



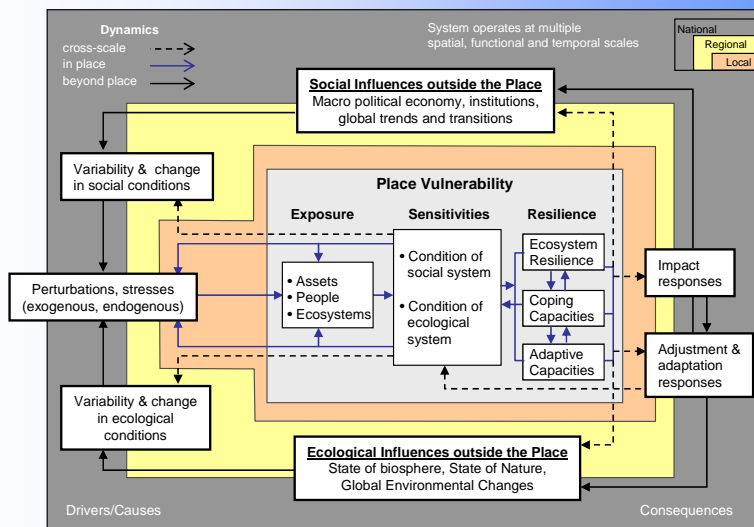
Capturing Vulnerability to Floods Brief Introduction

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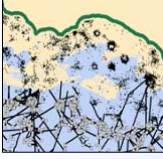
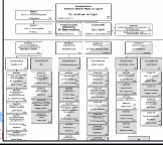


Conceptual Framework

Turner II et al. 2003. A framework for vulnerability analysis in sustainability science. *PNAS* 100:8074-8079. MODIFIED – Marion Damm



Key Dimensions of Vulnerability

Social Dimension
Vulnerability of different social groups,
Role of social networks (coping)

Economic Dimension
Vulnerability of different economic sectors and
critical infrastructure




Environmental Dimension
Environmental fragility (groundwater, land)
Dependency on environmental services

Institutional Dimension
Effectiveness and failure of structures and
institutions

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Ecosystem Services

Millennium Ecosystem Assessment, 2005

ECOSYSTEM SERVICES

<p>Supporting</p> <ul style="list-style-type: none"> ■ NUTRIENT CYCLING ■ SOIL FORMATION ■ PRIMARY PRODUCTION ■ ... 	<p>Provisioning</p> <ul style="list-style-type: none"> ■ FOOD ■ FRESH WATER ■ WOOD AND FIBER ■ FUEL ■ ... 	<p>Regulating</p> <ul style="list-style-type: none"> ■ CLIMATE REGULATION ■ FLOOD REGULATION ■ DISEASE REGULATION ■ WATER PURIFICATION ■ ...
LIFE ON EARTH - BIODIVERSITY		

CONSTITUENTS OF WELL-BEING

<p>Security</p> <ul style="list-style-type: none"> ■ PERSONAL SAFETY ■ SECURE RESOURCE ACCESS ■ SECURITY FROM DISASTERS 	<p>Basic material for good life</p> <ul style="list-style-type: none"> ■ ADEQUATE LIVELIHOODS ■ SUFFICIENT NUTRITIOUS FOOD ■ SHELTER ■ ACCESS TO GOODS 	<p>Freedom of choice and action</p> <p style="font-size: x-small;">OPPORTUNITY TO BE ABLE TO ACHIEVE WHAT AN INDIVIDUAL VALUES DOING AND BEING</p>
<p>Health</p> <ul style="list-style-type: none"> ■ STRENGTH ■ FEELING WELL ■ ACCESS TO CLEAN AIR AND WATER 	<p>Good social relations</p> <ul style="list-style-type: none"> ■ SOCIAL COHESION ■ MUTUAL RESPECT ■ ABILITY TO HELP OTHERS 	

Source: Millennium Ecosystem Assessment

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Weights and Aggregation

Agricultural

Exposure (E)

- % farmland (e_1)
- % employees (e_2)

Sensitivity (S)

- unemployment rate of district (sh)
- contamination potential (se_1)
- erosion potential (se_2)
- water quality index (se_3)

Resilience (R)

- Water storage capacity (er_1)
- Filter/buffer capacity (er_2)
- % perm. grasslands (er_3)
- GDP per capita district (c_1)
- GDP per capita FS (c_2)
- side business income (c_3)
- % organic farms (a_1)
- % protected areas (a_2)

$$I_d = \sum_{q=1}^Q W_q I_q$$

CI Vulnerability

Forestry

Exposure (E)

- % forested area (e_1)
- % employees (e_2)

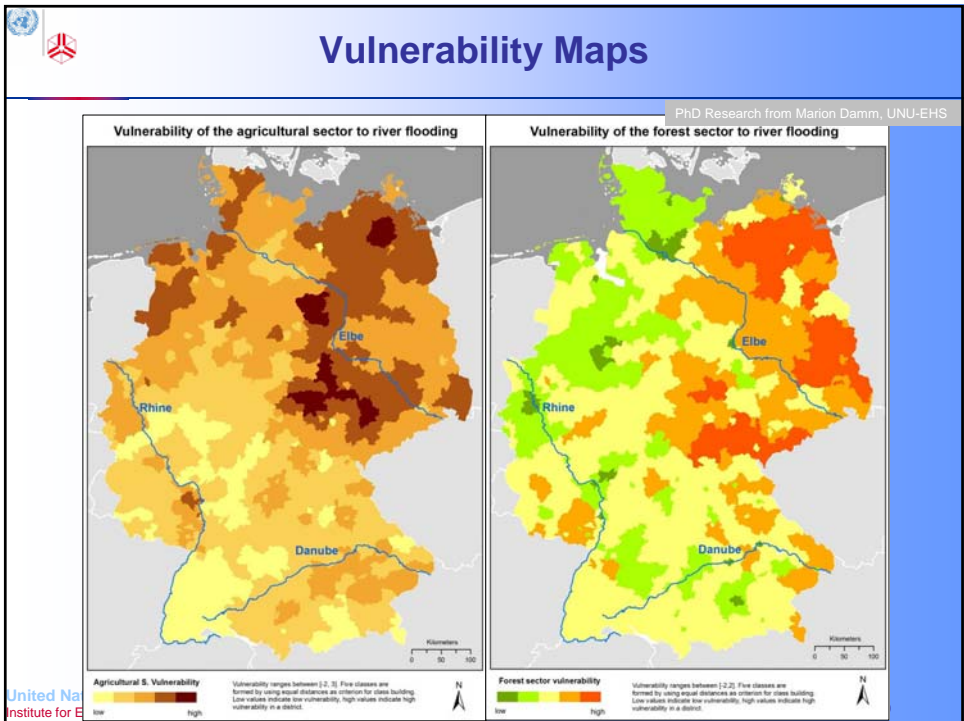
Sensitivity (S)

- unemployment rate of district (sh)
- % pre-damaged forest (se_1)
- water quality index (se_2)

Resilience (R)

- forest size (er_1)
- forest type (er_2)
- forest fragmentation (er_3)
- GDP per capita FS (c_1)
- GDP per capita district (c_2)
- mean annual income of households (c_3)
- forest growth rate (a_1)
- protected areas (a_2)

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Capturing Indicators – Participatory Approaches

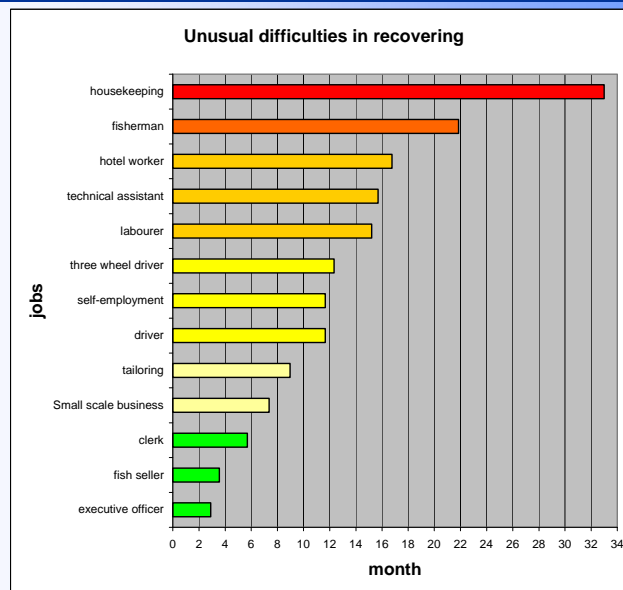


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Social Groups & Recovery



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Vietnam Importance of the Delta

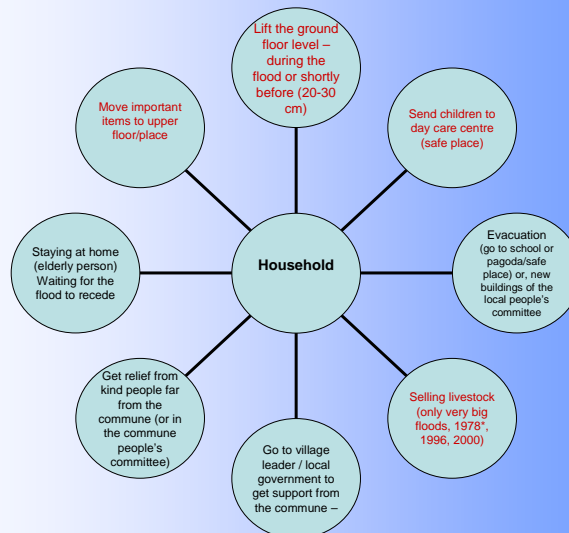


Image/Sensor: MODIS

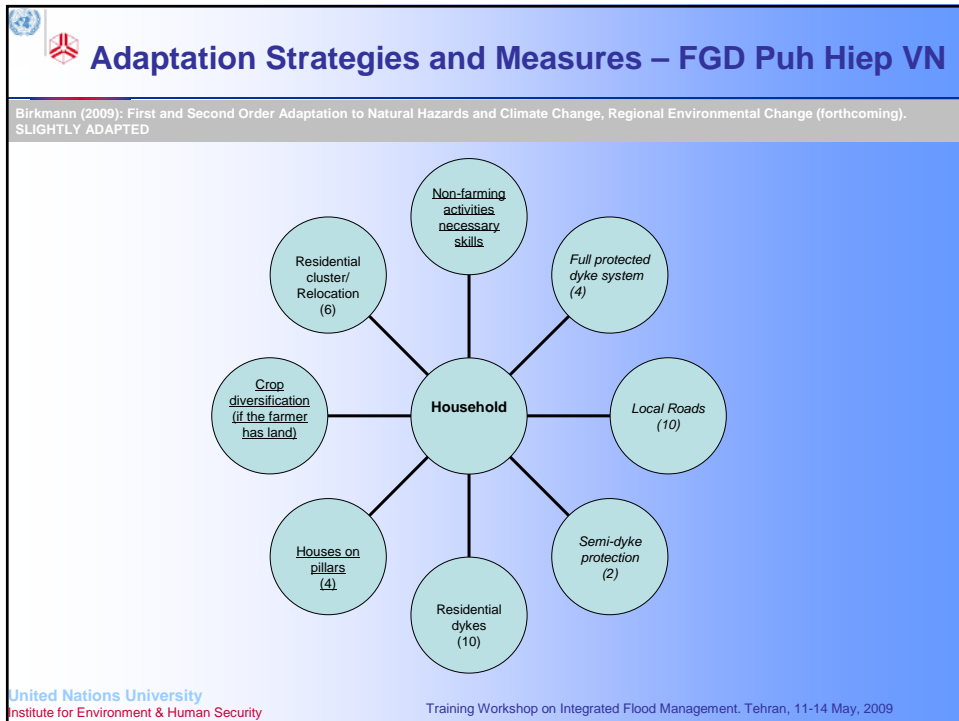
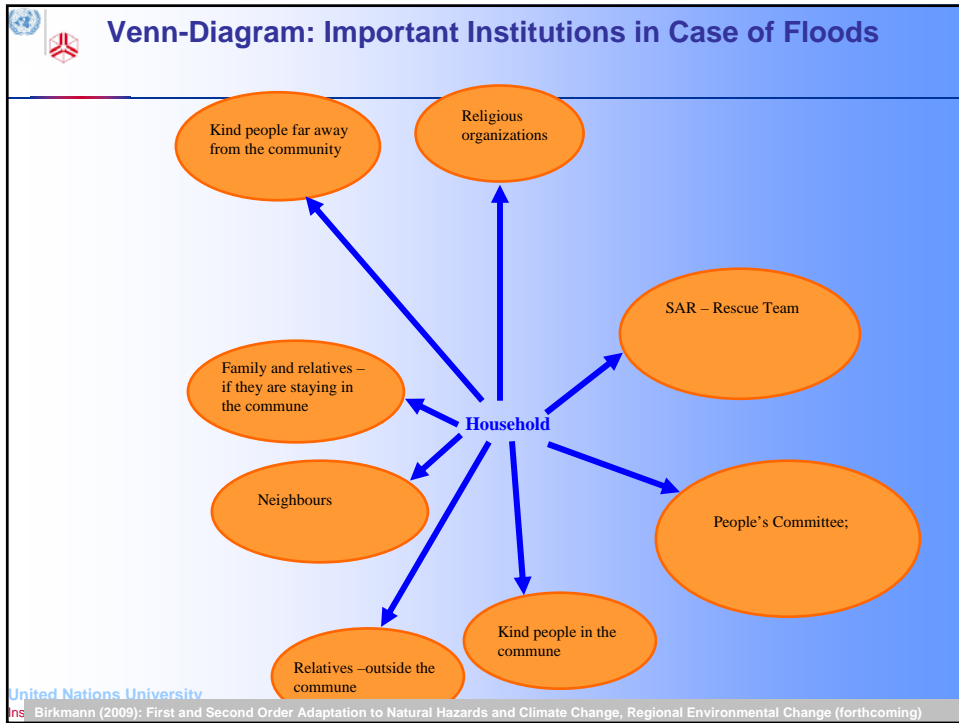
- 39,000 km²
- 18 million inhabitants
- 2/3 used for agriculture
- Supplies:
 - 50% of staple food
 - 50% fisheries
 - 60% fruit production
- For Vietnam as a whole, 1 m sea level rise means 10.8% of population affected (Dasputa et al. 2007, p30)



Coping with Floods – FGD Phu Hiep Commune VN



Birkmann (2009): First and Second Order Adaptation to Natural Hazards and Climate Change, Regional Environmental Change (forthcoming), SLIGHTLY ADAPTED





Thank You

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