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AVAILABILITY AND ACCURACY OF MEDITERRANEAN DATABASES RELEVANT TO AGRICULTURAL WATER USES

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SUMMARY – A fundamental component of the sustainable management of natural resources, including water, is a thorough understanding of their dynamic regime, both qualitative and quantitative, which requires data. Yet, accuracy and comparability is a matter of concern especially for the Southern Mediterranean area. Drawing on the experience gained during the implementation of Nostrum-Dss[1] (a Coordinated Action funded by the European Commission) focusing on the implementation of DSS tools in the Mediterranean area, this paper will explore the constraints and opportunities facing researchers, planners and managers in relation to data availability, accuracy and comparability. Experience gained during the project's implementation regarding the field of sectoral analysis necessary to support sustainable policy strategies shows that the available quantitative information related to water use in industry or tourism, or impacts of these sectors on water resources, are inadequate, or are often available only in dedicated commercial databases not accessible to the public. Nevertheless, the agricultural sector, representing the most important demand of water, is characterized by historical scarcity imposed by climatic conditions and appears to be critical in order to explore new strategies for the future.
The implication of these limitations on both data and sources is explored in the paper in relation to the implementation of the Integrated Water Resource Management (IWRM) principles. It starts with the comparative evaluation of information constraints in various countries across the Mediterranean Sea and then attempts to suggest instruments/approaches for improving the current situation, and provide more robust bases for policy making in the future.

Key words: Integrated Water Resources Management, DSS, Indicators, Guidelines,

RESUME – *Un élément fondamental pour la gestion durable des ressources naturelles, y compris l'eau, est la compréhension profonde de leurs dynamiques à la fois qualitative et quantitative. À ce jour, la précision et la comparabilité des données disponibles est toutefois loin d'être satisfaisante en particulier pour la zone sud de la Méditerranée. En partant de l'expérience acquise par NOSTRUM-DSS (une Action Coordonnée financée par la Commission Européenne) dont l'action se concentre sur le développement de Systèmes d'Aides à la Décision (SAD) dans la zone Méditerranéenne, cet article explorera les contraintes et les opportunités auxquelles sont confrontés les chercheurs, les planificateurs et les gérants de l'eau par rapport à la précision et à la comparabilité des données disponibles. L'expérience acquise pendant le projet montre que en ce qui concerne les analyses sectorielles nécessaires pour appuyer des politiques de développement durable, les données quantitatives existantes liées à l'utilisation de l'eau pour l'industrie et le tourisme ou les impacts de ces deux secteurs sur les ressources en eau, sont souvent inadéquates ou bien disponibles seulement dans des banques de données commerciales, non accessibles au public. Toutefois, le secteur agricole, qui représente le plus gros consommateur d'eau, est intéressé par une scarcité hydrique imposée par les conditions climatiques et apparaît crucial dans l'exploration de nouvelles stratégies pour le futur. Les implications de ces limitations sont analysées dans cet article par rapport au développement des principes de Gestion Intégrée des Ressources en Eau (GIRE). En partant de l'évaluation comparative des contraintes à travers les différents pays de la Méditerranée, l'article suggérera ensuite des instruments et des approches adéquats pour améliorer la situation actuelle.*

Mots-clès*: Gestion Intégrée des Ressources en Eau, SAD, Indicateurs, Lignes directrice*

[1] Network on gOvernance, Science and Technology for sustainable water ResoUrce management in the Mediterranean. The role of DSS (Decision Support System) tools. Contract 509158. August 2004–August 2007.

INTRODUCTION

NOSTRUM-Dss (Network on gOvernance, Science and Technology for sustainable water Resource management in the Mediterranean. The role of DSS (Decision Support System) tools. Contract 509158. August 2004–August 2007) is an EC-funded Co-ordinated Action (CA), started in August 2004 which lasts three years. The ultimate aim of the CA is to contribute to the achievement of improved governance and planning in the field of sustainable water management, by establishing a network among the science, policy, and civil society spheres, fostering the active involvement of the relevant stakeholders in the different project's stages, through the development and dissemination of Best Practice Guidelines for the design and implementation of Dss tools for IWRM in the Mediterranean Area[2].

In the first part of this paper, the initial stage of project implementation will be reviewed. It covers a comprehensive collection of indicators for the 15 countries involved in the CA; this produced 15 National Reports (NR) mostly based on each country's basic natural, physical, human and socio-economic data. On the basis of this survey, the strategy undertaken to build up a comprehensive review of the available data sources for the Mediterranean area will be detailed in the 2nd 3rd and 4th parts of this article.

The drafting of the NR represents the first and fundamental step of the CA; the definition of their structure has been a long and iterative process which involved the whole Consortium and the Project's Steering Committee in successive revisions from June to October 2004, when the outline had been finalised on the basis of the final comments and suggestions made at the Kick-Off (KO) meeting in Lisbon. More in detail, Part I reports statistical and qualitative information of relevance to water management both from a sectoral (agriculture, industry and domestic water uses) and cross-sectoral perspective (economic and environmental aspects). The social aspects were included in Part II which addressed the national legal and institutional setting for managing water resources, as well as the description and analysis of an example of a decision-making process, looking at the use of DSS (actual or potential), participation and conflict management.

A broad set of statistical indicators had therefore been chosen and collected to accompany the qualitative description of agricultural, industrial and domestic water uses as well as the economic and environmental aspects of IWRM for each of the 15 Mediterranean countries analysed within the CA. The procedure implemented to select the indicators pertaining to the agricultural sector, their operative collection through the World Wide Web, the assessment of their availability, reliability and comparability will represent the focus of the next section, setting the ground for the strategies subsequently implemented during the CA and particularly in Work Package 04 (WP4)

WP4, *Remote Sensing and Statistical Information in support of policy making*, is indeed a major activity of the CA as it focuses on assessing crucial databases and infrastructures that help secure them. Thus, WP04 is subdivided into 4 tasks: the 1st focuses on structuring socio-economic data relevant to IWRM in the Mediterranean; the 2nd is an inventory of advanced information centres, i.e. remote sensing/GIS centres as they are most vital in securing and updating water data; the 3rd is the status of climate change in the Mediterranean as this affects the availability of the water resource in the Basin; the 4th is a database structure that incorporates the above inputs as they interactively serve the CA on a geographic basis.

DATA COLLECTION FOR THE NATIONAL REPORTS

Introduction

The overall structure of the NR part I was based upon the themes that the Consortium acknowledged being relevant to characterise IWRM in the Mediterranean area; this structure has been approved by the European Commission and reported in the Description of Work. It includes a country analysis from a sectoral (agricultural, industrial and urban water uses) and a cross-sectoral perspective (economic and environmental issues). Once an agreement on the NR structure was reached within the Consortium, the literature review to choose the suitable indicators to describe each

[2] http://www.nostrum-dss.eu

of the Mediterranean countries' state-of-the-art began. The indicators to be chosen had to be at the same time meaningful (capable to describe a particular aspect of the sector/discipline considered), available and comparable across the 15 countries involved.

First, it is worth mentioning two relevant initiatives, both in the framework of the Euro-Mediterranean partnership[3] , pertaining to the collection of relevant indicators for the water cycle in the Mediterranean area: MEDSTAT-Environment and EMWIS[4] . Although the results of these two initiatives are not yet complete, they allow analysing a synthesis of the relevant research work performed in the field of IWRM indicators for the area of study (Plan Bleu, 2000, 2005; Margat, J. 2002) .

Starting from the main publications of the sector (see references) concerning the methodological aspects of IWRM, a first set of ideal indicators has been defined and submitted for revision to the attention of the Consortium; the most relevant suggestions were then collected thanks to the partners in charge of the thematic meta-analyses scheduled in the second phase of the CA. This ideal list was then compared with the effective availability of indicators in national and international databases: a further revision was therefore necessary considering that it would have been better to try to collect the data for all the partner countries from the same statistical source, i.e. utilising international databases whenever possible. This approach ensured that most indicators were directly comparable across countries – even though the information may not be up-to-date or complete (Fu, 2004). Lastly, at the KO meeting of the CA, this revised list of indicators was submitted to the attention of both the Steering Committee and the Consortium, allowing to collect final remarks and to adjust the data collection.

The following sections will detail the results of this survey on international sources, highlighting the qualities and shortcomings of the web data-providers browsed and the unavailable indicators. It will also document the attempts to gather the missing indicators through the different national statistical services, following the NR outline , pointing out once again the usual problems of data format and comparability (Fu, 2004).

International sources and indicators

Generally speaking, international databases offered a good coverage of the relevant issues and user-friendly interfaces which allowed easy searching of the information– especially with respect to water use in agriculture and countries' socio-economic profiling. Very useful online databases were, for instance, the *Human Development Reports*[5] *(HDR)* for socio-economic indicators, *AQUASTAT*[6] for statistics related to water and water use, *FAOSTAT*[7] for agricultural issues, *Earth-Trends*[8] (ET) and the *GEO data Portal*[9] (GEO) for environmental, time series and geospatial information. When the survey was performed, in October 2004, some of the specific indicators of these themes for particular areas (e.g. Balkans, Libya, Occupied Palestinian Territories) were missing. At the time this article was written, however, i.e. 2 years later, the coverage had considerably improved. In fact, the web data providers' sector was evidently highly dynamic in this period, and a complete coverage of the whole

[3] - European Commission. (1995, November): Barcelona Declaration. Euro-Mediterranean Conference. (http://ec.europa.eu/comm/external_relations/euromed/bd.htm), The Euro – Mediterranean Partnership-Overview (http://ec.europa.eu/comm/external_relations/euromed/),
- United Nations Environment Programme - Mediterranean Action Plan
(http://www.unepmap.org/html/homeeng.asp)

[4] - MEDSTAT-Environment is one of the 9 sub-programmes of MEDSTAT and falls under the responsibility of Plan Bleu; the first of the two phase (1999-2003) has now been completed and the indicators are available on NEW CRONOS for commercial use; the second phase will be completed in 2006.
- EMWIS (Euro-Mediterranean Information System on the know-how in the Water Sector) is an information and knowledge exchange tool between the Euro Mediterranean partnership countries, necessary for the implementation of the Action Plan defined at the Euro Mediterranean Ministerial Conference on Local Water Management in Turin in 1999. EMWIS is concerned with the information available in the 27 countries signatories of the Barcelona Convention in 1995: the 15 member states of the European Union and the 12 Mediterranean Partner Countries.

[5] United Nations Development Programme

[6] Food and Agriculture Organisation

[7] Food and Agriculture Organisation

[8] World Resources Institute

[9] United Nations Environment Programme

globe with meaningful and comparable statistical indicators at the national level is not so far from reality.

The forthcoming discussion will focus on aspects which are still up to date such as the reasons which determined the choice of a particular portal to collect specific data, rather than on the availability of particular variables for specific Mediterranean countries. However, interesting concluding points will concern the comparability between different data providers and the themes (not) covered by these international data sources.

The *Human Development Report* is an independent report released each year: it is the product of a selected team of leading scholars, development practitioners and members of the Human Development Report Office of the United Nations Development Programme (UNDP) which work in close contact with international organisations such as UNDESA[10], World Bank, WHO[11], UNICEF[12] and UNESCO[13] for data collection. The web homepage of the portal now represents a widely recognised open-door to comprehensive information and statistics on Human Development for a whole range of countries. The section dedicated to statistics[14] grants access through different modalities: by country, by indicator, by tables (as they appear in the HDR) or it alternatively allows building a users' own table. Of all the information available, this data provider has been used to collect an important part of the total number of indicators for the NOSTRUM-Dss survey, i.e. all the information related to the socio-economic background of each country, such as the demographic, GDP and Millennium Development Goals indicators.

The *International Labour Organisation* (ILO) offers a specific web platform dedicated to statistics named LABORSTA[15] and operated by the ILO Bureau of Statistics. If compared to other international databases, the interface is not so intuitive, but the database offers disaggregated data at the national level which are not available in any other web platform. For the purpose of our data collection, only a few indicators concerning employment classes were needed to complete the socio-economic profile of each country (drafted thanks to the HDR).

AQUASTAT is a global information system of water and agriculture developed by the Land and Water Development Division of the Food and Agriculture Organization (FAO). The AQUASTAT homepage[16] provides access to country profiles and regional overviews (standardised text by country and summary tables), spatial information on water resources and irrigation, databases of national and regional institutions, reviews of agricultural water use per country, links on water and agriculture, and finally an online database[17] with the related glossary of variables. The database's features are efficiently implemented and allow very simple organisation and reprocessing of the indicators. For the purpose of our data collection, the portal offered a good coverage of the basic indicators on water cycle, water uses and particularly irrigation.

FAOSTAT[18] is an on-line and multilingual database currently containing over 3 million time-series records covering international statistics on agriculture. The areas addressed are as follows: production, trade, food, balance sheets, producer prices, forestry trade flow, land use and irrigation, forest and fishery products, population, fertiliser and pesticides, agricultural machinery, food aid shipments, and exports by destination. Although the website does not have an up-to date design (if compared to most of the international databases) the interface is "user friendly" and should be improved in the near future. This portal has also been very useful for the NOSTRUM-Dss data collection as it covers many important aspects related to agriculture not addressed by any other web data provider, such as land uses, productions and means of production.

[10] United Nations - Department of Economic and Social Affairs
[11] World Health Organisation
[12] United Nations Children's Fund
[13] United Nations Educational, Scientific and Cultural Organization
[14] http://hdr.undp.org/statistics/data
[15] http://laborsta.ilo.org/
[16] http://www.fao.org/ag/agl/aglw/aquastat/main/index.stm
[17] http://www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm
[18] http://faostat.fao.org/

EUROSTAT[19] is part of the *European Statistical System* (ESS) which also includes the statistical offices, ministries, agencies and central banks that collect official statistics in EU Member States, Iceland, Norway and Liechtenstein. The ESS functions as a network in which Eurostat's role is to lead the way in the harmonisation of statistics in close cooperation with the national statistics authorities, coordinating its work with international organisations such as OECD, the UN, the International Monetary Fund and the World Bank. Although EUROSTAT is certainly a valuable source for many indicators, it does not cover all the South and East Mediterranean countries.

EarthTrends[20] gathers data from the world's leading statistical agencies, along with WRI-generated maps and analyses and allows rapid searching and retrieving. The *GEO Data Portal*[21] is the authoritative source for data sets used by UNEP and its partners in the Global Environment Outlook (GEO) report and other integrated environment assessments. Both these web portals are very intuitive, because of their similar searching mechanism which easily guides the user to the indicators and definitions of interest. They report most of the indicators available from international agencies (including time series not aggregated elsewhere) and they could have been used to collect relevant information for NOSTRUM-Dss, but unfortunately they do not allow collecting different variables at the same time.

Finally, other international databases (e.g. World Bank's World Development Indicators[22] Plan Bleu[23], UN-HABITAT[24], World Tourism Organisation[25], Transboundary Freshwater Dispute Database[26]) have been used for very specific indicators, as the ones on sustainability, settlements, tourism and Transboundary basins, respectively. These indicators however, have been collected by copying single values contained in different pdf or html documents. The very useful Plan bleu indicators on sustainable use of water resources are no longer available on-line but are for the moment being released in dedicated publications; they are now part of the hard version of Blue plan's Environment and development Outlook[27].

As shown, the international databases analysed for the NOSTRUM-Dss data survey have different and peculiar characteristics at the global level, but they certainly cover only certain aspects relevant for IWRM. Considering its importance, the agricultural sector is certainly the best covered across international data sources although statistical data are only provided at the national scale in these DBs. Some specific categories of indicators, very important to describe current water management and practices in the study area, are either unavailable or poorly available in such datasets (e.g. economic and environmental aspects, or disaggregated industrial and tourist water uses). The missing indicators needed to perform the meta-analyses scheduled in the second phase of the CA were collected, whenever possible, by the single partners and sub-contractors thanks to the respective national data services. Besides the usual problems of data comparability across sources (different methodologies and units), certain themes appeared to be unsatisfactorily covered by comprehensive sets of indicators, as detailed in the next section.

Data availability and comparability

The present section will point out the missing indicators pertaining to the agricultural sector, on the basis of the evidence that emerged from the data survey performed on international databases and on national data services.

As an empirical evidence, current knowledge or communication gaps will be identified, pointing out that they need to be comprehensively addressed in order to support policy makers in their attempt to carry out the different phases of an IWRM process. This provides themes with a wide range of

[19] http://epp.eurostat.cec.eu.int ; Long-Term Indicators/Environment & Energy/Environment/Water
[20] http://earthtrends.wri.org/
[21] http://geodata.grid.unep.ch/
[22] http://www.worldbank.org/ - Data & Research/ Key Products
[23] http://www.planbleu.org
[24] http://www.unhabitat.org - United Nations Human Settlement Programme
[25] http://www.world-tourism.org
[26] http://www.transboundarywaters.orst.edu
[27] Plan Bleu, MAP (2005). A sustainable future for the Mediterranean - Blue plan's Environment and development Outlook - (Sophia-Antipolis: Earthscan)

indicators covering the different cross-sectorial and multi-disciplinary issues of a Decision Making Process, as in the NR report structure.

Beginning from the general background information on the different countries (*Socio-economic profile*), including the efforts towards the achievement of the Millennium Development Goals, most of the international data portals provide these information thanks to different sources, depending on the specific content addressed. This section has the best coverage, and one can rely almost exclusively on the HDR-UNDP databases as they allow the simultaneous download of up to 15 different variables. If trends (time series) are needed, both the WRI and Geodata portals offer optimal alternative solutions, but they do not allow the simultaneous download of different variables. This last one also offers good geospatial coverage at the national, regional and sub-regional level for most of the indicators. Lastly, the LABORSTA web site may be needed to collect comprehensive disaggregate time series on employment at the national level.

Even though an attempt has been made to gather meaningful indicators, it has to be pointed out that comprehensive information for *Environment and the water cycle* (including those specific to the agricultural sector) should be gathered at least at the disaggregate level or as geospatial information, which is out of the scope of the survey undertaken for the drafting of the NR. In fact, within the NR, this issue has been addressed mostly qualitatively, analysing institutional and legal framework. However, besides the general indicators characterising human pressures provided in the HDR, interesting basic indicators on the water cycle and on agricultural pressures are available for all countries thanks to FAO's *AQUASTAT* and *FAOSTAT*. Other indicators characterising specific aspects of environmental quality at national level have been collected thanks to *Plan Bleu*, *WHO* and *WRI*, but different sound indexes capable of characterising *sustainability* are still missing or are not up to date.

Similarly, the section on *Economics of the Water Cycle* takes advantage mostly of the qualitative information provided on the institutional and legal setting of each country. Given the quantitative nature of the theme, a comprehensive list of indicators has nevertheless been included in the National Reports, but there was no chance to find such data in international databases. Concerning the indicators on *water markets* and on *permit allocation*, it must be said that they have often appeared inadequate to describe the south and east Mediterranean countries' characteristics. The ones describing the investments in *water infrastructure* and the *whole sale pricing*, were available at the national statistical services; for the latter, whenever available, the fees were provided in local currency and referred to different calculation mechanisms, and did not allow therefore robust cross-comparisons.

Not surprisingly, as mentioned earlier, the Water use in agriculture section is one of the best covered by the International web portals. Comprehensive indicators are available for all the Mediterranean area, thanks to the FAO statistical services (both AQUASTAT and FAOSTAT[28]) which provide a huge set of disaggregate data, time series and tools concerning all aspects of agriculture, including land use, irrigation, production and means of production.

For only a very few of the indicators initially selected for the agricultural sector (e.g. average farm dimension, area with soil conservation techniques, irrigation efficiency, investment in R&D) it was necessary to rely on national statistical services (with different rates of success).

To summarise, a huge set of indicators have been surveyed for drafting of the NR. The coverage and availability of such indicators for the agricultural sector is more than satisfactory. This work can however support the reader in its attempt to identify the relevant indicators which can be included in a statistical survey needed for an hypothetical phase of a Decision Making Process focused on the agricultural sector; for this purpose, see Nostrum-dss website[29] where all the 145 statistical indicators gathered are listed together with all the meta information retrieved. On the other hand, the survey allowed to point out the knowledge (or availability) of certain gaps pertaining to other sectors, however interesting for the primary one, as previously described and summarised in *Table 1*.

[28] At the time of writing, the FAOSTAT portal has been widely re-arranged; the interface and the technical features has considerably improved however not all data sets have yet been reported and/or updated.
[29] http://www.nostrum-dss.eu

Table 1. Missing or incomplete indicators surveyed for the National Reports drafting

Theme and Sub-themes		Variables
Environment and the water cycle		Number of main river basins (over * km2) Volume in groundwater systems (cubic km/year) Non renewable groundwater system (cubic km /year) Rate of change of the occurrence of flood phenomena (index) Index of river fragmentation (index) Area of wetland drained (ha)
Economics of the Water Cycle	Water use	Water use for Recreational uses (Percentage)
	Water market	Volume of water and groundwater market (Percentage)
	Water productivity	Water use productivity Industry, Agriculture, Total (US $ PPP Billions/cubic km)
	Water infrastructure	Investment needs in infrastructure (US$(PPP)/year) Share of public and private investment (Percentage)
	Permit allocation	Water permitted (as % of total, groundwater and surface water available)
	Whole sale pricing	Cost, charges, subsidies for water supply (US$ (PPP)/m3) for agriculture, industrial and urban uses Rates, costs, charges, for water treatment (%; US$ (PPP)/m3) for agriculture, industrial and urban uses Price of water to customer (US$(PPP)/m3)
Water use in agriculture		Average farm dimension (ha) Area with soil conservation techniques (ha) Irrigation efficiency (percentage) Investment in R&D for agriculture (US$(PPP)/year)
Engineering of the water cycle	General information	Water available per capita (cubic meters/ day)
	Quality of water supply	Total, Rural, Urban - Water consumption per capita (litres per day per capita) Average hours of suspension of the service per year
	Cross sectoral issues	GDP of tourist sector
	Time series	Irrigation network (km) Water from reused sources and desalinated/treated plant (million cubic m/year)
	Infrastructures	Planned investment in new technologies and new infrastructures

More importantly, the work undertaken points out that information do exist on the World Wide Web, thanks to International and National Services, but it is too disaggregated and this therefore lessens its impact on potential users.

NOSTRUM-DSS DATABASE AND META-DATA BASE

As previously stated, there are many problems related to data availability, defining data sources, uniformity, scale, classification... etc. There are over 18 themes of data packets, both national and human, related to IWRM, that are further subdivided into many items. The purpose of the Decision Support System (DSS) is to reorganise and structure the data into a tool that will aid the decision maker to arrive at proper decisions. It is an integrated information management approach to help decision makers utilise the appropriate knowledge to make the optimal decisions for solving problems. DSS can be simplified into a 3-stage system (Khawlie, 2001) as follows: 1st stage, planning, i.e identifying the problem, defining its criteria and weighting the criteria, 2nd stage monitoring, i.e analysing the inputs and suggesting alternative solutions, 3rd stage, testing, i.e. rating the alternatives based on the criteria to arrive at the optimal decision.

Accordingly, the data in the NR and in the sectoral analysis reports were screened to assess how far DSS is a functional tool in IWRM. The assessment was focused on five basic sectors for which IWRM is significant, namely the agricultural, industrial, urban, tourism, social and environmental sectors. Furthermore, the availability of the data – on a geographic basis – was assessed for these sectors with respect to the issues that affect IWRM, i.e. the problems, the driving forces, risk, and vulnerability, which help in the DSS process (the 3 above-mentioned stages). These issues can be observed as impacts of environmental deterioration, the need to reduce these impacts for improving the water domain plus living conditions, and the vulnerability indicators.

For the planning stage, data analysis showed that DSS is an appropriate tool only for the agricultural sector and only in terms of basic capacities and setting priorities. All the other sectors give DSS a secondary importance, including setting strategies, policies and implementation means, and this applies to agriculture as well. Data requirements of DSS in further stages, i.e. monitoring – analysis and decision making, unfortunately, grow worse for all the five sectors. This covers environmental capacities, EIA, and environmental monitoring at the second stage, and includes optimisation, integration, performance and sustainability at the decision stage. Of course, what the previous paragraph implies for IWRM, is that there is still a large gap in securing the appropriate data, notably in the monitoring and the decision making stages. This simply means a disconnection between the science and the management ends of IWRM. It is therefore important to bridge this gap by securing the data and by strengthening the relationship between the scientific community and management. This process of securing data and strengthening relationships must take place at different levels, both top-down and bottom-up.

Meta-database structure

Metadata is data about data. In the case at hand, it should relate to IWRM, DSS within the agricultural domain. It describes the attributes and contents of an original document or work, and can relieve potential data users of having full advanced knowledge of a dataset's existence and characteristics. In other words, standard bibliographic information, summaries, indexing terms, and abstracts are all surrogates (proxies) for the original material, hence metadata. The term is generally applied to electronic resources and refers to "data" in the broadest sense--datasets, textual information, web pages, graphics, music, and anything else that is likely to appear electronically (Milstead and Fieldman, 1999). Metadata is simply documentation for digital geospatial and other type of datasets. For example, several aspects of agriculture can be mentioned: distribution maps, water quality control, attributes on agricultural practices, integrated pest management … etc. It is a text document that describes the who, what, when, where, why and how questions about the data, so that a potential data user can decide whether or not the data are appropriate for his/her use.

Metadata is used to find datasets (e.g. show me all datasets produced since 2000 containing agricultural water management information) , to determine whether the dataset is appropriate for certain agricultural uses (fitness-for-use), to manage datasets (a record of changes, updates, procedures used), or to extract agricultural information needed to correctly use datasets (perform projection transformations, select on certain attributes). Meta data is a world of reliable information, and information competition should not lead to cheating (in the WWW sometimes searching for some term will bring different results which are not needed). In order to create a reliable metadata repository, the relevance of information stored in the repository is taken into consideration. All information should be supplied, no field should be left empty, misspellings of words should be avoided (a query doesn’t provide results because of misspelling), and finally using the same vocabulary to describe information will enforce homogeneity in metadata repository.

Another concern in our metadata repository is the accuracy of the data entered, where data accuracy is the foundation dimension of data quality. This is critical in the subject on water and agriculture, as it will have future negative impacts on the consumers. If the data are wrong, the other dimensions matter little. Accuracy can be achieved by measuring the ability of the metadata repository to provide a definition of what values are valid for each field in the repository (provide a data type, length restrictions, range of acceptable values, discrete list of acceptable values, rules for entering not known or not applicable). For an Integrated Water Resources Management (IWRM), and similarly used for agricultural purposes, our team created a metadata repository using MS Access, as presented in Figure 1.

This repository will help decision makers and researchers to find quickly and easily information about institutions or organizations working in the area of water resources management, and can be modified for specific sectoral purposes like agriculture. In addition, it will help in locating all materials related to IWRM which are available in these institutes and organizations, it has a simple and composite query system where it is possible to search for a simple field or many fields or one entity or many entities (Fig. 2). This metadata repository depends on the data availability in the organizations surveyed either through the international reports provided by each country in the Mediterranean basin or through web search. Planning to override obstacles concerning the availability of metadata and the problem of updating through the use of online repository (Internet facility) is underway.

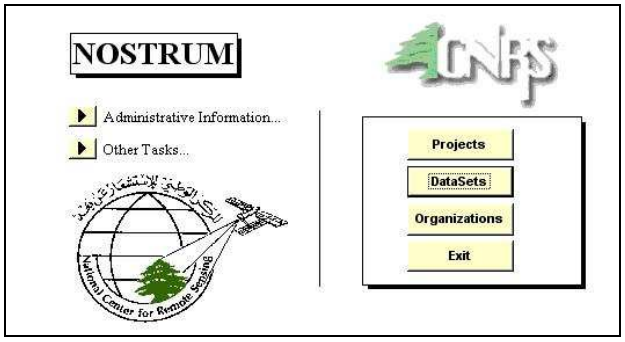

Fig. 1. Main menu of the metadata repository

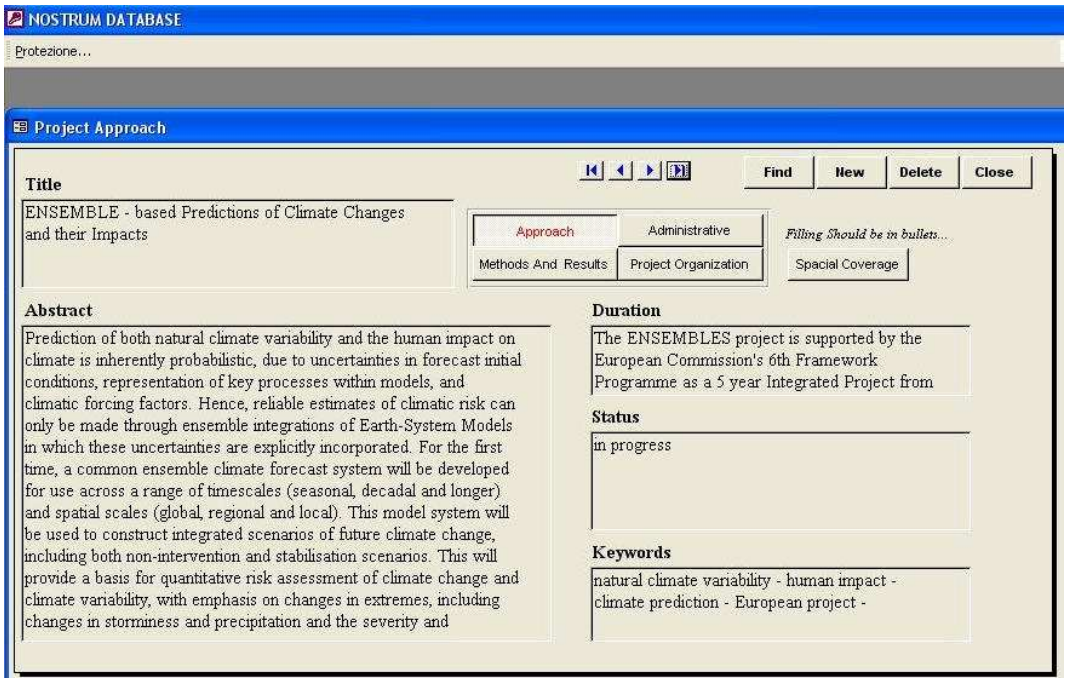

Fig.2. Screenshot of a one record of the meta-database

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