A gaming exercise to explore alternative land use and water management options for river floodplains challenged by uncertainty from global change

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Abstract
This paper addresses the question of how to create games that allow water managers and farmers to explore the consequences of their interactions in managing river-floodplain. The need for new approaches arises because conventional strategies appear incapable of coping with the rise of disordering events. Can alternative management regimes be developed that provide more effective coordination between administrative entities at different levels as well as between actors across the public/private and the expert/stakeholder divide? This question remains a ‘wicked problem’ despite decades of research in academic and policy circles. To merge these circles, action research explores possibilities created by integrating research within policy cycles to link inquiry with policy. One form of action research, participatory science, has extended this effort to allow scientists and stakeholders to observe information-processing in decision-making. The processes of perception and analysis often emerge more
fully in interactive exercises than from knowledge elicited in interviews or questionnaires. To facilitate this we developed a system dynamics model of a floodplain agriculture that drives an interactive game where participants assume roles of farmers or managers. The Floodplain Management Game can be used as a fully accessible educational resource, knowledge elicitation and transition management concerning agriculture and river management.

Keywords
Games, floodplains, knowledge brokering instruments, adaptive management, communications laboratory

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Introduction
Freely flowing rivers that generate a wide range of ecosystem services are a distant memory for all but a handful of river basins in Europe. Many river managers do not see basins as landscapes that work to deliver ecosystem services but as arenas in which industrial engines can perform. Fueled by the Industrial Revolution this vision has driven a river engineering campaign that has massively reconfigured the shape of river basins to maximize habitation, production and export. For a considerable period following these transformations of river valleys, society profited enormously. In addition to eliminating malaria, these changes proved the land for urban industrial expansion and the intensified production to feed rapidly expanding urban populations. Over time the people, farms and industry filling the floodplains became assets to defend against ‘dangerous’ rivers, and the continued investment to repair flood damage and bolster the dikes transformed the initial vision of productive expansion to the River Defense Paradigm (RDP).

The RDP successfully justified more than a century of expensive river engineering, but it is now challenged by feedbacks from its accumulating ‘side’ effects. The feedbacks challenging the RDP are clearly evident in the Hungarian reaches of the Tisza River Basin. Not only do all ecological, economic and socio-cultural indicators decline, but flood crises in the late 1990s severely undermined the credibility of river engineering dikes and canals to sustainably defend against high water emergencies (Sendzimir et al. 2007, 2008). Each new flood overtopped or severely threatened the latest reinforcement of the dikes. The potential for climate change to increase the frequency and severity of extreme weather events makes this new challenge urgent: how will European river valleys adapt to future sources of uncertainty?

At a juncture where chronic management failure calls for change, the current management regime’s resistance to any challenge to its infrastructure, practices or the underlying engineering paradigm only amplifies the sense of urgency. In the Tisza basin for the past decade this urgency was addressed by alternative strategies to open the dikes and use the floodplains to store floodwaters. These innovations that had been resisted for decades were relatively rapidly enshrined in national policy (the New Vasarhelyi Plan or VTT) in 2003 (Sendzimir et al. 2007, Werners et al. 2009). However, since then the new ideas have hardly been implemented. It appears that the River Defense paradigm continues to prevail and

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1 with the exception of one modest experiment at the Cigánd reservoir
prevent learning and innovation by experiment that marks credible transition to a more adaptive management regime. In most river valleys it is equally hard to even experiment with alternative river management strategies.

The question of how to effect transition is much larger than simply replacing the administrators or institutions of the current regime. Management regimes are far more than the people involved. The current river management regime in the most European rivers follows a tradition that has outlasted many generations of managers. It has sustained its identity for centuries through different political contexts (monarchy, democracy, communism) and crises (world wars, economic depression, floods). The resistance of the current regime to such diverse sources of change emerges from the variety of feedbacks that combine to reinforce its functional components and sustain its identity. These components include institutions, technologies, theories, networks, organizations, icons and paradigms (Sendzimir et al. 2007). This long-standing inertia to change suggests that transition to a new regime will be a qualitative leap, not an incremental progression. Rapid change might be possible if only a few components need adjusting or replacement. However, the fact that the current regime sustains such a long tradition suggests that transition involves modifying sufficient numbers of components to overcome or reverse the many feedbacks that reinforce its control of the basin’s trajectory.

Transition calls for simultaneously addressing multiple factors and the web of relations that bind them. Science by itself may not prove up to this task. Science historically has made dramatic advances in our power to understand and predict, but usually from the perspective of a single discipline, e.g. optimizing economic output, or maximizing biodiversity. Interdisciplinary concepts and methods are still rare in science’s efforts to inform policy. Outside science, our capacity to assess complex, evolving systems like river valleys is not well developed either. Yet the policy makers and stakeholders who can influence the future of river basins must juggle a diversity of facts from ecology, economics and social scientists to assess how to make society in the basin adaptive to uncertainty from change, both global and regional. These deficiencies raise the challenge of how to make the knowledge of science, policy and local practice accessible to each other. How to explore the possibilities of making the river valleys prosperous without undermining its natural capital? How to learn through experience but without experience's costs? This article explores one way to do this: play a game.
The article is structured as follows. First the alternative ideas of restoring river-floodplain connectivity are described. Then simulation games are shortly introduced as knowledge brokering instruments. The rules of the Floodplain Management Game are described in more detail followed by the history of game development. Then the evaluation after the game with Local Action Group “Land of the Great Bend of Warta River” is described. Finally the summary including the possible game applications is presented.

**Re-connecting floodplains with rivers**

The Floodplain Management Game was developed on the basis of a real-life situation in Tisza river valley in Hungary (Figure 1), which has been affected by severe floods of increasing volume and frequency in the past 15 years.

![The Tisza River Basin](image)

Figure 1 - Tisza - the actual river on which the game was based. A major river in Central Europe that is the largest tributary of Danube. The river originates in the Ukrainian Carpathian mountains, spans 1,358 kilometers, and is characterized by some of the most dramatic flood dynamics of Europe. Following heavy rains in Ukraine and Romania, the Tisza may rise 12 meters in as little as 24 hours, overflowing dikes, and leaving a trail of destruction.
Historically Hungary’s policy response to flood danger was to wall the river within a system of dikes 4500 kilometers in length (Figure 2). This system – the largest of its kind in all Europe – was mostly finished in the 1880s. For more than a century, with active support by the centralized authorities, the river was strictly controlled and seen more as a threat than a resource.

For a long time the river seemed to live up to its nefarious image. Floods only increased in height and power, each time overtopping that latest flood protection the central government erected. As the government’s efforts were proving more and more futile, a shadow network of scientists, activists, and local authorities formed in order to search for new approaches and, eventually, effective solutions. This informal alliance has been active for the last few decades, gathering and analyzing data on the mutual relations between the river and its social and biological surroundings. Such information may not be on the official agenda of the central authorities. But as the costs of flood-protection and flood damages become ever more severe, the knowledge built by collaboration within this alliance may bring about a fundamental change in river management policy. For the last century life and agriculture in the Tisza floodplain were realized in a struggle “against the river.” Now they may change to co-existence “with the river,” if recent flood crises provoke a profound rethinking of peoples’ place in the system, and the appropriateness of their past actions.
a) Dikes – defense against the river  

b) Water Distribution System – living with the river

Figure 3 – Comparison of conventional (a) and alternative (b) management schemes for the Tisza river channel and floodplain (illustration courtesy of Peter Balogh).

While the conventional model allowed for but one proper course of action – isolate the river by dikes and other flood-protection means – the new ideas incorporate many different mechanisms of water movement in the floodplain based on more flexible and adaptive strategies for farmers and local authorities. They recast the ebb and flow of river flooding as a useful and even beneficial element that can be harnessed for greater production and biodiversity, not a blind force of destruction. They stress the need for cooperation, broader horizons, and long-term thinking. However, they have to be tested, and such experiments involve everyone who lives and works in the floodplain.

**Games as knowledge brokering instruments**

For several decades experiments have been conducted to expand the range of perspectives that are actively used in scientific research. In addition to scientists, policy makers and key actors have been included in interdisciplinary teams that formulate research agendas and policies. Under the rubric of Participatory or Citizen Science or Action Research, such experiments explore a wide set of tools that facilitating communication in policy and decision-making in water resource management. How managers and users perceive and analyze the situation, as they decide how to use resources, is of increasing scientific and political interest. The processes of perception and analysis are often more visible when participants are engaged in interactive exercises and computer games than when knowledge is elicited from interviews or questionnaires.
Games offer an engaging medium for participants to explore questions that may be politically, economically or conceptually too difficult to address in everyday life. They enable learning through experience without bearing the cost of experience, provide practical knowledge and skills, “throw” gamers into real-life situations and their problems. In addition, the whole learning experience is much more efficient – participants remember more information and get more intuition about decision-making process than through conventional ‘briefing’ papers. Games provide a virtual arena where time and space can be compressed or expanded to allow participants to see the “big picture” of the situation, as well as feel it. In addition, it serves as excellent communications & dialogue laboratory, where one can experience how crucial the dialogue is for successfully adapting to change.

Games or microworlds are increasingly popular tools for learning, used at schools and universities, local communities, and private companies etc. More than fifty years ago Jay W. Forrester from MIT designed the Beer Game (Forrester, 1961), aiming at showing interconnections in managing a supply chain. Another example of a game developed to simulate the business environment is The Manufacturing Game, based on DuPont experiences. Games are also successfully used to explore issues in social-ecological systems. Examples include Idagon designed by Andy Ford from Washington State University (Ford, 1999) simulating a river basin and Fish Banks developed by Dennis Meadows at al. from MIT (Meadows et al 1993), helping to understand challenges regarding business operations dependent from renewable but limited resources.

**Floodplain Management Game description**
The Floodplain Management game is built on a knowledge base developed through years of interviews and interactive focus groups with local experts and stakeholders in the “NeWater” (New Approaches to Adaptive Water Management under Uncertainty) research project supported by the European Commission under the sixth framework program, running from 2005 to 2009. The game is driven by a stylized model of key elements of the knowledge base that influence the long-term sustainability of the Tisza river valley, e.g. the relationships between the social, economic, and natural factors impacting the ecosystems and communities`. It was created to allow participants to explore different management strategies for water and land use in the floodplain, and to experience the inner-workings and co-dependencies of the system in a comprehensible manner. This scientific model provides a foundation for a participatory game – combining hard data with an interactive experience.
The Floodplain Management Game simulates development of agricultural activities in a river valley floodplain. It allows players to experience dynamic interconnections between natural conditions and the decisions undertaken by other stakeholders in the region, which can be very often nonlinear and unexpected. It allows participants to test different management strategies, with a special focus on exploring alternative water management approaches using water distribution system in the landscape (Figure 3b), apart from traditional system of dikes. The game is a laboratory of negotiations, interpersonal communications, debating and problem solving in a multi-stakeholder environment. Everyone’s decisions influence everyone else. The game is designed to last 10 periods (1 period equals 1 year), each divided into 4 phases allowing players to debate, decide on, and implement their strategies. The number of periods can be reduced or extended, depending on specific audience needs, but the sequence of phases in each period is always the same. There are three available roles: Farmers, Local Authorities and Water Board.

Farmers, as farm owners, choose the kind of production on owned parcels, and trade the parcels and assets among each other. Unlike entertainment games here the players can choose their own goals as farmers. They can manage their farms in many different ways. One option is to develop a large-scale, intensive agriculture (mon-culture), which can be more profitable, but is more vulnerable to water excess or scarcity. Alternatively they may choose highly diversified agriculture (poly-culture), which is less productive, less vulnerable to extremes and generally results in lower, but more stable profits. Farmers can be interested in building and maintaining high dikes, and/or invest in the alternative, a water distribution system. Such choices depend on their parcels` elevation, on their awareness and understanding of alternatives, and on risk-taking. The profitability of the farm is affected not only by the farmer’s choices, but also by how other players’ decisions influence levels of biodiversity, river water and rainfall. Another role in the game is played by Local Authorities, who manage the overall regional budget. They set rates for taxes and subsidies, which can be different for different land uses. They also need to ensure that the Water Board has enough money to operate. Members of Water Board manage the water infrastructure. They can build and maintain dikes for flood defense and/or they can build and maintain water steering infrastructure for flood & drought control and to promote ecological functions.

Each period of the game is divided into four phases, in order to make the game’s progress smooth and transparent. As a first step in the given period, players analyze results from the
previous phase and plan activities for the current phase. Local authorities check income from taxes and subsidy expenditures and then announce financial plans for the current phase. The Water Board makes sure that water infrastructure is appropriate to the current situation and plans its maintenance and development. In the next phase the bank pays profits (if there was any) and may give credits to farmers and authorities (upon request). After receiving their money, players can trade assets and parcels (both with the bank and among themselves), and can change land type of the parcels. At the end of the game period players fill in their reports and give them to the facilitators. Reports contain information about farmers’ decisions on their parcels in the given period of the game. Based on the information in individual reports, that is fed into the computer, the results for all parcels and the whole floodplain are generated. These results also depend on the water scenario (local rainfall and average water level in the river) existing at the start of the period. Local Authorities obtain information about taxes paid per each parcel, subsidies received, as well as overall financial results for the whole area.

The game board (Figure 4) consists of 24 parcels, each exhibiting one of five different ground elevations that are represented on the board by different colours. The higher the parcel’s elevation, the lower the soil moisture and flood damage. Each parcel reflects the farmer’s land use decision as characterised by one of five production types: Fish Ponds, Orchard, Animal Husbandry, Crops Cultivation, or Forest. A parcel may only have a single production type at a time, but it can be changed. Each production type has its own individual assets characterized by operational costs, soil moisture requirements and influence on biodiversity.

Figure 4 - The game board showing the blue river channel bordered by land parcels at
different elevations from low (white) to high (red).

Production assets, which accompany each production type, are necessary to obtain profits from the parcel (basic asset) or to increase the profits (auxiliary assets). These include tools and machines like Tractors or Combine Harvesters (for Crops Cultivation), Truck or Fruit Storage (for Orchard) as but two examples. In case of Crops Cultivation, there is additional possibility of getting a High Yield Grain improvement asset that can generate higher profits, but in turn is more vulnerable to drought or water excess. Using assets requires their owner to bear operating costs (constant for each asset). If for any reason (e.g. flooding or drought) the parcel will not generate income in given period, operating costs are still borne, generating financial loss. Players can trade assets among themselves (at an agreed price) or with the bank (at a fixed price). All assets impact biodiversity – the more intensive the production is (more assets) the more the biodiversity goes down. Biodiversity indicators represent the environmental quality of the region, which influences all parcels by raising their productivity. Additionally certain land uses (forest, fish ponds) can positively affect biodiversity. Local Authorities can promote activities that support biodiversity through subsidies or taxes, but it is up to them whether they will choose such a strategy or let the market rule. Different parcel types are affected differently by the biodiversity level, but the lowest levels mean less profit for every kind of production.

Figure 5 - Alternative production type for farm parcels: crop cultivation, animal husbandry, orchard, forest and fish pond.

Water is a critical factor for farmers. Each parcel type has specific requirements regarding soil moisture, and its production is most effective within a given range of soil moisture. Soil moisture on a given parcel depends on local rainfall, ground elevation and river water level (including floods). If river water level exceeds the level of the dikes, it causes flooding, which in turn causes production losses. The basic tool for flood prevention are dikes that create a system protecting the whole floodplain. High dikes are expensive (both in maintenance and improvement) and can lead to high taxation. If dikes are used as the sole tool of flood prevention, soil moisture depends only on the local rainfall. Here is an
opportunity for using an alternative water management system that distributes water in the landscape - directing it from the river into the floodplain by a system of canals and water gates. As a result of using a water distribution system, flood heights are not as severe as when dikes are the only protection (if water outflows or breaks the dikes, it leads to serious damage), and the additional advantage is system’s capacity to irrigate the parcels when there is not enough local rainfall.

The Game is led by (usually three) facilitators. The Game Leader explains the overall game procedure, keeps control over the playing process and can also serve as another player character – Policy Maker. Playing the character, he informs players about decisions made at the European level, imposing guidelines for local policy, depending on the game scenario and specific needs during the play. The Bank Operator pays profits to the Farmers, Local Authorities and Water Board, and is also responsible for selling and buying different assets.

**History of playing the Floodplain Management Game**

The Floodplain Management Game was created in the Tisza case study of the NeWater project. The project developed theory and tools for adaptive management of water resources - especially in river valleys. The idea of the game was inspired by the “shadow network” (Olsson et al. 2006, Sendzimir et al. 2008) – a group of Hungarian scientists, activists and representatives of administration exploring the possibilities of implementing an alternative river management regime (RMR) in the region. A broad systems analysis of data in the knowledge base related to the RMR was elaborated into quantitative system dynamics model that was subsequently developed into a game. It has been continually improved and modified since then, bringing innovation with each play and being adopted for specific purposes.

The game was initially tested by students in Hungary as well as scientists engaged in the NeWater project. Although the initial version of the game contained very few visual elements (board, cards etc.) and limited decision options, it was met with great interest and many useful development suggestions.

At this early stage farm management options were very simple. The main focus in the game was on cooperation between farmers as well as managers regarding land use change. Each of the managers had their own policy based on their worldview. One represented a pro-intensive management approach. The second one preferred extensive land use, focusing on river-
landscape connectivity, and the third one was devoted to a *laissez faire* doctrine. A voting mechanism was used, enabling players to choose their preferred manager as the chief executive. After each game period each of the managers gave a short speech presenting his policy proposals, and then the election took place.

![Figure 6 - Pictures from playing the Floodplain Management Game](image)

Although the NeWater project was completed, based on its initial success the game was further applied and developed. Important inspiration came from running the game for psychology students and professional facilitators at the Department of Personal and Organisational Psychology, Katholieke Universiteit Leuven. A new innovation was tested there – organizing meetings of all stakeholders at certain times during the game. Also paper currency (in the form of toy euro bills) was used for the first time. Holding “real” money in their hands seemed to cause a significant alteration in players’ engagement in the game. During this game, one interesting behaviour was observed: when discussing chances of successfully transforming the production type of some of the parcels, players decided to set up a kind of insurance scheme, putting part of their money in the middle of the board as the insurance fund. The roles of the authorities were divided into Financial Manager, Water
Manager and Spatial Planner (later developed into Local Authorities and Water Board). In this scenario the role of Policy Maker was introduced for the first time as a way to structure and control the educational goals by facilitators. The scenario was tested to see how game dynamics were influenced if the managers were provided with contradictory goals. The Spatial Planner was given the aim of nature conservation, and Water Manager was focused on building dikes. These two player-managers were seated in different corners of the room in order to make communication between them more difficult. This arrangement simulated the policy fragmentation present in many real situations and provided opportunities for participants to engage this challenge and experience directly one factor that hinders the transition to a more harmonized management regime.

One problem emerged during this play: farms consisting of only one parcel can be boring and unrealistic for farmers. In later games farms consisting of more than one parcel as well as the possibility to trade parcels were introduced. Additionally the diversity of production assets was increased to create more development paths for farmers. Over the course of multiple experiments, the development process of the game started to converge – the game rules proved to be successful in reaching goals of the facilitators, and only minor technical improvements were introduced later. The Game was subsequently played with water managers (national and regional levels), scientists, NGOs and students in many countries in Western and Eastern Europe.

The game can be adapted to many different situations and problems. In order to apply the game to study irrigation problems the game was modified and renamed as the “Irrigation Management Game”. In this format it has been tested within the Scenario Development Workshop of Crimea Pilot Area in the SCENES (Water Scenarios for Europe and for Neighbouring States) UE 6th Framework Project. About 25 Crimean Stakeholders gathered in the last day of the Scenes Workshop in the premises of the Crimean Salgir Regional Water Board Department in Simferopol to play the Irrigation Management Game in order to explore the usefulness of such a tool for improving irrigation policies in Crimea.

In this version of the game also the conditions of unequal distribution of information were explored, a legacy from the Soviet era. Players were given only parts of the information about the factors influencing the situation on the area – e.g. only Local Authorities had the information about the impact of particular assets on biodiversity. So the additional goal of the play was to explore knowledge-sharing patterns among players: will they keep the knowledge
for themselves or try to share it in order to improve the overall results? Players did not share the information they had with each other, and when asked during the debriefing about the reason, the most common answer was: “because it did not cross my mind to do it”. Such lessons can contribute to a more effective collaboration between stakeholders.

**Evaluation after the game with Local Action Group “Land of the Great Bend of Warta River”**

In December 2009 the Game was run with members of a Local Action Group (LAG) named “Kraina Wielkiego Luku Warty” (Land of the Great Bend of Warta River) in Osjakow village on the area of Warta river, in central Poland. LAGs are the public-private entities created under Leader+ EU programme funded from European Agricultural Fund for Rural Development. Its main purpose is designing and implementing of local development strategies, which require cooperation between different stakeholders. The participants of the game were chosen from people focused on local development on the area concentrated around a part of a Warta river valley – they represented different local institutions like Local Agricultural Advisory Centre, county authorities and local NGOs dealing in local culture and development as well as individual farmers. What is particularly interesting is that they immediately identified themselves with the situation presented on the board – a head of LAG, seeing the game board for the first time, exclaimed vigorously: “Oh! It is Warta river! Here is even our river bend! Is this bend a low elevation?” The facilitators nodded in amazement over her intuition, but she quickly added: “We have got exactly the same land formation here and a big problem related to that – the river washes it away, so it disappears slowly”.

Facilitators of the game were aware of the issues and problems shared among LAG’s members (highly agricultural area, invaded by occasional flooding, lacking entrepreneurship and tourism infrastructure, with local community focused on developing agri- and eco-tourism as the key magnet for tourists). So they set their goal on presenting LAG’s members with systemic knowledge about solutions to problems they cope with. The second, more exploratory aim was to use the game to establish a virtual space where the attitudes of the local community engage directly with their situation and with the possibilities opened within the game reality, which in fact very much reflected their own. What would be the lessons learned, if any? Will the participants see any new opportunities for themselves or notice some new systemic interdependencies, which could serve as leverage points if intervened properly? For that purpose the questionnaires were used, evaluating both how the game progressed *per*
se, as well as tracking the changes in players’ mindset and strategies made during the game. Together with the debriefing and informal talks with participants after the game, they allowed us to explore participants’ way of thinking about their management practices and possible changes.

The game was met with great interest. The main lessons learned, as indicated by the participants were: awareness about the need to undertake decisions, even if risky, increased capacity of foreseeing the consequences of the flood or drought, financial constraints of investments into development, and the financial aspects of natural resources management in general, the usefulness of undertaking moderate risks and analysing the farm development, proper use of land, regarding its elevation and value and finally – careful decision-making. Players underlined the role of the game as “teaching decision-making”, “using the thinking learned during the game in daily life and farming”.

The main advantages of the game as highlighted by the participants involved the direct experience of: the need to foresee consequences and undertake decisions, the engagement of all participants in the management process, the possibilities created by becoming immersed in the situation, the integration of people, who had to consult each other, the ways in which local authorities, as well as the water level, influence the situation, and the level of communication between farmers. Only two of the participants (out of seventeen in total) expressed that what they did not like about the game was “little realism”.

**Summary**

In The Floodplain Management Game people play the roles of farmers or managers (administrators in government) of a river basin floodplains. In this play environment they can explore many possible outcomes, looking at the consequences of their decisions for the sustainable development of floodplains.

The game has been field-tested by students, farmers, NGOs, scientists and policy makers in Hungary, Spain, Belgium, Netherlands and Poland. Participants were surprised and impressed by how their decisions could not be made unilaterally – by either as farmers or managers. The game clarified how decision paths are limited by constraints of imperfect knowledge, environmental uncertainty, lack of policy integration, mutual interactions, sunk costs of infrastructure and technological lock-in. The avid participation by professional
scientists and water managers demonstrated that the game is an appealing and useful tool for those actually working in river floodplains. The game will be continually improved to make it a fully accessible resource for research, knowledge elicitation and education concerning river floodplain management.

Due to the Game’s flexibility, it can be used for many different purposes, serving as a tool for:

• Research – exploring peoples’ actions in complex systems, and their behaviour in multi-party collaboration situations

• Transition management – as a measure for promoting certain solutions as part of transition to more adaptive management regimes, teaching change managers and facilitators of the possibilities created by community dialogue and multi-stakeholder processes.

• Education – helping people to learn more about the dilemmas of integrated water management and multiple policies and actions that can facilitate engaging those dilemmas.

The game can be a tool for experimental research related to transition management in the area of water resources. A significant space for social exploration based on the game is being recognized, related to social interactions in complex social-ecological systems, with a focus on adaptive behaviour in uncertain conditions, caused especially by ecosystem alteration and climate change. The game, as a model, or “microworld” reflects social phenomena, which could foster or hinder transition towards sustainable management of water (or any other natural) resources. How can changes in the ownership structure of the land affect adaptability? How can factors like trust, group identity or framing support development of adaptive models of management? Leadership, conflict management, formal and informal institutional settings, decision-making process – all those phenomena significantly shape the conditions under which people adapt to their environment. Therefore, they are vital for social learning aimed at building resilience to uncertainty emanating from sources of global change. And the need for dynamic and effective learning is growing with as the uncertainties from climactic or economic change grow, leading to increased need of communication between stakeholders and levels of their participation in cooperation, information flow and knowledge management which encourage innovation. Given the broad possibility of introducing some modifications in the game scenario, the game itself can be used to explore many different research questions in the area of water management.
References


