ESTABLISHMENT OF A REGIONAL GIS DATA BASE FOR THE RED SEA AND GULF OF ADEN
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BACKGROUND
A Geographic Information System (GIS) is a computer program for storing, retrieving, analysing, and displaying cartographic (map-based) data. GIS represents the Earth’s features not only in pictorial form, as in conventional paper maps, but as information or data. Using a GIS to deliver geo-spatial data allows one to visually analyse any information that has a geographic reference. GIS have been used in numerous natural resources applications. These applications can be categorized as planning or management, process modelling, inventory, and assessment.

Data compilation representing spatial characteristics of significant features of the earth’s surface is undoubtedly a very important activity for any society. Not so long ago data was transformed either to documents or paper maps. Quite justifiably, analysis of this data proved to be of substantial difficulty: there were no means to incorporate different types of data in an integrated format. A major breakthrough was achieved in the second half of the twentieth century through the rapid development of computer technology, coupled with the development of mathematical tools, which lead to the ability to store, retrieve and analyse spatial data. Nowadays, spatial information systems, such as GIS, and remote sensing data are used widely in almost all aspects of life.

Understanding the environmental situation is an essential component of coastal resource management. This usually requires a great deal of data, and an information system can provide tremendous assistance in organizing, managing, understanding, and reporting this information. Managing and mapping the two-thirds of the Earth’s surface that is covered by salt water presents a unique set of challenges.

As marine and coastal applications of GIS have gained acceptance in the scientific and management community and the importance of this tool has become more widely acknowledged, PERSGA decided to establish a regional GIS for use throughout the Region through the Strategic Action Programme (SAP) for the Red Sea and Gulf of Aden. Highest priority has been placed on strengthening GIS capacity in the field of coastal zone and environmental management. The regional GIS database will be used as a tool for decision-making and management in coastal and marine environmental conservation, contributing to the timely and effective implementation of the SAP.

The Centre for Environment and Development (CEDARE), a regional not-for-profit organization located in Cairo, was designated to provided advice and services to PERSGA regarding the establishment and maintenance of the regional GIS database.

THE PROJECT
The first step towards achieving this ambitious goal was to build the capacity of PERSGA Lead Specialists. This was achieved through the introduction of basic GIS and remote sensing technology and applications, including hands-on-training on GIS visualization software (aimed at familiarizing PERSGA’s Lead Specialists with the use of GIS in assessment and planning), thus enabling them to identify their component-specific GIS requirements.
The objective was to capitalize on the use of GIS and satellite remote sensing in coastal and marine applications, with a focus on the extraction of information from satellite data.

The second step was to build the capacity of the key persons who will be in charge of maintaining the GIS activities in their respective countries. A regional team of GIS specialists was established (composed of one GIS specialist from each PERSGA member country). PERSGA, in collaboration with CEDARE, have conducted several advanced GIS and remote sensing training courses tailored for the GIS Technical Team members.

The third step was to conduct a regional assessment of GIS capacities and needs in co-ordination with the regional GIS Technical Team members. CEDARE staff visited Djibouti, Jordan, Saudi Arabia, Yemen and Sudan. As the first step in a regional assessment of GIS capacities and needs, the main objectives of the missions were to assess the present use of GIS in marine and coastal management, the need for further capacity building, and the requirements to harmonize the GIS systems currently in use.

During the needs-assessment missions, all existing maps were reviewed, along with existing data and departmental use; daily operations of various departments were analysed, including assessment, planning and development, etc. The required GIS applications for each department were reviewed. A GIS Implementation Plan was discussed with recommendations for the installation of computer hardware, software and data conversion in each country.

Following the previous steps a regional database for PERSGA was developed; the database currently includes data related to coastal, environmental and other issues identified in the needs-assessment report.

More than 400 GIS data layers have been prepared at the country and regional level. MetaData for all the layers was developed and a data dictionary for the layers was created. CEDARE has continued its effort to integrate all the available remotely sensed data covering the Red Sea and Gulf of Aden. This remote sensing data includes Landsat data, Spot, Ikonos and Radar imagery data images. Landsat Orthorectified Landsat Thematic Mapper Mosaics provided by NASA were integrated and clipped for all the Red Sea region.

The integrated remote sensing data also include some high resolution images covering some of the regions’ coastal cities (Jeddah, Port Said, Suez, Sharm el Sheikh, Aden, etc.).

PERSGA’s regional GIS database contains all of the UK Admiralty Charts covering the entire Red Sea and Gulf of Aden region. The Admiralty Charts were provided by the UK Hydrographic Office. They consist of over two hundred detailed navigational maps/charts and provide coverage at a range of scales to suit the requirements of professional, commercial and research users.

The maps can be categorized as Large Scale charts covering harbours, anchorages and navigational hazards, Medium Scale charts for coastal navigation and Small Scale charts for offshore navigation and passage planning.
Standard Navigational Charts are continually updated and are fully corrected to ensure that they include all safety-critical navigational information.

The charts can be viewed, manipulated and maintained in ArcView software using Arcs Extension and ARCS for GIS. The charts available for the project will be available in both raster and vector formats.

**ACTIVITIES**

Another important feature of this GIS, is that all the data specifically collected through each PERSGA component, have been linked to the system. Such a comprehensive integration of data will allow Lead Specialists, researchers, academics, and environmental institutions in the region, to overlay all the available data and analyse it in an integrated way. For example, data covering the historical sites of Aden, government districts & borders, fuel stations, fishing villages, fish landing sites, fibre glass factories, desalination plants, fishing areas, ice factories, public and private beaches, public roads and corniche sites, tourism projects, harbours, coral reefs, seagrass beds, turtle and bird nesting sites, vegetation, wetlands, sandy and rocky coasts, islands, sensitive areas, pressure areas, landfill, dredging, sewage outfalls, and cooling water areas are now available in the GIS.

Data from the three proposed marine protected areas at Isles des Sept Frères & Ras Siyyan in Djibouti, Mukkawar Island, Dungonab Bay in Sudan and Bir Ali - Belhaf, Yemen were entered in the regional GIS database and published through the PERSGA GIS map server. All marine protected areas in the Red Sea region will be available on the system.

PERSGA has developed user-friendly modelling software that will assist in the data analysis and data entry of the Red Sea and Gulf of Aden fishery (finfish, sharks, ornamental fishes). The software is intended to include a complete database for the above mentioned groups and provide in-depth analysis and calculations using different models. The overall objective of the program is to assist in the development of a sustainable management strategy for transboundary fish stocks and invertebrates.

Furthermore, a Geographic Biodiversity Information system is currently being added to provide information for decision makers and researchers about the status of marine species in the Red Sea and Gulf of Aden. Geographic locations of seabird nesting populations, turtles, coral reefs, seagrass, mangroves, etc. have also been included within the system. Further development of this data will include the development of a biodiversity map of the Red Sea.

The PERSGA GIS website was developed to act as a portal for all information that is being gathered by the GIS project. GIS Internet Map server was installed on the PERSGA GIS workstation. The ARC IMS will enable PERSGA member countries to integrate centralized GIS/Remote Sensing data sources with internet data sources for display, query and analysis in an easy-to-use Web browser.

**CONCLUSION**

The PERSGA GIS databases have been designed to be simple and user-friendly. The database structure allows users to browse data by region, country, theme, or by sensitive area. It also allows users to view, query, evaluate and report monitoring data.

The development of the PERSGA regional GIS database project has achieved many objectives. Among these, it allows experts, researchers, managers, scientists, regional and national institutions in each country to store, retrieve, update, analyse and manipulate coastal resource data.

The project has succeeded in building the capacity to create, use and maintain a coastal resource inventory in each country, and to
facilitate the sharing of coastal resource data within and between countries in the Red Sea region. However, sustainability of these activities requires maintaining and updating the data on a regular basis.