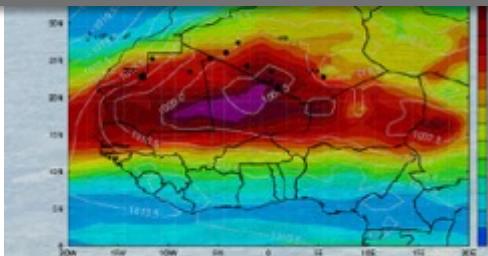


# Risk Mapping for Climate Change Adaptation – Using Open GIS Data and Tools to Build Resilience



# The Climate Technology Centre and Network

- Operational arm of the UNFCCC Technology Mechanism
- Consortium of organizations from all regions + Network
- Mission to stimulate technology cooperation and enhance the development and deployment of technologies in developing countries
- Technologies include any equipment, technique, knowledge and skill needed for reducing greenhouse gas emissions and for adapting to climate change effects
- Core services include:
  - Technical assistance to developing countries
  - Knowledge platform on climate technologies
  - Support to collaboration and partnerships



# CTCN Technical Assistance

## Support to remove barriers to technology transfer (financial, technical, institutional)

- ✓ Identification of needs and prioritization of technology, depending on country context
- ✓ Technical recommendation for design and implementation of technology
- ✓ Feasibility analysis of deploying specific technologies
- ✓ Support to scale up use and identify funding for specific technologies
- ✓ Support legal and policy frameworks

### ■ Country-driven

- Any organization from developing countries can express need
- Request endorsed and submitted by the NDE

### ■ Fast and easy access to assistance

- User-friendly access: 4-pages submission, in all UN languages
- Appraisal of request within 1-2 weeks and response design within 2-8 weeks

### ■ CTCN selects and contracts relevant experts

- Assistance provided through Consortium and Network (value up to 250,000 US\$)
- Collaboration with financial organizations to trigger funding



ADAPTATION FUND



GREEN  
CLIMATE  
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ADB  
Asian Development Bank

THE  
WORLD  
BANK

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AFRICAN DEVELOPMENT BANK

EPFAN  
CII PRIVATE FINANCING ADVISORY NETWORK

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DE DEVELOPPEMENT

# Networking and Collaboration



- **Join our network!**
- **Access commercial opportunities:** respond to competitive bidding for delivery of CTCN technical assistance services
- **Create connection:** network with national decision makers and other network members to expand your partnership opportunities and learn about emerging areas of practice
- **Increase visibility:** broaden your organization or company's global reach, including within UNFCCC framework
- **Exchange knowledge:** keep updated on the latest information and share via the CTCN's online technology portal

## Examples of collaboration

- Co-host climate related events
- Twinning arrangements with research institutions
- Engage in new technology projects

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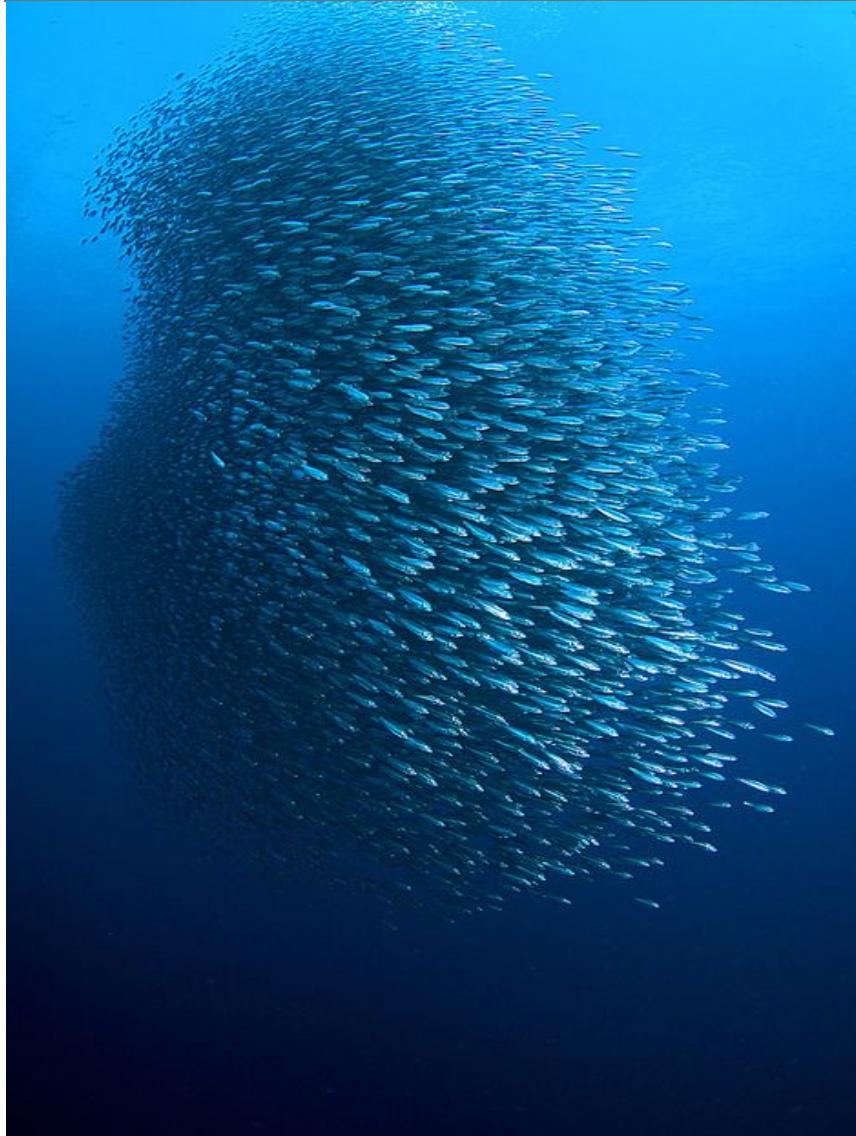
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# Risk Mapping for Climate Change Adaptation – Using Open GIS Data and Tools to Build Resilience



# Conceptual Basis for Risk Management and Mapping



# Conceptual Basis for Risk Management – Context and Overview

- Agriculture sector (crops, livestock, fisheries and forestry) absorbs 22% of the economic impact of hazards in developing countries
- Major data gaps on the impact of natural hazards and disasters on the agriculture sector in developing countries
- We are confronted with a higher frequency of storms, floods, and extreme weather events
- Need to understand where we are risk exposed – and do so on a regular basis

# Conceptual Basis for Risk Management – Climate Change

- Climate change has major impacts on yields but also on production
- Perceptions of riskier environmental conditions can cause stakeholder to plant less crops (confidence is a big issue now)
- Crop insurance is having to be dynamically altered
- The shifting temperature mean will mean different crops
- These adjustments are being made – eg. drought tolerant crops
- We need to plan for higher climatic variability and also systematic changes to climate over the long term

(FAO, 2015)

## Conceptual Basis for Risk Management – Climate Change – Time frame

- We have to think it terms of time frames in order to plan
- A fair assessment is that we can look to 6 months to 5 years for agricultural planning based on environmental change
- In terms of long term strategic planning, we need to look to at time increments such as 2025, 2050, 2100 when using GCM output
- Our immediate needs are to build resilient infrastructure – agricultural and otherwise
- Risk mapping is a key component of this as we want to avoid FOOD INSECURITY

(FAO, 2015)

# Country Example – Food Security in Guyana

NOVEMBER 23, 2015



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You are here: [Home](#) / Agriculture bears brunt of disaster impacts, new report says

## Agriculture bears brunt of disaster impacts, new report says

March 19, 2015 By [GuyanaTimes](#)

Nearly a quarter of damage wrought by natural disasters on the developing world is borne by the agricultural sector, according to initial results from a new Food and Agriculture Organisation (FAO) study. The report was released on Tuesday at the United Nations World Conference for Disaster Risk Reduction. The Organisation also announced the launch of a special facility aimed at helping countries better equip their food production sectors to reduce risk exposure, limit impacts, and be better prepared to cope with disasters.



Disasters like Cyclone Pam devastate agriculture

<http://www.guyanatimesgy.com/2015/03/19/agriculture-bears-brunt-of-disaster-impacts-new-report-says/>

Further information: Lesk, C., Rowhani, P., & Ramankutty, N. (2016). Influence of extreme weather disasters on global crop production. *Nature*, 529(7584), 84–87. <http://doi.org/10.1038/nature16467>

## Country Example – Food Security in Guyana

- Guyana is susceptible to different hydro meteorological, biological, and technological hazards
- Agriculture is vitally important to economic growth and development (rice, sugar, fruits and vegetables, livestock, and fisheries)
- Many smallholder farmers (<15ha) who are vulnerable to shocks in production
- Hazards can dramatically affect agricultural productivity

## Country Example – Food Security in Guyana

**Figure 1.1: Map of Guyana**



Guyana Ministry of Agriculture, 2013

# Country Example – Food Security in Guyana

**Table 1.3: Hazard matrix (Scale (1 to 5 with 5 been most severe)**

Type of hazard	Regions	Typical damage score	Typical loss score	Overall impact on lives and agriculture livelihoods
Flood	1 to 6 & 9	5	5	Very high
Drought	1 to 6	3	4	High
Sea level rise/salt water intrusion	1 to 6	3	2	High
Pest and disease outbreaks	2 to 6 & 10	4	4	High
Invasive species	Not determined	2	2	Medium
Chemical spills and fires	1 to 10	2	2	Medium
Forest fires	3, 6 and 10	2	2	Low
Earthquakes	Not determined	1	1	Medium
Tropical storms and fires	All	1	1	Low

Guyana Ministry of Agriculture, 2013

## Country Example – Food Security in Guyana

**Table 1.1: Flood events in Guyana, 1990 – 2012 (EM-DAT, 2009)**

Date	Number affected	Population affected %	Number killed	Economic damage US\$ '000	Percent of GDP
July 1997	21,000	Not available	Not available	200	Not available
July 1996	38,000	Not available	Not available	1,000	Not available
15 January 2005	274,774	37	34	465,000	60%
8 January 2006	35,000	4.7	Not available	169,000	Not available
8 December 2008	100,000	13.3	Not available	Not available	Not available

Guyana Ministry of Agriculture, 2013

# Disaster Risk Reduction and Management Models and Definitions

- We need to have definitions and a working framework for to understand risks how to formulate policy, and how to integrate data
- No such thing as natural disaster – only natural hazards
- DRR seeks to reduce impacts of natural hazards
- The goal of DRR and DM (Disaster Management) frameworks are to build resilience to natural hazards as a result of planning and actions to reduce causal factors
- The end game is resilience, risk maps are components of DRR

UNISDR, 2015

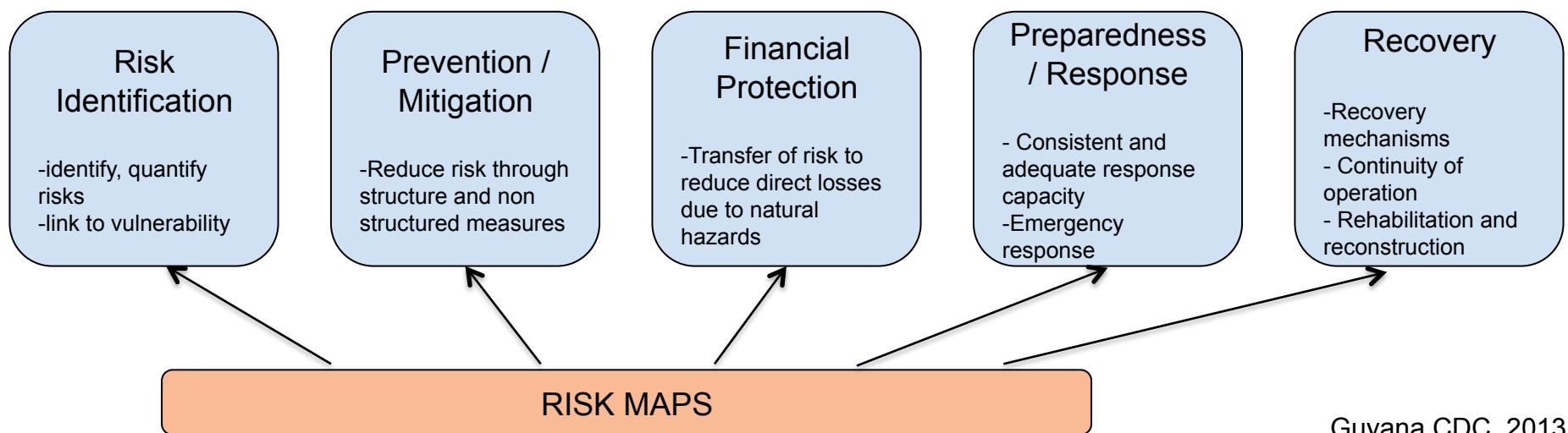
# Disaster Risk Reduction and Management GFDRR (Global Facility for Disaster Risk ... )

- Pillar 1: Risk Identification – recognize, assess, understand risks
- Pillar 2: Risk Reduction – improve land use planning and investments
- Pillar 3: Preparedness – early warning systems, capacity to react effectively
- Pillar 4: Financial Protection – disaster risk financing and insurance
- Pillar 5: Resilient Recovery – post disaster assessment and recovery planning

UNISDR, 2015

# Disaster Risk Reduction and Management

## DRR – Generic Model



Guyana CDC, 2013

# Disaster Risk Reduction and Management DRR Requirements

- Vulnerability needs to be addressed in each phase of the DRM framework
- There is a profound need for proactive response measures in all facets of national and local planning to reduce vulnerability and increase resilience
- Sufficient data and ongoing monitoring are required
- Sustainability of social and economic systems requires effective DRM

UNISDR, 2015

# Disaster Risk Reduction and Management Definitions

- Hazard: dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage
- Disaster: A serious disruption of the functioning of a community of a society causing widespread human, material, economic, or environmental losses which exceed the ability of the affected community or society to cope using its own resources
- Hazards are the events that might be damaging – the disaster is the actual disruption.

UNISDR, 2015

# Disaster Risk Reduction and Management Definitions

- Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard
- Adaptive Capacity: Adaptive Capacity is known to be the capability for change when confronted with a situation that is detrimental.  
Influenced by several factors – financial resources being one
- Risk: The traditional quantitative risk assessment approach is to use this expression: RISK = PROBABILITY x CONSEQUENCE
- However, in DRM one needs to clarify what kind of risk is being examined – eg. financial risk, human risk, ecological risk, etc.

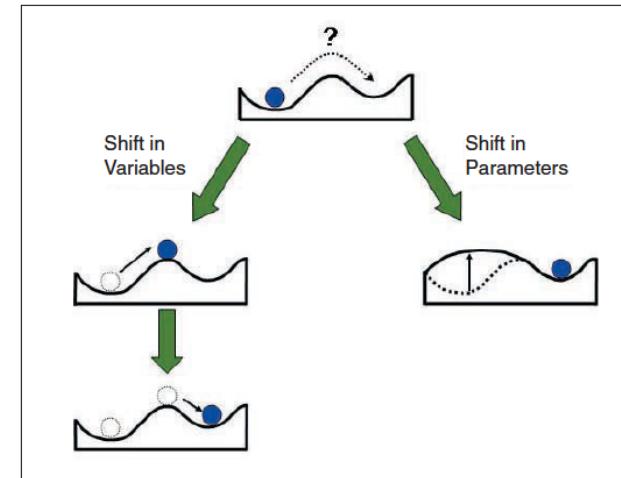
# Disaster Risk Reduction and Management

## Quantitative Risk vs. Risk Perception

- Quantitative Risk is not the same as Risk Perception
- Risk Communication:  $\text{RISK} = \text{HAZARD} + \text{OUTRAGE}$
- Studies have shown that actual hazard risk is not correlated with people's reaction
- Two phenomenon are different and thus we need to treat them as such
- Often, a low hazard can often have very high outrage (something is safe but people are upset)
- Or, something very is very unsafe but people are not worried
- <http://www.psandman.com/index.htm>

# Disaster Risk Reduction and Management Resilience

- The idea of stability and alternative states are shown in Beisner's diagram
- In climate risk analysis and mapping we want to have stable states
- Different factors can push a system out of stability and into another stable state
- The Amazon is an example – climate forcing and land use change has pushed parts of it to a different stable state

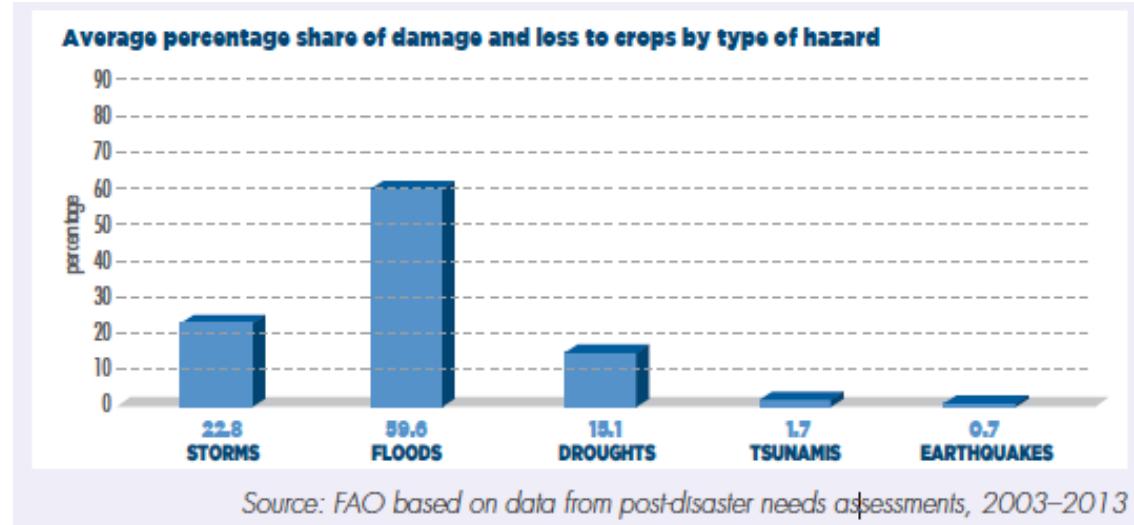


(Beisner, 2003)

# Disaster Risk Reduction and Management

## Flood Risk

- Disproportionate amount of damage due to flood
- Need to understand how risk exposed we are

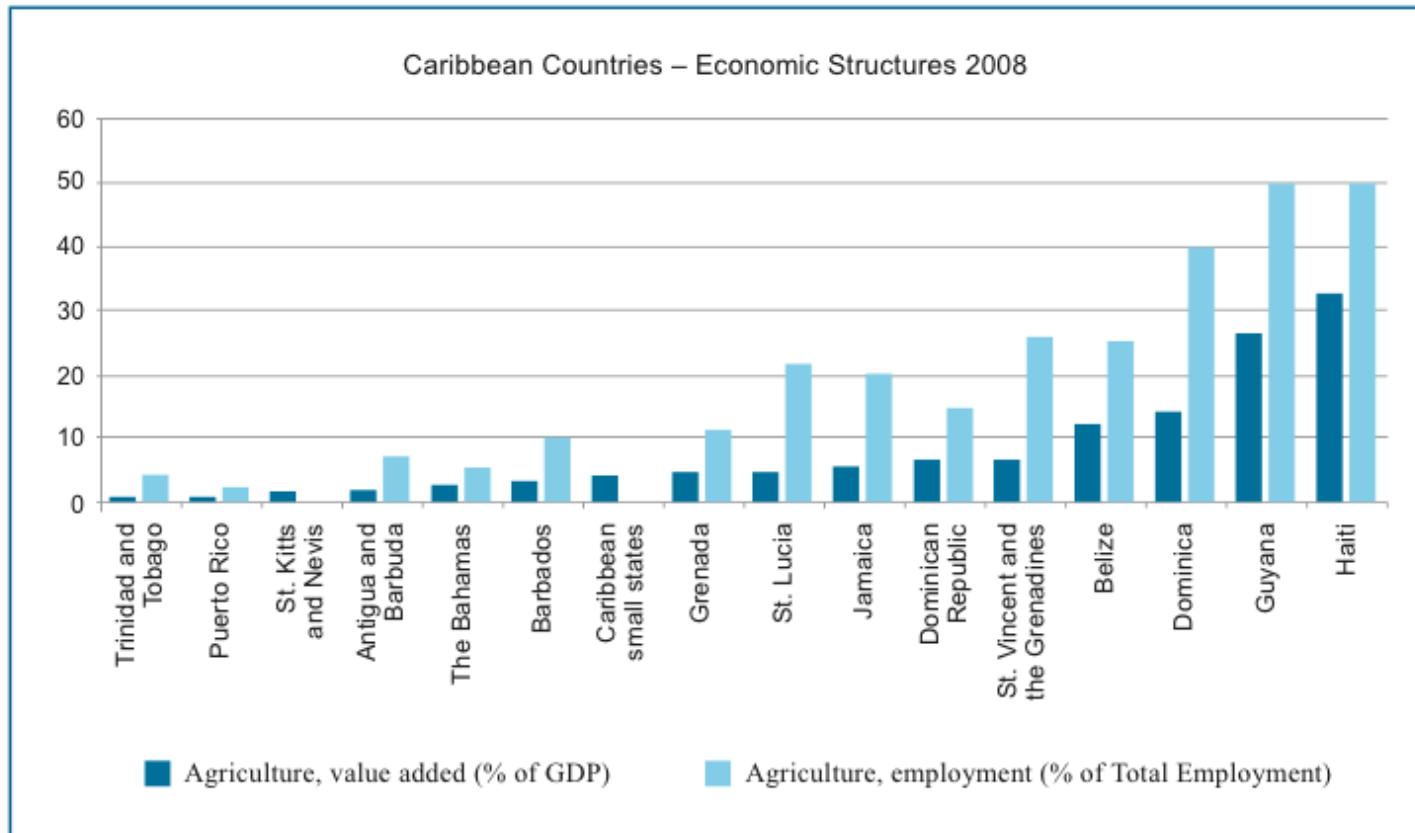


FAO, 2015

# Disaster Risk Reduction and Management

## Flood Risk

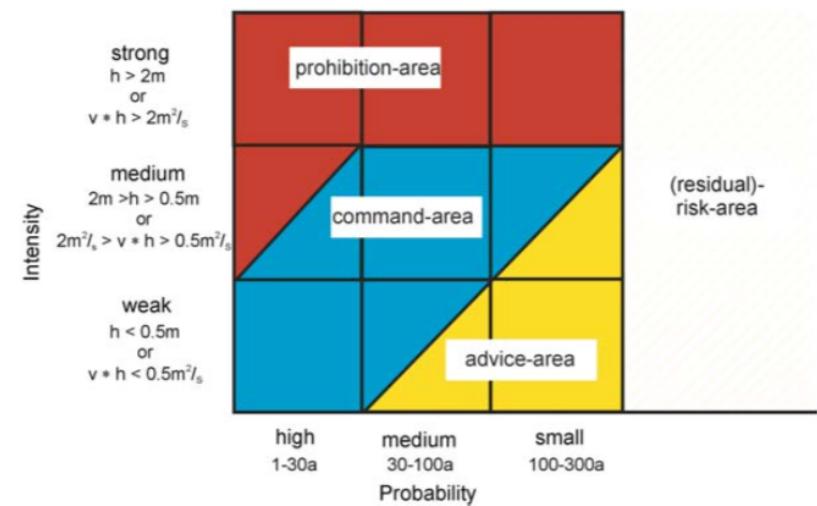
Figure 2. Caribbean Countries Agriculture Share (% of GDP and Employment)



# Disaster Risk Reduction and Management

## Flood Risk - Tools

- Construction and land use risk matrix
- Intensity-probability matrix
- Prohibition: no construction
- Command: with restrictions
- Advice: with recommendations

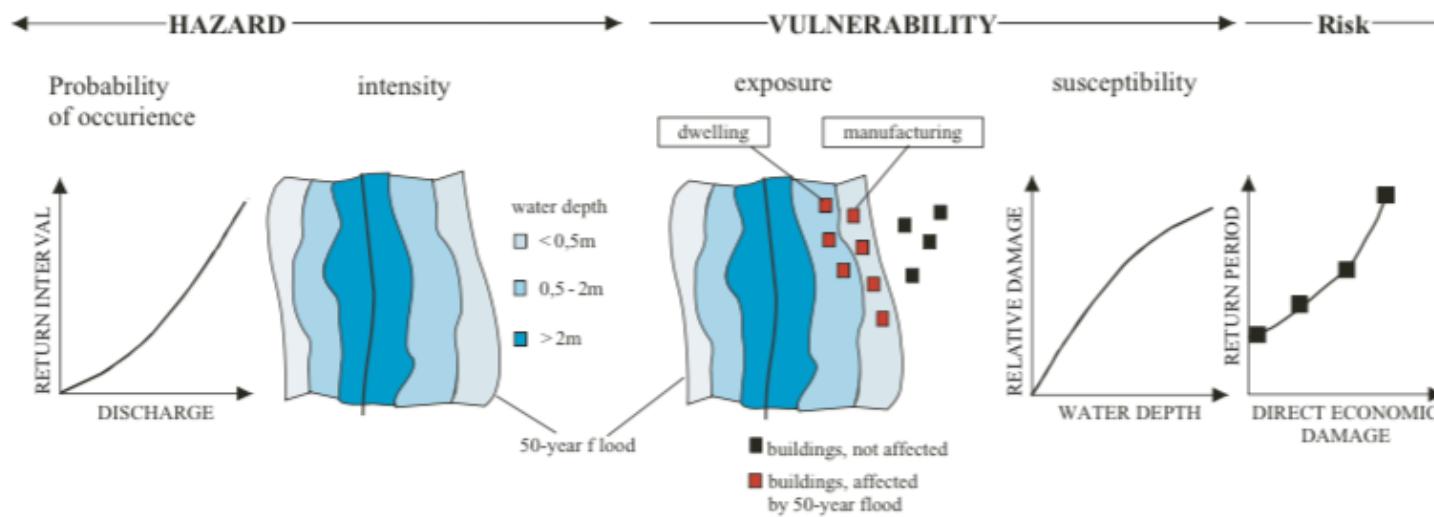


Merz et al, 2007

# Disaster Risk Reduction and Management

## Flood Risk

- Flood risk can be thought of as interaction of hazard (exceedance probability and intensity) and vulnerability (exposure and susceptibility)



Merz et al, 2007

# Disaster Risk Reduction and Management

## Flood Risk

- There are a variety of concepts used for flood risk mapping and hence the term 'flood risk map' can have different meanings

Type of map	Definition
Flood danger map	Spatial distribution of flood danger without exceedance probability
Flood hazard map	Spatial distribution of flood hazard (intensity and probability of occurrence included)
Flood vulnerability map	Spatial distribution of exposure and susceptibility
Flood damage risk map	Spatial distribution of expected damage

Merz et al, 2007

# Disaster Risk Reduction and Management

## Flood Risk Maps

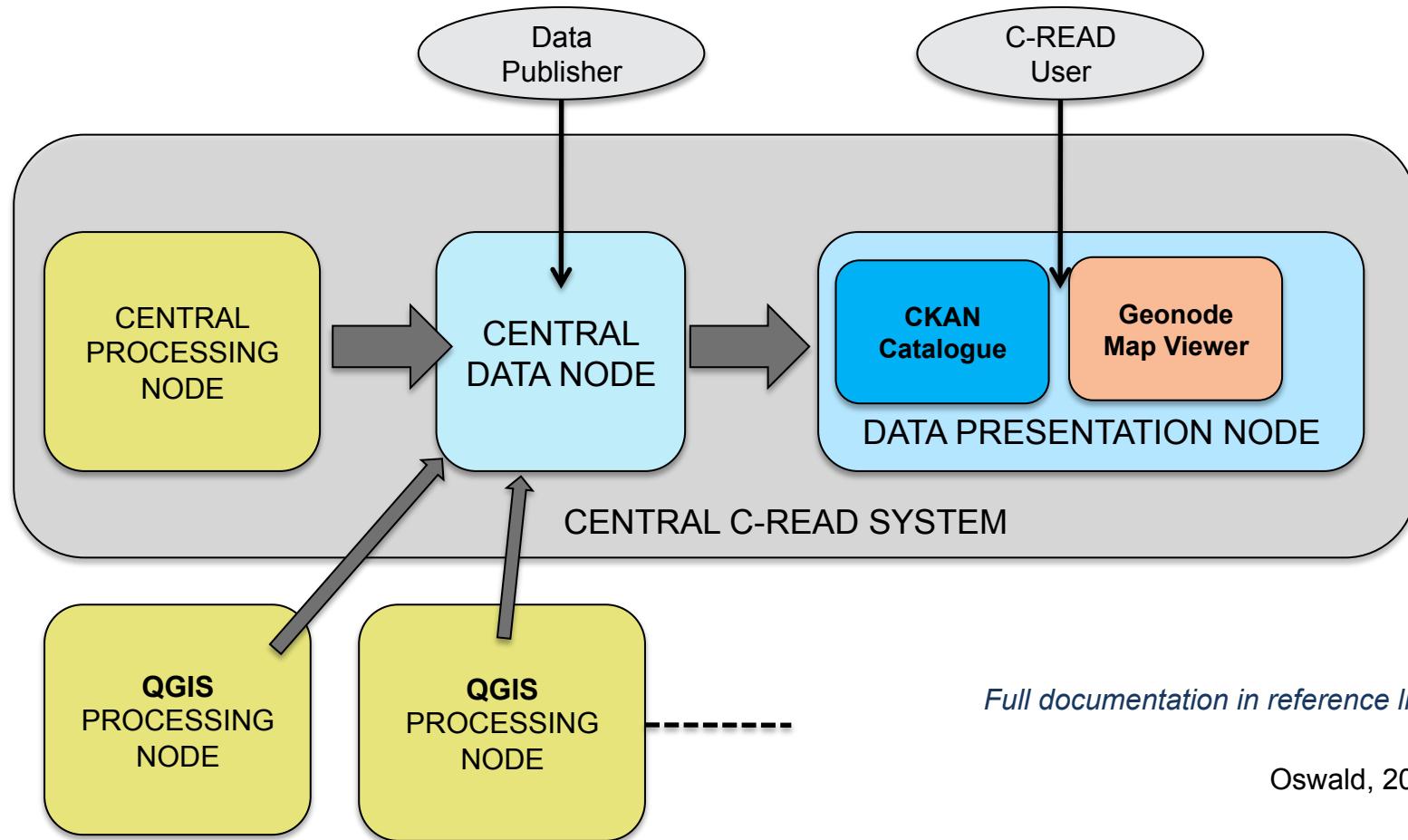
- Flood risk maps may become very sophisticated with hydrodynamic models being used in conjunction with digital elevation models
- The simplest form is a flood danger map which shows the flooded area for an observed event
- Although simple, this provides key insights into the potential for subsequent floods

# Open Data and GIS for Risk Mapping and Environmental Analysis



**DE** [www.design-environment.com](http://www.design-environment.com)

# Disaster Risk Reduction and Management Open Data, Geospatial System Architecture

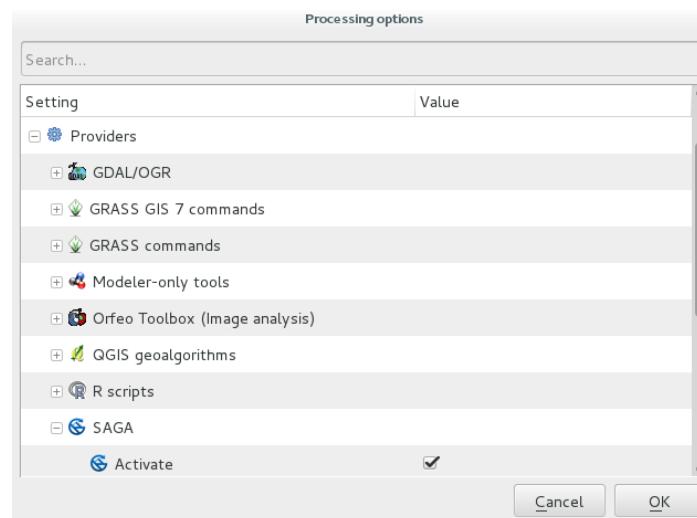


# Disaster Risk Reduction and Management Open Data and QGIS

- Software: QGIS
- Open source, freely available
- Community of support – however occasionally some issues
- Go to this site to find out about QGIS: <http://www.qgis.org/en/site/>
- Go to this site to download the software:
  - <http://www.qgis.org/en/site/forusers/download.html>

# Disaster Risk Reduction and Management Open Data and QGIS

- Download, install, activate plugins / activate processing options.
- SAGA (hydrological module) is one in particular that we find useful.



# Disaster Risk Reduction and Management

## Open Data and QGIS

- Wherever possible we like to find freely accessible, good quality data
- Need to determine the risk logic first, then data requirements

Source	Topics	URL
OpenGeoCode	Census, GIS (grid and vector), Agriculture, Climate, Socieconomic	<a href="http://www.opengeocode.org/opendata/">http://www.opengeocode.org/opendata/</a>
WorldGrids - A Public Repository of Environmental Grids	Climate, Meteorology, Land Cover/Use, Soil (grid and vector), Ecoregions, DEM.	<a href="http://www.worldgrids.org/doku.php">http://www.worldgrids.org/doku.php</a>
R.T. Wilson's Free GIS Data	Physical Geography (DEM, Hydrology, Soil, Climate/Meteo, Natural Disasters, etc.), Human Geography (Socioeconomic, Place Names, Admin Boundaries).	<a href="http://freegisdata.rtwilson.com/">http://freegisdata.rtwilson.com/</a>
NASA Landsat Data	SRTM, Historical Landsat, Orthophotos	<a href="http://landsat.gsfc.nasa.gov/?page_id=2367">http://landsat.gsfc.nasa.gov/?page_id=2367</a>
USGS EarthExplorer	Land Use, Remote Sensing, DEM	<a href="http://earthexplorer.usgs.gov/">http://earthexplorer.usgs.gov/</a>

# Disaster Risk Reduction and Management

## Open Data and QGIS

Dataset Name	Description	URL
ISRIC Soil Grids 1K (Updated 2014)	Statistically determined 1Km resolution raster grids that describe the soil qualities for all land areas globally.	<a href="http://soilgrids.org/">http://soilgrids.org/</a>
Gridded Population of the World (V4 - Beta)	Gridded population estimates and densities for the entire land surface based on radar photometry and census adjustments at the 1Km scale.	<a href="http://beta.sedac.ciesin.columbia.edu/datacollection/gpw-v4/sets/browse">http://beta.sedac.ciesin.columbia.edu/datacollection/gpw-v4/sets/browse</a>
ClimateSA (v1.12) (Grids not yet released)	Statistically downscaled CMIP5 climate models and observed data covering Latin and South America at the 1Km resolution. Monthly physical climate and bioclimatic variables for several periods and two RCP scenarios (4.5 and 8.5).	<a href="https://www.ualberta.ca/~ahamann/data/climatesa.html">https://www.ualberta.ca/~ahamann/data/climatesa.html</a>
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (V2)	DEM data developed from the NASA SRTM mission. Very high-resolution (~30m) ASCII grids available in 1 arc-second tiles for all land areas, globally.	<a href="http://asterweb.jpl.nasa.gov/gdem.asp">http://asterweb.jpl.nasa.gov/gdem.asp</a>

# Disaster Risk Reduction and Management

## Open Data and QGIS

Dataset Name	Description	URL
USGS Hydrological data and maps based on SHuttle Elevation Derivatives at multiple Scales (HydroSHEDS)	DEMs (100m resolution) and Shapefiles detailing void- and hydrologically-conditioned elevation and hydrological characteristics (Slope, drainage direction, flow accumulation) for all land areas globally.	<a href="http://hydrosheds.cr.usgs.gov/datadownload.php?reqdata=3accq">http://hydrosheds.cr.usgs.gov/ datadownload.php?reqdata=3accq</a>
Global Administrative Areas (v2.8) (Updated 2015)	Shapefiles of administrative areas, by state, province/region, and rural/metropolitan areas.	<a href="http://www.gadm.org/">http://www.gadm.org/</a>
PALSAR Mosaic Forested Terrain	Experimental raster dataset that describes areas composed primarily of vegetated and non-vegetated lands and water. Process from the Japanese Advanced Land Observing Satellites, ALOS-1 and-2. 25m resolution.	<a href="http://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm">http://www.eorc.jaxa.jp/ALOS/en/ palsar_fnf/fnf_index.htm</a>
CGIAR - Consortium for Spatial Information SRTM 90m DEM (V4 - Last Updated 2008)	Processed SRTM elevation grids available at 250m resolutions for global land areas. Some grids available at 90m resolution. Maximum margin of elevation error is 16m.	<a href="http://srtm.csi.cgiar.org/">http://srtm.csi.cgiar.org/</a>

# Disaster Risk Reduction and Management Open Data and QGIS

- We need to examine each issue and construct the ‘risk logic’ of the hazard
- For example, what conditions will lead to a flood (high rainfall, low water table depth, etc.) and what vulnerability exists
- We then go gather the appropriate data and begin the process of integrated data analysis
- **We now use QGIS**

# Disaster Risk Reduction and Management Open Data and QGIS

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# Disaster Risk Reduction and Management Open Data and QGIS

## Thank-you

## Questions?

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# Thank you



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