Cover up those differences, which I cannot endure to look on ? Making incommensurabilities explicit to discuss landscapes' sustainable management

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Cover up those differences, which I cannot endure to look on[1]? Making incommensurabilities explicit to discuss landscapes' sustainable management

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Abstract :

We analyze two research settings that formalize fundamental divergences among stakeholders about the sustainable management of landscape – one about quantitative water management, the other about agroecological pest control. Our point is that the elicitation and formalization process that took place in both cases fostered collective deliberation, by forcing participants to position their knowledge and values in regards with others. This way, the argumentative quality of the debate grew and we gained new insights on the problems tackled. Our experiences offer a counterpoint to convergence-seeking approaches, supporting that participatory processes should integrate representations in order to build a shared picture. Because this convergence view is at odd with the existence of incommensurabilities that characterize the plurality of people involved in landscape-scale issues, we emphasize the relevance of participatory methods that help focalizing the debate on problematic incommensurabilities, e.g. those that generate discord about the landscape changes to implement, so that they can be overcome.

Keywords : agroecological pest management, quantitative water management, social and technical incommensurabilities, participatory modelling and simulation, collective deliberation

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[1] To paraphraze Molière :

« Cachez ce sein que je ne saurais voir :

Par de pareils objets les âmes sont blessées » (Tartuffe, ou l'Imposteur, 1664, III, 2)

1. Intro

The landscape scale (e.g. watershed, community, agricultural production area) is fostering a growing interest for sustainable development programs. On one side, Agendas 21 symbolize a switch from the global to the community scale for sustainable development goals. On the other side, the focal scale to implement agroecological transition is moving away from the sole field to embrace the landscape. Although revealing contrasting processes (downscaling for Agenda 21; upscaling for agroecological transition), these two examples illustrate the appeal of environmental policy and science for the landscape.

One interest of the landscape scale is that environmental issues – pesticide use, biodiversity erosion, or low water flows – are more and more considered as "systemically" and "socially" complex. On the one hand, systemic complexity refers to the landscape as a complex system: many different entities and processes interact across time and space, leading to emerging functions fulfilling services to humans. Owing to this point of view, a sustainable landscape is one that maintains these multiple functions over time (e.g. de Groot 2006) and managing changes requires to understand social-ecological processes and interactions.

On the other hand, "social complexity" refers to the plurality of stakeholders that take part to or are affected by landscape changes and their relations. These stakeholders can have conflictive views, concurrent knowledge systems and use different languages of valuation (Martinez-Alier 2009). In ecological economics, we use the notion of incommensurability – the absence of a common metric to compare different options and preferences – to address this plurality. Munda (2004) distinguishes technical from social incommensurability. The former is linked to the coexistence of multiple descriptions of the same problem (depending for instance on dimensions or scales) while the latter refers to the multiple legitimate values that coexist in a society. In this respect, managing a "socially complex" landscape requires to account for such plurality of values and knowledge and art.

When scientists and decision-makers decide, for instance, to see pesticide use as a landscape-scale issue, they give to pesticide use a systemic dimension (and by this way they acknowledge that it is not merely a technical question of finding the right product at the right moment) and legitimate the existence of multiple views about how, why and to which extent reducing it. Once a problem is considered systemically and socially complex, participatory approaches become somehow obvious, when they are not yet a legal requirement. As far as scientific practices are concerned, participation is clearly promoted in integrated assessments (e.g. van Asselt et Rijkens-Klomp 2002) ; modelling of social-ecological systems (e.g. Bousquet et al. 2005; Voinov et al. 2016) ; sustainability appraisals (e.g. Garmendia et Stagl 2010), which often relate to landscape-scale issues. In these methods, participation aims either at getting a richer picture of the social-ecological system that is conceived or at clarifying the values and knowledge held by stakeholders.

This article will not question the legitimacy or benefits of public participation but instead turn to one common practice in participatory approaches, which is to look for converging diagnoses and representations. For example, the ARDI diagram (Actors, Resources, Dynamics, Interactions), a frequent first brick of participatory modelling (Etienne, Du Toit, et Pollard 2011), aims at having participants build a shared conceptual model that can be later computerized. Establishing a shared diagnosis from various discourses is also one of the task endorsed by "territorial engineering"

(Piveteau 2011), e.g. to elaborate Natural Park conventions or local plans for quantitative water management in France. To achieve a converging representation, those who facilitate the process (researchers, territorial engineering professionals) seek to rearrange the pieces of the puzzle that do not coincide through discussions and avoid the expression of "defensive routines" (Joldersma 1997). One widespread facilitation technique is to dedicate time to the expression of diverging ideas and views prior to the convergence stage aimed at building a shared representation.

This search for convergence is not neutral and relies on the implicit assumption that diverging discourses are a threat to a constructive dialogue; they should therefore be externalized, "resolved" or integrated in a shared model. This is however questionable. First of all, integrating or resolving divergences is inconsistent with the idea that they reflect incommensurabilities. In this case, "dialogue [could not be] one that combines many voices and reduces them to a single consensual view"(Frame et Brown 2008, 226). Another way out would therefore to favour "compatible" people, for instance being familiar with concertation exercises, which is once again debatable. First, more marginalized discourses can express by other means than the regular debate. Second, this selection risks to impoverish the knowledge derived from the participatory exercise. Third, there is no guarantee to achieve more than a vitrine consensus. For instance Mathevet et al. (2011) showed that members of a same discussion arena (the Water Board) tend to have a common general picture of the system under scrutiny and its stakeholders, but that some subtle differences (in this case about interactions among stakeholders and resources) can hide more profound value conflicts.

In this article, we try to move away from this search for convergence; our point is that formalizing incommensurabilities could favour collective deliberation and eventually collective action. Beyond experience sharing, the main question we intend to address is: How and to what extent the formalization of incommensurabilities creates conditions for managing landscapes' sustainability?

We draw our analysis from two contrasting case studies: one about agroecological pest management in orchards, the other about quantitative water management in a watershed experimenting recurring crises. Those case studies have in common: the landscape scale as the reference scale for tackling issues, the use of modelling and simulation, the construction and assessment of scenarios of change, and multiple interactions with stakeholders. Above all, both case study intend to elicit and formalize incommensurabilities, although through different media and for different purposes. After presenting the case studies, we will therefore focus on the way incommensurabilities were treated in each case and discuss how it enriched collective deliberation (*sensu* Dryzek et List 2003, see part 4) towards sustainable landscapes' management.

1. Presentation of case studies

2.1 First case study: agroecological pest management

In agriculture, pest damage can have dramatic economic impacts. In a country like France, many farmers tend to rely heavily on chemical spraying to ensure pest control and limit these negative impacts. However, pesticide-spraying leads to many externalities and many public programs try to reduce their use to limit them. One potential solution is to rely on biological pest control, where a biological entity is controlling a pest rather than a chemical compound. While farmers usually think pesticide use on a plot-by-plot basis, relying on biological entities may require to consider the landscape scale. Indeed, these biological entities' life cycles are complex and at a wider scale than just the plot. For example, hoverflies (predating on aphids) can overwinter as fertilized adult females in hedgerows while parasitizing aphids as larvae in crop field (Vialatte et al. 2007). In short, biological pest control agents do not respect farm boundaries. Therefore, neighboring famers may have to coordinate their action if they want to take advantage of such pest control solution (Salliou, Muradian, et Barnaud 2019).

We explored this agrocecological innovation in the southwest of France in an agricultural region specialized in fruit tree production. The majority of orchards in the area produce apples and the other major crop is maize, which regularly separates fruit farms from one another in the landscape. Apple production is a pesticide intensive crop due to high pest pressure and esthetical standards. We evaluated several scenarios on a Bayesian model constructed with local stakeholders about how could be enhanced biological pest control. First, with five different stakeholders (organic and conventional farmer, technical advisor, scientist and pedagogical farm manager), a conceptual model was built with the ARDI method (Etienne, Du Toit, et Pollard 2011). Then, a Bayesian hierarchy structure was deducted from it and agreed in a workshop. Finally, each stakeholder perspective was captured in an individual Bayesian Belief Networks (BBN), meaning that each stakeholder could parametrize the probabilities in the model according to its personal viewpoint. Each individual BBN was simulated with similar scenarios about biological pest control and compared (Salliou et al. 2019).

Exploring these scenario helped to understand why biological control at the landscape scale was not attractive to local stakeholders despite a promising potential from results in landscape ecology science. Behind the disagreement over the importance of the landscape to enhance pest control among stakeholders, all perspectives indicated that the effect of this pest control was generating very little production ecosystem service for apple producers. Establishing plot-based innovations, like growing spontaneous grass between apple tree lines, in order to stimulate biological control was considered more promising. This approach allows the establishment of priorities for research in agroecological pest control, in particular about the potential for collective versus individual action.

2.2 Second case study: quantitative water management

Many French watersheds, especially in the South-West, experience repeated crises – when river flows fall below environmental norms. Those crises have an ecological impact, sharper on the most little rivers because they are subject to flow interruptions, as well as an economic one, as the water restrictions that follow such crises disturb the activities depending on water. In the downstream Aveyron watershed – where our case study is located – these are for the most part irrigated productions (maize, fruits, maize seeds).

Crises are also a moment when criticism towards maize cropping crystallizes, as an activity that is water consuming, turned towards global markets, and often conducted in monocrops. Social tensions about water use distribution (among agriculture, domestic use, recreational activities, and the environment) and controversies about the agricultural model to pursue locally exacerbated since the violent death of an activist fighting against a dam project in the neighboring watershed.

The research that was implemented in this area aimed at evaluating contrasting scenarios supposed to make quantitative water management more sustainable. The perspective was "bottom-up" (based on the discourses of local people rather than on overarching frameworks for sustainability assessment), multicriteria (to consider the diversity of stakes linked to the water resource) and multiactor (to consider to diversity of people involved or affected).

We conducted card-sorting interviews and a meeting with a sample of local stakeholders in order to elaborate the multicriteria grid (examples of criteria were: adaptation to changes, biodiversity conservation, employment and local development, legibility of public action) and 4 scenarios of interest. The four scenarios were: implementing crop rotations instead of maize monocrops, reducing the irrigated area and restoring grasslands in upstream areas, mutualizing the water storage infrastructure, and using decision-support tools to optimize irrigation on field crops. Those scenarios were simulated and assessed in lab thanks to a multi-agent computer model (MAELIA, Gaudou et al. 2013). This integrated assessment stage helped understand the effects of the scenarios on water flows, water storage, water returns to the environment, field crop yields and production (Allain et al. 2018).

The simulation results then fed 7 evaluation workshops. The group participating to the workshop (people belonging to the same or related institutions) had to choose the indicators they judged most relevant to address each criterion of the multicriteria grid. Those indicators could come from computer simulations or be added on the spot. After choosing its indicator set, the group had to associate a qualitative judgment (improves / degrades / doesn't change the situation compared to the actual one; brings uncertain changes; cannot be assessed) to each combination scenario x indicator, then a weight to the indicator.

The different judgments were aggregated using the online Kerbabel Deliberation Support Tool (Chamaret, O'Connor, et Douguet 2009). We ended up with a multiactor multicriteria matrix featuring 3 axes (stakeholder groups, scenarios, criteria) with value judgments in each cell. We analyzed the matrix in lab and emphasized the weaknesses, strengths and controversies raised by each scenario. We presented the results to the stakeholders and discussed the most salient divergences among groups. We then asked them to make proposals (new scenarios) to overcome those divergences. The new scenarios suggested to implement innovative crop rotations instead of maize monocrops (but discarded the restoration of permanent grasslands) and to elaborate contractual requirements about agricultural practices for farmers who would use collective reservoirs.

2. Dealing with incommensurabilities (even when) using computer modelling

3.1 First case study: agroecological pest management

The case study on agroecological pest management addresses a problem – high pesticide use - that is not institutionalized and with no formalized demand for action other than general national objectives (the French "EcoPhyto" plan aiming at reducing farmers' pesticide use by 50% by 2025). One answer to this problem comes from landscape ecology: it suggests the increase of semi-natural habitats sheltering natural enemies and the complexification of the landscape mosaic. However, this suggestion has no echo in the practices and representations of the local fruit growers (Salliou et Barnaud 2017).

Considering this context, the research targeted at first technical incommensurabilities – i.e. diverging descriptions of the landscape system – in order to understand better the dissonance between landscape ecologists' recommendations and farmers' practices. Because the idea was to quantify differences in cause-effect relationships, a general structure needed to be agreed upon. This structure was the ARDI diagram and its Bayesian equivalent. The leeway given to stakeholders to express their own representation of the system rested in the parametrization of the Bayesian belief network. This allowed - at the extreme - to give a zero-probability to a link, and therefore express the absence of a causal relationship between two registered entities (although this eventuality did not occur).

The parametrization of the BBN was a heavy task (time consuming and not always intuitive). To facilitate this process, we used cards with images (Fig. 1) illustrating variables and their different states. Also we opted for questions about frequencies ("Considering A,B and C, in how many cases out of 100 would you observe D?") rather than probabilities, which are more difficult to handle. On the whole, the process lasted 3 hours per stakeholder in order to elicit the 266 probabilities of the whole network.

Fig 1 : Elicitating probabilities linking the different nodes of the Bayesian Belief Network (Photo : N. Salliou)

The construction of different models was key to observe diverging representations (by contrast with the second case study where the model has a more peripheral role). However, comparing parameters directly on a two-by-two basis was impossible given the number of parameters. To make this comparison legible, we went through the assessment of a "pest-suppressing scenario" (presence of sheltering hedgerows, no crop fields nor orchards in the neighborhood). Such scenario modified, through belief propagation, the probability distribution of the different variables and by consequence their final states. We focused on the effect on the "target node", i.e. apple production, which proved to be low in every case. This showed that although stakeholders disagreed on the intensity of the relationships between landscape complexity and insect abundance, they agreed on the relationship between landscape complexity and fruit production (low).

This result pointed out that the major divergence among stakeholders was on how to measure the interest of a complex landscape: either through ecosystem functions (sheltering and food provision for useful insects) or through ecosystem services (fruit production, hence revenue to farmers). This case shows that technical incommensurabilities and social ones are intricate, given that we could explain the different descriptions of the landscape system by different value systems (one that values ecological functioning vs one that values economic benefits).

3.2 Second case study: quantitative water management

The case study on water management takes place in a conflict-prone context. Institutionalized concertation settings had either aborted or reinforced power relations among stakeholders (Debril et Therond 2012). Dialogue was mostly limited to the crises moments, when a "drought cell", composed of State services, the agricultural advisory board, farmers' representatives and the local council, has to gather to decide on the level of water restrictions to apply. Owing to this context, the research setting addressed at first social incommensurabilities.

We elicited and formalized social incommensurabilities at two different moments. The first moment corresponds to the construction of the criteria grid, a bottom-up process based on the discourses of stakeholders. We conducted 16 interviews with the help of thematic cards in order to have interviewees select the ones most meaningful to them and develop discourses about what is a "good" water management. Discourses held by the interviewees showed different – and sometimes incompatible – views. One example was the relationship to hydrological variations (a thematic card selected with the highest frequency). For some interviewees, variations were a "natural given" that should be sustained in order to maintain the good functioning of rivers (e.g. "Hydrological regime is like a lung at the scale of rivers"). For others, water dynamics had to serve human activities and the access of people to water across space – a conception that supports the creation of reservoirs to adapt the water offer to the water demand. To reflect these divergences, different categories were created, then transformed into (incommensurable) evaluation criteria. Clarifying incommensurabilities allowed here to create an inclusive – although not consensual - evaluation structure. By this means, it provided legitimacy and legibility to opposing value systems. No stakeholder contested the criteria grid in the following stages of the research.

The second moment that contributed to elicitating and formalizing social incommensurabilities was the construction of the multiactor multicriteria matrix (fig. 2). In this matrix, judgment values were symbolized by colours and could be visualized at the level of indicators (less aggregated) or of criteria (most aggregated). Navigating within the matrix allowed observing differences across stakeholder groups. When, to a same scenario and a same criterion, stakeholders attribute different value judgments, we could infer that they reflected social incommensurabilities. These divergences could result from: different indicator sets, different weights, or different interpretations of the same indicator. On this last respect, one illustration is the concurrent use of maps showing cumulative water withdrawals at the scale of elementary river basins. Some stakeholder groups used it to build an argument on the hydrological benefits of concentrating the storing capacities (when the pressure is concentrated on a few basins and released on others) while others use it to exemplify the hydrological damages of water storage.

We decided to focus on the most salient controversies that appeared in the matrix and to surface their origin. Participants to the final restitution meeting were curious about confronting their value systems to the ones of other groups, but even more to discover the reasons why their evaluations differed. The investigation of incommensurabilities, at this stage, helped qualifying the different scenarios in terms of capacity to create consensus or disensus. It also offered a basis for discussing the ways to lever oppositions. Indeed, participants suggested new scenarios integrating the arguments of the others rather than discarded them.

In these process of formalizing social incommensurabilities, the MAELIA model had nearly no role. During the evaluation workshops that led to the elaboration of the multiactor multicriteria matrix, indicators coming from the simulation of scenarios (e.g. number of days under the minimal flow requirement) had the same status as indicators added *de novo* by participants and assessed by them (e.g. living soil). Both served as arguments sustaining a discourse on the desirability of water management scenarios. However, indicators coming from simulations showed more ability to generate a change of opinion within a group, given that simulations could provide counter-intuitive results. Also, the stakeholder groups (e.g. the technical institute for field crops) that relied more on computer-based indicators to formulate their value judgments were *de facto* more influenced by the model than the groups (e.g. environmentalists) that used preferentially their own indicators.

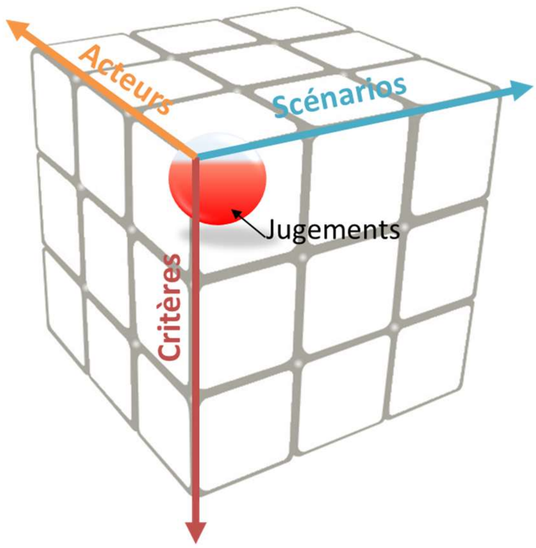

Fig. 2 principle of the multiactor multicriteria matrix : aggregated judgments are observed for each combination scenario x criteria x stakeholder group

3.3 Comparison / cross-analysis

	CASE STUDY 1: AGROECOLOGICAL PEST MANAGEMENT	CASE STUDY 2: QUANTITATIVE WATER MANAGEMENT
Design and implementation of the participatory modelling/simulation		
Scenarios tested	Different agricultural practices and landscape composition to enhance biological pest control	Contrasting agricultural changes aimed at making water management more sustainable
Characteristics of the model	Participatory Bayesian Network (BN). Co-design of BN structure (Directed Acyclic Graph (DAG) : nodes and causalities between them, states of nodes) Individual parametrization of the common BN structure (Conditional Probability Tables or CPTs) by diverse stakeholders.	-"Hard" model, based on expert knowledge -Multi-agent, spatialized and integrated. MAELIA represents at fine scale (field and days) the technical operations of farmers (among which irrigation) and their interactions with water flows and water management decisions, so to observe emerging watershed-scale effects -Already preexisting to the participatory research and calibrated for the case study area.
Use/Role of the model in the evaluation of scenarios	The model provides results in terms of changes in the probability laws for each node (and its states) as a result of a scenario. Results involves the change of "target nodes", which are nodes of direct interests to participants. Here, the main target node is related with apple production.	-The model as a simulation tool providing quantitative indicators at different scales and for different subsystems (hydrological, water management and agricultural ones). -Model-based indicators are on an equal footing with other indicators and feed the evaluation (qualitative) of scenarios by stakeholders.
Participating stakeholders (who, when)	Mainly five stakeholders (A scientist, an organic and a conventional apple farmer, a technician and the manager of the local agricultural high school)	-State services, farming advisors, local communities, environmental organizations, fishing representatives, dam managers…

		- to elaborate scenarios, define criteria of interest, evaluate scenarios, discuss the results of the evaluation, suggest new scenarios
Elicitation, formalization and communication of incommensurabilities		
Type of incommensurabilities adressed	Technical incommensurabilities among 5 stakeholders (at individual level).	Social incommensurabilities at first among 7 stakeholder groups (at group level). Technical incommensurabilities appear in the discussions about indicators but are not formalized.
Tools and methods to formalize and communicate incommensurabilities	Incommensurabilities take body through the individual parametrization of causalities between ecological, technical and social variables in the Bayesian Belief Network. Each stakeholder could individually indicate how he perceived the probability of events to happen in the network. As the process involved the elicitation of more than 200 conditional probabilities, we used cards with images representing the different combinations of variables to help this elicitation.	-Multiactor multicriteria evaluation. Incommensurabilities structure the criteria grid and the attribution of value judgments by stakeholders. -One can navigate in the matrix (3D) to observe where value judgments diverge and for which reasons i.e. investigate incommensurabilities that generate social conflict
Discussion stimulated by the discovery of incommensurabilities	There was not a real discovery of incommensurabilities. The main lesson is that incommensurabilities were not where we expected them. Stakeholders had diverse view on the role of the landscape on ecological functions but, quite surprisingly, not on ecosystem services derived from these ecological functions.	-About the levers that would allow overcoming crystalized oppositions -About the influence of the model (and its assumptions) on evaluation results

4. Contribution to collective deliberation

Owing to Dryzek and List (Dryzek et List 2003), collective deliberation fulfills multiple roles that allow overcoming social-choice problems :

- An informational role: confronting people with new information
- An argumentative role: clarifying controversies
- A reflective role: reviewing preferences
- A social role: interacting with others

We try here to show how and to which extent our two research works contributed to collective deliberation.

4.1. Informational role: confronting people with new information

Accounting for incommensurabilities supposed in both case studies to "enter" the reasoning of the different stakeholders. In the case of agroecological pest management, this reasoning was surfaced using Bayesian belief networks, which is one way to formalize how people conceive and quantify causal links between different entities (nodes). However, the confrontation between those different representations was not direct, through the comparison of each stakeholder's BBN, but using scenarios in order to exemplify the consequences of these different representations. The new information hence communicated was the impact of technical incommensurabilities on fruit production, which indeed proved to be low.

In the case of quantitative water management, the communication of incommensurabilities was more direct but occurred progressively. First, posters featuring the aggregated value judgments of the different groups allowed people to appreciate scenarios evaluation in terms of "general patterns" (which scenarios are the most/less appreciated; which ones create consensus/dissensus). Second, they could access to disaggregated information (the indicators used, the value judgments attributed to each indicator, the weights given) in order to capture the reasons underlying divergences between groups. Third, the elements that surprised participants were discussed in a plenary session, so that the people concerned could explain in more detail their arguments. Here the discovery of new information depended on the questions each participants were more eager to solve.

4.2. Argumentative role: clarifying controversies

According to Dryzek and List (2003), collective deliberation can draw people's attention to new arguments about the interdependence of issues, question their internal consistency, surface hidden assumptions and clarify the content of controversies (p9). In short, it pushes people to make their argument more robust. However, because landscape issues are considered socially complex, this argumentative role of collective deliberation is not aimed at distinguishing the right from the wrong or the legitimate from the illegitimate. It is rather turned towards reformulating arguments and knowledge in a more inclusive way (Brugnach et Ingram 2012).

This reformulation operates in both case studies through artefacts that force participants to structure their argument: conceptual diagrams and Bayesian belief networks in the first case study; a list of indicators having the status of arguments and their weights in the second one. An additional characteristic of the collective deliberation organized in both case studies was that it was "targeted" and not exhaustive. The discussion was turned towards incommensurabilities that generate conflicts of interpretations, and not those that result in similar value judgments. For agroecological pest management, the lesson was that incommensurabilities exist but do not lead to fundamental differences when looking at final outcomes (the production of apples) (Salliou et al. 2017). For quantitative water management, the lesson was that incommensurabilities are more or less manifest depending on the scenario that is evaluated; in some cases they generate locks-in while in other cases they create fragile consensus (Allain, Plumecocq, et Leenhardt 2018).

4.3. Reflective role: reviewing preferences

The reflective aspect was especially salient in the case about agroecological pest management. The assessment of scenarios according to the different mental models of the stakeholders showed relatively similar outcomes. Therefore, the ecological knowledge about the role of the landscape structure on natural predators became less central when looking at the effects on apple production. Indeed, when this knowledge is not isolated but inserted in a more complex web of causal relationships tending to explain what influences the production of fruits in quantity and quality, then its weight (not its credibility) diminishes. Therefore, one interest of the method was to lower down – even in the eyes of its promoters - the importance of more complex landscapes to produce apples.

In the case of water management, something similar occurred. In many political arenas, the technical language (hydrological, supported by numbers) is the one that predominates, which encourages environmentalists to adopt a discourse that emphasizes the negative consequences of reservoirs. Such discourse is quite easy to attack, because the hydrological consequences of water storage is poorly known (Carluer et al. 2016) and because the building of big reservoirs can also represent an opportunity to reduce the environmental pressure on other places and during summer. The research implemented unraveled the importance of agricultural and ethical issues in quantitative water management by comparison with hydrological ones. When this component surfaced from the discourse of the environmentalists, it helped displacing the axis of the debate from the effects of scenarios on hydrology to the question of the agricultural models (e.g. based on ecological processes or on substitution and optimization technologies) that a sustainability transition supposes. This understanding generated changes in the scenarios promoted: for instance, environmentalists did not defend a position "against reservoirs" but rather scenarios favoring ecological farming practices, a reduction of water consumption and the renaturing of degraded wetlands, even though reservoirs were parts of those secnarios in order to secure farming activities.

4.4. Social role: interacting with others

The social role of the collective deliberation was more obvious in the case of water management because the context was that of a locked dialogue, with crystallized power relations. On this respect, the research implemented proved successful through the simple possibility of a common restitution meeting. Furthermore, this restitution occurred in a peaceful atmosphere and participants expressed their satisfaction for having communicated "constructively" with others.

In the case of pest management, collective interactions were rich but limited to the construction of the ARDI diagram, e.g. a convergence stage prior to the formalization of inocmmensurabilities. Indeed, stakeholders expressed enthusiasm for the whole approach but also fatigue after the scenarios were assessed. There were only individual feedbacks but no collective discussion, which does not allow to say if formalizing incommensurabilities fostered social interactions.

5. Discussion – conclusion: it seems worthy to endure to look at differences

Our two case studies are examples when the formalization of incommensurabilities brings new insights about concrete landscape issues: it helped reconsidering plot-scale innovations in the first case; it generated "out of the box" proposals in the second one. Contrary to most divergence-convergence processes, this formalization did not seek some sort of collective catharsis, in which the sharpest disagreements are expressed on the first place in order to evacuate them and focalize afterwards on convergences. It was instead a key step to organize a collective deliberation and eventually collective action.

Our examples also show that using a model does not compel a converging process. The model can support the expression and confrontation of divergent representations, as in the case of Bayesian Belief Networks parametrized differently by stakeholders. It can also generate indicators that help stakeholders building or reviewing their discourses, as in the second case. These types of model uses provide a safeguard to framing bias. Indeed, one criticism towards the use of models in participatory settings is that they tend to promote a solution that is contained in the frame of the problem – a frame that is very much shaped by modelling constraints and expert knowledge (Elgert 2013).

When coming back to our core question – the extent to which the formalization of incommensurabilities can foster collective deliberation, our experience shows that the argumentative role is particularly enhanced. The methods and artefacts (scenarios, matrixes) that make divergences legible force participants to position their discourse comparatively to others. The consequence is that people work on their argumentation to increase its relevance rather than work on discarding the argument of the others. Both case studies for instance revealed that the interest of scientific or technical knowledge was relatively low to structure some aspects of the debate on pesticide use or quantitative water management. Moreover, as the line separating technical from social incommensurabilities proved porous, it examplified that "even" expert representations are value-ladden.

More importantly still, we showed that some legitimate argumentation lines escape scientific/ technical knowledge – they cannot be "integrated" or "translated" in such terms. This recognition seems key to organize an equilibrated confrontation of values and/or knowledge in plural arenas, especially when power relations are strong. This argumentative role can even be the substrate of social interactions (the social role of collective deliberation) in cases when the dialogue is broken. When the dialogue exists, having people elaborate a converging representation of the system or problem at stake permits to generate fruitful social interactions (Lardon et al. 2008; Gurung, Bousquet, et Trébuil 2006); so there is not necessarily an added-value on this respect of clarifying incommensurabilities. We could argue however that when people have the habit of working together and use a common grammar, surfacing tacit but structural disagreements can enrich the content of these social interactions.

To conclude then, eliciting and formalizing differences does not necessary mean opening Pandora's box and generating endless debate. On the contrary, this can help focalize and enrich discussions about the different options for change. This idea is in line with the view that landscapes' sustainable management is at first a social construct based on an inclusive public participation, rather than the local application of a normative imperative.

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