Living with Water & Building with Nature: Solutions for the Mekong River and Vietnam Coastal Areas

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Ni 2005
Geology and Soils formation

- Since -15,000 yBP sea level rised
- Sea moved towards inland from -15.000 to -6.000 yBP
- Then sea receded from -5,000 yBP to date (!?)
- When sea receded, sediment in water of the Mekong river deposited to form it’s delta; with 1M hecta in Cambodia and 4M hectares in Vietnam. Sedimentation continued to date (Tsukawaki, 2005)
- Soils were formed by sedimentation in fresh-brackish-saline water.
Different soil layers

- Sediment > 15,000 yBP (old sediment)
- Marine sediment deposited in 15,000-5,000 yBP
- Sediment contain pyritic materials in 5,000-3,000 yBP
- Fresh water sediment (<3,000 yBP)

Sea water level rise

Sea water level recede
Major soil types: acid sulphate soils (ASS) 1,590,000 ha; saline & potential ASS 1,080,000 ha; alluvial soils 1,100,000ha; the remain soils are mountainous and peat soils
There are two seasons, the rainy and the dry in the MD of Vietnam,

- The rainy season lasts from May to November (supplied 80% of rainfall)
- The dry season lasts from December to April.

Source: Sanh et al. (1998)
Flood areas of Cambodia and Vietnam
Flows of Mekong river and Tidal movement at the coastal areas

Low Tide

High Tide
History & Development
Disturbance to soils & water

• Canal construction:
  – Prior 1772: no man made canals
  – 1772 to 1874: by man labors
  – 1874 (French colony) onwards: by machines

• Regional dike construction:
  • Prior 1978: no regional dikes
  • 1978 semi-dike: prevent flood water from June-August (August dike) to protect the second paddy rice crop (Summer-Autumn) and then water over flows dike after rice harvested
  • 1990 onwards: closed dike prevent flood water entire the wet season (May-November) for paddy rice intensification (7 crops per 2 years!)
Semi regional dike from December to August (left) and August to December (right).

With closed dike, farmers can apply 7 crops of paddy rice per two years. Rice yield increased from 3 ton/ha/year (one crop with traditional rice variety) to 20 ton/ha/year (3.5 crops with high yielding varieties).
Herbicides sprayed during the Vietnam war on the Mekong Delta (1965-1971)

Disturbance to land covers

Fire for agricultures

Ponding for aquacultures
Land Uses
Major habitats in the Mekong Delta

**Rural area:**
- 83% of area (32,200 Km²)
- 70% population (13M)
- 100% food products

**Urban area:**
- 10% of area (4,000 Km²)
- 30% population (5M)
- 100% industrial products

**Forest area:**
- 7% of area (2,800 Km²)
- 100% replanted forest
- Biodiversity reserves
Land uses often depend on: topography, soils, water, policies, and economy.
Land uses depend on topography and water

- Aquaculture
- Rice/fish
- Irrigated rice

High tide
Low tide
Land uses (shrimp) depends on policy changes

The Government Decision No. 09 in June 2000, officially allowing diversification of land with low rice productivity into aquaculture or other uses.
A cross-section of land uses

- Melaleuca forest
- Depression area
- Irrigated paddy rice
- Canals
- Rivers
- Fruit trees
- Old settlement
- Rainfed paddy rice
- New settlement
- Aquaculture
- Coastal mangrove forest
- Sea

(modified from Tuan, 2009)
In the coastal zone: Intensive shrimp farming
In the fresh-saline water interface zone

Rice farming only

Rice_Shrimp farming
In the fresh and shallow water depth zone, cultivation is occurred whole year round.
Closed dikes allow farmer applied 7 rice crops per two year (3.5 crop/year!) in the deep flooded zone.
The Mekong delta contributed to Vietnam exporter of:
Catfish: 1\textsuperscript{st} (~1 M ton/yr); Rice: 2\textsuperscript{nd} (~7 M ton/yr) and shrimp: 8\textsuperscript{th} (~2.5 M ton/yr)
Threats
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Global threats

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75 per cent of the population affected by a 1 meter rise in sea level on the Asian megadeltas and deltas.
Salt water intrusion into the Mekong delta of Viet Nam in 1m of sea level rise scenario! (MONRE, 2009)

Flooding from September to November yearly

Source: MONRE 2009

Source: Triet 2003
Flow contribution:

- China 16%
- Myanmar 2%
- Thailand 18%
- Lao PDR 35%
- Cambodia 18%
- Vietnam 11%

Regional threats
Trends of water and sediment loads to the Mekong Delta

Water sources is reducing during last decade

Sediment content (g/m$^3$) has little variation but total sediment loaded to the Mekong delta is decreasing due water source is reducing!

Pink: at Tan Chau station
Blue: at Chau Doc station
Existing or planned dams on the Mekong river

Hydro-power dams on the Mekong river:
- Existing
- Under construction
- Planned
1. Habitat alteration

Cutting mangrove forest for aquacultures (shrimp farming) in the coast

2. Pollution & over-exploitation
3. Diseases & Invasive species

Apple snails

Mimosa pigra
4. Urbanization

Source: Thanhnien 2010

5. Social inequality
Adaptation
The first approach (A) is to use legislation to control over-exploitation or to prevent “unwanted migration”. The second (B) is the provision of direct assistance (land, credit, house) in order to prevent poverty worsening. The third approach (C) is adaptation by providing technologies for alternatives incomes and education to build human resource.
Technology assistance
1. On the coast: Reduce shrimp farming and replant the mangrove forest

The current land uses and it’s products

Direct incomes for the local people

Need technology support for replanting mangrove forest on extreme saline soils, strong wind and waves, high erosion. Need to link direct incomes for the local people and environmental conservation.
2. In extreme salty areas: Restore biodiversity

Need technology support to restore sea grass (*Scirpus littoralis*) in intensive aquacultures; need to integrate shrimp (*Penaeus monodon*), mud crab (*Scylla olivacea*), Tilapia (*Oreochromis niloticus*) or elongated goby (*Pseudapocryptes elongatus*): They are all salt-resistant species.
3. At the salt & fresh water interface: Shrimp_Rice farming model

Need technology support to restore the original habitats (Shrimp_rice farming model): Salt tolerant rice varieties (>5g/L); reconstruct water supply systems (irrigation, dykes, sluices, water quality control, water treatment, sedimentation). This model restored fresh water and sediment loaded to the field.
4. In drought prone areas: Rice + Fish farming model

Drought caused by intensive mono paddy rice cultivation

Need technology support to restore water (Rice + fish farming model): Drought tolerant rice varieties; reconstruct water supply systems (reservoir, irrigation, dykes, sluices, water quality control); the fish pond functions as a reservoir to supply water for the rice crops when drought happens.
5. In acid sulphate soil areas: Rice - *Melaleuca* model

Intensive rice farming decreases water pH of the river!

Need acid tolerant rice varieties, acid water treatments, reconstruct irrigation and drainage water systems, new materials (to replace cement and iron) to resist acid water (pH<3), new organic fertilizers (micro-organisms adapted to low pH). The forest functions as a sink and filters acidities while containing floods for irrigation in the dry season (reservoir) and reserved biodiversity.
6. In flood areas: Netting aquaculture model

Theses models allowed water and sediment loaded to the fields. Need technology management (new materials and techniques for dykes, sluices) to safeguard transportation and livelihoods during flood season; need to optimize sluice operation for irrigation, new sediment deposition, reduce pollutant accumulation and renew the environmental habitats for sustainable production.
8. The closed dikes: should manage for two months (September to October) for flood water re-enter the land (washing toxicities, re-load sediment, open feeding fish area...)

Without dike

With closed dike

Tuan 2010
9. Local experiences and cultures: living with water

Floating market

House can move up when high water level occur!
10. **Diversify infrastructures**: water flows through

- Traditional house on ground
- Adapted on sticks
- Sky way allowed water moving on the ground
- Floating house on fish cage

Ni 2009
Education
Exchange Knowledge
Teaching organic farming at schools (lefts) and practices at farms with the farmers (right).

KUA model
Knowledge-Understanding-Application

Locally

Ni 2005
3rd: Signing Ceremony - Extension of Agreement on Academic Cooperation among 18 members: 03 March 2013 at Cantho University, Vietnam

1st, 1 – 26 June 2003, Vietnam (25)

4th, 12 July–1 August 2006, Cambodia (25)

The University Network for Wetland Research and Conservation Trainings in the Mekong Region
To date, the Wetland university network has organized 10 regional training courses, visited more than 30 important wetlands in 5 countries and trained 224 participants; the wetland ecology subject has been taught in BSc and MSc academic programs.
E. Barran (2009)

Gaps to minimize!

Mekong Delta plume to East Sea
Conclusions

• The objectives of management of land, water and living resources are a matter of societal choice;

• Technologies should assists peoples to sustained use of their land, water and living resources;

• Sustainable planning assists to reduce population and improve education;

• Gaps to minimize:
  ✓ The Mekong Delta is a part of the Mekong Basin and East Sea!
  ✓ Sustainable development of the Mekong Delta is not sustain only Vietnam!
Thank you for your attention