Metaphor in natural resource gaming: Insights from the RIVER BASIN GAME

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Metaphor in natural resource gaming: Insights from the RIVER BASIN GAME

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The RIVER BASIN GAME is a dialogue tool for decision makers and water users tested in Tanzania and Nigeria. It comprises a physical representation of a river catchment. A central channel flows between an upper watershed and a downstream wetland and has on it several intakes into irrigation systems. Glass marbles, representing water, roll down the channel. Participants place sticks to catch the marbles and scoop them into the irrigation systems. The players become highly animated and learn that being at the tail end leads to water shortages. The game promotes mutual understanding of a catchment, factors controlling access to water, conflict dynamics and allows participants to react to scenarios. By drawing from their own and outsiders' knowledge, players explore solutions to redistributing water. We examine the RIVER BASIN GAME as a metaphor, proposing that it has a mix of simplicity and realism that encourages players to understand issues of real-world complexity and scale. We suggest that the game's success is related to its quality of metaphor, influenced by organizational factors and by six game and gaming experiential axes each with two polarities: seriousness and play, accuracy and generality, internality and externality, connection and disconnection, individualism and collectivism, rule following and rule breaking.

KEYWORDS: *access to water; accuracy and generality; complexity; conflict resolution; connection and disconnection; dialogue; dialogue tool; gaming/simulation; individualism and collectivism; internality and externality; irrigation systems; metaphor; participation; problem solving; realism; river basin; RIVER BASIN GAME; river catchment; rule following and rule breaking; seriousness and play; serious play; simplicity; source domain; system and conflict dynamics; water management.*

Management of surface water resources in highly contested environments is predicated on the success of acquiring and sharing knowledge. Although the imperative for participation in natural resources management by the communities who depend on them is under question (Cooke & Kothari, 2001), we argue that participation in knowledge sharing for water is a fundamental requisite because of "emergence"—the cumulative effects of individual actions on the patterns of water use at the irrigation system and river basin scales. Change the actions of the individual via new knowledge and it is possible to change the behavior of the collective. In addition, the nature of participation in water is revealed in water-short environments through the contest and competition for water found occurring on a regular if not daily basis. Water for irrigation is distributed through a branching system of canals for which

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whole communities initially draw water from rivers, groups within them draw from secondary canals, and individuals within those groups draw from "tertiary" canals. In other words, competition between individuals on an irrigation system's lower-level tertiary canal, competition between groups on a higher level primary canal, and competition between communities between irrigation intakes on a river are the evidence that users seek to involve themselves in highly participative ways. It follows that, via groupwork, improving a water user's knowledge of his or her interaction with other users, and of their water systems, is more likely to result in group solutions that match the systemic characteristics of those systems and in turn meet the needs of individuals who are now more aware of the constraints of a shared system. Parallel to the increase in amount of public participation in water resources management (Water Policy, 2001) is an understanding that the quality of that participation demands our attention (Vantanen & Marttunen, 2005).

Accepting the critical role that knowledge and participatory deliberation play in water system management, we explore the role of a particular type of game for generating user learning and higher quality deliberation, perhaps even phenomenologically (Seamon & Zajonc, 1998). The game is called the RIVER BASIN GAME, described below. We approach our evaluation from a metaphorical viewpoint. Previously (Lankford, Sokile, Yawson, & Lévite, 2004; Lankford, Sokile, Yawson, Lévite, & Sally, 2004), the game was evaluated using criteria developed by Ubbels and Verhallen (2000): "User-friendliness, collaboration, flexibility and assessment." In this article, we contend that the metaphorical quality of the game influences outcomes in the real world. We believe that the design of the game and its playing determines the relationship between a metaphorical world that is the space of the game, and a complex real world that is the space of an individual's reality in water management. Using terminology from the literature on cognitive metaphors (Forceville, 2002; Shen, 1999), the real world is our *target domain* and the gaming world within a deliberative workshop is our *source domain*. Our aim is to enrich the source domain experience sufficiently enough to effect action on the much more complex real world, the target domain. Put simply, the richer the metaphor of the game, the better the game.

However, though games can be designed from a functional point of view, metaphor quality (richness) is more difficult to quantify and design. We do not in this

AUTHORS' NOTE: The game was first developed as a teaching tool for the University of East Anglia in 2000. It was then developed as a conflict resolution tool under the Project RIPARWIN, (Raising Irrigation Productivity and Releasing Water for Intersectoral Needs), funded by Department for International Development, No. R8064 comanaged by the Overseas Development Group (ODG, University of East Anglia, UK), the Soil Water Management Research Group (SWMRG, Sokoine University of Agriculture, Tanzania), and the International Water Management Institute (IWMI–South Africa Office). Bruce Lankford was the principal investigator of RIPARWIN, and Drennan Watson an environmental consultant in Scotland. Both collaborated in the organization of an International Commission on Irrigation and Drainage (ICID) seminar on tools for participation in water held in London in February 2004. We acknowledge the contributions made by the RIPARWIN team in the development of the game, and the comments made on the manuscript by Sian Sullivan and the referees and editors of this journal.

article formulate a theory that predicts outcomes from metaphorical properties of the source domain, rather we propose a conceptual framework that might assist in discussing and refining games to generate desirable outcomes. This framework draws from our own observations on what the RIVER BASIN GAME tries to elicit from water users and how. At the heart of the framework is the notion of balance of design between juxtaposing polarities, the most important being simplicity and complexity. Finding the appropriate balance between simplicity and complexity is an issue that vexes designers of computer-based models (Bhalla, 2003; Gemino & Wand, 2005) and hydrological models (the RIVER BASIN GAME being a physical model) that are detailed enough from a scientific point of view but simple enough to be effective in participatory sessions with members of the public (Carmichael, Tansey, & Tobinson, 2004). Our framework has more in keeping with the research on learning modes (Cocking, Mestre, & Brown, 2000; Jones & Issroff, 2005) than the literature on cognitive linguistics (Lyon, 2000; Varma & Sivasankara Reddy, 1996) or the design of computer–human interfaces (Alty, Knott, Anderson, & Smyth, 2000), the latter two being major fields that engage with metaphor. That said, these literatures engage with issues of juxtaposition between, and simplicity and complexity of, images, words, actions, and icons to examine how metaphors function.

Dealing with complexity—Participation in water management

Messner, Zwirner, and Karkuschke (2006) in their opening discussion of water allocation problems suggest that in the face of "complexities, uncertainties, equity and sustainability issues, new forms of environmental participatory decision-making are required" (p. 1). Here we highlight similar concerns regarding decision making in the multifaceted arena of water management, represented diagrammatically in Figure 1. Within the figure, from the human point of view, water meets a range of essential needs outlined above the box "Water Yields." Engineers and others face the task of providing water yields that meet a range of five parameters termed *parameters of yield*. All this has to be achieved in the context of the general problems of environmental management. Here then is our "target domain"—the more sustainable, productive, and equitable management of water in the real world.

Accordingly, we must deal with complexity (Jensen, Bourgeron, Everett, & Goodman, 1996; Messner et al., 2006)—where the functioning of the ecosystem, the range of life forms within it, and other factors make for circumstances wherein we can never comprehend more than a fraction of what is happening within ecosystems—and yet our abstractions of them remain critically important in terms of a rich and researchable knowledge. They remain to a considerable extent at present unknowable. Hence, when we intervene with them as human beings for our benefit, we cannot reliably predict the outcomes. We have to deal with uncertainty (Carnell, Lawson, von Lany, & Scarrott, 1999; Moench, Dixit, Janakarajan, Rathore, & Mudrakartha 2003) and expect that ecosystems will surprise us. These problems are made more difficult by the wide range of human influences that now affect these systems.

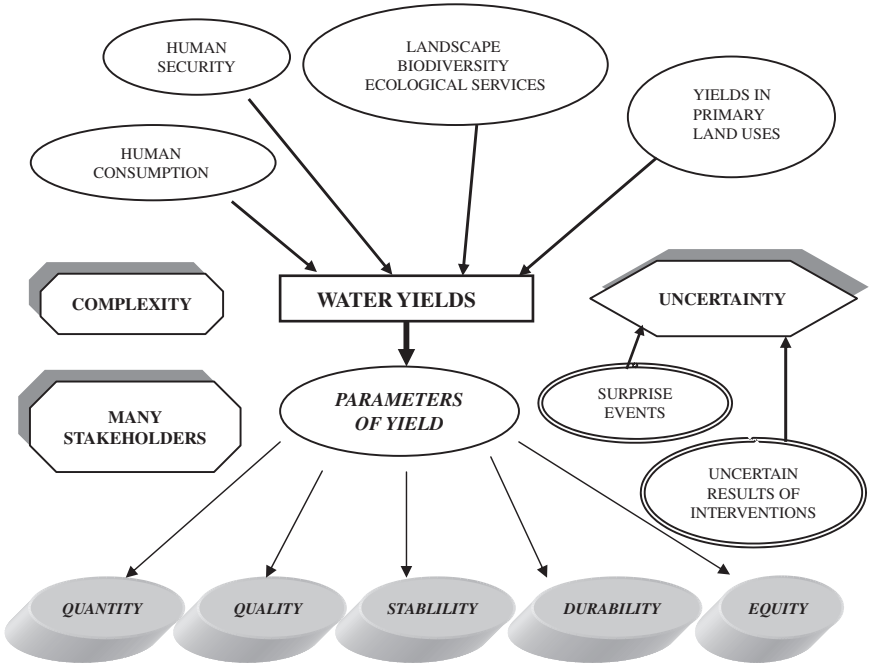

FIGURE 1: The Complexity of Water Management

Events such as unexpected floods, human induced or otherwise, add to instability. Last, in water management, we must deal with a very wide range of stakeholders, including nonhuman ones. Through all of this there runs a sense of crisis as reserves of freshwater are depleted (Falkenmark et al., 1998; Pereira, Cordery, & Iacovides, 2002) and perhaps even reduced in some areas because of climate change. Whether real or not, this sense of crisis lends urgency to our task.

Generic functions of tools for participation

There is a wide literature on participation in natural resources management; however we concern ourselves here with the relationship between social learning, participation tools, and issues of management outcomes. Iyer-Raniga and Treloar (2000) examined these connections, recommending that appropriate processes to enable participation need to be designed and implemented. Messner et al. (2006) proposed that social learning is itself a dimension of participation, outside of two key criteria termed *fairness* and *competence* taken from Webler and Renn (1995). Yet fairness and competence are criteria of outcomes of such tools, which must therefore

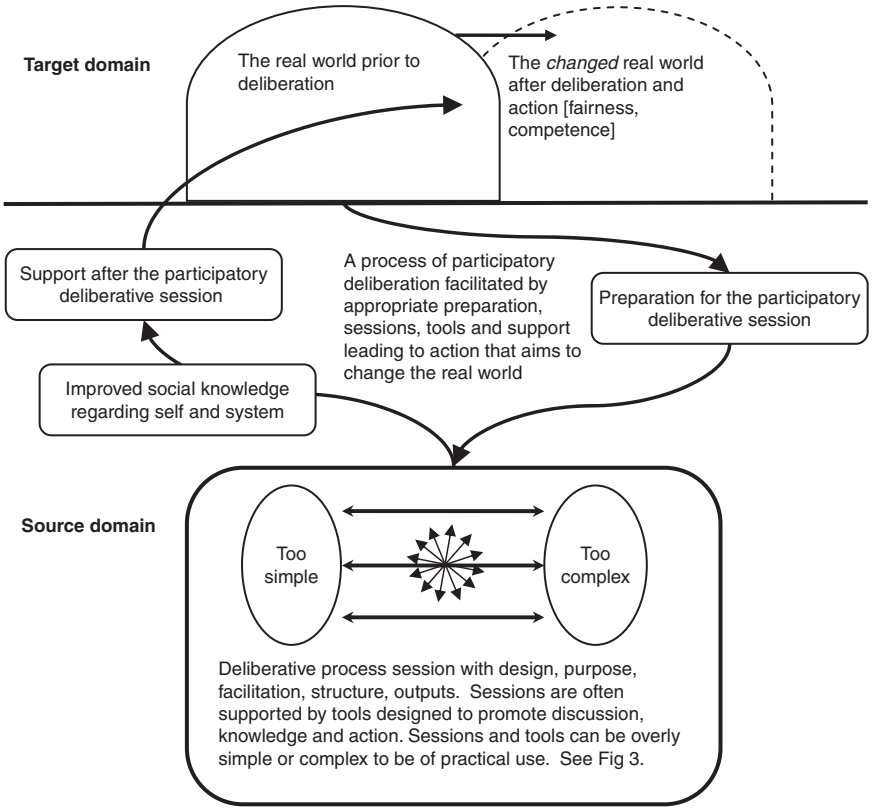

FIGURE 2: Use of Deliberative Tools as a Source Domain to Effect Change in a Target Domain

assume that "action is taken," which is not necessarily always the case, a fact that we argue makes "action" a critical measure of whether the participative process actually effect change, and to which measures of fairness and competence can then be applied. Questions of outcome in the real world or "target domain" highlights where metaphor in the design of participation tools might be located to elicit appropriate outcomes. In the following discussion, using Figure 2 as a guide, we propose that the use of participatory deliberative tools forms a "source domain" in which target domain issues are described, framed, and comprehended in an attempt to move us nearer to sustainable use of water. Barreteau (2003; abstract) similarly identified that tools "constituted a 'like society' about which scientists and stakeholders can think about." The terms *like society* and *source domain* address the same space in gaming where participants learn and from which action is triggered.

Tools for participation are commonly used in groupwork, which we can call here *workshops* or *sessions* (though one can imagine individual participation via Internet

and/or Web-based means). As we identify below, planning and preparation for such workshops is critical for their eventual success, including scheduling, logistics, equipment, food, and choosing the facilitators, their function, and if necessary additional assistance. Facilitation is important as Hagmann and Chuma (2002) noted: "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" (p. 23).

Another critical part of the workshop involves selecting and then building around appropriate tools to elicit participation, deliberation, and action. It is not the function of this article to explore these in depth; however, a nonexhaustive review of some of the tools is presented in Table 1 alongside some of their examples.

We hypothesize that these tools help humans comprehend some of the problems of water management in sessions of participation (see the larger box at the base of Figure 2). This is achieved by simplifying complex real-world situations to the extent that the real world is comprehended and simultaneously adding complexity or "realness" to the sessions to add sufficient richness for pedagogic learning and progression. It is the balance of simplicity and complexity that brings the necessary rigor and quality to the participatory and deliberative experience. In functional terms, this happens because deliberative tools can

1. create "safe, dangerous places" within situations such as games, role-plays, manipulation of models in which stakeholders can explore scenarios and options at a distance from conflicts and tensions on the ground and take risks that would not be acceptable in the "real world."
2. communicate without and beyond language—using for example pictures, which Luyent (2004) does with pictures.
3. calculate the incalculable—modern computers have been enormously extended to calculate the interactions between many more factors and at much greater speeds than ever before. More complicated and multifactorial situations can be explored.
4. mimic human and ecological processes and their interactions. Our increased capacity for calculation and the reach of modern science in its insight into hydrological and related processes permits us to come closer to simulating the real situation in information technology (IT) based systems.
5. bring the outdoors indoors—as a result of 3 and 4 above, we can have virtual experience of processes within ecosystems.
6. visualize the invisible—when we use computer-based systems, or even simple diagramming, we are often aiding human beings, as highly visual animals, to visualize processes that are invisible such as ground water flows or that may be only partially visible.
7. recycle ideas recursively—via feedback and repetition, tools can unpack and produce layers of complexity.

Learning outcomes of using deliberative tools

What effects do the tools have on participants in water management situations? Moving clockwise in Figure 2, they aim to improve knowledge of the participants' "self" and the system in which they sit. Toward effecting action in the real world, the tools

TABLE 1: Tools Used in Public Participation Sessions

Tool Descriptor	*Immediate Objective*	*Examples*
Intermediary technical objects.	Focus on key object as an indicator of wider issues	Marachaine cow in the Atlantic Wetlands (Brives & Steyaert, 2004) and Field Weirs in the Netherlands (Jiggins, 2004)
Drama and play	Scripted or unscripted, highlighting in a stylized, dramatized manner key issues	As demonstrated by the role-plays in an irrigation game (Burton, 1989)
Models and information technology	Explore what-if scenarios within virtual boundaries determined by a modeler	Present in sophisticated forms underlying the Aquavoice system (Jonoski & Harvey, 2004) and Geographic Information System (GIS) based tools (McIntosh, Jeffrey, Lemon, & Winder, 2005)
Visualization	Accentuate visual components of issues or strengthen this skill	As used in Luyent's (2004) use of photographs taken by participants in the Rhone Basin
Metaphor	Distills essential features of ecological and human processes into a physical or conceptual model	Of which the use of marbles in the RIVER BASIN GAME seems an excellent example (this article)
Fuzzy logic	Capture and rank nuances in choices	As in the Fact Machine in Aquavoice (Jonoski & Harvey, 2004)
Maps	Explore and generate spatial awareness	Villagers drawing own maps, or using accurate scale maps already produced (Mikkelsen, 1995)

1. can collectively increase the transparency of the whole situation and process.
2. can change the boundaries of peoples' concept of the system of water management, aligning it more broadly and closer to hydrological and social realities.
3. can aid participants explore the social, economic, and ecological rules of the sustainable use of water.
4. can explore future scenarios and options resulting from participants' choices in the use and management of water.
5. deepen participants' knowledge of hydrology, needs of other stakeholders, and other relevant factors.
6. establish or help deepen cooperative relationships between stakeholders that potentially help the establishment of more effective water management and use.
7. help stakeholders relate to scale.
8. help build trust and shared knowledge between stakeholders.

There is no doubt we could identify other effects on the users of such tools; however these at least seem to be processes that occur among participants that have taken part in the use of tools as described here. It is worth noting that such tools need to be part of a wider process and should not be relied on in isolation. 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. If the improved knowledge gained as a result of the deliberative sessions is supported by other interventions, such as ongoing meetings, finance, physical infrastructure, new legislation, as suggested by the next (clockwise) box in Figure 2, it is apparent that deliberative tools, with their iterative nature, can be important central aids in social learning or colearning toward joint action.

The RIVER BASIN GAME—An introduction

Having introduced the functions and benefits that deliberative tools have for water resource management and the processual cycle in which they reside, we now move to an exploration of the particular qualities of the RIVER BASIN GAME, first describing its functional place within a workshop on water management and then examining its metaphorical nature.

Description of the game and its setting

A detailed description of the game and its placement within a conflict resolution workshop is described in Lankford et al. (Lankford, Sokile, Yawson, & Lévite, 2004; Lankford, Sokile, Yawson, Lévite, & Sally, 2004) and Lankford and Sokile (2003). The game is a large board placed on a slope with a "catchment" at the top end and a "wetland" at the bottom end (Figure 3). A central river flows between the upper catchment and lower wetland and has on it several intakes into irrigation systems of varying sizes. The river "flows" when a large number of glass marbles are released down the river. The marbles represent water. This model assumes that flows are principally generated at top of the catchment and virtually none or very little from the rest of the catchment. Participants put small sticks (such as weirs) across the river to capture these marbles and scoop them into the irrigation systems where the marbles sit in small holes—thereby meeting the water requirement of that particular plot of rice or irrigation activity. The small sticks represent "traditional intakes" that scoop water from the river channel allowing water and marbles to bypass them to meet downstream users. Being at the top of the river advantages some irrigation systems, whereas others at the tail-end experience water shortages. Players can also choose larger sticks that allow capture of the marbles more easily, reducing the number of marbles that flow past the intake—these represent upgraded and modernized intakes associated with some irrigation improvement programs in Tanzania (World Bank, 1996). 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.

FIGURE 3: Playing the RIVER BASIN GAME

There are five phases of the game on Day 1 after the welcome. Phase 1 provides an introduction and demonstration to the game. Phase 2 demonstrates individual action to acquire water to determine the pattern of water use, creating the commonly found "top-end to tail-end" inequitable supply. Phase 3 builds on Phase 2, allowing individual action to acquire money (livelihoods). Thus individuals express how they will survive the phase based on renting land, buying water, and selling their own

labor. Phase 4 is critically different from Phases 2 and 3, promoting "community action" to allocate water more fairly and to priorities established by the community and not by any one individual. Phase 5 gives all players an initial opportunity for discussion covering lessons, feedback, future action, assistance, and a summary. A second day follows up on lessons learned from the game and brings together new institutional agreements to assist in improving equity of supply.

Brief description of outcomes and measures of success

The game has been played at the user and decision-maker levels in Tanzania (the Great Ruaha and Pangani Basins), in Northern Nigeria (Lankford, 2005a), India (Iyer, 2006), and South Africa (Mabiza, 2006). In all circumstances it was very well received by players, resulting in positive evaluations plus agreements to instigate new agreements to manage water. For example, in one subcatchment in Tanzania, users agreed independently to implement a new apex body to manage water collectively after the workshop. The game has been requested as a tool to extend the Ruaha Program being administered by WWF and was received well when it was played by participants of the Netword for Water and Sanitation (NETWAS) seminar in Kenya (Lankford, 2005b) to the extent that the workshop organizers contacted the Nile Basin Initiative to commend the tool.

Metaphorical qualities of natural resources gaming

In this discussion we explore the meaning of *metaphor* in gaming by reflecting on the various qualities of the RIVER BASIN GAME. We have created a simple conceptual diagram (Figure 4) and framework (Table 2) to help steer the discussion. In broad terms, Figure 4 represents an iterative or layered approach to the pedagogic use of tools, positing that stakeholders or participants are taken through a cycle of tools each targeting new fields of knowledge. Thus, though the RIVER BASIN GAME tackles competition between water users, another game or tool (e.g., water balance model) might explore the detail of in-field water management.

Overview

The metaphorical quality of the game is affected by material and organizational factors that also determine how the gaming or tool is deployed. Organized and designed well, as described below, the game can enhance the metaphorical qualities of its use in gaming. If the workshop is poorly organized and facilitated, its metaphorical qualities will not be elicited. To consider metaphorical quality, six experiential axes juxtapose to enrich the source domain of deliberative gaming and finding a pedagogic balance between oversimplistic and overcomplex knowledge and learning.

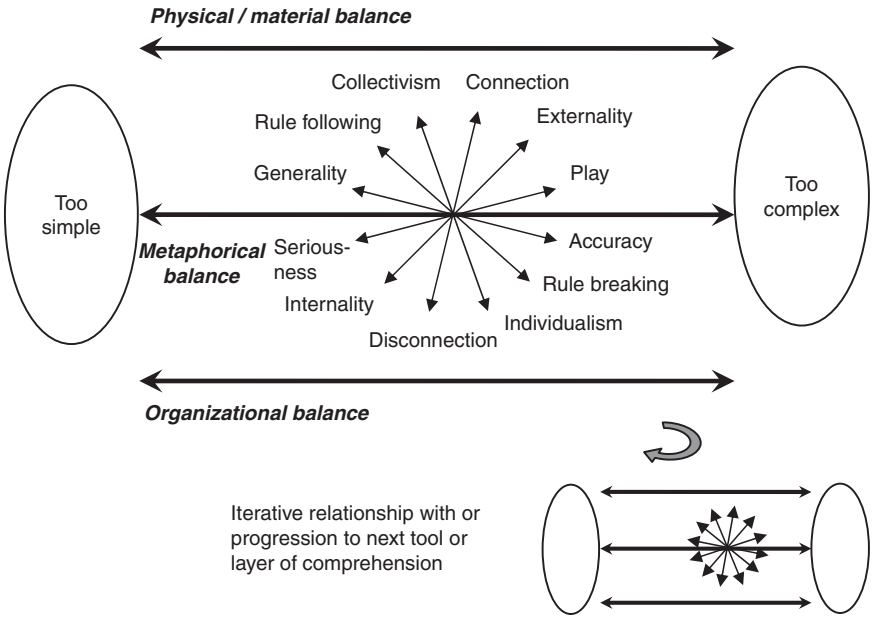

FIGURE 4: Metaphorical Balance and Enrichment of a Natural Resource Game

Material factors underlying metaphorical success

In this section we highlight the physical dimensions of the game that promote its success in a workshop setting. The game is cheap, using materials that can be obtained at little expense almost anywhere in the world. Certainly, marbles are easily transportable, and local artisans can manufacture the board. It thus has certain advantages over such devices as computer or IT-based games that require technically sophisticated equipment or any that require an external power source. The construction of the game from local materials is possibly part of its metaphorical quality. It is not overly sophisticated or covered in instructions or does not rely on battery power or other technology. Its simplicity allows a rapid conceptual understanding of what it is attempting to emulate; yet as the next subsection shows, the organization and facilitation of the game is layered on greater levels of complexity that match reality more.

Moreover, the relationship between handling "tactile" materials such as marbles and organizational learning is discussed in Roos, Victor, and Statler (2004) who observed corporate staff using LEGO bricks:

> Learning theoreticians such as Harel & Papert (1991) have argued furthermore that learning occurs when we literally manipulate material in the appropriate context to discover new ways of interacting with the world. If we accept that hand-mind relationship

TABLE 2: Conceptual Framework for Extending Metaphorical Qualities in Role-Playing Games

Subcategory	*Balance and Simplicity-Complexity Mix*
Physical and/or material qualities	
Platform: what the game is played on	A sloping table comprising a single channel with off-taking channels is a generic form that works well but should not be too simple with only a few intakes as this does not allow for representation of upstream-downstream differences. Overcomplex or too accurate representation of catchment limits applicability to other catchments and could lead to distributions of marbles that confuse players.
Medium: what the game plays with	Marbles are a simple medium that flows down the table. One marble represents one unit of water or water requirement. Some commentators suggested using water, which would be more realistic, but would be messy or require a very carefully designed game to contain the water. It could be difficult to parcel out real water to players, obscuring key processes and outcomes. Also, water may be too like the real situation around which much tension might already exist and hence discourage people from approaching issues in the right way, or approaching them at all. Marbles are a tactile, playful medium—this seems critical to its success.
Organizational qualities	
Logistical	A range of organizational factors affect this, such as the setting, numbers attending, representation, time scheduling, and location of workshop.
Gaming facilitation	The game has to be facilitated to work well in particular with the structure and time-keeping of the game in terms of phases and rules and the changing role of the facilitator in terms of explanation to eliciting farmers' knowledge. The facilitator needs to gauge progress, when to repeat, and so on.
Metaphysical qualities	
Levity: Seriousness versus play	Within a serious workshop setting with intended outputs and a relatively formal structure, the facilitator sets up exercises that are purposively fun, such as getting groups to run to obtain the most fortuitous intake position. Also, the game deals with conflict over water, a real issue to participants. The objective is to use play to enter into disputed issues. This sense of play is supported by the use of marbles—a "disarming" childhood toy.
Specificity: Accuracy versus generality	The game has basic rules that capture the reality of water consumption, hydrology, and distribution yet at the same time is unable to reflect all the different dimensions of water and water management (e.g., current version omits groundwater, storage, and water quality). The objective is to key into players' *essential* understanding of the science of people, land, and water.
Spatiality: Within and without (internality and externality)	The game gives users a whole picture of the catchment in a wider context generating a sense of externality. At the same time they are players of the game, intimately involved with

(continued)

TABLE 2 (continued)

Subcategory	*Balance and Simplicity-Complexity Mix*
	strategies and results that are specific to their location in the game (upstream or downstream). The objective is to give players an improved sense of spatial awareness.
Attachment: Connection versus disconnection	Players move from thinking about water to thinking about livelihoods. This reminds players of the reality of different levels of water access affecting livelihood strategies. Players are rotated around the game becoming "water rich" then "water poor" depending on their upstream/downstream location. The objective is to promote an emotional attachment to water poverty.
Solidarity: Individualism versus collectivism	The game has different phases of individual and community playing. The objective is to generate a strong sense of where "self" exists within and affects the collective.
Ingenuity: "Following rules" versus "creating new rules"	The game has basic rules but gives players a free reign to explore differing strategies with the game and in discussions afterwards. The objective is to strengthen confidence in creatively discussing existing norms and rules of water management.

is not simply an evolutionary curiosity, but a vital part of the modern human mind, then it seems likely that the use of LEGO materials to construct physical representations of ideas, concepts and models of strategy might help strategy-makers to generate new content. (pp. 560-561)

Organizational factors underlying metaphorical success

The metaphorical qualities inherent within the game do not simply happen spontaneously however. They are drawn out by the logistics of the workshop, including comfort factors such as *seating, space, time scheduling, location*, and so on. In particular, the organizational skills in "gaming" facilitation apply: the basic rules of the game and of the workshop that wrap around the game. The stages of the game are designed to move players toward effective results using at least five designed-in features:

1. After each period of play, purposeful dialogues are instigated between players about the implications of the play. Because these spring directly from experiments with clearly measurable results of actions in the game, with close parallels to players' "real life" experiences, these are unlikely to be abstract discussions but about derived rules tested directly against both sets of experiences.
2. Control is moved progressively from the facilitator to players.
3. The sense of strategy moves from "marbles" (players trapping them) to "water" (players discussing how they get hold of water) to the search for "livelihoods" (discussing how they get hold of money despite not getting hold of marbles/water).
4. The unit of discussion and decision is moved from individual players to groups and group rules.
5. The focus of discussion is moved progressively from the metaphor of the marbles to the realities of water partitioning—a situation that is completed on Day 2.

An important advantage is that it requires the players who must later cooperate in any resulting actions, and between whom there might already be strong tensions, to get together in a room for a considerable period and interact constructively face-to-face. With the game they explore and rehearse patterns of cooperative behavior they must be prepared to continue in the real world. Furthermore, because of its essential simplicity, anyone can play, irrespective of level of technical knowledge for example.

Metaphysical qualities of gaming in natural resources

The immediate thing that strikes an observer about this marble-based game is that it is of course not about marbles. It is about creating learning to solve a "real-life" problem through game experimentation and structured dialogue that focuses not so much on "problem solving" but on "improving whole systems." The people it is intended to help face the difficulty of approaching a situation of material loss, potentially intense conflict, and of complexity. How does the game help them do this? It seems to achieve its results by employing a range of stratagems integrated progressively into a single social device.

As well as the obvious "marbles replacing water," metaphor is made and strengthened through a tension of six different metaphysical polarities of the game, seriousness juxtaposed with play, the balance of accuracy and generality, a sense of within and without (internality and externality), connection and disconnection, a contrast between individualism and collectivism, and contrasts between "following rules" and "creating new rules." These various polarities, described below, seem to be the conceptual framework within which metaphor is constructed and enhanced. Steering a path between these polarities triggers intellectual and emotional connection with the game; we understand that metaphor is made and defined by the strength of the intellectual and emotional association created between the game and reality.

Levity—Seriousness and play

To sustain players' interest for 2 days, a game must engage considerable energy and commitment from them. The RIVER BASIN GAME perhaps achieves this by addressing an issue that is of key importance to the lives of players. Those invited to the game are irrigators, cattle keepers, and fishers whose livelihoods depend on access to water. Abstract discussions about the game and outcomes relate directly to their major concerns. Alongside this level of seriousness the game also engages the sense of play that is universal in human beings. Play leads to enjoyment, and this in itself provides some of the necessary energy to drive the process along. We argue that the game is ideal in a metaphorical manner in that it tackles a serious issue in a playful manner. We see "serious play" very favorably in this context, echoing recent research on play in strategy development and organizational learning (Roos et al. 2004). We also suspect that the game succeeds culturally because it has parallels

with the widespread Arab-African game of Mancala (also called Oware or Bao) wthat has elements of placement and capture of seeds, or small balls, and has been used by other researchers as a participatory tool for discussing natural resource management (Kuntashula & Mafongoya, 2005).

Specificity—Accuracy and generality

Although the core idea of the game is simple, it nonetheless tackles certain key problems of water resource management head-on by being "accurate." The game accurately captures some of the problems peculiar to water as a common-pool resource (Ostrom, 1992). These include the problems of partitioning a limited resource in a manner that acknowledges the need for shared rules of environmental justice that recognize equity as key parameter of sustainable yield. A marble placed in one part of the board cannot simultaneously be in another part of the board. This dynamic separates the impact of one stakeholder on another. In this instance, for example overextraction by upstream farmers leads to lack of water for those downstream. At the same time, the game is generic in design, the central stream and off-taking channels are highly simplified versions of any given real river. This does not matter and, in some respects, assists in moving the discussion to a safe arena of hypothetical location so that personalized accusations of overabstraction from a real intake are carefully steered away from.

Spatiality—Internality and externality

The game board promotes a social sense of the nature of geography and space. Being within the game occurs when players select a location from which to abstract marbles from the river. Jostling for position occurs, discussion is rich, and players lean into the game to place their chosen intake design. A sense of externality or separation also occurs that helps to tackle the problems created by the dynamic nature of water by working with a "bird's-eye view" of the system of interest—the subcatchment(s) of the players. Players have a bird's eye view prior to their chosen stratagem and then afterwards when the marbles have been sent down the stream and the pattern of distribution is revealed. Players are able to stand back and see externally a catchment-wide result and hence develop a shared, integrated, system-wide mental model of the resource that becomes an important basic factor in future water negotiations to evolve a collective strategy. Players are also reminded of the minor marginal value that a single marble has for someone at the top of the system who already has many marbles, as compared to the considerable extra utility one marble has for someone at the bottom who has none. This tuition in the marginal utility of water is spatially demonstrated, with the facilitator picking up one marble from the top and taking it to a part of the board where there is none. The shifting from "within-ness" to "without-ness" gives players further insights regarding the meaning of the game and its geographical and hydrological space within their reality.

Empathy—Connection and disconnection

The game playing utilizes "real-life discussions" and connection and disconnection with a position of power to generate empathy with the game as a facsimile of reality. Empathetic attachment is first and foremost targeted by moving water users from a phase where they are contemplating the search for water to a phase where they reflect on the search for livelihoods. This phase change stirs players considerably as they discuss a list of strategies that include selling labor and assets, turning to other livelihoods (e.g., charcoal making) and borrowing money. Furthermore, in the individual phases, the game thus permits players to explore, through their choices, high-risk and "selfish" scenarios that might not be easily explored through experiments in their own water management. Building on these two exercises, a key attachment tactic has players taking differing roles at different times to help them understand each others' perspectives. A player who is a water-rich top-ender then exchanges with a water-short tail-ender and vice versa. The player "connects" with hydro-power for a while and then disconnects to "connect" with hydro-poverty. This switching from water wealth to water poverty creates a sobering moment of reflection based on an emotional sense of gain and loss.

Solidarity—Individualism and collectivism

The game moves from two stages of "individual strategies" to a final stage of "collective strategy." Here we find an interesting and necessary contrast that again helps to build a metaphorical link between the game and the real world. The players contrast the links between individual strategies, inequitable patterns of use, and high conflict with a collective strategy associated with more-equitable patterns of use and low conflict. During the last phase of the game, when the marbles are equitably shared as a result of all the players negotiating a collective agreement of who gets what marbles, the sense of success and contentment was palpable. However, although the game is clearly moving toward this goal and could be omitted (as it mistakenly nearly was in one session), the fair sharing of marbles needs to be seen and experienced for a "feeling of success" to descend on the group.

Ingenuity—Rule following and rule breaking

The game steers a path through creativity of new possibilities and adherence to formalities and strictures. The game's manual (Lankford, Sokile, Yawson, Lévite, & Sally, 2004) advises that the game should be played according to a set of rules involving the stages used and the manner in which the players should play the game. Having established rules and undeniable facts (e.g., water flows downhill), the game asks players to develop new stratagems and new ways of thinking—literally leading to new by-laws being discussed. We posit that the game by example "opens minds" during the workshop that has benefits in the parallel real world, encouraging rural

farmers to understand their situation and to inquire how they might change their world yet remain bounded by various technical and societal norms. Metaphorically, the game explores various levels of confidence, ingenuity, and resourcefulness.

Discussion—Enhancing intellectual and emotional attachment

These opposing elements of the game enhance and create an increasing association with the game, drawing players almost without their knowledge into a highly believable facsimile of reality. This strong association happens intellectually and emotionally. Intellectually, the game presents choices regarding various options, rules, and possibilities. To build an emotional response, the game playfully deals with a very serious subject (water). Emotional attachment is also made by ensuring minimal frustration by ensuring a simple game that is built up using simple stages. And yet frustration of not getting enough marbles is felt too. Emotional attachment is also fomented by contrasting individual strategies based on self-serving needs with community strategies based on altruistic benefit spreading.

In summary, at the heart of the success of the game is an important feature that is its highly successful use of well-situated metaphor with the marbles representing water. On the scale of metaphors between the poles of fantasy and reality, the marbles' behavior is close enough to that of water because they are limited in number and move, to ensure that rules evolved through the game are clearly applicable to "real life." At the same time they are just sufficiently removed from it to permit situations of conflict and tension to be approached in a constructive, less adversarial manner. After all, marbles are a childhood toy.

Juxtaposition and balance in metaphor

We argue that the success of the RIVER BASIN GAME is aided by the fact that the game approaches potentially complex situations by selectively emulating key features of water and the social behavior of players in catchments. It produces a game that is elegant in its simplicity and transparent in the results of the actions and choices of players, the results of which are measurable by simply counting marbles and vacant holes in the field plots. Hence it can lead to "rules" that are clearly unambiguous in their supporting rationale of equity and the distinction between wants and needs, and their results in terms if the effects on water distribution, crop yields, a sense of unfairness, and so on.

The design of the game balances between juxtaposing experiences to promote intellectual and emotional responses. It steers a path between the above polarities to create a "simple yet rich," "serious yet playful," "constrained yet exploring," "individual yet collective," "connecting and disconnecting" experience for players.

Metaphor is inherent in these dimensions because the game does not veer too much toward each polarity; the game is not too serious or too playful, it is not too simple, or too complex. We suggest that if the game did not inhabit the approximate midground between these complementing characteristics, it would not work, and the metaphor for *reality* would be too simple, diluted, obtuse, or too extreme. Therefore without being too formulaic about metaphor design, we argue that the quality of metaphor associated with a game relates to choice in finding a balance between these juxtaposing polarities and experiences.

Clearly our game is more than just a verbal metaphor and works on various experiential levels to promote what might be called a phenomenological understanding of catchments. This allows players and observers to first experience the issues in a game, so that they can then discuss them from technical, engineering, social, and economics perspectives. This is the difference between our active metaphor and the kind of verbal metaphor that Igoe (2006) believes cannot work in the context of conservation because of a lack of precision leading to "systematic simplification of complex problems" (p. 4). In other words, the "big blue bear" metaphor loses utility by being too simple.

Conclusion

In this article, we explored how the link between reality and the space of a game is influenced by the quality of metaphor inherent in the game and its basic "rules for playing." We propose that the complex real world is our target domain that we wish to improve in some way, and that the groupwork participatory session built around a game or other tool is our source world where we wish to distil essential but enriched qualities of the target world so as to comprehend it. We have theorized that the metaphor quality is derived from achieving a balance between metaphorical polarities on six axes: seriousness and play, accuracy and generality, internality and externality, connection and disconnection, individualism and collectivism, rule following and rule breaking.

The process of the game is worth reflecting on and appears to condense into two key gains: "knowledge organization" and "knowledge building." With regards to the first, the game helps the players make their knowledge regarding their daily experience more explicit and organized and hence better labeled and named, and ultimately much more useful. With respect to the second, the game strongly promotes a "sharing" experience of shifts in understanding. Thus the new naming, labeling, and organizing occurs as a group phenomenon. The outcome of this sharing, we argue, is greater confidence in how to deal with knowledge collectively and therefore how to manage water more effectively.

The "action taken" elicited by the entire process seems to be of two kinds—what might be described as the material and the social. After playing, one would hope to see material results in the form of improved management of the water resources, improved partition of crop yields, less poverty, and other benefits. The social products

might be less obvious but are key to successful water resource management. They might include improved insight by players into the problems of environmental justice in the partitioning of water resources, the rules of equity that should govern it, and how to apply them. From these insights comes another key social outcome in the creation of a shared, integrated, systemic model of the resource. This might include the parallel development or improvement of relationships between upstream and downstream players for example that can lead to the evolution of effective social groups for water management and hence effective "joint action."

Appropriately selected tools can facilitate stages such as the identification of stakeholders, identification and articulation of qualitative and quantitative problems, and the attainment of a more thorough elucidation of the problems against each other. They can encourage key players to take experimental action to apply the results of that action. Throughout, by ensuring better processes of deliberation, they can sustain careful, responsible and long-term participation. There is a progression of stages through which a water project ideally moves as the dialogue between participants and other influences lead the situation on. How these different stages work together is also very important, and again tools can help with this integration.

Tools such as the RIVER BASIN GAME present opportunities. However, they also present challenges for organizations delivering services and facilitating change in terms of confidence and ability of their staff to master the skills required to respond to users and to adapt their policies and their functioning as organizations to the needs of users. The quality of the metaphor inherent within such tools is latent and by itself is not enough. Realizing the quality of the metaphor to draw out the game's benefits is dependent on the context of the game, the manner in which players are led into the game, its playing, and its follow-up. Organizing such a game so that it generates high learning outcomes follows from the skilful and delicate way in which metaphorical links between the game and reality are protected and nurtured.

References

Alty, J. L., Knott, R. P., Anderson, B., & Smyth, M. (2000). A framework for engineering metaphor at the user interface. *Interacting with Computers, 13*, 301-322.

Barreteau, O. (2003). The joint use of role-playing games and models regarding negotiation processes: Characterization of associations. *Journal of Artificial Societies and Social Simulation, 6*(2). Available at http://jasss.soc.surrey.ac.uk/JASSS.html

Bhalla, U. S. (2003). Understanding complex signaling networks through models and metaphors. *Progress in Biophysics and Molecular Biology, 81*(1), 45-65.

Brives, H., & Steyaert, P. (2004). *Changing practices and understanding for natural resource management: The example of the Marachaine local cattle breed in the Atlantic coastal wetlands* (SLIM [Social Learning for Integrated Management and Sustainable Use of Water at Catchment Scale] Case Study Monograph 8). Available at http://slim@open.ac.uk/objects/Outcomes/SLIM%20CSM%2008%20-%20Cattle%20breed%20and%20Atlantic%20Wetlands.pdf

Burton, M. A. (1989). Experiences with the irrigation management game. *Irrigation and Drainage Systems, 3*, 217-228.

Carmichael, J., Tansey, J., & Robinson, J. (2004). An integrated assessment modeling tool. *Global Environmental Change Part A, 14*, 171-183.

Carnell, J., Lawson, J. D., von Lany, H., & Scarrott, R. M. J. (1999). Water supply and demand balances: Converting uncertainty to headroom. *Journal of the Chartered Institution of Water and Environmental Management, 13*, 413-419.

Cocking, R. R., Mestre, J. P., & Brown, A. L. (2000). New developments in the science of learning: Using research to help students learn science and mathematics. *Journal of Applied Developmental Psychology, 21*, 1-11.

Cooke, B., & Kothari, U. (Eds.). (2001). *Participation: The new tyranny?* London: Zed Books.

Falkenmark, M., Klohn, W., Postel, S., Rockstrom, J., Seckler, D., Shuval, H., et al. (1998). Water scarcity as a key factor behind global food insecurity: Round table discussion. *Ambio, 27*, 148-154.

Forceville, C. (2002). The identification of target and source in pictorial metaphors. *Journal of Pragmatics, 34*, 1-14.

Gemino, A., & Wand, Y. (2005). Complexity and clarity in conceptual modeling: Comparison of mandatory and optional properties. *Data and Knowledge Engineering, 55*, 301-326.

Hagmann, J., & Chuma, E. (2002). Enhancing the adaptive capacity of the resource users in natural resource management. *Agricultural Systems, 73*(1), 23-39.

Harel, L., & Papert, S. (1991). *Constructionism*. Norwood, NJ: Ablex. Available at http://neptune.c3ed.uvsq.fr/gouverne/

Igoe, J. (2006). Engaging the big blue bear of African protected areas: Some reflections on a TPARI teleseminar. Boulder, CO: University of Colorado, Department of Anthropology.

Iyer, L. (2006). *An adaptation of the River Basin Game—A water dialogue tool*. Hyderabad, India: Thinksoft Consultants.

Iyer-Raniga, U., & Treloar, G. (2000). A context for participation in sustainable development. *Environmental Management, 26*, 349-361.

Jensen, M. E., Bourgeron, P., Everett, R., & Goodman, I. (1996). Ecosystem management: A landscape ecology perspective. *Water Resources Bulletin, 32*, 203-216.

Jiggins, J. (2004). *Weirs/small dams—Key informant studies 1: InterReg project water management in the Central Benelux area* (1st Generation Project) (SLIM [Social Learning for Integrated Management and Sustainable Use of Water at Catchment Scale] Case Study Monograph 2). Available at http://slim@open.ac.uk/objects/Outcomes/SLIM%20CSM%202A%20and%202B%20-%20Key%20Informant%20Studies,%20Netherlands.pdf

Jones, A., & Issroff, K. (2005). Learning technologies: Affective and social issues in computer-supported collaborative learning. *Computers and Education, 44*, 395-408.

Jonoski, A., & Harvey, H. (2004). Aquavoice: Prototyping participatory decision making. In B. Lankford, B. McIntosh, D. Watson, & P. Gillingham (Eds.), *Tools for Public Participation, Conflict Resolution and Decision-Making in Water Resources Management* (pp. 31-35). London: ICID British Section.

Kuntashula, E., & Mafongoya, P. L. (2005). Farmer participatory evaluation of agroforestry trees in eastern Zambia. *Agricultural Systems, 84*(1), 39-53.

Lankford. B. A. (2005a). *Facilitation of water sharing arrangements in the Hadejia Jama'are Komadugu Yobe Basin (HJKYB)—with the River Basin Game dialogue tool. Final report*. Dutse, Nigeria: Joint Wetlands Livelihoods Project, Department for International Development.

Lankford, B. A. (2005b, September 5-9). *The River Basin Game: A role-playing board game for initiating discussions on visions and strategies of water allocation*. Paper presented at "Managing Water Conflicts: Emerging Challenges and Opportunities," NETWAS—17th Regional Water and Sanitation Seminar, Mombassa, Kenya.

Lankford, B., Sokile, C., Yawson, D., & Lévite, H. (2004). *The River Basin Game: A water dialogue tool* (Working Paper 75). Columbo, Sri Lanka: International Water Management Institute.

Lankford, B., Sokile, C., Yawson, D., Lévite, L., & Sally, H. (2004, November 8-11). *The River Basin Game: A role-playing board game for initiating discussions on visions and strategies of water allocation*. Paper presented at the Water Resource Management for Local Development Workshop, Aventura, Loskopdam, South Africa.

Lankford, B. A., & Sokile, C. (2003, September 17-19). Reflections on the River Basin Game: Role-playing facilitation of surface water allocation in contested environments. In International Commission on Irrigation and Drainage (Ed.), *20th ICID European Regional Conference "Consensus to Resolve Irrigation and Water Use Conflicts in the Euromediterranean Region"*. Montpellier, France: International Commission on Irrigation and Drainage. Available at http://afeid.montpellier.cemagref.fr/mp12003/Conf/Lankford.pdf

Luyent, V. (2004). How to introduce the participative process in a large river management project? The Third Rhone Correction Project in Switzerland. In B. Lankford, B. McIntosh, D. Watson, & P. Gillingham (Eds.), *Tools for public participation, conflict resolution and decision-making in water resources management* (pp. 17-21). London: ICID British Section.

Lyon, G. (2000). Philosophical perspectives on metaphor. *Language Sciences, 22*, 137-153.

McIntosh, B. S., Jeffrey, P., Lemon, M., & Winder, N. (2005). On the design of computer-based models for integrated environmental science. *Environmental Management, 35*, 741-752.

Mabiza, C. (2006). Report of the River Basin Game workshop held in Pretoria and Sekororo, South Africa 22—25 March 2006. Pretoria, South Africa: International Water Management Institute.

Messner, F., Zwirner, O., & Karkuschke, M. (2006). Participation in multi-criteria decision support for the resolution of a water allocation problem in the Spree River Basin. *Land Use Policy, 23*, 63-75.

Mikkelsen, B. (1995). Methods for development work and research: A guide for practitioners. London: Sage.

Moench, M., Dixit, A., Janakarajan, S., Rathore, M., & Mudrakartha, S. (2003). *The fluid mosaic: Water governance in the context of variability, uncertainty and change* (A Synthesis Paper). Kathmandu: Nepal Water Conservation Foundation.

Ostrom, E. (1992). Crafting institutions for self-governing irrigation systems. Lanham, MD, San Francisco: ICS Press.

Pereira, L. S., Cordery, I., & Iacovides, I. (2002). *Coping with water scarcity*. Paris: UNESCO.

Roos, J., Victor, B., & Statler, M. (2004). Playing seriously with strategy. *Long Range Planning, 37*, 549-568.

Seamon, D., & Zajonc, A. (Eds.). (1998). *Goethe's way of science: A phenomenology of nature.* Albany, NY: State University of New York Press.

Shen, Y. (1999). Principles of metaphor interpretation and the notion of "domain": A proposal for a hybrid model. *Journal of Pragmatics, 31*, 1631-1653.

Ubbels, A. A., & Verhallen, A. J. (2000). *Suitability of decision support tools for collaborative planning processes in water resources management* (Rep. No. RIZA 99.067). Lelystad, the Netherlands: Institute for Inland Water Management and Waste Water Treatment (RIZA).

Vantanen, A., & Marttunen, M., (2005). Public involvement in multi-objective water level regulation development projects—Evaluating the applicability of public involvement methods. *Environmental Impact Assessment Review, 25*(3), 281-304.

Varma, V., & Sivasankara Reddy, A. (1996). Knowledge based metaphor interpretation. *Knowledge-Based Systems, 9*, 339-342.

Water Policy. (2001). Editorial: Working with people for watershed management. *Water Policy, 3*, 449-455.

Webler, T., & Renn, O. (1995). A brief primer on participation: philosophy and practice. In O. Renn, T. Webler, & P. Wiedemann (Eds.), *Fairness and Competence in Citizen Participation—Evaluating Models for Environmental Discourse* (pp. 17-33). Dordrecht, the Netherlands, Boston, London: Kluwer Academic.

World Bank. (1996). *River Basin Management and Smallholder Irrigation Improvement Project* (RBMSIIP—Staff Appraisal Report). Washington, DC: Author.

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