The impact of Coastal erosion on Bangkok-area of Gulf Thailand

By:

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Tidal Flooding in 2009, Samut Prakarn

Land subsidence in the Papradeang area (2010)

Land price is now continuing remained about ¼ of the last ten year price (2010)
The 30 Hot Spot of coastal erosion in Thailand and Prioritization of severity of areas affected by coastal erosion.

Present status of Coastal erosion in Thailand:

Total coastline about 666 kilometers, cover 3 provinces along the coastline, or 136 districts along coastline, or 807 sub-districts along coastline.
The situation of coastal erosion in the upper Gulf of Thailand

<table>
<thead>
<tr>
<th>Total coastline distance (km)</th>
<th>Coastal erosion distance (km)</th>
<th>Erosion distance (km)</th>
<th>Erosion distance (km)</th>
<th>Severe Erosion Rate (11-30 m/yr)</th>
<th>Moderate Erosion Rate (1-10 m/yr)</th>
<th>Total areas of coastal erosion in 30 year (Rai)</th>
<th>Total tidal mudflat areas of coastal erosion in 30 year (Rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td></td>
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</tbody>
</table>

The table above provides a detailed analysis of coastal erosion in the upper Gulf of Thailand. It includes the total coastline distance, coastal erosion distance, and the areas affected by severe and moderate erosion rates. The table also indicates the total areas of coastal erosion and total tidal mudflat areas affected over a 30-year period.
Tidal mudflat 5,000 m.
Landward Erosion 3,000 m.

Tidal mudflat 2,500 m.
Landward Erosion 1,000 m.

Tidal mudflat 2,000 m.
Landward Erosion 600 m.
Causes of Coastal erosion in Upper Gulf of Thailand by:

1) Due to over pumping of groundwater in Bangkok Metropolitan Areas, resulting in Land subsidence in the coastal areas is about 1-4 cm/yr in the Chao Phraya Delta (JICA 1993).

2) Due to the upstream damming, reduction in sediment inflex to the Gulf of Thailand by about 18.7 million ton/yr (or about 75% decrease).

3) Increasing of sea-level rise in the Gulf of Thailand of about 30-60 cm/decade due to the global warming.

4) Increasing of coastal erosion by inappropriate resolutions and over structural measure in the coastal areas like; Groin, Seawall, Rubble mound protection, and Sand Sausage Breakwater.

5) increasing wind/wave of 2 times more during Monsoon Season and Tropical Storm due to the global warming.

6) Decrease of mangrove forest areas in the coastal areas.

7) Causes of erosion by landuse patterns of coastal areas.
1) Due to over pumping of groundwater in Bangkok Metropolitan Areas, resulting in Land subsidence in the coastal areas is about 1-4 cm/yr in the Chao Phraya Delta (JICA 1993).
Effects of land subsistence factor to the coastal erosion rate
Land subsidence data at the king Chulalongkorn fortress from 1977 to 1997 (2542)

Map of Coastal erosion at the King Chulalongkorn fortress due to the effect of land subsidence
Emerging evidence of relative sea-level rise of 1 meter by tidal flood at Wat Khun Samutjeen (March 2005)
Emerging evidence of relative sea-level rise at Bang Khun Thien area by the Bangkok Landmark in the sea, originally on land margin, but now located about 1,000 m. offshore.
Evidence of land subsidence in the Bang Khun Thien Area (March 2005)

Earth dike along the road due to land subsidence, affected to inundation of the coastal areas in the upper Gulf of Thailand
Evidence of Land subsidence in the Papradeang Area (October 2010)
2) Due to the upstream damming, sediment yield of Chao Phraya river basin at Nakhonsawan station. The data are presented in this figure, showing a decrease in mean total yield of 25.3 million ton/yr in the period till 1972 down to 6.6 million ton/yr in the period beyond 1972. This is a reduction in sediment yield by about 18.7 million ton/yr (or about 75% decrease). The Bhumipol dam became in operation in 1965 and the Sirikit dam in 1972.
Due to the upstream damming and water Resources development, Discharge of Chao Phraya river at Ayuthaya Station. The data is presented in this figure, showing a decrease in annual maximum discharge of about 60% decrease after the Bhumipol dam and the Sirikit dam became in operation in 1972.
+ Comparison of shoreline between 2340 and 2399, the shoreline changed about 4 Km. within nearly 60 years (or at the accretion rate about 60 m/yr)

+ Comparison of shoreline between 2399 and 2503, the shoreline changed about half a kilometers within 104 years (or at the accretion rate about 5 m/yr)

+ Comparison of shoreline between 2503 and 2533, the shoreline changed at the erosion rate about 12 m/yr)

+ Comparison of shoreline between 2533 and 2545, the shoreline changed at the erosion rate about 30 m/yr)
3) Increasing of sea-level rise in the Gulf of Thailand of about 30-60 cm/century due to the global warming.
4) Increasing of coastal erosion by inappropriate resolutions and over structural measure in the coastal areas like; Groin, Seawall, Rubble mound protection, and Sand Sausage Breakwater.
5) increasing wind/wave of 2 times more during Monsoon Season and Tropical Storm due to the global warming
Causes of erosion by wind/wave during Monsoon Season and Tropical Storm

Monsoon Season in Thailand
- Eastern coast of Gulf of Thailand (SW-May to Oct)
- Upper Gulf of Thailand (S-Mar to Apr, SW-Mat to Oct)
- Lower Gulf of Thailand (NE-Nov to Jan)
- Andaman Sea (SW-May to Oct)

Tropical Storm in Thailand
- Eastern Coast of Gulf of Thailand (Typhoon-Aug to Dec)
- Upper Gulf of Thailand (Typhoon-Aug to Oct)
- Lower Gulf of Thailand (Typhoon-Oct to Dec)
- Andaman sea (Cyclone-May)
การเปลี่ยนแปลงทิศทางและความเร็วลมในช่วงลมมรสุมระหว่างปี พ.ศ. 2524 - 2546

ทิศทางลม ของ NE monsoon ทิศทางลม ของ SW monsoon
ความเร็วลม ของ NE monsoon ความเร็วลม ของ SW monsoon
6) Decrease of mangrove forest areas in the coastal areas
7 ) Causes of erosion by landuse patterns of coastal areas

Coastal landuse along the shoreline of Samut Sakorn

25 1 2005
The relationship between relative sea-level rise and coastal erosion rate in the Upper Gulf of Thailand

controlling factors by:
1) Land subsidence
2) Global sea-level rise
3) reduction in sediment inflex
By the Sediment Budget Methods:
To model reliable the three-dimensional situation, a full sediment budget needs to be calculated for the coastal segment being considered. This involves estimation of all inputs by littoral drift, onshore-offshore transport, losses to inlets etc (Everts, 1985; Komar et al, 1991; cox, 1968; Dean, 1991)

\[ R = 2Y(S + S_G + b + L - G) \]

Where:  
\( R \) = Predicted shoreline recession  
\( G \) = Gross Sedimentation  
\( N \) = Net Sedimentation  
\( S \) = Eustatic sea-level rise  
\( S_G \) = Sea-level rise by global warming  
\( b \) = Basin subsidence  
\( L \) = Land subsidence  
\( Y \) = Year in the future

Note: Eustatic sea-level rise = 1-1.2 mm./year (Fairbridge, 1966)  
: Basin subsidence = 0.5 mm./year (Somboon, 1990)  
: Gross sedimentation rate = 4.2 mm./year (Somboon, 1990)
Relationship between the land subsidence, sea-level rise, sediment influx, and coastal erosion in the Upper Gulf of Thailand

<table>
<thead>
<tr>
<th>Areas with subsidence rate (mm/yr)</th>
<th>Rate of Coastal Erosion by the three main controlling factors (m/yr)</th>
<th>The future erosion distance in the upper Gulf of Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>by land subsidence (av. 76.6%)</td>
<td>By global sea-level rise (A1F) (av. 16.2%)</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
<td>7-7.8</td>
</tr>
<tr>
<td>15</td>
<td>25</td>
<td>7-7.8</td>
</tr>
<tr>
<td>20</td>
<td>35</td>
<td>7-7.8</td>
</tr>
<tr>
<td>25</td>
<td>45</td>
<td>7-7.8</td>
</tr>
</tbody>
</table>
Relationship between the effects of relative sea-level rise and coastal erosion in the Upper Gulf of Thailand

△ Rate of land subsidence (mm/yr)

♦ Rate of relative Sea-level rise (mm/yr)

<table>
<thead>
<tr>
<th>Relative sea-level rise (mm/yr)</th>
<th>Erosion rate (m/yr)</th>
<th>Erosion of the next 20 years (m)</th>
<th>Erosion of the next 50 years (m)</th>
<th>Erosion of the next 100 years (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>26.3</td>
<td>526</td>
<td>1,315</td>
<td>2,630</td>
</tr>
<tr>
<td>20</td>
<td>46.3</td>
<td>926</td>
<td>2,315</td>
<td>4,630</td>
</tr>
<tr>
<td>25</td>
<td>56.3</td>
<td>1,126</td>
<td>2,815</td>
<td>5,630</td>
</tr>
<tr>
<td>35</td>
<td>76.3</td>
<td>1,526</td>
<td>3,815</td>
<td>7,630</td>
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</table>
How can the coastal areas of the upper gulf of Thailand region respond to the predicted shoreline recession?
Green Belt Barrier “Kong Thale”
Permeable breakwater Barrier “KSC 49A2”
Mangrove Belt
Tidal flood protection by road and dyke system
Sea-Level rise
Green-Belt Barrier

ถนนริมชายฝั่งป้องกันน้ำทะเลท่วม ชุมชนในอนาคต
Tidal flood protection by road and dyke system which construct above the recent ground level of 2-3 meters.
The concepture development of the Green belt barrier (Kong Thale) for protection of future relative sea-level rise in the upper Gulf of Thailand
Thank you