

Review

Fostering collective action through participation in natural resource and environmental management: An integrative and interpretative narrative review using the IAD, NAS and SES frameworks

Juan Felipe Ortiz-Riomalo^{a,*}, Ann-Kathrin Koessler^b, Stefanie Engel^a

^a Department of Environmental Economics, School of Business Administration and Economics and Institute of Environmental Systems Research (IUSF Research Centre), Osnabrück University, Germany

^b Institute of Environmental Planning, Leibniz University Hannover, Germany



ARTICLE INFO

Keywords:

Co-operation
Collective action
Social dilemmas
Participatory governance
Natural resource management

ABSTRACT

Solving humanity's social-environmental challenges calls for collective action by relevant actors. Hence, involving these actors in the policy process has been deemed both necessary and promising. But how and to what extent can participatory policy interventions (PIs) foster collective action for sustainable environmental and natural resource management? Lab and lab-in-the-field experiments on co-operation in the context of collective action challenges (i.e. social dilemmas) and case study research on participatory processes both offer insights into this question but have hitherto mainly remained unconnected. This article reviews insights from these two streams of literature in tandem, synthesising and analysing them using the institutional analysis and development (IAD) framework in combination with the network of action situations (NAS) framework and the social-ecological systems (SES) framework. We thus perform an integrative and interpretative narrative review to draw a richer and more nuanced picture of PIs: their potential impacts, their (institutional and behavioural) mechanisms and challenges, and caveats and recommendations for their design and implementation. Our review shows that PIs can indeed foster collective action by (a) helping the relevant actors craft suitable and legitimate institutional arrangements and (b) addressing and/or influencing actors' attributes of relevance to collective action, namely their individual and shared understandings, beliefs and preferences. To fulfil this potential, the organisers and sponsors of PIs must address and link to the broader context through soundly designed and implemented processes. Complementary follow-up, enforcement and conflict resolution mechanisms are necessary to nurture, reassure and sustain understandings, beliefs and preferences that undergird trust-building and collective action. The conceptual framework developed for the review can help researchers and practitioners further assess these insights, disentangle PIs' mechanisms and impacts, and integrate the research and practice of participatory governance and collective action.

1. Introduction

Resolving the pressing social-environmental challenges of our time calls for collective action (NRC, 2002; Dietz et al., 2003; Ostrom, 2010a; Muradian and Cardenas, 2015; IPCC, 2019; Dasgupta, 2021). The relevant actors involved must coordinate with each other to attain socially desirable goals, such as biodiversity conservation, water provision and food security. *Participatory (policy) interventions* (henceforth *PIs*) could

thus foster collective action in cases where self-organised collective action does not occur (Ostrom, 1990, 2010b; Baland and Platteau, 1996; Pahl-Wostl, 2002, 2015; Meinzen-Dick et al. 2018). By PIs, we mean policy interventions involving any relevant actors via consultation, information or active engagement at any stage of the policy and management processes (Fung, 2006; Newig et al., 2018; Reed et al., 2018). Despite their relevance for the deployment, understanding and analysis of PIs, two distinct streams of scholarship have evolved in parallel and

* Corresponding author.

E-mail address: juanfelipe.ortizriomalo@uni-osnabrueck.de (J.F. Ortiz-Riomalo).

<https://doi.org/10.1016/j.jenvman.2022.117184>

Received 7 May 2022; Received in revised form 27 December 2022; Accepted 29 December 2022

Available online 2 February 2023

0301-4797/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

remain largely unconnected, missing opportunities for cross-fertilisation. While one primarily focuses on the contextual, situational and behavioural conditions for collective action in social dilemma situations (i.e. collective action challenges), the other focuses on the features, mechanisms and impacts of participatory processes. Aiming to expand our understanding of PIs' potential for collective action in environmental and natural resource management, this article synthesises and analyses insights from both streams of research by employing the institutional analysis and development (IAD) framework.

The research on collective action sheds light on the variables and principles necessary for the relevant actors to build governance systems that foster and sustain trust and co-operation in natural resource use and management (Ostrom, 2000a; Ostrom et al., 1994). It has drawn upon case studies, social science experiments and game theory modelling (Poteete et al., 2010). Results of this research highlight the centrality of participatory decision-making for trust building and suitable and legitimate solutions to complex collective action challenges (e.g. Baland and Platteau, 1996; Ostrom, 2007a, 2010b; Cox et al., 2010; Heikkilä and Andersson, 2018). However, participatory processes take different forms (e.g. van Asselt Marjolein and Rijkens-Klomp, 2002; Rowe and Frewer, 2005; Fung, 2006; Lynam et al., 2007; Newig et al., 2018; Reed et al., 2018), and research on collective action has not delved into these or their potential impacts.

The literature on participatory governance describes and analyses the features, methods, context and outcomes of *participatory processes* (henceforth PPs). By PPs, we mean the series of activities created and facilitated by PIs through different possible *participatory methods* (henceforth PMs), such as participatory modelling (Voinov and Bousquet, 2010), serious games (Medema et al., 2016) and group deliberation (e.g. Fung, 2003). Research on PPs has primarily used case studies, literature reviews and meta-analyses of case studies. Case-study research, however, cannot easily track all relevant variables and processes. Changes in social-ecological outcomes, institutions and behaviours often do not materialise immediately. Although case study research does provide detailed descriptions of processes, contextual conditions and potential effects, it does not allow the neat disentanglement of different types of impacts, underlying mechanisms and possible confounding factors (Collier, 1993; Poteete et al., 2010). Furthermore, using different conceptual and methodological frameworks in each case study limits the extent to which meta-analyses can help overcome these limitations (Rudel, 2008; Poteete et al., 2010).

Experimental approaches could help disentangle the impacts and mechanisms of (different types of) PIs (e.g. Meinzen-Dick et al., 2018; Alpízar et al., 2019; Ortiz-Riomalo et al., 2023). These allow control over the data generation process and thus the isolation of the effects of incentives or alternative institutional arrangements on behavioural outcomes (Smith, 1982; Kagel and Roth, 1995, 2016). However, ethical, institutional, political and logistical constraints tend to make randomised controlled experiments less feasible, thus limiting the evidence base on the impacts of PPs in sustainable resource management (NRC, 2008). Nonetheless, results from the lab and lab-in-the-field experiments on collective action can provide insights into the potential impacts of PIs on collective action. These experiments recreate PMs such as collective decision-making and small group communication to identify their effects on co-operation and other behavioural outcomes in tightly controlled recreations of collective-action challenges (e.g. Cardenas et al., 2004; Ostrom, 2006; Dal Bó et al., 2010). Thereby, they allow linking collective choice processes resembling some features of PIs with relevant behavioural outcomes that are hard to gauge, track and disentangle when relying solely on field data from case studies.

Therefore, we conducted an integrative and interpretative narrative review of these streams of research. Specifically, we integrate insights from case study research on PPs with those from the lab and lab-in-the-field experiments on co-operation in social dilemma situations (i.e. collective action challenges). We use a common conceptual framework to synthesise and analyse these insights. The framework combines the

IAD framework (Ostrom, 2011; McGinnis, 2011a) with its conceptual extensions: the Network of (Adjacent) Action Situations (NAS) framework (McGinnis, 2011b; Kimmich et al., 2022) and the Social-Ecological Systems (SES) framework (McGinnis and Ostrom, 2014).¹ We expound on the conceptual framework and our approach in Section 2 and Section 3, respectively. Section 4 presents and analyses the insights we gathered, and Section 5 summarises and discusses our literature review's conclusions, limitations and implications.

2. Conceptual framework

Whether actors can coordinate their behaviour to achieve better collective outcomes, such as biodiversity conservation and climate change mitigation and adaptation, depends on several factors. These include the attributes of the involved actors, the structure of their action situation, and the characteristics of their broader biophysical, governance and social context (Ostrom, 2010b; Poteete et al., 2010). The IAD, NAS and SES frameworks encapsulate these elements (Kiser and Ostrom, 1982; Polski and Ostrom, 1999; Ostrom and Ostrom, 2004; Ostrom, 2005, 2007a, 2010b, 2011; Poteete et al., 2010; McGinnis, 2011a, 2011b; Heikkilä and Andersson, 2018; Schlager and Cox, 2018; Cole et al., 2019). We expound on these in Section 2.1 and Section 2.2. Insights from the institutional and behavioural analysis of collective action challenges enrich the presentation of the governance system (Section 2.2.2) and the actors' attributes (Section 2.2.3). These insights and concepts from the literature on participatory governance (Fung, 2006; Ansell and Gash, 2008; Newig et al., 2018; Reed et al., 2018) also shed light on the prospects for collective action in social dilemma situations (Section 2.3) and the channels in which PIs could foster collective action (Section 2.4). Fig. 1 summarises these ideas.

2.1. Action situation(s)

An action situation (AS) is the analytical focal unit of the IAD framework. It is where state and/or non-state individuals or organisations interact and produce joint ecological, institutional and/or social outcomes (Ostrom, 1990, 2005, 2011; Schlager and Cox, 2018; Cole et al., 2019). Depending on their (i) *position* or role, the involved (ii) *actors*, that is, the participants in the AS, decide among different possible (iii) *actions* based on the (iv) *information* they have on the attributes, positions and possible actions of the other involved actors, the potential (v) *outcomes*, (vi) *costs* and *benefits* of these actions, and the degree of (vii) *control* and *influence* they can exert over possible actions and outcomes. These seven basic working components structure any AS; the same components usually describe a game or decision situation in experimental economics (Ostrom, 2011; McGinnis, 2011a). (See box B in Fig. 1.)

Every AS is part of a network of adjacent action situations (NAS) that mutually shape one another's structure (Ostrom, 2005; McGinnis, 2011b) (see box C in Fig. 1). Based on an evaluation of the outcomes of their actions, actors may adapt their behaviour through various learning processes to attain better results for themselves and others (Ostrom, 1990, 2005; Pahl-Wostl, 2009; Pahl-Wostl et al., 2010; McGinnis,

¹ Poteete et al. (2010), McGinnis and Ostrom (2014), Schlager and Cox (2018) and Cole et al. (2019) expand on the relationship between these frameworks and the potential – and possible limitations – of using them in combination. Ortiz-Riomalo et al. (2022) suggest using them in combination to integrate insights from research on participatory processes and collective action for the design and analysis of PIs aimed at fostering collective action. They illustrate the potential of this combined approach comparing and analysing two PIs for collective action in watershed management in the Colombian and Peruvian Andes. (In a similar vein, Klok and Denters (2018) elaborate on the potential of institutional analysis and the IAD framework to characterise and design participatory (governance) interventions.)

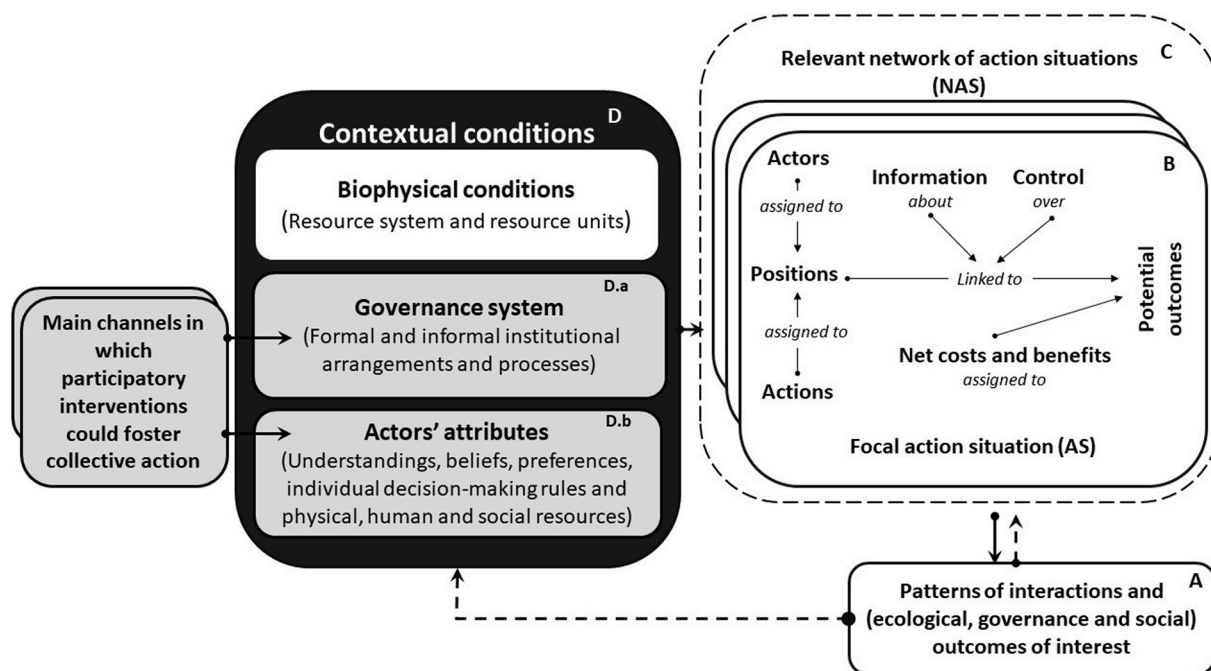


Fig. 1. Conceptual framework.

The (ecological, governance or social) **outcomes of interest** (box A) are the result of the relevant actors' interactions in the **focal action situation (AS)** (box B). The elements in box B are the working components that determine any AS's structure and thus mark actors' constraints and possibilities for collective action. Any AS is part of a network of relevant adjacent (institutional and operational) action situations (i.e. **the relevant NAS**, box C). The outcomes of **the relevant NAS** and the broader ecological, governance and social **context** (box D) shape the AS's structure. Policies and policy processes could influence these (pre-existing **contextual conditions**) to foster collective action. Specifically, participatory (policy) interventions (**PIs**) can address and influence (a) the **governance system** (box D. a) and (b) the **actors' attributes** (box D. b.) by, for example, creating new interconnected ASs or influencing existing ASs through soundly arranged participatory processes and methods. Since the **biophysical conditions** are relatively more difficult to change, **PIs** cannot alter them in the short-term but must consider and address them adequately. **Source:** Own elaboration based on previous representations of the IAD, NAS and SES frameworks (Ostrom, 2005, 2010b, 2011; McGinnis and Ostrom, 2014; Cole et al., 2019).

2011a). They can adjust their day-to-day operational choices in an **operational AS** or seek to modify the institutional arrangements that regulate these choices in the corresponding formal or informal **AS for institutional design and enforcement**. A series of pre-existing contextual conditions shape the structure of any (N)AS, thus constraining the actors and their possibilities for collective action (Cole et al., 2019). These conditions include the biophysical conditions, the governance system and the attributes of the relevant actors (see Section 2.2 and box D in Fig. 1). Policies and policy processes could potentially influence these to shape the prospects of collective action (see Section 2.3 and Section 2.4).

2.2. Contextual conditions

2.2.1. Biophysical conditions: the resource system

Biophysical conditions refer to the ecological and physical characteristics of the relevant resource system. These include the features of (the stock and units of) the relevant natural resources, goods and services. They also include the ecosystems, ecosystem functions and human-made physical infrastructure that sustain human life and activities (Ostrom, 2007b, 2009; Poteete et al., 2010; Cole et al., 2019).

2.2.2. Governance system: institutional arrangements and processes

Formal and informal institutional arrangements, in the form of rules, norms and shared strategies, also influence actors' (operational and

institutional) choices, actions and interactions (North, 1994; Crawford and Ostrom, 1995; Ostrom, 2005). **Operational-choice** arrangements, such as environmental and resource management policies, regulate actors' day-to-day operational choices and actions. They define how resource users can, should, must or must not use natural resources.² **Institutional-choice** arrangements determine how actors can craft, enforce and modify their current institutional arrangements and who can participate in the process.³ These arrangements and the processes for formulating and implementing them constitute the governance system (Poteete et al., 2010; McGinnis and Ostrom, 2014; Cole et al., 2019).

2.2.3. Actors' attributes

Actors' choices and actions are also conditional on their attributes (Kiser and Ostrom, 1987; Ostrom, 2005, 2011). Individual decision

² These are commonly known as operational rules (e.g. economic, environmental and natural resource use policies and regulations). We instead use the term 'arrangements' to acknowledge that norms and shared strategies, in addition to rules, also constitute institutional arrangements (Crawford and Ostrom, 1995; Ostrom, 2005).

³ The framework further differentiates between collective-choice and constitutional-choice arrangements (Ostrom, 2005). The term 'institutional-choice arrangements' encompasses both of these (Ostrom, 1990). Collective-choice arrangements (e.g. arrangements to regulate the policy-making process) define how collective choice comes about – that is, how operational arrangements must, may or should be crafted, enforced and changed by the relevant actors. Constitutional-choice arrangements (e.g. a country's constitution, an organisation's by-laws) define the participants and procedures that are allowed to transform, monitor and enforce the collective choice arrangements (Kiser and Ostrom, 1982).

factors include actors' background knowledge, mental models, beliefs, preferences and personal decision-making rules. Broader socioeconomic and sociocultural attributes comprise actors' physical, human and social resources, such as physical and financial assets, education, pre-existing levels of mutual trust and social networks (ibid; Ostrom et al., 1994; Dasgupta, 1999).

Actors' beliefs and preferences play a crucial role in collective action (Bates, 1988; Kollock, 1998; Fehr and Fischbacher, 2002; Fischbacher and Gächter, 2010; Ostrom, 2010c; Pavitt, 2018). Mental models and beliefs refer to actors' *understandings* and *expectations* about cause-and-effect relationships and the likely behaviour, beliefs, and expectations of other actors (Geanakoplos et al., 1989; Mantzavinos et al., 2004; Bowles, 2016; Bicchieri, 2017). Based on others' feedback and the biophysical context, actors learn and adapt individually and collectively. They may revise their individual and shared understandings and beliefs about desirable individual and shared strategies, norms and rules, potentially yielding better individual and collective outcomes (Mantzavinos et al., 2004; Ostrom, 2014; Pahl-Wostl, 2009; Poteete et al., 2010; Schill et al., 2019). Nevertheless, actors' limited information processing capabilities can hamper such learning processes (North, 1994; Ostrom, 2010c; Poteete et al., 2010).

In turn, different types of actors' *preferences* define their valuation of various decision and action options (Sen, 1977, 1997; Ostrom, 2005; Bosworth et al., 2016; Dhimi, 2016). *Social preferences* imply that actors may not only care for their own social and economic well-being (e.g. in terms of better social-ecological outcomes). They may also care for others' well-being, the state of their ecological environment (i.e. of nature), the norms they and others value, and others' actions, intentions, beliefs and expectations (Ostrom, 2010c; Cardenas, 2011, Cárdenas and Camilo, 2018; Bowles and Polanía-Reyes, 2012; Bicchieri, 2017). Actors with *other-regarding preferences* 'attach value to the [outcomes, i.e. the] well-being of others as ends in themselves (other humans, species or nature as a whole)' (Heinz and Koessler, 2021). In contrast, *self-regarding preferences* primarily attach value to individual well-being, that is, to the (material) outcomes for the individual decision-maker (Cox, 2004). People may also care about the features of the underlying decision-making processes and thus form *procedural preferences* (Frey et al., 2004; Dhimi, 2016). Many prefer decision-making processes they perceive as fair and legitimate, making them feel self-determined. They prefer processes that allow them to control and influence their potential actions, choices and outcomes, making them feel competent, autonomous and connected with the social and ecological environment (Tyler, 1990; Sen, 1997; Ostrom, 2000b; Frey et al., 2004; Bowles, 2016; Ezzine-de-Blas et al., 2019).

2.3. The prospects for collective action

Actors with different beliefs and preferences may favour collective action for various reasons. They may value collective action in itself, care for their personal and social image, care for their own and others' well-being and/or intrinsically value norms such as fairness, co-operation or reciprocity (Andreoni, 1988; Fehr and Fischbacher, 2002; Batson and Powell, 2003; Fehr and Schmidt, 2006; Ostrom, 2010c; Poteete et al., 2010; Cardenas, 2011, Cárdenas and Camilo, 2018; Bosworth et al., 2016). For any of these reasons, they may be interested in acting in favour of collectively desirable outcomes.

However, joint, coordinated action is often the only way to attain better outcomes for everyone in interdependent settings, such as those created by collective-action challenges. In such situations, people acting in favour of the collective may become worse off if the other relevant actors decide not to co-operate (Kollock, 1998; Ostrom, 1998, 2010c). Hence, a non-negligible proportion of people are conditional co-operators (Fehr and Fischbacher, 2002; Fehr and Schmidt, 2006). That is, they only co-operate if others do. For these people, beliefs about others' actions are crucial determinants of their behaviour (ibid; Fischbacher and Gächter, 2010). Thus, if they trust that others will

engage in collective action and value co-operation or co-operative outcomes, they also tend to co-operate. Hence, it matters whether or not they find the other relevant actors trustworthy (Gambetta, 1990; Baland and Platteau, 1996; Dasgupta, 1999; Ostrom, 1998, 1999, 2010c; Cox, 2004).

Trust – and trustworthiness – are primarily based on actors' information about their situation and the broader context: information on other actors' attributes and their possibilities and constraints, particularly the potential monetary and non-monetary costs and benefits of (not) co-operating (Dasgupta, 1990, 2007, 2021; Gambetta, 1990; Ostrom, 1999, 2010c). The structure of the AS of which they are a part, the adjacent ASs in the relevant NAS and the pre-existing contextual conditions thus influence trust and, thereby, collective action (ibid; Ostrom et al., 1994; Baland and Platteau, 1996; Ostrom, 1998, 2010c; Poteete et al., 2010).

2.4. Potential of PIs for collective action

Hence, this conceptual framework lays out two main channels for PIs to foster trust and collective action. Considering that biophysical conditions are relatively more challenging to alter in the short term, these channels are namely (a) the governance system and/or (b) the actors' attributes (see box D. a and box D. b, respectively, in Fig. 1). Depending on how organisers and sponsors design and deploy them, PIs could influence institutional arrangements and processes as well as actors' understandings, beliefs and preferences (i.e. their learning and trust-building processes). Through these channels, PIs can influence any of the working components of the focal (N)AS, thus shaping the prospects for collective action in environmental and natural resource management.⁴

Using shaded grey boxes and arrows, Fig. 1 marks these two channels (see boxes D. a and D. b). These channels provide the thematic units (i.e. thematic headings) to synthesise and analyse the insights we gathered from each stream of research. We elaborate on the review methods in Section 3.

3. Methods and procedures for the review

Ours is a narrative review of insights from case studies on PPs and experiments on co-operation in collective action challenges (i.e. social dilemma situations). We integrate and interpret the extracted insights using the conceptual framework we presented in Section 2. In this section, we describe our approach. The supplementary material lists and expounds on the literature selection (see Section S1) and schematically presents the insights our review generated (see Table 1 through Table 3 in Section S2).

Based on our background knowledge, we first selected a list of reviews and meta-analyses from each stream of literature to start the review (references 1–12 in Section S1). These are works that scholars within each stream of literature frequently cite and provide general insights on (a) the features, outcomes and mechanisms of participatory interventions (PIs) or (b) the conditions for collective action, respectively. We focused on literature reviews and meta-analyses to focus on the main patterns from the beginning.

From the initial list of reviews and meta-analyses concerning case studies on PPs (the first strand of literature; references 1–6 in Section S1), we extracted insights that helped us initially map out the potential outcomes of PPs and the likely underlying mechanisms. An insight comprises one specific outcome variable and a set of possible explanatory factors. Following the conceptual framework presented in Section

⁴ Here, we build upon previous research that has highlighted the importance of considering institutional and behavioural factors to foster pro-social action (e.g. Mantzavinos et al., 2004; Ostrom, 2005, 2010b; Bowles, 2016; Cardenas, 2018; Heinz and Koessler, 2021; Koessler and Engel, 2021).

2, we distinguished outcomes related to (a) the governance system (e.g. the attributes of institutional arrangements and policy processes) and (b) the actors' attributes (e.g. knowledge, beliefs, preferences, trust). We derived these two channels from the framework and used them as thematic units of analysis to cluster insights accordingly (Mays et al., 2005; Kastner et al., 2012).

Then, we contrasted these first insights against those we found in the second strand of literature, i.e. the reviews of experiments on collective action we initially surveyed (references 7–12 in Section S1). We focused on the impacts of PMs and the conditions for sustained co-operation identified through lab and lab-in-the-field experiments (e.g. group communication/deliberation, participative choice of rules, provision of relevant information and rule enforcement mechanisms). We considered insights from both abstract and framed experiments (Harrison and List, 2004) to garner general and context-specific insights concerning the conditions for collective action in social dilemmas. We thus considered experiments that examined co-operation in abstract recreations of social dilemmas (e.g. Ostrom et al., 1992; Ledyard, 1995) and experiments that added a specific environmental or natural resource management challenge to the social dilemma recreated in the experiment (e.g. Cardenas, 2011; Handberg and Angelsen, 2019).

As the review progressed, through snowballing and by incorporating further expert knowledge, we gained access to other literature reviews and meta-analyses, case studies of PPs, experiments on collective action and additional empirical, conceptual and theoretical research (see references 13–111 in Section S1). In total, we reviewed 111 academic works published between 1990 and 2022. Of these, 73 met our selection criteria: they focus on case studies on PPs or experiments on collective action. Eight of these are meta-analyses, 16 are literature reviews, eight correspond to case studies on PPs and 41 to experiments on collective action. We mainly delved into the experimental literature for our interest in the potential causal relationships between PMs, collective action and socially desirable (social-ecological) outcomes. The other 38 works provided additional input to revise, refine and annotate the emerging insights further, although they do not meet our selection criteria exactly (see Section S1 for further details) – we considered this aspect when drawing on their insights accordingly. In parallel, we synthesised the recommendations researchers have provided for overcoming potential hindrances to PIs through sound process design. We stopped the search and review of additional literature when we reached a 'saturation point' (Hennink and Kaiser, 2022); that is, when we stopped gathering new insights from further studies.

The insights we extracted come from studies with different units of analysis, research designs, conceptual frameworks and theoretical perspectives. These features make a systematic review or meta-analysis rather challenging (Bangert-Drowns, 1995; Poteete et al., 2010). For this reason, we opted to conduct this integrative and interpretative narrative review instead (Dixon-Woods et al., 2005; Kastner et al., 2012). We juxtapose, synthesise and analyse different types of evidence under a standard set of concepts and thematic units of analysis to generate new insights into our research questions (Dixon-Woods et al., 2005; Rudel, 2008; Kastner et al., 2012).⁵

Section 4 presents and analyses the insights we extracted and synthesised from the reviewed literature. Tables 1 and 2 in Section S2 of the supplementary material summarises the synthesised insights. Section 4.1 and Section 4.2 focus on the potential impacts of PIs on collective action via the governance system and actors' attributes, respectively. Section 4.3 wraps up the main caveats and recommendations that both streams of research have put forth for PIs to fulfil their potential (and Table 3 in Section S2 summarises). Lastly, Section 5 contains our review's main conclusions, limitations and implications.

⁵ See Baland and Platteau (1996), NRC (2008) and Reed (2008) for examples of how this type of review can be conducted. Bangert-Drowns (1995) and Poteete et al. (2010), Chapter 4, elaborate on its advantages and limitations.

4. Results

4.1. Potential impacts of PIs via the governance system

4.1.1. Recommendations on and eventual adoption of new institutional arrangements

The evidence from case studies indicates that PPs have the potential to support the development of new institutional arrangements concerning the (individual and collective) use and management of natural resources and the environment (i.e. the focal AS). (Beierle, 2002; Beierle and Cayford, 2002; Koontz and Thomas, 2006; Reed, 2008; NRC, 2008; Newig and Fritsch, 2009; Fritsch and Newig, 2012; Newig et al., 2019; Jager et al., 2020) Processes that convene the relevant state and non-state actors to exchange sources of knowledge, information and perspectives in often informal institutional ASs can facilitate common understandings and agreements on suitable institutional arrangements (e.g. binding regulations, management plans or non-binding policy recommendations.) (ibid.).⁶

Experiments on collective action suggest that PIs can facilitate the adoption of institutional arrangements, potentially improving co-operation on the focal AS effectively. Experiments demonstrate that groups of participants can devise rules and joint strategies for the common interest (e.g. the provision of a public good or the maintenance of a common resource) if they can vote or communicate (Ostrom et al., 1992, 1994; Ostrom, 1998, 2006; Cardenas, 2011; Dal Bó and Dal Bó, 2014; Dannenberg and Gallier, 2020; Koessler et al., 2021a).

However, case studies on participatory governance and experiments on collective action warn that participatory decision-making does not necessarily produce socially desirable outcomes. PPs may fail to ensure high social-ecological standards in the measures on which participants eventually agree (e.g. NRC, 2008; Maestre-Andrés et al., 2018). In experiments on collective action, some groups of participants tend not to vote initially for rules that guarantee socially optimal outcomes (e.g. Ostrom et al., 1992; Vyrastekova and Soest, 2003; Güerker et al., 2006; Dal Bó, 2014; Dannenberg and Gallier, 2020). Other groups may fail to communicate and reach agreements on joint action for socially optimal outcomes (e.g. Ostrom et al., 1992; Cardenas et al., 2011; Janssen et al., 2014; Schill et al., 2016).

Both research streams indicate that the relevant actors' attributes heavily influence the prospects for and content of collective agreements on natural resource management. Research on participatory governance highlights that the outcomes of PPs could primarily reflect the preferences of the most resourceful, interested and influential actors, and not necessarily the most environmentally friendly ones (Newig and Fritsch, 2009; Fritsch and Newig, 2012). Consequently, they may neglect the preferences of the less influential, often marginalised and excluded actors if organisers and sponsors do not ensure their inclusion (Beierle and Cayford, 2002; Koontz and Thomas, 2006; Behera and Engel, 2007; Reed, 2008; NRC, 2008; Gerlak et al., 2013; Lynham et al., 2017; Maestre-Andrés et al., 2018).

In general, experiments on collective action tend to suggest that

⁶ The literature documents various types of PMs (e.g. participatory modelling, participatory planning, vision-building exercises, serious games) through which organisers and facilitators can support these processes and outcomes. There are several reviews and analysis of some of these elsewhere. See, for instance, van Asselt Marjolein and Rijkens-Klomp (2002), Fung (2003), Rowe and Frewer (2005), Lynam et al. (2007), National Research Council (2008), Voinov and Bousquet (2010); Reed et al. (2009) and Medema et al. (2016). For participatory governance more generally, see Ansell and Gash (2008), Fung (2006, 2015), Emerson et al. (2012), Reed (2008), Newig et al., 2018 and Reed et al. (2018).

heterogeneities among the relevant actors encumber collective action.⁷ For instance, actors with solid communication and leadership skills may impose their (inaccurate) understandings of the situation on others, preventing them from reaching socially optimal solutions (Schill et al., 2016). In addition, actors with unaddressed concerns and uncertainties regarding the potential distributive impacts of alternative institutions may not support institutional change even if it contributes to improving co-operation (Kosfeld et al., 2009; Dal Bó, 2014; Dannenberg and Gallier, 2020). PPs should thus address these pre-existing contextual conditions through good design to guarantee desirable outcomes (NRC, 2008; see Section 4.3).

4.1.2. Increased legitimacy of and compliance with (new) institutional arrangements

Case-study research suggests that PPs can produce suitable, credible and legitimate institutional arrangements with higher acceptance and compliance rates than external policy interventions, thus contributing to the desired social-ecological outcomes. Particularly PPs that are clear and transparent about their purposes, involve the relevant actors, draw upon the appropriate knowledge, and grant participants influence at the relevant stage of the process (Beierle and Cayford, 2002; Reed, 2008; NRC, 2008; Newig and Fritsch, 2009; Fritsch and Newig, 2012; see also Fung, 2006). PPs can also potentially help the relevant actors anticipate critical aspects for implementing, monitoring and enforcing the agreed-upon institutional arrangements (Newig and Fritsch, 2009). By contrast, the exclusion of some relevant actors and an uneven representation of preferences and interests would hinder the legitimacy of the PP, the pertinence of its outcomes and thus the levels of compliance it may otherwise foster (Reed, 2008; NRC, 2008).⁸

Likewise, experiments on collective action show that socially optimal institutional arrangements can produce higher co-operation levels when participants choose them than when the experimenters (i.e. the 'external authorities') impose them (Dal Bó et al., 2010; Dal Bó, 2014; Dannenberg and Gallier, 2020).⁹ Moreover, in experiments involving communication, participants can reach and fulfil non-binding agreements on desirable shared strategies even in the absence of external enforcement

⁷ Studies have considered different types of heterogeneities, such as differences in initial endowments (e.g. Cardenas 2003; Margreiter et al., 2005; Ostrom, 2006; Poteete et al., 2010; Dal Dal Bó et al., 2010; Dal Bó, 2014; Schill et al., 2016), positions (e.g. in a watershed; Cardenas et al., 2011, 2015), preferences (Fischbacher et al., 2001; Fischbacher and Gächter, 2010; Andreozzi et al., 2020), expectations (Dal Bó, 2014; Chaudhuri et al., 2017) and understandings (Schill et al., 2016; see also Adams et al., 2003).

⁸ The experiment by Schmitt et al. (2000) – as reviewed by Ostrom (2006) – offers insight into some of the implications of this point. The results of the experiment illustrate how the exclusion of relevant actors hinders the monitoring and enforcement of the agreements that participants reach through communication. Observed deviations from the agreement may originate from actions of excluded actors, whom participants can use as scapegoats to justify their own breaching of the agreement.

⁹ Some studies have not found statistically significant differences between chosen and imposed institutions (i.e. institutional arrangements) (e.g. Abatayo and Lynham 2016; Handberg, 2018). Dal Bó (2014) and Dannenberg and Gallier (2020) extensively review the evidence on the effects of participants choosing their own institutions and discuss the conditions that may help explain the observed effects, or lack thereof. We touch and elaborate on this point in the rest of Section 4.1.2 and in Section 4.3. In brief, pre-existing actors' attributes and other features of the decision-making process such as the available information and enforcement, i.e. monitoring and sanctioning mechanisms seem to be critical.

(Ostrom et al., 1992, 1994; Cardenas et al., 2000; Ostrom, 2006; Balliet, 2010; Koessler et al., 2021a). Communication could also help participants generate levels of co-operation that match or surpass those caused by externally imposed efficiency-enhancing rules (Cardenas et al., 2000; Cardenas, 2004; Abatayo and Lynham, 2016).¹⁰

Nonetheless, both streams of research suggest that even if participants reach an agreement on socially desirable institutional arrangements, the levels of collective action initially generated may wane. In some cases of PPs, the agreed-upon (recommendations for) conservation measures and environmental policies do not necessarily ensure substantial improvements in current social-ecological outcomes (NRC, 2008; Newig and Fritsch, 2009; Fritsch and Newig, 2012; Gerlak et al., 2013; Bodin, 2017). Case studies show, for instance, how an initial agreement on joint strategies may not produce further co-operation to implement the agreed-upon strategy on the ground (Beierle and Cayford, 2002; NRC, 2008; Quist et al., 2011; Cavalcanti et al., 2013; Ortiz-Riomalo et al., 2022). In other words, co-operation throughout the PP may not translate into collective action in the relevant institutional and operational ASs outside the PP, including, most importantly, the focal AS. Generally, experiments show recurrently that collective action is feeble. Co-operation in groups comprising co-operators, non-co-operators and conditional co-operators will dwindle as soon as one or more participants stop co-operating in subsequent interactions (Ledyard, 1995; Fischbacher et al., 2001; Rodríguez-Sickert et al., 2008; Fischbacher and Gächter, 2010; Chaudhuri, 2011; Chaudhuri et al., 2017). Additional monitoring and enforcement mechanisms are thus warranted (see Section 4.3).

In sum, case studies on PPs and experiments on collective action suggest that PIs can potentially lead to co-operation in collective action challenges such as those pervading environmental management. PPs can garner otherwise dispersed resources, such as knowledge and personnel, and facilitate collaboration and co-production. They can avoid contestation, increase acceptance and compliance and eventually deliver socially desirable, legitimate outcomes at both the institutional and operational levels (NRC, 2008; Newig and Fritsch, 2009; Gerlak et al., 2013; see also Ostrom, 1996, 2000b; Ansell and Gash, 2008; Fung, 2015). However, case studies show that PPs may not be able to promote and sustain co-operation in other relevant institutional and operational ASs. The experimental evidence suggests that participatory decision-making can generate significant changes in the appropriate operational institutional arrangements, behavioural patterns and social-ecological outcomes, provided the proper follow-up and enforcement mechanisms are in place. We elaborate on the latter in Section 4.3.

4.2. Potential impacts of PIs via actors' attributes

Insights from the literature suggest that the (realisation of) PIs' potential for collective action also rests upon PPs' potential impact on critical actors' attributes, namely their understandings, beliefs and preferences. In particular, both streams of the literature suggest that (well-designed) PIs can facilitate individual and collective learning processes, foster trust-building and address/influence participants' preferences. The resulting changes in actors' attributes can promote collective action at the institutional and operational levels.

4.2.1. Learning: influence on individual and collective understandings

Case studies of PPs indicate that the convened actors can acquire,

¹⁰ Moreover, the evidence indicates that participants' communication in experiments (López and Villamayor-Tomas, 2017; Koessler et al., 2021a) tends to resemble that of actual participatory deliberative exercises (Fung, 2003; Delli Carpini et al., 2004; Koessler et al., 2021a). Which hints at the potential of deliberation to ensure socially desirable social-ecological outcomes (Dryzek et al., 2019).

exchange and assimilate new relevant information and perspectives: on the social-ecological challenges they face, the broader consequences their actions may have for themselves, others and the environment, and possible strategies to attain better collective outcomes (Beierle and Cayford, 2002; Pahl-Wostl and Hare, 2004; NRC, 2008; Lejano and Ingram, 2009; Newig et al., 2019). Consequently, individual and collective learning processes can take place. Participants can reach new or revised individual and shared understandings and thus increase their capability to design and carry out suitable strategies for socially desirable outcomes (Beierle and Cayford, 2002; Beierle, 2002 NRC, 2008; Pahl-Wostl, 2009, 2015; Newig et al., 2019; Kimmich et al., 2019; Jager et al., 2020; see also Fung, 2006; Scholz et al., 2014).

Experiments on collective action provide indirect evidence suggesting that PIs can facilitate learning processes in which participants build accurate understandings based on the best available information made accessible to them. In experiments where participants get the chance to talk to each other, they spend time trying to reach common understandings of the common challenge they face and potential solutions (Ostrom et al., 1992; Cardenas et al., 2004; Pavitt, 2018). They may struggle to improve collective outcomes, however. They may fail to overcome the collective-action challenge they face if they do not understand it or do not have access to the relevant information (e.g. participants' past actions and possible action options) (Cardenas et al., 2011; Janssen, 2013; Janssen et al., 2014; Schill et al., 2016). Furthermore, experiments have shown that groups of participants that receive expert information on the nature of a complex collective action challenge and its potential solutions before freely communicating with one another co-operate more than those groups in which only free communication is allowed (Moreno-Sánchez and Maldonado, 2010; Saldarriaga-Isaza et al., 2015).

4.2.2. Trust-building: influence on beliefs about others' likely co-operation

Case studies also indicate that PPs can nurture trust in the willingness of other (state) actors to co-operate and deliver on their promises: often, these are PPs with clear aims and purposes that involve all relevant actors effectively and facilitate fruitful, often intensive face-to-face interactions (Chess and Purcell, 1999 in Reed, 2008; Beierle and Cayford, 2002; Pahl-Wostl and Hare, 2004; Reed, 2008; Fritsch and Newig, 2012; Jager et al., 2020). PPs that allow participants to understand their shared challenges, specify possible concrete solutions, clarify the potential joint benefits of collective action and effectively influence the course and outcomes of the PP are particularly effective at building trust (ibid.). These PPs can even help overcome challenging contexts with high initial levels of mistrust and entrenched disagreements (Beierle and Cayford, 2002; NRC, 2008; Jager et al., 2020). Likewise, the exclusion of some relevant actors and an uneven representation of preferences and interests hinder trust building (Reed, 2008; NRC, 2008).

The evidence from experiments on collective action also suggests that PPs can potentially induce participants to examine, reflect upon and revise their beliefs about each other's intentions and expectations about co-operation, thereby influencing trust building (according to the conceptualisation of trust we present in Section 2). To the best of our knowledge, the impact of specific PPs on such beliefs has not yet been systematically investigated in the participatory governance literature. Experiments suggest, however, that the effects on these beliefs would depend on the types and features of the PPs and the information provided and exchanged by organisers, participants and other relevant actors.

In experiments where participants can communicate, participants also learn about each other's past actions and their likely preferences, intentions and (normative) expectations by gathering and exchanging information on past, potential and desirable strategies (Ostrom et al., 1994; Cardenas et al., 2004; Ostrom, 1998, 2006, 2010c; Pavitt, 2018). On the one hand, information about some participants' lack of co-operation tends to undermine subsequent co-operation by downgrading participants' expectations about others' intentions to co-operate

(Ledyard, 1995; Fischbacher and Gächter, 2010; Janssen, 2013; Chaudhuri et al., 2017; Andreozzi et al., 2020). This evidence suggests that a non-negligible proportion of people act as conditional co-operators (Fischbacher et al., 2001; Andreozzi et al., 2020). On the other hand, information on the presence of conditional co-operators (Ostrom, 1998, 2010c; Chaudhuri, 2011), normative messages on the desired action (Cardenas, 2011; Dal Bó and Dal Bó, 2014), shaming and guilt-inducing messages (López et al., 2012) and advice from fellow (past) participants to co-operate (Chaudhuri, 2011; Koukoumelis et al., 2012; Brandts et al., 2016) all tend to motivate participants to co-operate, seemingly by nurturing optimistic beliefs about others' intended co-operation (Chaudhuri, 2011; Dal Bó and Dal Bó, 2014; Chaudhuri et al., 2017).¹¹

In general, for communication to effectively foster co-operation, three factors appear to be critical: the exchange of information on specific possible optimal strategies (Lopez and Villamayor-Tomas, 2017), the intended co-operation of other actors (Ostrom, 1998; Brosig et al., 2003; Cardenas et al., 2004) and normative statements promoting co-operation (Brosig et al., 2003; Janssen et al., 2014; Lopez and Villamayor-Tomas, 2017). General information about the problem and its potential solutions, while an essential element of communication, appears to be insufficient for increasing co-operation (Ostrom, 1998; Brosig et al., 2003; Lopez et al., 2012; Brandts et al., 2016; Lopez and Villamayor-Tomas, 2017; Pavitt, 2018; Koessler et al., 2021a). Hence, experiments suggest that PPs can nurture optimistic beliefs, trust and co-operation. These are often PPs that allow participants to interact, recognise the value of co-operation, and agree on joint action (Ostrom, 1998, 1999, 2010c; Fehr and Fischbacher, 2002; Cardenas et al., 2004, 2011; Fehr and Schmidt, 2006; Chaudhuri, 2011; Dal Bó and Dal Bó, 2014; Chaudhuri et al., 2017; Pavitt, 2018; Koessler et al., 2021a, 2021b). (As noted above, the literature on participatory governance has put forth similar insights and suggestions.)

4.2.3. Consideration of and/or influence on participants' preferences

The evidence reviewed so far suggests that PPs can foster collective action by addressing participants' preferences, namely their social, other-regarding and/or procedural preferences. As reviewed above, PPs can influence participants' perceptions of the legitimacy and credibility of the decision-making process and its outcomes; PPs can also influence participants' expectations about others' intended actions (Reed, 2008; NRC, 2008; Newig and Fritsch, 2009; Jager et al., 2020). Furthermore, some evidence suggests that PPs may not only address but even alter participants' preferences (e.g. Uphoff, 1999; Baland and Platteau, 1996; NRC, 2008). The cumulated evidence on deliberative processes, for instance, suggests that such methods encourage participants to revise their opinions and perceptions as well as the ways they value potential actions and outcomes and assess different options (Fung, 2003; Delli Carpini et al., 2004; Kenter et al., 2016; Dryzek et al., 2019).

The experimental evidence helps to corroborate the impact PPs can have on collective action by addressing and/or influencing participants' preferences. Participatory decision-making can influence participants' perceptions about the fairness and legitimacy of the policy process and its outcomes (e.g. DeCaro et al., 2015; see also Liu et al., 2020). Furthermore, by exposing participants to normative messages about doing the right thing, PPs can influence participants' beliefs about the likely behaviour and normative expectations of others (e.g. Dal Bó and

¹¹ These messages sent by fellow participants tend to be people-oriented, appeal to participants' emotions, instil a group identity and/or promote reciprocal action in favour of co-operation (Chaudhuri, 2011; Brandts et al., 2016). In contrast, expert advice is problem-oriented, primarily appealing to participants' rationality by 'coldly' depicting their collective action challenge and its potential solutions. In general, information from fellow participants tends to have a strong bearing on participants' actions (Chaudhuri, 2011; Chetty and Saez 2013; Schill et al., 2016; Brandts et al., 2016).

Dal Bó, 2014). Thus, PPs can address participants' social preferences and possibly create a taste for (conditional) co-operation (Baland and Platteau, 1996; Kollock, 1998; Ostrom, 1998, 2010c; Cardenas et al., 2004; Chaudhuri, 2011; Dal Bó and Dal Bó, 2014; Pavitt, 2018). In addition, PPs can potentially activate and/or promote other-regarding preferences by allowing participants to understand the potential consequences of their actions on others and the environment (see Heinz and Koessler, 2021). Experiments suggest that persuading participants to consider (the perspective and situation of) the other relevant actors may motivate participants to act for their benefit (Sally, 1995, 2001; Batson et al., 1995; Iris and Bohnet 1999; Czap et al., 2015; Heinz and Koessler, 2021; Ortiz-Riomalo et al., 2021).

4.3. Caveats and recommendations for the organisation of PIs

The results reviewed in the previous sections indicate that the impacts of PIs relate to specific design features of PPs. They also hint at the pre-existing contextual conditions – particularly the pre-existing attributes of the relevant governance system and actors – that often pose cumbersome challenges if not adequately addressed. Ultimately, the potential of PIs hinges upon their design and the extent to which it tackles the challenges imposed by the context (NRC, 2008). In this section, we wrap up the caveats and recommendations for the organisation of PIs that the reviewed literature has put forth. In general, PIs should ensure the adequate involvement of the relevant actors, even-handed and inclusive facilitation of their interactions, and effective recognition and incorporation by the governance system.¹²

Careful actor analysis should allow organisers to identify and characterise the relevant actors and/or their legitimate representatives. It should also assist in choosing and arranging participatory methods and facilitation techniques (PMs) accordingly, considering how actors differ on crucial attributes such as preferences, expectations, demographics, endowments and clout (Reed, 2008; NRC, 2008; Reed et al., 2009; von Korff et al., 2010; Sterling et al., 2017). A fine selection, arrangement and use of PMs should help handle existing asymmetries reasonably by ensuring an even consideration of all relevant perspectives at the appropriate stage of the PP (Chess and Purcell, 1999; Reed, 2008; NRC, 2008; Dryzek et al., 2019).¹³

In turn, suitable method selection and deft facilitation should provide opportunities for participants to voice, understand, discuss and address each other's preferences and concerns (e.g. about policy trade-offs and distributive impacts) (NRC, 2008; Fritsch and Newig, 2012; Reed et al., 2014; Jager et al., 2020). Furthermore, the insights reviewed above indicate that organisers and sponsors should strive to guarantee equitable and effective access to primary, accurate social-ecological information (by, for instance, combining expert advice and peer testimonies). This information should help participants comprehend the benefits of co-operation and revise their understandings, beliefs and expectations (e.g. Vollan, 2008; NRC, 2008; Moreno-Sánchez and Maldonado, 2010; Chaudhuri, 2011; Saldarriaga-Isaza et al., 2015; Schill et al., 2016; Jager et al., 2020; Dannenberg and Gallier, 2020). Moreover, a fine selection of PMs should foster productive exchanges among participants in which they build shared understandings, expectations, preferences, explicit agreements and trust in favour of collective action

¹² For extensive discussions on design principles for PPs, see the works by Beierle and Cayford (2002), Reed (2008), the NRC 2008, von Korff et al. (2010), Reed et al. (2014) and Sterling et al. (2017).

¹³ Careful actor analysis might reveal, for instance, the presence of relevant actors with entrenched positions and trajectories of conflictual interactions and who are not necessarily interested in co-operating up front. These actors may require special handling, e.g. through bilateral negotiation, to fairly incorporate their input (i.e. not at the expense of the other participants' interests and preferences) and avoid their potential resistance to (or neglect of) the processes and outcomes of the PPs.

(Ostrom et al., 1994; Ostrom, 1998, 2006, 2010c; Cardenas et al., 2004, 2011; NRC, 2008; Poteete et al., 2010; Pavitt, 2018; Koessler et al., 2021a). As noted above, providing just general information on the environmental challenge to be addressed and potential strategies to overcome it would be insufficient to effectively boost collective action (Ostrom, 1998; Lopez and Villamayor-Tomas, 2017; Pavitt, 2018; Koessler et al., 2021a).

Finally, the sponsors and organisers of the PP should provide for further follow-up, enforcement, monitoring, assessment and conflict-resolution mechanisms to reassure trust and sustain co-operation. In experiments, repeated communication and decentralised sanctioning schemes have helped detect non-co-operators, exert peer pressure, clarify misunderstandings, sanction defectors and/or reassess joint strategies, thus sustaining collective action (e.g. Ostrom et al., 1992; Fehr and Gächter, 2002; Cardenas et al., 2004; Bochet et al., 2006; Kroll et al. 2007; Dal Bó and Dal Bó, 2014; DeCaro et al., 2015; Dannenberg and Gallier, 2020). Hence, sponsors and organisers should embed PPs within the broader governance system. They should complement and link them to other relevant activities and decision-making processes (Ostrom, 1990, 2000b, 2005, 2006, 2010b; Ostrom et al., 1994; Beierle and Cayford, 2002; NRC, 2008; Edelenbos et al., 2009; Quist et al., 2011; Reed et al., 2014; DeCaro et al., 2015; Pahl-Wostl, 2015; Bodin, 2017; Sterling et al., 2017; Klok and Denters, 2018; Ortiz-Riomalo et al., 2022). This way, other relevant actors, decision-making processes and institutional arrangements would not neglect, collide with or override the PP and its outcomes. Instead, they would recognise, allow and/or actively support their follow-up, monitoring, implementation and further development.

5. Conclusion

Previous research on collective action and current legislative frameworks deem stakeholder participation necessary and promising for collective action in overcoming complex challenges in natural resource and environmental management. Narrative reviews and meta-analyses of previous research on participatory governance indeed suggest that PPs can deliver socially desirable outcomes in the context of natural resource management. However, the evidence causally establishing the potential of PIs to substantially change institutional arrangements, behavioural patterns, and critical social-ecological outcomes is somewhat scant. Moreover, the available insights remain broadly scattered across distinct yet related strands of literature.

In this article, we synthesised and analysed critical insights from the literature on participatory governance and the literature on collective action under a standard set of concepts. For the integration and interpretation of the extracted insights, we drew on the IAD, NAS and SES conceptual frameworks and concepts from the participatory governance literature. We focused on the insights from (meta-analyses and literature reviews of) case studies on PPs and lab and lab-in-the-field experiments on collective action.

In summary, the reviewed insights indicate that well-designed PIs have the potential to foster collective action. PIs often create and structure situations where users can meet, exchange knowledge and perspectives and craft adequate institutional arrangements to tackle common challenges. PIs can also address and/or influence key actors' attributes, such as their individual and shared understandings, beliefs, preferences and levels of trust, thereby improving their chances of collective action in favour of socially desirable outcomes.

Yet, the reviewed insights indicate that these effects are far from immediate and guaranteed. They are conditional on the way PIs address and incorporate the relevant context and provide for additional follow-up, monitoring, enforcement and conflict-resolution mechanisms. Poorly designed, implemented and supported interventions will likely cause initial patterns of conflict and cynical beliefs to remain or grow and initial levels of trust and collective action to wane over time. In general, the reviewed literature suggests that PIs' potential hinges on the

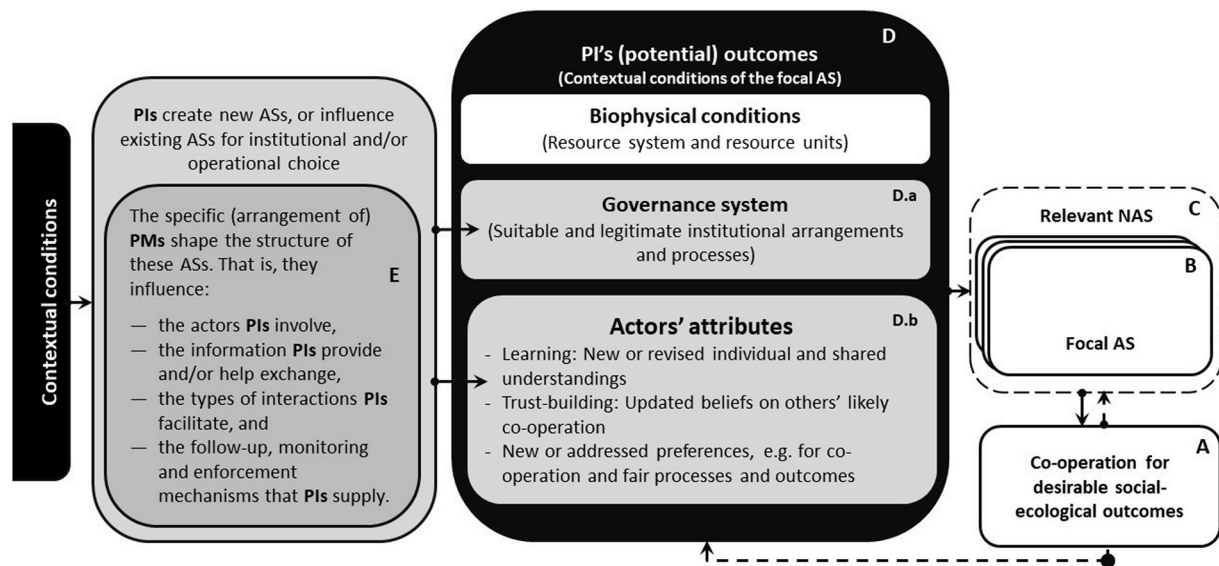


Fig. 2. Summary of potential impacts and mechanisms of PIs.

PIs can facilitate action situations (ASSs) with the potential to influence the attributes of the relevant (a) governance system and (b) actors (boxes D. a and D. b, Section 4.1 and Section 4.2, respectively, in the main text). PIs can shape the prospects of collective action for desirable ecological, governance and social outcomes (box A) in environmental and natural resource management – i.e. in the focal AS and its associated relevant network of action situations (NAS) (boxes B and C, respectively). However, outcomes depend on how PIs' organisers and sponsors select, design and arrange participatory methods (PMs) and address and incorporate the relevant context (box E; Section 4.3 in the main text). **Source:** Own elaboration based on previous applications and representations of the IAD, NAS and SES frameworks (Ostrom, 2011; McGinnis, 2011b; McGinnis and Ostrom, 2014; Pahl-Wostl et al., 2010; Pahl-Wostl, 2015; Cole et al., 2019; Ortiz-Riomalo et al., 2020; 2022).

way organisers and sponsors address the relevant attributes of the context, select and interweave the appropriate methods and techniques, and embed the intervention within the broader context, namely the ecological and governance systems and the actors' relevant attributes. Fig. 2 summarises the main insights we derived from reviewing case studies of PPs and experiments on collective action under a common conceptual framework.

By jointly reviewing the insights from these streams of research, this paper enriches and complements our understanding of the potential impacts of PIs, together with the underlying institutional and behavioural mechanisms that enable or hinder these potentials. In the conceptual framework, we integrated elements of the IAD, NAS and SES frameworks and contributions from the behavioural and institutional analysis of collective action. Along with the empirical insights from research on participatory governance, these insights help map out the potential (institutional and behavioural) impacts and mechanisms of PIs. In turn, the evidence from collective action experiments adds support, caveats and nuance to these general insights. It backs insights on the potential of participation to deliver (inputs for) suitable and legitimate institutional arrangements and to influence critical actors' attributes that condition the prospects for collective action. It also suggests that it is particularly vital to arrange PPs so that they nurture and sustain shared understandings, beliefs and preferences in favour of collective action at both the institutional and operational levels of choice and activity. Finally, it indicates that, if properly designed, implemented and supported, processes similar to those facilitated by PIs (e.g. collective decision-making and deliberation) can generate and sustain substantial changes in current institutional arrangements and levels of collective action in the focal AS. A causal relationship that research on participatory governance, primarily drawing on case studies, has not been able to establish so far neatly, and which the experimental evidence helps to illuminate further and clarify.

However, our paper's findings and conclusions are empirically-grounded yet provisional propositions on the potential of PIs. These can constitute building blocks for further (middle-range) theories (Morrow and Muchinsky, 1980; Corbin and Strauss, 1990; Boudon,

1991) on PIs (see, e.g. Newig et al., 2018; Reed et al., 2018). Although the paper synthesised the main patterns and insights garnered from the reviewed studies, these studies do not share precisely the same research aims, designs, frameworks and theoretical perspectives. Furthermore, the findings do not come from a systematic review. They come from an integrative and interpretative narrative review of a selection of works from these two streams of literature.

Together with the IAD, NAS and SES frameworks, our conclusions can guide further systematic theoretical and empirical lab and field research, as well as systematic reviews and meta-analyses of the scholarship on participatory governance and collective action, to assess and develop them further. For example, future research could expand on the moderating role that biophysical conditions may play in any PI. It can also study the relationship between PIs and other actors' attributes, such as leadership skills and attitudes (e.g. Sterling et al., 2017). Scholars could also investigate how PIs can address (and subsequently shape) pre-existing patterns of interaction among the relevant actors, their pertinent attributes and different configurations of networks of action situations (NASs). In general, disentangling the interactions between PIs, governance systems, NASs, actors' attributes, behavioural patterns and ultimate social-ecological outcomes warrants additional research. The framework we developed for this review and the insights it helped to generate can support these future research endeavours. They can also guide the design, comparison, assessment and refinement of prospective PIs aiming to fulfil their potential for collective action in environmental and natural resource management.¹⁴

Declaration of competing interest

The authors declare the following financial interests/personal

¹⁴ In suggesting this approach for systematic synthesis and comparative analysis, we follow Beierle and Cayford (2002), NRC 2008, Pahl-Wostl (2015), Newig et al. (2013, 2018), Jager et al. (2020), Villamayor-Tomas et al. (2020) and Ortiz-Riomalo et al. (2022), among others.

relationships which may be considered as potential competing interests: The corresponding author himself has supported and sometimes led the organisation of participatory processes for sustainable watershed management. Notwithstanding, none of the involved organisations participated in the conception and development of the submitted paper. The conclusions of the paper, though relevant for the types of processes in which the corresponding author himself has been involved, are strictly based on the evidence gathered and analysed for this paper. For the sake of transparency, however, the corresponding author discloses the details of his involvement in participatory processes. (For details of these participatory processes, see [Ortiz-Riomalo et al., 2022](#)) Between 2014 and 2016, together with Juan Camilo Cardenas (Universidad de los Andes, Colombia), he co-organised several multi-actor workshops in the basins of the rivers rising from the Santurbán páramo (Santander and Norte de Santander departments, Colombia). The Colombian Ministry of Environment and Sustainable Development called for and supported the first workshops and activities in 2014. Likewise, the *Instituto de Investigación de Recursos Biológicos Alexander von Humboldt* and the corresponding regional environmental authorities (i.e. CDMB and Corponor) supported the realisation of these activities. PROMAC (GIZ, Colombia) and USAID (through its ABC - LA program) funded some subsequent workshops between 2015 and 2016. Between October 2018 and March 2019, the corresponding author and the second author of the paper provided pro bono support and advice to the Peruvian Ministry of Environment and Pro Ambiente II (GIZ) for a participatory process for watershed management in the Cañete River Watershed (Lima, Peru). The corresponding author co-organised the workshops that this process comprised. The MERESE - FIDA project and Pro Ambiente II cover the logistics and other costs. However, none of the persons and organisations mentioned influenced (or bear any responsibilities for) the views and arguments expressed in the paper.

Data availability

Data will be made available on request.

Acknowledgements

This paper is a substantially revised and improved version of Ortiz-Riomalo, Koessler and Engel (2020). Funding for this research was provided by the Ministry of Science and Culture of Lower Saxony (Germany) and by the Alexander von Humboldt Foundation in the framework of the Alexander von Humboldt Professorship endowed by the German Federal Ministry of Education and Research. We also received support by the Deutsche Forschungsgemeinschaft (DFG) and the Open Access Publishing Fund of Osnabrück University for the open access publication of this article. Juan Camilo Cárdenas, Johannes Halbe, Marco Janssen, Bosco Lliso, John Lynham, Claudia Pahl-Wostl and Geeske Scholz provided helpful literature recommendations and feedback on earlier concepts and versions of the manuscript. In turn, Amy Samuelson, Amy Rafferty and Rachael Torkar provided excellent editorial assistance at different stages of the writing process. Thorough, critical and constructive comments by two anonymous reviewers helped improve the manuscript substantially. We gratefully acknowledge all these contributions and bear full responsibility for any remaining inaccuracies. (None of the funding sources mentioned here influence the writing or research for this paper.)

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2022.117184>.

References

- Abatayo, Lou, Anna, Lynham, John, 2016. Endogenous vs. exogenous regulations in the commons. *J. Environ. Econ. Manag.* 76, 51–66. <https://doi.org/10.1016/j.jeem.2015.11.006>.
- Adams, William M., Brockington, Dan, Dyson, Jane, Vira, Bhaskar, 2003. Managing tragedies: understanding conflict over common pool resources. *Science* 302, 1915–1916. <https://doi.org/10.1126/science.1087771>.
- Alpizar, Francisco, María Bernedo, Del Carpio, Ferraro, Paul J., Meiselman, Ben S., 2019. The impacts of a capacity-building workshop in a randomized adaptation project. *Nat. Clim. Change* 9, 587–591. <https://doi.org/10.1038/s41558-019-0536-3>.
- Andreoni, James, 1988. Why free ride? Strategies and learning in public goods experiments. *J. Publ. Econ.* 37 (3), 291–304. [https://doi.org/10.1016/0047-2727\(88\)90043-6](https://doi.org/10.1016/0047-2727(88)90043-6).
- Andreozzi, Luciano, Ploner, Matteo, Saral, Ali Seyhun, 2020. The stability of social cooperation: beliefs alone cannot explain the decline of cooperation in social dilemmas. *Sci. Rep.* 10 (13610) <https://doi.org/10.1038/s41598-020-70681-z>.
- Ansell, Chris, Gash, Alison, 2008. Collaborative governance in theory and practice. *J. Publ. Adm. Res. Theor.* 18 (4), 543–571. <https://doi.org/10.1093/jopart/mum032>.
- Baland, Jean-Marie, Platteau, Jean-Phillipe, 1996. Halting degradation of natural resources. In: *Is There a Role for Rural Communities? Food and Agriculture Organization of the United Nations, Rome*.
- Balliet, Daniel, 2010. Communication and cooperation in social dilemmas: a meta-analytic review. *J. Conflict Resolut.* 54 (1), 39–57. <https://doi.org/10.1177/0022002709352443>.
- Bangert-Drowns, Robert L., 1995. Misunderstanding meta-analysis. *Eval. Health Prof.* 18 (3), 304–314. <https://doi.org/10.1177/016327879501800305>.
- Bates, Robert H., 1988. Contra contractarianism: some reflections on the new institutionalism. *Polit. Soc.* 16 (2–3), 387–401. <https://doi.org/10.1177/003232928801600207>.
- Batson, C. Daniel, Adam, A. Powell, 2003. Altruism and Prosocial Behavior. In: Millon, Theodore, Lerner, Melvin J. (Eds.), *Chap. 19 in Handbook of Psychology*, vol. 5. John Wiley & Sons, New Jersey, pp. 463–484. <https://doi.org/10.1002/0471264385.wei0519>.
- Batson, C. Daniel, Judy, G. Batson, Matthew, R. Todd, Beverly, H. Brummett, Laura, L. Shaw, Aldeguer, Carlo M.R., 1995. Empathy and the collective good: caring for one of the others in a social dilemma. *J. Pers. Soc. Psychol.* 68 (4), 619–631. <https://doi.org/10.1037/0022-3514.68.4.619>.
- Behera, Bhagirath, Engel, Stefanie, 2007. Participation and joint forest management in Andhra Pradesh, India. In: E Dinello, Natalia, Popov, Vladimir (Eds.), *Political Institutions and Development: Failed Expectations and Renewed Hopes* (Elgar).
- Beierle, Thomas C., 2002. The quality of stakeholder-based decisions. *Risk Anal.* 22 (4), 739–749. <https://doi.org/10.1111/0272-4332.00065>.
- Beierle, Thomas C., Cayford, Jerry, 2002. *Democracy in Practice: Public Participation in Environmental Decisions*. Resources for the Future, Washington DC.
- Bicchieri, Cristina, 2017. *Norms in the Wild. How to Diagnose, Measure, and Change Social Norms*. Oxford University Press, New York.
- Bó, Dal, Pedro, 2014. *Experimental Evidence on the Workings of Democratic Institutions*. In: Galiani, Sebastián, Sened, Itai (Eds.), *Institutions, Property Rights, and Economic Growth: the Legacy of Douglas North*. Cambridge University Press, New York, pp. 266–288.
- Bó, Dal, Pedro, Foster, Andrew, Putterman, Louis, 2010. Institutions and behavior: experimental evidence on the effects of democracy. *Am. Econ. Rev.* 100, 2205–2229. <https://doi.org/10.1257/aer.100.5.2205>.
- Bochet, Olivier, Page, Talbot, Putterman, Louis, 2006. Communication and punishment in voluntary contribution experiments. *J. Econ. Behav. Organ.* 60, 11–26. <https://doi.org/10.1016/j.jebo.2003.06.006>.
- Bodin, Örjan, 2017. Collaborative environmental governance: achieving collective action in social-ecological systems. *Science* 357 (6352). <https://doi.org/10.1126/science.aan1114>.
- Bohnet, Iris, Frey, Bruno S., 1999. The sound of silence in prisoner's dilemma and dictator games. *J. Econ. Behav. Organ.* 38 (1), 43–57. [https://doi.org/10.1016/S0167-2681\(98\)00121-8](https://doi.org/10.1016/S0167-2681(98)00121-8).
- Bosworth, Steven J., Singer, Tania, Snower, Dannis J., 2016. Cooperation, motivation and social balance. *J. Econ. Behav. Organ.* 196, 72–94. <https://doi.org/10.1016/j.jebo.2015.12.005>.
- Boudon, Raymond, 1991. What middle-range theories are. *Contemp. Sociol.* 20 (4), 519–522. <https://www.jstor.org/stable/2071781>.
- Bowles, Samuel, 2016. *The Moral Economy. Why Good Incentives Are No Substitutes for Good Citizens*. Connecticut. Yale University Press.
- Bowles, Samuel, Polanía-Reyes, Sandra, 2012. Economic incentives and social preferences: substitutes or complements? *J. Econ. Lit.* 50 (2), 368–425. <https://doi.org/10.1257/jel.50.2.368>.
- Brandts, Jordi, Rott, Christina, Solà, Carles, 2016. Not just like starting over - leadership and revivification of cooperation in groups. *Exp. Econ.* 19, 792–818. <https://doi.org/10.1007/s10683-015-9468-6>.
- Brosig, Jeannette, Weimann, Joachim, Ockenfels, Axel, 2003. The effect of communication media on cooperation. *Ger. Econ. Rev.* 4 (2), 217–241. <https://doi.org/10.1111/1468-0475.00080>.
- Cardenas, Juan Camilo, 2003. Real wealth and experimental cooperation: experiments in the field lab. *J. Dev. Econ.* 70, 263–289. [https://doi.org/10.1016/S0304-3878\(02\)00098-6](https://doi.org/10.1016/S0304-3878(02)00098-6).
- Cardenas, Juan Camilo, 2004. Norms from outside and from inside: an experimental analysis on the governance of local ecosystems. *For. Pol. Econ.* 6, 229–241. <https://doi.org/10.1016/j.forpol.2004.03.006>.

- Cardenas, Juan Camilo, 2011. Social norms and behavior in the local commons as seen through the lens of field experiments. *Environ. Resour. Econ.* 48, 451–485. <https://doi.org/10.1007/s10640-010-9452-8>.
- Cárdenas, Juan Camilo, 2018. (Real) behavior meets (real) institutions: towards a research agenda on the study of the commons. In: Claude, Ménard, Mary, M. Shirley (Eds.), *A Research Agenda for New Institutional Economics*, pp. 119–126. <https://doi.org/10.4337/9781788112512.00022>. Elgar.
- Cardenas, Juan-Camilo, Stranlund, John, Willis, Cleve, 2000. Local environmental control and institutional crowding-out. *World Dev.* 28 (10), 1719–1733. [https://doi.org/10.1016/S0305-750X\(00\)00055-3](https://doi.org/10.1016/S0305-750X(00)00055-3).
- Cardenas, Camilo, Juan, Ahn, T.K., Ostrom, Elinor, 2004. Communication and cooperation in a common-pool resource dilemma: a field experiment. In: Huck, Steffen (Ed.), *Advances in Understanding Strategic Behaviour: Game Theory, Experiments and Bounded Rationality*, pp. 258–286. https://doi.org/10.1057/9780230523371_12. Palgrave Macmillan.
- Cardenas, Camilo, Juan, Angela Rodriguez, Luz, Johnson, Nancy, 2011. Collective action for watershed management: field experiments in Colombia and Kenya. *Environ. Dev. Econ.* 16 (3), 275–303. <https://doi.org/10.1017/S1355770X10000392>.
- Cardenas, Camilo, Juan, Rodríguez, Luz Ángela, Johnson, Nancy, 2015. Vertical collective action: addressing vertical asymmetries in watershed management. Documento CEDE No. 2015-07. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2572494#.
- Carpini, Delli, Michael, X., Lomax Cook, Fay, Jacobs, Lawrence R., 2004. Public deliberation, discursive participation, and citizen engagement. *Annu. Rev. Polit. Sci.* 7, 315–344. <https://doi.org/10.1146/annurev.polisci.7.121003.091630>.
- Cavalcanti, Carina, Engel, Stefanie, Leibbrandt, Andreas, 2013. Social integration, participation, and community resource management. *J. Environ. Econ. Manag.* 262–276. <https://doi.org/10.1016/j.jeem.2012.09.004>.
- Chaudhuri, Ananish, 2011. Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature. *Exp. Econ.* 14, 47–83. <https://doi.org/10.1007/s10683-010-9257-1>.
- Chaudhuri, Ananish, Paichayontvijit, Tirnud, Smith, Alexander, 2017. Belief heterogeneity and contributions decay among conditional cooperators in public goods games. *J. Econ. Psychol.* 58, 15–30. <https://doi.org/10.1016/j.joep.2016.11.004>.
- Chess, Caron, Purcell, Kirsten, 1999. Public participation and the environment: Do we know what works? *Environ. Sci. Technol.* 33 (16), 2685–2692. <https://doi.org/10.1021/es980500g>.
- Chetty, Raj, Saez, Emmanuel, 2013. Teaching the tax code: Earnings responses to an experiment with EITC recipients. *Am. Econ. J.: Appl. Econ.* 5 (1), 1–31. <https://doi.org/10.1257/app.5.1.1>.
- Kastner, Monika, Andrea, C. Tricco, Charlene, Soobiah, Erin, Lillie, Laure, Perrier, Tanya, Horsley, Vivian, Welch, Cogo, Elise, Antony, Jesmin, Straus, Sharon E., 2012. What is the most appropriate knowledge synthesis method to conduct a review? Protocol for a scoping review. *BMC Med. Res. Methodol.* 12 (114) <https://doi.org/10.1186/1471-2288-12-114>.
- Cole, Daniel H., Epstein, Graham, McGinnis, Michael, 2019. Combining the IAD and SES frameworks. *Int. J. Commons* 13 (1), 244–275. <https://doi.org/10.18352/ijc.864>.
- Collier, David, 1993. The comparative method. In: Finifter, Ada (Ed.), *Political Science: The State of the Discipline*. American Political Science Association, Washington D.C., pp. 319–345.
- Corbin, Juliet, Strauss, Anselm, 1990. Grounded theory research: Procedures, canons and evaluative criteria. *Zeitschrift für Soziologie* 19 (6), 418–427. <https://doi.org/10.1007/BF00988593>.
- Cox, James C., 2004. How to identify trust and reciprocity. *Game. Econ. Behav.* 46, 260–281. [https://doi.org/10.1016/S0899-8256\(03\)00119-2](https://doi.org/10.1016/S0899-8256(03)00119-2).
- Cox, Michael, Arnold, Gwen, Tomás, Sergio Villamayor, 2010. A review of design principles for community-based natural resource management. *Ecol. Soc.* 15 (4), 38 [online]. <http://www.ecologyandsociety.org/vol15/iss4/art38/>.
- Crawford, Sue, Ostrom, Elinor, 1995. A grammar of institutions. *Am. Polit. Sci. Rev.* 89 (3), 582–600. <https://doi.org/10.2307/2082975>.
- Czap, Natalia V., Czap, Hans J., Lynne, Gary, Burbach, Mark E., 2015. Walk in my shoes: nudging for empathy conservation. *Ecol. Econ.* 118, 147–158. <https://doi.org/10.1016/j.ecolecon.2015.07.010>.
- Dannenberg, Astrid, Gallier, Carlo, 2020. The choice of institutions to solve cooperation problems: a survey of experimental research. *Exp. Econ.* 23, 716–749. <https://doi.org/10.1007/s10683-019-09629-8>.
- Dal Bó, Ernesto, Dal Bó, Pedro, 2014. “Do the right thing:” the effects of moral suasion on cooperation. *J. Publ. Econ.* 117, 28–38. <https://doi.org/10.1016/j.jpubeco.2014.05.002>.
- Dasgupta, Partha, 1990. Trust as a commodity. In: Gambetta, Diego (Ed.), *Trust. Making and Breaking Cooperative Relations*. Blackwell, pp. 49–72.
- Dasgupta, Partha, 1999. Economic progress and the idea of social capital. In: Dasgupta, Partha, Serageldin, Ismail (Eds.), *Social Capital: A Multifaceted Perspective*. World Bank, Washington, D.C., pp. 325–424.
- Dasgupta, Partha, 2007. *Economics. A Very Short Introduction*. Oxford University Press, Oxford.
- Dasgupta, Partha, 2021. The Economics of Biodiversity: the Dasgupta review. London: HM Treasury. <https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review>.
- DeCaro, Daniel A., Janssen, Marco A., Lee, Allen, 2015. Synergistic effects of voting and enforcement on internalized motivation to cooperate in a resource dilemma. *Judgm. Decis. Making* 10 (6), 511–537. <http://journal.sjdm.org/15/15529/jdm15529.html>.
- Dhami, Sanjit, 2016. *The Foundations of Behavioural Economic Analysis*. Oxford University Press, New York.
- Dietz, Thomas, Ostrom, Elinor, Stern, Paul C., 2003. The struggle to govern the commons. *Science* 302 (5652), 1907–1912. <https://doi.org/10.1126/science.1091015>.
- Dixon-Woods, Mary, Agarwal, Shona, Jones, David, Young, Bridget, Sutton, Alex, 2005. Synthesising qualitative and quantitative evidence: a review of possible methods. *J. Health Serv. Res. Pol.* 10 (1), 45–53. <https://doi.org/10.1177/135581960501000110>.
- Dryzek, John S., André, Bächtiger, Simone, Chambers, Joshua, Cohen, James, N. Druckman, Andrea, Felicetti, James, S. Fishkin, et al., 2019. The crisis of democracy and the science of deliberation. *Science* 363 (6432), 1144–1146. <https://doi.org/10.1126/science.aaw2694>.
- Edelonbos, Jurian, Klok, Pieter-Jan, Tatenhove, Jan van, 2009. The institutional embedding of interactive policy making. Insights from a comparative research based on eight interactive projects in The Netherlands. *Am. Rev. Publ. Adm.* 39 (2), 125–148. <https://doi.org/10.1177/0275074008317157>.
- Emerson, Kirk, Nabatchi, Tina, Balogh, Stephen, 2012. An integrative framework for collaborative governance. *J. Publ. Adm. Res. Theor.* 22 (1), 1–29.
- Ezzine-de-Blas, Driss, Corbera, Esteve, Lapeyre, Renaud, 2019. Payments for environmental services and motivation crowding: Towards a conceptual framework. *Ecol. Econ.* 156, 434–443. <https://doi.org/10.1016/j.ecolecon.2018.07.026>.
- Fehr, Ernst, Fischbacher, Urs, 2002. Why social preferences matter - the impact of non-selfish motives on competition, cooperation and incentives. *Econ. J.* 112, C1–C33. <https://doi.org/10.1111/1468-0297.00027>.
- Fehr, Ernst, Gächter, Simon, 2002. Altruistic punishment in humans. *Nature* 415, 137–140. <https://doi.org/10.1038/415137a>.
- Fehr, Ernst, Schmidt, Klaus M., 2006. The Economics of Fairness, Reciprocity and Altruism - Experimental Evidence and New theories. In: Serge-Christophe, Kolm, Mercier Ythier, Jean (Eds.), *Handbook of the Economics of Giving, Altruism and Reciprocity, Volume 1*. Elsevier B.V. doi, 10.1016/S1574-0714(06)01008-6, 615–691.
- Fischbacher, Urs, Gächter, Simon, 2010. Social preferences, beliefs, and the dynamics of free riding in public goods experiments. *Am. Econ. Rev.* 100 (1), 541–556. <https://doi.org/10.1257/aer.100.1.541>.
- Fischbacher, Urs, Gächter, Simon, Fehr, Ernst, 2001. Are people conditionally cooperative? Evidence from a public goods experiment. *Econ. Lett.* 71, 397–404. [https://doi.org/10.1016/S0165-1765\(01\)00394-9](https://doi.org/10.1016/S0165-1765(01)00394-9).
- Frey, Bruno S., Benz, Matthias, Stutzer, Alois, 2004. Introducing procedural utility: not only what, but also how matters. *J. Inst. Theor. Econ. JITE* 160 (3), 377–401. <https://www.jstor.org/stable/40752468>.
- Fritsch, Oliver, Newig, Jens, 2012. Participatory governance and sustainability: findings of a meta-analysis of stakeholder involvement in environmental decision making. In: Brousseau, Eric, Dedeurwaerdere, Tom, Siebenhüner, Bernd (Eds.), *Reflexive Governance for Global Public Goods*. MIT Press, pp. 181–203.
- Fung, Archon, 2003. Survey article: recipes for public spheres: eight institutional design choices and their consequences. *J. Polit. Philos.* 11 (3), 338–367. <https://doi.org/10.1111/1467-9760.00181>.
- Fung, Archon, 2006. Varieties of participation in complex governance. In: *Public Administration Review* 66 (Special Issue: Collaborative Public Management), pp. 66–75. <http://www.jstor.org/stable/4096571>.
- Fung, Archon, 2015. Putting the public back into governance: the challenges of citizen participation and its future. *Publ. Adm. Rev.* 75 (4), 513–522. <https://doi.org/10.1111/puar.12361>.
- Gambetta, Diego, 1990. Can we trust trust? In: Gambetta, Diego (Ed.), *Trust. Making and Breaking Cooperative Relations*. 213–237, Blackwell.
- Geanakoplos, John, Pearce, David, Stacchetti, Ennio, 1989. Psychological games and sequential rationality. *Game. Econ. Behav.* 1, 60–79. [https://doi.org/10.1016/0899-8256\(89\)90005-5](https://doi.org/10.1016/0899-8256(89)90005-5).
- Gerlak, Andrea K., Heikkilä, Tanya, Lubell, Mark, 2013. The promise and performance of collaborative governance. Printed from Oxford Handbooks online. In: Kraft, Michael E., Kamieniecki, Sheldon (Eds.), *The Oxford Handbook of U.S. Environmental Policy*. Oxford University Press. <https://doi.org/10.1093/oxfordhnb/9780199744671.013.0019>.
- Gürerk, Özgür, Irlenbusch, Bernd, Rockenbach, Bettina, 2006. The competitive advantage of sanctioning institutions. *Science* 312, 108–111. <https://doi.org/10.1126/science.1123633>.
- Handberg, Øyvind Nystad, 2018. No sense of ownership in weak participation: a forest conservation experiment in Tanzania. *Environ. Dev. Econ.* 23 (4), 434–451. <https://doi.org/10.1017/S1355770X18000190>.
- Handberg, Øyvind Nystad, Angelsen, Arild, 2019. Pay little, get little; pay more, get a little more: a framed forest experiment in Tanzania. *Ecol. Econ.* 156, 454–467. <https://doi.org/10.1016/j.ecolecon.2016.09.025>.
- Harrison, Glenn W., List, John A., 2004. Field experiments. *J. Econ. Lit.* 42 (4), 1009–1055. <https://doi.org/10.1257/0022051043004577>.
- Heikkilä, Tanya, Andersson, Krister, 2018. Policy design and the added-value of the institutional analysis and development framework. *Pol. Polit.* 46 (2), 309–324. <https://doi.org/10.1111/psj.12299>.
- Heinz, Nicolai, Koessler, Ann-Kathrin, 2021. Other-regarding preferences and pro-environmental behaviour: an interdisciplinary review of experimental studies. *Ecol. Econ.* 106987. <https://doi.org/10.1016/j.ecolecon.2021.106987>.
- Hennink, Monique, Kaiser, Bonnie N., 2022. Sample sizes for saturation in qualitative research: a systematic review of empirical tests. *Soc. Sci. Med.* 292, 114523. <https://doi.org/10.1016/j.socscimed.2021.114523>.
- Intergovernmental Panel on Climate Change, IPCC, 2019. Summary for policymakers. In: Shukla, P.R., Skea, J., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.O., Roberts, D.C., Zhai, P., et al. (Eds.), *Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land*

- Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems. In press. https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf.
- Jager, Nicolas W., Newig, Jens, Challies, Edward, Kochskämper, Elisa, 2020. Pathways to implementation: evidence on how participation in environmental governance impacts on environmental outcomes. *J. Publ. Adm. Res. Theor.* 30 (3), 383–399. <https://doi.org/10.1093/jopart/muz034>.
- Janssen, Marco A., 2013. The role of information in governing the commons: experimental results. *Ecol. Soc.* 18 (4), 4. <https://doi.org/10.5751/ES-05664-180404>.
- Janssen, Marco, Tyson, Madeline, Lee, Allen, 2014. The effect of constrained communication and limited information in governing a common resource. *Int. J. Commons* 8 (2), 617–635. <https://doi.org/10.18352/ijc.473>.
- Kagel, John, Roth, A., 1995. *Handbook of Experimental Economics*. Princeton of University Press. <https://doi.org/10.2307/j.ctvzsmff5>.
- Kagel, John H., Roth, Alvin E., 2016. In: *Handbook of Experimental Economics*, vol. 2. Princeton University Press. <https://www.jstor.org/stable/j.ctvc77b40>.
- Kenter, Jasper O., Mark, S. Reed, Fazey, Ioan, 2016. The deliberative value formation model. *Ecosyst. Serv.* 21, 194–207. <https://doi.org/10.1016/j.ecoser.2016.09.015>.
- Kimmich, C., Gallagher, L., Kopainsky, B., Dubois, M., Sovann, C., Buth, C., Bréthaut, C., 2019. Participatory modeling updates expectations for individuals and groups, catalyzing behaviour change and collective action in water-energy-food nexus governance. *Earth's Future* 1337–1352. <https://doi.org/10.1029/2019EF001311>.
- Kimmich, Christian, Baldwin, Elizabeth, Kellner, Elke, Oberlack, Christoph, Villamayor-Tomas, Sergio, 2022. Networks of action situations: a systematic review of empirical research. *Sustain. Sci.* <https://doi.org/10.1007/s11625-022-01121-2>.
- Kiser, Larry L., Ostrom, E., 1982. The three worlds of action: a metatheoretical synthesis of institutional approaches. In: Ostrom, Elinor (Ed.), *Strategies of Political Inquiry*. SAGE, Beverly Hills, CA, pp. 179–222.
- Kiser, Larry L., Ostrom, Elinor, 1987. Reflections on the elements of institutional analysis. In: *Workshop in Political Theory and Policy Analysis*, Indiana University. Paper prepared for the Conference on "Advances in Comparative Institutional Analysis" at the Inter-University Center of Post-Graduate Studies, Dubrovnik, Yugoslavia, pp. 19–23. October.
- Klok, Pieter-Jan, Denters, Bas, 2018. Structuring participatory governance through particular 'rules in Use': Lessons from the empirical application of elinor ostrom's IAD Framework. In: Heinelt, Hubert (Ed.), Chap. 7 in *Handbook on Participatory Governance*. Edward Elgar Publishing, pp. 120–142. <https://doi.org/10.4337/9781785364358.00012>.
- Koessler, Kathrin, Ann, Engel, Stefanie, 2021. Policies as information carriers: how environmental policies may change beliefs and consequent behavior. *Int. Rev. Environ. Resour. Econ.* 15 (1–2), 1–31. <https://doi.org/10.1561/101.00000123>.
- Koessler, Ann-Kathrin, Felipe Ortiz-Riomalo, Juan, Janke, Mathias, Engel, Stefanie, 2021a. Structuring communication effectively—the causal effects of communication elements on cooperation in social dilemmas. *Environ. Resour. Econ.* 79, 683–712. <https://doi.org/10.1007/s10640-021-00552-2>.
- Koessler, Ann-Kathrin, Page, Lionel, Dulleck, Uwe, 2021b. Public cooperation statements. *J. Econ. Interact. Coordinat.* 16, 747–767. <https://doi.org/10.1007/s11403-021-00327-4>.
- Kollock, Peter, 1998. Social dilemmas: the anatomy of cooperation. *Annu. Rev. Sociol.* 24, 183–214. <https://doi.org/10.1146/annurev.soc.24.1.183>.
- Koontz, Tomas M., Thomas, Craig, 2006. What do we know and need to know about the environmental outcomes of collaborative management? *Publ. Adm. Rev.* 66 (s1), 111–121. <https://doi.org/10.1111/j.1540-6210.2006.00671.x>.
- Kosfeld, Michael, Okada, Akira, Riedl, Arno, 2009. Institution formation in public goods games. *Am. Econ. Rev.* 99 (4), 1335–1355. <https://www.jstor.org/stable/25592511>.
- Koukoumelis, Anastasios, Vittoria Levati, M., Weisser, Johannes, 2012. Leading by words: a voluntary contribution experiment with one-way. *J. Econ. Behav. Organ.* 81, 379–390. <https://doi.org/10.1016/j.jebo.2011.11.007>.
- Kroll, Stephan, Cherry, Todd L., Shogren, Jason F., 2007. Voting, punishment, and public goods. *Econ. Inq.* 45 (3), 557–570. <https://doi.org/10.1111/j.1465-7295.2007.00028.x>.
- Ledyard, John O., 1995. Public goods: a survey of experimental research. In: Kagel, John, Roth, A. (Eds.), *Handbook of Experimental Economics*. Princeton of University Press, Princeton, pp. 111–194.
- Lejano, Raul P., Ingram, Helen, 2009. Collaborative networks and new ways of knowing. *Environ. Sci. Pol.* 12 (6), 653–662. <https://doi.org/10.1016/j.envsci.2008.09.005>.
- Liu, Lu, Bouman, Thijs, Perlaviciute, Goda, Steg, Linda, 2020. Public participation in decision making, perceived procedural fairness and public acceptability of renewable energy projects. *Energy Climate Change* 1, 100013. <https://doi.org/10.1016/j.egycc.2020.100013>.
- Lopez, Maria Claudia, James, Murphy, Spraggon, John M., Stranlund, John, 2012. Comparing the effectiveness of regulation and pro-social emotions to enhance cooperation: experimental evidence from fishing communities in Colombia. *Econ. Inq.* 50 (1), 131–142. <https://doi.org/10.1111/j.1465-7295.2010.00344.x>.
- Lopez, Claudia, Maria, Villamayor-Tomas, Sergio, 2017. Understanding the black box of communication in a common-pool resource field experiment. *Environ. Sci. Pol.* 68, 69–79. <https://doi.org/10.1016/j.envsci.2016.12.002>.
- Lynam, Timothy, Jong, Wil de, Sheil, Douglas, Kusumanto, Triakurnianti, Evans, Kirsten, 2007. A review of tools for incorporating community knowledge, preferences and values into decision making in natural resources management. *Ecol. Soc.* 12 (1), 5 [online]. <http://www.ecologyandsociety.org/vol12/iss1/art5/>.
- Lynham, J., Halpern, B.S., Blenckner, T., Essington, T., Estes, J., Hunsicker, M., Kappel, C., et al., 2017. Costly stakeholder participation creates inertia in marine ecosystems. *Mar. Pol.* 76, 122–129. <https://doi.org/10.1016/j.marpol.2016.11.011>.
- Maestre-Andrés, Sara, Calvet-Mir, Laura, Apostolopoulou, Evangelia, 2018. Unravelling stakeholder participation under conditions of neoliberal biodiversity governance in Catalonia, Spain. *Environ. Plann. C: Pol. Space* 36 (7), 1299–1318. <https://doi.org/10.1117/2399654417753624>.
- Mantzavinos, C., Douglass, C. North, Shariq, Syed, 2004. Learning, institutions, and economic performance. *Perspect. Polit.* 2 (1), 75–84. <https://doi.org/10.1017/S1537592704000635>.
- Margreiter, Magdalena, Sutter, Matthias, Dittrich, Dennis, 2005. Individual and collective choice and voting in common pool resource problem with heterogeneous actors. *Environ. Resour. Econ.* 32 (2), 241–271. <https://doi.org/10.1007/s10640-005-3359-9>.
- Mays, N., Pope, C., Popay, J., 2005. Systematically reviewing qualitative and quantitative evidence to inform management and policy-making in the health field. *J. Health Serv. Res. Pol.* 10 (1), 6–20. <https://doi.org/10.1258/1355819054308576>.
- McGinnis, Michael D., 2011a. An introduction to IAD and the language of the Ostrom Workshop: a simple guide to a complex framework. *Pol. Stud. J.* 39 (1), 169–183. <https://doi.org/10.1111/j.1541-0072.2010.00401.x>.
- McGinnis, Michael D., 2011b. Networks of adjacent action situations in polycentric governance. *Pol. Stud. J.* 39 (1), 51–78. <https://doi.org/10.1111/j.1541-0072.2010.00396.x>.
- McGinnis, Michael, Ostrom, Elinor, 2014. Social-ecological system framework: initial changes and continuing challenges. *Ecol. Soc.* 19 (2), 30. <https://doi.org/10.5751/ES-06387-190230>.
- Medema, Wietske, Furber, Alison, Adamowski, Jan, Zhou, Qiqi, Mayer, Igor, 2016. Exploring the potential impact of serious games on social learning and stakeholder collaborations for transboundary watershed management of the St. Lawrence River Basin. *Water* 8 (5), 175. <https://doi.org/10.3390/w8050175>.
- Meinzen-Dick, Ruth, Marco, A. Janssen, Sandeep, Kandikuppa, Chaturvedi, Rahul, Rao, Kaushalendra, Theis, Sophie, 2018. Playing games to save water: collective action games for groundwater management in Andhra Pradesh, India. *World Dev.* 107, 40–53. <https://doi.org/10.1016/j.worlddev.2018.02.006>.
- Moreno-Sánchez, Rocío del Pilar, Maldonado, Jorge Higinio, 2010. Evaluating the role of co-management in improving governance of marine protected areas: an experimental approach in the Colombian Caribbean. *Ecol. Econ.* 69, 2557–2567. <https://doi.org/10.1016/j.ecolecon.2010.07.032>.
- Morrow, Paula C., Muchinsky, Paul M., 1980. Middle range theory: an overview and assessment for organizational research. In: Craig, C. Pinder, Larry, F. Moore (Eds.), *Middle Range Theory and the Study of Organizations*. Springer, Dordrecht, pp. 33–44. https://doi.org/10.1007/978-94-009-8733-3_3.
- Muradian, Roldan, Cardenas, Juan Camilo, 2015. From market failures to collective action dilemmas: reframing environmental governance challenges in Latin America and beyond (Editorial to special section). *Ecol. Econ.* 120, 358–365. <https://doi.org/10.1016/j.ecolecon.2015.10.001>.
- National Research Council (NRC), 2002. *The drama of the commons*. In: Ostrom, E., Dietz, T., Dolsak, N., Stern, P.C., Stovich, S., Weber, E.U. (Eds.), *Committee on the Human Dimensions of Global Change*. Division of Behavioral and Social Sciences and Education. National Academy Press, Washington D.C. <https://doi.org/10.17226/10287>.
- National Research Council (NRC), 2008. *Public Participation in Environmental Assessment and Decision Making*. The National Academies Press, Washington D.C. <https://doi.org/10.17226/12434>.
- Newig, Jens, Fritsch, Oliver, 2009. Environmental governance: participatory, multi-level and effective? *Environ. Pol. Govern.* 19, 197–214. <https://doi.org/10.1002/eet.509>.
- Newig, Jens, Ana, Adzersen, Edward, Challies, Oliver, Fritsch, Nicolas, Jager, 2013. *Comparative Analysis of Public Environmental Decision-Making Processes – a Variable-Based Analytical Scheme*. Institute for Environmental and Sustainability Communication, Leuphana University, Lüneburg. Discussion Paper No. 37 / 13.
- Newig, Jens, Edward, Challies, Nicolas, W. Jager, Elisa, Kochskämper, Ana, Adzersen, 2018. The environmental performance of participatory and collaborative governance: a framework of causal mechanisms. *Pol. Stud. J.* 46 (2), 269–297. <https://doi.org/10.1111/psj.12209>.
- Newig, Jens, Nicolas, W. Jager, Elisa, Kochskämper, Challies, Edward, 2019. Learning in participatory environmental governance – its antecedents and effects. Findings from a case survey meta-analysis. *J. Environ. Pol. Plann.* 21 (3), 213–227. <https://doi.org/10.1080/1523908X.2019.1623663>.
- North, Douglas, 1994. Economic performance through time. *Am. Econ. Rev.* 84 (3), 359–368. <https://www.jstor.org/stable/2118057>.
- Ortiz-Riomalo, Felipe, Juan, Koessler, Ann-Kathrin, Engel, Stefanie, 2020. The effects of inducing perspective-taking through role-reversal in a give-and-take dictator game on pro-social behaviour. PhD thesis. In: Juan, Felipe Ortiz-Riomalo (Ed.), *Participatory Interventions for Pro-social and Collective Action in Natural Resource Management: an Institutional and Behavioural Approach*. economics, Osnabrueck University, Osnabrueck (Germany), pp. 105–156. <https://repositorium.uni-osnabrueck.de/handle/urn:nbn:de:gbv:700-202012163935>.
- Ortiz-Riomalo, Felipe, Juan, Koessler, Ann-Kathrin, Engel, Stefanie, 2021. Inducing perspective-taking for prosocial behaviour in natural resource management. *J. Environ. Econ. Manag.* 110, 102513. <https://doi.org/10.1016/j.jeem.2021.102513>.
- Ortiz-Riomalo, Felipe, Juan, Kathrin Koessler, Ann, Miranda-Montagut, Yaddi, Cardenas, Juan Camilo, 2022a. Participatory interventions for collective action and sustainable resource management: linking actors, situations and contexts through the IAD, NAS and SES frameworks. *Sustain. Sci.* <https://doi.org/10.1007/s11625-022-01215-x>.
- Ortiz-Riomalo, Felipe, Juan, Kathrin Koessler, Ann, Engel, Stefanie, 2022b. Fostering cooperation for sustainable resource management through participation. *Lit. Rev.*

- Osnabrück University. SSRN Working paper https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4093075.
- Ortiz-Riomalo, Felipe, Juan, Kathrin Koessler, Ann, Engel, Stefanie, 2023. The impact of participatory interventions on pro-social behaviour in environmental and natural resource management: evidence from the lab and the field. In: Bucciol, Alessandro, Tavoni, Alessandro, Veronesi, Marcella (Eds.), *Behavioural Economics and the Environment: A Research Companion*. Routledge. <https://www.routledge.com/Behavioural-Economics-and-the-Environment-A-Research-Companion/Bucciol-Tavoni-Veronesi/p/book/9781032003535>.
- Ostrom, Elinor, 1990. *Governing the Commons: the Evolution of Institutions for Collective Action*. Cambridge University Press, New York. <https://doi.org/10.1017/CBO9780511807763>.
- Ostrom, Elinor, 1996. Crossing the great divide: coproduction, synergy, and development. *World Dev.* 24 (6), 1073–1087. [https://doi.org/10.1016/0305-750X\(96\)00023-X](https://doi.org/10.1016/0305-750X(96)00023-X).
- Ostrom, Elinor, 1998. A behavioral approach to the rational choice theory of collective action. *Am. Polit. Sci. Rev.* 92 (1), 1–22. <https://doi.org/10.2307/2585925>.
- Ostrom, Elinor, 1999. Social capital: a fad or a fundamental concept? In: Dasgupta, Partha, Serageldin, Ismail (Eds.), *Social Capital: A Multifaceted Perspective*. World Bank, Washington, D.C., pp. 172–214.
- Ostrom, Elinor, 2000a. The danger of self-evident truths. *PS Political Sci. Polit.* 33 (1), 33–44. <https://doi.org/10.2307/420774>.
- Ostrom, Elinor, 2000b. Crowding out citizenship. *Scand. Polit. Stud.* 23 (1), 3–16. <https://doi.org/10.1111/1467-9477.00028>.
- Ostrom, Elinor, 2005. *Understanding Institutional Diversity*. Princeton University Press, Princeton and Oxford.
- Ostrom, Elinor, 2006. The value-added of laboratory experiments for the study of institutions and common-pool resources. *J. Econ. Behav. Organ.* 61, 149–163. <https://doi.org/10.1016/j.jebo.2005.02.008>.
- Ostrom, Elinor, 2007a. Challenges and growth: the development of the interdisciplinary field of institutional analysis. *J. Inst. Econ.* 3 (3), 239–264. <https://doi.org/10.1017/S1744137407000719>.
- Ostrom, Elinor, 2007b. A diagnostic approach for going beyond panaceas. *Proc. Natl. Acad. Sci. USA* 104 (39), 15181–15187. <https://doi.org/10.1073/pnas.0702288104>.
- Ostrom, Elinor, 2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325 (5939), 419–422. <https://doi.org/10.1126/science.1172133>.
- Ostrom, Elinor, 2010a. Polycentric systems for coping with collective action and global environmental change. *Global Environ. Change* 20, 550–557. <https://doi.org/10.1016/j.gloenvcha.2010.07.004>.
- Ostrom, Elinor, 2010b. Beyond markets and states: polycentric governance of complex economic systems. *Am. Econ. Rev.* 100, 641–672. <https://doi.org/10.1257/aer.100.3.641>.
- Ostrom, Elinor, 2010c. Analyzing collective action. *Agric. Econ.* 41 (s1), 155–166. <https://doi.org/10.1111/j.1574-0862.2010.00497.x>.
- Ostrom, Elinor, 2011. Background on the institutional analysis and development framework. *Pol. Stud. J.* 39 (1), 7–27. <https://doi.org/10.1111/j.1541-0072.2010.00394.x>.
- Ostrom, Elinor, 2014. Do institutions for collective action evolve? *J. Bioecon.* 16 (1), 3–30. <https://doi.org/10.1007/s10818-013-9154-8>.
- Ostrom, Elinor, Ostrom, Vincent, 2004. The quest for meaning in public choice. *Am. J. Econ. Sociol.* 63 (1), 105–147. <http://www.jstor.org/stable/3488034>.
- Ostrom, Elinor, Walker, James, Gardner, Roy, 1992. Covenants with and without a sword: self-governance is possible. *Am. Polit. Sci. Rev.* 86 (2), 404–417. <https://doi.org/10.2307/1964229>.
- Ostrom, Elinor, Gardner, Roy, Walker, James, 1994. *Rules, Games and Common-Pool Resources*. The University of Michigan Press. <https://doi.org/10.3998/mpub.9739>.
- Pahl-Wostl, Claudia, 2002. Participative and stakeholder-based policy design: evaluation and modeling process. *Integrat. Assess.* 3 (1), 3–14.
- Pahl-Wostl, Claudia, 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environ. Change* 19, 354–365. <https://doi.org/10.1016/j.gloenvcha.2009.06.001>.
- Pahl-Wostl, Claudia, 2015. *Water Governance in the Face of Global Change. From Understanding to Transformation*. Springer.
- Pahl-Wostl, Claudia, Hare, Matt, 2004. Processes of social learning in integrated resources management. *J. Community Appl. Soc. Psychol.* 14, 193–206. <https://doi.org/10.1002/casp.774>.
- Pahl-Wostl, Claudia, Holtz, Georg, Kastens, Britta, Knieper, Christian, 2010. Analyzing complex water governance regimes: the management and transition framework. *Environ. Sci. Pol.* 571–581. <https://doi.org/10.1016/j.envsci.2010.08.006>.
- Pavitt, Charles, 2018. The path to cooperative action during group social dilemmas: a literature review, set of propositions, and model describing how the opportunity to communicate encourages cooperation. *Rev. Commun. Res.* 6, 54–83. <https://doi.org/10.12840/issn.2255-4165.2018.06.01.016>.
- Polski, Margaret M., Ostrom, Elinor, 1999. An institutional framework for policy analysis and design. In: *Workshop in Political Theory and Policy Analysis*. Indiana University.
- Poteete, Amy R., Janssen, Marco, Ostrom, Elinor, 2010. *Working Together: Collective Action, the Commons, and Multiple Methods in Practice*. Princeton: Princeton University Press.
- Quist, Jacob, Thissen, Wil, Vergragt, Philip J., 2011. The impact and spin-off of participatory backcasting: from vision to niche. *Technol. Forecast. Soc. Change* 78, 883–897. <https://doi.org/10.1016/j.techfore.2011.01.011>.
- Reed, Mark, 2008. Stakeholder participation for environmental management: a literature review. *Biol. Conserv.* 141, 2417–2431. <https://doi.org/10.1016/j.biocon.2008.07.014>.
- Reed, Mark S., Graves, Anil, Dandy, Norman, Helena, Posthumus, Klaus, Hubacek, Joe, Morris, Christina, Prell, Quinn, Claire H., Stringer, Lindsay C., 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. *J. Environ. Manag.* 90, 1933–1949. <https://doi.org/10.1016/j.jenvman.2009.01.001>.
- Reed, M.S., Stringer, L.C., Fazey, I., Evelyn, A.C., Kruijssen, J.H.J., 2014. Five principles for the practice of knowledge exchange in environmental management. *J. Environ. Manag.* 337–345. <https://doi.org/10.1016/j.jenvman.2014.07.021>.
- Reed, Mark S., Vella, Steven, Challies, Edward, Joris de Vente, Lynne, Frewer, Daniela, Hohenwallner-Ries, Tobias, Huber, et al., 2018. A theory of participation: what makes stakeholder and public engagement in environmental management work? *Restor. Ecol.* 26 (S1), S7–S17. <https://doi.org/10.1111/rec.12541>.
- Rodríguez-Sickert, Carlos, Andrés Guzmán, Ricardo, Camilo Cárdenas, Juan, 2008. Institutions influence preferences: evidence from a common pool resource experiment. *J. Econ. Behav. Organ.* 67, 215–227. <https://doi.org/10.1016/j.jebo.2007.06.004>.
- Rowe, Gene, Frewer, Lynn, 2005. A typology of public engagement mechanisms. *Sci. Technol. Hum. Val.* 30 (2), 251–290. <https://doi.org/10.1177/0162243094271724>.
- Rudel, Thomas K., 2008. Meta-analyses of case studies: a method for studying regional and global environmental change. *Global Environ. Change* 18, 18–25. <https://doi.org/10.1016/j.gloenvcha.2007.06.001>.
- Saldarriaga-Isaza, Adrián, Villegas-Palacio, Clara, Arango, Santiago, 2015. Phasing out mercury through collective action in artisanal gold mining: evidence from a framed field experiment. *Ecol. Econ.* 120, 406–415. https://doi.org/10.1016/j.ecolecon.2015.04.004?utm_source=ideas.
- Sally, David, 1995. Conversation and cooperation in social dilemmas. A meta-analysis of experiments from 1958 to 1992. *Rational. Soc.* 7, 58–92. <https://doi.org/10.1177/1043463195007001004>.
- Sally, David, 2001. On sympathy and games. *J. Econ. Behav. Organ.* 44, 1–30. [https://doi.org/10.1016/S0167-2681\(00\)00153-0](https://doi.org/10.1016/S0167-2681(00)00153-0).
- Schill, Caroline, Wijermans, Nanda, Schlüter, Maja, Lindahl, Therese, 2016. Cooperation is not enough—exploring social-ecological micro-foundations for sustainable common-pool resource use. *PLoS One* 11 (8), e0157796. <https://doi.org/10.1371/journal.pone.0157796>.
- Schill, Caroline, John, M., Anderies, Therese Lindahl, Carl, Folke, Stephen, Polasky, Juan, Camilo Cárdenas, Anne-Sophie, Crépin, Janssen, Marco A., Norberg, Jon, Schlüter, Maja, 2019. A more dynamic understanding of human behaviour for the Anthropocene. *Nat. Sustain.* 2, 1075–1082. <https://doi.org/10.1038/s41893-019-0419-7>.
- Schlager, Edela, Cox, Michael, 2018. The IAD framework and the SES framework: an introduction and assessment of the Ostrom Workshop frameworks. In: Christopher, M. Weible, Sabatier, Paul (Eds.), *Theories of the Policy Process*. Westview Press, pp. 215–252.
- Schmitt, Pamela, Swope, Kurtis, Walker, James, 2000. Collective action with incomplete commitment: experimental evidence. *South. Econ. J.* 66 (4), 829–854. <https://doi.org/10.2307/1061532>.
- Scholz, Geeske, Dewulf, Art, Pahl-Wostl, Claudia, 2014. An analytical framework of social learning facilitated by participatory methods. *Syst. Pract. Action Res.* 27 (6), 575–591. <https://doi.org/10.1007/s11213-013-9310-z>.
- Sen, Amartya, 1977. Rational fools: a critique of the behavioral foundations of economic theory. *Philos. Publ. Aff.* 6 (4), 317–344. <https://www.jstor.org/stable/2264946>.
- Sen, Amartya, 1997. Maximization and the act of choice. *Econometrica* 65 (4), 745–779. <https://doi.org/10.2307/2171939>.
- Smith, Vernon, 1982. Microeconomic systems as an experimental science. *Am. Econ. Rev.* 72 (5), 923–955. <https://www.jstor.org/stable/1812014>.
- Sterling, Eleanor J., Betley, Erin, Sigouin, Amanda, Andres, Gomez, Anne, Toomey, Georgina, Cullman, Cynthia, Malone, et al., 2017. Assessing the evidence for stakeholder engagement in biodiversity conservation. *Biol. Conserv.* 209, 159–171.
- Tyler, Tom R., 1990. *Why People Obey the Law*. Yale University Press, New Haven and London.
- Uphoff, Norman, 1999. Understanding social capital: learning from the analysis and experience of participation. In: Dasgupta, Partha, Serageldin, Ismail (Eds.), *In Social Capital: A Multifaceted Perspective*. World Bank, Washington D.C., pp. 215–252.
- van Asselt Marjolein, B.A., Rijkens-Klomp, Nicole, 2002. A look in the mirror: reflection on participation in Integrated Assessment from a methodological perspective. *Global Environ. Change* 12, 167–184. [https://doi.org/10.1016/S0959-3780\(02\)00012-2](https://doi.org/10.1016/S0959-3780(02)00012-2).
- Villamayor-Tomas, Sergio, Oberlack, Christoph, Epstein, Graham, Partelow, Stefan, Roggero, Matteo, Kellner, Elke, Tschopp, Maurice, Cox, Michael, 2020. Using case

- study data to understand SES interactions: a model-centered meta-analysis of SES framework applications. *Curr. Opin. Environ. Sustain.* 44, 48–57. <https://doi.org/10.1016/j.cosust.2020.05.002>.
- Voinov, Alexey, Bousquet, Francois, 2010. Modelling with stakeholders. *Environ. Model. Software* 25, 1268–1281. <https://doi.org/10.1016/j.envsoft.2010.03.007>.
- Vollan, Bjørn, 2008. Socio-ecological explanations for crowding-out effects. *Ecol. Econ.* 67 (4), 560–573. <https://doi.org/10.1016/j.ecolecon.2008.01.015>.
- von Korff, Yorck, Patrick, d'Aquino, Katherine, Daniell, Rianne, Bijlsma, 2010. Designing participation processes for water management and beyond. *Ecol. Soc.* 15 (3), 1 [Online]. <http://www.ecologyandsociety.org/vol15/iss3/art1/>.
- Vyrastekova, Jana, Soest, Daan van, 2003. Centralized common-pool management and local community participation. *Land Econ.* 79 (4), 500–514. <https://doi.org/10.2307/3147296>.