

Chapter 10

The companion modelling approach: dealing with multiple scales and multiple levels of organization

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The companion modelling approach initially was conceived and tested at a local level because of the focus on resource users. Based on the premise that different stakeholders involved in resource management operate with different areas of reference and time scales in mind, the approach focuses on the representation of this diversity in its tools and in the form of coordination workshops (d'Aquino *et al.*, 2002b; Étienne *et al.*, 2008c; Le Page *et al.*, 2001). Like many participatory approaches developed at the local level, the approach quickly confronted issues posed by the institutionalization of participatory processes (Pimbert, 2004): the institutional integration of collective learning developed at a local level, taking into account stakeholders not present at the local level, and the need to interact directly with regulators and decision-makers at higher levels. A study group was formed within the ComMod network, in parallel to the ADD-ComMod project, to discuss the novel challenges raised by the application of companion modelling to several organizational levels of action and decision and by changing scales in a companion modelling approach.

In a companion modelling approach, the recognition of diverse viewpoints is a central element. Therefore it must pay special attention to preserving and integrating diverse ways of thinking, and must structure action, particularly collective action, in 'levels'. Knowing that the multiple levels of organization in which a ComMod process operates is just one of several cognitive representations of structuring action within a society, and that this representation is not necessarily shared by all stakeholders, the 'multi-levels' issue may be broken down into three questions.

- Which multi-level representations should be used and how should they be integrated into the approach (which tools and participatory methodology)?
- What impacts do these choices of stance and methodology have on the context?
- How can one position oneself in relation to these questions in a way that would be the most rigorous and consonant with the core principle of companion modelling?

This chapter begins by defining several key concepts and by describing the biophysical and social processes underlying multi-scale issues. We then define the challenges that these issues pose for companion modelling approaches and analyse how the ComMod group has addressed changing scales and multi-level accompaniment in different case studies. We then explore more generally the scientific questions raised by such exercises and identify the main fields of research before concluding with the positioning of the ComMod group.

Analytical framework

Definitions

This section reviews the key concepts encompassed by the terms ‘level’ and ‘scale’. We treat these concepts thanks to three complementary notions, namely dimension, level and resolution. Lévy and Lussault (2003) define dimension as ‘a manner that favours the intersection of partial viewpoints over a vast set of phenomena rather than the partition of a field into fragmented and unrelated areas’. Spatial and temporal dimensions are the two most often used to characterize a process, for example, a biophysical process in ecology often is described in terms of length of time or spatial expanse. However, this definition may designate all other quantitative or analytical dimensions used to study a phenomenon. Following this logic, Cash *et al.* (2006) cite more specific dimensions to study social dynamics, including, for example, dimensions linked to the institutional structure of societies, and juridical and regulatory dimensions, characteristics particularly of political organizations. Each of these dimensions may be considered on several levels (Figure 10.1). These levels constitute hierarchies that may be interlocked (e.g. a region is made up of landscapes that are themselves composed of fields) or not (e.g. a constitution sets the framework for possible laws without containing all of them just as a regional administrative authority constrains the operations of communal administrations without being constituted by these communal administrations). Finally, resolution corresponds to the degree of precision of the system description or perception. In spatial representations, it corresponds to the cartographical sense of scale. A field, like a region, may be studied on the scale of a hectare.

Depending on the set of problems under consideration, these concepts were long considered to be predefined and unique, a particular question falling more specifically under a particular field and treated at a particular level and resolution. Yet due to the diversity of viewpoints of a system, there are in fact a multiplicity of dimensions, levels and resolutions to consider. The representation and sharing of this multiplicity is part of the challenges of collective management. In the remainder of this book, the term ‘scale’ refers to the ensemble of these three concepts.

These definitions sketch a simple picture of the relationships between levels and dimensions, but our analysis also requires the consideration of transversal organizations bridging different levels.

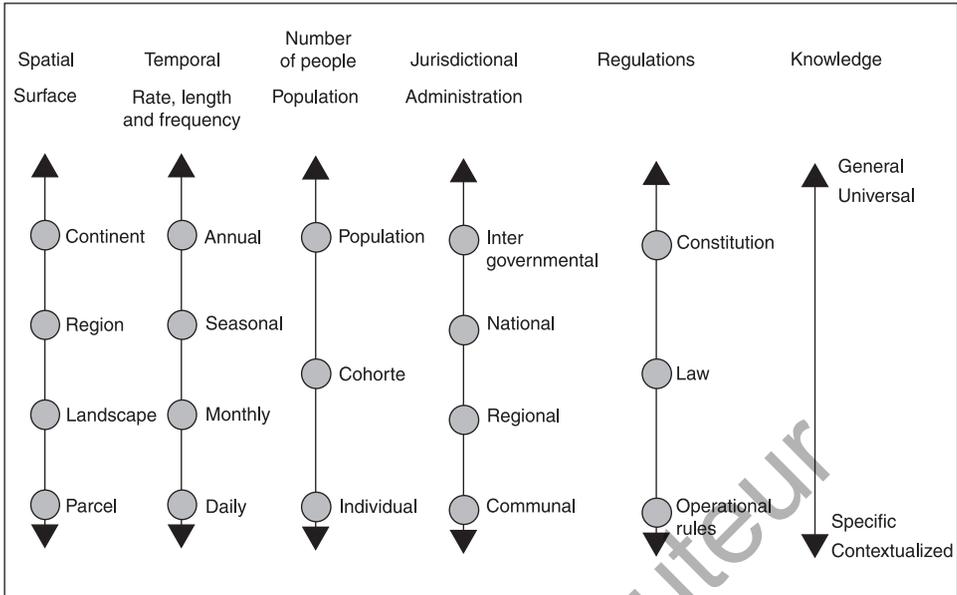


Figure 10.1. Examples of dimensions and levels potentially relevant to the study of links between society and the environment (adapted from Cash *et al.*, 2006).

Questions of scale in environmental dynamics

The acknowledgement of linkages between spatial and temporal scales has always fuelled the analysis of biophysical processes. The study of matter and energy flows, for example, has led to the development of a set of tools and methodologies in ecology and geology, among others. However, taking into account links between levels is much more recent and controversial. It was long thought that a given process should be monitored and discussed at a specific spatial level and time scale. For example, the study of hydrological mechanisms usually focuses on a small-scale watershed level and an hourly time scale when analysing flood processes, yet tends to focus on a large-scale watershed level and a monthly basis when studying allocation mechanisms between different uses subject to seasonal climate variations. This manner of analysing biophysical processes rests on the fact that most of these processes predominate at certain combined levels of space and time. In hydrology, the infiltration of surplus rainfall relates to localised (within one square kilometre) and rapid (about one hour) phenomena while underground flows concern water tables of several dozen to several hundred square metres over multi-year timeframes (Bloeschl and Sivapalan, 1995).

Nonetheless, the major changes affecting our environment increasingly highlight the importance of interactions between levels of the same or different dimensions. For 30 years, numerous disciplines have studied and sought to theorize these phenomena. The theory of hierarchies (Koeslter, 1967) applied to ecology (Allen and Starr, 1982) describes complex systems as sets of small systems that are merged into a limited number of larger systems. This hierarchy presumes a correlation between spatial and temporal

dimensions and levels of the biophysical processes that are described; rapid cycles of small spatial scales are embedded in slower cycles involving larger spaces. This coupling between cycles explains in particular the potential transmission of disturbances along spatial and temporal dimensions. Elmqvist *et al.* (2003) thus attribute the degradation of the Jamaican coral reef system to the overfishing of herbivores in the region. The disappearance of green turtles followed by herbivore fish weakened the coral reef system to the point that the elimination of the last grazing organism (a type of sea urchin) by a particular pathogen and the passage of a hurricane were enough to allow fatal algae to invade the coral reef. A second essential theory of multi-scale dynamics and complex systems is the theory of emergence. Considering that the articulation between two description levels (micro and macro) of phenomena has different resolutions, the macro-level may only be a simple aggregation of what happens on the micro-level. In this case there is no emergence. However, it is possible that the macro-level possesses particular properties that cannot be reduced to, or exist outside of, the elements that make up the system at the micro-level. The phenomenon of emergence is then said to take place¹.

Questions of scale in social dynamics linked with environmental dynamics

Social processes regulating the relationships between societies and the environment operate in various dimensions (i.e. spatial, temporal, regulatory, demographic), often on several levels, and are linked through these dimensions (Figure 10.1). The uses of a resource by individuals organized into social groups, the formulation of management rules, or more generally the governance of ecosystems, are thus defined at numerous levels and dimensions.

Yet the analysis of social processes rarely calls on the notion of scale², most often favouring descriptions at a single level. This is due to the difficulty of describing global processes at a reduced level and aggregating local processes at higher levels and indeed, identifying forms of emergence. Numerous questions are raised when considering scales of structure and representation of these social processes.

One question concerns the pertinence of the scales chosen when the structure of the social processes affecting the governance of ecosystems is evolving. The scales conventionally chosen represent a linked stack of spaces and structures of regulation and decision. However, a society's collective modes of action (i.e. transversal, vertical and horizontal) cannot be summed up in this hierarchal structure. On the one hand, contrary to this concept of a set of descending, interlocked regulatory arenas dividing society from top to bottom, society is 'a continuum' (Rosenau, 1990, 1992). The shift from a local to a global perspective is a continuous process of interactions that pass through levels of variable and circumstantial aggregation according to the type of interactions being established (Rosenau, 1990). On the other hand, networks, lobbies and social or personal

¹ More precisely, Dessalles *et al.* (2007) stated that the macro-level emerges from the micro-level if the micro-level is constituted by interacting elements whose properties or dynamics are described in a certain theory D, generating a property or global dynamic at the macro-level that can be described by another theory D', such that D' is irreducible to D, in other words, there is no possible way of calculating the elements of D' from the elements of D.

² The exception is geography, which uses spatial representations in the form of successive, hierarchical levels of organization, and geographic objects dependent on these organizational levels.

ties associating stakeholders motivated by shared action principles (Breiger and Pattison, 1978; Vachon, 1993; Bakis, 1993) contribute as much 'behind the scenes' (Goffman, 1979) to multi-level links as do the operational links between hierarchical levels of organization. The combination of these processes and power mechanisms (i.e. confrontation, cooperation and domination) results in an organization of ecosystem governance based on collective groups, institutions and evolving subdivisions (Swyngedouw, 2004; Young, 2006). Modes of governance also vary in time: some collective groups or institutions (e.g. decision arenas, reference territories) appear or even disappear as certain processes (affecting the rules or the constitution of the collective) are reintegrated into other levels.

A second question concerns the understanding of the mechanisms underlying one level in order to understand the processes that exist at other levels and indeed other dimensions. Numerous authors have examined the mechanisms underlying various levels and have proposed matching analytical frameworks. An example is the IAD (institutional analysis and development) framework, which aims to identify universal mechanisms operating at different levels and dimensions and suggest a taxonomy (Ostrom *et al.*, 1994; Young, 1995). The regularity of social behaviour at these different levels creates structures that affect behaviours and their outcomes. This analysis leads to the identification of a core unit of analysis straddling several dimensions, that is, the action arena (Ostrom, 2005). In modelling, the agent-group-role concept, inspired by analogies derived from organization theory, aims to describe different levels and entities that hold different positions, either simultaneously or changing over time, in these different levels. Interactions within a system can only take place within a group, interactions between groups being generated by agents who play roles in several groups (Abrami *et al.*, 2005; Ferber and Gutknecht, 1998). These different approaches call for a nested scale approach. The question thus looks at how representations of these divisions are constructed.

In the analysis of governance systems, it is now largely accepted that scales are social and political constructs (Adger *et al.*, 2005; Lebel *et al.*, 2006; Meadowcroft, 2002). Representations of the dimensions relevant to address society-nature relations thus vary according to stakeholders and are affected by their modes of comprehension and political, economic and scientific simplifications (Bulkeley, 2005; Lebel *et al.*, 2006; Meadowcroft, 2002; Sneddon, 2002). The legitimacy, credibility and means of integrating and understanding knowledge are strongly dependent on the level at which the knowledge was produced and analysed and thus, the type of associated stakeholders. Broadly applicable, generic knowledge produced by formal scientific procedures often is favoured at global levels while lower levels mobilize knowledge based on practice or situation experience³ that is based on scientific procedures or traditional knowledge (Cash *et al.*, 2006; Weible *et al.*, 2004; Young, 2006).

Power relations between institutions and mechanisms of domination, resistance and cooperation contribute to the definition of scales (actual divisions or representations of divisions) and their reconfiguration. 'Politics of scales' illustrate how the choice of scale is thus an inclusionary or exclusionary instrument of power that modifies the means of

³ More overarching levels sometimes mobilize processes of cognitive hegemony that impose certain models or types of management (Molle, 2008). However, this hierarchical authority cannot adequately take into account the complexity of relations between levels as is shown by the difference between how a rule thought out at a higher level is reinterpreted at a local level (Urwin and Jordan, 2008).

access to resources and decisions (Lebel *et al.*, 2006). ‘Empowerment’ processes are thus linked to the acquisition of strategies of scale and capacities to mobilize scales and different levels (Swynghedouw, 2004). This capacity depends not only on the capacity of stakeholders to make sense of questions raised, but also on their capacity to develop ties and alliances with stakeholders operating at, or mobilizing, different dimensions and levels (Boelens, 2008; Bulkeley, 2005).

Companion modelling and questions of scale

Problems of scale in modelling

Problems of scale in modelling are well known in the representation of biophysical processes. They derive from the potential inadequacy between the scales taken into account in the different steps of abstraction leading to a model, that is, observation of a process, analysis of observations, then the representation of the process. Numerous methods have been developed to prevent such inadequacies. The non-linear character of certain processes, their different timing, as well as technical measurement constraints, pose problems for data sampling, which become increasingly difficult to resolve as the processes studied become increasingly heterogeneous. Some methods, notably statistical ones, specifically address the representation of this variability within a unit of reference in order to allow the parameterization of one spatial unit to another and to ensure the distribution of parameters or their interpolation under boundary conditions (Bloeschl and Sivapalan, 1995). From the perspective of modelling, they thus ensure the transfer of information between the modelling scales and the inquiry scales based on the assumption that a pertinent level exists to address the dynamics studied. The choice of scale, therefore, helps to reduce complexity (Ewert *et al.*, 2006).

The challenge in terms of representing socio-ecological systems is how to better take into account their co-evolutionary character and their capacity to adapt to change (Folke *et al.*, 2007). This assumes that ecosystems, in all their hierarchical complexity, are taken into account. However, the scientific approaches cited above consciously simplify representations through their choice of scales. Having done so, they also largely ignore the strategic value of scales in discussions between stakeholders, as well as the different rationalities implemented in the choice of these scales (Karstens *et al.*, 2007). This new discrepancy is even more important for modelling approaches operating at the interface between scientific and public policies spheres (Sterk *et al.*, 2008).

Problems of scale in companion modelling

Companion modelling is, in addition, faced with the integration of different scales during the confrontation of representations, the development and use of tools and the ensuing discussions of simulations. However, compared with other participatory approaches, companion modelling is challenged in a unique way because the scales to be taken into account are not all determined *ex ante*. The open nature of the modelling process effectively allows participants to introduce new scales during the process. Lastly, the involvement of stakeholders from diverse organizational levels and stakeholders who actually represent several levels simultaneously raise the issue of information transfers between levels: how should the sensitivity of certain information

transmitted through the mechanism be handled? All of these questions raise issues of stance and methodology.

Stance

One of the priority challenges of the ComMod approach is to construct an accompaniment that allows the recognition and formalization of different points of view on an issue. When divisions of scale are understood to be a subjective perception and, therefore, able to take multiple forms, the following question is raised: which levels should be taken into account given the fact that the differentiation into levels is subjective and linked to the dominant cognitive model?

All segmentation of society into levels, most often conceived of as a set of nested dolls, is artificial and, therefore, potentially plural. Such structuring can be considered for analytical or operational objectives. However, in participatory approaches, the operational issue is not the only one to be taken into account because these approaches also seek to encourage the participation of different elements of society in the process. In general, one seeks to involve analytical stakeholders from 'internal' levels of society (e.g. spokespersons with different points of view, traditional leaders, etc.) on an operationally conceived level (e.g. management committee, collective, etc.). When a participatory approach addresses several operational levels, it usually reproduces its analytical questioning (which stakeholders should be integrated so that the points of view are representative?) at each level of intervention. However, some agents keep in mind that the 'vertical'⁴ organization of a society (e.g. from a territory to a region) may also be considered differently to the operational stack with which they work. They favour in their approach the intervention of networks and other non-stacked structuring modes without necessitating the use of the stacked representation⁵ system of operational levels.

In our operational contexts, the shift to multiple levels means, in particular, the integration of much more differentiated cooperation arenas: in other words, the degree of differentiation of issues and perceptions between the level of a village and the level of national government is by nature much greater than the degree of differentiation between a farmer and a livestock owner or between a village head and the head of a commune encompassing several dozen villages. There is thus a specificity to this question linked to a context that one may refer to as more multi-institutional than multi-level.

Methodology

The multi-scale question traverses the set of processes

The question of which levels and institutions to take into account is raised from the start of the process and is directly linked to the choice of stance discussed above. The formulation in question of a problem and the expectations of the institutions supporting the approach more or less explicitly predefine the entry point, which will restrict the choice of scales.

⁴ In the rest of the text, we only will refer to the 'vertical' dimension to simplify the discussion. However, at each use of the term, we imply that a 'horizontal' dimension to the structure of action exists in addition to the 'vertical', particularly as these two dimensions are themselves very artificial.

⁵ Representatives of level $n-1$ participate in discussions at level n

The linking and integration of points of view continue during the modelling phase due to the iterative and evolutionary character of the ComMod approach. The choice of participants, the formulation of the question to be addressed, the ways the participants' representations are elicited and the conceptual frameworks used all consider the question of scale in a more or less explicit fashion. For example, the ARDI method (Étienne, 2006) includes a step dedicated to identifying clearly the levels and territorial and temporal divisions that make sense to different participants.

The representation of multiple levels also affects application choices, particularly the selection of formalisms and tools. Each tool offers different possibilities for representations and partitions between scales. For example, GIS are powerful tools that can be used to represent spatial and territorial dimensions but they are ill suited to capturing temporal dimensions. The latter, which are fundamental to the representation of flows or dynamics, require the use of simulation models. In addition, certain divisions or clusters of levels are more or less possible depending on the tool. Lastly, the implicit or explicit scales included in the tools have an impact on simulation results, their subsequent discussion and the confrontation of perspectives regarding these results. The technical and pedagogical potential of each tool (Chapters 3 and 6), therefore, must be analysed and discussed according to the chosen scales. The companion modelling approach is characterized by the use of different tools in order to make the most of their complementary aspects and diminish their limitations. Broadly, there are three ways of integrating multiple scales (Figure 10.2): by integrating stakeholders holding multi-scale representations, integrating multiple scales into the tools used, and lastly, implementing these tools in arenas with multiple mandates.

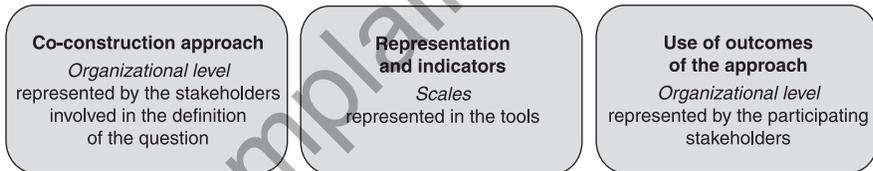


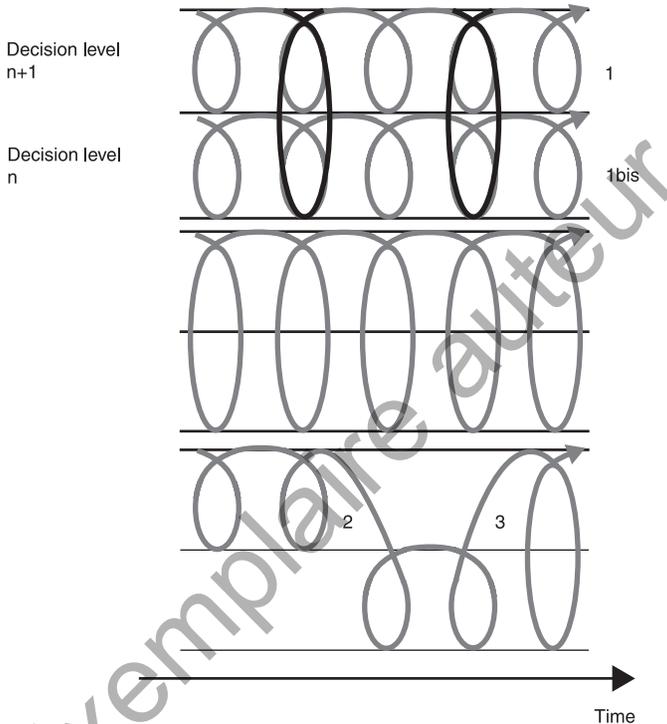
Figure 10.2. Schema of three ways of taking into account multiple scales in a companion modelling approach.

Different forms of shifting scales

Snapp and Heong (2003) described numerous ways of dealing with shifting scales in participatory approaches. In the ComMod approach, there are two main types. The first is the change of scale that follows when the process, while still addressing the same general issue, is applied to a different level of decision-making. This is referred to as 'up-scaling' when the shift is towards a more encompassing level and 'down-scaling' when descending towards a more local level. The second is the integration of a larger number of stakeholders or situations, in other words, a horizontal dissemination of the approach known as 'out-scaling'. This second type includes the replication of the approach or broadening its reach to encompass other forms of participation that may involve a greater number of people. A particular example would be the local definition of a principle or regulation defined at a higher level. Two routes have been developed by the ComMod group: the diffusion of the approach through training (Chapter 11) and the

development of generic, 'de-contextualized' models based on abstract issues and fundamental processes (Chapter 3).

Lastly, the companion modelling approach assumes the existence and succession of learning loops linked to the evolution of the issue and partnerships. The inclusion of multiple levels of organization can be broken down in numerous ways over time, successively using the strategies we have just presented (Figure 10.3). One of the catalysts for a change in loops may indeed be a change in the decision level, which is translated by a change in the questioning and in the reconstitution of the group of participants.



The numbers 1, 2 and 3 refer respectively to strategies that: take multiple levels into simultaneous account (two types), down-scale, and up-scale.

Figure 10.3. Examples of the sequencing in time of taking multiple organizational levels into account.

Taking questions of scale into account in the case studies

A question left out of the evaluation methodology

Within the framework of the ADD-ComMod project, the integration of questions of scale was evaluated in 18 study cases, 14 of which were undertaken by commodians. The evaluation methodology did not explicitly take into account questions related to

shifting scales and multiple levels. Consequently, the strategies selected, the questioning developed and the problems met were not necessarily laid out in the available material. The issue of multiple levels was only really studied in cases where: the designers of the approach explicitly addressed this subject and were confronted with the methodological difficulties it raises; the concealment of this issue limited the reach of the approach in one way or another; the evaluator was aware of, and interested in, the subject.

A multi-scale, multi-level or multi-institutional approach?

Approaches that are more or less explicitly multi-level

Twelve studies explicitly considered questions of scale in the process while only two implicitly took the issue into account. Nonetheless, multi-level integration is a recurrent issue in a significant majority of the cases studied. It occurs in the choice of spatial and temporal scales and the level of organization of the representations and tools developed, but also directly in the objective of the operation itself. Certain operations aim to help one level of organization to get a better grasp of another level or institutions other than those it is accustomed to considering. In a certain number of cases, and depending on the subject studied, what really is under discussion is a multi-institutional integration rather than a multi-level one (Table 10.1).

Table 10.1. Distribution of studies as a function of jurisdictional levels integrated into the approach as they were initially defined.

	Departure point local or supra-local	Departure point regional⁽¹⁾
Issue of multi-level integration around the same dimension	AtollGame (island user)	Domino Réunion (town and region)
	Njoobarri (irrigation scheme plot)	Nîmes-Métropole (town, inter-town, administrative division)
	Pays de Caux (watershed plot)	Domino Senegal (regional level)
	Lingmuteychu (watershed scheme)	
	AguAlocá (watershed large demand)	
Issue of multi-institutional integration	Ter'aguas (community to town)	
	Nan (individual, community, park)	Ouessant (individual park)
	Mae Salaep (individual, community, collective)	
	Kat Aware (large, multi-sector use watershed)	

(1) A regional level is considered here as an intermediary level between a local and specific (plot) level and a more encompassing level (state, agro-ecological region). This term does not correspond to a predefined administrative organization (such as UNESCO's definition of a region or a French administrative region).

Operations principally focus on the 'local' level (the user as an individual), or the 'supra-local' level (groups of users with a recognized representative), and the immediate territorial and jurisdictional levels nearby. Sometimes stakeholders from levels further away are periodically associated. Only four study cases (Nîmes-Métropole, Domino Réunion, Njoobaari and Lingmuteychu) actually integrated more than two territorial and jurisdictional levels. At the most local level, two studies (Mae Salaep and Nan) were interested in the role of community representatives in its interface between users and local authorities.

Frequently, the question raised and its relation to the dynamic of the resource and institutions determines the jurisdictional, spatial and institutional levels considered. With the exception of the La Réunion case study, there appears to have been a lack of specific will to apply the approach to the set of different arenas encompassed by the issue addressed. However, sometimes levels other than those mobilized in the participation arenas were able to be considered in the tools developed. For example, the Nîmes-Métropole study addressed the individual parcel level in a GIS even though the discussion models and arenas did not include this level. The available material did not, however, allow for a detailed analysis of the relationship between the territorial and jurisdictional levels taken into account in the tools and those represented in the discussion arenas of the approach.

Multi-level integration is almost always a simultaneous process. The exceptions occurred when the higher regional and watershed levels were taken into account during the approach (Lingmuteychu) or local authorities were integrated only once the users felt sufficiently comfortable (Mae Salaep and Nan). The levels chosen could lead to a disengagement of stakeholders (and, therefore, their respective levels) whose preoccupations are located at territorial levels other than those considered, or even their withdrawal from the process. This was the case of small farmer representatives in La Réunion.

Working with public policy-makers

Two case studies worked from the start at the public policy organizational level. They chose fairly similar strategies characterized by an upstream mobilization of institutional support for the approach at the level of decision-makers, its insertion into social networks at this level, and the differentiation (to a greater or lesser degree) between arenas in which tools are developed and those in which simulations are discussed. The first relied on technicians operating at the regional level under consideration (if necessary, representatives of users with a mandate at this level), while the second directly mobilized decision-makers (e.g. mayors, etc.). This decoupling permitted more active participation of non-academic stakeholders in the modelling stage, while allowing the effective participation of decision-makers in the approach as long as it was possible to work around their scheduling constraints.

Taking into account the temporal dimension and the integration of scales

There are few references regarding dimensions other than jurisdictional or spatial, notably the temporal dimension. Nevertheless, this dimension is integrated, indeed even explicitly taken into account, in numerous simulation tools (i.e. computer models and role games). In AguAloca, for example, a game round representing a climate season was subdivided into two periods (i.e. collective time and individual decision time), while the hydraulic model turned on a monthly basis. One study was able to consider up to four different timeframes for two spatial and jurisdictional levels (i.e. parcel and irrigated scheme) to address the temporality of irrigation coordination. Short timeframes (i.e. day and week) were taken into account in the computerized part of the game while the part played by participants covered longer timeframes (i.e. month and season) (Barreteau and Abrami, 2007).

The modalities of shifting scales in the case studies

Numerous evaluations refer to questions pertaining to modes of changing scales. Most designers were confronted with these questions during the process and the strategies chosen were rarely supported by theoretical considerations or exchanges of experience. In order to detail these strategies, we describe how these questions were addressed and the problems raised by using the four categories defined in Chapter 3.

Ascending scales or up-scaling

The strategies implemented followed two directions: the institutionalization of an approach developed at a local level in order for it to be replicated more easily (four cases); or the evolution of an approach initiated at a local level towards a higher organizational level with the aim of allowing or facilitating decision-making (four cases).

Institutionalization of an approach developed at a local level

Institutionalization aims for either: (i) to facilitate horizontal dissemination or the replication of the approach; (ii) the autonomization of participants; (iii) a better appropriation of the benefits of the approach. However, the selected strategy seems to have resulted in real institutionalization in only two cases, Lingmuteychu and Nîmes-Métropole.

In Lingmuteychu, a member of the institution made use of his academic training to develop and test this type of approach in the role of designer. When he was reintegrated into his institution at a decision-making level, he proposed using the companion modelling approach in a systematic fashion to support the implementation of basin committees. The training of staff to implement the approach within the institution was planned.

In Nîmes-Métropole the participation of certain stakeholders as observers in the process enabled its effective appropriation by one of the institutions (the Conseil Général du Gard). However, the cost of this replication to all communes in the department due to the recruitment of a consulting firm now limits its effective implementation (see Box 10.1).

In the second option, the institutionalization strategy principally rested on the participation of high-level stakeholders either in the approach's design or deployment (as actors in a game where the model is discussed). The weak effectiveness of this strategy was due either to the institutional representative's attitude, which was reserved for personal (Nan) or institutional (Ouessant) reasons, or by the difficulty in mobilizing representatives from a certain level to participate in the approach.

Faced with this difficulty, 'demonstration' games were implemented in higher level arenas with two principal outcomes. In the absence of direct confrontation with representatives from lower levels, the validity of the representation that promotes the issues as they are expressed at a lower level was called into question (Ter'aguas). The tool is seen at best as a training tool for the organization's technicians who operate at a local level. One might ask if the issue must be the institutionalization of the approach or the institutionalization of the topic. In this case, different strategies may be chosen, such as the mobilization and consolidation of a socio-technical network⁶ around the question.

⁶ For example, in the SosteniCAP case: the collective development of work on the question of mobilizing numerous stakeholders; seminars presenting outcomes to regional decision-makers relying on this work.

Box 10.1 - The Nîmes-Métropole case study.

During the feedback of a ComMod approach dealing with conflicts between foresters, livestock farmers and hunters in a Mediterranean forest (see case study in the Appendix), the Gard district Direction départementale de l'Agriculture et de la Forêt (DDAF) proposed adapting the approach to the issue of forest fires at the urban-wildland interface. Aware of the interest of the Environmental Service of the Nîmes urban community in raising the awareness of the elected representatives to this issue, DDAF persuaded the director and vice-chairman to propose their territory as a case study. In a first phase, the process went through the co-construction of a shared representation of the issue by a pool of technicians from different institutions in the district dealing with activities related to fire prevention. One of the outputs was a virtual map of the area based on three archetypes of village layout that covered the diversity of patterns between natural, agricultural and urban areas. The second phase was devoted to organizing situation action exercises by involving all elected representatives (i.e. mayor and the urbanism or environment deputy) in role-playing game sessions (NîmetPasLeFeu) that encompassed the decisions of farmers at the plot level (abandonment of cropping), elected representatives and urban developers at the village level (new settlements and building permits), and administrators at the urban community level (inter-municipal development project, fuel-break). In a third phase, the Conseil Général du Gard, informed by one of its agents who was invited as an observer in one of the game sessions, volunteered to have the process implemented in all the district municipalities concerned with wildfire risk. After seeking European funding, this institution was able to launch, one year later, a new ComMod process for four urban communities located in the north of the district. An accelerated training process was then set up to allow local stakeholders to handle and adapt the method (adjustment of the conceptual framework and the land map to the local context), with the progressive withdrawal of the researchers (transfer of the facilitation role to consultants) and the progressive empowerment of the Conseil Général to lead the process (appointment of a technician for the monitoring of the operation).

**Evolution of an approach from a local level to a higher level
with the aim of consolidating decision-taking**

In the Mae Salaep study case, an official was invited to participate in a role-playing game session at the request of villagers. However, this participation (in the form of an observer in the game, but an actor in the debriefing discussions) did not have the intended effect and was perceived as a failure due to the poor preparation of the official and an unfavourable institutional context (see Box 10.2). In contrast, in the Lingmuteychu study, the approach was part of a favourable institutional context because the authorities sought to promote the creation of a management body at the watershed level, a jurisdictional level that the approach progressively was considering. Officials (regional level) were invited to participate at a key moment in the process, but they were neither participants nor observers as a particular role (moderation) was assigned to them. This strategy allowed them to orientate the taking of decisions towards the creation of this management body.

In the Larq'asninchej case study, the change of work scales during the process was not recognized as such, but as a simple integration of new stakeholders no longer able to ignore the process due to strong local mobilization and the participants' involvement in the field. Yet even if there had been no real change in scale in the approach or outcomes, the issue had been completely appropriated at this organizational scale due to the engagement of key stakeholders and a campaign to disseminate the theme despite its initial emergence at a very local level.

Box 10.2 – the Lingmuteychu case study in Bouthan.

This Commod process was initiated to deal with a conflict over the sharing of water between two villages during rice transplantation. At the same time, the authorities were looking to implement participative bodies for natural resources management. In a first step, the approach dealt with the way water was shared between the two irrigated areas of the villages. The tools – a role-playing game and multi-agent simulation model – emphasized the relationship between the collective and individual processes of water management in two irrigated schemes sharing the same resource. After a first series of games and simulations with participants from both villages, it was decided to expand the work to the seven villages of the catchment area. Representatives of these villages, chosen for their legitimacy, ability to make decisions on behalf of the village, knowledge of hydraulics and ability to participate in public debate were invited to participate in a game session. During this session, at the request of the authority, representatives of the regional level were also invited to participate in the debriefing at the end of the game session as mediators of the discussion. The process led to the creation of a catchment committee and the implementation of small collective activities (e.g. rehabilitation of the hydraulic network, tree plantation). This work was developed as part of the PhD fieldwork of a technician from the Ministry of Agriculture who proposed to the administration after the completion of his doctorate that this approach be used to develop one of the tools (participative management bodies) of new legislation for natural resources management.

Other strategies also merit note. The replication of discussion sessions at the same territorial level enables a ‘quasi-statistical’ extrapolation. This type of outcome is particularly valuable at a higher level of organization and may facilitate the appropriation and integration of results at this level. This approach was developed particularly in Vietnam where numerous games were conducted at a local level and the outcomes extrapolated to the regional level using GIS (Castella *et al.*, 2007). However, this type of approach raises questions concerning sampling and the representativeness of experiences given the heterogeneity of representations in the same category of users. In the Domino Senegal case study, this ascent in scale was perceived through a regional tool calibrated to the local level. However, the advantage of this approach cannot yet be objectively analysed due to a lack of detachment.

The following issues emerged from the strategies tested.

- The sporadic participation in the companion modelling approach of an individual (as an observer or direct participant) who is removed from local dynamics does not appear to be an effective strategy and may even be dangerous by promoting the unilateral revealing of local strategies.
- Stakeholders from higher levels are often in positions of dominance in relation to other stakeholders, which should be explicitly considered in the process.
- These stakeholders are often also part of complex and/or hierarchical organizations (administrations), therefore, they must hold a clear and well-defined institutional mandate that is compatible with the objectives of the approach and the feedback mechanisms within the organization facilitating institutional learning. This strong institutional support occasionally requires the approach to work upstream, for example, through parallel activities allowing the involvement of the organization.
- The deployment of a tool in a discussion arena mobilizing levels distant from the territorial ones where the tool was designed is also risky because the change in level accompanies a change in representations, and even underlying hypotheses, of the

questions and pertinent dynamics that need to be considered. This risk is even more important when direct dialogue with local representatives is limited or impossible (no local representatives, or difficulty of local representatives in expressing themselves).

– At times, the institutionalization of the theme or the issue under study is more important than the institutionalization of the approach.

The horizontal enlargement of the approach and work with a large user group

The out-scaling strategy followed three directions:

- the mobilization of a sufficiently representative number of participants to ensure the territorial legitimacy of the approach (six cases)
- the replication of the approach in different sites or communities, meaning the deployment of tools in discussion arenas that are different but on the same level (five cases)
- the dissemination of outcomes from operations or discussions to users who have not participated in the experiment in order to associate them with the decision (five cases).

The mobilization of a large group of different users

Underlying this objective is either an attempt to reinforce the legitimacy of the operation, sometimes with the aim of facilitating an ascent in scale, or to facilitate a better appropriation of outcomes through wider participation. It may also involve an effort to ensure the understanding of the heterogeneity of representations.

In four cases, this strategy was used during a single stage (generally the discussion workshops and simulations, notably the role-playing games). It plays out through a preliminary ‘sampling’ of participants that is meant to ensure a ‘good’, ‘geographic’ representation or a good territorial cover. For example, designers sought to mobilize at least one elected official or representative from each town in the territory considered to be in the tool deployment arena (e.g. Nîmes-Métropole), under the assumption that the representations used in this stage were valid for all members of this category of participants.

The effectiveness of this approach depends on the capacity of representatives to participate in an exchange of knowledge about the issue, to institutionalize new learning, and to engage the institution or organization in decisions when decisions are expected. It was to ensure these points that in the case of Lingmuteychu different person in a newly included village were solicited, each bringing one of these ‘capabilities’. Some advocate the mobilization of ‘champions’ of the approach and their social network to mobilize participants. However, this type of strategy raises the question of the effective legitimacy of the approach and its capacity to guarantee that the ensemble of heterogeneous representations is considered and that the effective participants contribute only their personal representations. It is this ambiguity that two case studies in Thailand sought to highlight by confronting the representations of leaders in charge of the interface with those of local authorities and a diversity of users.

Given the capacity of the proposed tools, this strategy of conscious selection is only interesting when the target ‘population’ is relatively limited. Even when this is the case, the repetition of certain stages, such as games, may prove to be necessary (Nîmes-Métropole). When the population is very dense, the simple replication of the experiment can prove to be difficult or even impossible to carry out. Yet the discussion tools used often do not allow the mobilization of a sufficiently significant number of participants to ensure a true representation of the ensemble of users, a point that is likely to affect

the legitimacy of results. In the same way, the activities proposed are rarely sufficient to enlarge the participation base and cause a participatory dynamic in the medium term (Larq'asninchej). Lastly, the multiplication of experiences may lead to the development of quite different discussions and scenarios, posing the problem of their confrontation and sharing, not to mention the integration of new representations that were not initially noticed.

Finally, other avenues are proposed such as: (i) a return to simpler mobilization procedures, for example using a technological medium such as the Internet or the telephone accompanied by investigations into the impact of these technologies on group dynamics and outcomes (ii) the autonomous development of the method by non-expert third parties allows the multiplication of the approach but is accompanied by the risk of normative and prescriptive drifts. This second type of approach assumes training on the approach and its ethic is provided (Chapter 11).

The reproduction of the approach to other groups or similar situations

Given the transaction costs of certain stages in the companion modelling process, notably in developing tools, there is a strong temptation to develop 'generic' tools that can be reused in a relatively complete companion modelling approach. Several of the case studies put or will put into place such a strategy based on seeking generic or de-contextualized tools.

In the Ter'aguas case study, the reproduction of the approach was planned at the beginning of the process given the large number of stakeholders (residents of a suburban zone) affected by the problem. The approach focused on a group of stakeholders to reinforce their capacity to participate although confrontations with other stakeholders were also planned. The generic character of the tools was in the integration into the role-playing game of the heterogeneity of representations concerning the theme studied and on the development of simple tools (e.g. drawings, theatre, cards) that helped to structure rapid discussions around key points of the conceptual model. The latter can be rapidly adapted to the diversity of local situations that have been previously described. The development of different stages in the reproduced approach rested then on the hypothesis that the heterogeneity of representations (within the target stakeholder group) was adequately understood and integrated in the tools so that these *a posteriori* reconstruction processes did not fundamentally put into question the integrated representation proposed by the game. Nevertheless, the approach required an adaptation of certain tools at the stage when the model was reconstructed to fit local specifications. One might then ask under what conditions such adaptations are possible when the process is carried out by non-expert third parties.

This question was raised in the SosteniCAP case study (a non-commodian participatory simulation) where a partnership with an NGO was developed to reproduce the approach that had previously been simplified to facilitate its application. The evaluation showed that this strategy did not produce the desired results. The process carried out by the NGO was much more directive and normative than the designers had planned. On the one hand, the extreme simplification of the approach partially discredited it among stakeholders, while on the other, it led facilitators to reinforce control over decisions at certain stages. These problems probably are indicative of the risks raised by the systemization and broad reproduction of a companion modelling approach and raise questions regarding the specific training of animators (Chapter 11).

The diffusion of outcomes to a large group of users

The dissemination of outcomes may prove to be important in guaranteeing the legitimacy of the operation or in promoting the appropriation of results. The difficulty is that a large portion of these outcomes consist of situation learning based on the direct confrontation of one participant with other members of the group and/or tools.

The evaluation of the Nan case study was the only one⁷ to refer to a communication strategy through a game in which virtual and real players assembled together and were given the task of explaining the strategy of the game to a village audience. The standard practice of designers generally is to rely on the dissemination, up- or downstream of the approach, of information, elements of the problem, outcomes and possibly, discussions and products of the process by mobilizing their social networks and diverse communication mechanisms. Others choose to present the results of work made in small groups with the aim of validating them in a legitimate ‘ratification’ arena (e.g. a general assembly of users). To avoid overly long or detailed presentations, spokesmen generally are encouraged to present only the elements that were the subject of debate within the work group (SosteniCAP). However, the validation of decisions is thus conditioned by the legitimacy of the arena itself and/or by the level of participation at the time of the debriefing.

Ascent into generality or abstraction

Some approaches rely on existing concepts and theories. This was the case of the simplified game used in the Lingmuteychu case study’s third series of workshops in which an emphasis was put on the articulation between collective and individual water resource management in a virtual scenario. The CherIn game initially was designed as a training tool (Chapter 11), but was used with local stakeholders to discuss principles of communal resource management by highlighting certain concepts (i.e. cooperation, competition, discussion and communication).

Other approaches emphasize the design of tools that can be contextualized easily and adapted to specific situations. For example, the Domino approach sought to test the possibility of developing a generic land-use allocation model that could be adapted to two situations (La Réunion and Senegal) (see Box 10.3). In reality, there was movement back and forth between the successive draft designs of the generic model and the specific models. The evaluation noted that the heterogeneity of the areas involved (a French overseas department and an African country) and the diversity of issues allowed the identification of generic elements of the approach but not the construction of a generic tool.

The third option aims to highlight the representation of generic processes, particularly biophysical ones, in the model to enable transposition to other similar situations. This option was chosen by the Pays de Caux case study with a game that could be transposed to other situations involving watersheds submitted to erosive runoff.

However, other approaches could be envisaged. For example, the ‘degradation’ or ‘simplification’ of existing contextualized tools by identifying underlying management principles in the Kat Aware series (South Africa). Another possibility is the adjustment of an approach to enable the collective identification and modelling of management principles and testing the tools derived at different organizational levels.

⁷ Game outcomes were presented also in different arenas in the Domino Senegal study.

Box 10.3 – The Domino-Réunion case study.

The French law of 'Solidarité et de renouvellement urbain' (SRU) sets new rules for legal land-use plans: planning procedures must include a participatory approach, and a general framework organizes coherence between the plans of the various levels of territorial organization. In Réunion Island, the land-use plans of the region, inter-municipalities and municipalities were under revision. The main challenge from an information system perspective was to develop something coherent from geographical data produced periodically by a number of different institutions and make effective use of it. The Domino-Réunion project aimed to fuel these multi-level debates thanks to the development and use of tools allowing the elicitation and sharing of multiple viewpoints.

To do so, some members of the extension and support services at the various institutional levels and researchers first developed an integrated simulation model. This development took place in an informal framework that allowed the expression and consideration of viewpoints of minor stakeholders (such as agricultural stakeholders). This model was used to build scenarios of interactions between urban, agricultural and nature conservancy stakes and to simulate the long-term resultant land-use map. In parallel, the region started its own legal participatory approach to revise its regional land-use plan. Both projects collaborated in a second phase. The model was revised and used to illustrate prospective scenarios that the region had pre-defined with its partners. The methodology allowed the fuelling of institutional debates with a dynamic prospective approach and to institutionalize part of the debates that had taken place in the first phase less constrained by political struggles.

In this project, to take account of the multiple levels of management and to develop the data necessary for the land-use allocation processes, we relied on both the models themselves and the involvement of stakeholders from development through to the use of the tools.

The effective advantage of this type of approach, notably for the replication of simulation sessions and the eventual transfer of the approach outside the research world, remains completely open. One also could question the value of having stakeholders who are involved in operations within a given situation participate in the co-construction of a generic model that they may perceive as being distant from their preoccupations.

Definition at a local level of one or several principles and/or regulations

Eight studies were aimed explicitly at analysing with users the local impact of a regulation decided at a higher level or at promoting its application at a local level. The initial demand was often prescriptive even if it was at times subtle. Decision-makers considered the operation to be a kind of communication exercise meant to teach users new rules or help them understand previously misunderstood rules, enabling at best some flexibility in the local adaptation of the new regulation, at worst the exploitation of the approach. What often is involved is more along the lines of 'explaining how something should be done to users' than analysing and understanding the appropriation of these rules by users or collectively analysing how to adapt certain rules to local circumstances. However, more specific expectations may be added to this prescriptive demand, such as an analysis of the combination of two regulations (Nîmes-Métropole), or the definition of local criteria of water rights (Kat Aware).

While the approach effectively enables users to better understand the rules, it also allows decision-makers to better understand users and their constraints. Decision-makers mention their own individual learning when directly confronted by users. Communication

flows, therefore, are not as one directional as initially imagined. In contrast, as shown in the Ter'aguas case study, the deployment of a tool enabling discussion of a regulation's application in the regulators' arena without the participation of users does not allow this type of learning. Furthermore, the regulators' effective consideration of this knowledge appears limited. A return in the form of institutional learning thus assumes the implementation of a multi-level strategy effectively integrating the regulator level as an organization. Yet this rarely is the case: representatives often are presented as individuals without a real mandate from their institutions. Some only participate as observers while many reveal themselves to be sceptical of participatory approaches.

The analysis of these case studies thus revealed a set of specific issues that represent new scientific challenges allowing a better evaluation of the pertinence of the companion modelling approach in the particular context of changing scales or multiple levels of organization.

Suggestions for advancing further

The analysis of the challenges posed by multiple levels and of the difficulties and outcomes of different strategies put forward in the case studies lead to the identification of a certain number of methodological questions. Some questions aim simply to clarify the presuppositions held by the designers of the approach while others are research questions. The latter focus on three ways of taking multiple scales into account in a ComMod process: through the association of stakeholders from different levels in the definition of the issue and the design of tools; through the integration of multiple scale representations into the tools; through the mobilization of these tools and their outcomes with stakeholders from different organizational levels (Figure 10.2). Some of these questions are specific to the application of the ComMod approach to multiple levels of organization while others are raised systematically but take on a special connotation due to the multi-level context.

Identification and formulation of questions

The identification and formulation of questions are closely tied to the scales involved, notably through the different consultation arenas chosen to mobilize and which can call upon different levels and even dimensions, and the choice of participants.

Participation and formulation of questions

The management of natural resources raises questions that multiply depending on the scale, level and arenas of governance. The way these questions are defined at different levels, therefore, must be taken into account. It also is useful to verify whether the hypotheses regarding a system's operations and the perceptions of different stakeholders are modified by the scales of work mobilized as priorities and the divisions made. The initial formulation of the project effectively may pre-define a privileged discussion arena, the associated scale, and the dominant cognitive domain due to the complexity of the issue. However, the participating parties (whether within the arena or in relation to the question as formulated) may not be affected by the issue at the same territorial or organizational level. The approach must analyse and take into account the manner by which

these different participants identify the question, which may lead to a modification of the discussion arena (Chapter 4).

When addressing a question, each participant, including practitioners and research scientists, also holds his own representation of which scales are pertinent and of how they are structured. The dominant cognitive model of the intervention and the choice of participants can help reinforce a conception of the structure of scales (e.g. political-administrative), or indeed certain organizational levels and thus, certain actors. Yet the approach's choice of scales and divisions, which probably will result in compromise and/or competition between participants, may also be a mechanism of exclusion. Thus the process might influence power struggles around scales: it might thus contribute either to the reinforcement or legitimization of a level or arena, or to a better understanding of other levels based on the confrontation of stakeholders' points of view.

Choice of participants and transparency

One of the principles of companion modelling is transparency for all participants. In a 'multi-level' approach that is undertaken in a parallel or sequential manner, the objectives of the links and interactions between the levels that the approach seeks to develop to address a given environmental problem must be explicit.

Some stakeholders may not wish to interact with other levels due to power relations (Chapter 5). Other stakeholders who are to be associated when there is a change in scales or levels may choose to simply 'participate as an observer' in the simulation stages. Yet the experiments analysed show that this type of participation rarely produces encouraging results. Consequently, one should consider how to mobilize best the representatives of these multiple levels around their centres of interest and ensure that each one's involvement in the process is real depending on the progress of dialogue. Two aspects must be taken into account: (i) the specific activities enabling the mobilization of institutions and actors involved that are not necessarily linked to participatory modelling or simulation activities; (ii) tools that can address the ongoing changes introduced by the integration of new actors and levels.

Multiple representations and their set of tools

The question of multiple representations is not specific to changing scales but is amplified by the multiplication of levels and dimensions to be taken into account and their articulation within the same representation or within a set of coordinated representations. This complexity of representations and their formalization in a multi-level context poses strategic questions regarding modelling choices. We distinguish three issues: (i) the development and use of 'generic' representation; (ii) the choice of an integrated tool versus the choice of several tools; (iii) the choice of formalisms in the tools.

Multiplicity of knowledge and move towards abstraction

Scientific knowledge leans towards the generic or that which is applicable to diverse contexts. A move towards abstraction is expected to provide an opportunity to derive tools that can be used in different contexts and at different levels. This kind of questioning, mentioned in Chapter 3, may be applied in particular to the out-scaling process. The first question raised when generic representations are discussed regards what is meant by generic. Is it 'inclusive' representations, allowing all variants of a process to

be represented regardless of the context, or ‘exclusive’, where only invariants of these processes are represented (whether through intersection or abstraction)? This initial question greatly affects how corresponding tools are built and the added scientific value that may result. It would seem that the first option is richer, allowing a complete representation of a system even if all possible variants are not represented. Yet the use of these generic tools on specific cases raises numerous practical questions, for example, regarding what methodology should be followed, and ethical questions, notably regarding their capacity to allow specific representations to emerge.

Between a toolkit and an integrated tool

Faced with the diversity of partners and the specificity of issues at each decision-making level, two extreme strategies are possible: a single tool integrating all of the representations or one tool per issue and per audience.

The integrated tool option poses a double design challenge: to integrate several levels, dimensions and resolutions, making clear the links between these three aspects of the question, and integrate rationales or heterogeneous cognitive systems. This tool must effectively be capable of representing the key specificities of each participating party’s point of view while also being understandable and meaningful to all participants. This strategy has the advantage, however, of gathering all representations into a single coherent frame. This was the option taken in the Domino case study in La Réunion.

The toolkit option was used explicitly at multiple decision levels in two study cases, one in Senegal (Domino), the second in Vietnam (Castella *et al.*, 2007). In the two cases, the reason given was the need for tools adapted to different audiences and different facets of the same problem. The disadvantage lies in the coherence of these different tools, particularly when they do not derive from the same domain model (Chapter 3). It is perfectly possible to combine the two strategies according to the context and evolution of demand.

Multiple formalisms and multi-formalism

Formal tools of expression, often very different, are associated with various scales and particularly dimensions. Among these formalisms are ontologies and more generally formalisms of knowledge representations (e.g. conceptual graphs) produced by artificial intelligence, spatialized and non-spatialized information systems, differential equations and computer models (e.g. UML, cellular automata, MAS). Consequently, the question of integrating knowledge (integrated tool) or of establishing coherence in multiple forms of knowledge (toolkit) technically is defined as a problem of articulation of the different formalisms used. We then find ourselves confronted with either choosing a unique pivot formalism in which knowledge from different scales must be expressed, or to work on multi-formalism platforms while ensuring bridges between discourses. This question, in addition to the one posed in the preceding section, is raised in all ComMod experiments but is even more delicate when the group of participants is very diverse.

Learning in the approach and transmission of outcomes

Finally, a multi-level companion modelling process raises questions that specifically concern the learning permitted by the approach and the transmission of outcomes in arenas and multiple organizational levels.

Social learning

Knowledge acquired through a companion approach consists less of stable, transferable learning than an ephemeral product of interactions between the various stakeholders involved. Consequently, this knowledge is only mobilized by participants during the process, which by definition represents only a limited number of people in relation to the population concerned. Some of these participants may be charged with representing their institution. The question, therefore, is raised regarding how this knowledge can be integrated into these institutions, or, in other words, its institutionalization. Here we find methodological questions concerning the dissemination of the approach among a large number of participants and the integration into the approach of participants from levels other than the ones initially mobilized.

In addition, one might ask how choices of scale affect learning processes. Certain ComMod tools integrate several spatial, jurisdictional and temporal scales. To what extent can participants take into account the sum of this complexity? How do the choices of scales in the representations mobilized limit social learning processes? Lastly, how do these choices affect power relations?

Transmission of outcomes between levels and at the conclusion of a project

Whether the transfer concerned the tools or their outcomes, numerous case studies chose to use, or were led to mobilize with a given audience, tools that were built with other audiences. This was the case particularly when the tool served as a mediator between different groups. Regardless of whether the tools themselves are modified or whether their outcomes alone are used, this procedure raises numerous questions. What information is transferred? How can one enable the new audience to appropriate the tool's underlying hypotheses, regardless of the stage of its development? How can the first set of partners be assured that their choices and representations will not be misunderstood when transmitted? More prosaically, how can they be convinced to accept this transmission? The latter question raises the issue of objectives (e.g. information, validation, appropriation, etc.) and the legitimacy of those involved. It is important to keep in mind that these information transfers do not play a neutral role in power relations between organizational levels and participants.

Lastly, there is the question of the restitution of the approach's outcomes. This question already is delicate in a simple ComMod approach but becomes more complicated in a multi-level approach. How can one take into account the inter-level sharing of representations, debates, decisions and lastly, social learning which may include institutional reorganization?

Conclusion

The results presented in this chapter show diverse methodological approaches that display few invariants, the development of the theme having barely begun. The true multi-level organization may be thought of as an internal process, natural to a society that uses different, stacked official regulatory levels to insert the results of internal, backstage consultations. On the one hand, one also may hypothesize that the way consultations are organized within these official arenas can influence and gradually modify the society's actual internal consultation modes, for example, by favouring a gradual change in the

weight of various challenges, values, groups, etc. One returns here to the challenge of a certain form of participation that seeks to insert gradually into the society a greater number of 'regulatory and counterweight operations in response to power struggles' (Viard, 1994).

In a companion modelling approach, all *ex ante* structuring into levels must be assumed. If we return to the fact that the difference in our problem between our 'uni-level' and 'multi-level' interventions lies in the larger disparity of frames of reference (e.g. issue, appropriate procedures, values evoked, etc.), this fundamental difference might better be expressed by the term 'multi-institutional'. An institution is defined as a set of actions or organized practices that are stable and recognized by all, in other words, a field of convergent and legitimate social relations defined by rules, codes of conduct and behavioural norms, but also by the way these conventions are applied (Ostrom, 1990; Putnam, 1993; Weber and Reverêt, 1993; Clarke, 1995).

Faced with the consideration of several scales, the ComMod stance may be interpreted as a mediator between levels and dimensions. By facilitating an understanding and expression of issues at several levels, the approach promotes exchanges between levels, and thus could be viewed as feeding a mediatory organization. The latter contributes to, and is influenced by, the 'politics of scale' (such as defined by Lebel *et al.*, 2006), and more generally by interactions between levels of organization. This is made possible thanks to two main resources: multi-level participatory strategies during co-construction and the use of representations, and the integration of multiple scales in the tools (Figure 10.2).