

SaDIN (Sahel-Doukkala Information Network) Progress in the Realisation of an Online Geoinformation System in Morocco

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Abstract

A critical necessity to achieve international standards in public health, sustainable development and land management is to monitor all natural resources, problems and potentialities of a region.

With the contribution of the LIFE – THIRD Countries financial instrument of the European Community, the SaDIN project creates a knowledge pool in the centre of the Chouaïb Doukkali University, El Jadida (Morocco), in collaboration with the Data Centre of the GeoForschungsZentrum Potsdam (Germany) and the private enterprise smartcube ltd. (Germany), in order to provide a basis for any kind of environmental investigations. It comprises tools for data acquisition, sample collection and multidisciplinary analysis with a long-term storage database. It addresses fundamental scientific, environmental and anthropological problems of national importance and social relevance. The aim is a regional real-time geoinformation system with worldwide access via Internet and interdisciplinary dynamic content enabling the communication between scientists, technicians and policy makers.

The scientific objectives of this project focuses on the evaluation of the potential of aquifers in the region, which supply an arid, yet increasingly densely populated area. These investigations are accompanied by an epidemiological study on the health situation of the local population, which would be seriously affected by groundwater pollution. Another main focus is based on environmental parameters, such as wildlife, vegetation and illegal waste dumps.

The project has been carried out since January 2004 and a huge amount of data has just been entered into the databases already implemented. It is the interaction of the different working groups and partners, which make a permanently textual and technical enhancement of all components of the system possible.

The experience and knowledge gained in this project will be a source for technology transfer and policy decisions. This is a pilot project, which could serve as an example for similar projects in other regions of northern Africa and beyond.

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1. The idea

In the framework of the LIFE – THIRD Countries program of the European Union, a cooperation between Morocco and Germany has taken place since January 2004. The project SaDIN (Sahel Doukkala Scientific Information Network) is composed of three partners: the Chouaïb Doukkali University in El Jadida (Morocco), the GeoForschungsZentrum Potsdam (Germany), and the private enterprise smartcube Ltd. (Germany). This project is the result of an existing cooperation between the researchers of the involved organizations and will profit from the existing knowledge of the Sahel Doukkala region.

The aim of SaDIN is the creation of an “information center” at the Chouaïb Doukkali University in El Jadida gathering data and information about environment, water resource management, geology, ecology and health. This enables the university to be integrated in the process of land management, offering environmental services and data to local authorities and decision makers. Also, education of the population concerning environmental problems is required. Therefore, the university could become a regional interface providing scientific data and information management systems. Alongside the data and information itself, the training of experts in these areas, and the creation of human resources is one of the major steps towards implementing such structures.

2. The investigation area

The region of Sahel Dokkala is a coastal plain along the Atlantic Ocean between the cities Casablanca to the North and Safi to the South. It is a basin belonging to the Coastal Meseta of western Morocco with a surface of about 7700 km². The basin is limited in the North and the East by the Oued Oum Erabiaa, in the West and the Northwest by the Atlantic, in the South by the hills of Mouissate and in the Southeast by the Rhamna massif. It is situated in a typical agricultural environment with the semi-arid climate of northern Africa.

The region is projected to become the secondary most important industrial agglomeration after Casablanca. Its industry is characterized by chemical industries (the complex of Jorf Lasfar and its harbour). Another important activity in the region is the extraction of marine salt from the evaporating onshore swamps (Oulja). Because of these economic activities, the region is a strong attraction for rural populations from near and far.

Considering the Sahel Doukkala region as an industrial, urban and rural environment, with their typical advantages and problems, the investigation area offers outstanding conditions for a pilot project, whose results could be exploited in a broader national or international way.

3. The working groups responding to the environmental problems

With respect to the environmental problems, SaDIN works upon data from research in different scientific disciplines like geology, hydrogeology, ecology and epidemiology. The investigations focus on three main problems: water resources, waste deposits and desertification (see figure 1).

The water resources of this region are becoming increasingly contaminated due to industrial and agricultural activities. Particularly, irrigation degrades the water quality through the process of salinity. The extensive use of fertilizer and pesticides also negatively affects the water quality. The extent of these processes are very poorly analysed. Another problem exist due to the intrusion of sea water into littoral zones, which endangers water use.

Waste management deficiencies also play a major role in water resources. Domestic waste originates primarily from urban agglomerations and is deposited at their periphery. The lack of basic infrastructure leads to superficial watercourses transporting all manner of effluent.

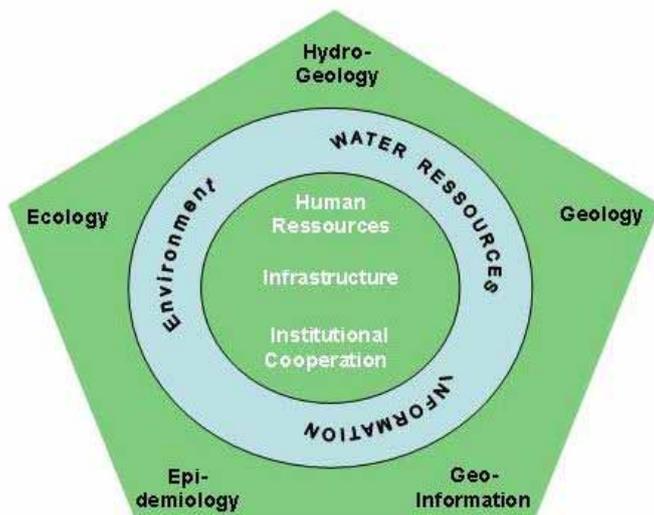


Fig. 1: The working groups and the environmental problems and interests

The second main problem is the increasing waste production, due to the rise in socio-economic activities in the Sahel Doukkala region. The waste is collected and transported in an unseparated manner, throwing together domestic, industrial and hospital waste without treatment. It is deposited in uncontrolled and unprotected dumpsites, which often exceed their capacity with no possibilities for treatment or recycling. The investigation area contains four large dumpsites. The largest is situated in the suburbs of El Jadida, a side-effect of the rapid urbanisation. Operational since 1983, it accommodates approximately 125 tonnes/day, respectively 0,9 to 1 kg/habitant/day. These rates are far in excess of the national average (0,6 to 0,7 kg/habitant/day). The dangerous effluents resulting from the waste materials contaminate the potable water resources often in direct and visible contact with surface water.

The environmental impacts on the atmosphere and the soil water present potential health risks to the population, especially those living in close contact with the dumpsites.

Desertification is the third main environmental problem investigated in this project. The Sahel Doukkala is one of Morocco's regions, where the effects of interactions between the semi-arid climate and anthropological activities are clearly noticeable. This stress increases desertification and endangers the ecological and socio-economic equilibriums in general. Another important factor, which intensifies desertification is the extension of soil salination due to extensive water use, particularly where is irrigations carried out. Ultimately, irrigation results in regression of agrarian production and land abandonment.

4. The scientific results

The aim of each working group is two-folded :

- An archive and overview of already existing data is established. The data sources therein are very various, and local authorities are often included in the working process.
- new data is collected in the field and in the laboratories of the Chouaïb Doukkala University, increasing the older already existing data pool.

Concerning water resource problems, new scientific results are essentially recorded from detailed geological investigations and the analysis of over 400 wells equally distributed over the research area. The extracted data permitted analyses of the architecture of the aquifer and of ground water levels, of the distribution of chemical elements in the ground water, as well as a soil and fauna inventory. A data structure including geological and hydrogeological geographic referenced data was created, which describes the surface and subsurface of the Sahal Doukkala region. An additional gain of these investigations is the variety of thematic maps for all aspects of geology, for the aquifers and the distribution of salinity and chemical elements.

This geoscientific research evaluates the impact of water use, polluted by waste disposal sites and illegal waste dumpsites, by the population.

With regard to the problems of waste dumps, the health risk for the endangered population is the focus of this project scientific research. 800 persons (aged between 20 and 40) were subject to broad epidemiological investigations, concentrating on women and children. For the first time in this region, scientific data of the frequency of diseases and their potential causes have been recorded and a health balance of the population was established. Investigations on potential genetical modifications within the population due to the living circumstances completed this research. Additionally, education of the population on environmental problems and first aid programs for the most effected persons were included.

In order to understand the different problems of desertification in the Sahel region, the actual state of natural vegetation and the land use in general was recorded and analysed. Simultaneous investigations on the coastal area focused on the fauna and the identification of endangered species, considering the hydrodynamic data. A result of this work is an archive of faunistic and floristic species and a definition of environmental parameters for this region.

These investigations underline the multidisciplinary character of the project: the data of this diverse research will be integrated at a “data center” permitting analysis, comparison and interpretation leading to added value and further information.

5. The geoinformatic system

The Internet is revolutionizing the technical and economic conditions of human knowledge management. In Morocco, as in a lot of other African countries, the use of these new technologies is limited to some few sectors. Many qualified scientific studies and research projects are realised in Morocco each year, but their results remain dispersed and unexploited. This is due, primarily to the bad conditions of the infrastructure of information but also to a limited use of the information technology. One of the reasons is a lack of trainee possibilities in information technology connected to an insufficient infrastructure, especially for students, not forgetting the traditional methods of teaching that have to be revised.

In the geoscientific section of the Chouaib Doukkali University we tried to address these problems by creating of a “geoinformatic knowledge pool” based on new technologies, especially Internet. SaDIN enables the storage, analysis, abstraction, synthesis and structured scientific data management in geology, hydrogeology, ecology and epidemiology. Scientific studies will be integrated into a geoinformatic system, which can be adapted to the needs of the users of this region. This will promote data access, search and controlled manipulation and the scientific discussion.

The main objectives of the installed system reflect the users needs to exploit information:

- The access to information is guaranteed to all members of the project and, by the end of the project, to all researchers, technicians and other interested parties in accordance with copyrights, policies and all security aspects;
- The maintenance of a communication tool for the members of project, the researchers and the technicians;
- The access to complex data, derived and processed data and to interpretations based on this data;
- The regular acquisition of multidisciplinary data and its direct dissemination via internet (“real time information system”)

The objective is the creation of a scientific data management center for the region of Sahel Doukkala. It will be a “knowledge pool” for the diffusion of information and of an information technology conform to European standards.

The geoinformatic management will follow the strategies developed by GFZ Potsdam and smartcube, worldwide applied in ICDP projects (International Continental Scientific Drilling Project, www.icdp-online.de).

6. Three step realisation

The realisation of the geoinformatic part of the project is a three step process. During all steps, an interactive discussion between the computer scientists, geomatic scientists and the geoscientists allows a continuously accompanied adaptation of the users needs users and an ongoing correction of the models. The geoinformatic group, which integrates staff members from Morocco and Germany, performs as an interface between the technology and its architecture at one site and the geoscientists at the other site (see figure 2).

In this first step between January and October 2004, multiple analysis of the existing data and of the needs and requirements of the users was undertaken. The resulting user specifications are the foundation for the following investigations. At the same time a web presentation (www.sadin.org) and the corporate lay-out of SaDIN was realised.

To achieve the more significant goals of the project, we also had to implement the basic technical requirements. The local area network was functional by February 2004, and integrated in the Network of the Chouaib Doukkala University. This work was completed with a highly independent and secure local network.

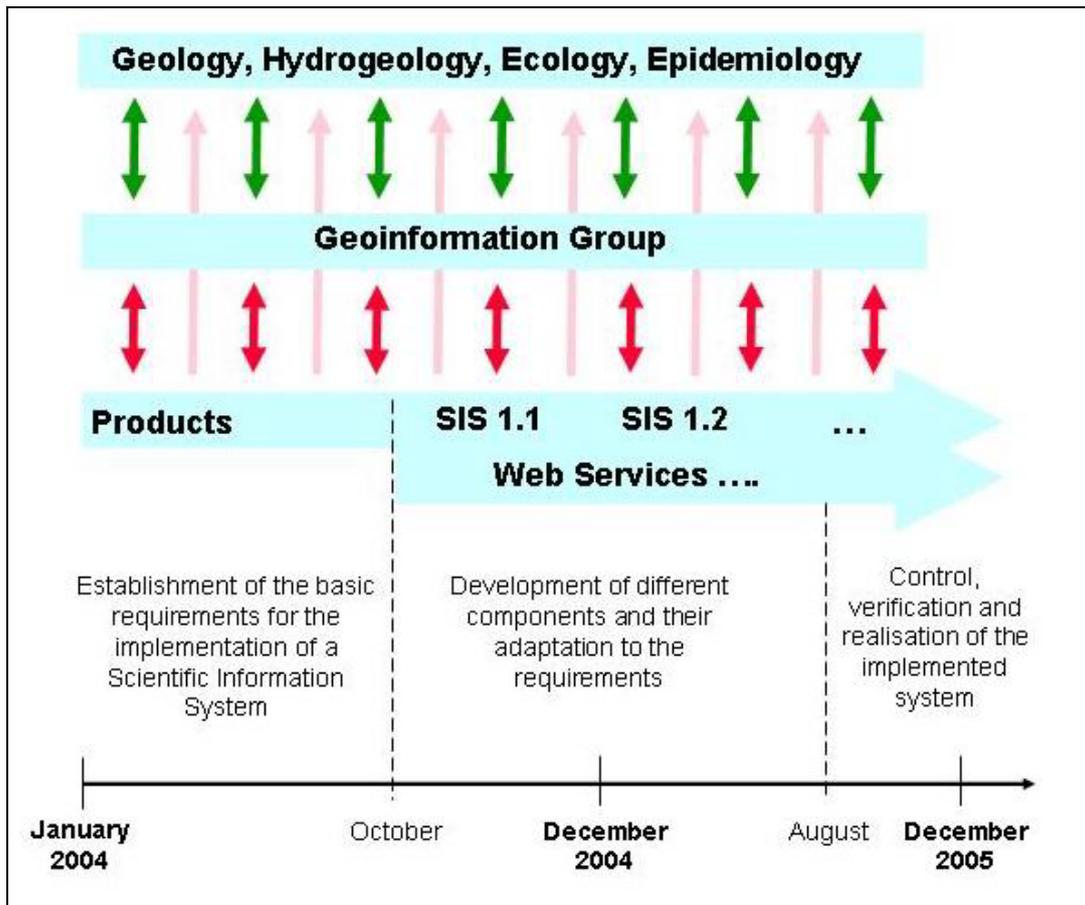


Fig. 2: Workflow and integration of the geoinformatic group

A data structure model was implemented (see figure 3) and used for the adaptation of the Drilling Information System (DIS). This software, developed by smartcube with the assistance of the GFZ Potsdam, was used as the fundament for the developed Scientific Information System (SIS). The two main problems, that had to be resolved were the geospatial reference of all data and the extremely high multidisciplinary, both attributes not applicable to drilling projects. The developed SIS is a system for data entry, storage, web publication and visualisation, and had been made functional since October 2004 in the internal Network of SaDIN.

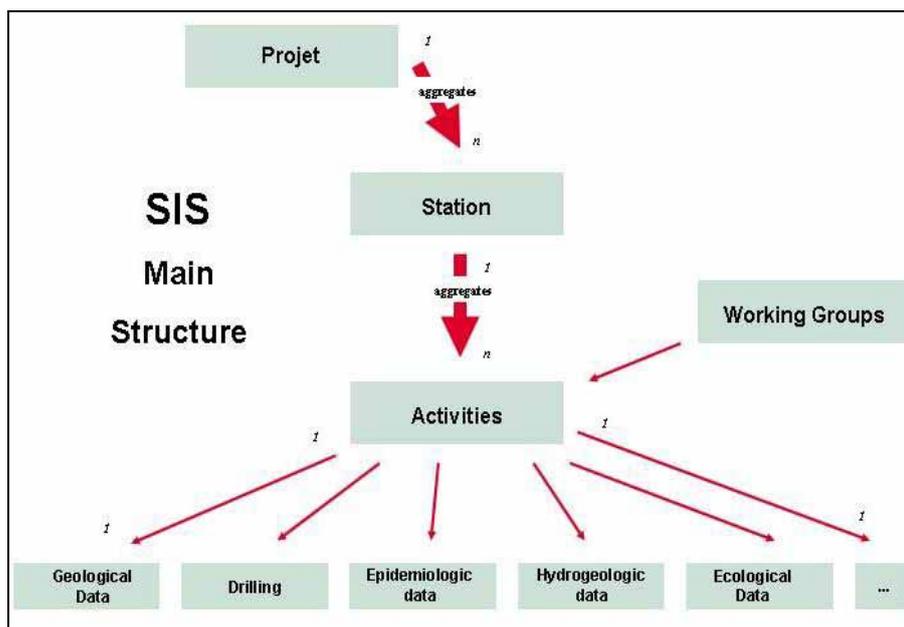


Fig. 3: Superior data structure of the Scientific Information System (SIS) data model

Trainee programs in geoinformatics for researchers and students accompany the whole project as well as the progressive formation of human resources qualified in geoinformatics.

The second step between November 2004 and August 2005, focuses on the elaboration of further models and additional services. The main issue is the integration of the SIS in an overall data structure with a data warehouse for long time storage (see figure 4) and a clearinghouse for data retrieval and visualisation via internet. Different other services will be realised, such as map services and transformation services. Additionally, a content management system separating content from logic and lay-out, was implemented, so that all project members could edit the content of the web presentation remotely. A database for the concerning literature as well as a thesaurus completed this work.

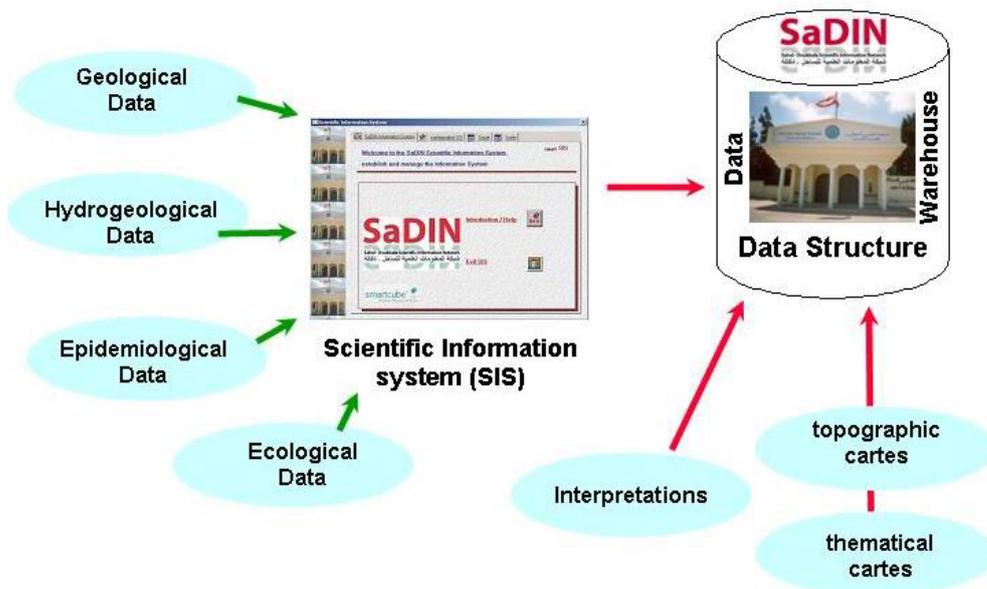


Fig. 4: Integration of the SIS in an overall data structure

Finally, a third step between September and December 2005 comprising control, verification and final adaptations will lead into the realisation of the implemented system and the diffusion of data and information.

7. Future

The SaDIN project could spark the implementation of a Spatial Data Infrastructure (SDI) in the Sahel Doukkala region and maybe in Morocco itself. The developed “knowledge center” may work as an internet based communication and information platform (see figure 5), which integrates all related disciplines and concerned parties, using a virtual infrastructure. Future work should concentrate on the development of this Spatial Data Infrastructure.

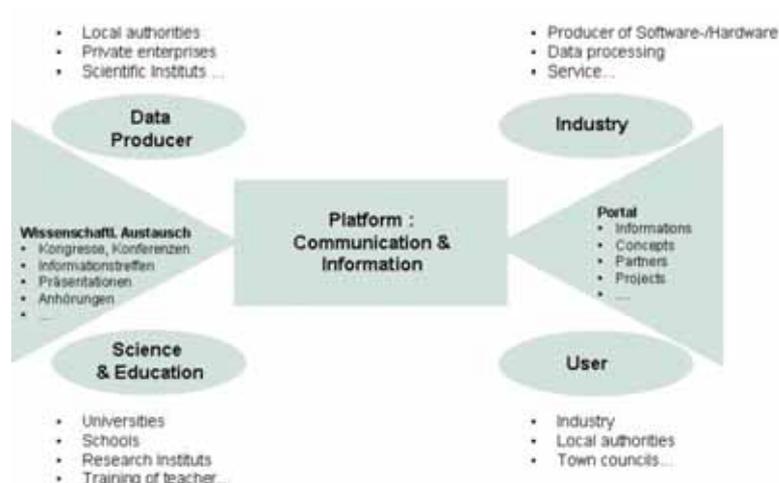


Fig. 5: SaDIN as an internet based communication and information platform

8. Conclusion

The SaDIN project will make state-of-the-art technology available in the field of provision and protection of groundwater resources. The investigations lead to a system, where active and dynamic availability of centralized information (“Knowledge Pool”) is ensured. Different scientific aspects are incorporated in the framework of this project.

First, a simulation of different scenarios of future groundwater exploitation and of possible dissemination of salty and polluted fluids into the groundwater. Secondly, an ecological inventory (Fauna and Flora) and possible solutions for the desertification problems for the Sahel region. Finally, the influence of the environmental situation on the population and on human people in general.

SaDIN enables planification and information management via Internet for future field work, laboratory analysis or other investigations in every research field. It offers the opportunity for cooperation with other organisations (universities, public or private institutions). This project will be integrated into the regional land management and used by the local authorities.

The results gained in the SaDIN project could be applied on other regions in north Africa and world-wide.

9. Acknowledgement

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