Integration Activities in Indonesia: 
The Integration of Land and Marine Spatial Data Sets as Part of Indonesian SDI Development

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Overview of Indonesia

- Archipelagic country with 17,502 islands.
- More than 100 thousands km length of coastline.
- Total area is over 5.3 million sq km.
- 63.7% of its area consists of water.
- Population is over 220 millions.
- Consists of 33 provinces and 474 districts.
Why is coastal area important for Indonesia?

- More than 100 thousands km length of coastline.
- About 22% of Indonesian populations live in coastal area.
- 80% of marine activities are concentrated in coastal area.
- Most of marine natural resources are located in coastal area.
- Tsunami high risk area:
  - Flores Island (12 December 1992)
  - Biak Island (17 February 1996)
  - Aceh (26 December 2004)
  - West Java (17 July 2006)
Why needs spatial data integration?

• The increasing activities and complexities in coastal area require an integrated information for sustainable development and good governance of coastal area.

• The number of spatial information (in quantity and variety) to support decision making is growing at rapid rate. The information may include living and non-living resources, bathymetry, sea boundaries, shoreline changes, marine contaminant, seabed characteristics, water quality, property rights, etc.

• The number of organizations that provide spatial data in coastal area is also increasing.

• As the variety of spatial data is increasing, users may require data from more than one sources.
Spatial Data Integration Issues in Indonesia

- No standard at national level has been implemented.

- Each organization (data providers) has its own policies and ways on managing spatial data.

- Technical and non-technical aspects.
Spatial Data Integration Issues

Technical Aspects

- Various spatial reference system
  → (horizontal datum, vertical datum, coord system).

- Various storage format
  → CAD files, GIS files, DBMS
  → Data duplication

- Various scale.

- Differences in spatial data quality
  → due to the differences of resolution or data acquisition method.

- Various data model
  → object definition, geometry, features name, attributes, field type, topology, etc)
### Differences between data sources – an example

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Topographic Map (Bakosurtanal)</th>
<th>Nautical Chart (Hydrographic Office)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coastline</td>
<td>Taken from aerial photograph (the boundary line of land and sea at time of exposure)</td>
<td>High tide water level</td>
</tr>
<tr>
<td>2</td>
<td>Horizontal Datum</td>
<td>- Indonesian Datum 1974 (for map published prior to 1996)</td>
<td>- Bessel 1841</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- WGS 84 (for map published from 1996 on)</td>
<td>- WGS 84 (recent publications)</td>
</tr>
<tr>
<td>3</td>
<td>Vertical Datum</td>
<td>- Mean Sea Level (MSL) for land elevations.</td>
<td>- Mean Sea Level (MSL) for land elevations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- no depth information.</td>
<td>- Chart Datum for depth information (e.g. Low tide water level).</td>
</tr>
<tr>
<td>4</td>
<td>Projection system</td>
<td>Universal Transverse Mercator (UTM).</td>
<td>Mercator</td>
</tr>
<tr>
<td>5</td>
<td>Digital Storage Format</td>
<td>Various format (DWG, ARC, SHP)</td>
<td>S57 files</td>
</tr>
<tr>
<td>6</td>
<td>Scale</td>
<td>Sistematically (1 to 10K, 25K, 50K, 100K, 250K).</td>
<td>Not Sistematically (range from large scale to small scale)</td>
</tr>
</tbody>
</table>
Coastal Data Integration Case

- **Case 1: Difference in vertical datum.**

  - MSL is a common reference level for elevation.
  - Chart Datum (usually low water tide level) is a common reference level for depth information as well as a baseline where sea boundaries (*territorial sea, EEZ, continental shelves*) are measured.
  - Chart datum may only be used locally, since it varies at different location.

→ *Integration of land and marine information requires a common reference level for elevation and depth (this case is not applied to nautical chart).*
What is the elevation of point P (refer to MSL or Chart Datum)?
Coastal Data Integration Case

- **Case 2: Difference in coastline definition between data sources.**

  - Topographic map: *Mean Sea Level*
  - Nautical Chart: *High Water Level*
  - Aerial Photo: *Land and sea boundary at time of exposure*
  - Satellite Image: *Land and sea boundary at time of exposure*
  - UNCLOS’82: *High Water Level*

*(An island is a naturally formed area of land, surrounded by water which is above water at high tide (Article 10(1) 1958 Convention on the Territorial Sea).*
Effect on coastline definition difference

Different object definition will be drawn differently on map.

Results:
Differences in geometry, coastline length, area of island.

Solution:
• Use the same definition of objects.
• Use the same standard.
Spatial Data Integration Issues
Non-Technical Aspects

- Different policies and rules between organizations on managing spatial data.
- Different understanding and knowledge between organizations about NSDI.
- No regulation has been implemented to enforce that all spatial data providers should involve in and contribute to the development of NSDI.
- Most of spatial data providers do not publish enough information (spatial metadata) to enable users finding the spatial data easily.
Efforts on Spatial Data Integration

- Regular meeting between spatial data providers.

- Promoting the implementation of spatial data standard at national level.

- Encourage spatial data providers to involve in Indonesian NSDI development.
Spatial Data Integration Case Study

- The integration of Indonesian topographic map series of scale 1 to 25K, 50K and 250K (published by Bakosurtanal). Each map series is stored in different schema of database.

- The integration of Indonesian coastal map of 1 to 50K scale (published by Bakosurtanal) that contain both land and marine information of the coastal area.

- Integration is implemented within the geospatial database (*Oracle 9i with Spatial Data Option*).
Integrated Spatial Database Architecture

Data Sources

- Topo
- Marine
- Theme

Data Cleaning & Integration

- Admin
- Spatial
- Metadata
- Non-Spatial

Data Warehouse

- Maps
- Disaster Management
- Nat Resources
- S57

Data Mart

Applications & Services

- Autodesk
- MapInfo
- Web Services
- Metadata Explorer
- Other GIS software

Maintenance & Development (ArcGIS, ArcIMS, ArcSDE)
Summary

- Spatial data integration is very important to build an integrated and comprehensive spatial information system that covers the whole area of Indonesia.

- Efforts have been made by the Government of Indonesia by developing a national spatial data infrastructure (NSDI) and the progress is moving forward.

- More spatial data providers at national and regional level are joining the development of Indonesian NSDI to provide users with easy access to spatial data they need.
Thank You

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