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Chapter 7 - Geoprospective: looking for potential scenarios

Thomas Houet

Introduction

The future is by definition uncertain. While this can frighten, make one sceptical or guessing, another attitude can be anticipation which will result in defining various adaptation strategies. For example, when buying a property, everyone has information about the risks (floods, landslides, technological risks) linked to the property's location. The absence of anticipation consists of not considering a risk of flooding for example. A first strategy would be to accept the risk and adjust the way of living (upstairs only) or the architecture of the property (on stilts). The second strategy would be to refuse this location and look for another property outside a flood zone defined in a Flood Risk Prevention Plan (PPRI¹). The last strategy could be to go beyond the geographical perimeter of the current regulation (look for an even more remote area, another locality or region) on the assumption that the current regulation defining PPRI is insufficient with regard to climate change.

While this example illustrates an individual choice, societal demand has evolved and the democratization of the concept of sustainable development since the 1970s (Meadows 1972) has made it possible to integrate this anticipation into current land-use planning tools (*Schéma d'Aménagement et de Gestion de l'Eau - SAGE*, *Schéma de Cohérence Territoriaux - ScoT*, etc.) because of their long-term scope.

Anticipation through complex thinking (Morin 1990), based on the principle of a future made up of several possible futures (or "futuribles" according to de Jouvenel (1964)) has thus contributed to the emergence and generalization of *la Prospective*. *La Prospective* can be defined as an approach (Godet 1977; Godet 1986) or a posture (Berger 1958), including foresights studies, which "consists of gathering elements of appreciation, whether or not quantified, concerning the future, the aim of which is to make it possible to make decisions which will enable the said future to be more in line with our preferences than if there had not been this prospective insight" (Hatem *et al.* 1993). While this definition refers to a baseline (successfully conforming to something), the plurality of possible futures gives it an eminently polysemic character.

And then, geography got involved... both through this book, for example, which questions the baseline notion, and through approaches and methods designed to take into account the spatial dimension in the construction of these visions of the future. Territorial foresight (Delamarre 2002; Loinger 2004), geoprospective (Voiron 2006; Gourmelon *et al.* 2012; Emsellem *et al.* 2012), and prospective modeling (Houet 2006; Houet *et al.* 2011) are all concepts and methods that have contributed to refining, or even transposing, this baseline notion in geography or ecology (Albert *et al.* 2020), but also to multiplying it.

This chapter attempts to shed some light, probably non-exhaustive, on the various meanings that the notion of a baseline can have in geoprospective. While the particle "geo" is the prerogative of geographers, it has no other ambition than to be able to integrate the spatial dimension in all its complexity in prospective. Indeed, while the multidisciplinary character is intrinsic to prospective, i.e. taking into account social, economic, historical, cultural, demographic, political dimensions, etc., the geographical dimension was only used until the 2000s as a

¹ In France these are called PPRI, the acronym for *Plan de Prévention du Risque Inondation*.

cartographic medium to represent future scenarios. Geoprospective is distinguished by the integration of spatial processes resulting from nature-society interactions (neighborhood, inertia, multi-scalar relationships) to refine the location of future land use and/or landscape changes. Even if spatial simulation models are used to produce scenarios, a common approach used to explore a wide variety of possible futures consists of implementing, in a first step, participatory methods intended for the construction of narratives and which will, in a second step, feed spatial simulation models intended to produce cartographic representations of them (Houet *et al.* 2016a; Houet *et al.* 2017). As the spatial dimension can be integrated at all stages of scenario construction (Houet *et al.* 2010), this chapter aims to illustrate, through examples, the declensions of the notion of a baseline in geoprospective.

The construction of prospective scenarios is based on three stages (Godet 1986): (1) the phase of construction for the knowledge base necessary and shared for the construction of scenarios (Poux 2003), (2) the scenarios themselves made up of narratives and images of the future, and (3) the action phase during which quantified elements of appreciation are provided in order to be able to make decisions, define a strategy. Four meanings of the notion of a baseline can be defined in geoprospective:

The first occurs during the construction phase of the knowledge base, which must be shared by all the people participating in the prospective exercise. Thus, even if the points of view and objectives diverge, the knowledge base constitutes a common baseline.

The second meaning concerns the scenario construction phase. It refers to the notion of validation, in particular of the methods used for their construction, in order to provide supporting elements intended to reinforce the confidence that the actors will ultimately have in these scenarios.

The last two are part of the action phase: they can be used to evaluate, in an exploratory way, the impacts of these scenarios in relation to the initial situation (the current one), but also to define an objective to be reached in order to define the actions to be implemented.

7.1. The baseline, as a shared and objective knowledge base

The definition of a shared knowledge base refers intrinsically to the first part of this book, "Defining baselines". In prospective, it is a matter of defining the current state, past dynamics, systemic functioning (driving and dependent variables and their causal relationships), projects and seeds of change in the system being studied. As soon as this system is assimilated to a territory, the spatial dimension can be integrated via multiple geographic methods: remote sensing, geostatistics, participatory methods (social surveys, participatory mapping, for example), modeling of complex systems...

Hatem (1993), Piveteau (1995) and Poux (2003) have identified one of the main limitations of a prospective exercise: the tyranny of received ideas. Very often, participants have fixed ideas about certain landscape evolutions and their explanatory factors, the result of their personal experiences and perceptions. For example, while the closure of mountain agropastoral landscapes is well known, the areas concerned and the rates of progression of encroachment and reforestation may be largely underestimated (Houet *et al.* 2012). Indeed, between 1990 and 2006, the Corine Land Cover database detected almost no change in land uses in the Pyrenees, whereas, using higher spatial and temporal resolution remote sensing data, clear changes were visible between the eastern and western Pyrenees. Similarly, using aerial photographs, it was shown that the Vicdessos valley has been experiencing since the 2000s a process of encroachment and afforestation as rapid as the slopes or valley bottoms during their peak rate after World War II (in the order of 50 to 60 ha / year) (Fig. 1).

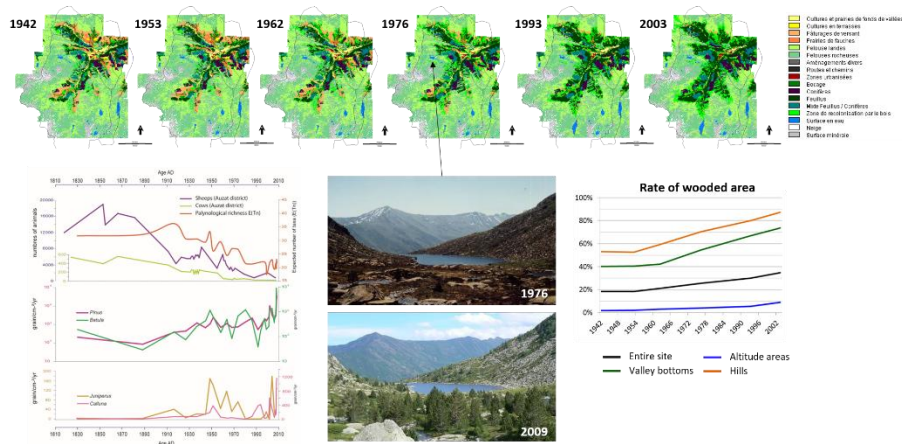


Figure 7.1. Illustration of the contribution of multidisciplinary approaches to establishing an objective and shared knowledge base using perceptual elements (landscape photographs) and figures (maps and graphs). The example is that of the Haut-Videssos valley (and the Bassiès valley) and the closure of the landscape (from Galop *et al.* 2011 and Houet *et al.* 2012)

These received ideas may also have a time frame that does not match the time horizon of the prospective exercise. This may cause bias in the perception of certain practices. For example, slash-and-burn is now considered a cultural practice, part of the pastoral heritage of the Pyrenees, and should be given special attention in the future. Galop *et al.* (2011) were able to demonstrate, using palynological data, that the appearance of mountain fires is posterior to the dynamics of grazing in the Videssos valley. In the 1930s and 1950s, slash-and-burn appeared to be an adaptive practice to fight against encroachment following the decline in pastoral activity that began at the end of the 19th century. This knowledge makes it possible to envisage the non-maintenance of these practices in certain scenarios, since they have not always existed. Similarly, the oral knowledge shared during participatory meetings on the former uses (pastoral pressure) of these summer pastures, also made it possible to consider scenarios of abandoning certain summer pastures to increase pastoral pressure on others (Houet *et al.* 2017) (Fig. 1). While the divergence of viewpoints is essential to consider highly contrasting scenarios (to fight or not to fight against land abandonment), it must reflect the stakes for the local actors involved and not be dismissed by the tyranny of received ideas. Thus, this knowledge base necessary for the construction of scenarios constitutes a tangible and shared baseline.

7.2. The baseline, a way to improve confidence in scenarios

The knowledge provided by scenarios must be used with confidence by local actors to establish their action plan. Although prospective does not aim to predict, it is the plurality of possible futures that will make it possible to define management and land-use strategies that are less bad than if there had not been this insight into the future. But then, how can scenarios be verified and validated, since the future cannot be validated on the one hand, and since the paradigm of foresight is opposed to that of prediction? This dilemma is particularly marked when modeling tools are used to simulate prospective scenarios.

This confidence is therefore focused on demonstrating that the methods and tools mobilized are working "as they should" or as predicted by the scenarios (as a set of parameters) and not on validating the results as such. In order to validate a prospective exercise, Piveteau (1995) proposes to check whether four principles are verified: relevance, transparency, plausibility and coherence.

Transposed to geopropective, they question the use of (spatial) models in prospective (Houet, 2015) whether they are cellular automata, multi-agent systems or other modeling platforms. These tools are more and more commonly used to simulate scenarios of land use and land cover changes. "Validation" is becoming more complicated and can no longer be summarized in a single performance indicator (Fig. 2)

- The relevance is to justify the choice of a model by an analysis of the literature and/or a comparative study of existing models. The aim is to demonstrate its ability to simulate landscape changes that make sense for the territory or the issues studied (e.g. crop rotations, urban sprawl, etc.) in terms of both their spatial representation and their temporal dynamics, and even the underlying decision-making processes.

- Respect for the principle of transparency is demonstrated by the ability of the user to understand and explain the functioning of the model used. The aim is to avoid the "black box" effect which, if presented in this way to local actors and other participants in the prospective exercise, can sow doubt, mistrust, or even constitute an excuse to reject all the results.

- Consistency must allow for demonstrating that the model is able to simulate processes or trajectories envisaged by the scenarios. Unit, integration or sensitivity tests can thus demonstrate that new spatio-temporal processes can be simulated, in coherence with other existing or new processes.

- Plausibility is part of a "classic" model validation logic, where the predictive power of the model is evaluated through specific indicators, used in isolation or combined (Paegelow *et al.* 2014). It is then a question of carrying out a simulation on a past period and comparing it with an observed situation.

Compliance with these four principles is fundamental because, while a model can perfectly meet the plausibility principle by simulating a past trajectory perfectly, its calibration and the parameters it uses can make it unsuitable for simulating scenarios that are at odds with past trends (Houet *et al.* 2016b). Moreover, let us also recall that the plausibility of simulations depends on the plausibility of scenarios, which must be checked beforehand. A model, once validated, can in any case plausibly simulate a completely inconsistent scenario.

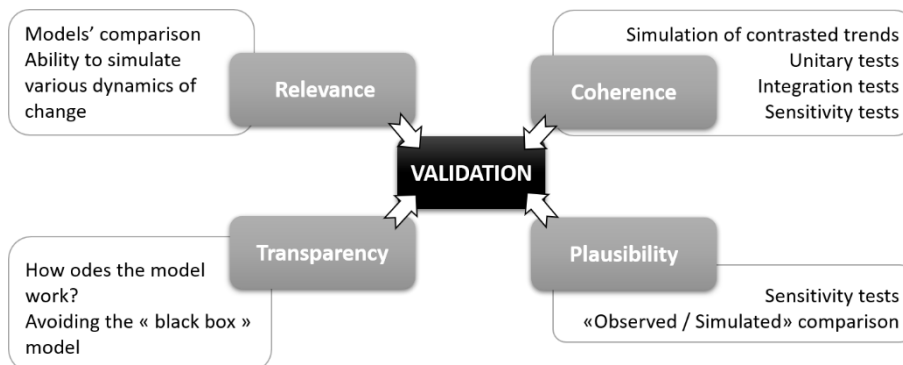


Figure 7.2: Illustration of the methods that can be used in modeling to respect the four principles of validation of a foresight approach.

7.3 The baseline for the exploratory evaluation

Prospective is intrinsically based on a plurality of possible futures. Knowledge about the future therefore comes from the multitude of situations, desired or not, and from their comparison. The analysis of future changes in land use and land cover patterns allows us to evaluate the impacts (positive or negative) on the environment or ecosystem services, for example. The comparison of future states is therefore made in relation to a baseline situation, often assimilated either to the current situation or to another scenario, called the baseline scenario.

A classical approach therefore amounts to comparing the future image resulting from a trend scenario (of the "what if nothing changes" type or integrating future elements whose occurrence is certain) or not with the image of the present situation. This allows, for instance, to quantitatively assess the evolution of landscape closure in the mountains (Vacquié *et al.* 2015; Houet *et al.* 2015) (examples in Figure 7.3). It is then possible to assess the impacts of these changes on hydrology (Sczycpta *et al.* 2015) or even on gravity risks (Bernardie *et al.* 2021). The advantage of using modeling tools for this assessment is that it is possible to distinguish between the part attributed to climate change on the one hand, and the part linked to anthropogenic activities (or lack of activities) causing a change in the landscape on the other.

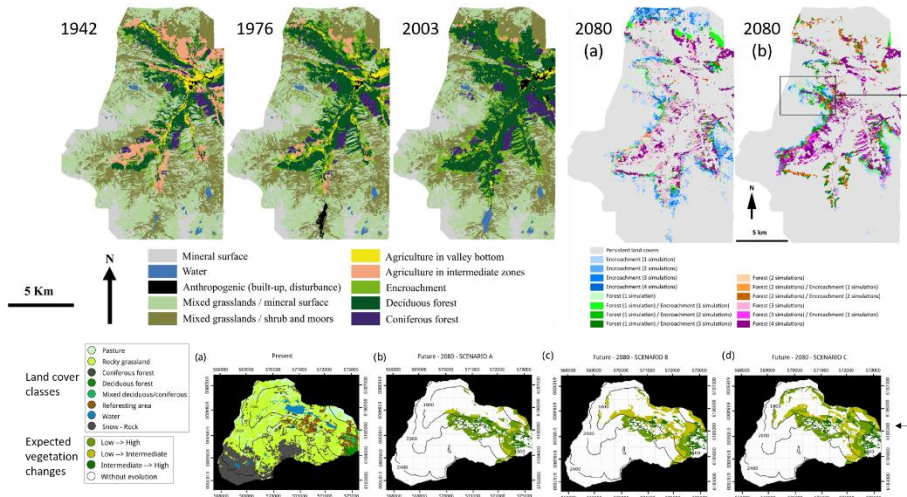


Figure 7.3. Examples of exploratory scenarios of environmental closure in the Upper Videssos Valley in 2080 (top) for two pasture management strategies: (a) maintaining low pastoral pressure everywhere and (b) abandoning the least favorable summer pastures) (from Houet *et al.* 2015) - and their variation at a finer scale for levels of (A) strong, (B) medium or (C) zero pastoral pressure in Bassiès (from Sczycpta *et al.* 2015).

Whatever the baseline considered, the present situation or a future situation, this approach is fundamentally exploratory aiming at evaluating what would happen / what would be gained if...

7.4. The baseline as an objective to be reached

As soon as the scenarios are normative, i.e., starting from a future to be achieved (or avoided), the future becomes an objective, a baseline to be achieved. Any deviation from the desired trajectory can then constitute a warning signal of the ineffectiveness of the policies at work. Nevertheless, we must also take into account the potential inertia of the socio-ecological system with respect to the effects of the measures at work, which may not be immediately perceptible. The latest IPCC scenarios fall rather into this category of scenarios: the description of the "Representative Concentration Pathways" (RCP) defines four trajectories of greenhouse gas emissions and concentrations resulting from a multitude of possible socio-economic and technological scenarios. However, regardless of macroeconomic, demographic or other assumptions, if the situation is close to a pessimistic trajectory (RCP 6.0 or 8.5), it will simply reflect the failure of regional, national or international policies.

This type of approach is very rare in geopropective because the backward construction of spatio-temporal landscape trajectories from a future goal to the present situation remains very challenging. Brunner *et al.* (2016) propose an original and efficient multi-agent system modeling approach for this type of approach. However,

while it clearly has the merit of existing, this type of modeling seeks a location that minimizes land use conflicts resulting in an often "direct" trajectory between two dates. This type of optimization or equilibrium search method makes it difficult to model a bifurcation of the socio-ecological system (trajectory from a neoliberal use model to an agroecological model, for example).

Sometimes, the interest lies not in the landscape trajectory, but in the retrospective identification of the means to be implemented to achieve this landscape, or the errors to be avoided (lack of interventionism). For example, the Rennes agglomeration has created the concept of "urban fields" in its *Schéma de Cohérence Territoriale* (Territorial Coherence Scheme). This zoning makes it possible to protect agricultural land, located in the immediate vicinity of Rennes and largely under pressure from urbanization, which has been made unbuildable in the Local Urban Plans of the municipalities concerned. The goal is to preserve the landscape qualities, the ecological environments of interest, and support development by structuring commuting and linking recreational areas. This would not have been possible without having first identified the objective of implementing a concrete green belt and pursuing development as an "Archipelago City".

Whether it constitutes a monitoring indicator in relation to a "desired trajectory", or a means of defining the regulations or actions to be implemented to achieve a territorial objective, the future in the normative sense thus constitutes a particularly useful baseline for present action.

Conclusion

The notion of a baseline in geopropective thus has a multitude of possible meanings, summarized in Figure 7.4 and taking up the three meanings defined in the introduction. Globally, we can distinguish between an "observed and shared" baseline (construction of the knowledge base), a baseline "made explicit" by modeling and finally a "desired" baseline linked to the future. Most of these notions refer to aspects of scientific, rigorous and objective methods. In this case, the baseline is not called into question, such as the idea of the presence of the bear mentioned by the author in the general introduction to this work. It is essentially a starting point, relative and subjective, of the order of the sensitive, but which, once compared to the various possibilities that the future represents, brings a new, objective and quantified light.

In fact, he mentions three reasons that may call into question the idea of seeing a bear. Firstly, that it may be implausible and should not be considered. In this example, implausibility is only a human concept, or even a manipulation or a simple oversight. The knowledge of history is thus fundamental to contradict this first reason, because it is the means to fight against the tyranny of the received ideas, mandatory to any prospective.

The second reason concerns the position between science and the sensitive. It is a state of affairs, I myself have long felt a bit schizophrenic: on the one hand, divided between the duty of preserving that a scientist must have when he leads and animates a participatory foresight exercise, where only the opinion and the desires of the participants must be taken into account to hope for a collective strategy (they would certainly not adhere to the opinion of a scholar foreign to their territory proclaiming to them what is good or bad); and on the other hand, that of the scientist activist having to incite a more sustainable development or to alert on the urgency of acting... Nevertheless, being aware of such a pathology allows us to take a step back, to avoid being the reason, as a scientist, for a possible failure of a prospective. It is clear that, on the part of the participants this time, this type of exercise has a kind of medicinal virtue: when we talk about the future, people who no longer talk to each other start to discuss again. Current tensions are, for the duration of a meeting, put aside for a while. The exploration of the future (carried out with rigor and method) desecrates positions of principle and divergence because the future intrinsically evokes a common good and a collective interest. This is what geopropective is all about: at the beginning, the opinions and points of view on the issue of a territory illustrate the divergences of the stakeholders; the scenarios allow for the emergence of ideas, of desirable or undesirable futures; finally, the

knowledge on the future allows a convergence of interests and even the definition of a consensual strategy for the development and management of the space.

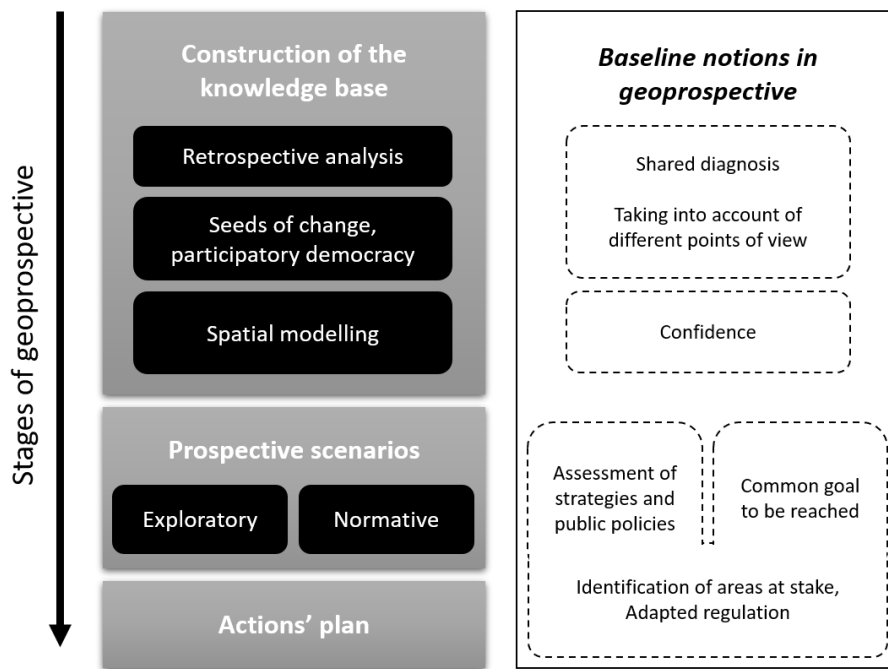


Figure 7.4. The different variations of the notion of baselines in geopropective according to the stages of construction of spatialized prospective scenarios

Finally, the third reason concerns the Anthropocene itself, where human action would already be too important and nature would no longer exist. Without getting into this philosophical or even ideological debate where Nature and Society are opposed by definition but both deserve a place on this Earth, would it not be simpler to consider this as one scenario among others? And if the challenge consisted of making a prospective of the Anthropocene? ... and then I realize. This has already been done by Meadows *et al* (1972). So what went wrong? Probably, the collective acculturation of this famous concept of sustainable development, the acceptance of the failure of a development model, the questioning of a carefree generation? Still, without this, the seeds of change would not have been sown. Today, the future generation is ready, but it is up to it to decide where it wants to go.