Some Novel Information Systems for the Empowerment of Decision-making Process on a Territory: Outcomes from a Four-Year Participatory Modeling in Senegal

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The Maps, the Geographical Information Systems (GIS), the Role-Playing Games (RPG) and the other participatory supports, the Multi-Agent Systems (MAS): all are modeling supports designed through their conceivers' perception. Even in participatory approaches, these designing and modeling supports can take off towards technocratic, but often unconscious, drifts. Yet, a true empowerment of local governance means to let stakeholders and their principals totally handle their information and modeling systems. The mere access to information is certainly a first step but it is far from a true power over it, so long as the local people are unable to select, process, and manage their information systems. Actually, the present fast-developing use of these tools could be a threat as much as a progress for the democratization of information. These new information technologies are still often a way to reinforce technical point of view into the decision-making process. This analysis brought us to methodological experiments between 1997 and 2001 in the Senegal river area, to support a land use management local process based on Information Systems Self-Governance (ISSG). Novel forms of maps, GIS, RPGs, other participatory supports and MASs in a designing approach were conceived and tested truly reversed. For all these supports, stakeholders or their local principals guided all steps of designing and modeling process. This method rests on two principles: 1) the endogenous nature of a decision-making process that we consider always continuous and iterative; 2) the self-design of the modeling tools to supply supports for decision-makers much suitable, much handy and much controllable. In such a decision-making process on territories, the technical supports are merely a sort of mediating accompaniment. The results of the four-year experiment allow us to formalize a self-designed modeling approach, for simple maps as well as GIS, RPG and MAS supports. The outcomes also show that this sort of endogenous and self-designed participatory modeling is efficient to let an endogenous dynamics of governance come across into a bottom-up regional policy and planning, from local (2,500 km²) to regional (18,000 km²) scales. In other words, a bottom-up participatory modeling and planning is more fitted with the more humble place where our post-normal science should be in the 21st century.

For a Self-Designed Process of Information Systems

Multi-Land Uses Management (MLUM) is a complex and unpredictable issue that principals have to contend with along an iterative route. Hence, in the matter of modeling, it implies

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a participatory modeling within continual comings and goings between model and terrain. But, without deep adjustments, the grounds of participatory approaches do not seem to be really suitable to support collective decision processes (D’A quo, 2001a), and (D’A quo et al., 2002a). In effect, the theoretical assumption lays on the interest within a parity appraisal and design (of models, planning, etc.) between experts and people. But on the contrary, we postulate here that the process of tools design and supporting advice is too deeply handled by experts to allow truly parity dialogue and influence right at the beginning. We then need before a classic participatory approach a different process with different theoretical assumptions to help people reach equal handling of knowledge tools and decision processes than experts and technicians. This is the kind of pre-participatory process we have experimented since 1996 in the Senegal River Valley, within tools designing as well as decision process leading.

We are looking here for a supporting methodological environment that places information at the disposition and under the control and influence of civil society. In this fashion, the goal should be to target a deeper leading of people in all the decision-making processes involving information. This objective implies, resolving the paradox between the international standardization of information on one hand and adjusting information to the needs of local people and their stakes on the other, in a way that some authors (Lorentzon and Forsström, 1992) advocates a specific “gateway technology” that will develop new ways of link-up. Such a “gateway technology” should rest on first three principles; first, the assembling of the information desired by the decision-makers; second, only providing external information when the need is clearly expressed by people; and third, the validation of everything through an internal debate before any implementation or information usage occurs. But all this is still not sufficient for the setting-up of a democratizing decision-making process. The stake not only involved the handling of information, but also its organization, and accurate representation in a process. It must be in accordance with the decision-makers’ perceptions. This new sort of information “access” means the users are also enabled to appraise information, including its weaknesses, and then to adapt and use it on their own.

In fact, the usual technical complexity designers who often put in MLUM models is due to their wants to reproduce any possible impact, of an interaction between any players. This sort of designer sets thus, instinctively matter in the frame of a perfect decision being found in a given time (the decision time), as against a complex and realistic situation they can reach to set in their models. This tacit hypothesis is that, all the elements essential for the decision can be selected and then put in the model. Moreover, the designer puts himself in the role of an expert who proposes, to the principals his own, presumed, relevant, external perception as a support to improve the decision-making process. The threat is in the difficulty to reach a model sufficiently close to the complex matter of the reality, without falling into an intricate device which is no more suitable for efficient use. The possible weakness is in the ambiguous character of the designing expert, who puts himself as the master of the decision-making process. Many participatory modeling or information systems
fall in these traps. But here, the purpose of a tool cannot be to produce right decisions but, to help people to improve their own imperfect decisions. Then the first crucial step in order to improve a MLUM decision process lies much more in the reinforcement of principals’ and stakeholders’ empowerment abilities (D’A quino et al., 1999), that are in the chronological order, at first being considered by all parties as wholly responsible for their territory; next having access to an accurate and unbiased\(^1\) information for the decision; and lastly being involved within a democratic decision-making process. In other words, an Information Systems Self-Governance. This effectively implies, that the main constraint in MLUM issue lies not in any technical advice or knowledge, but, in the efficiency of a socio-political debate, decision and action. Consequently, the first aim of our tool is to accompany the decision-makers in their iterative and progressive own route towards a shared perception, and then decision, to face their complex matters. That demands the tools to be (1) designed from people’ perceptions; (2) putting advisers’ knowledge at local disposal; (3) being directly controllable by people. That means, start without a previously designed model and let principals of the decision-making process design themselves, progressively and incrementally, their own decision supports.

Yet, in the current participatory modeling approaches, even before the participatory modeling steps, the previous modeling by expert selects the items, the perception framework, the important information, dynamics and interactions. Whereas, we think that the MLUM issues are too multifaceted to be simplified in a neutral way. Hence, in current participatory modeling approaches, the route toward the involvement of people may then unfold which are already boxed, little allowing the people to configure to the design with their own stakes, perception framework and implicit social interactions. Yet, we consider that these kinds of endogenous points of view and implicit realities are highly crucial for supporting the success of a collective decision.

In the matter of modeling, all this leads to our self-design modeling principle (D’A quino et al., 2001b), and (D’A quino et al., 2002b) the most endogenous the design is, the best fit is the tool. Our purpose is to set a novel design of some “mediating supports” (Boltanski and Thévenot, 1989), facilitating emergence of worthwhile debates, better taking into account all the different legitimate points of view instead of a supporting advice leaning only on one of them. The use of the term “mediation” lies within the Boltanski’s and Thévenot’s fashion (1991): It is often through adoption and sharing of some common technical devices that various people with different reasoning, get to novel conventions, where communication becomes feasible. Here, if there is not only “common” but really joint technical devices built up on their own, they will not only achieve common conventions, but also come within joint actions and a more efficient learning by doing decision-making process. It would be more efficient because: (1) it best fits the stakes and points of view of the decision-makers; (2) it best fits the pace and the incentives of their decision-making process; (3) it is more receptive to the following evolvement of experts’

\(^1\) That means information not previously interpreted by experts but provided by the more neutral way.
knowledge and exchanges with external stakes. As a result, this means to test a “self” modeling design of tools (Maps, GIS, MAS) by stakeholders and principals, right from the initial stages and with as little prior work designed by the modelers as possible. The method seeks to solely make people progressively formalize, solely the farther they advanced in their debates, and the elements which seem useful to us for the improvement of their decision-making. This was experimented with since 1997 in the northern Senegal: A self-governance of Information and Modeling Systems within MLUM issues.

The Information Systems Self-Governance (ISSG) Experiment

The ISSG experiment has been under way in the Senegal River valley. It was involved within a pilot project, which gathered local community representatives and public institutions in order to test new supports which fit into the needs of the community within the decentralization policies. The Senegal River valley is within a very dry area where uses of water and other renewable resources entail strained competitions. Agriculture and breeding relationships are especially tricky, melding items about land tenure, water access and multipurpose uses of the vegetation. Communities then ask for supports to help them to handle these multipurpose use competitions. Several workshops were organized through a year’s time by the rural council of the local community of Ross-Béthio in Senegal, a local partner that volunteered for this experiment. The experiment was thus laid on two methodological guidelines. First, starting right from people’s reasoning for the framework modeling, then introduce only the external information (bio-physical and other) which they identify by their own. Expert knowledge will be summoned up progressively afterwards by the principals on their own request and within the context of their own objectives. Strictly speaking, this is the self-design stage. Secondly, people are allowed to organize right handling of all the modeling and processing information tools set up. Strictly speaking, this is the self-handle stage. All this demanded to conceive and tested an appropriate learning by doing process that led to a complete Bottom-up and Incremental Regional Development (BIRD) planning (D’Aquino, 2001).

The self-design stage is a special process coupling the self-design of a GIS, next the self-design of a RPG, and then, the self-design of MAS. About the territory, maps are one of the best ways to transfer information. It is a very visible way to share the incentives of the decision-making process about the territory (see above our perception of “mediating support”). GIS can allow more people to make visible, share and handle information which was previously not available. At last, to go further than maps, towards more prospective supports, simulation tools are interesting: RPGs and MASs. RPG have already been often used in MLUM matters (Burton, 1989; Ostrom, 1994; Piveteau, 1994; and Heathcote, 1998). But for operational uses, they are reported to be limited within a collective decision-making process because of their cumbersome setting up, their slowness to develop a practical action and the uneasy analyses of their results. Then, computer modeling is interesting, and peculiarly MASs. MAS promotes a gradual and iterative learning-by-doing progress vis-à-vis a complex environment: modeling only requires a few formal rules to begin and
may be continuously improved through the input of earlier simulations in the decision-making process. This means, taking up a complex situation within an incremental and iterative framing of a progressive modeling that leads to greater understanding. This also entails an ability to take into account the different perceptions of “world” (and space, and territory), which is central to placing modeling at everyone’s disposal, whatsoever his perception of the world is.

Initial self-design of the GIS began by allowing people to select on their own the first MLUM issues they wished to deal with. Consequently, our GIS project team began work without any previously defined priority topics (soil characteristics, ecological features, etc.). Next, they identified on their own during internal workshops, the information and maps that they thought would be useful for resolving their MLUM issues. Furthermore, in comparison with current participatory approaches, our desire is to transfer the ability to handle information efficiently rather than to merely provide oversimplified (say local knowledge participatory appraisals) or already part-analyzed knowledge (say external diagnosis before participatory workshops). This implies placing at people’s disposal at the outset, a geographic information totally accurate (data, legend, etc.) for very operational MLUM issues. The challenge was to succeed to sufficiently and quickly developing people’s abilities to identify, read and interpret very accurate maps that are similar to classic GIS products but defined by local people. In fact, the participants thus built a crude GIS, crude in its organization but not in its data resolution.

In practice, people identified their own informational needs for coping with their MLUM matters and afterwards helped the technical team to gather the knowledge until precise maps could be generated by GIS software. Then, the first maps designed by this way were shown to people. At that point, participants determined gaps in the information, based on their perception of the required quality. So, if they could complete by field investigations, they do it by themselves and technical assistance only mends it for GIS. On one hand, the GIS team has its own “classical” GIS technology (remote sensing, data base...) which allows it to quickly supply most of the information that people ask for (soil characteristics, crops and settlements location, hydraulic schemes...). On the other hand, thanks to the people’s strong motivation and participation, it could organize an accurate protocol to collect some peculiar data (types of wetlands, livestock journeys, follow-up of the multi-uses of ponds...). Afterwards, this first basic cartographic information was returned to the local people to be appraised of, rectified, enriched and finally acknowledged, during several workshops led by local principals in each decentralized community area. All this process rolled out during a short period (less than three months) through a learning-by-doing process of map analysis.

For instance, in the case of Ross Béthio community, the first subject chosen by local principals was the coordination of land use for crop and animal farming. From Figure 1 one can see an example of accurate maps designed and filled out by participants with the support of this method. The map in Figure 1 is the result of a collective decision concerning

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2 MapInfo software.
3 Around 2500 km² and 40000 people, in the delta of Senegal River.
This first stage of ISSG experiment was organized between 1997 and 2000 on a primary land-use scale of around 2,500 km² and 40,000 people and from then it has been extended to the Senegal River Valley (around 20,000 km² covered nowadays).

Then, people began to debate using their maps as support and searched communally for new ways to improve their collective situation. Outcomes of the experiment include new collective rules of land and resource usage that were legitimated in a formal charter (D’Aquino et al., 1999). People finally asked for new supporting developments, peculiarly by requesting the inclusion of the dynamic effects of interactions between the different uses implemented and their medium-term evolutions. In concordance with our aims to transfer empowerment abilities in design, simulation, and modeling, this is the second step of our ISSG approach: a self-designed simulation model, called the Self Cormas method (D’Aquino et al., 2001a), which begins with a self-designed RPG which so far was a self-designed MAS modeling. This self-designed simulation modeling was carried out in four situations, ranging in size from 180 km² to 700 km².

RPG have been already used to support land use management. But, in this experiment, a deeply different form of RPG was used. There were no prioriy rules and setting of the game drawn for previous diagnosis. The RPG is solely designed from the self-analysis of their situation which the players produced in the first step, not knowing that this analysis will afterwards be used to set a RPG. Obviously, this kind of RPG rests on very crude and simplified rules and on setting game. But, the goal is not to conceive a game technologically achieved and satisfying from the expert’s point of view. This effectively implies, a keen technical advice is less useful to start MLUM local governance than an accompaniment of the decision-makers in their iterative and progressive own route towards the complex and technically insoluble management matters.
In practice, the first step of this second stage laid the identification, and acknowledgment by people for the satisfaction criterion of all sorts of stakeholders involved, say as “the fundamental elements for every stakeholder to succeed to provide a living for his family”. Here, there is no external input, but, merely a knowledge perhaps already known by every participant which is still not built up and shared in a public arena, and not shown without indictment of anyone’s behavior. The framework model must be very close to decision-makers, their perceptions as well as their stakes and needs: in other words, a self-designed simulating support, allowing people to “set in motion”, and consequently to test, their first common representation of their MLUM issues.

Outcomes of the experiment also include new agreements between farmers and breeders to use water for improving pastures (D’Aquino et al., 2001c), to settle conflicts between farmers and a National Park (D’Aquino et al., 2001d). However, RPG is rather unwieldy at an operational level and for offering continuous support in a decision-making process. Moreover, RPGs do not provide for a sufficiently incremental and iterative process that progressively integrates information and knowledge (Figure 2). Consequently, after the start-up of a RPG, computer modeling, and especially MAS, then becomes worthwhile. A special MAS platform, CORMAS (Bousquet et al., 1999) was used. MAS platform, CORMAS, is coupled with GIS software and a cartographic support based on the previously designed maps. Thus, the same game setting, GIS maps, and crude rules designed by the participants are transferred from the game into MAS model: self-designed MAS. The MAS model is organized in “activities” (breeding, hunting, farming...) gathering a group of features and a point of view, all withdrawn from participants. Given there is any constraint for adding new attribute, this process is very flexible and could integrate any sort of spatial representation, which is obviously useful in our self-design context. Moreover, new forms of land improvement could be created only by combining new values of attributes. Then, every social MAS entity can have a real collection of points of view, as regards, all the different activities is able to practice. At last, by switching run-time from an agent point of view to another, CORMAS allows to correct and value during a simulation the first representations of stakeholders directly with them (for more details see (D’Aquino et al., 2001b) (Figure 3).

4 Common-pool Resources and Multi-Agent Systems: see http://cormas.cirad.fr
Initially, as the designers themselves carried out the simulations, they were aware of the distance between the model and reality, and they did not consider computer outputs as reliable predictions of a “black box”. The permanent link with an accurate GIS that presents data and precise maps enabled participants to shift from a mere exercise to a hot discussion of the future of each area and of each type of stakeholder (see Figure 4). Thus, getting into the following stage of the ISSG approach: The self-handling, which is a subtle learning-by-doing process starting within the self-design stage, then goes on through an autonomous local process of incremental decision and management, which cautiously integrates expert advice, only on local demands and at the pace of the people’s progress in their MLUM issues.

Conclusion

In conclusion, it’s a self-incremental modeling process supported by an accurate information system (GIS), which succeeded to make progress even within so conflicting local situations in the decision-making process. This ISSG is therefore, quite different as regards the usual participatory assumptions. It could yet be put before these approaches, allowing decision-makers, peculiarly local decision-makers, to reach sufficiently sound
status, power and knowledge in order to withstand a parity technician-people debate and exchange. These sort of supporting tools are growing richer progressively at the same pace as the shared decision-making process. They produce in this way a fitted and progressive self-improvement of MLUM negotiation and decision processes. However, our ISSG approach does not take care of the others phases within the decision process supporting: quantified technical appraisal, strictly speaking expert advice, technology transfer... etc. In effect, ISSG approach takes place before the usual technical advice, in order to develop the empowerment abilities (see above) of people as regards external perceptions and influences and to improve their usages. But the ISSG approach lays also upstream the current participatory approaches (and modeling), which implicitly rest on a parity nature in the technician-people couple (D’Aquino, 2001a).

Bibliography

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