THE IMPLEMENTATION OF SEAWATCH INDONESIA IN THE PARTICIPATION ON GOOS COASTAL MODULE

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Abstract

The coastal zone contains many of the earth's most complex, diverse and productive ecological systems. It functions as a protective buffer and filter between the land and the sea. The ecosystems are important for biological and economic productivity, storm protection and erosions control as well as for vital breeding, nursery and feeding areas.

Meanwhile, about 60 % of the world population lives within 60 km of the coast. This condition leads to competition for finite resources, environmental degradation and often environmental social conflict. If coastal areas are to maintain their productivity and natural functions, one have to have plan for and manage coastal development. One of the tools for an effective coastal management is to have systematic ocean (include coastal zone) observation. The Global Ocean Observing System (GOOS), initiated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO is the international effort in the cooperation of observing the ocean. One of the GOOS module is about coastal that will enable improved observation and management of ubiquitous coastal problems and processes.

Seawatch Indonesia - a technology application in the field of monitoring, forecasting, modeling and information system for marine environment - obviously become one of a relevant participant in the observation activities. By using one of the Seawatch software called as OCEAN-GIS it is expected that one will have a complete understanding on the coastal and marine resource structures, function and dynamics so that utilization of these resources can be conducted in a productive and sustainable manner. OCEAN-GIS as an information solutions plays a very important role in providing venues for management, analyzing and communicating various information related to the opportunities and the constraints of the coastal and marine resources development.

I. INTRODUCTION

The coastal zone - where land meets sea and where fresh and salt waters mix - contains many of the Earth's most complex, diverse and productive ecological systems. It functions as a protective buffer and filter between the land and the sea, and is increasingly valued for recreational and aesthetic purposes. The ecosystems in the coastal zone are important for biological and economic productivity, storm protection and erosion control. Reefs, mangroves, wetlands and tidelands are vital breeding, nursery and feeding areas for the majority of known marine species. Worldwide, over two thirds of all marine fisheries species depend on coastal systems.

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About 60 % of the world's population - about 3 billion people - now lives within 60 kilometres of the coast. This number is increasing rapidly due to a combination of population growth, migration and urbanization. Two thirds of cities with populations over 2,5 million are situated near estuaries.

The unrestrained pursuit of multiple activities in coastal areas inevitably leads to competition for finite resources, environmental degradation and often environmental and social conflict. Furthermore, development practices which ignore the dynamics of coastal systems can be catastrophic, as evidenced by the increasing loss of lives, property and investment due to coastal flooding and erosion.

If coastal areas are to maintain their productivity and natural function, there must be major improvements in the way we plan for and manage coastal development. Effective coastal management must be based on a solid scientific foundation, taking into account the limitations of natural systems, while balancing and integrating the demands of the various sectors which depend on these systems for their livelihoods. Today, in order to achieve the improvement of managing the complex problem of coastal zone, an effort called Integrated Coastal Management are well known. This is an effort on how to allocate coastal resources efficiently and minimize environmental degradation. Choices have to be made between competing uses, and limits to resource exploitation must be set, if escalating conflicts and resource degradation are to be avoided.

In order to practice effective coastal management, planners need to understand the way the natural environment and human activities are interconnected to form a system. Key aspects of the system include the environmental processes that create coastal ecosystems and maintain their health and productivity, functioning of coastal ecosystems, flows of resources that coastal systems generate, potential use of these resources to fulfill social and economic development objectives, and the type and extent of existing and future conflicts in resource use within the context of changing social, economic and political circumstances.

To know more in details and the interconnectedness between those aspects one should have a certain tools and techniques. The systematic collection and analysis of data yield vital information to the resource manager, including quantification of existing conditions, identification of information gaps and projection of future trends (e.g population growth, sea-level rise). Moreover, routine monitoring provides feedback to the manager, making possible the evaluation and adjustment of management actions. Ultimately, data collection and analysis should result in an understanding of the *carrying capacity* or limits for sustainable use of the system and an ability to predict the effects of changes to the system.

Systematic ocean observations, including observations of coastal zones, provide the knowledge and predictive capabilities needed for more effective coastal zone management. The Global Ocean Observing System (GOOS), initiated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO in cooperation with the World Meteorological Organization, the United Nation Environment Programme and the International Council of Scientific Union, provides a framework for international cooperation in this field.

II. WHAT IS GOOS COASTAL MODULE

According to Colin Summerhayes, Director of the GOOS Project Office, GOOS is designed to provide long term, multidisciplinary, operational oceanographic monitoring of seas and oceans as the basis for enabling the uses of ocean data in creating and disseminating reliable assessments and predictions of the present and future states of these environments in support of their health and sustainable use and contributing to prediction of climate change and variability, for the benefit of a wide range of users.

So far, the progress of GOOS plan is the official GOOS Pilot Project called as NEAR-GOOS centered on the Japan Sea, as well as the EURO-GOOS consortium of 22 operational agencies from 14 countries that creating a suite of projects with the emphasis on the Baltic, Mediterranean, the Northwest European shelf and the Atlantic.

NEAR-GOOS is a regional project in the Western Pacific Region, presently with the participation of China, Japan, the Republic of Korea and the Russia Federation with a view to demonstrating the usefulness of a regional ocean observing systems within the framework of GOOS. The essence of NEAR-GOOS is to promote free oceanographic data exchange in real-time through internet in support of daily mapping of sea conditions in marginal seas bordered by NEAR-GOOS participating countries, benefiting a wide range of marine users. During the initial operational phase of NEAR-GOOS, data on temperature, salinity, currents and waves are exchanged through the system. As it develops, other data, for example sea-level, as well as biochemical data on dissolved oxygen and nutrients, etcetera, will also be included in the system.

GOOS has 5 overlapping phases that are :

1) The planning stage include design and technical definition,
2) Operational demonstrations called Pilot Projects.
3) The incorporation of *suitable existing and new observing activities*.
   GOOS will have complementary data observing elements, a communication network, a data management system and will develop and provide *products and services from a production line* (or end-to-end) system in which data can be tracked and their quality assessed from their collection.
4) Gradual operational implementation of the *permanent* or on-going Global Ocean Observing System, and
5) Continued assessment and improvement in individual aspects and in the entire system.

All of the phases will grow incrementally from national and regional efforts.
There will be five modules product under consideration :

a. Coastal ; will enable improved observation and management of ubiquitous coastal problems and processes by taking a globally consistent approach. Coastal forecasting model will require oceanic observations as the basis for defining boundary conditions.

b. Climate ; data assimilation is a major area demanding technological advance to enable GOOS to make the best use of remotely sensed data from satellites. A global Ocean Data Assimilation Experiment goes into the field in 2003-2005.

c. Health of the Oceans ; a Strategic Plan, already provides the basis for determining prevailing conditions and trends in the sea in relation to the release of contaminants. Now, there are plans for pilot project.

d. Living Marine Resources Module ; will develop a system to monitor the biological, chemical and physical parameters needed to describe marine ecosystems and their variability, and predict change.

e. Data and Information Management ; this is at the heart of GOOS and is thus a high priority. It's a multi-agency effort and where possible will use existing data and information management system as a basis.

f. Ocean observations from space

In this paper, coastal module will be elaborated and Seawatch Indonesia hopefully will become one of the tools of analysis of this module.

Furthermore, at the meeting of the IOC Assembly, delegates repeatedly stress that for most countries the major one of benefits will be generated in the coastal zones, and the developing countries in particular want to see the rapid development of the coastal products from GOOS. There are some goals for GOOS Coastal Modules defined by the Panel in their meeting in April 1998 (Unesco,1998) that are among others :

- Determine user needs is the coastal zone and specify the environmental data and products required.
- Identify regions where present monitoring efforts are inadequate and formulate plans to fill these gaps.
- Identify inadequacies in the measurement programs of present of present observation systems in terms of variables measured, scales of measurement; and usefulness
- Promote capacity building in developing nations to provide the opportunity to contribute and participate in C-GOOS as key feature of the GOOS Strategic Plan.

OPERATIONAL CATEGORY	ISSUE
Preserve Healthy Coastal Environments	Habitat loss modification (e.g., wetlands, SAV, coral reefs), nutrient over-enrichment (e.g., eutrophication, hypoxia/anoxia) toxic contamination, oil spills diseases in marine organisms, harmful algal blooms, non-indigenous species biodiversity
Promote Sustainable Use of Coastal Resources	Exploitation of living resources mariculture (pond and open water), saltwater intrusion
Mitigate Coastal Hazards	Flooding, storm surges, tsunamis wind: tropical storms, erosion, Seal level rise
Safe and Efficient Marine Operations	Safe navigation, efficient maritime commerce, ports, construction, exploitation of nonliving resources, oil, gas, minerals, spills of hazardous materials (oil, chemicals, radioisotopes) ballast water (e.g., transport and release of non-indigenous species).

Source : Unesco, 1998

Table1.Globally ubiquitous issues organized according to operational categories fore coastal products and services

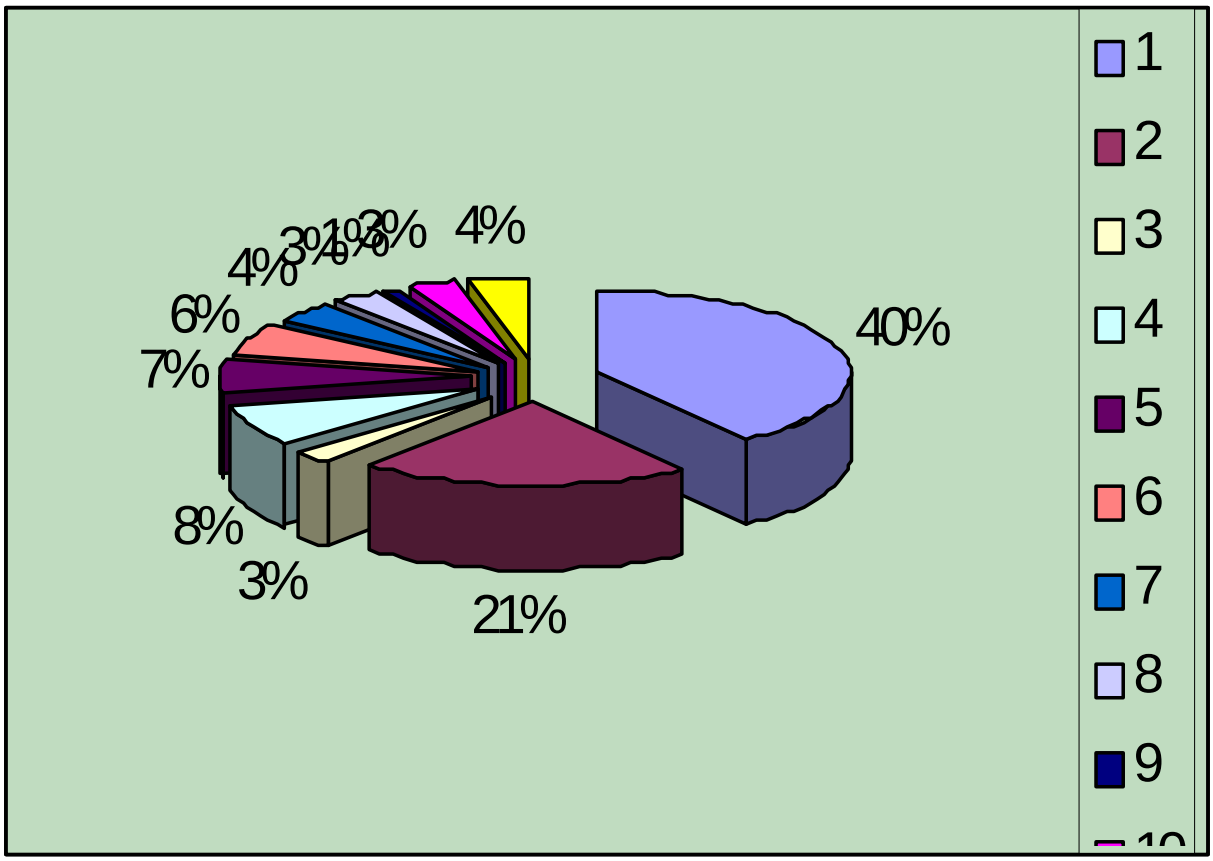
It is obvious that the coastal zone exhibits a wide range of physical and biological marine processes, There has to be a definition of functional groups of coastal systems called as coastal classification scheme :

- Pattern of external forcing, meteorology, terrestrial inputs, exchange with ocean
- Habitat characteristics, circulation regime, size, shape, depth, benthic substrate, nature of margins
- Scaling relationships for comparative analysis : drainage basin area relative to area and volume of the receiving body of seawater ; anthropogenic nutrient load as a proportion of total load ; surface area to volume ; freshwater fill time ; tidal relative to non-tidal flows, benthic production relative to pelagic production.

Benefits of GOOS

Obviously it is difficult to define the benefits in hard cash terms. Estimates say the turnover of marine-based industries and services is 3-5 % of GNP in most coastal countries. If these benefit from GOOS to 1-2 % of their revenue then the benefit could be US $ 10 billion a year. Benefits will be in different economic and social forms i.e improved commercial cash profit, reduction of commercial risk and uncertainty, improved management of the environment, reduction in pollution, early warning of developing environmental problems, the assessment of the effectiveness of ameliorative actions; public good such as improved health and reduction of natural hazard; longterm climate prediction and protection of biodiversity. All those benefits has a dual ultimate goals of a) conserving the productivity and biodiversity of coastal ecosystems, and b) improving and sustaining the quality of human communities.

For example in 1996, Pugh and Skinner (Unesco, 1998) estimated that in UK marine related activities contributed • 27 ,8 billion or 4,8 % of the GDP in 1994-1995.



Source : Unesco, 1998

Figure1. Contribution of marine - related activities to the UK economies

He than goes on to suggest that these functions of GNP are representative of the major economies and that the global marine sector represents an economic activity of some $ 800 billion - $ 1.000 billion per annum. On this basis each 1 % of efficiency gain in the marine sector will deliver $ 8 billion to $ 10 billion per annum of benefits. It is important to note in passing that the benefits may not fall to the sector, but to the consumers of its services and products, and that there may well be losers both within the sector and among its suppliers. The key point is that the GOOS environmental information services enable the marine sector to deliver more useful output from less input.

III. SEAWATCH INDONESIA SYSTEM

Seawatch Indonesia System is a system applied in Indonesian waters – based on science and technology cooperation between Indonesia and Norway – that have the activities of monitoring, forecasting and modeling the Indonesian marine environment.

The Seawatch system itself consist of the following modules :

- Data acquisition

- Data storage, analysis and presentation
- Environmental modeling and forecasting
- Distribution of data to the user

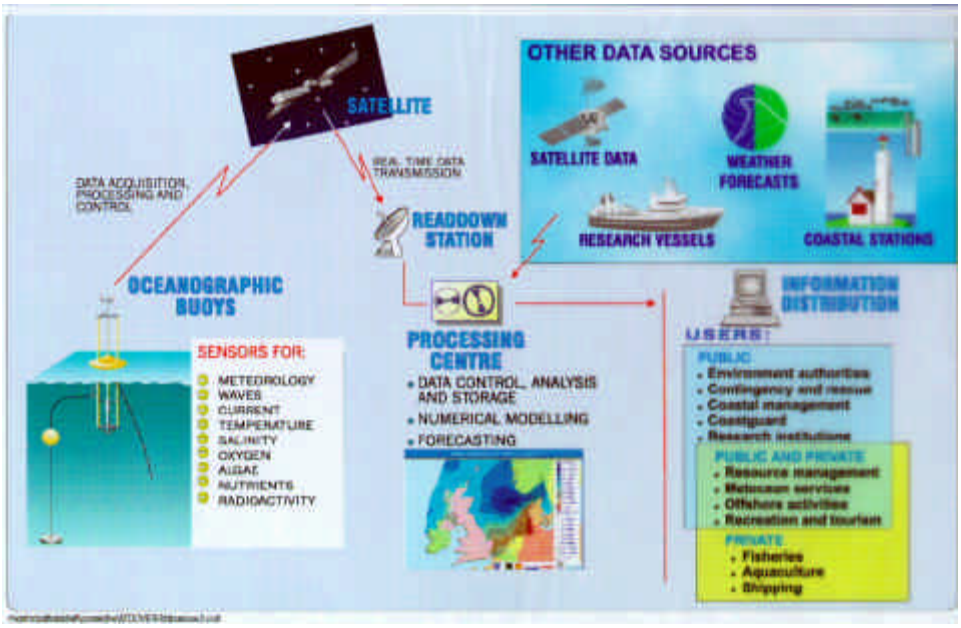


Figure 2. Seawatch System Overview

As it is mentioned above, one of the GOOS modules is Coastal Module. As Coastal Module will also have an oceanic observations, there are range of advances in technology needed including among others :

- Computer power
- Developing numerical models and in assimilating data into them
- Measuring instruments, including antifouling to keep instruments measuring longer
- Techniques for communicating data from instruments to shore

Those requirements above have already provided in the Seawatch systems, a system of monitoring, forecasting, modeling of marine environment.

Ocean GIS Application

Ocean GIS is an application within Seawatch Indonesia System for generating data presentations. The application is tightly coupled with the OceaNet* data distribution system for dynamic data such as environmental measurements and observation.

OceaNet* is data distribution system for dynamically updated data, provided by OCEANOR A/S. In Seawatch System environmental data is collected in near real time and stored at the Seawatch central location. OceaNet extracts Seawatch data from the storage systems and makes them available for local remote users and application.

OceaNet interfaces with the Oracle** and Orkan*** data base systems from providing these data. OceanGIS also accesses Oracle and Orkan directly whenever required. In addition, OceanGIS maintains its own data base for storage of information and results.

Shortly described, OceanGIS provides the following main functions :

- Graphical presentation of OceaNet dynamic data
- Basic drawing capabilities for text, symbols, etc
- Presentation of background map information such as land contour, bathymetry, etc (static information)
- Presentation of results from simulation models
- Generation of Arc/Info map compositions, meaning that the user can design (and build up) data presentations containing elements from all the above mentioned
- Image functionality for presentation of background maps that are frequently used
- Printing of map compositions and screen

OceanGIS and its menu system is built as an Arc/Info application. The menu-driven user interface of OceanGIS has been implemented by using the AML concept of Arc/Info, which provides programming capabilities for development of tailored user interfaces.

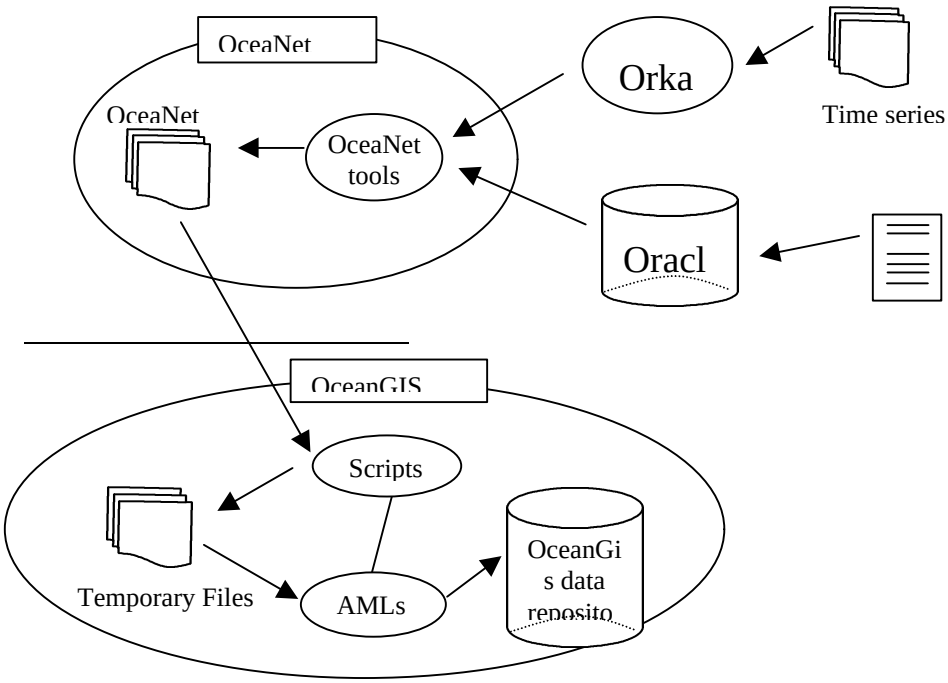


Figure 3a. Data flow of observation data into OceanGIS

Oracle** Trademark for the Oracle Relational Database management system from Oracle Corporation. Oracle is used as data base management system in the development of the OceaNet.

Orkan*** is data base with application programs for efficient storage and handling of time series, provided by OCEANOR.

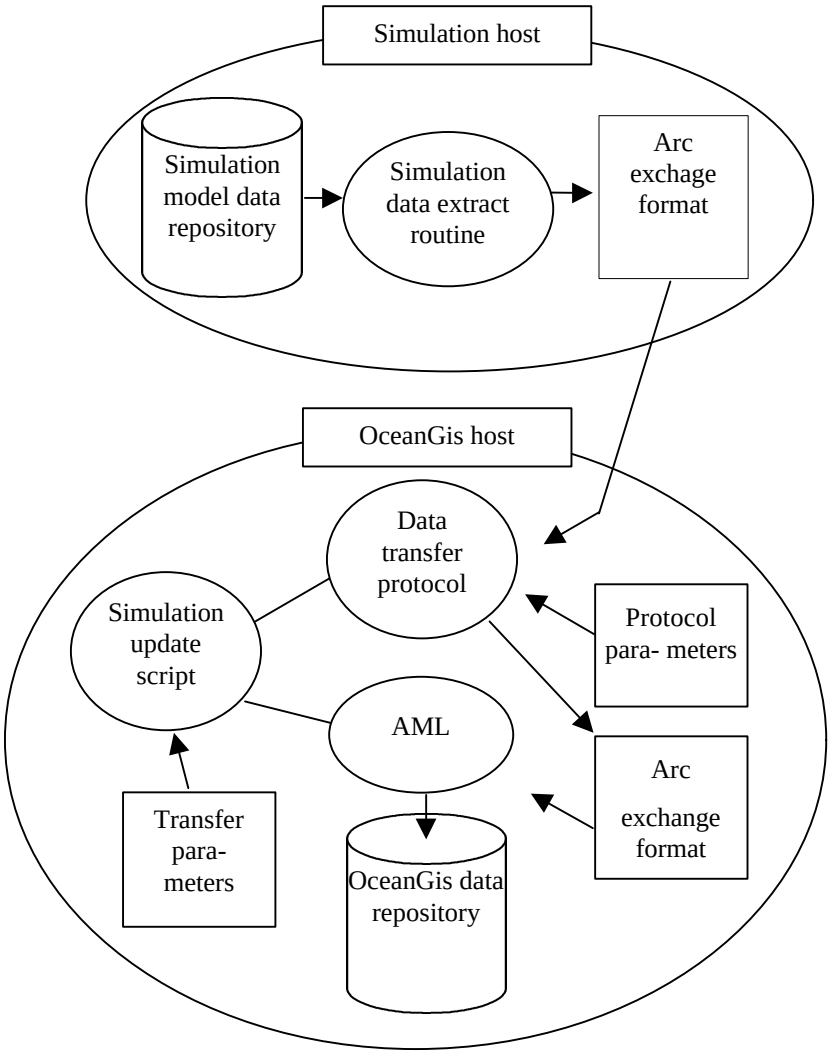


Figure 3b. Data flow of simulation data into OceanGIS

Figure above presents an overview of the automatic data flow from the databases via OceaNet and into OceanGIS application. The data base system ORKAN stores the time- series, while Oracle contains the user administration information such as user profiles. OceaNet programs produce data files by combining these two types of information.

The OceaNet data files are read by a dedicated program in the OceanGIS application, and intermediate files are created which are suitable for AML processing. Special AMLS read this intermediate files and generate A1 data structures, which then can be processed by A1 and thus by OceanGIS.

Zonation

If Seawatch observation data are to be joined together with the technology of Geographical Information System (GIS) called as Ocean GIS in the Seawatch

Systems, than one of the application can be used for Zonation Activies as part of the Coastal Zone Management.

As it has already mentioned in the previous chapter, in order to cope with the complexity of the human activities, natural system and coastal zone utilization, it is important to have a plan of integrated management of the coastal resources utilization efficiently with the approach of avoiding or minimizing environmental degradation. Those plan should be based on the priority scale. Zonation / Zoning is one of the important parts in the marine and coastal zone management. With Zonation activity, one can have an easy and clear picture of the planning objectives. Seawatch Technology combined with GIS technology including the satellite image processing can be one of the tool in managing the coastal area accurately.

Some steps that has to be followed in the Coastal Zone Management for the Integrated Development Area are as follows :

1. Inventarization of Secondary Data as well as digital data
2. Secondary and Digital Data Analysis
3. Primary Data Collection
4. Data Compilation to the GIS
5. Analysis of field as well as buoy data
6. Spatial Data Processing
7. Analysis

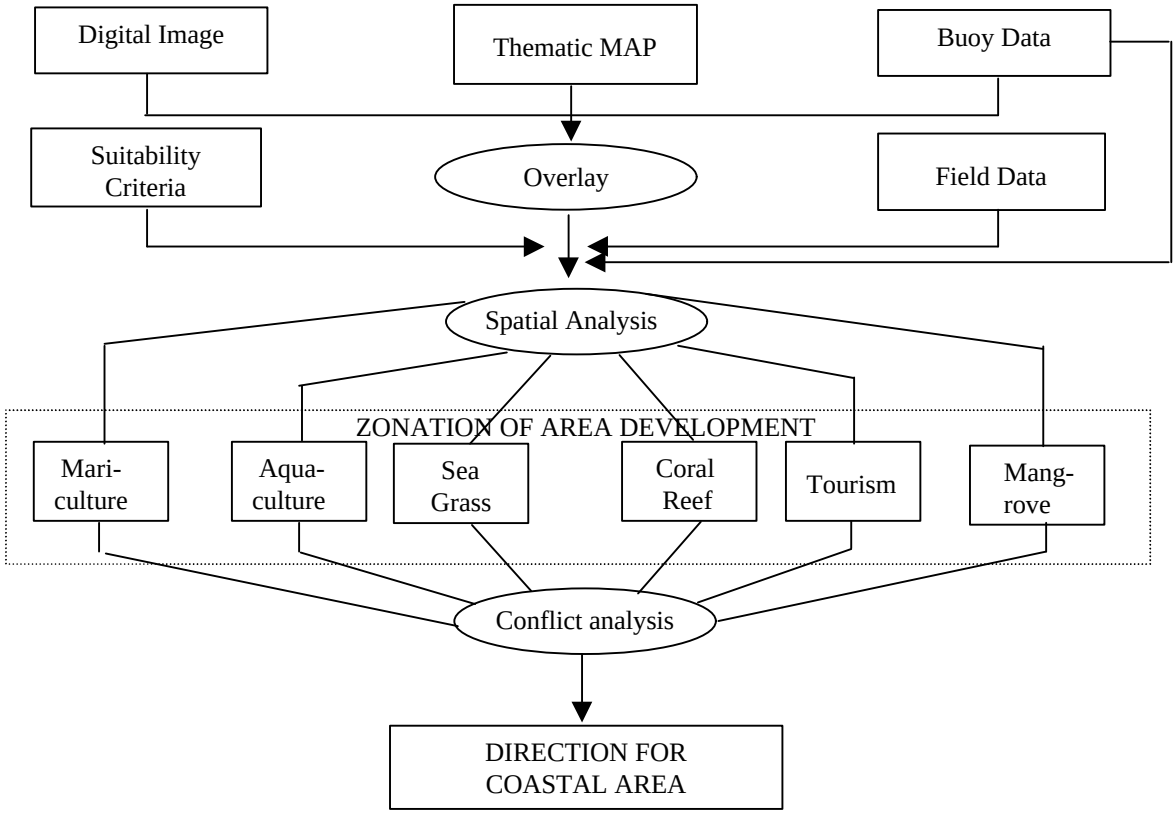


Figure 4. Flowchart of Zonation Activities in Coastal Areas

Specific problem occurs on the coastal development is the degradation of the coastal resources caused by overexploitation and other human activities that are not economically valued. For example, the mangrove forest destroyed to be industrial, settlement, recreation as well as the area for fish cultivation and agriculture have great contribution in the coastal environmental degradation since mangrove forest has the environmental role as a buffer zone for coastal degradation or for fish reproduction area.

Other problems that occur in the coastal zone area among others :
- Conflicting between development sectors
- Natural hazard, etc

As it is mentioned previously, it is important to have accurate data and information system to have Integrated Coastal Zone Management. Methods that are used for the determination of land use based on the area analysis using the properness criterion for particular utilization. Furthermore, for spatial data analysis, one can use Geographical Information System. This method can be used for the activities of data collecting, data storage, spatial analysis as well as to present all those information for specific purpose. Input data that are collected consist of spatial data (from map as well as LANDSAT images) and attribute that can be gathered from field / primary data and secondary data. With overlaying as one of the GIS techniques that are effectively used to manage and analysis various spatial information, so the output – as a result – can be spatial map for the area that will be developed for the suitable potencies.

As for the needs of monitoring, GIS can provide facility to ease attribute changing into the spatial analysis. Software that are used in the GIS processing is ARC / INFO version 7.0.4 in the Seawatch Technology System.

Digital Image Processing

Spatial data processing from the satellite image can be done by the using interpolation on the observational sample points. With the image reflection processing, one can determine the specific parameter classification.

Image processing use the standard formula using software of ILWIS version 1.4. The information gathered by remote sensing or aerial photograph are suitable for decision on the planning stage, especially for the area that has a limited data as well as human resources and fund.

Data Analysis

There are two activities on the GIS data analysis to be a database, that are (a) overlay analysis and (b) attribute processing using score. Overlay analysis can be done before one come into the real field in order to have the unit of the marine and coastal area to take the sampling. Overlay methods will be used for the map in the form of the digital spatial data. After field data collected for each unit then the data will become a database as an attribute, to be processed and scored to determine the level of the suitability.

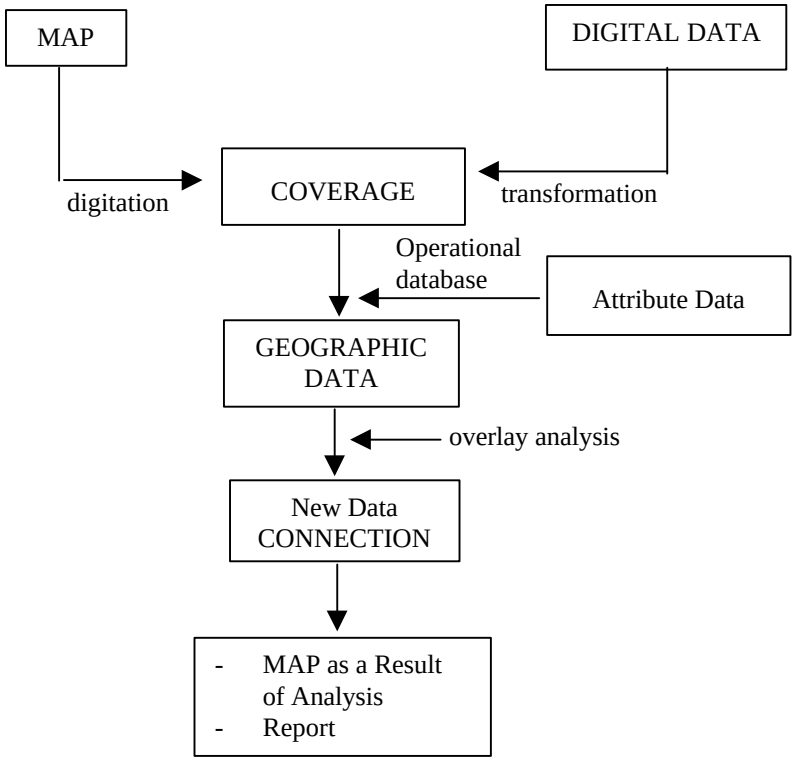


Figure 5. Processing Scheme and Analysis of GIS

There are 3 categories for the suitability as follow :

a) most suitable
b) suitable
c) not suitable

IV. CONCLUSIONS

1. Coastal Zone is the most complex, diverse and productive ocealogycal system that are important for both biological and economic productivity indicated by multiple human as well as natural activities that leads to competition for finite resources, environmental degradation and often environmental and social conflict.
2. Effective coastal management based on solid scientific foundation, taking into account the limitations of natural system, balancing and integrating demands of the various sector are well known called as an Integrated Coastal Management.

3. Systematic ocean observation (including coastal zones) are the tool the basis for enabling to collect the ocean data to be analysed, and forecast in order to have the present and future states of these environments in support their health and sustainable use for the benefit of a wide range of user. These are the ultimate objectivities of the GOOS (Global Ocean Observing System) activity. One of the GOOS module is about coastal.
4. Seawatch Indonesia System is a system a coastal and monitoring, forecasting and modeling. With the use of Ocean - GIS - one of Seawatch software - Zonation activity can be expected to yield a clear picture of the land and sea use for multiple uses such as the suitable area for mariculture, tourism, transportation, mangrove, coral reef, sea grass etcetra in the sustainable basis.

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