Utilization of GIS for Natural Resources and Environmental Management

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QUESTION:
Can the earth continue to provide and regenerate the resources we need for supporting life and encourage development?...

Natural resources and environment is:

- an economical issue.
- a financial issue.
- a personal issue
- Political!
Features of Natural Resources

- Source of wealth
- Relate to environment
- Covers large areas (cross boundaries and administrative jurisdictions)
- Depleting asset and difficult to recover (Preservation, conservation, protection)
- Multidisciplinary, multi agencies
Characteristics of the nature resource data

- Spatial (distributed over the earth’s surface);
- Multiple uses (e.g. mangroves are used for forestry, fisheries, agriculture, and recreation);
- Subject to change with time (retreat and accretion);
- Affected by use (pollution of rivers by untreated discharge, reduction of water resources, siltation of rivers and sedimentation in the coastal waters by excessive land clearing).
Activities and impact on Natural Resources

Land and Marine based Natural Resources

Activities using Resources

Impacts/Effects

Human Settlements / Development

Non-Resource-based Activities

(Pollution. Economic Generation)

Definition of “resource rich”:

i) average share of hydrocarbon and/or mineral fiscal revenues in total fiscal revenues at least 25% over the period 2000-2005 or
(ii) average share of hydrocarbon and/or mineral export proceeds in total export process of at least 25%.


See http://www.sigafric.net/ for detailed Geological maps

Over the last 3 years a growing number of countries, particularly in SSA, are developing new oil and mining projects.

Source: IMF Country Reports with Statistics supplements
<table>
<thead>
<tr>
<th>Kelebaran Laluan air antara tebing</th>
<th>Keperluan Kelebaran rizab dari kedua belah tebing berdasarkan keluasan sungai sediadaa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lebih dari 40 meter</td>
<td>50 meter</td>
</tr>
<tr>
<td>Antara 20 dan 40 meter</td>
<td>40 meter</td>
</tr>
<tr>
<td>Antara 10 dan 20 meter</td>
<td>20 meter</td>
</tr>
<tr>
<td>Antara 5 dan 10 meter</td>
<td>10 meter</td>
</tr>
<tr>
<td>Kurang dari 5 meter</td>
<td>5 meter</td>
</tr>
</tbody>
</table>

DID Manual 1973 on river reserve

![River Reserve Map](image-url)
GIS Technology

- GIS allows us to measure our natural resource assets
- Understand our patterns of change
- Better understand the resources we are using
- Identify the impact of human-induced geographic change

GIS provides policy makers and planners with transparent predictable guide (planning) for management thus helping to better utilize the resources and support development
These are not natural resources BUT they are important data to manage natural resources, hence the use of GIS.
Environmental management data
Remote sensing has these capabilities!!

WHY REMOTE SENSING?

1. Quick update
2. High reliability and cover large area
3. Could be used for many applications
NATURAL RESOURCES AND DISASTER MANAGEMENT

MODIS - 19 Aug 2002

Smoke
Hot spot
Damage
Use:

Mapping of the extend of flood

Planning of future development site - less flood prone

Valuation of land

Using radar image - can penetrate clouds
Concept of Sentinel Asia Step2
Application of WINDS for Sentinel Asia in Step2
Sentinel Asia Information-sharing Platform

Information-sharing Platform

- Digital Asia (Internet-based Web-GIS) is used
- Satellite images overlaid on maps with disaster-related information on the Internet
- Upload data by putting them on a Digital Asia server (OGC-based)

Content (Sharing Data)

- Satellite images from space organizations
- On-site digital camera images
- Fine regional digital maps from national geography organizations, etc.
- Detailed disaster information
- Regional social / economic data
## SPATIAL ANALYSIS CRITERIA (example)

<table>
<thead>
<tr>
<th>NO</th>
<th>CATEGORIES</th>
<th>LAYERS</th>
<th>CRITERIA/THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PHYSICAL</td>
<td>TOPOGRAPHY</td>
<td>Above 1000m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLOPE</td>
<td>Above 25m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CATCHMENT</td>
<td>Inside Catchment Areas + Buffer 20m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RIVER RESERVED</td>
<td>River + Buffer 50m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CANAL RESERVED</td>
<td>Canal + Buffer 50m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LIME STONE</td>
<td>Lime Stone Hill + buffer twice from height</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SOIL CLASS</td>
<td>Class 1 and 2</td>
</tr>
<tr>
<td>2</td>
<td>LAND USE</td>
<td>RECREATIONAL</td>
<td>Recreational Areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PADDY</td>
<td>Within Grannary Areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WETLAND</td>
<td>Wetland + Buffer 500m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FOREST</td>
<td>Forest + Buffer 500m</td>
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<tr>
<td></td>
<td></td>
<td>BUILT-UP AREA</td>
<td>Existing Built-up Areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HERITAGE</td>
<td>Tourism - Heritage Areas</td>
</tr>
<tr>
<td>3</td>
<td>UTILITIES</td>
<td>POWER LINE</td>
<td>Transmission Line reserved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SPECIAL ZONE (DUMP SITE)</td>
<td>Within + Buffer 250m</td>
</tr>
</tbody>
</table>
Unit analysis, based on pre-defined neighbourhood functions.

SPATAIL MODELLING (CELLULAR AUTOMATA)

State at t1

State at t2
Using various settings of the growth rate factor until a target of urban growth is met.
Strategic Action Plan to Achieve the Status of Developed State by 2015 for the State of Perak

Legend:
- Town
- ESA Rank 1 (309,200 Ha)
  1. Slope > 35 Degrees
  2. Elevation > 1000m
  3. Forest Reserve
  4. Wildlife Reserve
  5. Grainery Area (Paddy)
  6. Dam Catchment Area
  7. River
- ESA Rank 2 (366,000 Ha)
  1. Slope 25 - 35 Degrees
  2. Elevation 300 - 1000m
  3. Forested Area
  4. Soil Class 2
  5. Ex-Mining Pond
- ESA Rank 3 (41,900 Ha)
  1. Slope 15 - 25 Degrees
  2. Elevation 150 - 300m
  3. Water Catchment Intake

Source: Amend from RSN Perak

Figure 2.3c

ENVIRONMENTAL SENSITIVE AREA (ESA)