lined drains and gullies
- 4 Water from household plus foul water

What is causing the landslides?



What is the impact of water supply?

Science

Metered water supply but **no drainage**



High density (>70%) unplanned housing



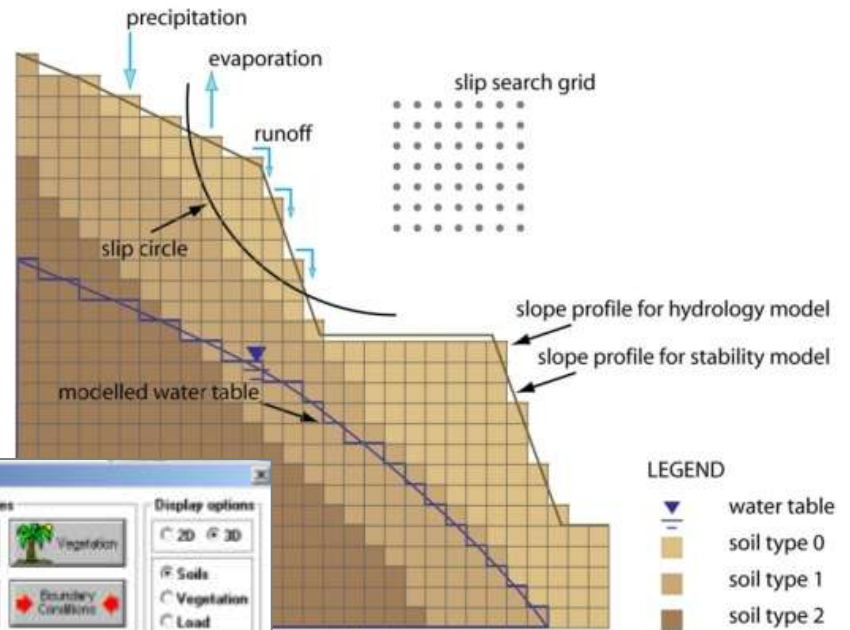
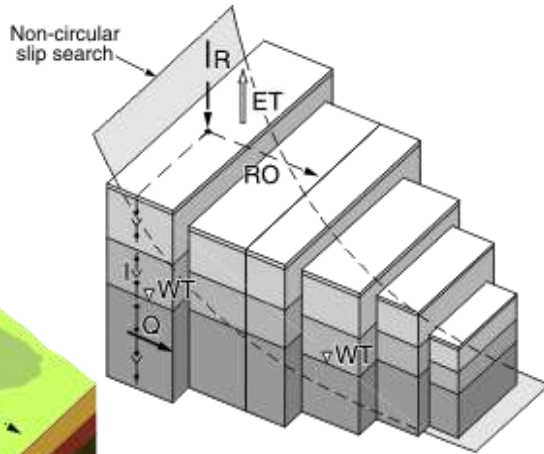
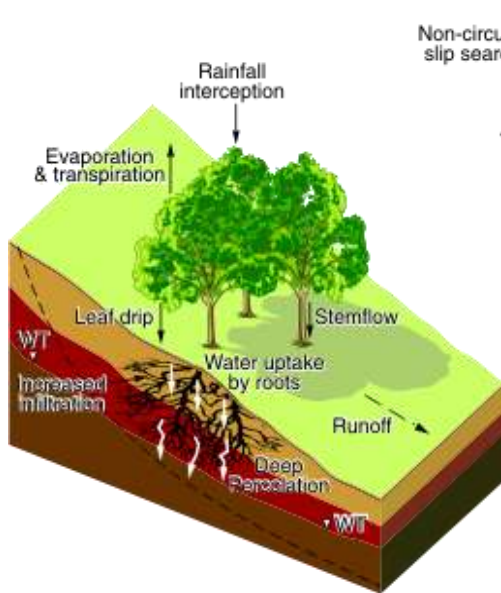
But, roof guttering + proper surface drainage reduce the level of soil saturation to...



Days per month soil is saturated

Can the hazard be reduced?

Science



OSASM 4: Hydrology summary

Slope Number of columns: 16 Detention capacity: 15 mm Maximum evaporation: 0.0005 mm/hr Number of soil states: 1		Hydrology properties <input type="button" value="Change soil"/> <input type="button" value="Vegetation"/> <input type="button" value="Storm event"/> <input type="button" value="Boundary conditions"/>		Display options <input type="radio"/> 2D <input checked="" type="radio"/> 3D <input checked="" type="radio"/> Soils <input type="radio"/> Vegetation <input type="radio"/> Load	
Column Current column: 1 Number of cells: 16 Column width: 1 m Column breadth: 6 m Load: 0 Kg Water table height: 0 cells		Slope display 			
Cell Current cell: 1 Cell depth: 1 m		<input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="Help"/>			

LEGEND

- water table
- soil type 0
- soil type 1
- soil type 2







...with residents and government teams

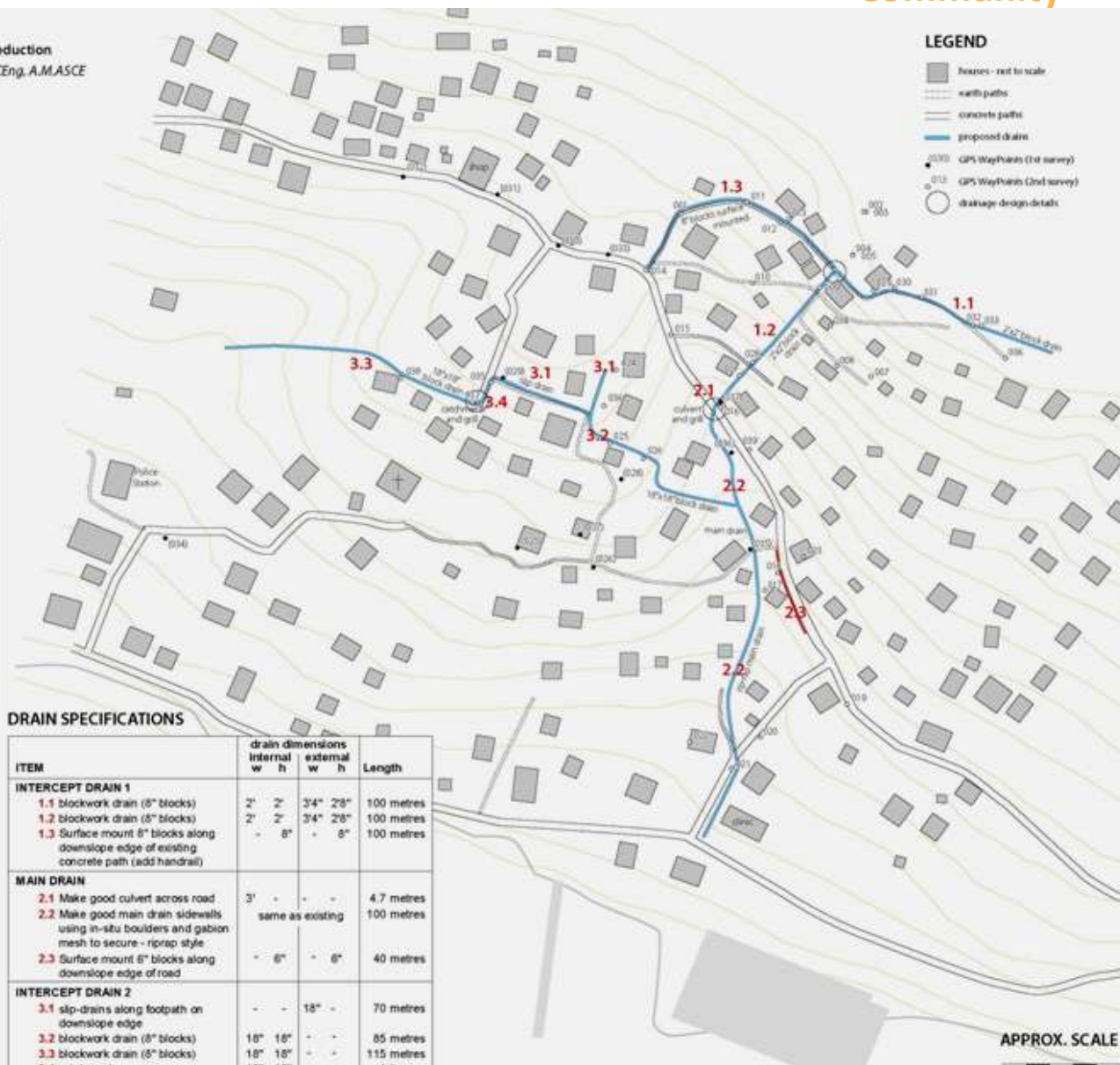
Community





GPS WAYPOINT NOTES

WP	northing	easting	elevation	notes
001	12.989055	-61.25171	119	drainage from field onto footpath
002*	12.989066	-61.250972	126	Marcia Bynoe: front corner of balcony/step with view of relict landslide scarp directly north (bearing 0°)
003*	12.989085	-61.250982	125	(duplicate waypoint... see WP 002 above)
004*	12.988888	-61.251024	126	concrete steps
005*	12.988888	-61.251025	126	(duplicate waypoint... see WP 004 above)
006	12.988466	-61.250416	130	Zita Bynoe: Pink House. Cracking of new extension built on fill material: water entering house
007	12.988392	-61.250952	115	bedrock outcropping
008	12.988435	-61.251088	107	bedrock outcropping - looking downslope on route of flood
009	12.988755	-61.251157	111	Harold James: bedrock outcropping on earth footpath below house
010	12.988776	-61.251424	102	concrete tank by earth footpath
011	12.989105	-61.251446	110	50m from start of concrete path (WP 014); 30m from WP 001
012	12.989021	-61.251311	113	30m from WP 011; 30m from WP 005 (concrete steps)
013	12.989034	-61.251276	114	(duplicate waypoint... see WP 012 above)
014	12.988825	-61.251848	96	start of concrete path
015	12.988563	-61.251751	85	new concrete path with retaining wall and no drain - water floods over top of path onto houses downslope
016	12.988264	-61.25155	74	Bouton Compton: gulleying between water tank and upslope neighbour's retaining wall. spongy level reading up natural drainage route @ = 36"
017	12.98752	-61.251375	53	Anita Davis: next to drainage route - flooding of yard
018	12.98759	-61.251323	56	4-inch block up-stand required to prevent water flowing off road into houses below (distance = 40m)
019	12.987053	-61.251048	52	flooding from road to back of shop - road blocks with debris after heavy rains (source = natural drainage route flowing from east of WP 006)
020	12.989921	-61.251393	41	natural drainage from road (WP 019)
021	12.986792	-61.251507	36	culvert under road
022	12.986901	-61.251674	39	path by drainage route
023	12.987656	-61.251221	41	gulley - floods onto road
024	12.98842	-61.251967	69	Ulaana Hazell: water floods back of house
025	12.98812	-61.251994	68	boundary between Coffal Williams and Guide household - possible route for drain. Flooding at back of William's house. front yard concrete cracking. Neighbours downslope (Imelda Hazell) started excavation for retaining wall.
026	12.988057	-61.251858	63	Ouida: boundary with Williams. possible route for drain.
027	12.988396	-61.251477	47	Compton: corner of water tank - gulleying in heavy rains. Possible route for drain.
028	12.988451	-61.251424	57	new concrete path with no drainage (see WP 015). Possible route for drain across path - would require breaking up and re-construction of section of path for culvert.
029	12.988742	-61.250943	101	possible route of intercept drain following earth path
030	12.988755	-61.250859	103	possible route of intercept drain following earth



DRAIN SPECIFICATIONS

ITEM	drain dimensions		Length
	internal w	external w	
INTERCEPT DRAIN 1			
1.1 blockwork drain (6" blocks)	2' 2"	3'4" 28"	100 metres
1.2 blockwork drain (6" blocks)	2' 2"	3'4" 28"	100 metres
1.3 Surface mount 8" blocks along downslope edge of existing concrete path (add handrail)	- 8"	- 8"	100 metres
MAIN DRAIN			
2.1 Make good culvert across road	3'	- - -	100 metres
2.2 Make good main drain sidewalls using in-situ boulders and gabion mesh to secure - riprap style	same as existing	- - -	100 metres
2.3 Surface mount 8" blocks along downslope edge of road	- 6"	- 6"	40 metres
INTERCEPT DRAIN 2			
3.1 slip-drains along footpath on downslope edge	- - -	18" -	70 metres
3.2 blockwork drain (8" blocks)	18" 18"	- - -	85 metres
3.3 blockwork drain (8" blocks)	18" 18"	- - -	115 metres

and with the government and local engineers

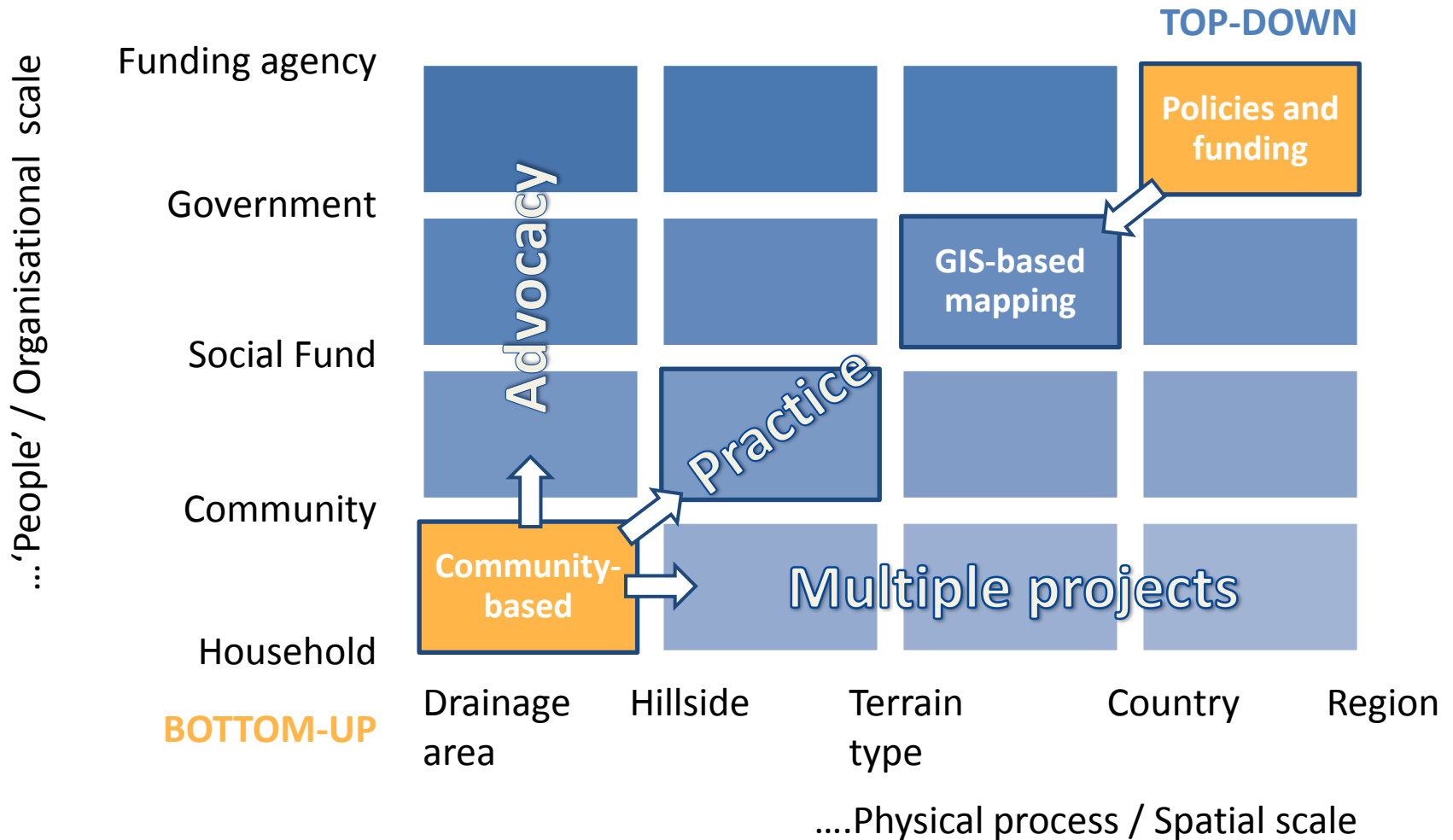




...that capture surface water



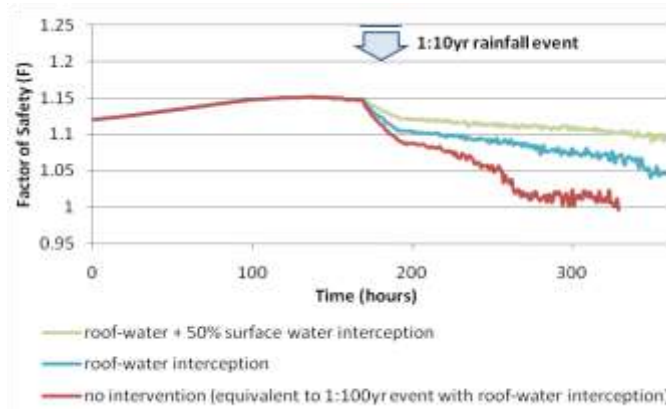
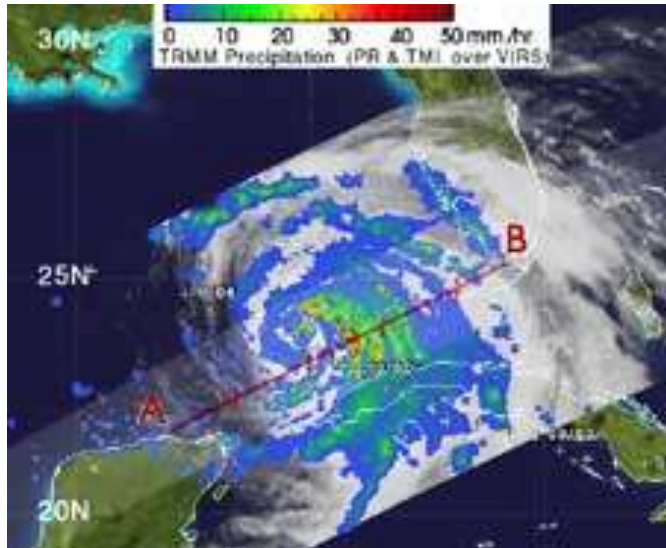
Community







Evidence



Community (number of households)	Pre-MoSSaiC intervention rainfall impact on slope stability	Post-MoSSaiC intervention rainfall impact (Year and major triggering rainfall event)			
		2006 1 in 4 year, 24 hour event 2-3 September 111mm	2007 Hurricane Dean 1 in 5 year, 24 hour event 16-18 August: 132mm	2008 1 in 100 year, 15 day event 9-24 October 340mm	2010 Hurricane Tomas >1 in 500 year, 24 hour event? 30 October 533mm
Community 1	55 Major slides at low rainfall rates	None reported - Landslide in adjoining area	None reported	None reported - Reactivation of landslide in adjoining area	None reported
Community 2	428	Major slide and evacuation of 100 homes in adjoining area	-	None reported	Minor slide within community
Community 3		Major slide	-	None reported	None reported
Community 4		Modest slides affecting properties	-	None reported	None reported
Community 5	20 Retaining wall failures and significant slides	-	-	None reported	None reported
Community 6	60 Major previous slide with several lost houses. Subsequent minor landslides.	-	-	-	None reported

MOSSAIC PROJECT DRAFT COMMUNITY QUESTIONNAIRE

INTERVIEWER SAY: The reason for this questionnaire is to work out how much difference the drainage project has made to people in this community. The first two parts of the questionnaire will help give a picture of life in your household and how much a landslide might affect you. The other parts of the questionnaire will look at whether the project has been effective in reducing problems caused by flooding and landslides.

SECTION 1 THE HOUSEHOLD

Household profile:	
1. Number of people in household	<i>Mean</i>
Adults – senior citizens	0.3
Adults – working age	1.85
Children – secondary school / collage age	0.3
Children – primary school age	0.7
Babies and infants	0.2
2. Number of children attending school	<i>Mean</i>
Number at secondary school / collage	0.3
Number at primary school	0.7
3. Highest educational qualifications of head	<i>Prop</i>
<input type="radio"/> Tertiary / unaveruary	0
<input type="radio"/> Secondary complete	0.2
<input type="radio"/> Secondary incomplete	0.15
<input type="radio"/> Primary complete	0.55
<input type="radio"/> Primary incomplete	0.1
<input type="radio"/> None	0
4. Employment status of adults	<i>Mean</i>
Number of adults working – permanent job	1.1
Number of adults working – intermittent	0.7
Number of adults not working	0.15
5. How long have you been living in the community?	
<input type="radio"/> months	
<input type="radio"/> years	
Mean: 15.85 years	
Questions relating to accommodation:	
6. Tenure	<i>Prop</i>
<input type="radio"/> Owned land and house	0
<input type="radio"/> Rented land (built own house on land)	0.8
<input type="radio"/> Rented land and house	0.2
7. Number of bedrooms	<i>Mean</i>
Number of bedrooms	2.15
8. Wall type	<i>Prop</i>
<input type="radio"/> Brick / block / concrete	0.1
<input type="radio"/> Wood and concrete	0.6
<input type="radio"/> Wood	0.3
<input type="radio"/> Wattle / Tapia / Makesift	0
9. Toilet type	<i>Prop</i>
<input type="radio"/> WC to sewer / septic tank	0.55
<input type="radio"/> Pit latrine / none	0.15
10. Light source	<i>Prop</i>
<input type="radio"/> Electricity	1
<input type="radio"/> Kerosene / none	0
11. Household possessions	<i>Prop</i>
<input type="radio"/> TV	1
<input type="radio"/> Telephone	0.4
<input type="radio"/> Video / DVD	0.9
<input type="radio"/> Stove	1
<input type="radio"/> Fridge	1
<input type="radio"/> Washing machine	0.8
<input type="radio"/> Car / pick-up	0.15
Direct benefits from project	
12. Physical benefits	<i>Prop</i>
<input type="radio"/> Drnin adjacent to house	0.6
<input type="radio"/> Footpath access to house	0.4
<input type="radio"/> Roof guttering and downpipes	0.85
<input type="radio"/> Water tank	0
13. Employment on project	<i>Prop</i>
<input type="radio"/> Awarded contract for construction / installation	0.15
<input type="radio"/> Employed by contractor as mason / carpenter	0
<input type="radio"/> Employed by contractor as labourer	0.25
Number of days employed	<i>Mean: 34.5</i>

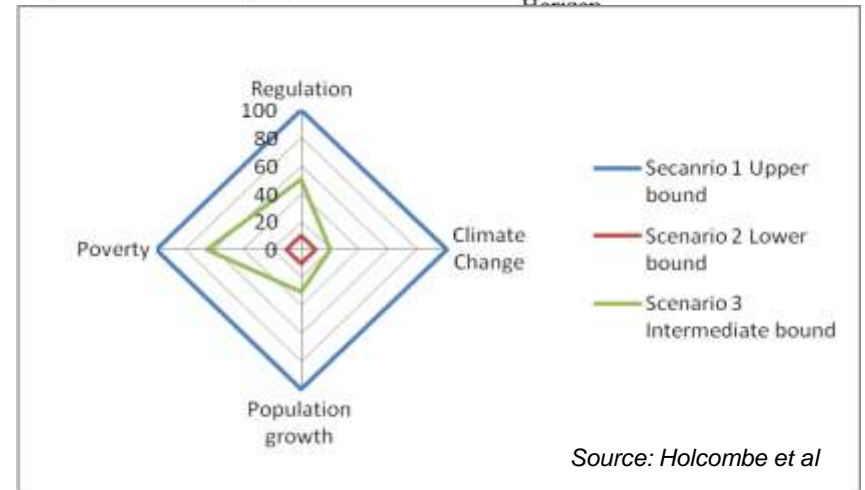
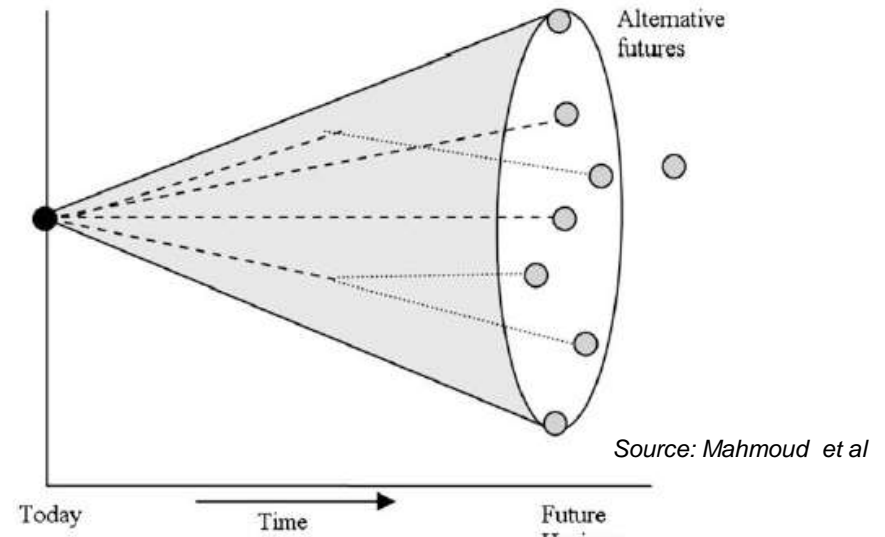


Benefit cost ratio of ~2.7:1

Undertake future scenario modelling

Acquire data on landslide mitigation relevance at the regional level

Develop a delivery mechanism

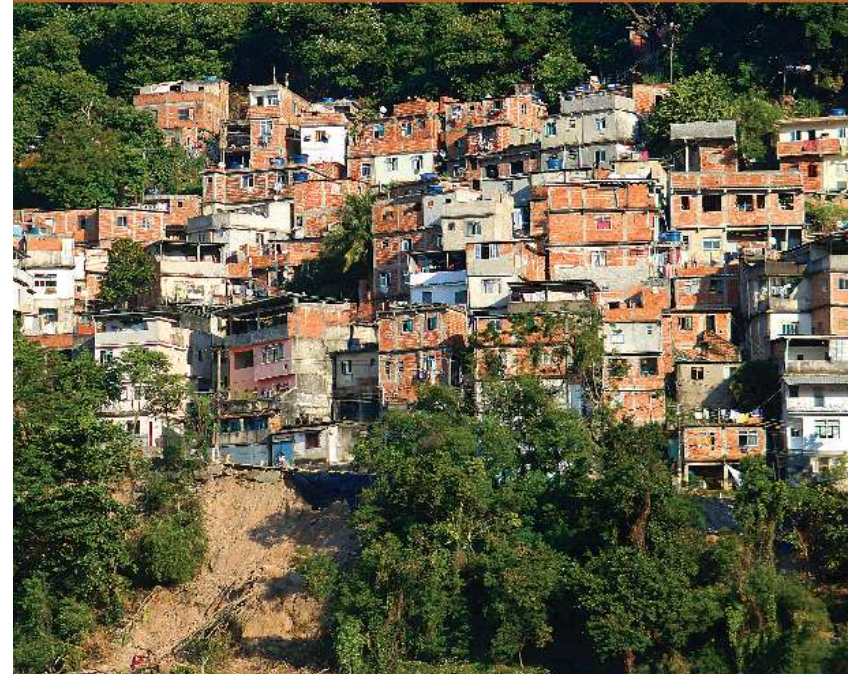


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**COMMUNITY-BASED
Landslide
RISK REDUCTION**

Managing Disasters
in Small Steps



Community

