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Wat-A-Game, a toolkit for building role-playing games about integrated water management

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Abstract : Participatory modeling and role-playing games have been successfully implemented for a few decades as tools for social learning and supporting water management and governance. However engaging the stakeholders and scientists in building a dedicated playable model is a repetitive, lengthy and costly process, furthermore not easily transferable. The Wat-A-Game (WAG) methodological toolkit provides generic components ("bricks"), methodological guidelines, training sessions and online support to managers, technicians or teachers who wish to become autonomous in developing and using such approach. With WAG, process managers and other stakeholders can easily assembly land plot cards, hydrographic units, actions and role cards, and let physical water drops (marbles), clean or dirty, flow, be captured and used. Many scales can be addressed and even interlinked. Policies can be tested. WAG is free.
WAG has been extended in South Africa (2007-2010) for a process discussing the Catchment Management Strategy with several levels and types of stakeholders. Based on the evaluation made, this process appeared actually successful in bringing stakeholders to share views and understand better their catchment, while providing insights for research on such processes. Outside South-Africa, developments occur in Mozambique (1 executive course), in the Niger basin (2 executive courses, 9 countries), in Ethiopia (1 executive course), in Tunisia (1 operational workshop) and in France (3 projects). In these sessions, participants are guided in developing prototype WAG applications for their own case studies, resulting in new diverse issues and scales (e.g. sedimentation, hydro-electricity, urban expansion...) which at next stage bring new insights and developments for the generic toolkit. For further development and processes, WAG now proposes long term support and a web site including custom tailored design of games, a simulator and a community access.

Keywords : participatory modeling, role-playing games, methodological toolkit, integrated water management

1 INTRODUCTION

Wat-A-Game (WAG) is a methodological platform providing toolkits, methodological guidelines, online simulation and web-services for supporting the design of Role-Playing Games (RPG) by and for a wide range of stakeholders in

order to explore water management strategies and discuss water policies. WAG may be used in an operational context, as a tool to support social learning, coordination and design of public policies for catchment management, as well as in a pedagogical context as an experimentation tool for learning modules related to multi-level governance. WAG paradigm is inspired from the Companion Modeling (ComMod[1]) principles (Barreteau et al, 2001), and assumes that the design and building of the model supporting the participatory simulation (the game) is as important as the game itself in the overall learning and decision process.

1.1 WAG history and rationale

WAG has been designed as a follow-up of series of applied projects (Barreteau et al., 2001; Ferrand, Nancarrow, 2005; Cavailles et al, 2005; Farolfi, Rowntree, 2007; Daniell, 2008) dealing with water management and governance, using games as educational, exploratory and transformative processes. The idea was to find a way of capitalizing the common features appearing in those experiences to design RPG building blocks and a dedicated methodology that could speed up the costly RPG development process. Another objective was to instrumentalize the upscaling of companion modeling processes (Barreteau & al, 2003) by providing local partners ready-made abstract tools as well as means and support for becoming more easily autonomous in the development and use and of RPG. Then the rationales for the WAG platform were :

- Providing an infrastructure which could support the representation of any basin and any management situation : adaptable to the structure of the basin, the various resources including water, land, labor and money, scalable in terms of basin size and number of players
- Providing an infrastructure which could support the design of RPG where players visualize physically and get quantitative feedbacks of their actions in the game
- Addressing multi-level governance by supporting the simultaneous participation of actors from different sectors and different levels and supporting the design of games that can be used to test and compare policies
- Being easily transferable: only a limited amount of training should be necessary for non experts to use the infrastructure to develop and use new games with actors. This implies in particular to limit the use of a computer to the calibration phase.

1.2 WAG principles and building blocks structure

In early 2009, the basic principles of WAG and the type and topology of the WAG building blocks were designed in the lab and set up, as described in (Ferrand et al., 2009). A catchment is represented by Land Plot Cards (LPC) representing sectors of use of water and connected by water ways where water can circulate and water is materialised with colored marbles that can figure clean or polluted water. Additionnal hydrological elements such as dams, aquifers or transport pipes may be added. Individual players own some LPC that they manage by deciding at the beginning every game turn which activities among a set of pre-defined activities they will make on this LPC, and then how much of the water that is accessible to them they use for their activities. Activities are represented by cards specifying resources needed to conduct the activity and how much resources will be returned by the activity depending on how many resources it gets (production abacus). Resources may be water (clean or dirty), money or other kind of resource (labor, social satisfaction...). An activity generally needs an amount of water and release a smaller or equal amount of modified water (mix of clean and dirty marbles). Water

[1] http://commod.org

marbles circulates from upstream to downstream : after players have decided their activities, the animator places a certain amount of clean water marbles at the entrance of the catchement (inflow) and possibly on the LPCs (rain). This amount of water depends on a climatic scenario. Then water marbles follow water ways until they reach a LPC intake. There the player who owns the LPC take the marbles he needs and release the quantity of clean and dirty marbles specified by the activities and the water marbles can continue to circulate until the next intake.

This structure and principles have been stable ever since but what exactly lies in an activity, what rules may be used to manage the LPC and how specific issues may be dealt with had to be experienced and tested through case studies applications. The lead case study that was used for the testing and refinement of WAG was dealing with Catchment Management Strategy discussion in the South African Sand River catchment (Inkomati) and will be developed further in the paper.

2 THE LEAD IMPLEMENTATION FOR THE SAND RIVER

The Sand River case in South-Africa has been a key process for experimenting and developing the toolkit structure, as a long term cooperation with the NGO AWARD (Association for Water and Rural Development), which is based and operates on the Sand River catchment. It's been designed in the context of the research program “Upscaling Commod”, which aimed at proposing solutions for adapting the “Companion Modeling” practices to larger and independent situations, and testing different ways for easing and disseminating them widely and outside direct expert interventions.

2.1 Local context and objectives

From the South-African National Water Act (NWA), water allocation planning is required to be a participatory process led by the Catchment Management Agency (CMA), and resulting in the definition of minimal requirements and priorities for the different sectors of a catchment. However CMAs are lacking methodology and support on how to effectively implement participation in water allocation plans design and implementation. Issues such as clarity of the implementation process (who should do what and when), understanding of preferences, willingness to change and social regulation processes of stakeholders, or identification of possible allocation solutions are open. The objective of developing a WAG application in the Sand River catchment was to experiment a new way of enforcing this participation through the design and use of a Role Playing Game (RPG). The RPG is expected to support learning by increasing stakeholders understanding of water dynamics and water mediated interactions in their catchment and to support discussion on water allocation strategies in the catchment.

The Sand River catchment is a poor and densely populated territory with pine plantations upstream and several big game conservation areas, including Kruger Park, downstream.Besides the lack of practice in participation and water management, several tensions existed within and between sectors of the catchement at the time where the collaborative process began. Owing to the contentious and fragmented situation, the NGO had high expectations for the collaborative modelling process to build trust among catchment stakeholders and representatives and the capacity for them to work together. Conservation representatives and small farmers shared these expectations; although, the other representatives regarded the process as a threat.

2.2 Process

The WAG-Sand process was held from July to October 2009. The RPG conceptual model (water sources connections, constraints, respective importance, impact of sector activities, and dependence of sectors on water and development options)

was developed by WAG researchers and local experts. A calibration process used existing hydrological, demographic and economic data, as well as the knowledge of the experts. Flows have especially been defined referring to the national Water Strategic Assessment Model (WSAM) developed by the Department of Water Affairs and Forestry, and using data from 1999.

Sample RPG elements were produced and used as artefacts to interview individuals and small groups from the different sectors. Then an operational RPG was developed by the researchers using the data from these interviews and local experts' knowledge and material. Two role-playing game workshops were organised. The first one included only the agricultural sector. The objective was to train the lay stakeholders in interacting with an abstract tool as well as focusing on agricultural sector issues that were of interest for the NGO. The second workshop concluded the process and gathered stakeholders and representatives from the various levels and sectors.

2.3 Results for stakeholders

Using RPG sample to interact with local actors in early stages of the RPG design served the dual purpose of informing the model and getting the stakeholders acquainted with the tool. These interactions were also useful in training the NGO assistant. She was translating and helping with the manipulation of the artefacts in using abstractions and artefacts to explain complex catchment level dynamics to the communities who trust her as one of them.

The materialisation of hydrological connections through stripes and water through marbles was efficient in helping poorly educated participants in attaining a good understanding of water circulation dynamics within the catchment and the meaning of legal constraints of Ecological and Human Needs Reserve. Agricultural leaders think it is a valuable pedagogical tool for helping lay farmers to understand complex dynamics and interactions. During the workshop, the interactions around the game and during the following discussion were acknowledged as useful in understanding each stakeholder's issues. In particular, the lay farmer leader who was trained before had to support the official representative in playing the game. For this the official representative who had never visited the field had to understand concrete issues the lay leader was importing in his game explanations. Finally, the workshop was organised and presented as a test for future decision-making process through simulation, with no link to any actual decision-making. The RPG setting and the publicized absence of stake provided a safe harbor for stakeholder that did not trust each other to begin the process of learning to communicate one with the other. The previous trust built among agricultural sector by the NGO as well as the remarkable personal capacities of the field assistant in gaining the commitment of stakeholders contributed to the success of the RPG.

In a more recent process (De Fooij, 2011), additional developments and validations have been made for a larger closeby catchment, the Crocodile river. In this latter case, the presence of large scale commercial farms, as well as some mining industries, leads to yet more difficult conditions for negotiations and requirements for stronger calibration.

2.4 Results for WAG

At the beginning of the process the basic structure of WAG building blocks (Land Plot Cards, Activities, Hydrologic Connections and Items, Water Marbles) was already stabilized. However four different prototypes of the game were produced during the process, resulting from trials and adjustments that were made to design a generic default configuration of the building blocks. Then the case was used to design a more generic game that could be used to represent an archetypal catchment from semi-arid Africa.

The different issues which led to adaptations in the meta-model (the kit) or the process have been:

- Representing complex integrated strategies where different actions are combined. In this case the simplified model of WAG doesn't easily allow for players to adjust and assess the effects of such strategies. Typically a city manager (mayor) choosing to go for a very active pro-eonomic development would choose series of joint actions, technical or non technical, which overall effect is difficult to compute only via the main WAG principle. Therefore we have tried proposing players to access directly such combined strategy, with pre-computed needs and outcomes: e.g. "anarchic city" vs. "fast growing city". However the practice has shown that such comprehensive strategy card leave a very limited space for the player's decision, which can be frustrating. We have finally kept the simplified atomistic model of action, and accepted the trade-off of the limited computability of the non-linear combination of outcomes.
- Production functions have been step by step simplified. In the first versions, the water quantities were giving exact outcomes in economic or social terms, based on a fine abacus. But the understanding of such abacus, plus its calibration, limited its use and led finally to specifying only a target production ratio (outcome / water) with a linear tuning for intermediary values. In the ultimate case of INI-WAG, the water requirement is absolute: if the water is not available exactly as specified, the activity is lost for the round.
- Hydrology is limited to a water balance model with a dependency graph. The flows are physically represented by circulating water tokens to materialize the model, but they don't show detailed dynamics. The whole system is equivalent to a grape of reservoirs, where the stock is released downstream after abstraction by the previous user. For rainfed systems, part of the inflow can be distributed directly on the land plots, but in most simulations for dry conditions, only the river flow and the aquifer(s) are used. Furthermore, in most cases, upstream players finish their season before downstream can get access to water, including returned polluted water. An alternative could have been to let the flow go and release step after step so that the downstream users would actually get water in different phases. The current version with a pure sequential distribution tends to emphasize the upstream-downstream dependency.
- Aquifer recharge is currently independent from activities (but not from climate). In one implementation (Têt, France, P. Robin 2011), recharge is tuned to the activities. In another (Fogera, Ethiopia, 2012) chains of 3 aquifers exchange water according to their piezometric levels.
- Flooding dynamics have been implemented. Two different cases exist: 1. slow processes in floodplain and recession agriculture as for the Inner Niger Delta, where the incoming flow determines the number and magnitude of flooded land plots, hence the typology of satisfied activities 2. fast / flash flood processes (Lez, France, 2011) with the processes of flood wave generation by runoff accumulation, water rising in lowlands and damage assessment. Activities have two parameters: infiltration / absorption capacity and flood vulnerability. Although the latter is technically feasible, the complexity of this model limits its usability outside pedagogical applications.
- Time steps in the simulation are critical. But when playing with humans very few rounds can be played (usually no more than 8 in a normal session), also accounting for climate variability. Therefore most runs have only one season per year, even sometimes the dry or wet season can be skipped. Some runs have even used multi-years rounds. The design criterion is to assess when the key decisions (crops, land use) are actually taken by the players. This gives the standard round pace.
- Considering the specific conditions of non-fiducial food security economies which triggered WAG development, we have looked at several ways of modeling non monetary systems. We have included a notion of "opportunity", which could be won based on the success of an activity. As such it represented the direct outcome as a new set of possible actions. We have also worked on the representation of labor and knowledge, and its use for starting new activities. Labor has been used

in the Wet-Wag model (South-Africa, Morardet, Murgue, 2011), and in the Diga-Bikilla and Fogera (Ethiopia, 2012) cases. In these cases, labor is a limiting factor often more constraining than water itself.

- Regarding social effects, two approaches have been tested. 1. We have included smileys and "angrys" to model outcomes of actions. However in a second stage, the use of this "social capital", positive or negative, has been difficult to validate. Some actions may require social support, represented by smileys, while angrys can compensate or consume them. External events also can be triggered by the holding of such indicators. 2. In the events phase, participants can receive specific information on social processes occurring in the territory. Meanwhile it's clearly through the direct social interaction among players that the main social outcomes are exhibited.

3 FURTHER DEVELOPMENTS AND APPLICATIONS

Trials and adjustment continued during the following 16 case studies and workshops, in 8 countries, to converge to the current final WAG "lexicon" and "grammar":

- Water demands can be satisfied either from the hydrographic system or rainfed.
- There are 3 possible kinds of activities: actions that use the land of LPC, transform water and produce resources, services that transform water and produce resources but do not use land, and infrastructures that only transform water. Activity cards combine the skill and the equipment.
- Activities may need and /or produce various kinds of resources : financial, material and human / social
- Activities needs and production are specified with small number of simple units, to facilitate handling
- When an action or a service does not fulfill its needs, it's impacted or even frozen and does not produce any resource. If not recovered in few round, the action or service is lost. Removing an activity from a LPC may imply a cost.
- Individual players have control over some LPCs, and may share some community land.
- Each LPC can be occupied by only 1 land-use action but may have several services and infrastructure
- Event cards are drawn by players at the end of each turn. Different kind of events can be specified to introduce a bit of randomness but also infer qualitative rules by defining incentives or sanctions that may depend on the player or other players current activities (maintenance, migration, diversity of activity…)

This is a description of the basic structure of WAG building blocks. It can of course be adapted depending on the case studies issues. For an up-to-date description of WAG building blocks, reader can refer to the WAG web site[2]

3.1 WAG versions and developments

WAG has initially been developed for the Sand River case in South-Africa, detailed above. Based on this first experience, 15 other applications have been made in 8 countries, and different versions have been specified throughout several sessions. Three main categories of use are formally defined:

1. Discovering and discussing water use, sharing and regulation, based on an abstract and simplified case ("INI-WAG"). This easily transferable version doesn't use language specific elements. It is based on a common set of international bricks and rules. Final validation is currently ongoing, before inclusion in a wide dissemination toolbox. Users can build their own catchment model in some minutes, and play it immediately.

[2] http://watagame.info

2. Exploring and testing existing use cases, based on past developments (“MINI-WAG”). Users can understand how some key issues are addressed, and how these basins are managed and evolve.
3. Developing ones’ own components, rules and specific features, using the meta-rules and web services provided (“CREA-WAG”). References are provided for given bioclimatic area and basic components are provided.

The list of these application is documented on our website.

3.2 Transfer and reusability

The production process of the transferable WAG platform and toolbox is now under finalization. The WAG platform consists of rules and methods, physical boxes and an accompanying website. The physical boxes contain building blocks, methodological booklets and numerical contents on DVD, in different languages. Different kits will be produced corresponding to different levels of uses of the toolkit : a basic “INI-WAG” box containing a “turnkey” simple and generic RPG which allows participants to understand and discuss how water circulates and may be shared and valued by various usages in a catchment; “MINI-WAG” application boxes which contain “turnkey” but more complex WAG applications on archetypal catchments which allows participants to experiment contextualized water management issues; a “CREA-WAG” adaptation kit which guide participants in representing original cases with the included components by experimenting different organisations and scenarios; a “SELF-WAG” extension box which purpose is to allow the users to generate their own WAG application with reusable building blocks, methodological booklets and cards generation and calibration software applications. The finalised website will provide background information on WAG, but also a users forum and an access to webservices and a simulator to support the generation and calibration of specific cards and scenarios. In this way we expect to be able to monitor, register and mutualise new WAG applications and grow an active users’ community which will contribute in the enrichment and improvement of the platform. The different elements of the WAG platform are developed in different languages and provided under Creative Commons licence, for free reuse for researchers and public services. A commercial license will be established with commercial companies. Long-term support will be provided by the research team.

4 CONCLUSION AND PERSPECTIVES

We presented WAG principles and the initial South African case study where a WAG application was developed and used as a discussion support with the stakeholders, as well as a test bed for the development of the WAG platform. We presented the key evolution factors and the choices we have made based on the several test experiments. We especially discussed trade-offs between accuracy, transferability and autonomy for the users, outside intervention of external specialists of RPGs.

The current research developments with WAG include systematization of experiments using the platform and dealing with key collective decision-making issues, like the role of mutual information, conditions for governance, the role of procedures in the implementation. The generic and large scale transfer of the boxes will allow for an international set of experiments from which we expect to get several repetitions of key tests, in real conditions. Therefore all users worldwide who receive the WAG kit commit into providing in return systematic evaluations of the processes. We are currently working also on linking participatory planning processes with WAG for pre-testing the integrated management plans with stakeholders on the simulations provided by WAG. This is ongoing in 5 african countries. Finally we work also on the extension of the WAG principles for other natural resources outside land and water, to account more generally for the exchanges and scarcity in complex multi-resources systems.

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