Sediment: double edged sword?

Unwanted outcome of inappropriate land management
Sediment generation drastically increased
Sedentary based farming systems
Over exploitation of forest resources
Slash-and-burn
Changed land use and vegetation
Deposition in dams

Coastal protection of deltas
Sediment is vital to primary production
Sediment is vital to the growth of deltas
Sediment is vital to high level of agriculture productivity
– or a shield?

Preserving Ecosystems
Provides nutrients to Agriculture
Provides nutrients to Freshwater Fisheries
Provides nutrients to Marine Fisheries
Reduces bank erosion
Prevents algae bloom by blocking light
Preserves the delta
Provides costal protection
What is sediment?

**Sediment** is naturally-occurring material that is broken down by processes of weathering and erosion and is subsequently transported by the action of fluids such as wind, water, or ice, and/or by the force of gravity acting on the particle itself.

Grain size:
Gravel
Sand
What is silt?
>70% of suspended load in the Mekong is silt
Transport by water

Primary production

N P K Ca...

equilibrium

Dissolved Load

Suspended Load

Bed Load
1h 45min

Suspended load
Tonle Sap–Mekong Confluence
Provenance: Precipitation and slope creates sediments
From Local Watershed Management to Integrated River Basin Management at National and Transboundary Levels

09 March 2011, Chiang Mai

High land

UMB

160 mill T/y

Key
- Mekong mainstream
- Tributary
- Streams Order
  - 1st Order
  - 2nd Order
  - 3rd Order
  - 4th Order
- Catchments with uncontrolled rivers (3 m cfs)
- Agglomerates of small catchments (in concentric)
Deposition Riverbed / Alluvial plain – Give and Take

Channel changes at Chaktomuk Junction between 1992 and 2004
Deposition Tonle Sap

~1 mm/y
Deposition
Flood plains

~1 mm/y
~ 40,000 km²

20.09.2008
Groundwater: Varies with flooding

Replenished during the wet season
Deposition Coastline

Upper delta plain
- Floodplain
- Backswamp
- Swamp
- Marsh
- Hood plain

Lower delta plain
- Coastal plain
- Mangrove marsh
- Sand dune/beach ridge
- Tidal flat
- Sand spit

Fluvial
- Natural levee
- Point bar
- Channel bar

Other
- Salt marsh
- Abandoned channel
- Alluvial apron
- Late Pleistocene deposits
- Basement
- Weathered basement

Bathymetry (meters)
Temp increase 4-6 Deg C?

Climate change:
Increased temperature

Snow cover trend
1990-2001

SW monsoon
Mean monthly discharge (cumecs)

Mean monthly snowmelt contribution at Chiang Saen

- Chiang Saen
- Snowmelt
- Proportional snowmelt contribution

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Climate change: Increased variability

**Figure 10.** Mekong at Vientiane: water levels between January 2009 and February 2010 compared with their long-term average and those of 1992/93, previously the lowest on record.

More water -> more sediment, less water -> less sediment

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Human activities: Land coverage

<table>
<thead>
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<tbody>
<tr>
<td>Cambodia</td>
<td>&gt;70%⁴</td>
<td>&gt;70%⁴</td>
<td>67%¹</td>
<td>53%⁴</td>
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<tr>
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<td>47%¹</td>
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<td>Burma</td>
<td>58%³</td>
<td>-</td>
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<tr>
<td>Yuman</td>
<td>55%⁶</td>
<td>-</td>
<td>-</td>
<td>33%⁶</td>
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Change in forest cover over continental SE Asia from the 1960’s to 2000.

..no evidence of any overall change to the mainstream flow regime in the direction that would suggest the impacts of deforestation. Lower mean annual flows post 1984 confirm that these decades were generally drier...
Human activities: Land cover change
MB Catchment area 795,000 km\(^2\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Catchment Area. km(^2)</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
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<tr>
<td>Average flow</td>
<td>✓</td>
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<tr>
<td>Peak discharge</td>
<td>✓</td>
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<tr>
<td>Base (low) flow</td>
<td>✓</td>
</tr>
<tr>
<td>Sediment and nutrient load</td>
<td>✓</td>
</tr>
<tr>
<td>Water quality (eg pesticides, salinity)</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ observable impact.  × no observable impact

The spatial dimension of land use effects on catchment hydrology and water quality. Adapted from Kiersch. (2001).
Human activities: Hydropower dams

Cumulative trapping efficiency: Depends heavily on dam construction and operation,
…..but
Reduction in sediment loads due to sediment trapping by dams upstream pose a major threat to the stability of the Mekong River delta coastline in the near to mid-term future.
Human activities: Mining

Reduction in sediment loads due to mining of the riverbed for sand and gravel in Cambodia and Vietnam pose a major threat to the stability of the Mekong River delta coastline in the near to mid-term future.
Human activities: Infrastructures:
Highways, railways, power grid, irrigation infrastructure…
Irrigation infrastructure

Irrigation now ~10%
Expanded Irrigation ~10%
Dams ~10%

Sum 30%

May Change the hydrology
May Reduce ground water
Will change the sediment flux

MB: 475 km$^3$ water / y
Watershed Management issue that may be most important at a macro scale (national and trans boundary (MB))

maintaining a near natural sediment flux

as a shield against

bank erosion,

delta degradation,

coastal erosion

and

nutrients losses leading to

reduced freshwater fish productivity,

reduced agriculture productivity and

reduced marine fish productivity.

Please visit MRCS Portal: http://portal.mrcmekong.org/

09 March 2011, Chiang Mai