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PLANNING IN DEVELOPING COUNTRIES: A DSS APPROACH FOR MANAGING THE WATER RESOURCES IN THE LUSHNJE DISTRICT, ALBANIA

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Introduction

The current pattern of use of water resources is worldwide characterized by growing pressures. Natural circles have been broken, with the consequence of enormous ecological damages and natural impoverishment, so that usable water resources are either more and more difficult to be exploited and more and more polluted. All this seriously affects the capability of the nature to recover its living potential and, besides, imposes unsustainable costs especially on the more disadvantaged groups and on the less developed countries. Since they usually have less power in deciding an autonomous pattern of development in the face of the globalized economy.

The evidence that who has a stake on the transformations of the environment and on the choice of the pattern of exploitation of natural resources doesn't usually fall among those who bear the costs of these decisions must make us reflective on the political dimension of such issues traditionally considered just technical ones (Shiva, 1995). This is particularly evident in the case of water because of its scarcity; in this case, many conflicts are likely to emerge among different uses (agricultural versus industrial versus municipal) and areas (urban periphery versus central locations, mountain versus flat landscapes) as well as on the schemes for the exploitation of the resources (in agriculture: large-scale irrigation schemes versus small-scale projects; in municipal use: network distribution patterns versus hybrid ones linking technology to collaborative and informal work,…).

In this conflictual context, it's evident that decisions about the pattern of exploitation and distribution of water resources can't be only a technical matter; besides, a similar reduction strongly contributes to the reproduction of unbalanced relations in the priorities given in the planning agenda. The situation will inevitably put an uneven burden on those who can't give voice to their needs, thus making their stake in society, and their living conditions, more and more critical (Parikh, 1998).

In this respect, the western rational-comprehensive planning tradition, largely applied in developing contexts with its technocratic, top-down model of action, largely contributes to the creation of the highly unbalanced social and ecological situation we face there. Planning should, therefore, find new goals and methodologies, since

the externally driven ones can no longer be considered sustainable. Development planning should define them according to potential and weaknesses of the local context where it works. That's the only way in which developing countries might find their own pattern of development and recover their right to make autonomous decisions. This doesn't mean to neglect global interdependency among countries, yet it aims at fostering positive recover of self confidence and self-reliance actions.

Planning theory and practice, thus, face new challenges in less developed countries as far as they embrace the shift from a comprehensive, top-down planning approach to a bottom-up, collaborative and transactive one. Anyway, this turn is made much more difficult in these contexts, mainly because of the political conditions of less developed countries. In these contexts, indeed, local governments usually prefer top-down, technocratic approaches to planning as they consider the traditional way of decision making more effective. Therefore, democratic processes of public involvement in decision-making are quite rare.

In this situation, many key aspects of the proposed shift still remain unclearly defined. They are about the difficult communicative and linguistic interaction between experts and local communities, the integration of expert and non-expert knowledge in the planning tools, the development of effective planning devices to manage these hybrid knowledges and to foster their growth and refinement.

The proposed case study is particularly significant, in this perspective, since it is about water resources planning in a situation characterized by socio-political and economic uncertainty, as far as it's about planning in a country in transition from a centralized to a free market economy. Besides, the existence, in that area, of a very fragile ecosystem equilibrium, greatly dependent on water availability and quality, makes choices about water use even more complex. All this inevitably raises deep conflicts about the strategic options for the future development of the district.

In this context, we have tried to promote a collaborative approach to planning practice, and to foster local participation as a preliminary step towards the integration of expert and non-expert knowledges in a DSS for water resources strategic planning. We have, thus, built up some modules of the DSS and obtained some significant results in growing the knowledge base and singling out the implications of some collaborative scenarios of development.

Changes in development planning approaches and methods

The crisis of the technocratic and top-down approach in development planning is one side of a more general crisis of the rational-comprehensive planning model of the western tradition. This crisis has a dominant epistemological feature, since it comes from the acknowledegment of the limits of the scientific cognitive approach in understanding the reality and of the importance of common sense knowledge for a

better understanding of the real significance of the observed phenomena. This is all in one with the rediscovery of the importance of non scientific perceptions of reality, of emotional versus rational cognitive models of learning coming from experiential and intuitive local knowledge.

It's well recognized that different forms of learning exist, coming from dialogue, from experience, from the comprehension of symbolic signs, from contemplation and from action (Sandercock, 1999). The interaction of these different ways of knowing, traditionally ignored by the conventional top-down planning model, can be very useful in giving a more realistic (that doesn't mean neutral or objective but, instead, complex, pluralistic, sensitive to differences) understanding of reality. That is what Sandercock names an 'epistemology of multiplicity'.

In our planning discourse, to acknowledge these different ways of knowing and to embrace a local perspective of action also means to acknowledge the importance of local knowledge workers and their central role non only in problem setting, but also in problem solving and decision making and, besides, in the implementation of collaborative action plans.

Indeed, if planning has to shift from a top-down to a bottom-up approach, as far as empowerment of local communities and capacity building is concerned, it's necessary to consider local people as active workers in the decision and action process, and no more as mere objects of planning. Many case studies demonstrate that a big fault of the traditional large scale projects for water resources in developing countries has been the neglection of the enormous potential of local communities in fostering self-help and creative solutions to development problems (Hirshmann, 1967; Parikh, 1998). Local communities, indeed, have traditionally developed strategies to face scarcity and have acted as agents of environmental regeneration. In many cases they have survived just thanks to the creation of social webs.

Anyway, we must avoid thinking that local knowledge is always sustainable, since the insight embedded in local adaptive strategies can be ignored by local patterns of action as far as conflicts on scarce natural resources occur in the face of a globalized economy. In this case, in the struggle between the well-to-do and the poor persons, the less privileged are likely to react to the deprivation of natural resources by acting in defiance rather than as protectors of their environment, in order to obtain more resources to survive. In this way, the undiscriminated use of natural resources made by the more powerful groups of a country or by the outsiders makes people forget the traditional respect of the ecological limits imposed on the use of natural resources and gives life to a vicious circle of unsustainable exploitation of the nature (Kinyunyu et al., 1996). We must, however, admit that in many cases local communities have given life to forms of spontaneous cooperation for mutual help that constitute a sustainable alternative, to face scarcity, to the atomizing forces of

globalization and to the western pattern of exploitation of natural resources.

The strong opposition of local communities to the implementation of top-down water resources schemes often comes from the acknowledgement of the inadequacy of these projects to their real needs and of the disruptive side-effects they are likely to create, above all upon the most disadvantaged groups (Rached at al., 1996). In these situations, therefore, the problem of conflicts among different interests and frames of the problem becomes central to any planning discourse if a really sustainable planning process has to be fostered.

All this underlines the political and social dimension of planning versus the technical one. This calls planning to the necessity to put on the political agenda also the hidden conflicts and the needs of those traditionally unheard, trying to overcome the unbalanced relationships among different social groups. This isn't very easy in developing countries, where very centralized governments try to block democratic political processes, and planners, who want to foster a bottom-up and collaborative planning process for sustainable development, seem to be compelled to work in the interstices of power and sometimes in the face of power (Forester, 1989). Besides, their role is made even more difficult because of the natural diffidence of local people in taking part to the decision making process, as we have acknowledged in Albania, since people have experienced long time of political invisibility and thus share a deep disillusionment in public participation. In this case, the empowerment of local communities is a fundamental pre-requisite for an effective public involvement and a really communicative and collaborative turn in planning.

Besides, it underlines that bottom-up and collaborative planning practice also contributes to gain some important goals towards the democratization of the political process and the creation of stronger social webs inside local communities. In this respect we share the idea of those who maintain that planning processes results can't be confined to the technical ones, but they must include other essential results such as transformative learning (Friedmann, 1987), communicative networks (Forester, 1989), institutional capital and consensus and commitments. In the context of the developing countries, where this goals are likely not to be easily targeted by specific political actions, the importance of this 'side-effects' seems to be even more relevant (Hirshmann, 1967).

The shift in the goals of development planning must correspond to a shift in the approach and in the methods of planning practice. What is needed is a collaborative, transactive, communicative mode of planning that appreciates differences and conflicts as tools for a deeper comprehension of reality. In this way, conflicts might prevent planners from giving for granted problem definition and traditional paths of problem solution. The alternatives might be generated, indeed, by re-framing problems and conflictual perceptions and expectations (Barbanente et al., 1998).

Besides, the communicative turn in planning seems fundamental for the process of collective learning and reciprocal understanding coming from dialogue and confrontation. Many obstacles for the implementation of planning policies, indeed, come from the opposition people make because they can't see proposals from another perspective and can't exit their prejudices and opinions about what is right and what is not. Reframing is, thus, fundamental to help people to adopt other perspectives and acquire a better understanding of the real benefits and risks associated to planning purposes, thus reducing conflicts as a consequence of the growth in mutual learning (Schön and Rein, 1994).

Emerging problems

In the interaction between local community and experts, planners don't aim at assuming the role of teachers, but tend to be part of the process of collective learning; their scientific knowledge is only one of the cognitive frame on the arena for debate and not the universal frame within which the conflicts must perform and bring creative ideas. This process seems to be very important for knowledge building, since understandings of experts and non experts also differ because of the different focus of observation. Indeed, while scientific knowledge is more keen in understanding macro-level, global issues, local communities have usually more insights in understanding limited phenomena that characterize their living environment (Hambly et al., 1996). Thus, to foster interaction among different knowledge systems also means to give life to a multiscaled and multidimensional knowledge.

In this interaction, the main problems lie in the possibility to find a common language that can allow it. Some authors maintain that poor translation between scientific and grassroots language is responsible, in many cases, of an 'artificial knowledge conflict' (Mwesigye, 1996). If this occurs, scientific knowledge is likely to prevail and dominate because of the long tradition associated to it, thus simplifying the contents of local knowledge by reducing it to significant elements inside its pattern of analysis. But, taken away from the vision that has given life to them, the creative and explorative solutions coming from the local conceptualization of problems loose their real significance. In order to avoid these consequences, scientific and common sense knowledge must meet in order to give life to hybrid forms of knowledge where every component keep its epistemological value.

In this process, not only data, but also local indicators must be included, as well as pieces of cognitive reasoning. Many authors maintain that grassroots indicators may help to overcome the barriers between the "three solitudes" of developing planning: policy, research and action. Indeed, they are at the same time a method and an outcome of upholding and safeguarding local knowledge and can be far more powerful for local people to identify environmental change and to link decision to action (Hambly et al., 1996).

Therefore, as far as linguistic variables, non scientific perception schemes, qualitative versus quantitative descriptions and evaluations are concerned, the main difficulty lies in the construction of tools that can help planners in representing these different ways of perceiving reality, in storing and managing data and knowledges coming from different observation systems, in diffusing knowledge and making it more democratic as a base for new learning processes.

Case study: water issues in the Lushnje district

The study area is the district of Lushnje, that has an extension of 712 sq. Km and is located on the "environmentally most valuable part of the Albania's coast" (UNEP, 1996), approximately fifty km. south of Tirane, in an alluvional plain between the Shkumbini river, at the northern border, and the Semani river, at the southern one. The dominant feature of the district is the Karavasta lagoon, which lies between a strip of dunes and a barrier of coastal hills and which constitutes the very relevant biotops, mainly due to the presence of rare birds. With its extension on 4000 ha, it constitutes the biggest lagoon of the whole Albania, and contains the more various mosaic of natural coastal habits.

It's classified by UNDP as "Environmentally Sensitive Area" and it is obviously very sensitive to water balances. This is the reason why the lagoon and some surrounding areas, up to a total of 5900 ha, are protected by the Convention of Ramsar, an international agreement on wetlands. Apart from the Convention, other pieces of legislation put under protection the National Park of Divijake (that has an extension of 7,8 sq. km) and the National Reservoir of Divijake (on 6,7 sq. km). Anyway, the legal system for environmental conservation is rarely brought about.

The maintenance of the ecosystem equilibrium seems particularly difficult, indeed, because of the very unstable and dynamic features of the coastal area between the mouths of the two main rivers. The very position of the river mouths is rapidly changing as the river beds change due to large flow variations and to the presence of many abandoned meanders. As a consequence, new lagoons are forming whilst some areas of the coast, such as those close to the mouth of the Semani river, are progressively eroded (UNDP, 1996).

The morphological features of the district can be summarized in:

- a section of internal hills, no more than 200 m. high, where many rivers originate and sometimes are obstructed to create reservoirs;
- the alluvial plain where marshes were transformed in arable land in the past years;
- a slim area of coastal hills that separates the pain from the lagoon;
- the coastal strip, composed by: the western slope of the Divjaka hills (crossed by several short streams), the Karavasta lagoon, the littoral belt, the coastal plain (mainly composed by reclaimed swamps).

The hydrographic regime is very dynamic and various. Apart from the two main rivers, in the district there is a great amount of small streams flowing in the plain and on the hills of the internal part of the region. This abundance of water is a distinctive feature not only of the district, but also of the whole Albania.

Anyway, the enormous potential offered by this situation is greatly reduced by the high level of pollution of surface water because of the uncontrolled discharge of industrial and urban wastes. All this makes the level of pollution unsustainable in most streams (that's the case, for example, of the Shkumbini river; see Saraci, 1995). The same considerations can be drawn for the potential of groundwater resources. They are heavily polluted by dump sites disseminated on the territory, by pesticide and by skeptic holes commonly used in almost every urban areas in the place of sewage network systems. All this contributes to a dangerous reduction of the available freshwater.

Indeed, this isn't the only reason why water resources effectively used in the district are so scarce. The main reason is the absolute inadequacy of the freshwater storage and delivery systems. In the Lushnje district there are only two main potable piped lines providing access to water facilities only to a small number of villages. Instead, most inhabitants are compelled to carry water from distant sources, using public fountains sometimes placed as far as 10 km from their living place and usually less accessible in the villages on the hills.

As regard to water used for agricultural purposes, the district has an articulated irrigation and drainage system dated back to the second post-war period, when the socialist regime gave high priority to its construction to increase the arable land. Nowadays, indeed, it's very damaged and in many cases out of use because of the lack of maintenance. In fact, with the massive destruction of public properties after the demise of the socialist regime in 1991, the state-owned water enterprises, always charged with the responsibility of the entire irrigation and drainage sector, gradually suspended maintenance because of the lack of budget. In their place, no other public bodies or private associations took the management responsibility, although in 1994 an Irrigation and Rehabilitation Project finance by FAO has been introduced with the task to promote the participatory irrigation management. That's a strategy based on the creation of Water Users Associations (WUAs) with the task of self-maintenance of irrigation schemes at the farm level (FAO, 1999; Antoneta et al., 1999).

The lack of intervention on the drainage and irrigation system is also responsible for the turn of some arable land into swamps, as they were in the past. This situation clearly calls for a quick intervention in the sector.

These considerations about the environmental context and the infrastructural provision of the district should make us reflective about potential and risks associated to water resources management, since they are the very core of many unsolved conflicts among users. In fact, agriculture, that is the most important

economic activity of the district, often has to face serious difficulties because of the lack of an efficient irrigation system. That's why some farmers use freshwater also for agricultural purposes, thus contributing to the reduction of the availability of potable water for civil uses. Besides, industrial activities, although in many cases can use water of less quality, are compelled to use potable water because of the lack of dual water piped lines and of recycling practices (the treatment of wastewater is, indeed, prevented by the lack of the sewage system).

This situation is clearly unsustainable either from a social point of view – the population is not equitably served across the region and the existence of conflicts, if not adequately managed, is likely to favour the interests of the more powerful social groups – and from an ecological perspective – the actual rhythm of exploitation and pollution of water resources is clearly unbearable, especially for the lack of any serious commitment for recycling or for the development of dual piped lines.

Thus, water resources planning in this context becomes a very complex task, and requires deep reflections not only on the technical problems of water supply, but also on environmental and social problems. The case study has given us the possibility to go in depth to potential and difficulties of the new bottom-up perspective and to use a reflective action as an important tool for learning through experience. What we are going to write are not certitudes, but a problematic explanation of a tentative approach, of its concrete methodologies and questionable outcomes. The discussion and the possibility of implementation and of betterment are still clearly on the way.

A DSS for water resources management

The considerations we have outlined contribute to define the water resources planning process in the district of Lushnje as a complex problem, since it needs deep considerations not only of technical aspects, but also of ecological, environmental and socio-cultural ones. Cognitive researchers use to define this kind of problem bad-structured, since it's impossible to find a sustainable solution only through rational analysis in a structured quantitative environment.

We have, thus, proposed a bottom-up approach to problem setting and management, and we have decided to develop a DSS as a multiscaled tool able to represent, manage and display multiple knowledges, qualitative and quantitative data in a bad-structured environment. In fact, the proposed DSS might be defined a Spatial Decision Support System based on Knowledge (KB-SDSS) as it combines algorithmic potential of DSS – data management, use of mathematical models,… – with those of ES – possibility to manage information in unstructured, even qualitative knowledge domains – and of GIS – storage, analysis, display of large amounts of data coming from different and multiscaled sources of information.

The first problem we have faced in the construction of the DSS lies in the difficulty to create an adequate knowledge base. In the Albanian context, in fact, official data are not only scarce, but also unreliable because of many reasons: speed of changes, loss of a great number of archives, existence of informal and precarious activities which aren't registered by official statistics, lack of coherence and uniformity in available data.

Therefore, in coherence with the defined bottom-up approach, we have integrated different sources of information in the knowledge base of the DSS. We has, thus, fostered a learning process between experts and non experts through:

- the distribution of a structured questionnaire about the basic feature of the district to representatives from communes and municipalities;
- the distribution of a semi-structured questionnaire to 27 stakeholders whom have been asked to focus on the relevant problems of the district, on their causes and possible solutions, on the potential and risks of the current pattern of development;
- some meetings with the selected stakeholders in order to build relational webs with them and create a shared base for dialogue and mutual understanding;
- individual visits to the district, in order to grasp the rhythm and the spirit of those living environments.

We should define the constructed knowledge base heterogeneous, full of knowledge discontinuities, incomplete. But our opinion is that planning practice has to learn to work in unclearly defined contexts, with incomplete and often unreliable information, and must cope with this situation to build a knowledge base from incomplete data during the action itself. The traditional division between analysis and planning, thus between theory and practice, must be avoided since planners will not be able to construct a comprehensive knowledge base before action, yet this false expectation is, moreover, likely to prevent planners from action itself. That's particularly evident in developing countries, as it's shown by our case study.

In the previous paragraphs we have maintained the necessity to give local communities not only the role of sources of alternative information, but also of subjects in the planning process and implementation. Therefore, at the beginning of our study, we have tried to construct a shared frame for a locally centered problem definition. This also comes from the recognition that the traditional scientifically reduction of the water problem to the confrontation between demand and supply for diverse uses – agricultural, industrial and municipal – must be challenged to give place to a sustainable and ecosystem approach in the place of a man-centered perspective. We have, thus, sustained that also ecological needs must be taken into consideration, and water for ecosystem equilibrium must be evaluated.

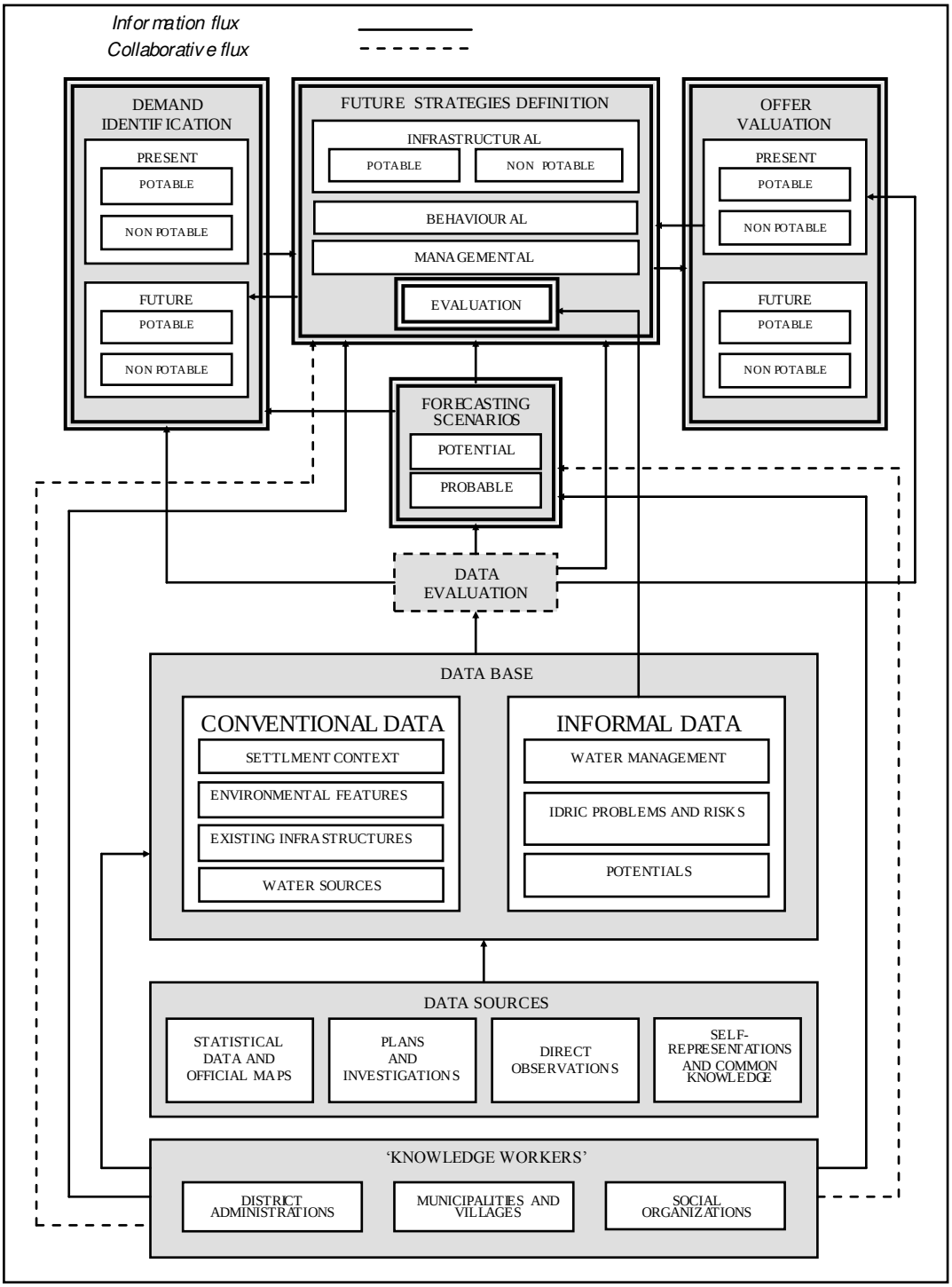

Fig. 1. The DSS Architecture

That's why during the meetings with stakeholders we have asked them to define the main problems of the district, to frame potential and risks of their living place, thus encouraging them to think in a more global perspective and to consider every problem in a multidimensional context of global sustainable development. Therefore,

we have assumed the strategic options they have outlined for the development of the district also as important elements for the forecast of future events. This operation, indeed, can't be realistically done only on the base of the extrapolation of past trends as it was in the traditional approach to planning. That is especially evident in the Albanian context, where unpredictable events happened since 1991, and nowadays radical changings are occurring in such a way that experts can hardly anticipate.

In this context, therefore, in coherence with the idea previously expressed, we have adopted a self-reliance approach to make realistic prediction about the future, and have constructed various scenarios according to different development hypothesis made by the local 'knowledge workers'.

This turn in planning methodologies is possible also thanks to the turn in the way of considering local people and their active role in shaping their own future instead of adapting to externally driven schemes. They relate to the planning process not only through an information flux, but also through an active involvement in strategic options definition and in their implementation. The betterment in the level of maintenance of the irrigation system, for example, can't be realistically foreseen within a short period if we don't consider the possibility to engage local people.

All this also challenges the traditional way in which planners consider water demand and its relationships with the supply side. In fact, traditional water resources planning studies usually start with the evaluation of water demand and with its confrontation with the available supply, and go on exploring the possibility to expand supply to match demand. In this way, planners focus their attention on the supply side, assuming that demand is a given datum and that is generally growing with the level of development of a nation – that's why in developing countries planners have derived water standards from those constructed for industrialized countries, reducing them in the face of the lower level of development.

In our case study we started from the recognition of the unsustainability of such an approach and we have tried to implement feedback relations between demand and supply inside the DSS, so that strategic options in development planning are able to modify the use of water resources, and thus the related demand.

Anyway, the problem of the definition of the present demand is itself quite a big problem, since the criticism about the standardization of demand on the basis of adapted western data forces us to develop a more reflective and bottom-up approach to the definition of the real needs of local people (Illich, 1998). Moreover, official data often fail to map the real presence of activities in developing countries, making our task even more complex. Besides, we must remember that in developing countries it must not be taken for granted that supply must satisfy an existing demand. Sometimes it might happen demand is generated by supply; all this underlines, even more, the strategic role of water resources management.

Strategy definition is the core of our system since the different hypothesis must be locally oriented and, at the same time, globally sustainable. In their definition, dialogue between experts and non experts has been fundamental as a process of mutual learning. The false assumption that local communities, in whatever country they are and whatever tradition are informed by, are likely to abandon their way of using water resources and start acting according to rational western model of consumption is at the roots of the failure of the many big development projects. At this regard, many case studies demonstrate that the reason of the ineffectiveness of many traditional water resources plans are due to the divergence between the kind of use they impose upon society and the way in which people accomplish their daily life and use water resources (Balbo, 1995).

Planning the GIS module

The construction of a Geographical Information System (GIS) as a module of a Decision Support System for the sustainable management of water resources revealed itself as a problematic task even if considered in relation to a narrow goal such as that of defining the criticality of potable water supply in the Lushnje district.

Problems concern, on the one hand, the role and the specific task of the GIS considered in the context of a complex DSS architecture and, on the other, specific issues regarding the design of the information system.

A first requirement is the adequacy of the system to the specific socio-political context which is characterized by a process of transition from centralized to market economy. This process is producing deep contradictions between the need for environmental protection and the need for economic development which is often oriented by western models thus altering and changing local identities.

Moreover the use and the control on water, which is a scarce resource, are typically associated to intractable conflicts (often enduring and difficult to resolve). These conflicts emerge not only from the processes of natural resources planning and management which require that different actors attribute values to water seen as a local resource, necessary for ecosystems dynamics; they emerge also from the strategic role played by the water resource in the economic development of territorial contexts which are competing for rebuilding weak economies. In particular in environmental planning, water management is considered a problematic field identifiable either by the environmental structure or by the space of the external infrastructural relationships. These relationships manifest crucial issues which are related to the iniquity in the use of the natural resource and related to the under estimation of natural resources potentials involving different actors in different contexts.

In changing contexts, like that of the Lushnje district, where it is difficult to sustain actions of environmental protection because of the pressures due to the need of

economical development, communicative an creative approach appear more suitable in facing social and environmental transformations than the incremental approach. How and to what extent GISs could contribute to generate solutions which are far from western consolidated models in managing environmental resources is a crucial question in the light of problems of efficacy of decision making, democracy of the decision process, and adequacy to sustainable development.

As is well known, GIS theory and methods have been developed inside well defined power relationships environments dominated by a vision of expert knowledge considered neutral. A world arose as separated from social-environmental transformation and focused more on the applications of global theory than on the representation of complex processes at different levels.

The construction of a GIS oriented to a specific context poses some relevant issues referable to the planning process seen as a knowledge design process not abstract but rooted in an operative context; not objective but subjective; not partisan but plural; not reserved to expert knowledge but including common knowledge (Barbanente et al., 1999).

These issues concern: the acquisition and the use of significant information in a district where data availability, reliability and quality can only meet the basic informational needs required for analyzing and interpreting environmental and socio-economical dynamics; the construction of local knowledge as an output of the comparison between expert and common knowledge needed for setting up spatial/environmental frames on which possible shared interpretations and ways of managing (management path) environmental resources are based.

With regards to the more consolidated and diffused use in supporting decision making, GISs could not meet the informational requirements induced by environmental planning and management theoretical evolutions. GISs, traditionally aiming at simulating ecosystems dynamics, have represented integrated supports for environmental and spatial analysis thus representing useful tools in the environmental management decision processes. The problem is that information has been utilized in an instrumental way by decision makers since, although decisions on environment are characterized by a non-eliminable uncertainty due to the complexity of environmental dynamics, the necessity to minimize environmental impacts of policies requires wide information on environmental dynamics.

The environmental management is shifting towards integrated approaches required by the demonstrated inefficacy of sectoral approach and the inadequacy of mere technical solutions to specific socio-cultural contexts of environmental policies. In the integrated resources management a particular relevance is recognized to learning processes which are linked to the collaborative dimension considered as an inescapable orientation for the efficacy of actions (Bellamy et al., 2000).

Even though these theoretical shifts are considered relevant in terms of sustainability, the integrated management appears to be a challenge rather than a practice effectively applied even in developed countries. This is due to the persistence of the rational approach (Wallace at al., 1996).

One of the most important difficulties in putting in practice this integrated approach is related to the role of the information process. The "quality" of the information process is still largely based on the "quantity" of available data: policy makers are overwhelmed with data and information that may or may not be useful for them. This phenomenon could be described as "data –rich but information poor syndrome" (Timmermann et al., 2000). In this regard GISs appear to be challenged as tools supporting the search for significant information thanks to their abilities in managing and integrating large amount of data.

Large amount of data do not necessarily imply adequate solutions to relevant questions emerging from a specific context and process. Indeed possible solutions to complex problems could emerge from problems structuring. In this perspective "the process by which information is produced and agreed on is crucial" and for this reason it "must include substantial debate among key players and a social process to develop shared mining for the information." Moreover dialogue and communication in themselves change people and situations (Innes, 1999).

The process by which the information is produced, assumes a crucial role in setting up shared spatial frames with regards to the innovation potential in interpreting local environment and to the possibilities to induce learning processes as pre conditions for managing conflicts (Schön et al., 1994). It becomes more and more crucial in contexts where data and information are lacking but necessary for promoting local self-sustainable developments.

These issues about information represented the basis for the construction of the GIS module which, meeting the theoretic evolution in environmental planning and management, could support the decision process even starting from scarce availability, reliability and quality of data needed for more traditional GIS for environmental and spatial planning and management.

In building the GIS module, the focus on processes induced a perspective favoring the introduction of local common knowledge together with expert knowledge, thus recognizing the need for information of the different local communities and representing multiple realities coherently with different ways of knowing (Sandercok, 1999), exploring the potentials of open decision making processes, and assuming the decision making process as deeply contextual and filled with conflicts.

The GIS module support would consist in enabling the management of problems, appearing or really being intractable, making explicit facts, values, and processes of knowledge construction where expert and common knowledge continuously merge

in a planning conversation. These considerations conduced to the construction of a GIS module as a reference structure in building information useful as input for the ES module.

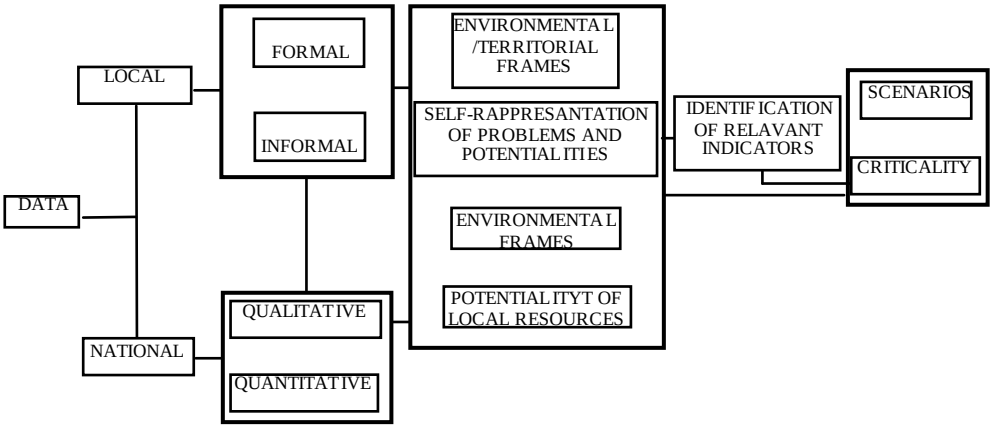

Fig. 2. The GIS module architecture

In this perspective, the construction of the map of the criticality of potable water was useful, on the one hand, for the production of information oriented to the traditional balance between offer and demand and, on the other, for the focusing on elements of sustainability and non-sustainability of existing development processes and for the selection of significant indicators oriented to the construction of strategic scenarios.

Such a system needed to be based on the comparison between quantitative/ qualitative, formal/informal data related to both environmental and socio-economic processes, thus making crucial the use of different information sources such as questionnaires or environmental maps made available on the web by the national environmental agency.

Perhaps, only the integration of qualitative analysis with traditional quantitative ones enables to discover "hidden territories" as well as to acquire the ability to look at reality with different eyes and recognize those diversity, varieties, and subjectivities representing development potentials (Barbanente et al., 1999). In effect, the use of questionnaires, as further informative sources, gave the possibility to build an image of the territory in terms of problematic situations, present potentials, and existing criticalities. With regards to environmental dynamics available data were not enough for any suitable modeling or analysis: on the basis disciplinary and sectoral knowledge the comparison of information available at the local scale with that qualitative available on the web at the national scale enabled the construction of a knowledge base supporting the description of the idrogeological context.

The interpretation of the available and different informative layers and scales and the comparison between lay and expert knowledge showed their adequacy in facing a complex context reality far and different from that one where the GIS module was

built confirming the need to open these systems towards different, multiple, and plural knowledge sources thus showing what has been defined the tension between spatial analysis and participatory GIS (Goodchild, 2000).

The ES module: the development of future strategies

The ES module's task is to develop future strategies depending on different possible scenarios of water resources conditions. The Knowledge Base (KB) has been mainly acquired from literature on both water management policy for developing countries and sustainable use of natural resources. Only in the implementation phase it was validated, in terms of task analysis (Hoffman et al., 1995) with experts in urban planning and water system management domains. No specific case-based cognitive interview (Moody et al., 1996) was made because of the lack of precise information and because of the need of keeping the KB at a very high level of the strategy composition reasoning.

Presently the KB (fig.3) simply identifies the general orientation which strategies should have: orientations are strongly linked with elements identified as sources of problems thus suggesting direction for action: the search for problems is action oriented and strongly context dependent. Problems are derived from the observation of the context described for both present and future conditions.

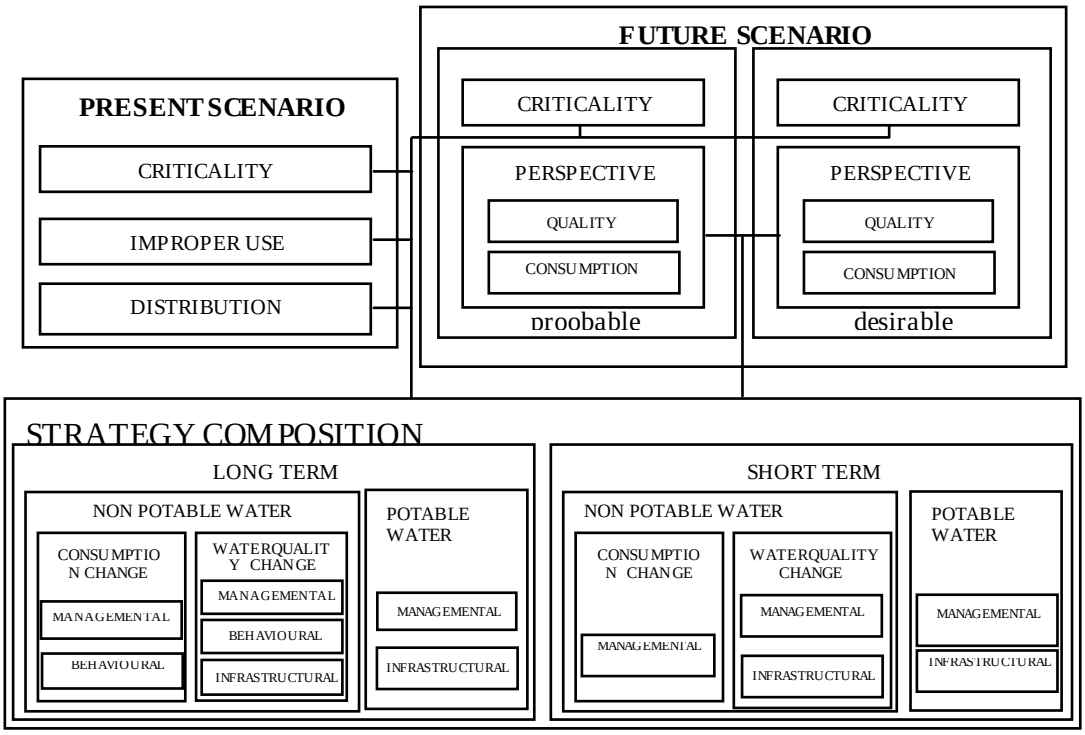

Fig. 3. The ES Knowledge Base

Present scenario is described referring to three basic characteristics of water use/management: criticality, improper use and distribution satisfaction.

The latter is acquired directly from the community monitoring (questionnaires) and refers not only to the quantity but also to the quality of distribution. In many communities of developing countries, and particularly in the Lushnje district, water does not reach directly all the final users who have to move to distribution points which can be rare in the village and therefore far to be reached.

Improper uses are mainly related to the use of potable water for tasks not requiring good quality water like agriculture or domestic activities. Improper uses enable the activation of long or short term strategies oriented to behavioral transformation.

To get this information the ES currently presents questions to the user. Further work is carried on to connect the ES with a data base containing this kind of informal knowledge.

As it is possible to observe in Figure 3, three main strategic orientations are possible: infrastructural, behavioral, managerial. These orientations are firstly related to the kind of problems focused during the running of the ES: need for change in consumption, need

for change in the quality of water. These problems are firstly referred to the quality of water (potable or not) and finally to the perspectives of the strategy orientation (long or short term).

Because of the general definition of strategies orientation, the ES still maintains in this current configuration the architecture of a Decision Tree since it still works with a forward chaining mechanism but it shows its ES features in the ability to compose the strategic orientation. A Decision Tree has got different possible solutions, of which, just one is possible as the good one. The current KB supplies many different solutions which are only partial and can be aggregated differently depending on the context conditions in managing and using water.

The ES uses descriptors of present and future scenarios which are oriented to focus on problems of using and managing water resources and is able to derive the strategy orientation referring to the problems characteristics. Because of this direct correlation between problems and actions, it is possible to consider those problematic characteristics as those toward which it may be useful to direct research on sustainability indicators oriented to action.

Conclusions and open questions

Starting from the analysis of the general problems in managing natural resources in developing countries the contribution supplies a critical description of “western approaches” when planning water use and distribution. Considering that water

represents a scarce resource and that, in terms of sustainability, a particular attention has to be given to water cycles, to water use behaviors and to endogenous capacities to self organize the water management. In this perspective the contribution focuses on the potentials of bottom-up approaches in planning water use in developing countries where interactions between expert and lay knowledges become relevant because of the necessity to relay on local experiential frame and behavioral models.

A mutual learning approach, between decision makers and communities, is investigates when designing the architecture for a DSS oriented to "bottom-up decision making" in water management. The system architecture has been designed taking into account the needs for an adaptive decision making process: strategies are defined referring to conflicts conditions, consensus levels, monitored behaviors, and, in general, to the observation of decision implementation effects both on the water resource and the community.

Because of this kind of approach, it has not been possible to develop entirely the system staying outside the context in which it has to be used. More preferable a contextual development of the system should be carried out (Borri et al., 1999) and therefore the architecture has been studied to be oriented to an adaptive design of the system itself.

Nevertheless other problems need to be investigated in the near future of the present research. The most relevant of them, because of the bottom-up orientation of the system is the representation of local lay knowledge: representation and processing models are required which enable an easy and immediate communication of decision makers with the systems without loosing relevant information coming from local common language, local cognitive mapping and imaging of water use, local tradition and culture all being essential in supporting capacity building and self organization. Approaches to and models for representing and processing informal information still represent a big challenge for researchers in DSS domain.

Another problems is the construction of indicators of sustainability which are considered essential means for evaluating the outputs of the decision making process supported by the system. Indicators have to be developed which enable a direct recognition of problems and reasons determining not-sustainable conditions thus facilitating immediate modifications of cognitive and decision trajectories throughout the whole decision making process. Problem oriented indicators seems an efficient means for evaluating decision processes since they focus on origins of unsustainability thus being action oriented.

Notes

The present paper is the result of a joint work of the authors. Neverthless their contributions are divided as follows: paragraphs 7th and 8th are by Grazia Concilio, paragraphs 1st, 2nd, 3rd,4th, 5th are by Laura Grassini, paragraph 6th is by Valeria Monno.

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