Support continuous collective processes in resources management: The linked uses of Multi-agent simulations, GIS, and role-play to improve collective decisions.

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1. Multi-Agent Systems for land use management

For several years Multi-Agent Systems have been used in the field of natural and renewable resource management. Rapidly, the researchers in Mas and resource management have raised the issue of the interactions between agents and their environment. Cormas is a multi-agent simulation platform specially designed for renewable resource management. The authors consider that in complex agrarian situations, decisions on land management changes should be based on a common understanding of the interactions between ecological/bio-physical and socio/economic dynamics that are at work. As agricultural and environmental issues are more and more inter-linked, the increasing multiplicity of stakeholders, with differing and often conflicting land use representations and strategies, underlines the need for innovative methods and tools to support their coordination, mediation and negotiation processes aiming at an improved, more decentralized and integrated natural resources management (INRM). Cormas gives the possibility to manipulate and to incorporate into the same model spatial entities defined at different hierarchical levels. Involved in applied research on land and resource management we have tried to go beyond the classical laboratory experiments. During the past ten years, very significant advances in the simulation of societies in interaction with their environment have been achieved. More and more powerful and user-friendly computer modelling tools facilitate the understanding and simulation of such complex interactions. The main objective of this research is to study the use of MAS models and cartographic tools, associated with role games, for knowledge integration in collective learning processes focusing on key local INRM issues. How can these kind of tools be involved in such a processes, i.e., how can they help actors to govern the land? We are seeking to develop a companionable modelling use of multi-agent systems. We conducted participatory modelling experiments through the joint use of MAS models, others modelling tools (GIS for instance) and role-play. We will present some results or lessons drawn from these experiments with a special emphasis on respective positions of the different methodological steps and their effects to improve the collective process.

2. Some first experiments

Several experiments have been conduct in Europe, Africa and South Eastern Asia, specially about scheme irrigated management, natural resurces and land use management. One of the main experiment, called "SelfCormas", has been under way since 1997 at the POAS (Plan d'Occupation et d'Affectation des Sols) experimental unit in northern Senegal. In support of a local decentralization policy, the aim is to test tools (maps, GIS, simulations, role-play,...) that will help local rural authorities and the people under their jurisdiction to improve their empowerment on planning decisions about sustainable land use management (agriculture, animal production, the environment, etc). The management scale considered is around 2 500 km² and 40 000 people. The simulation developed needs to help to stakeholders at every stage of the decision-making process: when zoning the area, identifying rules of access to a given

type of area, and evaluating possible social and environmental impacts. It should also make it possible to forecast the different possible options, and therefore needs to be flexible. Two precise objectives were set right at the start of the experiment. The first was to test direct design of the MAS model by the stakeholders right from the initial stages, with as little prior design work by the modeller as possible, hence the "self" added to the CORMAS name. This means that upstream modelling work had to concentrate on producing an environment enabling the stakeholders to express themselves in designing their model. The second objective was to test the use of a geographical information system (GIS) managed by the region's public development company[1], to sustain the decision-making process and modelling work regularly if necessary. The modellers used this blueprint, not to develop a specific model, but to develop tools within and around CORMAS (cf. role game, GIS, etc), so as to formalize as accurately as possible the knowledge and views expressed by the stakeholders (including the GIS) during the continuous, collective decision-making process. This "self-design" experiment was organized in the form of discussion workshops. The use of these three linked tools (Cormas x GIS x role-play) lead on discussions, appraisals, and even decisions, about definition of possible futures (scenarios) in the form of either trends (for instance population growth) or events (for instance the digging of new canals).

3. Some first conclusions

This operation provided us with confirmation of the feasibility of using computers in such socio-cultural situations. Thus, developing a role game in conjunction with stakeholders seems to be an interesting way of enabling stakeholders to play an active part in design a multi-agent model. The role game serves in this case as a sort of dialogue interface between computer modelling, the "machine", and stakeholders. The stakeholders who developed and played the game were fully capable of interpreting the results of the model. As they were themselves the initial designers of the simulations carried out, they were also entirely aware of the distance between the model and reality, and of the way in which simulation results should be used. Moreover, simulation made it possible to go much further than the role game. For one thing, it would have been physically impossible without computer simulation to "play" the different scenarios selected by the stakeholders and to observe their multiple impacts over sufficiently long time lapses. Furthermore, a sufficiently flexible modelling platform offers many more possibilities of modifying the rules on request than cumbersome game sessions. Simulation thus multiplies the effectiveness of the role game and can take the decision-making process much further, be it by taking account of the long-term future or through the feasibility of the decisions made.

Lastly, in line with the option of supportive modelling, in this case, it is not up to the model to provide solutions to problems, but to encourage discussion of the different alternatives, to improve the effectiveness of a collective decision-making process and even to change the behaviour of local stakeholders with respect to their technical partners. In our approach, recourse to technical expertise is the stage that follows, and not that which precedes, the collective choice of scenarios that can "reasonably" be envisaged by the community. From this initial discussion, which supportive modelling made both endogenous and technically valuable, it was the representatives of local populations who themselves identified the priority types of support they required within their decision-making process and who contacted the services capable of satisfying their needs directly. Decision-making processes are about that too.

[1] SAED, Société d'Aménagement et d'Exploitation des terres du Delta du Sénégal et des vallées du fleuve Sénégal et de la Falémé (a public regional development company)