

Integration of multi-scale stakes in governance by applying companion modelling to land use foresight

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Abstract: Decentralization of land use governance creates new challenges for participatory approaches, including the involvement of highly diverse participants and the search for coherence among multiple regulations. In France, the 2000 law of Urban Reform and Solidarity (“Solidarité et Renouvellement Urbain”) provides a legal framework to land use decentralization. It requires the planning design process to be participative and to involve civil society through consultation phases. It also addresses the issue of coherence among legal planning documents along the scale hierarchy, the larger scale plan conditioning the others. In the Reunion Island, the multi-level institutional system includes a region, its four micro-regions and 26 districts; each having their own land use plan. The revision of the regional plan (“Schéma d’Aménagement Régional”, SAR) was the opportunity to revisit the various plans to make them more coherent across scales. This paper presents how research was included in this political process.

The SAR revision was initially thought as a one-scale regular participatory foresight process in three stages, i.e. (1) a land use assessment (diagnostic); (2) the definition and discussion of contrasted scenarios; (3) the development of the final land use plan. The overall consultation process involved a large group of participants, including members of various institutions and of the civil society. They defined the logic of four contrasted land use scenarios, and sorted key challenges for the future of the Reunion Island. Stage 2 was however handled in an innovative way due to the collaboration with a research project called DOMINO-Reunion. The DOMINO-Reunion Project put together a team of researchers from various disciplinary backgrounds, and members of extension and support services for rural and agricultural development involved in the various debate on land use at each scale. Together, the team followed a companion modelling approach to develop a prototype of a dynamic model meant to assist the main players in building various land use scenarios and simulating their mid- to long-term consequences on urban, agricultural and natural stakes. A subset of participants of both processes, the SAR revision and DOMINO-Reunion, collaborated to adapt the model prototype to the SAR scenarios and feed the regional land use debate.

This paper analyses how our companion modelling approach in two steps has helped integrating multi-scale stakes in the SAR revision process. It discusses specific challenges for participatory modelling, which are linked to power balance such as stakeholder’s exclusion, over representation of specific interests and political co-optation, focussing on two specific processes:

- the integration of multi-scale negotiation processes and indicators in the evolving model;
- the implication of stakeholders, which are involved in various land use decision-making arena, in the participatory modelling of the system.

We showed that companion modelling helped increase the representation and the weight of agricultural issues in the debate, although urban considerations still prevailed in the regional arena. The paper concludes on the benefits and drawback of integrating progressively different decision-marking scales in a participatory process.

Keywords: *participatory approach, multi-scale, land use governance, modelling, decision support system*

1. INTRODUCTION

1.1. Institutional issues and multi-scale integration for land use governance and prospective

Decentralization in resource governance implies a higher diversity of decision makers, managers and stakeholders than in state-centralized governance. It requires the devolution of power and control over the allocation of productive resources (Favereau et al., 1994). It also has to cope with divergent interests among these actors, so that the externality associated with land and resource uses are not borne by any subgroup (Agrawal et al., 1999). In France, decentralization of land use governance has a legal framework since 2000, thanks to the “Solidarité et Renouvellement Urbain” Act (SRU act). This act is framed within the 1982 decentralisation law which first organized the transfer of formal power from the State to local governments (region and department) to design more appropriate policies¹. The SRU act especially addresses the issue of coherence among legal planning documents, and states that the planning design process must be participative and reinforce the involvement of inhabitants through a consultation phase.

The decentralization process raises major issues related to negotiated decision-making. A first issue deals with the multiple interests that are represented and weighted, and calls for assessing the structure of negotiated decision-making. A second issue is linked with the complexity involved in land use at various scales, the high diversity of stakeholders and levels of decision-making to be considered and involved. Specific methods and tools are requested to deal with multi-scale and multi sectoral representation and to make explicit these representations through clear rules of the games.

As presented, the expected benefits of decentralized land use governance are linked to more efficient, equitable, accountable and participative policies. Land use governance can be analysed in terms of transparency and rule of law, but also in terms of direction and self-organization capacity. The last two are intimately linked to the capacity to plan, anticipate and foresight possible development paths. “Prospective” analysis has been developed to explore possible futures as seen from various angles, and is roughly equivalent to scenario analysis². Its use has increased in the last two decades (Börjeson et al., 2006, Piveteau 1995). Prospective analysis of land use issues has been done mainly for sectoral stakes (agricultural or urban development) and sometimes mixed environmental issues. It is now becoming more participatory, and involves a greater variety of tools, coming from operation research and management sciences. These tools are yet limited by lack of technical or “hard” means (Checkland, 1981), by difficulty to tackle ill-structured situations, and by weak formulation of the problem setting (Daniell et al. 2006). Among the plethora of available tools there are few, if any, that integrate stakeholders at both the conception stage (identification of the problem setting to consider) and the prototype development stage. The participatory development of agent based models within a companion modelling approach is one way to achieve and confront the expression of viewpoints necessary for joint-learning to be effective.

1.2. Up-scaling the companion modelling approach

The companion modelling approach (Barreteau et al., 2003) is based on the postulate that in environmental or common pool resource management, all stakeholders’ viewpoints are legitimate. Their elicitation and the discussion of underlying hypothesis are assumed to increase the legitimacy, and therefore the viability, of the common decision emerging from the process, as stated in the communicative action theory (Habermas, 1987). Indeed, we suppose that actors’ acts are partly driven by their own representations, often controversial, of their environment. Thus, sharing these representations should add to mutual understanding and potentially make them evolve. Modelling is used as a way to support and confront representations (Bousquet et al. 2002, Piveteau, 1995) and dynamic simulations as a way to articulate their projection in time.

As for many participative approaches, companion modelling has rapidly been confronted by the questions raised by the necessary inclusion of larger and multiple levels of decision: to which extent is it possible to transfer the collective knowledge developed to the people that were not involved in the process; and how to associate various levels of decision-making. Castella et al. (2007) were the first to write explicitly about multi-scale land use foresight using companion modelling. Their approach was to work with each decision

¹ An alternative form of decentralisation process is the devolution to local stakeholders through the allocation of rights on specific resource. In this case, the stakeholders’ knowledge is supposed to facilitate acceptable arrangements.

² Prospective is an aggregation of the French words « prospection » (exploration of new areas, i.e. exploration) and « perspective », which carries the idea of viewpoints [Berger, 1958].

arena independently. They ended up building several tools to fit the diversity of knowledge and questioning that arose in each arena. Our strategy to involve multiple stakes was different, as it focused on the multi-scale representation and on the overlapping of different arenas of respectively development, validation and use of a unique modelling tool.

After introducing the local institutional context of land use governance and its levelled structure, this paper presents the key points of our methodology. Then, it analyses multi-scale stakes representation in the developed tools, and discusses stakeholder's involvement in the participatory processes and in the decision arenas involved. It finally concludes on the advantages and drawbacks of such a methodology with regard to politics of scale.

2. THE LOCAL CONTEXT OF MULTI-SCALE INTEGRATION IN LAND USE GOVERNANCE

2.1. Major land use stakes and power balance among stakeholders

In the Reunion Island, the major stake is to manage efficient trade-offs among concurrent sectoral land uses, located in a bounded territory. On one side, a demographic continuous growth associated with an urban anarchic sprawl is on the verge of jeopardizing the economic viability of agricultural activities. On the other side, environmentalist lobbies, which are well structured, have already secured a large patch of natural land since the National Park creation in 2007. In this context, the agricultural stakes that are plural and sometimes in competition are the weakest. The current debate stands still as each sector is building its own development strategy without recognizing the necessity to eventually compromise with the others.

In addition, the Reunion Island has several institutions in charge of land use planning, including those corresponding to the local government levels defined by the 1982 decentralization act: region, micro-region and district. That institutional complexity calls for multi-scale participation in the application of the SRU act. The principle of subsidiarity is announced but the actual articulation is less effective than sought. The Region is supposed to define the land use planning and orientations of each sector without limiting the prerogatives of the sub-regional institutions. The districts over-emphasize their need for housing in order to better control the costs of urban sprawl. Finally, the newly created micro-regions can not be considered as a simple aggregation of districts as they have their own policy and competences on land uses development (linked notably to sustainable urban policy or to land settlement).

The exiguity of the Island implies that policy makers, technicians and stakeholders often belong to the same local social networks. This characteristic enhances the relative importance of informal arenas towards formal ones. In this context, the position of researchers involved in a companion modelling approach on land use governance is ambivalent. Because of the scientific legitimacy obtained outside the local networks, they tend to end up facilitating discussions between stakeholders in formal arenas, and are considered neither as supporters of one or another networks, nor as too far as to be unaware of informal local negotiations (Daré *et al.*, 2008). However, most local scientists are actually part of these local social networks.

2.2. The legal setting of regulation and land use planning

The Reunion Island illustrates that land use decentralized governance is based upon land use planning as ad'hoc normative provision. The two major stakes are the negotiation process for decentralized land use planning, and the incentives to negotiate as regard to the weight given to specific stakeholders' interests. The Region, the micro-region and the districts are each in charge of defining their own land use plans: (1) at the coarse granularity, the Region encompasses the whole Island with its regional development scheme or "Schéma d'Aménagement Régional" (SAR); (2) at the finer granularity, the 26 districts have urban master plan "Plan Local d'Urbanisme" (PLU); (3) in between, each of the four micro-regions has a "Schéma de COhérence Territoriale" (SCOT). Other territorial and sectoral institutions may not have a specific and legal mandate on land use regulation, and yet they strongly influence land use management. For example, the newly created National Park is determining the evolution of land use in more than 43% of the Island.

3. MATERIAL AND METHOD

3.1. How we adapted the companion modelling approach to this context

We combined two processes that we see as arenas for involving the stakeholders in land use development: the institutional project of revision of the regional land use planning (i.e. the SAR revision process), and the DOMINO-Reunion research project (Figure 1).

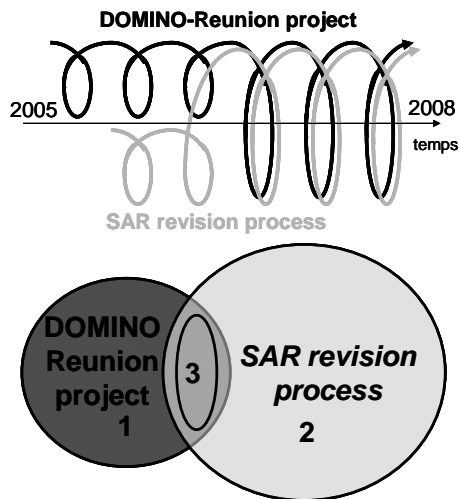


Figure 1: Articulation between the two participatory projects presented in this study. (Top) Evolution in time of the two projects; the loops illustrate the modelling iterations. (Below) Arenas corresponding to the three modelling sequences: 1- the conception of the prototype of multi-agent model of land use by the DOMINO-Reunion project team; 2- the definition of the four prospective scenarios for the SAR revision; 3- the adaptation by a subset of the two previous groups of participants of the multi-agent model to illustrate the SAR scenarios.

DOMINO-Reunion followed a companion modelling approach, which aimed at facilitating the integration of multi-scale stakes in regional land use planning. It involved a multidisciplinary team of 11 researchers and 6 members of extension and support agricultural services (holders of stakes from local to regional scales). That team developed a first multi-agent model prototype to build various scenarios of agreement among land use stakeholders, and to simulate their impacts on the Island land use at medium to long term (up to few decades). Once this prototype was done, the goal was to share and challenge that composite representation in legal arenas.

Concurrently, the Reunion Region started the review of its land use plan, by involving more than 50 participants from various institutions and from civil society. The SAR revision process was planned in three stages:

1. In the land use assessment stage (diagnostic), the participants identify the main challenges for the future of the Reunion Island.
2. In a second stage, they extract a subset of 13 key challenges and built four contrasted planning scenarios by ranking the challenges.
3. Lastly, based on the debate emerging from scenario analyses, they define and map the most appropriate land use for the Island.

For the second stage, the regional team in charge of the whole process (called the “Cellule SAR”) felt the need for

integrated and dynamic tools. They were thus willing to collaborate with the DOMINO-Reunion project for operational support to develop a participatory modelling process and to simulate the land use scenarios. This collaboration resulted in a revision of the multi-agent model prototype to better illustrate the implications of each of the prospective scenario, emphasizing the necessary trade-offs among sectors and detailing few indicators at the various administrative levels (region, micro-region and districts).

3.2. Analytical grid for assessing the added-value of our approach

In addition to the cognitive added value that this methodology brought to the understanding of multi-stake representations in land use governance of the Island, we propose to analyse more specifically two aspects of it, as related to the ways multi-scale stakes were integrated in the process:

- Integration of multi-scale processes and indicators in the tool itself
- Integration of stakeholders involved in various levels of decision in the participatory construction of the conceptual model of the system and its use in decision arena mandatory of various scales of governance

4. RESULTS

4.1. Lessons about the multi-scale representation in land use governance

The main lesson we learnt from this experiment is about the limits of the combination between two of the major principles advocated in the SRU act: participation and subsidiarity.

With this new SRU act, several levels of land use planning have been created with their own prerogatives but with the principle of subsidiarity. This principle states that the upper government unit should be given the liability of a public action if this unit is able to solve the targeted problem. Our case showed contrarily that the orientations given by the upper level has been followed by the lower two. Because of the small social system and the small size of the Reunion Island territory, the exercise of prerogative of each level comes up against the others. For instance, at the district level, the crucial stake is about housing the district population and to anticipate the crisis. Land use management tends then to favour urban activities and the urban electorate at the expense of other sectors (conservation of rural lands to ensure the economical viability of this sector or conservation of natural areas). When all the districts’ PLUs are aggregated at the micro-region level we assist, on one side, at a multiplication of tourism or energy projects, and of new areas of economic

activities, while on the other side, there is a clear lack of infrastructure for waste treatments. The arbitration within a micro-region, made by elected members some belonging to district council, increases the tensions among districts because many would like to be considered as the economic centre of the micro-region.

Moreover, to review its SAR, the Region must apply the participation principle. The intervention of scientists in the public decision process generally consists in providing decision makers turnkey solutions and predictive models to shed light on their decisions. In the companion modelling approach, however, the relationship between scientists and decision makers is different. Models are meant not for prediction but as catalysts for collective thinking. But political games and the different schedules of each plan create local tensions, which slow down the participatory process of the SAR. Confronted with this reality, the use of participatory modelling in some decision arenas becomes trickier, as it can be more difficult to maintain the needed level of reflexivity and to promote multi-scales participation. The Region, for instance, will prefer bilateral negotiations to multilateral ones.

4.2. Integration in the tool

We implemented the multi-agent model (referred as DS) on the multi-agent simulation platform GEAMAS-NG developed at the University of the Reunion Island. The way the idea of scale is taking into account in DS is rather simple. There are three levels: the region, the micro-region and the cell (Figure 2). The district level is directly accounted in DS through its impacts at the cell level. Each cell is initialized with a unique land use type (natural, agricultural, or urban), and, for each class of land use, with a suitability score (null, low, medium, or high). The human population dynamics that drives urbanisation is inferred through demographic parameters at the cell level combined with migration and densification processes at the micro-regional and regional levels (Figure 3). The land use allocation is supervised by three macro-agents that represent respectively the urban, agricultural, and natural sector at the regional level. For each simulated year, according to the suitability scores of the cells and the agreements among macro-agents, each of them tries to transform the “best” cells to urbanize them, cultivate them, or preserve them in order to reach objectives fixed by the simulation parameters and the evolution of the population dynamics. For each level a specific set of indicators have been defined and can be either plotted or mapped directly in the model interfaces.

DS can be initialized with different sets of parameters, enabling to build alternative scenarios of simulations (e.g. urbanization rush, or economic development, or complete preservation of pristine habitats). More details can be found in David et al. (2007).

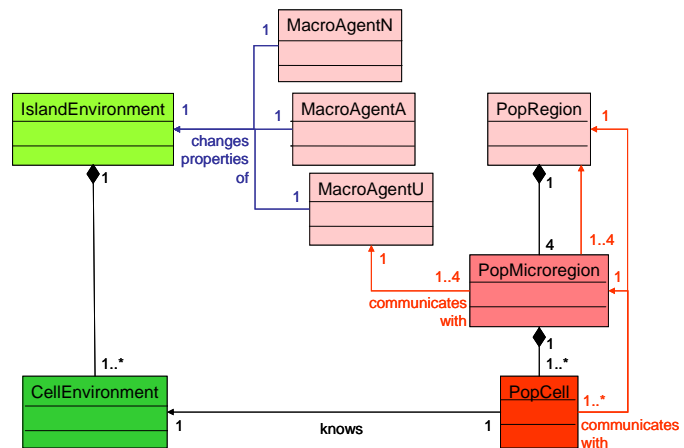


Figure 2: UML class diagram of the MAS model structure. In pink and red are the social entities, while the green classes correspond to spatial entities. The darker the colour is, the smaller the corresponding spatial level is.

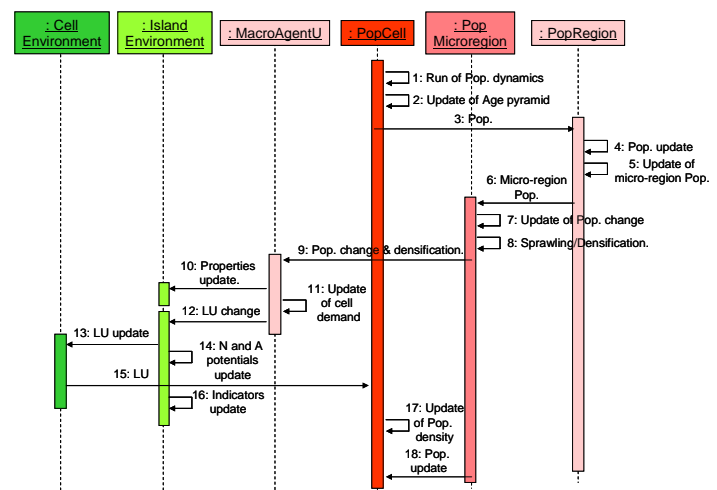


Figure 3: UML sequence diagrams of the population dynamics and its link with the urbanization processes at various levels.

4.3. Integration in participatory and decision processes

The first phase of our methodology within the DOMINO-Reunion research project allowed us to include participants whose stakes are usually overlooked in regional debates. The second phase done in collaboration with the SAR revision was the opportunity to partly bring their viewpoints in the political debate.

This two-stage process led to increase the accounting of agricultural stakes in the SAR revision process (arena 3 of Figure 1); although the SAR revision team had excluded from the collaboration the representatives of the small agriculture of the DOMINO-Reunion team, privileging representatives of the sugar cane lobby. Doing so, they partly reinforced the inequality among the agricultural stakes. Nevertheless, the fact that the evicted stakeholders had participated in the first stage of modelling had two consequences: (1) their viewpoints regarding the limitations of the model were included in the documentation accompanying the model (Botta et al., 2007); (2) their full understanding of the model and the key-information they obtained helped them building their line of argument when the Region refers to the results of that tool for identifying land use policy options. Finally, an unexpected event happened after the first official restitution of the model results by the Region. Holders of agricultural stakes that so far had refused to collaborate with either the DOMINO-Reunion team or the other agricultural institutions asked the Region to organize a specific arena including representatives of the whole agricultural world to build a coherent strategy and diagnostic of the sector.

5. DISCUSSION AND CONCLUSION

5.1. Intrinsic difficulties associated with legal multi-scale planning processes

Temporal constraints of embedded decision-making arena

The SAR revision process started in 2006 is still on going in 2009. The third stage of their methodology, which is also the most sensitive because it maps the most appropriate land use for the island, is being postponed for political reasons. Because of the subsidiary principle, that delay is directly affecting the revision of the land use plans of the lower scales such as the SCOTs and the PLUs. The initial objective to accompany the whole multi-scale planning process was therefore impossible given the timeframe of DOMINO-Reunion.

Participation in multi-scale governance processes

Multi-scale governance implies a multiplicity of stakeholders, which is challenging the way participation is usually done. In addition to up-scaling issues, participative methodology must address out-scaling ones. Although a participatory approach is mandatory for each level of planning, the links among levels are still “behind closed doors” deals, with no public elicitation or debate. In this context, the idea of promoting a companion modelling approach on the matter is challenging. Nevertheless, the progress report meetings that we have organized along the way in various arenas including representatives of lower institutional levels and of sectoral lobbies, may be seen as many chances to open the black box of the tools used by the Cellule SAR.

Adoption of the companion modelling results in institutional arena: a necessary manipulation?

To be appropriated our tools and approach must be reinterpreted by stakeholders. But these reinterpretations may not be in line with our objectives and ethic. Therefore some may argue that this flexibility can easily lead to manipulation of scientists by decision makers. To be legitimate and effective, our approach had to be linked to the on-going legal participatory processes on land use planning. The Cellule SAR was therefore leader in the revision of the tools that the Reunion DOMINO team first built in a more open way. In the process, it evicted some of the DOMINO-Reunion team members, and privileged some dynamics and indicators toward others to defend its own strategy. So how did we manage to reduce the scientific backing of already made political decisions that had no scientific basis? By opening the black box to stakeholders not involved in the second phase and by multiplying the restitutions. Nevertheless, as the Region has adopted our first prototype with all the points of view previously integrated and the main principles of companion modelling approach, the Cellule SAR have increased its awareness to others stakes.

5.2. Number of tools and its implication on the participative process

We argue that the methodological choice to develop one or several tools to facilitate multi-scale management depends on the prior issue among stakeholders. Most of previous studies addressing land use management at multi-scale ended up developing several tools; each tool focusing specifically on the question associated to one scale. The same strategy would have been possible in the case of the DOMINO-Reunion project, as

different questions came up whether the regional or the local level was favoured. Yet, in the Reunion Island, local data and tools are very often opposed to regional ones. To facilitate communication, we therefore decided to focus on a single tool and to have a common support of debate among stakeholders. Nevertheless, this tool privileges the regional representation to match the SAR main concerns. By making that choice, we partly lost the representatives of the local stakes.

5.3. Conclusion and future outlook

The integration of multi-scale stakes in land use governance may be facilitated thanks to specific processes integrating viewpoints at various scales, and specific participative strategies that involve holders of stakes at various scales. Previous studies mostly focused on the integration of multiple viewpoints and levels of social organisation in one or several tools, mobilizing these tools in separated mono-scale arenas. This study implies that there are other ways to facilitate communication among social organisation levels in the land use debates. In the case of the regional planning process in Reunion Island, our modelling approach encouraged agricultural institutions to collaborate, to increase their chances of defending their stakes in the land use debate at the various decision levels. This was possible thanks to two features of our methodology: first, the involvement of agricultural representatives in the design and use of the DS prospective tool to animate regional debate, and second, the partial integration of their viewpoints and of the different institutional scales in the tool itself. Nevertheless the second point, which is usually referred to as the key solution, was less essential to the results than we had first expected. Even a simple tool with a crude representation of multi-scale processes may help people to better think their involvement and their interactions at each level.

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