Vulnerability: methods of assessment and linkages to adaptive capacity

Dr. Anestoria Shalkowski

OBJECTIVES

- Define vulnerability
- Terms associated with vulnerability
- Types of vulnerability
- Examples and determination of vulnerability
- Adaptive capacity/resilience
- Vulnerability and adaptive capacity building

OUTCOMES

The participants should be able to:

- Define vulnerability
- State the terms associated with vulnerability
- List types of vulnerability within the region
- Give examples and determination of vulnerability
- Define adaptive capacity/resilience
- State the role of vulnerability in building adaptive capacity

ACRONYMS

IPCC – Intergovernmental Panel on Climate Change

ISDR – International Strategy for Disaster Reduction

Terms associated with Vulnerability

Adaptation – the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

- Coping capacity - the ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.

Terms associated with Vulnerability

Hazard - A dangerous phenomenon, substance, or condition that may cause loss of life, injury, property damage, loss of livelihoods and services, social /economic disruption, or environmental damage.

Resilience – the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Terms associated with Vulnerability

Risk - The combination of the probability of an event and its negative consequences.

Taken from ISDR Handbook of Terminology

VULNERABILITY

IPCC SAR

- “the extent to which climate change may damage or harm a system. It depends not only on a systems sensitivity but also on its ability to adapt to new climatic conditions” (Watson et al. 1996:23)

VULNERABILITY

Sustainable Science

- “the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation of stress/stressor.” (Preston *et al.*, 2009)

Climate Scientist

- “the likelihood of occurrence and impacts of weather and climate related events” (Nicholls *et al*., 1999).

VULNERABILITY

ISDR Terminology

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Factors that affect vulnerability

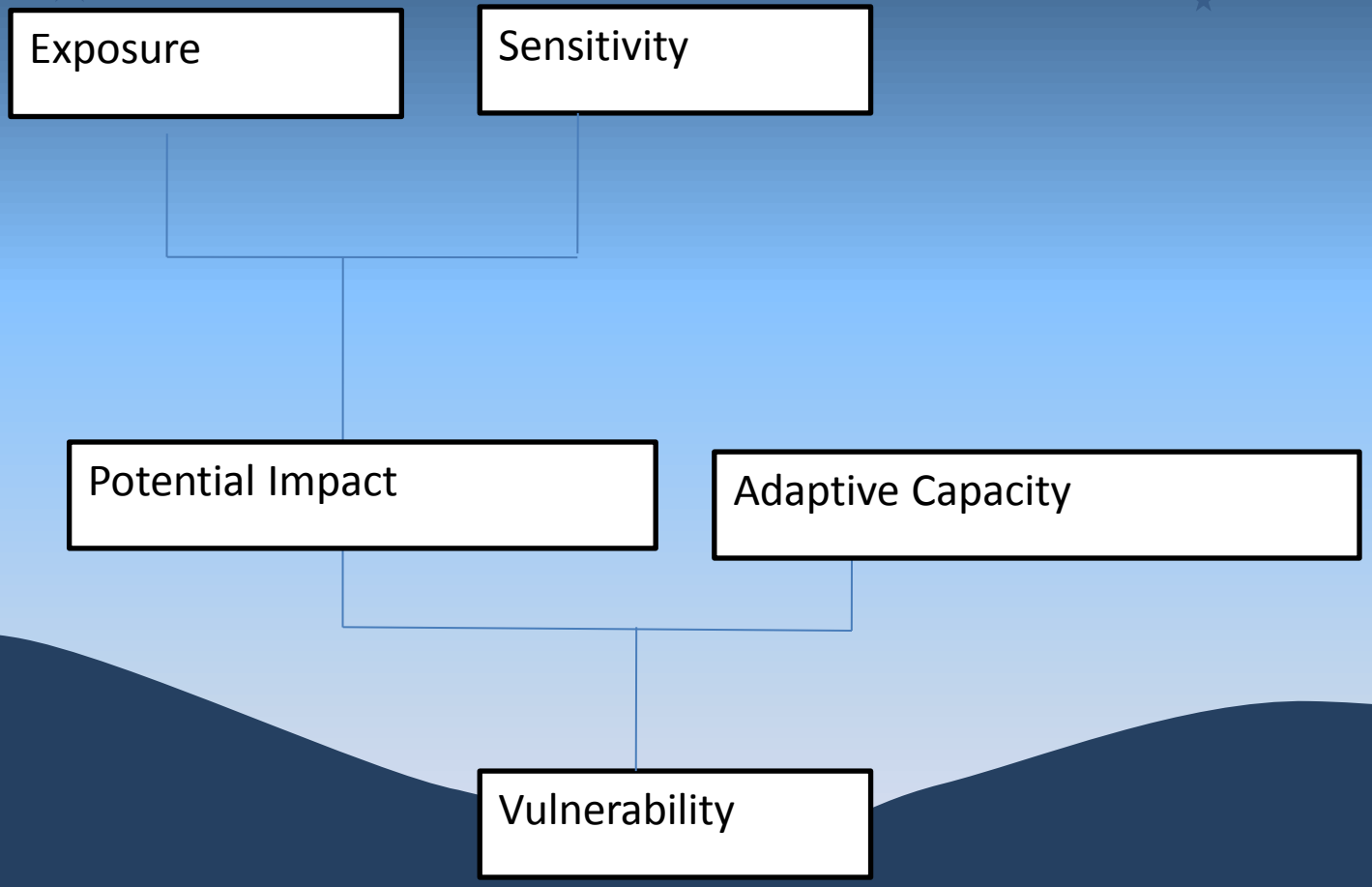
- Physical - physical impact on the built environment or infrastructure and population
- Social – refers to the well being of the individual and to the communities
- Economic loss – classified into 2 categories that is tangible and intangible. Each of which is further subdivided into 2 groups direct and indirect loss.

Types of Vulnerability

Biophysical vulnerability – a function of the character, magnitude, frequency, sensitivity, and adaptive capacity of a system to the hazard to which is exposed

Social vulnerability – the extent to which a system is susceptible to damages

VULNERABILITY



Adapted from: Marshall et al., 2009

Group Exercise 1

Classify the types of vulnerabilities that exist within your community – 5 minutes

Measurement of vulnerability

- Measured via an assessment of place in a process know as Vulnerability Assessment.

- Measurement often referred to as in index

There are three basic methods for computing a vulnerability index:

  - Normalization procedure.
  - Mapping on a categorical scale.
  - Regression method.

Types of Vulnerability Assessment

- CVA – Community Vulnerability Assessment
- HVA – Hazard Vulnerability Assessment
- CVCA – Climate Vulnerability and Capacity Analysis

Vulnerability and Resilience

Vulnerability – main components

- exposure,
- sensitivity, and
- capacity of response

Resilience -

- to prepare for
- recover from
- prevent / minimise disruption and/or **mitigate** the effects of future hazards

Importance of Resilience

Grenada

% GDP 212

Impact on Productive Sector EC 539.2 m

Infrastructure 262.4m

% of Housing 89

% Population 79

Cayman

% GDP 138

Impact on Productive Sector CI 1117.7m

Infrastructure 488.4m

% of Housing 83

% Population 83

Cost of Vulnerability

Infrastructure and Lifeline Systems

Northridge Earthquake 1994

- 27% of regional business loss due to Highway disruption

Kobe Earthquake 1995

- Infrastructure failure brought business activity almost to a halt

What needs to resilient

- Infrastructure – Roads, Bridges,
- Critical Facilities- Hospitals, Fire Stns.,
- Lifeline Systems – Health, Water, Power
- Housing
- DRM System
- National Security Systems
- Education Systems

Achieving Resiliency

Resilience must be built into **Development**

Resilience should be achieved through development which should address

- Technical
- Organisational
- Socio-economic aspects
  - Environment

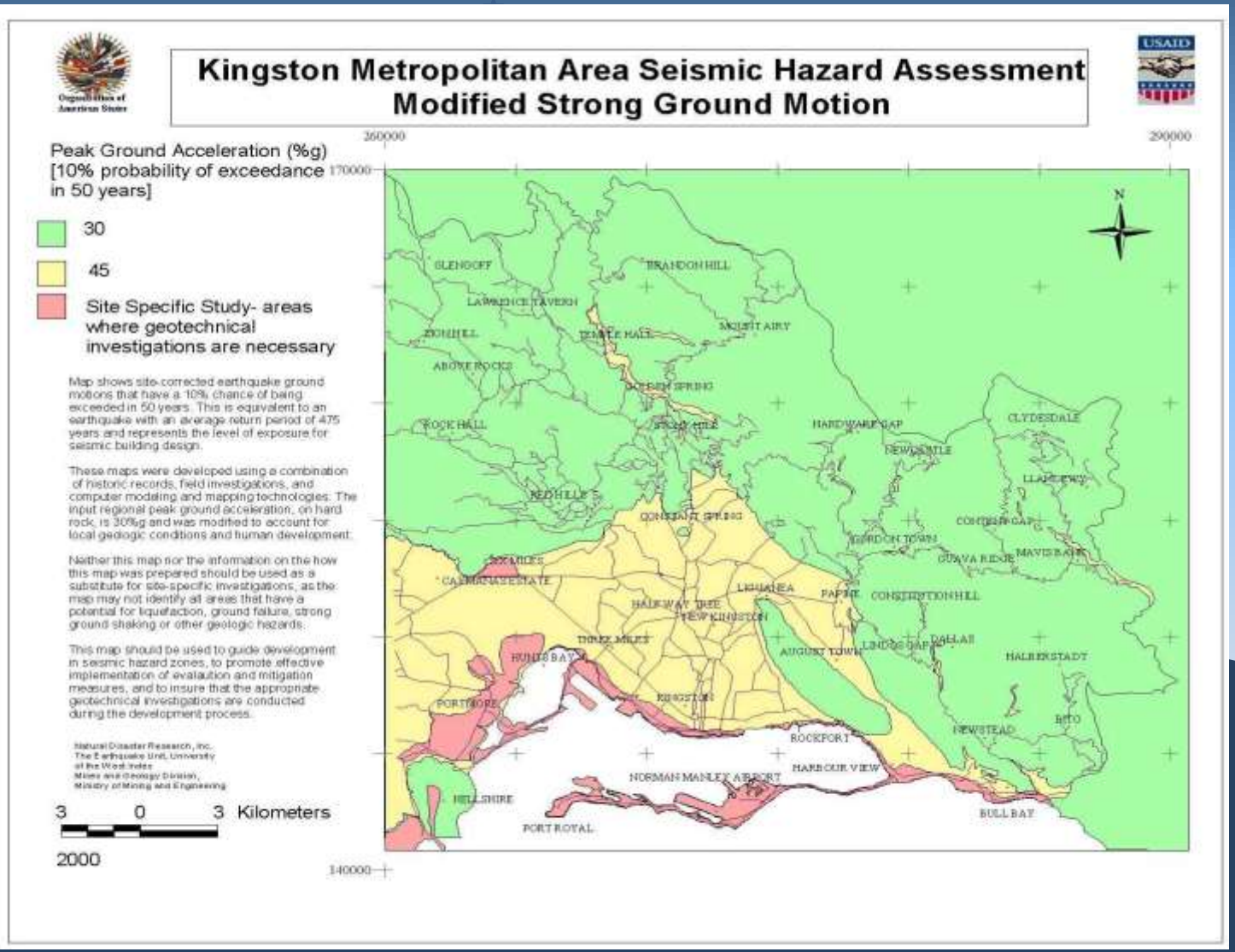
RESILIENCE

Technical

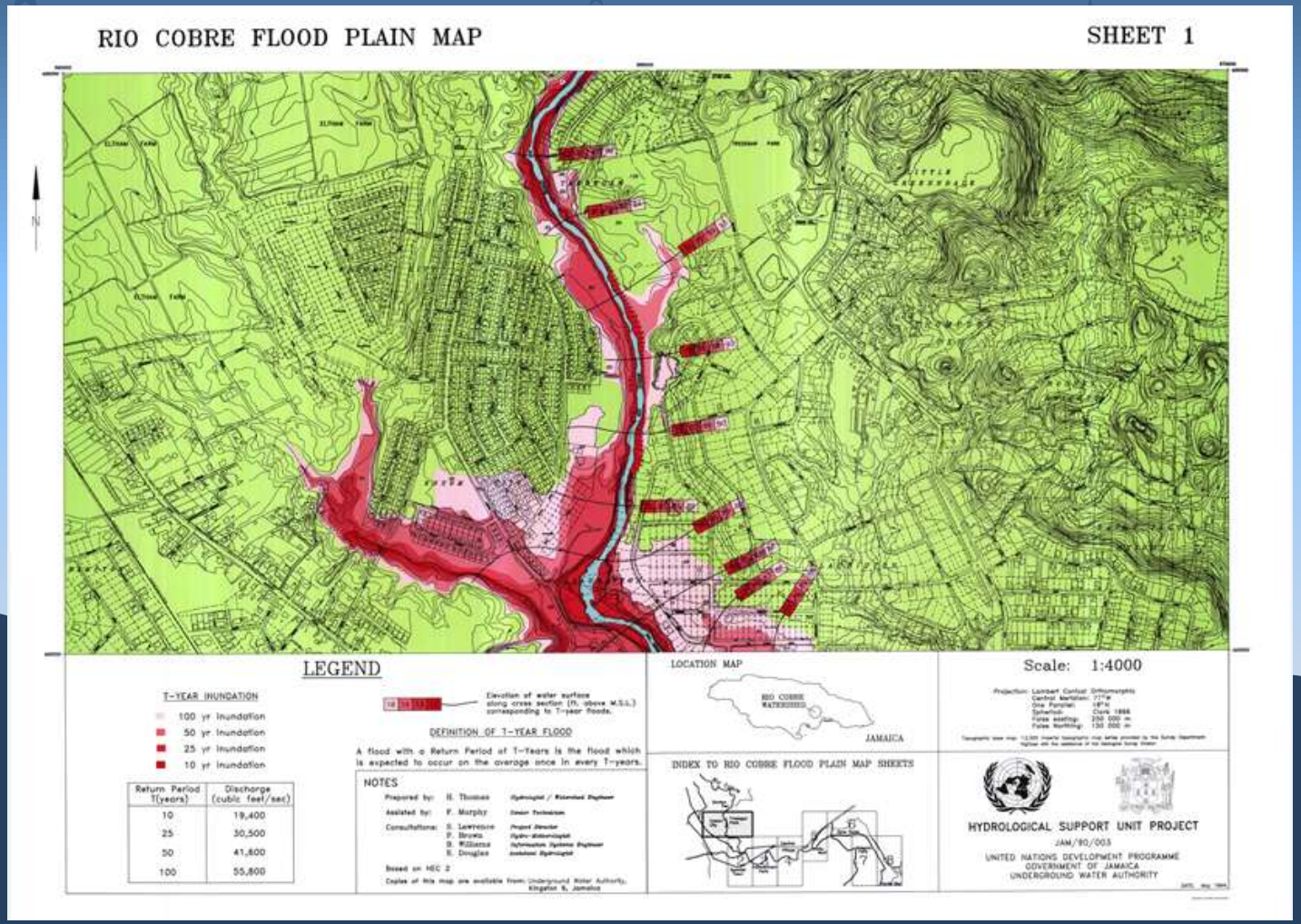
Risk analysis, mapping should inform

- Location
- Design of structures
- Type of infrastructure

Risk Maps


Kingston Metropolitan Area Seismic Hazard Assessment
Modified Strong Ground Motion
USAID
Peak Ground Acceleration (%g)
[10% probability of exceedance in 50 years]
30
45
Site Specific Study- areas where geotechnical investigations are necessary
Map shows site-corrected earthquake ground motions that have a 10% chance of being exceeded in 50 years. This is equivalent to an earthquake with an average return period of 475 years and represents the level of exposure for seismic building design.
These maps were developed using a combination of historic records, field investigations, and computer modeling and mapping technologies. The input regional peak ground acceleration, on hard rock, is 30%g and was modified to account for local geologic conditions and human development.
Neither this map nor the information on the how this map was prepared should be used as a substitute for site-specific investigations; as the map may not identify all areas that have a potential for liquefaction, ground failure, strong ground shaking or other geologic hazards.
This map should be used to guide development in seismic hazard zones, to promote effective implementation of evaluation and mitigation measures, and to insure that the appropriate geotechnical investigations are conducted during the development process.
Natural Disaster Research, Inc.
The Earthquake Unit, University of the West Indies
Mines and Geology Division, Ministry of Mining and Engineering
3 0 3 Kilometers
2000
360000
290000
170000
140000
N
GLENGOFF
BRANDON HILL
LAWRENCE TAVERN
ZION HILL
TEMPLE HALL
MOUNT AIRY
ABOVE ROCKS
GOLDEN SPRING
ROCK HALL
HARDWARE GAP
CLYDESDALE
NEWCASTLE
LLANRUMNEY
RED HILLS
CONSTANT SPRING
CONTENT GAP
GORDON TOWN
GUAVA RIDGE
MAVIS BANK
PAPINE
CONSTITUTION HILL
HALFWAY TREE
NEW KINGSTON
LIGUANEA
THREE MILES
AUGUST TOWN
DALLAS
HALBERSTADT
HUNTS BAY
PORTMORE
KINGSTON
ROCKFORT
NEWSTEAD
HARBOUR VIEW
NORMAN MANLEY AIRPORT
HELLSHIRE
PORT ROYAL
BULL BAY

Risk Maps


RIO COBRE FLOOD PLAIN MAP
SHEET 1
LEGEND
T-YEAR INUNDATION
100 yr Inundation
50 yr Inundation
25 yr Inundation
10 yr Inundation
Return Period T(years)
Discharge (cubic feet/sec)
10
19,400
25
30,500
50
41,800
100
55,800
Elevation of water surface along cross section (ft. above M.S.L.) corresponding to T-year floods.
DEFINITION OF T-YEAR FLOOD
A flood with a Return Period of T-Years is the flood which is expected to occur on the average once in every T-years.
NOTES
Prepared by: H. Thomas
Assisted by: F. Murphy
Consultations: G. Lawrence
P. Brooks
B. Williams
E. Douglas
Based on HEC 2
LOCATION MAP
RIO COBRE WATERSHED
JAMAICA
INDEX TO RIO COBRE FLOOD PLAIN MAP SHEETS
Scale: 1:4000
HYDROLOGICAL SUPPORT UNIT PROJECT
JAM/90/003
UNITED NATIONS DEVELOPMENT PROGRAMME
GOVERNMENT OF JAMAICA
UNDERGROUND WATER AUTHORITY

RESILIENCE

Technical

- Critical facilities, infrastructure must be designed with an additional factor of safety
- Redundancy – alternative/duplicate
- Maintenance - structures must be properly maintained

RESILIENCE

Organisational

Resilient EM systems

- Evacuation routes remain open
- Emergency telecomms functional
- EOCs must survive or be up within hours
- Shelters should be safe, equipped

RESILIENCE

Socio-economic

- Diversified, vibrant economy
- Robust private and public sector
- Risk Transfer

RESILIENCE

People need to be resilient too…

- Adequate income to afford safe housing
- “Cushion” – insurance/savings/family
- Knowledge and skills to make their communities resistant

Summary

- Vulnerability is the exposure, sensitivity, potential impact and adaptive capacity
- Resilience = adaptive capacity (DM)
- Decreased vulnerability does not indicate increased resilience

REFERENCES

Arnold, Margaret, ed. (2006). Natural Disaster Hotspots Case Studies. Disaster Risk Management Series Number 6. Washington D.C.: World Bank.

Benson, Charlotte and Edward Clay. (2004). Understanding the economic and financial impacts of natural disasters. Disaster Risk Management Series Number 4. Washington D.C.: World Bank.

Birkman, Jorn (2006) Measuring Vulnerability to Natural Hazards: Towards disaster Resilient Societies. New York: United Nations University Press.

Collymore, J. McA. 2011. Disaster management in the Caribbean: Perspectives on institutional capacity reform and development, *Environmental Hazards*, Volume 10, Number 1, 2011, 6-22

Hazard Mitigation Planning. Caribbean Hazard Mitigation Capacity Building Programme. http://www.cdera.org/projects/champ/mitiplcy/vulnerb.shtml.

REFERENCES

Introduction to Hazards, 3rd Edition, UNDP Disaster Management Training Programme. http://www.undmtp.org/english/hazards/hazards.pdf. Accessed September 5, 2007.

Kininmonth, William (2004). Climate Change: A Natural Hazard. Essex: Multi-Science Publishing Company

Nicholls, R. J., Hoozemans, F. M. J. and Marchand, M. (1999) Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses, **Global Environmental Change, 9,** S69-S87.

Opadeyi, J. and B. Spence (2006). Disaster Risk Management Benchmarking Tool. http://www.eclac.cl/portofspain/noticias/paginas/2/27912/ConceptNote.pdf

REFERENCES

Preston, B.L. and Stafford-Smith, M. (2009). Framing vulnerability and adaptive capacity assessment: Discussion paper. CSIRO Climate Adaptation Flagship Working paper No. 2. *http://www.csiro.au/org/ClimateAdaptationFlagship.html*

Watson, R.T., Zinyoera, M.C., and Moss, R.H. 1996. Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analysis. Contribution of Working Group II to the Second Assessment Report of the Intergovermental Panel on Climate Change. Cambridge:C ambridge University Press.

.

Wisner, B.; Blaikie, P.; Cannon, T.; and I. Davis (2004) At Risk: Natural Hazards, People's Vulnerability and Disasters, 2nd Edition. London: Routledge

Hazard identification vulnerability analysis (2005). Office of Emergency, King County, Washington. http://www.metrokc.gov/prepare/programs/hiva.aspx . Accessed September 4, 2007.