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Exploring the Role of Relational Practices in Water Governance Using a Game-Based Approach

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Abstract: The growing complexity and interdependence of water management processes requires the involvement of multiple stakeholders in water governance. Multi-party collaboration is increasingly vital at both the strategy development and implementation levels. Multi-party collaboration involves a process of joint decision-making among key stakeholders in a problem domain directed towards the future of that domain. However, the common goal is not present from the beginning; rather, the common goal emerges during the process of collaboration. Unfortunately, when the conflicting interests of different actors are at stake, the large majority of environmental multi-party efforts often do not reliably deliver sustainable improvements to policy and/or practice. One of the reasons for this, which has been long established by many case studies, is that social learning with a focus on relational practices is missing. The purpose of this paper is to present the design and initial results of a pilot study that utilized a game-based approach to explore the effects of relational practices on the effectiveness of water governance. This paper verifies the methods used by addressing the following question: are game mechanisms, protocols for facilitation and observation, the recording of decisions and results, and participant surveys adequate to reliably test hypotheses about behavioral decisions related to water governance? We used the "Lords of the Valley" (LOV) game, which focuses on the local-level management of a hypothetical river valley involving many stakeholders. We used an

observation protocol to collect data on the quality of relational practices and compared this data with the quantitative outcomes achieved by participants in the game. In this pilot study, we ran the game three times with different groups of participants, and here we provide the outcomes within the context of verifying and improving the methods.

Keywords: serious games; social simulation; social learning; relational practices; river basin management; water governance; multi-party collaboration; stakeholders; experimental social research

1. Introduction

Water governance involves many complex issues beyond the conventional scope of technical and environmental aspects. Water catchments can be characterized by connectedness, complexity, uncertainty, conflict, multiple stakeholders, and multiple perspectives [1]. Berg [2] identifies seven crucial elements that affect water governance: institutions, interests of stakeholders, information, incentives, ideas, ideals (i.e., priorities placed on objectives), and individuals (meaning leadership). In order to integrate all these aspects in water governance, traditional top-down and technocratic approaches must be replaced by new management paradigms [3]. By this account, collaborative or participatory and multi-scale or multi-level modes of governance have been widely recommended to reconcile environmental, economic, and societal goals in the water sector [4–7].

Crucial factors for successful collaborative governance include face-to-face dialogue, trust building, commitment, and development of a shared understanding [8]. Dialogue enhances stakeholder empowerment and network building, and fosters learning [9]. Previous studies have found that learning processes based on social relations are essential for sustainable water resources management [10–12] since they provide positive outcomes, providing an increased understanding of key issues, reframing, building trust, improving relations, developing new organizations, and producing substantive results [13]. These outcomes of social learning may be both technical (e.g., effectiveness, sustainability, and integration) and relational or normative, such as a sense of ownership of solutions by different stakeholders, active citizenship, inclusive governance, and self-governing capacities [14]. Social learning occurs in multi-party collaboration processes that take place in the actors' networks or in "communities of practice" [3]. Multi-party collaboration is an emerging work system of two or more legally independent parties formed to address a certain problem while still retaining their autonomy within the new entity, e.g., network.

Multi-party collaboration involves a process of joint decision-making among key stakeholders in a problem domain directed towards the future of that domain. However, the common goal is not apparent from the beginning but rather is created through a process of collaboration [14,15]. According to the relational theory of multi-party collaboration processes, organizing can be defined as the process of making new meaning from the given diverse inputs while building communities of practice, and relational practices constitute the core of the social learning process (Figure 1). Relational activities (we use term interchangeably with relational practices in this paper) include getting the attention of stakeholders, committing to collaborate, legitimating stakeholders, fostering dialogue, connecting stakes and interests, negotiating roles and identities, guaranteeing commitment of constituencies, and aligning efforts and agreements [14]. They are often neglected at the expense of the focus on technical problem-solving. All too often such neglect of relational practices turns out to be highly detrimental to the outcomes. Social learning for interdependence among the parties is regarded as a central aim of multi-party collaboration, of which the main goal is to acknowledge and accommodate interdependent interests through the process of continuous negotiations. Unfortunately, most multi-party projects do not reliably develop improvements in policy or practice [14]. This might be caused by stakeholder assumptions about intended outcomes. Quaghebeur et al. [16] document that the emerging participation may be very different from what the convening party originally intended or

what the financing institution expected. A greater challenge arises in regard to framing and reframing issues, e.g., when different actors, by definition, take different perspectives on issues. This is often the core problem in interdisciplinary projects related to natural resources [17]. Difficulties in creating co-ownership of the solution among all parties may occur even if the interactions among the parties are very intensive and well-guided [18].

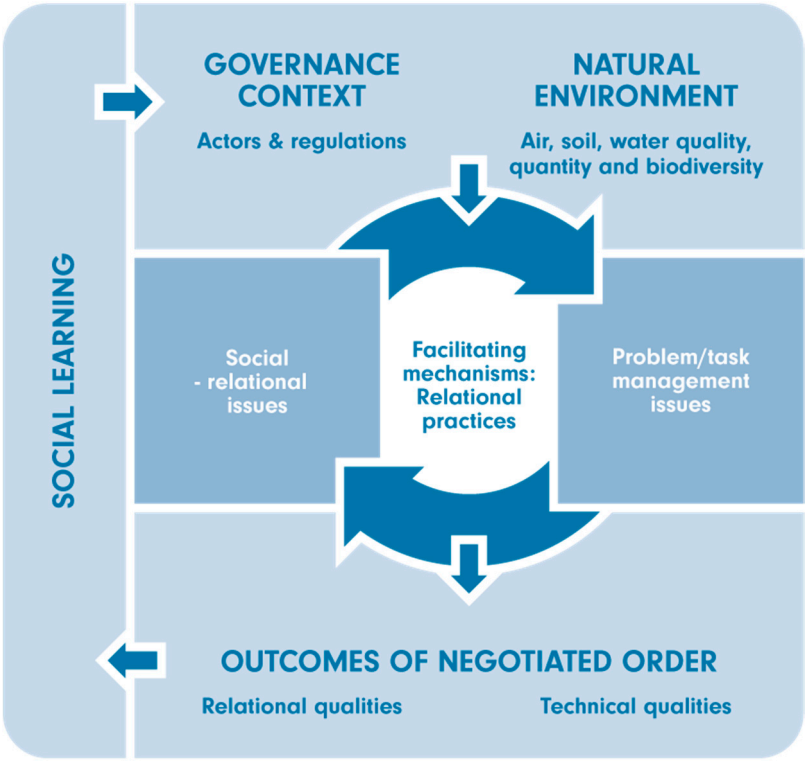

Figure 1. Social learning cycle through multi-party collaboration on natural resources [14] (p.149).

When conflicting interests of different actors are at stake in environmental projects, social learning that is centered on relational practices may prove to be crucial in overcoming these problems. Water management can serve as a perfect reflection of multi-party collaboration issues. Water itself might be perceived as a strong metaphor for the interconnectedness among many stakeholders since it connects geographical regions and diverse groups of providers and users, and as such symbolizes ecological and social interdependencies [14]. The purpose of this paper is to consider the abovementioned issues within the context of a multi-party collaboration experiment based on a serious game devoted to the challenges of water management in a river valley.

Environmental management games have long been used to support learning and to promote awareness of sustainability challenges [19] in a broad range of policy domains, such as climate change mitigation and adaptation [20,21], flood risk management [22–24], and land use and urban planning [25]. Environmental management games have been used both at different levels of education systems as well as in public policy to support social learning and encourage collective action [26–28]. Educational uses of serious games are further expanded into support for participatory policy analysis and strategic management [29,30], and it has been found that almost one-quarter of these games relate to water governance [31]. According to Mayer [32], the success of gaming for policymaking derives from the power of gaming to tackle both the technical-physical and the social-political complexities of policy problems.

Parallel to gaming applications in education and policy making, serious games have also been used to support experimental research. The application of laboratory experiments in the social and political sciences has continued to increase since the 1980s; however, there are still many objections

regarding the lack of realism and generalizability. However, Falk and Heckman [33] argue that many of these objections are misguided, and laboratory experiments provide the possibility to control variation, which is basic for empirical scientific knowledge. According to these authors, such experiments, including games, can be used to study behaviors and institutions under the conditions of strong control of decision environments (e.g., payoffs, information that parties possess, and rules of action). There is an established tradition of experiments in the field of experimental economics regarding policy-relevant issues, such as cooperation and public goods [34] or the importance of reciprocity and social approval [33,35]. Progress in experimental games has been achieved by evoking the essence of complex dilemmas in simple settings, though it leaves many questions about social processes in more realistic policy situations untouched.

Regarding complex policy questions, games seem to be a research method with potentially high external validity, especially when it is not possible (or very difficult) to test alternative policies in real-life situations. Games may be designed in a manner that is less artificial than laboratory experiments, and thus, they may more adequately depict real-life scenarios [36]. Empirical studies in the organization and policy sciences might have a form of "research with gaming" [30] or "gaming for pure research" [36], i.e., when games are used as an observation context to develop and test hypotheses on the policy-relevant behavior of individuals, groups, and organizations. The strongest advantage of games as quasi-experiments relates to the controlled variation that is crucial for causal knowledge [37]. Games provide the possibility of systematically manipulating variables in complex organizational environments and measuring the effects in systematic ways, including statistical methods, even in mostly qualitative projects [36]. The analysis of available experiments with games provided several conclusions on the advantages of "research with gaming" [30,36]:

- identical policy environments for experimental and control groups, though the stimuli for all groups can be structured in a controlled and desired way;
- the possibility of complete observation and reconstruction (by writing down all actions in observation protocols) of all decision-making processes, which is hard to achieve in real-life situations;
- opportunities to observe situations (raised by simulations) that are rare, hidden, risky, and socially unacceptable or in other ways that are difficult to access in reality.

Questionable correspondence between the experimental environment and reality can be checked among participants [30,36], who should include experienced policy makers (strongly recommended), not just students. This "member check" provides a serious opportunity to assess the psychological and procedural validity of the game. However, there will always be difficult-to-avoid trade-offs between the control of experimental conditions and the real-life resemblance of experimental environments. Furthermore, a trade-off exists between representing real-life experiences and playability since participants often undertake certain actions within a game in order to "have fun" that they would not initiate in the real world. Next, an issue that always arises with social research is the effect of the observer's presence on participants' behavior. However, the same problem occurs in interviews, so this problem is not exclusive to gaming research.

The LOV game has been used repeatedly as an educational serious environmental management game. Because it is based on a real-world situation in the Tisza River Valley of Hungary [38], it also has the potential to serve as an experimental environment for research in the field of water governance [22]. With a more complex representation than experimental economic games, LOV allows researchers to examine the social interactions that emerge from the role-playing situation linked with causal mechanisms from the environment. The main outcome from this paper is the verification of the methods used by addressing the following question: are game mechanisms, protocols for facilitation and observation, the recording of decisions and results, and participant surveys adequate to reliably test hypotheses about behavioral decisions related to water governance?

2. Materials and Methods

We developed the LOV game as a tool to support a multi-party collaboration quasi-experiment. The original version of the game was created as a part of the NeWater project [39]. The goal was to create a simulation, based on interviews with stakeholders and experts, which enables participants to explore alternative river management regimes and introduces the concept of river-landscape connectivity. After the finalization of the project, the game was further developed in cooperation with the University of Leuven (Belgium) to expand on the existing biophysical model by introducing new roles for the participants, thus exploring social aspects of floodplain management. The goal was to represent the problems connected with engaging multiple stakeholders and thereby emphasize the importance of relational activities. This development created the social simulation that is currently used regularly in the context of educating about river basin management and social aspects of creating multi-lateral agreements. Furthermore, it has been implemented as a supplementary tool in real-world processes to engage participants and give them an opportunity to explore the problem, similar to the real one, in a safe, simulated environment (for example, sessions with Dutch Water Sector Intelligence [40]. The current version of the game is available to be played online using tablets and computers for all operations and calculations [41].

The biophysical model in the game refers to a short river reach. It is limited and does not include any details on water quality, aquatic ecology, or groundwater. Since the game focuses on a small community in a river valley, upstream–downstream relationships are not included. The game is not intended to recreate biophysical complexity—rather its goal to represent a minimalistic representation with only basic feedbacks. Even such a minimalistic representation is hard to handle for participants. The main purpose of our quasi-experimental approach is to study the social complexity of water governance systems. Many experimental studies follow an experimental economics approach that limits game features to bare essentials. Adding game features has to be done carefully in order to match the cognitive limits of participants within the assigned time (which is rarely longer than a 1-day workshop). Hence, the scope of our biophysical model must have been limited. At the other end of the game complexity spectrum, role-playing simulations are rarely assessed with quantitative methods. The contribution of this study lies in bringing more structure to qualitative studies of social behavior relevant to water governance.

We applied a "research with gaming" approach in order to examine the impact of relational activities on the outputs in the game setting. It is not the goal of this experiment to reproduce real life social learning, although the game itself might be used as a support for multi-stakeholder processes (we provide some comments on such a use of this game in the discussion section). In other words, we use the game for empirical research on complex systems in a laboratory situation.

Using the LOV game as an observational context [30], we have designed structured observation protocols and used the record of game results to measure the impact of relational activities on the game's outputs. Relational activities such as leadership, sharing information, stereotyping, and ground rules were selected for this study from the longer list based on research and training experience [42].

In this article, we report our initial results from three case studies. While it is obvious that these results are not statistically significant, these results represent a pilot study of the research method that allows one to explore relational activities and social learning in a controlled environment. Therefore, the contribution of this article is methodological in nature, and there is no claim made regarding the validity of the results. Rather, we demonstrate how this type of research can be conducted; additionally, although the actual results in the three case studies support our hypothesis, we are aware that a larger sample is needed to develop valid conclusions. Despite the modesty of these assumptions, we believe the challenges inherent in the empirical research of complex social-ecological systems make this pilot study novel and relevant to both the use of serious games for empirical research the understanding of social processes in complex environments.

Our main research direction focuses on determining whether relational activities act as facilitating mechanisms that affect the game's two main outcomes: the players' economic status and the state

of the environment. Based on the existing research in the area of multi-party collaboration [14,15], we propose the following hypotheses:

1. Groups that allow/stimulate all members to share information, express their understanding of the problem, and build a shared reality are better able to cope with inherent system complexity; thus, they achieve better content outcomes.
2. Having a leader (leaders) that is (are) both process- and outcome-oriented facilitates the processes of defining the problem and agreeing upon solutions, which, therefore, leads to better content outcomes.
3. Stereotyping and/or lack of ground rules to facilitate interactions make conflict management more difficult; as a result, it lowers the chance of developing common solutions and negatively affects content outcomes.
4. The ability of the group to formulate and agree upon a common solution leads to better content outcomes.

We will attempt to verify these hypotheses in the subsequent research. In this article, based on the pilot study, we will verify if the methods that we use are appropriate for testing these hypotheses. In the LOV game, participants take the roles of inhabitants of a river valley threatened with droughts and floods. They are asked to identify with their roles; however, no decisions are imposed on them—they can make them freely. Some assume the roles of farmers, and their task is to manage the farms they own. They make decisions about the type of production on a particular plot. There is also the possibility to buy land, so they can expand their farms. Free plots belong to the Local Government, which determines the sale conditions and taxation levels of specific farmers. Money acquired in this way can be transferred in the form of subsidies to other players.

The Water Board main task is to build and maintain elements of the flood-protection infrastructure, e.g., dykes and the water steering system. Dykes protect the valley from flooding, while the water distribution system helps reduce flood losses or increases soil moisture in the valley during a drought. The farmers' financial performance depends on external factors, such as the precipitation, the water levels in the river, the associated soil humidity, and the performance of different types of production on the individual plots under different moisture regimes. Farmers can decide to set up crop cultivation (with options to use high-yield grain), animal husbandry, orchards, and fish ponds, or they can decide on the commercial use of pre-existing forests. Each production type is characterized by a different resilience to environmental conditions as well as by losses caused by floods or excess irrigation from the water steering system. Therefore, it is crucial to match each production type with the anticipated conditions on the board. These are, in turn, the result of both external factors, independent of the participants and the investments made by the Water Board. Additionally, all activities undertaken on plots by farmers as well as the extent of the water steering system affect the biodiversity in the valley. The intensification of production may damage the local ecosystem, which elevates crop sensitivity to pest attacks and may cause additional losses.

There are also two other important institutional roles in the game, i.e., the Bank and the Environmental Non-Governmental Organization (NGO). In the first case, as Banker, a player has the option of granting loans to other entities in the valley, but he must also ensure that they are recovered, including the interest charged. An environmental NGO has information on the impacts of particular methods and types of production on biodiversity. This knowledge, together with the possibility of making complaints about other players to the Central Government, which is represented by the Moderator, can help protect the valley's ecosystem.

The game presents two layers of complexity. One comes from the general complexity of the simulation model, i.e., multiple interactions between environmental variables that affect production within the valley and its economic condition. That, in turn, results in further investments that create feedbacks, which can affect the environmental conditions. The second layer of complexity comes from interactions among participants. Therefore, the process can be described as encompassing social

complexity. The economic dependencies between specific roles and the asymmetry of information mean that communication and cooperation between and among players are the key aspects of the game. Game facilitator applies the protocols of gameplay to impose restrictions on conversational possibilities between individual participants. These restrictions are introduced to represent real-life problems related to the dispersion of information. For example, representatives of more than three roles cannot talk with each other at the same time. This simulates real-life challenges connected with engaging other parties. As in real life, the only opportunity to assemble all inhabitants of the valley and reach a broad agreement is through a so-called "community meeting." Community meetings are convened twice throughout the entire game, and representatives of all roles can participate. The way they are carried and the topics discussed are regulated by the participants themselves. The overview of the game physical model is attached in Appendix A.

The game was played over 7 rounds with the total time between 4 and 5 h, followed by 1–2 h debriefing. It is a long and intensive game designed to allow players to immerse in its narrative and for the social relations to develop within the game world (Figures 2 and 3).

Figure 2. Social interactions in progress—Lords of the Valley (LOV) game workshop, Wrocław (photo Anna Zemlak).

During the game, participants have to deal not only with both layers of complexity but also with their own preconceptions and ideas about the effective management of the river valley. The underlying model simulating environmental conditions (flood, drought) tests these ideas in terms of feasibility and provides feedback about the consequences of their decisions. This process shows that some actions may have unforeseen long-term consequences that can affect the environment of the entire valley. Yet, for participants, the greatest challenge can be the social element within the simulation. Creating a common understanding of the situation, let alone some management agreements, can be difficult when all participants have their own perspectives on the problems being addressed, their own goals and personal values, as well as different levels of access to the in-game information. The setting, as well as the emphasis on the role-playing element of the game, enables each participant to observe how real-life communication problems emerge and how they affect the outcomes. The safe environment of social

simulation creates a "laboratory" where participants can not only learn about the challenges connected with multi-party collaboration but also test their ideas and potential solutions in a safe environment.

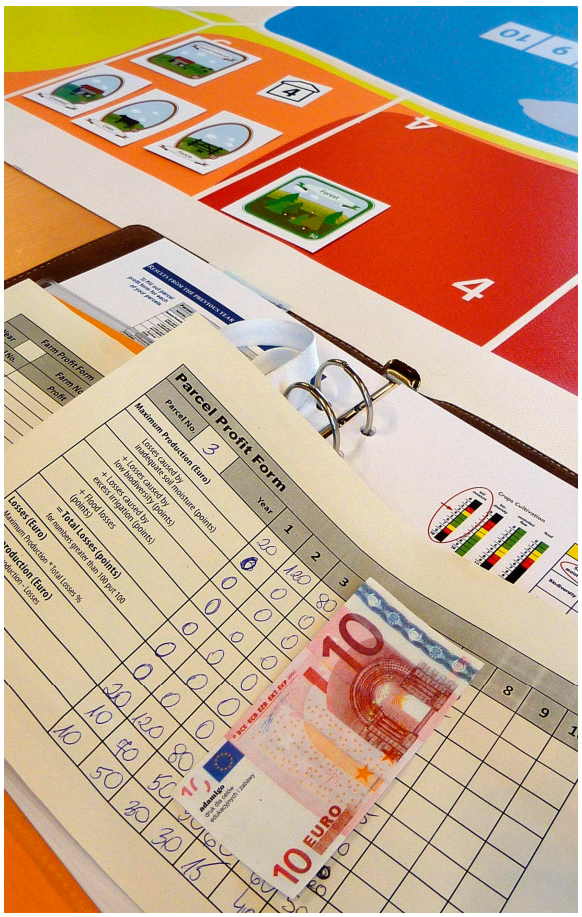

Figure 3. Financial performance in progress—LOV game workshop, Wroclaw (photo Anna Zemlak).

The game was played during workshops in three cities: Wrocław, Rzeszów, and Kraków. The number of players participating in these workshops varied from 15 to 25. Observations involved 11 observers trained in observation procedures (Appendix B), who were assigned to different roles; one observer was assigned to follow general interactions at the game board. The results of the observations include both quantitative and qualitative parts. However, due to the pilot study character of this research, the quantitative results are not statistically significant and are used here only for testing the methodology. There were two observation protocols applied: one for the rounds of the game and one for the community meetings (Appendixs C and D). They both contained multiple choice as well as open-ended questions regarding communication and interactions between teams, sharing information, leadership, conflicts, and overall group dynamics. Moreover, in the community meetings, where representatives of all groups could participate, the observation protocol questions referred to defining, understanding, and solving problems. Questions about exclusion (are some parties ignored by others?), a common understanding of the problem, establishing agreed solution, and ground rules are relevant only for community meetings. Results concerning internal dynamics come from participants' evaluation feedback, while the rest of the results come from observation protocols.

The questions in the observation protocol were related to specific categorizations (relevant for the stated hypotheses) that were in turn narrowed down into specific variables. Observations were recorded as data and transformed to indices (added) to measure variables that were later compared between the cases (cities) to verify our hypotheses.

For binary variables, observations were recorded as "yes" if that response was the majority, "no" if that response predominated, and "hard to say" (HTS) if the distribution between the two was roughly equal. In case of conflicts, answers indicate how many of the observers indicated "yes", e.g., 7 from 10. For the variables measured on ordinal scales, values presented in the table are the average of the scores.

In the case of stereotypes, the number indicates how many times they were noticed. Sharing information specific to a player's role was measured on a scale from—3 (*No, actors actively refuse to share information very much*) to 3 (*Yes, actors share information very much*) with no neutral value. Both competition and cooperation were measured on a scale from 3 (very much) to 1 (a little), and observers were able to estimate both scales in each round. Common understanding of the problem was measured on a scale from 0 (not at all) to 3 (very much). Establishing and agreed solution is measured on a scale from 1 (*Yes, and the solution is made explicit*) to 4 (*No, actors explicitly set individual solutions*). For all questions represented with ordinal scales, the values shown in the table are the average of the scores.

Additionally, over the course of the game, participants completed surveys (3 times during the game and before and after the game), intended to gather information on their subjective assessment of cooperation and competition levels (Appendix E). In order to understand the time dynamics of the sequence of game events round after round, both quantitative and qualitative data (including participants direct quoted) have to be used jointly.

Recruitment for the games was open, advertised mostly in the academic community (mostly students, doctoral students, and researchers) and resulted in a rather random group composition, the impact of which is later discussed. Again, the study should be treated only as a pilot study.

3. Results

The results of observations carried out by observers during rounds and community meetings, as well as from evaluation protocols, are presented in Tables 1–3.

Each single workshop (gameplay) created its own history of multi-party collaboration related to managing natural resources in the face of threats. Multiple actors collaborated to address the issues of water and soil management, nature preservation, land use, farming practices, introduction of technology, innovation, and related problem domains. Participants in different cities had different attitudes and different definitions of the problem domain. Each story was unique in terms of participants decisions, results, and frames applied by participants about what happened in the valley and why.

In Wrocław, participants initially focused on "deal-making" among themselves. They were mainly engaged in bilateral conversations and agreements. Actors shared information specific for their roles and goals; however, there was primarily "lots of talking between groups to figure out other team's roles and how to operate" (Quotes in italics come from observation protocols). In Rzeszów, there was almost no communication at the beginning; some players openly refused to share or "held information close and shared little with other teams." In Kraków, actors were looking for general solutions. They "seemed to be looking for the best solutions; not entirely self-focused." In addition, there were some bilateral conversations without open communication, but actors shared information, especially organizations (i.e., Water Board, Bank, and NGO). These differences in attitudes at the beginning of the game influenced further development of trajectories in different cities gameplays.

In Wrocław, leadership functions were rotating between selected teams (playing their roles): NGO, Local Government (LG), and Water Board (WB). The participant playing the LG was perceived as a natural leader. The participant playing the NGO was focused on both technical content (problem-solving) and on group processes. The NGO emerged as a group facilitator and "was accepted by all". It was the only group (Wrocław) where the function of the facilitator was clearly identified and enacted. The first round began in a climate of competition. However, better outcomes became possible as other factors appeared: the emergence of a leader and facilitator, much smaller number of conflicts, and sharing information during the first community meeting. At the time when the drought occurred,

competition reappeared (the second Community Meeting) and even conflict (9/10), which clearly shows the effect of the crisis. However, due to the collaborative practices established earlier as well as effective leadership and facilitation, the group was able to recover from the crisis and, already in the 5th round, information sharing was very intensive and cooperation more pronounced than competition. This led to higher profits (visible in the game results). Although participants indicated a high level of competition in their evaluation sheets, a summary of observational data of the participants provides a broader view than the participants' perceptions of competition and cooperation by revealing the effect of a facilitator or leader and of sharing information on the outcomes. This also demonstrates that conflict can be constructive when relational practices are positively established.

In Rzeszów, responsibility for the group was dispersed among different actors in each round. There was no clear leader identified until the seventh round. As a consequence, there was "more chaos than conflicts or cooperation." Actors were "not sure who's leading the circus." Institutions like the LG or the WB were recognized as leaders responsible for the valley, but "not all players paid attention to them."

In Kraków, there was no unambiguous leader. Rather, responsibility was dispersed. The LG and the WB were recognized as leaders a few times, but they were mainly focused on technical content. Cooperation was less intensive than in Wrocław and Rzeszów. There was much more competition and rivalry, with obvious arguments and conflicts.

In each gameplay, stereotyping emerged over the course of interactions, and it was probably transferred from actors' experiences in the real world. Expressions of stereotyping affected mainly the LG but also the NGO, WB, and sometimes (rarely) farmers:

> "Government was initially distrusted by farmers."
>
> "Role of the government as a money source."
>
> "Thought that the government is greedy."
>
> "Farmers think government should subsidize poor farmers. NGO thinks farmers want money for silly things. Farm 3 called NGO the "green guy." NGO did not trust in the farmers' abilities to change their land use, since they claimed at the meeting that they do not have the knowledge. Farmers are poor and not environmentally friendly."
>
> "I don't like the Bank, they are bloodsuckers (. . .) Those blood suckers, those bank people . . . you like them?"

The data collected indicate that every single multi-party collaboration process was characterized by different internal dynamics. Behaviors linked with some variables, such as exclusion or stereotyping, were common in each gameplay, but there was significant variation with respect to most of the variables observed. For example, some groups were poorly organized. Some had a history of conflict, and there were disparities in power and resources. In addition, there were differences in access to expertise and information. In general, the Wrocław group was better organized than the other communities. In Wrocław, the leadership functions were shared successively between different roles not only during game rounds but also during the community meetings. The final outcome was much more satisfactory because parties were able to cooperate effectively, share information, and agree on which solutions to implement. This is confirmed by both qualitative and quantitative data. In Rzeszów and Kraków, information sharing was low, and there were fewer leadership attempts and no facilitation function. Exclusion and conflicts occurred much more often than they did in Wrocław. Observations from community meetings indicate that, in all cities, participants were not able to achieve a shared understanding of the problem (nevertheless, Wrocław has the highest rate). This is often the case in the real world, where stakeholders quickly jump to solutions without deeper reflection on how problem perception differs among them.

Table 1. Observation and evaluation data analysis from Wroclaw.

WROCŁAW	Sharing Information	Exclusion	Common Understanding	Solution	CLEAR Leader	Facilitator	Rules	Stereotypes	Conflicts	Competition	Cooperation	Internal Dynamics
Observation data Round 1	1.13	–	–	–	YES	HTS	–	4	7/10	1.38	1.40	Competition
Evaluation data Round 1	–	–	–	–	–	–	–	–	–	2.00	1.83	Cooperation and competition
Observation data Round 2	1.22	–	–	–	YES	NO	–	5	7/10	1.40	2.10	More cooperation than competition
FLOOD												
Observation data #1CM	1.22	5	1.33	1.22	YES	YES	NO	1	5/9	1.25	2.50	More cooperation than competition
Evaluation data #1CM	–	–	–	–	–	–	–	–	–	2.00	2.71	More cooperation than competition
Observation data Round 3	2.13	–	–	–	YES	NO	–	4	2/10	1.40	2.14	More cooperation than competition
Observation data Round 4	1.83	–	–	–	YES	NO	–	0	3/10	1.33	2.00	More cooperation than competition
DROUGHT												
Observation data #2CM	1.63	7	0.85	3	YES	NO	NO	4	9/10	2.38	1.60	Competition
Evaluation data #2CM	–	–	–	–	–	–	–	–	–	2.00	2.14	Cooperation and competition
Observation data Round 5	2.33	–	–	–	YES	NO	–	1	2/10	1.00	2.00	More cooperation than competition
Observation data Round 6	1.13	–	–	–	YES	NO	–	1	4/10	2.00	2.14	More cooperation than competition
FLOOD												
Observation data Round 7	1.83	–	–	–	HTS	NO	–	3	6/10	1.40	1.78	More cooperation than competition
Evaluation data Round 7	–	–	–	–	–	–	–	–	–	2.00	1.86	Cooperation and competition
Evaluation data debriefing	–	–	–	–	–	–	–	–	–	2.00	2.50	Cooperation and competition
Summary	14.44							23	45	23.53	28.71	

Table 2. Observation and evaluation data analysis from Rzeszów.

RZESZÓW	Sharing Information	Exclusion	Common Understanding	Solution	CLEAR Leader	Facilitator	Rules	Stereotypes	Conflicts	Competition	Cooperation	Internal Dynamics
Observation data Round 1	0.50	–	–	–	NO	NO	–	4	6/11	1.60	1.60	Cooperation and competition
Evaluation data Round 1	–	–	–	–	–	–	–	–	–	2.00	2.14	Cooperation and competition
Observation data Round 2	0.78	–	–	–	NO	NO	–	1	6/11	1.40	1.25	More cooperation than competition
FLOOD												
Observation data #1CM	0.60	8	1.28	2.71	NO	NO	NO	1	8/11	1.43	1.75	More cooperation than competition
Evaluation data #1CM	–	–	–	–	–	–	–	–	–	1.86	2.57	Cooperation and competition
Observation data Round 3	0.57	–	–	–	YES	NO	–	2	4/10	1.50	1.67	More cooperation than competition
Observation data Round 4	1.00	–	–	–	HTS	NO	–	1	3/10	2.00	1.80	Cooperation
DROUGHT												
Observation data #2CM	0.83	8	1	2,4	NO	NO	NO	1	5/9	1.50	1.60	Cooperation and competition
Evaluation data #2CM	–	–	–	–	–	–	–	–	–	1.43	2.29	Cooperation and competition
Observation data Round 5	1.33	–	–	–	YES	NO	–	3	3/10	1.40	2.00	More cooperation than competition
Observation data Round 6	1.75	–	–	–	YES	NO	–	3	5/10	1.67	2.33	Cooperation
FLOOD												
Observation data Round 7	1.56	–	–	–	YES	NO	–	1	2/10	1.50	2.13	More cooperation than competition
Evaluation data Round 7	–	–	–	–	–	–	–	–	–	1.43	2.57	Cooperation and competition
Evaluation data debriefing	–	–	–	–	–	–	–	–	–	1.67	2.43	More cooperation than competition
Summary	8.92							17	42	22.38	28.13	

Table 3. Observation and evaluation data analysis from Kraków.

KRAKÓW	Sharing Information	Exclusion	Common Understanding	Solution	CLEAR Leader	Facilitator	Rules	Stereotypes	Conflicts	Competition	Cooperation	Internal Dynamics
Observation data Round 1	1.50	–	–	–	YES	NO	–	4	3/11	1.50	1.67	Cooperation
Evaluation data Round 1	–	–	–	–	–	–	–	–	–	2.40	2.29	More cooperation than competition
Observation data Round 2	1.80	–	–	–	YES	NO	–	0	2/11	1.17	2.00	Cooperation and competition
FLOOD												
Observation data #1CM	1.80	9	1	3.12	NO	NO	NO	5	10/10	1.67	1.78	Cooperation and competition
Evaluation data #1CM	–	–	–	–	–	–	–	–	–	1.75	2.17	More cooperation than competition
Observation data Round 3	1.36	–	–	–	YES	NO	–	2	4/11	1.00	2.09	Cooperation
Observation data Round 4	0.67	–	–	–	NO	NO	–	1	3/11	1.33	2.11	More cooperation than competition
DROUGHT												
Observation data #2CM	1.22	5	0.6	2.87	NO	NO	NO	4	10/10	2.11	1.86	Conflict
Evaluation data #2CM	–	–	–	–	–	–	–	–	–	1.50	2.57	More cooperation than competition
Observation data Round 5	1.10	–	–	–	HTS	HTS	–	0	6/11	1.60	1.50	More cooperation than competition
Observation data Round 6	1.00	–	–	–	YES	NO	–	1	6/11	1.40	2.14	More cooperation than competition
FLOOD												
Observation data Round 7	1.18	–	–	–	YES	NO	–	2	8/10	1.00	1.55	More cooperation than competition
Evaluation data Round 7	–	–	–	–	–	–	–	–	–	1.43	2.25	Cooperation and competition
Evaluation data debriefing	–	–	–	–	–	–	–	–	–	1.50	2.29	More cooperation than competition
Summary	11.63							19	52	21.36	28.25	

Besides observations, game decisions and results over the course of the gameplay were collected to support the key hypotheses. Economic outcomes in the context of events in the river valley ecosystem (flood and drought) are presented in Figure 4. The Wrocław group achieved better economic results. Natural disasters (floods and droughts) occurred similarly in every scenario, but in Wrocław, there was the greatest variability in outcomes related to events (i.e., floods and droughts); however, this variability did not decrease accumulated profits. The most difficult economic situation was in Kraków, where multi-party collaboration finished with conflict and economic bankruptcy. In Rzeszów, a leader emerged in the seventh round, and they finished the game with better economic results than those observed in Kraków. In Kraków, the greatest economic losses occurred due to drought, while losses in Rzeszów were due to flooding. Regarding biodiversity, both Kraków and Rzeszów resulted in a decreasing value, in contrast with Wrocław. Obviously, one can achieve high outputs in both accumulated profit and biodiversity. This is because the underlying game model includes feedback mechanisms that undermine economic outcomes in the long term when ecosystem services are reduced due to negative environmental impacts.

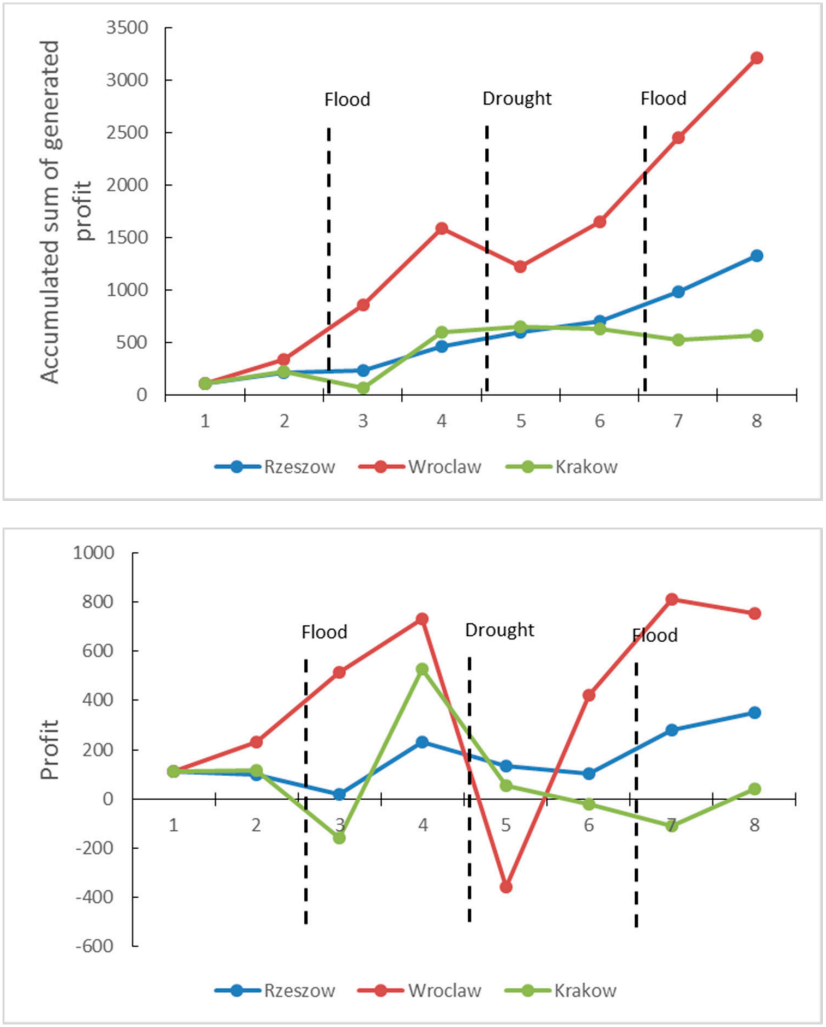

Figure 4. *Cont.*

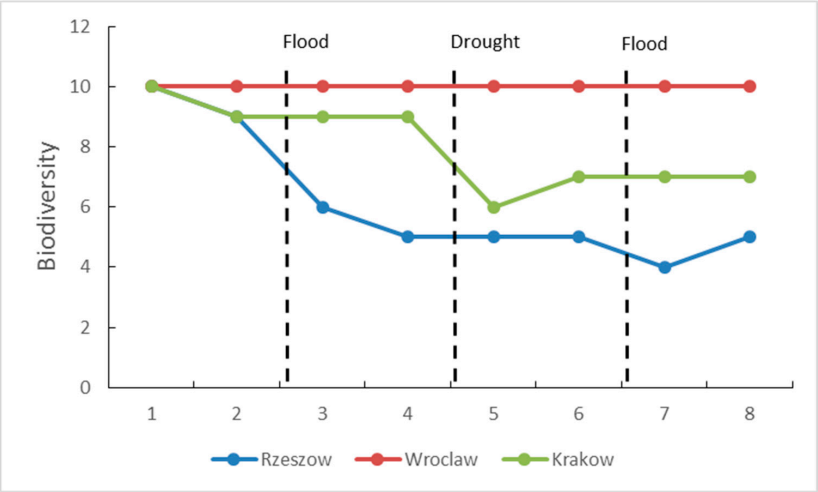

Figure 4. Economic outcomes and biodiversity levels in the context of the events in the ecosystems of the valleys.

The results and their analysis presented above (Figure 4) provide the basis for the assessment of our hypotheses. As indicated earlier in the article, verification of the stated hypotheses is beyond the scope of this paper because our sample is too small. However, we can discuss the findings from our case studies (gameplays in different cities) and note to what extent observed regularities contribute to the stated hypotheses, which is necessary to verify our "research with gaming" approach. Subsequent discussion of the pilot results should be seen in this light.

The Wrocław group achieved the best game outcomes both in terms of profits and biodiversity. Table 4 presents observations indicating potential causes of this advantage, linked to specific hypotheses. There is supporting evidence for Hypotheses 1, 2, and 4 but not for Hypothesis 3.

Table 4. Summary of observations highlighting the Wrocław group that achieved the best outcomes.

Hypothesis	Summary of Observations
Hypothesis 1. *Groups that allow/stimulate all members to share information, express their understanding of the problem, and build a shared reality are better able to cope with inherent system complexity, and thus achieve better content outcomes.*	The Wrocław group scored high on information sharing, much better than other groups. The difference between the groups with respect to achieving the common problem definition was not pronounced.
Hypothesis 2. *Having a leader (leaders) that is (are) both process- and outcome-oriented facilitates the processes of defining the problem and agreeing on solutions, therefore leading to a better content outcomes.*	The leadership effect was observed throughout the game in the Wrocław case. It emerged naturally (NGO) or was discussed, agreed and transferred between the roles. It allowed the whole group to get through the crisis caused by floods and droughts.
Hypothesis 3. *Stereotyping and/or lack of ground rules facilitation of interactions makes conflict management more difficult; as a result, it lowers the chance of developing common solutions and negatively affects content outcomes.*	Wrocław case was the only one where facilitation was present and this group was definitely better organized than other cases; however, establishment of the ground rules was not recorded. The intensity of stereotyping was similar between the cases.
Hypothesis 4. *The ability of the group to formulate and agree on a common solution leads to better content outcomes.*	An agreement on a common solution was reached only in the Wrocław case.

Above we have presented all the steps necessary to analyze the results of the pilot study with the game using data gathered with the observations protocol and participants' surveys. These data provide us with measures to draw the conclusions with respect to the stated research goal. Once we have a larger dataset, we can test stated hypotheses statistically. The method is also rich enough for qualitative research of smaller samples.

4. Discussion and Conclusions

The LOV game was designed in such a way that relational practices were as important as problem-solving aspects, and this is a novelty that combines game mechanics with role-playing (identifying with and role taking in a party/organization from the game world). We aimed to provide a space to observe how players behaved both in terms of the openness of interactions and the structured observation protocol. Since this was a pilot study, the results are not statistically significant, and the results are presented to demonstrate the method rather than to emphasize specific findings. The limitations of this approach are similar to those in other experimental settings in social sciences and include the artificiality effect, as well as the issues of psychological and process validity. The real-life resemblance might be evaluated by participants themselves if participants were real stakeholders, and the artificiality effect is difficult to avoid in laboratory experiments. On the other hand, during the game, we may ensure a similar experimental environment for different groups in order to achieve a level of controlled variability that is not possible in real-life situations. In order to make comparisons possible, a larger study with more LOV sessions is necessary. Moreover, additional data about participants should be collected and included in the analysis. For example, it is not possible to retroactively determine why the group in Wrocław was better at embracing relational activities, especially leadership. In future research experiments, participants should be examined with regard to their background, including domain knowledge, previous experience in public policy making and serious gaming, and social or public activities in real life. The authors are aware of their own cultural background, including the current emphasis on participatory approaches in water governance research. In spite of our effort to create a neutral environment (a "sandbox"), where participants could try different governance styles, there are unavoidable cultural biases that may be present in game and research design. Different governance regimes can produce different outcomes in different cultures [43,44]. In order to verify the stated hypotheses, this cultural background should also be controlled in the experimental design, especially regarding the nature of relational activities under observation, since this might differ depending on the cultural context. This issue might be the subject of further research.

Indices constructed from observations can be developed with greater complexity or greater specificity to identify relevant processes. For instance, conflicts may be focused on relations or tasks. Several task conflicts can be a sign of diversity, so the balance of task conflict to relational conflict is important. In this case, an index can be based on the ratio of task/relational conflict. In terms of ground rules, they concerned procedural issues, task issues, and relationship issues. We usually observe process interventions by some actors when they handle these issues, and gradually, these become accepted (i.e., written) rules. Improved indices may take the nature of these interventions under consideration, e.g., the effort to reframe the common ground to ensure that the concerns and interests of all members are recognized in the problem formulation.

The application of the LOV game to do research with gaming described in this article is not the only possible option for using this game. It can also be used to support real-world multi-party processes related to the management of river valleys. Often the soft, relational activities do not receive enough attention in the actual processes of formulating policy and making decisions. By participating in a "social simulation" based on this game, stakeholders can become aware of the importance of relational practices, and based on this experience, discuss how they can change their real world relations, interactions, rules, or procedures.

By considering all limitations, we find the initial results obtained from this pilot study provide a solid verification of the proposed research method used to study the effects of relational activities and social learning for improving water governance.

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Appendix A. Overview of the Biophysical Model for the Lords of the Valley Game

The game uses a simple stylized model defining critical relationships and processes connected to the small-scale management of the floodplain valley. The area is restricted to the segment of the river with surrounding water infrastructure and local farms. Furthermore, all values presented to the participants are treated as yearly averages (rainfall, soil moisture, the water level in the river, etc.). What is more, due to the limited size of the modeled area and the scope of the game, biodiversity is treated as an aggregated value representing average biodiversity within the valley. Introducing such simplifications to the system was conscious design choice as limiting the physical complexity of the simulation was required to conduct the workshop within the sensible timeframe along with the debriefing. Figure A1 presents the general schematics of the system as well as the feedbacks between simulation elements. The model transforms the participants' decisions into the changes of food production and of water infrastructures, such as dikes. It also combines the environmental scenario (rainfall and the water level in the river) with choices made by the players (farmers and the Water Board) to produce the concrete values of farmers' production. Together the model and the players' decisions form an integrated social-ecological system with many interacting feedback loops.

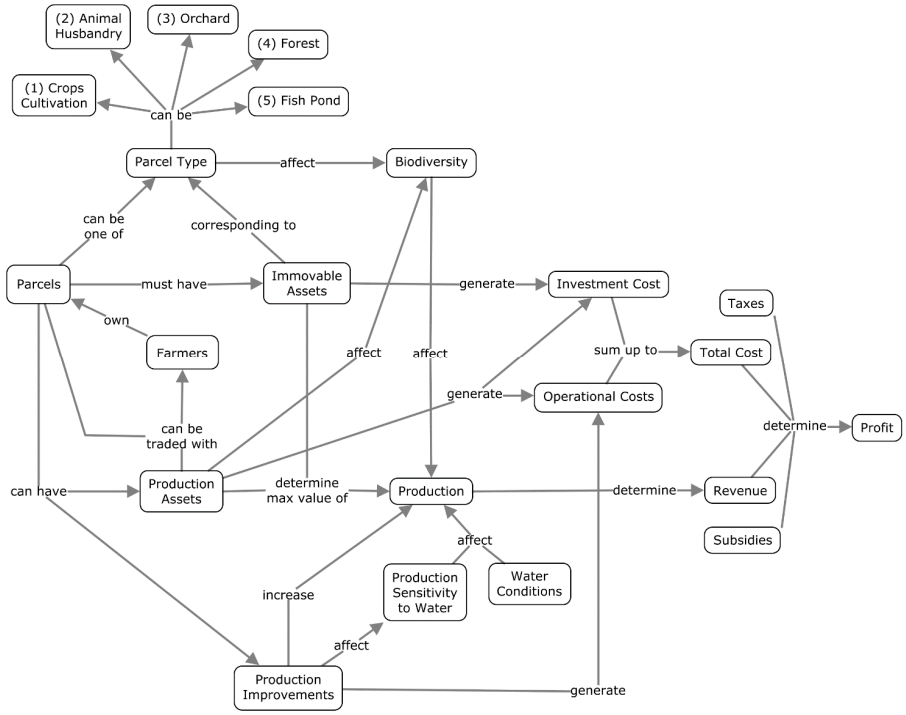

Figure A1. *Cont.*

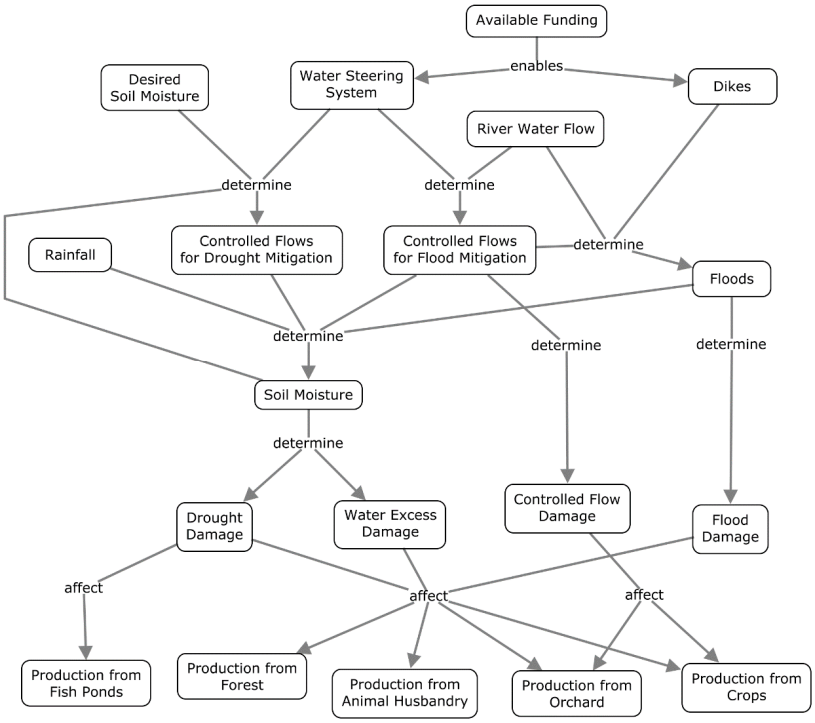

Figure A1. General schematics of the game system.

Appendix B. Instructions for Observers

Appendix B.1. Observation of Multi-Party Processes—Selection of Behaviors to be Recorded

- Communication between teams
- Conflicting goals and interests at different levels
- Dealing with unequal distribution of information
- Shared reality (common understanding of the problem/the system)
- Inter-group relations-conflict, cooperation, competition
- The role of trust (inter-group and intragroup)
- Setting interaction ground rules
- Commitments, responsibilities, control
- Learning about interdependence of actors
- Leadership style and facilitation
- Dealing with risk and uncertainty

Appendix B.2. Main Directives for the Observers

1. Stay "invisible"—do not talk to participants. In case they have questions—gently but firmly redirect them to the main moderator. Do not to express your feelings and opinions about whatever is going on—do not comment, nod, smile, etc. Do not laugh at their jokes.
2. Whatever you hear is confident during the game—you must not share any information with other players.
3. Focus on relevant issues—do not listen/make notes if players are discussing topics unrelated to the game. Respect their privacy!
4. Try not to distract players but make sure you can hear what they are saying.
5. Remember to write down interesting, vivid quotes, they will be useful also for debriefing.

6. After the game, go through your notes and make a short list of the 3 most important observations you had—report them to Piotr.

Appendix B.3. If You are Assigned to Observe One Team in the Game

1. In case "your group" splits—follow one player for a while to find out what she/he is doing, then try to find the second player and figure out what they are doing, etc. Your information will not be complete but you need to know more or less about all players in your group.
2. During community meetings stay focused on "your group" and try to understand (and record) how they relate to other groups. Be as specific as you can.

Appendix B.4. If You are Assigned to Observe the Whole Game at Once

1. Try to observe where people congregate, walk around the room, try to listen to their conversations, and record who talked to whom, about what and how. You should visit all actors in each round to see what they are up to—even if you cannot capture everything, it will give you a good overall impression.
2. During the community meeting, try to observe group-level dynamics. Identify dominant actors and observe how the groups decide the mode of discussion (process-related issues) and topics of discussion (content-related issues).

Appendix B.5. Examples

Below, you will find examples of behaviors/quotes that correspond to each item of the observation protocol. This is NOT a complete list, just a guide, to give you the sense of what we are looking for. Participants' behaviors are likely to be slightly different, so use your common sense to qualify them. For each item of the observation protocol, we list several possible behaviors that we've see during our pilots (with examples of what participants might actually say in italics)—please code this behavior based on occurrence of any of these examples. For example, you code that participants share information if they talk about anything related to the current situation in the valley with other role representatives.

Appendix B.5.1. Example 1

Actors share information specific for their roles

- Comments about the state of the situation in the Valley
    - *In this round we have no money for . . .*
    - *We have cut all the trees now . . .*
- Comments about changes
    - *We will have a problems with low level of water*
    - *The prices of parcels will raise*

Appendix B.5.2. Example 2

Participants declare adopting common norms/rules

- Announcing common rules
    - *Next round everybody in the group can only . . . (at least several participants nod or confirm verbally)*
- Announcing sanctions for disobedience
    - *If anyone . . . , we will all sanction him/her*

Appendix B.5.3. Example 3

Can you identify a leader among participants in this round? Please write who it is. What is the main focus of the leader?

- Who do you think is the most influential participant?
- Who can affect other participants' decisions/behaviors?
- Who is asked for advice or guidance? (Technical content and problem solving)
- Who can stop fights and solve conflicts? (Interpersonal/group process)

Other interesting behaviors (please describe)

- Active resistance
  - ○ *"I am not going to let you order me around."*
  - ○ *"I don't have to tell you how much I earned"*
- Aggressive behaviors
  - ○ *I don't trust some of you, I think we should check each other.*
  - ○ *Visible conflicts—squabbling, yelling . . .*
- Direct statements suggesting lack of trust
  - ○ *I don't trust that bastard, he always cheats.*
  - ○ *I want to see how much money you earned*
- Nonverbal behaviors suggesting lack of trust (depending on the context)
  - ○ *Remaining silent during the general discussion or when asked questions*
  - ○ *Trying to check the content of other peoples' boxes*
- Confusion about rules of the activity
  - ○ *I don't understand how . . . works.*
  - ○ *What happens if I . . . . . ?*
- And more . . .

Appendix C. Observation Protocol for the Game

1. How would you evaluate communication between teams regarding identifying, understanding, and solving the problem of the Valley?

○(very much)	○(moderately)	○(a little)	○(a little)	○(moderately)	○(very much)	○
Actors are mainly engaged in bilateral conversations and agreements			Actors are looking for solutions that will work for the whole group			It's hard to say

2. Who is taking responsibility for the future of the whole valley? (multiple choice possible)
   - Local Government
   - Water Board
   - NGO
   - some farmer(s)
   - all farmers
   - Bank
   - It's hard to say

3. Do actors share information specific for their roles?

○(very much)	○(moderately)	○(a little)	○(a little)	○(moderately)	○(very much)	○
No, actors actively refuse to share information			Yes, actors share information			It's hard to say

4. Under what conditions and for whom do they provide the information? (please describe below)
5. How would you evaluate interactions between teams? (you may tick on both sides of the scale)

○(very much)	○(moderately)	○(a little)	○(a little)	○(moderately)	○(very much)	○
Competition/rivalry/conflicts			Cooperation			It's hard to say

6. Can you observe conflicts?

- Yes, there are conflicts (please describe how they are dealt with)
- No, there seems to be no conflict

7. Can you observe stereotyping?

- Yes, certain actors get stereotyped (please describe)
- No, there seems to be no use of stereotypes

8. Is there a clear leader?

Yes, there is clearly a leader. Choose one:

- Local Government
- Water Board
- NGO
- Farmer
- Bank

Vaguely yes, there seems to be a few actors aspiring to leadership. Choose all applicable:

- Local Government
- Water Board
- NGO
- Farmer
- Bank

No, there seems to be no leader.

9. What is the main focus of the leader?

○(very much)	○(moderately)	○(a little)	○	○(a little)	○(moderately)	○(very much)	○
Technical content and problem solving			Both equally	Interpersonal/group process			It's hard to say

10. Describe the internal dynamics of the team you are observing—how are they making decisions, sharing information, and delegating tasks?
11. How were the actors dealing with uncertainty and risk?
12. Other interesting observations

Appendix D. Observation Protocol for Community Meetings

1. Can all actors give their view on the definition of the problem of the Valley?

- Yes, they all said how they see the problem.
- Most actors are able to say how they see the problem but some actors are ignored.

- Discussion is dominated by one or few actors, and many actors are ignored.
- There is no discussion about the problem of the Valley.

2. Which actor(s) are repeatedly ignored by others when discussing the problem of the Valley?

- Local Government
- Water Board
- NGO
- Some farmer(s)
- All farmers
- Bank

3. Do the actors seem to achieve common understanding of the problem?

○(not at all)	○(a little)	○(moderately)	○(very much)	○It's hard to say

4. Did the group establish an agreed solution?

- Yes, and the solution is made explicit (please write it down below)
- Vaguely yes, the solution is implicit
- Vaguely no, it seems that actors have different solutions and these solutions are not articulated
- No, actors explicitly set individual solutions (please write them down below)
- It's hard to say

5. Who is taking responsibility for the future of the whole valley? (multiple choice possible)

- Local Government
- Water Board
- NGO
- Some farmer(s)
- All farmers
- Bank
- It's hard to say

6. Do actors share information specific for their roles?

○(very much)	○(moderately)	○(a little)	○(a little)	○(moderately)	○(very much)	○
No, actors refuse to share information			Yes, actors share information			It's hard to say

7. How would you evaluate group-level interactions? (you may tick on both sides of the scale)

○(very much)	○(moderately)	○(a little)	○(a little)	○(moderately)	○(very much)	○
Competition/rivalry/conflicts			Cooperation			It's hard to say

8. Can you observe conflicts?

- Yes, there are conflicts (please describe how they are dealt with)
- No, there seems to be no conflict

9. Can you observe stereotyping?

- Yes, certain actors get stereotyped (please describe)
- No, there seems to be no use of stereotypes

10. Is there a leader?

    Yes, there is clearly a leader. Choose one:

    - Local Government
    - Water Board
    - NGO
    - Farmer
    - Bank

    Vaguely yes, there seems to be a few actors aspiring to leadership. Choose all applicable:

    - Local Government
    - Water Board
    - NGO
    - Farmer
    - Bank

    No, there seems to be no leader.

11. What is the main focus of the leader?

○(very much)	○(moderately)	○(a little)	○	○(a little)	○(moderately)	○(very much)	○
Technical content and problem solving			Both equally	Interpersonal/group process			It's hard to say

12. Are there any ground rules created by the group? (multiple choice possible)

    - rules about making decisions
    - rules about dealing with conflict
    - rules about sharing information
    - rules about mutual respect
    - other rules (please describe)
    - the group does not have any rules established

    Other interesting observations

Appendix E. Evaluation Questionnaires for Farmers

FARMER No . . . . . .
Beginning of Round 1
Please recall the moment AT THE BEGINNING OF THE GAME, JUST BEFORE ROUND 1.
How did you expect your interactions to develop with the following teams?

Local Government	a little	moderately	very much	hard to say
cooperation				
competition				
Water Board	a little	moderately	very much	hard to say
cooperation				
competition				
ecoNGO	a little	moderately	very much	hard to say
cooperation				
competition				
Bank	a little	moderately	very much	hard to say
cooperation				
competition				
Other farmers	a little	moderately	very much	hard to say
cooperation				
competition				

Additional Comments:

The whole valley community	a little	moderately	very much	hard to say
cooperation				
competition				

After community meeting #1

Please recall the moment IMMEDIATELY AFTER THE FIRST COMMUNITY MEETING.

Considering your experience of the previous rounds and what happened at the first community meeting, how did you evaluate your interactions with the following teams at that moment?

Local Government	a little	moderately	very much	hard to say
cooperation				
competition				
Water Board	a little	moderately	very much	hard to say
cooperation				
competition				
ecoNGO	a little	moderately	very much	hard to say
cooperation				
competition				
Bank	a little	moderately	very much	hard to say
cooperation				
competition				
Other farmers	a little	moderately	very much	hard to say
cooperation				
competition				

Additional Comments:

The whole valley community	a little	moderately	very much	hard to say
cooperation				
competition				

After community meeting #2

Please recall the moment IMMEDIATELY AFTER THE SECOND COMMUNITY MEETING.

Considering your experience of the previous rounds and what happened at the first community meeting, how did you evaluate your interactions with the following teams at that moment?

Local Government	a little	moderately	very much	hard to say
cooperation				
competition				
Water Board	a little	moderately	very much	hard to say
cooperation				
competition				
ecoNGO	a little	moderately	very much	hard to say
cooperation				
competition				
Bank	a little	moderately	very much	hard to say
cooperation				
competition				
Other farmers	a little	moderately	very much	hard to say
cooperation				
competition				

Additional Comments:

The whole valley community	a little	moderately	very much	hard to say
cooperation				
competition				

Immediately after the last round

Considering your experience during the game, how do you evaluate your interactions with the following teams?

Local Government	a little	moderately	very much	hard to say
cooperation				
competition				
Water Board	a little	moderately	very much	hard to say
cooperation				
competition				
ecoNGO	a little	moderately	very much	hard to say
cooperation				
competition				
Bank	a little	moderately	very much	hard to say
cooperation				
competition				
Other farmers	a little	moderately	very much	hard to say
cooperation				
competition				

Additional Comments:

The whole valley community	a little	moderately	very much	hard to say
cooperation				
competition				

After the debriefing

Considering all you have heard and experienced during the debriefing session, how do you evaluate your interactions with the following teams?

Local Government	a little	moderately	very much	hard to say
cooperation				
competition				
Water Board	a little	moderately	very much	hard to say
cooperation				
competition				
ecoNGO	a little	moderately	very much	hard to say
cooperation				
competition				
Bank	a little	moderately	very much	hard to say
cooperation				
competition				
Other farmers	a little	moderately	very much	hard to say
cooperation				
competition				

Additional Comments:

The whole valley community	a little	moderately	very much	hard to say
cooperation				
competition				

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