aquaculture and resilience

WorldFish Center, Penang, 15 January 2009

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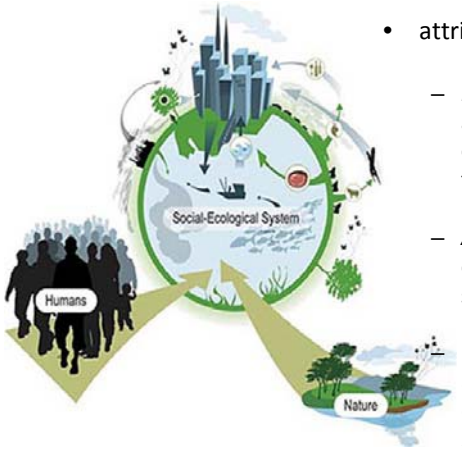
SES – a resilience perspective

human and ecological systems (SES) are dynamic, interacting & interdependent



source: http://www.albaeco.com/sdu/36/htm/main.htm

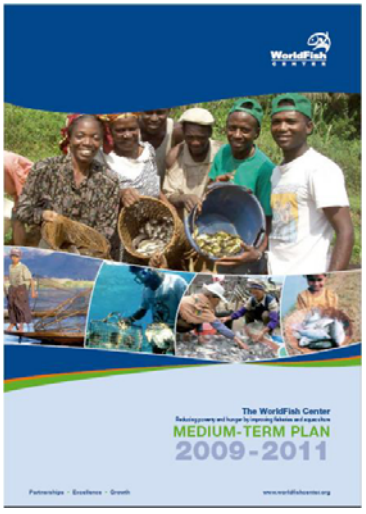
- attributes
  - *Resilience* - capacity of linked SES to absorb disturbances so as to retain essential structures, functions and feedbacks
  - *Adaptability* - regenerative capacity of ecosystems and capacity of social systems to learn and adapt
  - *Transformability* – the capacity to create a new system when ecological, economic or social structures make the existing system untenable

from Walker *et al.* (2004)

SES, resilience and development

- from a development perspective, it is increasingly widely recognized that it is critically important to understand resilience/vulnerability
  - how to build resilience of social systems and maintain ecosystem resilience
- ***… which brings us to aquaculture …***

Our Development Challenge for aquaculture



- provides food, nutrition and economic opportunity for those that need it most
- produces aquatic products in ways that do not store up environmental problems for the future
- uses land, water, food and energy wisely and efficiently to deliver the full range of benefits it is capable of
- is integrated into national economies in ways that maximize its development impact

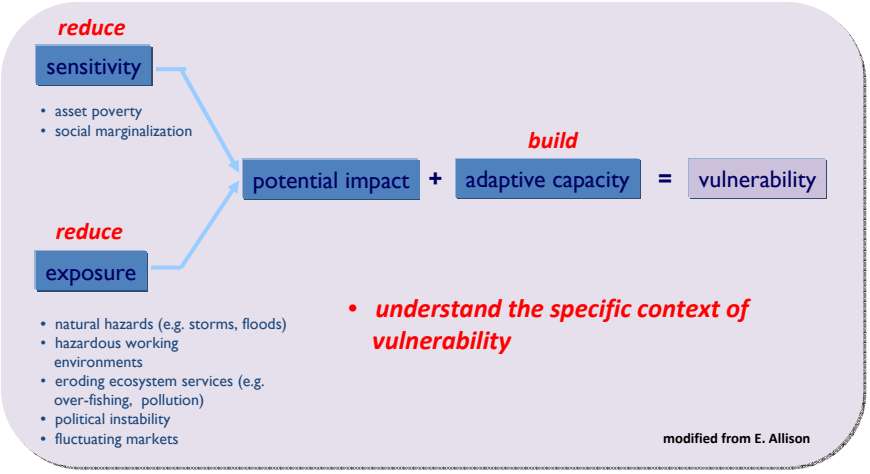
but ….

- can aquaculture increase resilience of vulnerable poor (MTP 4)?
- … and can it do so without impacting on ecosystem resilience (MTP 5)?
  - examples
  - conclusions
  - aquaculture and resilience in practice
  - the research challenge

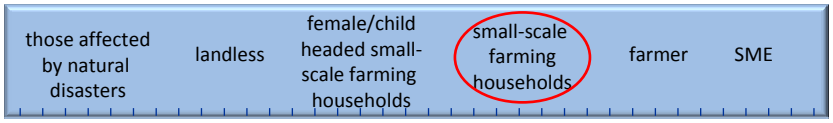
MTP 4
can aquaculture contribute to resilience of social systems?

resilience, vulnerability and social systems

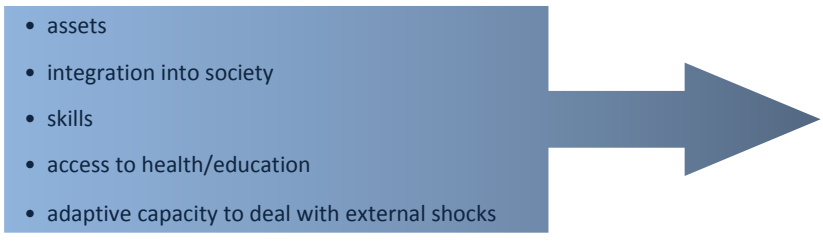
… some principles



vulnerability scale



context specific



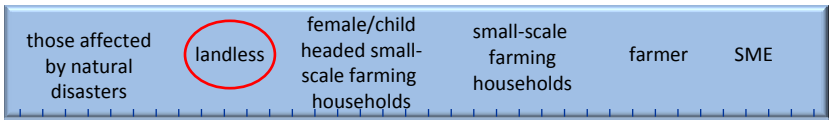
USAID DSAP, Bangladesh

- objectives
  - improve resilience of small-scale farmers through better technologies
- Sustainable Livelihoods approach
  - assess household capabilities and assets
  - optimize on-farm resource use
  - increase profits and food security
  - empower women
- tailor technologies
  - Participatory Action Research
  - NGO capacity building (500 staff)
  - build learning networks

USAID DSAP, Bangladesh - *outcomes*

- beneficiaries
  - 68,400+ households
- food security
  - >8200 t
- household-level benefits
  - production – 1542 to 3046 kg ha^{-1}
  - aquaculture income - $1130 to $2200 ha^{-1}
  - total farm income - 13% to 17%
  - fish consumption - 46 to 58 g $person^{-1}$ day^{-1}
  - empowered women

vulnerability scale



context specific

- assets
- integration into society
- skills
- access to health/education
- adaptive capacity to deal with external shocks

landless Adivasi, Bangladesh

Activity	Adivasi households
fish culture in ponds/ditches	1251
fish culture in rice fields	533
fingerling production in cages in pond/canal	493
fingerling trading	157
food fish trading	414
fish harvesting team member	756
habitat restoration	42
total	3646

- **skills, assets, livelihood diversification**

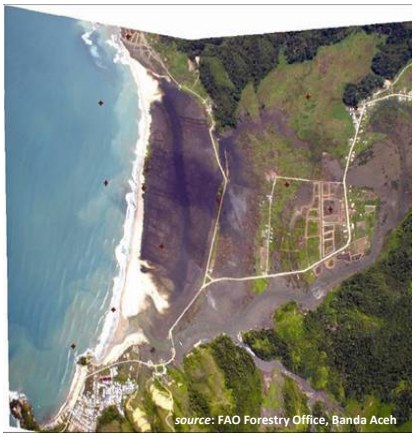
source: Benoy Barman, September 2008

vulnerability scale

context specific

- assets
- integration into society
- skills
- access to health/education
- resilience to external shocks

development of practice – *tsunami, Aceh*



Objectives

- increase community understanding of relationships between habitat restoration, livelihoods and resource management
- test and implement livelihood and management options
- identify livelihood status indicators for adaptive management and building of resilience

source: Alex Tewfik, Dedi Adhuri and colleagues

tsunami, Aceh - *approach*


Stakeholder workshop

- Phase I – *diagnosis*
  - focal groups, surveys, spatial analyses
- Phase II – *planning*
  - people-centered approach
- Phase III – *testing*
- Phase IV – *implement plan*
- Phase V – *reiteration*
  - awareness and capacity building
  - partnerships

where we are

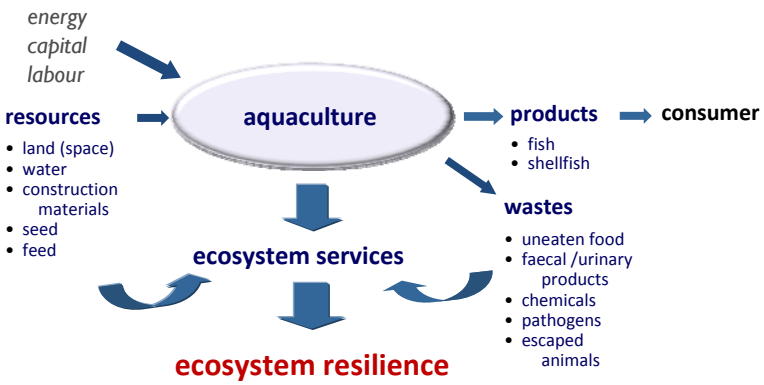
tsunami, Aceh - *activities*


mud crab fattening pens, Sampoinet Sub-District, Aceh

- traditional fisheries management support
- coastal re-greening
  - fisheries, agro-forestry, coastal defense
- post-harvest evaluation and support
- mud crab and lobster fishery assessment and culture
  - fish ponds and tambaks
- fish culture
  - modular cages

MTP 5
… what about aquaculture and the resilience of ecological systems?

aquaculture and the ecosystem



modified from Beveridge et al. *(1994, 1997)*

aquaculture and ecosystem resilience

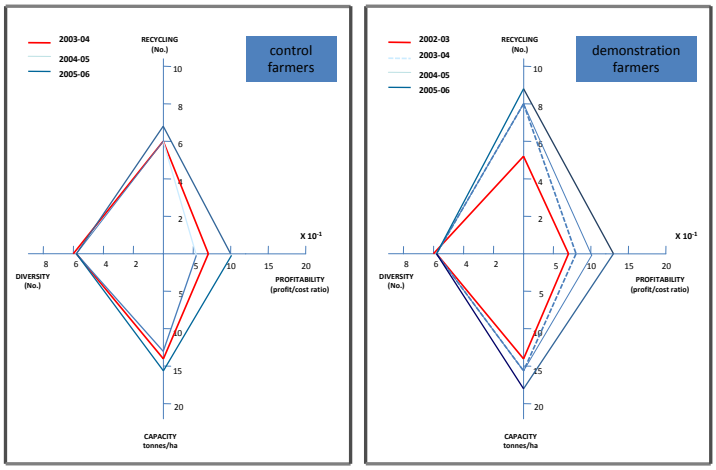
- context specific
  - the ecosystem
    - resilience
    - pristine or highly modified (e.g. agriculture)
    - other pressures
  - quantity and type of services used
    - aquaculture system
    - species
    - intensity of production methods
    - Management
  - governance

IAA and ecosystem resilience

- 20 years' research, semi-arid Malawi
  - low income, smallholder farmers (incl. HIV-AIDS affected households)
- objectives
  - improve food security
  - increase resilience to external forces
    - increased total farm production and incomes
      - drought years
    - greater diversity; higher value crops
  - increase resilience of agro-ecosystem

e.g. RESTORE™

- 5000 farmers; 22% increase per annum 1996 – 2001 (40% p.a. 2003-2006)



source: K M Jahan, WorldFish

Key points

- greater diversity of crops and recycling
- in drought years IAA farmers had smaller fall in production and profits
- greater resilience of IAA agro-ecosystems
- ***but how much water harvesting is sustainable?***

cage aquaculture and ecosystem resilience

- high ecosystem services demands
- changes to ecosystem structure and function
  - but can be managed to limit impacts on ecosystem resilience within agreed norms

$$\text{cage production (t)} = \left(\frac{[\Delta P] z_{\rho}}{(1-R_{cage})}\right) \times SA \Big/ P_{production}$$

where:

$[\Delta P]$	=	predicted increase in total P (µg l^{-1})
ρ	=	flushing rate (times per year)
R_{cage}	=	sedimentation coefficient = $1/(1 + 0.747\rho^{0.567})$
z	=	mean depth (m)
SA	=	lake surface area (m^2)
$P_{production}$	=	g P tonne caged fish production^{-1}

modified from Beveridge (1983, 2004)

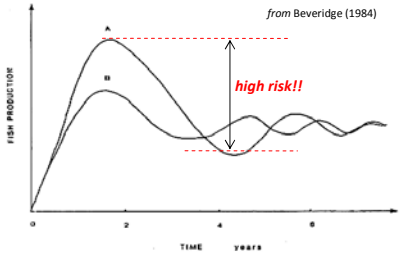
…or can it …?

conclusions

ecosystem resilience

- little research on resilience & aquaculture
  - most on ecological systems
  - much less on social systems
  - none on linked SES
- aquaculture is heavily dependent upon ecosystem services
  - system, species , methods, management
- … **but**, *if implemented well*, there is minimal impact on - or even an *increase* in - ecosystem resilience (e.g. agro-ecosystems)

social resilience



- aquaculture can build social resilience

but

- also increase social vulnerability
  - cage aquaculture …?
  - export-oriented aquaculture…?
- building resilience
  - understand causes of vulnerability
    - context and governance are crucial
  - focus on vulnerable individuals and on maintaining capacity of ecosystems to provide services

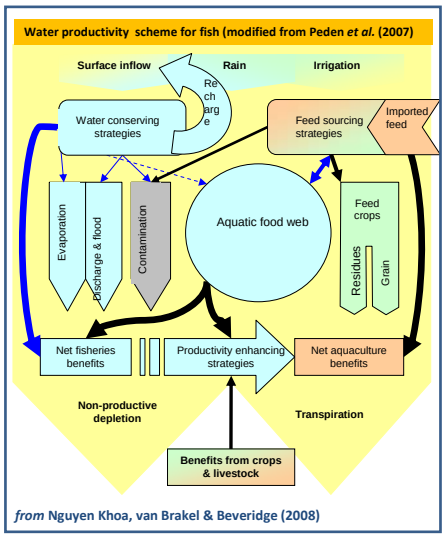
a resilience-based aquaculture research agenda

research – *on-going*

- field research platforms
- development of resilience theory and practice

Concepts	Country
Reducing vulnerabilities of post-disaster coastal communities	Aceh
Increasing resilience in drought-prone and HIV-Aids communities	Malawi
Increasing resilience of rural landless poor	Nepal, Bangladesh
Increasing resilience of rural poor farmers	Malawi, Bangladesh, Nepal, Vietnam
Vulnerability of small—scale farmed seafood producers to global markets	Asia
Development of a water productivity framework for aquaculture and fisheries	Egypt, etc.

aquaculture–SES resilience research priorities



MTP 1 Global Drivers of Change

- aquaculture and climate change

MTP 2 Markets and Trade

- influence of trade in aquaculture products on resilience of SES

MTP 3 Multi-level governance

aquaculture, governance and resilience of SES

MTP 4 Aquaculture Technologies

- aquaculture and water productivity
  - water productivity framework
  - multiple water use systems and social and ecological objectives (CP)

MTP 5 Aquaculture and the Environment

- cage aquaculture

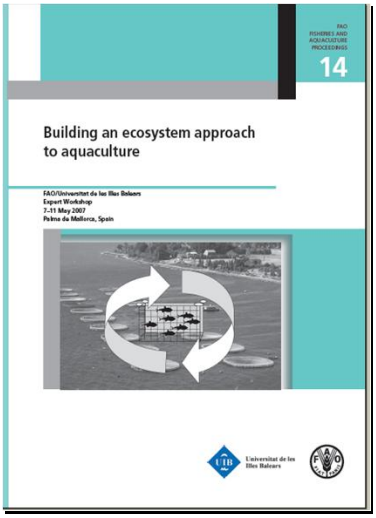
research agenda – *scale and scope*

- development of robust resilience theory around aquaculture and the development agenda
- development of practice for implementation of aquaculture to reduce vulnerability of SES

Research priorities
Intensification of aquaculture and resilience of SES
increasing the resilience of small-holder farming households in semi-arid, climate change-prone areas by incorporating aquaculture into sustainable agriculture practices
increasing the resilience of the coastal poor to external shocks by diversification of livelihoods into aquaculture
temporal and cross-scale trade-offs in resilience
cage aquaculture and resilience of SES in sub-Saharan African lakes
desirable social and ecological states: determining when transformation is appropriate

implementation

an Ecosystems-Based Approach



- definition
  - *'.. a strategic approach to development and management of the sector aiming to integrate aquaculture within the wider ecosystem such that it promotes sustainability of interlinked social-ecological systems'*
- FAO Technical Guidelines on the Implementation of an Ecosystem Approach to Aquaculture
- EC proposal for an Asian network on implementation of the Ecosystem Approach (*AENEAD*)
- *are they same thing…?*

thanks

Dedi Adhuri, Eddie Allison, Neil Andrew, Benoy Barman, Madan Dey, K M Jahan, Sophie Nguyen Khoa, Alex Tewfik, Max troell, Martin van Brakel

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