The contribution of Serious Gaming to the Negotiated Approach

Applying game design to groundwater management in Khulna, Bangladesh

Master Thesis Report

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PREFACE & ACKNOWLEDGEMENTS

When anyone asked me what exactly I was doing for my thesis, I often responded with: ''just making a marble game'', in order to enjoy the confusion and surprise in the eyes of the beholder. It is hard to imagine a topic that would have suited better to my analytic and creative side and my passion for global & sustainable development. Although I have faced the valley of despair and had sometimes vivid nightmares of being stuck in an infinite orbit around my thesis project, I really enjoyed it.

Writing a thesis project is like hill climbing (by bicycle); the top is the means that stimulates you to grow and rise above yourself and gain perseverance. Certainly I am proud of the work that lays in front of you, but the real value for me is in the personal learning process that I have been through. I admit I have not been the most efficient student. But life is more about effectiveness (and its goal is learning). Ironically, I have learned most from courses which I failed most frequently, including this project. Through this mountain stage, I learned better to deal with my perfectionistic attitude by losing the fear of being wrong. I learned to handle my chaotic attitude better by taking a step back to let the 'sand in the bottle settle' to be able to see clear through the water again. While previously my basic strategy was to fix all problems myself, I learned the importance of frequently asking feedback. In addition, I learned better to estimate my limits and anticipate on them. I once heard that limits can 1) stop you or 2) make you more creative; I succeeded better over time in following the second option. Finally, I learned to appreciate learning and that life is too short to do all the interesting courses out there. After my BSc in Mechanical Engineering, I could not have imagined how much I would learn from this MSc and how much it would enrich and broaden my perspective. I am grateful for this opportunity and I am confident it will be a stepping stone towards even more challenging learning experiences.

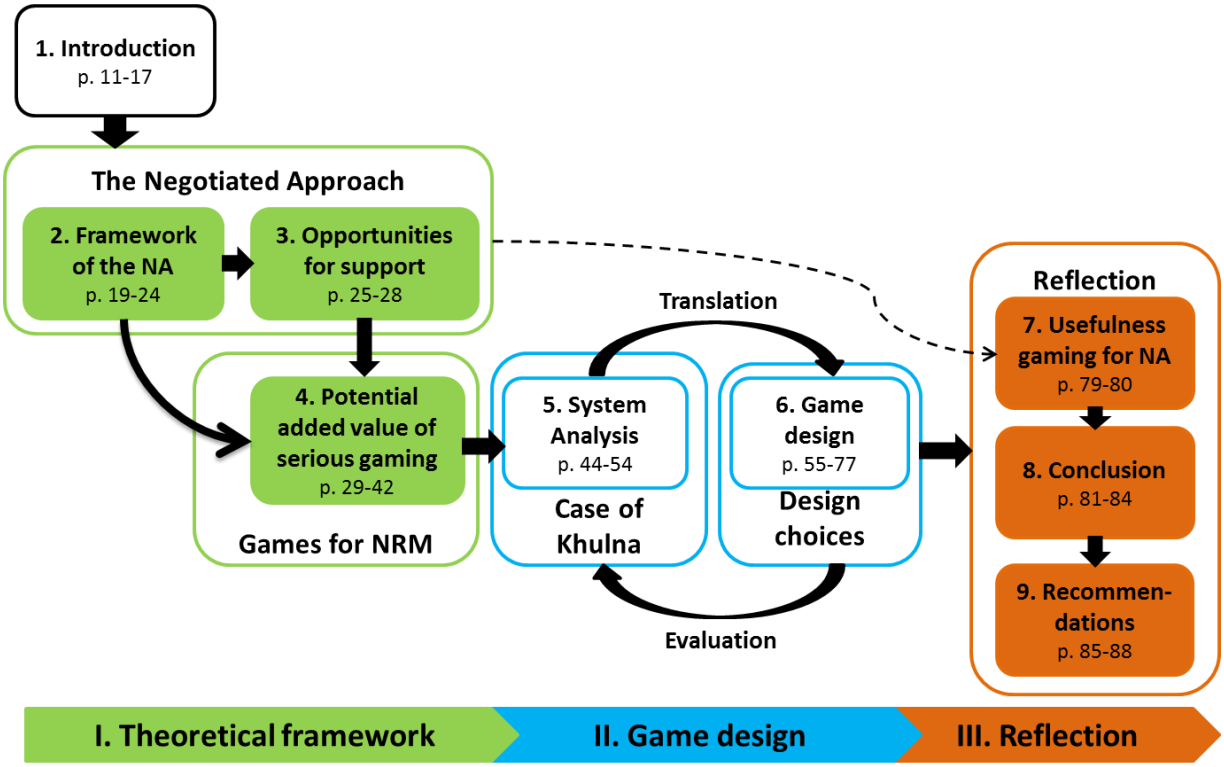
I am really grateful for all the support I have got; without the people around me I probably would have had to drop during a steep hill climb. I would like to thank the following persons: Leon Hermans for your warm support, constructive feedback and the opportunity; you deserve the supervisor-of-the-year award, without any doubt. Geertje Bekebrede, for your critical look on the design and your contribution in the 'UDW-Project-minded' exam commission. Remi Kempers; for introducing me into the 'ngo-world' and for your guidance and your valuable contacts. I really appreciated the atmosphere and the critical feedback of the colleagues at Both ENDS. It learned me how difficult development actually is, which made me a bit more a 'realistic' idealist (It has not discouraged me at all). I also would like to thank Wil Thissen for his valuable contribution in the exam commission. This project would not have been possible without the valuable insights from experts from Both ENDS, SaciWaters, JJS, Deltares and the Delft University of Technology. I also would like to thank Marja Brand, who really helped me as student advisor in handling my boundaries. In addition, I especially want to thank my parents and family; you supported me all the time, encouraged me in heavy times and survived my game explanations. As followed, I certainly want to thank my friends and roommates as well, who were around for a backing shoulder, a meal, a conversation or for playing a game. And I am of course grateful to my play-testing audience. Without you all, the design process would have been like swimming without water; it is senseless and looks stupid. Last but not least, I am grateful to my Creator, from whom I believe I receive in the end all opportunities and strength from.

Jesse Schell (May 30, 2013) says: *''Teaching is really hard. Making entertainment games is really hard. And now we're proposing that we're going to do both of them simultaneously! It's like stunt riding on a motorcycle and juggling, and now I'm going to do them at the same time. And hey, you screwed up, because it's really hard. But when you do it right, it's frickin' amazing!''.* I totally agree with him. I leave it up to you to judge whether my stunting and juggling did worked out well. (Source picture front[1].)

[1] Source picture frontpage: Eawag aquatic research, Khulna, Bangladesh.
http://www.eawag.ch/medien/bulletin/archiv/2007/20070822/bangl.jpg?hires [accessed October 20, 2014].

READING GUIDE

It is best to start with the summary if you have little time. If you have more time it is advised to read the introduction and the conclusions. In advance; you could scan the report and read the conclusions of the chapters. If you are interested in a specific part, the flow chart will help you to find it. And if you take the time to read it all, I will feel honoured even more.



The first chapter describes the context of the problem and the goal of the report. The thesis aims to answer the question ***To what extent can serious gaming support the process of the Negotiated Approach?*** As followed, chapter two analyses the theoretical background of the NA and how this relates to the principles and the process of NA. Based on this, the part of the process that needs to be improved is identified in chapter three. Chapter four compares and links game function categories to the process analysed in chapter two and selects a function based on the insights of chapter three and a literature review of existing applications.

In advance, chapter five analyses the context and the problem of the case in Khulna to which the game will be applied. In addition, chapter six explains how these insights are translated into the gaming model. There is also evaluated to what extent the game fits the client needs and predefined requirements.

As followed, the seventh chapter starts prescribing when games are in general useful and when not for the NA. By synthesizing previous insights, there is recommended how games should be used in the whole approach. The eighth chapter concludes by reflecting on the research question and discussing the added value of the research. Finally, there is suggested how the game should be finalized and recommendations for further research are given.

SUMMARY

Groundwater is used as main water supply in Khulna (Bangladesh) and Kolkata (India), which lay in the Ganges delta basin. Increasing water demands and declining water qualities through waste dumping, salinization and arsenic contamination, peri-urban groups are increasingly excluded from extraction. The 'Urbanising Deltas of the World' Project researches the causes of the problem and uses the Negotiated Approach (NA) to support communities in negotiating institutional changes, to reduce inequity. The NA is developed by Both ENDS and partners and aims to make Integrated Water Resources Management (IWRM) more problem and need-driven by supporting local communities to manage their own ecosystems. Although used successfully, the NA remains abstract.

Serious Games are proposed to make the process more accessible, tangible and concrete. Games are useful because they can help to comprehend the social-technical complexities of the peri-urban system. Because they can stimulate perception change, improve communication and facilitate experimentation; games have potential to support the collective learning process of the NA. This will improve cooperation. The research identifies *whether* games are useful, *in which part* the of the process, *based* on which conditions. To back this argument, a game is developed for the case of Khulna.

THEORETICAL FRAMEWORK

The NA was analysed to understand how the game can be grounded in its principles and embedded in its process. The NA can be seen as a set of principles that facilitate learning rather than a fixed script. A review showed that its principles are well-grounded in literature. By starting with local action and empowerment, the NA is a bridging medium between bottom-up and top-down water governance. The sequence and emphasizes of the process is highly flexible; this is both its unique strength as the cause for its abstractness. Overlapping principles make the process also less conceivable. The focus on pro-poor empowerment complicates its mediation role and makes buy-in of more powerful stakeholders difficult. A literature review showed that the NA improves IWRM by making it more need-driven, but that tools how to operationalize it are still lacking. Interviewees emphasized the need for support of the **mediation** process and **negotiation training** of communities. The tool should **democratize** the negotiation process but remain neutral. The need to support the third block that *created an environment for dialogue* was mentioned by most interviewees. Framing the game as effective 'learning tool' connected best to the perceptions of the interviewees.

In order to select the most needed and feasible function, different categorizations of functions were linked to the process of the NA. These categorizations connected to the frame which perceives games as **'learning tool'**. In addition, relevant existing games connecting to the functions of mediation, negotiation training and democratization were analysed. This showed that it is most effective to improve the 'creation an environment for dialogue' block by the mediation function. Democratization showed more a condition than a key function and negotiation training showed to be possible to combine with mediation or fulfilled by simple existing formats. The review of gaming literature showed that the game should be open and support interaction between players. Pulling the function of mediation apart into phases. showed that the game should be applied in the first phase of exploration. Therefore, the game should represent the problem less realistically.

GAME DESIGN

Khulna was selected as case. A qualitative, 'soft systems oriented' System Analysis, verified by interviews, showed that the conflicts mainly arise due to a (perceived) resources drain from peri-urban to urban areas. Urban areas depend on fresh foods and water from peri-urban areas. Urban waste end up in peri-urban areas, peri-urban public service coverage is minimal and water is salinized partially by the shrimp farming industry. In addition, fierce competition among tube-well owners and privatization of the water market leads to over extraction and exclusion of peri-urban users. The key stakeholders; farmers, the Shrimp Industry, peri-urban and urban domestic users and governmental parties, show to have ***negative perceptions of each other***. The problem is caused by ***competition over a finite common-pool-resource*** and ***lacking understanding of interdependency***. In addition, some stakeholders ***perceive the causes as externally driven***, while a review

showed that over-extraction, pollution and up-stream water diversion are major drivers of the water security crisis. Deeper aquifers showed to be salinized, while surface water is polluted by urban waste and shallow aquifers contaminated by arsenic. Moderated coordinated extraction, mixing cropping patterns, intensive rainwater harvest and a clearer spatial distinction between aqua-cultural and agricultural plots are alternatives to improve water security.

Combing previous insights showed that the game should be highly adaptable and playable with different combinations of stakeholders. The format should be playable by uneducated peri-urban water users, level the hierarchy between them and be neutral. Adding and adapting the content of the game by players should enhance the feeling of ownership and acceptance. These requirements, the combination of specific learning effects and the desired realism make that an existing format cannot be used. The problem is represented by a paper-based format with the aquifer as a single bucket and water as marbles. All players extract at once from this bucket and trade, buy technologies and negotiate to accomplish their goals. Levels can be added in which players choose to dump or clean their waste and negotiate which rules should be added to the game. Validation of the game inputs and face validation of the format shows that it represents the problem well. Five play-tests show that the format clearly shows what the problem is, improves cooperation and is playable. This makes the game a workable prototype rather than a conceptual start. However, because it is designed and tested outside the context of Khulna, without involving the actual stakeholders, redevelopment in-the-context and extensive testing is required.

REFLECTION

Synthesizing these insights, games will be most useful in the NA to experience the impact of interventions, train stakeholders to negotiate and create awareness of the problem and the alternatives within communities. Based on the scope of possibilities and inherent resources constraints of the NA, the use of existing games will be most practical for the NA. Especially the 'knowledge development' and 'empowerment' building block show potential for such games. Although initial client needs connect best to games framed as *learning tool*, games that enhance *self-organisation* connect very well to the principles of the NA and to global trends.

A quiet homogeneous interviewee selection limits the identified needs; further evaluation of in-the-field needs is required. Constraining the search to *learning tools* constrains the diversity and richness of the alternatives. It was found that most games have multiple functions in reality, which reduces somewhat the usefulness of the categorizations of functions. The absence of a rigorous local hydrological study make further validation necessary. Interviews did not include the viewpoints of public and private parties; they should be included as well. The thesis project did however deliver a **workable prototype which is conceptually strong**. The research did deliver a comprehensive review of the NA, an overview of opportunities for improvement and an advice which parts can be usefully supported by games and which not. This makes the research highly relevant for the client, Both ENDS. Providing clues for further research makes the research also scientifically relevant. In addition, the research has delivered insight to rethink the functional framework of Bots & van Daalen, Linking search strategies to the different frames of games, distinguishing the *mediation* and *democratization* functions will be valuable for future *mediation* game designers. In addition, linking the realism of a game to the different parts in a *mediation* process will make mediation games more effective.

Finally, there is recommended to redesign the game cooperatively with local stakeholders, in Khulna. The use of local game formats is highly recommended. The game can be improved by including preference maps of players, enriching the story and distinguishing individual and cooperative goals. Little effort is needed to adapt the format to the case of Kolkata, although this will require further research. Further research is required whether people will behave competitively in Khulna and hints are given how cooperation and constructive group dynamics are exactly created.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
CDKN	Climate and Development Knowledge Network
ComMod	Companion Modelling
CPR	Common Pool Resources
CSO	Civil Society Organization
DPHE	Department of Public Health Engineering
IGRAC	International Groundwater Resources Assessment Centre
IHE	Institute for Hydraulic and environmental Engineering
IWRM	Integrated Water Resources Management
KCC	Khulna City Cooperation
KDA	Khulna Development Authority
KWASA	Khulna Water Supply and Sewerage Authority
NA	Negotiated Approach
NGO	Non-Governmental Organization
PETLab	Prototyping Education and Technology Lab
RBA	Right Based Approach
RBC	River Basin Commission
RBM	River Basin Management
RPG	Role-Playing Game
UDW	Urbanizing Deltas of the World
UNESCO	United Nations Educational, Scientific and Cultural Organization
WASA	Water Supply and Sewerage Authority
WRM	Water Resources Management

1. INTRODUCTION

The chapter will explain the occasion of the thesis project, its context, its objective and the approach to reach this objective.

1.1 Context of the thesis project

Groundwater systems have important economic and social functions and are often used as water supply source in developing countries, because of their relative low extraction costs and relative high initial water quality (Foster, 2001). In the Ganges delta region in Bangladesh and India, groundwater is used as main water supply. Due to rapid urbanization and industrialization, the water security is increasingly threatened (Thissen et al., 2013). Quantities are declining through overexploitation and water quality is declining due to salt intrusion and pollution by industrial and urban waste. This increased pressure led in Kolkata (India) to unequal distribution of natural resources and exclusion of lower caste groups. The situation in Khulna (Bangladesh) led to severe conflicts between peri-urban communities and urban (public-private) water extractors. Due to the high speed of urbanization, existing institutions are not yet adapted to the situation. An institutional transformation is required.

In cooperation with local partners and research institutes, Both ENDS wants to facilitate this transformation by supporting local stakeholders in the process with the use of the Negotiated Approach (NA) (Thissen et al., 2013). The NA aims to improve *Integrated Water Resources Management* (IWRM) by making it more problem and need-driven by supporting local communities to manage their own ecosystems (Both ENDS and Gomukh, 2011). In order to improve the effectiveness of the NA to support this institutional transformation, there is a desire for concrete supporting tools within the approach. The purpose of the thesis project is to give insight in what serious gaming could contribute to the NA. The term ''serious gaming'' refers to the use of a game with another primary function than purely entertainment and was initially used by Clark Abt (Abt, 1987).

> ***IWRM:*** *''The process to develop and manage water, land and related resources in coordination, in order to maximize economic and social welfare in an equitable manner, without compromising the sustainability of vital eco-systems'' (GWP, 2000)*

UDW INTEGRATED PROJECT - SHIFTING GROUNDS

The thesis project will connect to the Urbanizing Deltas of the World (UDW) Integrated project, also called 'Shifting Grounds', but will be executed independently from it. The goal of this larger research project is to gain insight in the problem of water sharing inequity among parties in Bangladesh and India, in order to support an institutional transformation (Thissen et al. 2013). The desired result of the project is to deliver insights that will strengthen the negotiation capacities and positions of local communities. This is done by increasing the understanding of the system. The research is a practical-oriented diagnosis; the problem is already clear but the exact causes of the problem are still unclear. The results will increase the insight in the system, which will contribute to the design of the institutional transformation. The situations of Khulna and Kolkata will be compared as case studies. The UDW project is relevant because the applicability of the findings in de UDW project will determine the social relevance of the thesis research. Serious gaming is considered to be part of the UDW project to distinguish it from other research projects in innovativeness and originality. This is amongst others necessary to attract funding.

1.2 THE NEGOTIATED APPROACH

The goal of the NA is to close the gap between local bottom-up management and the governmental top-down approach (Both ENDS and Gomukh, 2011). The NA evolved in the nineties based on experiences that practices in the field of IWRM still were supply-driven, fragmented, with no integration of the user needs and struggling

to commit all stakeholders to the collective interest (Biswas, 2004, Goldin et al., 2008, Ostrom, 1990). The NA does not replace IWRM but aims to support its operationalization.

The approach is based on subsidiarity, the principle of decentralization, which states that systems need to be managed at the lowest appropriate level. For water systems, this is often the (village) community level. The NA takes this level as starting point of the process and empowers communities to participate in each part of the process. This is done by providing local communities with the knowledge, training and resources to make them able to protect their own rights, manage their own ecosystems and participate in the development of a strategic plan. Community participation cannot replace institutions that operate top down, but by connecting both layers, IWRM can become more need-driven and better implementable. The Negotiated Approach distinguishes itself from other bottom-up management approaches in its broadness and its flexibility. This *''allows local stakeholders to design their own solutions for what they perceive as their own problems''* and makes the approach applicable in different situations (Reynolds, 2008). The approach needs to be flexible, iterative and adaptive in order to be applicable in different dynamic contexts, adaptable by local parties. This makes the NA more a set of principles than a fixed script.

STRUCTURE OF THE APPROACH

Figure 1-1 gives an overview of the steps that can be identified within the NA process. Although the image shows a linear and sequential process, in practice the process is iterative. The appropriate sequence of the steps is highly context dependent. The three main blocks of the approach (A, B and C) will be further explained.

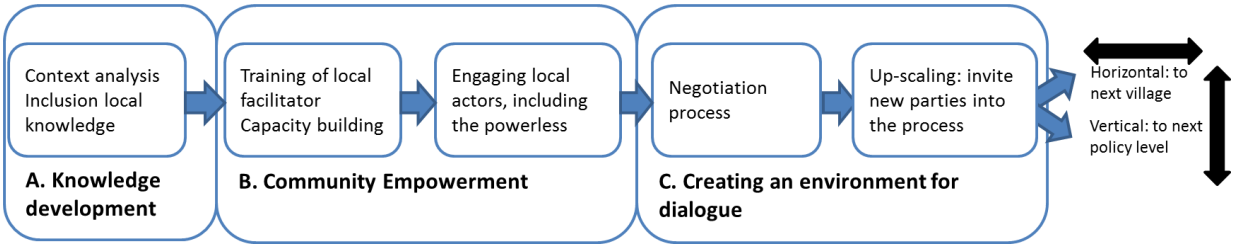


Figure 1-1: Structure of the Negotiated Approach. Based on (Reynolds 2008) **and NA building blocks (Both ENDS, 2013)**

At first, knowledge about the system is developed by (external) researchers and exchanged with the local community. This is done by analysing the physical system, the institutions and the legal framework related to the water system and by mapping the current distribution of water resources. The local community is trained in IWRM practices, the existing local knowledge about the system is identified and finally the impacts of possible IWRM interventions are studied. Second, the community is prepared and mobilized to participate in the negotiations, by enlarging the awareness of the problem and their rights, by negotiation trainings and by preparing a local leader to facilitate the process. However at first the needs and ambitions of the communities are identified. This is done in cooperation with local civil society organizations (CSO's), to make the local community aware of their rights and support them in initiating the Negotiation process. In the last step of the process, a platform for dialogue and negotiation is established; in which other stakeholders are also involved in the process. Finally, the process can be scaled-up horizontally to other communities and vertically to higher policy levels (Both ENDS & Gomukh 2011). The desired outcome of the process in the case of Khulna and Kolkata is institution building.

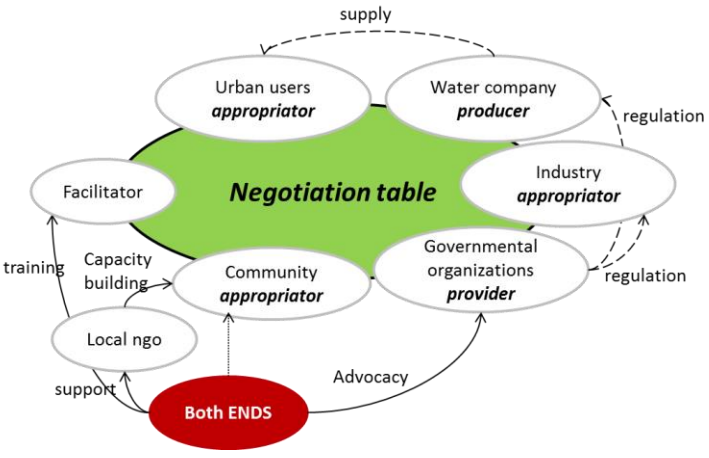


Figure 1-2: Relation of Both ENDS with the stakeholders

Figure 1-2 shows the involved stakeholders; the entities with interests in the groundwater system (Bryson 2004). The problem is a typically *Common Pool Resource* (CPR) problem, with groundwater as the CPR, since users cannot be excluded from extraction and this extraction reduces the possibilities of other users to extract (Gardner and Walker, 1994). The involved stakeholders are categorized based on this theory: *producers* deliver the resource that the *appropriators* can use. In addition, *providers* facilitate or arrange this extraction. The provider, the producer and the appropriators all need to get involved. Both ENDS depends on the local CSO or NGO to realize this and strengthen the community in the negotiations. The facilitator is a local leader and trained by Both ENDS and the ngo. Finally, Both Ends influences the provider to change the rules of the game in favour of a more equal and sustainable extraction.

Common Pool Resources *are resources that are non-exclusive (it is hard to exclude users from extraction) and rival (the extraction of one user limits the extraction possibilities of other users connected to the pool)(Gardner*

The purpose of the whole process is not only negotiation, but giving autonomy to local people as initiators and owners of the process and *''support them to get their concerns heard at higher policy levels''* (Reynolds 2008). Community participation needs to be used to proactively develop and implement the water plan, rather than just reacting on it. The goal of the approach is not to negotiate about how to split the 'pie', but rather to enhance collective learning improve communication between stakeholders. The NA includes therefore more than only negotiations, but also an analysis of the context and capacity building.

1.3 SERIOUS GAMING

This paragraph will explain what serious gaming is and why it is relevant for the NA. In addition, the limitations of applying games will be described.

DEFINITION

Salen & Zimmerman define a game as *''a **system** in which players **engage** in an **artificial conflict**, defined by **rules**, that results in a quantifiable **outcome**''* (Salen and Zimmerman, 2004). It is play, organized by rules which limit the players and give meaning to the actions of the players. A game has both an internal meaning (in soccer; winning through scoring) and an external meaning (fun, physical training…). *Serious* gaming refers to the application of games with another external meaning than only entertainment; for instance education, research or policy support. The terms 'simulation gaming' or 'policy gaming' refer to the same definition; the latter refers specifically to games applied to support policy-making (Mayer, 2009b).

While initially applied in the military, games became more popular in policy analysis from the seventies on (Mayer, 2009b). Then, the limitations of rational public decision making were recognized by multiple scholars (Simon, 1957, Druckman, 1971, Cohen et al., 1972). Games showed to be useful to incorporate both (social) multi-actor and (rational) system analytical components into the decision making. From the eighties and nineties, games were used more as tools to improve stakeholder communication and participation (Duke, 2011). Game design advanced further on due to improvements in simulation technologies and the ICT revolution and are currently used to cope with the increasing complexities in policy making.

ADDED VALUE

Serious gaming can potentially add value to the NA for the following reasons. At first, serious games are useful to handle both political and systemic complexities (Mayer, 2009b), which are both inherent to the type of issues the NA is applied to. Games do not change the complexity of reality, but offer 'a pair of glasses' to players to comprehend it better. Systemic complexity is caused by interactions between ecological, technological and social systems. Non-linearity's of those interactions and delays often lead to counterintuitive behaviour (Hjorth and Bagheri, 2006). The issues are political complex because the approach requires involvement of a broad range of stakeholders with conflicting interests and at the same time radical action. In addition, most of the

issues the NA is applied to are typically *prisoners dilemmas*[2], whereby individuals have the incentive to start behaving strategically (Straffin, 1993). Secondly, games make experiential learning possible which is a very effective form of learning, because consequences of actions can be simulated and experienced (Kolb, 1984). Games are able to help actors perceive the problem from different perspectives and enhance a paradigm shift. For instance, in river basin conflicts, rotation between up-stream and down-stream players will increase empathy between actors (Lankford and Watson, 2007). As followed, games can be used to validate actor models. This are models which analyse the relations between involved entities and their interactions (Hermans and Cunningham, 2013). Thirdly; serious games are useful to improve communication between stakeholders according to (Duke, 2011), which might reduce the gap between 'plan and practice' in IWRM. Because games can improve communication and create positive joint experiences that enhance trust, they are useful tools for creating mutual understanding.

LIMITATIONS

Serious games are models of the reality to which the learnings of the play need to be translated to. The required playfulness constrains the model; in order to keep the game playable; the number of time steps is limited. Simulation of historic behaviour is often useful to discover current trends, but in a game this would lead to passive first rounds. In addition, since gaming is real-time simulation, fast forward or backwards playing is more complicated (Meadows, 2001). This makes games more useful in delivering a conceptual framework for communication or summarization of the important interrelationships in the system rather than making precise predictions or behaviour mode projections. The inclusion of human beings in the model limits also the applicability since their information processing capacity is limited, they are fallible and their rationality is constrained (Simon, 1957). The dependency on a trained facilitator increases the risk for failure and operational costs of a game. As followed, a serious game requires relatively a longer development time than other learning methods and is therefore more expensive. Finally, games have the potential to manipulate, which raises ethical dilemmas (Barreteau et al., 2007).

Therefore, pre-research is important to find out whether other methods could enhance the desired learning effects as well. In general; games are powerful tools to trigger behavioural change by influencing the attitudes and perceptions, but are less useful to transfer (large amounts of) information or making precise predictions. Resource constraints and the mentioned limitations make *gamification*[3] of the entire process not feasible and appropriate. Therefore, the first part of the research will be devoted to identify which part of the NA is most useful to support with gaming.

1.4 PROBLEM DESCRIPTION

Although the Negotiated Approach has proven itself in practice as a valuable approach to IWRM, there is a desire within Both ENDS to improve the approach. In its current form, the method is still abstract, non-visual and complex which reduce the accessibility of it. The addition of a serious game seems promising, since it has potential to increase the learning effects by experiential learning. Simplification of the problem by a game will make it easier to handle the complex problem and communicate its essence.

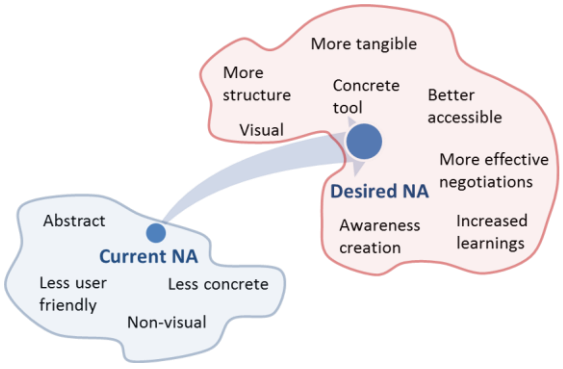


Figure 1-3: Existing and desired state of NA

The problem can be defined as the discrepancy between the current useful but less user friendly, abstract and

[2] A 'Prisoners dilemma' is a situation in which it is rational for parties to prefer their own interest above cooperation, although all parties are worse of if they all pursue their own interest above the collective interest.
[3] Gamification is adding gaming elements to a current process in order to get the advantages of games. Although the method is very popular it is despised by some game designers. They argue that the power of play cannot be enhanced by adding a layer of fun to regular educative or business activities without making game mechanisms fundamental to the activity. MCGONIGAL, J. 2011. *Reality is broken: Why games make us better and how they can change the world*, Penguin..

non-visual method and the desired improved method which is more attractive and has larger learning effects. The goal of the project is to bridge this gap **by delivering insight of how serious gaming could improve the process of the NA**. The nature of the research is practical and design-oriented, since its goal is to contribute to an intervention in order to change the Negotiated Approach, by designing a serious game (Verschuren and Doorewaard, 2010). However, the problem where the game will be designed for needs to be analysed first and the causes of it need to be diagnosed.

KNOWLEDGE GAPS

To get from the current state to the desired state, insight in the Negotiated Approach and the usefulness of serious gaming is needed. First of all, the accessibility and effectiveness of the approach needs to be improved by a serious game, but what exactly makes the approach less accessible and effective is unknown. Secondly, it is unclear what the function of the game should be, what the need for it is by current users of the approach, when and where is should be applied in the process and whether a game, in the first place is the right alternative to improve the approach. Possible functions are facilitating the transfer of knowledge about the system, empowering the community to participate in the negotiations, to learn how to manage the water resources by the local community or to facilitate the negotiation process itself. But for which function a game is appropriate and which improvement has priority, based on which criteria is unknown.

Thirdly; which conditions need to be met according to the social-cultural and political context of the UDW Integrated Project needs to be researched. Finally; a deep understanding of the whole approach, the need for it and its contribution to IWRM is required; in order to make sure the game is integrated well and makes the overall process more effective.

RESEARCH OBJECTIVES

The objective of the project is to contribute to the improvement of the NA, by delivering insight in what serious gaming could add to the approach. The project will deliver recommendations to Both Ends to what extent serious gaming can be used within the NA. A tested prototype of the game will be delivered, to support the argument how gaming could contribute to the approach. Insight in the theoretical framework of the NA is obtained by researching the fields of IWRM and CPR governance. As followed is the NA (the research object) confronted with simulation & gaming (the research perspective) (Verschuren and Doorewaard, 2010).

RESEARCH QUESTIONS

The required knowledge will be specified by formulating the main research question and specifying this question into sub-questions. The main research question of the project will be:

- ***To what extent can serious gaming support the process of the Negotiated Approach?***

This question will be answered, by answering the following sub-questions. After each question there is described which type of knowledge is required to answer the research question, categorized by (Verschuren and Doorewaard, 2010).

1. What is the theoretical framework of the Negotiated Approach? (descriptive)
2. What are the needed improvements to the Negotiated Approach? (explanatory)
3. Which improvement has priority to be improved with the facilitation of serious gaming? (explanatory)
4. What design specifications does a game need to meet in order to fulfil the selected function? (explanatory)
5. To what extent are existing alternatives able to meet the design conditions? (evaluative)
6. What structure of a game model should be developed based on the design specifications? (prescriptive)
7. What is the usefulness of gaming for the whole NA process, based on the previously gained insights? (prescriptive)?

1.5 RESEARCH APPROACH

The research approach can be explained by using the Design Science model developed by Hevner (2007), shown in figure 1-4. The cycle between the knowledge base and the designed object of grounding and contributing makes the research rigor; the research will be grounded into the theories related to the NA. The knowledge base is made visible in Appendix I, in which the used literature is clustered and linked. The relevance will be obtained by embedding the needs of Both ENDS and partners in Bangladesh into the requirements. This is done by interviewing different experts with experience with the NA and knowledge about the context. Testing the game outside its intended context due to practical considerations reduces the relevance of the research. The contribution will be providing a theoretical bases, a prototype, recommendations how to use gaming in the NA and how to finalize the game. It is acknowledged that field testing will be necessary before the game can be applied. The research consists of three parts:

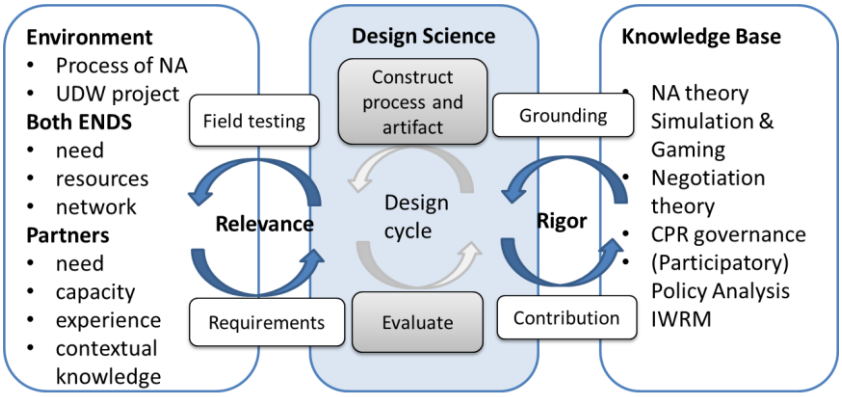


Figure 1-4: Application of Design Science Model of Hevner (2007) to thesis project

PART I: THEORETICAL FRAMEWORK

In this part, the part of the process that is most useful to support with serious gaming was identified. This was done as followed:

- Review of the theories behind the process of the NA. Reynolds (2008) was used as start since it offered a 'Policy Analysis' perspective on the NA. Then, available reports with cases were analysed (Both ENDS and Gomukh, 2005, Both ENDS and Gomukh, 2011, Both ENDS, 2012). As structure of the NA, its building blocks were used (Both ENDS, 2013).
- A review of the theoretical fields related to the NA was executed: (advice-oriented) Negotiation Theory, IWRM and CPR theory, of which Ostrom was recognized as authoritative scholar. From the field of Participative Governance, Arnstein was identified as authoritative scholar.
- Identification of the need for support, related to the parts of the NA. This was done by interviewing experts involved in the development of the NA, from (the network of) Both ENDS. All interviews were recorded, documented and verified by letting interviewees afterwards.
- To identify the usefulness of gaming and identify design conditions, there was started with reviews of the field from recognized scholars (Mayer, 2009b, Meadows, 1999, Duke, 2011, Hofstede et al., 2010). From this, functional categorizations of games were identified and compared. Bots and van Daalen (2007) was used as starting point for the review and (combinations of) search terms in scientific databases as 'simulation gaming', 'water management', 'negotiation games', 'power asymmetry', 'CPR governance' and 'NRM' were used. In addition, terms as 'Gaming Tragedy of the Commons' and terms as, The 'River Basin Game' and 'Groundwater game' are used.
- Based on the needs for support and the feasibility, determined by the review of functions, a single function was selected. Design conditions were extracted from a synthesis of the existing games.

PART II: GAME DESIGN

As followed, a set of design conditions was formulated, based on the intended context of the game and the selected function. There was investigated whether the design conditions could be satisfied with existing applications.

After the function the applicability of existing games was clear, the game was designed based on the format developed by Mayer in occasion of their game design course at the Delft University of Technology (Mayer, 2009a). This format is based on the work of Duke (Duke, 1980, Duke, 1974). It uses also insights from Bjork and Holopainen (2005) and Fullerton et al. (2004). The method is chosen since Dukes methodology emphasizes system analysis more than other methods and connects therefore better to Policy Analysis. Insights from the other mentioned scholars connect more to (regular) game design and add insights about game mechanisms to the more analytical approach of Duke. Previous experience with the method would make the design more feasible. The game was evaluated by organizing five play-tests and interviews with different experts with knowledge of the context of Khulna, groundwater systems, the selected function and gaming. The focus was on validating assumptions and face validation of the model.

PART III: REFLECTION

Finally, there was reflected on the usability of serious games within the NA and how the NA could be improved based on the findings. The social & scientific contribution was discussed and recommendations were made on how to improve the NA process and finalize the designed prototype.

RESEARCH PERSPECTIVE

The research object will be perceived from a 'systems thinking' perspective. This is a systemic, holistic step-by-step analytical approach which aims to understand the link between the whole structure of the system and its behaviour rather than breaking it down into components and analysing the behaviour from the isolated part. Mainly 'soft systems thinking' will be used, which emphasizes the process of approaching the problem and systematic structuring the different relations, interests and points of view rather than quantification of the variables (Checkland, 1989). This is based on the assumption that not all variables are quantifiable and that the perception of the problem matters. Awareness of my own perspective and a critical reflection of the effect of the cultural differences between the design and application contexts is required.

Part I: Theoretical framework

2. FRAMEWORK OF THE NEGOTIATED APPROACH

In this chapter, the Negotiated Approach will be analysed further in order to gain insight into the principles, consistency and the structure of the approach. The goal of the chapter is to answer the following question: *What is the framework of the Negotiated Approach?* Understanding of the framework behind the NA is necessary in order to understand *what* value serious gaming can add *where*. In order to identify *where* in the process the application of a game will be most effective, the different steps in the process, their consistency and their interrelation needs to be identified.

2.1 THEORETICAL BACKGROUND

Figure 2-1 gives an overview of the scientific fields that are related to the Negotiated Approach. This paragraph will describe their link to the NA. Natural Resources Management (NRM) refers to the management of resources by conserving the related ecosystems in a way future generations will be still able to meet their needs. IWRM and CPR theory also connect to this field. Participative Governance theories stem from the field of public management and describe the inclusion of stakeholders into the decision-making process, based on democratic values. Since IWRM, Strategic Management and Negotiation theory especially have influenced the framework of the NA, these will be explained in more detail.

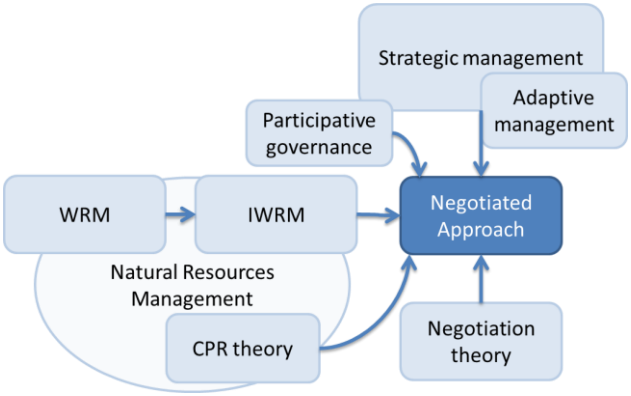


Figure 2-1: Theoretical background of the NA

IWRM

The Negotiated Approach is formulated as response to problems in Integrated Water Management (Both ENDS and Gomukh, 2011). Before the imperial period that started around the 18th century, natural resources were managed locally based on native knowledge and was managed in a holistic manner. This perspective shifted towards centralized, state-regulated governance of resources when populations grew exponentially, became more concentrated and more interdependent on resources around the 20th century. Rapidly growing demands stimulated resource providers and producers to specialize and improve economic efficiency. This resulted in more technocratic, fragmented natural resources management (Biswas, 2004). According to Biswas, the concept of IWRM existed already in the fifties, but became more dominant from the eighties on. This was due to the growing awareness that a reductionist perspective was not useful to address systems that are actually interrelated and complex.

STRATEGIC AND ADAPTIVE MANAGEMENT

The Negotiated Approach is grounded in strategic management, which helps to operationalize vague formulated policies applied to 'wicked problems'. A problem is 'wicked' if its definition changes over time, if it does not have a 'right' solution and has many (uncertain) underlying causes (Rittel and Webber, 1973). By adding feedback loops to the process for monitoring its performance, the approach aims to create an adaptive, goal-seeking behaviour. This approach is related to the idea that decision-making needs to be iterative and incremental in order to cope with imperfect information (Etzioni, 1989). Colvin et al. (2008) therefore argue that IWRM should be perceived more as a set of principles and practices that facilitate learning than as a management strategy. This exactly captures the way the NA should be perceived.
Adaptive management is *"the continually improvement of management policies by learning from the outcomes of implemented strategies"* (Pahl-wostl and Sendzimir, 2005). Pahl-Wostl & Sendzimir argue that this 'learning by doing' is necessary to cope with the uncertainties in IWRM (Pahl-Wostl, 2007). Policies in adaptive management

could be perceived as ''theories'' and their implementations as ''hypotheses''. In this way, the implementation is perceived as part of the experiential learning cycle and aims to improve the formulated policies. Conditions for implementation are that policies remain reversible after formulation and focus on improving the adaptive capacity of systems itself. Incremental, reversible decision-making will be much more difficult in processes concerning (water) infrastructure. Some examples of adaptive practices are reducing the lifetime of constructions. Other options are including more decision moments by breaking down the project in pieces or extending the functionality of constructions to functions that are not yet usable. In addition, the existence of effective monitoring and feedback mechanisms is essential for adaptive, strategic managerial approaches.

NEGOTIATION THEORY

Negotiation is the back and forward communication between parties with different interest to reach an agreement (Ury and Fisher, 1981). Basically, three traditions can be distinguished in this field; the first is an advice-oriented approach based on experiences with negotiations; Ury & Fisher belong to this category. The second tradition is based on game theory which is uses (mathematical) formal models to explain strategic behaviour of actors (Straffin, 1993). It stems from the field of economics and is also called 'Negotiation Analysis'. Amongst others, Raiffa and Young belong to this group. The third tradition is behavioural-oriented and studies the effect of the social context on the negotiation outcomes by using insights from psychology. Amongst others, Pruitt and Carnevale (1993) belong to this category. The steps in the NA that create an environment for negotiation are based on insights from the first advice-oriented approach which is called 'Principled Negotiation' or the 'Harvard model' (Ury and Fisher, 1981). The approach distinguishes zero-sum, *distributive* negotiations from *integrative*, win-win negotiations. The goal is to shift the focus from positions and distribution of a fixed 'pie', to integrating interests by enlarging the 'pie'. This means that options for mutual gain are created.

2.2 PRINCIPLES OF THE NA

This paragraph will address the values behind the approach in order to gain insight how the process is evolved from the principles. Insight in the underlying values will also help to address the need behind the function the game needs to fulfil. Figure 2-2 shows the principles of the NA; the first three principles are NA specific and will be explained in more detail.

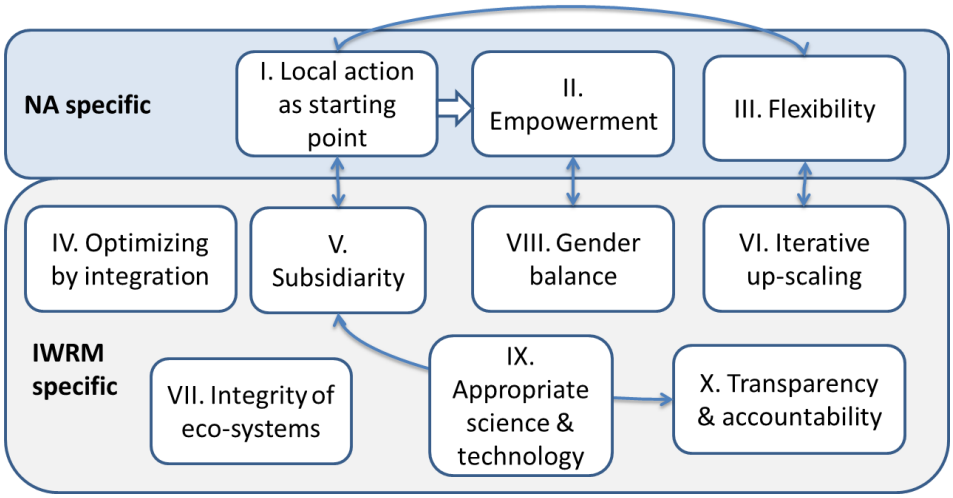


Figure 2-2: Principles of the NA and their relation with IWRM。 (Both ENDS and Gomukh, 2011)

Because the IWRM principle of subsidiarity (V) relates strongly to the first principle of the NA and the principle of transparency (X) is required to make these principles effective, they are explained in more detail as well. But first, the other principles that relate to IWRM as described by the GWP (2000) and UNESCO (2009) are shortly

explained. Optimization by Integration (IV) relates to the first of the Dublin Principles[4], which states that optimal usage of a scarce resource requires integration (GWP, 2000). The importance of subsidiarity (V) is acknowledged by the GWP, but the difference is that local initiation is not prioritized. Many scholars argue that IWRM needs to be implemented iterative, cyclical and adaptive (VI) (Pahl-wostl and Sendzimir, 2005, Anderson et al., 2008). The local initiated planning becomes integrated and applied at the river basin level by scaling the process up iteratively. This is done horizontally (including other villages) and vertically (including other policy layers). Principle VIII relates to the third Dublin Principle, which prioritizes the support of women since they have a central role in water distribution. The assurance of unbiased scientific information and the use of technology (IX) that fits into the context while taking the whole product-life-cycle into account are also recognized by the GWP. The principle of transparency is also recognized by them.

LOCAL ACTION AS STARTING POINT

Since stakeholders in water issues are often highly interdependent and cooperation is essential to prevent strategic behaviour, participation of all stakeholders is important in IWRM (GWP, 2000). 'Participation' can be defined as involvement of stakeholders into the decision-making process. The involvement of citizens in public decision-making is almost an empty concept since every policy-maker encourages it but few actually support its consequential redistribution of power. Without actually shifting influence in the decision-making process to the powerless, participation will only frustrate and demoralize citizens since it will emphasize their impotence (Arnstein, 1969). In order to become really need-driven, stakeholder involvement needs to become more than a 'tokenism' but needs to be shifted upwards on Arnstein's 'Ladder of Participation' towards 'partnership and citizen control', in which power is redistributed in a way communities can engage in negotiations about trade-offs with the power-holders. The first principle of the Negotiated Approach is that the initiative of the planning process is shifted to the local community with the assumption that the step of 'citizen power' only is achieved if the planning is not framed in advance by governmental parties. The assumption is that top-down plans by governmental parties are biased and do not reflect the users' interests. It is also assumed that there is an initial level of perceived connectedness to the CPR and initial awareness of the problem. Self-motivated initiation prevents the technocratic bias of 'solutions looking for problems' by taking the local needs as the starting point. It is likely that citizen empowerment will improve the implementation success of master plans. Dietz et al. (2003) argue that CPR governance will become more effective if the users of the resource support rule enforcement and participate in monitoring of rule compliance.

Participation without actual power redistribution only frustrates stakeholders

EMPOWERMENT

Since the success of 'citizen power' depends on the ability to self-organize and to create accountability mechanisms for community leaders, the principle of empowerment follows from participation (Arnstein, 1969). This is shown in figure 2-2. Reallocating power implies shifting control over financial and production resources, improving information symmetry and access to skills. According to Goldin et al. (2008), knowledge development is critical in participation; it is a way to increase 'production power' (De Bruijn and Heuvelhof, 2008). In addition to the mentioned forms of 'production power', communities need to get 'blocking power' which could be done by consolidation of their rights in laws (De Bruijn and Heuvelhof, 2008). Without capacity building, power redistribution will not take place. In addition, the process does not only start locally, but communities are involved in all the steps (Both ENDS and Gomukh, 2011). Leendertse et al. (2008) argue that the implementation of IWRM will be especially effective when 'powerless' groups are supported by involving them into practical projects that improve their livelihoods. This is also included in the NA process. The process also aims specifically to improve the gender balance by including women in the process.

By making community empowerment the centre of gravity of the approach the organization implementing the NA takes position and is non-neutral but pro-poor. Although this is perhaps inevitable, it might complicate their

[4] The Dublin Principles are considered as a consolidation of IWRM and were developed in 1992 on the International Conference on Water and the Environment in Dublin and state that: 1) water is a finite and vulnerable resource, 2) All organizational levels should participate in water management, 3) women play a central role, 4) water has value and is recognized as economic good.

mediator role and might increase the difficulty of acceptance finding among the more powerful involved stakeholders.

FLEXIBILITY

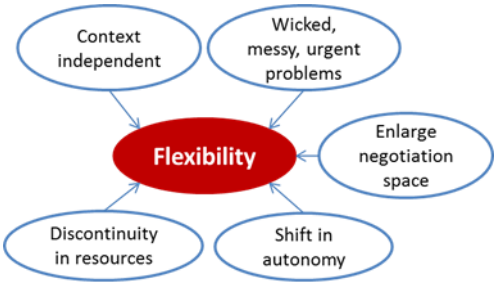


Figure 2-3: Factors that cause need for flexibility

Flexibility within the NA is required for the following reasons. First of all, the NA has to be applicable in different contexts. Secondly, CSO's need to have the freedom to shape the process themselves, since the NA aims to shift autonomy to them; flexibility therefore follows from principle I. Thirdly; the problem to which the NA is applied is *messy* and *unstructured* since there is no consensus about the knowledge and values (Enserink et al., 2010). In addition, the context is highly uncertain and dynamic, which requires reformulation of the problem definition anytime new information arrives (Pahl-wostl and Sendzimir, 2005). Therefore, the principle of flexibility is linked to the principle of iterative upscaling. The political process has *garbage can features* and is therefore dynamic and uncertain (Cohen et al., 1972). Since stakeholders power positions and interests will change over time, the approach needs to be adapted continually. Fourth of all, flexibility is required to enlarge the negotiation space. Finally, discontinuity in supply of resources for the projects often require flexible and pragmatic handling to fulfil the long-term goals of the NA.

The flexibility of the NA is as well its unique strength as the cause for its vagueness

The downside is that the obtained flexibility goes at the expense of structure, rigor, and concreteness. As explained in the introduction, these are exactly the points that require improvement. According to the working paper 'Approach with Caution' the challenge is to formalize the approach more and make the steps more explicit, *''without suggesting a fixed roadmap''* (Both ENDS, 2012).

SUBSIDIARITY

Although IWRM clearly states to support decision-making at the lowest appropriate level (GWP, 2000), its implementation is difficult. Biswas argues that decentralization conflicts with integration and the protection of the collective interest (Biswas, 2004). He argues further that institutions tend to centralize which improves integration but that stakeholder interests are not integrated as well (Biswas, 2004). It is likely that centralization reduces the affiliation providers and producers have with the users of the CPR, and mutual. Ostrom argues that communities which are most close to the resource are more able to come up with solutions that are more sustainable and effective since they will correspond more to what is actually needed (Ostrom, 1996). Because the local community is likely to pursue its self-interest above the collective interest, coordinated cooperation is still necessary to prevent a 'tragedy of the commons' and to make sure integration of needs is achieved. The NA recognizes that besides local governance, central governance is required to ensure the collective interest is served. Central governance needs to be balanced with bottom-up governance to ensure it will actually deliver value to the end-user. The valuation of the top-down policies will depend on the extent it connects to the perceived user needs. The 'bridge' of the NA aims to equate these different valuations. The NA is meant to 'bridge the gap' between local initiatives and central coordinators instead of 'burning the bridge'.

The NA is a bridging medium between bottom-up and top-down management

TRANSPARENCY & ACCOUNTABILITY

'Transparency' and 'Accountability' are important conditions in IWRM since most water governance issues are prisoners dilemma's. The stability of cooperation in these dilemmas depends on the (perceived) functioning and credibility of monitoring and sanctioning systems (Straffin, 1993). Accountability will make long term

cooperation more likely. This principle connects to subsidiarity since decentralization requires the establishment of accountability mechanisms (Gardner and Walker, 1994).

The overlap between principles makes the process more diffuse and inconceivable. Starting locally (I) is based on subsidiarity (V). Principle I and II are inseparable; without empowerment, participation cannot take place. Empowerment (II) focuses among others on restoring a gender balance (VIII). Shifting autonomy (I) and power (II) to users and up-scaling (VI) the approach, is strongly related to flexibility.

2.3 THE PROCESS OF THE NA

Having the principles as outline and the local community as starting point, the process still can take any shape due to its flexibility. A step in formalizing the approach without losing its flexibility was the creation of a set of ''building blocks'' (Both ENDS, 2012). Figure 2-3 gives an overview of the blocks with the steps of which the blocks consist, the figure is based a document of Both ENDS which includes a matrix with the activities per block and the related methods or tools that are often used (Both ENDS, 2013). Although *knowledge development* is mainly the first step of implementing the NA after sufficient support to start the approach locally is identified, the process is not sequential but can be implemented non-linear and in parallel. All elements that are represented in Figure 2-3 are relevant, but the sequentially of the process and the priority and emphasizes are context dependent. The flexibility is constrained by the complementarity of some elements; setting up a strategic platform is for instance not possible without a stakeholder analysis and community mobilization is not possible without mapping first the relations within the community. If for instance negotiations are already ongoing in the initiation phase, knowledge development needs to be done in parallel.

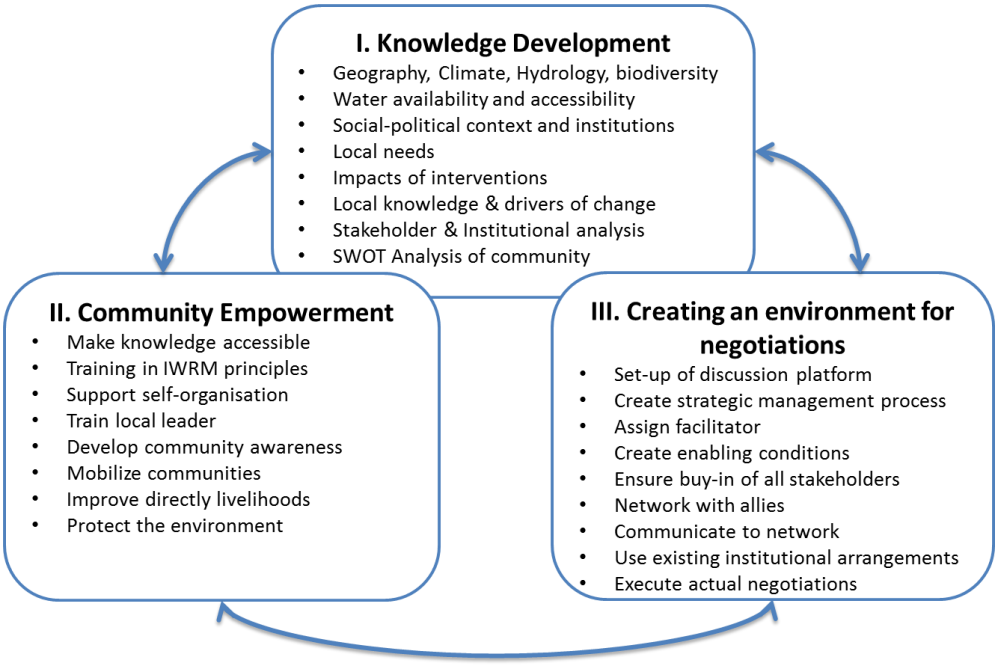


Figure 2-4: Building blocks of the Negotiated Approach.

STRUCTURE OF THE APPROACH

The structure of the approach is context dependent. According to the working paper 'Approach with Caution', the NA can be applied in any context but will get more support in contexts with weak public governance (Both ENDS, 2012). In a context with a functioning legal system which is enforced *and* complied by the government itself, the Right Based Approach (RBA) is more appropriate (Both ENDS, 2012). This approach is applied by partners of Both ENDS and supports communities in asserting their legal rights. The RBA is also used in combination with the NA, in which the RBA can create political space or improve the BATNA of the community.

This 'Best Alternative To a Negotiated Agreement' is the best option of a party if no agreement is reached; a more favourable BATNA will give a party more leverage in negotiations (Ury and Fisher, 1981).

The initial level of community organization depends on the strength of central governance, the awareness of the problem and the capacity to organize. Weak central governance will create both more need and room for local participation. It is plausible that a 'grassroots' approach in which the public is fully empowered is more useful in case of weak governance while an 'adapted approach' described by Krütli et al. (2010) in which public involvement varies between information and empowerment is more useful in cases of strong governance.

The awareness of the problem is related to the perceived connectedness with the resource, the existence of an external threat and the impact of that external threat on the livelihoods. The Negotiated Approach is often initiated as a reaction on an external threat on the environment, imposed by for instance an infrastructural project (Both ENDS, 2012). The right timing for initiation is important (Reynolds, 2008). There needs to be a 'window of opportunity' in which the political landscape is favourable and the NA as 'solution' addresses an urgent problem which is also perceived as problematic by current policy makers (Kingdon, 1984). An external threat will lead to awareness of the problem, dependent on the (perceived) connectedness of the livelihoods with the resource. Since environmental impacts at the local level will most directly have an effect on livelihoods, it is likely that there will be a delay between the problem awareness at the local level and at the higher policy level. In order to ensure that both levels 'meet each other', policy influencing and awareness creation at higher levels needs to start in parallel with knowledge development and empowerment of local communities.

CONCLUSION

This chapter aimed to answer what the theoretical framework of the NA is. The approach does not replace IWRM but supports it, by adding three principles to it and reinterpreting the existing IWRM principles. The NA distinguishes itself from other NRM approaches by prioritizing self-motivated local participation. Empowerment follows from local participation to ensure power redistribution; without it participation will remain an empty concept. Bottom-up governance is necessary to ensure top-down policies are valued locally, while top-down coordination is necessary to prevent a 'tragedy of the commons' and to ensure the integration of local actions into the larger system. The NA aims to bridge this gap. The NA needs to be flexible to provide local communities with autonomy to shape the process themselves and to broaden the negotiation space. This flexibility is the strength of the NA but also its pitfall since it complicates the formalization of the approach. In addition, the overlap between principles makes the process more difficult to understand. All blocks in the process are essential, but the emphasizes and sequentiality of the process is context dependent.

The chapter did succeed in describing the consistency of the principles of the NA but did not explain how the principles are reflected in the structure of the NA process. Paragraph 2.3 gave an overview of the factors that influence the structure of the process, although incomplete. The analysed building blocks will be used to identify *where* a game can be applied but the description of the process remains general. *Where* in the process the application of a game is most useful will be specified in chapter four.

3 OPPORTUNITIES FOR SUPPORT

The previous chapter described the structure and functioning of the Negotiated Approach, based on the principles of the approach and its underlying theories. In this chapter, the described structure will be used to identify opportunities for support. The following question will be answered: ***What support of the process of the NA is needed?*** This question aims to identify *what* the needs are and to which part in the process this need is related. The needs will be linked to the defined process in chapter 2. This will be done by describing the general required improvements, based on IWRM literature and existing papers reflecting on the approach. As followed, the needs according to different experts will be described. Finally, a synthesis will be formed of both parts on which will be reflected.

3.1 GENERAL IMPROVEMENTS FOR THE NEGOTIATED APPROACH

The Negotiated Approach emerged to cope with flaws in the implementation of IWRM, which were widely recognized. The NA aimed to make IWRM more need-driven and better implementable. The question is to what extent the NA succeeded in tackling the problems related to IWRM and which of these issues still require attention. This thesis project does not aim to design improvements for the mentioned challenges in the NA; the aim is not to improve the approach but to support a part of the process. The findings can however be used to reflect on the extent inclusion of the designed game could contribute to the general challenges.

Table 3-1; Comparison of IWRM.

Limitations of IWRM	State of affairs in the Negotiated Approach
Vagueness of concept makes it more difficult to operationalize (Biswas, 2004)	Collection of tools **improves operationalization**. It remains general. See it more as a guideline, a philosophy than a blueprint or methodology.
Weak measurability of goals & targets, (Biswas, 2004)	Quantification and evaluation of effects of the NA is also challenging (Both ENDS, 2012).
Complexity of **integration**; what to integrate and how to set boundaries to make it feasible difficult	Community still needs guidance what to integrate and where to start. Setting of boundaries challenging.
Claims for change in management practices primarily based on normative claims; **lacking scientific rigor** base	Connection to research institutes has priority, but challenging to get partners on same 'scientific' level as governmental parties (Interview, March 3, 2014,)
Few examples of successful implementations (Pahl-wostl and Sendzimir, 2005)	The NA has several successful implementations (Both ENDS, 2012)
Existence of trade-off between **integration vs. decentralization** / stakeholder participation (Biswas, 2004)	Local community initiates and is leading. Efforts to connect bottom-up with top-down might make it less of a trade-off (Both ENDS, 2012).
Actual **redistribution of power** in participation **problematic** due to lacking capacity building and ignorance of power-holders	Combination of capacity building to strengthen communities and lobbying to ensure buy-in of other parties and power-holders in negotiations.
Lacking attention on how to deal with **uncertainty** (Biswas, 2004)	Adaptive management helps to cope with uncertainties (Pahl-wostl and Sendzimir, 2005)
Solution-oriented and supply-driven instead of problem-oriented and need-driven (Ostrom, 1996) (Goldin et al., 2008)	Starts with self-motivated local action, **user needs** are **central** (1th principle).
Creation of high-level, **long-term** stakeholder **commitment** difficult (Pahl-wostl and Sendzimir, 2005)	**Long term buy-in** governmental parties remains **challenging** (Interview, March 3, 2014,, Interview, February 24, 2014,). A lack of resources for long-term capacity building is serious constraint for long-term participation (Both ENDS, 2012)

Table 3-1 provides an overview of limitations of IWRM and how the NA has dealt with these points. The NA cannot be compared with a 'general' IWRM since such a form or blue-print does not exist. The theoretical concept of IWRM has not changed significantly since the Dublin Principles of 1992, but there have been many efforts to operationalize it since then. The NA can be seen as an early adaption to IWRM which fits into this stream of efforts. The NA distinguishes itself however in its broadness and flexibility and by taking the local level as starting point rather than involving communities later on in (some parts of) the process (Reynolds,

2008). This makes the NA problem-oriented. The concept of the NA remains however abstract, but there are many examples of successful implementations (Both ENDS, 2012). In the described cases, application of the NA led to the establishment of institutions and dialogue platforms, concrete improvements in livelihoods, resolutions of long-term conflicts, the involvement of previously excluded groups and improved sustainable resources management. Some limitations are based on Biswas' reassessment of IWRM from 2004 which findings were reassessed by him in 2008 (Biswas, 2008). More recently, Butterworth et al. (2010) plead for a more pragmatic approach to IWRM. They recognize the mentioned limitations and plead for a more adaptive and service-centred approach. Their view of IWRM as philosophy rather than blue print confirms the vision behind the NA.

During a workshop in Entebbe, Uganda, which was held with Both ENDS and several partners, some strengths and weaknesses of the approach were discussed. It showed that the process needs to be formalized more. The principles are clear but the tools to operationalize them are not yet concrete enough. Other points were the need for business involvement to establish market access in some projects and a need to improve the measurability of effects of the approach. This shows that the problematic measurability of targets Biswas pointed out still holds for the NA to some extent. There is also a need for more clarity *when* to involve *which* stakeholders; decision support on this is difficult due to the context dependency of the approach. A disadvantage of the NA compared to less participative approaches is the relative long lead time. According to a program officer at Both ENDS, the process risks to be bypassed by governmental parties due to its longer duration, by appointing concessions to private parties without local involvement (Interview, February 24, 2014,). The NA recognizes that direct improvement of livelihoods is sometimes necessary to maintain involvement of communities. The time lag should be short enough, otherwise communities will revert to previously used management practices (Leendertse et al., 2008). Decision-support tools that speed up the process could reduce this risk. Another risk for the long term continuity of the NA is the increased difficulty to ensure longer term financial support. In addition, the working paper 'Approach with Caution' mentions the following general challenges:

- Strengthening of local CSO's needs priority, to teach CSO's basic management practices aimed to make them more independent.
- Dealing with power imbalances is challenging. This is also experienced in other participatory approaches. The dilemma of stakeholder participation with asymmetric power relations is that without empowerment the asymmetry inevitably will be reflected in the decision-making process. On the other hand, external efforts to shift this power balance might affect the neutrality and legitimacy of the mediating party (Barnaud et al., 2010).
- Creation of a legal and institutional enabling environment: In order to formalize the approach more, input from experts is needed about what the appropriate mechanisms are that enable effective implementation of the NA.
- There is no overview yet of instruments that address specifically environmental sustainability.

Another challenge of the NA is that the economic valuation of water was not explicitly found in the literature on the NA, although it is a key IWRM principle (UNESCO, 2009, GWP, 2000). The possibility to regulate CPR's with financial incentives needs to be at least considered since such mechanisms potentially could make the regulation more efficient (Dietz et al., 2003). Recognition of water as an economic good instead of a free good is an important step towards the development of win-win solutions in water negotiations since it makes water tradable and reframes disputes over water, since it is *"the scarcity of water and not merely its importance for survival that gives water its value"* (Fisher, 2008). Fisher discusses the use of a quantitative water allocation model to support negotiations in the Mountain aquifer under Palestine and Israeli territory. The model simulates water allocation under free-market circumstances. Fisher is aware that water markets are not perfectly competitive, tend to have natural monopolies and produce market failures such as externalities. An economic analysis to optimize the benefits obtained from water can still be useful to inform policy makers. Such quantitative outcomes of the model that represents the world more ideally than realistically are useful if interpreted qualitatively. This approach is useful if more realistic models are too expensive, too complex or not possible at all to construct.

3.2 SPECIFIC NEED FOR GAMING SUPPORT

This paragraph will assess the needs for support, based on the perceptions of different experts during interviews. The experts were asked about what they perceived as flaws in the approach and in which part of the process support was needed, based on the building blocks. Because these blocks offered a clear decomposition of the NA, they would be useful as starting point to identify the 'block' or 'part' which needed support. In addition the different game functions of Bots and van Daalen (2007) were explained and the interviewees were asked about their preferences for the functions. This categorization was chosen because it allowed to distinguish games on the most fundamental design choice; its function. The risk of biasing interviewees by showing them forms of games or creating expectations about forms would be reduced on this way. The provided metaphors with the different functions would make them easily understandable. This approach connected best to existing research on the NA; a former researcher already linked the policy roles to applications of the NA (Reynolds, 2008). Teaching or training and research were also included to broaden the possible functionality, since the categorization of Bots and van Daalen (2007) was limited to the field of policy analysis while the process of the NA also relates to educative and research-oriented fields.

Table 3-2: Comparison of game preferences

	Interviewee	Desired applications	Function	Desired effect of application
1	Coordinator water at Both ENDS, December 12,2013	Community empowerment, negotiation game	Mediation, support actual negotiation process	Learn about interest other stakeholders
2	Programme officer at Both ENDS, January 30, 2014	Double layered game; simple training part and more complex negotiation part	Negotiation training, knowledge transfer	Mastering negotiation skills, increased understanding trade-offs and perspectives other stakeholders
3	Programme officer at Both ENDS, February 24, 2014	Tool to balance power differences, effects of different options,	Decision-support, to level power imbalances	More consensus, more equity in the process. more accepted outcome due to neutrality of tool, time-savings
4	Programme officer at Both ENDS, March 3, 2014	Support of building block III, 'creation of enabling environment'.	Mediation, decision-support	Consensus creation, support of the process on a way it connects to the role of local governance

Table 3-2 gives a short overview of the interview results, a more elaborate overview can be found in Appendix II. The first three experts from Both ENDS stated that priority for support lays in the third block of the process, which aims to enable an environment for dialogue. Another interviewee stated that the required support in block I and II depended on the competences of the partner organization and on the context while there is in general always a need for support in block III (Interview, March 3, 2014,). All respondents emphasized that the importance of each step in the NA is context dependent. The third interviewee stated that insurance of buy-in for all stakeholders is most crucial. However, another interviewee emphasized the importance of the 'community empowerment' block and showed a preference for a training game, which could train both local actors as governmental actors how to participate in the negotiation process. According to him, negotiation skills are on both levels often lacking and there is a need for a training method.

Negotiation training, support of the actual negotiation process or decision-support to level the power asymmetries is related. An employee from Both ENDS proposed a double-layered game, with a simple and a more complex layer; the simple layer would be purely for training purposes and could be extended with a more complex layer which could be used in the actual process and could include scenarios. Advantages are that the simple training tool can be generalized and made applicable to multiple contexts. The representation of the physical system in the tool could be based on a 'tragedy of the commons' metaphor, since the approach is always applied to a CPR problem.

3.3 CONCLUSION

The chapter aimed to identify the needs for support of the process and to answer the question *what the needs for improvement of the Negotiated Approach* are. A comparison between the Negotiated Approach and a literature review of IWRM showed that the implementation of the NA has improved the concept in making it more demand centred, although some challenges remain. Perceiving IWRM more pragmatically as a philosophy rather than a methodology or blueprint as the NA does is likely to improve the applicability. Issues as setting boundaries and coping with the managerial complexity of integration remain challenging. There should be noted that the added value of the comparison is limited; a limited review of IWRM literature was done and there is no such thing as the 'generic or common' form of IWRM against which the NA can be compared. The review might be however useful to evaluate the effect of the game on the whole NA shortly, in chapter seven.

After the interviews it was realized that all respondents worked on the strategic level, while more operational information was needed to identify implementation problems that could be tackled by gaming. Two experts mentioned that it would be more useful to interview partner organizations, since the preferred game function would depend on the context, the available local resources and the capacity of the partner organization. The interviews were useful to identify general flaws and general contextual variables that determined the structure of the process, but less useful to get information about the usefulness of gaming in a specific context. Nevertheless, the desired applications can be narrowed down to the following options:

- To mediate, the game supports the negotiation process (Interview, March 3, 2014,) (Interview, December 16, 2013,).
- To democratize, the game improves equity in contribution to the decision-making process (Interview, February 24, 2014,).
- For training; the game improves the negotiation skills of the involved stakeholders (Interview, January 30, 2014,)

The following research will be narrowed down to the three mentioned options, of which one will be selected in the fourth chapter. The reflection after the game design process will diverge shortly again and reflect on how the findings could contribute to the whole NA process.

4 POTENTIAL ADDED VALUE OF GAMING

The aim of this chapter is to give insight in the potential contribution of serious gaming to the NA, by relating insights from the structure of the process (chapter 2) to the needs for support (chapter 3), with an overview of the feasible functions. The chapter aims to answer the following question: *Which of the identified improvements can be supported by serious gaming?* In addition the question *which improvement has priority* is answered. Statements can only be made about the *potential* added value. The actual contribution can only be evaluated after using the game in the intended context, with the intended players, which is not in the scope of this research.

4.1 GAME DEFINITIONS

First of all, a clarification of important concepts related to game design will be given. Many scholars have tried to grasp what 'play' actually is, of which Huizinga is the most famous scholar. He states that play has the function to *'transcendent the immediate needs of life and impart meaning to the action', by* stepping outside reality and allowing the creation of an own reality (Huizinga, 1938). Play is thus separated from reality in time and space. He argues further that it is *the* natural way in which humans tend to evaluate the relationship between actions and effects (Salen and Zimmerman, 2004). According to Huizinga, play has an important social function in conveying language, culture, traditions and behaviour. The quality of play lays in its freedom. Play is inherently voluntary; motivation is prerequisite. Play is also something elusive, it emerges from the interactions between entities, objects and their environment, based on the rules which define the relation between the objects at play. It is therefore not possible to validate actual gaming effects outside their intended environment and without their intended players.

A game is organized play and therefore separated from reality. Figure 4-1 shows the relation. Game design creates a model of reality. Stahl defines a game as a model (Ståhl, 1988), which can be defined as a simplification of reality in order to analyse the reality in a more efficient manner. This simplification is done by selecting a part of reality that is under study as result of an problem. In addition, the selection is abstracted from reality and idealized to gain efficiency. Games are models of (human) interaction in which the rules are selected, abstracted and idealized; they set the boundaries of the represented system and assign meaning to the elements. Serious gaming presumes the possibility to translate the learnings obtained in the game back to reality; the meaningfulness depends on the quality of this translation. The translation is performed in the 'debriefing' (figure 4-1). All models are however imperfect representations of reality since they are simplifications and should therefore be judged on their usefulness in serving their designed purpose (Sterman, 2002). Games should be judged more on their ability to achieve their learning objectives than on their predictive validity (Peters et al., 1998a). The validity of the game will be further discussed in paragraph 6.6.

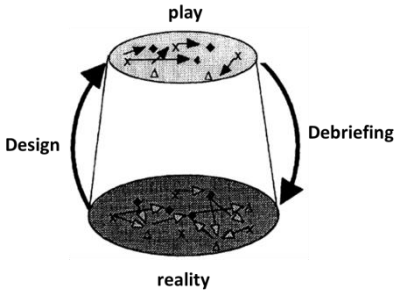


Figure 4-1; Relation between play and reality: based on (Peters et al. 1998)

Games are often confused with simulations, which *are ''imitative representations of the functioning of a system, by means of another (simplified) system'',* according to the Webster dictionary[5]. All games are simulations but not all simulations are games (Salen and Zimmerman, 2004). Simulations do not include play; they are not shaped by rules and therefore have no internal meaning. A simulation game can be created by including human decision-makers into the simulation, giving him/her objectives and limiting his/her actions by rules. In reality, the distinction between simulations and games is less absolute and more fluent. The distinction is however mentioned because pure simulations will not have the benefits of 'play'.

[5] Simulation. 2014. In *Merriam-Webster.com*. Retrieved June 18, 2014, from http://www.merriam-webster.com/dictionary/simulations

4.2 CATEGORIZATION OF GAME FUNCTIONS

In order to specify the added value of serious gaming for the Negotiated Approach, first a categorization of possible game functions will be chosen. These are in advance related to the steps in the NA. This will also structure the comparison between existing applications. A more comprehensive table of existing applications can be found in Appendix III.

FRAMING PERSPECTIVES ON GAMING

Before categorizing functions, it is useful to frame games based on the perspective or 'Weltanschauung' from which they are developed (Mayer & Warmelink). Making this frame explicit is important because it says a lot about the underlying assumptions and criteria behind the game. An interventionist perspective presumes to have influence on the problem and that it can be tackled (see figure 4-2. 'Evolutionists' presume to be part of a larger flow and perceive the problem as mainly externally driven. A realist perspective aims to see the world 'as it is' while an idealist perspective aims to see the world more 'as it should be'.

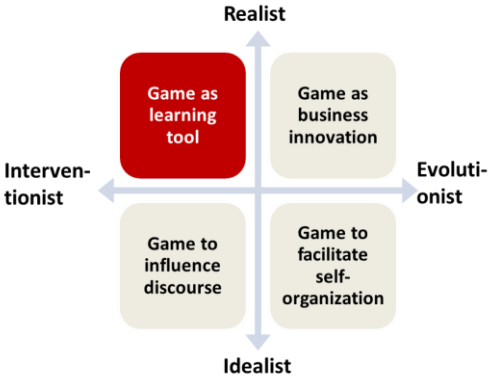


Figure 4-2: Perspectives in serious game design: (Mayer & Warmelink, lecture notes)

The game is perceived as an effective, innovative 'learning tool'. The tool is used to intervene based on the belief that the NA can change the current inequity in water sharing. The underlying goal of the NA is to enhance collective learning. Games are perceived as effective tools to support this ''learning process''. Learning will allow power redistribution and enhance integrative bargaining. Interviewees emphasized that the tool the negotiations should be perceived as learning process. In addition, there was stated that the game should be *''neutral''* and *''not frame or steer the process too much''* (Interview, December 16, 2013,, Interview, February 24, 2014,). The NA shows to be developed from a realistic perspective and statements of interviewees connect better to the 'learning' perspective than the 'persuasive' or 'idea influencing' perspective. The pitfall of this perspective is that the actual learning effects might not be measurable (Mayer & Warmelink, 2014). This will be further discussed in section 6.6. The review of existing applications will be narrowed down to games that fit the 'learning perspective', since these fit best to the client (Both ENDS) needs. (see also section 1.4).

COMPARISON OF CATEGORIES

Many different categorizations of game functions are made in the past and are possible to make. By comparing some categorizations, insights about possible applications, their differences and similarities can be extracted. Here, a choice has been made to categorize games based on their function since the function is the most fundamental design choice (Salen and Zimmerman, 2004). With *function,* the mode of action by which the game fulfils its purpose is meant while with *purpose,* the intention or meaning why a game is created is meant (Rosenman and Gero, 1998). The learning effects follow from the function and relate to the behaviour of the 'game system'; learning effects are the result of how the game *''acts under specified conditions or circumstances'',* in relation to the players. Presumed is that a game has a single function and can have multiple desired learning effects.

Geurts and van Wierst (1991), Mayer and Veeneman (2002), Bots and van Daalen (2007) and Geurts et al. (2007) all distinguish games based on their function, but their categorizations are based on different perspectives (see table 4-1). Geurts & van Wierst base their categorization on the field of application while Mayer & Veeneman focus only on games applied in infrastructural projects. Bots & van Daalen use the different roles policy analysts can play as categories and Geurts et al. look at the actual contribution of games. The later relates more to the learning effect of a game, but since their categories are still abstract, they are still considered as useful. Only categorizations of policy games are included since applications in this field are most relevant to

support the NA process. Further on, there are more 'non-policy gaming' oriented categorizations. The site ''serious.gameclassification.com[6]'' for instance categorizes over three hundred serious games, but is not restricted to ''learning-oriented'' policy supportive games. Caillois (1958/2001) classifies games based on forms of play (competition, chance, simulation and vertigo). Such a categorization will be less useful for policy oriented games since the play element used does not directly relate to the purpose of the game. The game elements fall under the form of a game. Because form follows function (Duke and Geurts, 2004), it will be more useful to categorize policy games based on their function from which the intention of the design can be deduced. Since the taxonomy of Maier and Größler (2000) includes also modelling-oriented simulations and the intentionality cannot be deduced from their categories, their categorization will also not be used. Finally, Mohammed and Pruyt (2011) also categorize games but their categories are less comprehensive and overlap with the mentioned categories in table 4-1.

Geurts and van Wierst (1991) mention three different categories of game functions: research, teaching and policy support. With research, a game is used to collect data of a reference system on a more efficient way than by collecting it in reality. The game stimulates participants to behave as in reality; the predictive value of the game is positively related with the realism of the game (Green, 2002). Applying games as validation tools also relate to this function. An example is the use of a role-playing game to validate the related agent-based model (Castella et al., 2005). The second category are as conveying medium; as teaching or training tool or to raise awareness. The game creates the environment to learn experientially. Examples are the Levee patroller, which is a game used as training tool for dike inspectors (Harteveld et al., 2009).

Table 4-1: Policy games categorisation

Author:	(Geurts and van Wierst, 1991)	(Mayer and Veeneman, 2002)	(Bots and van Daalen, 2007)	(Geurts et al., 2007)
Categorized on:	Field of application	Applications in Infrastructural projects	Policy analysis activities, based on analyst roles (Mayer et al. 2004)	Actual contribution, based on evaluations of game sessions
Categories	Research Teaching Policy support	Research Learning Intervention	Research & Analyze Clarify values and arguments Design & Recommend Mediate Democratize Strategic advice	Communication Complexity Consensus Creativity Commitment to action

Another example is KARKNONSZE, which aims to teach students about environmental conflict resolution (Krolikowska et al., 2007). In the third category, a game is used for policy support; it creates conditions in which participants can explore different policy options (Peters et al., 1998a). The game functions considered by Bots and van Daalen (2007) and Geurts et al. (2007) correspond to this category, since they primarily aim to support Policy Analysis activities. Geurts et al. (2007) categorize games on their actual learning effects. Games that help to handle complexity help participants to see the bigger picture and to learn how the system works. Games that enhance communication help to get participants 'on the same wave length'. Games that enhance creativity help participants to think out-of-the-box and imagine the in-imaginable. Games that create consensus help participants to look beyond traditional options and reframe the situation from zero-sum to win-win. Games that enhance commitment to action, give participants a sense of urgency and build the confidence that change can work.

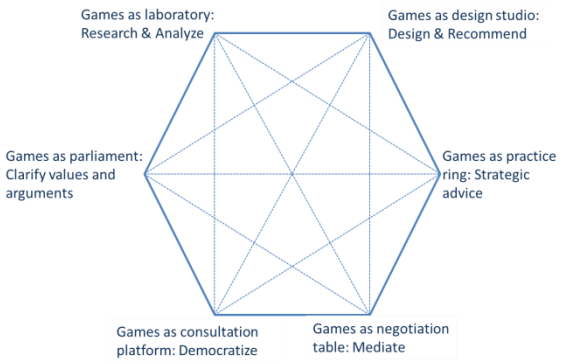


Figure 4-3: Categorization of game functions for policy support. Source: Bots and van Daalen (2007)

[6] http://serious.gameclassification.com/EN/games/index.html?display=taxonomy

Bots & van Daalen relate the six activities policy analysts can undertake to game functions (Mayer et al., 2004). The upper half of the activities are more object-oriented, while the Figure 4-3 shows that a game can be used as 'design studio' by stimulating participants to enter an open mode that enhances creative problem solving (Tassoul, 2009). *Gamestorming* is a term for applying games to facilitate such creative processes (Gray et al., 2010). The metaphor of a game as 'laboratory' corresponds to the 'research category' of Geurts and van Wierst (1991). A game as 'practice ring' is designed for a single stakeholder to experiment with his/her strategic interdependency with other stakeholders, by playing different strategies. Games based on game-theoretical models of the Cuban Missile Crisis are examples of such games (Straffin, 1993). A game as 'negotiation table' can be used as 'consensus creating vehicle' in the formulation phase of the policy design cycle (van Daalen et al., 2002). This category aims to enhance communication between real stakeholders about an artificial problem and is based on the assumption that communication improves cooperation. Examples are the River Basin game of Lankford and Watson (2007) and the irrigation game applied in Bhutan (Gurung et al., 2006). Games as 'consultative forum' stimulate equal access for all stakeholders to the process and inclusion of all views and opinions by levelling hierarchies between players, to allow previously neglected people to speak more freely. A game as 'virtual parliament' can be used to make values explicit and clarifying underlying reasoning. When playing a role, positions and opinions of stakeholders can be magnified and identified more easily and the game can for instance reward players for their clarity or quality of argumentation.

4.3 RELEVANT EXISTING APPLICATIONS

The exploration of existing applications makes the exploration about the applicability of games within the NA more concrete and will help to discover design conditions. The overview can also help to determine whether an existing game can be used for the function that will be prioritized. The main selection criterion is the **relevance** of the game for the problem and the NA process. Games that are applied to CPR/ prisoners dilemmas, have the function of *democratization*, *mediation* or *negotiation training* are relevant. Relevant games for the NA process have themes as 'participative water governance', 'empowerment', 'capacity building' or themes clearly related to the steps mentioned in the NA building blocks (see figure 2.4). Other relevant themes are 'institutional building', 'conflict resolution', 'urban waste' or 'peri-urban management'. Primarily, **scientific databases**[7] are used for the search. Selected applications are thus peer-reviewed, described in a consistent way and underpinned by existing theories. A limitation of this approach is that only scientific relevant applications will be discovered, while 'non-serious' games with a social relevance but a less clear scientific contribution might be as well valuable for the NA. Implicitly, another criterion is '**findability**'; the game should be traceable by terms related to the mentioned relevant themes (in scientific databases). Appendix III provides a broader overview of existing games. Finally, games will be selected based on **diversity** in their format and functionality, to create an impression of the scope. Diversity relates to the use of technology, a (non)digital format, realism, complexity or context of application.

NATURAL RECOURSES MANAGEMENT GAMES

Fish Banks is *the* classic example of a game based on a CPR problem, in which players (individual or in teams) manage fishing companies and experience a 'tragedy of the commons' (Meadows et al., 1986). Since it is in each player's rational interest to expand their fleets to maximize profits, extraction will exceed the carrying capacity of the 'common pool' of fish till it will be finally depleted. The game exists in many forms; from simple board-games to single-player online games or advanced multi-player simulations. By dividing players in teams, emphasizing the aim of profit maximization, most players will start behaving competitive which will be inevitable followed by a collapse of the resource. The timing of the collapse will depend on the initial stock, the regeneration rate and the initial extraction capacity. Additional rules on the expansion of extraction capacity (fishing boats) and information transparency influence the timing of collapse as well. The speed of the depletion of the resource is in general proportional to the level of competition between players. The power of Fish Banks lays in its simple format while it's debriefing potentially can enhance understanding of the interdependencies and in-depth discussions on rule-compliance and monitoring mechanisms. When these learning effects are desired, the concept of Fish Banks will be very useful for the NA. By adapting the CPR of 'fish' to the case-related

[7] Google scholar, Simulation & Gaming Journals, Sage Publications, ISAGA / NASAGA

CPR and integrating it into a story, successful translation of the lessons to reality will be more likely. The function of Fish Banks is typically to create 'systems understanding' (Meadows and Sweeney, 1995), but its debriefing can trigger discussions on design options and enhance negotiations as well. While 'systems understanding' connects to the block 'knowledge development', the concept could be also valuable for 'empowerment', since the ability to propose alternative options will improve the power position of communities (Interview, March 3, 2014,).

The **River Basin Game** is a RPG which aims to support a process of *mediation* for water equity in river basins (Lankford and Watson, 2007, Lankford et al., 2004). Farmers are the main target group. The game has been applied in different contexts in Africa and South Asia. The objectives of the game are: 1) to create understanding of the system (for both the stakeholders as the researchers) and 2) to facilitate discourse and negotiations between users. The basin is represented by a board with a gradient and water by marbles. The board represents a simplification of the river basin for which it is meant and is built and validated on location. Players place sticks in the board to guide the marbles to irrigation fields. They can use their own experience as farmer in different scenarios. Wet and dry seasons alternate and capacities of the irrigation intakes can change as well. In addition there are three strategies: individual water-seeking (competitive), individual money-seeking (side-payments allowed) and community-based sharing (cooperative). The game is structured as followed:

Figure 4-4; River Basin Game.
Source: http://www.youtube.com/watch?v=9MUGQ5whQZA

1. Farmers are separated in up-, middle- and downstream groups, based on their real position.
2. Then the groups have 10 min. to decide where they would like to farm; representatives will then run to the board to claim the spots, which is used to engage the players.
3. The groups get 35-45 min. to play according to each strategy and discuss the effects.
4. Finally, players are asked to identify (real) problems and propose solutions according to the available resources. The solutions are then clustered and prioritized.
5. Players fill in an evaluation questionnaire to assess their understanding and ask how the game could be improved.

The concept of the River Basin Game is applied as community empowerment tool, to create understanding and prepare communities for negotiations.

UNESCO-IHE uses the **ShaRiva** simulation game which is used to teach students and policy-makers about the challenges of negotiations in trans-boundary river basin management (Douven et al., 2014). The game is loosely based on the Mekong river basin. The participants are divided to represent the less developed, upstream Sha-country or the more developed downstream Riva. The goal of the game is to reach consensus on projects both countries want to implement which mutually influence the two countries. The effects of the measures are simulated with a hydrological model made in SOBEK, a modelling program developed by the water institute Deltares. Players experiment with measures separately and use the insights in several negotiation rounds. The goal is to come to an agreement. Strengths of the game are the level of detail of the context description, the openness of the negotiation process and the possibility to experiment with a hydrological simulation model. The simulation model remains however a 'black box' and the negotiable measures are constrained by the programmed options. The emphasizes on background information and procedures balances the format towards 'reality' at the expense of 'play'. In the session I participated in, emphasizes was put on the representation of the physical system by descriptions, impact assessments and a simulation model. Less effort was put in getting students into the role of organization representatives. Subtle elements like batches with names could have immersed players a bit more. Inclusion of game elements like a currency to finance measures and side-payments and time pressure could also make the approach more playful. In addition, more learnings could have been harvested during the debriefing. Asking players whether they experienced 'distributive' or 'integrative'

bargaining and what would have been needed to make the negotiation more 'integrative' would have been meaningful. However, it is likely that the intended target group (middle-level technical representatives) will be absorbed more quickly in the roles than students since they would recognize the procedures. There should been noticed that the findings are based on a single three-day experience with the simulation game (Appendix II.A), which limits the generalizability of the mentioned strengths and weaknesses of the game.

Another category of existing applications are simulation games developed by **Tygron**, who use a spatial planning software platform to help payers in 'seeing the bigger picture' of complex planning challenges. The function of games made by Tygron is *decision-support* rather than *learning*, according to Warmerdam (February 2, 2013,), in an interview with 'gamer.nl'. The platform allows customization of the environment by clients and let players experience the effects of options. The **'Mekong Delta game'** and the **'Climate game Rotterdam'** are examples which stimulate participants to immerse into the context of the problem and experience the consequences of different alternative solutions to the problem, under different scenarios. The focus on decision-support and the high technical requirements are less suitable in the contexts the NA is applied. Nevertheless, the example gives an impression of the scope of possibilities.

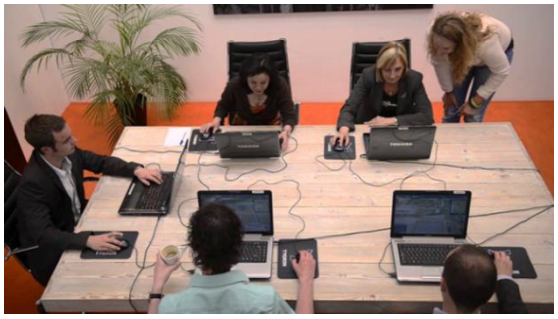


Figure 4-5: Setting of 'Climate game'. Source: http://www.youtube.com/watch?v=s3q_i8fVPEI

MEERVISIE is a simulation game to support a spatial planning process of the Dutch lake 'IJsselmeer'. The goal is to discover how to cope with different interests and demand/supply fluctuations during different seasons (Uithol et al., 2001). The game has the form of a RPG and representatives play their own roles. They have to form a common vision on how to invest resources in different functions in the region. While Bots & Van Daalen (2007) frame the game as *mediation* tool, Ubbels and Verhallen (2001) emphasize more the *clarification* function because it helped the stakeholders in forming their vision and goals on the management of the IJsselmeer. An explanation for the different visions on the function might be that functions are in practice more blurred and depend on the players and the facilitation. The vision forming concept of MEERVISIE can be used in the empowerment block of the NA. However, the interviewees mention no need to support community vision building, because partners already use tools for this.

NEGOTIATION SKILL TRAINING GAMES

Strike Fighter is a tool that teaches players negotiation skills and learns them to reflect on their own skills and is developed by the Polish company 'Pracownia Gier'. In a military scenario, players negotiate on the purchase of strike fighters. The game is based on negotiation theories of Ury and Fisher (1981) and Thomas (1974), figure 4-6 shows the theoretical model behind 'Strike Fighter'. Ury & Fisher argue that each negotiator has substantive interests (concerns for the outcome) and procedural interests (concerns for the relationship). Based on these dimensions, five negotiation styles are possible. Players experiment with all the five styles in order to learn that the collaborative style will be most successful. Richard Shell however argues that the best style will depend on the professional setting and the style of the other party (Shell, 2001). The concept will be useful to train communities. According to an expert of the NA, there is especially a need for such a game since both community members and governmental agencies often lack negotiation skills (Interview, January 30, 2014,). Training of both sides with the 'principled negotiation' method will make the process more likely to succeed since it improves collaboration mutually (Ury and Fisher, 1981).

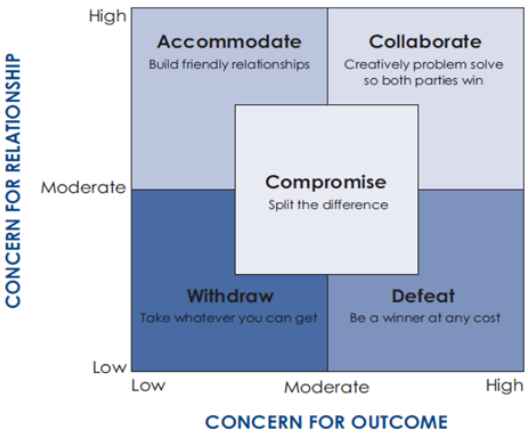


Figure 4-6; Theoretical model behind 'Strike Fighter'. Source: (PracowniaGier, 2009)

Another game that is used to teach negotiation skills is the **Two Dollar Game**, developed by Prof. Mary Rowe from MIT[8]. The game works as followed: the group is divided into pairs and each one gets a *general instruction* to divide two dollar and each individual a *secret instruction* which will tilt each player towards competition, accommodation or compromise. From the general-rule perspective, players will tend to split the dollar in half, but the 'secret instruction' will change the game. The individual instructions relate to reputation, the amount of money a player must win or an assigned negotiation style of the Thomas – Kilmann model, shown in figure 4-6 (Thomas, 1974). The game lasts three rounds, but this is unknown for the players. Based on the game, the participants will learn about distributive (win-lose), integrative (win-win) and mixed motive bargaining. Other concepts as the BATNA and the 'Reservation Point' are also explained with the game. Based on the manual, the game seems simple, effective and potentially engaging, but particularly useful when integrated in a lecture series. It will be more difficult to debrief the game by relating all the mentioned theories to the game if the participants are not yet familiar with the terms. Integrated into a capacity building workshop and by choosing an appropriate local metaphor for 'two dollars', the game might be more useful to train community and governmental officials negotiation skills. 'Strike Fighter' seems to enhance more practical negotiation skills and styles while the 'Two Dollar Game' seems to be more useful to address different negotiation theories.

KARKNONSZE was primarily designed for educating about negotiations in NRM cases; the secondary goal of the game was to enhance the public dialogue of the existing conflict, were the role playing game was based on (Krolikowska et al., 2007). Students interviewed real stakeholders and represented the real stakeholders in the negotiations. The real stakeholders were afterwards involved to judge the accuracy of the simulation. An intended side-effect was to confront the real stakeholders with the outcomes of the negotiations in another setting than in reality. Based on the results, the game succeeded in immersing students in the role of stakeholders and learning them about negotiation and the underlying problems of the real conflict. The game did not succeed in stimulating the public debate, since stakeholders stuck to their own viewpoints, kept negotiating on positions and failed to separate people from problems. The case shows that negotiation games run the risk of consolidating initial stakeholder viewpoints which might reinforcing strategic behaviour. This might be prevented by creating sufficient distance with a metaphor and role reversal.

COMPANION MODELLING

There is reflected on the potential value companion modelling could add to the Negotiated Approach, since this modelling methodology has been applied successfully in different NRM cases, similar to the cases in which the NA is applied. Companion Modelling (ComMod) is an approach that was initially developed by Bousquet & Barreteau, connected to CIRAD, a French agricultural research centre which does amongst others research in developing countries. It combines participatory modelling with Role Playing Gaming (RPG). The RPG serves two functions:

1. To create knowledge by researching the behaviour of the agents played by the stakeholders; these insights are used to improve the model.
2. To convey knowledge and enhance collective learning, to support the decision-making process.

The approach uses a RPG based on an agent-based model to enhance a discussion among the stakeholders, in order to validate the agent-based model (ABM) and incorporate local knowledge into it (Janssen, 2005). ABM is a bottom-up modelling perspective that takes 'agents' as building blocks which interact according to a set of rules . 'Agents' are decision-making entities with properties such as preferences and decision-rules. It is used to explain the emergence of macro-level behaviour from the interaction of a heterogeneous set of agents on a micro-level. By changing rules, the system behaviour can be improved. The objective of companion modelling is to facilitate collective learning in order ''strengthen the adaptive management capacity of local

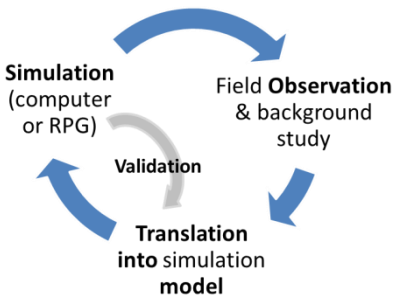


Figure 4-7: The ComMod process

[8] More examples of negotiation simulations and documents related to the 'Two dollar game' can be found on the Open Courseware site of the MIT. The manual can be found here as well. http://ocw.mit.edu/courses/sloan-school-of-management/15-667-negotiation-and-conflict-management-spring-2001/lecture-notes/ (Last access October 2, 2014)

communities''. Figure 4-7 shows the modelling cycle; at first the system is analysed by field observation and literature studies to formulate hypotheses that explain the system behaviour. As followed, a simulation model is build based on the gained insights. Finally, the model is validated and community discussions are supported by executing a RPG based on the simulation model.

Companion Modelling was applied in **Bhutan,** to support water sharing between villages which depend on small-scale mountain agriculture (Gurung et al., 2006). This case is mentioned because it shows how games successfully can improve communication in asymmetric power relations. The design of the game was based on an extensive primary and secondary data analysis. The game was played by real farmers who wanted to maximize their returns; the irrigation scheme was physically represented by a wooden game board; cards determined rainfall (before the round) or market prices (after the round). The exchange of water for labour or cash was allowed. As scenarios, three forms of communication were used: within villages (intra), between villages (inter) and by changing the roles of villages. Learning effects were measured before and after the two game sessions with questionnaires; the game increased the understanding of social interdependency between villages, economic valuation of water share and the benefits of water management. Through the game, the villagers realized that the current water sharing behaviour was based on implicit (traditional) rules that only stimulated inequity and they were able to identify and negotiate adaptions to the rules. This was done over a time span of several years and several gaming sessions.
The AguAloca role-playing game was used in Sao Paulo (Brasilia) as a didactic tool, to help players understand the interdependencies between different factors in IWRM (Clavel et al., 2008). The game also helped the players to connect social aspects with technical aspects and to understand the roles and interests of other stakeholders. In addition, needs for capacity building and negotiation skill improvement could be identified. This example is relevant for the NA as empowerment tool.

A strong point of ComMod is its integration of RPG's into larger research projects, which benefits the perceived seriousness of the RPG and therefore the willingness to play. The built in validation cycles of the agent-based model and the RPG make the process scientifically rigor and the back-and-forward cycling between field-testing and modelling make the process adaptive. The approach has been implemented in many different contexts but is still more formalized than the NA. However, ComMod does not necessarily start with local initiation and does not prioritize to empower communities to participate in the entire process. With emphasizes on research, ComMod fundamentally differs from the principles of the NA. The process is more formalized because it requires less flexibility than the NA. No autonomy is shifted towards communities and not all ComMod cases require room for negotiating among power asymmetrical relations. Relatively more top-down involvement reduces the discontinuity of resources. Based on the literature review, a broadening in functions of the applied RPG's can be noticed, from a focus on research towards mediation with more emphasizes on democratization and dealing with power asymmetries (Gurung et al., 2006) (Barnaud et al., 2007) (Barnaud et al., 2010) (Barnaud and Van Paassen, 2013). This makes the ComMod method more interesting to be applied within the NA.

4.4 RELATING THE PROCESS TO FUNCTIONS

The categories of game functions explained in paragraph 4.2 are linked in figure 4-8 to the different building blocks of the Negotiated Approach. Games that improve the handling of *complexity* by showing the bigger picture will be useful to support all the blocks. In the third block emphasizes lays on multi-actor complexity and in the first block on system complexity. The *research* function link clearly to the 'knowledge development' block, since they aim to analyse the problem, map the physical- and social system and integrate the traditional knowledge into the research. This identification of local knowledge aims also at mutual *learning*, but primarily is meant to describe and include knowledge. *Design & recommend* and *creativity* can be used to find solutions to improve local livelihoods which will empower the community. Design of options is also a part of the negotiation process, which will be described in 4.5.

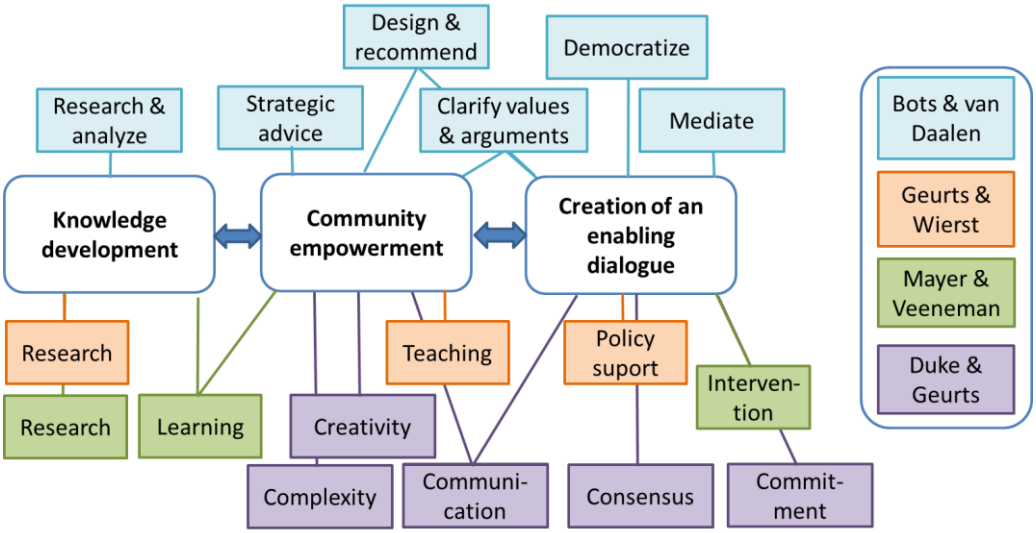


Figure 4-8: Linking the policy gaming categories to the NA building blocks

The desired effect of the first block is primarily the creation of knowledge (learning) while the second block primarily aims to convey knowledge (teaching). Since *strategic advice* aims to support a single stakeholder, it is only useful to empower communities. Before the community participates in a dialogue with other (more powerful) stakeholders, it will be useful to formulate their common arguments and make their common values and interest explicit. In this way, improving communication will be an important means to enhance relational and collective empowerment (Vermeulen, 2005). Games with these two functions are also useful to support the third building block, since clarification of values and making arguments explicit between stakeholders will help stakeholders to shift their focus from positions to interests in the negotiation which opens up space for integrative (win-win) bargaining (Ury and Fisher, 1981). The functions *democratization* and *mediation* are primarily useful to support the dialogue between the stakeholders. These functions might be useful as well in the second step, since communities are heterogeneous and will also have internally conflicting interests and values. Games which support *intervention* will be useful in the final building block. The four stages of the policy design cycle shown in figure 4-9, will iteratively alternate each other, in which i*ntervention* relates to the 'implementation' phase. The 'formulation', 'implementation', and 'control' steps relate to the building block of dialogue. The design of policy options is part of the negotiation process rather than an output of it. Since there will be a mismatch in 'recognition' between different stakeholders as described in paragraph 2.3, different policy design steps will be proceeded in parallel in practice, rather than sequential. After a dialogue is established, games that improve *consensus* and *commitment to action* of the stakeholders will be useful to support parts of the dialogue workshops.

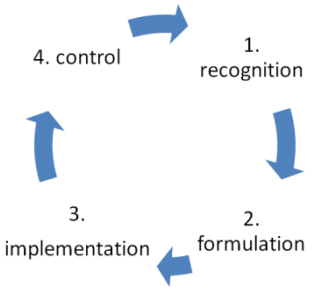


Figure 4-9: Policy design cycle: (van Daalen et al., 2002)

4.5 PRIORITIZATION OF THE GAME FUNCTION

In this paragraph, the different game functions will be compared and prioritized based on their desirability and feasibility. Chapter three showed that there is especially a need for a decision-supporting tool. Several experts emphasized the need for a supporting tool in block three, the creation of an enabling dialogue. The core of the NA is democratization; to empower communities in managing their resources and bridging the gap between local community needs and central coordination, the community influence on the policy making process becomes more proportional to the influence of other stakeholders. This 'proportionality' is of course subjective and based on 'western' democratic values, so a local discussion is required to determine to what extent power redistribution is desirable and feasible. In order to get there, negotiations to redistribute the power are needed to make the participative process actually work. As mentioned in chapter 3.3, most experts prefer *mediation* as general function of the tool; the emphasis only differs. One expert mentioned that democratization is the most important challenge to overcome while another expert perceived the lack of knowledge on how to negotiate

more useful to be overcome by a game (Interview, February 24, 2014,, Interview, January 30, 2014,). The preferred options are:

A. Mediation, the tool is used to support the negotiation process.
B. Negotiation training tool, the game is used to teach stakeholders negotiation skills.
C. Democratization

Before the options are compared and a decision will be made, there is first understanding needed about what negotiation and democratization actually is and which specific learning effects are related to these functions.

A. MEDIATION

A mediation tool needs to establish conditions which will steer the negotiations towards consensus. According to William Ury, reframing the problem is essential to get towards consensus (Ury, 2000). Reframing shifts the focus from positions to interests. Debates on 'what and why' stakeholders want something instead of 'how much' they want can create room for win-win solutions since interests are often not mutually exclusive. Communication is the essence of negotiation. According to Ury, negotiation is mainly about listening and asking questions in order to define the others interests and opportunities for agreement. Often stakeholders are not even aware of their own interests (Ury and Fisher, 1981). Poteete et al. (2010) argue in their book 'Working Together' that communication leads to cooperation, because it stimulates 'collective learning'. This form of learning is established by interaction with other stakeholders and creates awareness of the own interests, perspectives and mental models and how they differ from other stakeholders. Games are useful to reframe problems and create 'balconies' which give stakeholders an overview of the situation and an opportunity to take a step back from the (emotional) debate, in order to focus on what is really important (Ury, 2000). Figure 4-10 shows that a collective learning process towards integrative negotiation consists of increasing awareness, learning about each other's perceptions and creating systems understanding (Leeuwis, 2008, Leeuwis, 2000). The outcome of the process is a rephrased problem. This corresponds to the structure of the River Basin Game, the Irrigation game in Bhutan and SYLVOPAST. Through helping players to see the bigger picture and creating system understanding, constructive agreements could be made. In Bhutan, these agreements where made mainly behind the scenes instead of during the gaming process or debriefing (Gurung et al., 2006). The actual learning will take place after the debriefing, but games should trigger this learning process. This suggests that mediation tools should only support the establishment of the conditions shown in figure 4-10 and participants should get sufficient room to play.

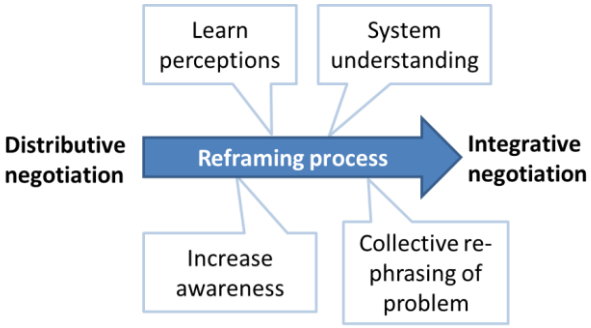


Figure 4-10; Shift towards integrative negotiation

B. NEGOTIATION TRAINING

Many games used as mediation tools were also used for educational purposes (Lankford and Watson, 2007, Douven et al., 2014, Krolikowska et al., 2007, Etienne, 2003). Most games developed with the ComMod method are play-tested and improved in an educational setting before played with the real stakeholders. This implies that a single game might be useful to fulfil both *teaching* and *policy support* functions. However, each function has different implications for the design choices. In mediation games, players play in the first place their own role. In training circumstances this might differ. A game designed for experts will enhance different experiences and learnings by students, as was remarked with the ShaRiva game. Losing the game will be beneficial for the learning process while loss within a real setting should be avoided to prevent stakeholders losing face.

Players need to behave realistically in training games to make sure the obtained skills are the same as would be obtained in reality, they require a high level or realism. The type of realism that is required (physical or social) depends on whether the skills relate to interactions with the physical or inter-actor environment. A game like 'levee patroller' requires therefore a high physical realism (Harteveld et al., 2009), while a negotiation game requires a high social realism. When applied within the NA, such games will be likely used to train a homogeneous user group, which will lower the social realism of the game.

DEMOCRATIZATION

Democratization was stated as desired function during the interviews and is therefore considered as an option. It connects best to the core principles of the NA since it aims to create a 'level playing field'[9] and makes communities capable to participate in higher policy level negotiations themselves. *Democratization* relates thus to the notion of 'power'. The sociologist Max Weber defines power as *''an ability to achieve a wanted end in a social context, with or without the consent of others''* (Vermeulen, 2005). Empowerment of the powerless when there is an asymmetric influence on the decision-making process between stakeholders will give the powerful an incentive to seek the consent of the powerless as well. Vermeulen defines power as relational and states that it does not exist in isolation. She describes three types of power: Personal power relates to improving self-esteem and develop skills and knowledge, to build power to act. Selection and training of local leaders in the 'empowerment' building block relates to this type, but also the direct improvement of livelihoods. Relational power relates to relational skills such as negotiation and communication skills and the acquirement of information for strategic purposes. Collective power relates to the mobilization of communities, the *level of self-organization, the level of awareness and the homogeneity of the community vision* (figure 4-11). The blocking by communities of a the construction of deep-tube wells by the KCC in a peri-urban district of Khulna is an example of 'collective power' in action (Thissen et al., 2013).

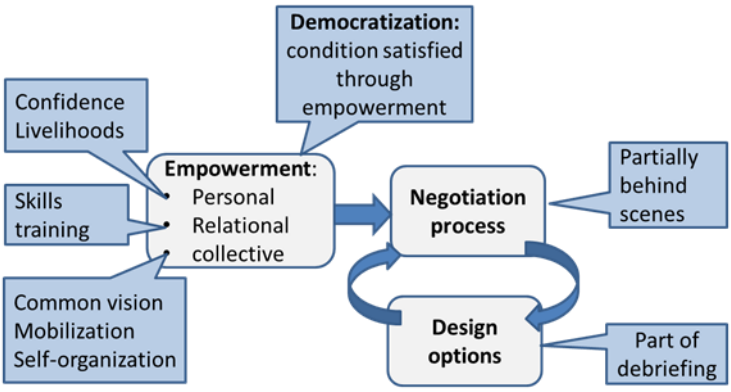


Figure 4-11: Role of empowerment within the negotiation process

The three mentioned ways of empowerment mainly connect to the building block of 'empowerment'. Empowerment of communities is required before they participate in the negotiation process in order to ensure their voices are actually taken into account. *Democratization* is rarely the main function of a game; reviewing existing games showed that *democratization* rather was used as means to create a 'fair' negotiation process (see figure 4-12). Games that enhance creativity have 'design' as function but manipulate the group dynamics to create open, non-judgmental, expressive conditions. *Democratization* is therefore considered as a condition necessary to fulfil the game function *mediation* or *design & recommend* in case a game is used to support participative design.

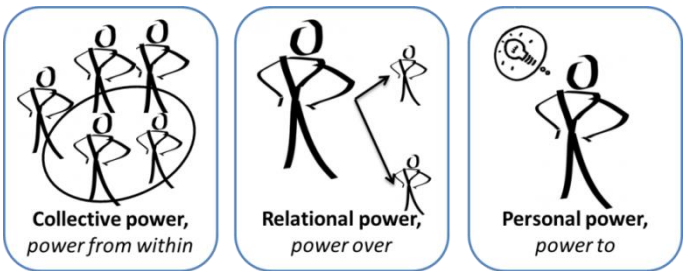


Figure 4-12: Types of power, related to empowering communities

[9] [9] This is a concept of fairness, which states that not all players need to have equal chance to succeed, but all players need to play by the same rules of the game.

Because *democratization* is considered to be a design condition rather than a primary function and *negotiation training* can also be achieved with a *mediation* game, *mediation* is selected as the function that requires most support. Most of the interviewees considered a game which supports the actual negotiation process itself as most useful. It is plausible that a game can have both the function of *training* and *mediation*, by using the mediation game to educate community representatives about the perspectives of the other stakeholders. The game will be designed for mediation and afterwards there will be discussed how the game can be used for training purposes.

4.6 SYNTHESIS OF EXISTING APPLICATIONS

In this paragraph the described games will be compared and evaluated. The goal is to distil general insights from this synthesis that help the development of design conditions for the game.

INTEGRATION OF MODELS AND STAKEHOLDER INTERACTION

Zhou and Mayer (2010) map for different decision-support tools used in water management the level of integration of modelling into the process and the function user interaction. Modelling applications with gaming characteristics are distinguished in 'playable tools' and 'play-around-the-tool' tools. Comparing the applications based on this distinction will help to determine which role the designed gaming tool needs to have in the process.

With a 'playable tool', stakeholders mainly interact with the model. The engagement is embedded in the model by an attractive visualization, clear objectives and a consistent story-line. 'Play-around-the-tool' tools give players more freedom, the scenario is much more open and users are stimulated to create meta-play and adapt the game. The game facilitates stakeholder interaction instead of interaction with the model. Immersion[10] lays in the emotional involvement created by stakeholder interaction. Games based on physical realistic simulations like Levee Patroller (Harteveld et al. 2009) or games designed by Tygron look more like 'playable tools'. In contrast, the River Basin Game, the ComMod RPG examples and MEERVISIE are typically 'play-around-the-tool' tools. The ShaRiva game of UNESCO-IHE seems also to belong to this category since the entire workshop is meant as gameplay and the hydrological simulation model more as supportive tool. The low intensity and pace of feedback in the entire process and the lack of rules that constrain the players' actions make the workshop less game-like.

The game should support interaction between players rather than dominating or restricting the process

'Play-around-the-tool' tools will be more useful within the NA process since it improves stakeholder communication, the exchange of viewpoints and supports in this way the negotiation process. The challenge of 'playable tools' is to make the underlying model transparent, avoid manipulation and distract players not from the core of gaming by too much emphasizes on high-tech (Duke, 2011). The challenge of 'play-around-the-tool' is to immerse and engage players as much as in 'playable tools', while still giving them freedom to form meta-rules and reflect during the process. Engagement can be created by emphasizing game elements as competition in an appropriate way. Fish Banks succeeded in this; players play highly engaged around the computer model. The River Basin Game succeeded to engage with letting participants run for positions, changing these positions and by metaphorically representing the system with marbles, sticks and a board.

HYBRID FUNCTIONALITY

The mentioned functions relate to the main purpose of a game; in reality most games have multiple functions of which one function is more dominant. The different functions also depend most often on each other. In a *design & recommend* game, understanding of the behaviour of the system will be necessary to design

Mediation is selected as function

[10] Immersion is a term used in the field of gaming and is the state in which players lose their critical distance to the game and any relation to space and time. MCGONIGAL, J. 2011. *Reality is broken: Why games make us better and how they can change the world*, Penguin..

useful options to improve this behaviour while understanding of the system is also prerequisite in making negotiations more integrative (Barnaud et al., 2010). The game on watershed management in Bhutan (Gurung et al. 2006) and the game on irrigation water sharing in Thailand (Barnaud et al., 2010) are typically examples of games in which the function *democratization* is combined with *mediation*. *Mediation* with the existence of large power asymmetries will be ineffective without first levelling the playing field through *democratization*.

A game can be used to serve different functions (Bots and van Daalen, 2007). Role-playing games in the ComMod method are always used for *research* (to validate the agent-based model), for *design* (participatory design of the model) and for decision-making support. The primary function only differs between the cases; while the core of the PIEPLUE game (Barreteau and Abrami, 2007) and Samba GIS simulation (Castella et al., 2005) is research to validate, the core of the *AgoAloca* game is teaching (Clavel et al., 2008). In addition, the core of the watershed management game in Bhutan is policy support, by using the game primarily as *mediation* tool (Gurung et al., 2006). The SHRUB BATTLE game (Depigny and Michelin, 2007) and SYLVOPAST (Etienne, 2003) were used both as education & training tools and as policy-supportive tools. While hybrid functionality seems inevitable for policy support, restriction of the number of functions is preferable. It will only increase the complexity of the game, complicate its validation and make it more difficult to facilitate. As Mayer et al. (2004) argues; different policy roles can be combined only at the expense of increased complexity. Aiming to achieve too much learning effects with a single game seems to be a pitfall for serious game designers; a better option is to integrate multiple games within a single workshop as Duke and Geurts (2004) suggest.

Restricting the functionality of a game will increase its effectiveness

PLACE IN NEGOTIATION PROCESS OF GAME

Now a choice is made for *mediation* as function, the question *where* in the process the game can be applied best still needs to be answered. The function *mediation* fits best in the final building block of the NA, as argued in paragraph 4.3. To be specific, the function of *mediation* will be further disentangled. In general, mediation processes always have a preparation phase, a mediation phase and a phase of closure, according to Brenninkmeijer et al. (2005). The authors argue that most mediation processes consist of the five phases shown in figure 4-13; the relation of the phases to the scope and the level of realism is my own interpretation. In the preparation phase practical agreements on the negotiation process are made and the closure phase consolidates the agreement and plans the implementation of the solutions. In the reconnaissance or exploration phase, there is investigated what the problem exactly is, what the interests of the parties are, where these collide and to what extent the interests collide. In the second phase there is communication between the parties in search for cues for cooperation. In advance, most negotiation processes have a specific point in time when parties commit themselves to continue searching for solutions or break up. In the solution phase the problem is reframed and a wide range of options is investigated to deliver mutual gain. In the final phase, the solution is selected, evaluated and consolidated. The scope of each phase differs during the process, from explorative diverging phases to converging phases with more focus. This is illustrated with the red lines (figure 4-13). Games that enhance systems understanding or create awareness such as Fish Banks are most useful in the exploration phase, to create awareness of the problem and necessity of cooperation. The River Basin Game is mainly used in the exploration phase by letting players explore different scenarios (Lankford et al., 2004). Role reversal to enhance empathy fits best to the 'Rapprochement phase'. The Irrigation game in Bhutan is applied in the first two phases (Gurung et al., 2006). In this case, the moment when the parties between two game workshops started talking to each other behind the scene can be seen as turning point. This was possible because firstly the game had catalysed the rapprochement phase between the two villages. The follow-up game workshop was then used in the solution phase. This shows that it is possible to apply the same game in both phases. However, it is best to design a game for a specific phase since each phase has different learning

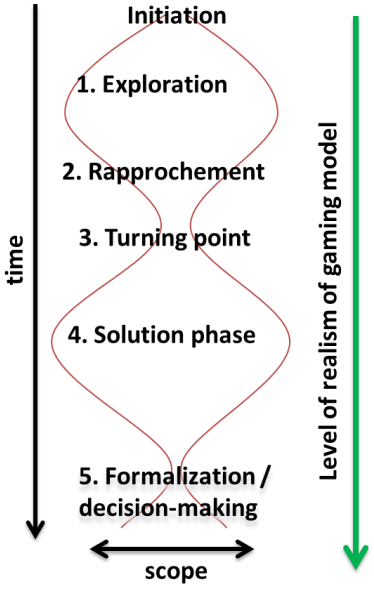


Figure 4-13: Phases in a mediation process

objectives with different requirements. In the exploration phase, the use of a metaphors will be useful to create distance from reality. According to a mediation expert, the use of a numerical format early on in the process risks to reinforce the conflict since it will divide players more easily in winners and losers (Interview, June 30, 2014,). He confirmed that the level of realism of the game should increase towards the final phase; players should be able to link a game played in the 'solution phase' more clearly to reality than in the 'exploration phase'. The game that will be developed will be applied in the 'exploration phase' because in this part a trigger is most needed to change the perceptions of participants and increase their understanding of the problem (Interview, September 10, 2014,). This phase relates to the task of *joint* fact-finding and problem analysis which is executed after a platform for negotiation is established in the NA process (Both ENDS and Gomukh, 2011).

The game should be applied in the exploration phase, its representation should therefore be less realistic

4.7 CONCLUSION

This chapter aimed to answer the question which of the identified improvements of the NA can be supported by serious gaming. The chapter also aimed to answer which of the identified improvements has priority. The game was framed as learning tool because it will be used to intervene in situation and is perceived as an effective way to support a collective learning process. After the possible improvements were restricted to 1) mediation, 2) negotiation training and 3) democratization in chapter three; first a categorization of the different game functions was made.

The overview of the different categorizations gives insight in the scope of possibilities to support the NA with gaming. The most common functions are policy support, teaching and research. 'Knowledge creation' oriented functions such as research and learning relate to the first building block of the NA, while 'knowledge transfer' oriented functions relate more to the second building block of empowerment. Subject-oriented functions such as mediation and democratization and learning effects as 'commitment' and 'consensus' and 'intervention' relate best to the final building block. The categorization is useful in showing the scope of possibilities and selecting systematically a function from it. However, most games have multiple functions. Therefore, the distinction between categories blurs in reality which makes the overview less applicable.

Mediation is chosen as function since this function fits best to the preferences of the majority of the interviewees. Apart from that, *democratization* is considered more to be a condition established by empowerment than main function of a game. A review of existing games shows that almost all *mediation* games were also used for teaching or training purposes while this was not the other way around; a mediation game will be more versatile than a *negotiation training* game. The game should allow the players to shape its content instead of prescribing the players exactly 'how' to do it and narrowing the bandwidth of possible actions.

Part II: Game design

5 ANALYSIS OF PERI-URBAN GROUNDWATER SYSTEM IN KHULNA

The goal of this chapter is to develop a conceptual model of the social and physical system of Khulna. This analysis will be used in chapter six to create a gaming model. The case of Khulna is chosen because it is one of the areas under study of the UDW Integrated Project. This choice will make the research more relevant and increase the likelihood that the designed game will be actually tested, finalized and used in the context. There is no specific reason that Khulna is chosen above Kolkata apart from the fact that there were more case studies found on groundwater management in Bangladesh and Khulna.

5.1 SPECIFICATION

PROBLEM DESCRIPTION

Unplanned and unregulated urbanization has led to uncontrolled growth of Khulna City Corporation and (land- and water) resource scarcities in the peri-urban area around the city centre (Khan and Kumar, 2010). The peri-urban area is changing more rapidly than the current institutions are able to adapt which results in mismanagement and inequity as result of unregulated competition over scarce water resources (Thissen et al., 2013). The water related challenges in Khulna are increased demand, pollution, encroachment of the water body, a declining groundwater table and under capacity of water services (Narain et al., 2013). The question is how stakeholders with more access to water can be influenced to cooperate and share water more equally with parties with less water access. The game needs to improve the stakeholders understanding of the benefits of cooperation, without increasing the risk of strategic behaviour.

SYSTEM PERSPECTIVE

System Analysis is the application of mathematical and analytical methods to solve social problems (Enserink et al., 2010). It is the systematic study of costs and effects of policy alternatives which are means to arrive at a certain goal (van Daalen et al., 2009). This is done by creating a model which is able to explain and predict the relevant behaviour of the system. The model is used to select a control strategy which improves the systems behaviour.

System Analysis is related to the scientific paradigm of ''systems thinking''. This is a systemic, holistic, step-by step analytical approach which aims to understand the link between the whole structure of the system and its behaviour rather than breaking it down into components and analysing the behaviour from the isolated parts (Forrester, 1969). 'Hard' and 'soft' systems thinking can be distinguished. 'Hard' systems thinking is the quantitative selection of a means to arrive at a known end in an optimal manner. 'Soft' systems thinking emphasizes the process of approaching the problem and the systematic structuring of the different relations, interests and points of view rather than quantification of the variables (Checkland, 1989). This approach is more suitable to apply to 'messy' or 'wicked' problems and is based on the assumption that not all variables are quantifiable and that the perception of the problem matters. The latter approach will be applied to analyse the case, since the problem is typically 'messy'. There is not yet scientific consensus on what the exact causes of arsenic contamination and salinization of the aquifers around the Khulna City Corporation (KCC) are and what the best policy options are. The question is not how to find the most efficient means but rather how to include the different interests and perspectives on the problem into the analysis in a way that satisfies all stakeholders.

How to improve players understanding of benefits of cooperation, without increasing their strategic behavior?

Apart from taking the stakeholders worldviews into account it is important to critically reflect on my own Dutch cultural perspective, since this will inevitably influence the research.

DELINEATION

Since the function of the game is *mediation* and support of the 'exploration phase', both the inter-actor environment and the physical environment requires less realism. The relations between the stakeholders and their environment can remain generic since a metaphor of the real situation can be used. A simple, highly aggregated model will be sufficient for this purpose, it is however important that the presumed relations are validated so the players can develop the *right* systems understanding.

Only groundwater conflicts will be considered; the different conflicts will be shortly described but the main focus will be on the conflict between urban domestic users and peri-urban farmers. The research will focus on the groundwater system, but will also include subsystems with strong influences on the groundwater issue. Agriculture and aquaculture are important factors to be included; aquaculture seems to influence strongly the salinization and agriculture is important since it demands the majority of the abstracted groundwater for irrigation.

5.2 CONTEXT OF THE PROBLEM

With 1.5 million inhabitants, Khulna City is the third largest city of Bangladesh. It is the capital city of the Khulna division, which is a south-western district of Bangladesh (see figure 5-1). Khulna is governed by the Khulna City Corporation. Khulna faces a rapid population growth of 3.8% mainly due to rural-urban migration and has a very high population density (Kumar et al., 2011). The majority of the peri-urban inhabitants are engaged in informal business activities within the city. The peri-urban area is partially agricultural. The last decades, farmlands have been transformed to shrimp farms around Khulna, especially in the Southern part (Ali, 2006). Shrimp is the second export product of Bangladesh and most of it is cultivated within the Khulna division, which indicates the economic importance of the industry for the KCC (Ahmed et al., 2008, Paul and Vogl, 2011). In advance, Khulna inhabits heavy industries and is an important logistic hub.

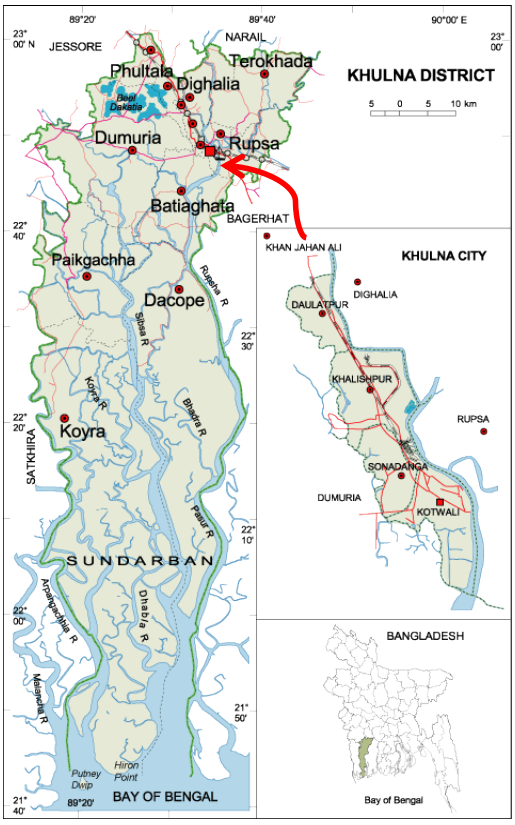


Figure 5-1: Khulna district map Source: (Khan and Kumar, 2010)

PERI-URBAN –URBAN LINKAGES

The water demand is increasing due to rapid rural-urban migration while fresh water supplies are declining due to salinization. In addition, surface water bodies are polluted with urban waste. Recharge rates are decreasing because of mismanagement. The resource pressure is experienced especially in peri-urban areas (Khan and Kumar, 2010). These areas could be basically defined as the interface between the rural and urban area, but different interpretations are found in literature. Some scholars define the interface spatially or temporally while others see it only as a concept (Narain, 2010). Although the term 'area' is used, it seems more useful to perceive 'peri-urban' as a process, a concept rather than a spatial distinction. The area shows already urban characteristics while institutions are not yet adapted to the situation. Peri-urban communities are still treated as rural while they behave more like urban communities. According to Narain (2010) the area is characterized by a very heterogeneous mix of functions, applicable institutions and a continuously changing social profile.

Conflicts between peri-urban users and urban users are arising from the perceived resources and service imbalance between the areas (see figure 5-2). Although most peri-urban people pay taxes to the KCC, they still have limited access to public services. Water is transported from the peri-urban to the urban area and urban waste streams are returned. Without regulation and coordinated spatial planning, it is likely that the urban area

will expand into the direction of the least resistance, at the cost of the less powerful peri-urban communities. The conflict could be also perceived as a cultural clash between the 'rural' and the 'urban' culture in which rapid urbanization might result in a 'loss of identity' and social tensions by peri-urban communities who are not able to adapt to the changed 'rules of the game' and feel they cannot express their culture anymore.

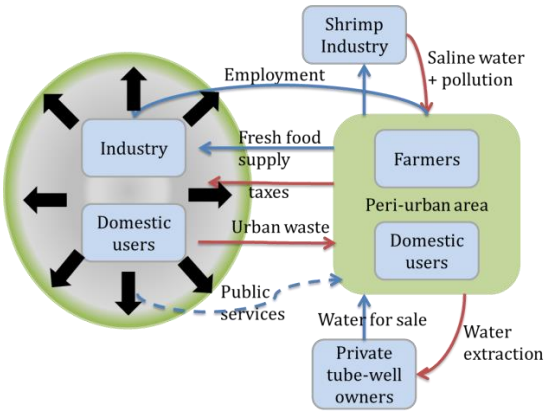


Figure 5-2: Peri-urban linkages

Both 'areas' depend on each other; most peri-urban dwellers do informal businesses in the city and depend on some utility services while the urban area depends on the resources of peri-urban area. According to an expert of SaciWaters, the food production in the peri-urban area has a significant influence on the urban fresh food supply, most of the fresh food is produced close to the city. This is partially due to the lack of cool logistic chains, making fresh food consumption close to its production required. Midmore and Jansen (2003) argue however that peri-urban agriculture will be unable to compete in the long run for land and labour with the urban area unless agriculture will be strongly supported by regulations. This is already visible around Khulna were farmers more often sell their lands to urban developers or the shrimp industry (Quasem, 2011). This has probably multiple causes; climatological changes, pressures from powerful actors and increasing land prices. It is debatable whether this is problematic or not since urbanization is likely to increase the chance that peri-urban communities will profit from positive externalities of the urban area like public services, employment and business opportunities. However, the downside is the disappearance of agriculture will have a negative impact on urban air quality and will lead to a decreased biodiversity and groundwater recharge. In addition, the risks of flooding and water logging might only increase. Ideally, an industrial symbiosis between the peri-urban and urban area is developed in which agricultural functions reuse urban wastewater and compostable waste while they return fresh products. This is relatively more sustainable than central production further outside the city area (Mojid et al., 2010, Midmore and Jansen, 2003).

5.3 STAKEHOLDER ANALYSIS

The goal of this paragraph is firstly to provide an overview of the key stakeholders which are involved in the issue of water security in peri-urban Khulna. Secondly, there is investigated how the stakeholders interact and what their perspectives, interests and power is. The key stakeholders will be represented in some way in the game which make it important to understand their relation, interdependency and influence on the problem. According to Khan and Kumar (2010) the five key stakeholders that are involved in the issue are:

1. DOMESTIC USERS

Peri-urban water users depend on public tube-wells installed by the KWASA. Within the KCC area, domestic users depend on the pipelines installed by the WASA, which cover only 30% of the population (Kumar et al., 2011). This under capacity results in some districts in long queues, some tube-wells are shared by 200-300 households. Private tube wells which are mostly unregulated, contribute to ¼ of the total water demand of 240 million litre/day (Kumar et al., 2011). KWASA supplies just $^{1}/_{7}$ of this demand. It is unknown who supplies the other 60%; this is likely abstracted privately from surface water and groundwater. In the past, the KCC has tried to import water from the peri-urban area into the city, which resulted in protests. The conflict was finally brought before the court and the project was abolished. According to Kumar et al. (2011), there is a conflict between peri-urban water users and urban users and among peri-urban users about access to water.

2. AGRICULTURAL USERS

The area around Khulna was originally agricultural dominated but this is changing due to urbanization and a shift to shrimp farming. Peri-urban domestic water users depend partially on agriculture for their livelihoods. Urban domestic users depend also on it as food supplier since most of the fresh food in Khulna is produced in

the rural and peri-urban areas near to the city. A collapse of agriculture will probably (temporarily) lead to higher food prices in Khulna or a change in diet. Due to an increase in land prices, farmers are selling their land to real estate developers and start working in the industry, the shrimp industry or as employee at other farms. In the district Chota Boyra farmers depend on the Mayur river, which is polluted by urban waste and currently almost a death river (Kumar et al., 2013). Apart from conflicts with urban users, farmers have conflicts with shrimp farmers about flooding of agricultural plots with saline water and salinization of the Mayur due to mismanagement of the Alutala gate, which separates the (fresh) Mayur river from the more brackish tidal rivers. According to an expert, the conflict is most severe between farmers(Interview, May 12, 2014,-a). Well-off farmers have tube-wells and sell water to poorer farmers, which gives them a strong position.

3. SHRIMP/PRAWN FISHERY INDUSTRY

Shrimps are a major driver of the economy of the KCC. This gives the industry a very powerful position. The industry depends on access to (cheap) labour, the right (brackish) mixture of saline and fresh water, for which also groundwater is consumed. There can be assumed that all their products are sold on the international market. Bangladesh delivers only 1,6% of the international supply, which means that their influence on the total supply is small and that prices can be perceived as externally determined (Paul and Vogl, 2011). The profit margin of shrimp farming is much higher compared to rice farming. The industry has been contested over the previous years (Paul and Vogl, 2011).

According to Primavera (1997) and Paul and Vogl (2011), farmers have lost their land due to salt water flooding. They argue that the flooding is not totally natural but caused by the shrimp industry, since they need brackish water to cultivate shrimps in ponds. The industry has had a negative impact on the ecological environment since pesticides are needed to protect the fish monocultures from diseases. Wild shrimps are caught in small brackish streams and then cultivated in ponds. For every caught shrimp, fifty juvenal fishes die as by-catch. Shrimp farmers legally build drainage systems through dikes that are supposed to protect farmlands from flooding. There have been dike breaches during Monsoon due to these interventions. According to Roy et al. (2012) there exists a strong public antipathy among the poor towards the shrimp farming industry. Lönnqvist et al. (2010) observed that shrimp farmers use musclemen to intimidate people to give up their land for shrimp. Land is grabbed by corrupting governmental spatial planners, pressuring farmers and committing fraud with land contracts.

4. INDUSTRY

The industry is less influential compared to Kolkata, but still needs to be considered as a key stakeholder in terms of water usage and supplier of employment in Khulna. Khulna inhabits heavy industries like jute mills, brick factories, hardboard mills and suppliers for the garment industry which is Bangladeshi's main export product. Khulna has also one of the largest river ports of Bangladesh which makes the city an important logistic hub. The industry consumes large amounts of ground- and surface water (Kumar et al., 2011).

5. GOVERNMENTAL PARTIES

The KCC is the governmental party in Khulna which members are elected; the KCC is led by the Mayor of Khulna City. The Khulna Water Supply and Sewage Authority (KWASA) is the public water supplying authority and is governed by the National Department of Public Health Engineering (DPHE). The KWASA was established in 2008 to deal with the under capacity in public water services in Khulna. The Khulna Development Authority (KDA) is responsible for solid waste management, drainage systems, sanitation, and transportation and utility service sectors. The objective of the KDA is to coordinate the urban planning of the city. According to Kumar et al. (2011) there have been conflicts in the past between the KDA, KWASA and KCC about authority and responsibility for the water crisis in Khulna.

Figure 5-3 maps the linkages between the stakeholders and shows their perceptions. The opinions are somewhat negative, but give some idea of which perceptions contribute to the conflicts. An objective of the game is to stimulate the stakeholders to adjust their perceptions by supporting communication and confrontation of these implicit perceptions. Figure 5-4 provides a power-interest map of the situation. By mapping the power and interest on the dimensions of power and interest, four general stakeholder types can be identified (Bryson, 2004). The stakeholders with the least power and high interest in the issue are the peri-urban (poor) domestic users and slum dwellers. These user groups have to share tube-wells with many (200-300) households, are most vulnerable for climate change effects such as flooding and have no means to influence the situation. Farmers have a little bit more power since the urban area depends partially on their fresh food supply, but individually they have no means to influence the decision-makers. Their access to water and ability to merchandise water gives private tube-wells more power. In practice they are restricted by the KWASA, but it is likely that the KWASA has in practice limited means to monitor rule compliance.

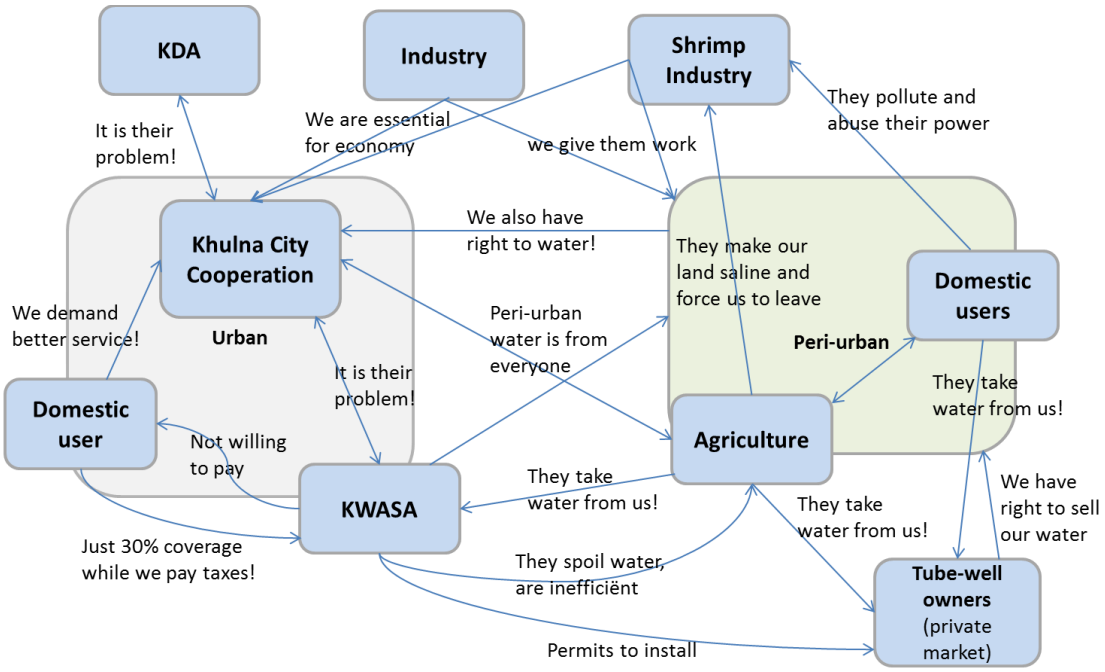


Figure 5-3: Stakeholder perception map of the groundwater problem in Khulna

The KCC is considered to be the most influential party since they have most blocking power. The KWASA has higher interests and therefore more intent to use its power. As explained before, the shrimp industry is considered as another important player, due to their access to resources and capital. Upstream water boards of the Gorai and Rhupsa-Pasur rivers should be also considered as stakeholders since upstream water diversion is a significant driver of salinization of water bodies in Khulna, according to Mondal et al. (2013). They themselves have less interest in the groundwater issue.

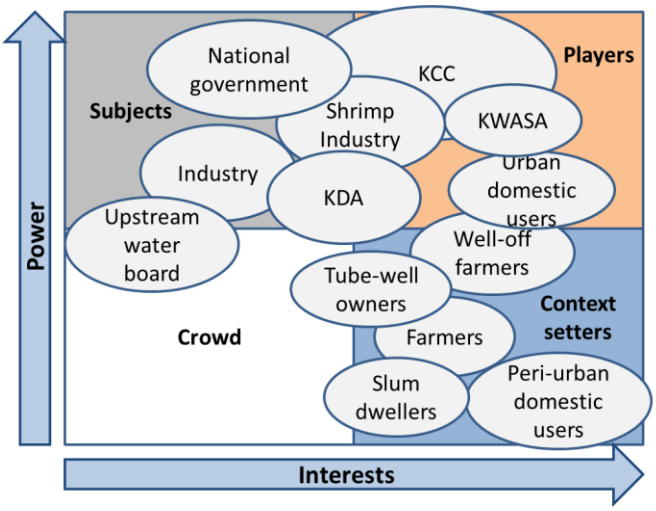


Figure 5-4: Power – interest map of groundwater problem in Khulna

Appendix VI summarizes the characteristics of the stakeholders. It should be noted that the mentioned stakeholders are in reality internally

heterogeneous and have conflicting means and interests. The map is meant to give a simplified overview of the positions of the different parties. In reality, there will be different types of farmers, (peri-urban) domestic users and tube-well owners, who also mutually have conflicts. Bryson relates different participation strategies to the stakeholder types. In contrast to Bryson, the theory of the NA states to not only inform and consult the 'context setters', but to empower them in a way they will shift upwards in the map, to create a level playing field between 'context setters' and 'players'. Based on Bryson's theory, this would strategically make no sense for the decision-making parties. In collaboration however, this upward shift does not need to go at the expense of the influence of the 'players'; empowerment is not necessarily zero-sum. Another remark with the power-interest map is that the diagram is static while relations in reality are dynamic.

WATER CONFLICTS

There are conflicts over water between all types of stakeholders. Farmers and shrimp farmers have conflicts about water pollution and salinization of surface water and land. In addition, the (perceived) peri-urban – urban resource drain (figure 5-2) leads to conflicts between peri-urban and urban users. Finally, there are also conflicts among governmental agencies about responsibilities and budget allocations. The high profit margin on shrimp products, the availability of cheap labour and the lack of (monitoring) regulations leads to exploitation and conflicts. Finally, Khulna has a large and profitable private water market. The private market is highly concentrated and has monopolies due to a lack of regulation (Interview, May 12, 2014,-a). Transport, resale and the use of water as power means by well-of farmers or citizens that own a tube well fuels also conflicts.

RULES THAT GUIDE THE BEHAVIOR

Underlying (implicit) rules that lead to the unequal water sharing are:

- *'Water in my land belongs to me'*; this is based on an unwritten rule that stems from the British Colonial administration (SaciWaters, 2013). People tend to perceive all the groundwater abstracted in their land as their property and lack awareness of the fact that the groundwater system is connected. There is a belief that groundwater is static and never moves, which leads to the perception that groundwater users do not influence each other. The understanding that groundwater users are interdependent and influence each other's available water quantity and quality is still lacking. Another misperception that groundwater is infinite will be less apparent in Khulna since many users have already experienced scarcity.
- The current behaviour is mainly *driven by competition* and the rule that who *first come*, are *first served* applies. It is likely that stakeholders are not aware of the long-term consequences of competition over a finite common-pool resource.
- There is a *strong social hierarchy* in the Bengal society (Hofstede, 1991), which influences partially the common perception of water rights and the meaning of 'fairness' in water distribution. In India, lower castes and in Bangladesh people from lower social classes are perceived to have less water rights. This leads to exclusion and marginalization of groups at the bottom of the social hierarchy.
- Climate change is perceived as the main cause of the problem. Some stakeholders use climate change to argue that the *causes of the problem are external* and not possible to influence, according to an expert at SaciWaters (Interview, May 12, 2014,-a, Interview, May 12, 2014,-b). This belief might be part of the South Asian culture in which the notion of free will and the necessity to intervene in the environment is less present than in western societies.

5.4 ANALYSIS OF THE PHYSICAL SYSTEM

Since the game will be more strategic than operational, the aggregation level of the model of the physical system needs to be high and the boundaries will be very broad. The analysis will start with the groundwater system, but will also address variables directly related to the groundwater system. The purpose of the analysis is to get a general impression of the physical system instead of describing in detail what influence the variables have on each other.

Groundwater is the only source for fresh drinking water in Khulna. Its functionality is extended increasingly over the years, to functions as irrigation. This is due to pollution of surface water bodies by urban waste and salt intrusion from the tidal rivers the Bhairab and the Rhupsha. Groundwater is essential for irrigation in Bangladesh; the promotion of shallow tube-well groundwater irrigation from the 60's onwards has made Bangladesh food self-sufficient (Harvey et al., 2006).

CHARACTERISTICS OF AQUIFER SYSTEM

Bangladesh lays in the Bengal Basin which is one of the largest sedimentary basins of the worlds (Shamsudduha et al., 2011). These sediments make Bangladesh one of the most fertile regions in the world, but currently the soil fertility rates are dropping due to salinization (Haque, 2006). The surface geology of Khulna consists of tidal deltaic silt deposits from the Holocene period. The soil has first an upper silt and clay layer with a thickness of 25-30 m around Khulna. The soil is stratified; silt, silt with clay and coarse sand layers alternate each other (Roy et al., 2005). Most classifications distinguish aquifers into two categories: shallow and deep. The shallow aquifer is around 80 meter deep and the deep aquifer starts around 100 meter and is separated from the shallow aquifer by a silt and clay layer. There is not much known about the connection and interaction between these aquifers but it is likely that the leakage of shallow water into deeper aquifers is little since aquifers in the Bengal basin are built up from many horizontal layers. There is however a horizontal flow, dependent on the elevation. The general direction of this flow is from North to South. Deep aquifers are recharged by older upstream aquifers (Reference!).

ARSENIC POLLUTION OF THE GROUNDWATER SYSTEM

Arsenic is a heavy metal which naturally exists in rock layers; the occurrence when taken in through contaminated water or food it can cause severe health problems such as Arsenicosis, skin cancer or internal cancer. It is estimated that around 1,86 million people suffer from Arsenicosis and 125.000 from skin cancer in Bangladesh (Harvey et al., 2006). Arsenic gets solvent and mobilized by oxidization which is triggered by weathering, erosion or micro-biological activities. The mobilization process can be triggered by over-exploitation of groundwater or pollution of groundwater with carbon or organic material (Das et al., 1996). There is no consensus yet about the exact mechanisms of Arsenic mobilization. In south-central Bangladesh where Khulna is located, the arsenic levels found in tube-wells are high with values above 50 µg/L, which is five times higher than the limit described by the World Health organization (Chowdhury et al., 2000).

From the sixties onwards, shallow groundwater was strongly promoted as drinking water source and source for irrigation by (international) organizations (Harvey et al., 2006). This was done to prevent the infection with water borne diseases, since surface water bodies and groundwater close to the surface were polluted with urban, industrial waste and agricultural pesticides. However, in the nineties the widespread arsenic contamination of the shallow aquifers was discovered. Currently, around $^{2}/_{3}$ of the shallow-tube wells are contaminated, according to Harvey et al.. Shallow aquifers contain the highest concentrations of Arsenic and iron while deeper aquifers contain higher calcium concentrations than shallow aquifers (Harvey et al., 2002).

CLIMATE CHANGE

Climate change will affect evapotranspiration, the rainfall pattern, groundwater recharge and sea-level rise will increase salinization. Climate change will result in larger fluctuations in water surplus due to heavy rainfall and water shortage due to heat-waves, evapotranspiration and salinization. The rainfall pattern has become more unpredictable and variations are increasing (Walsham, 2010). In addition, several studies show a continuous increase in global sea-level rise (Nicholls and Cazenave, 2010, Church and White, 2011). Predicted sea-level rise impacts will be most severe in the south-western coastal zone in which the Khulna division is located (Mohal et al., 2006).

Based on a trend analysis, Jalal et al. (2013) conclude that *''human interventions through upstream diversion and other means have contributed more in hydro-morphological changes in the south-west than the climate change induced sea-level rise leading to salinity intrusion in Khulna''*. This indicates that despite the large influence of climate change, the internal influence of stakeholders on the groundwater problem is significant.

GROUNDWATER RECHARGE

According to Shamsudduha et al. (2011), the gap between the actual and potential recharge around Khulna is around 200-300mm/year. Most of the potential recharge is lost due to surface run-off or evapotranspiration. 90% of the shallow aquifer recharge takes place during the Monsoon via surface water and rainfall (Adhikary et al., 2012). On average, 75% of the total precipitation is run-off. Figure 5-5 shows the yearly distribution of rainfall in Khulna with the red line being the temperature; the yearly precipitation is high with 1736 mm. Figure 5-7 shows a more detailed course of the temperature over the year.

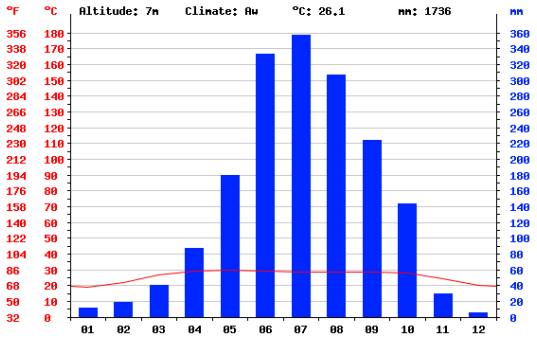


Figure 5-5: Yearly precipitation distribution Khulna

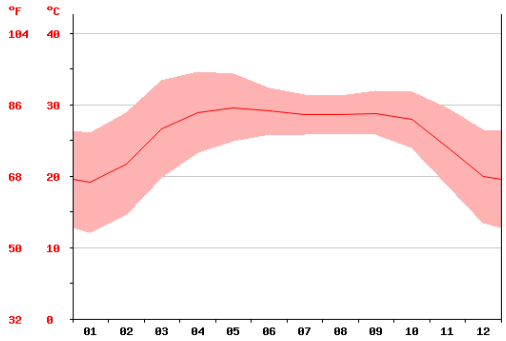


Figure 5-6: Yearly temperature distribution Khulna.

Source: http://en.climate-data.org/location/3943/. Visited last at 14-05-2014.

Shamsudduha et al. (2011) recommends more intensive abstraction of shallow aquifers since this would increase the recharge capacity and make even more abstraction possible the next season. They found that shallow aquifers are already full half-way (July) the Monsoon. This is however only recommended if further abstraction does not lower the groundwater table, which is the case for Khulna. In Khulna city, the groundwater table is dropping with 0.5-1.0 m/year (Shamsudduha et al., 2009). More extensive abstraction could also cause more arsenic mobilization since there is a positive relation between the throughput of water and the mobilization of arsenic due to erosion in an aquifer (Das et al., 1996). Increased abstraction might cause an increase in recharge, but will also cause a drop in groundwater levels and increase pumping costs. Khulna also has a slightly declining net recharge rate of 20-50mm/year. According to Mondal et al. (2013), recharge rates are dropping due to increased upstream water diversion of the rivers of the Gorai and Rhupsa-Pasur river. Plausible other causes are urbanization and increased shrimp farming, which might decrease soil permeability and therefore increase run-off. Another less plausible cause might be the agricultural transition from dry season irrigation towards shrimp farming.

SALINIZATION OF GROUNDWATER

The Khulna region suffers from severe salinization due to both climatological and anthropogenic influences . The shallow aquifer is highly arsenic and salt, which makes it almost undrinkable. Table 5-3 provides an overview of the anthropogenic and natural drivers of salinization according to the International Groundwater Resources Assessment Centre (IGRAC). High rates of pumping for irrigation and domestic use has resulted in an Northern shift of the salt water interface, as shown in figure 5-7 (Mondal et al. 2001). Both the shallow and deep aquifer can be polluted by this form of

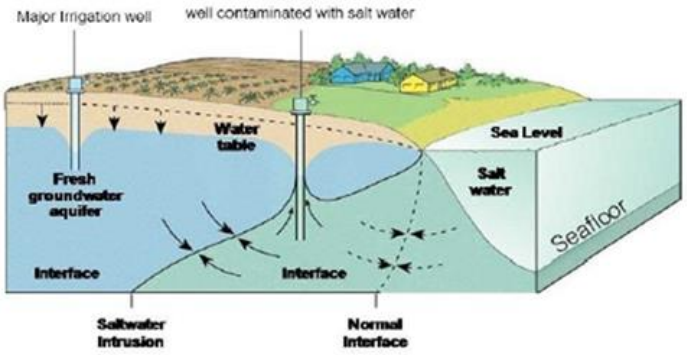


Figure 5-7: Groundwater salinization caused by marine influences. (studyblue.com, 2014)

salinization. Another form is the infiltration of saline surface water carried by the tidal rivers the Bhairab and the Rhupsa. It is plausible that only the shallow aquifer is influenced by this form of salinization.

Table 5-1: Drivers of salinization, obtained from the site of IGRAC, Monday 28th of April 2014, www.un-igrac.org/publications/341

Natural drivers of salinization	Anthropogenic drivers of salinization
Deposition of marine sediments: water remains in empty spaces after land has been flooded.	**Coastal protection, land reclamation, drainage.** If drainage results in a declining groundwater table, connate water might migrate into formerly fresh aquifers and lateral intrusion of seawater becomes more intensive.
Sea water intrusion: salt water intrusion into aquifers which are hydraulically connected to the sea. This can be driven by sea-level rise or intensive groundwater abstraction (figure 5-7)	**Groundwater abstraction.** This lowers local subsurface hydrodynamic pressure field, causing flow towards the well. If saline groundwater is part of the subsurface system, then it becomes mobilized.
Meteorological processes: Evaporation contributes to the formation of saline groundwater while rainfall reduces salinization.	**Irrigation:** Tends to gradually increase salinity levels in soil and surface water. This is because crop eva transpiration leaves a residue of dissolved substances in the soil.
Climate change: global rise in atmospheric temperatures will increase evaporation and sea level rise.	**Disposal of waste and pollution**: Injection of saline water or salt containing waste.

A literature review of empirical groundwater studies done in the Bay of Bengal showed that there is no consensus about the exact causes. Ravenscroft and McArthur (2004) argue that most shallow aquifer salt water abstraction is caused by flushing, which is the abstraction of earlier intruded saline surface water. They did not find any evidence for lateral intrusion of the deep aquifer system at research sites south eastern of Khulna City, which makes the contamination of the deep aquifer less likely (Ravenscroft et al., 2013). Their study is based on a comparing samples of 43 working deep tube wells between 1998 and 2011. Three of them were during evaluation abandoned by locals because of 'bad water'; near operating tube wells were tested and no extensive aquifer pollution was found. However, aquifer pollution might be very local which limits the conclusions of the research.

In contrast to the findings of Ravenscroft, Rahman et al. found evidence of deep aquifer salinity at sites western of Khulna City near the border with India (Rahman, Majumder, Rahman, & Halim, 2011). They found that salinity decreased towards the South and increased towards the North, which contradicts with marine influenced salinization. After comparing the origin of the salinity by analysing Br-/Cl- ratios, it was found that the salt had however a marine-origin; old seawater which had remained in empty layers had mixed with fresh groundwater.

No empirical studies of deep groundwater salinity in the Khulna City Cooperation area itself were found. The different outcomes of the mentioned studies show that the exact causes of salinization depends really on the local composition of the soil. Also no research has been done about the interconnection between the shallow and deep aquifer. Therefore, no statements about exact causes of the problem can be made. However, something can be said based on interviews with two experts. An expert of SaciWaters stated that especially deeper aquifers are more saline while shallow aquifer are contaminated with arsenic (Interview, May 12, 2014,-a). Further on, fresh water spots are very local since the aquifers are not continuous. Higher salinity of deep aquifers was also confirmed by an expert from JJS (Interview, May 12, 2014,-b). This might imply that salinization is mainly caused by sea water intrusion but further research is needed to conform this.

AGRICULTURE

Bangladeshi agriculture was originally totally depended on surface water and rainfall during the Monsoon (Rahman & Mahbub, 2012). Since the seventies, Boro rice cultivation has been promoted which has higher yields but needs groundwater irrigation since it is a dry season crop (figure 5-8). Groundwater fed irrigation is essential for Bangladesh since it has made the country food self-sufficient. Currently around 45% of the cultivable area and 87% of the irrigated area is covered by boro-rice (Harvey et al. 2006). Figure 5-8 shows a

rapid growth in shallow tube well abstraction due to intensified agriculture. Irrigation around Khulna is mainly done by low-lift pumps which extract water from shallow tube-wells and surface water (Adhikary et al., 2012). According to JJS, tube-wells are only affordable by well-off farmers, which gives them a stronger position over the poorer farmers (Appendix II.B). They depend on water from rivers, canals and ponds.

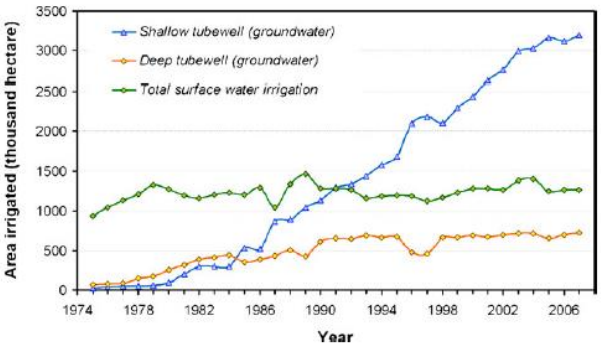


Figure 5-8: Annual trends in deep and shallow aquifer extraction in Bangladesh, compared to surface water extraction. Source: (Shamsudduha et al., 2011)

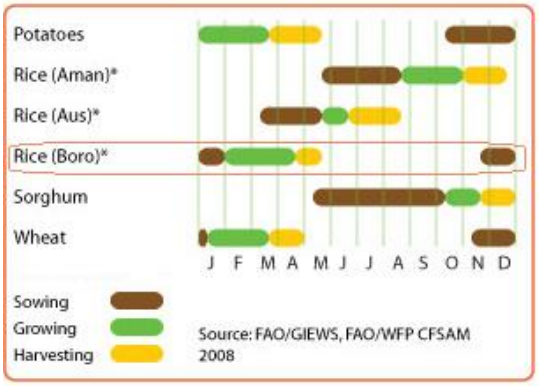


Figure 5-9: Crop Calender Bangladesh. Source: FAO/GIEWS, FAO/WFP CFSAM 2008 http://www.fao.org/giews/countrybrief/country.jsp?code=BGD. Updated June 16, 2014.

Figure 5-9 shows the crop pattern of Bangladesh. Based on a study with crop irrigation models, Murshid (2012) argues that a mixed cropping pattern of vegetables and rice would lead to increased groundwater recharges in Bangladesh. Another insight related to agriculture is that Mondal et al. (2001) found that the longer plots are fallow, the more they salinize since salt will accumulate in the top-soil when evaporation forces exceed gravitational forces that work on the water present in the soil. From this perspective, shallow-aquifer irrigated dry-season cropping might reduce more severe salinization of the top soil. This insight could be included in the game by adding a rule that plots become unfertile after several rounds of extracting polluted water or after several rounds that a plot has remained fallow.

SOLID WASTE MANAGEMENT

Solid municipal waste in Bangladesh mainly ends up on waste dumps in the peri-urban areas of the city (Alamgir et al., 2007). Waste management infrastructure and institutions are lacking in Khulna which results in contamination of surface- and groundwater sources with waste. The Mayur river is used by urban and peri-urban users as water source, by farmers for irrigation and by fishers (Kumar et al., 2013). Kumar et al. describes that due to extensive solid waste dumping, loss of connectivity, salinization and encroachment, the current state of the river is lifeless. Solid waste in Khulna is mainly (86%) generated by residents and for a small amount by commercial activities (12%) (Alamgir et al. 2007). The composition is mainly organic with 79% for food and vegetables and 9.5% paper products. This distribution is promising for local recycling and decomposition. However, if the economic growth in Bangladesh continues the share of plastics and metals is likely to increase. It will have a positive effect on the quantity and heterogeneity of waste which will complicate waste treatment even more.

POLICY OPTIONS

Based on the insights from the reviewed literature some policy alternatives are identified that could increase the available groundwater quantity or improve the quality. An overview of these alternatives and their feasibility is given in Appendix VI.

Ravenscroft et al. (2013) see deep aquifer extraction as the best solution to provide in drinking water, based on their finding high qualities in South Bangladesh. They see depletion of the deep aquifer as a justifiable means to prevent further contamination with arsenic. They assume that the economic growth gained by long term public health improvements will make purification and artificial aquifer recharge more economically feasible.

Although the economic feasibility of artificial recharge certainly deserves further research, this policy of increasing deep aquifer abstraction is likely to worsen the problem in the KCC. Further abstraction in the KCC will likely increase sea water intrusion into the deep aquifer. The groundwater table is currently already dropping at a pace of 0,5-1 meters/year (Shamsudduha et al., 2009). A better option for Khulna is probably a combination of intensive rainwater harvesting, local purification of arsenic contaminated wells and aquifer storage recovery, although the latter two options are expensive. The huge difference between the actual storage and potential storage calculated by Shamsudduha et al. (2011) and the fact that most of the rainfall disappears as run-off indicates that artificial recharge has large potential. More local adaptation strategies which are considered to be most feasible are the stimulation of mixed cropping patterns and the construction of (communal) collective rainwater harvesting installations.

A point of dispute is whether shrimp farming should be perceived as a threat for local communities and farmers or as an opportunity to adapt to the changed environment. Whether this industry will remain a threat or become an opportunity for local communities in the long run will depend on how the sustainability (social, economic and environmental) of the sector will develop, which is not likely to happen without regulations. A more clear spatial distinction between agricultural and aqua-cultural farming might reduce the risk of salinization of agricultural plots, but requires a spatial redevelopment of parts around Khulna.

5.5 CONCLUSION

The lack of perceived interdependency and connectedness between water users and the occurrence of competition over water resources among groups are important causes of the problem. Therefore, the game aims to increase the awareness of players that they are interdependent, that everyone will benefit from cooperation and that water is finite and valuable. The perceived outflow of resources from peri-urban areas to urban areas contributes to the conflict. (Peri-urban and urban) domestic usage, Agriculture, Shrimp farming, the Industry and Governmental agencies are the five key stakeholders. Conflicts occur between almost each combination of stakeholder group. The game will focus in the first place on the conflict among farmers and between farmers and domestic users.

Based on a system analysis, it is found that salinization of groundwater takes place through a combination intrusion from tidal rivers, sea water intrusion and abstraction of water from present older marine sediments. Although some factors are climatological and not impressionable by the stakeholders, the salinization around Khulna is predominantly anthropogenic caused. Some scholars consider the shrimp farming industry as a significant contributor to salinization. Apart from that, wells in the Khulna division have high rates of arsenic which is a heavy metal which occurs naturally in rock layers but can be mobilized by anthropogenic activities. The rapid urbanization reduces the recharge and increases the run-off and chance for flooding. The poor functioning of the urban waste system reduces also the accessibility of groundwater.

Another dilemma is that the food security of Bangladesh depends on intensive, dry-season boro-rice and irrigation is the major consumer of groundwater. A mixed cropping pattern will be necessary in the future. Training and compensation for the decreased income will be necessary to support this transition. It is doubtful whether the on-going transition from agriculture towards (brackish) aquaculture will benefit the water quantity and quality. A literature review showed that the current (weakly regulated) aquaculture contributes to the deteriorating water quality. For conclusions on its share and to deliver constructive solutions, further research will be required. A promising policy to improve the water quantity and quality is a combination of intensive rainwater harvesting, local purification of arsenic contaminated wells and a clearer spatial distinction between aquaculture and agriculture.

6. GAME DESIGN

In this chapter, the findings of the system analysis are translated into the gaming model (see figure 6-1). The chapter aims to answer which game model should be developed based on the design specifications. The chapter will describe what will be selected, abstracted and idealized in order to make the game as simple as possible, without reducing the learning effects of the game. In reality, this process of selection and aggregation is done iteratively. This chapter will provide the argumentation behind the design and aims to expose the assumptions behind it.

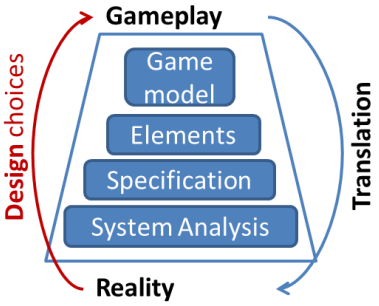


Figure 6-1: Game design

6.1 SPECIFICATION

DESIRED LEARNING EFFECTS

Based on the described problem, the following learning effects the game needs to deliver are formulated:

1. **Increased understanding about the system that:**
   a. All users are interdependent.
   b. Everyone will lose in case of competition; everyone will profit in the long run from cooperation.
   c. Groundwater is finite and valuable.

   After the game, people know that they are interdependent, that everyone loses in case of uncoordinated extraction and competition. They know that the deep and shallow aquifers are finite, that players influence each other through pollution and extraction.
2. The **causes of the problem** are not just natural, all users are part of the problem. Nevertheless, all users can become part of the solution. Although climate change reinforces the problem, the solution lays partially in designing 'rules' that make the 'game' more cooperative. Climate change makes it even more impossible to survive as commons without coordination and cooperation.
3. Increased understanding of **how other users perceive the problem.** There are four different roles, the players are interdependent. There is an asymmetry between the roles, some have more easily access to resources than others and are more advantaged. By changing roles after a game, empathy for the other perspective is increased.

DESIGN REQUIREMENTS

In this paragraph the requirements on which the game will be assessed are defined (figure 6-2). Because the functionality of the game depends on the extent it is able to enhance the desired learning effects, this should be the first requirement. During the interviews to assess the need for support, interviews were also asked which requirements the game should satisfy (Appendix II.B). Interviewees emphasized that the game should be neutral, appropriate for the context and create more equity in access to the negotiation process. A lowered hierarchy between players and the playability by different groups. Since it is desired to involve parties with higher social status who are less familiar with gaming, the perceived seriousness of the game was mentioned as well.

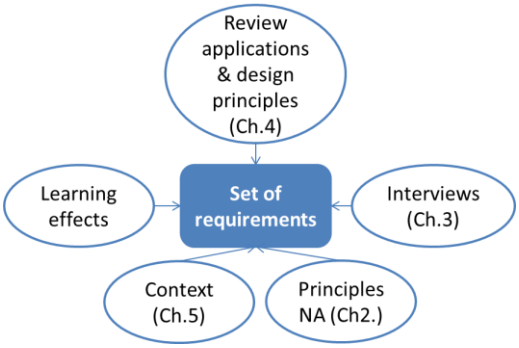


Figure 6-2: Sources of design requirements

Based on its *mediation* role in a policy analysis process, the game should be judged on pragmatic criteria, like its *workability*, *usability* and whether it connects to the right opportunity (Mayer et al., 2004). The aim in interactive policy design is to improve *mutual understanding* and the values underlying a *mediation* game are finding acceptance, learning, sharing perspectives, creating commitment and the reaching of agreement (Mayer et al., 2004). Based on further findings in chapter four, the game should be metaphorical because it will be applied in the first phases of the mediation process. The game should simplify the complexity of peri-urban groundwater management as much as possible, to help players to comprehend the issue better. On the other hand, elements corresponding with reality need to be added to ensure the meaningfulness of the game (Lankford and Watson, 2007). Therefore, the identified key stakeholders should be included in the game as well as the mechanisms behind salinization, pollution and depletion of the CPR.

As followed, the game has to be in line with the principles of the NA, as described in chapter two. Based on the first principle, the design process should be participative. The game should stimulate a power shift to the communities, but be neutral as well. Preferably, the game is highly flexible and adaptable and involves both genders as roles. Finally, the scope and quality are constraint by limited time and resources.

Table 6-1: Requirements of the game

Category	Description
Learning	Application of the game in the context of Khulna enhances the learning effects by the target group. The target group is representatives of peri-urban and urban domestic users, (well-off) farmers, the shrimp industry, KCC officials and KWASA officials.
Flexibility	The game is adaptable to local circumstances in a few days. The bases of the game needs to be generic enough to be playable in different contexts.
	It is easy to modify the game on the spot, based on feedback of participants
	The game is payable with different combinations of player groups (farmers, fishers, industrials, domestic users, governor)
Process	The game takes not more than 2-3 hours to play (a part of a day), including debriefing
	It is easy to integrate the game into a larger workshop and research method
	The game is playable without the instructions or guidance of the facilitator *during* the game. The game is easy to facilitate
Communication	The game improves communication by making interaction and cooperation essential
Context	The game is playable by representatives of local farmers and peri-urban water users.
	The game is playable by uneducated Bangladeshi people and is therefore as language neutral as possible, by using symbols and pictures.
	The game connects to the local Bangladeshi culture. The game does not include sensitive topics (gender, religious, sexual suggestive content). Players are able to relate the form to traditional games and cultural expressions (Lankford and Watson, 2007)
Playability	The game is experienced as enjoying by the targeted player group
	The game establishes open, constructive group dynamics (stimulating descriptive language, problem-orientation, spontaneity, empathy, equality, tentativeness, humour (Remmerswaal, 2008), Appendix X)
	The format of the game creates a high willingness to play for the target group.
	In the game, the hierarchy between players is lower than it is in reality.
Neutrality	The assumptions made in the game need to be transparent and the model behind the game are 'white box'.
	The game includes different viewpoints, is not biased towards a specific user group
Ownership	It is possible for players to add content to the game. After playing the game; players feel ownership for the content (ideas, solutions) generated through the game.
Realism	In the game, players are able to obtain distance from the conflict, but are also able to translate the lessons back to reality.
	The game is metaphorical, the story clearly distinguishes play from reality

6.2 DESIGN APPROACH

In this paragraph, the way how the game is designed is described. The design process has followed the steps described by Mayer (2009a), in occasion of the Game Design course at the Delft University of Technology. Figure 6-3 shows the steps mentioned by Mayer and mentions the paragraphs the steps are described in. The System Analysis is consciously separated from the other design steps, to make this part better accessible for readers only interested in the case of Khulna, such as researchers of the UDW project. The design is executed in the mentioned sequence and the parts are iteratively improved after feedback.

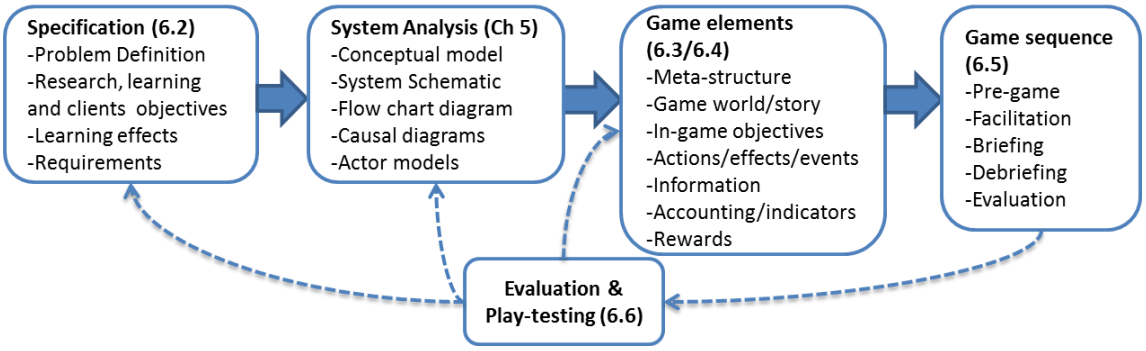


Figure 6-3: Design steps

The design is specified through discussions with the client and experts involved in the UDW project. The learning effects were also defined by a review of articles in the 'Water Security in Peri-Urban South Asia' paper series (Narain, 2010). Perceptions and interdependencies between stakeholders were identified by posts on the blogspot of SaciWaters[11], but later on verified by experts from SaciWaters and JJS. During the System Analysis, actor models were created. After the main actors were identified by interviewing experts of ngo's working in Khulna, the relations and interdependencies between the actors was modelled.

VERSIONS AND PLAY-TESTS

Multiple versions were created, that translated the System Analysis in a coherent set of game elements. For the sake of simplicity, the versions are linked to the play-test in which they were tested. In practice the difference between the versions was more fluent. The game has been tested five times during this project; the format has changed radically between these tests. Elements of 'serious' as well as 'non-serious' games were analysed during the research. Apart from the play-tests; the game has been shown to multiple experts to validate the assumptions behind the game and its inputs.

From the start, a prisoners dilemma was used as concept (figure 6-4). After attempts of adapting the River Basin Game to groundwater, the idea of a bucket was used, which came from Fish Banks. The first version included three buckets representing surface water and the shallow- and deep aquifer. The representation evolved from a spatial representation with similarities to Catan[12] and GetH20[13]. The spatial version allowed land grab and exchange. The representation evolved from realistic, based on maps of Khulna[14], to more metaphorical. In the first play-test, a metaphorical board was used. To visualize the players interdependencies, stream diagrams were created which showed the inputs and outputs of players. In early versions, players exchanged labour, money, waste, water, food and land. In the final version, only water and money was exchangeable. Since the game showed to be far too complex during the first play-tests, the use of different levels with a gradually increasing complexity was chosen. The roles of 1) domestic user, 2) farmer, 3) shrimp farmer, 4) industrial and 5) governor were included from the start based on the Stakeholder Analysis (paragraph 5.3). The role of Governor was however excluded from the second play-test on. The versions used during the thirst play-tests also distinguished peri-urban domestic users from urban domestic users, while this was not done in later

[11] http://periurbansouthasia.blogspot.in/search/label/Khulna. Workshop documents and discussions. Last visited on 23 Sept. 2014.
[12] The Settles of Catan is a board game in which players earn points by building settlements, purchased from different resources.
[13](Serious) board game; players have different goals and use water in a slum; based on Kibera in Nairobi, Kenya. See Appendix III.
[14] As example, maps of http://masumbillah.tripod.com/thesis/011.htm were used (Last access: 23-09-2014).

versions. These versions differentiated domestic users in initial resources and income. From the 2th version on, a non-spatial representation was used with a single bucket. The micro-cycle[15] changed radically between the 2th and 3th version; in the 3th version the facilitator only drew the ordered marbles while resources and income distribution (playing the ''bank'') also was the facilitators role in earlier versions. This significantly increased the speed of the game. From the 2th version on; the presumed relations between the factors included in the gaming model were summarized in a causal model, shown in Appendix IV. To summarize the difference between versions; the game has become less realistic and more simplistic. At the start, there was focused on systems understanding while in the end more emphasizes was put on cooperating and making the game playable.

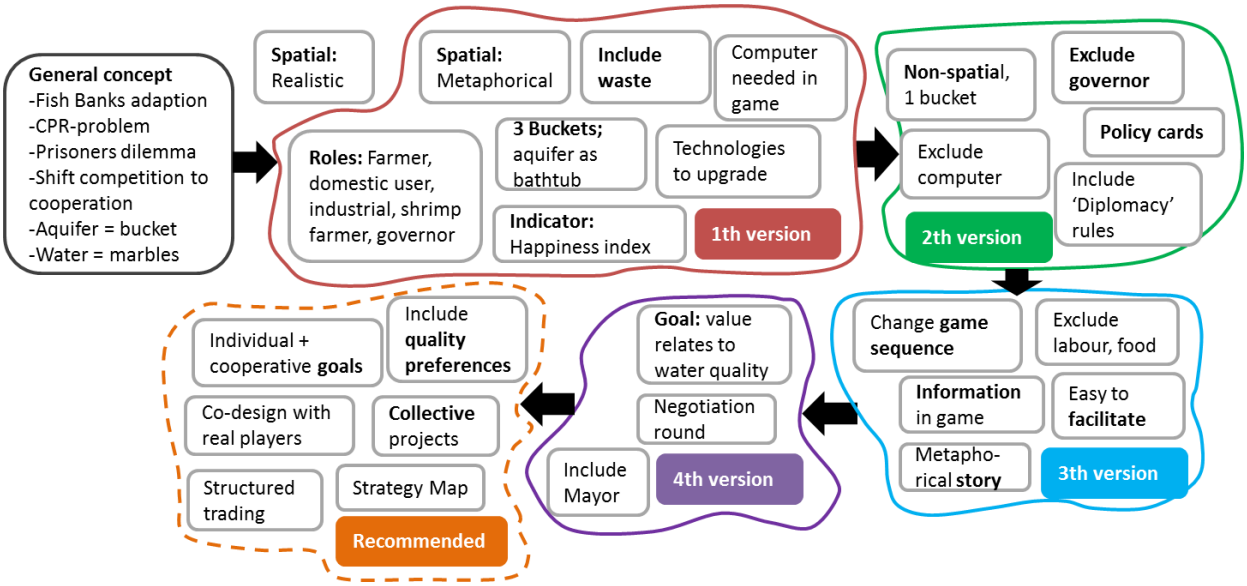


Figure 6-4: Evolution of game concept over time

Paragraph 6.3 explains which elements from which existing games are used. In addition, the design choices and transformations between versions will be explained and justified. But first of all, what players need to learn from the game will be explained in paragraph 6.2. The requirements on which the design choices are made will be explained as well.

6.3 DESIGN CHOICES

In this paragraph the design choices will be made explicit and backed up.

OFF-THE-SHELF VS. TAILOR-MADE GAMES

Because the clients resources are limited and the scope of existing games with a similar function is enormous, there is first investigated whether these applications fulfill the requirements (See Appendix III). Off-the-shelf applications are basically context independent, while inclusion of local knowledge and play elements could be beneficial for the acceptance of the game and helps translating the learnings back to reality. On the other hand, tailor-made games are expensive, require much development time and risk 'reinventing the wheel'. Because learnings from games with a higher level of abstraction can be related back more easily to different realities, they can be used better in different contexts. The River Basin Game has been applied in different contexts due to its metaphorical representation. The essence of the problem was similar; conflicts between farmers due to upstream over-extraction and pollution. The disadvantage is that the learning effects remain general as well. It is plausible that the ShaRiva game will also enhance in different river basins learnings as 'confidence to engage in negotiations' and 'awareness of difference in upstream/downstream interests' (Douven et al., 2014).

[15] This is the sequence of game rounds; such as turns between players, pulling of events and distribution of resources. The macro-cycle is the sequence of preparation, briefing, actual game-play and debriefing. The micro-cycle is thus part of the macro-cycle.

Learnings related to the Mekong Agreement and procedures of the commission will only be enhanced with the intended target group of 'Mekong' experts. Participation in the game workshop showed that these specific learnings were enhanced less when playing the game in an educative setting with students. Therefore, the game was then experienced as 'too realistic' at the expense of 'play'. The added realism did not convey the same meaning it would have been when played by the target group.

Off-the-shelf games are useful when a specific general concept which is context independent needs to be communicated. Examples are the games of Meadows and Sweeney (1995) that are based on archetypical system behaviors. It is possible to achieve the learning effect 'understanding of the system' with an off-the-shelf-game in which players experience a CPR prisoners dilemma (Fish Banks). Awareness on urban waste dumping can be created as well by the context-independent game 'Ditch' (Appendix III). The need to create at the same time an understanding of the other perceptions and awareness that the causes of the problem are (partially) anthropogenic, disqualifies Fish Banks. Role reversal in a mediation game requires that all the roles of the participants involved in the mediation process are represented. The characteristics of the roles need to correspond and (cultural) behavior rules need to be similar, to enhance a high level of social realism. This suggests that off-the-shelf mediation games are only effective to players with similar values, perceptions and attitudes as the intended target group. The effectiveness of a game like 'strike fighter' will be culturally dependent and might also differ across organizational cultures. As followed, no existing application was found with the desired stakeholder heterogeneity. Fish Banks has only the role of 'fishing company' and the River Basin game the role of 'farmer'. The 'Tragedy of the Groundwater Commons' game of IGRAC includes both a 'fishery' and an 'agricultural role' (van Weert and van Duinen, 2010). In addition, most described mediation games address River Basins. Because the (perceived) connectivity between users and the openness[16] of a river basin fundamentally differs from a groundwater system, a similar format cannot be used. 'River Basin' based games will create a different understanding of 'interdependency' and 'finiteness' of water than desired.

In short; the more desired learning effects and the higher the required level of realism, the less likely it is that an off-the-shelf game can be applied. Because 'perception change' requires a high level of social realism, a specific game for the Khulna case will be created. In addition, because the learning effects complement each other and are interrelated; fulfilling the learning effects with three separated off-the-shelf games will be less meaningful. In an homogeneous player group, the game can be used to enhance systems understanding and to prepare the players for playing the game together with other types of users. In such a setting, the game 'Harvest' could be used as well, to learn communities how CPR problems basically work. In chapter eight, suggestions will be made how the game can be adapted to the case of Kolkata.

DIGITAL VS. NON-DIGITAL FORMAT

A choice is made for a non-digital game world. The game needs to be flexible and quickly adaptable to the local context, on the spot. Another requirement is that players need to be able to add to the content of the game, to make it their own. The requirement of 'designing on the spot' with local, limited resources constrains the possibilities in favour of non-digital games. Advantages of digital games are that they are able to create a more optimal *flow*[17] of experiences and immerse players more instantly by stimulation of more senses compared to non-digital games. Another advantage of a digital format might be the perceived 'seriousness' of the tool which might be more important in hierarchic settings with players unfamiliar with the concept of serious gaming (Lankford and Watson, 2007). In such settings a higher perceived 'seriousness' will lead to a higher 'willingness to play'. Finally, my personal background and competences inevitably influence the decision. My education in Policy Analysis hints me towards a more analytical game which emphasizes system analysis more than designers from for instance Utrecht might do. My lack of graphical design and programming skills and personal interest in board games might also bias the decision. But because the requirements of 'flexibility' and 'ownership' are clearly better fulfilled by a non-digital game, the decision to proceed in that direction can be made without hesitation.

[16] With openness, the ratio between the flows and the stock of the system is meant. Although groundwater is dynamic, it is plausible that the ratio between the input/output rates and the stock is lower than for a river basin.
[17] Flow is the state in which the tension between the abilities of the player and the presented challenge is in optimal balance; a lower challenge will be boring, while a higher challenge will create anxiety. Since the abilities of the player will improve during the gameplay, the challenge should be adaptable. This theory is developed by the psychologist Mihaly Csikszentmihalyi.

CONFLICT & COOPERATION IN MEDIATION GAMES

In order to enhance the understanding that cooperation is essential, the failure to cooperate and the consequences of that needs to be experienced. In order to learn *how* to cooperate and to have something to negotiate about, the game needs to be also cooperative. Therefore, multiple mediation games shift in several rounds from competition to cooperation (The River Basin game, the Bhutan irrigation game, Strike Fighter). An option is to stop the game after failing to cooperate, which is done by Fish Banks. A criticism on Fish Banks is that players are not able to experience *how it should be*. On the other hand, the frustration of failure in Fish Banks is a powerful opening for the debriefing. It is plausible that the same frustration cannot be created a second time. The 'fun' of the game will diminish after some rounds if the presented challenge does not adapt to the skills of the players. The only way to know what the right balance is, is to test the game many times, in various settings.

There is decided to play the game multiple times sequentially; the first game will be simple and competitive while the next game will be extended to allow more room for negotiations. It will trigger players more to cooperate. Cooperative (co-op) design is more complicated than competitive design; competition is the natural mind-set of most players and co-op requires a more complicated reward system which rewards consensus seeking behaviour. Players will need to get their satisfaction from socializing, exploring or creativity. This might make the game less suitable for players which are more competitive. Bartle maps four player types based on what delivers players fun, in which *killers* like to interfere with the play of other players while *achievers* like to beat others based on the rules (Bartle, 1996). *Explorers* enjoy discovering the underlying system of the game and *socializers* enjoy developing relationships and storytelling more. This is based on whether they like to act upon world objects or players and perceive them more externally or interact with them more internally (Figure 6-2). It is likely that more player-oriented types will enjoy the game more (socializers and killers), since the representation of the 'world' will be minimal and the fun needs to be obtained from social interaction.

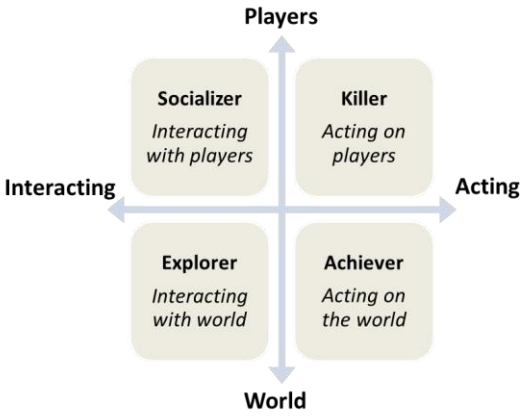


Figure 6-5: Player types of Bartle (1996)

Other challenges are the inevitable existence of a knowledge and skill mismatch between players, according to Tanya Short in an interview with the site 'Gamasutra' (Short, November 14, 2012). She argues that it might be more difficult in co-op design to prevent players loosing face since not only the design can be blamed when the game is not entertaining, but also the fellow players. If the game will be further co-developed with the actual players, it is important to investigate which player types are common, which games the local players enjoy for what reasons and how the co-op design challenges can be tackled best. A format in which players together have to beat elements in the environment as common enemy and in which cooperation results in a clear advantage above individual competition will be useful.`

GOVERNANCE

An important design choice is whether and how to include the role of *governance* in the game. Common solutions to CPR governance problems are improved coordination, collective restriction of abstraction by quota and the establishment of monitoring and sanctioning systems to guarantee rule compliance (Gardner and Walker, 1994, Dietz et al., 2003, Poteete et al., 2010). These solutions can be internalized or externalized. They are externalized by discussing in the debriefing which solutions are appropriate and how they can be implemented. Here, a choice is made to externalize governance policies in *competitive* rounds and internalize it in more *cooperative* rounds. After the first competitive round with the expected outcome of depleted and polluted water resources, there will be discussed in the debriefing what went wrong and what can be done to prevent it. Players are then triggered to think of solutions; the proposed solutions can then be added to the game as 'policy option cards' (See Appendix VIII.2). One can also add a governmental representative as role in

the game. The *governor* wins when everyone wins or when two proposals are implemented. As actions, the player can monitor pollution levels or groundwater levels and can propose policy options (So, instead of all players pulling the 'policy option' card sequentially, only the governor pulls it). Monitoring needs to be costly, the governor needs to make trade-offs on what to do. Players who play the role will learn that governance in reality is hard; it is almost impossible to align all players behind a proposal and there is an immense gap between proposal and actually implementation. A choice is made to not include a *governance* role; all players need to think of policy options, adding the governance role will make the game more complex and it was more difficult to make the governance role playable.

GROUNDWATER AQUIFER AS BUCKET

The groundwater aquifers are simplified as 'buckets', which means that all the water in for instance the shallow aquifer is put into a single bucket, from which all users can abstract at the same time. The model is thus non-spatial. This is chosen since the local aquifer is presumed to be relatively static and the diffusion of the effects of local actions is presumed relatively fast. In reality, the aquifer system under the KCC has local water packages and is non-static. The spatial characteristics of the problem is however assumed to be not essential to enhance the main learning effects. A clear interdependency of the stakeholders is essential, which is more simple to represent by letting stakeholders abstract from- and pollute in a single bucket. The game needs to involve stakeholders from different levels and needs to simulate the depletion of the aquifer, which requires a time horizon of at least a decade. This makes the game more strategic than operational.

Figure 6-6: Bucket with marbles

Only the shallow aquifer is included as bucket; the deep aquifer will not be considered. Although the deep aquifer is an important source of drinking water in Bangladesh, the shallow aquifer is most intensely used in Khulna. Although the KWASA mainly abstracts water from deep tube-wells, most peri-urban water users use the shallow aquifer and surface water.

A bucket is chosen to represent the water system. Marbles are an useful representation of water. A simple, visual and tangible representation will make it easier to understand how the system works.

DELAYS IN GROUNDWATER SYSTEM

Understanding of delays in systems is essential in order to understand the behaviour of a system (Sterman, 2000). Several delays occur in groundwater systems. The recharge itself is delayed, dependent on the soil permeability, presence of a permeable sand layer and the connectedness between surface water bodies and the shallow and deeper aquifers. The diffusion of surface point pollution into the groundwater is delayed, the mobilization of arsenic till its abstraction is delayed as well. The diffusive effect of point recharge or abstraction on the larger aquifer is also delayed. There will be a delay between the actions of users and the effects, which will make it more difficult for users to perceive their own influence on the problem, to relate effects back to individual users. Delays make it more difficult to identify underlying causes and might lead to symptom mitigation.

Basically three types of delays can be distinguished (Sterman, 2000). If the delay is perceived as a stock with an in- and output, the extent that recharged marbles are mixed with the already present marbles determines the type of delay. The delay can be:

1. **Totally mixed**: there is no relation between the input and output. This can be simulated by shuffling the bucket with marbles first before drawing marbles from it.
1. **Partially mixed**: The bucket is not shuffled. Since marbles on top will be drawn more quickly, abstraction will be not totally random and there will be some relation between input/output sequence.

2. **Not mixed** (pipe-line delay): Marbles that just enter the delay are not mixed at all with marbles already waiting, the process is sequential and the ''first in, first out'' principle applies. This can be simulated by literally putting the marbles in a pipe.

A choice is made to mix the marbles partially (2), since this delay corresponds best to reality and is also easy to execute. Because there will be some relation between input/output sequence, the sequence in which the marbles for each player will be extracted *does* matter. An option is to do the extraction randomly (figure 6-7) or sequential (figure 6-8). In the latter case, the inequity between players in resources to abstract which results in an unequal distribution of polluted water among users, can be represented. The additional meaning that could be related to sequential extraction is considered to be not worth the increased complexity of the game; a choice is made for *random abstraction*. The game was tested with both types of extraction and the 'random-abstraction' outcome was considered more desirable (Appendix VIII. session 1 = non-random, session 2 = random). Apart from the level of realism and meaning, the game needs to be playable and the computational actions of the facilitator should be limited as much as possible to maintain flow in the game. In addition, it will improve the ease of facilitation, which is a criterion.

Figure 6-8: Random abstraction

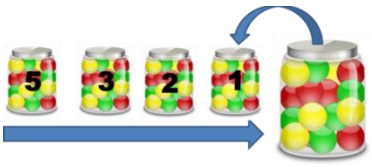


Figure 6-7: Non-random abstraction

INEQUITY BETWEEN PLAYERS

Inequity between stakeholders is important to include in the game since the ultimate purpose of the game is that through increased system understanding and cooperation, equity in water sharing will improve. Inequity is included by:

- Asymmetry in **resources:** Some players have more money, which can give them more access to shallow/deep tube wells. If the water is polluted, they can still buy clean water. Players get different initial resources.
- Asymmetry in **information:** Some players can get more information than others. The game includes *secret information* about what each player exactly abstracts, what their next action will be, whether they pollute, what their resources are and with whom they cooperate in which way.
- Asymmetry in **influence**: All players get one vote in the negotiations, but players that have more resources in the game will have a better BATNA and therefore more influence on the negotiations. More people will be willing to form coalitions with them and they will have more possibilities for side-payments.

Inequity is more complicated to visualize in groundwater than in a river basin, in which it is clearly visible that upstream players have an advantage over downstream players. Access to *deeper* tube-wells with more *capacity* would correspond to inequity in groundwater access. A spatial distribution of marbles in which it is clearly visible that polluted water is unequally distributed is another alternative. In the first play-test, the abstraction was done sequentially and the sequence was based on the capacity of the pumps (Appendix VIII.1). Players with larger tube-wells would have a larger chance to get clean water. The individual abstraction was calculated with a spreadsheet model (Excel). This made the game more complicated and since there was not reflected in the debriefing on this reasoning, this additional meaning was not translated into learning. A spatial model will make the game much more complicated than necessary, so a choice is made to only represent inequity in asymmetries of resources, information and influence.

CLIMATE

Climatological effects will not be included at all in the game. There will be only reflected on the influence of climate change in the debriefing. The point then can be made that if the problematic behaviour already occurs without considering the fluctuations in water supply caused by climatological effects, the argument for cooperation will be even stronger in reality than in the game. Exclusion of the factor 'climate' can thus enhance understanding that climate change is not the only cause of the problem and that the players certainly have an influence on the systems behaviour.

POLLUTION

The possibility to pollute will be included in the game since it is a realistic type of behaviour and it will give an extra dynamic to the game which might make it more fun to play. Feedback on the UDW project proposal during a stakeholders workshop was that pollution by solid waste dumping required more attention (Thissen et al., 2013). The proposal mainly focused on arsenic contamination and salinization. Players will receive a waste card for every house they have. By letting players decide to clean their waste by paying money for it or dumping it in a way unknown for other players, a prisoners dilemma is created. Dumped waste is included in the water by changing a 'blue' marble that is recharged for a 'black' one.

WATER & FOOD & LAND MARKETS

It is possible to include an 'external' water market in the game. In this way, water is always available, but not always accessible, due to increasing market prices. Transport of 'external' water could be included as event, the amount could be for sale to the highest bidder, which would give the game another element of competition and add playfulness. There is chosen to not include this element, because it will complicate the game more without adding essential meaning that relate to the desired learning effects. In addition, The abstraction cost of water can depend on the number of marbles in the bucket. Less marbles represent a lower groundwater table which implies higher pumping and piping costs. The game was tested in the 2th play-test with this element, but later excluded. Although the dynamic is realistic, water will already relatively become more expensive when it gets more polluted. The element adds only complexity and makes the game more difficult to facilitate.

Earlier versions included food, labour and land as tradable resources. In order to ensure players have something to negotiate about, they should be interdependent. It was considered that only including water as tradable good would narrow down the negotiation space and make it more zero-sum. Elimination of the farmer player would result in a higher food price, which would hurt the domestic water users. Elimination (or migration) of the domestic users would lead to problems in labour supply for the industry. This was considered because an interviewed expert suggested that urban areas depend on the fresh food supply of peri-urban areas (see section 5.3)(Interview, May 12, 2014,-a). However, there is decided to exclude these elements because it will triple the complexity of the game and the required information processing capacity of the facilitator and players. In reality, direct bilateral trades do not exist. The perceived interdependency in reality is lower due to interference of a market place. It is plausible that individual peri-urban workers or farmers have no significant influence on the labour and food markets of Khulna, because the (labour and food) supply will be relatively large and the market relatively open.

IN-THE-GAME OBJECTIVE

With, the winning condition in the game is meant. The goal should be clear, measurable and challenging. It should be very clear for players which actions they can perform to reach the goal (Salen and Zimmerman, 2004). Everyone's goal is to maximize their assets. This is the value of all properties (houses/plots/factories) in the end of the game plus the cash[18]. The value of all properties is multiplied by the ratio of clean marbles left at the end. Otherwise, winning is totally determined by the initial resources and the only game dynamic is an exponential growth and a 'success of the successful', till the system collapses. This will become or too boring or too frustrating for underprivileged players. Making the value of the properties dependent on the water level is realistic; extraction installations will lose value in case of water quality deterioration. Land and house prices will decline if the living circumstances deteriorate by depleting resources and shifting employment.

PLAYERS

Fish Banks is quiet simple to learn and straight forward to play since the player roles are homogeneous; there are only fishers who all have the objective to maximize their returns. However, in order to achieve the function

[18] This idea stems from Fish Banks. There, the objective is to maximize your assets. Assets are: your *bank balance* + *ships* x *the ships salvage value*. This is the price that would be paid for each ship if the game ended that year. It depends on the average profit per ship and thus on the *amount of fish catch* x *fish price*. Thus, overcapacity and a depleted fishing pool results in a low value.

of *mediation*, multiple roles will be needed to include. Heterogeneity is essential to represent the inter-actor complexity described in the Stakeholder Analysis in chapter 5.3. Players need to play themselves as well in order to learn how the system works and translate the learnings more easily back to reality (Bots and van Daalen, 2007). This can be combined with role reversal to improve mutual understanding, empathy and understanding of each other perceptions. By making the *roles* heterogeneous, but the *underlying mechanism* homogeneous, the game will satisfy both realism and playability requirements better. While extensive explanation was still needed in the first play-tests when the underlying mechanisms were heterogeneous, the last play-tests needed little explanation. The roles are made heterogeneous by different stories, pictures and symbols. Players will have different technologies and 'production' units, such as plots, factories or houses. The mechanism behind every player will be similar; they will have the same goal and the same strategies to reach this goal.

To reach their goal, all players can buy technologies, adapt their ordering, manage their waste or influence other players (D) (see figure 6-9). Technologies affect the production unit by upgrading it or making it more efficient (A), the production of waste (B), the water input (C). As example; with a filter, players can change polluted for clean water and with a rainwater harvest technology, players can get a free clean marble every round. Inequity is expressed in a difference in initial resources. The marginal returns of water and waste production also differs per player type.

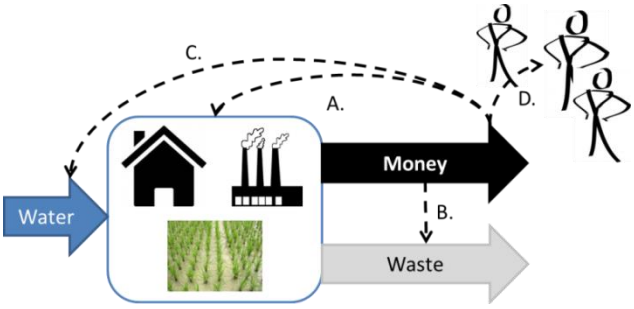


Figure 6-9: Mechanism behind every player type

WATER DEMAND

Water demand needs to be variable, players need to be able to choose how much water they want to extract, otherwise the ordering round will make no sense, which needs to be included to make the game a prisoners dilemma. A choice is made to let the water demand partially depend on the initial number of plots and houses of players. Players will have a fixed, minimal water demand but can get extra income with extra water. The returns per plot are therefore variable. Chapter 5.3 described that private tube-well owners contribute significantly to the competition around water in some districts (for instance in Labonchara (Kumar et al., 2011)). This behaviour can be simulated in the game by including the option to buy a tube-well or give some players initially a tube-well. Tube-well owners can extract by ordering water from the 'bucket', their chance of getting polluted water is equal to other players. However, they can buy (abstract) water under the market price which makes it interesting for them to sell it to other players. The maximum extraction of all players, including tube-well owners depends on their budget, which is hidden from other players.

LEVELS

The game will be build up from different levels, in which the first level allows more competitive behaviour but the latter levels stimulate more cooperative behaviour. The choice is made to build the game up from different levels to increase gradually the difficulty and complexity. The first game needs to be playable without an elaborate explanation; it needs to be short and simple to learn players the rules and what the effect is of their actions. Therefore, the first game will only include water as tradable resource. Sub sequentially cooperative objectives, negotiations about policy options and waste management are added to the game in the form of new levels. The cooperative level will be most effective if first a competitive level is level is played and if all players have formulated actions to prevent this, based on their current role. After that, the roles will be reversed and players will experience the 'effects' of their former actions and how their preferred strategy might change after role reversal. Between the basic game and the negotiation addition, the game needs to be debriefed since this gives players the possibility to rethink policies from a broader perspective and add own policies to the game. Appendix VII gives a more extensive description of the different levels that will be considered. To summarize, the levels are:

1. **Basic game:** All roles included.
2. **Cooperative level:** Basic format; only a cooperative objective is added. Everyone loses if 3/5 of the water level is polluted.
3. **Waste expansion**: players now receive waste and need to clean it or dump it.
4. **Negotiation round:** policy cards and time for negotiation is added. This is embedded in the macro cycle of a basic/cooperative game to make sure the effects of the added rules can be experienced and rule compliance can be 'tested'. Therefore, negotiations will take place after every three rounds of play. Dependent on the group size, the negotiations will take much longer than a basic micro-cycle (15-30 min. versus 5 min. for the basic cycle). Time pressure therefore is essential. To shift responsibility of time monitoring and the lead of the discussion to the group, a 'Mayor'[19] can be appointed. Everyone can become a Mayor and is chosen by the majority. This will add fun and structure to the discussion and forces players to rethink articulate their intentions.

Exchange of land between farmers and shrimp farmers is possible in any round, since everything is tradable. It was also considered to let players play on a spatial board and include *land grabbing*. Players could then pay money (bribing) to grab the land and this could be prevented if other players would help the victim by blocking the grabbing[20]. Although it would increase the playfulness of the game, it was not included since it would further increase the complexity and make a spatial representation of the conflict necessary. Since there is chosen to use a non-spatial representation, such a format would add no meaning but only complicate the game.

NEGOTIATIONS

Players should get room 'to play around the tool', as prescribed in chapter 4.6. The negotiation part of the game should be like a sandpit; the boundaries will be set and the material provided, but the form of the negotiations can be totally shaped by the players. The game should create expectations and stimulate the construction of 'beautiful sandcastles' constructed in collaboration, without strait-jacking players. This is done by suggesting already a couple of policy options and giving space to add own policy options.

An example of a game in which this works successfully is 'Diplomacy', an entertainment game which simulates negotiations between superpowers in Europe around World War I. Players intensely negotiate while the objective is zero-sum: who first controls over 50% of the (army) supply centres wins. Elements that make Diplomacy successful and can be used in the groundwater game are:

- All actions are executed at once instead of sequentially as in games like Risk. Therefore players do not know what others will do for sure and a 'trust game' evolves.
- Before all actions are ordered there is room for communication and negotiation. This requires sufficient room at the location to move around and talk privately to players.
- The key rule is that all treaties, deals or promises made in the negotiation round can be broken. The core of the game is to find out ''whom to trust when''. Players thus have procedural interests to maintain repetitive relations.
- Collaboration is necessary to win the game; the person who gets the most support and builds up trust wins.
- Include few elements of chance in the game.

Rules need to give players incentives to negotiate and trade. There cannot be expected that players will start to negotiate spontaneously. Certainly not if players are divided into different teams since this will make them presume the game is competitive. Players need to have different options with different costs and benefits to negotiate about, in order to make compromises, exchange or compensation possible. Negotiations in prisoners dilemmas are aligning other players to trade high short-term gains with larger risks for lower long term-gains with less risks. Table 6-2 gives an overview of what players prefer from each other. A farmer can ask a worker to spend money in cleaning waste in return for an investment in less water consuming technologies. A tube-well owner could try to sell water under the market price to other players in return for others voting against quota or monitoring, buying efficient technologies or cleaning their waste. It should be noticed that a tube-well owner is framed as player type while each player has the ability to own a tube-well and thus play the additional role of tube-well owner.

[19] This element stems from 'Wherewolf'. In this card game, players need to point out the 'Wherewolfs' and try to convince each other. Players have different roles and different information. The discussion is let by a Mayor.
[20] 'GetH20' has a similar mechanism. A 'Settlers of Catan' board format was considered.

Table 6-2: Overview of how players prefer other players to behave

	Farmer	Worker	Industrial	Shrimp farmer	Tube well owner
Farmer	Irrigate less, invest in efficient techs,	Clean waste, compensate for loss in yields from eff. techs	Clean waste, compensate for loss in yields from eff. techs	Clean waste, compensate for loss in yields from eff. techs	Sell water under market price to me or do not extract at all
Worker	Irrigate less, invest in efficient techs,	Invest together in techs, extract less, clean waste	Invest in clean techs, extract less, clean waste	Invest in clean techs, extract less, clean waste	
Industrial	Irrigate less, invest in efficient techs,	Clean waste, vote in favor for me	Invest together in techs, extract less, clean waste	Invest together in techs, extract less, clean waste	
Shrimp Industry	Trade land, extract less, vote in favor	Clean waste, vote in favor for me	Clean waste, vote in favor, extract less	Clean waste, vote in favor, trade land, extract less	
Tube well owner	Do not extract self but buy my water. Buy eff. techs	Do not extract self but buy my water. Eff. Techs, clean waste	Do not extract self but buy my water. Eff. Techs, clean waste	Do not extract self but buy my water. Eff. Techs, clean waste	Extract no/less water, price agreement

More diverse technologies can be added to enlarge the negotiation space. Integrating a difference in quality preferences between players will enlarge this space as well (see table 6-3). This could shift the negotiations from bargaining on quantities (their positions) to finding solutions for mutual gains. The difference in the function of water (their interests) creates room for negotiation. For instance; since a farmers has lower quality preferences than a worker, a farmer could use urban waste water for irrigation. This will make the game more complicated but also show why players with the lowest quality preferences have stronger positions in reality and how this could be changed.

Table 6-3: Players preferences

Player	Preferred outcome	Policy preferences	Quality preference
Farmer	All others extract less, waste less and buy eff. techs while I maximize water/plot	Collective techs,	Moderate
Worker	All others extract less, waste less, buy eff. Techs while I dump waste and extract more	Monitoring, quota and collective techs.	High
Industrial	All others extract less, waste less, buy eff. Techs while I dump waste and extract more	No monitoring, efficiency measures	High
Shrimp Farmer	All others extract less, waste less, buy eff. Techs while I dump waste and extract more	No monitoring, reuse of waste streams, efficiency measures	Low
Tube-well owner	Players buy my water with profit margin, buy eff. techs, clean waste, while I maximize own extraction	No quota, waste monitoring, no collective tube-wells, no quantity monitoring	High

INFORMATION

In the second play-testing session some participants suggested that the game model should be more open and that the assumptions behind the game should be clearly explained before (Appendix VIII.2). There was suggested that the water bucket should be transparent and that it should be visible what is in the bucket and what is recharged. A prisoners dilemma however exists basically due to information asymmetry; if players exactly know the carrying capacity of the system, when it is exceeded and what other players extract or pollute, there will be no dilemma anymore. It should not be communicated what the initial water quantity exactly is. If the working of the system is not communicated, there should be however sufficient room (in time and resources) for players to explore the system and find out how the system works by themselves.

ASSUMPTIONS OF THE SYSTEMS BEHAVIOR

Based on the system analysis described in chapter five the following assumptions about how the socio-physical system works are made:

- **Recharge shallow + deep = constant, till bucket is full.** The recharge can be made constant or dependent. In reality it is likely that the recharge is dependent and is influenced by the stakeholders behaviour. There is however chosen to idealize the recharge by making it constant. The aquifer will have a maximum level until it will be recharged.
- **The lower the water level, the more salinization**. Salinization is taken into account since it adds an essential dynamic to the problem. A lower water level will lead to more pollution since lowered pressure will increase seawater intrusion, since the groundwater system in Khulna is hydrologically connected to the sea.
- **Arsenic** contamination: There will be an initial amount of polluted water in the pool of 1/5. Further mobilization of arsenic is not taken into account.
- **Waste is created by all users, excluding farmers:** It is assumed that domestic users, industrial users and shrimp farmers produce waste but that the waste produced by farmers can be neglected.
- **Delay intrusion of waste into water is 1 round:** It is assumed that waste is intruded into the groundwater after a round.
- **Price water depends on level water table**: The abstraction costs of water are proportionally to the level of the groundwater table: the lower the groundwater table, the higher the price of water will become.
- **Every resource** (land, water, food, labour) a user can have **is tradable**: It is assumed that the costs and benefits of the goods are transferable.

6.4 GAME ELEMENTS

Table 6-4 shows how the game choices made in chapter 6.3 are translated into a format.

Table 6-4: Game elements

Element	Description		
Language	English. The game still needs to be translated into Bangla, which is the language in Khulna and Kolkata.		
Board	No board is used; only cards and marbles		
Plots **Houses** **Factories**	Each player receives plots (farmer), houses (worker/domestic user) or plants (factory manager). The income and the waste a player receives depends on the number of houses/plots/plants and is variable; the more water is put on it; the more income is received. Players can buy additional plots/houses/plants.		
Waste	Players can chose to dump or clean their waste. Cleaning is done by discarding money on the waste staple, instead of waste.		
Cards	Money and waste cards have the same size, so that they cannot be distinguished from each other when discarded closed.		
Technology	Each player can buy different technologies. Technologies decrease the water demand or waste or can increase the income per plot/house/plant		
Bucket	A bucket represents the aquifer; locally a bucket can be used that is normally used to carry water.		
Player descriptions	Each player receives a description of their 1) role, 2) objective, 3) resource demand, 4) income, 5) two actions (technologies) which can be executed. For every action, the costs and the effects are provided (See Appendix VIII.1).		
Indicators	Money and houses/plots/plants		
Water price	The water price depends on the number of marbles in the bucket.		
Recharge	The recharge is constant; the number depends on the initial water demand of all players.		
Information	**Known**	**Unknown**	**Knowable**
	Initial marbles in bucket	Water ordered per player	Guess ordering; based on houses/plants/plots
	Technologies bought per player	Exact black/blue marbles in bucket	
	Initial recharge	Pollution level	Income/water received per player

	Plots, houses, plants/player	Waste cleaned/dumped per player	Guess left marbles; based on initial numbers
	Water received per player		
	Role of player		
(Intended) Feedback	When receiving black marbles: Lots of waste has been dumped by others or myself, or the water level is very low; we all have extracted too much.		
	Players receiving money or buying technologies: These players received income and therefore ordered probably a lot of water.		
	Higher market price: The water level is lowered, (other)players have ordered more water		
	The water is shared; if I order more, there is less left for others. If I pollute more, all players have a larger chance of receiving a black marble (and vice versa)		
Rules	No treaty/coalition is binding		
	All resources are tradable		
	A lower water level results in a higher market price (of water)		
	A lower water level results in a recharge of more black marbles		

6.5 SEQUENCE OF THE GAME

PREPARATION

This will increase the willingness to play in a more hierarchical context. Players should not just be invited in the validation phase of the design, but be involved from the start on through co-design (ButterflyWorks, 2013). This has not only democratic value, but will increase the acceptance of the findings as well (Vennix, 1996). The game will be most effective when integrated in a larger workshop or research, which will improve the perceived *seriousness* of the game. Buy-in of sceptical parties will be much easier if the see they contribute to something bigger and feel ownership for the game itself. Curiosity of how their ideas are finally implemented will get them on board.

BRIEFING

The objective, the rules of the game and the meaning of the game elements need to be explained clearly. The briefing should not explain more than necessary to understand the basics of the game since the working of the game should be learned by experience. The following assumptions will be explained:

- Only the dry season will be simulated, no surface water and only groundwater will be available.
- The lower the water level, the more expensive the water will become. (It is not explained that the price is a logistic function of the water level)
- The lower the water level, the more pollution.
- The amount of recharge per round. (which depends on the nr. of players and the initial level)
- Every resource is tradable.
- Dumped waste can infiltrate into the groundwater.

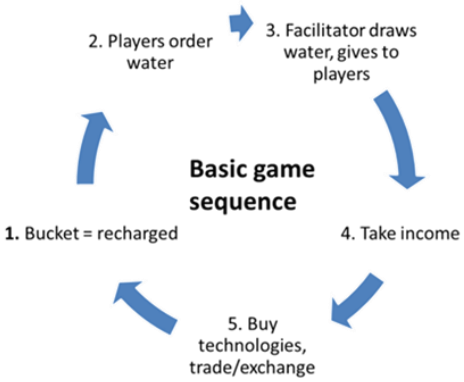
Besides providing the information to be able to play the game properly, the purpose of the briefing is also to facilitate players to step from reality into play. To trigger this transition, ice-breaking activities might be useful. These activities should get participants out of their comfort zone, give them a feeling that it is allowed and safe to behave out-of-the-box and level the hierarchic difference between players (Tassoul, 2009). This transition might also help to limit the effect of 'external' or 'implicit' rules (cultural, organizational etc.) in the game, but the presence of such implicit rules should be always taken into account. A simple but functional ice-breaking game would be 'thumb wrestling' in which participants grouped in pairs get the objective to pull the thumb of the opponent down as many times as possible. In competitive mode, this will be very hard but the game becomes easy if pairs discover that a cooperative mode is also possible (Meadows and Sweeney, 1995).

SCHEDULE OF THE MICRO-CYCLE

The steps that will be taken and their sequence are given for every level in the description of the game in Appendix VII. The last three play-tests showed that the basic game cycle takes not more than five minutes (see

table 6-5). Communicating the sequence on a board on the table will speed up the process (4th play-test). The role of the facilitator is to recharge the bucket and change blue for black marbles in case of the 'waste level'. In addition, he/she draws the marbles on a visible spot; but this is done preferably by 'neutral' people currently not involved in the game. In the cooperative level, round five will take longer and in the 'waste level', the dumping/cleaning step is added between step four and five. In this way, recharge still can be done in parallel of round five. Playtests 3-5 show that adding the 'waste mechanic' does hardly increase the total time required for the round.

Table 6-5: Game sequence

Game sequence		Explanation	Time
	1	This is done by the facilitator, in parallel with step 5, to save time. The bucket is placed centrally and visible.	-
	2	Ordering is done by putting money in a (closed) 'private' bucket; invisible for the rest of the group.	1
	3	This is done clearly random	1
	4	By placing the unused money in the middle of the table as 'bank' (in boxes), players can take their income and change, while cheating is made difficult. This is done sequentially.	1
	5	Proceeds sequentially; players alternatively start.	2
		Total	**4-5**

By field tests in Kenya, Dutta found out that more focus on game play rather than explaining the game rules is effective to engage communities in gaming (Dutta, 2012). The challenge is to minimize the need for a facilitator in the micro-cycle, without giving players more information than necessary. The number of marbles, the share of pollution and the how much other players waste should remain unknown to conserve the prisoners dilemma. Strict guidance of the facilitator might interfere with the feeling of ownership for the content. The intention of different levels with a gradually increasing difficulty is to learn the players how to play by playing. Ideally, games are cheaply distributable and the micro-cycle can ran without facilitation. Participants than can bring the game with them and play it further on. To illustrate this; the breakthrough in the negotiation process in the case of Bhutan was due to post-workshop game-play and discussions between participants (Gurung et al., 2006). Such a format does not need to be low-tech; Butterfly Works developed an application of GetH20 playable on simple nokia's which outperformed the board version in usage by far. A debriefing will be however remain necessary to consolidate the learnings.

END OF THE GAME

For games based on a prisoners dilemma which is finitely repeated, it is rational for players to pursue their individual interest above the collective interest in the final round since there will be no procedural interest anymore to stay in the coalition (Straffin, 1993). For example: If players know round seven is the final round and they know that everyone knows this, it will be more rational to default any cooperation already in the pen-ultimate round, since it is likely that all players will default in the final round. In a finitely repeated cooperative non-zero sum game, this logic will hold for every round. This phenomenon is called *backward induction*. Backward induction in a finitely repeated prisoners dilemma can be prevented by withholding in which round the game will be finished exactly. If the game stops when the resource stock is depleted and the exact level of the stock is unknown, this will be also sufficient.

DEBRIEFING

The debriefing is an essential part of a serious game and depends on its the purpose, in the debriefing the meaning of the in-the-game learnings are translated back to reality (Peters et al., 1998b). With a *negotiation training* game, performance criteria are known in advance and the simulation is more closed. Players know in advance on which criteria they will be assessed in the debriefing. A *mediation* game debriefing is however more

open and more *explorative*; participants should be stimulated to come up with policy options to deal with the problem in the debriefing or design options which allow a win-win situation. Players can be measured to some extent on learning effects that are strictly defined up front, but some flexibility is necessary to allow the exploration and improvisation necessary for *mediation* purposes. This 'exploration' can be structured with the following questions used by Thiagi, a scholar in game design.

Figure 6-10: Sequence of debriefing; adapted from (Thiagarajan, 1997)

The first question facilitates the transition from play into reality. First of all, players need to be allowed to let of steam; this can be done by asking participants how they feel and how they experienced the play in general. Collective recognition of emotions will benefit the openness of the group dynamics. The next questions facilitate the enhancement of the learning effects. This can be done as followed:

- **Increased understanding about the system will be enhanced as followed:**

After the game ended in a 'tragedy of the commons', ask: What happened? Why? What or who do you think caused the problem? How could you prevent it the next time? How can the water effectively be divided among the groups? This can be made visible by using the bucket and letting participants divide the marbles among different user groups (see figure 6-11). Use the bucket and ask participants to divide the water between categories. Which group should get priority and why? What is fair? After prioritizing the categories, the water can be divided amongst the groups. This should be done first individual per player. After collecting the individual preferences, they can be compared (anonymous) and a collective ranking can be made. This will prevent that some players will dominate the discussion. The concept of ranking preferences stems from a method called the 'Reserve', in which participants are asked to 'put' the water of a certain area into a bucket and rank it (Chevalking et al., 2008). Up front, the human needs, ecological needs and economic needs should be quantified as much as possible.

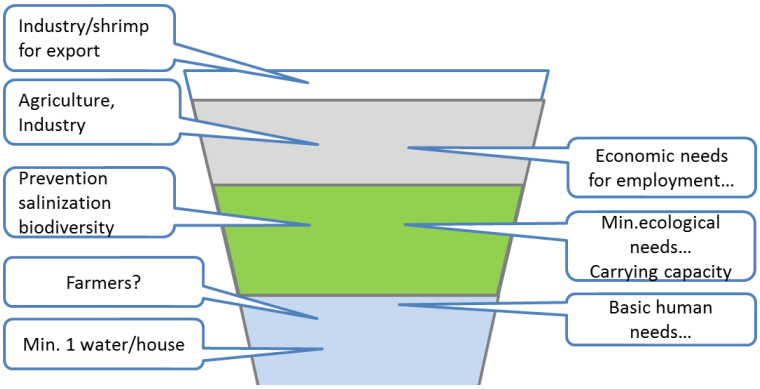


Figure 6-11: Water allocation between categories

- **Understanding of interdependencies:** How did other players influence your possibilities? How did you influence other players? What can you learn from this?
- **To identify the causes of the problem:** After brainstorming about the causes of the problem, it is useful to introduce the effect of 'climate change'. State that climate change was not included in the game. What if it would be included? How do people currently experience climate change? What are the effects? Ask how climate change will influence the outcome of the game? Will players start behaving more cooperatively, more competitively? Will it be more or less difficult to reach the objective? Based on the results of the game and the discussed real effects of climate change, discuss to what extent the causes are anthropogenic or climatological.
- **To understand how others perceive the problem:** After changing roles: how did you experience the other role? What was different? Was it more or less difficult? What did you learn from it? What if you would be the other player in reality?

- **Policy options:** After the causes of the problem are identified and people understand how the system works and what the effects of their actions were, there can be brainstormed about solutions to overcome the problem. These solutions can be used in the follow-up game as input. In the cooperative level, there can be asked: Which options did you prefer? (How) did your preferences change after the bilateral discussions? What happened during the negotiation round? Were you satisfied with the result? What if these options could be implemented tomorrow? How would it affect you? How would you change your behaviour?
- Let each player **specify their water quality preferences**. How do they value water? Is there a difference in how the players value quality? If so, what are solutions for mutual gain that can be developed based on that difference?
- Discuss the possibility of **side-payments**. Should users be compensated for their loss in yields/income if they use less water consuming or polluting technologies? How?
- Another important step in a negotiation process is to **reframe the problem**. This can be done by first letting participants make a problem statement from their own perspective which can be done hidden from other groups. As followed, the groups need to make a collective problem statement and their initial perspectives of the problem will be mutually confronted.
- After the participants are triggered to think of their experiences related to the learning effects, **feedback to improve the game** can be collected.

According to Meadows[21], it is important to let the participants understand their own experiences in relation to the game by themselves. A facilitator should not tell participants what they should think or have to learn, but only steer, guide and pose questions. The ideal debriefing process proceeds organically; the facilitator should only sow the questions and provide the 'nutrients', instead of dominantly trying to pull the plants out of the soil.

> *People are generally better persuaded by the reasons which they have discovered themselves than by those which have come into the mind by others*
> *- Blaise Pascal-*

Using ice-breaking techniques and facilitating in a 'strange' environment are useful to limit the effect of hierarchy on idea generation (Tassoul, 2009). Decorating the space subtle with familiar (board) games, pictures and toys will simulate an open atmosphere. Before the session, the power dynamics between the participants need to be mapped and the participants need to be carefully selected (Magombeyi et al., 2008). Techniques which are more beneficiary for introvert people such as brain writing can be used, dependent on the culture of the players (Tassoul, 2009). It is also powerful to let people draw the problem as problem statement, since visualization will make hidden perceptions explicit or make vague, abstract terms such as 'inequity', 'fairness' or 'sustainability' more concrete and tangible.

6.6 ASSESSMENT OF THE GAME

In this paragraph, the validity of the game is discussed. For a game framed as learning tool, the validity depends on the extent the game is able to create the predefined learning effects (section 6.1). These learnings could be metaphorically described as the emergent property of the game system, which emerges through interaction between players, the gaming model and the facilitator, in a certain context (Figure 6-12). These interactions are defined explicitly by the rules of the game and implicitly by (contextual) cultural or organizational rules (Hofstede et al., 2010). The learning effects can only be studied properly if the system functions as a whole. Because the game is tested outside its intended context, without its intended target group, proper validation of the learning effects will be

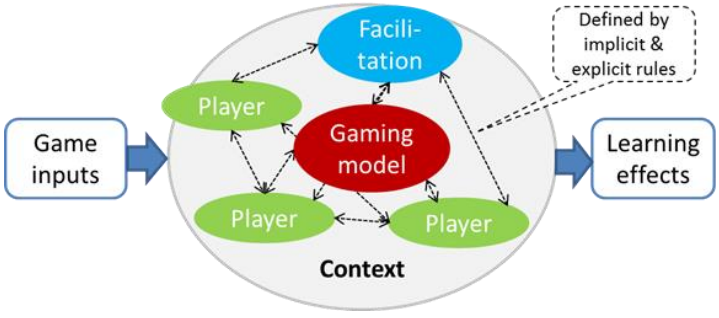


Figure 6-12: Game system and its components

[21] Dennis Meadows made this statement in an interview published on YouTube on July 17th, 2013. For the interview, see: http://www.youtube.com/watch?v=H56jI43MsRI (Watched on 09-09-2013).

impossible. In order to validate the effects rigorously, performance criteria need to be defined in advance and the players need to be assessed on them before and afterwards. It is almost impossible to do this in a scientific rigorous way; this would require comparison with a representative, random control group which do not play the game but are assessed ceteris paribus. The more open the simulation is (which is the case for *mediation*), the more difficult it will be to rule out *multi-colinearity*[22]. Therefore, there is chosen to assess the game on a more pragmatic way.

At first, the game inputs will be assessed. This is done by asking experts whether the right problem is modelled in the first place. Valid game inputs do not guarantuee valid effects, but invalid inputs do guarantuee invalid effects. In addition, there is described to what extent the design requirements are fulfilled. This assessement is done based on the results of five play-tests. The tests cannot demonstrate the creation of social constructs among the target group in Khulna. Nevertheless, the tests will be useful to identify design flaws and whether the game is playable and easy to facilitate. Finally, the design process is evaluated. This does not garantuee a qualitative product, but flaws and inconsistencies in the process will inevitabily have their effect on the product.

VALIDATION OF THE GAME INPUTS

The inputs that need to be validated are specified in chapter five. The design problem, the underlying rules that lead to problematic behaviour, the desired learning effects, the requirements and the analysis of the system with the used boundaries and perspective are the main inputs to be validated. Actually, the function of *mediation* itself should be the first input to be validated. Experts were interviewed to validate the system analysis and choices made in the translation of the analysis into the gaming model. The game was assessed on:

Table 6-6: Set-up of validation of gaming inputs

Reviewers	Ngo working in Khulna (JJS), research institutes: SaciWaters, Deltares
Method	Interviews, face validation of the gaming model, after explaining how it worked.
Information gathering	Context experts: Face validation of actor models, problem perceptions, stakeholder characteristics Water institute: Physical validity, assumptions on groundwater system and translation to game
Questions	Problem? Causes? Which elements to include? Abstraction/idealization valid? Format workable?
Criteria	Contextual validity: Are the characteristics of the situation in Khulna represented correctly?
	Physical validity: Does the model abide physical laws? Are the assumptions realistic?
	Workability: Is the concept useful/applicable in practice? Is it relevant for partner organisations?

Contextual validity: A senior fellow researcher at SaciWaters and the director of Jagrata Juba Shangha (JJS) were approached to assess the contextual validity and workability of the game (Interview, May 12, 2014,-b, Interview, May 12, 2014,-a). There was started by asking them to define the problem. How the stakeholders perceived the problem was discussed as well. It showed that more powerful elites tend to blame the problem on climate change while communities do not blame everything on climate change, but blame to some extent the KCC for the problem since they are responsible to cover them with services, which are lacking. While some scholars stated that the deep aquifer is clean and abundant and that the shallow aquifer is mainly polluted (Ravenscroft et al., 2013), the conversation with JJS showed that especially the deep aquifer is saline in the KCC and that the shallow aquifer is therefore used more extensively. It was also understood that water provided by KWASA to peri-urban communities is free while this was not presumed in the game. Since the analyses of the system of the UDW Integrated Project will mainly start from September 2014, the game design relies on hydrological studies done in areas surrounding Khulna. The contradiction of salinity causes by different scholars shows that a thorough study of the actual system beneath the KCC is really needed due to the locality of the characteristics of a groundwater system. Face validation of the perception map (figure 5-3) confirmed the validity of most perceptions. No statement could be made about the conflict between governmental agencies, but the negative perceptions of peri-urban inhabitants on the shrimp industry and perception on tube-well owners was confirmed. It was suggested that the game should include water transport. There was stated that the waste cards and addition of tube-well owners represented the situation well.

[22] A term used in statistical analysis. It occurs when it cannot be determined whether a change in Y is solely caused by a change in X only, since X and Y are both also influenced by other factors.

Physical validity: In addition, a conversation with two experts from Deltares, a Dutch water research institute, was performed (Interview, July 2, 2014,). The experts were at the time involved in a salinity monitoring project and also had performed research in the Khulna division. The goal of the conversation was to verify the assumptions and the game inputs considering the (physical) hydrological system. It showed that it will be difficult to generalize the game if a learning effect is to understand what the causes of the problem are. The causes of salinization differ locally because the system is very heterogeneous and the soil is stratified. In general it is likely that shallow salinity is caused by surface water intrusion while deeper salinity is caused by point abstraction of remained old marine layers. The conversation showed that the amount of individual abstraction especially affects the salinity. The groundwater level, which was taken into account in the game, has a weaker effect on salinization[23]. Another remark was the effect of monitoring on repeated saline water abstraction; in reality players will stop abstracting and move to another point. Since the occurrence of high salinity levels is widespread there will be not much space for adaption anyway. Therefore, a non-spatial 'bucket' representation will be still applicable. An expert from SaciWaters preferred using a single bucket because it would make the point very clear that the different users are part of the same system.

Workability: According to an expert from SaciWaters, including more than two user groups at a time in the game play is likely to make the game too difficult to facilitate (Interview, September 10, 2014,). She also emphasized that policy makers play an important role in the actual process. The current lack of communication and mutual understanding between policy makers and farmers/domestic users makes their inclusion important. There was mentioned that breaking the skeptical attitude, which is fed by preconceptions of other parties, should be a main learning effect. In addition, the expert stated that involving a party as the shrimp industry will be difficult, because they will doubt whether they will be targeted or not. To increase the workability, more emphasizes should be put on what this party can learn from the game and what they could get out of it. The interview also showed that it might be less useful to customize a game for a specific part in the mediation process, because the course of a mediation process really depends on recent political developments. Finally, a way to gather information during the gameplay and link it to research was missed in the format. It showed that partner organizations should be facilitated to mix familiar research tools with the gaming tool.

PRODUCT ASSESSMENT BASED ON DESIGN CRITERIA

In this section there is evaluated to what extent the game is able to fulfil its requirements based on observations and feedback of five play-tests. The play-tests were executed as followed:

Table 6-7: Set-up of play-test sessions

Versions	The form used each play-test is described in Appendix VIII
Participants	Play-test I + II: Employees from Both ENDS, familiar with NA and (similar) contexts. Play-test III-V: students (Average familiar with games and from social science backgrounds)
Structure	Instructions/briefing, game-play, open discussion.
Information gathering	Plenary discussion in which open questions were asked. Comments are given in Appendix VIII. Only in play-test V, in addition a short MC-questionnaire was used.
Questions	Play-test I, II: Mainly validity assumptions, contextual validity, workability. Because the players were familiar with NA applications, more focus was put on the appropriateness and realism. Play-test III-V: Mainly playability & working of game mechanisms. Questions: What happened, Do you like the outcome, H2 play next time, Enjoyed playing?, Instructions, cards/tokens clear?, How to improve the game? Because the students were unfamiliar with the context, playability was the focus and asking 'what-if' this form should increase cooperation, perspective change.

Table 6-7 describes the results of the evaluation, based on the requirements formulated in section 6.1. The second column evaluates the extent the evaluation is context dependent. Social constructs such as 'communication', 'mutual understanding' and 'open group dynamics' depend on implicit rules, determined by interaction between players, within a context. Because the game is tested outside its context, less value can be attached to high context dependent statements. More value can be attached to evaluations on criteria that relate to the functioning of the game mechanisms. Observations and discussions during play-tests focused on the

[23] In the game, the less marbles there are left in the bucket, the more black marbles there are recharged. However, the interview showed that there should be a stronger relation between the amount of individual abstraction and the share of black marbles that are recharged.

'playability' of the game. This relates to the duration, the consistency of the rules and whether the structure and sequence of the game is logical. These elements are considered to be less context dependent since their functioning is not determined by social interactions. Green colours indicate a strong fit to the requirements while red indicates a weak fit.

Table 6-8: Confrontation of design with predefined requirements

Category	Context	Evaluation of the requirement
Flexibility	-	Because the game is build-up from levels with increasing complexity, the form can be adjusted to the player group. The non-digital, paper-based format makes the game adaptable on the spot and cheaply replicable. Just-in-time changes in player numbers, set-up of the room and adding cards during the play-tests confirms this flexibility.
Player groups	-	The four last tests with different combinations of user types prove that the game is playable with any combination, without adding much complexity. The game is simplified by making the mechanics behind every role similar. Due to this, extra technologies and farms/houses/factories could be easily added halfway the third and fourth play-test, when it showed that the settings were not balanced well.
Roles	-	Due to the possibility to combine different roles or add different levels to the basic game, the basics of the different conflicts that exist between stakeholders can be simulated. This increases the flexibility and applicability of the game.
Duration	+	The last three playtests show that it is feasible to play the two levels, with role reversal and increasing complexity for 6-9 rounds, within an hour. This is long enough to experiment with strategies. 4 rounds showed to be too short (play-test 5). It is likely that the game will not take longer than 2-3 hours if a negotiation round and a debriefing is added. Because the target group will be less familiar with the principles of board games than the test audience, it is likely that the (explanation of the) game will take longer in Khulna.
Integration in process	+	There is not prescribed how to integrate the game into existing workshops or how to combine it with existing research tools, to integrate the results into existing research.
Role of game model in process	-	Play-test I-IV showed that the game remains a *'playable tool'* during the basic game; communication strictly takes place through the game. During the first two play-tests, interaction between the players was minimal. Play-test V showed that the game became more a *play-around-the-tool*; players more extensively communicated with each other during negotiations. The role of tube-well owner also improved this.
Communi-cation	+++	Because the test audience played with very different implicit rules than the target group will do, little can be said about the effect of the game on in-context communication. During the playtests, communication between players has improved from almost nothing (test I) to cooperation and agreement on adapted rules (test V). The cooperative and negotiation levels require interaction; they therefore likely enhance communication.
Group Dynamics	+++	The metaphorical representation of the system with marbles should help to stimulate an open mode, but this alone is likely to be insufficient to create non-defensive dynamics. This point is very much influenced by implicit rules and is therefore context dependent; statements will remain speculations.
Appropriate ness in context	++	The paper-based, low-tech format with marbles makes the game likely suitable for the context. This requires further testing, by capturing the tests on video[24] and by playing traditional games. No clear connection was made to traditional games.
Fun	+	Although players ''liked to play the game again''(III, V), and found the game ''fun'' (V) this was not formally asked. An anonymous questionnaire should reduce social acceptable statements.
Ease of Facilitation	+	In the first play-test, the facilitator had to calculate the income of players and did perform a lot of actions, while his/her only task from the third was to extract the marbles. In the final version, this task can be done as well by a (neutral) representative; the facilitator then only executes the (prescribed) briefing and debriefing. However, facilitation was

[24] IDEO, a design and innovation consultancy, has composed a **toolkit** with many **practical methods** that are very useful to **collect** information from users, to **create** a product or service **with users** and to make sure the product is **delivered** to the **users**: http://www.ideo.com/images/uploads/hcd_toolkit/IDEO_HCD_ToolKit.pdf. The toolkit is specifically developed for applications in development contexts, but also usable elsewhere.

		always executed by myself. Someone with no extensive knowledge about the design choices should be able to facilitate the game.
Language	+	The game is not language neutral, it requires English reading skills. This can be improved by translating the game into Bangla and symbolizing the text more in symbols/images that are understood by the target group (identified by testing).
Difficulty to play	++	The last two playtests required 10 min. explanation before the game could be played; because the game sequence was made explicit on a board and the mechanics behind every role was made similar. Because the initial skills and experience with board games will be lower and more diverse within the target group, the format likely requires more simplification in Khulna.
Willingness to play	++	No statements can be made about the motivation of players to play the game; this will differ strongly in an unfamiliar, formal context, in another culture.
Transparency	+	Shifting all actions except abstraction to the players (as in play-test 3-5), makes the game more transparent. However, feedback on the third and fourth play-test showed that it is still unclear for players how the facilitator manages the recharge.
Neutrality	++	'Poor' players showed frustration during the third and fourth play-test of their lacking possibilities, while well-off players did not experience the problem that much. One player indicated (play-test III) that the game was powerful to show the different situations with role reversal, but that well-off players do not have much incentive to cooperate.
		The game-inputs were only assessed by ngo's and research institutes which gives a limited perspective on the problem. Public/Private viewpoints should be included as well.
Ownership	-	Players do not add anything to the first three levels, but are able to add rules finally. Preferably, more emphasizes is put on the adding of content and rules.
Realism	-	The behaviour (depletion of CPR, exclusion 'poor' players, trust issues, exploitation by tube-well owner) showed in play-test III-V are realistic. The story behind the game is metaphorical, but if the game is applied in the 'explorative' phase, it will likely require more metaphorical distance (Appendix VII.9).

The colours indicate a moderate to reasonable fit of the product to the requirements. The game is highly flexible and the different levels complement each other. Players said that the 'basic' and 'waste' levels clearly showed the problem, while the 'negotiation' level was finally the crux of the game (Play-test V). The individual play in the first level was seen as ''boring'', but the ''trading'' and ''proposing rules made the game more fun''. The game was seen as ''playable but not easy'', players doubted whether uneducated farmer could follow it. The addition of the rule proposal rounds increased the communication, players also started to cooperate to get their preferred rule through (V) or started buying together technologies (IV). Weaknesses are the lack of a challenging winning condition which promotes cooperation and is unbiased to any player. The inequity related to the current goal is powerful for perception change after role reversal (III), but it is not clear for players how to reach the goal (III, V) and it still favours the well-off. To conclude, the play-tests show that the game is playable, that the mechanisms of the game work and feedback of the players showed that and ''understanding of the problem''(III, IV, V), ''perception change''(III) can be enhanced by the mechanism. However, the product remains a prototype which requires in-the-context improvement; balancing of the settings, including viewpoints and a clear in-the-game goal are required.

ASSESSMENT OF THE DESIGN PROCESS

In chapter 4.6 there was mentioned that it is not recommended to develop a game with multiple functions to avoid that the game design would become too complex or too difficult to validate or facilitate. However, the function of *mediation* itself is still broad, multiple steps are necessary to transform a negotiation into a collective learning process in which win-win solutions can be achieved. It is debatable whether it is useful or feasible to separate the different steps into different games. It will be challenging to develop a more simplified game than Harvest (the simple version of Fish Banks) to enhance *systems understanding* of how a CPR governance dilemma works. But transforming such a format into a *mediation* game with a highly heterogeneous stakeholder group increases the complexity of the format disproportionately. Making *perception change* the only function is meaningless when not embedded in a *multi*-stakeholder context and *restatement of the problem* is useless without *systems understanding*. I do not attempt to advocate that the game inevitably has to be complex, but in some way designing a 'complex' game is easier than designing a simple game since it requires much more iterations in order to abstract the model further from reality without losing its key message. This

might have been less an issue if the level of abstraction was explicitly considered as a design choice, which was not done during the design.

According to Dennis Meadows[25], it is best to start very simple, get the game running and then try to make the game more realistic and add more game elements, which will add complexity to the game. The ideal process starts with very frequent small iterations, the frequency can be reduced when the scope of the process increases. Ideally, much more, smaller feedback loops and play-testing sessions should be built in. Another way the design process could be improved is by defining a much more specific problem statement. Although it is certainly possible to design a game applicable to multiple conflicts, the design will become much more simple and effective when it will be specified for a single conflict. As shown in chapter 5.3, there are multiple related conflicts in Khulna, between almost all possible combinations of key stakeholders. Aiming for simplicity when designing a game for a 'wicked' problem is problematic since the problem definition will evolve and the more the problem is analysed the more complex it seems. There should be said humbly that the game only captured a glimpse of the complex dynamics of peri-urban groundwater management.

A pitfall for serious game design is the bias towards meaning and reality without making play central to the design

A pitfall for serious game design is that games tend to be biased towards the *meaning* and *reality* corners of the triadic figure developed by Harteveld et al. (2009). For instance, Duke's methodology starts with the external *meaning*, the purpose of the game and the desired learning effects. This is followed by a system analysis which basically aims to make a representation of *reality* as basis of the game. *Play* should not be added as layer, but needs to be integrated into the game system from the start on. As stated in paragraph 4.1, the properties of *play* differentiates a game from non-experiential forms of learning which are less effective to enhance behavioural change. But before criticizing serious game design in general, I should first look at my own design. Meaning and reality were prioritized in time allocation and later on there was tried to increase the playability of the game. Therefore it remained difficult to finally fix the imbalance between *play*, *meaning* and *reality*. It is plausible that system-oriented game designers will struggle with a bias towards reality while play-oriented game designers will struggle with a bias towards play[26]. Another pitfall I already mentioned in 4.6 but also felt in was the attempt to put too much functionality in a game. The urge for efficiency and maximization of learning effects is somewhat contradictory to play because Caillois (1958/2001) argues that play is inherently unproductive. Such an endeavour will obstruct playfulness to occur.

[25]Dennis Meadows made this statement in an interview published on YouTube, on July 17th, 2013. For the interview, see: http://www.youtube.com/watch?v=H56jI43MsRI. (Watched on 09-09-2013)

[26] Here, the paradigms in Dutch game design education are meant. As generalization; (in my opinion) designers from Delft are more *reality* oriented while designers from Utrecht are more *play* oriented.

6.7 CONCLUSIONS

In order to change the behavior of the stakeholders of peri-urban groundwater management in Khulna from competition to cooperation, without increasing the risk of strategic behavior the following learning effects are required. An understanding of their interdependency, that everyone will benefit from cooperation and how others perceive the problem is needed.

A paper-based, non-digital format which represents the groundwater system as a bucket and water as marbles are selected. The model is non-spatial; all players will extract water from the same bucket. Seasonal effects and climate change are not included in the game in order to show players in the debriefing that the causes of the problem are not only natural. Governmental agencies are not included as roles in the model because this will make the game more complex. Tests showed that it will be difficult to make the governance role playable while the game might become more engaging if all players have direct influence on the proposed policies. Further on, the game is playable with different user combinations and is build up from five levels. Table 6-9 provides an overview of the most important design choices.

Table 6-9: Overview of design choices

Selection	Abstraction	Symbolization / idealization
Only 1 aquifer is represented	The aquifer is represented with a bucket	Water is represented by marbles
Only groundwater is included, no surface water	Waste intrusion takes 1 round	All forms of pollution are represented with black marbles
The basic level only includes farmers and domestic users	Delay is partially mixed	Extraction is done in a random sequence
Governmental parties are not included as role	Water, money, waste and 'techs' are only tradable resources	
Inequity represented by initial resources; not by available options	Water prices depend on marbles in bucket (pumping costs <–> groundwater table)	
No climate change or dry/wet season effects included	Each player has 2 technology options	
	The game in non-spatial	

Based on several interviews with experts, the inputs of the game were assessed. Assessment of the game inputs shows that representing groundwater with a bucket is not realistic and that the amount of point abstraction influences salinization more than the groundwater table, as was presumed in the game. Experts working in the context confirmed the metaphorical strength and meaningfulness of representing aquifers as single buckets. The roles of the stakeholders, the technologies and the resulting behaviour from the game was confirmed as realistic.

The use of different levels with increasing complexity, the possibility to play the game with different user groups and its paper-based format makes the game adaptable. The difficulty of facilitation and play are likely too high. Because the game is developed and tested outside its intended context, further field-testing and adaption is necessary before the game can be applied in the UDW project. The product remains a prototype which requires further balancing of the settings, including viewpoints and a clear in-the-game goal.

Part III: Reflection

7. GENERAL USEFULNESS OF GAMES IN PROCESS OF NA

In this section, ***recommendations will be given on the usefulness of gaming for the whole process of the NA***, based on the gained insights. Chapter two showed that the sequence and emphasizes of building blocks varies per application of the NA, but that all blocks are present. In addition, the flexibility is only constrained by the complementarity of some blocks. This implies that standardized tools such as 'off-the-shelf' games are applicable multiple contexts. First of all, there is clarified when games can be used and when not. This is related to the process of the NA and an overview of opportunities to apply games in the process is created. Finally, based on the design insights and the principles of the NA, the feasibility of these opportunities is discussed. Awareness is required that games are not 'hammers' that apply to each 'nail'.

WHEN TO APPLY SERIOUS GAMES AND WHEN NOT

Gaming presumes that the in-the-game learnings can be transferred to the world outside the game (Mayer, 2009b). Because this translation is indirect, it creates *safety* and room for *experimentation* and *creativity*. If these effects are not required, a more direct form of communication will be more efficient; play is inherently *unproductive* (Caillois, 1958/2001). Games are useful if an integrated comprehension of technical-physical *and* social-political complexity is required. Separately, actor or system models might be more useful. The *uncertainty* of play is not desirable in case of controlled experimentation and *voluntary* participation might not be always possible. The labor intensity of the design and the dependency on a skilled facilitator makes games expensive relative to modelling methods. Games are useful for research purposes if the data from observations is *context-dependent* and includes a *few subjects* (Poteete et al., 2010). If generalizations are desired, controlled experiments with for instance agent-based models are more useful. Poteete et al. (2010) argues further that in case of many available subjects, field studies are more useful. Duke (1974) classifies simulation gaming as a relatively *uncalibrated* and *intuitive* method which includes *many variables*. Other methods are likely more efficient for non-complex issues. If there is no specific need to integrate stakeholder participation into the model, other model types (depending on the problem and data characteristics) are more useful (hydrological models, databases...) (Zhou and Mayer, 2010). If the problem is not 'messy' and there is already consensus about the structure of the system, scientific knowledge and ethical aspects (Vennix, 1996), *participation* might not be necessary at all. When designing the IWRM masterplan, participation is necessary in all decision-making stages (based on the principles of the NA), but less in implementing stages. Apart from monitoring and sanctioning, since these are more effective when executed participative (Dietz et al., 2003). In case implementing parties *do* play by the rules, an 'adapted approach' will be more efficient (Krütli et al., 2010)[27] (section 2.3). Other methods are more useful in non-participative stages. Finally, games design generally *balances* between dimensions[28] while in many cases an optimization of particular aspects might be more desirable. Games integrate knowledge, emotions, practices and social aspects (Hofstede et al., 2010); if a focus on one field is required, other tools will be more useful.

LINKAGE TO THE PROCESS OF THE NEGOTIATED APPROACH

Although these characteristics are generic, linking them to the building blocks (figure 2.4) and the parts that require improvement (3.2) roughly shows where the most potential is for applying games in the NA.

Table 7-1: Parts in the process

Part of process	Added value of games?	Type of games or tools?
Physical/social-political context analysis	Little; no balance, oriented on one type of complexity	Systems modelling, field studies, literature study, information gathering workshops
Local needs	Depends on hierarchy within community and lacking *safety* of alternatives;	HCD-tools, Gamestorming, future imaginations with role plays.
Impact interventions	Moderate, if experimentation is necessary, might require higher physical realism	Scenario Analysis, gamified simulation models. See ShaRiva & Tygron example (4.3)

[27] The 'adapted' pathway is context dependent and will differ from the example given by Krütli et al. in figure 2; page 867.
[28] Examples of design dimensions for games are: Lankford & Watson, 2007; Harteveld, 2009; Wenzler, 2008

Accessible knowledge	Low, no balance and indirect transfer needed	Open source[29] & visualizations more useful
IWRM training	To experience the necessity of integration	Systems understanding & awareness game
Negotiation training	High, human behavior easily, relative cheaply and realistically simulated by role RPG's.	(Simple) RPG's; see section 4.3
Community awareness Mobilize communities	High: Engagement, communication beyond language, experimenting with uncertainty	Theatre, system understanding (Meadows), Red Cross examples, Self-organization games
Ensure buy-in	Little, first voluntary participation needed. Seriousness and neutrality important.	Participative design & research methods. Earlier gameplay will reinforce willingness.
Actual negotiations	High; both safety, creativity, experimentation important. Shows both types of complexities	See section 4.3 & 4.5.
Shorten lead time	Not shorter, but showing long term benefits will reduce negative effects of longer lead time	Stimulate short term investment for long term benefits with lotteries, regret mechanisms and reminders[30].

Because many effects of the NA are difficult to valorize economically (equity, autonomy, democracy), implementing parties will likely face resource constraints. Therefore, (open-source) off-the-shelf games connect best to the client needs. Roughly said; the desired *meaningfulness* and the level of *realism* of a game, the less likely it is to find an off-the-shelf game that fits the problem. Meaning depends on the integration of actions and effects into a larger context (Salen and Zimmerman, 2004), and therefore relates to complexity (Lankford and Watson, 2007). On the other hand, the meaningfulness of games with more abstract learnings (such as systems understanding games of Meadows) will depend more on the facilitation skills and therefore on the competences of the NA partner. The level of realism of a game correlates with its development costs. In this respect, it is useful to distinguish *procedural* realism from *behavioral* realism. Procedural realism such as required in a *strategic advise* game (Bots and van Daalen, 2007), or as shown in the ShaRiva game will require more research and is therefore more expensive than an RPG based on human interaction. Games in which (technical/physical) impacts can be experienced will be more expensive and therefore less relevant for the NA.

The potential to apply off-the-shelf games relates to the flexibility of the process. Non-specific, abstract learning effects will be easier translated back to predefined, non-unique realities. The third building block requires relatively more flexibility because enlargement of the negotiation space is needed (section 2.2). Flexibility related to maneuvering to fit the 'window of opportunity' fits best to this part (Etzioni, 1989). Therefore, the thirst two blocks have relative more potential for off-the-shelf applications. If applied in the third block, these games fit best in the exploratory stages, which require a less realistic representation (section 4.6). Because it is more likely that 'IWRM training', 'Negotiation training', 'awareness' & 'mobilization' functions can be fulfilled with context independent applications, they are highly relevant for the NA. Most games with these functions and developed for development contexts, have 'Creative Commons' licenses[31] and are freely usable.

DISCUSSION & CONCLUSIONS

For practical considerations, a trade-off should be made for off-the-shelf games with lower realism and less specific learning effects. Off-the-shelf applications will fit relatively best to the first two building blocks, since they require less flexibility than the 'creating an environment for dialogue' block. Although the initial client needs connect best to the 'learning' frame, games that relate to the 'self-organization' frame (section 4.2) have high potential. The success of the NA depends on the self-organizing capacity of communities and coverage ratios of phones will likely increase (Muto and Yamano, 2009)[32]. This shows great potential for bottom-up monitoring applications[28]. A pitfall of using off-the-shelf games in different situations due to resources constraints is the bias of 'solutions looking for problems'. The applicability of games greatly depends on the nature of the problem. Starting with identifying the local needs and only using them if they clearly match to the need is necessary. This will help in navigating between the 'skylla and charybdis' of 'reinventing the wheel' on the one hand and 'perceiving all problems as nails that can be hammered'.

[29] AKVO(.org) develops for instance different types of open-source platforms to make knowledge accessible in developing contexts.
[30] The principles Dan Ariely applied in games can be used as well to create awareness about the long term benefits of cleaning your waste and doing other (small) long term investments related to groundwater. See for examples the 'Games for Change' channel: https://www.youtube.com/watch?v=V1AsL8_cifk&list=PL1G85ERLMItCtiABavQCxex-RrYL8bo6Y [watched October 18, 2014].
[31] All Red Cross examples, SimPachamama, The River Basin Game and ComMod examples have such licenses.
[32] This research relates to Uganda, and cannot be generalized. However, it is plausible that these trends apply to more countries.

8. CONCLUSIONS

The objective of the thesis was to deliver insight in how serious gaming could support the process of the Negotiated Approach. Besides defining which support is needed and the place in the process where the game needs to be applied, the research would be applied to the case in Khulna in Bangladesh. This chapter will reflect to what extent these objectives are accomplished and will discuss the added value of the results.

8.1 REFLECTION ON THE RESEARCH QUESTIONS

1. ***What is the theoretical framework of the Negotiated Approach?***

The NA connects to the paradigm that complex systems should be studied in an integrated manner. IWRM is seen as a set of principles and practices that facilitate learning rather than a fixed script. The NA adds to IWRM by making it more user centred. This is done by taking local action as starting point and empowering communities to ensure effective participation. The overlap and interrelation between principles makes the process less clear. Flexibility is both a strength and a weakness since it allows communities to shape the process and enlarge the negotiation space, but also complicates the formalization of the approach.

2. ***What are the needed improvements to the Negotiated Approach?***

Based on a literature review and comparison of IWRM and NA improvements, and four expert interviews, the needs for support were identified. The 'why' and 'what' of the approach is clear, but 'how' to do apply it 'when' and 'where' remains a challenge. The principles are clear but the tools to operationalize them are not concrete enough. The process risks to be bypassed by public parties or constraint by resources, due to its relative long lead time. The need for neutrality of the process and ensuring buy-in of 'powerful' stakeholders conflicts with the empowerment that needs to level the playing field between parties. Taking its limitations into account, economic valuation might help to reframe the problem.

Based on existing building blocks of the NA, the needs to *train* negotiation skills and *to democratize* the process was identified but most interviewees preferred a tool that could support the *mediation* process itself. The research did not identify the need to improve the accessibility of the NA, although mentioned in the introduction.

3. ***Which improvement has priority to be improved with the facilitation of serious gaming?***

Based on different categorizations of gaming functions and a review of existing applications, functions were linked to the different steps of the NA. The game is framed as a *learning tool*, because the tool is perceived as an effective intervention tool to support a collective learning process.

The process was limited to the desired functions of *mediation*, *democratization* and *negotiation training.* A literature review showed successful cases of *mediation* and *negotiation training* applications; *democratization* was recognized as a condition that enhanced these functions instead of a key function. Based on the preferences of interviewees and the review, *mediation* was finally selected as most desirable and feasible. *Mediation* can be separated into different phases; the game will be applied in the first exploratory phase and requires therefore a relative low level of realism.

4. ***What design specifications does a game need to meet in order to fulfil the selected function?***

This function is fulfilled best with an open format that does not dominate the stakeholder interaction. It should also have an open scenario that gives room to players to adapt it and to create meta-play. Adding content needs to give players a feeling of ownership. The game needs to create understanding that all water users are interdependent, that groundwater is finite and that everyone will benefit from cooperation. The game needs to increase mutual understanding through role reversal and it needs to communicate that the causes of the problem are not only natural. The game should embed sufficient meaning that it is possible to refer in its debriefing back to the mechanisms behind waste dumping, salinization and depletion of the CPR. The format

needs to represent the different conflicts over groundwater within the KCC between different user types and needs to be adaptable. Further on, interviewees emphasized the importance of neutrality and fitness to the context of Khulna.

5. To what extent are existing alternatives able to meet the design conditions?

No existing alternatives were able to represent the CPR with groundwater characteristics, the desired user heterogeneity and meaningfulness. General, context independent learnings as 'systems understanding' can be created with an existing game. Role reversal and awareness of the anthropogenic share in the problem makes a tailored design for the Khulna case necessary. In addition, the complementarity of the desired learning effects make separated enhancement of them by different existing games less meaningful.

6. ***What game model should be developed based on the design specifications?***

The peri-urban system is represented by a paper-based format which represents the aquifer as a single bucket, from which all users extract at once water, to achieve their objectives. The roles of farmer, domestic user, factory owner and shrimp farmer are playable in different combinations. The game is based on a prisoners dilemma and lets players experience competition and cooperation in different levels. The results of five play-tests shows that the game is highly flexible, playable with different user groups and easy to facilitate. Separation of the learnings in levels with gradually increasing complexity makes the game reasonable easy to play. Play-tests showed that the first levels clearly communicate the problem. Negotiations about adding rules to the game and sharing technologies enhances cooperation. This makes the prototype promising for further development in Khulna. These findings were based on validation of the game inputs by interviewees with expertise in groundwater and the situation in Khulna.

7. Which improvements are recommended to the NA, based on the gained insights?

There is suggested that off-the-shelf games or co-developed context-independent games are most appropriate for the NA and are applicable especially in the thirst two blocks. This implies a lower realism and less specific learnings. Games that relate to the 'self-organization' frame (section 4.2) have high potential. Adding game elements to open-source platforms will benefit activities such as monitoring, but show also potential for 'knowledge developing' and 'community mobilization' activities. Awareness is however required because off-the-shelf examples are not developed from a specific local need and therefore risk to end as 'solutions looking for problems'. Starting with a needs assessment and adapting only existing games that match with the identified need, in a participative manner, will prevent this bias.

8.2 ADDED VALUE OF THE RESEARCH

In this section, there is reflected on the added value of the research. This is done by discussing the limitations, the scientific added value, the social relevance and the generalizability of the research.

DISCUSSION OF LIMITATIONS

Reasons that limit the applicability of the mentioned results are:

- The selection of interviewees on which bases the need for support was defined was quiet homogeneous. They came all from the same organization and worked on a strategic level.
- Chapter three analyzed how there was dealt with flaws in IWRM identified in literature within the NA. There is however no 'generic' form of IWRM; its concept is broad and its implemented forms differ widely. The review therefore should be seen as an indication rather than an evaluation.
- The paradigm behind a theoretical field or game frame determines its 'findability' and should therefore match with the used search strategy. Criteria behind games developed as 'learning tool' as 'validity' and 'measurability' demand scientific documentation. Because this is less essential for ''persuasive'', ''self-organisation'' or ''business innovation'' games, examples of these games will be more hard to find in scientific literature. In the same way, examples of analytical mediation tools are easier to find than tools developed from an 'advice-oriented', more practical perspective. More diversity in applications would have enriched the linkage of game types to the whole NA process. More importantly, the framing also affects the linkage of game functions to the NA process; only 'learning' categorizations were used. The inability to find *democratization* applications can be also related to the framing. This function clearly aims to influence ideas about democratic values and connects to the rhetoric and persuasive ability of games. While *mediation* aims to intervene, *democratization* aims to change the world by changing ideas, based on preoccupations of what is 'fair' and 'right'.
- Linking the functions of games to the process of the NA gives an idea of the scope of applications and it also structured the selection process. However, the review of existing applications showed that most games have multiple functions. The distinction between categories blurs in reality; 'putting games in boxes' turns out to be less useful if most games fit in many 'boxes'. Interviews with experts showed that it often depends on contextual developments *when* and *where* such tools are used in a mediation process; strict advices are less relevant in a dynamic, complex context in which ngo's facilitating such games will have to face the erratic reality of politics.
- The stakeholder analysis was verified by research institutes and ngo's. To make the analysis more neutral, interviews with public and private parties should be performed as well.
- No specific hydrological study was found about the groundwater system under the KCC. Interviewees emphasized the spatial heterogeneity of groundwater; this makes it difficult to generalize insights from the literature review. Contesting statements on the salinity of shallow and deep aquifers among different scholars and interviewees confirm the need for a local research of the groundwater system.
- As mentioned in section 6.6, designing the game outside its intended context limits its applicability.
- The results of the play-tests are limited because cultural rules and group dynamics will be totally different when applied with the target group. A different familiarity between players will lead to a difference in trust building. Because the target group has likely less experience with board games, the perception on the 'playability' will also differ. Nevertheless, it is likely that the target players will emphasize much easier with their roles. Because the learnings are context specific, they are likely enhanced stronger within the target group (p. 59, first section).

SCIENTIFIC CONTRIBUTION

- Although the categorization of gaming functions seems less applicable from hindsight, it did structure the process of identifying the desired function. This makes the research of function identification better repeatable. The existing examples reviewed in section 4.3 shows that in practice, many games have a hybrid functionality. Despite the homogenous interviewee selection, the research did deliver a

more compact and comprehensive overview of the theoretical background of the NA than existed. The overview of flaws of the NA provides a bases to formalize and improve the process further on.

- Relating the search strategy to the game frames is more a contribution than a limitation, because it will help to make explorations more efficient. Although the diversity of examples would have been enriched, the search to 'scientific' and 'relevant' examples has kept the research feasible.
- Building further on the insights of (Bots and van Daalen, 2007) enriched their overview and makes it possible to validate their model further, based on the categorized gaming examples. Framing *mediation* and *democratization* differently helps to understand and distinguish these two functions further.
- There is advocated to specify the function of *mediation* by pulling it apart in the five steps a mediation process has. This is relevant because exploratory phases will require a low realistic representation of the conflict while later phases that focus on decision-making will require a higher level of realism.
- The design shows that although *role* heterogeneity might be needed to represent the inter-actor system realistically, *rule* and *mechanism* homogeneity behind every role is still possible and will simplify the game.

SOCIAL RELEVANCE

- Although remaining superficial, the system analysis delivers a broad and comprehensive 'picture' of the problem, which is relevant for UDW project.
- Although the game requires further development in Khulna, the last three play-tests show that the game is more than just a start. The functioning of the explicit rules behind the game makes it a workable prototype.
- The game includes a focus on waste management in the game, which was less emphasized in the proposal of the UDW project.
- Although the identified contextual factors of the NA did not benefit directly the game design, it did help to recommend improvements of the 'Inception plan. This is a preliminary study executed before implementing the NA which specifies (amongst others) contextual factors.
- Linking an overview of trade-offs when (not) to apply games to the earlier identified improvements of the NA shows the client the potential of games beyond the function of *mediation*.
- Linking existing games to the building blocks of the NA will help to implement games further on to support the different parts of the NA.

GENERALIZABILITY OF RESULTS

The homogeneous selection of interviewees makes the identified improvements for support less generalizable. On the other hand, the needs were backed-up by analyzing NA documents written in cooperation with partners. The relation of game functions to the NA is context-independent. The game is tailored to the context of Khulna and its application is strictly limited to Khulna. However, due to the similarity between Kolkata and Khulna and the generality of the core mechanisms of the game, the game will be easily adaptable to the case of Kolkata. The specific combination of learning effects make it less likely that the game will be applicable in more cases. However, the characteristics of off-the-shelf games and tailor-made games and the advice on the usefulness of gaming for the whole NA are valuable for any NA case.

8. RECOMMENDATIONS

This chapter will provide recommendations to the involved parties and give follow-up researchers clues for further research.

SUGGESTED IMPROVEMENTS TO THE DESIGN PROCESS

- Because a successor can start with the theoretical bases, a mapped NA and a concept, outside-the-context design will add little and make no sense. **Redevelop the game on the spot** based on the remarks of the target group. It is strongly recommended to do this in a team, preferably gender and cultural backgrounds should be mixed. Use the design principles used by the Pardee institute and the CDKN (de Suarez et al., 2012, Dutta, 2012).
- A **redesign approach** which is highly **participative** will connect best to the principles of the NA since it will shift the power of the designer over the design to a larger extent to the users. A form of co-design, which is for instance used by Butterfly Works, is therefore recommended to finalize the game(ButterflyWorks, 2013). Shifting from 'design for' to 'design with' will make the product more demand centred and make the design process a single step in a larger process of collective learning (Geurts et al., 2007).
- It is acknowledged that the way the play is organized, how the problem is framed and who is involved has a large influence on the outcome (Barreteau, Le Page, & Perez, 2007). To **assure the neutrality** of the game, involvement of all stakeholders, including powerful actors as the shrimp industry, is necessary. Involving stakeholders by interviewing them individually, and inviting representatives to design sessions & playtests will enhance ownership and acceptance for the outcome. It might also reduce some of the scepticism up front, making the design already part of the collective learning process.
- Limited **testing** of the game outside its intended context and without its intended target group gives only room for speculations about the realisation of the learning effects; testing the game at least ten times while completing the whole macro-cycle as described in section 6.3 is necessary. The five tests that are performed are a nice start but insufficient. The right balance between the initial numerical settings can only be achieved by testing the game many times, with different settings, while varying the levels.
- Preferably **record the sessions on video** (after asking permission) and ask the players what can be improved about the game. It is likely that players will come up especially with remarks regarding the realism of the game, it will help to let the players compare the game to existing games they played before. Playing local games will help to make the remarks more constructive. First play local games with the communities; record the play sessions with video[33]. Analyse the sessions and determine the common player types of players. Why do people like to play games? With which formats and game elements are they familiar? What are their preferred player types (paragraph 6.2)? What are their skills/knowledge? Evaluate the willingness to play.
- Before the test, serious effort should be put in socialization between participants[34]. For instance, meet together in the afternoon and arrange the rest of the day for social events. Play some (local) games at night and have a drink together.

[33] For more information on video tools see: http://www.wri.org/our-work/project/world-resources-report/putting-vulnerable-people-center-communication-adaptation. For more information on appropriate design tools: http://www.ideo.com/work/human-centered-design-toolkit/

[34] Several researchers emphasize this; Lankford & Watson; Verbraeck mentioned this during the ISAGA 2014 Summerschool.

SUGGESTED IMPROVEMENTS TO THE PRODUCT

- It is unlikely that players will start to negotiate and cooperate unless they get strong incentives to do so. Therefore:
    - **Specify the preferences** of technologies, water quantities and qualities better for all players. By making the differences explicit there can be quantified how players value water. This will help to balance the game further and will also help to support the discussion in the debriefing about compensation, side-payments and how exchanges could be made. Formalize the possibility to offer side payments or cross subsidization in rules.
    - **Experiment with** including the table with **players preference** and how they value water into the game. Such a table could have the same function '**strategy maps'** have in the game 'Diplomacy'. Such strategy maps help players to negotiate, to identify exchanges and possible coalitions. The table will be more effective if participants have filled in them their selves during the debriefing of the basic game. The challenge is to let the participants formulate their preferences as concrete, precise, quantified and compatible as possible, without restricting them too much. Pre-printed formats, visualizations and the use of tangible objects (marbles etc…) will help in this.
    - **Specify implicit rules for every level**, from non-cooperative to cooperative behavior. Formulate specific rules which the player need to follow to behave non-cooperatively. This rules do not need to be made visible to the players, but are necessary to understand the implicit working of the game and the expectancies of the players behavior. Factors mentioned in Appendix X., cultural-dependent factors should be translated in rules. In addition, implicit rules mentioned in 5.3 (p.48-49) can be used.
- Discuss the **required level of abstraction** with the client and chose the level that suits best to the place of the game within the negotiation process. This is a choice instead of an outcome (Peters and Westelaken, 2008).
- **Story:** Appendix VIII.9 gives a story behind the game, but the story might be still too realistic to be used in the 'exploration phase' in negotiations. Enriching the story behind each role and integrating all actions more clear into it will improve the player experience. (for instance; recharge = yearly rainfall, house upgrade = family extension, education or job promotion…)
- **Language:** The game needs to be translated into Bangla; according to SaciWaters most farmers and inhabitants are able to write and read Bangla.
- **Experiment with changing the macro-cycle**. Do players get bored when playing multiple games after each other, as was suggested to occur in Fish Banks? Is a debriefing needed between each level? For which target group is which combination of levels most suitable?
- Extent the range of **technologies**. For instance; an option to compensate the 'peri-urban vs. urban' resource imbalance could be to create more (public) services for peri-urban citizens. Play-test 3 and 4 showed that the 'water filter' technology mainly stimulates 'symptom mitigation', while root mitigation would be to mutually moderate and tune extraction through cooperation.
- **Use of insights from UDW Project** to improve and validate the systems analysis. The 'Social Systems mapping' (part 2) will help to validate the stakeholder analysis, especially the power and perception diagrams. The Governance mapping (part 3) can be used to make the policy options more realistic and to specify the 'strategy map'. Based on the cross-case comparison (part 4), the game should be adapted to Kolkata.
- **Digitalisation:** See Appendix VII.7.

ADAPTING THE GAME TO THE CASE OF KOLKATA

Based on an interviews with an expert from SaciWaters, a 'quick & dirty' overview of the differences and similarities between Khulna and Kolkata is provided in table 9-1 (Interview, September 10, 2014,).

Table 8-1: Differences and similarities between Khulna and Kolkata

	Khulna	Kolkata
Dominant party	Shrimp farming industry has a powerful lobby around Khulna	The (manufacturing) industry is more powerful around Kolkata; Industries like Pepsi consume a lot of water around Kolkata.
Water sources	Mainly shallow groundwater, deep aquifer is salinized. Surface water saline, therefore less used.	Surface water used for irrigation, but groundwater is mainly used.
Climate change	Flooding, waterlogging, heavy rainfall	Similar problems, less flooding
Salinization	Strong salt intrusion	High salinity in the south central part (Sonarpur)
Arsenic	Less problematic than in Kolkata	High in the North of Kolkata (Barrackpur II block)
Urbanization		Much larger, more urbanized; likely larger slums and peri-urban areas.
Problems	Salinization/pollution partially caused by shrimp industry, peri-urban – urban water grabbing, urban waste dumping, exclusion of lower social classes	Exponential tube well growth, urban waste dumping, exclusion lower castes
Institutions	Different institutions; different regulations on tube-wells	
Culture	Both are embedded in the Bengali culture; common language and traditions	
Land transformations	Transformation of agriculture into shrimp farms	Transformation of (shrimp) ponds into brick making industry.

Because the general concept of the game (see figure 6-3) is applicable to both Khulna and Kolkata and the representation of the physical system and the player roles is metaphorical, the game requires limited adaption. In addition, the cultural contexts and the main dynamics of the problem[35] are similar. However, different problems are playing in North Kolkata than in the Southern part. Therefore, it was advised to make different versions for each region (Interview, September 10, 2014,) In Khulna, the problem is more homogeneous. Different initial settings could make the industry in Kolkata relatively more powerful. It is plausible that just the player combination needs to be changed. A comparison between stakeholder analyses of the two cases is however needed to confirm. Khulna It seems that farmers around Kolkata do rely relatively more on surface water, which might make the selection of only groundwater less relevant. The more open the water system is, the more difficult the metaphor of the bucket will hold. Further on, the causes of salinization in Kolkata need to be investigated; the rule that a lower water level will lead to more salinization might not hold for Kolkata, because it refers to salinization by sea-water intrusion. It is however plausible that the differences in the physical system will be small since Kolkata is located on the same deltaic plan with possibly a similar stratified soil of Himalayan sediments. Further geo-hydrological research is needed to confirm these statements.

The game requires limited adaption to be applied to Khulna

[35] prisoners dilemma, competition over a CPR, exclusion of less powerful users, urban -> peri-urban resource drain which causes social unrest, exponential growth of private tube-well owners, anthropogenic caused salinization.

FURTHER RESEARCH

- **Combine *research & design* with *mediation***. Companion Modelling is an option, but there are more possibilities. Agent-based modelling would be suitable to research the evolution of rules that lead to competition and cooperation in the peri-urban interface. According to Poteete et al. (2010) generalized, controlled experiments are useful to understand the dynamics of CPR governance problems with ''repeated n-prisoners dilemma'' characteristics. Insights from Pande et al. (2013) could be used to improve the 'strategy maps' and preferences for technologies in the game. Cooperation with Pande[36] with regard to the UDW project will be mutually beneficial. It could make the inputs of the game more scientific rigor and formal while an adapted version or similar game might be used to validate the game-theoretical and agent-based models of Pandes group. System Dynamics will be however more useful to model the relation between groundwater stocks and flows, the waste management and the effects on the local economics over time. In my opinion the dynamics of peri-urban groundwater management are captured best by hybrid models with agent-based and system dynamics elements, if the model needs to be strategic, have a high level of aggregation and a long time horizon.
- The evaluation of the game included a conversation with members of the SwiBangla project; organized by Deltares and IRC. Since their analyses will be used to support 'Water Safety Plans' of Bangladesh. Their **knowledge about the 'Water Safety Plans'** will be valuable in the 'Governance Mapping' phase of the UDW project.
- Get in touch with IGRAC; an intern just (August 2014) started working on their groundwater game and unfortunately it did not work out yet to meet him.
- The (long-term) **dynamics of** the different **conflicts** might be captured with the TWINS model of Mirumachi and Allan (2007) in which different stages or events in a conflict are be mapped on a nexus of low-high intensity of the conflict against low-high cooperation intensity.
- **Compare the ComMod process with the NA.** Explain how they are able to combine flexibility and broad applicability with scientific rigor and formal structure. Evaluate whether these points are usable to formalize the NA.
- Section 6.3 (p.60) suggested that **competition** is the natural mindset of players, but this is **cultural dependent**. It is plausible that competition will evolve less spontaneously in more collectivistic cultures and that there will be a gender difference. Further research and field experimentation is required to find out in what circumstances competition or cooperation will occur in the Bengali cultural context.
- The **'why' people start exactly cooperating** was based on reasoning of scholars who did not rely on controlled experimentation (Poteete et al., 2010, Ury, 2000, Ury and Fisher, 1981). The scope of the research did not allow to specify a theoretical model about what makes people cooperative. A set-up of such a model is provided in Appendix X. Further research could focus on empirically testing the hypothesized relations, based on for instance a game. The research should start with a review of research that focuses on cooperation in prisoners dilemmas and CPR cases (see Poteete et al., 2010). Much research has been done based on game-theoretical prisoners dilemmas applications, but little based on games (Williams and Williams, 2007). Games will allow testing of 'behavioural psychology oriented' theories on negotiation (Pruitt and Carnevale, 1993).
- The current scope did not allow formulation of concrete steps on how to make the **group dynamics** 'open', 'non-defensive' and how to **'level the hierarchical difference'**. Further research on this will be relevant for the NA, since its negotiations are always characterized by power asymmetries. There is a clear need on how to deal with this in-the-field (Interview, March 3, 2014,, Interview, February 24, 2014,).

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PERSONAL REFLECTION

There are many possible ways to approach a thesis project and it is difficult to define up front which way is best without any experience, especially if things change during the project. Some challenges and alternative routes are discussed.

THEORETICAL FRAMEWORK

During the kick-off there was warned not to get stuck in the exploratory theoretical part of the NA and move on quickly to the confrontation of the NA with gaming, but I felt into this pitfall. Instead of reading a lot about IWRM and the NA it would have been helpful to arrange more (informal) conversations about the NA with users. The interviewees selected to identify the need for support all four originated from Both ENDS and worked on a strategic level. A more diverse set of interviewees with people working on the operational level would have been more useful. In addition, in search for the part of process that needed support, there was spend some time on solving the wrong problem (how to structure the process without losing flexibility?) instead of the assigned problem (how to support the process with gaming?). Appendix X shows some of the models that were created in understanding the contextual factors influencing the flexibility and structure of the process of the NA.

FUNCTIONAL ORIENTATION OF GAME DESIGN

If I would have to redo the research, less emphasizes would be put on defining the exact function, but more on interviewing local experts to understand local political processes. I would also analyse the current tools that are used in the field for mediation and capacity building to advice in what circumstances a game is usable compared to existing tools. Because this approach fits better to the needs of the client, it would deliver a more relevant tool.

GAME DESIGN

The transition between the system analysis (chapter 5) and the game design (chapter 6) was experienced as difficult. First, choosing the appropriate level of abstraction and selecting only the relevant variables to be included in the game needs to be done. The matrix used by Peters and Westelaken (2008) that systematically links system components with gaming components will be helpful the next time to bridge the gap. But before that matrix can be used, a 'picture' of how the game works must have been made; this is more an art than a science. I experienced that creating such a picture alone is quiet difficult while I experienced in other projects that it is much easier to develop concepts in groups when synergy can be created. Game design is team work in my opinion; at least I flourish better in a design team than individually.

Exploring existing games did certainly help; as described earlier I got inspiration from Fish Banks, the River Basin Game, Diplomacy and GetH2O, amongst others. It might have biased the 'picture of the game' and let to path dependency. For a longer time I was focused on how to modify Fish Banks or the River Basin Game in such a way it would fit the problem, while the heterogeneity of the user group and the complexity of groundwater compared to a river basin required a whole different approach. A next time, I would organize one or two creative sessions while starting from scratch. Gaming elements from the mentioned games then could be used as ideas, just considered together with other ideas since quality follows from quantity in design process.

If the system analysis had to be redone, I would put a clear focus on actor characteristics, goals, roles, connections, their SWOT, dilemmas, resources, and the relationship with other actors. Paragraph 5.3 includes an actor analysis, but more effort was put in the analysis of the physical system, while I think this is less important in subject-oriented games such as *mediation* games. (The dilemma is that the function *systems understanding* was considered as essential in mediation games, while this requires as well an extensive analysis of the physical system). More emphasis in contacting local experts instead of doing literature reviews is recommended (in context-dependent design).

INTERVIEWS

It was experienced as difficult to ask interviewees for preferences without biasing the interviewees with examples that had to be provided. Examples of existing serious games were needed to give the interviewees who were asked about the need for support an idea of the possibilities. The hexagon of Bots and van Daalen (2007) was first of all used to provide different options of functions but it is possible that *democratization & mediation* were mentioned more often due to the fact the respondents had more associations with these functions. When the game was evaluated with experts who worked in Bangladesh & India, a table with a short description of examples of games (mentioned also in chapter four) were provided beside the description of the developed groundwater game. An overemphasizes on the developed game and examples of mediation functions increased the risk of a confirmation bias. A better way would have been to provide very similar descriptions of games, to make sure the own game is not more striking and then ask the interviewees which game they preferred most and thought would fit best to the problem. The question remains how to evaluate tailor-made games in an objective manner when the experts are not involved in the design process and do have no associations with gaming.

LITERATURE & BACKGROUND RESEARCH

Another challenge I experienced is to identify relevant and reliable sources for the literature review and to identify relevant existing games, on a rigorous way. Overview articles of fields or citation indexes gave an impression of relevant authors, but it was still a challenge to prevent path dependency[37]. Appendix I provides a visual overview of the different scientific fields that were studied. The start with Bots and van Daalen (2007) which led to Barreteau et al. (2007) might have led to an overemphasizes on ComMod applications. Later on it the process, gaming applications developed by the Red Cross and PETLab were however discovered and in the final stage the Tragedy of the Commons Groundwater game developed by IGRAC was discovered, which showed similarities with the concept that I already had developed (van Weert and van Duinen, 2010).

The potential scope of the project and the complexity of the problem under study makes the thesis an open-ended story; progressive insights make it possible to adapt and add content continuously. A strict focus on whether additional content helps in solving the research problem does not always help if the problem is wicked. In that case, its definition will be dynamic and the framework of reference on which bases the thesis proposal is defined will also change over time.

[37] With this there is meant that the sequence in which authors are discovered becomes more important than the scientific relevance and contribution of an author, since author will lead to referred authors. A more scientific rigorous way is to define the authors and their relations up front and justify the search terms and methods up front.

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INTERVIEW. December 16, 2013,. *RE: Both ENDS, Amsterdam, The Netherlands. Personal communication with Annelieke Douma, .* Type to VAVIER, M.

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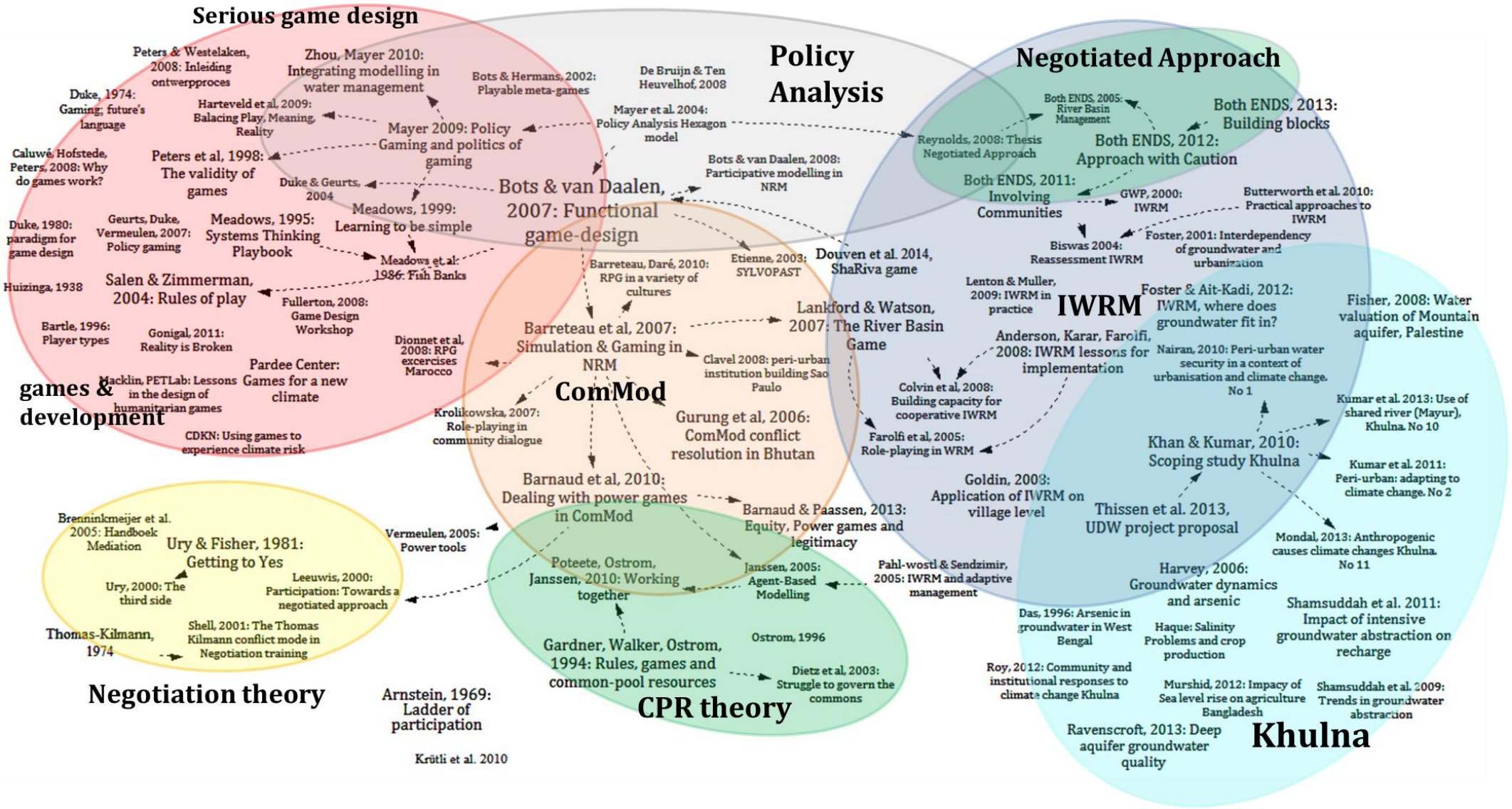
INTERVIEW. March 3, 2014,. *RE: Both ENDS, Amsterdam, The Netherlands. Personal communication with Christa Nooy, .* Type to VAVIER, M.

INTERVIEW. May 12, 2014,-a. *RE: Hyderabad, India to Amsterdam, the Netherlands. Personal communication with Poulomi Banerjee. medium: Skype.* Type to VAVIER, M.

INTERVIEW. May 12, 2014,-b. *RE: Khulna, Bangladesh - Amsterdam, The Netherlands. Personal communication with Zakir Hossain. medium: Skype.* Type to VAVIER, M.

INTERVIEW. September 10, 2014,. *RE: Hyderabad, India to Amsterdam, the Netherlands. Personal communication with Poulomi Banerjee. medium: Skype.* Type to VAVIER, M.

APPENDIX I. VISUAL LITERATURE OVERVIEW



APPENDIX II. EXPERT INTERVIEWS

APPENDIX II.A OVERVIEW OF RELEVANT DATA GATHERING ACTIVITIES

Activity	Date	Medium	Description	Use in thesis research
ShaRiva role-playing workshop at UNESCO IHE	16-18 July 2013	In person	Participation in three-day ShaRiva workshop. The game is described in chapter 4.3 (p.31)	Analysis of existing mediation games, some insight in game design and facilitation at UNESCO-IHE
Nile River Basin RPG during IWRM course	19-09-2013	In person	Participation in RPG on Transboundary RBM, Facilitated by Erik Mostert from TU Delft.	Insight in existing games used in the field of IWRM education.
Interview Annelieke Douma, Both ENDS	16-12-2013	In person	Working NA, need for support, function of game	Need, challenges (Ch3), choice of function (Ch4)
Interview R. Kempers, Both ENDS	30-01-2014	In person	Working NA, need for support, function of game	Need, challenges (Ch3), choice of function (Ch4)
Interview Marie Jose van der Werff ten Bosch	24-02-2014	In person	Working NA, need for support, function of game	Need, challenges (Ch3), choice of function (Ch4)
Interview Christa Nooy, Both ENDS	03-03-2014	In person	Working NA, need for support, function of game	Need, challenges (Ch3), choice of function (Ch4)
Conversation with Sena Alouka, JVE	07-03-2014	Phone	Director of Jeunes Volontaires pour l'Environnement ; user of the NA in Togo	Limitations of NA and feasibility to use the River Basin Game in the NA, in the Mono basin
Conversation with Butterfly Works, Amsterdam.	20-03-2014	In person	Informal conversation about the GetH20 game. Asking feedback on own design approach.	Review GetH2O, Participative design, design tips, possibility of cooperation finalizing game
Play-test I at Both ENDS, Amsterdam, NL	22-04-2014	In person	Testing the game with BE employees	Feedback on assumptions, realism and format
Interview Poulomi Banerjee, SaciWaters, India	12-05-2014	Skype	Case of Khulna/Kolkata, games in context	System Analysis (Ch 5)
Interview Zakir Hossain, JJS, Bangladesh	12-05-2014	Skype	Case of Khulna, NA in practice, games in context	System Analysis (Ch 5)
Play-test II at Both ENDS, Amsterdam, NL	25-05-2014	In person	Testing the game with BE employees	Feedback on playability, realism and format
Seminar Groundwater in the Political Domain, UNESCO-IHE, Delft, The Netherlands	11-06-2014	In person	Presentation of different projects related to groundwater conflicts; amongst others the CoCoon project (NWO)	General insight in politics behind groundwater and the TWINS (conflict&cooperation) model.
Conversation with Els van Daalen, TU Delft	18-06-2014	In person	Informal conversation about functional game design, participation and the game itself	Feedback on game; interdependencies of players, confirmation of hybrid functionality of games
Conversation with Saket Pande, TU Delft	30-06-2014	In person	Informal conversation to ask feedback on game and link to research of Pandes' group.	Game rules, tradability resources, effect of difference in water valuation on cooperation
Conversation with Ebel Smidt, TU Delft	30-06-2014	In person	Conversation about the role of games in mediation in groundwater management	Steps in de mediation process (Ch4.6) and linking realism of game to these steps
Sandra Borgas Freitas, PhD at CiTG, TU Delft	30-06-2014	E-mail	Anthropogenic/natural causes Arsenic mobilisation	Clarification of As causes, recommended literature
Interview Deltares	02-07-2014	In person	Interview with two experts from Deltares, involved in a salinization monitoring project	Causes of salinization, validation of gaming inputs, representation of physical system (Ch 5)
ISAGA summerschool 2014, Delft; organized by the Delft University of Technology	18-23 Aug.	In person	Intensive week of game design (theory/practice) with a mix of students, professionals and experts	Design process, level of abstraction, facilitation, balance play-realism, how to play-test (Ch 6)
Contact with Anjal Prakash, former SaciWaters director, experience with RPG's	08-09-2014	E-mail	Use of RPG's in Bengali culture, local faciliation of RPG's, acceptance of RPG's	Examples, confirmation of current acceptance and usage. He is interested in research games.
Play-test III with six students, Leiden, NL	18-09-2014	In person	Test: 2x 7-10 short rounds.	Feedback on playability of game (Ch 6)
Play-test IV with four students, Mierlo, NL	20-09-2014	In person	Test: 6x competitive + 6x cooperative rounds	Feedback on playability of game (Ch 6)
Play-test V with six students, Leiden, NL	14-10-2014	In person	4x competitive, 4x waste addition, 6x negotiation level	Feedback on playability of game (Ch 6)

APPENDIX II. B EXPERT INTERVIEWS TO IDENTIFY NEEDS FOR SUPPORT

Interviewee	Flaws NA	Context aspects	Desired game applications	Priority	Effect	Requirements game
Annelieke Douma; water cluster coordinator at Both ENDS	Less concrete, non-formalized, technical aspects more needed	Room for local governance, external threat, perceived connectedness with river	Community empowerment and actual negotiations.	Support of actual negotiation process. **(mediation tool)**	Learn negotiation skills, learn about interest of other stakeholders	No framing, neutral, not limited to single perspective, language-neutral, local-large scale interventions, gender component
Remi Kempers; program officer at Both ENDS	Less concrete, more 'body'	Existing negotiation skills, existing understanding of system behavior,	Double-layered game; simple training + more realistic. Inclusion of scenarios, to change perspectives, build-up trust	Community empowerment; **Negotiation skill training** (for both communities and gov. parties)	Transfer of skills, knowledge. Emotional involvement of people in the case through fun elements. Creation of safe playing ground.	Playable by different groups in different policy or organizational layers,
Marie Jose van der Werff ten Bosch; program officer at Both ENDS	Long duration, risk of by-passing by government. Ensuring buy-in difficult.	External threat, local motivation, level of self-organization, power symmetries, political climate	Tool to align stakeholders, to balance power differences. Effects different options, ensure neutrality of process	**Decision-support**, **democratization**.	More consensuses, more equity in process. More acceptance of outcome due to neutrality of tool.	Neutrality, time-saving, reduction complexity decision-process. Perceived as serious for everyone
Christa Nooy; program officer Both ENDS	Difficulty to involve and commit government on long-term	Capacities of local partner, planning cycle government, institutional and political context.	Block III most difficult, most support needed.	**Mediation tool**	Consensus creation, support of the process on a way it connects to the role of local governance	Leveling of playing-field, equal access to process. See negotiations as learning process

APPENDIX III, RELEVANT GAME EXAMPLES

Bots and van Daalen (2007) is used as starting point for the review and search terms and combinations in *google scholar* as 'simulation gaming', 'water management', 'negotiation games', 'power asymmetry', 'CPR governance' and 'NRM' are used. In addition, terms as 'Gaming Tragedy of the Commons' and terms as, The 'River Basin Game' and 'Groundwater game' are used. Companion Modelling examples were obtained from an overview of the Simulation & Gaming conference in 2007 on Natural Resources Management (Barreteau, Le Page, & Perez, 2007). Companion Modelling examples were also obtained from the website of the Companion Modelling workgroup from the CIRAD research group[38]. Games were selected based on their relevance. They relate to the themes of institution building, the peri-urban interface, (ground)water management, conflict resolution and dealing with power asymmetries in conflicts. First of all, there was looked in scientific literature. The functions correspond to the game function categories in table 4-1.

Game	Description	Function	Form	Reference	Selected based on:
SHRUB BATTLE	Landscape, agricultural management	Teaching	Board game	Depigny and Michelin (2007)	Relevance theme: NRM governance
FISHBANKS	Based on archetype of the Tragedy of commons; competition and expansion between fleets leads to deplete sea	Design & Recommend	Simulation (System Dynamics), board game to represent sea, fishes and boats	Sweeney & Meadows, 2000. The Systems Thinking Playbook.	Relevance problem: prisoners dilemma, competition over CPR.
MEERVISIE	Simulation aided role-playing game on planning of the Ijsselmeer.	Mediation	Computer aided RPG, user roles on paper	http://www.actoranalysis.net/documents/ROMM2001.pdf	Negotiation function, role of RPG in process
SYLVOPLAST	Forest management; negotiation game between herders and foresters	Learning, Teaching,	Simulation training	Etienne, 2003 : http://jasss.soc.surrey.ac.uk/6/2/5.html	Mediation function
KARKNONSZE	environmental conflict in natural park, Economic vs. ecologic development	Teaching, negotiation	Role-playing game	http://sag.sagepub.com/content/38/2/233.full.pdf	Relevance function & theme: conflict resolution in NRM issue
BUTORSTAR	Wetland, land-use, water management	Mediation, Learning, Research	ABM model, virtual landscape	http://sag.sagepub.com/content/38/2/233.full.pdf	Relevance function
TADLA	Support of transition in Moroccan small-scale agriculture. 1) RPG & 2) policy exercise.	Learning, complexity Design & Recommend	RPG, paper-based. Farmers can use own data as input	http://sag.sagepub.com/content/39/4/498.full.pdf+html	Relevance theme: capacity building of farmers
ATOLL-GAME	Groundwater supply on coral islands. Opening up the stakeholder debate	Facilitate dialogue, design & recommend	Simulation aided board game. Companion approach	http://sag.sagepub.com/content/38/4/494.full.pdf+html	Relevance: creation of dialogue in groundwater management
PIEPLUE	River basin management; Dealing with time scale issues. Combine long-term thinking with short term adaption	Research & Analyze	Agent Based simulation, RPG game	http://sag.sagepub.com/content/38/3/364.full.pdf+html	Relevance: uncertainty and time scale issues also apparent in peri-urban water management
REEFGAME	Helps local fishers understand impact on ecosystem and provide researchers insight	Research, Design & recommend	Computer assisted RPG	http://sag.sagepub.com/content/43/1/102.full.pdf+html	Embedding of gaming in research relevant for the UDW project
River Basin Game	RBM, mediation in upstream – downstream conflicts and role reversal	Mediation, Learning	Board game, RPG. Marbles represent	(Lankford & Watson 2007)	Relevance of mediation function. Relevant design conditions on

[38] http://cormas.cirad.fr/ComMod/en/caseStudies/ville.htm

			water.		games for collective learning
AguAloca	Water management in peri-urban catchment area, Sao Paulo, Brasilia.	Learning, Complexity	Agent Based simulation assisted RPG; supported with board game elements	(Clavel, Ducrot, & Sendacz, 2008)	Relevance theme: Peri-urban water management
Lingmuteychu	Watershed management in Bhutan; institution building about sharing irrigation water	Mediation	ComMod; simulation supported by physical model.	(Gurung, Bousquet, & Trébuil, 2006)	Relevance function: Conflict resolution, mediation
Thailand	Water management in Northern Thailand	Mediation, Communication	ComMod	(Barnaud, Van Paassen, Trébuil, Promburom, & Bousquet, 2010)	Relevance function: dealing with power asymmetries, empowerment
Senegal	Conflict resolution between farmers and herders. The farmers cultivated crops near the river but the cattle had to cross the fields to reach the water	Mediation		Barreteau et al. 2001, (Daré & Barreteau, 2003)	Relevance theme: Conflict resolution. Design of games in an Islamic cultural context.
KatAWARE	Support of multi-actor negotiation process in water allocation.	Mediation	RPG	(Farolfi & Rowntree, 2005)	Relevance of mediation function, participative water management
Teraquas	IWRM in peri-urban areas. Facilitating the negotiation capacity of local actors.	Negotiation training	RPG	http://cormas.cirad.fr/ComMod/en/caseStudies/Teraguas/index.htm	Relevance for NA; participative peri urban water management
Get H2O	Awareness creation game about water scarcity, pollution and peace building in the context of an (African) urban slum. Players have competitive objectives which they can achieve best in cooperation.	Teaching, Entertainment	Board and mobile version	http://www.geth2ogame.com/w/index.php?option=com_content&view=article&id=2&Itemid=7	Relevance function: awareness about pollution & scarcity of water. Selected on relevance of game elements: competitive vs. cooperative objectives.
Sim Pachamama	Agent-based simulation tool that gives insight in the dynamics of deforestation. The game is specifically developed for Bolivia, but there are online training courses to adapt the game to other situations.	Teaching, problem awareness raising	Digital (single-player?) RPG, based on an agent-based model (created in netlogo)	http://www.inesad.edu.bo/simpachamama/	Function: Awareness creation and capacity building in NRM management. Relevance for NA, since approach is also applied to forests.
Strike Fighter	Negotiation training game. Players play different the departments of a National Defense and negotiate about budget allocations and preferences.	Teaching	Computer aided RPG.	http://www.simxp.com/en/simulations-games/strike-fighter/	Relevance negotiation training.
Two dollar game	Teaching negotiation theories; usable integrated into lecture series.	Teaching	Paper-based		Relevance negotiation training
Diplomacy	Players need to negotiate to conquer WI Europe; whom to trust when is the question.	Entertainment	Board-game	http://www.wizards.com/avalonhill/rules/diplomacy.pdf	Relevance of game elements: trust in negotiations.
ShaRiva	RPG in which a trans-boundary river basin conflict between two countries is simulated. Used by UNESCO IHE as teaching tool.	Teaching, negotiation training	RPG supported with hydrological model and extensive case	http://vietnamfacility.info/Introduction/Resource-materials/Shariva-	Relevance of negotiation function

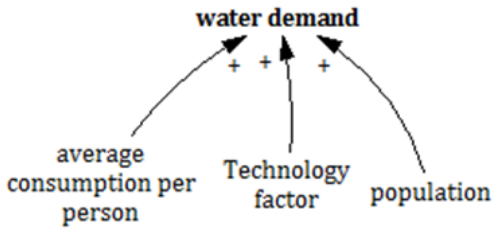
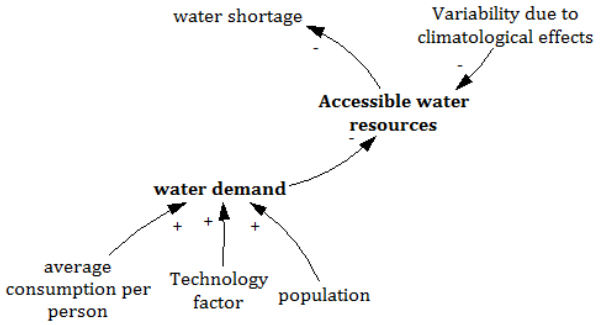
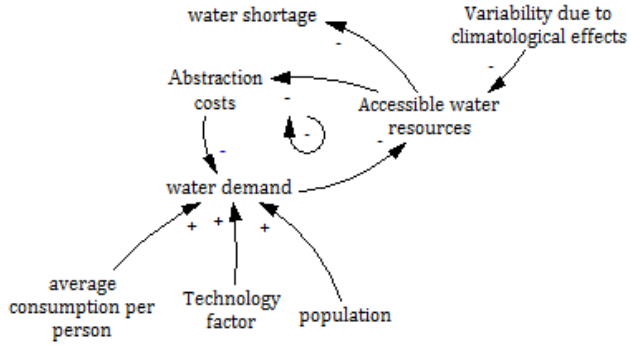
	Developed by Deltares and based on the Mekong River Basin.		material	MasterClass.aspx	
Calypso	Multi-stage simulation game on international water negotiations; formerly used in the same course as the ShaRiva game	Teaching, negotiation training	RPG	SG Mediation & Consultancy	Mediation tool; more simple than ShaRiva game, but similar story and set-up
River Basin game Hoekstra	Illustrate CPR characteristics of water within a river basin	Teaching, Training	Computer supported RPG	http://www.waterfootprint.org/?page=files/Riverbasingame	Relevant: Similar multiple bucket model as first version of game.
Tragedy of Groundwater commons	Developed by IGRAC to let players experience the complexity of (trans-boundary) groundwater management.	Teaching, Training	RPG supported with computer model (spreadsheet-based)	http://www.un-igrac.org/publications/296 (van Weert and van Duinen, 2010)[39]	Relevant: negotiation over groundwater, similar 'general concept'
Ditch	Managing urban waste, based on a prisoners dilemma. Developed by the Red Cross	Teaching, awareness	http://www.climatecentre.org/downloads/File/Games/dwelling%20near%20the%20ditch/DND_RULES%20-%20ENGLISHupdated.pdf		The theme of urban waste is relevant for the UDW project
New Commons Game	Based on 'Tragedy of the Commons' and CPR research. Developed by Richard Powers, 1975.	Awareness, System understanding			CPR-based, classic game: extensive documentation & adaptions
Useful sources	**Description**		**Source**		
Website Red Cross	Catalogue of many games used by the Red Cross, mainly used to teach and create awareness. Instructions and videos are included.		http://www.climatecentre.org/site/games-catalogue		
Petlab	PETlab is a joint project by Games for Change and Parsons the New School for Design in New York City and works with the Red Cross.		http://petlab.parsons.edu/redCrossSite/games.html		
Pardee Centre	The Pardee Centre for the study of the Longer-Range Future is related to the Boston University and also linked to the RAND corporation. Amongst others, academic and field research is performed to develop games that deal with climate issues.		http://www.bu.edu/pardee/research/task-force-meeting-and-gaming-session-games-for-a-new-climate/		
ComMod	Online catalogue with case studies in which the Companion Modelling method is applied.		http://www.commod.org/		
Classification	Classification of over 300 serious games		http://serious.gameclassification.com/		
Waterfootprint	Site which includes several RPG's related to water efficiency and water sharing. (Amongst others, the River Basin Game of Hoekstra)		http://www.waterfootprint.org/?page=files/TrainingMaterials		

[39] van Weert, F., & van Duinen, R. (2010). Addressing socio-economic and institutional dimensions in Transboundary aquifer management by using hydro-economic modeling and serious gaming.

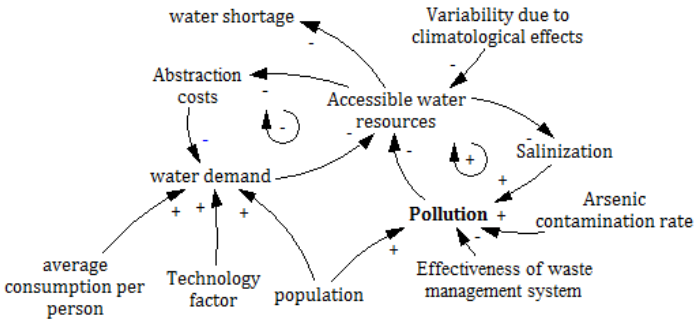
APPENDIX IV, CAUSAL DIAGRAM OF THE SYSTEM

This appendix explains the causal diagram of the socio-physical system of peri-urban Khulna which is represented in the game. The figures give an overview of the presumed causal relations between the variables that influence the level of cooperation and conflict in groundwater management. The goal of this model is to communicate which (simplified) variables are considered in the research, how they are interrelated and what the means are to improve the behavior with the designed game. The ***blue factors*** are considered to be influenced by the game. The arrows represent the presumed relations; a positive sign presumes a proportional effect and a negative sign a disproportionate effect. For instance; because a positive sign is given, it is assumed that the higher the *average consumption per person* is, the higher the *water demand* will be. Because a negative sign is given between *water demand* and *accessible water resources*, there is assumed that the higher the *water demand*, the lower the *accessible water resources* will be.

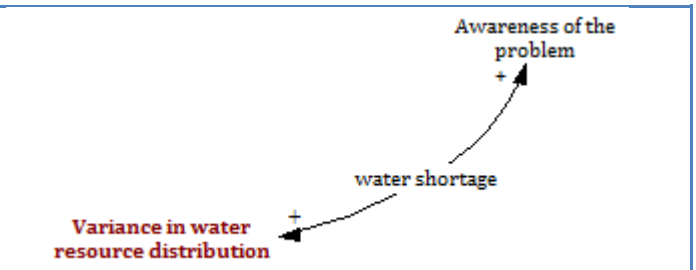
If a change in a variable is (partially) influenced by itself (in case of a loop), a feedback loop is created; this is shown by the circular signs in the figure. The overall effect of the loop can be positive or negative. If the overall effect is positive, the feedback will be reinforcing. If the overall effect is negative, the feedback is balancing or goal-seeking. In combination however, feedback loops can create more complex non-linear behavior such as oscillation. Effects can be delayed; a delay in combination with feedback can lead to all kinds of counter-intuitive (non-linear) behavior.

Description	(Part of) the causal diagram
Generally; water demand is determined by the three factors of population (P), per person consumption (A) and a technology factor (T), based on the formula: $\boldsymbol{Impact = A * T * P}$.	
More water demand leads to less accessible water resources and more water shortage; the accessibility of water is also determined by a climatological factor (figure 2).	
The assumption is that the lower the accessible water level is, the higher the abstraction costs will be; this has a balancing effect since higher costs will lead to less demand. However, this effect is expected to be small since the demand of water will be price inelastic.	

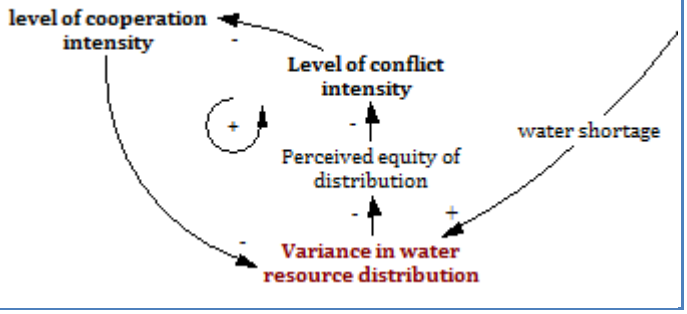
The accessible resources are also determined by the level of pollution, which depends on the population and the effectiveness of the waste management system. Salinization and arsenic contamination are also included under 'pollution'.
The lower the water level, the more salinization will take place (a falling groundwater table will lead to more seawater intrusion)



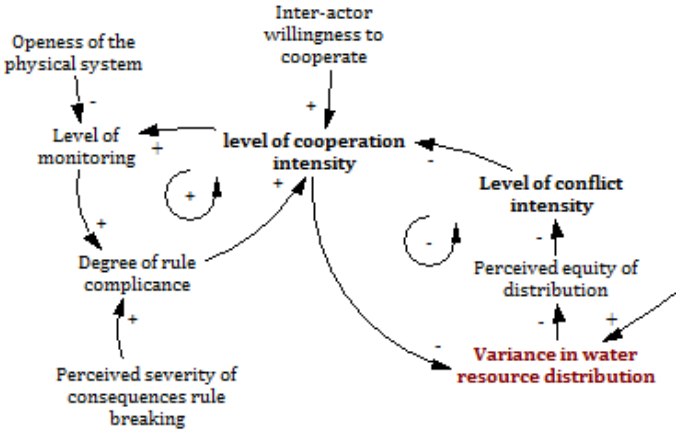
There is presumed that water shortage will increase the awareness of the problem and will also lead to more variance in the distribution. 'Equity' in water distribution is thus operationalized with the variable 'variance in distribution'.



The variance does also depend on the cooperation intensity; there is presumed that more cooperation will lead to less variance.
The variance influences the perceived equity negatively, which influences the conflict intensity. More conflict will lead to less cooperation, which might lead to escalation of the conflict

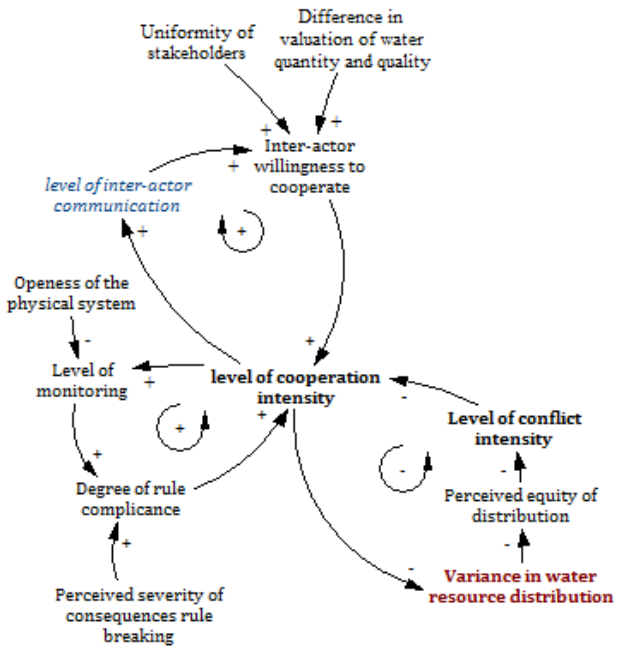


In advance, the level of cooperation will depend on the degree of rule compliance and the willingness to cooperate.
More cooperation will lead to more monitoring, which leads to more rule compliance. Rule compliance will also depend on the perceived consequences of rule breaking.
The more open the physical system is, the more difficult it will be to monitor the CPR (or exclude users from extraction who do not comply to the rules).

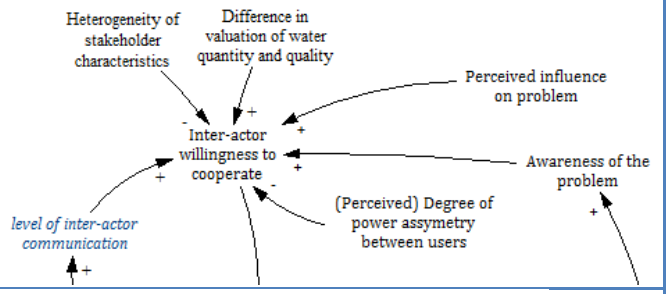


Communication will reinforce cooperation since it will increase mutual understanding and trust since it creates positive shared experiences. This feedback is bilateral; negative shared experiences will lead to less cooperation.

The willingness to cooperate depends on uniformity of stakeholders and the difference in valuation of water resources. If stakeholders value water differently; the chance for win-win solutions is larger. For instance; since farmers can use water of lower quality than domestic users, farmers could use the waste water (output) of domestic users as input.
Stakeholders with more uniform characteristics will have more uniform interests, which will makes cooperation more likely.

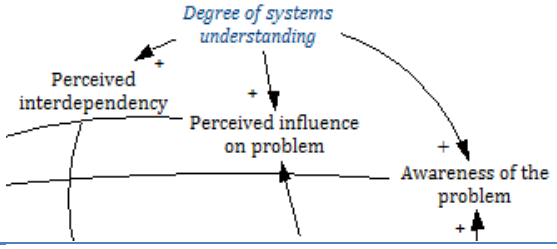


The willingness to cooperate is also influenced by the perceived influence stakeholders have on the problem, the awareness of the problem and the degree of power asymmetry between users. If stakeholders perceive they have no influence at all on the problem, they will be less engaged to cooperate. A high degree of power asymmetry will discourage parties to cooperate.

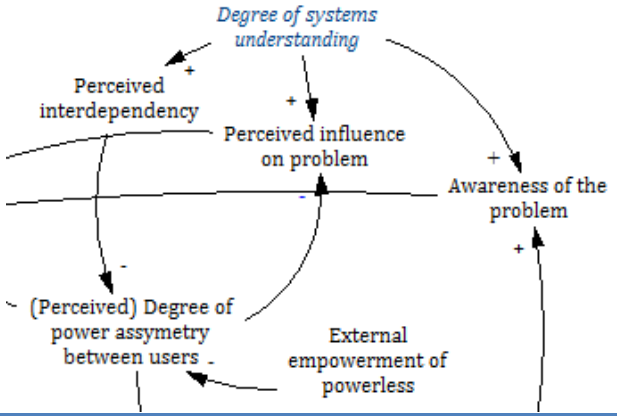


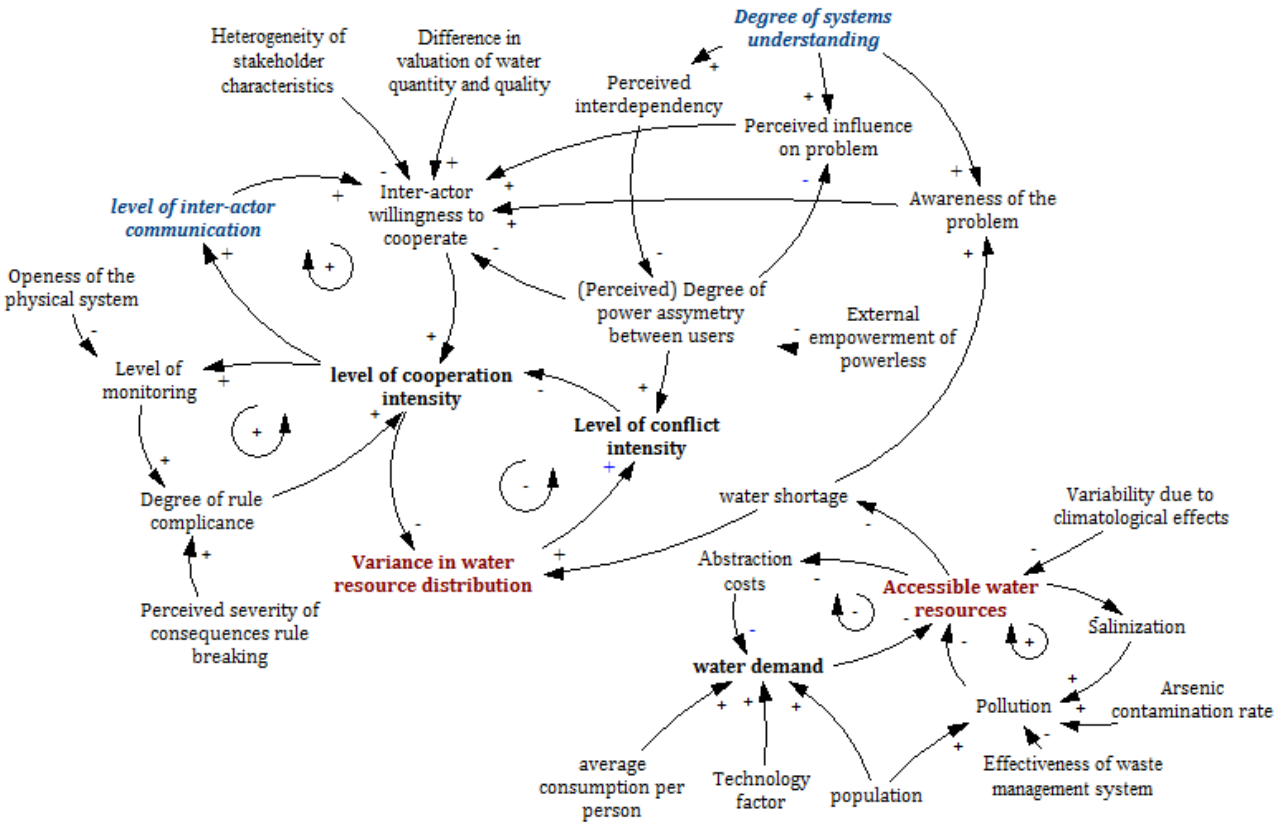
The more people understand how the system works and how they are related to the other stakeholders; the more they will be:

- aware of the problem
- think they can influence the problem
- understand that they are interdependent



If players perceive more that they are interdependent, there will be less perceived power asymmetry between users since players understand that they are mutually dependent and both need something from each other. Their abstraction points are hydrologically connected and they need resources from each other.
A lower perceived power asymmetry will lead to a stronger overall belief of players that they can influence the problem. The degree of power asymmetry can be also influence by empowerment of players by external parties.





If the described parts are combined, the following causal diagram is obtained. The **red** variables are the **criteria** and the **blue** variables are the **means**; they are asumed to be influenced by the game and are the learning effects of the game. The game aims to improve systems understanding explicitly and there is presumed that in-game communication will be improve communication in reality.

Criteria: A lower variance in water resources distribution is desired (equity) and a higher level of accessible water resources is desired (sustainability).

APPENDIX V, STAKEHOLDER ANALYSIS TABLE

Stakeholder	CPR stakeholder type	Problem statement	Interest	Power
Industry	User, producer	How to improve reliability of water supply, without causing too much social resistance?	Increase profit, reduce production costs, increase reliability of access and water quantity	Production power, capital; information of water needs, resources.
Shrimp Industry	User	How to improve our international competitive position, without losing continuity in supply?	Mixture of saline/fresh water Protection against diseases Expansion of land ownership	Very strong lobby. Production power: capital, information of water needs.
KCC	Provider	How to improve long term water access for all parties, without increasing the coordination costs/burden?	Economic growth, prevention of unrest / instability, providing water access to urban domestic users without harming villagers	Blocking power, some production power in terms of information and financial resources
KWASA	Producer	How to provide water for urban domestic use without harming peri-urban livelihoods too much? While preventing social unrest?	More reliable access to clean drinking water, on the long term. Reduce maintenance costs. High willingness to pay of peri-urban users	Is accountable to the DPHE. Blocking power (tube-well permits), production power (sanitation services)
KDA	Provider	How to stimulate economic development, without reducing urban cohesion?	Attract private investors, stimulate cooperation between industries, stimulate shrimp export	Access to capital, production power
DPHE	Implements, monitoring	How to improve water sanitation services, without increasing service costs?		Production power (sanitation services)
Local well-off farmer	User	How to consolidate well-off position, while obeying social norms? How to improve yields, while obeying social norms?	Irrigation water to increase yields and profits	Power determined by social norms? By status? Personal power
Marginalized farmer	User	How to improve access to irrigation water, without increasing conflicts with well-off farmer? How to increase income security?	Irrigation water to increase yields and profits	Low power, no blocking or production power. Some collective power, which depends on level of self-organization
Urban domestic user	User	How to get more water quantity and quality, without increasing the price?	Heterogeneous. Clean water access. Food, employment, safety. Low taxes.	Some power, influence on KCC.
Peri-urban domestic user	user	How to get more quantity / quality water, without increasing the price?	Employment, access to clean water	Limited collective power when represented by a CSO

APPENDIX VI, POLICY OPTIONS

These policy options are mainly obtained from the website of IGRAC. The site was visited last on September 14th 2014: http://www.un-igrac.org/publications/348

Alternative	Description	Feasibility
	Mitigation	
Efficient abstraction	-Micro- or drop-by-drop irrigation -Efficient domestic flushing systems -domestic water recycling -Reuse of urban waste water for agriculture	High, but awareness needed among farmers and domestic users. Financial incentives might help. Further research: (Roy et al., 2012, Haque et al., 2014).
Tidal barriers	Physical barrier to prevent salt water intrusion of fresh water bodies. Exists already; Alutala regulator to protect salt intrusion of the Mayur.	Upstream possible but not near the coast since the mangrove forests depend on brackish water, economically not feasible
Aquifer storage (ASR)	Artificial recharge of aquifer with fresh water.	Expensive, high pump pressure needed, energy intensive.
Prevent evaporation	Plantation of vegetation around fields and rivers	Prevention of deforestation possible but in conflict with further urbanization.
Effluent treatment	Prevention of leaking of saline effluents back into the groundwater after irrigation	Behavior change through education of farmers possible on the middle-long term.
Desalinization	Recovery of clean water through interception of evaporation	Expensive, energy intensive.
Prevent evaporation	Plantation of vegetation around fields and rivers	Prevention of deforestation but in conflict with further urbanization thus contested.
Rainwater harvest	Rainwater is catched and stored (above or under the ground). The water can be treated to prevent micro-biological activity	High, Khulna has a high precipitation which mainly ends as run-off. Affordable and appropriate to construct and maintain at the village level.
	Institutional	
Rights & ownership	Registration, licensing, rights and quota, land use restrictions, emission rules	Only feasible on long term.
Banning	Ban intensive dry-season crops such as boro-rice	Not feasible since land depends to food self-sufficiency depends on dry season crops; requires system innovation.
Distribution	Distribution of water per user group, per group quota	Games could enhance the discussion of which group should get priority; feasible on middle-long term.
Economic	Subsidies to manage salinity, investments in ASR programs, environmental taxes, compensation	Middle long term; Cross-subsidization might distribute the cost and benefits a bit better between peri- and urban users.
Information	Access to information, support of networks for bottom-up monitoring and evaluation	Middle term feasible since infrastructure need to be set-up; currently already projects. See for instance: http://akvo.org/
	Adaption	
Shrimp farming	Shift crop production to Northern parts, change to shrimp farming	Contested but in practice already widely applied as adaptive strategy.
Salt tolerant crops	Salt tolerant types of potatoes, tomatoes are developed and even rice is almost possible	Diet and culture change might be difficult but feasible on the long term.
Change cropping pattern	A mixed cropping pattern of vegetables and rice reduces groundwater abstraction caused salinization (Murshid, 2012)	More directly implementable and feasible than salt tolerant crops since less knowledge and behavioral change will be required.
Blending of water	By blending poor and higher quality water, an acceptable quality can be obtained	Short term symptom mitigation, high quality water is very scarce in Khulna since both the shallow and deep aquifer are polluted.

APPENDIX VII, GAME LEVELS

In this Appendix, the different game levels with instructions are described.

1. BASIC GAME

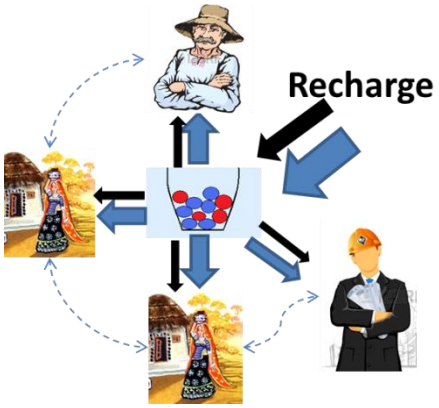
All player types can be played in the basic game. The types are: farmer, factory manager, fish farm manager and worker (also called villager/cleaner/dweller/seller; they all own houses).

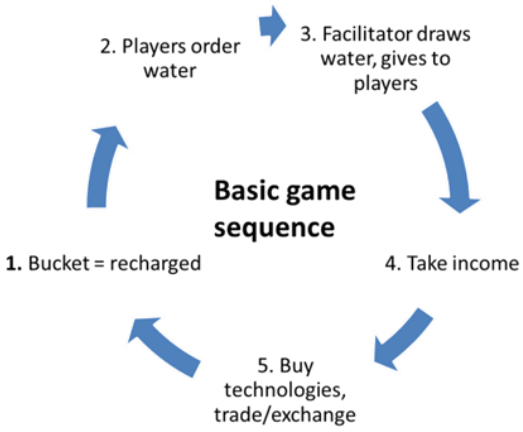
Goal: Maximize your assets (value properties + cash); the one with the highest value wins. The final value of your properties (=house/plot/farm) depends on the ratio of dirty/clean water. For instance; if you have 3 plots with a total value of ₰90, but half of the water is dirty, your total value will be ₰45.

Briefing: Start with the story (See Appendix VII.8), state in the story that more extraction might lead to more polluted water. Mention the initial water level and that initially 1/5 is dirty. Players can get clean (blue) or polluted (black) water. Polluted water is useless, but their our technologies that deal with them. Trade/exchange or communication is allowed. The game ends if 1) no player has left any clean marble or 2) after six rounds. The water is recharged every round with an X amount (depends on initial demand), but can vary.

Rules:

1. Only the dry season is simulated, surface water is not taken into account
2. The lower the water level, the more saline the water will become
3. The game stops 1) when none has abstracted clean water or 2) in round 5-6.
4. The income each player gets is **₰10** per farm/house/factory. Players start with different technologies and numbers of farms/houses/factories, according to the role description of players.



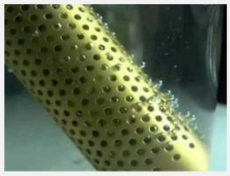
Game sequence		Instructions per step	Time
	1	Recharge the bucket, based on the spreadsheet. This is done by the facilitator, during round 5, to save time.	-
	2	Facilitator: ask players to place order by putting money in their buckets. This is done sequentially and invisible for other players.	1
	3	Facilitator: draw randomly the ordered marbles and return the buckets to the players.	1
	4	Players sequentially deploy the water on their plots/houses/factories and take money	1
	5	Players can sequentially buy technologies, trade/exchange water or technologies	2
		Total	**4-6**

Role reversal: When the game is finished and debriefed, the game is played again, but then roles are reversed randomly.

1. Players make an individual problem statement and think of options to perform better next time
2. Roles are reversed by giving players the role of their neighbor. This reversal should be unknown for players when they make their problem statement + actions to perform better.

Technologies Farmer	Technologies domestic user	Generic technologies

Salt resistant crops
Costs: ʃ 10
Effect: 1 black + 1 blue water = ʃ 15/plot



Water filter
Costs: ʃ 20
Effect: Change each round 1 black for 1 blue water

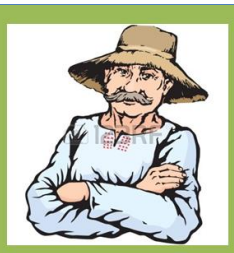
Tube well
Costs: ʃ 50
Effect: Buy water for ʃ 3 less than the marketprice.
-Sell to other players
-Sell clean water back to bank for marketprice

Micro irrigation
Costs: ʃ 20/plot
Effect: -1 water need per plot. (min. 1 water/plot)

Rainwater harvest
Costs: ʃ 30
Effect: Free water card every round

Player discriptions

Akash: Rice farmer.
Owns: 3 plots.
Income:
1 water/plot = ʃ 10
2 water/plot = ʃ 20
3 water/plot = ʃ 25



Special actions:
-Irrigate plots
-Buy a plot: ʃ 30

-Buy water
-Buy a technology
-Trade with other players

Player description farmer

Anik: Factory manager
Owns: 1 factory plant
Income:
1 water/plant= + ʃ 10
Maximum 5 water/plant
Waste: 1 card/water

Special actions:
-Buy a plant: ʃ 60

-Buy water
-Trade with other players
-Buy a technology

Player description factory manager

Farhana: Seller of vegetables & fruits
Owns: 2 houses
Income: ʃ 10 / house
Waste: 1 card/house

Special actions:
-Buy a house: ʃ 20

-Buy water
-Trade with other players
-Buy a technology

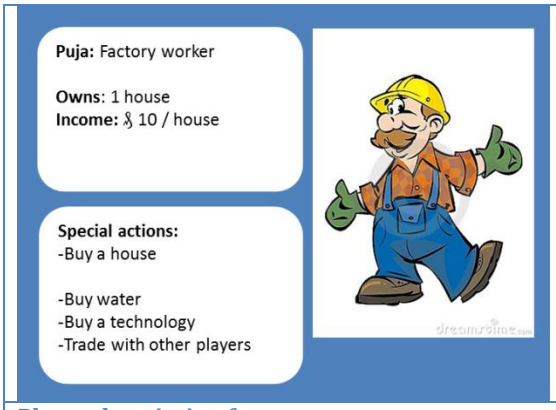
Player description house owner

Rohan: Fish farmer
Owns: 2 fishing plots
Income:
1 water/plant= ʃ 20
2 water/plant= ʃ 30
3 water/plant= ʃ 40
Waste: 1 card/water

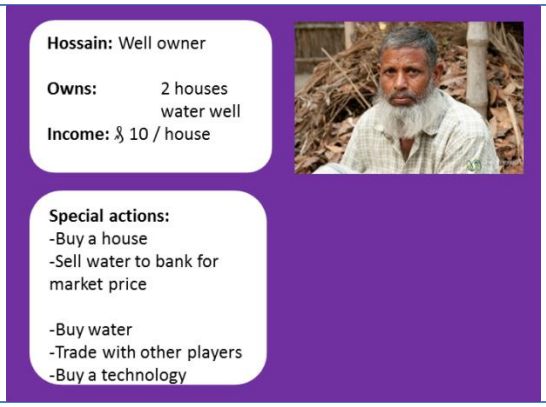
Special actions:
-Buy a plant: ʃ 60

-Buy water
-Trade with other players
-Buy a technology

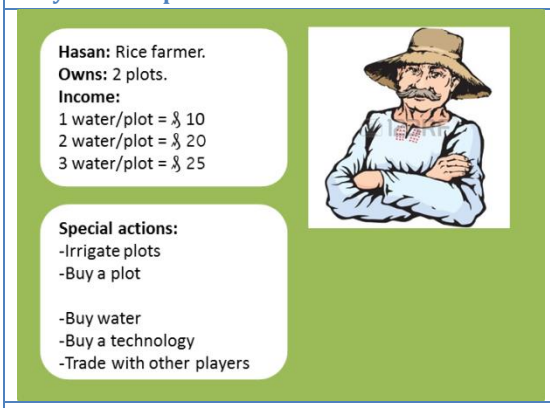
Player description fish farmer



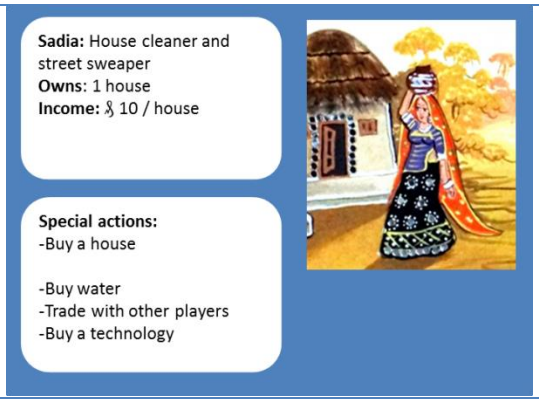
Player description farmer



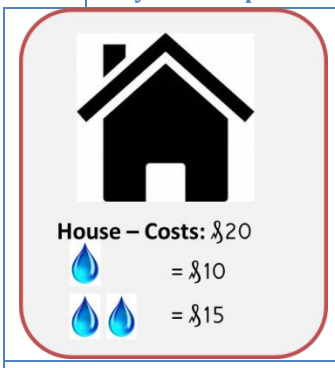
Player description factory manager



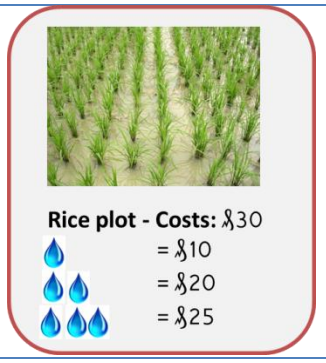
Player description house owner



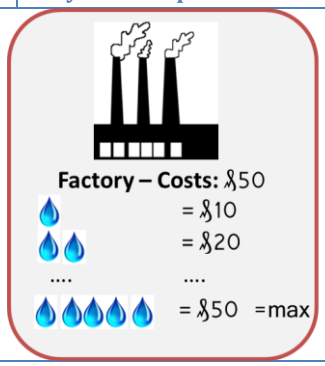
Player description fish farmer



Card house owner



Card farmer owner



Card factory manager

Card fishing farmer

SPREADSHEET CALCULATIONS

Initial demand	Level	nr. blue	nr. black	recharge
10	22	18	4	12
15	33	26	7	18
16	35	28	7	19

Initial level		46
level	price water	black recharge
46	5	0
42	5	1
38	5	2

Initial level = Initial demand + Recharge. Recharge = Initial demand x 6/5. Initial black = 1/5 of level.
$Black\ recharge = \text{MIN}\left(\frac{Initial\ level}{actual\ level} * initial\ level * \frac{1}{5} - \left(initial\ level * \frac{1}{5}\right); initial\ level - nr.blue\right)$. The nr. of black recharge depends on the water level; the lower the ratio of $\frac{Initial\ level}{actual\ level}$, the higher the salinization. The total black + blue marbles cannot exceed the initial level.

2. COOPERATIVE LEVEL

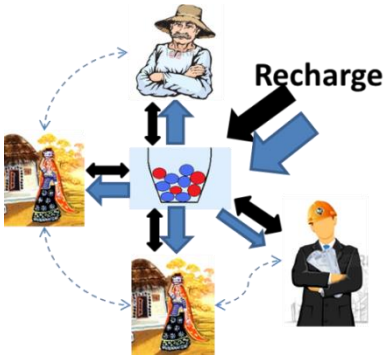
All the rules and elements of the basic game apply. Only the following two rules are added:

- Everyone loses if there is no clean water anymore or if after the final round, more than half of the marbles are black.
- It is allowed to cooperate buy buying together technologies or by showing your cards to other players. Nothing is prohibited (except from cheating and checking freely the (main) bucket), but nothing is however required as well.

3. WASTE EXPANSION

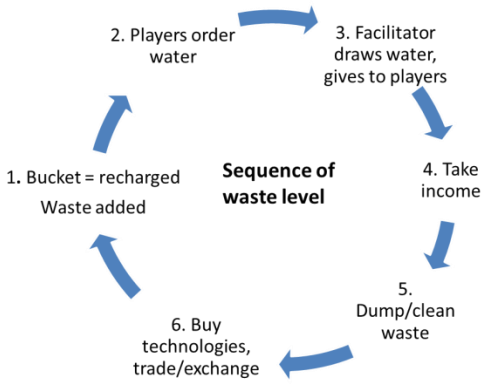
Since the pollution of surface- and groundwater by urban waste is a significant contributor to the problem, an expansion is added which specifically aims to create awareness about waste management. Apart from abstracting, users also able to pollute water. The waste card is identical to the money card, so that they cannot be distinguished when discarded closed by players, on the 'waste staple'.

Rules:



1. Apart from income, each player can get every round waste cards.
2. The amount of generated waste is ½ the amount of ordered water; odd numbers are leveled up. For instance if you order five water, you will receive three waste cards.
3. Waste can be dumped or cleaned. Cleaning costs **$5**, dumping is free.
4. 1 waste card = 1 black marble added to the recharge of the next round.
5. Waste or money cards are disposed closed and sequentially. You do not have to show other players whether you dump or clean.

Before the next round, the players manage their waste by cleaning it or dumping it. Money or waste cards are discarded closed in the middle of the table. In this way, players do not know who has cleaned or dumped their waste and a prisoners dilemma is created.

Game sequence		Instructions per step	Time
	1	Recharge; change blue marbles for black.	-
	2	Players order water	1
	3	Facilitator draws randomly the ordered marbles.	1
	4	Players sequentially deploy the water. Players take income + waste cards.	1
	5	Players dispose closed and sequentially money or waste on a staple	0,5
	6	Players can sequentially buy technologies, trade/exchange water or technologies	2
		Total	**4-6**

Additional debriefing:

- Tell how much waste there was dumped and cleaned. Ask who dumped and who cleaned. Why? Did your strategy change during the game? Based on what?
- What is the best strategy in reality? How to make sure people will follow this?
- Statistics about actual waste management in Khulna (if available) can be showed in the debriefing, to compare the game outcome with reality. But be careful: steer the discussion in a way that players won't start blaming each other. Focus on general strategies, not on player groups.

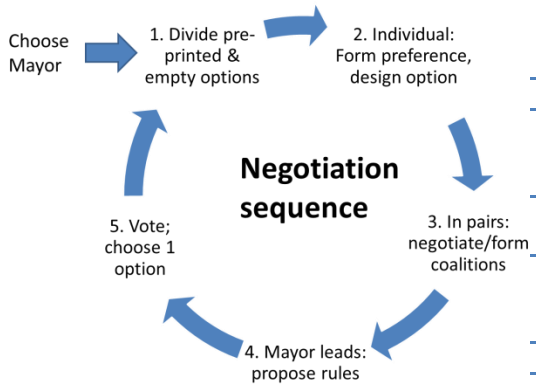
4. GOVERNANCE EXPANSION

In this expansion, the cooperative game sequence is interrupted by negotiations. These negotiations will take place in round 3 and eventually in round 6. Up front, players are informed in which round the negotiations will take place.

Goal: Find a strategy to improve the water quantity/quality, so that the cooperative objective can be fulfilled. Reach agreement on rules that can be added to the game.

Rules:

1. Not more than two rules can be added each time.
2. Examples of options can be adapted or own options can be created. An option can be stated in 1 rule that can be applied in the game.
3. The discussion is facilitated by a mayor; which is a player who is chosen by the majority[40]. Every person who wants to become a mayor gets max. 30 seconds to convince other players to vote for him/her. Voting is done by writing the players (role) name on a card.

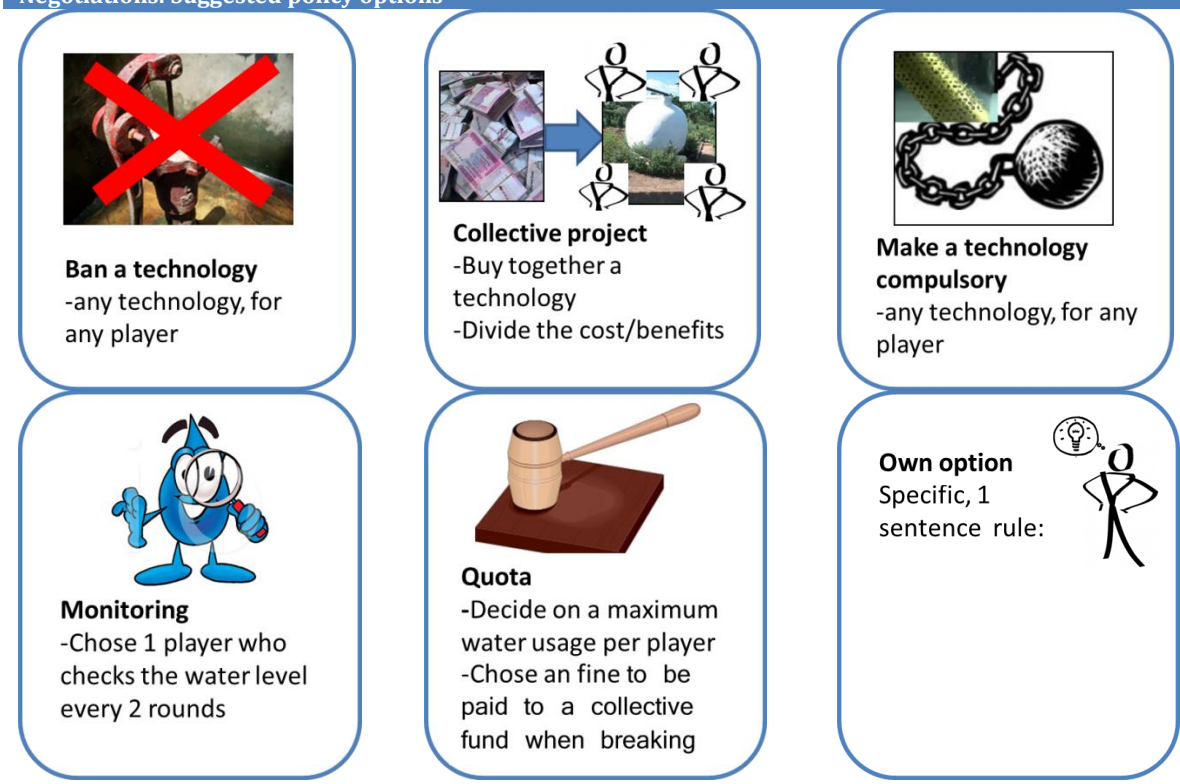
Game sequence		Instructions per step	Time
		Facilitator ask who wants to become mayor. Every candidate has 30 seconds to speech. After the speech, there is voted and the mayor is appointed.	3
	1	Divide sheets with instructions and examples of options.	0,5
	2	Players determine their preferences and design an option, if desired. The required time depends on the team size. (nr. of people that play a single role)	5
	3	Players have bilateral communication. The duration depends on the group size	10
	4	The mayor facilitates the discussion. He should watch the time very strictly. If there is no consensus after 10 minutes, the negotiation round is over and the basic game continues.	10
	5	If consensus cannot be reached, there can be voted	2
	6	**Total**	20-30

Additional debriefing:

- Reflect on the proposed options. Did anyone design own options?
- How did the preferences change after the bilateral negotiations or discussions?

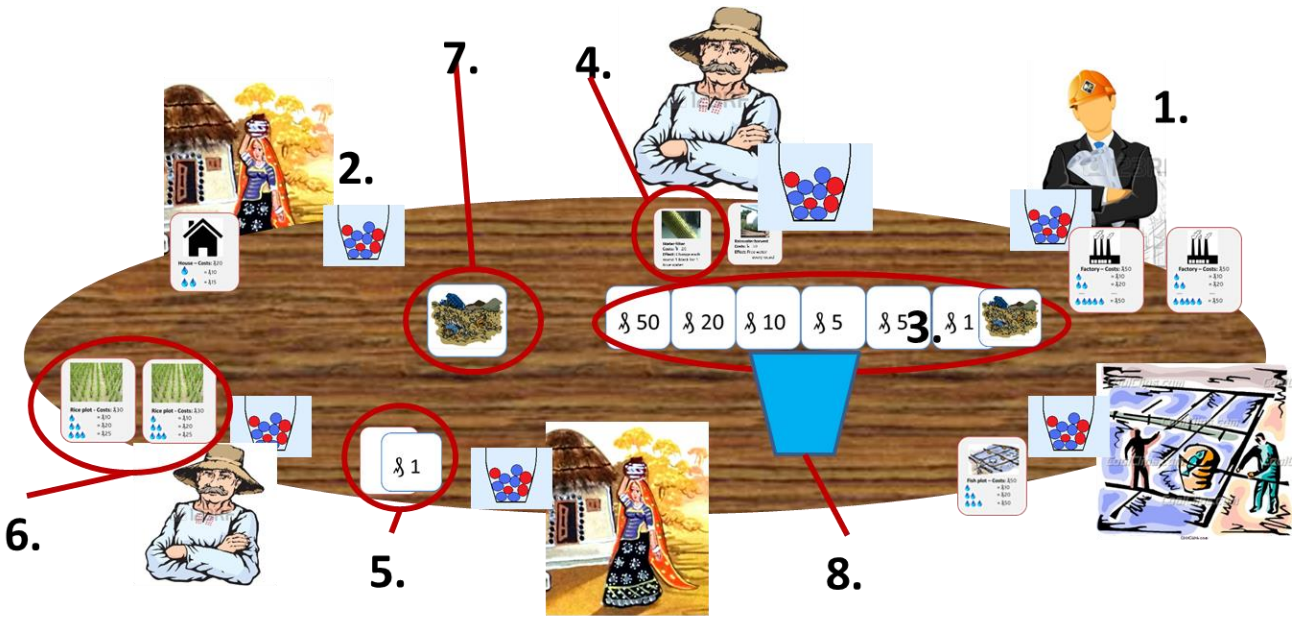
[40] The idea of the Mayor stems from the game 'Werewolf' and is added to structure the discussion.

Negotiations: Suggested policy options



5. SET-UP OF GAME

The figure below shows the set-up of the game. All players are gathered around a table with the cards in front of them. In case the game is played by a large group is it wise to form teams and let several players play a single role. In this way, players will have to rethink their strategies and actions more concisely than playing individually. In such a setting, each group could sit on the ground of at a separate table.

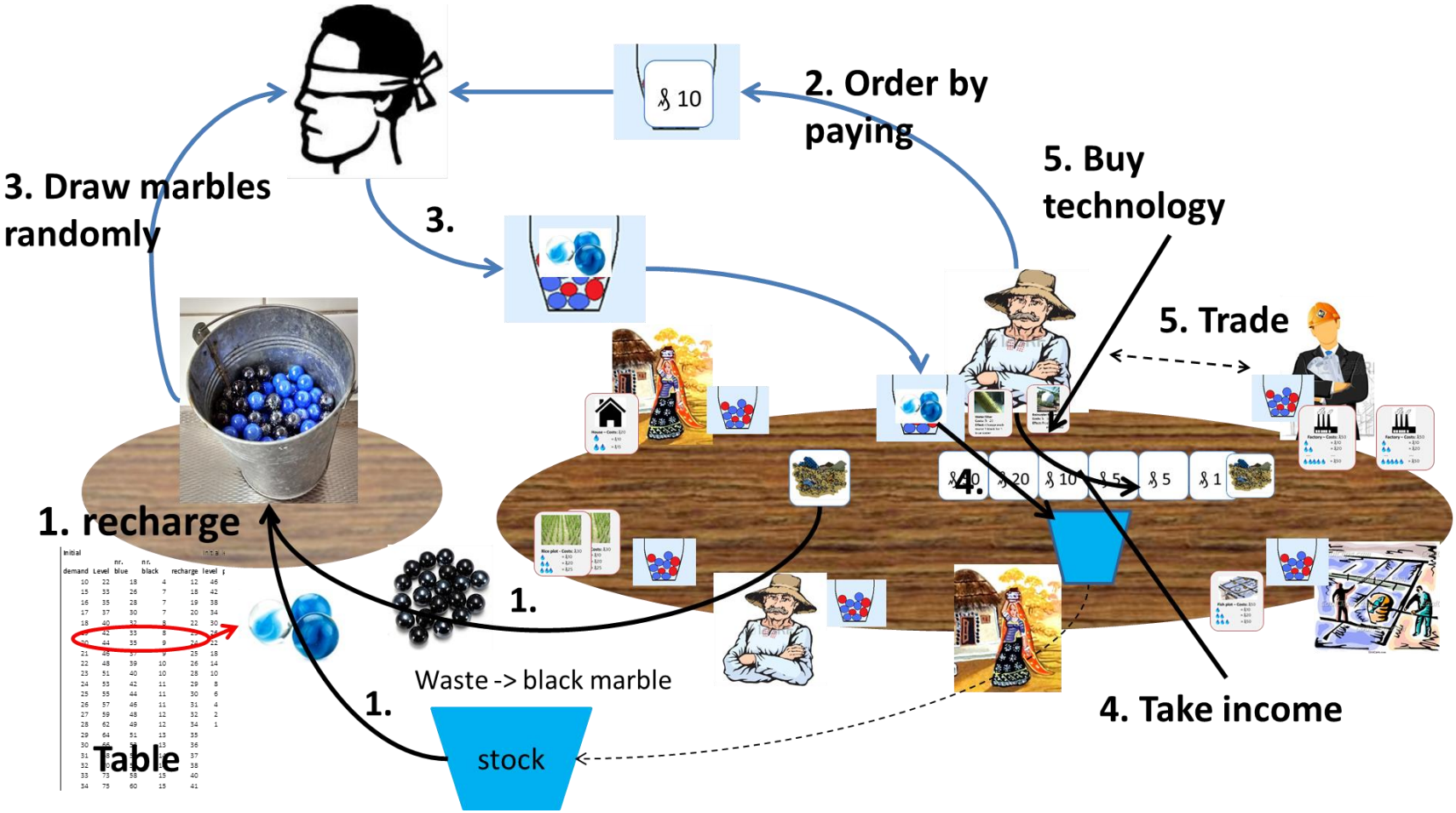


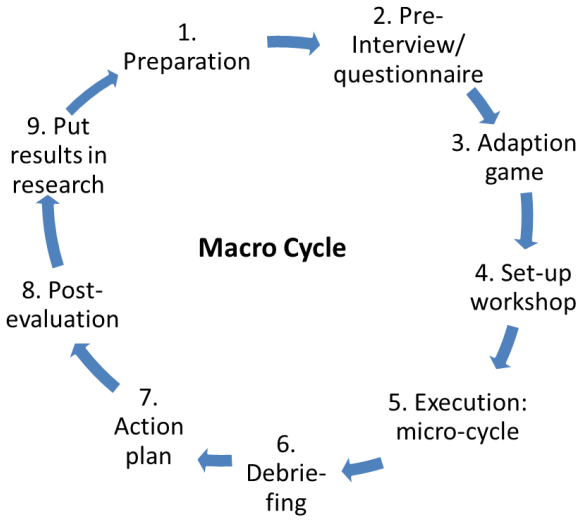
1. **Players:** The sequence how players sit around the table is random. However, it might be wise to rethink this and make it non-random if the tension between players is high because of a conflict in reality. The effect of the set-up on the group dynamics should be tested.

2. **Private bucket:** Every player has a bucket in which he/she puts the money to order water and in which he/she receives the marbles. Because the bucket is non-transparent and optionally closed, other players do not know how much water everyone exactly orders. It is not mandatory to reveal the content of your private bucket.
3. '**Bank':** The money that is not in use lays in front on the table, preferably in a box. This money is the 'bank', which means that players can take their income from it and can change their currency from the staple. Putting the box in the middle of the table will allow everyone to take their income or change themselves, while cheating is prevented. It is possible to assign someone to manage the bank, but this is not necessary. In the waste level; the waste cards are included in the 'bank'. Then, players have to take waste apart from taking their income.
4. **Technology card**: Each bought technology is activated by laying it open on the table, so that everyone can see it. Initially, all players start with all technologies that belong to their role and all generic technologies. These are all closed. However, some players can start with an activated technology (for instance tube-well owners).
5. **Closed cards**: Waste cards, technologies that are not activated or money cards can remain closed. It is not mandatory to close your money or waste cards.
6. **Plots/houses/factories**: Each player starts initially with a given number of plots/houses/factories, which determine the 'production capacity' of the player. When players 'deploy' their water in step 4 (see basic game sequence), they put the marbles on the card and take the corresponding amount of money from the bank. This is done sequentially.
7. **Waste staple**: On this staple players put money (৳5) or waste, after the facilitators collects it.
8. **Extra bucket**: Here, the marbles are put which are 'deployed' already. Players can use these marbles to change black for blue marbles, in case they have as technology a filter. They can also take a blue marble if they have an activated 'rainwater harvest' technology.

6. FACILITATION OF THE GAME

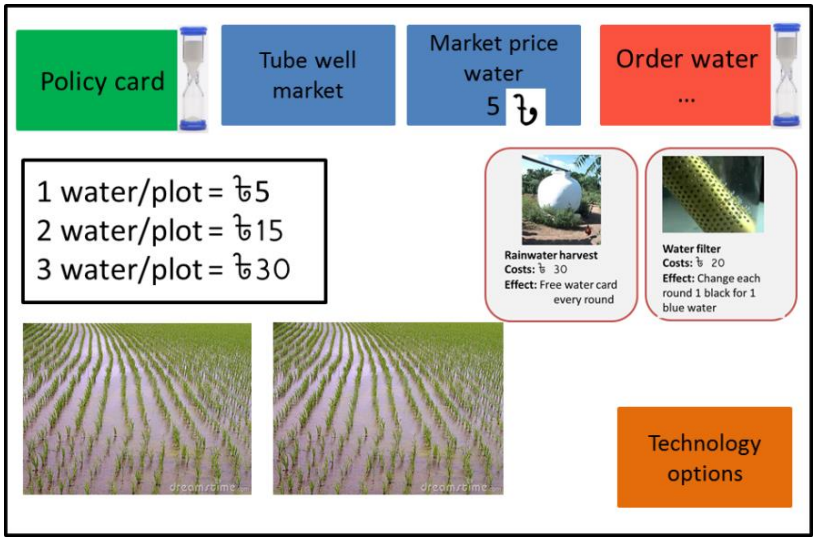
The numbers relate to the steps in the basic game (the micro-cycle). The facilitator should keep track of the number of marbles in the bucket (groundwater table).



	Activities	Macro cycle
1	Inception report. Play-testing in context. Adaption of game. Adjustment of game Co-redesign of game. Invite participants.	
2	Identify the initial perception of stakeholders on the problem and on other stakeholders. Assessment on learning effects. Interviewing skeptical stakeholders and asking them to review the game and deliver input, will make them less skeptical. In the end, they might participate just out of curiosity, to see how the game works which they helped to develop.	
3	Adapt the game based on the interview	
4	Set-up the game workshop, with the elements shown in section five. Apart from extra buckets and sufficient black/blue marbles, pens, paper and preferably post-its are needed.	
5	See the previous sections of Appendix VII. How to handle group dynamics?	
6	See section 6.5: How do you feel? What happened? What did you learn? How does this relate to your work/reality? What if? What next?	
7	What will players do differently next week? How is there assured that the step between the plans and practice is as small and easy as possible?	
8	Repeat the interview or questionnaire as executed in step 2 after six months.	
9	Integrate results into research	

7. DIGITALIZATION OF THE GAME

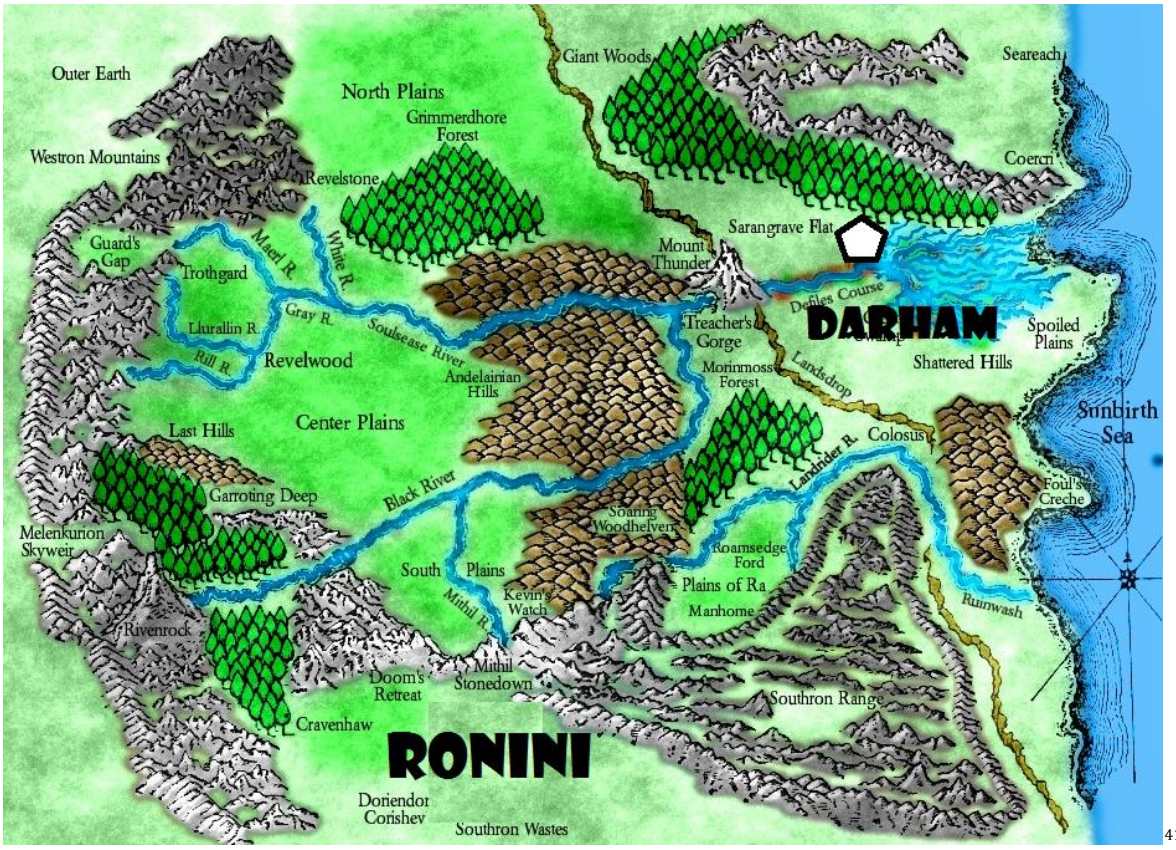
- How to digitalize the game?
- The negotiations and the communication can be internalized or kept external; the latter is more feasible. Internalization will make it easier to scale the game up, immerse the players and control the game, but will make the game a 'playing-with-the-tool' instead of a 'playing-around-the-tool' game. Advantages and disadvantages of these approaches are discussed in chapter 4.6. Each player(group) will need a laptop with the shown screen.
- The 'order' button should be available for a limited time, which is visualized by a countdown or an hourglass. The same holds for discussions on the policy cards. The water/plot needed can become dynamic. Market prices of water, waste or water efficiencies of agricultural plots could be easily made dynamic in a digital version.



8. EXAMPLE OF A'STRATEGY MAP'

Here, an example of what is meant with a 'strategy map' still needs to be shown. The map can be used by players to find options on which they can negotiate with other players.

9. STORY BEHIND THE GAME



[41]

You are inhabitant of the city of Darham in the country of Ronini. Ronini is a diverse country with expansive forests, mountains and plains. Different rivers cross the plains of Ronini, among which the Anur intersects the city of Darham. Most inhabitants of Darham originally worked in agriculture, but currently more and more people are working in manufacturing industries. In addition, Darham has a thriving fish cultivation sector. Therefore, more and more people move to Darham to find a job.

Most of the people eat rice which is grown in the dry season. This requires a lot of irrigation. Because the water of the Anur river is not drinkable, most people use groundwater from wells in Darham. Due to the growth of the city, more and more wells are in use. More water extraction increases the risk that the wells will also get polluted by dirty water from the Anur. More extraction will also lower the water level in the wells, which will make it more expensive to pump the water up. Some inhabitants dispose their waste on dumping sites outside the city. However, dumped waste can leak into the water and pollute it.

Around Darham, rice and vegetables are grown. Most of the men who work on the fields live in the settlements Manyana, Phulgina, Shavrani and Bhorod pur, which are located around Darham. Most of the women sell the fruits and vegetables in Darham or work as tailor or cleaner. The Darhamnians pay with the ₨, pronounced as 'Ro'; which is the currency of Ronini.

Goal: You live in Darham and you are a farmer, factory manager, villager, factory worker or fish farmer. Your task is to increase your income by extracting water and buying technologies.

[41] This picture is adapted from http://daelstorm.byethost13.com/maps.php (Last visited 24th Sept. 2014); Stephens Donalson's 'The Chronicles of Thomas Covenant the Unbeliever'

APPENDIX VIII, PLAYTESTING REPORTS

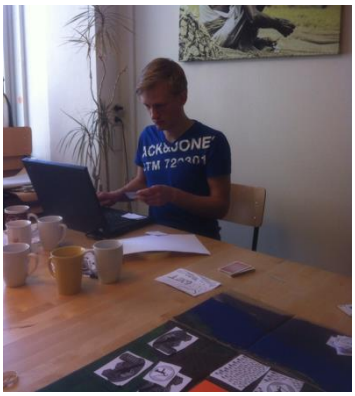
1. PLAY-TEST SESSION I: 22-04-2014, 09:30 AT BOTH ENDS, AMSTERDAM.

Location: kitchen Both ENDS, Amsterdam. Attendants from Both ENDS: Huub Scheele, Annelieke Douma, Huub Kistermann, Remi Kempers, Loes Wijnen.

DESCRIPTION

Players: There were 5 attendants and 4 different roles.

- 1 farmer which owned the farm plots. He could chose to get water from the river for free or pump water. By putting water on the plots income was generated. 3x unclean water would make the plot unfertile.
- 2 villagers, who had an income, got free water and 1 waste card. They could buy (clean) water, buy medicines for to keep working after getting dirty water.
- 1 industrial: Needs water to produce, produces waste cards.
- 1 city dweller: 1 house = 1 water need. Every 2th round the city dweller receives another house.
- 1 governor: Got income from the bank, could propose actions and pull every round a governors card. Two cards were used: The first one was *rule proposal* in with which the governor could propose an additional rule which would be adapted if 2/3 of the players would be in favor. The second card was *corruption* in which the governor would lose his money. The governor could pay money to check the water level and the pollution rate.



Form: (paper) play-board, descriptions for every players with his/her income, the possible actions, the objective and a score indicator for the 'smiley' points. The facilitator calculated with an excel-sheet the water every player would get.

- Climate change is included with a card with dry/wet on both sides, which is flipped every round. In the dry season, the aquifers are not recharged.
- The villagers, city dwellers and industry received 'waste cards' which they had to put every round on the waste staple. They could clean the waste by putting money on the staple. Since the staple was closed, a prisoner's dilemma was created between wasting (individual interest) and cleaning (collective interest)

Briefing: The goal is to increase your income. You receive income by receiving clean water as villager or city dweller. Water is input, income is output

Sequence: Define strategy, write orders down on paper, proceed order, return order, optional exchange of water

Role of the facilitator: Operates as simulator, calculates recharge and how much water everyone gets and operates also as 'bank'.

FEEDBACK

- It took a while before the game started to explain how the game should be played and during the game, elements still needed to be explained. The play slowly started and there was no moment when players clearly immersed into play. It seemed that the working of the game was not understood by players quickly and explanation during the game made that 'reality' and 'play' were not clearly separated.
- There was stated that the rules and the assumptions of the game were not explained sufficiently in advance.
- The 'negotiation' card of the governor was not actually played. The governor proposed a couple of rules to the facilitator, but the proposals were not discussed with the other players centrally.

- There was suggested to not include climate change, which was simulated by using a card with dry/wet season on both sides. Climate change should not been included in the game if a desired learning effect is that the causes are not totally natural but certainly also anthropogenic. During the game; the governor could pull three cards; 'bribing' which would result in the governor losing all its money, 'negotiation', which was a sign that the governor could propose a policy option and finally a 'disaster' card. In the game, only the negotiation card was actually pulled. A participant stated that climate change in reality occurs slowly and effects are more subtle. Farmers will observe climate change by gradually decreasing yields, less regular cropping seasons and precipitation seasons. Although climatological disasters are common in Bangladesh, the main impacts will be felt gradually.
- There was discussed on which organizational level the game should be played: With representatives of villages and farmers first. Then also potentially with water boards and city officials.
- Form: Clearly state what costs are, what is income, what expenses etc. Currently, these are not clearly distinguished on the player description card.
- There was mentioned to change 'manage' waste to 'clean' waste.
- More transparency is needed of how the gaming system works. It was unclear up front what happened with the waste, whether it actually infiltrated in the groundwater or not and how. The effects of the actions (putting waste on the staple) were not recognized. With the initial settings of the model it took too long for the groundwater to be depleted or polluted. After three playing rounds, players did still not receive the negative consequences of their actions.
- There was stated that the term ''city dweller'' has a negative connotation. In reality, ''dwellers'' are not the well-off urban water users but the poorer slum inhabitants.

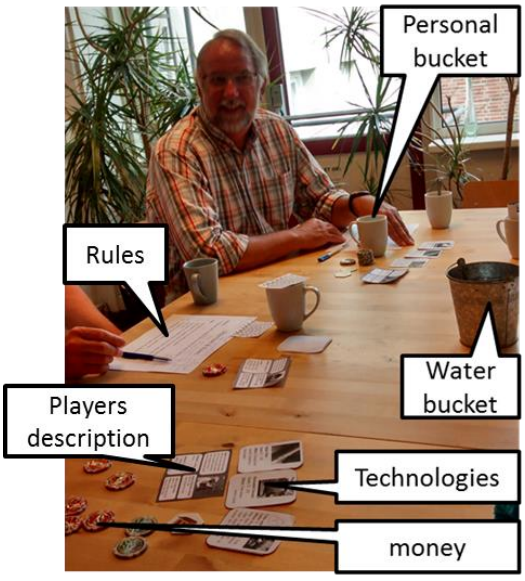
The governor's role was not really played due to lacking explanation and facilitation by the facilitator during the game. Some policies were proposed by the governor, but no discussion and voting round was executed. Although the session was very useful in getting feedback, the session was more characterized by a discussion on how to play and a feedback on the concept afterwards than there was actually played.

2. PLAY-TEST SESSION II: 27-05-2014, 09:30 AT BOTH ENDS, AMSTERDAM.

Location kitchen Both ENDS, Amsterdam. Attendants from Both ENDS: Annelieke Douma, Remi Kempers, Gijsbert Koeters

DESCRIPTION OF THE GAME

The second time the game was played within Both ENDS, three people participates in the session. At first, the rules of the game and the roles and properties of everyone were explained for 15 minutes. After that, the game was played for about 30 minutes in which 4 rounds were played. Some elements in the game were changed drastically.



- **Form:** No collective play board. The domestic users receive houses and the farmer plots which indicate the basic water needs of players and are visible for everyone. Each player can buy technologies which increase the efficiency or increase returns.
- **Players:** 1 domestic user with little income, 1 domestic user who initially owns a tube-well, 1 farmer with 2 plots.
- **Briefing:** The goal is to increase your income. You receive income by receiving clean water as villager or city dweller.

- **Sequence**:
    - Recharge of bucket and announcement of water price
    - Decide water demand and place orders and buy technologies
    - Return water, implement technologies and get income for water
- **Role of the facilitator**: Simulator, calculates recharge, price of water and divides water. No computer is used, the recharge and water price is calculated with a pre-printed sheet. This was even easier and faster than using the computer.

FEEDBACK

- The game is clear than the previous version. Although the working of the game was not directly clear and the game was still perceived as complex, the game was received as more playable.
- A discussion on whether the assumptions should be transparent and known before playing the game. Some participants stated that this is not necessary, while later on there was stated that more transparency of how the underlying gaming system works needs to be done. There was stated that the bucket should be made transparent and that the recharge should be visible for the players.
- An open, transparent first 'practice' round was suggested, in which players could learn the working of the game before starting seriously.
- Again, it took too long for players to receive feedback on their actions; the aquifer did not deplete or did not become severely polluted.
- There was suggested to limit the number of possible actions. Some players could choose to buy four or five different technologies. There was suggested to limit it to a maximum of two options.
- In case of role reversal, there was suggested that players first should play themselves before playing other roles.
- Although players got the opportunity to negotiate and trade, they did not have any incentive to do so since there was no difference in their interests (they all desired more water)

3. PLAY-TEST SESSION III: 18-09-2014, 20:00, LEIDEN, THE NETHERLANDS

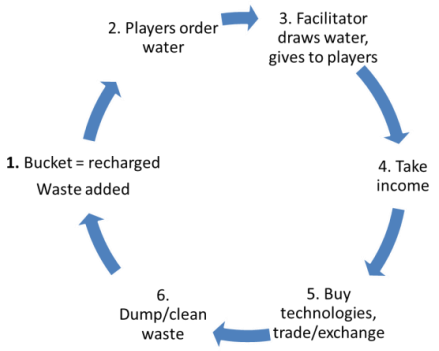
Attendants: six students with different backgrounds in social sciences. All players have an average/reasonable experience with board games.
Instructions: Only the in-the-game objective is explained; why the game is created and what the desired learning effects are is not explained in advance. The background story is that the players are inhabitants of Darham, a city in Ronini. Your goal is to increase your income without emptying the bucket. The bucket included blue (=clean) and black (=dirty) water. Dirty water is useless. There are techniques to improve your gains. Trading/Negotiation is allowed.
Format: 3th version: Paper cards, everyone performs similar actions and can buy the same technologies. Some players start however with less houses or initial resources.
Roles included: Farmer 2x, Industrial, Domestic user 3x (Randomly pulled from all available roles)

Time in min.	Activity
15	Explanation of rules, test round
30	7x basic level: Everyone plays competitive, but trading/cooperation is allowed
30	7x basic level + waste addition + role reversal.
+/-45 min.	Open group discussion on what was experienced, what you can learn from the game and what can be improved in the design.

FEEDBACK

- Structure the rounds. Explain up front to the players how the micro-cycle goes and make sure this sequence is followed. A diagram or a turntable could help to make clear in which round we are.

- Execution of actions per player should be sequential (using water, getting income, buying technologies, dumping waste). The extraction can be still performed in a random order; but a sequence in the other steps structures the rounds.
- The difficulty to facilitate the game was improved radically by letting players themselves collect their income from the water they obtained and letting them perform all the actions themselves. This gave the game more speed, made it more fun to play and easier to facilitate. It will remain necessary to extract marbles and recharge the bucket with marbles, if you want that players do not know exactly how much is in the bucket and how much waste is added. To make the game more neutral; a local actor should be chosen to handle the bucket with water. Each user group could for instance deliver someone who pulls the marbles alternatively (one person for a whole game, who does not play him/herself).



- The feedback on the actions was in the first game not really strong. The initial water level, the recharge and the share of black marbles was too high. Only the poor players with less options realized the pollution of water.
- In the second game; when players dumped waste as well, richer players also started to experience the consequences of waste dumping.
- Shorter rounds with more direct feedback (lower initials); plan a discussion every three rounds to stimulate that players will start to trade or cooperate
- Briefing: Be clear, take the lead. Let not players interrupt you too much. Start with the goal and then explain how this can be reached.
- The game was not experienced as difficult. Whether other elements should be added depends on the function. If the game only wants to let players perceive the problem from a different perception, the format is good and works well. If you want to let them understand how the system works, you should balance the initial settings more, lower the water level values. But do not add much more, since local players will not understand much more than this.
- Local players are not familiar with this type of games; with roles and cards and upgrades, while the current participants were familiar with it. (By having experience with the H2O game and games such as Colonists of Catan or Machiavelli.
- It was difficult to see what the incentive of the well-off players would be to cooperate. They were not dependent on the poorer players. This represented reality good. In case of role-reversal, this inequality is not problem.
- The political layer in the game was missed in the game. How others could be forced to cooperate or forced to cooperate or start polluting was missed. On the other hand, it might be not realistic to include this, since reality is unequal. Appointment of a mayor who leads the discussion or facilitates the negotiation would be helpful. (Similar as in the game ''Werewolf'', players have to vote for the Mayor).
- Separate the game into two parts. The game needs a clear goal and a clear winning condition.
    - First a competitive part: Increase income. The one with the highest income in round X will win; but if the water is depleted or only black marbles are left before round X, everyone loses; independent from how much money you have. Or if the water level is depleted in round X, the player who has extracted the least wins/or used the most efficient technologies…
    - Cooperative part: add a clear in-game cooperative goal. Having both an individual and a collective goal could be used. Collective goal: water should be clean in round X. Share of black marbles should be below X in round X. Build together a technology or a project.
    - The individuals can only win if the collective objective is reached.

OBSERVATIONS

- The mechanic behind players success is strongly exponential. If you have bad luck in the start or have lower initial funds, you are screwed. If you have high initial resources and invest; your growth will be exponential. The extraction develops exponentially as well, which is realistic.
- All less well-off players experienced frustration. While they had limited options, the well-off players had lots of possibilities because they had more resources.
- After role reversal, former 'poor' felt pity for the new 'poor' end started to help them. The role reversal did help in showing players the implications of their behavior on other players.

- It is best to first start competitive. Than debrief the game and let players formulate their view on the problem. Let them come up together with a solution. This solution will be based on the perspective the player had in the previous round. Starting the new round in a different role will show the implications of your behavior 'old' perspective and behavior on your 'new' role. After role reversal, let them restate the problem again and come up with another solution. A session should include at least 3 role reversals. In the end, the difference and evolution in problem statements should be discussed plenary.
- Most players dumped their waste instead of cleaning it.
- In the second game play; players started to cooperate spontaneously. One players proposed up front a cooperation and a moderation of extraction, but players did not really follow this up. (The player who proposed cooperation had been the most aggressive player in the previous round)

4. PLAY-TEST SESSION IV: 20-09-2014, 20:00, MIERLO, THE NETHERLANDS

Attendants: Four (former) students with backgrounds in pedagogical and public administration sciences. All players have average-extensive experience with card and board games.
Format: The set-up and format of the game is exactly similar to the play-test of 18-09-2014; the only difference is that there is played with four players instead of six.
Roles included: Industrial 1x, Domestic user 3x. (Randomly pulled from all available roles)
Game play: On a board, the sequence of the steps was drawn. This made the gameplay more structured and clear for the players. Since the facilitator only drew the ordered marbles, the rounds were quick and required little facilitation.

Time in min.	Activity
10	Explanation of rules, test round
20	6x basic level: Everyone plays competitive, but trading/cooperation is allowed
20	6x basic level + waste + role reversal.
+/-15 min.	Open group discussion on what was experienced, what you can learn from the game and what can be improved in the design.

OBSERVATIONS

Seven rounds were played and the gameplay evolved almost similar to play-test III. Players with initial high resources showed exponential growth while the less well-off players struggled all the rounds to survive. Black marbles were almost fatal for poor players, while well-off players could cope with them easily. In round seven, the bucket was emptied and the game-play was stopped. In rounds five and six, players got already large amounts of polluted water.

After the gameplay; the players were asked what happened. Why was the bucket emptied? How can it be prevented? Although players admitted that the depletion of the bucket was mentioned up front, they did not realize this risk during the game and 'just played'. The poor players were frustrated about their lack of resources and blamed the richer players. Buying technologies together and investing in 'water filter technologies' was suggested as solution.

During the second round, the option to dump or clean your waste was added as element. The players were also explicitly told that they now had two goals. 1) To increase their income and 2) to prevent the bucket from depletion. If the bucket would deplete or pollute beyond 2/3, everyone would lose. Finally, roles were reversed by turning all the roles to the right.

FEEDBACK AND REMARKS

- The amount of initial marbles was communicated, but the recharge was not communicated in the first round. After it was stated that the recharge was around 8 marbles/round, players started to cooperate and only extract 2 marbles per player.
- Players started to cooperate right from the start. Everyone revealed their ordering without any restraint.
- Players started to buy water filters for each other. There was decided that everyone should get a water filter and that only 2 marbles per player should be extracted.
- No waste was dumped.

The cooperation evolved successfully. The difference between Play-test III in cooperation was that cooperation was explicitly stated as goal. Another explanation is the smaller group size; this made communication and revealing of the

orders and waste more easy. A remark was that the objective in the competitive round was not clear. Players asked several times when the game would be finished, but this was not explicitly stated to prevent *backward incubation*. Players did not default the cooperation in the last cooperative round, since they all had a clear cooperative goal.

5. PLAY-TEST SESSION V: 14-10-2014, 20:00, LEIDEN, THE NETHERLANDS

Attendants: six students with average to extensive experience with board games; one of them also attended Play-test III. They all had backgrounds in social sciences.
Format: Similar to Play-test III and IV.
Roles included: Factory manager, 2x farmer, 2x house owner, 1x tube-well owner

Time in min.	Activity
10	Explanation of rules, test round
20	4x basic level: Everyone plays competitive, but trading/cooperation is allowed
20	4x basic level + waste + role reversal.
30	Negotiation round + 4 x level.
45	Open group discussion on what was experienced, what you can learn from the game and what can be improved in the design.

OBSERVATIONS

- Appointment of a Mayor is very helpful since it provides both structure to the process, while the autonomy/ownership of the process remains with the players.
- A clear in-the-game goal that stimulates cooperation is needed. 'Clean' water should be a means rather than a goal, to make the game playable and fun. Everyone, including the 'initial poor', should be able to win.
- Two rules were executed: 1) a quota and 2) open discarding of waste or money cards, so that everyone knows who is dumping.
- The whole gameplay should emphasize the rule proposing negotiations; the players commented that they liked this part the most and said that it was really the climax of the game.
- In the discussion, the need for a clear goal was emphasized several times.
- The negotiation level greatly stimulates communication and cooperation. It easily takes longer; a choice should be made to stop valuable discussions or to extent the total duration of the game.
- In the 2th round, the role of tube-well owner was added. The majority of players started after a while to extract water via the tube-well owner, on a 'hidden' way. The tube-well owner exploited his function by selling water just below the market price. He let players play against each other by asking different prices per person.

FEEDBACK

- You should only change the ratio of black/blue when more water is extracted; this will give players a more direct feedback than waiting to stop the game till the bucket is emptied.
- Poor people do not have money for waste cleaning. Is the message that it is difficult for poor people to clean their waste? If you get waste, you also get sufficient money to clean it.
- I don't get with which strategy you can win. What can you do to succeed? Cleaning all our waste? Is it even possible to increase the ratio of blue marbles at all?
- The effects of some upgrades takes too long; playing for 4 rounds is too short for the current settings. A water filter is profitable on the short term while it is actually symptom mitigation. A rainwater harvest system only pays back after six rounds, which takes too long (the first two games took only 4 rounds).
- I choose to pollute more because I thought, ''if I have a water filter, it will harm myself not that much''.
- As facilitator you should clearly remain in charge. Currently, there is no lead in the negotiations and also not in the trading rounds. Provide more clear room for discussions.
- An addition would be to collect collectively money to monitor the water level.
- As poor players, you can do little to change your destiny.
- The bucket should be frosted, so that you know a little bit; is it true that the water level is also unknown in reality?

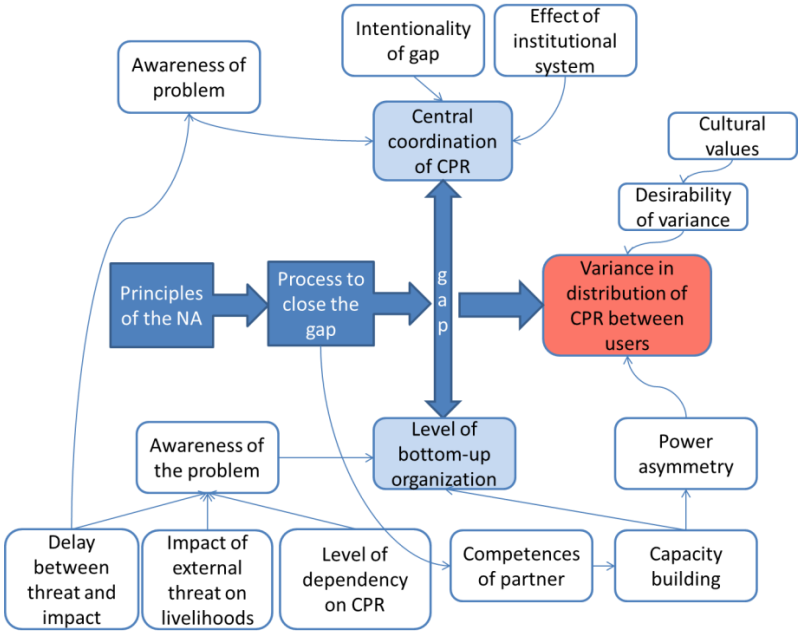
- The game should take longer, the rounds were too short. It was a pity that we could not experience the proposed rules longer.
- An idea is to make rules for sale, influence could depend on your resources. Others commented on that ''this is called corruption''.
- I think proposing rules really was the crux of the game, it makes the game also more fun.
- Through the rule addition, I really experienced to have influence, which made the game more fun.
- There should be multiple rule proposing rounds. Then, you can see the effect of your proposals. It also adds a negotiation element. A rich factory manager could buy the vote of a factory worker after a while, to introduce a rule which is more in favor for him. Or players could have different voting power.
- I think inequity in voting is not necessary; there is already inequity in resources
- I dumped all my waste because I realized it was a prisoners dilemma and I knew others would also do it. I think. in the third gameplay, finally a sustainable situation was created through the rules.
- In the first two rounds you saw clearly what the problem was; we all took too much water. Short rounds before the negotiations will remain necessary.
- The first game we found out how the production worked, the second round we exploited the system based on that, with ordering all the water via the tube-well owner.
- The tube-well owner has a strong position.
- That everyone gets a percentage of does not matter; the winner remains the winner.
- The farmer role is probably not realistic, they are well-off and easily make money.
- Only buying water and deploying is boring; dealing and trading makes the game more fun.
- Each player should be interdependent; they should need something from each other. For instance, the factory manager should give a part of his money to the factory worker. Do not add game elements, but extend the transactions/interactions within the game.
- With the current objective, it is at the start clear who will win; it should be undecided up front.
- The mechanism is understandable but it is doubtful whether uneducated farmers will understand it as well.
- The game is playable, but not easy. Structuring of the rounds by the facilitator will make the game more playable.
- The core mechanism is easy to understand. Getting water, deploying water. The question is; are people used to games? Are people familiar with similar formats? If not, the game will be more difficult to play.
- It is not clear what the final goal is. And it is also not clear how you get there.
- I played cooperative games which were really exciting, but I did not have that excitement with this game.
- Every role should have an individual goal; clean water should be the means and not the goal in itself. The goal of the factory worker is to not lose his house. Everyone who has accomplished his/her goal at the end of the rounds wins, but
- The frustration of the game was not motivating; we know that should keep the water clean but we do not like the clue. It's like everyone knows that driving less is better for the environment, but I still like to drive.

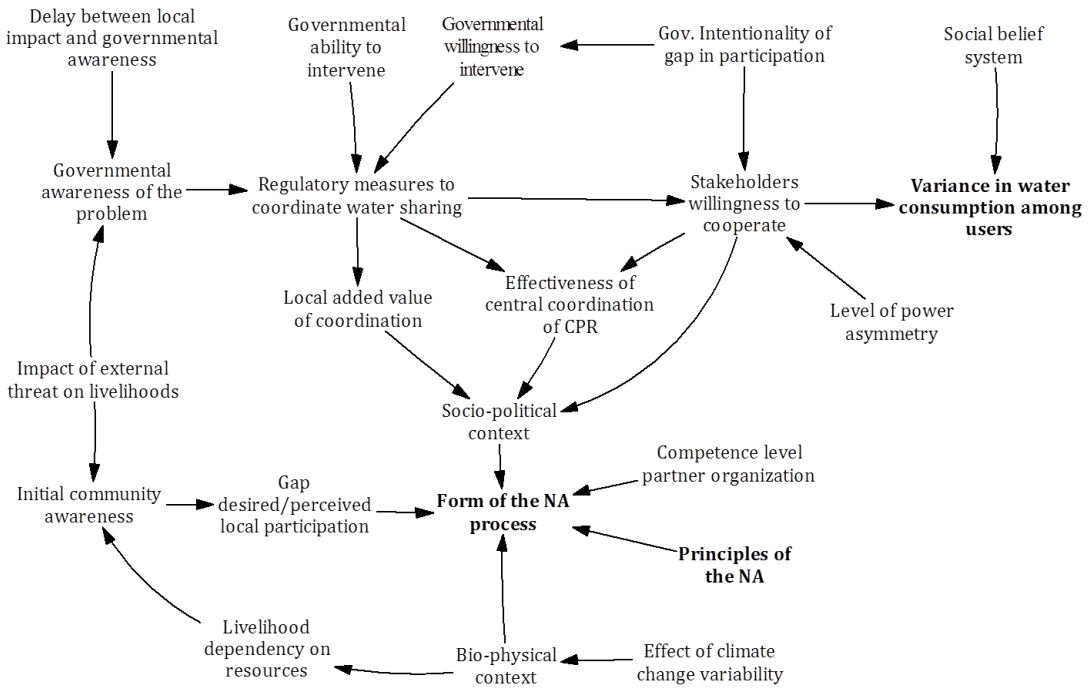
This short questionnaire was prepared but unfortunately not used during the fifth play-test.

Evaluation form of game		**Disagree - Agree**				
Nr	**Question**	**1**	**2**	**3**	**4**	**5**
1	I forgot a sense of the time and where I was during the game					
2	I influenced other players strongly with my actions					
3	I did talk to other players in the game					
4	It took a long time before I understood how the game works					
5	The symbols and texts on the cards are clear					
6	I cooperated with other players because I had to do so					
7	The game took too long					
8	I cooperated with other players because I liked to do so					
9	Now I understand better how other players experience the problem					
10	I would like to play the game another time					
Water depletes & is polluted because:						
I (dis)liked the game because:						
The game could be improved by:						
My first role was:	*Farmer*	*Worker/Seller/Cleaner*	*Industrial*	*Fish farmer*		
My second role was:	*Farmer*	*Worker/Seller/Cleaner*	*Industrial*	*Fish farmer*		

APPENDIX IX. CONTEXTUAL FACTORS THAT INFLUENCE THE NA PROCESS

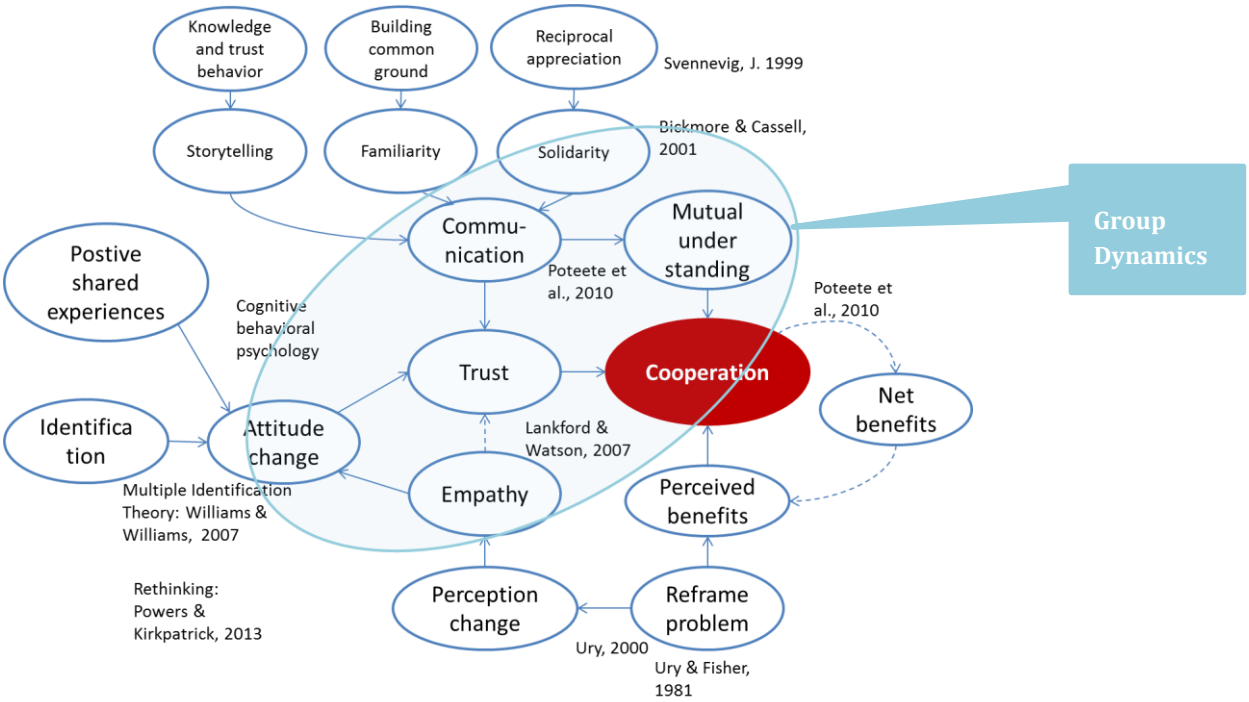
Based on NA literature (Both ENDS, 2005, 2011, 2012, 2013), different models of contextual factors that influence the process of the NA were created. The idea was that mapping the contextual factors would help to structure and formalize the NA. An attempt was made to combine these factors together with the identified tools into a decision tree, which would help implementers by stating under which circumstances, which (type of) tool should be applied. However, more factors (than only the context, see figure 2.3) influence the flexibility. It showed more practical to improve the Inception plan of the NA based on the factors. However, with future attempts to formalize the approach, the models might be useful inputs.



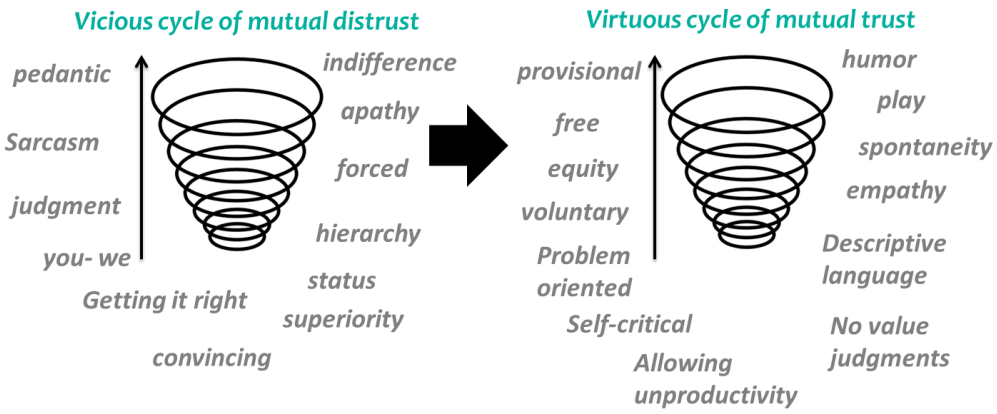


APPENDIX X. SET-UP OF MODEL BEHIND COOPERATION

This model combines several factors which influence cooperation over a CPR. This framework might help future researchers who want to research empirically the relations further on.



Behavior & attitudes that influence group dynamics



Because cooperation has much to do with group dynamics, the second figure is added. The left part shows the defensive mode leading to mutual distrust while the right part shows the open, 'playful' mode. The characteristics of play formulated by Caillois were used as well. Based on the work of Huizinga, he states that play is inherently unproductive, free, separated from reality, uncertain, governed by rules and illusionary. This 'group dynamics' figure is as based on insights from the following scholars:

Remmerswaal, J. L. M. (1995). *Handboek groepsdynamica: een nieuwe inleiding op theorie en praktijk*. Nelissen.
Forsyth, D. (2009). *Group dynamics*. Cengage Learning.
Tassoul, M. (2009). *Creative facilitation*. VSSD.