



Strategy games to improve environmental policymaking

Claude A. Garcia^{1,2}✉, Sini Savilaakso^{3,4}, René W. Verburg⁵, Natasha Stoudmann⁶, Philip Fernbach⁷, Steven A. Sloman⁸, Garry D. Peterson⁹, Miguel B. Araújo^{10,11}, Jean-François Bastin¹², Jürgen Blaser¹, Laurence Boutinot¹³, Thomas W. Crowther¹⁴, Hélène Dessard¹³, Anne Dray², Scott Francisco¹⁵, Jaboury Ghazoul^{16,17}, Laurène Feintrenie^{13,18,19}, Etienne Hainzelin²⁰, Fritz Kleinschroth¹⁶, Babak Naimi²¹, Ivan P. Novotny², Johan Oszwald²², Stephan A. Pietsch^{23,24}, Fabien Quétier²⁵, Brian E. Robinson²⁶, Marieke Sassen^{27,28}, Plinio Sist¹³, Terry Sunderland²⁹, Cédric Vermeulen³⁰, Lucienne Wilme^{31,32}, Sarah J. Wilson³³, Francisco Zorondo-Rodríguez³⁴ and Patrick O. Waeber²✉

While the scientific community documents environmental degradation and develops scenarios to identify the operational margins of system Earth, less attention is given to how decisions are made that steer the system in one direction or the other. We propose to use strategy games for this purpose, increasing the representation of human agency in scenario development and creating spaces for deliberation between different worldviews. Played by the right people, strategy games could help break free from established norms and support more transparent democratic dialogues, responding to the human and social limitations of current decision-making. The question is, who gets to play?

The world's governments did not reach most of the international social and environmental targets set for 2020. None of the 20 Aichi Biodiversity Targets have been fully achieved and only 6 have been partially accomplished^{1–3}. Current trajectories continue diverging from goals and pledges⁴. This is a problem involving every single human, albeit with vastly different degrees of responsibility⁵. Some of us are unaware of the problem. Many of us actively resist change. Others do not care, and a small but growing number are concerned and trying to push for change. Collectively, humans have thus far proved unwilling, unprepared or unable to change^{5,6}.

The post-2020 global biodiversity framework of the Convention on Biological Diversity is being developed and new ambitious

targets, goals, actions and strategies for biodiversity and sustainability are being proposed⁷. These will affect governments' actions for decades to come⁸. The responses, ambitions and policy decisions that are being drafted for the post-2020 agenda are, inter alia, informed by Integrated Assessment Models (IAMs) developed by combining different strands of knowledge^{9,10}.

Current IAMs have been built to explore policy options; besides being heavily constrained by data and models¹¹, they are also constrained by the values they integrate. To address this constraint, the Nature Futures Framework recently developed by the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES) proposes a heuristic framework that

¹University of Applied Sciences, Berne, Zollikofen, Switzerland. ²Forest Management and Development, Institute of Terrestrial Ecosystems, Department of Environmental Systems Science, ETH Zürich, Zürich, Switzerland. ³Liljus Ltd, London, UK. ⁴Department of Forest Sciences, University of Helsinki, Helsinki, Finland. ⁵Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands. ⁶School of Technology, Environments and Design, University of Tasmania, Hobart, Tasmania, Australia. ⁷Leeds School of Business, University of Colorado, Boulder, CO, USA. ⁸Cognitive, Linguistic, and Psychological Sciences, Brown University, Providence, RI, USA. ⁹Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden. ¹⁰Department of Biogeography and Global Change, National Museum of Natural Sciences, CSIC, Madrid, Spain. ¹¹Rui Nabeiro' Biodiversity Chair, MED Institute, University of Évora, Évora, Portugal. ¹²TERRA Teaching and Research Centre, Gembloux Agro Bio-Tech, Université de Liège, Liège, Belgium. ¹³CIRAD, UPR Forêts et Sociétés, Montpellier, France. ¹⁴Institute of Integrative Biology, ETH Zurich (Swiss Federal Institute of Technology), Zurich, Switzerland. ¹⁵Pilot Projects Design Collective, New York, NY, USA. ¹⁶Ecosystems Management, Department of Environmental Systems Science, Institute of Terrestrial Ecosystems, ETH Zürich, Zürich, Switzerland. ¹⁷Centre for Sustainable Forests and Landscapes, School of GeoSciences, University of Edinburgh, Edinburgh, UK. ¹⁸CATIE, División de Investigación para el Desarrollo Verde e Inclusivo, Turrialba, Costa Rica. ¹⁹ICRAF Latin America Office, Lima, Perú. ²⁰CIRAD, Montpellier, France. ²¹Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland. ²²UMR CNRS 6554 LETG, Université de Rennes 2, Rennes, France. ²³IIASA (International Institute of Applied Systems Analysis), ASA (Advancing Systems Analysis) Program, EM (Exploratory Modelling) of Human Natural Systems, Laxenburg, Austria. ²⁴Department of Forest and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Science, Vienna, Austria. ²⁵Biotopie, Mèze, France. ²⁶Department of Geography, McGill University, Montréal, Canada. ²⁷UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), Cambridge, UK. ²⁸Plant Production Systems Group, Wageningen University and Research, Wageningen, The Netherlands. ²⁹Faculty of Forestry, University of British Columbia, Vancouver, Canada. ³⁰Laboratoire de Foresterie tropicale, Unité Gestion Ressources Forestières, FORIL, Faculté de Gembloux Agro-Bio Tech, Université de Liège, Gembloux, Belgium. ³¹Madagascar Program, World Resources Institute Africa, Antananarivo, Madagascar. ³²Madagascar Research and Conservation Program, Missouri Botanical Garden, Antananarivo, Madagascar. ³³PARTNERS Reforestation Network, Department of Ecology and Evolutionary Sciences, University of Connecticut, Storrs, CT, USA. ³⁴Departamento Gestión Agraria Facultad Tecnológica, Universidad Santiago de Chile, Santiago de Chile, Chile. ✉e-mail: claud.garcia@bfh.ch; patrick.waeber@usys.ethz.ch

accommodates a plurality of perspectives on what is desirable for the future¹². There is, however, a second difficulty: IAMs fall short in representing how humans behave and interact¹³. Scenarios derived from IAMs are therefore restricted to the exploration of target-seeking scenarios in which transformations do not result from emergent behaviour of the decision-making processes represented in the model, but are imposed 'ex machina'¹⁴. These limitations make it difficult to link IAMs to decisions. Ignoring or misrepresenting human agency in these models limits the range of options that are contemplated and opens doors to systemic stalling and unwelcome surprises during implementation, as people develop adaptive responses and coping strategies to whatever action plan is proposed¹⁵.

There is a better way to represent human agency in the models that underlie environmental decision-making processes, one that we have tested successfully in a variety of settings: on the negotiations around the management of intact forest landscapes (IFLs) in Central Africa and on the sustainability of the palm oil supply chain in Colombia, Cameroon and Indonesia. The approach involves the design of strategy games to represent what stakeholders understand about the issue they are trying to change, and the use of these games in strategy formulation, conflict resolution and the construction of new agreements. This approach requires stakeholders—those vested with power to change the way a system works—to play the game and explore the possibilities that exist to steer the course of events and potentially discover new solutions. Doing so takes games away from being a downward educational tool and transforms them into a vehicle for democratic dialogues bridging local, national and international processes, with an explicit set of rules shared by all players dictating how the system behaves. Our goal here is to describe examples of how we have implemented this approach, propose explanations for why this form of engagement has transformative potential, discuss the conditions that must be fulfilled for change to happen and end by discussing how to apply these concepts to trigger the global forest transition.

Modelling human decision-making

Games are models. A game being played, with facilitation and debriefing, is a constructive process of co-creation (Supplementary Note 1) that produces a common understanding among the players of how the system works¹⁶. The gameboard and tokens represent the landscape and all its major components. Players represent specific stakeholders with power to shape the board and adapt to changing conditions. Game rules represent system processes. A game session is the equivalent of a simulation run: a narrative about how things could unfold. Through gaming, players can engage in a decentralized collective and distributed process of seeking new solutions. They can identify winners and losers and revise strategies. These games represent an untapped potential to address environmental issues¹⁷. Yet, despite their capacity to integrate a plurality of perspectives and to support collective action preparing stakeholders to better cope with surprises, they have yet to be successfully deployed at the scale of international decision-making to achieve macro-scale impact. Why? We propose it is because they have not been played by the right players. Anyone can play the games we describe here. However, unless they have the power to shape norms and policies, the lessons drawn by participants will not translate into changes of the normative landscape and therefore will fail to register on the ground¹⁸. Having farmers playing will not change farming subsidies. Having students playing will not change laws. Having interns playing will not change corporate strategies.

Policymakers playing games

Placing strategy games at the centre of the science–policy interface allows policymakers to personally engage with the underlying models and the construction of scenarios. Such an approach requires

decision-makers to agree to engage in the role playing that the games propose, taking on the role of the different actors in the systems they intend to transform. The game rules can then be the subject of debate from within, limitations and knowledge gaps identified through discovery, play and dialogue¹⁹. Different sessions with different players and different outcomes can be compared, contrasted and balanced. Decision-makers engaging in such processes have the chance to play out future scenarios and explore counterfactuals. Counterfactual thought occurs when a person considers a change to the current state of affairs and then assesses the consequences of that change²⁰. A critical distinction from other forms of engagement is that counterfactual information is not provided to the participants through gaming. Instead, they are the ones developing the counterfactuals on the basis of the game they are discovering as they play. This ownership of the outcome helps challenge one's assumptions and cognitive biases²¹.

Participatory games have been used at large scales to connect science and policy in sectors such as health and defence^{22,23}. Below, we give three examples where they were applied to the field of natural resources management.

In 2017, negotiators of the Regional Working Group on High Conservation Values (HCV-RWG) of the Forest Stewardship Council (FSC) supported the development of a set of indicators related to the identification and management of IFLs in the Congo Basin. The participants of the workshop played MineSet, a game we developed that represents regional landscape dynamics for Central Africa and the interactions between extractive industry projects, logging, agribusiness, infrastructure development, population growth, forest dynamics, market fluctuations and regional policies (Supplementary Video 1). With the support of game masters and facilitators, they analysed their game session and established connections between the issues at stake and their experience during the game. This collective understanding enabled them to find an agreement after three days of play, discussion and negotiation, resolving a gridlock that had lasted for more than two years (Supplementary Note 2)^{19,24}.

Another example of large-scale strategy gaming is the Oil Palm Adaptive Landscape (OPAL) project. Between 2015 and 2021, some of the authors designed landscape and supply chain games to understand and support decision-making processes in the palm oil supply chain in Cameroon, Indonesia and Colombia. In 2016, members of the Inter-Ministerial Committee on Palm Oil responsible for regulating palm oil pricing in Cameroon, played one such game—CoPalCam—designed with smallholder farmers and professionals from the industry to understand the bottlenecks in the production at the country level (Supplementary Video 2). The game sessions brought together participants from the Ministry of Agriculture and Rural Development, six smallholder cooperatives, and representatives of the agro-industry and civil society organizations. Scenarios around price fixing and farmers' cooperation were at play. After this session, the game was used by the government to support dialogues with smallholders on the creation of cooperatives—one of the most promising strategies that emerged from the game. Following this, smallholders close to the plantations of the Société Camerounaise de Palmeraies (SOCAPALM) in Dibombari initiated the creation of a cooperative on the basis of the lessons they drew from the game. Others renegotiated contracts with the industrial mills²⁵.

In 2019/20, civil servants from the Indonesian Ministry of Agriculture revised the rules for the Indonesian Sustainable Palm Oil certification scheme on the basis of the discussions that followed game sessions held with the OPAL research team. The game used was co-designed and validated with small-scale oil palm growers, villagers, local government officials, non-government organizations (NGOs) and private companies in East Kalimantan, and then brought to the ministry offices to support the critical analysis of the contemplated policies. Using the lessons from the game and

Box 1 | Allowing for a diversity of partners to sit at the table

“(The game) helped us think, reduced the level of conflict and changed the mood of the debate.” (Participant P1). According to the convener of the meeting, the director of the FSC Program for the Congo Basin at that time, the game and the facilitation “(...) allowed members of the HCV-RWG, coming from different cultures, countries and with a very heterogeneous educational background, to acquire in only two days the same level of understanding regarding the IFL concept, and how each management decision could impact the landscape, its resilience and the forest-dwellers.” (Supplementary Note 2).

Quotes are from participants of the FSC workshop and are available in detail in ref.⁵⁶.

debriefing, local government and private companies are currently discussing scenarios for sustainable oil palm plantations.

In all cases, the value and impacts of game sessions depend on the nature of the participants. The games enable a dialogue between different scales of decision-making. We have taken them from the farm to the ministry offices, from the concessions to the regional working group. In all these cases, the games were designed at the lowest local management level and brought upwards to the higher decision-making levels¹⁷. They served to convey how different stakeholders perceive the system and did so better than other forms of scientific communication¹⁶. The games neither dissolve existing power structures and asymmetries, nor the inequalities they create. Instead, they reveal them, as they highlight the winners and losers, and the constraints on each stakeholder group¹⁶. They do not show the solutions, but place people in a situation where they may discover promising and innovative strategies.

How games work

It is worth detailing more precisely how gaming impacts the process of collective decision-making, using the example of the FSC dialogue in Central Africa.

Allowing for a diversity of partners to sit at the table. The negotiators had not been selected to play a game, but to conduct a negotiation and build an agreement that would be presented at the FSC General Assembly. They had been selected through a process initiated when the discussions around Motion 65—a motion that called for the conservation of the vast majority of the IFLs within FSC certified forest management units—began in the region, in 2016. Twelve of them had been selected out of a pool of 300 candidates. They represented and spoke on behalf of the Environmental, Economic and Social Chambers that are the constituencies of the FSC General Assembly. While all 12 negotiators had been part of the discussion since the first day, their level of engagement and familiarity with the concepts differed. No matter their grasp of the topic, they were all new to the game, and received the same instructions. After one day, all the negotiators had the same level of understanding of the game. In the subsequent discussions on days 2 and 3, whenever points were unclear or misunderstood, the game components were used to illustrate the situations that were being discussed, bringing clarity to the discussions. The game had a tangible impact on the way the dialogue was carried out (Box 1).

Changing the mental models of participants. Mental models are the functional but incomplete representations people have of their own capabilities, the capabilities of others, and the natural and physical processes at play at the time of making a decision^{5,19,26}. Mental models are by definition partial views of the world²⁷, and appear valid to those who hold them²⁸. They are shaped by society,

Box 2 | Changing the mental models of participants

“Before coming, I thought there would not be an evolution in the way I would comprehend the things. When I arrived, I saw the game on the table and asked myself what this is. And after two hours, I began to understand.” (Participant P2). This initial scepticism is probably the single most difficult obstacle to the uptake of the method.

“With the game, it was possible to explain things that are difficult to understand and imagine in reality.” (Participant P4).

“In a situation of absolute blockage and despite the group was not well prepared for such a technical discussion, within less than one day we obtained a better understanding of the situation by all stakeholders.” (Participant P5).

“I realized that strategies can be distinct; that companies and individuals can have very different objectives. All that, in the game and in reality, has a big impact not only on the forest, but on oneself and others.” (Participant P3).

culture and history, as well as by individuals’ direct experiences²⁹. Individuals compare direct experiences with their existing mental model, and if the new information does not match—when surprise is experienced—it can be modified or the new information rejected. Humans tend to accept information that matches existing constructs, disregarding the rest²⁹. Therefore, major changes to mental models are not made readily. To make things more difficult, such changes are not easily accessible to external enquiry, and there is little to no direct introspective access to higher-order cognitive processes. Could the self-reports (Box 2) misrepresent the actual cognitive processes at play? Yes; however, the validity of the reports matters less than the fact that the group managed to arrive at a productive agreement that was voted for and endorsed by the participants (Box 3).

Strengths and weaknesses of games

For a particular game session to trigger transformation, three events must happen sequentially, one enabling the others³⁰. First, the session must happen. Second, the session must transform the mental models of the participants. Third, the participants must act upon these learnings. Each of these steps requires specific conditions to be met and failure in any of them precludes impact. The lack of clarity on these conditions until now explains why the use of games is not widespread despite their effectiveness.

Leadership. The first condition for a session to be organized (step 1) is for a convener to step forward. The person or institution calling for the meeting, inviting the participants and proposing the use of the game as support for dialogue, is critical for the success of the process. The power relationship between the convener and the prospective players dictates whether a session happens or not. Based on our experience, the difficulty in fulfilling this initial condition explains why there have not been more sessions, particularly at higher levels of decision-making. Potential conveners either have not heard of the method, do not believe in its transformative potential, do not want the transparency it brings or lack the time, resources and know-how to convene such dialogues⁵.

Participation. The second condition for a game session to take place is for players to respond to the call of the convener. There are a variety of reasons that can trigger the decision to join. Participants will join because they can, because they want and/or because they must. They can respond to the convener, they can be attracted by the other participants, by the venue or by whatever they expect will happen. Three actionable levers deserve mention to attract

Box 3 | Translating the experience of gaming to changes in policy design

How did the game translate the experience of gaming to changes in the design of policy? Answering this question is best left to the ‘convener’ of the workshop who was in charge of the entire negotiation process. He writes: “From the beginning of the internal HCV-RWG discussions, no consensus seemed to be achievable across the different interests (...). Thanks to (games and facilitation), the HCV-RWG reached a consensus (...). This first solution is a major step globally to move, in the short-term, towards an internationally acknowledged way to manage IFLs in Congo Basin Forests.” (Supplementary Note 2).

How?

“By breaking the problem down into different cases, we were able to find situations where there was agreement. The game and the way it was facilitated helped the group find a more productive, positive dynamic without focusing on points of conflict.” (Participant P6).

“Whenever the negotiation got stuck, we were going to see how we could manipulate the (gameboard) and it became clear. The back and forth between the game and reality allowed to illustrate and clarify the concept. The consensus was easier to find, and the game allowed for a more constructive debate. Hence, it was only afterwards that it became clear why the game is useful.” (Participant P7).

participants. (1) Signalling. Bystanders will be convinced to join when other participants signal and broadcast the quality of the experience. In management sciences, this is the best solution for the so-called ‘empty restaurant syndrome’³¹. (2) Interest. The concept of self-interest is foundational in economics and decision sciences. People will do something if they believe doing it will bring them a benefit³². If prospective participants think participating will help them achieve their own objectives, they will join. (3) Conformity. Recruiting players for the initial sessions can be difficult. If people expect others will participate and they prefer to act like most others, the conditions are met for a social tipping-point that will make further sessions easier to organize^{6,33}.

Once the session begins, a different set of conditions is required for participants to change their mental models.

Validity. The first condition for a transformative experience is that the game must represent the constraints and opportunities stakeholders face in the field (Supplementary Note 1). The games described here are models of the reality as the game designers view it, a description of what they think a landscape is and how it works. For the game to be useful, it needs to share the logical structure of the system it represents (*sensu* Wittgenstein³⁴). The rules of the game must be congruent with the structure of cause and effects and the magnitude of the responses known from the system. This is achieved during the design phase, when stakeholders themselves are part of the design team and beta testers. The game is valid when these early players say ‘this feels real’³⁵. Once this is achieved, everyone playing the game will experience what it is to interact with the system from their perspective.

The game, like any model, is a simplification of reality. FSC participants acknowledged that not all details are necessary to understand the system. Failure to achieve validity can result either in the loss of credibility of the session or, worse, it can lead participants to ill-founded and potentially counter-productive conclusions (Supplementary Note 1). We avoid these pitfalls by teaching participants to maintain a critical distance from the game, recognizing that it is a model with all the limitations this entails. In addition,

Box 4 | Transformative power of games

“It was interesting to play around and visualize something you think you know, but with a model it jumps out. It really deepened the understanding.” (Participant P3, FSC session).

“Playing the palm oil game was a real eye-opener for me. It became clear that it is so easy to get the perspective of a smallholder very fast, like it would for every role one plays. Playing such a game can achieve a lot of understanding of different perspectives in a short time.” (CoPalCam session, July 2018).

participants also need to learn the rules of the game to play. In so doing, they are able to judge whether or not these rules correspond to their understanding of the system. Discrepancies here highlight the different perceptions between these players and the stakeholders engaged in the design of the game.

Facilitation. Skilled facilitation is the second condition to ensure that the game and the discussions that follow are fruitful. While the game sessions can be fun, the process of confronting one’s own cognitive limitations and incorrect assumptions can be a source of frustration and discomfort^{36,37}. Additionally, participants that have a self-perception of high expertise on the topic can have a closed-minded attitude or feel belittled if the game reveals gaps in their understanding^{38,39}. Facilitation can help transform these difficult personal experiences into opportunities for learning and self-reflection. Another danger to avoid is that power relations can invade the game session. Power—the capacity to do things and particularly the capacity to influence others—is represented in the games, and is an essential element of any player’s strategies, but is also part of the social interactions between the players. There must be room to discuss its origins, distribution and limits^{40,41}. The facilitator can ensure that powerful players do not curtail the discussion. Deciding strategically who will play what role can contribute to the success of the discussion. We have organized sessions where only allies were invited to play, giving them a safe space to explore strategies in response to more powerful stakeholders represented in the game by our research team³³.

Engagement. The attitude of the players is the third condition that drives the success of the game itself. Irrespective of the reason why the participants joined the sessions to begin with, the game can only exist for as long as the players are engaged with it and decide to play (Supplementary Note 1).

Transformational experience. We believe the combination of emotional responses and the surprises that happen during a game primes participants to engage in belief revision and makes epiphanies more probable. How people learn is a central question in behavioural sciences. Information alone is insufficient to generate change⁴². Besides reinforced learning characterized by a gradual shift in behaviour or improvement in performance, insight learning is evidenced by sudden and dramatic behaviour changes⁴³. We resist changing values, but we adjust our expectations and our mental models of the world on a regular basis whenever we experience surprise⁴⁴. Surprise, the reaction to a mismatch between incoming information and our expectations, formed through our mental models, can invoke a specific behavioural response aimed at revising the mental model, precisely to improve one’s capacity to anticipate future states of the world⁴⁴. Players undergo emotional responses when playing. Surprise, frustration and triumph, anger and joy can all be experienced through a well-designed and well-run game session⁴⁵. We propose that the personal, direct emotional experience

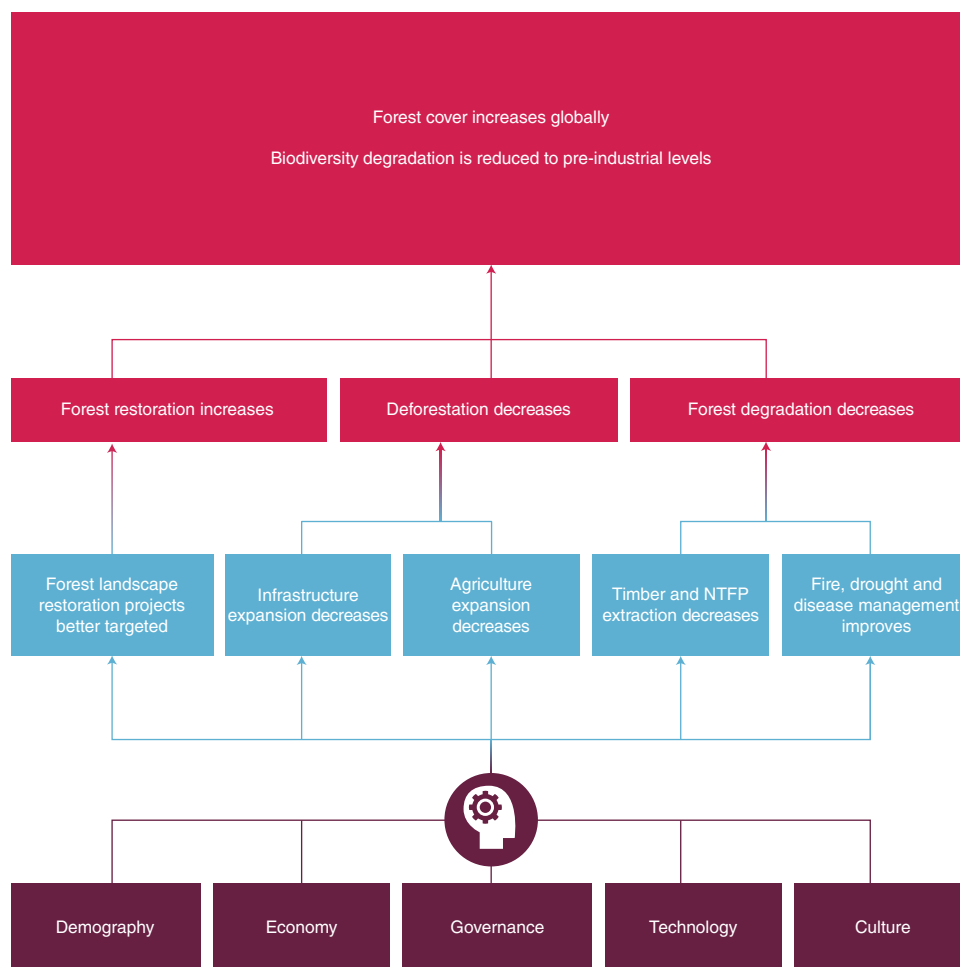


Fig. 1 | How and why the forest transition will happen. Change in forest cover and biodiversity influenced by human activities that can be traced back to five types of underlying driver (burgundy boxes). These drivers condition the transformation of practices (blue boxes) leading to the global forest transition (red boxes). Both drivers and practices rest on the decisions made by humans. Cultural values—Indigenous, western, postcolonial or others—constitute the core element of the cultural family of underlying drivers and shape the decision-making process of everyone^{50,51}. NTFP, non-timber forest product.

of the impacts of decisions transforms the things one knows into things one cares for. We think this is the reason why games have transformational power (Box 4) and invite more research to explore these open questions.

Time. Finally, the last condition is time. In view of the complexity of the systems and the possibilities offered by the games, players need to devote sufficient time to learn the rules, explore different strategies and consider counter-plays and possible setbacks. Failure to spend enough time playing can lead to missed opportunities and to hasty, suboptimal decisions. This means hours and in some cases days, not minutes—the threshold people spontaneously allocate to gaming.

If all the conditions above are met, the choices participants make afterwards will be better informed, although not necessarily different. Participants will make different choices if they can, if they want and/or if they must. For participants to enact change, conveners and facilitators need to mind the following:

Self-agency. Participants will resist if they feel the process is an exercise in manipulation⁴⁶ (Supplementary Note 1). Trust in the model, transparency in the design process and willingness of the convener to revise assumptions and to act upon the lessons learned are defining elements that will contribute to the willingness of the participants to follow through and implement change.

Empowerment. Players need to be empowered to make decisions. This can stem from their position in society, their mandates, their networks, their assets, their charisma or personal considerations⁴⁷. Empowerment can also stem from the venue where the sessions were convened, or the policy process to which they are connected. If the players are constrained by their hierarchies or social norms, change will be difficult or impossible. These considerations need to be integrated in the design of the game sessions³³.

Self-efficacy. Empowerment can also come from within. Lacking the core belief that one can make a difference by one's actions⁴⁸ contributes to apathy, inaction, displacement behaviour, resignation or adhesion to the current pathway⁵. Finding promising strategies directly contributes here. A powerful way to promote this is to compare game sessions showing how others have solved the same problem to collectively identify better solutions⁴⁹.

An application for global sustainability

Let us apply this approach to an ongoing, global environmental problem whose resolution has eluded us over the past 30 years: the global forest transition¹⁹. Can we stop deforestation and biodiversity degradation, and bring back tree and forest cover on Earth to pre-industrial levels? Our knowledge of the drivers of deforestation and degradation^{50,51} allows us to formulate a narrative for this transition as a series of interlocked conditional statements (Fig. 1).

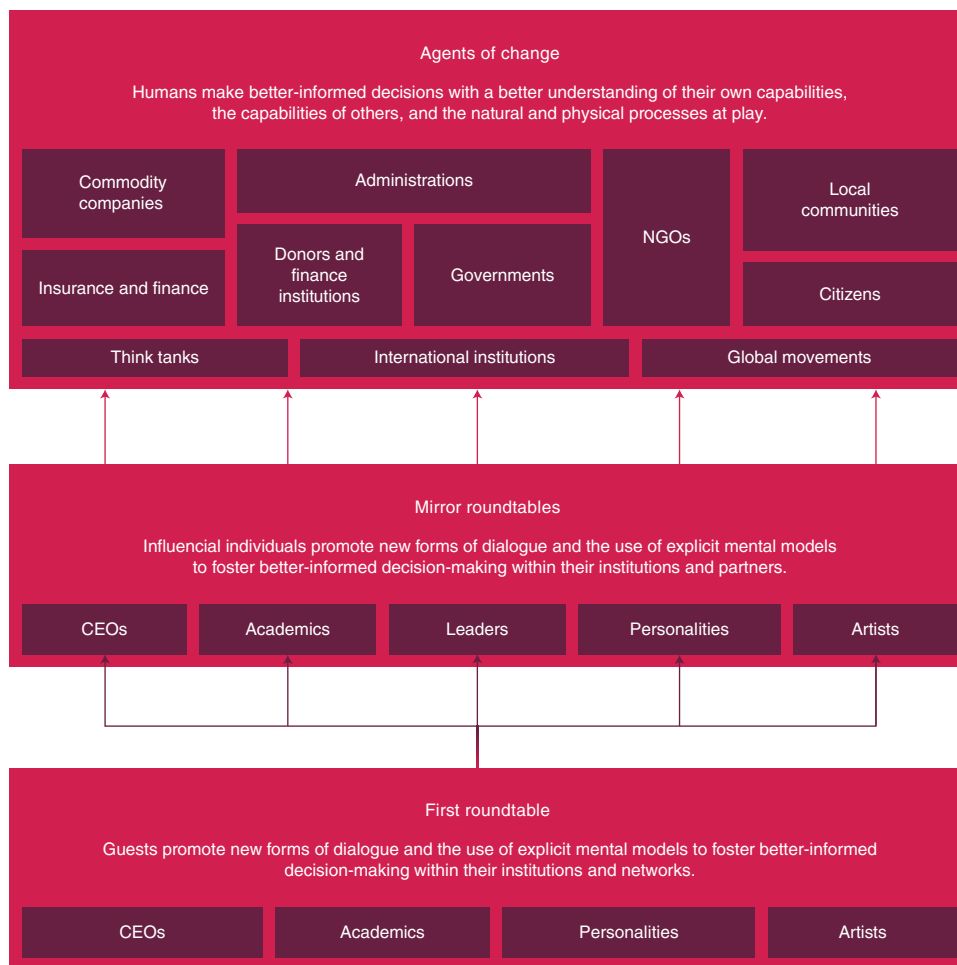


Fig. 2 | Designing landscape change. We propose that, to transform the system that results in deforestation, we can change the decisions people make by changing the way people make decisions. We describe a process that begins necessarily with one session with public figures, and then cascades and percolates. This can happen through a decentralized, distributed process in three stages: (1) High-profile influencers are invited to discover the method to promote the new forms of dialogue and the use of games to foster better-informed decisions within their institutions and networks. Who these personalities are is not specified. Cultural idiosyncrasies are not the focus. (2) Encouraged by this early example, influential individuals promote the use of these tools within their institutions and constituencies. (3) Stakeholders and agents of change make better-informed decisions in their respective arenas on the basis of modified incentive structures redesigned on the basis of dialogues and games.

For forest cover to increase globally, forest landscape restoration must increase, and deforestation and forest degradation must decrease and eventually halt. For forest landscape restoration to increase, forest landscape restoration projects must be better targeted, with trees planted only where it makes sense and forest growth not disrupted. For deforestation to decrease, infrastructure development and agricultural expansion on forest land must decrease and eventually halt. Finally, for forest degradation to decrease, extraction of timber, fuelwood, charcoal and other non-timber forest products must decrease, and fire and disease management needs to improve. Throughout this process, climate change will help in some places and/ or hinder in others, reducing the potential for forest cover in the tropics and increasing it in boreal regions⁵².

This narrative (Fig. 1) says nothing about how to operate the transition or how difficult each step will be. A key missing element is the agency of the people involved in making the decisions that shape the landscapes^{5,19,26}. For the transition to happen as we have described, the context in which individual decisions are made at many different levels must change. For the millions of farmers, the agro-industries, and the mining, road and infrastructure development firms to change their practices, the contexts must change, as well as the combination of demographic, economic, governance,

technological and cultural underlying factors in which they operate⁵³. For this to happen, donors and finance institutions, governments, non-government organizations, local communities, administrations, all must change the way they make decisions and the bases of their decisions. This sounds impossible to achieve. Indeed, we do not think the forest transition can be triggered through a centralized process. We believe a more promising path is to rely on a decentralized, distributed process⁵⁴ (Fig. 2). This can begin with a session where high-profile participants participate in a strategy game, experience the transformation of their mental model, and then signal to others the validity of the approach. Enabled by this demonstration, early influential adopters begin testing, adopting and promoting the method within their networks, institutions and constituencies. Percolating through the hierarchical structures, stakeholders may then end up making decisions on the basis of redesigned incentive structures.

Redesigning decision-making

A recent call was made to help the Intergovernmental Panel on Climate Change (IPCC) listen receptively to alternative forms of knowledge, to imagine new forms of expert contribution⁵⁵. Here we outlined one way to do so. As long as human agency remains

external to international science–policy interfaces and policy decision-making processes, it will be difficult to develop robust policies that adequately consider the complexities of social and ecological system transformations. It is probable that we will miss the intended environmental targets again. The approach we have described may help design more effective post-2020 sustainability strategies. How is what we propose different from any other form of science–policy interface? The answer is structured collective intelligence. We are proposing collective, explicit and transparent problem exploration and solution identification processes to counterbalance hidden, unformulated and/or opaque decision-making processes happening in the minds of decision-makers. We propose a way to redesign the way decision-makers come to decisions through a pragmatic, value-agnostic yet inclusive method to develop narratives and update mental models. We will change the choices we make when we change the way we make choices.

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Author contributions

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Competing interests

L.B., P.S., L.F. and H.D. work for CIRAD, a French public research centre. C.A.G., P.O.W. and A.D. are shareholders of LEAF Inspiring Change (<https://leafic.ch/>), a Swiss

spin-off of ETH. F.Q. works for Biotope (<https://www.biotope.fr/>), a French consultancy company. CIRAD, LEAF and Biotope all offer, among other consultancy services, the use of strategy games to clients in the public and private sectors.

Additional information

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Correspondence should be addressed to Claude A. Garcia or Patrick O. Waerber.

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