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The Invitational Drought Tournament: What is it and why is it a useful tool for drought preparedness and adaptation?

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ABSTRACT

Proactive drought preparedness is a challenge for a variety of physical, institutional, and social reasons. Significant progress has been made in monitoring and forecasting water deficits, both temporally and spatially. However, less progress has been made in translating this information into proactive decision-making frameworks to support drought preparedness. The Invitational Drought Tournament (IDT), a simulation adaptation framework developed by Agriculture and Agri-Food Canada, is a recent innovation that supports drought preparedness efforts. The IDT provides a mechanism for presenting physical science information to decision makers across a variety of educational levels and professional backgrounds, in a way that allows for peer-to-peer education and synthesis. Second, the game simulation environment allows players to integrate this information into economic, policy and institutional frameworks in a non-threatening manner. Third, it maintains realism by constraining players' risk management options via a budget, the physical realities of the drought presented, and the technical expertise of the 'referees'. Post-game follow-up allows players to explore lessons learned and to identify topics that warrant further in-depth exploration of policy options and subsequent implementation. The game provides an interim step between recognition of the risk posed by drought hazards and the actual implementation of vulnerability-reduction actions. This allows for a broad discussion within a sports-themed process that provides room for reflection and a richer understanding of the issues that must be addressed to ensure drought preparedness actions are effective.

1. Introduction

Droughts create challenges for all socioeconomic sectors and are particularly problematic, due to their slow onset compared to other extreme climate events (e.g., floods, hail storms) and their variability across space and time. In Canada, for example, the 2001–2002 drought had devastating impacts on the agricultural sector alone and resulted in $5.8 billion in Gross Domestic Product losses (Wheaton et al., 2008).

While a universal definition of drought that can be applied to all sectors is impossible, most definitions make reference to water shortages caused by a lack of precipitation (Wilhite, 2011). Drought impacts are context specific and depend on a system's (e.g., agricultural sector, community) vulnerability, or susceptibility to harm, which is influenced by its capacity to mitigate, prepare for, respond to and recover from drought events. As a system's adaptive capacity increases, vulnerability decreases, and vice versa (Smit and Pilifosova, 2003). A system's adaptive capacity is influenced by a variety of factors, including access to resources and livelihood choices, and is manifested in the form of adaptive strategies. As a result, each system experiences drought differently than others and has different strategies that can effectively increase their adaptive capacity. This means that drought preparedness efforts will be different for each system (Nelson et al., 2007).

Extreme drought events challenge traditional crisis management approaches, and since there is deep uncertainty around future climate and water resources, practitioners are calling for more proactive, participatory approaches. Proactive and participatory approaches emphasize the need to mitigate and better prepare for extreme climate events as well as include all stakeholders in the planning process. This will help ensure the best solutions are developed, and these solutions are broadly accepted by stakeholders (Wilhite, 2011; Wilhite, 2007).

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Proactive drought preparedness has proven challenging for three reasons: it is difficult for all the affected parties and decision makers to consider all the factors that influence drought preparedness; it is difficult for people to envision and plan for more severe droughts than those experienced in the decision maker's memory or the historic record; and it is difficult to stay focused on drought, as they occur sporadically and management efforts therefore face inevitable time and budgetary constraints. As a result, there is growing interest in understanding how water resources can be proactively managed under uncertain conditions (e.g., Gober et al., 2011). Simulation games provide a safe environment for stakeholders to experiment with decisions (Mayer, 2009) and have been used, with great success, to facilitate learning, research and intervention in this context (Lankford et al., 2004; Rusca et al., 2012; Magombeyi et al., 2008).

A variety of water-management simulation games have been developed to encourage collaborative decision-making and consensus building in navigating water shortages e.g. (Lankford et al., 2004; Rusca et al., 2012). According to Mayer and Veeneman (2002), simulation games provide a forum: for learning about a system; to facilitate research into the models and gameplay; and for intervention through the identification of practical solutions. They provide a safe space to experiment with decisions without real consequences, facilitate discussion and learning about complex systems, and fill a gap between problem identification and action that allows for reflection regarding drought preparedness options (Crookall and Thorngate, 2009). In the context of water management, using a fictitious drainage basin for gameplay that is based on real data encourages players to be creative in their decision-making, ensures an appropriate balance between realism and simplicity, and ensures participants identify with the actors they represent in the game (if they are not representing themselves) (Rusca et al., 2012).

The Invitational Drought Tournament (IDT) was inspired by the chronic problem of limited or uncoordinated efforts to proactively reduce drought impacts, described as the Hydro-Illogical Cycle by Wilhite (see Fig. 1). The cycle describes a crisis management approach to drought, where society's level of concern rises as the drought intensifies, and responses are ad-hoc, expensive, poorly coordinated and ineffective. When the drought subsides, apathy follows, and the cycle begins again with the next drought (Wilhite, 2011). A key factor contributing to the Hydro-Illogical Cycle is the challenge of integrating physical science with the long-term environmental and socio-economic effects of drought in a manner understandable for laypersons (Hurlbert et al., 2009; Birkmann, 2006; Hilhorst, 2004).

Precursors to the IDT were first explored in a partnership between Agriculture and Agri-Food Canada (AAFC) and the Canadian Foundation for Climate and Atmospheric Sciences-funded Drought Research Initiative (DRI) (Hill et al., 2008). This attempt to develop a drought preparedness methodology was not a simulation game but a structured discussion called the Drought Preparedness Partnership (DPP). The DPP focused on understanding how participants responded to a recent drought (e.g. 2001–2002 in Canada), how the responses would differ in the present if the same event occurred, and what might differ in 30 years if a similar drought occurred. Key benefits of the DPP were mentoring and reflection on steps that could be taken to prepare for future droughts with similar characteristics. However, primary limitations of the DPP process were that little could be done to address droughts outside the experience

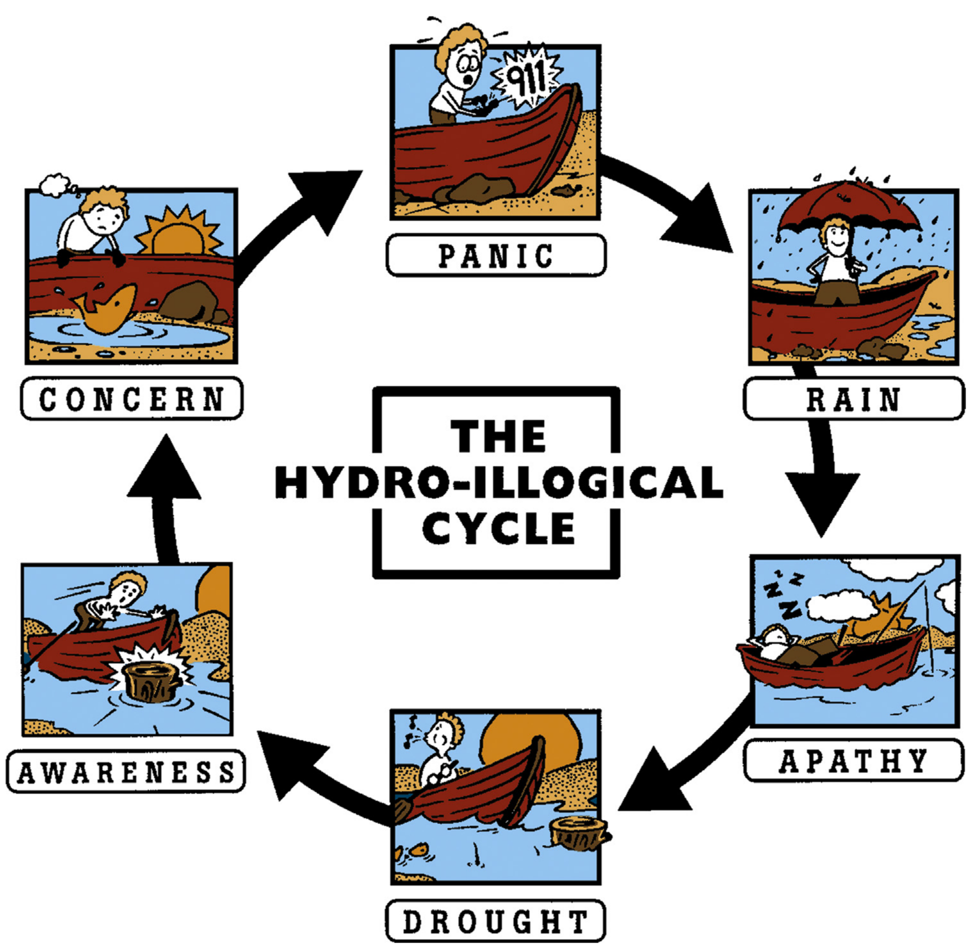

Fig. 1. The Hydro-Illogical Cycle. This cycle highlights why proactive drought preparedness has proven to be challenging (Lankford et al., 2004).

of the participants, and the ability to assess the feasibility of the proposed changes was limited. In 2010, the IDT project was initiated by AAFC to address gaps identified in the DPP.

The IDT allows individuals to work competitively in teams to identify proactive solutions for a simulated drought scenario. Teams are constrained by an uncertain budget and a specific regulatory, institutional, and cultural framework. The competitive element is based on the comparison of the teams' proposed actions. The purpose of this paper is to describe the IDT simulation game developed by AAFC, its strengths, weaknesses and anticipated refinements. This paper also presents the IDT Framework, which has been developed through many iterations of the game.

2. Background

Since the first iteration, the IDT has rapidly evolved through refinements from tournaments conducted in North America. The IDT is a day-long workshop designed to enhance discussions between stakeholders from different specialties on proactive drought management policies. Participants are invited to attend a workshop, where they are placed on multidisciplinary teams. These teams are given a brief introduction to the game as well as a workbook that contains information on the watershed selected for the game – which can be real or fictitious. AAFC has developed two semi-fictitious watersheds for the game: Oxbow Basin (based on a Canadian Prairie watershed) and Seco Creek (based on a sub-watershed in the Okanagan, British Columbia). Although both watersheds are based on real-world data, they are presented as fictitious in the game in order to reduce sensitivities and to capture a broader group of participants, while at the same time maintaining realism. A workbook has been created for each watershed, consisting of background information on the game and watershed. The workbook is distributed to participants prior to the game. Before the game begins, teams are allowed time for a brief discussion on any long-term drought management strategies they would like to purchase with their limited pre-game budget. These paper-based selections are submitted to the referees, who are also present to answer questions about management strategies or game rules, and to assist with scoring at the end of each round of a multiple-round game.

The game consists of three to four 'rounds' (Fig. 2). Each round begins with the distribution of a paper-based drought scenario that describes the conditions in the watershed (typically one year or bi-annual); the corresponding scenario data can either be based on historical or instrumental drought data (from one or a series of droughts) or modeled future climate projections. Information provided to participants includes climate measurements identified as important by stakeholders, such as streamflow, snowpack, precipitation, temperature and water demand, as well as social, economic and environmental drought impacts. Also included in the scenario is a list of management options from which participants develop a management plan, while ensuring they stay within their budget constraints; plans are required to encompass the three pillars of sustainability – environmental, economic, and social. Management options are grouped depending on the drought impacts to which they relate – environmental, social, institutional, or hydrologic – and include options ranging from water use restrictions and increasing irrigation efficiencies, to promoting tourism and developing wetlands. Teams are also encouraged to develop their own management strategies, termed 'innovations' in the game. Innovations must be feasible and teams are required to develop reasonable cost estimates for their implementation. The innovations must also be 'approved' by the referees. Teams are then required to present their management plans to the other teams, and players, teams and referees vote for the plan that best reduces environmental, economic and social drought impacts on the watershed. The team with the highest score at the end of the game is declared the winner.

3. Applications of the IDT

The IDT simulation game, described in the Background section above, has been tested with a variety of audiences in different Canadian provinces. It was tested in Calgary, Alberta in 2011 with interprovincial water managers (46 participants; called the Calgary IDT); Saskatoon, Saskatchewan in 2012 with graduate students from four universities across the Canadian Prairies (49 participants; called the Saskatoon IDT); and Kelowna, British Columbia in 2012 with water stakeholders from the Okanagan Basin (53 participants; called the Okanagan IDT). The IDT has also been tested more recently in the United States: the National Integrated Drought Information System (NIDIS) and the Colorado Water Conservation Board hosted a Drought Tournament with state water managers and other water stakeholders in 2012 using similar methods. In addition, seven simplified one-round exercises have been held with university students, water professionals and watershed groups to initiate conversation on drought preparedness, vulnerability and adaptation. AAFC has refined the IDT game based on feedback from participants over the various iterations. Fig. 3 provides details on the applications and refinements of the IDT. This paper focuses on the Calgary, Saskatoon and Okanagan IDTs.

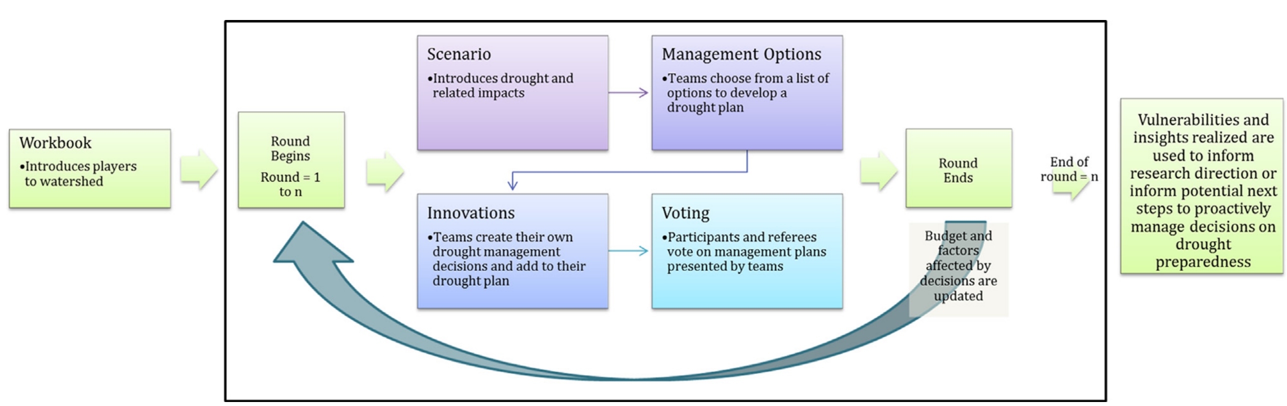

Fig. 2. The IDT Process. The IDT is an iterative process that uses a game format to arrive at an informed decision on next steps for proactive drought management and research.

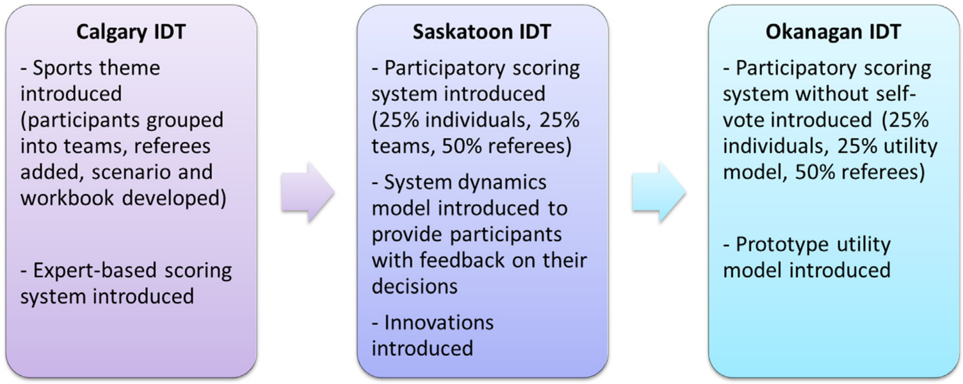

Fig. 3. Iterations of the IDT.

4. Materials and methods

Pre-game preparation helps the game to run smoothly. A planning committee consisting of representatives from various organizations involved in the game was established for each application described above. The committee made decisions related to the game's goals and objectives, content (scenarios and workbook), agenda and invitees, in order to ensure the goals and objectives were met, the materials were locally relevant and there was participant buy-in. Committee members also generated stakeholder interest for the game. After the participants were confirmed, pre-tournament teleconference calls were held to introduce the participants to the game, workbook and logistics. Four well-respected subject matter experts were identified to be referees for each tournament. A separate teleconference call with the referees before the tournament was used to review in-depth all the IDT materials, scoring system, game logistics, and referee roles and responsibilities. Team captains were assigned to take a leadership role in guiding their team through the tournament. The team captains were also responsible for submitting their teams' long-term drought management plans to the planning committee prior to the game.

Each game commenced with a brief explanation of the overall goals and objectives, game structure and scoring system. Team players and referees were asked to introduce themselves, and then the organizers presented the key characteristics of the fictitious watershed. Teams were given a budget, guided through a drought scenario (see Fig. 4 for a sample scenario) and given time to discuss the scenario and decide on their management plan, based on a list of options provided to them at the beginning of each round (see Fig. 5 for teams in the midst of gameplay). The option to develop innovations was introduced after the first round. The teams submitted their plans to the referees, and were given time to prepare their presentations. They then presented their plans to the other teams. In Calgary, the scores for each option were predetermined by an expert technical committee. In Saskatoon and Kelowna, the scoring process was revised and players and referees were engaged in the scoring process (refer to Section 5.3). Participants (players and referees) scored the plans based on their ability to reduce social, economic and environmental drought risks in the watershed. The scores were tallied in an Excel spreadsheet and shown to the participants at the end of each round. A debrief at the end of the tournament allowed participants to discuss their impressions of the game, including what they liked and did not like, as well as future improvements. Participants were also asked to complete an evaluation form that consisted of both closed- and open-ended questions. There were seven closed-ended questions in the form (e.g., "The tournament was a good learning experience"), each with five Likert items as possible answers (strongly agree, agree, neutral, disagree and strongly disagree). Open-ended questions included "What did you like about the tournament?", "What did you dislike about the tournament?" and "Do you have suggestions for improving future tournaments?" Feedback from participants, referees and observers were also obtained through reports compiled by referees and expert observers who were invited to view the game and provide recommendations for future improvements. The results from the discussions and evaluation forms, as well as the feedback obtained in the reports, are described in the following section.

5. Results and lessons learned

This section summarizes the results from the discussions, evaluation forms and reports from the Calgary, Saskatoon and Okanagan IDTs (see Section 5.1). It also documents the two main lessons learned from these tournaments, including the need for a feedback mechanism for participants to better understand the impacts of their decisions on their watershed (see Section 5.2), and to develop a participatory scoring process (see Section 5.3).

5.1. Participant feedback

Each iteration of the IDT has helped refine the game to better suit stakeholder drought preparedness needs. Certain elements of the game have reached maturity, and some challenges have been identified that require ongoing refinement. Consistently across all tournaments agreement was high that the tool supports interactive learning in the area of drought management and that the team format is a unique way to gain knowledge and explore creative ways to address drought systematically.

Participant feedback has indicated that the IDT is extremely effective at bringing diverse stakeholders together with different perspectives to engage in meaningful dialog and to achieve consensus decisions around drought preparedness in a competitive environment. Ninety-six percent of participants (i.e. 25 of 26 evaluation form respondents) at the Okanagan IDT in Kelowna either strongly agreed or agreed that the tournament enabled team building and interaction between different sectors.

At the Okanagan IDT, 96% of participants found the drought scenarios and the workbook to be concise and easy to understand. In the evaluation forms many people mentioned the game materials were effective in supporting team discussions and the information relevant to their specific reality; the more realistic and relatable the materials are the more engaged participants seem to be. As participants got deeper into the game, they became more comfortable with the materials, playing the game and interacting with

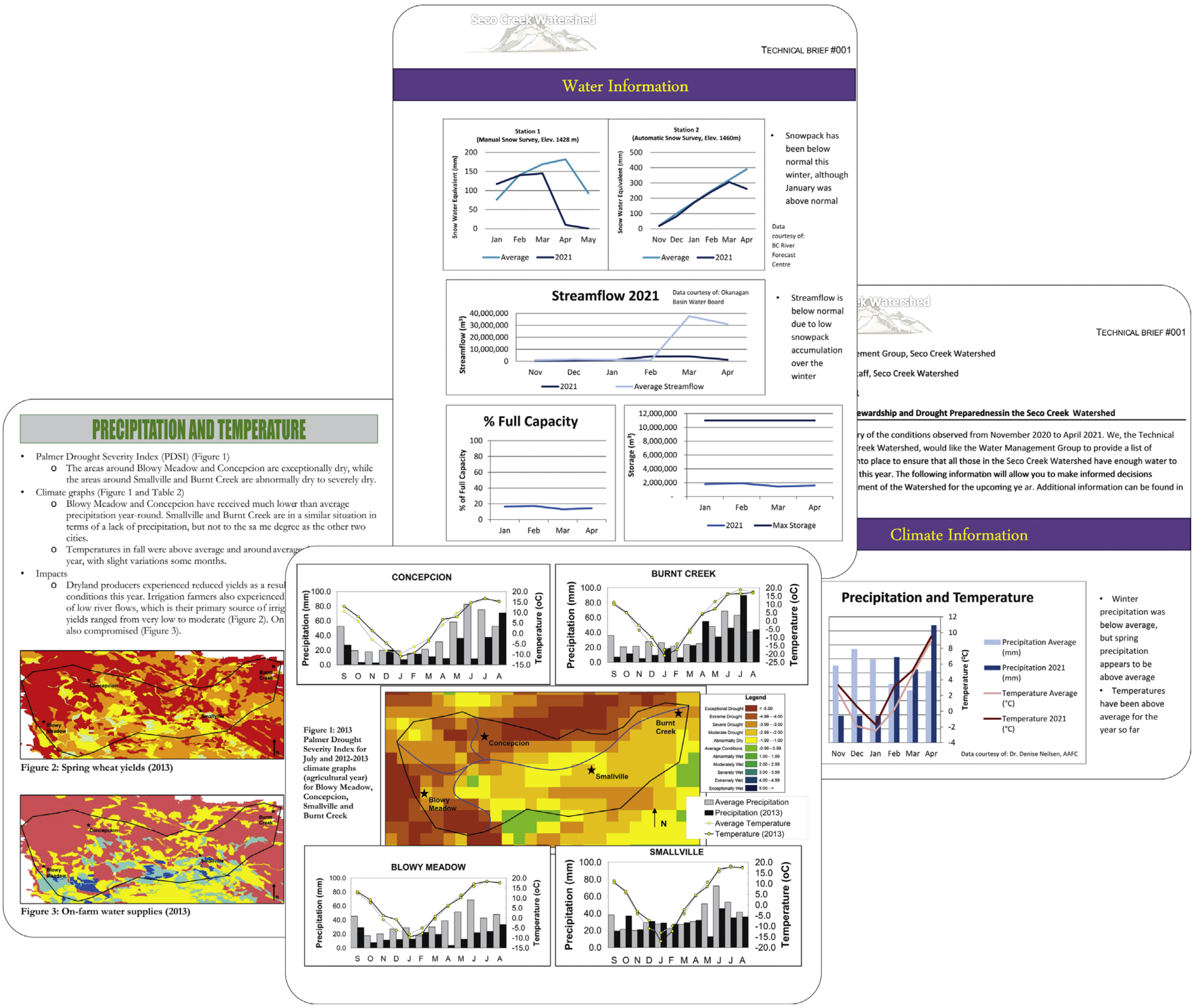

Fig. 4. Sample scenarios from two Invitational Drought Tournaments watersheds (the Oxbow basin [bottom] and Seco Creek [top]).

their teammates; this is why the option to propose innovative solutions is provided after the teams play at least one round.

A number of participants have found the integrated approach to solving complex problems under uncertainty and assessment of trade-offs to be valuable, and the decisions and innovations developed by the teams to have real world applications. Participants liked the opportunity to think freely, propose their innovations and network. They also improved their understanding of drought impacts and had increased sensitivity to the complexity of, and issues associated with, enhancing drought resilience. Ninety-six percent of participants at the Okanagan IDT either strongly agreed or agreed that the IDT was a good learning experience and 77% (i.e. 20 of 25 respondents) felt they learned a lot about water management issues from the tournament.

5.2. *Providing participants with feedback on their drought plans*

A consistent challenge in the IDTs has been to integrate the decisions of the teams into the water budgets in order to show how their decisions affect water supplies, allocations across sectors, and so on. Therefore, many participants have commented that more feedback on the cumulative effects of their decisions is desirable. In Calgary, for example, participants made decisions each round of the game, but consequences of their decisions did not carry forward into the subsequent rounds. If feedback had been provided, it would have helped players and teams to understand the implications of their watershed decisions in terms of increased resilience or risk. It would have also provided important learning opportunities and assistance in scoring.

To address the participants' concerns, a system dynamics model that supports the IDT is currently under development at the University of Alberta. The IDT Model is intended to be flexible and simple to use, allowing non-experts to modify model parameters to fit the circumstances of their own IDT event with minimal effort, and to understand the model results with little training in model use or knowledge of the modeling methodology. Simultaneously the model must be powerful and comprehensive enough to provide reasonable, meaningful results for the effects of the selected policies on the basin water balance, demand and use, crop and livestock production, industrial production, technological progress and economic welfare. Particular advantages of the current version of the model are that it (1) enhances understanding of the effects of policy selections on important basin characteristics; (2) illustrates dynamic interactions between the policies each team selects in each round of the IDT, unanticipated consequences of those policy choices, and their short and long-term impacts; and (3) quantifies divergences in the basin water balance, municipal water use, crop yields and land use between

Fig. 5. Gameplay at the Okanagan Invitational Drought Tournament in Kelowna, British Columbia on November 16, 2012.

the teams over the course of the game, and thus the quantitative effects of the various policy combinations selected by each team.

The IDT Model was developed to represent the main characteristics of the water system in the fictitious basin created by AAFC. To be useful for a drought-focused game, the model is intended to be comprehensive, covering the key components of economy, land use, agriculture, water demand, water supply and human and animal populations. Because the policies in the IDT affect both the water supply and demand, the model was divided into three main parts: (1) water supply; (2) water demand; and (3) water management policies. Moreover, as in other similar water resources management models e.g. (Ahmad and Simonovic, 2004; Langsdale et al., 2007; Williams et al., 2009), the water demand component can be further divided into two pieces: municipal (residential) water use and agricultural water use. Land use decisions are also represented in the model as shifts between areas allocated to dryland and irrigated agriculture, and to fallow land and greencover. Thus, the model currently consists of five main sectors that are connected through water allocations and land use decisions: a simplified hydrological cycle, including reservoir storage; municipal water use; irrigated agricultural water use and crop production; dryland agriculture and crop production; and livestock production. Further, municipal water use is subdivided into five components – four indoor water uses (kitchen, toilet, bathing, and laundry), and outdoor water use – while agricultural crops include forages, grains, oilseeds, root vegetables, and pasture, and livestock includes beef cattle, dairy cattle, pigs, and chickens. Recent model additions include a user-friendly graphical interface, expansion of crop types to include tree and vine crops, recreational use of reservoirs, and mining and thermoelectric power production. The basic logical framework of the water components of the model are shown in Fig. 6.

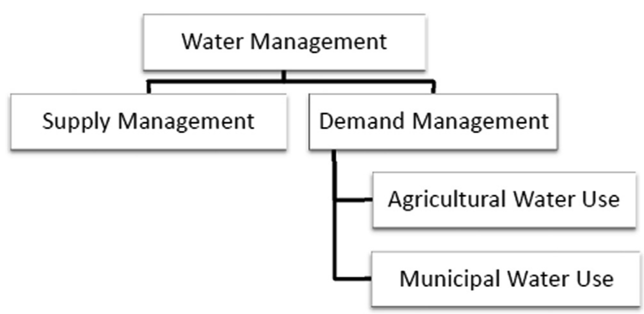

Fig. 6. Basic Structure of the IDT system dynamics Model.

The participant comments from the Saskatoon IDT were positive. The model enabled participants to understand better the cumulative effects of their decisions and the associated trade-offs and to have more meaningful discussions about the long-term impacts of their policy and water management decisions. One sample output from the model is shown in Fig. 7. The output illustrates teams' water use in the fictitious Oxbow Basin over rounds 2013–2018 and allows for comparisons to be made in terms of the differing impacts of teams' decisions on water use.

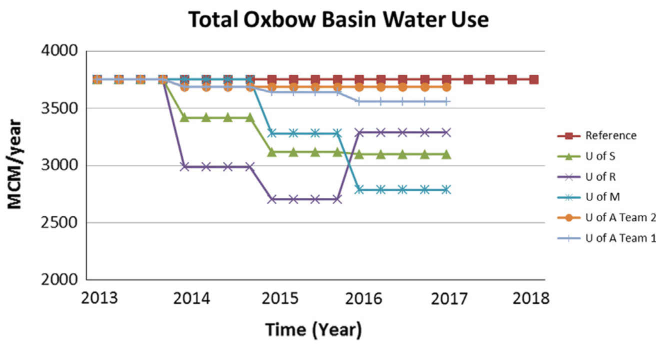

Fig. 7. Total Oxbow Basin water use. Sample output chart from the IDT Model used at the Saskatoon IDT in 2012.

5.3. Evaluating and scoring drought plans

A scoring system is used to facilitate competition between IDT participants and allows for the assessment of teams' management plans each round. The scoring process requires participants to reflect on other teams' plans and to assign them a numeric value, which helps determine the game's 'winner'. In the game, participants make decisions about which plans they feel best address drought preparedness and reduce drought impacts (environmental, economic and social) in the fictitious watershed. This provides important insights into the trade-offs people are willing to make and which strategies people favor in the context of drought. The scoring system has evolved through several applications of the IDT. Thus far there have been three types of scoring systems: expert-derived (top-down), participatory (bottom up), and a hybrid approach (balanced). Each of the systems has strengths and weaknesses depending on the context.

The first scoring system, used in the Calgary IDT, was an expert-derived scoring system, which was developed by technical experts who assigned particular scores to specific management options. This approach was efficient, but participants voiced concerns over its lack of transparency, subjectivity, and for narrow valuation of choices. The desire for more participant input in the scoring reflects a transition to a strategy of collaborative, transparent decision-making in time-sensitive natural resource management, and policy making (Sasaki, 2011; White et al., 2010). In order to overcome these drawbacks, a second scoring system was developed to give participants in the game input on the outcome of the game, but also afforded oversight from referees.

The second participatory system, applied in the Saskatoon IDT, used the audience response system called Turning Point. As teams presented their chosen adaptation options at the end of each round, all of the participants took part in a voting procedure that determined the scores for each team. The scoring occurred on two levels. First, every individual player and referee voted on each team's management plan presentation. Participants were asked to assess the plans' ability to reduce the impact on environment, society and economy. After each individual player had voted, teams were given a short time for discussion about the presentation of the strategies. Then each team voted (i.e. scored the other teams). The teams were informed that the final scores consisted of cumulative averages from each round, and were weighted as follows: 25% individuals, 25% teams, and 50% referees. The winning team was the one with the best overall score at the end of the game.

Two specific drawbacks were identified with the participatory system used at the Saskatoon IDT. First, it took considerable time for individuals and teams to enter their votes/scores. Second, the self-vote led to 'gaming behavior' among some of the participants, as certain groups and individuals who were involved in the game began to award high scores to themselves and low scores to other teams regardless of the adaptation options selected. A Monte Carlo analysis of the scores under different weight regimes shows that the scoring system can be used to identify self-serving patterns in individual's and teams' scoring (Strickert et al., 2012, 2013). To eliminate selfish behavior a hybridized scoring system was developed for the Okanagan IDT.

The third hybrid scoring system was developed to balance subjectivity and objectivity in the Okanagan IDT. The subjective portion of the scoring used a paper-based scoring system that was similar to that of the Saskatoon IDT. The self-votes and team-votes were removed to regulate teams from playing in a self-serving manner. The weightings of votes from participants were maintained at 25% individuals, and 50% referees. The team vote was removed in favor of what was an attempt at a pseudo-objective component to help with scoring, namely a utility model that comprised 25% of the score.

The strengths of the hybrid system are twofold. First, it provides participants with input on the outcome of the game. Second, it appeared more efficient because participants only scored on the perceived effectiveness of economic, social and environmental spheres and not on the long term and short term effects for each sphere. Furthermore, the team vote was eliminated, thus saving time from more team discussion.

The hybrid system also had two weaknesses as it was applied in the Okanagan IDT. First, although removing the team votes increased efficiency, it resulted in the loss of important interactions between the teams. In the Saskatoon tournament, the teams voted on other teams' performances. This provided feedback and reference points on their individual thoughts, justification for their team's choices, and helped to crystalize their management strategies in the later rounds of the game. Second, the introduction of the Utility Model in the Okanagan IDT was an excellent idea, which needs more consideration and planning for future tournaments. However, the utility model was essentially a black box model with no participant input. Furthermore, the utility model outputs influenced how individuals scored the other teams and it distracted teams from their task of choosing the best adaptation strategy by having the teams attempting to select options to satisfy the utility.

6. Discussion

Building on the feedback and lessons learned described above, AAFC and its collaborators have developed the IDT Framework to help guide users who wish to conduct their own IDT. The IDT Framework is shown in Fig. 8 and is described in the following sections.

6.1. IDT logistics

The first step in the logistical planning of an IDT is to characterize the issues of concern to the game organizers and participants, their needs and the desired outcomes. This is an important step as it enhances participant buy-in and interest in the tournament. It also helps identify the target audiences, possible participants, set the goals and objectives for the game and identify collaborators and partners. Setting realistic expectations and making them explicit will help ensure participants have a fruitful experience. Clients can include a wide range of people or organizations; participants can include a combination of referees, observers, coaches, players and consultants (see Table 1 for definitions). Referees and players are required, the other roles are optional.

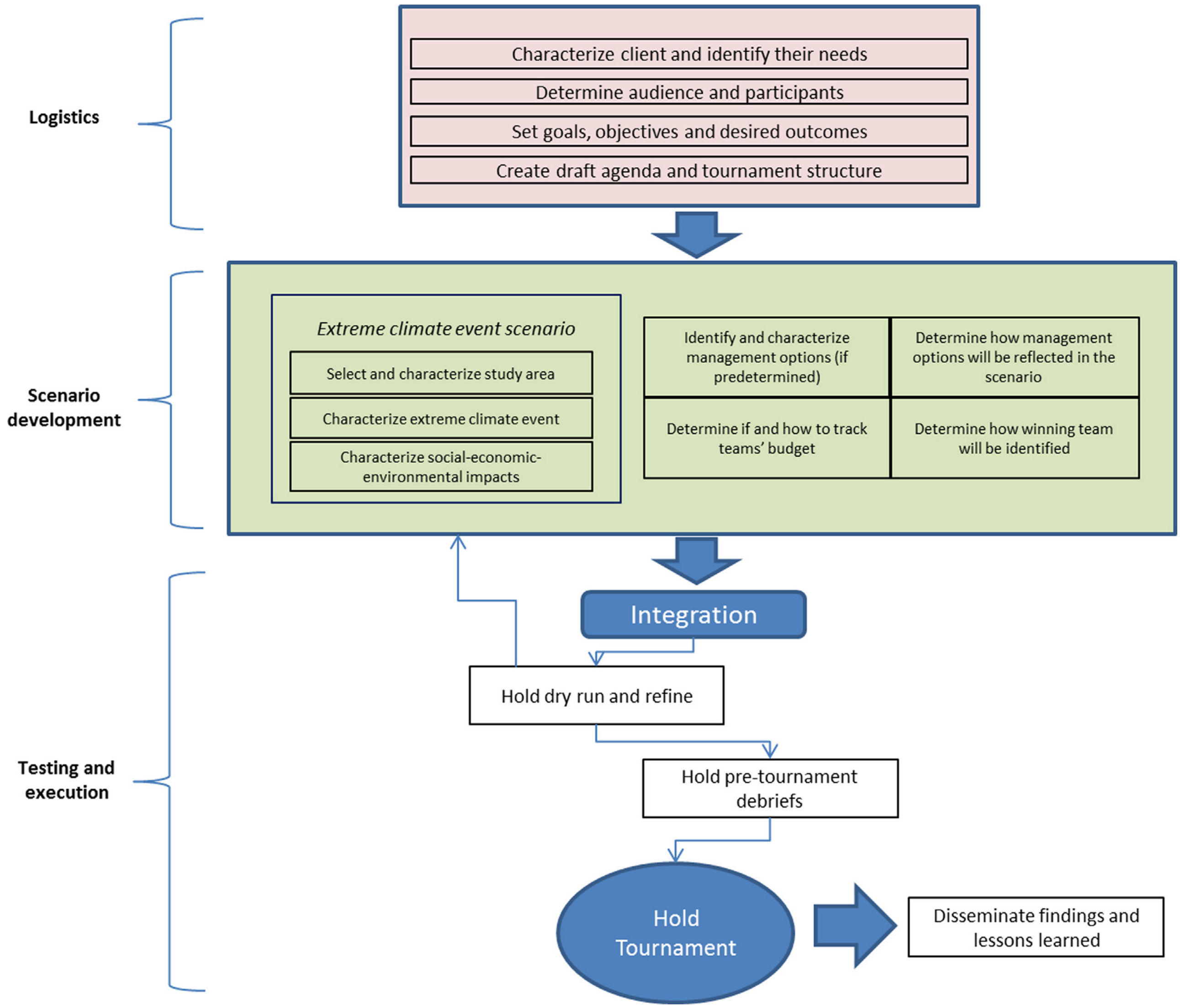

Fig. 8. The Invitational Drought Tournament Framework components. These steps are necessary to plan an IDT and for the IDT exercise to be successful.

Table 1
Description of participants in an IDT.

Role	Description
Referees	People familiar with the IDT process and respected experts in their field. Teams can consult them for a price and have expertise in a range of areas. They may contribute to the scores teams receive for their management options, and make decisions regarding tournament logistics or gaps in the IDT process.
Observers	People observing the IDT for: possible future applications, out of interest, for feedback on the IDT process, to write reports, etc.
Coaches	*Players* whose responsibilities align with team discussions and play the role of team leader in support of one team's interests.
Players	Members of a team and actively participating in the IDT.
Consultants	People with rich knowledge in relevant areas. Teams can consult with them for a price, and they may also be *observing* the tournament.

Creating the agenda and tournament structure is the second step in planning. Tournament structure refers to how the exercise will be set up and how the game will be played (e.g. discussion, decision process, scenario time-step, models to be used, if any, scoring system, etc.). These steps are essential, especially when there are numerous collaborators, and serve to guide and inform scenario development. Ambiguity in terms of goals and objectives at this stage creates confusion and results in a lack of coordination and potential overlap (e.g. duplication) in the work. The structure can be captured informally through discussions but could be formally documented to ensure everyone is clear as to what will occur.

6.2. *Scenario development*

After a study area (e.g. watershed, sub-watershed, etc.) is selected, a decision needs to be made as to whether it will be presented as real or fictitious in the game. The next step is to characterize the study area, including any background information of importance to participants (e.g. past extreme drought events and impacts). The background information can inform any materials distributed to participants before or at the tournament and help identify the appropriate drought scenario and impacts for participants (e.g. magnitude, length and severity of drought, variability, etc.). The biophysical scenario can be based on an event that occurred in the past (historic or instrumental record) or one projected in the future (climate models), and include one or more types of drought (i.e. meteorological, agricultural, hydrologic and/or socioeconomic). To maximize participants' experience in the game, it is necessary to translate the biophysical drought into social, economic and environmental impacts. These can be incorporated in the scenario via indicators, visualizations, or other means.

Management options with which teams can experiment need to be identified and depend on the goals, objectives and anticipated outcomes of the exercise. Some questions to consider include: what is the scope for management options? Are the game designers going to target or narrow them (e.g. to a pre-determined list, to certain types of options, etc.)? Another decision to be made is whether to include a decision-support system in the game. Is a decision support system necessary to maximize the learning experience and realism of the game, or is a discussion around the management options sufficient? There are varying levels of complexity at this stage, from simple discussions to complex tools. The answers to these questions will depend on the resources available, goals, objectives and anticipated outcomes.

The type of scoring system also needs to be selected. The main consideration here is which criteria to use to evaluate the management options (e.g. three pillars of sustainability, effectiveness, cost, etc.). AAFC has tested a few approaches, described in Section 5.3. In certain circumstances, such as during a one-round game primarily intended to trigger dialog, the scoring can be completed through a simple show of hands (i.e. each player can raise their hand to vote for any team they think had the best plan besides their own).

6.3. Testing and execution

The testing phase refers to the test run with a group of people that will not be participating in the actual IDT. This allows for identification and correction of any minor glitches and for materials to be modified if necessary. The pre-tournament debriefs are optional but are strongly recommended. They allow distribution of information on the game concept to participants and discussion on what will transpire at the actual event. As such, they provide an opportunity to address questions and concerns, and maximize the use of people's time at the game. Finally, execution refers to the completion of the game and dissemination of key findings and results.

7. Conclusions

The IDT simulation game has provided the opportunity for participants to learn from one another and share their knowledge and experiences, as well as to collaboratively develop realistic solutions to drought preparedness, response and other drought-related challenges. Interesting research opportunities have also emerged, and as a result, many models (e.g. system dynamics and utility models) and theories (e.g. cultural theory) have been tested and explored. These research results have, in turn, informed game development and helped enhance participants' experiences in the game. Although not discussed in detail in this paper, incorporating a decision support system such as the the IDT System Dynamics Model has improved team decision-making in the game and the scoring system has yielded valuable insights into the ways in which people make drought management decisions.

The IDT has also proven to be an effective mechanism to support drought preparedness planning and post-drought assessments. An initial driver for the Okanagan IDT, for example, was to test the Province of British Columbia's Water Act Modernization framework in a watershed setting. The innovations proposed by teams at the Okanagan IDT are being considered in the province's policy development. NIDIS in the United States has co-funded one drought tournament that was well received, and as a result of its success, is actively exploring how to integrate the IDT concept in its proactive drought mitigation and drought planning processes.

The IDT can also potentially support efforts to increase drought preparedness in other parts of the world, as well as planning for other extreme climate events and hazards. Many participants have suggested the overall IDT Framework could support learning, consensus building and planning for a variety of complex issues requiring input from multiple stakeholders.

The IDT is an innovation in the field of drought preparedness planning tools and simulation gaming. The IDT's structure allows for social learning but also goes beyond, challenging players to holistically consider the impacts of drought and build consensus around possible solutions. It helps players consider proactive measures and innovative responses to drought that can generate increased resilience and reduced vulnerability, and does so within a framework that is fun for participants. It also facilitates communication with non-traditional stakeholders in drought preparedness processes and provides an opportunity to test a range of theories and models.

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