Climate change vulnerability assessment in mangrove & coral reef ecosystems in Tanzania

Jason Rubens, WWF
PROJECT OBJECTIVES

1. to develop a generalizable methodology for vulnerability assessment in mangrove and associated coral reef ecosystems

2. to identify patterns of CC vulnerability & resilience in relevant ecosystems in project area

3. to identify and design appropriate adaptation strategies and activities

4. to build capacity in-country to promote effective vulnerability assessment and adaptation.
Identifying patterns of vulnerability

Vulnerability and resilience are a function of:

- Exposure
- Sensitivity
- Adaptive capacity
Identifying adaptation activities

Vulnerability and resilience are a function of:

- **Exposure**
- **Sensitivity**
- **Adaptive capacity**

Adaptation activities may:

- reduce exposure/preserve resilience
  - and/or
  - reduce sensitivity/preserve resilience
  - and/or
- enhance adaptive capacity
Climatic & not-climatic impacts on mangroves

Changes in precipitation upstream affecting hydrology, salinity & sedimentation

Rise in air Temp + CO2

Cutting, clearing aquaculture etc.

Sea level rise

Land-use, dams etc.

Tectonic activity?

Subsidence?
Methodological approach - Tanzania


5. Above tide elevation & land-use study

4. Stratigraphic coring study

1. Baseline & repeat field (plot) survey

2. Local knowledge survey
LESONS

1. There is no formula for conducting vulnerability assessments

2. Reliable trend data for key climate parameters is often not available

3. Downscale projections can provide useful backdrop but are ambiguous, theoretical and data dependent

4. No single study conclusively characterises CC vulnerability as vectors of change are multiple

5. Need to triangulate results from different studies
5. changes in vegetation over time can provide a proxy indicator of climate trends and impacts

6. but need to be interpreted with care

7. community-based assessments are necessary but not sufficient

8. quantifying severity of impact is important ... time-scales of CC impacts & livelihood concerns may not be reconciled
Rufiji-Mafia-Kilwa Seascape

Mangrove area = ~ 73,500 ha

Delta population = ~ 27,000
North Rufiji Delta mangrove survey sites

Loss of 25m of mangrove in 2 yrs

Slow colonisation by Avicennia

Slow accretion & vegetation change
Mangrove zonation in Rufiji Delta

Nine mangrove species present Tanzania (Kathiresan and Rajendran, 2005 and Wang et al., 2003), show distinct zonation (Taylor et al., 2003) with respect to tide levels. 

- Heritiera littoralis
- Xylocarpus granatum
- Bruguiera gymnorrhiza
- Ceriops tegal
- Rhizophora mucronata
- Sonneratia alba
- Avicennia marina

HWST

MSL
Unit blocks for remote sensing analysis - Tanzania
Vegetation change, Mawanda, Rufiji
Landsat May 1991 and June 2000
Landward core: mangroves well developed 1300 BP - high % of Rhizophora.

Since 900 BP, mangrove gradually declines then absent, giving way to *Pteridophytes* fern & grasses etc. Suggests either sea level in retreat after 900 BP OR deltaic progradation?
Community knowledge & perceptions

- Major shift of outflow patterns from south delta to north delta during 1960s and again 1978
- Major die-off of Heritiera during el Nino rains, 1998

- Getting hotter
- Humidity decreasing.
- Rainfall decreasing and more irregular
- Aware of sites of erosion and accretion but not of trends in sea levels
Coral reef resilience survey

Repeat surveys 2007 & 2009
27 sites in 2007
25 sites in 2005
17 sites repeat sites
34 sites total

Coral reef CC resilience indicators

1. Benthic cover – coral, algae, rubble
2. Physical factors
   - topographic complexity
   - cooling & flushing
   - temperature
   - shading & screening
   - acclimatization
3. Coral community - colony size, mortality, disease
4. Coral associates – fish community, bio-eroders
5. Direct anthropogenic pressures
   - water quality
   - fishing pressure
   - management capacity
Coral reef resilience analysis
Landward colonisation & land-use in Rufiji
Adaptation response

73 ha degraded areas replanted

Implications for future land-use planning in high tide margins