Background

Coastal management should be wisely done as a part of watershed management.

Typologically, a coastal area has high flood hazard:
- can be lower than mean sea level
- become an area of river estuary

In the disaster risk management, the risk caused by flood can be minimized by mitigation actions started with analysis and mapping vulnerability of element at risk.
Method

Study area: downstream of Ciasem watershed

Administratively: Muara Village, Blanakan Subdistrict, north coastal region of Subang District

Materials: digital topographical map, high-resolution satellite imagery, soil sampler rings, soil drill, GPS, clinometer, computer, and field equipment.

Tidal flood hazard area:
- mapped using iteration (looping) technique using ILWIS 3.4 software.
- Soil permeability of undisturbed soil samples to characterized the length of inundation

River flood hazard area:
- Identified by hydrological modeling based on elevation, slope, and river characteristics
- Tools: hydrological tools (HEC-geoRAS and HEC-RAS) in ArcGIS 10.1 software
- Elevation points were derived from detailed topographical map
- Cross sections of Ciasem River: 6 points of river station (RS); point 6 is at the upstream and 1 is the downstream
- Input: river discharge at 6th point
- Output: floodwaters characteristics such as the extent, depth, and current speed
Result

In the Muara village, flooded area caused by tidal flood or river flood mainly were in kampong Sindang Laut 1 and Sindang Laut 2. Physical vulnerability assessment were focused on the element at risk in both kampons.

The land use of those kampons was dominated by fish pond. Settlement areas were located around Ciasem river bank together with paddy field.
Tidal flood hazard

- Affected by sea water level rising due to daily tides, rising of sea wave height, or a combination of both
- The lowest sea water height was 13 cm and and the highest was 112 cm (Tanjung Priok tidal station)
- The wave heights : 2 - 3 m; maximum 6 m (BMKG)
- Tidal flood was simulated started with 10 cm rising of sea water level. At the 160 cm, the whole area of kampong Sindang Laut 1 and Sindang Laut 2 would inundated
- Inundation was started in the northern region and the rising of 70 cm was begun to inundate the western area
- Settlements were inundated after sea level rising reach 90 cm
### Area inundated by tidal flood for each land cover

<table>
<thead>
<tr>
<th>Sea water rising (cm)</th>
<th>Bush/schrub</th>
<th>Fish pond</th>
<th>Swamp forest</th>
<th>Settlement</th>
<th>Paddy field</th>
<th>Total</th>
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<tbody>
<tr>
<td>10</td>
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<td>153.3</td>
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</table>
Fish pond was the largest area of elements at risk inundated by tidal flood

Paddy fields was also an element that widely affected by tidal flood → many farmers have converted their paddy fields into fish ponds due to tidal flood events are getting worse from year to year

River flood hazard
In the 1st scenario, seven profiles (PF 1 - PF 7) has been tested using streamflow discharge input respectively 5, 10, 20, 40, 80, 160, and 382 m$^3$/s. The last profil value (382 m$^3$/s) was the discharge of 2 year flood return period.

HEC-RAS output showed that the river flood began to occur in the profile 6 (debit = 160 m$^3$/s), which occurs in the area around the river station (RS) 5 as

The affected element at risk were paddy fields, fish ponds, and settlements.
• In the 2\textsuperscript{nd} scenario, six profile (PF1 - PF6) the input used maximum flood-plan discharge in the periods of 2, 5, 10, 25, 50, and 100 year with consecutive annual discharge 382, 464, 519, 589, 641, and 693 m\textsuperscript{3}/s (BBWS Citarum, 2007)
• HEC-RAS output : the flood started to inundate the river banks in the RS 5 for all profiles (PF)
Inundation depth on each cross section for the maximum flood-plan discharge in the periods of 2, 5, 10, 25, 50, and 100 year in river station (RS) 5

Inundation height (cm) | Bush/schrub | Fish pond | Swamp forest | Settlement | Paddy field | Total
---|---|---|---|---|---|---
< 40 | 11 | 815 | 4 | 45,6 | 369,9 | 1247
40 – 60 | 17 | 1039 | 4 | 45,6 | 369,9 | 1476
60 – 80 | 17 | 1262 | 4 | 45,6 | 369,9 | 1700
80 – 100 | 17 | 1622 | 4 | 97,4 | 390,4 | 2133
100 – 120 | 17 | 2359 | 4 | 155,4 | 443,7 | 2980
120 – 140 | 17 | 3255 | 4 | 246,5 | 564,4 | 4088
140 – 160 | 17 | 3324 | 4 | 292,1 | 730,9 | 4370
> 160 | 17 | 3394 | 4 | 337,7 | 745,9 | 4500
Vulnerability of elements at risk

- River and tidal inundation maps were overlayed with land cover map to get the area of each element at risk.
- The built up areas cover residential areas, roads, and fish ponds while vegetated areas were paddy field, bush/shrub, and coastal forests (mangroves).
- Field observations found only the settlements and roads that have different levels of vulnerability to the flood inundation, while the others were not different.
- High vulnerable areas are located in the north and partially in the middle.
- The northern part area will be inundated firstly during tidal flood, also inundated during river flood.
- On that northern part, there is a settlement cluster with houses made of woven bamboo and road conditions are only hardened soil.
- Both areas should receive more attention during flood event, not only they are vulnerable from the physical aspect, but also their socioeconomic condition was also need more attention.