Games, Sustainable Developmental Goals, Local Communities and Natural Resource Management Systems: An Expert Event

SESAM Research Program

WAGENINGEN
UNIVERSITY & RESEARCH

Games, Sustainable Developmental Goals, Local Communities and Natural Resource Management Systems

SESAM Research Program

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Photo cover: Erika Speelman (coffee agro-forestry system in Chiapas, Mexico)

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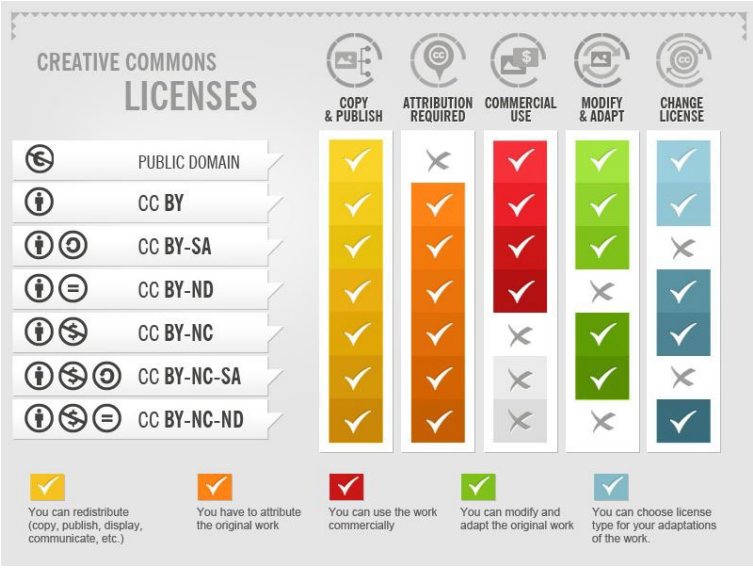
In the field of natural resource management studies, the interest in games as boundary objects, and as research, learning and intervention tools, continues to grow strongly. The associated increased amount of published literature on games – ranging from water to forestry - suggests that games are seen as a promising tool in this applicative context. However, while the total number of papers reporting on games used in relation to natural resources is increasing, questions related to methodological aspects have not gained central stage in this growing body or literature. Against this background we launched the SESAM (Scenario Evaluation for Sustainable Agro-forestry Management sesam.wur.nl) research programme coordinated at Wageningen University (WUR), where we aim to address some of these challenges. Over the past two years, SESAM has been actively working on questions related to the use of games. As part to the SESAM program, we have been reviewing literature, and other available material on this subject matter and we began to trace trends, themes, and gaps in current research. The work done suggests that theoretical and methodological aspects of game conceptualisation, development, and use, falls behind the fast-growing empirical base. In view of these findings, we organized an Expert Workshop with the broad objective to create space for exchange also with the ambition to gather, and reflect upon on the collective experiences on the challenges and opportunities of using games in work about natural resource management systems in October 2021. In this document we summarize the outcomes of this expert event and describe some core questions that have emerged.
Keywords: serious games, SDG, sustainability



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1. Summary

In the field of natural resource management studies, the interest in games as boundary objects, and as research, learning and intervention tools, continues to grow strongly. The associated increased amount of published literature on games – ranging from water to forestry - suggests that games are seen as a promising tool in this applicative context. However, while the total number of papers reporting on games used in relation to natural resources is increasing, questions related to methodological aspects have not gained central stage in this growing body or literature. Against this background we launched the SESAM (Scenario Evaluation for Sustainable Agro-forestry Management sesam.wur.nl) research programme coordinated at Wageningen University (WUR), where we aim to address some of these challenges. Over the past two years, SESAM has been actively working on questions related to the use of games. As part to the SESAM program, we have been reviewing literature, and other available material on this subject matter and we began to trace trends, themes, and gaps in current research. The work done suggests that theoretical and methodological aspects of game conceptualisation, development, and use, falls behind the fast-growing empirical base. In view of these findings, we organized an Expert Workshop with the broad objective to create space for exchange also with the ambition to gather, and reflect upon on the collective experiences on the challenges and opportunities of using games in work about natural resource management systems in October 2021. In this document we summarize the outcomes of this expert event and describe some core questions that have emerged.

2. Introduction

A core challenge for contemporary governance and management of natural resources working towards the United Nations Sustainable Development Goals (SDGs) is to **identify, understand, and meet the many different needs, values and views of the multitude of stakeholders** about use and access to resources. In this context participatory methods and tools are well advocated for and widely used by researchers and practitioners. Games, as one of these participatory methods, have become popular and increasingly more used. Multiple cases have shown that games can be useful, and effective in exploring and simulating alternative approaches to the governance of natural resources. As a result, games are attracting ever more attention from the academic and the practitioner community. Yet, despite this growing number of (local) studies, large conceptual and methodological questions that could help to mature the field remain unanswered.

The SESAM (Scenario Evaluation for Sustainable Agro-forestry Management) programme coordinated by Wageningen University (WUR) aims to address several of these questions while exploring more sustainable management of tropical agro-forestry systems through 15 empirically based case studies (van Noordwijk et al., 2020). A first scan of published academic literature on the topic of games conducted within SESAM suggests that the debate on conceptual and methodological aspects of games in the context of natural resource management seems to fall behind the fast-growing empirical base. In addition, the debate on methodological developments seems limited which makes impact assessment and comparing the use of games and associated empirical gaming data difficult. Consequently, under current conditions evaluating the performative potential of games ex ante is problematic.

Consequently, we identified the need for an academic debate within the gaming community that goes beyond reporting individual cases and addresses the conceptual and methodological dimensions of game development, use, and assessment. We aimed to contribute to this debate by creating space for scholarly exchange and sharing of experiences amongst a experts by organising an expert event. The core objectives of this event developed around two main questions. Given that most of current literature reports on individual case studies, and little space is taken for a broader discussion on the direction of the field, its challenges, and opportunities, we felt that it was timely and highly relevant to centre the discussion with a diverse group of expert participants around this. Two questions were discussed in small groups in parallel sessions and were formulated as: 1) *What are the most pressing challenges for the use of games in research and practice in the context of natural resource management systems*?, 2) *What are the most promising opportunities for addressing these challenges for the use of games in natural resource management systems that could move the research frontier in this field?*

This report provides an overview of the expert event which took place online on October 28, 2021. It is our ambition that the SESAM research programme will continue to create a space for scholarly exchange and generation of relevant initiatives and that the event will be one of a series of many.

3. Workshop setup and participants

3.1. Workshop setup

Before the workshop, all participants were asked to provide information and ideas to a set of questions on: i) expert's background and experience, ii) Specific aspects of the resource context, iii) Specific aspects about game conceptualization/research design, iv) Specific aspects about game development, v) Specific aspects about game use & assessment, and vi) the next research frontier (see for full pre-workshop questionnaire, **Appendix IV**). Participants were also asked to provide a short bio (around 250 words) to be shared with all participants in advance of the workshop. The information from both the pre-workshop questionnaire and the participants' bios was used to prepare groups of participants to work together during the workshop. The information was also used to become more familiar with the group of participating experts and allow a smooth start workshop by providing information of the participants before (bios) and at the start (questionnaire) of the workshop.

The workshop itself was set up in three parts. The first part of the workshop was characterized by presentations that introduced the workshop, its objectives and participants. In addition, the SESAM programme from which the workshop was organized was briefly introduced (See **Appendix II**). The second and third parts of the workshop were structured as a discursive exchange where participants were asked to brainstorm and share experiences with use of games in the context of natural resource management issues

The first discussion slot centered around the current challenges with the following central question: "*What are the most pressing challenges for the use of games in research and practice in the context of natural resource management systems?".* The second discussion slot focused on current opportunities and evolved around the following main question: "*What are the most promising opportunities for addressing these challenges for the use of games in natural resource management systems that could move the research frontier in this field?".* During the parallel discussion slots, participants were invited to post and present their views and ideas on a joint online jam board and engage in discussion with one another. In addition, notes were taken for post-workshop analysis alongside the developed virtual whiteboards (google jamboards). After the discussion slots, the workshop was finalized by thanking the participants for their contribution before and during the workshop and some ideas for possible follow-up activities were presented.

The participant groups for the parallel discussions were made beforehand and were formed aiming for diversity among participants and this by considering i) years of expertise so to have a balance between senior and junior colleagues, ii) geographic distribution of field work seeking to have diverse coverage of the different continents , and iii) gender seeking to have a percentage of both genders. After the workshop, the notes made on the virtual whiteboards were transferred to excel and categorized to distill broader themes in relation to each question.

3.2. Workshop participants

A total of 25 experts from the academic and practitioners field were invited to participate in the workshop, of which 19 accepted the invitation. Due to some last-minute unforeseen circumstances e.g. illness, travel, a total 16 experts participated (for the participant list please see**:** **Appendix II**). The invited participants were carefully identified and selected during the workshop preparation process to form diverse group of participants in experience profiles and fields of expertise. Of the 16 attending participants, 9 were female and 7 were men. Participants originated from Australia, Asia, Africa, Europe and North and Latin America.

Figure 1: Word cloud based on the field of work/knowledge domain in which the workshop participants identified to have been most active in over the past 10 years

Based on the information and bios submitted ahead of the event, the group of participants showed to have a very interdisciplinary profile which showed to centre around the management of natural resources, social-ecological systems, climate change and land management (**,** see: **Appendix IV** for pre-workshop questionnaire).). The collective experience in using games of the group of experts was a total of 325 years, with an average of 17 years (**Table 1**). Geographic coverage of the affiliations of the pool of experts seemed to be mostly linked to organizations in the global North. Interestingly most of the experts reported to have used games mostly in projects and research done in the Global South (with some exceptions) (**Table 1**).

Participant	Experience (yrs)
1	3
2	3
3	4
4	4.5
5	5
6	11
7	15
8	15
9	15
10	15
11	17
12	20
13	20
14	20
15	24
16	25
17	26
18	40
19	42
SUM	**325**

Table 1: Total years of experience matured by the participants in this area of work.

4. Current challenges

During the first part of the workshop participants discussed what they experienced, or identified, as pressing challenges in this area of work. Based on the discussions unfolding during the three parallel sessions and information posted on the virtual whiteboard we identify the following as core challenges as expressed by the participating experts: 1) *Conceptual and theoretical challenges; 2) Methodological challenges,* 3) *Challenges related to Out-scaling*, 4) *Ethical challenges*, and 5) *Challenges related to Scepticism* (**Figure 2**).

Conceptual and theoretical challenges (C1)
During the discussion a number of conceptual and theoretical challenges were brought up by the participants in relation to the use of games in this field. For instance, participants noted how a substantial amount of work, where games are used in the context of resource management, shares a strong interest about **human behavior** and games are used with intent to explore, experiment and further our understanding in relation to resource use and management. Yet, theoretical frameworks for behavior change in this area of work are incomplete, and often lacking on more substantial aspects. Incomplete or lacking theoretical frameworks on human behavior have certain consequences. For instance, participants mentioned the challenge of how to **capture sociality in games** and how to put that into practice when using games in the field. But also those who aim and value generalizability of outcomes commented on the challenge of working with a small sample size and localized cases / gameplay since the outcomes then are hardly generalizable to other cases. Related to this, participants noted how with increasing pressures on resource systems, there is also an increase of resource centered conflicts and thus the challenge is how to bring aspects, and ideas, relating to **social justice** in serious games about local resource systems. Further to this, participants noted the need for more discussions about the scope and role of **debriefing.**

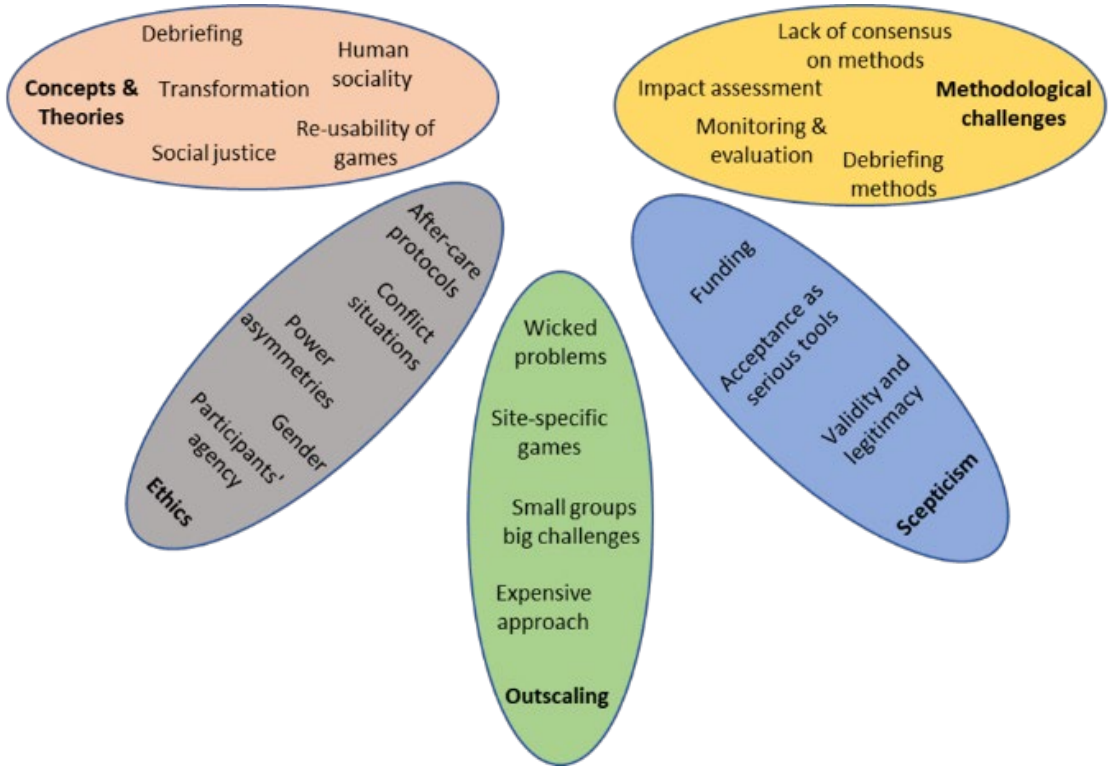

Figure 2: Overview of the 5 broad themes that were identified from the parallel discussion on "Current challenges".

Many scholars in the field of natural resource management borrow, notions and ideas from well-established areas of work in which there is a strong tradition to study human behavior often centered on the individual and less on the collective e.g. psychology, economics. On the other hand, in this applicative area where it is recognized that natural resources are used and managed by multiple individuals, there is a strong interest to better understand how individuals participate, influence, and contribute to shape communities, and its impact on the natural resource system. This lack of consensus on the way of embedding game based research in human behavioral studies, greatly limits the possibilities and opportunities for **comparability across studies** and consequently hinders the development of a solid evidence base about what games can, or cannot, do in terms of expected outcomes (behavioral change, learning, training, etc.). This in turn may limit the way we make progress in understanding the way games may be used to influence, and shape human behavior in the context of natural resource systems.

Methodological challenges: general (C2)
Participants commented on multiple methodological challenges and a closer look suggests these can be grouped into two further sub-themes. One sub-themes includes **general methodological aspects** the other ones includes challenges related to **assessment**. Under the category general methodological challenges we recorded limited, and lacking, protocols about how to go about game development and use, how to assess its outcomes, and how to communicate about the work done. This greatly impacts on the possibilities and opportunities to build an evidence base on the effectiveness of games which the participants mentioned to be a connected issue. This in turn limits the way we make progress in understanding the way games may be used to influence, and shape human behavior in the context of natural resource systems. Under the category methodological challenges related to the assessment participants have brought forward more specific arguments about a lack in agreement about the way games shall be assessed and what can be considered to be impact indicators in this context is a problem felt by the community. This further contributes at a fragmentation of research and limits opportunities to develop an evidence base about the effectives and potential games have as tools in this area of work.

Ethical challenges (C3)
Participants commented on a number of challenges which can be clustered under the umbrella of ethical consideration as follows. For instance, participants observed how in some case there is a concealed colonial approach in how games are delivered and facilitated across local communities – often driven by certain assumptions and epistemic views – these may end up being delivered with the intent to test such academic assumptions but with little, or no regard about how that gameplay may affect the households /local communities from that moment onwards. Participants observed how games may unveil certain dynamics, information, connections, and relationships in the local context, of which some could turn out to be challenging to handle by some participants / players afterwards (e.g. family dynamics, gender issues). Here the challenge being discussed relates to the relative absence of recommendations, or protocols, on how to take ethical matters serious into consideration, and what steps are advisable to take as part to an "aftercare" process where the participants should not be left to deal with possible challenging information alone and by their own means.

Challenges related to scepticism (C4)
A further category of challenges that were mentioned relates to how games are perceived and received outside this epistemic community and includes core societal actors, as for instance are, policy makers, decision-makers and donors, who often have a sceptical outlook on how games can be used for serious proposes. This impacts on the opportunities to access funding, but also to

Challenges related to out-scaling (C5)
Challenges related to scaling have been discussed by the participants in relation to usability, time and size. Participants referred to the challenge of game development to be time consuming and so hard to upscale when the specific research project ends. Also, participants saw challenges in how to extract lessons learned from gameplay in a given case in ways that can be convincing and usable by policy makers also elsewhere or at larger scales.

5. Current opportunities

During the second part of the workshop participants discussed opportunities which may support researchers and practitioners to push the field further. From the comments posted in the virtual whiteboard (google jamboard) and the associated discussion five broader themes of opportunities were identified: 1) *Strengthening the evidence base*, 2) *Intrinsic characteristics of the gaming approach*, 3) *Current research agenda*, 4) *Linking to other research fields*, and 5) *Collaboration within the field* (**Figure 3**).

Strengthening the evidence base (O1)
The participants identified the recently strongly increased number of game-based studies reported in literature, as a large opportunity to strengthen the field's evidence base. Within this broader theme of strengthening the evidence base of the gaming field, three distinct aspects surfaced, namely opportunities to: i) Build on previous work, ii) Develop comparative studies, and iv) Perform impact assessment. It was discussed that the field should aim to make better use this trend and build more upon literature and previous work. By doing so, participants agreed that a more solid basis could be developed to explore future developments in the field, as well as larger conclusions could be drawn. Another important aspect discussed was the opportunity to develop more comparative studies to solidify the development of games as well as game dynamics and game analysis. In addition, the development of suitable and perhaps more consolidated impact assessment methods was discussed as being instrumental in both building more on previous work and guiding comparative studies.

Intrinsic characteristics of gaming approach (O2)
The intrinsic characteristics of the gaming approach e.g. its interdisciplinary, engaging, and inclusive nature, were discussed as being an opportunity to enlarge the field of applications, especially in relation to today's societal challenges that requires a broad knowledge base from different fields and engaged stakeholders. Specific mention was made of how gaming approaches

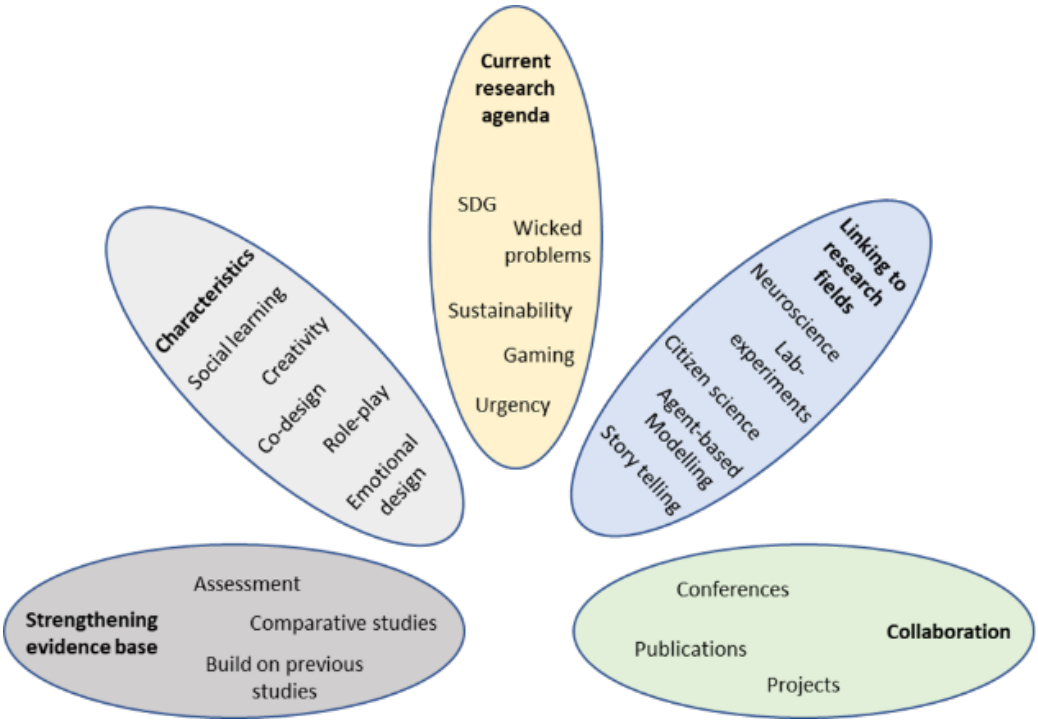

Figure 3: Overview of the five broad themes that were identified from the parallel discussion on "Current opportunities".

commonly stimulate social learning though bringing together various stakeholders to jointly explore and experience new situations. The commonly used co-design approach to develop a game together with stakeholders was another of the identified strength that allow for a shared sense of ownership of the developed game and the developed dynamics which results in stronger commitments towards lessons learnt or management alternatives developed during game sessions. The combination of participants' active participation, emotional involvement and activation of their creative sides, were in addition mentioned as unique characteristics of the approach that could be used to create opportunities.

Current research agenda (O3)

The current research agenda was identified as a large opportunity for the gaming field as many of today's most urgent societal issues are complex and require an interdisciplinary and transdisciplinary approach. The use of games in highly suitable to address these type of complex issues as the approach in itself is transdisciplinary. Specific aspects mentioned of the current research agenda were, the sustainable development goals (SDG), wicked problems, and the increase urgency of a wide range of sustainability issues. The increased interest and popularity of gaming approaches was seen as another major opportunity to create more interest in the use of games and to develop more (research) projects to advance the field itself.

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Linking to other research fields (O4)

While the field of gaming grew a lot in recent years also other relevant research fields developed fast. With the field of gaming being highly interdisciplinarity in itself, exploring (new) developments, and methods from associated fields of research was discussed as an opportunity to further develop and/or strengthen the gaming field. Specific mention was made of current developments in: i) neuroscience linking to impact assessment, ii) scenario evaluation, iii) agent-based modelling, where clear communication protocols were successfully developed, and where laboratory experiments have been developed and used to do more detailed assessment of decision-making and impacts, iii) citizen science, iv) communicational science where new methods like story telling are explored.

Collaboration (O5)

Networking and increased collaboration within the field was also discussed as an opportunity to strengthen and push the field further. Ample opportunities were discussed such as shared publications, project collaboration, conference organization and contributions and joined courses and seminars

6. Discussion

The workshop allowed interesting discussions to develop and it gave space to considerations about current challenges and opportunities pressing on the field of gaming in natural resource management in relation to sustainability goals and local communities. Overall, we observed that a similar number of broad themes were discussed within the challenges and opportunities, and that no clear one-on-one link between a challenge and an opportunity could be identified. Instead a more complex picture unfolded, one where multiple opportunities could potentially contribute to shaping synergies needed to address and confront the challenges (**Figure 4**). In the following paragraphs, we elaborate on how the identified challenges can be addressed by the opportunities mentioned during the expert event.

Conceptual and theoretical challenges

The identified lack of a larger scientific debate within the field of gaming in the context of sustainable developmental goals, local

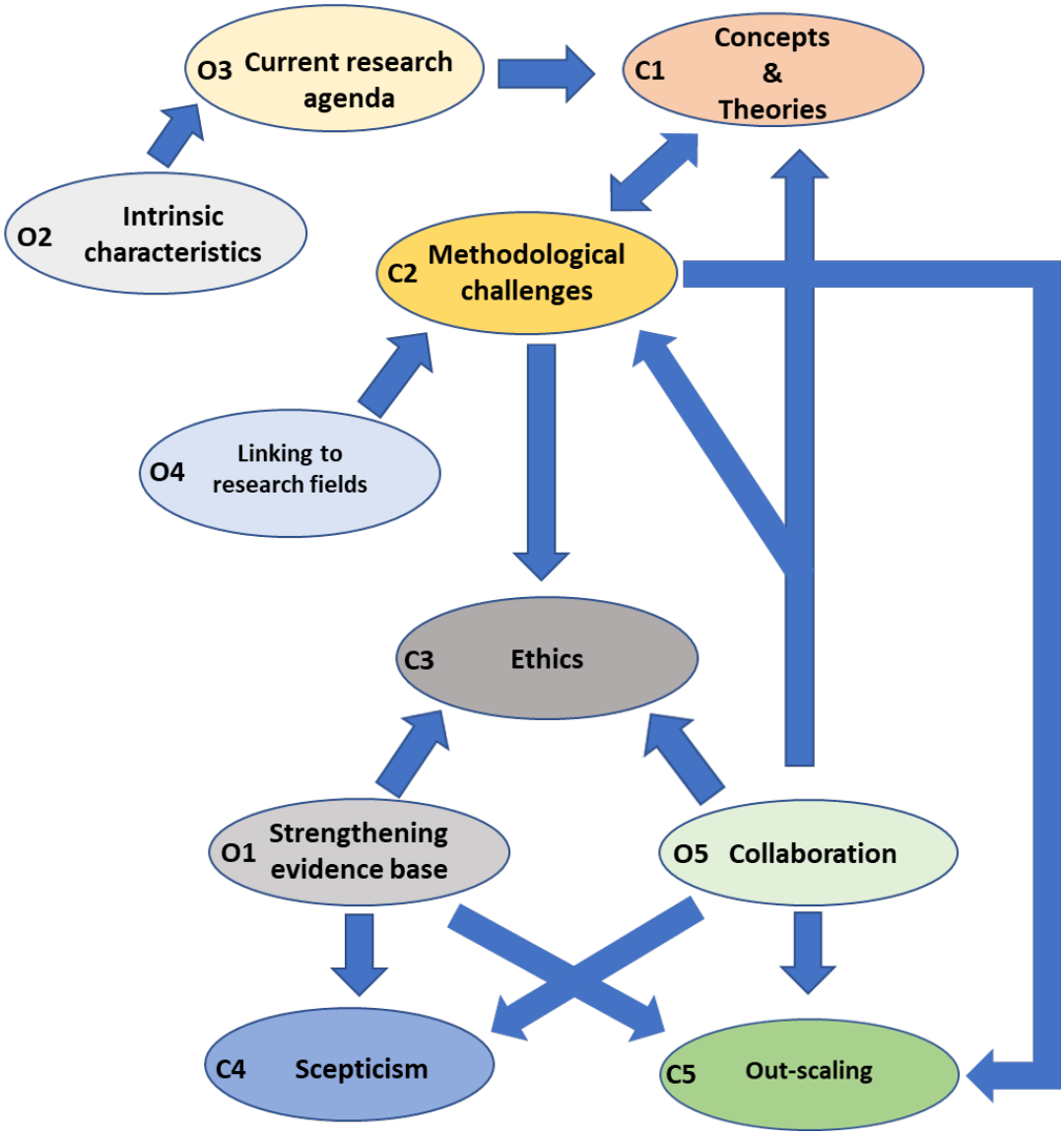

Figure 4: Identified links between challenges (C1-5) and opportunities (O1-5).

communities and natural resource management systems was the reason to organize the workshop and was identified as one of the main challenges. We believe that taking advantage of the **current research agenda** of many large societal issues that require an inclusive, action approach inherent to the gaming approach could create momentum for the use of gaming approaches in this field. Games seem suitable to become boundary objects for discussion on concepts and movements that are currently gaining traction such as social justice, the need for societal transformation and the role of human sociality, but require more internal discussion within the field. Through **collaboration** in projects, seminars, papers and conferences, the much needed in-depth conceptual and theoretical debate can be developed in greater depth and serve to support further development of the field.

The gaming field is inter-and transdisciplinary in nature with researchers and practitioners coming from both social as natural sciences.. This leads to diverse objectives for the use of games from research tools to tools of intervention. In addition, scientific philosophy and approaches strongly differ between the different disciplinary areas . Peer discussions and **collaboration** will allow for a clarification of assumptions associated to each field and initiate discussions on core aspect of research. A particular interesting discussion to be held is on the broader role of the games in research, learning and/or transformative processes and the role of debriefing within. In the field of practitioners and action-research, where games are mainly used as intervention tools, a consensus on the key role of debriefing seems to be present, this is less so for the research field and the field as whole.

Methodological challenges: general & assessment
The identified **methodological challenges** could benefit from linking and borrowing methods already developed in other associated areas of work. Frameworks, assessment tools and communication protocols from other fields could be used to develop firmer methods also in our field. A stronger **collaboration** with other gaming projects could facilitate this and allow for the much needed comparative studies. In addition, the methodological challenges would also benefit from the debate addressing the larger **conceptual and theoretical** challenges, as clarifying and articulating conceptual aspects can guide methodological developments.

Out-scaling
Scaling out the gaming approach, is an often discussed challenge and the failure to do so a strong and often heard critique from people outside the gaming community. The high development and implementation costs in combination with the generally small number of participants, strongly limits its application to other large scale projects. We see opportunities for addressing this challenge by **strengthening the evidence base** of gaming through methodological approaches leading to outcomes that have potential of being comparative and so could contribute to building a stronger evidence base. Also, **methodological developments** and agreement on such developments such as frameworks and approaches, as well as potential toolkits for game development and use could be of help in addressing the scale issue, by making the development and use of games more accessible to newcomers in the field. Also, exploring the re-usability of games and the development of so-called “frame games” that are easily and widely implementable are options to address current scaling issues. **Collaboration** will be essential in this process.

Ethical challenges
The identified ethical challenges can benefit from building more on previous work (**strengthening the evidence base**) and reviewing lessons learnt. Through **collaboration** and **methodological** advances common and evolving ethical issues need to be discussed and associated methods for dealing with these issues included in debriefing guidelines and methods guiding the development and implementation of games, especially in local communities. Protocols for after-care would be helpful to guide future endeavours.

Scepticism
Instances of scepticism towards the use of games as a serious tool were mentioned in relation to (stakeholder) participation, in the broader world of academics and practitioners and also in relation to obtaining funds from donors, and research agencies. Scepticism strongly limits the

development of any field as it hampers true engagement and meaningful discussion. Growth of any field requires these type of open and meaningful discussions, constructive criticism from outside and reflection from within the field. However, constructive criticism is not possible without active engagement. **Strengthening the evidence base** of gaming is in our view one the main opportunities to reduce scepticism. By improving the impact assessment and thereby the ability to present results and impacts of using games more clearly, would take away any ground for sceptical arguments on lack of impact. In addition, through increased **collaboration** within and outside the field, especially collaboration with (popular scientific) media would increase the methods visibility.

7. Conclusions

Natural resource management systems involve complex interactions between multiple natural resources and local communities that depend on them. The need to work closely with local communities and the usefulness of participatory methods and tools in this context has long been acknowledged. Ideas about the need and potential of such participatory tools and methods inform a substantial portion of scholarship on games in this area of work. Most of these ideas are normative and assume a certain type of transformative potential on behalf of participatory methods and tools. However, in overall there is rather little discussion of the conceptual evolution of games in the file of natural resource management with reference to broader paradigm shifts driving research. Consequently, there is less engagement with conceptual and methodological questions that arise from these changes. The majority of published empirical studies reports on the way games are used across one, ore more cases. Rarely are studies elaborating on the empirical evidence in the context of broader theoretical frameworks. Consequently, there is little engagement with conceptual aspects, but also methodological issues that researchers are confronted with when working with games in a real-world natural resource management context.

In an attempt to address these methodological and conceptual challenges, an expert event was organised by the SESAM programme of Wageningen University. The discussions among 16 experts in the field of games, Sustainable Developmental Goals, local communities and natural resource management systems during the workshop were sharp. Participants succeeded in taking stock of the present status of the field and unpacking the challenges. Capitalizing on the collective expertise and experiences, they drafted a list of interesting ideas for further research and development. In the discussion of this report we elaborated on the current status and future of the gaming field, describing how the identified challenges could be addressed by the large opportunities identified by the workshop participants. May this workshop be the start of an interesting and much needed academic debate among peers to further strengthen this field.

8. Acknowledgments

The SESAM research programme is a collaboration of 6 Universities, 5 research institutes and 6 civil society organisations from 10 countries from Asia, Africa, Europe and North and South America, led by Prof. Gert Jan Hofstede, Prof. Meine van Noordwijk and Assoc. prof. Erika Speelman. It includes a cohort of 15 PhD students enrolled at WUR who are now pursuing their PhD-degree working in distinct agro-forested landscapes in 10 countries developing and using games as a research method. Based on that effort SESAM will develop i) a large set of empirical gaming data consistently collected from 15 distinct landscapes, as well as ii) it will deliver a synthesis of the status of the current scientific base and debate.

The SESAM programme is financed by INFRI. The overall objective of the SESAM programme is to: Develop interdisciplinary participatory Scenario Evaluation Games (SEG) for supporting and enhancing social learning and action by actors involved in multi-level decision-making processes around the forest-water-people nexus, and understand their impact on participatory decision-making on water and (agro)forest landscape management (sesam.wur.nl),

9. Appendices

I Scientific Rationale and Day Program of the SESAM Expert Event
II Workshop agenda
III Overview of participants bios
IV Pre-workshop questionnaire
V Original output Parallel sessions

Appendix I - *Scientific Rationale and Day Program of the SESAM Expert Event*

Title: *Games, SDGs, Local Communities and Natural Resource Systems*

WHEN: Thursday, 28th October 2021 (held in English)
WHERE: Zoom video-conferencing

WHY: The use of games in the field of natural resource management is on the increase with fast-growing literature. Yet, the debate on conceptual and methodological aspects of game development and use in the context of SDGs, local communities, and natural resource systems is falling behind the fast-growing empirical base. As a result, there is a rather weak debate about questions related to the conceptualization, design, and delivery of games in natural resource management, and there is limited agreement about how such work shall be communicated, assessed and evaluated. Also, lack of a methodological debate in this area of work makes it harder for newcomers to step in, explore and use games in participatory processes, and thereby contribute to the academic debate to further strengthen this field.

Over the past year within the SESAM programme (sesam.wur.nl), we have been reviewing literature and other available materials with the intention to produce input and guidelines for our cohort of 15 PhD candidates. In that process, we identified several gaps in currently published literature. Therefore, the purpose of this event is to bring together a diverse group of practitioner and academic experts with the aim to create space for scholarly exchange about these. The purpose of the event is to:

- to learn, reflect and exchange about the current status of the use of games in environmental governance and natural resource management systems. To identify core research questions that remain unanswered;
- to contribute at the academic debate about use of games in environmental governance and management in relation to SDGs, Local Communities and Natural Resource Systems;
- to expand and build on the opportunity for collaborative exchange across specialties at the international level;
- to consider the needs, and draft ideas about tools and materials about the use of games in environmental management that are missing, but needed;
- to summarize the outcomes of this event in collaborative outputs including: **i) event report, and ii) commentary/manuscript/article**.

It is our ambition for this event to take stock of the present status of the field, to capitalize on collective expertise and experiences, and to cast out gaze on the future and further development of this field as an applied and interdisciplinary area of work. We hope that the outcome of this workshop will lead to a short series of workshops to further discuss the identified future needs and challenges in the field.

Scientific Committee
Erika N Speelman – Lab of Geo-Information Science and Remote Sensing, Wageningen University
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Gert-Jan Hofstede – Information Technology group, Wageningen University

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Appendix II – *Workshop agenda*

Programme SESAM Event: Expert Workshop on Games, SDGs, Local Communities and Natural Resource Management Systems

WHEN: Thursday 28th October 2021, 14:00-16:30 (Central European Time).
Online event via ZOOM:

AGENDA

14:00 - 14:05	Welcome by the SESAM PI team Gertjan Hofstede, Meine van Noordwijk & Erika Speelman
14:05 - 14:25	Brief introduction of the participants: name, affiliation, specializing
14:25 - 14.35	A brief introduction to the SESAM Program & Introduction of Aims and objectives of the expert event by the SESAM team
14:35 – 15:15	Work in parallel break-outgroups for discussion A: Current challenges **Q1***: What are the most pressing challenges for the use of games in research and practice in the context of natural resource management systems?*
15:15 – 15:25	Plenary discussion & summary of the core points.
15:25 - 15:35	Break *(The plenary will be open and you may stay connected, or reconnect)*
15:35 – 16:10	Work in parallel break-outgroups for discussion B: Current opportunities **Q1***: What are the most promising opportunities for addressing these challenges for the use of games in natural resource management systems that could move the research frontier in this field?*
16:10 – 16:20	Plenary discussion & summary of the core points
16:20 – 16:30	End the expert meeting and plans ahead

Scientific Committee

Erika N Speelman:	Lab of Geo-Information Science and Remote Sensing, Wageningen University
Romina Rodela:	Information Technology group, Wageningen University; Södertörn University, Sweden
Meine van Noordwijk:	ICRAF, South-East Asia & Plant Production Systems, Wageningen University
Gert-Jan Hofstede:	Information Technology group, Wageningen University

Acknowledgment
This workshop is organized in the context of the SESAM programme is financed by WUR-INREF. SESAM aims to deepen our current understanding of the Forest-Water-People nexus in complex agro-forested landscapes by performing empirical research in 10 distinct contexts in eight countries in Asia, Africa and South America as well as using and developing generic research tools e.g. ABM and games.

Appendix III - *Overview of participants bios*

Overview is in alphabetical order. In case of missing bios, relevant information that was openly available on the internet was used

**Unfortunately, Christophe was unable to participate due to unforeseen circumstances.*

Nicolas Becu

Nicolas is a senior researcher at the Centre national de la recherche scientifique in Nouvelle-Aquitaine, France. He is an active member within the Companion modelling network.

David Crookall

David Crookall, PhD, works on a large variety of research topics related to the environment and learning. These include:Environment: limits to growth (planetary boundaries, overshoot, carrying capacity), ocean, climate change & anthropogenic warming, tragedy of the commons, geoscience, geoethics, sustainability, resource depletion, water, sea level rise, extreme weather, common pool & natural resources, feedbacks, deforestation, ice-melt. Experiential learning: Debriefing, post-experience analysis, simulation/gaming, participatory simulation, computerized simulation, educational & training games, policy & planning exercises, modeling, role-play, active learning, structured exercises, agent-based models (ABM), companion modelling, project work,. David has taught at several universities in several countries (France, Singapore, Thailand, USA, etc.). For many years, he was Editor-in-chief of Simulation & Gaming (Sage), and is on the editorial board of several scientific journals. He has published several books and many articles in top journals. He is often invited to run workshops and seminars.

William's Daré

Environmental sociologist, William's Daré is a researcher at CIRAD since 2003. He conducts research on the social change resulting from the introduction of the principle of participation in the integrated management of resources and territories. Adopting a research-action posture, he accompanies collective decision-making processes and proposes a critical analysis of consultation mechanisms. Water (in Burkina Faso, Ghana, Senegal, Cambodia, and Reunion Island) and human-wildlife relations on the periphery of protected areas (in Southern Africa) are the subjects of his interventions, which aim to promote interactions between the different levels and types of stakeholders involved in the socio-ecological systems studied. He also analyzes the effects of participatory approaches, focusing on the multiple learning of users and decision-makers, the posture of the facilitators of these approaches with respect to power plays, and questions the registers of justice mobilized or expressed by the participants in these arenas of consultation. He has coordinated several international research projects or led workpackages (CGIAR, EU, ANR). He is one of the founding members of the ComMod network, member of the board of the Research Committee 23rd "Sociology of the Environment" of the AISLF, and co-organizer of ComMod training courses for researchers, students and territorial managers in France and abroad.

Anne Dray

Anne is a Research Fellow at ETH Zurich, ForDev group, Switzerland. Anne is an active member within the Companion modelling network and coordinates and teaches in the international PhD course on Companion Modelling taught in Switzerland, the Netherlands and France. **Interests:** I am interested in applied research projects dedicated to renewable resources management and conflict resolution with a strong emphasis on community participation and engagement in order to promote ecological sustainability. I develop and use dedicated tools to support stakeholders' engagement such as agent-based models and role-playing games.
Keywords: participatory research, agent based models, role-playing games, natural resources management

Thao Do

Thao Do is based at the Sustainability Learning and Research Centre (SWEDESD), Uppsala University. Her work involves design and facilitation of stakeholder co-inquiry and co-creation processes, as well as development of innovative methods such as serious games for transdisciplinary research. In recent years, she has been involved in EU-funded research projects with a particular emphasis on the Baltic Sea Region and the enactment of social learning processes as a vehicle to address "wicked" sustainability issues. Currently, she is part of the Mistra Environmental Communication research programme, in which she together with colleagues from the University of the Sunshine Coast examines the capability of environmental communication embodied in knowledge co-production to enable new forms of practice and processes to support transitions towards more sustainable futures.

Stephan Flood*

Stephen Flood has over twelve years' experience in climate change, environmental policy and social science research. His research interests include climate information platforms, serious games, climate adaptation implementation, resilience and systems thinking, coastal management, vulnerability assessment and hazard management. He has worked as a postdoctoral fellow at the Climate Change Research Institute at Victoria University of Wellington in New Zealand, as an environmental social science researcher at Landcare Research, also in Wellington (2016–2018), and as a senior postdoctoral scientist at the SFI Ireland Centre for Energy, Climate and Marine Research and Innovation (MaREI), at University College Cork. He is currently based at the Irish Climate Analysis and Research UnitS (ICARUS), Department of Geography, Maynooth University, working on a range of projects focused on various aspects of climate change adaptation and resilience. He is lead editor on forthcoming Palgrave Macmillan edited volume "Creating Resilient Futures Integrating Disaster Risk Reduction, Sustainable Development Goals and Climate Change Adaptation Agendas"

Luis García Barrios

My lifetime work as a researcher during the past 45 years has been to carefully understand, make clearly visible and help transform the very vulnerable life conditions of impoverished rural people and other sentient beings (aka "biodiversity") most of which barely survive in the vast and highly transformed tropical mountains of Southern Mexico, a situation induced by an aggressive anti-peasant neoliberal regime. In collaboration with many scholars and local people, I have approached the many dimensions of this challenge through participatory action research and popular education, based on (1) developing long term empirical observation, (2) designing and developing agricultural ecological and social field experiments with farmers, (3) developing dynamical models, board games and agent-based simulations with and for rural people and their allies. In the process, I have been lucky to teach and publish extensively with many colleagues from different countries in the fields of agroecology, the ecology of multicropping and agroforestry, what exactly is a complex process, rural livelihood transformation, land use change, serious games in popular education, and the need to go beyond neo-institutional theory when promoting multiactor collaboration in the face of current social and environmental challenges. I have been for long a researcher at El Colegio de La Frontera Sur, in Southeast Mexico. Currently I am proud to be a full time Public Servant at the Consejo Nacional de Ciencia y Tecnología (CONACYT) (2018-2024) which is "rocking the boat" of the scientific establishment through its redefinition of public science and its radical commitment with the people and the biosphere, for the common good.

Marco Janssen

Marco Janssen a Professor in the School of Sustainability and Director of the Center for Behavior, Institutions and the Environment, both at Arizona State University. He received a PhD in mathematics from Maastricht University in 1996 and has been working since 1991 on models of human-environmental interactions. Since 2005 Janssen is also pursuing behavioral experiments in the lab and the field to test conditions of cooperative outcomes in common-pool resources. His current research focuses on collective action experiments in situations of high uncertainty, such as a human habitat on Mars, the use of games as an intervention tool for the groundwater crisis in rural India, and modeling social and political processes in social-ecological systems. Website: https://marcojanssen.info/

Christophe Lepage*

Christophe is a Senior Researcher, CIRAD UR GREEN, Montpellier, France. Christophe is an active member within the Companion modelling network and teaches in the international PhD course on Companion Modelling taught in Switzerland, the Netherlands and France. In addition, he teaches in the agent-based modelling course (MISS-ABM) taught in France. **Interests:** I am a modelling scientist from CIRAD, working in Montpellier (France). I am a member of the Green Research Unit, which is promoting a companion modelling approach (http://www.commod.org) for natural resources management. With a background in fish population dynamics, I have progressively specialized in building agent-based models to simulate the interplay between ecological and social dynamics in ecosystems holding renewable resources used or managed by different categories of stakeholders. I am participating in the development of the CORMAS platform (http://cormas.cirad.fr), with a special interest on spatial aspects and computer-assisted role-playing games.
Keywords: companion modelling, natural resources management, agent-based models, role-playing games, participation.

Romina Martin

Romina Martin is passionate about simulation model development and analysis to better understand complex phenomena. This activity, she feels, becomes most meaningful for the purpose of untangling ecological dynamics which

are in various ways intertwined with the human ingenuity to celebrate and lead a more or less sustainable lifestyle. Her applied methods range from agent-based, system dynamics modeling to diverse participatory approaches. She works since 2013 at the Stockholm Resilience Centre. Romina Martin graduated in computer science and biology and holds a PhD in biology from the University in Cologne, Germany, supervised by Prof. Michael Bonkowski and Dr. Anja Linstädter. The topic of her PhD was pastoral livelihood security and rangeland management in drylands using ecological-economic modelling approaches. The project was conducted in close collaboration with the Centre for Environmental Research (UFZ) in Leipzig in the Department of Ecological Modelling, where most of the work was carried out and supervised by Prof. Karin Frank and Dr. Birgit Müller. Beyond simulating complex features from social-ecological systems, Romina is interested in disentangling and translating these complexities for transdisciplinary activities or environmental education purposes. Along with her PhD, Martin developed a board game on pastoral rangeland management ("NomadSed") and was involved in analysing and improving an online game on sustainable land management ("LandYous").

Ruth Meinzen-Dick

Ruth Meinzen-Dick is a Senior Research Fellow at the International Food Policy Research Institute (IFPRI). She received her MSc and PhD degrees in Development Sociology from Cornell University. Much of her work has been interdisciplinary qualitative and quantitative research on land and water policy, property rights, governance arrangements, gender analysis, and the impact of agricultural research on poverty, drawing on field work in India, Nepal, Sri Lanka, Bangladesh, Tanzania, Kenya, Uganda and Zimbabwe. She is co-developer of the Women's Empowerment in Agriculture Index (WEAI) and has over 150 peer reviewed publications. She is co-leader of the program on Governance of Natural Resources under the CGIAR program on Policies, Institutions and Markets, past president of the International Association for the Study of the Commons (IASC), and recipient of the Elinor Ostrom Award on Collective Governance of the Commons 2019 Senior Scholar award.

Meine van Noordwijk

Meine van Noordwijk is a Distinguished Science Fellow at Word Agroforestry (CIFOR-ICRAF), Professor (em.) of Agroforestry at Wageningen University, and Advisor at Brawijaya University (Malang, Indonesia). An ecologist by training, he has 40 years of work experience (publication record), mostly in the context of tropical agroforestry, bridging between the details of roots and soil carbon, the productivity of land use system, the quantification of ecosystem services, simulation models that connect spatial patterns and temporal processes across these scales (incl. Fractal branching analysis, WaNuLCAS, GenRiver, FALLOW), and more recently the institutional arrangements to provide effective economic rewards to land users. While most of his work experience is in Southeast Asia, he worked for two years in (Southern) Sudan, and has been active for 20 years in the ASB Partnership for Tropical Forest Margins, in multiple roles. He co-chaired the GFEP study on forest and water and currently is a convening lead author in an IPBES assessment.

Cora van Oosten*

Dr. Cora van Oosten is project manager at Wageningen University and Research. She teaches students, trains professionals, carries out research and provides advice to policymakers and practitioners worldwide. Her focus is on landscape approaches and landscape governance, particularly in relation to restoration. Based on 30 years of practical experience, she considers governance to be key to successful landscape restoration, as it addresses the questions of who decides on what to restore, where, how and for whom. Cora also works at the Global Landscapes Forum, leading in the design and development of the Landscape Academy, which is a multi-partner initiative to promote Restoration Education for All.

Gert Jan Hofstede

Gert Jan was born in the Netherlands in 1956. He graduated as a population biologist, with a PhD in production planning, a career in Information Systems and a track record as a speaker on culture. Gert Jan's long-standing aim is teasing out the generic dynamics of human social behaviour. His stance is that people are not unpredictable, but ill-understood. Knowledge is patchy, obscuring the big picture. He uses simulation gaming and social simulation as preferred methods that integrate knowledge from many fields to yield operable knowledge that can be applied in all kinds of practical contexts. In 2015 he co-organized the Summer School of ESSA, European Social Simulation Association, see video report. In 2016 he founded SiLiCo together with co-researcers in Complex Adaptive Systems. He is a personal professor, that is, a full professor based on his work's merit, in Artificial Sociality. See his inaugural lecture here.
More can be found on www.gertjanhofstede.com.

Romina Rodela

Romina Rodela is a senior researcher and associate professor at the School of Natural Sciences, Technology and Environmental Studies of Södertörn University (Sweden). She is working in the field of environmental governance, and is now busy with two research projects focused on participatory methods and tools, with a focus on when, how and the way in which, such tools can support knowledge integration, learning, and just outcomes. Romina has collaborated with practitioners and researchers from across diverse disciplines. She is committed to interdisciplinary research seeking to further understanding of the dynamic inter-relationship between our society and natural environment.

Udita Sanga

Udita Sanga is a post-doctoral researcher at Stockholm Resilience Centre (SRC) in Sweden. She holds a dual Ph.D. degree in Community Sustainability and Environmental Science and Policy from Michigan State University, USA (2020). Udita has extensive experience working with communities and stakeholders in diverse contexts, particularly focusing on climate adaptation, food security, water management, and sustainable agriculture in sub-Saharan Africa (Mali, Nigeria) and South Asia (India, Nepal, Bangladesh, Vietnam). Her research focuses on integrating social and ecological dynamics within agricultural systems. She develops systems models to support informed policy making towards agricultural resilience in developing countries using diverse methodological tools such as participatory games, mental models, system dynamics, and agent-based modelling. Udita's dissertation examined the past, present, and future trajectories of food security and socio-ecological resilience in Mali as a response to the Sahelian droughts of the 1960s. Her study explored the influence of agricultural decision-making, institutional governance, socio-demographic changes, agricultural production, and climatological trends on food security in Mali using a mixed methodology of historical process tracing, participatory role-playing game design, and system dynamics modeling, In her current work at SRC, Udita is involved in the MuSES project (Towards middle-range theories of the co-evolutionary dynamics of multi-level social-ecological systems) where she is developing an agent-based model of cross-scalar interactions and processes within agricultural innovation systems; particularly juxtaposing exogenous donor-driven innovations with endogenous community-driven social innovations using Mali as a case study.

Erika N Speelman

Erika is an agronomist by training with a Master degree in Tropical Land-use from Wageningen University, the Netherlands. She has been developing and implementing gaming and simulation tools to explore and facilitate (social) learning about the dynamics in complex social-ecological systems since 2006. In 2014, Erika completed her PhD thesis on the same topic entitled: 'Gaming and simulation to explore resilience of contested agricultural landscapes'. Her main focus is on board games and agent-based models and the combination of both in the context of contested agricultural landscapes in the tropics. Erika has worked is several parts of the world for a variety of organisations. She is currently an Associate Professor at the Geo-Information Science and Remote Sensing group at Wageningen University, where she explores the use of gaming and simulation tools in tropical agro-forestry systems. Together with Gert Jan Hofstede and Prof Meine van Noordwijk, she runs the SESAM programme in which 15 PhD candidates explore the use of games to deepen our current understanding of the Forest-Water-People nexus in 10 distinct contexts in eight countries in Asia, Africa and South America.

Grace B. Villamor

Grace B. Villamor is currently the Research Group Leader for the Economy and Society group of the New Zealand Forest Research Institute (Scion). She currently leads three research projects on (1) managing risks and uncertainties of the Resilient Forest Programme; (2) socio-cultural aspects of Forest Flows Programme; and (3) Doughnut economics of bioenergy. At the same time, she is a Research Associate at the Center for Development Research (ZEF), University of Bonn, Germany where she mentors doctoral students. Prior to that, she was involved in a National Science Foundation (NSF) project on social-ecological-technological solutions to waste reuse in food, energy, and water systems of the Center for Resilient Communities, University of Idaho, the USA between 2017-2019. For more than five years, she was a Senior Researcher at ZEF for the West African Science Service Center on Climate and Adapted Land use (WASCAL) program. Between 2012 and 2013, she was a Post-Doctoral Research Fellow at the World Agroforestry Center (ICRAF) in Indonesia. Her research interest is in agent-based land-use models and decision-making of land managers using a mixed-method approach. She was also involved in various biodiversity-related research projects in Southeast Asia with the International Fund for Animal Welfare, ASEAN Biodiversity Center, ICRAF, Royal Society, and Conservation International.

Marieke de Wijse van Heeswijk

Currently I am a phd researcher for the Radboud university, specialty Facilitation and intervention effect measurement. I contribute to the Urban Labs program, where we have student develop sustainability games related to infrastructure, policy and urban planning. I am involved in some Radboud University Projects for case study research on effects of learning and change interventions. In my career as game designer/developer I have constructed or helped construct over 200 games on diverse topics, mainly related to sustainability. My favorite sustainability game is Hex developed by Duke, it is well designed, multi-faceted and lets you experience the complexity of the real word in just a small game. Many things can be learned from it.

Appendix IV - *Pre-workshop questionnaire*

Questions in preparation of the workshop

General info

1.1 In which field of work/knowledge domain have you been most active over the past 10 years?

1.2 For how long have you been using games in your professional life?

1.3 For which purpose have you used games in your professional life?

1.4 Have you ever been involved in the development of a game?

If so, how many times? Can you share the name of the games/associated projects/articles?

Specific aspects of the resource context

2.1 What has been the geographical / country focus in your work with games over the past 10 years?

2.2 What has been the context(s) you have been mainly focused on in your work with games? (e.g. water, forest, biodiversity, land use, communities, other)

Specific aspects about game conceptualization/research design

3.1 Which approach do you commonly use for research/project design at the start of a new project? (i.e. as referred to the overall strategy to carry out research inclusive of the logic that links the research questions with collection, interpretation, analysis, and discussion of data).

Specific aspects about game development

4.1 Do you use specific guidelines/manuals?

If so, which one(s)?

Specific aspects about game use & assessment

5.1 Do you usually assess the impact of the game(session)?

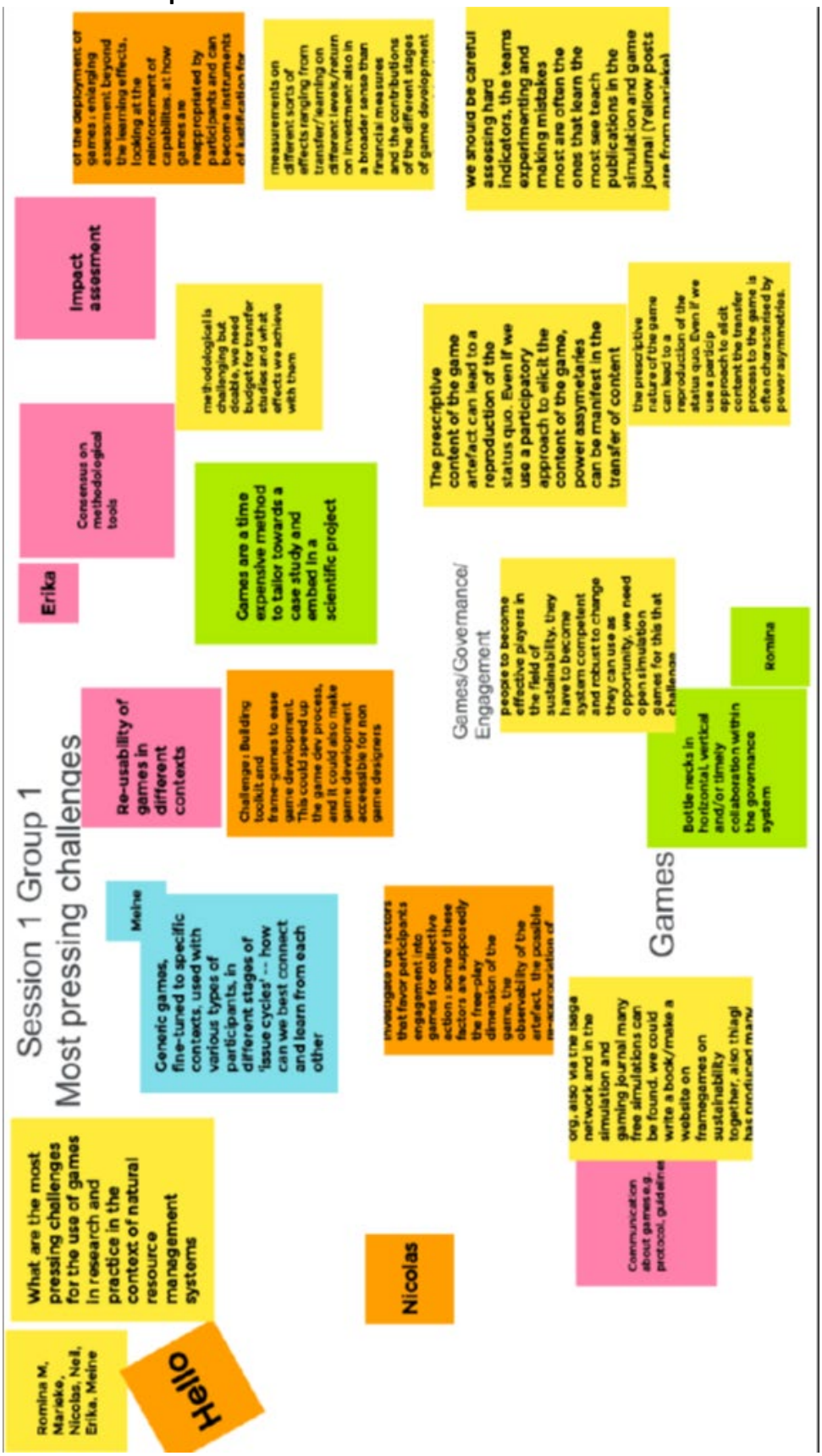
If so, how do you usually assess the impact?

6. The next research frontier

6.1 What do you see as the next research frontier in the use of games in the context of SDGs, Local Communities and Natural Resource Management Systems?

Appendix V- *Original output Parallel sessions:*

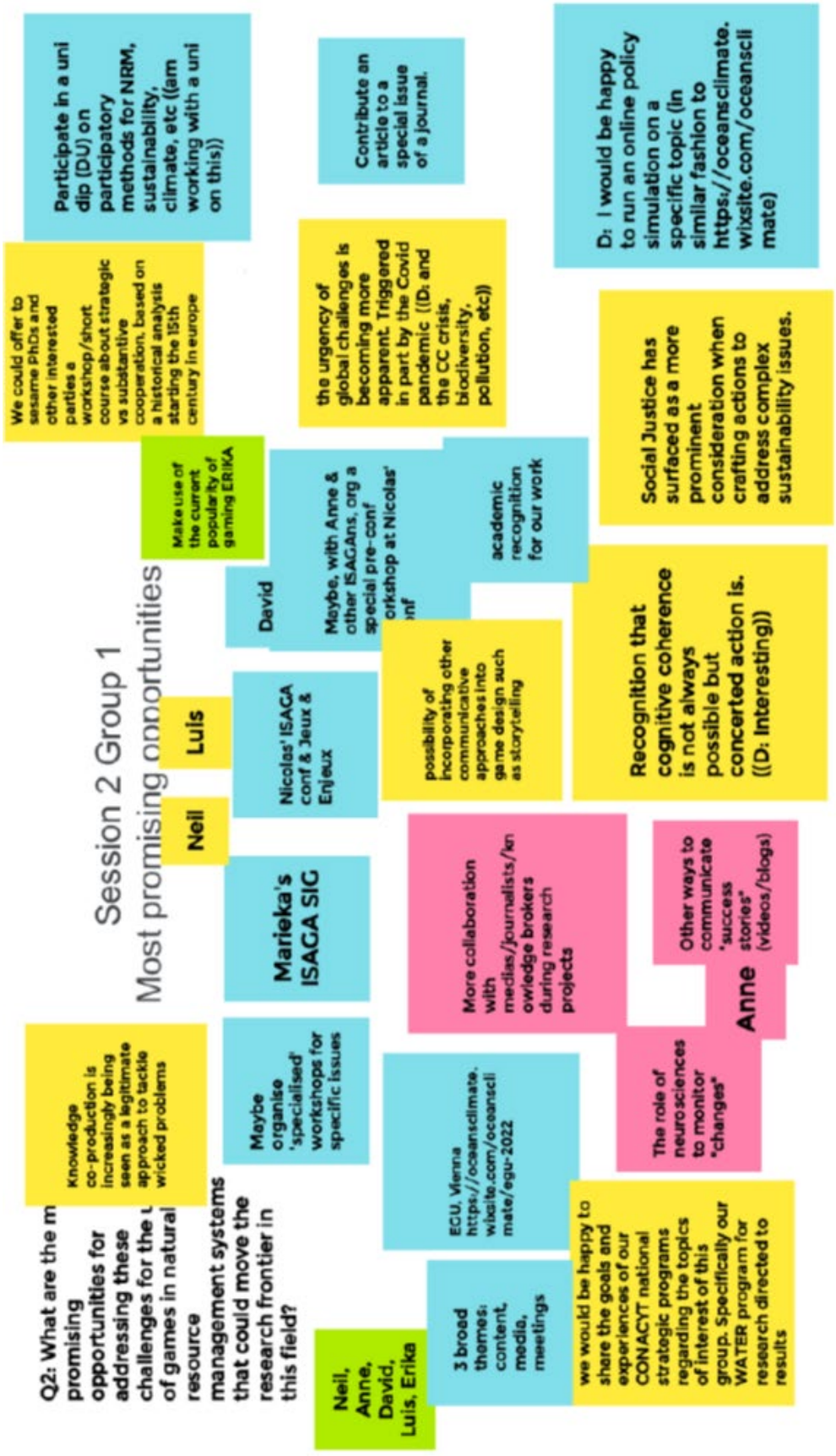
Session 1 Group 1- Jamboard



Session 1 Group 2- Jamboard

Session 1 Group 3- Jamboard

Session 2 Group 1- Jamboard



Session 2 Group 2- Jamboard

Session 2 Group 3- Jamboard