WORKING PAPER 75

The River Basin Game: A Water Dialogue Tool

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International Water Management Institute

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RIPARWIN
Raising Irrigation Productivity And Releasing Water for International Needs
river basin management research in Tanzania

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Summary

Raising Irrigation Productivity and Releasing Water for Intersectoral Needs' (RIPARWIN) is a study of river basin management in the Great Ruaha River, Tanzania. The objective of the study is to examine the theory that if irrigation productivity can be raised then water can be released to meet downstream and intra/intersectoral needs. In similar situations role-playing tools have proved to be effective in solving water management conflicts. The River Basin Game described in this working paper is a dialogue tool for decision-makers and water users that has been tested in Tanzania. It comprises a physical representation of the catchment in the form of a large wooden board. The central river flows between the upper catchment and a downstream wetland, and has on it several intakes into irrigation systems of varying sizes. Glass marbles that 'flow' down the channel represent the river water.

Participants place small sticks (like weirs) across the river to capture the marbles and scoop them into the irrigation systems where they sit in small holes—thereby meeting the water requirement of that particular plot of rice or irrigation activity. The players learn that being at the top of the river has advantages, whilst tail-end systems experience water shortages. The implications of different and new management strategies can be evaluated in depth by various stakeholder groups.

The game promotes mutual understanding of different people's levels of access to water and allows participants to actively react to scenarios. Experience shows that participants become highly animated and by the end of the game, they have a good understanding of system dynamics and common property pitfalls, of which issues are most critical and of what solutions might be considered. If the game-playing is part of a workshop that is spread over two days, participants are able to contribute in detail to new solutions and institutional agreements. The second day is used to follow up on lessons learnt and to bring together various institutions to assist in improving the equity of water supply.

This report includes a literature review of gaming in water resources management, a complete description of the game, details of the practical arrangements required to organize a game-playing session and possible approaches to evaluate the effectiveness of a session.

Introduction

The working paper describes how to arrange, budget for, deliver and monitor the River Basin Game (RBG), which is a role-playing tool for promoting dialogue and decision-making over water resources. The River Basin Game is a physical representation of a catchment (or small river basin) with a gradient to show upstream-downstream flow of water. Upstream abstractors/users of water tend to be favored over downstream abstractors and users of water. This difference often gives rise to inequality in water access for rural people—which can result in conflict. The game allows local users to reflect on the distribution of water in various given situations and to strategize accordingly by taking up roles (upstream abstractor and downstream abstractor). The game is explained in this working paper by reporting on a case study in Tanzania where it was used in two 2-day workshops and is continuing to be used.

As seen from the photos (figures 1 through to 4), the game is a large board placed on a slope with a 'catchment' at the top end and a 'wetland' at the bottom end (see also appendix D for design specifications). The central river flows between the upper catchment and lower wetland, and has on it several intakes into irrigation systems of varying sizes. Being at the top of the river advantages some of the irrigation systems, while others at the tail-end experience water shortages. This model assumes that the flows are principally generated at top of the catchment and virtually none or very little from the rest of the catchment. The river 'flows' when a large number of glass marbles are released down the river. The marbles are like water. Participants put small sticks (like weirs) across the river to capture these marbles and scoop them into the irrigation systems where they sit in small holes—thereby meeting the water requirement of that particular plot of rice or irrigation activity. The pictures (figures 1 and 2) show the very large sticks that allow capture of the marbles very easily—these represent upgraded and modernized intakes associated with some irrigation improvement programs in Tanzania (World Bank 1996; UVIP 1993). During the game, on the first day of the workshop, participants become highly animated and by the end of the game, they have a good understanding of what is going on, what needs to be targeted and what solutions might be considered. A second day is to follow up on lessons learnt from the game played the previous day, and to bring together various institutions to assist in improving equity of supply. Both days need good planning to be successful, which this working paper gives advice on.

Role-playing games and public involvement in decision-making

It is widely acknowledged that public decision-making, consultation and participation in watershed management is seen as good practice (WWF 2001; Chave 2001; Water Policy 2001). Such participatory practices help “to define problems, set priorities, select technologies and policies, and monitor and evaluate impacts and in doing so is expected to improve performance” (Johnson et al. 2001 page 507.). The value of these deliberative processes (that aim to solicit public debate) over other forms of decision-making is argued cogently by Collentine et al. (2002) who see intrinsic advantages in increased legitimacy and deliberative democracy and debate particularly over methods that rely on acceptance/rejection modes of participation.

Role-playing is a well-known tool in participatory rural appraisal, community empowerment and facilitation of natural resource management (Forester 1999). In the last 5 years, the function and benefits of role-playing games (RPG) in community management of natural resources has increasingly been attracting research. The Cormas Unit (Cormas 2003) at Cirad in France is, for example, conducting in-depth research on the use of agent-based simulations in natural resources. Becu et al. (2003) describe ‘CatchScape’, a computer-based model for examining conflicts over water at the catchment scale in Northern Thailand based on options for land use and water management. Farolfi et al. (2003) have initiated AWARE (Agent-based Watershed Analyses for Resource and Economic Sustainability), a multi-agent systems model to investigate the economic efficiency, environmental sustainability and social desirability of some of the potential water management strategies that South African Catchment Management Committees could use.

Other researchers are also examining multi-agent based games, though most are computer - based. Feuillette et al. (2003) describe a multi-agent computer-based model to negotiate water demand management on a common property water table in which users establish parameters and decisions reflecting various dynamics of demand and drivers.

A review of the literature demonstrates a wide variety of advantages and dimensions associated with games and gaming. These are listed here:

- Games are a decision support tool where human players become interdependent decision-makers (Ubbels and Verhallen 2000).
- Gaming allows inputs during the session rather than only at the beginning, and that roles of different kinds of decision makers are provided for (Ubbels and Verhallen 2000).
- Decision-making occurs in a nonthreatening setting to facilitate communication (Ubbels and Verhallen 2000) or promote enjoyable learning regarding complex issues (Burton 1989).
- Games can be used for training technical and nontechnical staff involved in the operation of irrigation schemes (Burton 1989).
- Games show higher-level decision-makers how their actions affect local resource users Burton (1989).
- Games reveal the benefits that meaningful shared communication can have in reconciling differences in understanding (Burton 1989) and serve as a discussion support tool, opening up new channels of interaction (Barreteau et al. 2001).

- Gaming simulations provide the ability to test what is happening in the real world without the need to use or endanger the system that it is testing (Burton 1989).
- These instruments represent and simulate the presence or absence of collective rules for common natural resource management (Barreteau et al. 2001).
- Such discussion support tools allow full and shared exploration of problems encountered by and known to every stakeholder (Barreteau et al. (2001).
- Games can prevent certain misrepresentations or bad faith behavior. In defining one example of misrepresentation, we suggest that games help avoid a technocratic bias that can occur between engineers and local users when discussing water because the latter gain confidence to ensure their viewpoints are heard (see also D'Aquino et al. 2003).
- The authors' experience with the River Basin Game is that complexity can be engaged via a relatively simple game design and deployment without loss of credibility or the player's sincerity towards the game. This accords with Barreteau (2003) who believes that games and model simulations help set clear boundary conditions and condense complex issues in both space and time, suggesting long-term issues can be readily captured.
- The learning aspects of role-playing around games involve improvements in stakeholders' cognitive capacities (Teulier-Bourgine 1997). Games also aid learning about visions and values concerning the distribution of water (Hagmann and Chuma 2002).
- Games help participants understand key natural and social processes (Hagmann and Chuma 2002). For example, RIPARWIN used the River Basin Game to explain the Pareto productivity curve of water.
- Gaming enhances the experimentation process through exposure to options (Hangman and Chuma 2002). In a similar vein, they help reveal management alternatives and potential win-win scenarios (Ubbels and Verhallen 2000).
- Gaming trains users for unusual circumstances (Ubbels and Verhallen 2000). The authors envisage this as developing emergency procedures originally, but this purpose is significant for the River Basin Game where decisions during on-going drought are different to those made during 'normal' climate.
- Games allow participants to gain insights into the decision-making process. Players and observers see what information is required to make decisions, how decisions are actually made and what value-position various stakeholders have (Ubbels and Verhallen 2000).
- Furthermore, role-playing is also seen as a legitimate tool for qualitative social research (Bloor 2001; Mikkelsen 1995; Nichols 1991; Pratt and Loizos 1992).

With respect to the last point, it is worth briefly discussing the advantages and disadvantages that games pose for research. Barreteau et al. (2003 paragraph 1.1) believe role playing games are "a means to reveal some aspects of social relationships by allowing the direct observation of interactions among the players," and goes on to caution that they need to be carefully managed, be systematic in some respects and encapsulated within formal validation, feedback and follow-up activities. Cardenas (2003), for example, used joint decision-making exercises to explore the notion that heterogeneity of participants ultimately undermines their ability to enact promises arrived at through common agreement.

As a true research tool, if one hopes to compare outcomes in a systematic way, a role-playing game suffers from difficulties associated with statistical sampling, quantitative analysis, bias and reproduction of results. Barreteau et al. (2003) rightfully point out that too many factors remain uncontrolled and that repetition of the game with the same players is problematic since the insights gained from the first session cannot be erased. This changes the context and atmosphere of the game session and the prior knowledge that the attendants begin with.

Some work has been conducted on designing games with users, which D'Aquino, et al. (2003, abstract paragraph) believe takes empowerment further: “In fact, to truly integrate people and principals in the decision-making process of land use management and planning, information technology should not only support a mere access to information but also help people to participate fully in its design, process and usage.” The River Basin Game does not go this far; it was pre-designed, albeit hopefully sensitively to the conditions found locally.

Recognizing these positive and cautious dimensions of role-playing and gaming as a part of generating greater exposure to deliberative inclusionary decision-making, we believe a physical-based board game has considerable benefit in such processes and objectives.

Figure 1. Detail of the top part of the River Basin Game, showing main channel, abstraction points, intake design, farms and fields, marbles used to depict water and holes in fields to depict irrigation need.

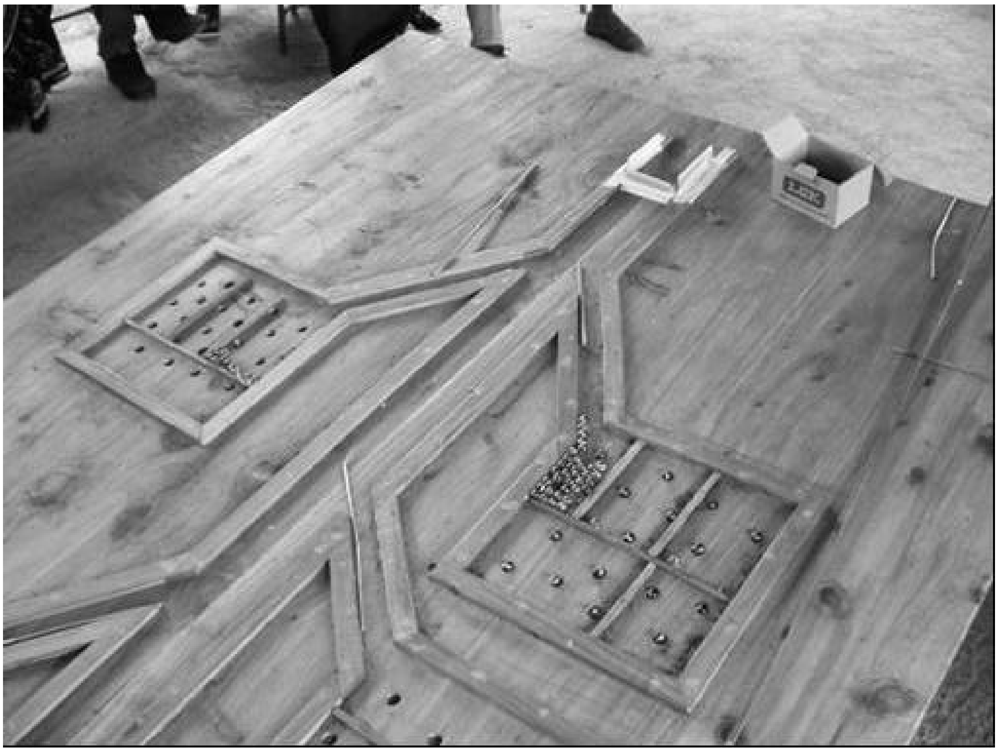


Figure 2. Day 1. Participants playing the River Basin Game by choosing water abstraction strategies.

Figure 3. Day 1. Participants contemplate current inequitable division of water.

Figure 4. Day 2. Participants discussing new resolutions to manage and share water.

Background to the game

This section provides contextual information so that planners may decide if the River Basin Game is an appropriate tool to use.

In what type of environment is the game best played?

The game is best suited to smaller catchments (50–500 km^2) where surface water is shared between numerous users aligned upstream-downstream in sequential access to the available water. A groundwater version of the game has not yet been developed. Users of water are small and large irrigation systems, domestic users, environmental 'users' (wetlands, fisheries, and livestock), industry and electricity generation. If the catchment is too large, the system becomes too complex. In such cases, the basin needs to be subdivided.

Who plays the Game?

There are four ways of playing the Game:

1. With students and researchers of water management to self-teach various issues related to common property management of water.

2. With local resource users of water to facilitate local decision-making with regard to the allocation of water. This requires a facilitator who is also knowledgeable about water. This type of game also allows outside researchers to observe what the game reveals in terms of current problems and proposed solutions.
3. With higher-level decision-makers to encourage an appreciation of the issues facing local users, and the beneficial and negative outcomes that formal decision-making might have on water management and availability.
4. With both higher-level institutions and local resource users to generate a comprehensive picture of how mutual collaboration, flexibility and support is required to manage water at the sub-catchment level.

Decisions about who to invite should be carefully made, and the advice in this manual tailored accordingly. In addition, invitees can be divided into players and observers. Appendix A gives as advice some 'golden rules' for playing the Game.

Historical development and case study

The River Basin Game was devised by Bruce Lankford in 2000 at the University of East Anglia, United Kingdom (UK) to teach undergraduate students the principles of common property resource management as applied to surface water. The game shows students that water-claiming strategies result in certain members of the community gaining while excluding others.

In 2002 and 2003, the game was tested with farmers and stakeholders under the project RIPARWIN (Raising Irrigation Productivity and Releasing Water for Intersectoral Needs). RIPARWIN is funded under the Knowledge and Research fund (KAR), for the Department for International Development (DFID) and is joint-managed by the Soil-Water Management Research Group, the Overseas Development Group (University of East Anglia) and the International Water Management Institute through its Africa Regional Office, South Africa. In these tests, the game was successfully applied to generate dialogue about water in the Mkoji sub-catchment. Our message was to show that we could encourage participants, using local and outsider knowledge, to consider ways of maintaining agricultural productivity whilst at the same time reducing water abstraction. This productivity gain could then enable the release of water downstream to meet critical livelihood and environmental needs.

The Mkoji sub-catchment is located in the Usangu Plains of the Great Ruaha River basin in the Southern Highlands of Tanzania (figure 5). The Usangu Plains has been the location of a number of studies regarding hydrological and environmental change associated with water utilization and competition between sectors within the Ruaha Basin, most notably between irrigation, a major wetland and hydroelectricity production. These changes and their context are well documented in recent papers (Baur et al. 2000; Lankford and Franks 2000; Franks and Lankford 2002; Lankford and van Koppen 2002) stemming from analyses conducted by a previous project—Sustainable Management of the Usangu Wetland and its Catchment (SMUWC)—funded by the UK Department for International Development (DFID 1998).

The Mkoji sub-catchment (area 2,500 km^2, between latitudes $7^0$48 and $9^0$25 South, and longitudes $33^0$40 and $34^0$09 East) is the name of seven smaller streams that feed into the Mkoji confluence. Inhabitants are mostly poor to very poor rural people and in the last 20 years population growth has resulted in increases in water demand, principally from rice grown during the wet season and maize and beans grown during the dry season. Approximately 110 irrigation intakes have been developed supplying approximately 4,000 ha and 12,000 ha in the dry and wet seasons, respectively. Domestic needs have also increased, plus there has been a realization that environmental water should be safeguarded to provide for fish, wildlife and related livelihoods. During the dry season, or during dry years, when individual stream flows are on the order of 0.5 to 1.5 m^3/s, upstream irrigation intakes and farmers tend to abstract most of the water leaving little for lower intakes and downstream environmental and/or livelihood needs. These differences in access have been exacerbated by the replacement of 'leaky' traditional irrigation intakes constructed of soil and stones that allow water to bypass downstream, with modern concrete intakes funded by irrigation improvement programs that block river flow more efficiently (Lankford and Gillingham 2001). Surveys found that discord exists during low flow periods resulting in individual, group and village level disputes. It is only during the rainy season when streams exceed 2–5 m^3/s are all needs met and conflict decreases.

Recently, at the September 2003 Conference on Water and Conflict held in the city of Montpellier, France (http://afeid.montpellier.cemagref.fr/cei2003.htm), the game was presented as a paper (Lankford and Sokile 2003). This generated further interest and was felt by some in the audience to be applicable to their situation, including, for example, mountain rivers in Peru feeding a series of irrigation intakes.

The UK version of the game was shown to participants at a game simulation session at a EURAQUA (2003) workshop at the Centre for Ecology and Hydrology in Wallingford, UK alongside other games for irrigation. When compared to other games the salient point was that these games could be very simple in design but elicit very interesting discussions and strategies that accurately reflect complex collective issues. The ability of simple games to represent complexity is put well by Barrateau (2003 paragraph 2.21.):

> *"It builds an artificial system by specifying and controlling some of the interactions among players using quite simple individual behavioral patterns. It then assumes that this designed system, notably thanks to the presence of human players, will feature other interaction patterns, which are to be observed. Both controlled and observed interactions together make it a complex system. These systems are, of course, far simpler than real ones, but they feature and simulate some complexity, which is partly controlled and thus can be studied."*

Detailed planning for the game

The success of the game lies in planning and preparation. The importance of this cannot be overemphasized. Although the game is quite simple in many respects, omitting elements can considerably reduce its learning impact.

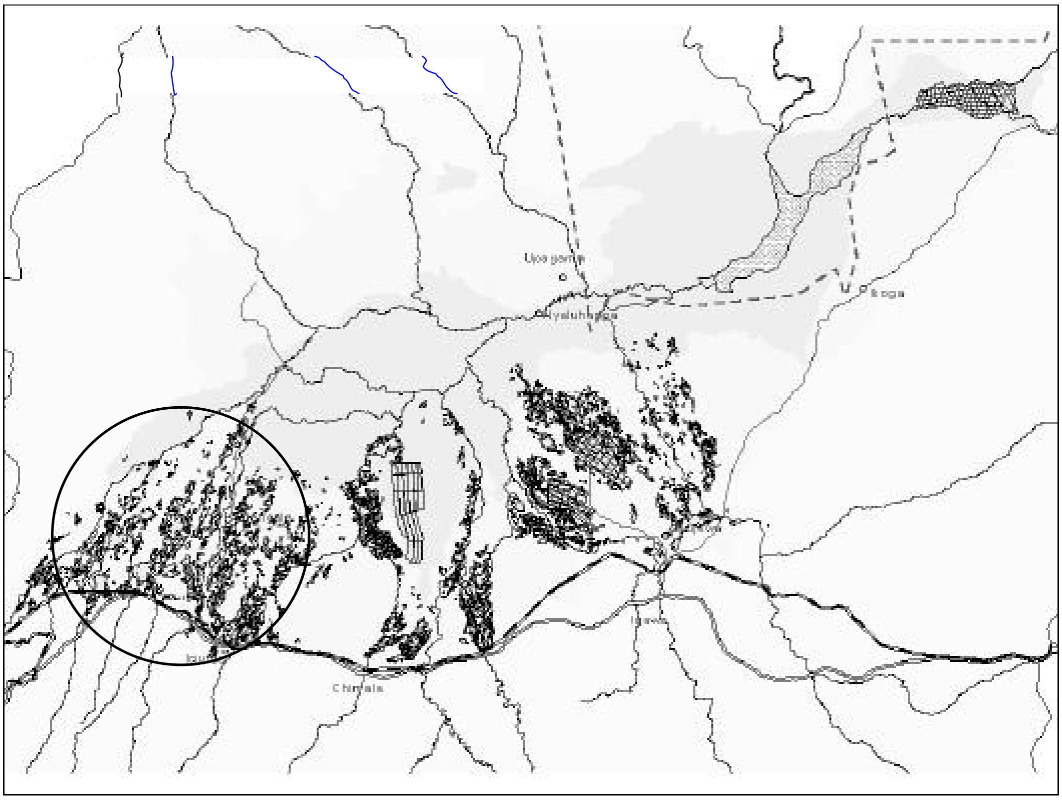
Overview of the Program

Each game is played over two days. The format for the version in Usangu is particular to the types of problems found there.

Day 1: The River Basin Game and the video “Talking about Usangu” (a stakeholder “talking heads” type documentary). Finishing late afternoon. (Optional: Evening of day 1 for social event).

Day 2: Detailed follow up asking “How can we use the video and the River Basin Game and what means are there to save and share water?” “What means are there to support local users?” “What role do higher level institutions have?” “What new institutions and agreements are required?” The participants (users or higher level institutions) finish about 1 to 2 hours after lunch—but can go on longer, if necessary. Later in the afternoon, there should be a feedback session between players and observers and the managers of the Game to discuss the outcomes of the two days, and to draw up lessons and conclusions.

Figure 5. Location of the Mkoji sub-catchment (circled) in the Upper Ruaha Basin.



Source: SMUWC project website (www.usangu.org)

Preparation questions

In planning, it is important to consider some key questions:

1. What are we trying to achieve? To demonstrate role-playing can benefit understanding of top-tail inequities of water supply and that solutions lie with communities, particularly if given support by formal institutions willing to respond to their needs.

2. How many participants and observers? If choosing water users—say 10 from upstream, 10 from middle and 10 from lower end, but not people who are rain-fed farmers, they must be users of surface water be it domestic, livestock or for irrigation. Rain-fed farmers are not able to release water!
3. Who to invite as players or observers? It could be local water users and/or governmental organizations such as the river basin water offices.
4. What preparation is required? What back-up is required? What follow-up is required?

This working paper helps answer some of these questions, and appendix A ("Golden rules") should also be referred to.

Budgeting

This budget assumes a 2-day workshop and about 50 participants. In effect this is a whole day, requiring arrival of participants, refreshments, lunch, evening and social event. The cost components, which for 50 people amounted to approximately US$500 for two days, are as follows:

1. Two lunches for 30 players, plus 20 other observers = 50 persons.
2. Dinner for same number of persons at the end of first day.
3. Breakfast for same number of persons for the second day.
4. Summary for food equals four meals.
5. Residential fee paid to host.
6. DSA and per diem for farmers and other invited participants.
7. Invited observers per diem.
8. Transport, collection and delivery of farmers and invited personalities.
9. Stationery and other sundry costs.

Dates and preparation

Dates chosen will depend on local customs, public holidays and cropping calendars. Allowing time for invitations to go out, followed up with additional emails/letters was also deemed prudent. An allowance of 50 percent extra invitations could be considered as all invitees do not come. Sufficient time should be allowed to carefully identify farmer and water user groups from the target area. Clearly, the 'office' of invited observers is important. Suggestions include the basin water offices and sensitive ministries that deal with water. For the Great Ruaha RBG, we invited the Rufiji Basin Water Office (RBWO), Ministries of Water and Livestock and of Agriculture and Food Security, District Irrigation Officer, Zonal Irrigation Officer and some local NGOs.

It is possible to video the game as it may generate requests from local communities or river basin authorities to provide conflict resolution and re-engineering of intakes. Taking this message to these higher institutions can be done by edited video. On-going analysis of the day was found to be useful. For example, it is good idea to get two researchers to keep notes of points made by farmers but which do not get aired in the discussion. Finally, plans for evaluation should be drawn up. An example of an evaluation form is given in appendix B.

Playing the River Basin Game

This section describes in detail the playing of the game. The step-wise nature of building on five phases is believed to be critical to the final success of the tool. The basic format is open to suggestion and evolution. (The times are indicative since the whole session takes about 3–4 hours and should be allowed to evolve according to discussions and clarifications).

The River Basin Game—Day 1

As table 1 indicates, there are five phases of the game on Day 1 after the introduction:

- Introduction to the 2-day event.
- Phase 1: Introduction and demonstration to the game.
- Phase 2: Individual action to acquire water.
- Phase 3: Individual action to acquire money (livelihood).
- Phase 4: Community action to allocate water more fairly and to priorities.
- Phase 5: Initial discussion, lessons, feedback, future action, assistance and summary (main discussion is left until Day 2).

Introduction to the two days

The pre-game introduction is to welcome everyone, and to allow latecomers to settle down. Round-the-table introductions are conducted here. The facilitator can also outline some main rules – each and everyone should participate.

Farmers and other users appreciated their concerns being 'contextualized' within global water problems regarding intersectoral allocation, water productivity, conflict management, the increasing water needs of many sectors and distinguishing between needs and wants so that we can ask "how do we meet the needs of the poorest in the sub-catchment?" This introduction reminds participants that to poor tail-enders a small amount of water has very great value to their livelihoods, whereas to a top-ender rich in water, giving up that small amount of water will probably not make a difference or even be noticeable. In our case study, we referred to other donor, district and NGO projects that have tackled water in the area and introduced a map of the whole Great Ruaha River Basin to locate the Mkoji sub-catchment, asking participants to locate and name users such as; domestic, cattle, rice, non-rice, wetlands, fisheries, wildlife, the Great Ruaha National Park, tourists, and the electricity generating Mtera-Kidatu Reservoirs. Although a formal map was first provided, the facilitator then encouraged hand-drawing of a map so that all could refer to it. Since the board game was not an accurate representation, there were many features (canals, intakes, and drains) that were added to a map.

Table 1. Demonstrating real water sharing situations by playing the River Basin Game.

What is being shown	How	What happens
Phase 1. Simple introduction scenarios		
No intakes	No rods are sticking into the river	Water goes down to the bottom
Few intakes	One or two sticks are installed (can be modern or traditional)	Some water is captured by rice systems, much water flows to the wetland
Many intakes	All sticks are put in	All water is captured, little water (few marbles) ends up in the downstream wetland
Dry year or dry season	Few marbles are used	Water tends to be used in upstream plots, with little water going downstream
Wet year or wet season	Many marbles are used	Water meets everyone's needs
Change of traditional to improved modern intakes	Change in design from small sticks that partially stick into river to large sticks that block the whole river	More water is captured by modern intakes—less water flows downstream and inequity increases
Phase 2. Individual person and individual intake strategies—the search for water		
Upstream/downstre-am inequity of supply	Using modern intakes	More water into top intakes
Excess water use	Too many marbles per plot	Each plot has more marbles than holes for the marbles showing that upstream farmers tend to take more water than they need
Phase 3. Individual person and individual intake strategies—the search for money—livelihoods		
Livelihood searches	Farmers move upstream	Farmers rent land higher up or take jobs where water is or move out and do other jobs
Insufficient water	Too few marbles per plot, or no marbles per plot	Farmers are left with no water, migrate, walk further for domestic water, start a business, rent land, sell labor, etc.
Swapping places	Tail-ender and top-ends switch place	Encourages people to see another viewpoint about access to water
Phase 4. Community person and whole-river sharing strategies		
Agreeing on sharing of water between intakes	Adjust intakes to let water through to downstream intakes	Water is shared among the different intakes, and so each farm gets some water
Agreeing on sharing of water between fields	Share out marbles so that each plot gets the correct number	One marble per hole—and equal between plots so that each plot might be minus one marble
Phase 5. Discussion time (lessons learnt, feedbacks, future actions, further assistance and the summary of Day 1		

PHASE 1: Introduction to the River Basin Game. This lasts about one hour. All times are approximate—time must be allowed for good understanding

This phase is to show how the game works. Basic rules and agreements (listening, asking questions etc.,) of the game are explained. The participants were informed what they would see, that they would conduct a 'round' and that the facilitator would explain what they had seen. Although it is important to let the game have a natural flow, it is also necessary to steer the game to achieve certain results. Discussion is allowed between water users before each round so they 'get into the game'—at which point the facilitator should not dominate the proceedings.

- 0–15 minutes: Welcome session. Aim of the day. Aim of the game. Rules and agreements for being part of the team. (E.g., listening, asking questions etc.)
- 15–25 minutes: Explanation and demonstration of flow of glass marbles down the river in four basic situations; without any intakes, with many intakes, with high flow (wet year) and with low flow (dry year). Each demonstration of one flow is called a 'round'.
- 25–30 minutes: Dividing participants into groups and initial play of a simple scenario using sticks that represent traditional intakes (i.e., those that let water pass by).
- 30–35 minutes: Second play using a change of intakes upstream to modern intakes—these are larger sticks that capture all or most of the marbles.
- 35–45 minutes: Discussion. Who is happy? Who got water? Who is short of water? Why? Who obtained lots of water, perhaps too much for their needs?
- 45–55 minutes: Recap. Summary of what happened. Ratio of land to water—the fact that there is more land than water. Variability in rainfall and river flow (wet years and dry years, wet and dry seasons). The desire for rice and water. The growth of irrigation over last 20 years. The difficulties of supplying the downstream users.

PHASE 2: Individual action—the search for water

This phase demonstrates that individuals acting alone searching for water and can sometimes acquire more water than they need leading to lower efficiency of water use and tail-enders getting no water.

- 0–10 minutes: Introduction to this phase of the game. Explain the objective: That each individual needs to seek a solution to his or her water shortage. This means 'no or very little community action'. What needs to happen? What do people do?
- 10–15 minutes: Farmers think about their options prior to the release of the new season's flow of marbles. Asking the question—how can I get water?
- 20–35 minutes: Various rounds are played so that farmers can situate themselves most advantageously to get water, and think about solutions that meet their individual needs.

PHASE 3: Individual action and coping surrounding water shortages—the search for income/livelihoods

This phase demonstrates that individuals acting alone search for water-based livelihoods or alternatively cope by developing other livelihood strategies.

- 0–10 minutes: Optionally, in the second part of this phase, fake paper money can be handed out so that participants could rent or buy plots, hire labor, etc. This worked very well in our case. But it can also work with no fake money (and it is recommended that on first trial no money is used). Now farmers ask the question—how can I get an income? Pause while users think about what they will do. Remember, by the end of the play of marbles, they must have an answer about how to get money, even if they do not get any marbles.
- 10–15 minutes: Allow one game to be played so that users are able see that they might or might not get marbles.
- 15–20 minutes: Now repeat the game, but this time ask all the top-enders to become tail-enders and vice-versa. This is to demonstrate to both groups what it is like to get or not get water. This helps top-enders sympathize with tail-enders.
- 20—30 minutes: Recap. Summary of individual actions taken to secure a livelihood. Livelihood lessons in water management—that water can bring benefits indirectly. Ask the farmers if they see some of the same things happening along their river.

PHASE 4: Collective action and coping surrounding water shortages

This phase demonstrates that individuals and communities can decide to use water more wisely to ensure that people's needs are met, and that water is reallocated to priority needs downstream leading to higher efficiency of water use and greater benefits all round. This includes meeting environmental, domestic and livestock needs downstream.

- 0–10 minutes: Introduction to this phase of the game. Objective: That each community or river basin needs to find better solutions to sharing water. What needs to happen? What do people do? What by-laws are needed? How can water be shared more fairly? (Please ensure that a discussion occurs first about this—see next stage.)
- 10–20 minutes: Farmers and other users collectively discuss their options prior to the release of the new season's flow of marbles. This means that all the farmers around the table discuss a group solution to the division of water.
- 20–35 minutes: Various rounds are played so that communities are able to optimize allocation of water between different irrigation systems and users and, therefore, allocate water over the whole river basin. Each round is used to fine-tune (adjust the stick weirs) the allocation of water so that it is fairly shared out in accordance with needs. Players review these more equitable results.
- 35–45 minutes: Recap. Quick summary of what happened. The collective or group approach compared to the individual approach.

PHASE 5: Final session—group discussion

- 0–5 minutes: Introduction to the final session. Objective: That farmers must discuss lessons learnt, how they will apply any of these lessons, whether and why this has been useful, what assistance do they require. The farmer-groups must appoint a secretary to report on their discussions.
- 5–10 minutes: Farmers break out into groups. Suggest about three groups in total.
- 10–35 minutes: Farmers discuss the game, lessons learnt, needs, institutional support required. The secretary makes notes.
- 35–55 minutes: Reporting back by secretaries of farmer groups.
- 55–75 minutes: This is followed up by a final conclusion and discussion. Ensure that a list is made of main points, lessons learnt, and solutions that seem appropriate.
- 75–85 minutes: Formal evaluation of the day. Voting by farmers based on the feedback on how the day has been. This is needed for project justification of the game and monitoring of success.

The River Basin Game—Day 2

The objective of this day is to go into more detail about resolutions and agreements needed to begin implementing new ways of managing water. It is important that the organizers decide what they want out of this day. For example, two options exist, first, to provide time for water users or decision-makers to discuss how they might save water whilst insuring productivity (e.g., technical solutions) or how to bring about new ways of managing water and supporting local users (e.g., institutional and legal ways). There are four main sessions for each, as shown in table 2. Although a format for emphasizing either technical or institutional agreements is given, the organizers are welcome to use these as examples for establishing their own format for Day 2. For example, under the legal and institutional discussion, the advantages and disadvantages of formal water rights and fees are discussed and debated as a way of exploring them to recommend changes. Whatever the discussion, we remind organizers that the purpose(s) of Day 2 must be made clear by putting up a clear statement of intent.

The day finishes with final summary statements and an evaluation exercise. After the participants have departed, either immediately or the next day, the organizers should hold a meeting (post-evaluation) to discuss follow-up.

Table 2. Options for breaking down Day 2 discussions.

For water users/decision-makers—technical discussions	For water users/decision-makers—institutional and legal discussions (with rights and fees as an example)
Session 1 is to summarize the previous day, its outcomes and intentions, and to introduce this day. The aim is to bring all users together to discuss what means can be agreed to share water whilst maintaining productivity—for example, crop choice, planting schedules etc. (15–30 minutes).	Session 1 is to summarize the previous day, its outcomes and intentions, plus then to introduce this day. The aim is to bring all users together to discuss what means can be agreed to implement new agreements, by-laws and if necessary institutions. This will be done by a debate on the pros and cons of water fees and rights (15–25 minutes).
Session 2 is to allow the users to completely brainstorm all the different methods they think work to maintain income while saving water. What have they seen while growing rice? What practices save water but do not harm rice growing? During this session outside experts should add to the methods - see appendix C on questions related to water management that might promote further discussion (1–2 hours).	Session 2 involves dividing the group into two sub-groups. Each sub-group will then either support the notion for water rights and fees, or alternatively will argue that the current format for rights and fees is failing water management and having a negative effect on local people's access to water. Start by asking from the group who supports which motion—this will then allow each sub-group to be made of people who sincerely believe that motion. Allow each sub-group time and space to discuss their case, appointing a timekeeper, spokesperson and secretary (1 –1.5 hours).
Session 3 is to prioritize these methods by a system of voting (30 minutes).	Session 3 is to hear both sides of a view expressed as a debate (with both cases being argued by a spokesperson) (40 minutes).
Session 4 is to draw up agreements by farmers that they can try these methods. What other institutions need to be involved? What do the formal institutions need to do? How can we increase exposure to other farmers? (1 hour).	Session 4 is to review what has been said, perhaps to agree the plus points of both methods, and to agree on a way forward. What does the workshop recommend? What other institutions need to be involved? What do the formal institutions need to do? (1 hour).

Post-game evaluation

Workshop evaluation

The next stage is for observers and organizers to collect feedback and draw lessons from the workshop—how did the two days work? What outcomes should the financier/sponsor know about? Appendix B gives an example of an evaluation form we used.

Post-evaluation stage

At this stage, the organizers should be clear about what new agreements were discussed in meaningful ways and that need to be followed up. In other words, how can institutional and cross-compliance issues be sustained by stakeholders and the facilitators of the game? (Cross-compliance is about taking mutual agreements—meaning interventions from one or more parties being undertaken on the basis of the implementation of previous agreements by other parties.) Various questions should be set here:

- What real steps were agreed by game participants?
- What schedule did the organizers/other participants agree to?
- How can successful implementation of this schedule be monitored?
- What should the facilitator/participants do to keep to the schedule?
- How can success be measured and monitored?
- What happens if one or more parties is/are very slow in responding to agreements established by the game?
- How can a series of mutual agreements be negotiated and implemented? (For example, would our catchment users agree to release downstream water during the dry season if the water fees are waived or cut by 50% by the basin office).

Conclusions

Using the Ubbels and Verhallen (2000) suitability criteria of decision-support tools for water research and management, including those based on gaming, we have conducted a preliminary appraisal of the River Basin Game (table 3).

In our case study, players benefited from having two days and a highly structured and organized schedule to explore in detail various issues. Players could call upon with their own experiences to discuss issues, but did not need any specific prior training. In a relatively safe and sociable environment, the game demonstrated various dimensions of irrigation, water-based livelihoods and river basin management at the local level. The game verified simple linear relationships between upstream abstraction and downstream water shortages (these relationships may seem obvious to outsiders, but often one would hear the upstream users saying that they did not realize the consequences of their actions on users some 50 km away). The game elicited many suggestions regarding solutions and revealed to users that they held the key to managing water rather than relying on external agents and solutions (although timely suggestions from attendant technical experts were well received by participants). Consensus-building was encouraged by the game, particularly on agreements to start catchment-wide meetings to share water. These positive outcomes reflect well with findings by D'Aquino et al. (2003) who argue for a framework that supports dialogue on options and collective decision-making capacity rather than imposing a specific resolution.

With reference to comments by Barreteau et al. (2001 paragraph 2.13) "*Misrepresentation or bad faith behaviors may nevertheless reappear in the discussion of the model's validity in representing reality*", we see this as being expressly designed into the River Basin Game as the format includes individual strategies that build on ‘bad faith’ (phase 2 and 3 of the game) that can then be contrasted to collective strategies in phases 4 and 5, that build on a more ethical construct of their social environment—in other words, that promote notions of fairness and altruism. The positive feelings shown by participants at the end of the collective phase of the game were real. The question, however, is whether these feelings can be translated into meaningful and long-term actions given wider legitimacy by users not present at the workshop.

The workshop enabled support organizations to observe various representations of conflicts and solutions, allowing them to work with rather than against local ideas. The two days provided material for researchers triangulating results derived from other methodologies so that survey, subject and participant biases could be carefully addressed. In summary, we feel that the game is a very effective tool which assists in conflict-mediation and resolution through local dialogue about water distribution and sharing, and also in research and learning for observers. This accords with conclusions made by Barreteau (2003) on the multi-function benefits of some games as a learning tool for the players and observers.

Notable disadvantages included not being able to include more than 35 players, though by allowing local user observers the total exposure might be increased to 50–60. Thus, without replicating the board, or playing more frequently, widespread displays of the game will be limited. There may be problems if the game is played in more sophisticated catchments where pipe networks reticulate water, where groundwater is the major source, or where water quality is an important issue. The game cannot be quickly adjusted to reflect particular characteristics. There will also be limitations if users are brought together from different parts of very large basins since the community-based resolutions that this game attempts to generate are unlikely to be institutionally sustainable given the distances involved. The success of the game is dependent on the facilitator, also observed by Barreteau et al. (2001 paragraph 5.6) and by Hangman and Chuma (2002 page 23.) “*high quality process facilitation led by strong vision, empathy and a culture of inquiry is considered fundamental to unleash the potential of learning tools and process approaches*.” Clearly, the appointment of a facilitator needs careful consideration.

We also purposively did not explore via the game sensitive social power relations except where they arose via positioning in the catchment. Interestingly, this decision or direction is supported by Barreteau et al. (2001) when they faced similar issues in their irrigation game.

It is worth noting (echoing thoughts from the Montpellier Conference on Water and Conflict) that such tools need to be part of a wider process and should not be relied upon in isolation. Indeed, if deployed alone or without sufficient follow-up, such exercises can stir up expectations and issues resulting in a more problematic situation than that which existed previously.

Although a longer-term evaluation of the game has not been possible as yet, the authors are optimistic that this workshop design can be taken forward as one conflict-mediation approach in the region. This needs to be done thoughtfully; Hangman and Chuma (2002) caution that scaling up is not simply a matter of recommending that tools be replicated, instead, ‘promoting the process of learning’ is focused upon. There is interest from key support groups and in addition, the game will be reviewed as a part of curriculum overhaul for irrigation diplomas, and we believe it can be a part of a Dialogue Initiative with IWMI, WWF and the Ministries of Water and Livestock and of Agriculture and Food Security in Tanzania (some ministry staff have requested future invitations). Moving on from early 'trials', we will be inviting representation by other water users in the catchment and from those institutions obliged to assist water users in the area (e.g., Ward Leaders, District Council, Zonal Irrigation Office and the

River Basin sub-offices). These invitees are arguably part of the structures and factors that foster long-term sustainability of the agreements made by farmers, although the lack of external support was explored by the farmers (“its up to us," as one game participant said).

Our other conclusion agrees with Bousquet et al. (2001) that natural resource games represent a rich area for research encompassing a number of theoretical fields of study including game theory, agent-based modeling and decision-support systems.

Table 3. Evaluating the river basin game.

Main characteristic	Criteria and explanation	The River Basin Game
User-friendliness	Background knowledge required	No technical knowledge regarding the game is required Water users come with their own experiences
	Complicated rules, language or codification required to play	The game is played in either English or a local language. No specific esoteric game codes are used
	Guidance and a manual is necessary	Guidance is given by the facilitator. Rules are simple so no manual needs to be sent out before playing
	Visualization is provided for by the tool	The tool is highly visual and physical. All parts are visible to all parties
Collaboration	Communication and discussion is provoked	The game appears to be excellent in this regard
	Storing generated knowledge is enabled	The game does not store outcomes—it is reset at each round for new playing, but the outcome can be discussed until reset
	Collective problem definition enabled and supported	The RBG explores this very well
	Consensus building is supported	The RBG specifically targets consensus building, especially compared to outcomes pursued by individuals
Flexibility	Range of policy and technical options are explored	The game works well here. A very wide range of decisions can be explored and agreed upon
	Flexible architecture to allow new problems to be explored	The game is rather rigid. New issues have to be incorporated as amendments to the design, which would require a carpenter
Assessment	Integrated analysis allows all dimensions and factors (technical, social, etc.,) affecting water distribution to be explored	The game begins as a rather technical exercise, but supports far-ranging discussion. To explore all dimensions requires the skills of a good facilitator and inputs by other specialists
	Goals and objectives (visions) can be voiced	With the assistance of the facilitator, various visions of water sharing can be explored
	Initial ranking of possible solutions and screening is enabled	The game generates discussion on ranking but does not specifically target this
	Linear relationships (cause and effect) explored	The game shows the relationships between water abstraction and downstream shortages
	Expert system requires the presence of an expert	The game is relatively simple to play; although an expert is not required, skill is needed to generate valuable discussion

Appendix A: Golden rules for the River Basin Game

This appendix suggests some 'golden rules' for playing the game. The rules have been devised based on past experiences.

Before playing—trial games

1. The facilitator must go through the five phases of the first day before the participants arrive. It is surprising how easy it is to forget key issues, and the facilitator should look comfortable with the game.
2. Remember to play the game so that you can find out whether you need the carpenter to fix any problems before the participants arrive.

Before playing —who should be there?

1. Main facilitator—especially one who is familiar with institutional/social issues, and who has helped program the day and chosen the participants.
2. At least one or two technical assistants, those who know about water management.
3. Good note keepers, if not the above assistants. Plus a video operator.
4. About 30–35 water users from different parts of the sub-catchment; farmers, top-enders, tail-enders, domestic users, pastoralists, fisherfolk. (More can be used as observers, but 35 is about the maximum number that can play). Some of these might be local leaders.
5. Stakeholder players or observers—with a particular emphasis on those who might be responsible for assisting water users; irrigation training specialists, staff and officers from Ministry of Agriculture and Food Security (MAFS), Zonal Irrigation Office, Ministry Of Water and Livestock (MOWL), and District staff.

Before playing—introduction

1. Aims of the water project, global water management, intersectoral allocation, raising productivity, conflict management, increasing needs of many sectors, distinguishing between needs and wants—how do we meet needs not wants. How do we meet the needs of the poorest in the sub-catchment?
2. Please remind participants that to poor tail-enders (domestic user, cattle keeper or small rice farmer) even a small amount of water is of great value to their livelihoods, whereas to a top-ender rich in water, giving up that small amount of water will probably not make a difference or even be noticeable.
3. Specific aims of the River Basin Game—to show how we might improve sub-catchment management of water in the chosen sub-catchment. To learn from playing the game this day and to promote the game, if desired, in other sub-catchments and other regions.

4. (Refer to other projects that have worked in the area: SMUWC, RIPARWIN, RBMSIIP—and their aims).
5. Refer to the map of the region; locate the relevant sub-catchment and other catchments, and downstream users.
6. Refer (or ask them to name) to many users in the basin (e.g., domestic, cattle, rice, non-rice, wetlands, fisheries, wildlife, Great Ruaha National Park, tourists, and electricity Mtera Kidatu).
7. Suggest that a map of the river catchment is made at some point—so that you can refer to it. Remember the game is not an accurate representation and there may be many features (canals, intakes, and drains) that you wish to put on a map.

When playing

1. Prepare first, ensure you have traditional and modern intakes (the former is represented by thin sticks, and the latter by larger sticks).
2. Go quite slowly.
3. Explain what the participants will see, do it and then explain what they have seen.
4. Repeat if necessary.
5. Collect all marbles at the end of each round so that the game is ready to start anew, and that the results of the previous round do not confuse what happens in the next.
6. Remember to drive the game to see the results you wish to see. In other words, think before each round what you want to see happen and then fine-tune it so you get the result you want. You are not just a facilitator, but also a teacher! A small number of marbles can be used to represent a dry season, and greater number of marbles for the wet season... Choose small intakes for the traditional and large intakes for the modern.
7. Summarize at the end of each phase, ensuring questions and answers.
8. Allow discussion between farmers before each round is played so they ‘get into the game’. The facilitator should be careful of talking too much.
9. Allow this discussion to be relatively unstructured, (in other words, free-flowing), but listen to what is being said.
10. When something interesting is said, you may wish to tell the others, so that all can know of the interesting fact or thought.
11. Do not omit any stages—you need each building block to get everyone thinking about the same issue. Some stages look unnecessary but without them, you may lose your audience.
12. Explain that the model is just a model and not an exact representation of the sub-catchment that the users come from.

Technical aims—managing water better to share water

1. We are trying to get users to express the ways they know to save water.
2. Remember, the users already know what is required to save water, and to share water more equitably between them and other users.
3. Always go from player comments—draw up lessons and agreements from what they are saying. Try not to impose too much, except by managing the game well.
4. So, first ask them to list all the ways that save water.
5. Then use appendix C to perhaps suggest some more ways of saving water.
6. Now, once all the methods have been listed (on paper?) use group ranking methods to get the group to prioritize ways of saving water—ways that the whole group need to agree to, even if they might be difficult and require coordination or assistance from outside.
7. Now discuss this prioritized list of technical options to save water—in other words, validate this list back to them, giving them the option to change it again.

Institutional aims—ways of implementing technical means to save and share water

1. Above we listed the technical ways of saving water.
2. Now, what we are aiming at is to try to get them to agree that communal ways of managing water are more suitable, and this applies at the field level between neighboring farmers, to the system level between farmers in a Water User Association, and to the sub-catchment level between irrigation systems.
3. So, we are aiming at asking them to consider how they might implement these technical ways of managing water better to share water.
4. Thus, our objective is for them to identify helpful and hindering institutions. In other words, what institutions they can turn to (or should turn to) for assistance in water saving and sharing, and what institutions that do not help them (and that also they either ignore or tackle).
5. However, we are also asking them to consider ways of establishing new institutions if necessary—a sub-catchment management committee?
6. By asking observers from other institutions (e.g., RBWO and Mbarali District), we can try to get all parties to work together in more effective ways.

Getting the farmer's feedback on the game

1. Was the game too long or too short?
2. Was two days necessary?
3. What other improvements can be made to the program?
4. How might the wooden board game itself be improved? What would you like to see?

5. Were the instructions clear?
6. Did you need preparation before coming to the day's game?
7. Who else would the group like to see represented here? Are there more influential people in your village that should come? What other institutions are missing?

Follow-up—summarizing and analyzing the results of the game

1. Were all the users represented? Were all institutional observers represented?
2. What were the technical options listed? Were all options listed?
3. What were the group management and institutional ways agreed to implement these technical options? Were all the institutional ways and by-laws listed and discussed that could be possibly done?
4. What main institutions do you need to help solve your problems? What institutions do not help you share water and solve your problems?
5. Suggest that the video of the discussions is played back to the participants?
6. What follow-up is needed? How can we monitor on-going support for these new agreements?

Final self-reflection

1. Did anything unexpected occur? What? Did this mean anything?
2. Did everyone get a chance to speak?
3. Could you, the facilitator, improve the day? What would you change?
4. Did you forget anything?
5. Is there anything immediate that you need to see to?

Making adjustments to the game

1. Adjustments and improvements should always be considered and welcomed. The game must evolve.
2. Be careful of introducing improvements that do not represent what happens on the catchment —always think about what you are trying to improve.
3. Before the workshop commences, fix small frustrating issues after a trial play—otherwise, your playing of the game with the workshop attendants will be hampered by these faults.

Appendix B: Evaluation form

Dear participant,

We highly appreciate your participation in the River Basin Game (RBG) workshop. We therefore kindly request you to honestly fill in this evaluation form. Your views will make us improve the workshop in future.

1. Is the RBG representative enough for you to understand upstream-downstream water use relations?
   a. It is highly representative
   b. It is fairly representative
   c. It is poorly representative
   d. It did not represent the relations

2. How did you find the different phases of the RBG in respect to the development of different water uses in a river basin with time?

   a. It's highly true
   b. It's fairly true
   c. It's poorly true
   d. It's not true at all

3. Do you think the RBG plays an appropriate role in eliciting water users understanding and soliciting their views on individuals' strategy for access to water?
   a. Yes, if yes, why?
   ----
   b. No, if no, why?
   ----
   c. Indifferent, why?

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4. What do you think would be done by individuals so as to make them use water equitably?

   ----

5. What do you think would be done by individuals so as to make them use water productively?

   ----

6. What water storage strategies you think would be done by individuals so as to mitigate the water scarcity?

   ----

7. Do you think the RBG plays an appropriate role in eliciting water users understanding and soliciting their views on communities' strategy for access to water?
   a. Yes, if yes, why?
   ----
   b. No, if no, why?
   ----
   c. Indifferent, why?
   ----

8. What do you think would be done by communities so as to make them use water equitably?

   ----

9. What do you think would be done by communities so as to make them use water productively?

   ----

10. What water storage strategies you think would be done by communities so as to mitigate the water scarcity?

   ----

11. Consider the time allocated to each session; what would you say about the time if the game were to be played in the villages by local water users?

   ----

12. Any other comments concerning time allocated for each RBG session?

   ----

13. Do you think RBG is a tool for reducing water use conflicts through role-play?
   a. Yes, why?

   ----
   b. May be, why?

   ----
   c. Not at all, why?

   ----

14. What do you think we need to improve from the RBG?

   ----

15. Do have any other comment for RBG?

i. --

ii. ---

iii.--

16. How did you find the facilitation of the RBG?

a. Good
b. Fair
c. Poor

17. What would you advice to improve facilitating the RBG?

Thank you very much.

Appendix C: Thinking about water management in relation to the River Basin Game

These questions are grouped together under headings, and are designed to help you begin thinking about water management in different ways.

Planning and calendars

When are the first rice seed beds/nurseries made?

When are the last rice fields harvested?

What is your main constraint? What affects the calendar (land, water, labor, seed, machinery, or money)?

What are your by-laws on dry season planting? What are your plans for future dry seasons?

Do you change your water management for a dry year, compared to a wet year? If so, how?

What are your rice varieties? How many days do they take to ripen/harvest?

Calendar and Time questions

When is your water right for?

What is the delay between first irrigation and transplanting?

How long does a field take to irrigate at the beginning of the season?

How long should a field take to irrigate at the beginning of the season?

Water scheduling, sharing and cycling questions

How do you tell if water is short for a crop? When is the crop stressed?

How do you decide when to start irrigating a field, and when to stop irrigating the field?

What depth of water do you allow?

Can you tell, or do you monitor, if one field gets more water than another?

Do you cycle water between fields?

How are flows shared between the fields? When do you decide to do this?

How long between cycles (meaning how long before water comes back to the same field, in days)?

Area questions

What is the total area that you 'farm'?

Is this one continuous area, or many small plots in different places?

How does this farming pattern affect your water management?

What is the rate of area transplanted (answer in area in hectares per week or per 10 days or per month, or number of fields per week or per 10 days or per month). (What is the rate in September, October, November, December, January, February, and March?)

What controls this rate of area transplanted (ie., what slows it down, or speeds it up?)

Water flow questions

What is your water right? What is your water right at different times of the year?

What instructions do you give regarding water/gate openings at the main intake?

What is the maximum flow you use? (cumecs, or l/sec)

What is the normal flow you use? (cumecs, or l/sec)

What is the minimum flow you use? (cumecs, or l/sec)

What is the flow for each field? (cumecs, or l/sec)

Do you ever close the main gate? Do you close it during heavy rains?

Water demand and supply questions

Is the water available enough for the area irrigated?

What creates the most water demand from your fields? (evaporation? wetting up? field design? or seepage?)

What depth of water is required to create the standing water layer? What is the depth of water in your fields?

When do you think there is no demand for water on your farm? What months, or what dates?

When do you stop irrigating before harvesting? How many weeks before harvesting?

Canal water management

Is water delivered by field to field irrigation or by channels?

How do you manage water control in your canals? How do you adjust water flows?

How is flow switched (moved) from one canal to another canal?

In-field water management questions

Who manages the spreading of water inside the fields?

Is the depth of water variable inside the fields?

What do you think is the difference between smallholders and NAFCO water management?

Does the sunken field-edge canal inside the field increase water demand?

Which uses more water—dry seeding or transplanting?

Location questions

Where do you put your nurseries? Are they grouped together?

Which fields are transplanted and irrigated first?

Water efficiency questions (water losses)

Do you have irrigation (water) losses? Are your losses great or small?

Where are the losses mostly occurring—meaning from where are they arising? Who is causing them?

When do you think most of the losses are occurring?

What are the effects or results of these losses?

Are there causes of losses that you could correct and fix?

Are there times when your fields are using water but are not growing rice? Why is this so?

Is water returning to the rivers? What percent of water abstracted is returning to the rivers?

Who uses your excess water? How much land is irrigated using your runoff?

People making decisions

Who makes the decisions about water management? When? In what forum?

How are these decisions arrived at?

Saving water

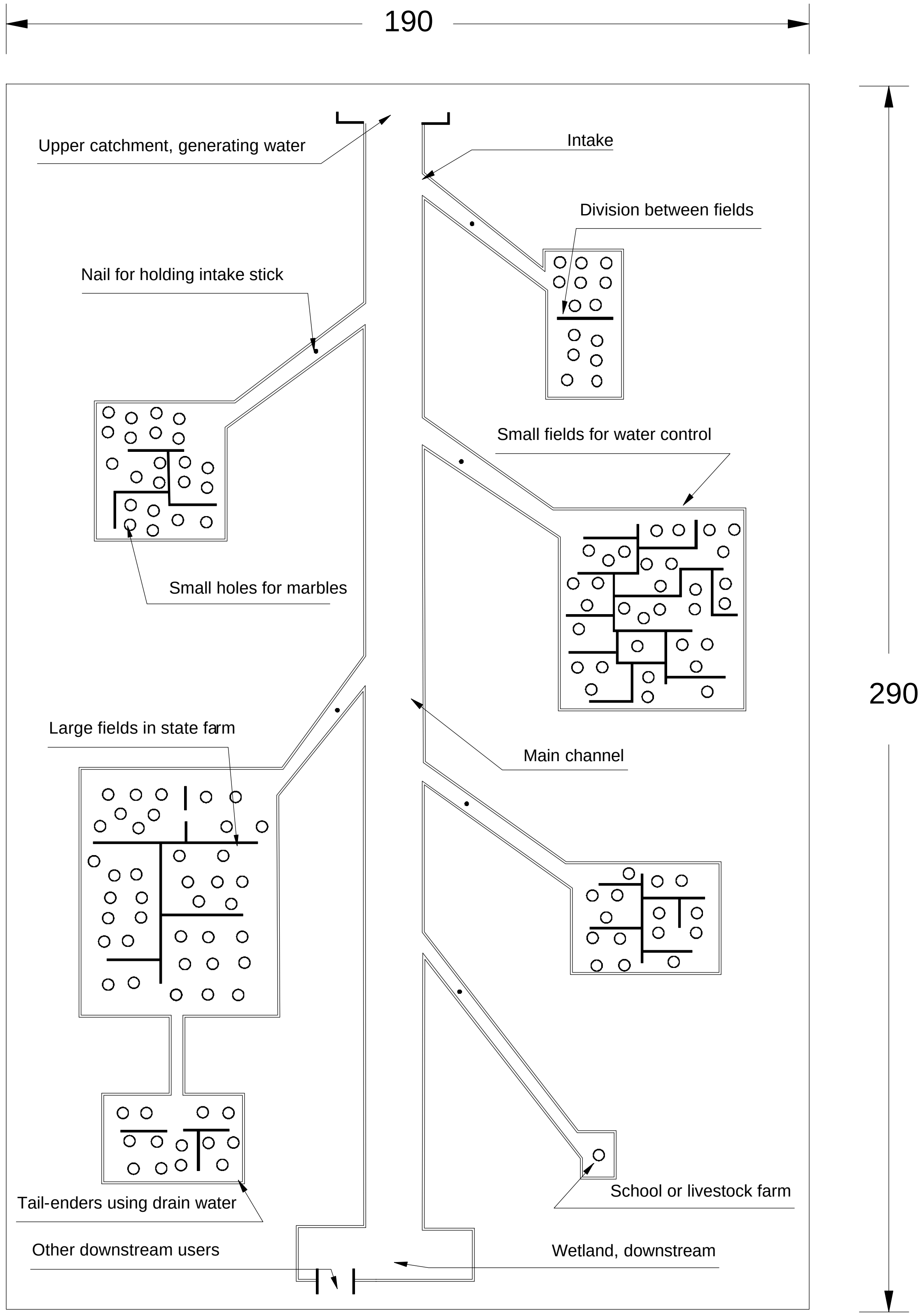
How do you think you can save water? What are the main ways in which you can save water?

When is the best time to save water?

How much water can you save at different times of the cropping calendar (cumecs, litres/sec, or percentage, or days, or weeks)?

Appendix D: Design of the River Basin Game

(Dimensions in centimeters and are approximate—see over for further details)



Construction details on the River Basin Game

Note that this version is quite large, a smaller version can easily be constructed using three-fourth dimensions.

1. All centimeter dimensions are approximate and should be decided with the carpenter.
2. The holes for the marbles should be big enough to accept marbles, but not too large so it is difficult to get the marbles out.
3. The wooden board can be divided into four parts for ease of movement.
4. The slope should not be too steep—around 15 cm higher at one end than the other over 290–300 cm long. Separate legs can be built.
5. The fields are divided by small wooden sticks (batons).
6. The carpenter should make the game in stages so a careful eye can be kept on progress and so that mistakes are avoided.
7. The wood should be varnished to make it hard-wearing.

Options = It is possible to introduce additional components such as a storage dam that can store wet season water for later release or even boreholes for villages.

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