Climate risk in the Philippines

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Goals of study

- “Socio-ecological resilience to extreme events in the Philippines”
  - “Resilience” originally a concept in ecology similar to “recoverability”
  - Popular in discussing climate change risk
  - Growing interest in “general resilience” to unpredictable impacts.

Goals of study

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OPEN ACCESS

sustainability

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www.mdpi.com/journal/sustainability

Communication

General Resilience to Cope with Extreme Events

Stephen R. Carpenter [1,*], Kenneth J. Arrow [2], Scott Barrett [3], Reinette Biggs [4], William A. Brock [5], Anne-Sophie Crépin [4,6], Gustav Engström [4,6], Carl Folke [4,6], Terry P. Hughes [7], Nils Kautsky [8], Chuan-Zhong Li [9], Geoffrey McCarney [3], Kyle Meng [3], Karl-Göran Mäler [6], Stephen Polasky [10], Marten Scheffer [11], Jason Shogren [12], Thomas Sterner [13], Jeffrey R. Vincent [14], Brian Walker [4,15], Anastasios Xepapadeas [16] and Aart de Zeeuw [6,17]

Goals of study

- Drawbacks of “resilience” framework:
  - Definable?
  - Measurable?
  - Predictive?
  - Appropriate for human social systems?

Goals of study

- Drawbacks of “resilience” framework:
  - Definable?
  - Measurable?
  - Predictive?
  - Appropriate for human social systems?

VIEWPOINT

Social-Ecological Resilience to Coastal Disasters

W. Neil Adger,[1]* Terry P. Hughes,[2] Carl Folke,[3] Stephen R. Carpenter,[4] Johan Rockström[5]

Hazards in coastal areas often become disasters through the erosion of resilience, driven

resilience <> risk

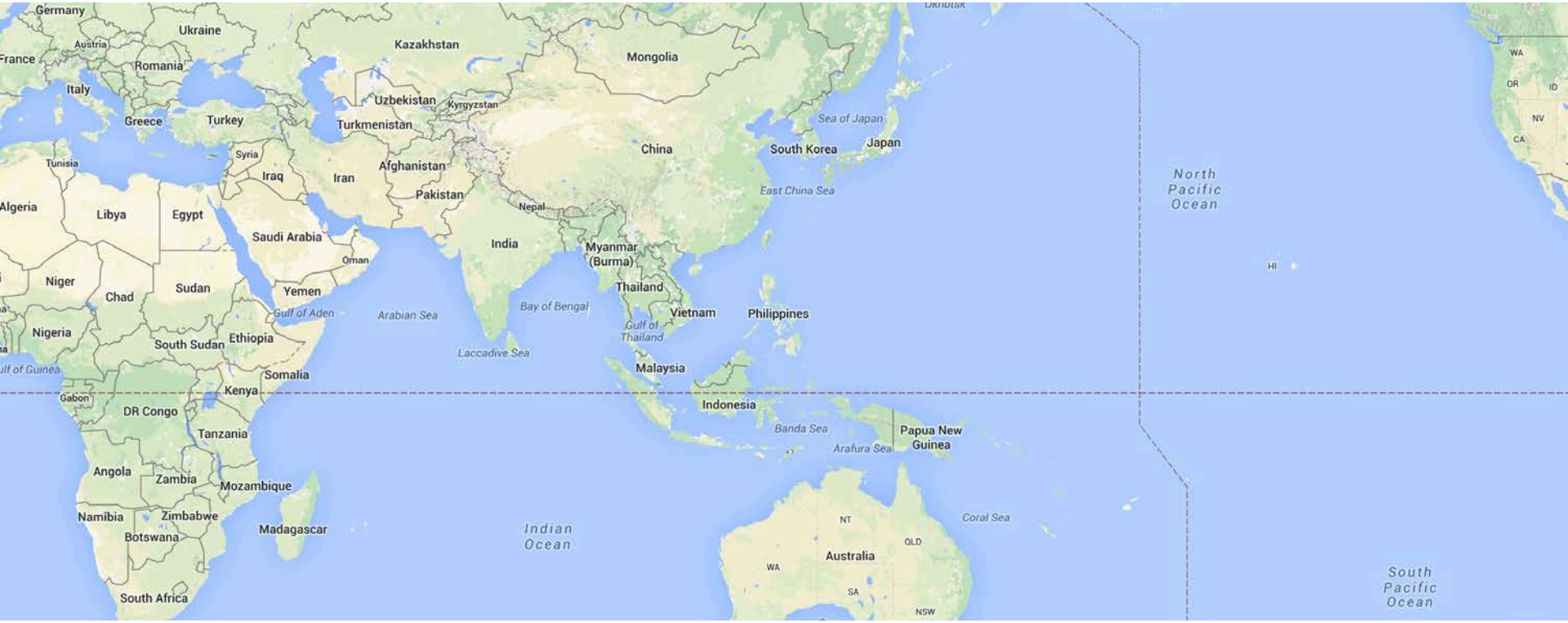
Goals of study

How to understand general resilience in a practical way

or

How to reduce climate-related risk

(in the Philippines)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Uzbekistan
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Syria
Iraq
Iran
Afghanistan
Pakistan
China
Sea of Japan
South Korea
Japan
East China Sea
North Pacific Ocean
Nepal
India
Myanmar (Burma)
Thailand
Vietnam
Philippines
Gulf of Thailand
Bay of Bengal
Arabian Sea
Laccadive Sea
Tunisia
Algeria
Libya
Egypt
Saudi Arabia
Oman
Yemen
Gulf of Aden
Niger
Chad
Sudan
Nigeria
South Sudan
Ethiopia
Somalia
Kenya
Gabon
DR Congo
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
South Africa
Madagascar
Indian Ocean
Malaysia
Indonesia
Banda Sea
Arafura Sea
Papua New Guinea
Coral Sea
NT
QLD
Australia
WA
SA
NSW
South Pacific Ocean
WA
OR
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Approach

Approach

- Case study approach
  - Focus on extreme weather impacts associated with climate change (tropical storms)
  - Urban and rural settings
  - Understand risks and how to reduce them
  - Identify major risk areas to address for general resilience

Approach

- Three sites
  - Cagayan de Oro (tropical storm Sendong)
  - Iloilo City and Province (tropical storm Frank)
  - Tacloban and Samar (typhoon Yolanda)


SAFETY+FIRST

Approach

- Qualitative interviews (2014)
  - About 30 interviews/site
  - Line agencies, LGUs, barangay leaders, civil society organizations, aid organizations, business representatives, academia
  - Goal was to assess the risks revealed by storm impact, ongoing risks within communities


FUBU
Original


Wilkins

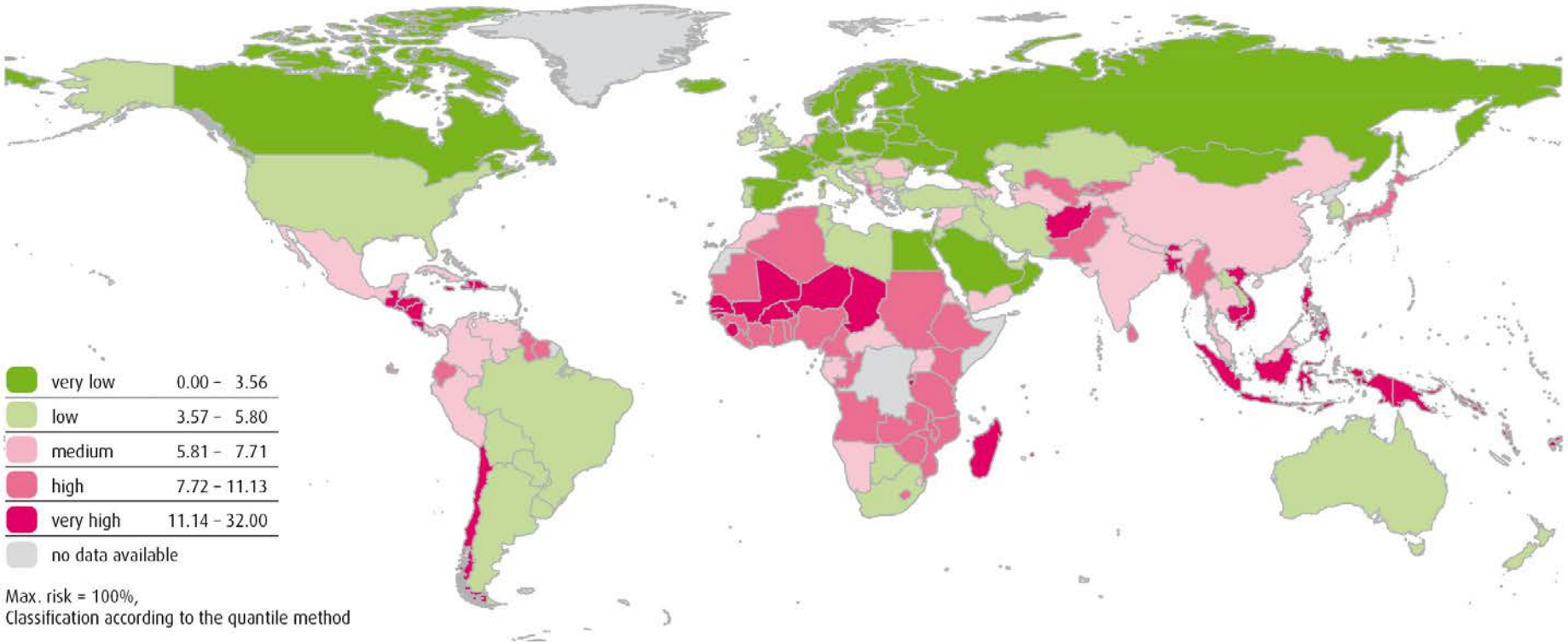
What are the local risk factors to address for local resilience?

What are the national risk factors to address for national resilience?

Climate change in the Philippines

WorldRiskIndex

WorldRiskIndex as the result of exposure and vulnerability



Max. risk = 100%,
Classification according to the quantile method

Drier dry seasons, wetter wet seasons

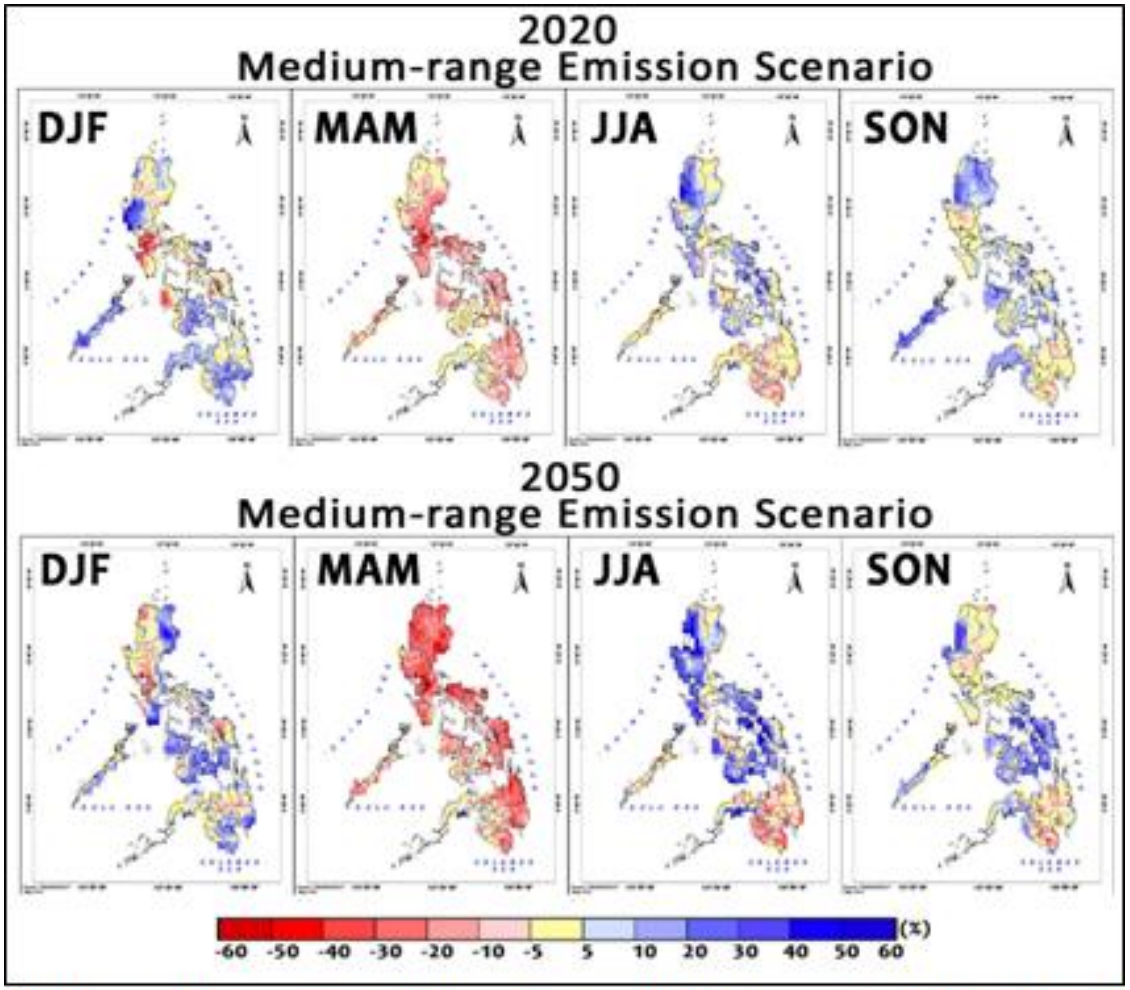


Fig.18: Maps showing the projected rainfall change (increase/decrease) in % in 2020 and 2050 in the Philippines.

Cagayan de Oro


Luzon
Baguio
Tarlac
Cabanatuan
Olongapo
Manila
Dasmariñas
Batangas
Naga
Mindoro
Philippines
Masbate
Samar
Tacloban
Panay
Kabisayaan
Spratly
Islands
Bacolod
Cebu
Leyte
Palawan
Negros
Bohol
Dumaguete
Butuan
Sulu Sea
Mindanao
Iligan
Cotabato
Davao
Zamboanga
General Santos
SABAH
Sandakan
Lahad Datu
Tawau

Cagayan de Oro

- Fifth-largest city outside of Metro Manila
  - Population of 600,000 [2010 census]
- Economy
  - City: residential real estate, shopping mall retail, tourism, foreign investment
  - Province: agriculture (1/3 of land area, Del Monte plantation)
  - One of Philippines' most competitive cities

Cagayan de Oro

- Institutions
  - Universities (four major private universities, one state-run)
  - Archdiocese located in city
  - Civil society organizations (rural livelihood, informal settler interests, environmental management)

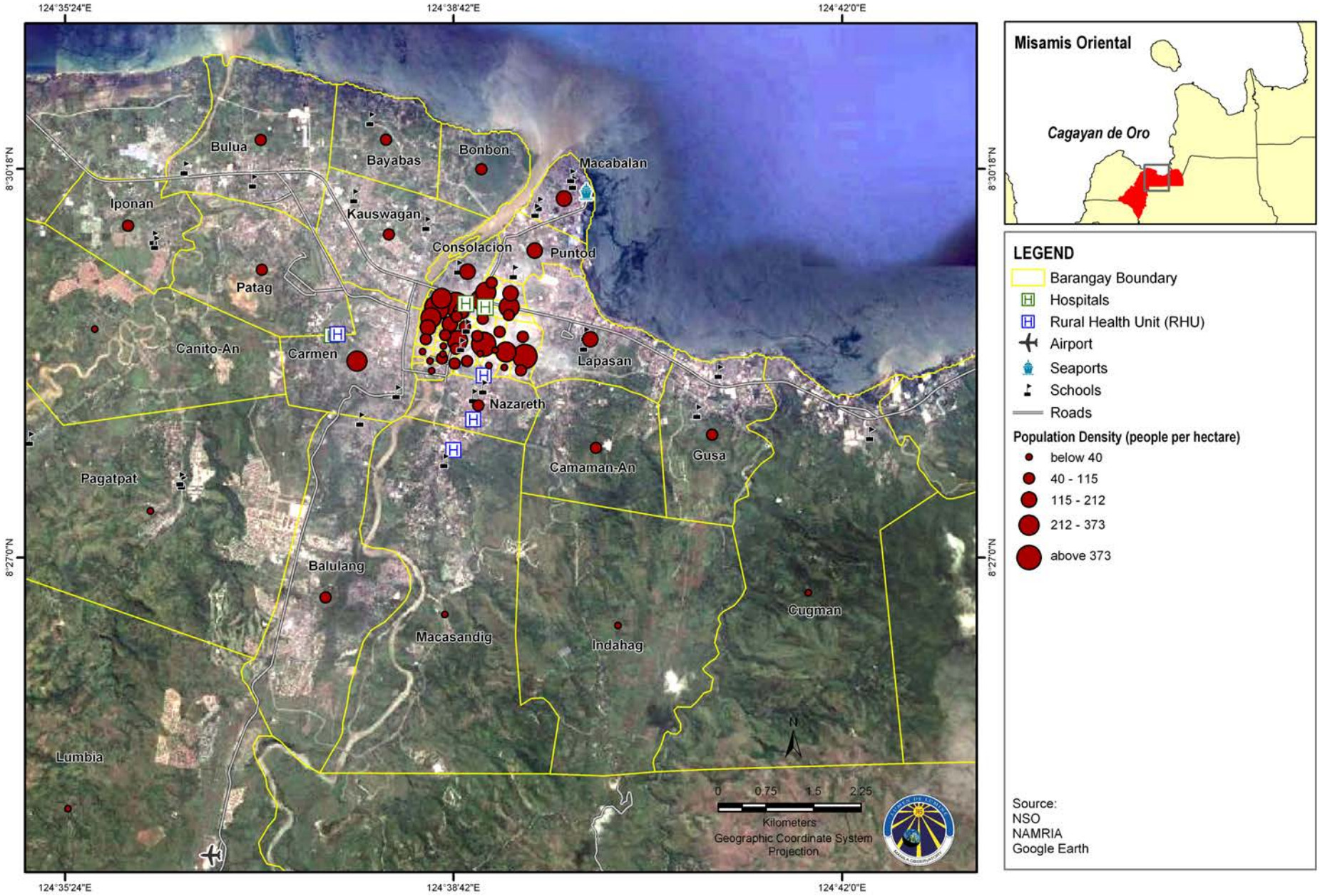
Cagayan de Oro

- Informal settlement
  - 15-20% of the city population (about 100,000 people)
  - 2010: LGU “piso-piso” program to sell parcels for 1 peso each
  - Poverty rate in region 35% [2012]

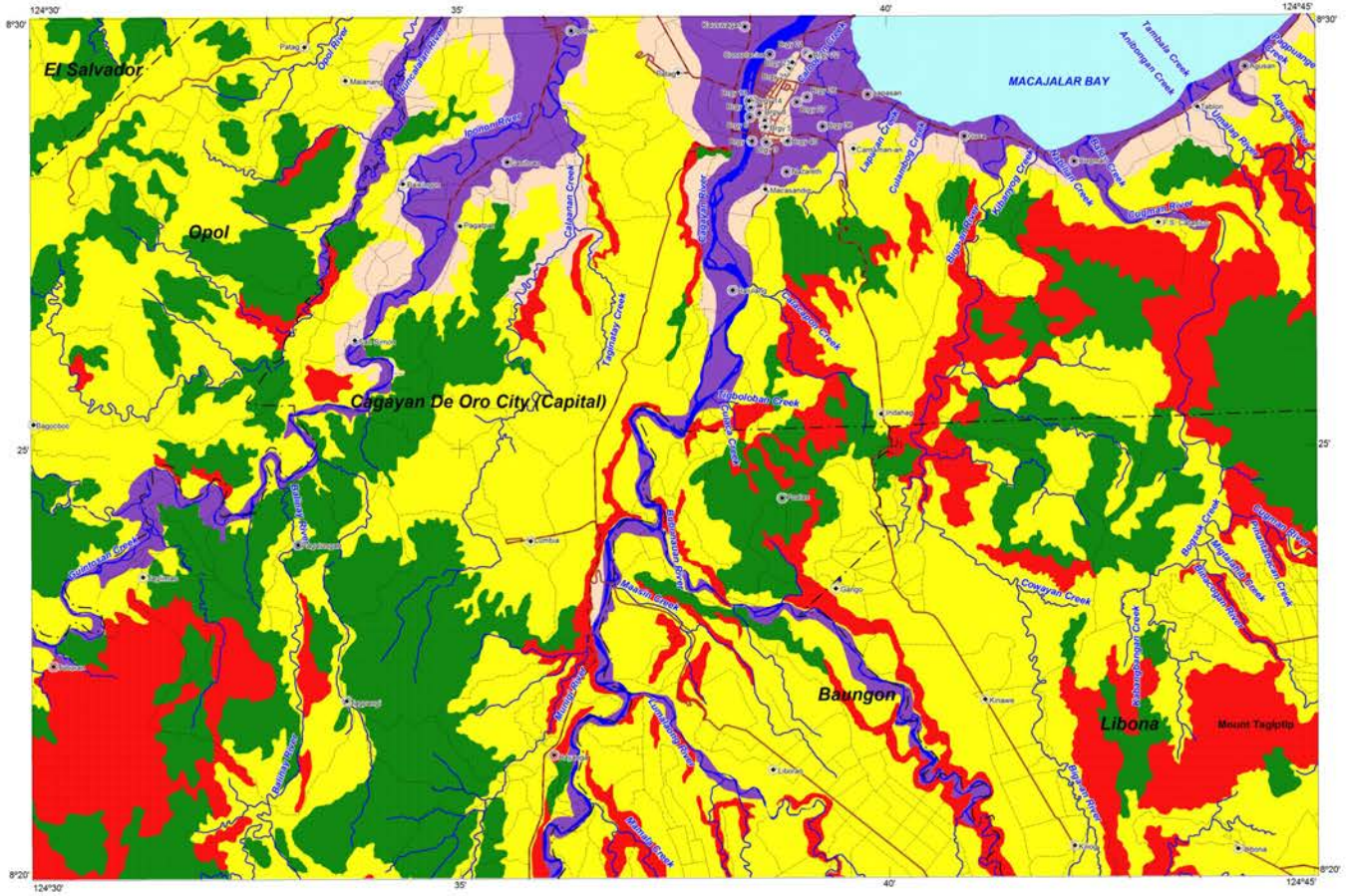
Cagayan de Oro

- Known hazards
  - 7 rivers from mountainous watersheds south of city
  - Flash floods, landslides: 2009 flash floods
  - Logging ban passed in 2010 to reduce deforestation
  - Cagayan Riverbasin Management Council formed

Cagayan de Oro: Population Density (2010)



LANDSLIDE AND FLOOD SUSCEPTIBILITY MAP OF CAGAYAN DE ORO QUADRANGLE MISAMIS ORIENTAL AND BUKIDNON PROVINCES, PHILIPPINES



INDEX MAP

LEGEND :

High susceptibility to landslide
Areas with high landslide susceptibility rating have active/recent landslides and tension cracks that would directly affect the community. Those with steep slopes and drainages that are prone to landslide damming are also highly susceptible to landslides.

Moderate susceptibility to landslide
Areas with moderate landslide susceptibility rating have inactive/old landslides and tension cracks which are located away from the community. These areas usually have moderate slopes.

Low susceptibility to landslide
Areas with low to gentle slopes and lacking tension cracks have low landslide susceptibility rating.

High susceptibility to flooding
Areas with greater than 1 meter flood height. These areas are usually flooded for several hours during heavy rains; include landforms of topographic lows such as active river channels, abandoned river channels and areas along river banks; also prone to flashfloods.

Low to moderate susceptibility to flooding
Areas with less than 1.0 meter flood height. These are usually inundated during prolonged and extensive heavy rainfall or extreme weather condition

- Main Road
- Secondary Road
- Trail
- River
- Municipal boundary
- Barangay center location

N
W E
S

0 1.5 3
kilometers

TRANSVERSE MERCATOR PROJECTION
MAPPING SCALE 1:50, 000

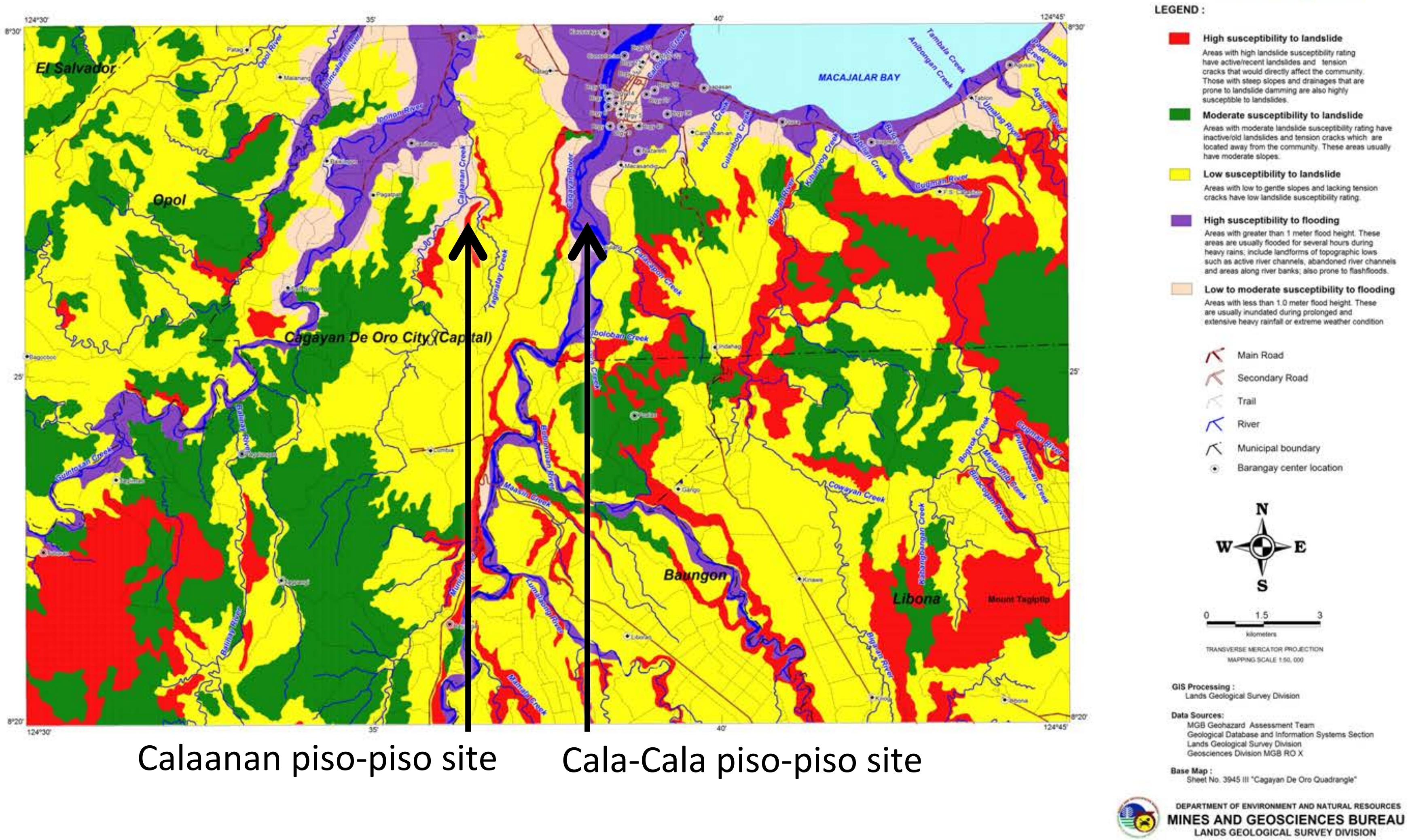
GIS Processing :
Lands Geological Survey Division

Data Sources:
MGB Geohazard Assessment Team
Geological Database and Information Systems Section
Lands Geological Survey Division
Geosciences Division MGB RO X

Base Map :
Sheet No. 3945 III "Cagayan De Oro Quadrangle"

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
MINES AND GEOSCIENCES BUREAU
LANDS GEOLOGICAL SURVEY DIVISION

LANDSLIDE AND FLOOD SUSCEPTIBILITY MAP OF CAGAYAN DE ORO QUADRANGLE
MISAMIS ORIENTAL AND BUKIDNON PROVINCES, PHILIPPINES



Cagayan de Oro

- Tropical storm Sendong (2011)
  - December 15
    - 11 p.m.: Public Storm Warning Signal No. 2 (storm within 24 hours; disaster preparedness on alert)
  - December 16
    - 9 a.m.: General flood advisory for Misamis Oriental
    - 4 p.m.: Landfall in Mindanao
    - 11 p.m.: Last PAGASA advisory for day; storm still approaching city; no evacuation

Cagayan de Oro

- Tropical storm Sendong (2011)
  - December 17
    - 12–5 a.m.: Flash flood in city
    - Cagayan River swelled from 2 meters to 10 meters
    - Floodwater fast; logs, boulders, mud
    - Two of city's major bridges destroyed
    - 1000 killed, 70,000 families displaced, 100 million USD in direct damage, 500 million USD in reconstruction
    - Informal settlements heavily affected: along banks of river, stayed behind to protect belongings

Cagayan de Oro

Cagayan de Oro

- Response
  - City government not prepared; political turfing created delays
  - Medical personnel not trained in emergency medicine; health centers in flood zone; psychosocial care often without professional training
  - Water, food, electricity, telecommunications shortages

Cagayan de Oro

- Response
  - "State of national calamity" declared after three days, allowing international aid to enter
  - Multisectoral Relief Response Operations Center created: governmental-nongovernmental partnership to fill response needs
  - Control assumed by nat. government after weeks and by local government after months

Cagayan de Oro

- Moving people from hazard zones
  - "No-build" zones declared, reoccupied
    - 3 out of 4 sandbars reoccupied
  - Relocation chosen as main strategy
    - Calaanan main site: 6000 families
    - 13 other resettlement sites: 8000 more families
    - 2014: about half completed
  - Challenges to sustaining relocation strategy

Cagayan de Oro

Cagayan de Oro

Cagayan de Oro

- Changed directions
  - LGU: Organic farming to reduce runoff, mangroves/bamboo to reduce riverbank erosion, large dike for flood control (requiring relocation), disaster contingency plan for 160,000 people
  - Civil society: Riverbasin Management Council active in watershed management
  - National: High-resolution flood hazard maps, population survey tools (“Twin Phoenix”)

Cagayan de Oro

- Continued risks
  - 10,000 people remain in high-risk zones
  - Continued demand for informal settlement
  - Sustainability of relocation strategy
  - Flood risk from intense storms and watershed land use

What led to disaster in Cagayan de Oro?

What led to disaster in Cagayan de Oro?

- Immediately, the risks were:
  1. Populations and critical infrastructure in flood-prone areas
  2. Informal settlements in flood-prone areas
  3. Land use practices in catchment, including illegal practices, that increase flood risk
  4. Lack of pre-emptive measures
  5. Complacency regarding possibility of flooding
  6. Sudden, night-time onset of the flood

What led to disaster in Cagayan de Oro?

- The immediate risks reflect more fundamental, widespread risk factors:
  1. Large population of informal settlers that often live in hazard-prone zones
  2. Insufficient incentives for governments and the political system to avoid disaster risks

What led to disaster in Cagayan de Oro?

- The immediate risks reflect more fundamental, widespread risk factors:
  1. Large population of informal settlers that often live in hazard-prone zones
  2. Insufficient incentives for governments and the political system to avoid disaster risks
- Even if the immediate risk factors are addressed, these risk factors can persist

Informal settlements

Widespread informal settlement increases risk

Informal settlements

- Philippines: estimates vary widely
  - 3%: 2007 government census
  - 30%: typical estimate within National Capital Region
- Globally: 15% of population
  - In developing countries, 1/3 of urban population is typical rate
  - Mexico City, Nairobi, Mumbai examples of cities with large informal settlements

Informal settlements

- Historically: common part of development
  - Europe and the US both struggled to address informal settlement for hundreds of years
- Practically: factors in informal settlement
  - Concentration of economic opportunities in cities
  - Difficulty in legalizing assets into capital
  - Inability to protect assets legally makes daily income even more important

Informal settlements

- Strategies for addressing informal settlements
  - Relocation
  - Upgrading
  - Awarding tenure security
  - None have been extremely successful

Addressing the factors that lead to informal settlement can make the Philippines more resilient to climate change.

Governance and politics

Heavy use of patronage in politics increases risk

Governance and politics

- Patronage in politics was cited as a risk factor in every case study site
  - Line agencies, LGUs, barangay leaders, civil society leaders, academics, etc. all cited patronage in politics
- Even when people don't like patronage in politics, it's difficult to avoid
  - Often promoted by discretionary resources (e.g., PDAF)

Governance and politics

- Patronage in politics increases risk in many ways:
  - Patronage appointments decrease government technical capacity to plan, respond to disasters
  - Patronage protection makes policy and law enforcement difficult
  - Reduces trust and cooperation between population and government

Governance and politics

- Patronage in politics increases risk in many ways:
  - Political turfing can occur in disaster situations
  - Patronage is sometimes the only way to receive basic resources for disaster risk reduction (e.g., funds for barangay storm shelter).
  - Can make post-disaster assessment extremely difficult

Governance and politics

- Patronage in politics is not unique to the Philippines
  - It has been a major issue in European politics at various points in time
  - It has been a major issue in the US (e.g., late 1800s political machines)
  - It continues to be a major issue in many political systems today (e.g., SE Asia)

Addressing the ways that politics can increase risk can make the Philippines more resilient to climate change

Iloilo City and Province

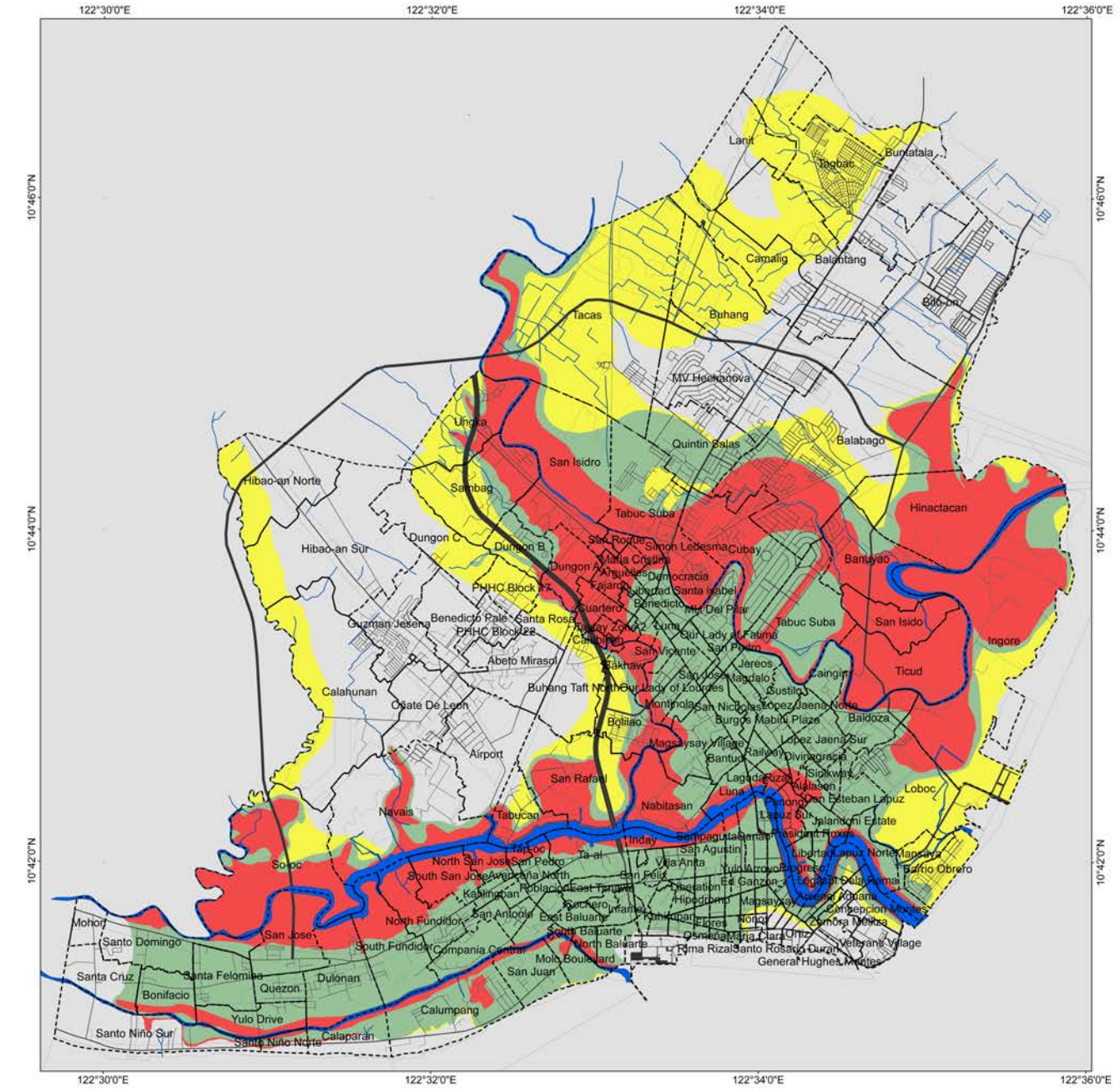

Luzon
Baguio
Tarlac
Cabanatuan
Olongapo
Manila
Dasmariñas
Batangas
Naga
Mindoro
Philippines
Masbate
Samar
Tacloban
Kabisayaan
Bacolod
Cebu
Leyte
Palawan
Negros
Bohol
Dumaguete
Spratly Islands
Sulu Sea
Cagayan de Oro
Butuan
Mindanao
Iligan
Cotabato
Davao
Zamboanga
General Santos
SABAH
Sandakan
Lahad Datu
Tawau

Iloilo City and Province

- Iloilo City
  - Regional center, population 400,000
  - Fast economic growth (national developers like Megaworld Corp. building hotels, malls; business process outsourcing is major employer)
  - New international airport (2007) and multibillion dollar flood control infrastructure project (2010)
  - Lots of universities and civil society organizations

Iloilo City and Province

- Iloilo City
  - Sits on low-lying alluvial plain (2.5 m above sea level) in SE Panay
  - Three rivers
    - Jaro River: flash floods, fed by watershed
    - Iloilo River: estuary that floods during high tide
    - Dungon Creek: occasionally floods
  - 10% of population informal settlers



City Planning and Development Office

FLOOD HAZARD MAP

0 0.5 1 2 3 4

Kilometers

1:15,000

Legends

City Boundary

Barangay Boundary

River

Road

Flood Hazard Level

- High
- Moderate
- Low

Iloilo City and Province

- Iloilo Province
  - Rice cultivation: half of land area
  - Also corn, coconut, banana, sugarcane
  - Bamboo planting promoted by 2010 government initiative
  - Over 100,000 individual farms, most 1-2 hectares each
  - Fishing major source of income in coastal areas
  - Poverty rate 20%


Aklan
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Antique
Iloilo
Visayan Sea
Iloilo City
Guimaras Island
Negros Island
Manila
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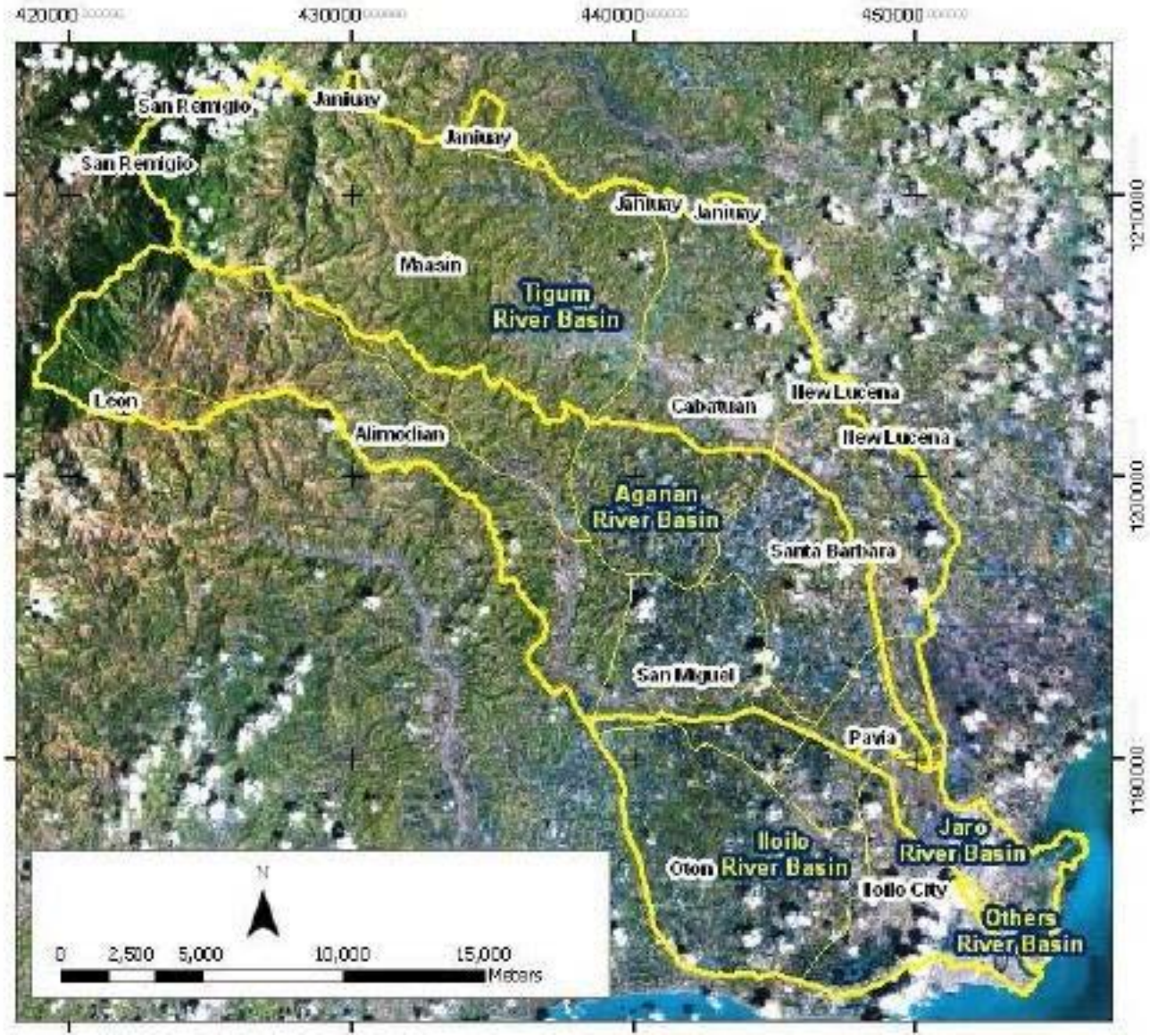
Iloilo City and Province

- Iloilo City and Province are tightly linked
  - Jaro River is fed by Tigum-Aganan Watershed
  - 40% of city water is from Maasin Watershed (part of Tigum-Aganan Watershed)
  - Upland erosion leads to city siltation (2 feet/year at mouth of Jaro River)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River Basin
Leon
Alimodian
Cabatuan
New Lucena
New Lucena
Aganan
River Basin
Santa Barbara
San Miguel
Pavia
Iloilo
Oton River Basin
Jaro
River Basin
Iloilo City
Others
River Basin
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5,000
10,000
15,000
Meters

Iloilo City and Province

- Known hazards: city
  - Flash flooding of Jaro River
  - Flooding of Iloilo River (estuary)
  - Siltation from upland (costly, increases flood risk)
  - Saltwater intrusion of groundwater
  - Land subsidence near coast
  - Earthquake-induced soil liquefaction near coast
  - Storm surge near coast

Iloilo City and Province

- Known hazards: province
  - Flooding
  - Erosion of topsoil
  - Landslides
  - Stability of water supplies for irrigation

Iloilo City and Province

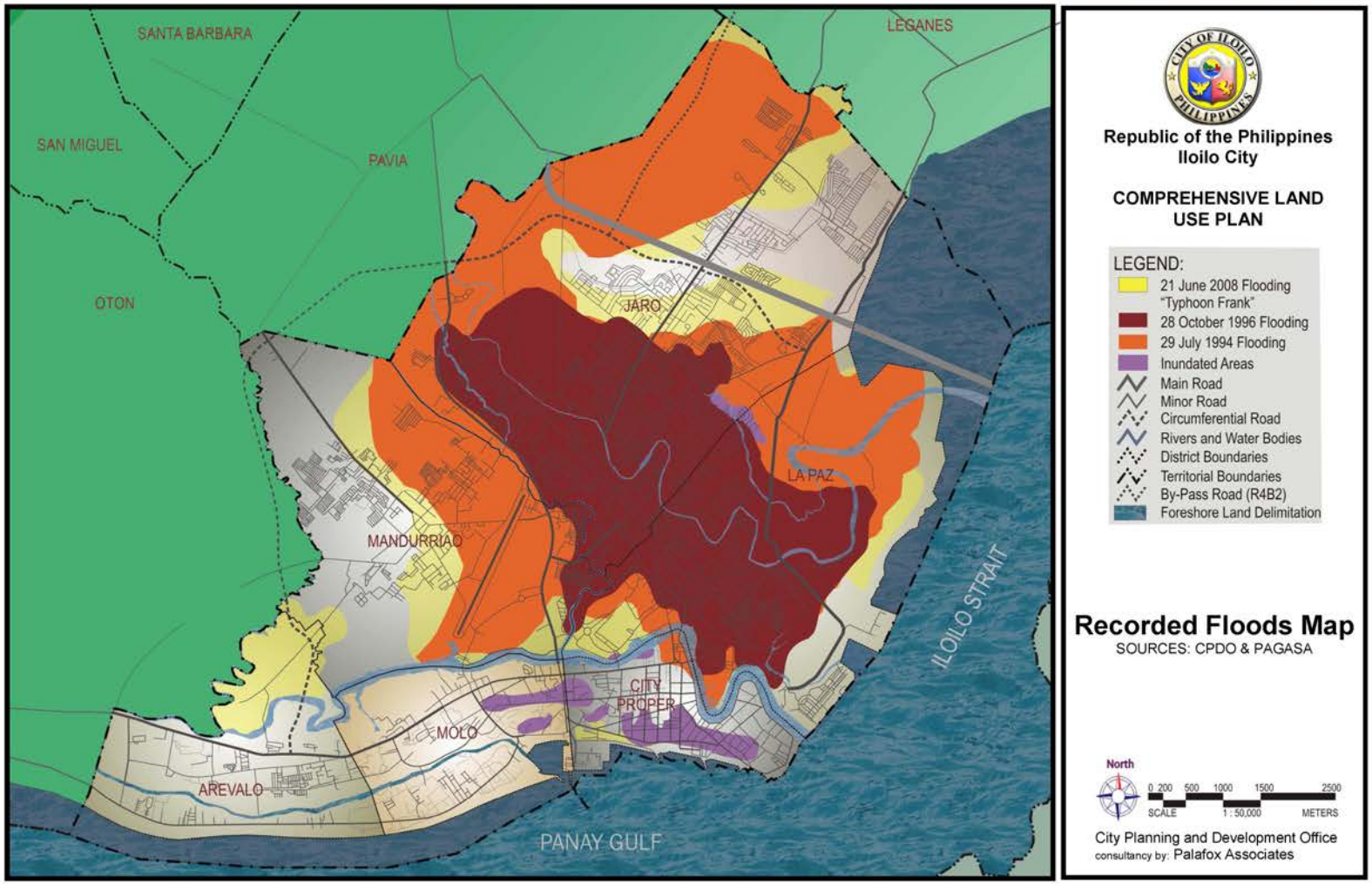
- Decades-long struggle to manage watershed
  - Early 1990s: Farming and logging led to reduction in city water supply; deforestation led to siltation and higher city water treatment costs; droughts led to crop loss and reduction in city water supply
  - Multiyear reforestation project (10% of watershed) by gov./nongov. groups
  - 2000: Tigum-Aganan Watershed Management Council established

Iloilo City and Province

- Decades-long struggle to manage watershed
  - 1994, 1996: Heavy rains caused Jaro River to flood city
  - 2006: Jaro floodway begun, designed for “20-year” floods, completed in 2010
  - 2008: Tropical storm Frank

Iloilo City and Province

- June, 2008: Tropical storm Frank
  - Very difficult to forecast track
  - Province received 1 month of rainfall in 1 day
  - 2.2 million m^3 soil eroded, 70 thousand trees uprooted
  - Flash floods worsened by breaking of natural dams and opening of artificial dams
  - 200 people killed, $28 million in damage


SANTA BARBARA
LEGANES
SAN MIGUEL
PAVIA
OTON
JARO
LA PAZ
MANDURRIAO
ILOILO STRAIT
CITY PROPER
MOLO
AREVALO
PANAY GULF
Republic of the Philippines
Iloilo City
COMPREHENSIVE LAND USE PLAN
LEGEND:
21 June 2008 Flooding "Typhoon Frank"
28 October 1996 Flooding
29 July 1994 Flooding
Inundated Areas
Main Road
Minor Road
Circumferential Road
Rivers and Water Bodies
District Boundaries
Territorial Boundaries
By-Pass Road (R4B2)
Foreshore Land Delimitation
Recorded Floods Map
SOURCES: CPDO & PAGASA
North
0 200 500 1000 1500 2500
SCALE 1 : 50,000 METERS
City Planning and Development Office
consultancy by: Palafox Associates

Iloilo City and Province

- Frank created ongoing problems
  - Thick layer of silt in city
  - Siltation of rivers in province reduced irrigation water by 40%
  - Pipeline to transport water from Maasin Watershed to city destroyed, reducing city water by 40%
  - Lack of water in city continues to this day

Iloilo City and Province

- Developments since Frank
  - Jaro River floodway completion
  - Esplanade along Iloilo River to control land use and remove informal settlers
  - DRRM plans incorporating climate change projections to 2028
  - Disaster training for medical professionals
  - Continued reforestation efforts
  - Increased spatial resolution in hazard maps

Iloilo City and Province

- Lots of progress, but risks still abound
  - 2012: Tropical storm Quinta caused flash flooding in province; 24 killed; $10 million in damage
  - Jaro floodway designed for “20-year” floods (e.g., Frank was “50-year” flood)
  - All major risks are still present and may increase

Iloilo City and Province

- City risks
  - Flash flooding
  - Inundation
  - Siltation
  - Saltwater intrusion
  - Land subsidence
  - Earthquake-induced soil liquefaction
  - Storm surge

Iloilo City and Province

- Province risks
  - Flooding
  - Topsoil erosion
  - Landslides
  - Crop and water supply security

Iloilo City and Province

- All of these risks are impacted by
  - Watershed land management
  - Shortage of risk accounting (ability to quantify risks to make planning decisions)

Just like the issues of informal settlements and governance/ politics, the issues of watershed land management and risk accounting affect the resilience of the whole Philippines

Conclusions

- We can increase “general resilience”, but we need to identify the major issues that increase risk across the board
  - Prevalence of informal settlement
  - Widespread patronage in politics and governance
  - Lack of long-term watershed land management
  - Shortage of ways to quantify risks and avoid them

Conclusions

- Case study method is useful for identifying these major risk areas and understanding how they contribute to local risk
- Many of these major risk areas are not specifically related to climate change
  - Useful way to broaden the tent on climate change adaptation
  - Climate risk provides a clear incentive to address long-standing social issues

Conclusions

- The strategy for making “general resilience” operational:
  - Local case studies to identify local risks and widespread risks
  - Compare major widespread risks from different case studies to understand their scope
  - Develop strategies (programs, teams, institutions) for reducing the impact of widespread risks