

# SYSCOLAG: A TRANSDISCIPLINARY AND MULTI-STAKEHOLDER APPROACH TOWARDS INTEGRATED COASTAL AREA MANAGEMENT. AN EXPERIMENT IN LANGUEDOC-ROUSSILLON (FRANCE)

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INTEGRATED COASTAL MANAGEMENT  
MULTIDISCIPLINARY  
PARTICIPATIVE APPROACH  
KNOWLEDGE-POOLING SYSTEM  
CO-MANAGEMENT  
INFORMATIC TOOLS  
METADATA

**ABSTRACT.** – The SYSCOLAG programme is a pilot operation at national level for experimenting with a knowledge-pooling system applied to the field of integrated coastal area management (ICAM). SYSCOLAG aims to constitute an interface between ‘knowledge’ and the ‘users of knowledge’ on questions related to the conservation and the development of the coastal zone of the Languedoc-Roussillon. To that end, SYSCOLAG offers both a transdisciplinary approach associating life sciences, earth sciences, social and informatic sciences and multi-stakeholders approach (associating scientists, decision-makers, professional users of the sea, environmental protection associations, and the general public) to integrated management of the coastal zone of the Languedoc-Roussillon. The system developed in this programme is based on know-how (particularly in integrated expertise and information systems) and an array of innovative information processing tools dedicated to a public of experts and for the general public. To date, SYSCOLAG has provided a basis for federating the multidisciplinary teams from various organisations concerned by issues related to this coastal zone. In addition, it has contributed to the improvement of communication between the scientific community and other coastal zone stakeholders, and in particular, with the local management organisations.

## INTRODUCTION

Situated at the interface between the terrestrial and marine domains, the coastal zone is characterised by highly variable environmental conditions, by its level of biological production and by a high level of biodiversity, but it is also highly vulnerable, particularly the coastal lagoons (Verlaque 2001, Mazouni 2004). In societal terms, these characteristics give rise to the strong attraction these areas exert on human populations and to the intensive exploitation of resources. The vulnerability of the coastal zone to human pressure is further exacerbated by the sharp rate of demographic expansion recorded at the global scale over the past decades (UICN 2004), which is particularly marked in the Mediterranean area (Beno t & Comeau 2005). Because the population of the coastal zone is expected to double in the next 20-to-30 years (FAO 1998), it is likely that human pressure will continue to increase. The resulting increase in and diversification of uses have given rise to numerous conflicts to which the existing sector-based management systems have not been able to find effective solutions.

Coastal zone managers do not dispose of a proper operational framework which might enable them to reconcile

two frequently conflicting facets of the management process: economic development and the conservation of the ecological value of these interface environments. This antagonism is all the more apparent in that the economic value of ecosystems and of biodiversity is rarely integrated in the decision making process because they are difficult to assess (Costanza *et al.* 1997, Loreau *et al.* 2006). In addition, the multiplicity of decision making levels and of territorial management scales, seriously complicates the sharing of information between the various stakeholders in the coastal zone. In this context, the need for effective communication between the different stakeholders for successful implementation of coastal zone management plans and policies is paramount (Mazouni & Rey-Valette 2002, Rolland 2005). This is exemplified by the diverse fields of disciplines of scientists and policy makers involved in coastal management (Woodward 2000).

The need to develop tools favouring communication between the various stakeholders was already apparent in the convention on biological diversity (Rio de Janeiro Summit, 1992), which underlined the necessity of organising “an exchange of information from all sources, accessible to the public” (Chapter 17, Oceans and coasts and Chapter 10, Planning and management). In 1998, the

Aarhus Convention covered access to environmental information in the interest of public participation. This convention spells out the commitment of the signatory states to developing public access to environmental information held by the public authorities, in particular by the provision of databases. This wish for networking and the sharing of information were further highlighted in the conclusions of the world summit for sustainable development held at Johannesburg (2002), which clearly signalled the necessity of presenting information in an appropriate form. Finally, this wish to forge links between knowledge and the users of knowledge (in particular decision makers) was confirmed by the European parliament<sup>1</sup>. Here the focus was on the necessity of "including systems of management and distribution to the public of information relative to the coastal zone. These systems should in due course make possible the gathering of information and its delivery to decision makers in compatible and appropriate formats". Altogether, these elements illustrate the growing awareness at international level of the importance of pooling environmental, social and economic knowledge and of its transmission to the public decision making authorities.

At national scale, the majority of developed countries have attempted to integrate the international recommendations within their own jurisdiction. In France, the coastal zone should be regarded on the basis of "an integrated approach favouring the management within a single process of the terrestrial and marine components of the territory and the taking into account of the full range of sectoral activities"<sup>2</sup>. However, although a nationwide strategy for the management of coastal zones and for sectoral scales policies has been decided on at national level since 2004, no specific system allowing the sharing of and access to knowledge has yet been proposed.

In this context, the research programme SYSCOLAG, launched by the Regional Council of Languedoc-Roussillon and its partners as part of the 2000-2006 State-Region Plan (Contrat Plan Etat-Région), is a pilot operation at national level for the experimentation of a knowledge-pooling system applied to the field of integrated coastal zone management. The aim of the present paper is to describe the approach developed in the SYSCOLAG programme and thus provide the general framework of the studies presented in this monograph.

### *The aims of the programme*

The aim of the SYSCOLAG programme is to constitute a real interface between 'knowledge' (issuing from the scientific community in the various disciplines

involved in the coastal zone, as well as the stakeholders in the coastal zone, elected officials, etc.) and the 'users of knowledge' (managers, local authority technicians, scientists, professional users of the sea, environmental protection associations, schools, etc.). This system is based on a know-how (particularly in integrated expertise and information systems) and an array of information processing tools destined for a public of experts and for the general public.

Among the primary aims of the SYSCOLAG programme, is the wish:

- to propose suitable indicators for monitoring the environment and uses, as a basis for assessing the effects of local policy and actions,
- to develop new knowledge-sharing tools,
- to develop scientific decision-aid tools,
- to define protocols for the implementation of integrated and sustainable management of the coastal zone.

### *The Regional context*

The coast of the Languedoc-Roussillon region, which extends for about 220 km, has strongly influenced the history, identity and economic development of the region. The importance attached to this coastal zone is apparent today in its strong potential in terms of research and education, in particular with regard to the lagoons (Courties *et al.* 1994, Mazouni *et al.* 2001, Alliaume *et al.* 2005). However, as in most cases, whether at regional or supra-regional scale, the scientific effort devoted to the marine and coastal domain in the Life Sciences, the Sciences of the Universe or the Social Sciences, remains too compartmentalised. As a result, there is too little interchange of knowledge between the disciplines. This lack of synergy gives rise to a too segmented view of the issues, and generally results in a loss of information and efficiency of assessment. In addition, the information produced by science is generally in a form unsuitable for decision making. Scientific knowledge is (1) usually mono-disciplinary, (2) disseminated among a large number of research organisations, and (3) couched in specialised scientific language that is difficult to assimilate and thus not easily exploitable from the operational point of view.

In this context, the multidisciplinary research programme SYSCOLAG was set up with as its main aim the integration of scientific expertises on questions related to the development of the coastal zone of the Region Languedoc-Roussillon. Set up jointly by the Languedoc-Roussillon Regional Council and Ifremer<sup>3</sup>, this research programme is supported by a close partnership between four universities in the region (located in Montpellier and Perpignan) and research organisations involved in

<sup>1</sup>Recommendations of the European Parliament and the Council for the development of an integrated coastal area management - 2002/413/CE - *Journal Officiel* n° L 148 du 06/06/2002, p. 0024-0027.

<sup>2</sup>French government commission of law and economic affairs.

<sup>3</sup>French research institute dedicated to the study and exploration of the sea.

Table I. - The 11 research projects funded by the Syscolag programme, with the presentation of their thematic and the domain of the concerned research.

PhD Student	Structure	Title of the project	Disciplines
AUNAY B	University of Montpellier II /BRGM	The use of detailed geological knowledge of coastal aquifers for improving the viability of hydrodynamic simulation models, in a water management perspective.	hydro-geology modelling
BARDE J	Cemagref	The pooling of data and knowledge : development of a metadata service based on international standards	informatics
BOURRIN F	University of Perpignan	Impact of the terrestrial inputs on the coastal zone : role of the prodeltas on suspended material. Application to the Tet river-coast system. Operational approach	sedimentary
CLAUDET J	IFREMER / University of Perpignan	Development of statistical tools and indicators to evaluate the impact of artificial reefs and marine protected areas on the demersal-benthic fishes	biology and statistics
DUVAIL C	University of Montpellier II /BRGM	Mecanisms, geometries and architecture of the plio-quadernary series around the Gulf of Lions, considering a terrestrial and marine continuum	geology
FERRATON F	IFREMER	Structure and dynamic of trophic food-webs of the Merlu ( <i>Merluccius merluccius</i> ) in the Gulf of Lions. Effects of the Rhône river plume and consequences on the fisheries	biology
GIORDANA G	Cemagref	Economic and environmental efficiency of the instrument of regulation of water uptakes in the coastal aquifers	experimental economy
ROUSSEL S	University of Montpellier I	Expected efficiency of integrated coastal area management based on the principle of spatial allocation for the public maritime territory.	economy
AUDOUIT C	University of Montpellier III	The occupation and use frequency of recreational users ? Toward new forms of management for the coastal zone of the Languedoc-Roussillon.	geography
LABRUNE C	Universities of Paris VI and Perpignan	The use of macrofauna as an indicator for the environmental changes. Elaboration of a regional database and proposition of a monitoring system for the Languedoc-Roussillon.	biology
REAU M	University of Montpellier III	Towards a sustainable regional governance of the coastal environments: between a uses recomposition and a redefinition of management strategy	political science

research on the coastal zone (BRGM<sup>4</sup>, CEMAGREF<sup>5</sup>, CNRS<sup>6</sup> and IRD<sup>7</sup>). In all, about twenty laboratories have been taking part in the programme. A Framework Agreement specifies the forms of cooperation and designates Cépralmar<sup>8</sup> organisation as the overall coordinating organisation of the programme.

### Methodology and tools developed

The approach proposed is mainly focused on the construction of an integrated multidisciplinary system of management for the coastal zone, on the basis of key issues for the regional council of the Languedoc-Roussillon and consultation between the main groups of stakeholders. The issues selected concern: the protection of the coast (protected marine areas and artificial reefs), the management of groundwater resources, the management of fisheries resources (from the point of view of uses and

management tools), the diversification of uses (in particular the development of leisure activities), inputs from the watershed and their impact and finally knowledge management. In phase with the aims of the SYSCOLAG programme, the project was organised in 3 complementary stages:

- stage 1 : Coalescence of the scientific community working on coastal zone issues
- stage 2 : Organisation of the process of consultation by associating local stakeholders
- stage 3 : Delivery of the information

The aim of the first stage of the project was to bring together the research teams working on coastal zone issues in the Languedoc-Roussillon region and to define the conditions under which the information produced by the different institutions and scientific teams could be made available. This work of co-construction required the gathering of a wide variety of information in terms both of the fields and disciplines concerned and of the nature of the operations which gave rise to it (institutional monitoring, upstream research programmes or expert reports, support programmes for the introduction of new regulations or innovative actions). Given the diversity of the issues, this stage was launched by the initialisation and financing of 11 PhD thesis research projects (Table I). To ensure the cohesion and complementarity of the projects on the various topics selected, regular working groups were organised throughout the duration of the programme. This multidisciplinary collaboration was

<sup>4</sup>French research institute dedicated to geology.

<sup>5</sup>French institute dedicated to agricultural and environmental engineering research.

<sup>6</sup>French national center for the scientific research.

<sup>7</sup>French public science and technology research institute contributing to sustainable development of the countries of the South, with an emphasis on the relationship between man and the environment.

<sup>8</sup>Cépralmar regional organisation dedicated to the coastal management and activities (fisheries, aquaculture) in the Languedoc-Roussillon.

Table II. - Presentation of the pilot models.

Pilot model	Objective	Deliverable	Target audience
Aquifers	Organisation of knowledge for its restitution Awareness raising among decision makers	Internet portal Metadata forms	Technicians and elected officials
Thau Lagoon	Organisation of knowledge according to the priorities identified during the public consultation process	General framework and guideline for decision making in relation to the maritime economy Metadata forms	Local authorities
Sète Harbour	Pooling of knowledge	Visual presentation of the different stages of a harbour planing project Metadata forms	Technicians and elected officials of the local authorities

centred on the development of tools for the pooling of information.

The aim of the second stage of the programme was to extend the field of involvement from the scientific community to other types of stakeholders in order to integrate and pool the specific 'know-how' of each of the different types of stakeholders. The aim was to enable the development of a tool that could deliver the information suited to the requirements of local stakeholders. The first phase of this action was focused on the development of a common language between members of the different professional communities. In the second phase, this process was taken a step further by the use of operational pilot models chosen in consultation with all the partners (Table II). The effort devoted to each of these pilot projects was determined by a common approach, but the level of investment varied. For example, on the issue of the management of underground water resources (aquifers), the choice of method was proposed exclusively by working groups dealing with a public of experts (scientists, local authority technicians) and elected officials. On the other hand, for a pilot model proposing a marine sub-project of the management plan for the Thau territory, the process of working out a methodology on the basis of working groups of experts was enhanced by the organisation of public meetings at the initiative of the local authority (Syndicat Mixte du Bassin de Thau) as part of the consultation process of this management plan. In this pilot model, which is the furthest advanced in the current state of progress of the programme, this phase made it possible to identify the stakes and the priorities for the sustainable development of the territory concerned (Thau lagoon) as well as the available resources (e.g. informations), which constitute the basis for the development of suitable information synopses.

The last phase of the programme was focused on the development of interfaces for the delivery of knowledge tailored to the requirements of the target group of stakeholders.

### ***Information processing architecture and tools developed***

From the point of view of access to knowledge, the choice of information processing architecture for the programme is based on a certain number of general concepts linked to the field of the pooling of information and knowledge. In order to localise and share resources within the SYSCOLAG community, several types of network infrastructure were possible, the criteria of choice being the degree of power over the management and control of information (Leitzelman & Dou 1998), from a centralised model to one involving total distribution, via intermediate infrastructures (federated or involving a mediator). Given the diversity of the partners and of the resources produced and used, both with regard to the content, to the form and to the mode of management, it seemed inappropriate to propose a centralised system of information management. This would have involved defining a single 'data model' to link up all sources of information. However, the available information is generally distributed and structured differently according to the field of research, and the copyright holders make its availability dependent on the acquisition of guarantees (Stoimenov & Dordevic-Kajan 2003)

The architecture of the information system (Fig. 1), which has been proposed and validated by all the partners in the programme, is structured around 3 main levels: a 'resource' level, a 'pooling' level and a 'user interface' level (Libourel *et al.* 2003, Barde 2005).

The resource level is composed of a number of 'resources', distributed among various copyright holders. Here we considered as "resources" all kind of information, knowledge, know-how, data available, from data set collection to interview, pictures, maps, etc.

The introduction of the 'pooling' level starts off from the notion of respecting the ownership of the resources while affirming the wish for collaboration. The notion of metadata underlies the commitment of the partners and makes possible exhaustive referencing (according to the

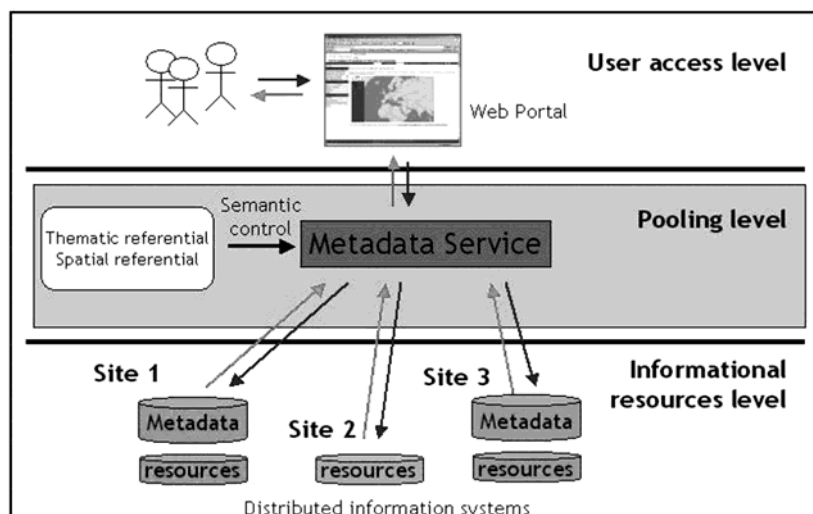


Fig 1. - Architecture of the information processing tools, based on the proposition of an intermediate level between the knowledge producers and the users : the "pooling" level.

ISO 19115 norm) of the available resources. In this system, the provision of direct access to the 'resources' is left to the discretion of the copyright holder.

The main originality of the SYSCOLAG system lies in this proposal of a 'pooling' level, which goes beyond simply providing a cataloguing service, since in addition to the metadata service, it includes a variety of information processing tools (semantic and spatial references, reference protocols, databases, etc.), integrating expertise derived from the various fields concerned. Even more than in other fields, the management of environmental resources in general (Douglas & Nebert 2004, Smits *et al.* 2002) and ICAM in particular, raises problems regarding the interoperability of databases. These problems are essentially linked to the heterogeneity of the resources and to their dissemination among the profusion of organisations involved in this field of activity. In the present state of progress, these management systems cannot interoperate. Nor could it be envisaged to require those working in the field to use a single mode of operation, which could not be adapted to the wide range of uses and disciplines involved. In practice, it is a matter of establishing correspondences between the existing systems, without modifying them. We have therefore opted for an infrastructure of mediation via the metadata. This can be defined as a system enabling users to access dispersed and heterogeneous sources of information by perceiving them as if they originated from a single homogeneous source (Libourel *et al.* 2003), all the while preserving intact the partners' systems of database management.

The highest level of the architecture, interface with the users, is at present provided via an internet portal ([www.syscolag.org](http://www.syscolag.org)) (Fig. 1), within which a particular search-resources engine makes it possible to easily structure the requests. To that end, four request criteria in particular have been adopted (geographical specification,

type of data, topic area, date), that may be used singly or as part of a multi-criteria search. In order to make the search engine more powerful, the requests are guided by the semantic control enhanced by thematic and spatial terms. It is also by way of this portal that the indexing tools are currently accessible to the partners for the referencing of their resources.

These choices were made in response to the problems associated with ICAM which is organised synoptically around thematic and spatial concepts (PNUE 1999, Heynoque & Denis 2001), the meaning of which must necessarily be understood by all in the same way. The semantic control (key words) significantly improves the quality of the indexing and the

resource search and thus enables better pooling of knowledge. To this end, we have proposed the use of a single semantic reference source which allows integration of all the concepts necessary for the description of the issues concerned by ICAM in Languedoc-Roussillon, by using the possibilities of cartographic representation for the particular case of spatial concepts. Given the omnipresence of the spatial dimension (implicitly or explicitly) in the ICAM concept, we decided at the methodological level to opt for 'mediation' between those involved, on the basis of the utilisation of spatial concepts. At this stage, we assumed that the spatial concept should be considered both as a resource, as a scale of management and also as a solution to the difficulties involved in exchanges between discipline-specific terminologies (semantic interoperability).

A prototype of the system has therefore been developed. Figure 2 shows schematically the functioning of the system from the point of view of identifying local resources. For each of the three pilot models proposed, the level of utilisation of the system is also specified. Thus, for the pilot model dedicated to the development of a passenger centre for the harbour of Sète, the metadata service search engine directly supplies the list of available knowledge items. For the other pilot projects, in addition to this access to knowledge item, a specific process of co-construction with the local stakeholders was necessary in order to achieve the integration of the knowledge required for the purposes of these pilot schemes (Table II).

## DISCUSSION

The contribution of the SYSCOLAG system can be broken down into several main parts. The first concerns

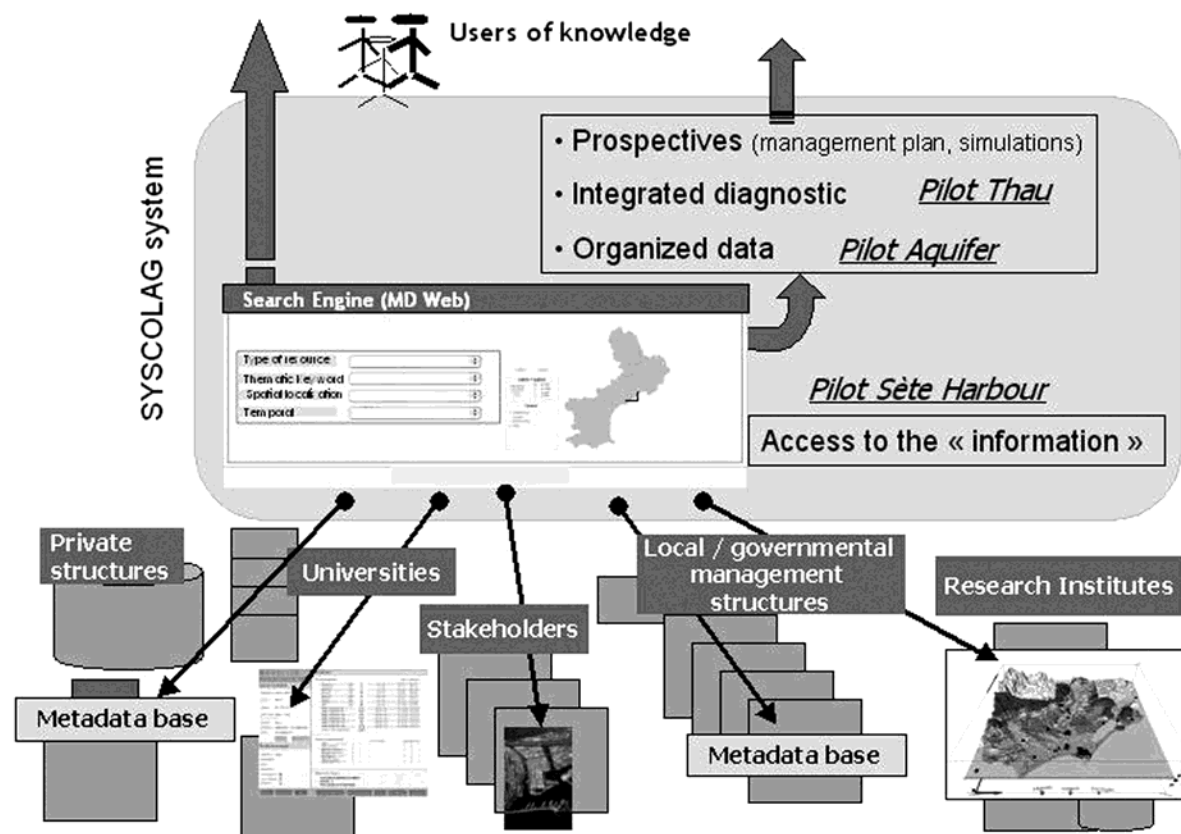


Fig 2. - Principle of functioning of the metadata service.

the advances in and exploitation of knowledge on a certain number of specific topics. For example, at regional scale, SYSCOLAG has made it possible to organise data on assemblages of benthic microfauna within a regional data base (Labrune 2006). This work has also made possible the characterisation of assemblages on the basis of analysis of several components of biodiversity (Labrune *et al.* 2006) which is in line with the process of characterisation of the ecological quality of water masses in accordance with the European Water Framework Directive<sup>9</sup>. On the issue of inputs from the watershed, we evidenced the potential influence of coastal rivers on sediment discharge in the Gulf of Lions (Bourrin & Durrieu de Madron 2006). In addition, the work carried out on the regulation and management instruments have made possible the identification of various management systems that might be developed with a view to improving the monitoring of the development of the coastal zone (Claudet *et al.* 2006) and the management of sampling of underground freshwater (Giordana & Montginoul 2006). This process has also made possible the dissemination of existing knowledge on the region's aquifers and the modelling of exchanges between these systems and the sea (Aunay *et al.* 2006).

The second part of the contribution of the SYSCOLAG programme concerns progress with regard to the development of pooling and aid to decision making tools. It might be envisaged that the approach developed for the SYSCOLAG programme could be extended in the form of a protocol for assisting the local authorities (in this case the Regional Council) at three levels, with ongoing interactions (Fig. 3). The first level concerns the system's benefits from the point of view of the localisation of existing resources and their integration for the purpose of construction of a reference state. This would consist of a diagnostic and a monitoring process. These items would then be directly usable by the local authority as input for the production of planning documents (regional territorial development schemes, for example). At this second level, the SYSCOLAG programme might generate information synopses and deliverables in order to provide input for the consultation process organised by the local authority or the local managers. This action is directly in phase with the management process recommended in the European Governance white paper (2001)<sup>10</sup>, while meeting the objectives for public participation in local government policy. This new trend towards a consultative basis for government policy requires the development of a proto-

<sup>9</sup>Directive (2000/60/EC).

<sup>10</sup>European governance: a white paper, COM-2001- 428.

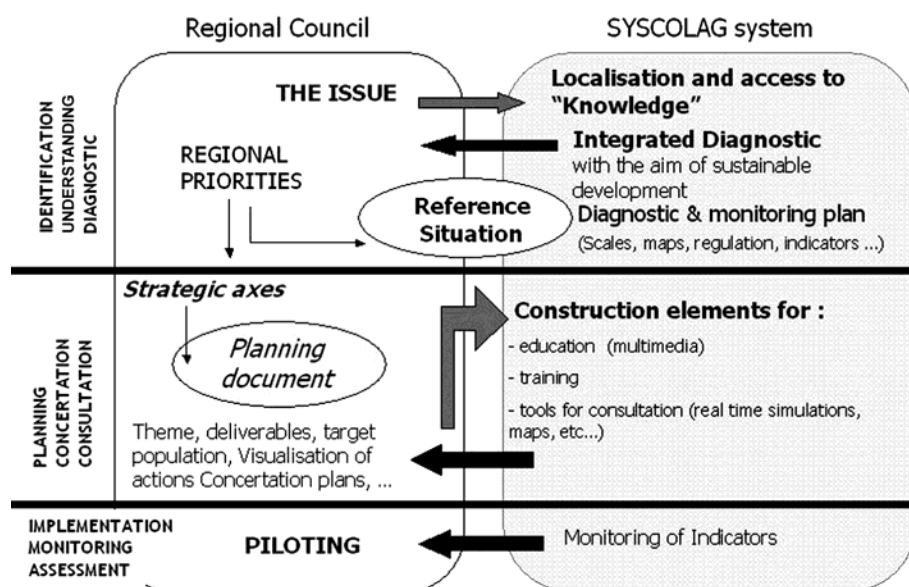


Fig 3. - conceptual schema of different levels of use of the SYSCOLAG system and its interaction with the procedures for the implementation of local government policy.

col for implementation. It has given rise to numerous experimental actions and policies undertaken by the local authorities and the scientific institutions. This process is undertaken in particular in the case of practices referred to as 'Participatory Action Research' (PAR) which offer a wide range of possibilities for joint action between authority managers and researchers (Mazouni & Rey-Valette 2002). More generally, recent works have highlighted the central role of information in the consultative process. They distinguish between three types of measures: the provision of information, the processing of information and the development of tools for providing support for projects. While the SYSCOLAG programme aims to facilitate the provision of information to the various stakeholders with a view to making the information available on an efficient and multidisciplinary basis, it is particularly focused on the processing of information. The aim here is the sharing of information, not only between scientific disciplines, or between managers and researchers, but also with the various stakeholders of the consultation schemes. This broadening of the arenas of policy negotiation brings new players into the management process (associations, NGOs, etc.). This requires the development of new standards for the provision of information which will be (as required by the Aarhus Convention) easily accessible to the greatest number of people and will facilitate the institutional training of those involved. What is at stake here is to facilitate the acquisition of knowledge by the users without having recourse to complex academic systems of access to knowledge which take time and are inappropriate given the voluntary nature of the participation of some of those involved in the consultative process. The use of maps and focused synopses of information (on the basis of research grids designed to take into account the most frequent questions) are among

the measures chosen for the SYSCOLAG approach at this level. It should be noted that these questions of access and training for access to information depend on the institutional structure of these schemes, as we have reported elsewhere (Rey-Valette 2006) and as Thévenot (2001) has also demonstrated by his comparative study of the modes of environmental negotiation. These issues and the questions raised by this new intermediate level of programming, cooperation and consultation shows that it cannot be a spontaneous process and that it therefore requires that suitable tools, protocols and procedures be defined. In addition, the questions of support for and facilitation of the consultation process may also be dealt with as part of the monitoring process when tools for the co-construction of an Observatory or of an Information System are developed.

For the third level, it should be emphasised that the process of producing sustainable development indicators also constitutes a mode of consultation and of local adoption of sustainable development policies by the stakeholders. This was evidenced by Boutaud (2005) in a review of 33 French experiments in the use of sustainable development indicators by local authorities. This author demonstrates that in most cases they concern participatory processes whose results in terms of the adoption of the indicators thus produced in the decision making process are very mixed. Nevertheless, he stresses that these methods constitute a means for stakeholders to formalise the concept of sustainable development. Thus these processes are apparently diverted from their function of producing 'technical' monitoring tools towards functions associated with the adoption and interpretation of the concept of sustainable development, which are procedures for the establishment of a norm on the basis of multiple decentralised sources.

Thus, in the medium term, the SYSCOLAG system can serve to improve the legibility of actions at the regional scale (whether carried out as scientific research or by local government or other local groups) and offer better knowledge of the network of parties involved in coastal zone issues (composition, mode of functioning). It thus represents a support system for local government and particularly Regional Council actions carried out within the framework of its coastal management policy.

#### ***Validation of the experiment by the adoption of the tools by local users***

The partnership established with the local agency (Syndicat Mixte du Bassin de Thau), as part of the marine sub-project of their management plan for the Thau territory, illustrates the system's benefits with regard to the process of territorial planning. Initially, it has made it possible to mobilise the various partners in order to work out a common conceptual framework of discussion on the question of the maritime economy and its components. The next phase involved identifying and indexing the available resources. Finally, as a backup to the discussions held in the public consultation workshops, the available knowledge provided a basis for the development of indicators for the monitoring of the environmental and economic impact of actions identified as essential for the maritime sector. It is also important to point out that in parallel with this SYSCOLAG pilot model, the tools developed here are currently used for the indexing of studies and projects on the Thau basin, related to the questions of the water quality and of the inputs. More generally, these SYSCOLAG tools are used for indexing all the resources gathered within the Thau lagoon Observatory.

More generally, these collaborations have confirmed the utility of the process, and the complementarity of the points of view of the various groups involved is well reflected in the support systems. The partners in the programme are aware that the common objectives go beyond the development of tools for the management of a specific territory and aim towards proposing a 'generic' integrated management methodology.

#### ***Specific but transposable information processing tools***

The interest of the SYSCOLAG system goes well beyond the regional context from which it originated. The approach developed has several original features: multi-disciplinary (life sciences, earth sciences and social sciences) co-construction of information processing tools, the development of indexing systems, the provision of protocols for the support of local government planning consisting of tools and expertise and based on a participative approach. In fact, the process was designed to be transposable to the ICAM process in other areas.

One of the main benefits of the programme lies in the fact that the information processing tools developed by SYSCOLAG are based on international standards with regard to referencing and interoperability (Norm ISO 19104, 19113, 19115, 19139), which guarantees them a certain life-span. They have also been developed in close collaboration with the users. Indeed, one original aspect of our approach is to propose tools that are tailored for the field of application of ICAM, in particular with regard to the multidisciplinary nature of the expertise and to the heterogeneous nature of the resources. The referencing system is designed to take into account the full range of resources and is not limited to geographical information alone.

In addition, the information processing tools developed in the metadata service are intended to be generic, that is to say potentially adaptable to a diversity of situations. So, the SYSCOLAG approach could be adaptable to work in other fields requiring the pooling and sharing of knowledge of a particular type (forestry resource management, natural risk or fisheries observatories, data bases for seafood industry companies, etc.). For example, the tool for the administration of 'profiles' makes it possible to generate, on the basis of ISO rubrics, a specific profile dedicated to the description of any type of resource for a particular community. They also make it possible to generate, on the basis of these profiles, specific forms according to the type of resource concerned. The ongoing exchange of information with the users has also made it possible to reduce the constraints bound to the inputting of references, by partially and variably automating the process.

The information processing tools, have been an intrinsic part of the process of collective debate. In addition, they constitute essential links in the construction of infrastructures for the sharing and distribution of information, such as those that are discussed in the working groups of the upcoming European Directive INSPIRE (The INfrastructure for SPatial InfoRmation in Europe). Other information processing tools similar to those developed in SYSCOLAG exist (M3Cat, GeoNetwork, etc.) and are used in particular for the development of geoportals at local, national or even international level, but the originality of the SYSCOLAG programme lies in the permanent enhancement of these tools by the process of co-construction with the users.

#### ***Constraints and limitations of the process***

A first constraint in the implementation of a process of this kind at regional level, concerns the considerable strain for local authorities (here the Regional Council) and research organisations, in terms of both financial and human aspects. In addition, the nature and level of the commitment required of the partners should be highlighted. Since the ultimate purpose of the programme is to



develop a demonstration prototype, a considerable investment has been required of the partners. A trans-disciplinary PhD thesis project (Barde 2005) has provided a basis for structuring the work around the information processing project of the metadata service. Nevertheless, the innovative character of the programme, in particular from the point of view of the information processing tools developed, has also been a source of difficulty. It was sometimes difficult for certain partners to fully understand the steps for the co-construction of the information processing tools. Here, the new vocabulary and concepts were in themselves constraints that we had to deal with progressively. To conclude, it is important to note that one of the key points of the process developed in the SYSCOLAG programme has been the maintenance of constant organisation procedure in order to keep active the ongoing exchange of information between the partners.

## CONCLUSION

The process developed in the SYSCOLAG programme has made it possible to organise a network of partners around a common objective: the pooling of knowledge. With regard to the scientific partners in the region Languedoc-Roussillon, the process has made it possible to organise multi-disciplinary working groups and to make them aware of the difficulty of providing the results of research in a form that is usable by and suited to the requirements of local stakeholders. In addition, this common objective of pooling knowledge has necessitated the development and use of innovative information processing tools. This experiment should continue to be improved, disseminated and validated at local level by the development of collaboration with other institutional partners (local authorities, water board, government agencies) and other local stakeholders. In the short term, the next stage of the SYSCOLAG process will involve enhancing the system by the addition of other topic areas, in particular those of coastal erosion and the improvement of the coastal area by the construction of artificial reefs. The uptake of this approach at the national scale might take the form of the development of partnerships with other Regional Councils and with leading organisations.

In this context, the second phase of the project should be included in the "project contract" for 2007-2013. The French report on the application of the Recommendations of the European Parliament and Council relative to the development of a strategy for the integrated management of coastal zones in Europe, coordinated by an inter-ministerial delegation for the development and the competitiveness of territories (held in May 2006), indicated that the regional scale is "the scale at which a strategic vision regarding the development of territories is constructed". It underlines the necessity of implementing a multi-scale

approach for the integrated management of the coastal territory. Regional level is here identified as the relevant level of vertical integration between national orientations and local action. The setting up of a Regional Observatory for the Coastal Zone in Languedoc-Roussillon could therefore be the next stage of the process initiated in the SYSCOLAG programme.

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