The central role of basin authorities in the governance of water challenges induced by climate change: A social network analysis of the Thau Basin in France (version 180202)

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Abstract

Due to the effects of global warming, water management has become more complex. Increased water scarcity creates rivalries between water users for the access and use of the resource. Since 1992, the French Government has elaborated the water management and development plans (*Schéma d'aménagement et de gestion de l'eau*, SAGE). In 2015, 179 SAGE were approved of which 108 have already been implemented. In line with the Water Framework Directive, these local plans developed an integrated and concerted water management that combines environmental protection with the human-induced water usages. They rely on a water basin authority which designs and implements the plan in a consensual way and encourages the definition of common goals between the local users. The aim of this communication is to question the actual role of the basin authority and asks whether it is central in the local water management. Alternatively, major stakeholders or public authorities may be the *de facto* decision-makers in the distribution of water uses. The communication relies on a case study conducted in the Thau basin in 2012. Drawing on social network analysis, a method used to visualize and describe social structures, it identifies the actors which occupy central positions and hold effective power. Specifically, the analysis looks at three measures of centrality linked to different forms of power: Degree centrality, closeness, and brokerage. As a result, the key actors of the SAGE, namely the Water Agency (AE-RMC), the local water agency (SMBT) and the users' assembly (CLE), appear as the most powerful actors in the management of the river basin, which validates the shift in power introduced with integrated water management from territorial and central authorities to functional and more local managers.

Keywords (5 max.): rivalries, integrated water management, climate change, social network analysis, governance

Introduction

Are river basin authorities pivotal in the management of water basins? This question is raised with two basic assumptions: A discrepancy exists between formal and actual institutional arrangements and public authorities contribute to the allocation of water between users. The first assumption relates to the literature on public choice which took some distance with pure institutionalist perspectives. An important distinction is made between formal rules and rules-in-use. Rules need to be permanently reactivated by its beneficiaries in order to keep in force. Otherwise, the rule recorded in legal texts progressively dies out. The second assumption asserts that most transfers of use rights occur in the 'shadow of the state'. Public authorities intervene in the resolutions of water rivalries, either directly as brokers or indirectly as guarantors of property rights or public regulations. In the empirical perspective, the main contribution of this communication is to see whether the river basin authorities designated to implement the integrated management of water gained power and legitimacy against the classical authorities in charge of water management (e.g. the national government and the municipalities). The question of the role of river basin authorities in integrated water management is addressed with a case study on the Thau river catchment in France. Users and managers within the basin were submitted to a Social Network Analysis (SNA) in order to assess the power relationships in water management. After a presentation of the analytical framework and the method, the Thau catchment will be extensively described in a third part. The result of the SNA will then be presented and discussed. The results show that the water basin authorities of the Thau catchment, namely SMBT and CLE, play a pivotal role in water management, but share their power with another functional manager the Water Agency Rhône-Méditerranée-Corse. Integrated water management induced a redistribution of power from territorial and central authorities to functional and more local managers.

1 An increasing involvement of local authorities with integrated management

The starting point of this communication is that climate change should worsen water scarcity and flood problems in the Mediterranean regions. Climate models predict a decrease and concentration of rainfalls and more pressure on the flow of rivers and levels of groundwater (La Jeunesse et al., 2016; La Jeunesse et al., 2015). Scarcity is a differential between supply and demand. All demands cannot be satisfied with the available supply. Scarcity is absolute when supply is too short to satisfy all the needs. It is relative when some demands are not met because the resource is unevenly distributed. Scarcity affects either the quantity of water available (in case of droughts) or the quality of water when the remaining water is polluted (e.g. with nitrates or because of salination). An increased scarcity due to climate change should provoke an increase of rivalries between water users.

A rivalry is a problematic situation occurring between competing users. It is "a situation in which two users face incompatibility between their respective uses, and at least one user does not have enough to satisfy his needs. It is a confrontation over the reallocation of a resource between different users" (Aubin, 2008: 214). For example, a rivalry appears between shellfish farmers and the companies of water treatment plants when water discharges are low in nutrients. The growth of shellfish is impeded, but the companies claim that they conform to their legal obligations in terms of wastewater treatment. Another example of rivalry would be a competition for water uses between farmers who want to increase irrigation and the development of housings and private swimming pools when both rely on the same supply. A rivalry is not a conflict, i.e. a situation of hostility between the parties when at least one does

not move his position and no one concedes (Freund, 1983; Simmel, 1999). Rivalries are usually solved before turning into conflict.

Once rivalries appear, there are many possibilities to resolve them but in a state of law their resolution is usually backed by the rules. Formal rules are legal prescriptions that lean on a coercive apparatus and that command and condition social actors' behaviour (Reynaud, 1993). They create positions, and require, permit, or forbid to take actions (Ostrom, 1986). In other words, they establish rights, duties, and privileges to every citizen (Bromley, 1991). Formal rules can be divided in two categories: public regulations and property rights (Gerber, Knoepfel, Nahrath, & Varone, 2009). Both kinds of rules are guaranteed by the state, which means that their enforcement relies on this guarantee. The breach in the rules is sanctioned by governments or courts.

This status of guarantors of the rules but also the legitimacy public authorities have to the citizens create the conditions of their involvement in the resolution of rivalries. On the one hand, they tell the rules. For instance, a court takes decisions that are imposed to users. For instance, the judge states that a settlement is illegal in respect to land-use regulation, or that a user infringed the water use rights of another user in withdrawing water. Also, a regional government can authorize the building of a new dam in delivering a building permit despite protests from environmental associations. On the other hand, public authorities can be asked to mediate rivalries. Users bring their claims to the authority in order to search for a resolution, e.g. to the mayor in case of local disputes. The public authority has the capacity to advise and propose compromises. Thus, public authorities are expected to play a strong role as intermediaries in the resolution of rivalries.

New institutionalists often consider public interventions as being hierarchical (Ostrom, 1990). Hierarchy means that the organizations exert authority on their subjects and take coercive decisions to which the subjects have to conform to. A pure hierarchical regime is absolutism, but in modern states hierarchy is a legal authority that interprets the law and gets its legitimacy from the law (Weber, 1978). Under pure hierarchy, rival users would come to the authority and be imposed a compromise which closes the case. In modern states, the public decision must be a valid interpretation of the legislation or the enactment of a new law by a legitimate parliament.

Besides hierarchy public interventions can take different forms than coercive decisions. They can be network or market-types (Bouckaert, Peters, & Verhoest, 2010). In network-type interventions, public authorities put stakeholders together in order to find a common solution to a problem. They do not necessarily have the capacity to decide or impose a solution, but they set procedures that, for example, involve stakeholders in a deliberation, put common positions to agreement and morally commit the participants to implement the common position in their own organisation. In market-type interventions, the public authorities create a market procedure in order to distribute access to the resource (e.g. public tendering, quotas). Even in pure markets, both the exchange procedures and the use rights exchanged are guaranteed by the state and any transaction is opposable to the court. As such, the possibilities of state intervention in water rivalries are many and can take different forms.

Of course, users can reach a solution to their rivalries without external interventions. They activate and confront rules in order to settle their disputes (Aubin, 2008, 2011; Aubin & Varone, 2013). Public authorities are a special kind of water users as they can either be users themselves (for instance, the *Direction régionale de l'environnement, de l'aménagement et du logement* as dam manager) or rule implementers (e.g. the *Préfet* who delivers the concessions for running hydropower plants, or the courts). Thus, it is important to establish a distinction between standard users and managers as public authorities play a special role in the process of

resolution of rivalries. The managers are the organizations in charge of the regulation of water access and uses. They don't supply water services but implement the legal framework and monitor enforcement. They also take decisions against individual users in delegation from the legislator. They are part of a broad institutional arrangement that is set up at multiple levels (e.g. international treaties, water directives from the European Union, national and regional laws, and local arrangements), organize the allocation of tasks and competences between the managers, decision-making procedures and describe the substantial rules that are in force and which require, permit or forbid individual behavior.

In the years 2000, sometimes earlier in some countries, water management has changed with the introduction of integrated water management that replaced the former sector-based approach. Water issues should no longer be addressed separately by sector departments in national governments (e.g. water for transport, water for agriculture, water for industry, and nature protection), but all sector interventions should be coordinated within a common structure. Integrated water management relies on planning activities as a support for coordination, i.e. a management plan, including a mapping of water uses and pressure, a monitoring program, common objectives and a list of specific measures. In local management, the approach was territorial, which means that sector departments had deconcentrated units at lower levels which cooperated with local authorities (in France at the regional or department's level, in Belgium at the provincial level, and at the canton's level in Switzerland). Integrated water management is organized around watersheds or river basins. Management is not anymore territorial, but functional (Varone et al., 2013). It goes across the borders of the political and administrative territories in order to follow the rivers and water streams. With integrated water management, a functional and networked management at the river basin scale has substituted to a former territorial and hierarchical management. It may also generate more decentralization, but this depends on the institutional arrangement retained in each country.

The change is not only spatial (for territories to functional spaces), but it is also a change in scale that possibly modifies power relationships among the stakeholders. Integrated water management has modified the scales at which water is managed (Varone et al., 2013). The institutional arrangement has become multi-level with combined dynamics of upscaling and downscaling. First, the European Union is the level at which broad objectives and procedures are set. Every public authority in Europe is bounded with the requirements of the Water Framework Directive (2000/60/EC). The coordination within international river basins also imposes supra-national institutions that decrease state sovereignty and oblige the Member States to cooperate.

Second, downscaling occurs in the implementation phase at the local level. Although the water basin authorities usually remain the national or regional government, the institutional arrangement set up local committees for managing local issues in smaller basins (e.g. river contracts in Wallonia and local water commissions in France, *Commissions locales de l'eau*). Deconcentrated sector administrations must cope with participatory mechanisms which involve the municipalities and the users. They tend to become one stakeholder among others. Thus, water management operates at multiple levels, but the main steering activities were upscaled at the European level. For example, the implementation of the Water Framework Directive is driven by a committee composed of the national water directors which sets up common guidelines to implement the directive the same way.

A change in scale means a change in power distribution. The effects of institutional arrangements on the positions of power of water users and managers must be stressed. The rescaling of the governance structure of water management is a power-laden process (Faure et al., 2007): "The emergence of new territorial scales of governance and the redefinition of existing scales (like the nation-state) change the regulation and organisation of social, political

and economic power relations" (see also Brenner, 1999; Swyngedouw, 2004). Any reconfiguration of the regulatory regime, with upscaling of some regulatory process (e.g. definition of standards for the measurement of water quality or criteria for establishing exceptions to the objective of good quality of water as of 2015 at the European level) and the downscaling of others (e.g. set up of the program of measures at the national or regional level and designation of natural areas, land-use planning, design of the sewage network at the local level) have impacts on the relative power position of the stakeholders. Some users benefit from tailored rules or a better access to the decision-making arenas, while others lose. The venue and scope of the issues are not power neutral. This is an empirical question worth being investigated. The nature and variation of the power relations between users becomes an empirical question.

Of course, the exercise of defining power cannot be escaped. As this communication is approaching power through relational and reputational perspective (see below), we will follow Manuel Castells in his appreciation: "Power is the relational capacity that enables a social actor to influence asymmetrically the decisions of other social actor(s) in ways that favor the empowered actor's will, interests, and values. Power is exercised by means of coercion (or the possibility of it) and/or by the construction of meaning on the basis of the discourses through which social actors guide their action" (Castells, 2009: 10). This definition combines two sources of power exercise: coercion, that is close to Weber's understanding of power (Weber, 1978), but also discourse, and more specifically the issue framing conveyed in discourses (in French the concept of énoncé is used, see Foucault, 1966; Jones & McBeth, 2010; Laws & Rein, 2003; Zittoun, 2014). "Throughout history communication and information have been fundamental sources of power and counter-power, of domination and social change. This is because the fundamental battle being fought in society is the battle over the minds of the people. The way people think determines the fate of norms and values on which societies are constructed" (Castells, 2007: 238). This perspective opens the way to approach power empirically through the study of the interactions between stakeholders. The perceived influence of one actor by the community members as well as the position on this actor within the information flow are telling about the distribution of power among a community. This communication looks at the fit between the power distribution perceived by the stakeholders within a river basin and the formal institutional arrangement governing water management in the basin. Who are the most powerful public authorities or users? Is it in line with the changes introduced by integrated management or are the former authorities still the most powerful?

Given the development of information flows and exchanges, it is hard to believe that interactions between actors are limited to formal procedures. In fact, there is a discrepancy or gap between formal procedures of water management and actual procedures. Actors are strategic and make the most of the rules in exploiting the grey areas of the law, and the "areas of uncertainty" (Crozier & Friedberg, 1977). These discrepancies between the formal institutional arrangement and the actual practice can be grasped with a specific method: Social Network Analysis. The method relies on the assumption that the actors positioned at the centre of the information flows and who have the best reputation are supposed to play a critical role in the decision-making process or the management structure (Knoke, 1990).

In sum, the aim of this communication is to assess if the river basin authorities introduced as agents of integrated management play a pivotal role in water management. This role will be measured with a Social Network Analysis, which mobilizes a reputational and positional definition of power. The river basin authorities are considered as influent if they have a strong reputation in terms of problem solving capacity and if they are at the centre of the information flows. The results of the empirical analysis will allow formulating predictions for facilitating

the resolution of new rivalries. In fact, we believe that the users in rivalry will refer the case to the pivotal managers, and that these pivotal managers will have the legitimacy to propose compromises.

2 A social network analysis to assess the actors' position and power

Social network analysis (SNA) is a quantitative method that formalizes the social structure of a particular network (Knoke, 1990). It allows visualizing the pattern of relationships among a defined set of actors. Grounded in graph theory, SNA uses mathematical procedures to explore actors' relational profile, the properties of the subgroups and the configuration of the whole network structure (Knoke & Yang, 2008; Wasserman & Faust, 1994). Various scholars have used this method to assess actors' power and role in organizations (Krackhardt, 1990), in the decision-making process (Ingold & Varone, 2011) or in management structure, specifically in the field of natural resource management (Bodin & Crona, 2008).

SNA allows grasping both the reputational and the positional power of an actor. The reputational power of each actor corresponds to the total number of actors within the network that judge this actor as the most powerful (Fischer & Sciarini, 2015). It provides results on who is perceived as the influential actor. In turn, positional power derives from the strategic location of an actor within the web of relations. It gives insight to actors' influence beyond their legal tasks or delegation.

Actors' location is determined by Freeman's (1977) centrality measures, which compare the effective number of relations an actor shares with the maximum number of relations that he might have with others participants in the network. This research combines analysis on degree and betweenness centrality. Degree centrality refers to the number of relations an actor has with others and relates to the power of direct influence (Knoke, 1990). It is divided in in- and out-degree, where in-degree is the number of relations that is directed to an actor and out-degree the number of relations an actor directs to others. Betweenness centrality measures the number of times an actor is on the shortest path between two other actors, which relates to the power of indirect influence: Actors with high betweenness have the potential to exert control over the flow of information. Measures and visualization are provided by UCINET6, software developed by Borgatti, Everett & Freeman (2002).

2.1 Relations and measures

To assess river basin authorities' power, four types of relations are studied. The assessment of an actor's importance determines the reputational power while the impact on decision-making, the exchange of information and the frequency of contact assess an actor's positional power. Those relations show who is perceived as the most important actor, who influences whom, where the different actors get their knowledge from and with whom they stay in regular contact. They are crucial indicators of the role an actor plays within the network and the opportunities he has to influence others' behavior (Knoke, 1990).

The importance of an actor is assessed by measuring how many times an actor is perceived as very important and important, or its in-degree centrality. The study of the impact on decision-making allows grasping the distribution of power and to distinguish influential actors. In this case, in and out degree centrality are calculated to determine who has the most impact on others' decision-making processes, displayed by in-degree, and who is the most impacted, shows by out-degree. Similar procedure is used to evaluate the exchange of information network and to figure out how many participants an actor gave information and from how

many he received information. The information exchanged must be in relation to the implementation of the institutional arrangement, for example reports and advice. Finally, betweenness centrality measure is applied to the network of contact frequency in the management of the Thau catchment. This measure reveals who bridge across participants by calculating how many time an actor is the intermediary between two others. It shows how many times an actor has frequent contact with participants that do not interact with each other.

2.2 Data

To define the actors to include in the study, or the network boundaries, the research relies on the positional approach based on delineating formal membership (Rice & Yoshioka-Maxwell, 2015). Because formal organizations are at the core of policy-making (Knoke et al., 1996:7), this research considers actors as the organizations which take part in the implementation phase of the policy process. The actors included in the list are therefore the organizations formally involved in water management of the Thau catchment, that is the ones concerned or mentioned in the national legislation.

Preliminary interviews took place in the Thau basin, in July and September 2010. The SNA surveys were distributed in French to 41 actors in November 2011. Respondents were asked to indicate with which organization involved in the management of the Thau catchment they share the four types of relations previously defined. 11 actors fulfilled the questionnaire. The response rate of 27 % is rather law but this does not impede the provision of reliable data as the main managers replied and no major actor is missing at least at the local level. Results have, however, to be treated with caution as they are not enough respondents for inferential statistics. This study provides therefore an interesting view of how water in the Thau catchment is managed but the conclusions cannot be applied to other contexts. In Annex I and II lists of all actors integrated in the network and the survey are provided.

Data collected were coded as a matrix in a Microsoft Office Excel sheet. The first column and line include the name of all the actors to whom a survey was sent. Each response was then transcribed in a column so that every line corresponds to one actor. Data were coded as follows excepted for the frequency of contact: A 0 was given when the relation was absent, a 1 when the relation was present. For instance, if an actor A sent information to an actor B, a 1 is coded at the intersection of line A with column B. For the frequency of contact, the code ranges from 0 (no contact at all) to 5 (almost daily contact). For data analysis, as betweenness degree does not support valued numbers, data were dichotomized to differentiate frequent contact from non-frequent contact. A 1 was given to monthly, weekly and almost daily contact, 0 otherwise. The threshold was defined so as less than 50% of the relations are frequent contacts. Missing answers were coded as 0. The Excel sheet was then imported into the UCINET6 software for data analysis and the NETDRAW package (Borgatti, 2002) for visualization.

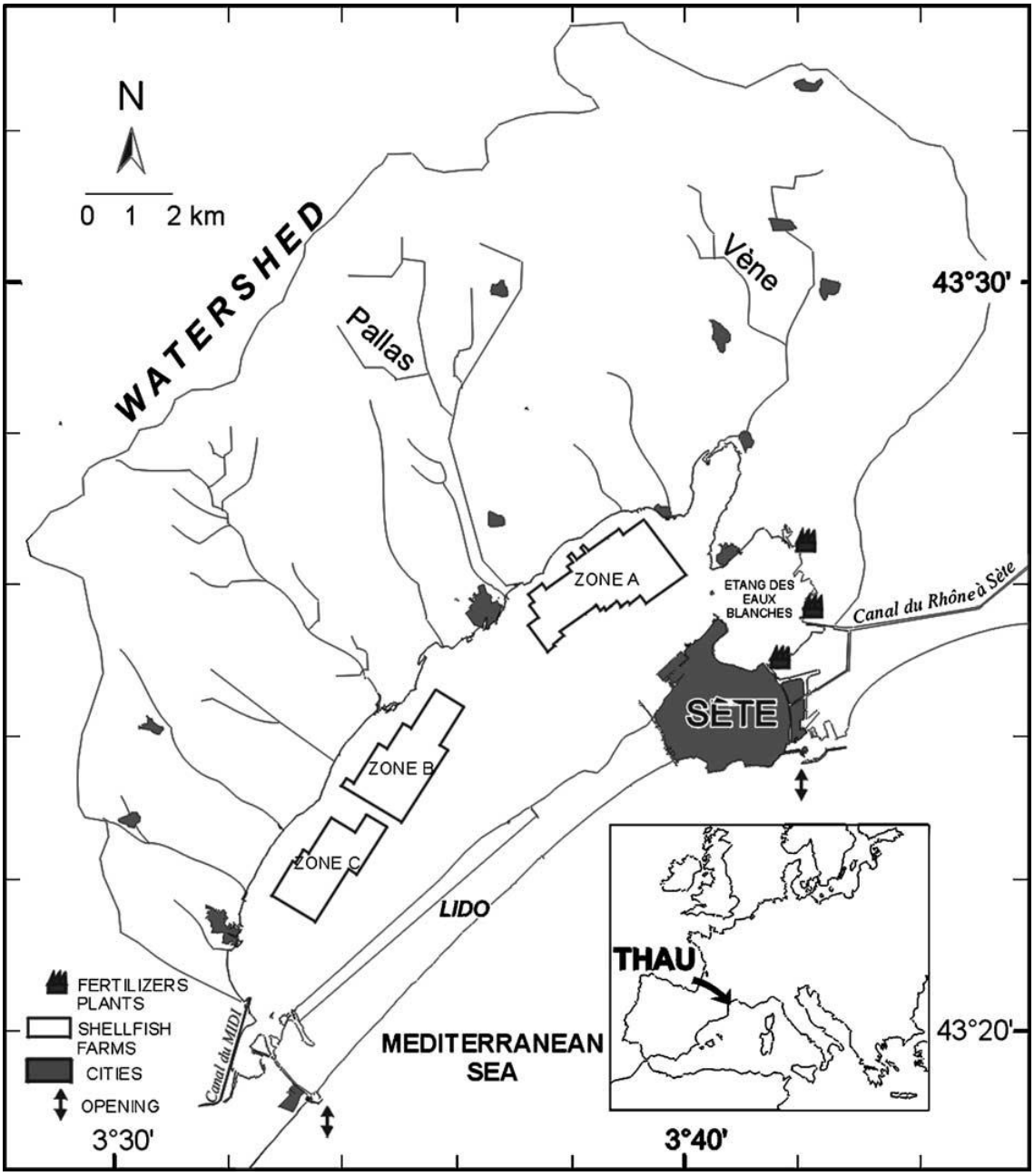
3 Presentation of the case: the Thau Basin

The Thau catchment is situated on the French Mediterranean coast. It covers 250 km² including a total population of 120,814 inhabitant with a half-concentrated in the city of Sète (about 450 inhabitants/km²). The total population doubles each summer through tourism mainly on the sea coast but also around the lagoon. The industrial activity is linked to the wine production and the transportation via the port of Sète. Chemical plants (fertilizers) are installed on the lagoon's coast in the periphery of Sète. The second thermal station of France is located in the catchment in the commune of Balaruc-les-Bains.

3.1 Socio-economic activities in the Thau watershed

The Thau coastal lagoon covers 75 km² (Figure 1). It has a mean depth of 4 m with a maximum of 11 m. It is microtidal with an approximate volume of 300 Mm3. It receives freshwater from small and non-permanent streams, except for the Vène connected with a karstic aquifer. The water resource of Balaruc-les-Bains is connected with the karstic aquifer of the catchment too.

Figure 1: Localisation of the Thau coastal lagoon and its catchment in the French Mediterranean Coast



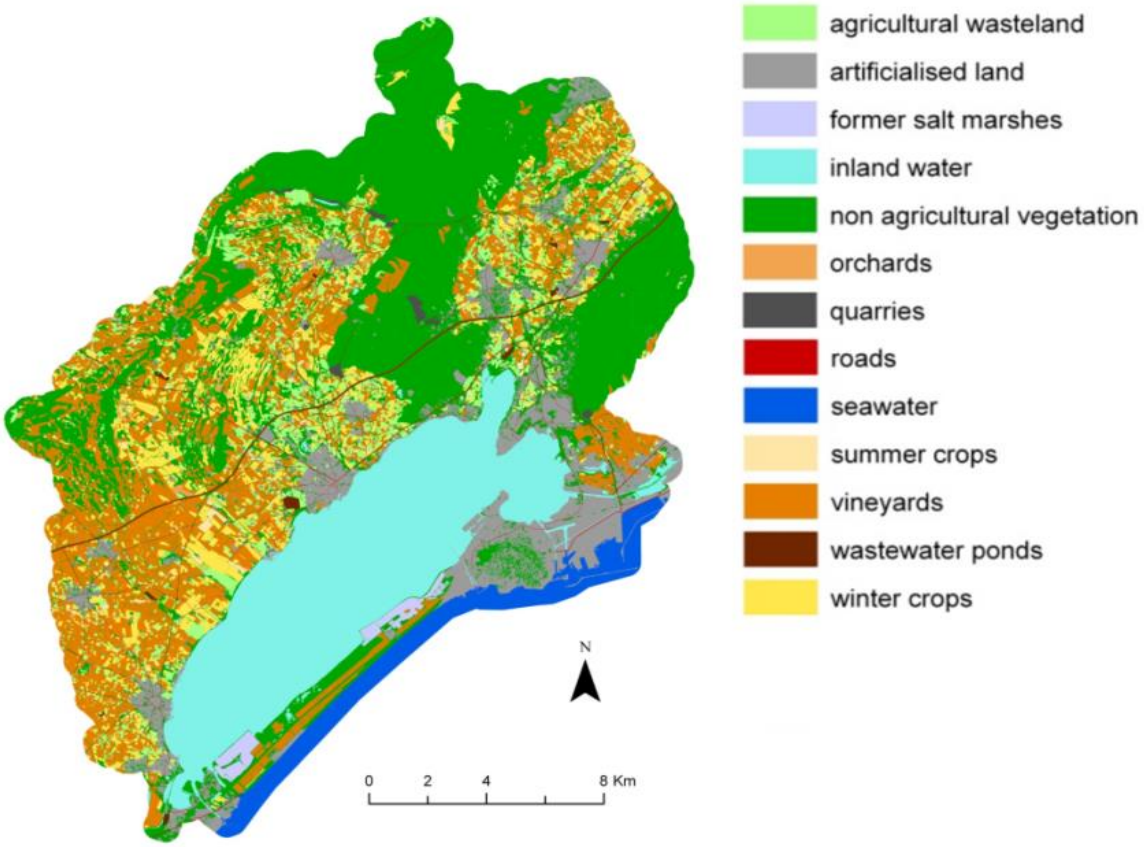
Shellfish farming represents the main lagoon-based activity. Approximately one fifth of the lagoon's area (1,500 ha) is farmed for shellfish production and occurring in three zones (Figure 1) with an annual production of approximately 13,000 tons of oysters and 2,500 tons

of mussels, accounting for around 1/10 of the national French production of shellfish (Rey-Valette 2004 in Loubersac et al. 2007). In the lagoon, shellfish-farming and fishing are designated priorities because of both the exceptional growing conditions and the major economic contribution to the region.

On the site of Thau, all rivers are intermittent, except for the Vène, which generally has a basic flow ensured by its link with the Karstic network. The other rivers have no ecological flow. The flow is generally represented by water treatment plant discharges. Further, the rivers are difficult to access and do not attract any recreational use on the catchment area.

About half of the area's land surface is devoted to croplands (Figure 2). The forests in the Thau basin are Mediterranean *garrigue*, a low, soft-leaved, scrubland plant community. This vegetation occurs both in continuous stretches in parts of the northeast quadrant of the study area as well as interspersed with crop lands. There are only minimal amounts of grasslands or pasturelands in the area. The land shown as agricultural wasteland is primarily abandoned. In many cases this has resulted from abandonment or removal of vineyards (supported a time by European subsidies). This situation is a concern close to villages because those areas spread fire.

Figure 2: Thau land-use, 2010



Source: Baghdadi et al., CLIMB EU Project

Almost 70% of land devoted to agriculture is used for vineyards. Vineyards and orchards in the vicinity of the village of Villeveyrac are the only irrigated crops in the area. Water comes from exploited quarries. Only limited amounts of fertilizers are used in vineyards. Winter

wheat, which is bare-fallowed in summer, and other cereals constitute the next largest use of agricultural cropland after vineyards. As 40% of the catchment is occupied by vineyards, wine and grapewine production is the main agricultural activity. Large areas of soil surface remain uncovered, even during the growing season, due to the wide spacing of the plants and weeding. Today, agriculture is mostly not irrigated in the Thau watershed.

Also, shellfish productions are impacted by transfers of contaminants (bacteria, pesticides) from the catchment. Nutrients fluxes are contributing to the eutrophication leading, depending on climatic conditions and the state of the sediments to anoxic crisis. The lagoon water temperature has also been an important concern since 5 years as when it exceeds 16°C, a virus which damages oysters is active. When it exceeds 29°C, mussels are dying.

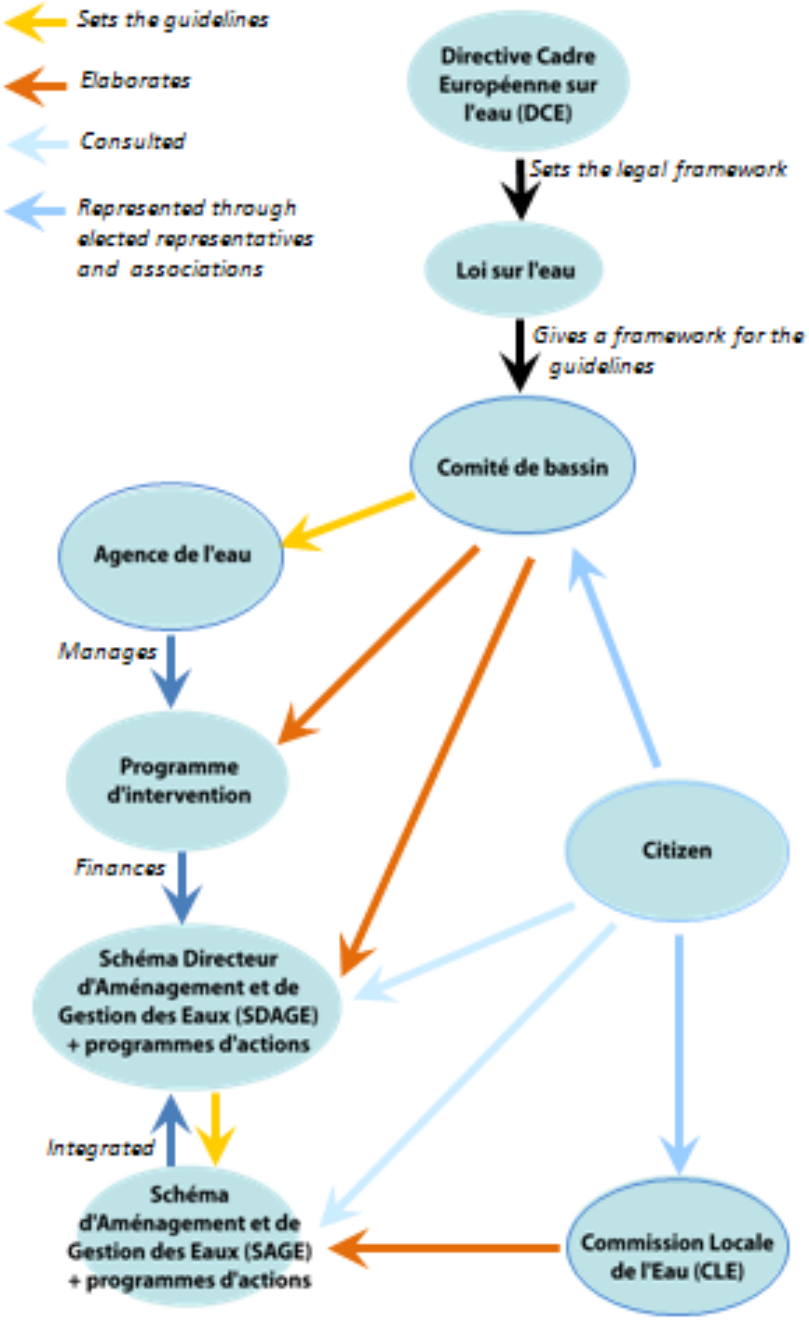
3.2 Water management in France

Although France is divided in regions and departments, water encounters a different partition with twelve hydrographic districts. Each hydrographic district holds a river basin committee (*comité de bassin*) composed with representatives of the local authorities (40%), water users (40%) and state representatives (20%). They set the water policy guidelines which implement the European and national standards. In France water management is based on master plans (*schéma directeur d'aménagement et de gestion des eaux*, SDAGE), their current version being approved in 2009, which implement the WFD and the 1992 Water Law (updated in 2006, see Figure 3). To achieve the goals set up by SDAGE, the actions to be taken are defined in a program of measures (*plan de mesures*, PDM). SDAGE are drawn up together by the national, regional and departmental authorities and implemented by the water agencies (*Agences de l'eau*). SDAGE manage the impact of human activities on the surface waters of each hydrographic unit.

Within the territory of SDAGE, local authorities can elaborate local master plans called SAGE (*Schémas d'aménagement et de gestion des eaux*). SAGE is a non-binding structure which acts through a Local Water Commission (*Commission locale de l'eau*, CLE) composed of representatives of the state (25%), local authorities (50%) and users (25%). Among the users, there may be consumer groups, industrials, farmers, and environmental associations.

About the organisation of water supply and sewage, local authorities can set up public companies or delegate the management of these services to private companies which then get a limited-term concession (*gestion déléguée*), a typical characteristic of the "French model" of water management (Barraqué, 1995).

Figure 3: Heuristics of the formal institutional arrangement for water management in France



3.3 Management of the water quality in the Thau coastal lagoon

At a local scale, state management is made through the decentralized services of the DREAL (*Direction régionale de l'environnement, de l'aménagement et du logement*, Regional Direction of Environment, Planning and Housing) and the DDTM (*Direction départementale des territoires et de la mer*, Departmental Direction of the Territories and the Sea).

In addition, a multitude of public managers is involved, mainly due to the administrative division of the territory at different scales from the region to the municipalities. In fact, the Thau catchment encompasses 14 different municipalities (Figure 4), separated into two main intermunicipal organizations (*communautés de communes*): CCNBT (*Communauté de communes du nord du bassin de Thau*) and CABT (*Communauté d'agglomération du bassin*

de Thau) (Figure 5). In January 2005, the two district planning authorities set up a common management structure: SMBT (*Syndicat mixte du bassin de Thau*). SMBT deals with the organizational complexity of the territory of the Thau catchment, and is more particularly competent on the following issues:

- To protect the environmental resources which support major economic activities: shellfish farming, fishing, tourism and thermal activities;

- To contain and manage population and economic growth by defining the limits of the capacity of the territory, an area facing the highest French demographic pressure;

- To integrate and implement the objectives of the WFD;

- To clarify the overall allocation of coastal space and resources by understanding the multiplicity of their uses.

One peculiarity of the Thau catchment is the important concentration of scientific and technical partners (such as IFREMER, Egis-eau and Bas-Rhône-Languedoc) and many users' organizations (Section régionale de conchyliculture, Prud'homie de pêche Thau-Ingril, etc.).

Figure 4: Municipalities and district planning authorities of communes in the perimeters of the SAGE and SCOT

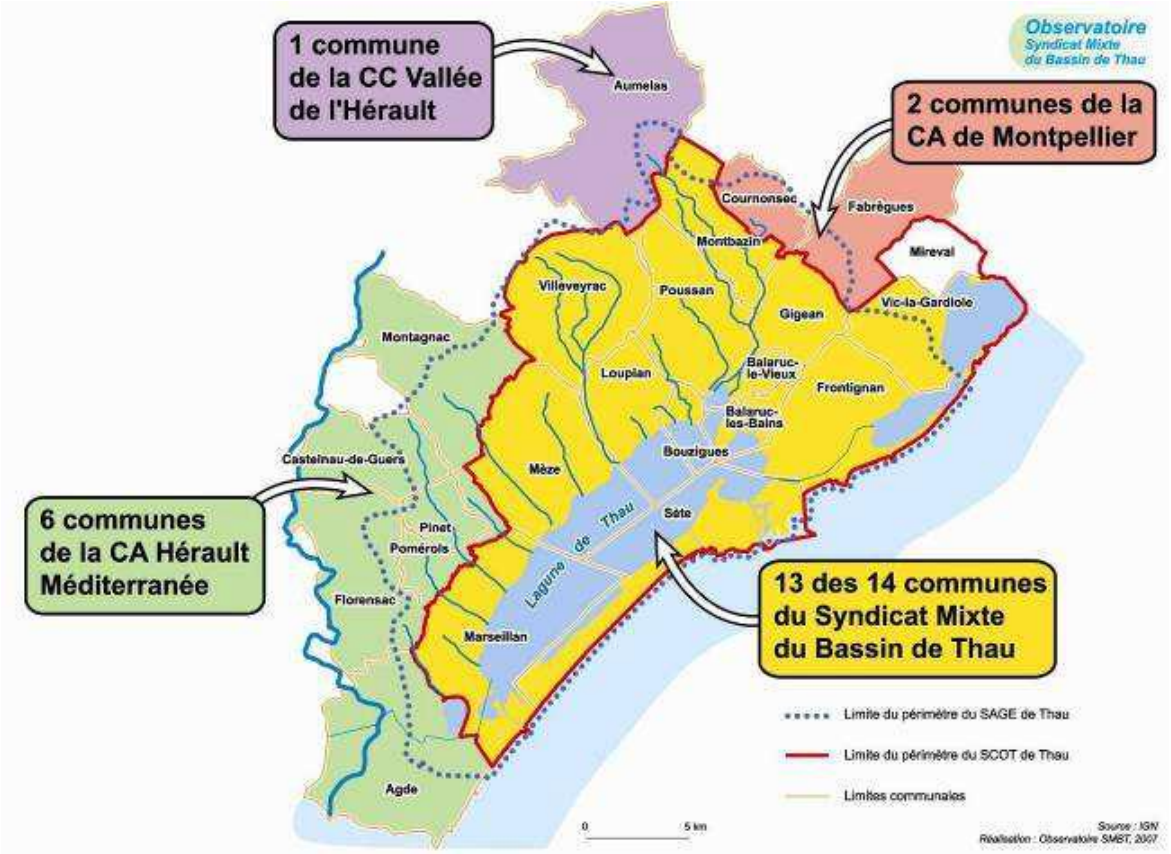
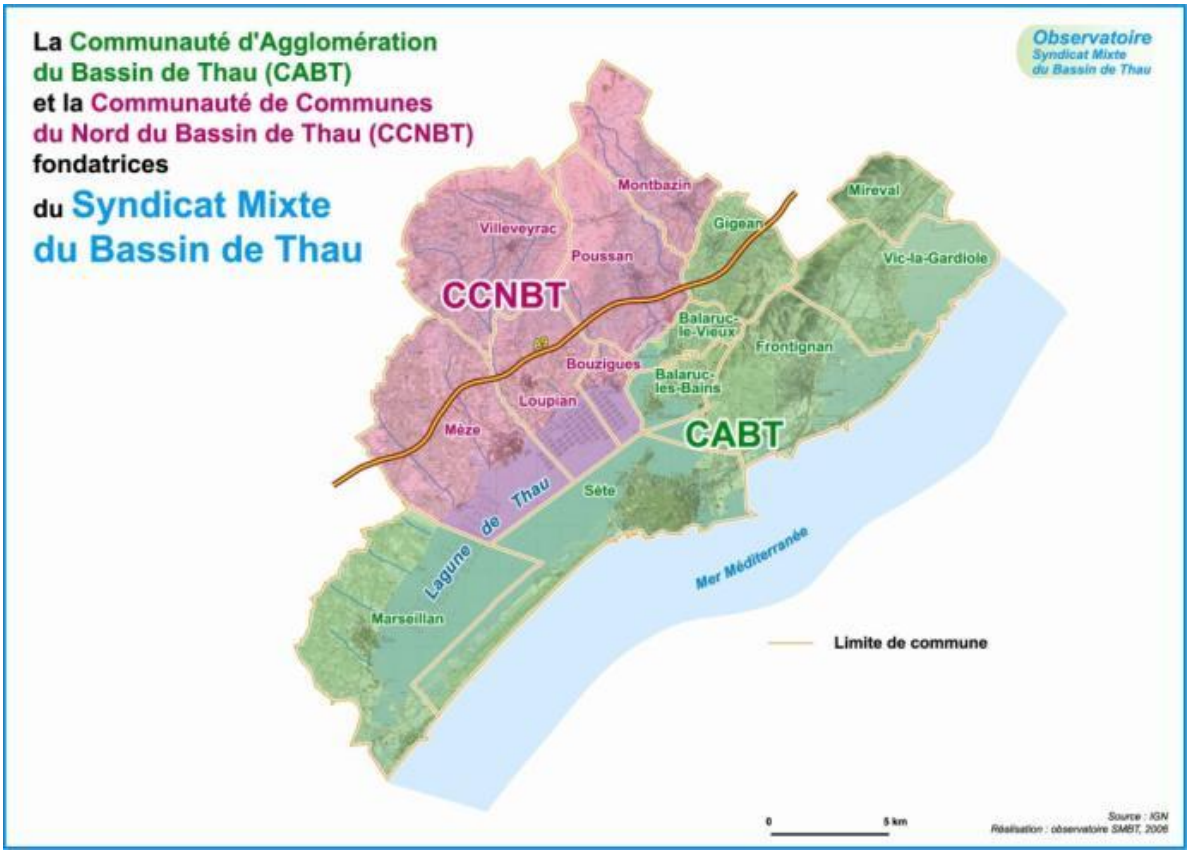


Figure 5: Perimeter of the SMBT initiated by two district planning authorities



3.4 *Water uses in the Thau catchment and identification of existing and potential rivalries*

This present part is describing the major water uses as they are seen by water users and water managers. Shellfish farming appears to be the major activity for all the stakeholders interviewed. The activities of fishing and thermal water are perceived as major too by the managers, but less by the users. This is quite surprising because the Spa of Balaruc-les-Bains is the second largest in France. The answers for the freight transport are mitigated. The environmental use, as recreational use, is not considered as a major use. This contrasts with the answers about point and diffuse pollution impacts which are considered as uses too. Livestock, hydropower, recreational, aesthetic, reserve, washing and cultural uses are mentioned as minor. The transfer of water is mentioned only twice.

Industry is not perceived as a major water use despite the fact that the Thau lagoon is lined of chemical industries for the production of fertilizers and hosts a concrete plant which is also highly visible. It is also surprising that these industries do not send representatives in the CLE, except the Chamber of Commerce (CCI).

In the Thau catchment, the first priority for water use that stakeholders perceive is drinking water supply. Fishing and shellfish farming are also mentioned, which contribute much to the socio-economic life in the area. Only a few mentioned recreational activities and hydrotherapy.

The demographic pressure is increasingly high, not only because of the influx of tourists but especially due to the resident population whose part of it is working in Montpellier. The catchment area's own water springs have never covered the population supply. Water from

surges and aquifers has been imported from the department of Hérault for several decades. However, in February 2012, water was routed from the Rhône as part of the Aqua Domitia project, to be distributed after treatment by the Bas Languedoc Water Syndicate (BRL). This project shows how domestic use represents an important part of water uses in the basin and how dependent the basin is on external regions.

Irrigation is a minor use in the Thau catchment. In Thau, only two large farms produce melons and wheat. The rest are small wine-growing domains organized in co-operatives. Although this catchment area largely reduced its wine-growing area during grubbing campaigns in the 1990s, grape-growing still represents 30% of the catchment area, but is not irrigated. Many wine-growing areas have been turned into fallow land for several years which have now been absorbed by the urban growth of the villages.

The interviewees omit to mention some water uses within the boundaries of the catchment. Some uses are considered far more important than is actually true. On the site of Thau, the connection with the Rhône is very recent and may explain users' inability to describe the source of water for the catchment area's requirements. Nonetheless, for years drinking water also came from pumping in the river Hérault aquifers and surges, outside the catchment area, while some sources of the catchment area are no longer exploitable due to salinity, caused by over-exploitation of the resource.

When surveyed about the rivalries within the catchment, both users and managers tend to raise problems with one specific use rather than identifying a situation of competition between two or more uses. In Thau, disputes are many, but they are mainly related to water quality in the lagoon. Between 1975 and 1990 water quality greatly worsened and a major crisis in the lagoon started, affecting all uses. The SMVM (Sea Enhancement Scheme) was then introduced by the French Government represented by the Service maritime et navigation Languedoc-Roussillon (SMNLR) to find solutions.

In the last 10 years, shellfish activity has suffered major loss of production or prohibition to sell the shellfish due to water quality problems in the lagoon which caused anoxic crises (or eutrophication) that kill shellfish. The problem is not considered as solved, but more research was undertaken to anticipate and predict these crises.

Bacterial contamination of the lagoon's water is also criticized. Urban waste is also mentioned as the cause. Both the *Préfet*, that is the local representative of the French Government, and SMBT are mentioned as having contributed to solving the problem, with the scientific support of IFREMER. Downgrading the entire lagoon to zone B, in other words demanding that shellfish are passed through a purification basin before being sold, has been one of the most important solutions to water quality-related problems. However, for several years a virus has been affecting oysters and no efficient and lasting solution has yet been found.

Conflicts between fishermen and shellfish breeders are mentioned several times. Fishermen are suspected to come around shellfish breeding tables, causing pollution and damage. These conflicts are now partially resolved. Thermalism is also mentioned. The water quality in the lagoon was supposed to have an impact on the spa activities of Balaruc-les-Bains, but it has been proven that the problem is physical, consisting in a change of pressure of the Karst springs. Little can be done, except to wait until a new balance allows the deep thermal spring pumps to be renewed.

Tourism is mentioned, both for its impact on water quality, indirectly with urban waste, and directly with recreational boats and the necessity to preserve bathing water quality in the lagoon. A few issues related to the drinking water supply were also brought up, such as a

burst pipe involving shutting off the water supply for over 48 hours, but with bottled water provided while the problem was solved. Irrigation is an issue too. Although the description of the impacts is vague, irrigation is perceived as routing water away from other activities. As for issues unrelated to conflicts of use, the impact of the water's over-salination on fauna and flora is mentioned, without further details.

The problems mentioned as being unsolved, although regular, concern competition between fishing/recreation every summer and fishing/shellfish breeding. For all of the other problems, solutions are being sought which involve the government's decentralized services and local authorities.

4 A shared influence between central and local authorities

The results of the SNA assess the actors' respective importance, influence on decision making, the flow of information between them and the frequency of contacts.

4.1 Actors' importance

In-degree centrality measures the importance of an actor. It is the number of time an actor is mentioned as 'very important' or 'important' by the respondents. Using two importance degrees independently differentiates the actors much better.

The results show that *Syndicat mixte du bassin de Thau* is the central actor (Table 1). Indeed, 10 over 11 respondents considered SMBT as a very important actor. Besides, both *Communauté de communes du nord du bassin de Thau* (CCNBT), *Communauté d'agglomération du bassin de Thau* (CABT), local water commission (CLE) and Rhone-Corsica-Mediterranean Water Agency (AE-RMC) are very important actors too. In fact, the importance of traditional public authorities such as AE-RMC is not diminished by local basin authorities (SMBT). Their role is still perceived as important.

Among the experts, IFREMER scores the best with 6 actors considering them as very important while CEPRALMAR is considered very important by 4 respondents. Fishermen associations, such as CR Conchy, also stand out.

Among (only) important actors, the Regional and Departmental Councils are cited as well as the Spa of Balaruc, BRL, the coastal conservatory authority (*Conservatoire du Littoral*), the wine producers and the European Commission. Expert organizations IFREMER and CEPRALMAR are also cited as 'important', by respondents who didn't classify them in the 'very important' category.

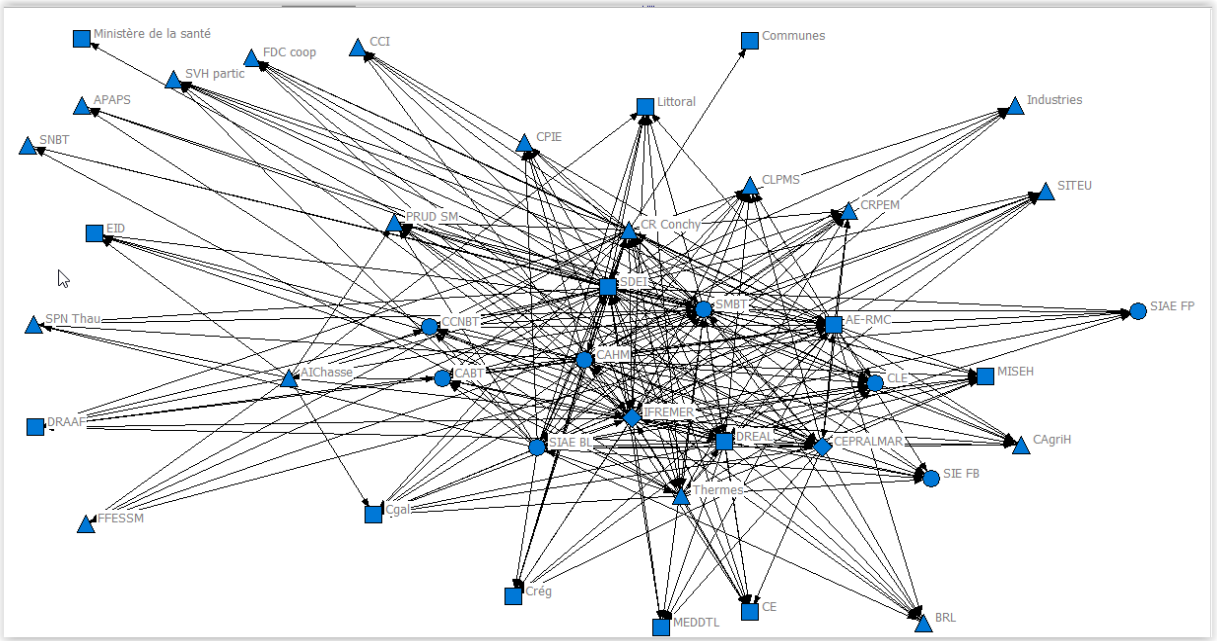
Figure 6 provides a visualization of the results. SMBT stands in the middle of the network, as being the actor cited the most as 'very important'. It is surrounded by the decentralized national administration (DREAL), the water agency (AE-RMC), the local users' assembly (CLE) and the local authorities. Only two users are located at the centre of the network: The Spa of Balaruc-les-bains (Thermes) and the shellfish farmers (CR Conchy). The other ones are peripheral and do not mention each other as being 'important'.

Table 1: 'Very important' and 'important' actors in the Thau catchment

		Outdeg	Indeg	nOutdeg	nIndeg
1	CE	0.000	2.000	0.000	0.050
2	MEDDTL	0.000	2.000	0.000	0.050
3	IFREMER	20.000	6.000	0.500	0.150
4	Littoral	0.000	1.000	0.000	0.025
5	MISEH	0.000	6.000	0.000	0.150
6	DRAAF	0.000	1.000	0.000	0.025
7	DREAL	13.000	5.000	0.325	0.125
8	Crég	0.000	2.000	0.000	0.050
9	Cgal	0.000	3.000	0.000	0.075
10	EID	0.000	1.000	0.000	0.025
11	CCNBT	0.000	8.000	0.000	0.200
12	CABT	0.000	9.000	0.000	0.225
13	CAHM	10.000	3.000	0.250	0.075
14	SIAE BL	8.000	4.000	0.200	0.100
15	SIE FB	0.000	4.000	0.000	0.100
16	SIAE FP	0.000	2.000	0.000	0.050
17	SITEU	0.000	3.000	0.000	0.075
18	AE-RMC	5.000	9.000	0.125	0.225
19	SMBT	23.000	10.000	0.575	0.250
20	CLE	0.000	8.000	0.000	0.200
21	Communes	0.000	1.000	0.000	0.025
22	SDEI	14.000	3.000	0.350	0.075
23	CAgriH	0.000	3.000	0.000	0.075
24	CCI	0.000	0.000	0.000	0.000
25	CEPRALMAR	10.000	4.000	0.250	0.100
26	BRL	0.000	2.000	0.000	0.050
27	FDC coop	0.000	0.000	0.000	0.000
28	SVH partic	0.000	0.000	0.000	0.000
29	CR Conchy	11.000	5.000	0.275	0.125
30	CRPEM	0.000	5.000	0.000	0.125
31	CLPMS	0.000	4.000	0.000	0.100
32	PRUD SM	0.000	4.000	0.000	0.100
33	APAPS	0.000	0.000	0.000	0.000
34	SNBT	0.000	0.000	0.000	0.000
35	AIChasse	10.000	0.000	0.250	0.000
36	Thermes	7.000	4.000	0.175	0.100
37	FFESSM	0.000	1.000	0.000	0.025
38	CPIE	0.000	3.000	0.000	0.075
39	SPN Thau	0.000	1.000	0.000	0.025
40	Industries	0.000	1.000	0.000	0.025
41	Ministère de la santé	0.000	1.000	0.000	0.025

		Outdeg	Indeg	nOutdeg	nIndeg
1	CE	0.000	6.000	0.000	0.150
2	MEDDTL	0.000	4.000	0.000	0.100
3	IFREMER	13.000	4.000	0.325	0.100
4	Littoral	0.000	7.000	0.000	0.175
5	MISEH	0.000	3.000	0.000	0.075
6	DRAAF	0.000	6.000	0.000	0.150
7	DREAL	13.000	3.000	0.325	0.075
8	Crég	0.000	7.000	0.000	0.175
9	Cgal	0.000	8.000	0.000	0.200
10	EID	0.000	4.000	0.000	0.100
11	CCNBT	0.000	1.000	0.000	0.025
12	CABT	0.000	1.000	0.000	0.025
13	CAHM	19.000	2.000	0.475	0.050
14	SIAE BL	16.000	3.000	0.400	0.075
15	SIE FB	0.000	4.000	0.000	0.100
16	SIAE FP	0.000	4.000	0.000	0.100
17	SITEU	0.000	4.000	0.000	0.100
18	AE-RMC	23.000	0.000	0.575	0.000
19	SMBT	15.000	0.000	0.375	0.000
20	CLE	0.000	2.000	0.000	0.050
21	Communes	0.000	1.000	0.000	0.025
22	SDEI	23.000	4.000	0.575	0.100
23	CAgriH	0.000	5.000	0.000	0.125
24	CCI	0.000	5.000	0.000	0.125
25	CEPRALMAR	7.000	4.000	0.175	0.100
26	BRL	0.000	6.000	0.000	0.150
27	FDC coop	0.000	6.000	0.000	0.150
28	SVH partic	0.000	6.000	0.000	0.150
29	CR Conchy	15.000	4.000	0.375	0.100
30	CRPEM	0.000	4.000	0.000	0.100
31	CLPMS	0.000	4.000	0.000	0.100
32	PRUD SM	0.000	6.000	0.000	0.150
33	APAPS	0.000	3.000	0.000	0.075
34	SNBT	0.000	3.000	0.000	0.075
35	AIChasse	1.000	2.000	0.025	0.050
36	Thermes	10.000	3.000	0.250	0.075
37	FFESSM	0.000	4.000	0.000	0.100
38	CPIE	0.000	3.000	0.000	0.075
39	SPN Thau	0.000	4.000	0.000	0.100
40	Industries	0.000	5.000	0.000	0.125
41	Ministère de la santé	0.000	0.000	0.000	0.000

Figure 6: 'Very important' and 'important' actors



Overall, the key actor of the SAGE, SMBT is the most important actor and that the other public authorities are perceived as being more 'important' than the users in local water management.

4.2 Impact on decision-making

The measurement of the impact on decision-making relies on both in-degree and out-degree to identify influential actors in the network. In-degree represents the number of actors which considers an organization as having an impact on others' decisions while out-degree is the number of actors a respondent mentioned as having impact on its own decision (see table 2).

Table 2: 'I receive influence from'

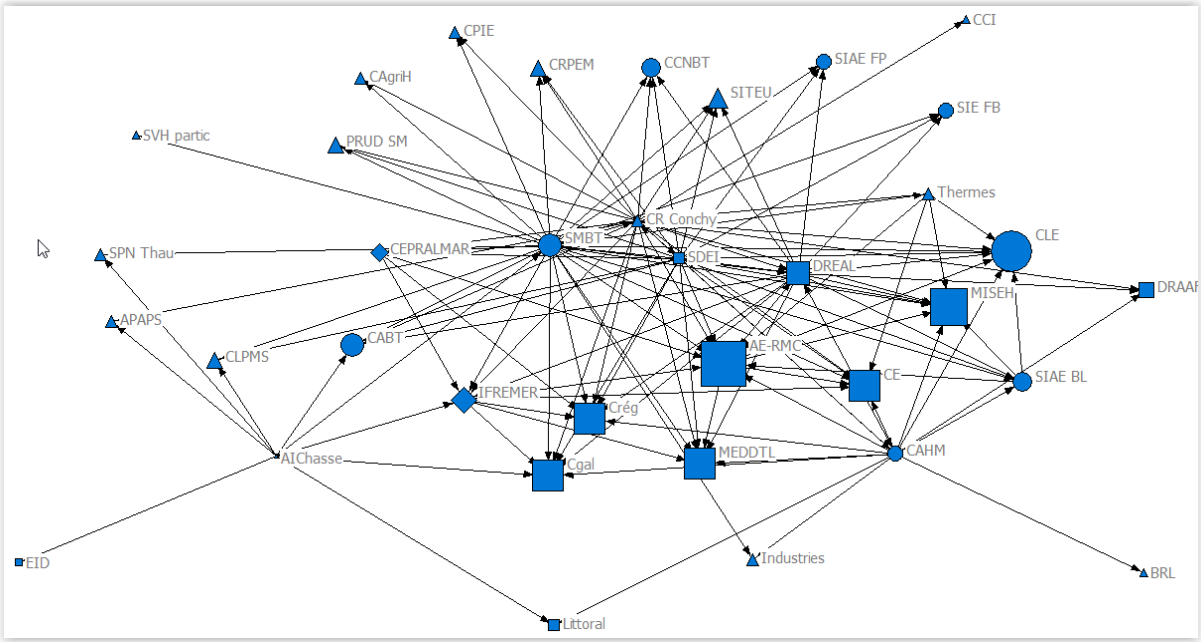
		Outdeg	Indeg	nOutdeg	nIndeg
1	CE	0.000	7.000	0.000	0.175
2	MEDDTL	0.000	7.000	0.000	0.175
3	IFREMER	5.000	5.000	0.125	0.125
4	Littoral	0.000	2.000	0.000	0.050
5	MISEH	0.000	8.000	0.000	0.200
6	DRAAF	0.000	3.000	0.000	0.075
7	DREAL	16.000	5.000	0.400	0.125
8	Crég	0.000	7.000	0.000	0.175
9	Cgal	0.000	7.000	0.000	0.175
10	EID	0.000	1.000	0.000	0.025
11	CCNBT	0.000	4.000	0.000	0.100
12	CABT	0.000	5.000	0.000	0.125
13	CAHM	13.000	3.000	0.325	0.075
14	SIAE BL	4.000	4.000	0.100	0.100
15	SIE FB	0.000	3.000	0.000	0.075
16	SIAE FP	0.000	3.000	0.000	0.075
17	SITEU	0.000	4.000	0.000	0.100
18	AE-RMC	5.000	9.000	0.125	0.225
19	SMBT	26.000	5.000	0.650	0.125
20	CLE	0.000	8.000	0.000	0.200
21	Communes	0.000	0.000	0.000	0.000
22	SDEI	21.000	2.000	0.525	0.050
23	CAgriH	0.000	2.000	0.000	0.050
24	CCI	0.000	1.000	0.000	0.025
25	CEPRALMAR	3.000	3.000	0.075	0.075
26	BRL	0.000	1.000	0.000	0.025
27	FDC coop	0.000	0.000	0.000	0.000
28	SVH partic	0.000	1.000	0.000	0.025
29	CR Conchy	24.000	2.000	0.600	0.050
30	CRPEM	0.000	3.000	0.000	0.075
31	CLPMS	0.000	3.000	0.000	0.075
32	PRUD SM	0.000	3.000	0.000	0.075
33	APAPS	0.000	2.000	0.000	0.050
34	SNBT	0.000	0.000	0.000	0.000
35	AIChasse	9.000	0.000	0.225	0.000
36	Thermes	5.000	2.000	0.125	0.050
37	FFESSM	0.000	0.000	0.000	0.000
38	CPIE	0.000	2.000	0.000	0.050
39	SPN Thau	0.000	2.000	0.000	0.050
40	Industries	0.000	2.000	0.000	0.050
41	Ministère de la santé	0.000	0.000	0.000	0.000

With an in-degree of 9, AE-RMC is perceived as the most influential actor by the other participants. MISEH and CLE are very influential too, as well as the Regional and Departmental Councils (in-degree of 7). With an in-degree of 5, SMBT only appear at the 8th position. Users do not have any influence on the other actors but they are subject to the others' influence, for example the shellfish farmers with an out-degree of 24. The impact of the experts on decision-making is also quite limited (IFREMET 5, and CEPRALMAR 3). The relative high in-degrees of MISEH (*Mission inter-service de l'eau de Hérault*) and the Departmental Council show their influence on the other actors' decision in the Thau catchment, more than the Region or the inter-municipal associations (CABT and CCNBT).

The limited role of SMBT and the significant influence of the other public authorities is congruent with the legal framework of water management. Formally, the main role of SMBT is to coordinate stakeholder demands, not to take decisions. AE-RMC, the water agency, which is granting the subsidies, is recognized as very influential.

In figure 7, the size of the actors varies according to their in-degree. The water agency (AE-RMC) and the inter-services mission of water of Hérault (MISEH) are situated at the centre, which is congruent with their formal attributions in water management. SMBT, which elaborated the SAGE is less influent than the CLE which is supposed to implement it. Among the users, only the shellfish farmers have a moderate influence (in-degree of three instead of two for the other users). The European Commission have a moderate influence on this network. Only CR Conchy seems to overestimate its role. All the other users remain at the periphery of the network. This underlines the remaining influence of the managers over the users in local water management. Finally, the experts and the regional and general councils keep a relative importance.

Figure 7: 'I receive influence from'



4.3 Information flows

SNA enables to state which actors potentially control the information flow. Two networks are scrutinized here: The network of who receives information from whom ('I receive information from') and the network of who sends information to whom ('I send information to'). In the information reception network ('I receive information from'), the in-degree of an organization is the number of actors that have received information from this organization while the out-degree is the number of actors from whom the organization has received information. In the information sending network ('I send information to'), the in-degree of an organization is the number of actors that send information to it while its out degree is the number of actors to whom the organization had sent information. With both networks, interpretations are based on the in-degree as this indicator is less sensitive to nonresponse and respondent bias.

In the information reception network, SMBT, MEDDTL, IFREMER and DREAL share the highest score with an in-degree of 7, which means that 7 actors declared they received information from them (see table 3). In other words, these organizations are reported by most respondents as information suppliers. They are followed by the Water Agency Rhone-Mediterranean Sea-Corsica (AE-RMC) as well as Regional and Departmental Councils. CEPRALMAR is also in the lead position with an in-degree of 5. Once again, users are at the bottom of the ranking as only very few actors received information from them.

Table 3: 'I receive information from'

		Outdeg	Indeg	nOutdeg	nIndeg
1	CE	0.000	5.000	0.000	0.125
2	MEDDTL	0.000	7.000	0.000	0.175
3	IFREMER	8.000	7.000	0.200	0.175
4	Littoral	0.000	2.000	0.000	0.050
5	MISEH	0.000	6.000	0.000	0.150
6	DRAAF	0.000	5.000	0.000	0.125
7	DREAL	0.000	7.000	0.000	0.175
8	Crég	0.000	6.000	0.000	0.150
9	Cgal	0.000	6.000	0.000	0.150
10	EID	0.000	1.000	0.000	0.025
11	CCNBT	0.000	6.000	0.000	0.150
12	CABT	0.000	4.000	0.000	0.100
13	CAHM	20.000	3.000	0.500	0.075
14	SIAE BL	9.000	2.000	0.225	0.050
15	SIE FB	0.000	1.000	0.000	0.025
16	SIAE FP	0.000	2.000	0.000	0.050
17	SITEU	0.000	2.000	0.000	0.050
18	AE-RMC	12.000	6.000	0.300	0.150
19	SMBT	20.000	7.000	0.500	0.175
20	CLE	0.000	4.000	0.000	0.100
21	Communes	0.000	0.000	0.000	0.000
22	SDEI	10.000	3.000	0.250	0.075
23	CAgriH	0.000	2.000	0.000	0.050
24	CCI	0.000	1.000	0.000	0.025
25	CEPRALMAR	6.000	5.000	0.150	0.125
26	BRL	0.000	2.000	0.000	0.050
27	FDC coop	0.000	0.000	0.000	0.000
28	SVH partic	0.000	0.000	0.000	0.000
29	CR Conchy	21.000	2.000	0.525	0.050
30	CRPEM	0.000	1.000	0.000	0.025
31	CLPMS	0.000	0.000	0.000	0.000
32	PRUD SM	0.000	3.000	0.000	0.075
33	APAPS	0.000	0.000	0.000	0.000
34	SNBT	0.000	0.000	0.000	0.000
35	AIChasse	5.000	0.000	0.125	0.000
36	Thermes	2.000	2.000	0.050	0.050
37	FFESSM	0.000	0.000	0.000	0.000
38	CPIE	0.000	3.000	0.000	0.075
39	SPN Thau	0.000	0.000	0.000	0.000
40	Industries	0.000	0.000	0.000	0.000
41	Ministère de la santé	0.000	0.000	0.000	0.000

The results of the information sending network differ substantively (see table 4). SMBT has the highest in-degree with a 9. This score means that 9 actors declare having sent information to SMBT. SMBT is followed by AE-RMC and MISEH (in-degree of 8), CLE (in-degree of 7) and DREAL, CEPRALMAR, the inter-municipal associations (CABT and CCNBT), and the Regional and Departmental Councils. Shellfish farmers (PRUD SM) and fishermen (CRPEM) are the first users cited with an in-degree of 4, meaning that few actors send information to users.

Table 4: "I send information to"

		Outdeg	Indeg	nOutdeg	nIndeg
1	CE	0.000	2.000	0.000	0.050
2	MEDDTL	0.000	4.000	0.000	0.100
3	IFREMER	17.000	4.000	0.425	0.100
4	Littoral	0.000	1.000	0.000	0.025
5	MISEH	0.000	8.000	0.000	0.200
6	DRAAF	0.000	2.000	0.000	0.050
7	DREAL	5.000	6.000	0.125	0.150
8	Crég	0.000	6.000	0.000	0.150
9	Cgal	0.000	6.000	0.000	0.150
10	EID	0.000	2.000	0.000	0.050
11	CCNBT	0.000	6.000	0.000	0.150
12	CABT	0.000	6.000	0.000	0.150
13	CAHM	10.000	5.000	0.250	0.125
14	SIAE BL	8.000	0.000	0.200	0.000
15	SIE FB	0.000	1.000	0.000	0.025
16	SIAE FP	0.000	1.000	0.000	0.025
17	SITEU	0.000	1.000	0.000	0.025
18	AE-RMC	11.000	8.000	0.275	0.200
19	SMBT	20.000	9.000	0.500	0.225
20	CLE	0.000	7.000	0.000	0.175
21	Communes	0.000	0.000	0.000	0.000
22	SDEI	10.000	1.000	0.250	0.025
23	CAgriH	0.000	3.000	0.000	0.075
24	CCI	0.000	1.000	0.000	0.025
25	CEPRALMAR	13.000	6.000	0.325	0.150
26	BRL	0.000	1.000	0.000	0.025
27	FDC coop	0.000	0.000	0.000	0.000
28	SVH partic	0.000	0.000	0.000	0.000
29	CR Conchy	21.000	3.000	0.525	0.075
30	CRPEM	0.000	4.000	0.000	0.100
31	CLPMS	0.000	3.000	0.000	0.075
32	PRUD SM	0.000	4.000	0.000	0.100
33	APAPS	0.000	0.000	0.000	0.000
34	SNBT	0.000	0.000	0.000	0.000
35	AIChasse	0.000	0.000	0.000	0.000
36	Thermes	3.000	2.000	0.075	0.050
37	FFESSM	0.000	1.000	0.000	0.025
38	CPIE	0.000	3.000	0.000	0.075
39	SPN Thau	0.000	1.000	0.000	0.025
40	Industries	0.000	0.000	0.000	0.000
41	Ministère de la santé	0.000	0.000	0.000	0.000

The high score of SMBT in both the receiving and sending networks is not surprising: Being the coordinator of local water management, their role is to share information with the others. The results show that SMBT fulfills their role. It is interesting to note that the two experts IFREMER and CEPRALMAR have different informational practices. IFREMER tends to inform the network while CEPRALMAR centralizes information. The fact that DREAL scores high in both networks strengthens the idea that the French Government is still present in local management through decentralized administrative units. The users' position within the flow of information is far less strategic. They are not considered as informants and only few actors send information to them.

4.4 Frequency of contacts

The frequency of contacts refers to the exchange, conversations, meetings that actors have together. This communication does not consider bilateral contacts, but looks at the brokerage roles that specific actors have within the network. Betweenness centrality measures the number of times that an actor is the intermediary between two actors that do not frequently interact with each other. Because there are several geodesic paths to reach one actor, numbers in table 5 are higher than the total number of actors. For the analysis, the data has been dichotomized. Actors seeing themselves at least monthly are considered as actors with frequent contacts.

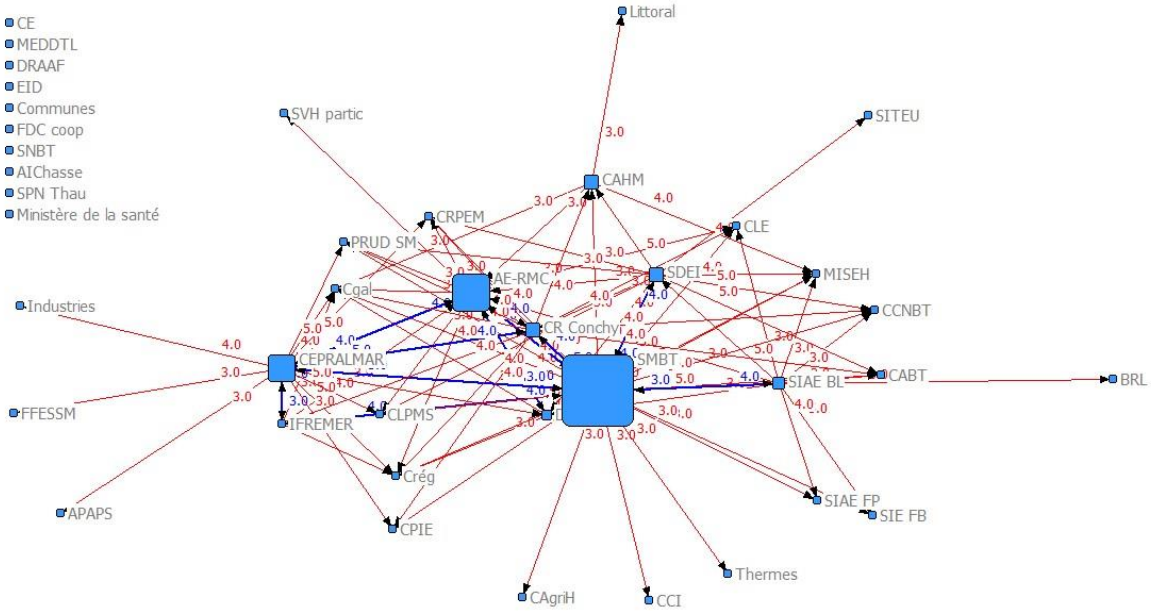
SMBT is the best performing actor with a score of 101.950. The organization plays the broker 102 times between two other actors. This confirms the coordinator role of SMBT. Most of the actors do not frequently interact between themselves but pass through SMBT. AE-RMC and CEPRALMAR appear to be in a specific position. Compared with the two networks related to information exchange, AE-RMC is informing actors who do not mutually interact while CEPRALMAR centralizes information from actors that do not interact with each other. Users and territorial authorities play a minor role in terms of brokerage.

In figure 8, blue ties are reciprocated, which means that actors mutually agree as having a contacts at least each month. The low figures are normal given the limited number of respondents. The actor size shows their degree of betweenness. SMBT is represented by the biggest square as it is the one which relates all the others. The water agency (AE-RMC) is also an important broker, but not CLE which is represented with a little blue square at the lower left of SMBT. Once again, users are peripheral to the network. They only reach the centre of the network through the intermediation of another actor, for example the expert organization CEPRALMAR. CEPRALMAR centralizes information from users and transfers them to the water managers, mainly SMBT and AE-RMC.

Table 5: Frequency of contacts

		1	2
		Betweenness	nBetweenness
19	SMBT	101.950	6.535
18	AE-RMC	46.117	2.956
25	CEPRALMAR	29.000	1.859
22	SDEI	10.333	0.662
29	CR Conchy	9.783	0.627
13	CAHM	9.200	0.590
14	SIAE BL	8.000	0.513
7	DREAL	2.117	0.136
3	IFREMER	0.500	0.032
6	DRAAF	0.000	0.000
1	CE	0.000	0.000
10	EID	0.000	0.000
11	CCNBT	0.000	0.000
12	CABT	0.000	0.000
15	SIE FB	0.000	0.000
16	SIAE FP	0.000	0.000
17	SITEU	0.000	0.000
8	Cr€g	0.000	0.000
4	Littoral	0.000	0.000
20	CLE	0.000	0.000
21	Communes	0.000	0.000

Figure 8: Frequency of contacts



5 Discussion

The aim of this communication is to question the central role of the basin authority in local water management. In the case of the Thau catchment, SMBT is the designer and facilitator of the SAGE, that is the local water management plan. After a shift into integrated water management, did SMBT gained power and legitimacy against the other public authorities involved in water management (for example the French Government and the municipalities)?

The SNA study is able to assess the position and roles of specific actors within a network, that is a group of actors that interact, meet or at least are committed to a specific issue. The method relies on the assumption that the actors positioned at the centre of the information

flows and who have the best reputation are supposed to play a key role in the management structure. River basin authorities are considered as influent if they have a strong reputation in terms of problem-solving capacity and if they are at the centre of the information flows. These position and influence are measured with the reputation, that is the individual assessment of the actor's importance and influence on the others' decisions, the information flows between actors and, the intermediate role in the contacts actors maintain in the network.

Among the community of water users and managers of the Thau catchment, SMBT is perceived as the most important actor. 10 over 11 respondents declared SMBT was a 'very important' actor, which is the highest score reached for this question. However this leading position is not confirmed by all the results. In the actors' perception, this importance is not meaning influence. SMBT only reaches the 8th position (in-degree of 5) in terms of influence they exert on others. Their importance relates more on the coordination and facilitation role they play in the catchment. However, CLE scores high (in-degree of 8, and also a 'very important' actor), that is the assembly of users which is implementing the SAGE (in a way, SMBT is the executive office of CLE). Taken together, the power of the functional local managers is strong. In the analysis of information flows, SMBT scores once again the highest, however in equal position with some other actors. Their leadership position is uncontested in terms of frequency of contacts. In fact, SMBT has the highest betweenness centrality and distances the followers. This means that SMBT is the broker between the different actors in the local arrangement. In conclusion, SMBT has succeeded within a few years (it was created in 2005) to become a central actor in local water management. However, their power is not absolute and shared with other managers. Although, they are not exerting a direct influence on the other actors, they play the broker in information flows and contacts between the actors. As such, they have a great potential for framing issues and a potential influence on the way people think inside the catchment area.

Despite their brokerage role, SMBT is not perceived as the most influential actor in the basin. This position is attributed to AE-RMC, the water agency which elaborates the SDAGE, the master plan from which SAGE derives, and above all which distributes the subsidies for the local investment in water treatment, and the protection of catchments. AE-RMC is not a territorial government (such as the municipality, and the Regional and Departmental Councils), but an agency governing a functional space (Varone et al. 2013). AE-RMC scores high in all the questions. They are perceived as a 'very important' actor, much involved in the information flows, and are the second broker after SMBT between the actors. AE-RMC remains a powerful actor in local water management.

The territorial authorities are very influential too. Although, they are not considered as 'very important', the French Government through the Ministry of the Environment (MEDDTL) and the decentralized administrations (DREAL and MISEH) are part of the most influential actors. They are also part of the information flows, both as the sender (MEDDTL, DREAL and MISEH) and receiver of information (MISEH). However, the central authorities do not seem so much in direct contact with the users, except with the drinking water suppliers (SDEI and SIAE-BL, see figure 8). This tends to reinforce the brokerage position of SMBT.

Finally, the sub-national governments are involved too, that is the Department (Departmental Council), and the Region (Regional Council). Their role is secondary ('important', but not 'very important' actors), but they nonetheless appear in the different sets of answers. They are perceived as influential actors as well as information senders and receivers. Their role is not straightforward, as they don't have a specific function in the national arrangement for water management, but they are known to have competencies in the environment, transport, and land-use planning, and run hydraulic installations. The two inter-municipal associations (CCNBT and CABT) equally appear in the results, which means that the municipal officials

keep a say in the management of water. Remind that SMBT is a delegate body of the municipalities.

The users do not appear as powerful stakeholders in the results of the SNA analysis, but some of them are nevertheless important secondary actors. In adding up 'very important' and 'important' actors, associations of fishermen and shellfish farmers are scoring relatively high (for example PRUD SM, CRPEM, and CR Conchy), but they are not really recognized as influential actors, and they are peripheral in the information flows. Only the water suppliers (SDEI, and SIAE BL) as well as CR Conchy play as brokers in the contacts between stakeholders. Thus, their influence in water management is mostly mediated by the local water managers such as SMBT and CLE, and they don't have much power alone. With integrated management, water management did not shift from the managers to the users, even if participation was at least formally increased.

Is there a fit between the power distribution perceived by the stakeholders and the formal institutional arrangement governing water management in the basin? Has power been redistributed with the shift to integrated water management or are the former authorities still the most powerful? It appears that formal rules and organization give a clear picture of the distribution of competence between stakeholders, but the relative weight of each one could only be assessed with a network analysis. The territorial authorities keep a power position in the arrangement, but they are overtaken by the functional water basin authorities at two different scales: AE-RMC at the Rhône basin scale and SMBT/CLE for the Thau catchment. Both of them are not equally influential, but both are located at the centre of the information flows and play a brokerage role between the users and managers. Power has shifted from the territorial to the functional authorities, but the management remains in the hand of the managers, and indirectly the user's assemblies (CLE, and *Comité de bassin Rhône-Méditerranée* which is the principal of AE-RMC). Another consequence of integrated water management is that the governance mode by territorial authorities shifted from hierarchical to more network-based and consensual, for example with MISEH which coordinates the national ministries at the departmental level and CLE which pushes the mayors to cope with users' assemblies.

Considering the rivalries and the way to solve them, it seems that SMBT is in a privileged position of brokerage. The main rivalries mentioned by the actors in the Thau catchment are: The impact of the poor quality due to waste water from housing on shellfish farming, the conflicts between fishermen and shellfish farmers in the lagoon, and a rivalry between recreational uses in summer and professional fishing and shellfish farming. In part, this last rivalry lies on the required quality for bathing water which not necessarily fits with the needs in nutrients of fish and shellfish. The network analysis has revealed that these different users were barely in direct contact, but all participate to the CLE and interact with SMBT.

Given the evolution of climate change the role of SMBT as problem-solver in the Thau catchment may increase. The projections of the influence of climate change on water in the Mediterranean regions at the horizon 2040-2060 predict a rise of temperature between 2°C and 6°C and an average increase of 4°C for the lagoon water in the Thau catchment (La Jeunesse et al. 2015). This rise in temperature put shellfish farming at risk. Above 16°C the oyster virus is awakened and above 29°C mussels are killed by the warm water. As a consequence of climate change, the traditional activities of oyster- and mussel-farming may have disappeared in the Thau lagoon at the horizon of 2040. In complement, the hydrological models predict a decrease in rainfalls and a decrease in surface water flow mainly in summer and fall (from May to December). At the same time, rainfalls should increase in quantity but also in intensity in January and February, with a related risk of floods.

The consequences in terms of water use are many. First, dry periods will increase the pressure from the farming sector for more irrigation, notably in the vineyards. Nowadays, the demand for irrigation is limited but will probably increase due to the rise in temperature. Second, the pressure on land is a second threat, with an increased housing demand as the Thau basin is located in the surroundings of the fast-growing city of Montpellier. Housing will increase its hold over agriculture, and demand for drinking water supply (notably to fill-in private swimming-pools) and wastewater discharges. Despite the presence of treatment plants, the water run-off should bring in more nutrients and pollutants in the lagoon that will compromise the recreational activities of the tourists. It is not certain at all that shellfish farming will remain, but if they do, the coexistence of this various uses will not be simple to guarantee.

Conclusion

Are river basin authorities central in the management of water basins? The Social Network Analysis of the Thau catchment has shown that integrated water management has caused a shift in power from the national authorities to more functional and local authorities. The Thau users and managers perceive the French water agencies as one of the most important and influent actors in local water management. The agencies have been seconded by more local, but still functional agencies. In the Thau catchment, SMBT (*Syndicat mixte du bassin de Thau*, mixed syndicate of the Thau catchment) is an agency created by the municipalities to design and run the SAGE management plan. SMBT is recognized as an important, but not so influential actor. Despite the fact that their direct power is limited, their position in the middle of the networks of information flow and contacts make them able to orientate the issue framing, and the set up and evolution of norms and values in the catchment. In addition, SMBT plays the role of broker between the different categories of users and may play a major role in the resolution of local rivalries. In fact, SMBT is the executive body of the local water commission (CLE), which puts together the different stakeholders of the catchment, notably the users, within a single assembly. This process modifies the traditional hierarchical public management of the central authorities to create a more local and network-based management model. Even if integrated water management did not grant power to the users, this local forum may be an essential component for the resolution of the acute problems that climate change will provoke in this Mediterranean region.

ANNEX I: Water uses listed in the questionnaire

Domestic water: potable water, garden watering
Irrigation: perennial or annual crops
Livestock supply: milk or meat breeding
Hydropower: energy production
Industry: food, mineral, timber, etc
Mineral or thermal water
Recreational: golf, skating, pool, artificial snow
Aesthetic: public gardens watering, fountains
Reserve: fire fighting, strategic
Export: water transfer to:
Fishing: in lake, river, reservoirs, coastal lagoon,
Aquaculture or shellfish farming: oysters, mussels
Freight transport
Sediment extraction: sand and gravel for aggregate, etc.
Environment: landscape, biodiversity
Recreational: aquatic sports, bathe
Washing (in-situ)
Cultural uses: religious, rituals, art,
Impacts related to urban or industrial discharge (= point pollution impact)
Impacts related to agricultural activities (=diffuse pollution impact)
Reserve: fire fighting, strategic
Export: water transfer to:
Freight transport
Washing (in-situ)
Cultural uses: religious, rituals, art,
Other:

ANNEX II: List of stakeholders in the Thau catchment

CE	Commission Européenne	**ADENA***	ADENA Réserve du Bagnas
MEDDTL	Ministère de l'écologie	**IFREMER***	IFREMER
AE-RMC*	Agence de l'eau Rhône-Méditerranée-Corse	**SDEI***	Société de Distribution d'Eau Intercommunale
DREAL*	Direction Rég. de l'Environnement, de l'Aménagement et du Logement du Languedoc-Roussillon	**CR Conchy***	Comité Régional Conchylicole de Méditerranée
Littoral	Conservatoire du Littoral	**Thermes***	Thermes de Balaruc les Bains
MISEH	Mission inter-services de l'eau de l'Hérault	***CCI***	Chambre du Commerce et de l'Industrie Sète-Frontignan-Mèze
DRAAF	Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt du Languedoc-Roussillon	**CEPRALMAR***	Centre d'étude pour la promotion des activités lagunaires et maritimes
Cgal	Conseil départemental de l'Hérault	***CLE***	Commission Locale de l'Eau
Crég	Conseil Régional du Languedoc-Roussillon	***CAH***	Chambre d'Agriculture de l'Hérault
SMBT*	Syndicat Mixte du Bassin de Thau	**PRUD SM***	Prud'homie des Pêches Sète-Môle
EID	Entente Interdépartementale pour la Démoustication du Littoral Méditerranéen	***CLPMS***	Comité Local des Pêches Maritimes et des Élevages Marins de Sète
CCNBT*	Communauté de Communes du Nord du Bassin de Thau	***FDC coop***	Fédération Départementales des caves coopératives
CABT*	Communauté d'Agglomérations du Bassin de Thau	**SVH partic***	Syndicat des vignerons de l'Hérault vinifiant en caves particulières
CAHM*	Communauté d'Agglomérations Hérault Méditerranée	CRPEM	Comité Régional des Pêches en Méditerranée (CRPEM LR)
SIAE BL*	Syndicat Intercommunal d'adduction d'eau des communes du Bas Languedoc	**AIChasse***	Association intercommunale de chasse de l'Etang de Thau
SIE FB	Syndicat Intercommunal des Eaux de Frontignan Balaruc	***APAPS***	Association des pêcheurs amateurs et plaisanciers de Sète
SIAE FP	Syndicat Intercommunal d'adduction d'Eau de Florensac Pomérols (SIAE Frontignan)	CPIE	Comité Permanent d'Initiatives pour l'environnement du bassin de Thau
SITEU	Syndicat Intercommunal de traitement des eaux usées de Pinet-Pomerols	***FFESSM***	Fédération française d'études et de sports sous-marins Comité de l'Hérault
BRL	Bas-Rhône- Languedoc	**KAY-THAU***	Canoë kayak Mèze Bassin de Thau
COVED*	Waste management and recycling (SAUR)	***SPN Thau***	Société de protection de la nature Languedoc-Roussillon Section du bassin de Thau
EGIS*	Bureau d'études	Industries	Industries
SNBT	Société Nautique du Bassin de Thau	Communes	Communes

Bold : questionnaire submitted (not answered in italic)

Bold + * : questionnaire filled in

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