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Tools for adaptive governance for complex social-ecological systems: A review of role-playing-games as serious games at the community-policy interface.

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Abstract:
The management of natural resources – from forests to fisheries to freshwater – is becoming increasingly complex and requires new tools and processes for engaging with individuals, communities, and decision-makers. Policy makers and practitioners have begun using Serious Games (those used for purposes other than entertainment) to overcome some of the complex challenges of governing resources in social-ecological systems. This paper uses a systematic literature review methodology to assess role-playing serious games for natural resource management. Fifty-two articles from the role-playing game (RPG) subset of serious games are identified, synthesised and analysed using a multi-criteria evaluation framework. First, we explore three theoretical and conceptual elements of games: principles of RPGs, functions of games, and (practical) game characteristics. We evaluate game elements, including game design, adherence to reality and the degree to which games integrate elements of participatory- and action research. These dimensions of RPGs are then analysed and discussed. Particular attention is paid to the value and application of RPGs to address complex problems with interacting environmental, social, cultural and economic challenges, and the extent to which they can inform adaptive governance solutions. Results show that RPGs can be a valuable tool at different levels; however, we also identify important gaps in the current state of knowledge, in particular, related to bridging community- and higher-level decision-making scales through RPGs.

1. Introduction and background

Serious Games (SGs) are games primarily intended for education, rather than amusement (Abt, 1987: 9), contributing to pre-defined objectives while engaging the user (Susi et al., 2007). In recent years, SGs have been used in diverse contexts including agriculture (Hill et al., 2014), risk management, food security, water resource management, climate change (Lawrence & Haasnoot, 2017), environmental management (Garcia-Barrios et al., 2017), health and education (Ricciardi & De Paolis, 2014) to engage individuals, communities, and decision-makers with complex resource problems, including wicked problems (Flood et al., 2018; Lawrence, 2010). Many of these games, in an environmental context, draw attention to, or focus on, adaptive governance mechanisms for resolving tensions between competing demands.

Adaptive governance in this context refers to an emerging mode of governance that rejects linear or goal-based frameworks in favour of flexibility, shared resources and mutual understanding (Brunner et al., 2005; Chaffin et al., 2014; Schultz et al., 2015). While there remains some debate in the literature about its precise definition (Koontz et al., 2015; Hasselman, 2017), several common characteristics have been identified (Karpouzoglou et al 2016), including adaptability (e.g. Folke et al., 2005; Olsson et al., 2006), collaboration to achieve desired outcomes (Chaffin and Gunderson, 2016; Wyborn, 2015), learning and experimentation (Crona & Parker, 2012; Sharma-Wallace et al., 2019), and flexible governance arrangements (Janssen & Van der Voort, 2016; Nanda et al., 2018). Adaptive governance
principles ensure that the social, political, cultural and ecological contexts of environmental problems are directly incorporated into existing governance structures in order to transform governance structures themselves and the whole system in order to address the problem(s) in a more holistic way (Folke et al., 2005).

The challenges of implementing adaptive governance for common-pool and other resources are well documented. Critically, we see an opportunity for SGs to provide a pathway for experiential learning and adaptation by different actors, providing a safe innovation space for experimentation, at various political and administrative levels across geographic scales (Johnson et al., 2011; Garcia-Barrios et al., 2017; den Haan & van der Voort, 2018; Flood et al., 2018). Given the growing interest in adaptive governance and SGs, the following review seeks to systematically identify, review and assess the literature, to support the empirical application of adaptive governance and accelerate conceptual and theoretical development. More specifically, the review focuses on a subset of SGs: role-playing serious games (RPGs) – in which individual players assume a different identity for the purposes of the game.

There are other reviews of SGs, although they are limited in number Roberts (1976) provides one of the most relevant and comprehensive reviews; however, given the adaptive governance turn in environmental and natural resource sectors, an update is warranted. Katsaliaki and Mustafee (2012) assessed sustainable development SGs focused on learning and teaching and find that these SGs are generally online, single player and aimed at young people. There was no examination of how games can support collaboration, a key element in adaptive governance. Reckien and Eisenack (2013) review 52 serious games for climate change, noting that less than half deal with adaptation to climate change, a gap that is dealt with in the review by Flood et al. (2018). Mayer (2009) published a review of gaming in policy – the promotion and use of gaming in policy-making, and how policy-making can be supported through gaming. Most recently, den Haan and van der Voort (2018) review 42 publications, specifically to assess social learning outcomes addressing sustainability issues.

Social learning refers to the “collective process of acquiring, processing and disseminating knowledge” (Heikkila & Gerlak, 2013: 486). It is understood as a change in understanding achieved through interaction in collaborative and participatory settings (den Haan & van der Voort, 2018). Deliberative interactions form the backbone of social learning approaches, whereby a broad range of stakeholders work together building relationships that result in some form of collective action (den Haan & van der Voort, 2018; Baird et al., 2014; Cundill & Rodela, 2012; ). Baird et al. (2014) define social learning as changes in cognitive (knowledge and thinking), normative (norms and approaches) and relational (interpersonal connections, networks and trust building) learning. SGs offer the collaborative and participatory stakeholder interactions necessary to generate positive social learning outcomes (Ampatzidou et al., 2018; Medema et al., 2016; Salvini et al., 2016; Becu et al. 2017).

We anticipate the outcomes of this review will inform both the growing body of literature in games and gaming, and the development, use and application of serious RPGs in adaptive governance approaches to community land-use management and development. The review can inform game design, particularly the scaling of games to fit particular decision-making contexts. The review will also demonstrate the ability of RPGs to inform adaptive decision-making and contribute to social learning. While previous reviews have included RPGs, none of these studies have systematically considered the use and application of RPGs with reference to adaptive governance.

The review is structured as follows: We begin by describing the conceptual elements and principles of serious games and role-playing games and their relationship to adaptive governance, and advance a framework for empirically evaluating their significance. We then present the results of the systematic review, focusing on the significance of RPGs for adaptive governance and their impacts, followed by discussion, conclusions and recommendations.

2. Adaptive governance and role-playing serious games
There is a growing body of literature investigating the relationships between institutional arrangements and the management of natural resources, for example, water management, conflict and cooperation around land and water and community management of forests (c.f. Cleaver, 2017). Developed over the last three decades, much of this work conceives the relationship between the biophysical environment and the human management systems, governance and institutional arrangements and practices used to sustain them, in terms of linked social-ecological or human-environmental systems. In theory, such systems are capable of responding to change, while preserving functionality (Berkes et al., 2002; Folke et al., 2005).

In practice, however, decision-making processes for natural resource management often entail complex social dynamics including trust building, power imbalances and vested interests. Stakeholders may become polarized, adopting antagonistic positions, or processes may be costly, leading to disillusionment. To overcome some of these challenges, adaptive governance has been proposed as a way to better account for the social dimension of adaptive co-management of ecosystems and landscapes (Brunner et al., 2005; Pahl-Wostl, 2009). Unlike conventional modes of governance which rely on linear- or goal-based frameworks, adaptive governance focuses on tools and approaches that seem to be of significance in responding to crisis, shaping change and building resilience for reorganization and renewal of social-ecological systems, both internally and in relation to shocks and stressors (Dietz et al., 2003; Folke et al., 2005; Walker et al., 2004). Marking a shift from management to governance, adaptive governance acknowledges the dynamic, multi-faceted character of environmental issues, which necessarily involve diverse scales, actors, and contexts, and notes the subsequent need for flexibility, social learning, and capacity for change in any proposed solution (Brunner et al. 2005; Olsson et al. 2007; Armitage et al., 2008; Akamani et al., 2016).

Recent reviews of the field note the continuing importance of adaptive governance in theory and practice but flag critical areas for further study (Chaffin et al., 2014; Karpouzoglou et al., 2016; Sharma-Wallace et al., 2018; Wyborn, 2015). The role of power and equity relations is an understudied but central component of adaptive governance process and outcomes, often contributing to either the success or failure of adaptive governance approaches on the ground (McDougall et al., 2013; Sharma-Wallace et al., 2019; Wyborn, 2015). Wyborn (2015) suggests that adaptive governance scholarship devote more attention to situated, contextual, or relational perspectives over the traditional focus on abstract design principles and conditions underlying adaptive governance systems.

Other challenges relate to the empirical operationalization of adaptive governance. A more comprehensive understanding of both the methods, tools, and frameworks necessary for adaptive governance approaches and the existing institutional and regulatory barriers to its application is still required for the successful implementation of adaptive governance across cases (Chaffin et al., 2014; Olsson et al., 2006). In order to help address this gap, Sharma-Wallace et al. (2018) reviewed 92 empirical cases of adaptive governance to distil eight methods or elements of adaptive governance in practice. They found that adaptive governance includes collaboration, coordination, social capital, community empowerment, capacity development, linking knowledge and decision-making, leadership and governance opportunities.

Collaboration involves meaningful cross-scale multi-actor interaction, emphasising the incorporation of a large range and diversity of stakeholder perspectives and capacities, including formal and informal opportunities (c.f. Brunner et al., 2005; Olsson et al., 2008). Coordination involves bringing together geographical, actor and issue scales, often through a formal coordinating body (Olsson et al., 2007; 2008). Central to adaptive governance is social capital, or base levels of trust, familiarity and goodwill between actors; often this is built up over long time periods (c.f. van Niekerk, 2014). Community empowerment is also critical, as communities are where governance change is implemented and felt (c.f. Olsson et al., 2008). Capacity development is necessary for adaptive governance and includes knowledge, resources and the scope for action to sustain governance activities (c.f. Abrams et al., 2015).
Adaptive governance also needs to link science and decision-making. Stakeholders require the best available information concerning the problem and potential solutions (c.f. Serrao-Neumann et al., 2016). While the foregoing elements are necessary, sometimes a skilled, charismatic and passionate leader is required to locate emerging or old problems, bring actors together and coordinate support (Olsson et al., 2004). Finally, Sharma-Wallace et al. (2018) highlight the necessity of being ready for windows of opportunity for adaptive governance – taking advantage of events (such as natural disasters or a change in government) to initiate adaptive governance (Brundiers & Eakin, 2018; Cradock-Henry et al., 2019; Olsson et al., 2006).

The notion of adaptation implies capacity to respond to change and even transform social-ecological systems into improved states (Folke et al., 2005; Olsson et al., 2006). Adaptive governance thus focuses on experimentation and learning, and it brings together research on institutions and organizations for collaboration, collective action and conflict resolution in relation to natural resource and ecosystem management (Brunner et al., 2005; Chaffin & Gunderson, 2016). The essential role of individuals needs to be recognized in this context (e.g., leadership, trust building, vision and meaning); their social relations (e.g., actor groups, knowledge systems and social memory); and social networks serve as the web that ties together the adaptive governance system (Gunderson & Light, 2006; Chaffin & Gunderson, 2016). It involves cross-level and cross-scale activities (Janssen & Van der Voort, 2016) and includes governmental policies that encourage creativity and experimentation with different tools, methods, and approaches.

Rumore and Susskind (2013) introduce the concept of role-playing simulations for adaptive planning. However, while not specifically designed for adaptive governance, several of the functions of games as described by Mayer et al. (2004) can be related to adaptive governance. Democratization or equal access for all participants links closely with Sharma-Wallace et al.’s (2018) cross-scale multi-actor collaboration element, which emphasises incorporating a large range and diversity of stakeholders (participants). Mediation and the development of methods for conflict resolution can also be related to adaptive governance through the element of social capital, where stakeholders negotiate initial disagreements or conflict, and over the longer term, go on to develop working relationships. Finally, we note Mayer et al.’s (2004) design and recommendation, which is described as ‘out of the box’ thinking and delivering solutions, links well to cross-scalar and multi-actor collaboration, where the results of the collaboration process are fed back into official policy and practice.

The characteristics of robust serious games, relationship with the real world, having purpose and value, and being engaging and enjoyable for players (Harteveld, 2011) and those described by ProActive (2009) in Table 1 also link to Sharma-Wallace et al. (2018)’s elements of adaptive governance.

**Table 1.** Linkages between game characteristics and adaptive governance, compiled from ProActive (2009) and Sharma-Wallace et al. (2018).

| Good game characteristic                                                                 | Adaptive governance element                      | Linkages                                                                 |
|----------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------|
| Conflicts and objectives; participants work towards a resolution                        | Cross-scale multi-actor collaboration            | Both elements touch on the diversity of stakeholders and the diversity of views that each will have, creating the opportunity to negotiate through conflicting positions. |
|                                                                                        | Community empowerment and engagement             |                                                                         |
|                                                                                        | Social capital                                   |                                                                         |
| **Short feedback cycles; feel the impact of their decisions quickly**                  | Cross-scale multi-actor collaboration            | While not necessarily quick in the case of adaptive governance, both elements describe how the results from participation in adaptive governance exercises need to |
be fed back to decision-makers for inclusion, and the implementation of policies or plans.

| Immersion and engagement; entertaining players | Cross-scale multi-actor collaboration | While not necessarily about entertaining participants, there is a need in adaptive governance to ensure that stakeholders are engaged in processes from planning to implementation. |
|-----------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Challenges; learning skills                    | Bridge and match scales              | Games can serve as learning tools that can help participants to develop their capacity to integrate different types of data into decision-making. |
|                                               | Capacity development                 |                                                                                                                                                |
|                                               | Link science and decision-making     |                                                                                                                                                |
|                                               | through data collection and monitoring |                                                                                                                                                |
| Collaboration amongst peers                   | Cross-scale multi-actor collaboration | Over time, participants will develop working relationships amongst themselves, collaborating on developing solutions. |
|                                               | Social capital                       |                                                                                                                                                |

Finally, Simons and Ruijters (2008) and ProActive (2009) suggest there are five metaphors for learning, where four can contribute to adaptive governance. Learning by doing relates to capacity development, participation and social concepts of learning relates to cross-scale multi-actor collaboration, discovery or transformative actions through engagement relates to community empowerment and engagement, and transfer of information can be linked to linking science and decision-making through data collection and monitoring. All of the metaphors for learning can be related to capacity development.

By focusing on role-playing serious games (RPGs) – in which individual players assume a different identity for the purposes of the game – the following review seeks to gain insight into the degree to which RPGs can.... Furthermore, the review focuses on RPGs as a subset of serious games, for their potential replicability in remote areas. While advances in computer simulations for SGs are welcomed, their suitability is limited in areas with poor telecommunications infrastructure, including some rural regions in developed countries and many developing country contexts, especially those that are data or bandwidth poor. As such, the review is broadly applicable to other remote or less developed regions, and relevant for nearly all complex environmental issues in crossing decision-making domains between community and other higher levels.

3. Methods

To assess the literature on function, use and potential of RPGs for resource management, a systematic review methodology was used. Systematic review provides a structured process for the collection and analysis of knowledge. Transparency and documentation allows for data validation and replication, while the typically large scope of the review helps generate new insight across existing work (Petticrew & Roberts, 2006; Higgins & Green, 2008; Booth et al., 2016).

We followed a multi-step systematic review process, including development and documentation of the research question and research protocol, progressive literature search and refinement phases and data extraction, synthesis and analysis (Khan et al., 2003; Higgins & Green 2008). Table 2 outlines the inclusion and exclusion criteria applied during the literature search and refinement stages of the review.

Table 2. Inclusion and exclusion criteria used in the literature search and document selection phase.
Inclusion Criteria | Exclusion Criteria
--- | ---
Must be a game or a role-play | Does not include game or role-play
Type of study: article, book, book chapter or conference paper | Type of study: NOT article, book, book chapter or conference paper
Must be land-based; may include urban, peri-urban and estuarine areas | Non-land-based or marine areas
English language publication | Non-English language publication
Novel/new information not repeated elsewhere | Repetition of published material
Date range*: Post-1990 to present | Date range: Pre-1990
Note: “A survey of serious games on sustainable development found that the first game paper dated back to 1990 (Katsaliaki & Mustafee 2012).

A preliminary search of the literature on game-based scenarios returned many education-focused results on ‘game-based learning’. Based on terminology found in previous studies on scenarios and natural resource management (cf. Castella et al., 2005), we expanded our search terms for the review to include: simulation gaming and multi-agent modelling; RPGs; multi-agent simulations; multi-agent system simulations; gaming simulation; game-based learning; and structured game-based training. The filter term ‘and natural resources’ was added to all keyword searches. Following the initial searches, we added the term ‘serious games’ and ‘natural resources’ due to its repeated appearance in the literature. We searched the Scopus, Web of Science, Science Direct, Google Scholar and Google Web databases and screened results for relevance on the keyword, title, abstract and full text level according to the inclusion and exclusion criteria (Table 2). If the search terms were present in any of the search fields, we included the result in the initial phase of literature collection (Table 3, Phase 1). Our literature database included the full bibliographic citation information for each search result and was screened to remove exact duplicates (Table 3, Phase 2). After inclusion/exclusion screening was completed, our final body of literature included 147 studies on game-based scenarios and natural resource management (Table 3, Phase 3).

Following a scan of the 147 systematic search results, we discovered that many of the articles located in our search reported the same or slightly different aspects of the same overall projects in which a RPG was embedded. From the scan of each article, the RPG was determined to be a “constant”, and thus, no new data about the game itself was presented in the multiple articles. As a result, only one or two papers from the same project were selected to provide the greatest ‘coverage’ of RPGs in natural resource management contexts where the RPG aspects remained constant while other data or methods were explored. In addition, the criteria for the type of papers to be reviewed were tightened, eliminating theses, working papers and most reports. Only peer-reviewed journal and conference papers were included in the final review. Some exceptions to these more stringent requirements included those papers that already had data extracted, and the few papers that provided an actual RPG, along with some information on its creation and/or deployment (c.f. Emerson et al., 1999; Barrett et al., 2003; Walsh et al., 2014). Fifty-two cases were included in the final review (Table 3, Phase 4).

**Table 3.** Summary of the literature search and refinement phase.

| Phase 1: Literature scope | Description | Number of studies |
| --- | --- | --- |
| Total studies | 955 |
| Web of Science | – | 127 |
| Scopus | – | 341 |
| ScienceDirect | – | 301 |
| Google Scholar | – | 71 |
| Google Web | – | 115 |

| Phase 2: Elimination of | Description | Number of studies |
| --- | --- | --- |
| Total studies | 955 |
| Total unique papers | – | 437 |
duplicate papers from different databases

- Total exact duplicate papers excluded = 518

### Phase 3: first stage literature refinement

| Category | Total included | Total excluded |
|----------|---------------|----------------|
|          |               |                |
|          |               |                |
|          |               |                |

- No role-playing game = 197
- Not land-based = 40
- Type of study: not article, book, book chapter, working paper, report, conference paper or thesis = 32
- Virtual (not face-to-face) = 2
- Pre-1990 = 7
- Multiple criteria not met = 12

### Phase 4: case extraction & refinement

- Total included = 52
- Total excluded = 95

- Working paper, report or thesis = 18
- Repetitive RPG description = 25

Notes: aIncludes relevant chapters extracted from edited books, accounting for the discrepancy between Phase 2 and Phase 3 inclusion and exclusion totals.

bSeveral studies included multiple and/or duplicate cases. We extracted individual cases from each study and screened the cases for relevancy according to the inclusion and exclusion criteria described above.

Table 4 summarizes the categories used in the data extraction, organization and analysis stage of the literature review. Data extraction methods followed the general systematic review template. We extracted, organized and analysed data from the final body of literature based on a series of data variables chosen for their correspondence to the research questions and foci. Manual coding, synthesis and analysis drew from these categories to emphasize mechanics of game purpose, design, execution, and evaluation and internal and external factors for success or failure. Knowledge gaps and lessons for practice within the context of the research programme were also identified.

### Table 4. Categories used in the data extraction, organization and analysis phase.

| Category       | Details                        |
|----------------|-------------------------------|
| Bibliographic details | Author(s), title, publication data |
| Study context | Research question(s)  |
|                | Type(s) of games used        |
|                | Definition for games used    |
|                | Study findings               |
|                | Study limitations            |
| Game(s)        | How each game was designed   |
|                | How each game was executed   |
| Case context  | Location                       |
|                | Scope                          |
|                | Timeframe                      |
|                | Sector                         |
|                | Community demographics        |
Table 5. Elements of adaptive governance and key words (from Sharma-Wallace et al., 2018).

| Elements of adaptive governance                          | Key words                                                        |
|----------------------------------------------------------|------------------------------------------------------------------|
| Cross-scale multi-actor collaboration                    | Stakeholders; diversity; scale                                   |
| Bridge and match scale                                   | Geographic scale; actor scale; issue scale                       |
| Social capital                                           | Trust; familiarity; goodwill                                     |
| Community empowerment and engagement                     | Community involvement; Communities; outcomes                     |
| Capacity development                                     | Knowledge; resources; scope for action (gained)                  |
| Link science and decision-making                         | Data collection; best information available; experiential learning |
| Strong leadership                                        | Skilled; charismatic leaders                                     |
| Exploiting social-ecological context                     | Change; implementation                                          |

3. Results and review

The following discussion, review and analysis is based on an examination of 52 papers on RPGs that have been applied to one or more aspects of natural resources management. An additional five papers on role-play simulations were also included. Of these, 39 were situated in developing countries and seven in developed countries. Three papers provided general overviews of RPGs, while the rest were focused at the international scale.

The demographic context for game design and play varied across the reviewed cases with a few major points of commonality. While the games targeted diverse sectors, agriculture and water management were predominant and frequently linked (Farolfi et al., 2004; Rajabu 2007; Souchère et al., 2010). Most of the games were designed and implemented in local or regional contexts in the global south, usually at the community or catchment level. Twenty of the papers related to games played to assist natural resource management at the local level, 23 at the regional level, and four at the international level. Of these international games, two were truly international, while the other two were played at the local/regional level and incorporated international components (e.g., international relations and trade). Generally these papers reported on games that had been played in a rural or peri-urban setting. The focus on the local scale potentially reflects the short-term fixed nature and livelihood dimensions of natural resource management, where regardless of the scale of governance, practice and outcome is enacted and experienced on-the-ground first. The majority of games nevertheless accounted for the multiple parties implicated in natural resource issues, with most designed around a particular collective...
environmental conflict or coordination problem. The range of game participants subsequently included a variety of community-level actors with some stake, agency, and pre-existing role in natural resource practice and outcomes such as farmers, landowners, municipal government officials and planners.

With respect to games’ purpose, the papers reviewed included one RPG for each of climate change and natural hazards/disasters, two for forestry, and three generally relating to natural resource management. Two games were purely for educational purposes within a resource management context. Five papers had a conservation focus. The highest number of games was focused on water management (15 papers) and agriculture (16 papers). Several papers provided general details of role-playing and triadic design games (games which balance reality, meaning and play – c.f. Harteveld, 2011), without the natural resources context. This mix of foci provide a variety of perspectives, designs and methods for creating RPGs that can be adapted or customised to deprived areas in developed countries and other adaptive governance contexts.

In practical terms, we found that the RPGs in the review were generally designed to advance sustainable solutions to complex natural resource management and common-pool resource problems. This is in line with the stated goals of adaptive governance, to provide collaborative, flexible and learning-based approaches to wicked or complex problems (Olsson et al., 2006). These might include protracted or emerging stakeholder conflict over resource use, such as tensions between methods of use and distribution of benefits (Etienne 2003; Dung et al., 2009; Hertzog et al., 2014). Problems may also involve overuse or mismanagement of resources, leading to environmental degradation. Examples include encroachment of farmland into areas of ecological significance or intensive agricultural practices contributing to soil erosion and runoff risk (Souchère et al., 2010; Vieira Pak & Castillo Brieva, 2010; Gourmelon et al., 2013; Villamor & Badmos, 2016). In all instances, the games we reviewed sought an acceptable balance or compromise in the form of conflict resolution between competing stakeholders or consensus between environmental protection and community livelihoods.

The following discusses results in more detail, focusing on the links between RPGs and adaptive governance, and evaluation of learning outcomes. A brief overview is next, we then identify and discuss examples of RPGs and their contribution to the following elements of adaptive governance: cross-scale interactions, social capital, community empowerment and engagement, capacity development, monitoring and evaluation, and social-ecological context. The approach is designed to examine RPGs from purpose to design, actual games and each evaluation phase as they relate to adaptive governance.

### 3.1 Games and adaptive governance

From the 57 examples of RPGs reviewed we found 35 with several close connections to characteristics or features of adaptive governance. No one game contributed to all elements of adaptive governance. For example, several of the RPGs highlight socio-ecological dynamics and/or governance arrangements. For example, Walsh et al. (2014) use the RPG to teach the complexities of socio-ecological systems and problems, while Villamor and van Noordwijk (2011) provide understanding of local dynamics and conditions for free and prior informed consent around payments for ecosystem services. There were 6 cases where the game was focused more on the farmer/forester, player and researcher interface; i.e., the game had elements of adaptive governance, but was more aimed towards what the researchers could gain from the game-play (Boisseau & Castella, 2006; Castella, 2009; Castella et al., 2005; Etienne, 2003; Gourmelon et al., 2013; Villamor & van Noordwijk, 2011).

#### 3.1.1 Cross-scale interactions

Adaptive governance seeks to account for the interaction and successful realisation of cross-scale opportunities. The games we reviewed were generally intended to facilitate a low-stakes, risk-free environment in which participants were free to clarify and negotiate values and perspectives, grow awareness, and create and test future innovative management strategies across scales. RPGs in
particular, are a useful facilitation tool as they provide virtual opportunities for collaboration rather than
c ompetition (Adamatti, 2009a). For example, work by Souchère et al. (2010) found that game
participants developed better ‘self-knowledge’ and ways to work with others, allowing the discussion of
classical and innovative strategies for watershed management, while Gourmelon et al. (2013) found that
having no written or recorded record of the game promoted knowledge acceptance and viewpoint
sharing because there were no consequences. Gourmelon et al. (2013) also found that spatial elements
(in particular 3D simulations) stimulated the sharing of opinions and discussion of different interests and
perspectives among participants. Rumore and Susskind (2016) highlight the collaborative approach, and
found that there was a significant increase in the perceived importance of engaging stakeholders and
collaboration.

D’Aquino et al.’s (2003) game worked to define and identify appropriate stakeholders for participation
in land-use decision-making, while Barreteau et al. (2007) used games to introduce current stakeholders
to new stakeholders. Other games attempted to encourage greater participation, interaction and
coordination between stakeholders (Ducrot et al., 2014; Dung et al., 2009; Etienne, 2003; Hertzog et al.,
2014; Rajabu, 2007), including ‘experimenting’ with collective action amongst landowners and
community members (Barreteau et al., 2007; Castella, 2009; Ducrot, 2008; Gourmelon et al., 2013).
Speelman et al. (2014), Barreteau et al. (2001), Souchère et al. (2010 and Vieira Pak and Castillo Brieva
(2010) encourage open discussion and negotiation between stakeholders. Villamor and Badmos (2016)
focus on communicative learning amongst stakeholders, while Barnaud et al. (2007) seek to coordinate
farming action between villagers. Dionnet et al. (2008) and Walsh et al. (2014) look to get stakeholders
out of a ‘conflict zone’ and in the case of Wash et al. (2014) develop a management plan that suits all
competing interests. Finally, some games focused on bringing different stakeholders together in new
constellations and provide a forum for novel interactions (Barreteau et al., 2001; Barreteau et al., 2007;
Blanchard & Buchs, 2015). However, Morardet et al. (2015) highlighted that even within the inclusive
embrace of RPGs, power differentials and organisational problems exist, and can and do lead to the
exclusion of stakeholders.

In the United States, Susskind (2010), Dolin and Susskind (1992) and Rumore and Susskind (2013) bring
together a wide variety of stakeholders both at single (city or local and national) spatial scales, and
across multiple scales – local, county, state and national (also Susskind & Corburn, 1999). Whether at a
single or multiple scales, a diverse variety of actors are included in the simulation games – town officials,
business leaders and residents at the local level (Rumore & Susskind, 2013) to local, county and state
officials, NGOs, community members and leaders (Susskind, 2010) to House of Representatives, Senate
members, company CEOs and heads of public institutions (Dolin & Susskind, 1992).

In a number of games, there were a limited variety of player roles and/or cases where participants
played their real-life roles (Dung et al., 2009; Souchère et al., 2010; Vieira Pak & Castillo Brieva, 2010;
Speelman et al., 2014). This method might help stakeholders to clarify their own perspectives, visions,
and management strategies. Nevertheless, the lack of player variety also limits learning across different
perspectives. Particularly in environmental and natural resource situations where the actions of one
party almost invariably affect other actors at another scale, a more nuanced understanding of other
stakeholders’ experiences may be crucial for game success and learning.

The majority of the games were focused at a single actor or geographic scale, usually local communities
(c.f. Adamati, 2004; Adamati, 2009; Castella et al., 2005; Ducrot et al., 2007; Dung et al., 2009; Hertzog
et al., 2014; Rajabu, 2007; Walsh et al., 2014; Villamor & van Noordwijk, 2011) or across two levels of
scale, usually household and local community or local community and regional/provincial scales (c.f.
Barreteau et al., 2001; Bernardo & Sanders, 1993; Boissau & Castella, 2006; Castella 2009; Ducrot, 2008;
Morardet et al., 2012; Susskind, 2010). Blanchard and Buchs’ (2015) RPG was played solely at the
international scale, but across a number of different sectors, which could be considered ‘issue’ scales.
Susskind (2010) has also designed games that cross sectors or issue scales, including public
education, wildlife, wetland, farm and forest land preservation and the built environment. Ducrot (2008)
highlighted one of the ‘concerns’ that adaptive governance aspires to address, namely the mismatch between organisational scales and the scale at which the problem manifests.

3.1.2 Social Capital

Social capital is developed through stakeholders getting to know each other, step-by-step negotiating through conflict (Etienne, 2013), collective action (c.f. Morardet et al., 2012), and improved exchanges between stakeholders (Ducrot et al., 2007). Barnaud et al. (2010) look to equalise power relationships, derive more equitable impacts and address social inequalities, all of which can contribute to building social capital. RPGs provide many of these opportunities for participants to develop social capital, whether directly or indirectly. D’Aquino et al. (2003), in pursuit of social capital, strive to not provide solutions through RPGs, but steer stakeholders in a shared direction. Barreteau et al. (2007) found that their experience with RPGs enhanced exchanges between players beyond the game, seeming to develop social capital in reality through gaming. In contrast, Blanchard and Buchs (2015), found that their game was not overly successful in developing group cohesion and bringing people together.

An additional social-capital building function of games are the relationships and trust built between “farmers”, players and researchers. Some of these games were partially aimed at building social capital to provide researchers with a more complete understanding of the social-ecological system under investigation (c.f. Boissau & Castella, 2006; Castella, 2009; Castella et al., 2005; Etienne, 2003; Gourmelon et al., 2013). This goal was not always the primary reason for RPGs, but a ‘side-effect’.

3.1.3 Community empowerment and engagement

To enhance their relevance for applied problem-solving and support decision-making, a number of RPGs seek to reflect participants’ reality as closely as possible (Dionnet et al., 2008; Dung et al., 2009). Many of the games relied on community-based participatory action research, working with participants to diagnose problems and assess and analyse relationships between actors and environments (Ducrot, 2008; Souchère et al., 2010; Morardet et al., 2012; Hertzog et al., 2014; Speelman et al., 2014). While potentially labour-intensive and time-consuming, a community-based approach has the dual benefit of targeted bottom-up knowledge production and enhancing a game’s legitimacy by engaging community members in the research process sooner rather than later.

Bourgoin and Castella (2011) note that game play in their work empowered participants to have input into land-use planning, while Rajabu (2007) simply noted that the RPG facilitated local involvement in local land management. We note, however, that the games that appeared to be farmer, participant, researcher interactions (Boissau & Castella, 2006; Castella, 2009; Castella et al., 2005; Etienne, 2003; Gourmelon et al., 2013) may also promote community empowerment, as Villamor and van Noordwijk (2011) note that their game was intended as a communication tool between researchers and community members.

On the other hand, pre-existing power differentials between game participants and researchers limited the extent to which local communities could benefit from or participate in the game play and outcomes (Rajabu, 2007; Dung et al. 2009; Villamor & van Noordwijk, 2011; Gourmelon et al., 2013; Ducrot et al., 2014; Hertzog et al., 2014). Stakeholder inequality can impede open dialogue and collaboration and influence choices within game play, factors that should be accounted for in the game design and execution stages. One group of researchers managed power imbalances in the case community by holding separate game sessions with different stakeholder groups (Hertzog et al., 2014) to minimise potential conflicts, but with the result of limiting cross-stakeholder interaction. A lack of official or government participation and openness in Gourmelon et al.’s (2013) case likewise dictated the use of an RPG as an education rather than mediation tool. A skilled facilitator regarded by the majority of the participants as being neutral therefore is crucial to ensuring maximum inclusion and accessibility of the
game even in the context of unequal power structures (Barrett et al. 2003; Rajabu, 2007; Dung et al., 2009; cf. Barnaud et al., 2010).

3.1.4 Capacity development

As RPGs are often intended as a learning tool, we contend that all of the games reviewed have some level of learning or capacity development (c.f. Blanchard & Buchs, 2015; Bourgoin & Castella, 2011; Dionnet et al., 2008). In keeping with the complex nature of most natural resource problems, and the need for flexibility and adaptability (Dietz et al., 2003, Walker et al., 2004, Folke et al., 2005), the ‘solutions’ promoted in the RPGs prioritise: stakeholder collaboration, communication and problem-solving over specific technical guidelines or mandated ecological outcomes. This is reflected in the evidence of positive social learning outcomes as RPG users acquire topical knowledge and understanding (cognitive learning), adjust their views and opinions (normative learning), and develop new interpersonal connections and networks in a trusting environment (relational learning) (Flood et al., 2018; Aubert et al., 2018; den Haan & van der Voort, 2018). In several cases, games were a preliminary step in a larger process, ‘priming’ participants for cooperation and ultimately behaviour change (Ducrot et al., 2014).

A number of the games specifically promoted learning about negotiation and communication, for example to facilitate bridging cultural divides (c.f. Barnaud et al., 2010; Barreteau et al., 2007; Bernardo & Sanders, 1993; Farolfi et al., 2004; Villamar & Badmos, 2016; Speelman et al., 2014; Rumore et al., 2016). Morardet et al. (2012), Rumore et al. (2016) and Bernardo and Sanders (1993) describe RPGs as helping make sense of different stakeholder positions and, for example, global factors, economics and policy, which are often poorly understood. However, Ducrot et al. (2014) found that social learning and skill acquisition attained from their RPG was not able to be sustained over a longer period of time.

Rumore et al. (2016) and Susskind (2010) note that RPGs or role-playing simulations (RPSs) are excellent vehicles to be able to transfer large amounts of technical, context and process based knowledge to participants (e.g. in the context of climate change) and help people understand the implications of it. Another way in which capacity development occurred is through learning that the process of negotiating e.g. a new energy policy, took so much time and effort that it would not be feasible if and when a crisis occurred (Dolin & Susskind, 1992).

3.1.5 Linking science and decision-making through data and monitoring

The RPGs in our review were implemented in order to affect social-ecological outcomes; to enhance collaboration through social learning or improvements in communication, or through changes in management practices, or some combination thereof. Uncommonly, in a few cases, researchers attempted to evaluate the tangible impacts of the games on participant behaviour and ecological indicators. To do so, games incorporated pre- and post-game surveys or questionnaires to aid the comparison of player knowledge, capacity and skills before and after the game session (Ducrot et al., 2014; Speelman et al., 2014; Walsh et al., 2014; Rumore et al., 2016; Rumore & Susskind, 2013). Rajabu (2007) describes the application of a post-game tracer study in their Tanzania case community to assess the game’s impact on long-term water management practices. The study incorporated key informant interviews and a structured questionnaire to compare the management performance of four villages involved in the RPG with a group of four control villages and found improved water management behaviours in the game villages. On the other hand, Ducrot et al. (2014) conducted individual interviews with game participants immediately following and eight months after implementation and found that although some social learning and skills acquisition had occurred, players were not able to maintain these skills in a real-world context over an extended period of time. Like the companion modelling process described earlier, results from comprehensive evaluation methods, including group debriefing, written feedback and post-game individual interviews was intended to be fed back into future games or management interventions to enact enhanced social-ecological and governance outcomes.
Several of the RPGs incorporated participatory research into the conceptualization and design of a computerized multi-agent systems model which was later integrated into the execution of the RPG (Dung et al., 2009; Souchère et al., 2010; Gourmelon et al., 2013; Ducrot et al., 2014). This approach, called companion modelling (Gurung et al., 2006), combines participatory, field, and desktop research methods with computer-based modelling tools to simulate the social-ecological effects of different land-use decisions; the model can subsequently be refined to reflect new variables and participants’ responses which are then fed back into the game. Use of companion modelling in the reviewed games allowed quick, accurate feedback on the short- and long-term consequences of player actions and associated participant learning, contingent on the model’s validity and robustness. For example, Villamor and Badmos (2016) attempt to understand farmer behaviour in response to climate variability and facilitate social learning. In their game, there are different outcomes depending on player behaviour, leading to experiential learning.

As one element of monitoring, we found that some form of evaluation of game play experience and effects is necessary in order to refine techniques and assess the game’s impact. Evaluation methods for RPGs varied across the cases in our review from no evaluation at all (Villamor & van Noordwijk 2011) to a detailed multi-step game assessment process combining participant debriefing sessions with post-game implementation reviews to determine real-world impacts (Rajabu 2007; Ducrot et al., 2014). At the earliest level of implementation, game test sessions were sometimes incorporated into project design to gauge game validity and accessibility and modify substance and format as needed prior to official play (Morardet et al., 2012; Villamor & Badmos, 2016). These tests took place over multiple sessions with a range of stakeholders and integrated post-game participant debriefing and player evaluations of the game design and structure.

In a few cases, the game sessions were video- or audio-recorded to facilitate more detailed analysis of player strategies and interactions during play (Etienne, 2003; Ducrot et al., 2014; Hertzog et al., 2014; Speelman et al., 2014). By far the most common form of game evaluation was a short (ca. 30 to 90 minute) post-play debriefing where players engaged in facilitated collective and individual discussions about game decisions, strategies, outcomes, and implications alongside a more general appraisal of the game experience and characteristics (e.g., Dung et al., 2009; Emmerson et al., 1999; Souchère et al., 2010; Speelman et al., 2014). Debriefs were frequently supplemented with written surveys or questionnaires and individual interviews meant to elicit open player reaction (c.f. Adamatti, 2009; Barnaud et al., 2007; Dionnet et al., 2008).

### 3.2 Impacts of game play and adaptive governance

From a game play perspective, ProActive (2009) proposes key elements for success in designing games. Elements include having clear goals and rules, holding all players’ attention through an appropriate level of challenge, entertaining and fun elements, promoting good competition, replayability and ensuring appropriate support and feedback is available. From the learning perspective, ProActive (2009) notes success elements in an education context; however, these can be adapted to other contexts, e.g., natural resource management. These elements for learning success include ensuring the game rests within the broad educational objectives of the ‘project’, and is embedded in a comprehensive learning scenario. Games may also be deemed success from a learning perspective where they are comprehensible to players, provide relevant learning resources and provide for a progressive acquisition of knowledge through a personalised learning process.

We assess 37 if52 games/papers (70%) to gain insight into learning outcomes and impacts of play. In these papers, outcomes from the RPGs have been described, together with the measurements used, including one paper (Rajabu, 2007) that conducted a tracer study to examine the impacts of the game on real-world behaviour. It is important to note that the majority of games were part of larger modelling/simulation exercises, and not played in isolation, so few had short-term goals or objectives
linked to game play specifically. Games contributed, for example, to long-term goals relating to landscape, or to direct participants to an interim stage from which they could collaborate more effectively over constitutional- or resource time scales. The behavioural impacts from these games therefore have not been examined, as they have occurred far beyond the actual playing of the RPGs, and the final impacts will be the product of other significant factors. Nevertheless, several of these studies do note increased player awareness and understanding of environmental issues immediately following the game sessions.

We further examined the games with outcomes described under a typology of learning effects proposed by Baird et al. (2014). They identify three types of learning effects in relation to environmental governance – cognitive, normative and relational learning. Cognitive learning is the acquisition or restructuring of knowledge, normative learning refers to changes in norms, values or paradigms, and relational learning relates to building understanding, relationships, trust and cooperation (Baird et al., 2014: 53). Two of Baird et al.’s (2014) categories - cognitive and relational - are closely related to Pahl-Wostl’s (2009) distinction between instrumental learning, which allows the acquisition of new skills and knowledge (cognitive) and communicative learning, which allows understanding and interpretation of knowledge through communication with others (relational).

In light of these categories and general criteria, we analysed the 37 papers that described anticipated and/or actual outcomes of the RPGs in their studies. Four papers provided anticipated or actual outcomes; however, these were technical in nature, i.e. describing the mechanics of the RPG and the anticipated or actual outcome of making the game, and the learning typology did not apply to them and they were excluded. The other papers did not provide any anticipated or actual outcomes with respect to the RPGs.

Table 6 provides the breakdown of papers with different learning typologies identified for both the anticipated and actual outcomes. Note that the totals do not add up to the same number of papers with outcomes as some anticipated and/or actual outcomes incorporated more than one of the learning typologies.

| Learning Typology | Anticipated outcome | Actual outcome |
|-------------------|---------------------|----------------|
| Cognitive         | 12                  | 20             |
| Normative         | 3                   | 7              |
| Relational        | 17                  | 20             |

Eighteen of the papers had ‘matching’ typologies for the anticipated and actual outcomes including: relational (c.f. Barnaud et al., 2007; Bernando & Sanders, 1993; Dionnet et al., 2008; Ducrot 2008; Ducrot et al., 2014; Dung et al., 2009; Hertzog et al., 2014; Rajabu, 2007; Souchère et al., 2010; Speelman et al., 2014; Viera Pak & Castillo Brieva, 2010); cognitive (c.f. Barnaud et al., 2010; Barreteau et al, 2007; Boissau & Castella, 2006; Ducrot 2008; Ducrot et al., 2007; Ducrot et al., 2014; Farolfi et al., 2004; Gourmelon et al., 2013; Hertzog et al., 2014; Morardet et al., 2012; Walsh et al., 2014); and normative (c.f. Bourgoin & Castella, 2011; Speelman et al., 2014). The majority of the ‘mismatched’ typologies refer to cases where the anticipated outcome was relational or cognitive and the actual outcome was cognitive or relational, respectively.

With the exception of Villamor & Badmos (2016), authors claimed to have realised anticipated and desired outcomes. In this study, the authors were hoping for normative learning, however, they found that the game only elicited player perceptions, expectations and goals (Villamor & Badmos, 2016). While the games reviewed in this work have generally been successful in achieving learning, it may not have necessarily been achieved as intended.

4 Games, gaps and governance
4.1 Games as a tool for adaptive governance

The findings from our review suggest RPGs are a useful tool for creating and nurturing a basis for adaptive governance. Games function as a social learning platform, enabling participants to familiarise themselves with long-term problem solving, and attune themselves with the complexity inherent in managing shared resources over time. For the majority of games in our review, their overall aim was to enhance collective awareness of environmental problems and foster collaborative capacity in immersive, low-risk settings. In cases where players switch roles, participants are directed toward a more holistic understanding of the problem and steps toward a potential solution through their experience of other stakeholders’ perspectives, values and challenges. Players’ increased understanding may eventually encourage a shared or common language which is an important first step to continued collaboration on environmental problem-solving in the future.

In particular, RPGs may provide one way to address, or explore, power imbalances in the context of environmental problem solving. In its simplest expression, power is the influence or control of others’ behaviour in relation to resource governance (Berbés-Blázquez et al., 2016). The influence and effect of power is a critical, but understudied component of adaptive governance (Brisbois & de Loë, 2016; Cooper & Wheeler, 2015; McDougall et al., 2013). We found evidence to suggest, however, that RPGs may help address power imbalances in the context of environmental problem solving, especially when participants switch roles during the game (Dionnet et al., 2008; Ducrot, 2008). When participants take on roles that are different to their own, their current roles are either ‘de-powered’ (more powerful players are directed to speak from and/or emphasise with less powerful roles), or empowered (less powerful players are enabled to participate in the decision-making process under the guise of a more powerful role and regardless of their prior standing). Players were assigned roles that were different to their own in some but not all the RPGs in our review. However, for the purposes of de-powering and empowering, we suggest that players switch roles during the game, and moreover, that the game includes a variety and number of different roles or characters.

As a tool or mechanism for adaptive governance, RPGs, when played with community members and decision-makers, allow community members to drive adaptation and restoration based on their own social and cultural capital. The use of RPGs is democratising: they allow anyone to play, regardless of their expertise, skills, technology, standing or resources. Games also provide a safe space for learning and experimentation. Such spaces are essential to support the emergence of solutions to complex problems (Pereira et al., 2015). For players within the game environment there is no right or wrong, no ‘real-life’ consequences, so they can be immersed in comprehensive and interactive simulations to gain new insight and perspectives. Additional factors for designing a credible RPG or simulation are to situate it in the future, to help alleviate any concerns about current reality, and also potentially level out power relations between players in real life. Using actor-based perspectives in designing characters and game play allows differentiated or individual consideration of the various actors who are modelling individual and organisational decision behaviour.

4.2 Research gaps and areas for further study

In closing, while the reviewed games presented a diversity of roles, none of them have been played at the interface between community and policy. We found instead, the majority of RPGs were played at two distinct levels. Games are typically played at the local level, with individual landowners gaming scenarios or games were played with decision-makers at higher scales and focused on policy and planning (c.f. Barrett et al., 2003). Very few games were played for community decision-making (c.f. Adamatti, 2009). Therefore, we identify a research gap in RPGs that include both local landowners and land-users and a higher-level policy-making domain, from local to regional to central government agencies. While this combination of lower- and higher-level governance scales may add complexity to
the design and implementation of a RPG, such a game would be applicable on a wide scale because complex environmental issues cross community, policy and higher-level decision-making domains.

We also found the predominance of computer-aided simulations and/or companion modelling in many of the reviewed games (Dung et al., 2009; Souchère et al., 2010; Gourmelon et al., 2013; Ducrot et al., 2014) potentially limits ease of replication of the RPGs in remote, under-resourced, unconnected or under-connected areas.

On the question of power, RPGs can enhance collaboration through de-powering and empowering stakeholders’ current positions or fictionalising a tense real-life problem context, but we found that games can only address power imbalances to the extent that the most powerful stakeholders actually participate in the game session. Gourmelon et al. (2013) and Hertzog et al. (2014) identified power as an obstacle that threatened RPG success in each of their cases, but were unable to satisfactorily address inter-group power imbalances through their games. In the context of existing power imbalances, game designers should be careful to ensure that all or most stakeholders are represented in the game or that the game results are otherwise fed back into decision-making processes. This potentially requires work outside of as well as within the game, echoing our findings in the literature that RPGs are an important, but not sufficient, tool for adaptive governance and improved environmental decision-making.

Finally, we found that RPGs can be an effective mechanism to achieve cognitive and relational learning among and between participants. In the reviewed papers that specified the desired and actual outcomes of the games, cognitive and relational learning were among the key stated goals. Conversely, there were only three cases in which a more normative application was desired, and only seven cases in which a normative outcome was achieved. Because normative outcomes were not a priority in the reviewed RPGs, nor a predominant outcome, further research is needed to 1) assess the potential of tools such as RPGs to achieve normative learning; and 2) to develop optimal RPG design, structure, and execution to elicit such outcomes.

5 Conclusions

Our review of RPGs in the natural resource sector suggests that games can be a productive way to engage stakeholders and improve environmental outcomes across cases, contexts and sectors. In particular, RPGs have broad potential to complement and strengthen adaptive governance approaches to environmental problem solving. As a social learning platform, RPGs may help establish and nurture the human relationships, trust, capacity and connections required to address the long timescales and uncertainty associated with complex environmental issues (Dietz et al., 2003; Walker et al., 2004; Folke et al., 2005). Social learning is thus highly complementary to the principles of adaptive governance, through building capacity and connections between stakeholders, amongst other elements, to address complex, environmental issues. While RPGs are seldom seen as a tool for adaptive governance (Sharma-Wallace et al., 2018), they represent an innovative way of advancing more holistic and context-sensitive decision-making practices.

Our review also highlights the adaptability and scalability of RPGs, and their potential application in a wide variety of contexts, situations and scales. RPGs can be designed for, and implemented across, disciplines, skills, backgrounds, positions and many other ‘demographic’ factors. The ability of researchers to incorporate interdisciplinary thinking into game development enriches the gaming experience for both participants and the researchers. Incorporating players from a wide range of personal and professional backgrounds – those that are most obviously relevant for the situation, but also those that may not be immediately seen as relevant – enhances the players’ experience as well as the data and information that emerges from playing the game. This is particularly valuable where there are complex, multi-dimensional problems. This potentially allows us to create an RPG that can be played with community members and others to assist in community-level decision-making.
Nevertheless, the review does highlight some important gaps in the RPG literature, for example, we find limited evidence of games that bridge community- and higher-level decision-making scales. Purposeful RPG design may be useful in this regard and will require outcomes and purposes to be clearly defined from the initial design stages. We also note limited application of RPGs played for community decision-making outcomes (c.f. Adamatti, 2009), even though there is a significant need for decision-making tools to address complex problems involving multiple stakeholders and scales. While the review advances a foundation upon which future researchers or communities will be able to use RPGs at the community decision-making level (between individual landowners and the policy level), further research is needed to fully realise RPGs’ potential in this area. As a first step, considering other literature (i.e., around simulation, conflict resolution and organisational change) into the theory behind game development and execution may provide rich exploratory pathways for better integration of community and policy scales into RPGs.

In this light, RPGs are best seen as a useful tool in the adaptive governance toolbox, which can contribute to robust environmental outcomes when used progressively and/or in combination with other management applications. Serious games and role-playing games are an effective way to trial innovative decision-making, assess the consequences of management actions and adapt thinking without real-world consequences in the context of environmental decision-making. By providing participants and players with the opportunity to assume other roles, game play enhances and enables social learning. Such safe innovation spaces can help advance effective environmental decision-making to resolve intractable problems, removing the risks otherwise associated with decisions, to allow for greater experimentation and flexibility (Geels, 2011), and accelerate progress towards adaptive governance solutions.

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Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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