First report of the Geographical Information System (GIS) application to western Mediterranean artisanal fisheries.

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Introduction.

Previous to the first steps to develop GIS tools for the analysis and representation of the results, it has been designed the supporting database for the storage and management of data in an adequate way to be used by the GIS. This work, carried out in conjunction with the team in Rome and with the project in Alicante, not only consider the data model, but also the development of specific queries to management the data, and connect them with the information layers in maps.

About GIS software used.

Geographical Information System (GIS) used for the present application is ArcView from ESRI. The decision to use this particular software is based in five main reasons:

- It is easy to use.
- It is enough powerful for the established purposes.

- It has good connectivity with ACCESS Database.
- It has a language program (Avenue) that allows automating reiterative cases.
- It can be customized for the final user.
- Many results can be viewed and queried using ArcExplorer, a free distributed browser for ArcView files.

Western Mediterranean Base Map.

The basemap has been constructed using cartographic data from several information sources. These are the following:

- IBCM (GEBCO): IBCM digital chart is the main source for the western Mediterranean basic map, including the coastline and bathimetry (contour lines for 50, 100, 200 and 400 m depth). The main problem of this source is that particular small areas are not too accuracy, also the 50 m depth contour line is lack for some zones (part of Morocco, for example). Therefore, it is necessary to improve in the future this basic cartography acquiring new digital information.
- ESRI Data & Maps (1988): a collection of CD-ROMs containing data and maps in a shapefile formats. These have been used to obtain data relative to political and administrative boundaries for all the countries in the region.
- Ports: the geographical coordinates of the fishing ports, and other fishing places, are included in the database and have been provided for the different participants in the COPEMED artisanal project.

Since different cartographic sources have been used, some problems have arisen in certain aspects relative to the overlapping of the maps. To solve problems dealing in topological aspects additional software from ESRI, named DAK (Data Automation Kit), has been used:

- Coastlines from IBCM and ESRI maps are not coincident. In this case, the solution adopted has been to consider the IBCM coastline as the better one. In the other hand, administrative boundaries contents in the ESRI maps have been modified (using DAK) in a suitable way to connect with the IBCM coastline.

- ESRI maps containing administrative boundaries for African countries were designed for display at scales to about 1:10.000.000, so the largest display scale suggested is 1:5.000.000. For European countries, maps were originally digitized from 1:300.000 scale source maps, so in this case the largest display scale recommended is 1:100.000. Larger scales than theses not offer a good resolution. In the cases that were desirable to zoom in a particular area over the recommended display scales, not coincident borders between countries can appear. To solve this problem borders have been modified (using DAK) to avoid gaps between polygons, although these modifications not strictly correspond with real boundaries.

- Location of the ports is displayed very accuracy since come from precise geographical coordinates. However, most of points representing ports do not match exactly with the coastline. In order to obtain the distance between ports along the coastline, an Avenue script is being prepared. This script first moves the points representing ports to the closest place in the coastline and, secondly calculates the distance between ports along the line representing the coast.

Database and GIS.

The main objective is to get graphics results (maps) useful to understand particular problems having a spatial dimension. Since artisanal fisheries are very dynamic, the

relationships between database and GIS outputs must allow a quick actualization of the information.

At the moment, **all data are referred to ports**. The graphical views of the different attributes are directly related with the feature that representing ports (points). In this way, the data selection that is represented appears as a group of points, with the same location than the ports in which the data chosen are present.

Moreover, there are also other graphical features (lines, polygons) representing spatial covers that can not be not directly obtained from the ACCESS database, but from ArcView shapefiles. The information associated to these shapefiles have been also recorded in the Database, and connected to the adequate ports. To achieve on a view the information of a concrete port, a special "script" has been programmed in such a way that allows obtaining only the features related with the port requested, even if the original shapefile also contains values for other ports.

In order to know the possibilities that the system DATABASE-GIS offers, some cases have been prepared.

1. **Ports**. The first layer of information is relative to the location of the ports. This theme is automatically updated in ArcView when any new record or modification is made in the database, since both are directly connected. Each point representing a port contains the same information that the correspondent table in ACCESS, except those dealing with hyperlinks.

2. **Ports description.** It has been made HTML files containing description of the ports. These HTML files can be opened directly from the Ports theme in ArcView, using a special key (a Hot Link) which permits accessing to Internet Explorer. This has been possible programming a special Avenue script. The script also returns to ArcView once the HTML file has been closed. By the moment are only allowable a limited set of HTML files.

3. **Connecting with ACCESS.** Another possibility to get visual information is to choose an appropriate set of data from ACCESS, connecting directly from ArcView through the SQL connect utility. In this case there are two ways to do it:

   - Writing the SQL sentence (query) in the "Database Connect Window". An example to obtain the number of boats by port is the following:

     SELECT a.*, VAL (b.attrvalue)

     FROM port AS a, port_attrib AS b

     WHERE a.idcountry = b.idcountry and

     a.idport = b.idport and b.attrcode like 'NBOAT';

     Although this is a very powerful utility has a problem: it is not possible to save the sentence in ArcView. So, the following option is better than this one.

   - Connecting directly with a query made in ACCESS. The number of different metiers by ports is an example of this case. The advantage of this procedure is that we can save the query in ACCESS, and only changing the value of the field requested it could be obtained a new set of data to display.

4. **Special queries.** To obtain the spatial distribution of the main species and fishing gears two sample scripts connected with the database have been made.

- Species. Each metier is made to catch a target species although frequently also catch some accessories species. In order to know in which ports are usually landed these species an Avenue script has been programmed. The script allows to the user to choose the country or countries to analize and the species of interest. Also it is possible to choose all the species belonging to a Genus or all the species belonging to a Family.

  To do the selection a window showing the necessary information is displayed. In this window there are boxes containing the information relative to the countries the genus and the species. Once the boxes have been completed, simply clicking in a

button a new theme with the information requested is added to the view. The script also zoom to the area in which the data processed must to appear.

- Gears. In the same way than above script, another one allows to the user to see the spatial distribution of a particular gear (referred to the ports) in the area. A gear must be chosen through FAO code for gears. In this way it is also possible to get the spatial distribution of a group of gears (gillnets and entangling nets, for example). The information requested is added to the view as a new theme and also zooms to the area that has the requested information.

Case Study.

There is much other information useful for the management of artisanal fisheries, which are not necessarily linked to ports.

When an alteration of the original conditions is introduced in a particular area, it is very interesting to foreseen which type of changes can be produced. As an example, a special case (a case study), relative to a small area of Italy (Cilento-Gulf of Policastro) has been arranged.

In this case it has been considered graphic information not recorded until now in the database, as the relative to fishing zones, and additional data of interest for the artisanal fishery. So, information such as fishing zones by metiers, marine parks, untrawlable areas, mariculture zones, detailed bathimetry, or CPUE, will improve the global knowledge of the area and can be used to evaluate what will be the impact to the artisanal fisheries, if different measures than existing are introduced.

First, in order to know which elements or, better in our case, which graphical features are related with the artisanal fisheries in a concrete port, a script has been programmed. With this script, the user can obtain easily in a new view all the features that are affecting or can

be affected for the fisheries in a port. The features appears as separated shapefiles (ArcView format) containing only the information directly associated with the requested port, even if the original files also contains data for other ports.

Once all the information is displayed on the view, it is easy to see how there is not spatial competition between hake and sepia fisheries, or how there are wide areas untrawlables that could be useful for fixed gears.

Also, we can find out what will happen in the case of a new activity or law will introduce in a zone. For example the projected Costa di Maratea marine park practically cover the same area than the sepia fishing zone visited for the Maratea trammelnet fleet. If a law forbidden any fishery activity in the marine park is established, we can know how many ships can be affected. This fleet will need to fish in proximal areas increasing the effort, to change the metier or must to dissapear. Having additional information for proximal areas, we can evaluate which is the best option to adopt.

ArcExplorer utilities.

Many of the results acquired with ArcView can be browse with ArcExplorer. This software, designed also by ESRI, is a GIS data explorer that allowing users to display and query a wide variety of standard data sources. So, it is possible to use shapefiles, pan and zoom through multiple map layers, display data using classifications, symbols and automated labelling or identify and query geographic and attribute data. ArcExplorer also features legends, overview maps, multiple views, saving and retrieve views and map printing.

Moreover, since ArcExplorer is a free GIS data viewer is the best solution for final users, of the artisanal fisheries GIS application, that have not got the possibility to retrieve and view data with ArcView.

In this way, it has been made several shapefiles, by western Mediterranean countries, containing data about the base map, the ports location and the administrative boundaries, to be checked and corrected by the partners in the project using ArcExplorer utilities.

This report corresponds to the previous contract of the author with FAO. The final report will be given at the end of the present assignement.