Active community for climate change: a Dynamic Performance Governance analysis of a biodiversity preservation program

Vincenzo Vignieri
Department of Business and Law Studies, University of Siena, Siena, Italy

Received 4 April 2022
Revised 12 November 2022
21 January 2023
3 May 2023
26 May 2023
Accepted 28 May 2023

Abstract

Purpose – This study aims to illustrate how collaborative platforms may leverage active community for climate change adaptation to implement biodiversity preservation policies.

Design/methodology/approach – This study adopts the Dynamic Performance Governance methodological framework to analyze the causal relationships affecting biodiversity preservation policy outcomes.

Findings – Active community reduces harmful factors for biodiversity (i.e. biological threats and anthropogenic pressure), limiting the risk of extinction of perennial plants. Stakeholders' prior knowledge is an enabling condition of climate adaptation processes as it triggers the adoption of prescriptions and cultural changes in a community.

Practical implications – The study provides methodological guidance to define measures to deliver material information to support environmental performance governance. It elaborates an inventory of short- and long-term performance indicators integrating natural-science targets into accounting measures that can support policymakers operating in other contexts to implement climate change adaptation policies.

Social implications – As a response to the study findings, social implications provide insights into how active community in collaborative platforms for climate change may support stakeholders to address natural resources imbalances, define strategies to share the burden among them and intervene on multiple policy domains (e.g. financial, environmental and social).

Originality/value – Climate change adaptation challenges are conceptualized as "super wicked problems," and the collaborative platforms designed to address them are rendered as complex adaptive systems. This makes the paper go beyond traditional environmental governance, demonstrating that stakeholders' interactions within collaborative platforms harness active community specialized knowledge.

Keywords Climate change adaptation, Active community, Biodiversity preservation, Collaborative platforms, Dynamic Performance Governance

Paper type Research paper

1. Introduction

In the past three decades, scientists have observed changes in the earth's climate, with remarkable warming in every region of the globe (Intergovernmental Panel on Climate Change, 2021). An established understanding of such phenomenon deems human activities-induced greenhouse gas emissions in the atmosphere as the primary cause of the expected 1.5°C increase in global temperature in the next decade (Canadell *et al.*, 2007). The carbon

The author thank Maurizio Giambalvo from NEXT (Next – Nuove Energie x il Territorio) for his availability to be interviewed about the "Life-CalMarSi" project. The author is grateful to the anonymous referees, the journal editor and the associate editor for their comments on the early version of this article.

2040-8021
DOI 10.1108/SAMPJ-04-2022-0167

dioxide (i.e. CO_2) emissions are causing multiple alterations in the fundamental components (i.e. water, air, sunlight, soil, plants, microorganisms, insects and animals) of every ecosystem. Due to the risk of further abrupt biodiversity losses and disruptive threats to life on Earth (Stern *et al.*, 2021), climate change is undeniably among the main challenge of our times. Public management scholars must contribute to robust performance measurement, analysis and evaluation in this field.

To conceptualize the challenge for public management and governance, the environmental issues driven by climate change have been framed as "super wicked problems" (Levin *et al.*, 2012, p. 123) since they lack straightforward policy responses (Rittel and Webber, 1973). This is due to four main features:

(1) time for effective interventions is almost gone (Pollitt, 2015);
(2) "The central authority needed to address them is weak or non-existent" (Levin *et al.*, 2012, p. 124);
(3) the governance context is multilevel, multi-actor and involves multiple interrelated policy domains (Head and Alford, 2015; Lægreid and Rykkja, 2014); and
(4) conventional policymakers heuristics are inadequate to face the dynamic complexity underlying such policy issues (Sterman and Sweeney, 2007).

Policymakers have traditionally addressed "super wicked problems" through discrete incremental interventions (OECD, 2017) with no concerns for path-dependency (Peters *et al.*, 2005), i.e. the adoption of specific policy interventions that can "constrain our future collective selves" (Levin *et al.*, 2012, p. 123). Once a path has been determined (Pierson, 2000), the policies adopted by institutions unfold as "self-reinforcing processes" (Peters *et al.*, 2005) that limit or even prevent the exploration of other potential solutions. Adopted solutions shape – or at least are expected to shape – future patterns of behavior of people and the role of institutions within society (North, 1990). Since "institutions are historically contingent" (Thornton *et al.*, 2012, p. 12), their initiatives coevolve with the characteristics of the societal system on which their policies are expected to impact.

In this sense, complex institutional arrangements can be regarded as the source of prescriptions (e.g. laws, codes or contracts) (Dicey, 1979; Ingram, 1985; Lynn, 2009) or the enabler of cultural changes in a community (Nalbandian, 1991, 1999; O'Leary and Bingham, 2003; Rosenbloom and O'Leary, 1997). This study elaborates on these two policy patterns to illustrate how collaborative platforms (Ansell and Gash, 2018) may leverage active community (Cooper *et al.*, 2006) to implement climate change adaptation policies. In doing this, the logic of interactions accommodating the different – and perhaps conflicting (e.g. environment sustainability vs economic growth) – stakeholder interests in such collaborative settings is conceived as a combination of the traditional environmental governance model (Mermet, 2020) with knowledge-driven advocacy coalitions (Sabatier, 1988). Such conceptualization renders collaborative platforms complex adaptive systems.

To investigate such collaborative settings, this study uses Dynamic Performance Governance (DPG) as a learning-oriented methodological framework to enhance collaborative platforms dealing with socio-ecological wicked issues (Bianchi, 2021, 2022). Such an approach is adopted to analyze the "LifeCalMarSi" case, i.e. a biodiversity preservation policy program.

Three central questions guide the analysis: what insights does the DPG framework provide to understand the role of active community in collaborative platforms for climate change adaptation? On which factors can policymakers and their stakeholders act to improve the biodiversity preservation policy program outcomes? What measures does the

DPG provide to govern and assess environmental performance outcomes? Through a "single-outcome study" (Gerring, 2006, p. 707) illustrating how collaborative platforms may harness active community to implement adaptive responses to climate change threats at the local level, this study contributes to research and practice for the governance of socio-ecological systems performance (Biesbroek *et al.*, 2017, 2018; Folke *et al.*, 2005; Mermet, 2020; Singh *et al.*, 2020; Wellstead *et al.*, 2013).

After the introduction, the paper is structured as follows. Section 2 discusses how collaborative platforms provide the context for various individuals and organizations to come together to achieve climate change goals on both a global and local level. To enhance collaboration and outcome-based policy analysis in this setting, Section 3 introduces the DPG framework, which is used, in Section 4, to frame the role of active community in collaborative platforms for climate change. Section 5 presents the "LiFe CalMarSi" case, which is analyzed in Section 6. Discussion and conclusions are given in Section 7.

2. Collaborative platforms for climate change adaptation and the role of active community in policy implementation

The initiatives to address climate change can be distinguished as mitigation and adaptation policies. While mitigation aims at reducing greenhouse gas emissions, adaptation implies strengthening the socio-ecological capacity to respond to climate change impacts.

From a policy-making perspective, adaptation refers to the process involving:

> Public and private actors at different administrative levels and in different sectors, which deals intentionally with climate change impacts, and whose outcomes attempt to substantially impact actor groups, sectors, or geographical areas that are vulnerable to climate change (Knoepfel *et al.*, 2011, p. 24).

In this perspective, climate adaptation policies require that a plurality of actors and groups from the public and private sectors operating at different jurisdictional levels convene together to pursue relevant climate change goals on a global and local scale. Examples of such plural agreements are the international treaties to address climate change, including the United Nations Framework Convention on Climate Change (1992), the Kyoto Protocol (1997), the Paris Agreement (2015) and the 26th United Nations Climate Change Conference of the Parties (2021). Though such initiatives are set at the global level, the implementation of envisaged actions entails significant involvement of the local stakeholders, including government, businesses, citizens and the community.

At this level of analysis, significant climate change initiatives can take multiple forms of interaction (Mermet *et al.*, 2013), showing differences in leadership, advocacy, motivation, engagement and knowledge. From such configurations, value conflicts and cultural tensions among the plurality of parties might emerge due to unbalances in power, resource distribution and role in the political arena. Dealing with environmental concerns requires accommodating different policy perspectives and mediating conflicting interests (e.g. environment sustainability vs economic growth) to envisage viable courses of action, perhaps by sharing knowledge, governance capacity and other strategic resources (Ansell and Gash, 2007; Emerson and Nabatchi, 2015).

Practical efforts in such a direction entail arranging stakeholders around patterns of interactions, implying that the emergent logic of action (e.g. authoritarian, collaborative and conflictual), its characteristics (e.g. prescriptive, participative and revolutionary) and expected policy outcomes configure the relational model (Mermet *et al.*, 2013). Traditional environmental governance is initiated by the relevant public authority in the area (or in a specific domain) to identify environmentally-sustainable solutions through direct negotiation with key stakeholders.

However, relying on the sole public authority may not be enough to make environmental pledges real. To prioritize issues, design actions and eventually evaluate outcomes, the traditional "diagogic" (Mermet, 2020, p. 41) model of public governance should integrate a collaborative regime in which the interactions over the most urgent environmental matters configure voluntary exchanges among convened stakeholders (Ostrom, 1990; Wunder, 2005). Actors like NGOs, scientific institutions or community organizations can take the "onus of acting" (Mermet, 2020, p. 42) to alleviate harmful circumstances for the environment (e.g. air pollution, electromagnetic radiation and floods carry contamination). By leading the formation of an "advocacy coalition" (Sabatier and Jenkins-Smith, 1999), such organizations aim to change the course of public decision-making. In these instances, the legitimacy of adopted decisions rises as the public authority exchanges resources and power with qualified knowledge and supports from vulnerable groups and underrepresented voices (Ansell and Gash, 2007; Nalbandian, 1991, 1999; Schuckman, 2001).

This is the domain of collaborative platforms based on a dialogic form (Choi and Moynihan, 2019; Rajala and Laihonen, 2019) of performance governance (Bianchi, 2022; Rajala *et al.*, 2020) for climate change adaptation (Emerson and Murchie, 2010). In collaborative platforms, "a wide array of actors at different geographical scales and across a wide range of issue areas" (Ansell and Miura, 2020, p. 261) work together to address policy issues that go beyond what an organization – either public, private or civic – could individually achieve. To this end, such platforms "embody a new organizing logic to achieve distributed participation and mobilization" (Ansell and Miura, 2020, p. 261) via collaboration.

As collaboration "takes its inspiration from the traditions of civic engagement and participatory democracy" (Fung, 2004, p. 9), it paves the "route to active citizenship and active community" (Osborne *et al.*, 2012, p. 639), whereas both concepts leverage citizens' participation and specialized knowledge within collaborative platforms (Ansell and Miura, 2020; Kilelu *et al.*, 2013; Steins and Edwards, 1999). The construct "active community" can be conceptualized as the participation of community members – individually and as groups – "for deliberation and collective action within an array of interests, institutions and networks, developing civic identity, and involving people in governance processes" (Cooper, 2005, p. 53).

Collaborative platforms can leverage active community (Sherry *et al.*, 2017) in different stages of the policy cycle (Axon, 2016) – from consultation to performance evaluation – to implement climate change adaptations policies (Lassen *et al.*, 2011; Steins and Edwards, 1999; Vignola *et al.*, 2013). To this end, involved actors convey "dedicated competencies, institutions and resources for facilitating the creation, adaptation and success of multiple or ongoing collaborative projects or networks" (Ansell and Gash, 2018, p. 20; Vignieri, 2020a; Vignieri *et al.*, 2019). In fact, by participating in collaborative platforms, relevant stakeholders and community members can get acquainted with climate change impacts, "acquire knowledge about the options that are available for a response and be empowered to take their own actions" (Khatibi *et al.*, 2021, p. 2). As a result, such a cognitive process may lead to behavioral responses of community members, including both "changing attitudes" and "taking actions" to reduce the anthropogenic impact on the socio-ecological system where they live (Sutton and Tobin, 2011). This is how the role of active community is regarded in this paper.

To make this concept the thrust of this article, a case study showing how collaborative platforms may harness active community to implement climate change policies is discussed. In the investigated real-world governance setting, policy implementation is framed as "the way in which stakeholders interact with each other in order to influence the outcomes of policies" (Bovaird and Löffler, 2009, p. 7). Outcomes can be defined as the ultimate ends that a policy program aims to achieve, whereas intermediate outcomes "represent interim accomplishments, which are expected to lead to those end results" (Hatry, 1999, p. 15).

However, when investigating problems that concern complex issues, such as climate change, outcome-based policy analysis implies some caveats. First, policy outcomes should be framed as a change in the shared strategic resource endowments at the community level since their generation is strongly affected by the ability of different stakeholders to outline collaborative policies. For instance, the "change in the quality of life" improves the value of the corresponding strategic resource "quality of life." Such a shared resource does not pertain to a specific stakeholder; somewhat, a plurality of aspects (e.g. services, job opportunities and infrastructures) under the (shared) responsibility of public, private and community stakeholders influence its endowment. Second, outcome-generation processes are driven by the multiple interactions among interinstitutional responses (Peters *et al.*, 2017), emerging as path-dependent feedback loops [1] (Sterman, 2000). This means that "what happened at an earlier point in time will affect the possible outcomes of a sequence of events occurring at a later point in time" (Sewell, 1996, p. 262). This also implies that such events may propagate their effects over time in multiple policy domains, perhaps in counterintuitive ways.

A systems perspective on the causation driving policy outcomes development over time is needed to frame such complexity properly. To this end, DPG (Bianchi, 2021; Bianchi *et al.*, 2021) can support outcome-based policy analysis to enhance collaborative platforms (Bianchi, 2022) for climate change.

3. Dynamic Performance Governance: a methodological framework for the implementation of climate change adaptation policies

Collaborative platforms as a "governance strategy" (Ansell and Gash, 2018) may host the increasing commitment of a plurality of actors toward actions for the climate (Emerson and Murchie, 2010) aimed at pursuing "the reduction in harm, the reduction in the risk of harm, or the realization of benefits to address climate variability and change" (Donatti *et al.*, 2020, p. 416).

Learning how to adapt habits or behavior to evolving system conditions is the ambition of the partners involved in collaboratives for climate change. Given these features, such arrangements can be conceived as "self-organizing systems in which order emerges in a bottom-up fashion from the local relationships" (Ritter *et al.*, 2004, p. 175). If framed as complex adaptive systems (Beinhocker, 2006; Capra, 1996; Cilliers, 1998), collaborative platforms can host adaptation processes through which stakeholders can learn as they interact with each other (Waldrop, 1992). As illustrated in the previous section, relevant relationships among partners do not stem linearly from the arrangement's formal aspects (e.g. prerogatives, rules of conduct, jurisdictions and competencies); instead, they originate from the evolving configurations of network interactions (Booher and Innes, 2010).

To support adaptation, performance management and governance routines should operate as a distributed information structure for decision-making (Rajala and Laihonen, 2019) rather than acting as mere measurement or reporting practices (Mussari, 2022). In this way, performance governance sustains stakeholders tensions for self-organization through learning (Laihonen and Mäntylä, 2017; Moynihan, 2005, 2008). This implies shifting the focus of traditional performance management from an "inside-out" (Bianchi *et al.*, 2021) to an "outside-in" (Bianchi and Vignieri, 2020, p. 620) perspective of stakeholders' collaboration, focusing on how organizational initiatives contribute to climate change policy outcomes. By taking this view, stakeholders may learn that addressing urgent challenges (e.g. biodiversity loss, sea level increase, changes in ocean acidity, reduction in soil's water-holding capacity and damage to soil's fertility) requires boundary-spanning collaborative relations.

As collaborative interactions are nonlinear, stakeholders' behaviors change, as well as the world around them (Kauffman, 1993, 1995; Levinthal and Warglien, 1999; McDaniel, 2008). It is "an infinitely complex dance of co-evolution" (Waldrop, 1992, p. 259) that calls for a fit between available knowledge, actions to undertake and current system conditions (Beinhocker, 1997; Rivkin and Siggelkow, 2002).

Performance management and governance routines must be involved in a conducive learning setting to support adaptation. This requires methods that act as "boundary objects" (Ansell and Gash, 2018, p. 23) capable of fostering a collective process of sensemaking (Weick, 1995) that may help stakeholders disentangle the different perspectives so as to help them develop an interpretative scheme of the causal structure underlying the dynamic and complex problem at hand (Freeman, 2008; Hall, 1993). Specifically, if the challenge for policymakers is understanding how human activities cause disruption and disturbance in several ecosystems (Feist *et al.*, 2020; Meadows *et al.*, 1972, 1974; Welsh, 2010), the support provided by a facilitator is a vehicle to foster policy learning. Such methodological support may challenge decision-makers mental models, whose "probabilistic" cognitive heuristics (Kleinmuntz, 1985) is inadequate when uncertainty conditions far exceed their operationalization capacity (Simon, 1947). Misperceiving the causality underlying complex issues has been proven to be a significant cause of policy failures (Forrester, 1969; Moxnes, 2004; Moxnes and Saysel, 2009; OECD, 2017; Sterman, 1989), policy resistance or unexpected outcomes (Sterman, 2000). "Learning in and about complex systems" (Sterman, 1994) requires methods and tools to disentangle the causal relationships tying emergent problematic behaviors with the underlying system structure that can be held responsible for the observed socio-ecological phenomena.

Though traditional approaches in policy analysis adopt a system perspective, their practical applications have been criticized due to the technical solutions on which they rely (Thissen and Walker, 2013; Walker, 2000). Such approaches mainly refer to the cost-benefit analysis (CBA) (Bollen *et al.*, 2009) or indicator-based performance evaluation (Hemphill *et al.*, 2004; OECD, 2000).

On the one hand, CBA aims to compare the costs and benefits associated with a specific policy (Nash, 1993; Prest and Turvey, 1965). Such a method may downsize some policy impacts (Mohring and Williamson, 1969) as it bounds performance analysis to those economic, social and environmental impacts that the financial module can account (Banister, 2008; Banister and Berechman, 1999; OECD, 2002; Weisbrod and Weisbrod, 1997). This is due to a methodological caveat that prevents CBA from "double counting" some benefits and costs (Mohring, 1993).

On the other hand, indicator-based policy performance evaluation methods provide metrics for comparative analysis to deliver league tables over specific policy domains (e.g. quality of life in cities, level of freedom, access to care and national education). Though such methods are widespread, the indexes they produce are insufficient for a robust causation analysis oriented to tearing down policy ideas or corroborating the quality of current decisions (Mitchell, 1996). Integrating multiple policy performance attributes (Vedung, 1997) into sophisticated indexes compromises the selectivity of performance information (Bell and Morse, 2013) with the risk of diverting policymakers focus from policy outcomes causal determinants to the final score. As Innes and Booher (2000, p. 177) have remarked, "indicators do not drive policies," meaning that synthetic and static measures might give an illusion of control, leading to irrationality in policy analysis.

CBA and indicator-based policy analysis methods are inadequate to source policy learning (Freeman, 2008; Sabatier and Jenkins-Smith, 1993) and performance evaluation (Rajala *et al.*, 2020). Such major limitations jeopardize the aptitude of the method to perceive the dynamic and complex nature of wicked issues. Such nature refers to the fact that complex systems are constantly changing over time, governed by feedback loops – mostly nonlinear, implying a shift in structural dominance – influenced by past decisions, adaptive, counterintuitive and policy resistant (Sterman, 2000, p. 22).

Given such features, implementing a policy program is a self-organizing process, emerging from a "modulating stream of decisions" (Forrester, 1992) influenced by stakeholders' values, information delays and discrepancies between desired and current conditions in some key states of the system. Therefore, to properly frame the problematic behaviors generated by wicked issues, performance management and governance methods should be enhanced by causation models capable of investigating the system underlying structure, which is responsible for the observed dynamics.

From a modeling perspective, the causal relationship between system structure and its behavior (Davidsen, 1991; Forrester, 1961) is captured by an integration process that cumulates into a stock the net flow value (i.e. inflows minus outflows) occurring over a time interval. This approach is generally referred to as system dynamics (Forrester, 1969, 1980; Meadows *et al.*, 1972; Morecroft, 2015; Sterman, 2000) to stress that "complex behaviors usually arise from the interactions (feedbacks) among the components of a system, not from the complexity of the components themselves" (Sterman, 2000, p. 12). Such components are the variables (i.e. stocks and flows) used to describe the system structure. The concept of feedback refers to the process that conveys the information resulting from action throughout the system structure and eventually returns to its point of origin, influencing future courses of action (Richardson, 1997). In this logic, feedback gives "the complex system much of its character" (Forrester, 1969, p. 108).

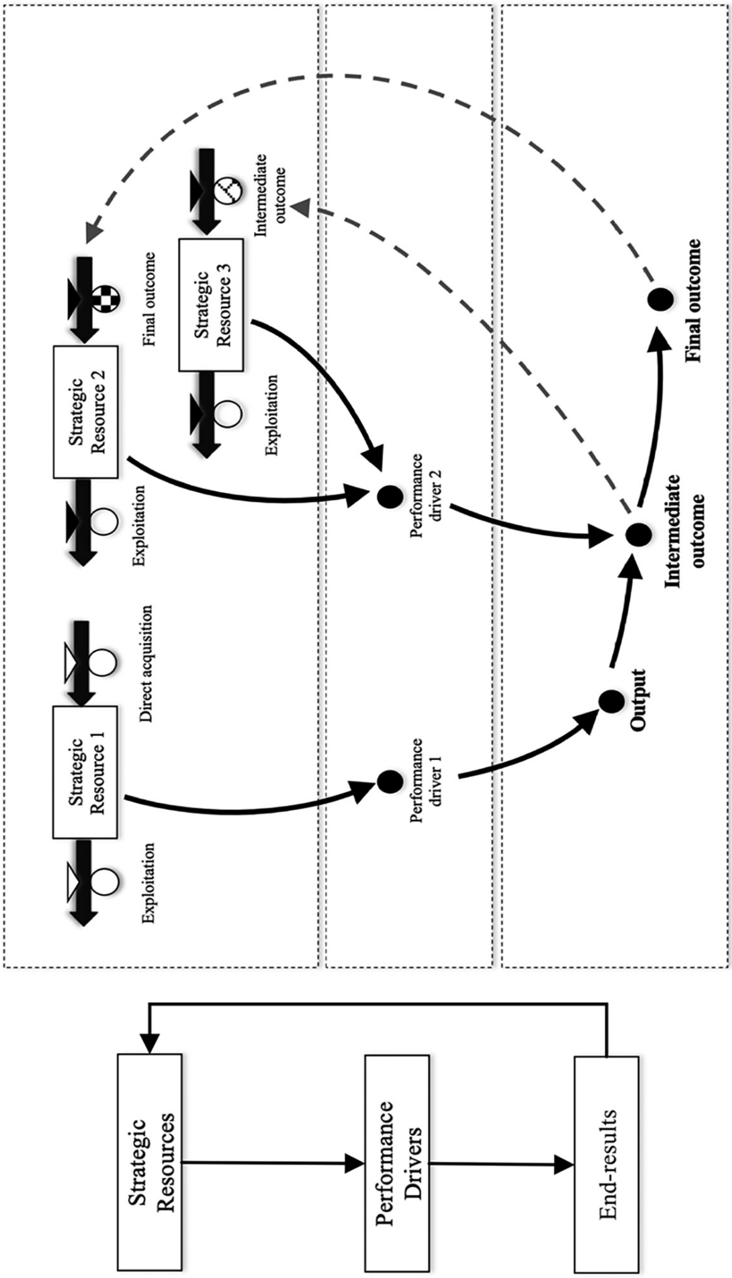
Such a systems approach underpins the DPG methodological framework (Bianchi, 2016, 2022). DPG models map the causal relationships involving the structural components of a socio-ecological system into closed boundary feedback loops, determining system performance behavior over time. Based on such a method, DPG insight models frame the causal structure underlying a real-world problem in three layers – strategic resources, performance drivers and end-results – as Figure 1 shows.

Through this framework, DPG models support decision-makers in:

- outlining the expected end-results (i.e. outputs, intermediate and final outcomes);
- causally relating the corresponding performance drivers; and
- setting different policies that local area policymakers would adopt to build up and deploy the strategic resources required to affect such drivers.

For each policy outcome displayed in the "end-results" section, the DPG model associates a change in the corresponding strategic resource, as a coflow, by using a "chessboard" symbol. In a DPG chart, strategic resources are modeled as stocks measuring the current endowments of tangible and intangible assets changed by inflows and outflows connected to them. Some strategic resources (e.g. service capacity or equipment) can be directly purchased on the market, as represented by the flow "direct acquisition" that changes the "strategic resource 1." Other strategic resources cannot be purchased on the market since they can only be changed through the intermediate and final outcomes generated by governance and management routines (Morecroft *et al.*, 2002).

To this end, DPG provides policymakers with performance drivers, i.e. measures describing specific critical success factors of a policy impacting the end-results (i.e. outputs and outcomes). Performance drivers are gauged as ratios comparing current strategic resource endowments with benchmarks (e.g. stakeholder expectations, law prescriptions or



Source: Bianchi (2016, 73)

Figure 1.
Dynamic Performance Governance framework

physical limits), which are adopted as specific points of reference (i.e. either internal or external) for policy analysis.

Such ratios play a crucial role in DPG analysis since they causally link end-results with strategic resources for generating the expected policy impacts. If properly designed, performance drivers may be sensitive enough to capture subtle variations in performance to provide information that allows policymakers to trigger feedforward control mechanisms. Insight DPG modeling is an established practice in policy analysis as it fosters learning through performance measurement and evaluation (Bianchi, 2021, 2022; Bianchi *et al.*, 2017, 2021; Bivona and Cosenz, 2018; Ghaffarzadegan *et al.*, 2011; Noto, 2020; Vignieri, 2022, 2019a, 2019b, 2020b; Xavier and Bianchi, 2019).

4. Framing the role of active community in collaborative platforms for climate change adaptation policy implementation through Dynamic Performance Governance

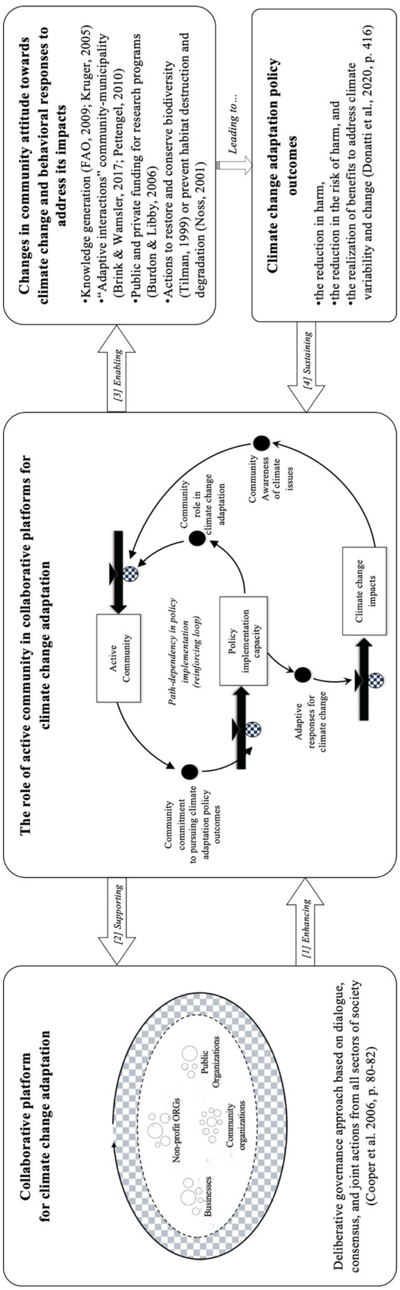
This section will illustrate how DPG frames the role of active community in collaborative platforms for climate change adaptation policy implementation.

As Figure 2 shows, a deliberative approach (Cooper *et al.*, 2006) to collaboration based on dialogue, consensus and joint actions from all sectors of society (e.g. nonprofit, public organizations, businesses and community associations) may enhance the role of active community for effective policy implementation (i.e. Arrow 1 in Figure 2). Communication, engagement and participation in collaborative platforms may lead policymakers, stakeholders and the community to change their perception of climate change impacts on the area where they live, particularly researchers and experts in the field facilitate the dialogic process.

As a result of a continuous learning process, community members may develop a systematic understanding of climate change impacts on the area where they live. Examples of impacts could include livestock reduction, predator increase, crop production reduction, worsening in water quality and quantity for human uses or landslides. The dramatic evidence of such impacts or the risk of their adverse effects raises community awareness of climate issues (i.e. performance drivers), which, in turn, may influence the change in active community. As the illustrative DPG analysis in Figure 2 shows, such performance driver affects the strategic resource active community, measuring the level of community engagement and active participation in collaborative initiatives.

From a DPG perspective, building active community implies an increase in community commitment to pursue climate adaptation policy outcomes, which will improve implementation capacity. Such a new system condition may reinforce active community since individuals and groups may receive mutual gains by collaborating with other societal actors to implement climate change actions.

Both community commitment (Alexander *et al.*, 1998; Gunton and Day, 2003; Margerum, 2001; Yaffee and Wondolleck, 2003) and mutual gains (Ansell and Gash, 2007) play an essential role in successful policy implementation. The first performance driver ensures acceptance of joint decisions so that individuals and groups can be empowered to contribute to pursuing common purposes (Ansell and Gash, 2007, p. 551; Emerson and Nabatchi, 2015), while mutual gains encourage trust among groups and toward government (Cooper *et al.*, 2006, p. 84). As portrayed in Figure 2, the reinforcing loop "active community → community commitment → climate change adaptation capacity → community gains → active community" makes the collaborative policy implementation path-dependent on the role of active community.



Source: Author's own elaboration

Figure 2.
Framing the role of active community for climate change adaptation policy implementation in collaborative platforms through DPG

A pattern of community engagement supports collaborative platforms (i.e. Arrow 2 in Figure 2), leading individuals, groups and organizations to organize in various ways to contribute to effective implementation (Ansell and Gash, 2007; Hoskins and Mascherini, 2009; Marinetto, 2003; Wichowsky and Moynihan, 2008). Since active community nurtures shared strategic resources (e.g. knowledge, leadership, trust and social capital) for policy-making, its contribution calls policymakers "attention to the changing strategies of collaboration as context changes" (Ansell and Gash, 2007, p. 557). Framing such strategies requires understanding how community-driven implementation paths may influence the resource endowments pertaining to the socio-economic context where policy outcomes are expected to impact (i.e. the "chessboard" area underlying the collaborative policy-making setting in Figure 2).

Through such a path, active community may enable collaborative platforms (i.e. Arrow 3 in Figure 2) to foster changes in both people's attitudes toward climate change and their behavioral responses to address its impacts (Sutton and Tobin, 2011). Examples of such actions may include sharing and generating knowledge (FAO, 2009; Kruger, 2005); developing effective small-scale interactions for climate change between community and municipality (Brink and Wamsler, 2018; Pettengell, 2010); getting research program funded by both public and private institution (Burdon and Libby, 2006); implementing actions at individual and community scale to restore and conserve biodiversity (Tilman, 1999) or prevent habitat destruction and degradation (Noss, 2001). Also, expected changes in people's behaviors may be used to activate feedforward performance governance mechanisms (Hofstede, 1978; Otley, 1999) through appropriate short-term measures (i.e. performance drivers).

Reducing climate change harms or diminishing the risk of harm through effective actions generates benefits for the community. As Figure 2 shows, such policy outcomes are essential for sustaining (i.e. Arrow 4 in Figure 2) the role of active community for climate adaptation policy implementation in collaborative settings.

5. The "Life-CalMarSi" case: implementing a biodiversity preservation policy program through active community

5.1 Case study materials and methods

A "single-outcome study" (Gerring, 2006, p. 707) is an appropriate research strategy for explaining a single outcome for a single case because it focuses on enlightening what causal factors lead to the outcome of interest in the investigated context, which in this case is preserving the remaining Calendula maritima Guss. (CM) population from the risk of extinction due to anthropogenic pressure. This makes the adopted methodological stance consistent with the purpose of the research.

In line with the case study method (Yin, 2013), multiple sources of evidence have been used to attain adequate primary and secondary data for understating the causal relationships responsible for the observed dynamics (Forrester, 1992, p. 56). In particular, to have primary information on community engagement processes and dissemination activities, two semistructured interviews with a key actor working for a community development organization were carried out in September 2021 (Naselli, 2021) and January 2022. Secondary information was retrieved by collecting documents from the "Life-CalMarSi" official website, covering a period from November 2016 to April 2022. This enabled a "secondary data analysis" (Bryman, 1989; Saunders *et al.*, 2007, p. 307) of project papers, on-site monitoring reports, newspaper articles (e.g. news and interviews), project meeting minutes, videos and photos of the area. Collected evidence made the "Life-CalMarSi" case "illustrative" (Smith, 2022, p. 135) of innovative active community practices for effective biodiversity policy implementation. Such an illustrative case provides a discussion basis to frame the interplay between the structure of a socio-ecological system and its behavior over time so as to support environmental governance with meaningful performance indicators integrating natural science targets into specific accounting measures.

5.2 Background

The "Life-CalMarSi" [2] case portrays an example of climate change adaptation policies that have been implemented by the Institute of Biosciences and BioResources of the National (Italian) Research Council (IBBR-CNR) and the Department of Environment of the Sicilian Region (DRA) with the active involvement of the local community. With a project duration of five years and six months, from November 2016 to April 2022, the "Life-CalMarSi" program aimed at preserving the "Calendula maritima Guss.," i.e. an endemic perennial plant (also known as the "sea marigold") that plays a vital role in various coastal habitats in Western Sicily, in southern Italy [3]. Despite CM's diffusion and capacity to adapt to different environments, during the past 150 years, CM has experienced a severe regression with a serious risk of extinction [4] due to intensive anthropogenic pressure, hybridization and competition with invasive alien species (Pasta *et al.*, 2017b; Troía and Pasta, 2006).

Such evidence profiles a critical condition for CM, which has motivated the IBBR-CNR and the DRA to outline a strategic plan to preserve the genetic identity of the species, strengthen the most impoverished population and limit the risk factors for the remaining CM population. Since 2016, scientific institutions, environmentalists, public authorities, community-based organizations and NGOs have arranged a coalition around these goals to implement project actions successfully.

5.3 A collaborative platform to implement the "Life-CalMarsi" project and the key role of community development organizations therein

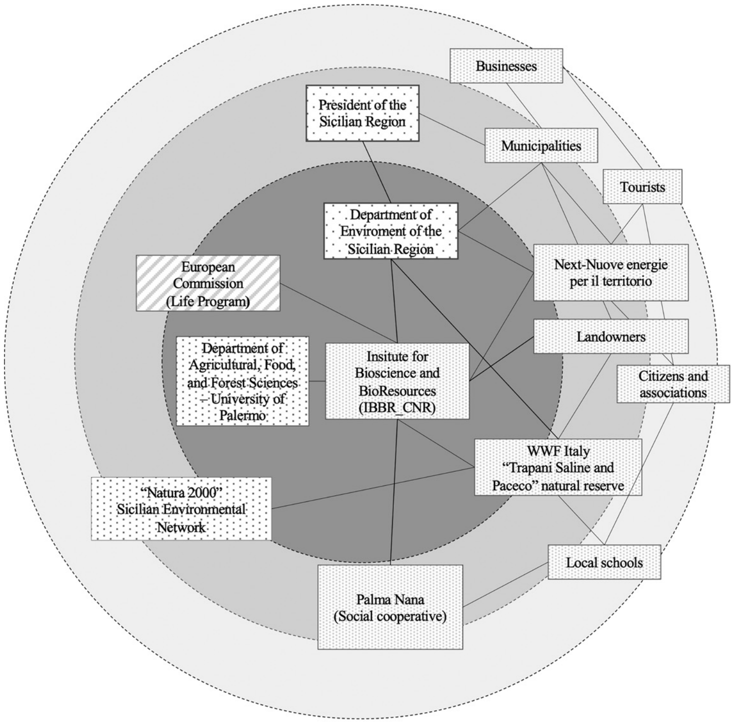
As Figure 3 shows, the "Life-CalMarsi" project has involved different stakeholders at different levels, with that positioned in the inner circles having played a leading role in the implementation of concreted biodiversity preservation actions, with respect to those stakeholders placed in the outer rings, committed to policy implementation and community engagement, respectively. Such stakeholders network successfully implemented concrete conservative actions for CM in the targeted area – as shown in the table in Figure 3 – and triggered institutional and cultural changes through community activism.

For developing the "Life-CalMarsi" project proposal, the IBBR-CNR and the DRA have leveraged their knowledge and expertise in the field of bioscience with a priority focus on the characterization and conservation of CM in the targeted area. The European Commission granted such a proposal through the life program [5].

To achieve biodiversity preservation policy outcomes, the Department of Agricultural, Food and Forestry Sciences of the University of Palermo (Italy) provided specific species translocation criteria to repopulate, plant or reproduce CM species *in vitro*.

The "Life-CalMarsi" project was not limited to CM population preparatory and concrete conservative actions. It also had the ambition of implementing specific actions [6] that may further contribute to preserving the CM population and, eventually, other species from human activities that might harm biodiversity, even beyond the project duration. To this end, a specific "after-life plan" was sketched with a five-year prospect partners commitment beyond the project end date.

The IBBR-CNR played a pivotal role in developing the required knowledge to frame the cause of biodiversity loss and the potential solution to tackle them. Such work led the President of the Sicilian Region to protect CM from the severe risk of extinction by adopting the decree n. 339/2019 (DPRS [7]), which ensures a special protection regime for the target



KEY:

- Supra-national stakeholder
- Regional level stakeholder
- Local stakeholder
- Concrete conservative actions area
- Policy implementation area
- Community activism area

Main qualitative results from project implementation

- ✓ In-vitro reproduction of CM plants to support the reinforcement and establishment of a new CM population along the coast.
- ✓ Official acknowledgment of CM as a species at risk of extinction by the decree n. 339/2019.
- ✓ Eradication of alien species.
- ✓ Positioning of protective barriers, catwalks, and signposts.
- ✓ Improved community awareness of biodiversity concerns through co-design, negotiation, and educational initiatives.
- ✓ Adoption of an MoU that commits both institutional and community stakeholders to adopt further preventive initiatives to protect the CM population.

***In-situ* concrete biodiversity preservation actions results**

		Site	*n. of plants*	*Distribution area (in m^2)*
In-situ conservation	*Reinforcement*	Ronciglio	355	1138
		Isola Colombaia	210	2169
		Isola Lunga	460	2620
		Total	1025	5927
	Translocation	Favignana	484	2220
		Calcara	613	2793
		Fortino	80	588
		Total	1177	5601

Source: Author’s own elaboration from the project website and CNR-IBBR (2022)

Figure 3.
“LifeCalMarsi” stakeholders’ network and associated results from project implementation

species in the entire regional area that explicitly forbids plant collecting, damaging and extirpating all present and future CM populations. Though the DRA and the municipalities located in the area have the authority to enforce the new prescriptions, their implementation was facilitated by the community development organizations involved in the project (i.e. Palma Nana soc. Cop and "Next – Nuove Energie X il Territorio [8]").

With the intent to raise community awareness on environmental issues, especially nature and landscape conservation, such organizations involved specific stakeholders in codesign, mediation and educational initiatives to design further biodiversity conservative actions. For instance, public sector organizations, landowners, business owners and residents were involved in the implementation of DPRS n. 333/2019. This activity led stakeholders to sign a multilateral memorandum of understanding which commits all the involved parties to adopt further preventive initiatives to protect CM population.

Also, community organizations, the WWF-Italy and the "Natura 2000 network" in Sicily have involved school students, citizens and tourists in educational initiatives in the natural reserve of "Saline di Trapani e Paceco" to raise community awareness on the relevance of CM for coastal biodiversity.

Such activisms profile two patterns of policy implementation which led the collaborative platform to adopt new prescriptions (e.g. laws, regulations or contracts) and to design educational initiatives triggering cultural changes in the community (e.g. awareness, attitude, habits or conflict resolution). Both aspects provide a discussion basis to illustrate the role of active community in collaborative platforms for climate change adaptation policy implementation through DPG.

6. Applying Dynamic Performance Governance to enhance outcome-based policy analysis in collaborative platforms

As discussed in the previous section, through the "LifeCalMarsi" project, the environmental governance had the specific ambition to preserve the remaining CM population in the whole area from extinction by:

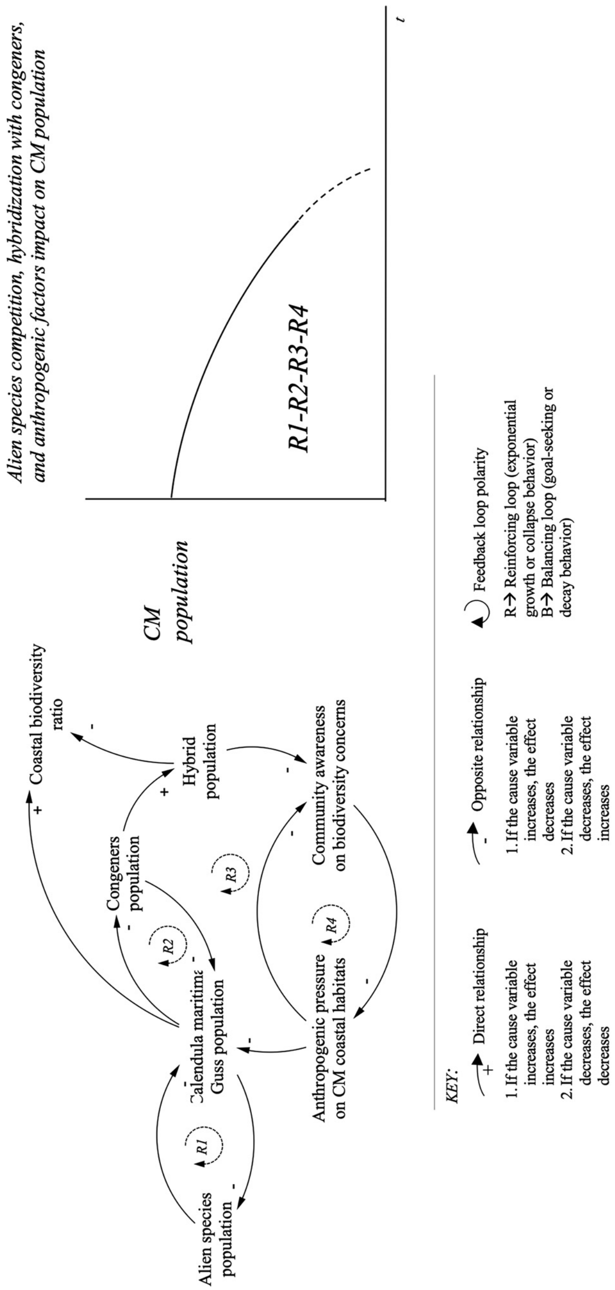
- hereticating alien species;
- limiting hybridization with congeners; and
- alleviating the anthropogenic pressure on coastal areas.

In this section, an "outside-in" perspective of stakeholder collaboration is adopted in a way that "local area performance is the main focus of analysis" (Bianchi, 2022, p. 421) through DPG. As a preliminary step to applying DPG to the investigated context, a feedback perspective of biodiversity preservation policy implementation through collaborative platforms is provided. This analysis set the stage to understand how the structure of a socio-ecological system affects its behavior over time and frame the role of active community in environmental governance.

6.1 A feedback perspective of biodiversity preservation policies implementation through collaborative platforms

Figure 4 portrays the main feedback loops describing the structural causes underlying CM population regression over time, plotted in the time graph on the right-hand side of Figure 4.

Four main feedback loops are responsible for CM population behavior over time. The loops R1 and R2 are associated with biological processes such as alien species competition and hybridization, respectively. As the alien species population increases, the distribution range of the CM population decreases, which, in turn, leaves more space for the former



Source: Author's own elaboration

Figure 4.
Main feedback loops describing the biological processes and anthropogenic factors impacting on Calendula maritima Guss. population in Western Sicily (Italy) and CM population behavior over time

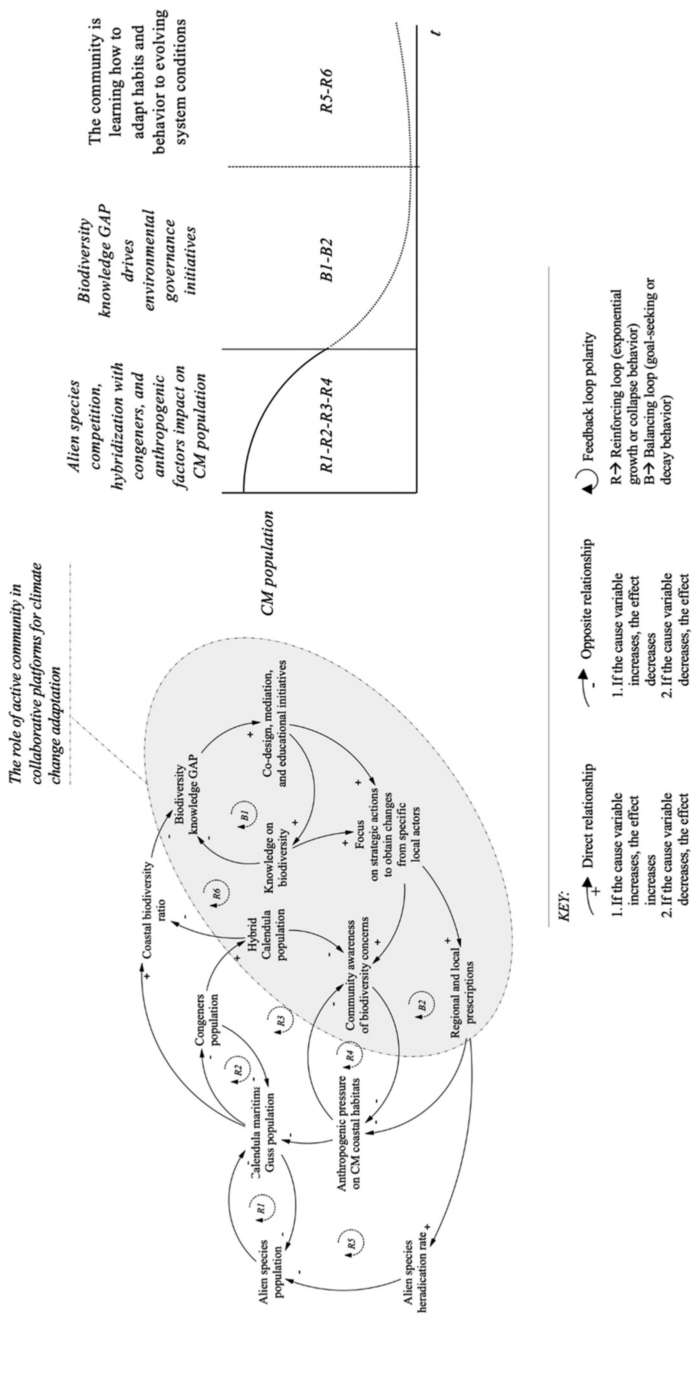
species to grow and prosper (Troia, 2011), leading to a further reduction in CM population. At the same time, a high presence of congeners (e.g. Calendula *suffruticosa* subsp. *fulgida*) represents a major threat to CM population (Raimondo *et al.*, 2012) since it increases the "risk of extinction via introgression" (Plume *et al.*, 2015, p. 68).

A third reinforcing loop (R3) determining a regression in CM population over time is driven by the anthropogenic pressure exerted by tourism, commercial and residential activities on CM coastal habitats. In fact, an increasing presence of a hybrid Calendula population in the area downgrades community awareness of biodiversity concerns since laypeople do not perceive the risk of extinction if similar species persist in the area. This leads residents and tourists to not limit human activities in the area, which, in turn, negatively impacts CM population; thus, enduring anthropogenic activities (e.g. tourism, traffic, road maintenance, harvesting and pollution) on coastal habitats reinforces community beliefs about biodiversity. The dominance of the above-described reinforcing loops (i.e. R1, R2, R3 and R4) leads to an exponential [9] regression CM population over time (i.e. the time graph displayed on the right-hand side of Figure 4).

To counteract such processes, active community can play a pivotal role in collaborative platforms for climate change adaptation, as illustrated by the feedback loop diagram in Figure 5. A decrease in CM population associated with an increase in the hybrid Calendula population (loop R3) reduces the performance driver "coastal biodiversity ratio." However, the appraisal of biodiversity loss is not as easy as one might think, given the difficulties in assessing species hybridization processes (Mallet, 2007). Also, in instances of biodiversity reduction, measuring the outcomes of hybridization is crucial (Genovart, 2009; Worley *et al.*, 2009) "for developing effective conservation strategies" (Plume *et al.*, 2015, p. 68). This creates a gap in biodiversity knowledge, which commits scientific institutions, environmental groups and activists to provide "compelling facts and arguments to support environmental advocacy confronting other interests" (Mermet, 2020, p. 43). As the knowledge gap increases, community activism from different sources (e.g. citizens, scholars, policymakers, NGOs) triggers codesign, mediation and educational initiatives through which to develop the required knowledge to adapt biodiversity conservation strategies to a changing environment (loop B1). Through the knowledge generated by community activism, environmental governance can focus on strategic actions to obtain changes from specific local actors, which, in turn, determine an increase in regional and local prescriptions aimed at relieving the anthropogenic pressure on CM coastal habitats (loop B2). This means securing CM plants from vehicles transit through fences or catwalks, providing tourists access to the beach. Also, strict regulations forbidding any kind of construction and prosecuting illegal waste abandonment contribute to preventing CM habitat degradation. In this way, the biodiversity knowledge generation process (loop B1) sustains the implementation of the prescriptions (loop B2) to counteract the vicious cycle of CM population regression (loops R3 and R4).

The time graph on the right-hand side of Figure 5 shows how the shift in loop dominance (from R1, R2, R3 and R4 to B1 and B2) turns a collapse behavior into a restructuring strategic perspective, which enables the "LifeCalMarsi" governance to preserve the remaining CM population to set the basis to eventually expands its distribution areas.

In fact, regional and local prescriptions allowed scientific institutions to adopt concrete conservative actions, including the eradication of the alien species population and *in situ* conservation by reinforcement and translocation, which, in turn, led CM population to gain distributive space (loop R5) in a relatively short time. As the focus of strategic actions is obtaining changes from specific actors, community activism positively impacted community awareness on biodiversity concerns, leading to a further reduction in anthropogenic pressure. Minimizing human disturbance and habitat degradation (Pasta *et al.*, 2017a) caused CM



Source: Author's own elaboration

Figure 5.
Main feedback loops triggered by the role of active community in collaborative platforms for climate change adaptation

population to grow (loop R6). However, such benefits occurred over a more extended period than those generated by loop R5 as they mainly originate from the effective implementation of the new prescriptions as a result of cultural changes in the community.

6.2 Applying Dynamic Performance Governance to frame the role of active community in collaborative platforms for climate change adaptation

As described by the feedback analysis, the target variable of the program is the CM population, whose value is affected by the flow "change in CM population." The latter can be regarded as a final outcome impacting the corresponding strategic resource "CM population." The DPG chart in Figure 6 portrays the causal structure affecting such variables.

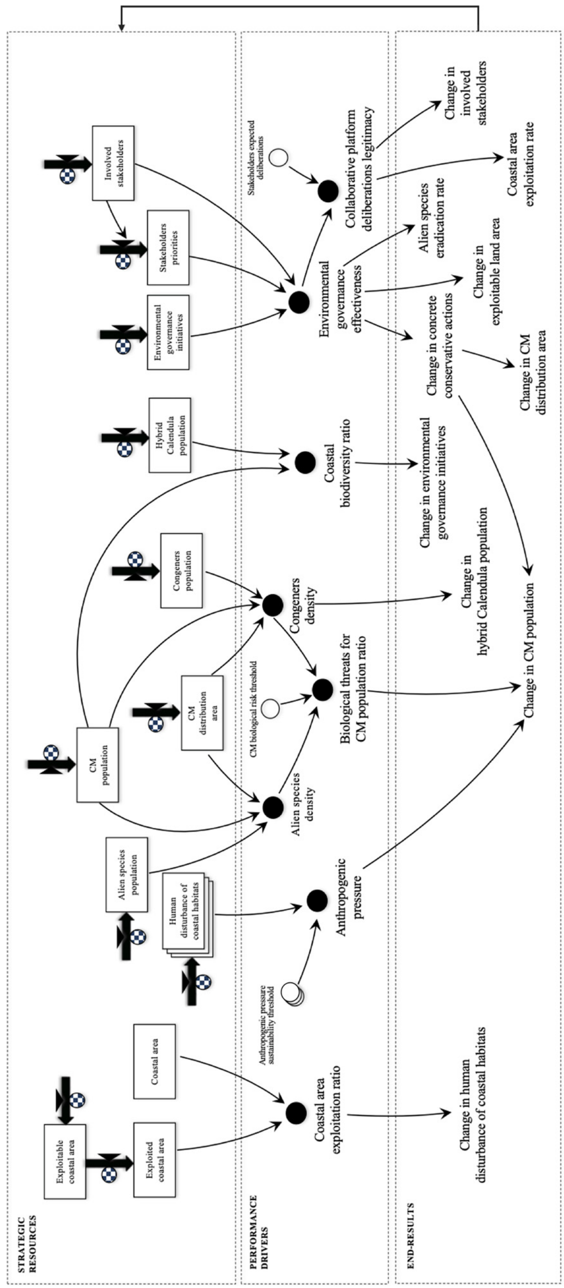
The change in CM population is affected by two performance drivers: "anthropogenic pressure" and "biological threats for CM population ratio."

The level of anthropogenic pressure depends on the ratio between the current level of human disturbance of coastal habitats, represented as an array [10] of strategic resources and the benchmark "anthropogenic pressure sustainability threshold by the coastal habitats." The latter is a reference point indicating the maximum level of human disturbance that allows CM population to survive through biological reproductive processes. In turn, the change in human disturbance of coastal habitats is affected by the coastal area exploitation ratio, relating the current level of exploited coastal area by human activities (e.g. tourism, vehicle transit and pollution) to the strategic resource "coastal area." An increase in the performance driver "anthropogenic pressure" has adverse effects on the change in CM population due to increased human disturbance of coastal habitats.

The "biological threats for CM population ratio" provides a short-term synthetic measurement of the effects of alien species density and congeners density on CM population since it merges the density of both alien species and congeners populations over CM population distribution area. In particular, "alien species density" and "congeners density" are second-level performance drivers capturing evidence of CM extinction risks due to the high competition of alien species or hybridization processes via introgression.

The latter performance driver affects the intermediate outcome "change in hybrid Calendula population," which, in turn, increases the hybrid Calendula population. An increase in such a stock implies a reduction in the performance driver "coastal biodiversity ratio." By providing material information on the effects of introgression on coastal biodiversity, such a measure triggers the change in environmental governance initiatives, i.e. an intermediate outcome impacting the state of environmental governance. In practice, such a resource is activated by social innovators within the local community (e.g. NGOs, scientific institutions, community-based organizations and activists) providing knowledge with the intent of promoting environmental advocacy so as to meet up with other local stakeholders (e.g. landowners, entrepreneurs and policymakers) to codesign initiative or mediate interests.

The performance driver "environmental governance effectiveness" captures the extent to which the interactions among the stakeholders involved in the different initiatives (e.g. deliberative meetings, conferences and discussions in governmental bodies) were constructive, fruitful and impactful. Specifically, it grasps governance implementation capacity by measuring stakeholders aptitude to make decisions by mediating among different values, interests and priorities. In fact, such a driver affects three intermediate outcomes. First, the alien species eradication rate decreases the stock of alien species population (e.g. a total area of 0.76 ha was cleaned). Second, the change in concrete conservative actions directly impacts the change in CM population and CM distribution area. Examples include *in vitro* reproduction of propagation material, *ex situ* conservation of plant, reinforcement of natural population and



Source: Author's own elaboration

Figure 6.
Dynamic Performance Governance chart mapping the role of active community in collaborative platform for climate change adaptation

translocation of new plants. Also, physical barriers to protect CM plants from vehicle traffic, people and animals were installed (e.g. a total of 0.46 km of barriers and 1.21 km of fences). Third, the change in exploitable land area reduces the stock "exploitable land area" whose value indicates the total surface where human activities are allowed.

However, to reduce the coastal exploitation ratio so as to alleviate the anthropogenic pressure on CM population, another relevant intermediate outcome comes into play, i.e. the "coastal area exploitation rate," measuring the annual variation in the coastal area surface that has been used for human activities. Such an intermediate outcome increases the stock "exploited land area," which, in turn, affects the performance driver "coastal area exploitation ratio," bringing adverse effects on CM population. A reduction of the coastal area exploitation rate depends on the collaborative platform deliberation legitimacy, i.e. a performance driver capturing the aptitude of the environmental governance to meet stakeholder expectations concerning deliberation through direct negotiation, codesign, collaboration and education.

Such activities refer to the kind of community activism that led the municipalities and the volunteers of WWF-Italy to install protective barriers and signposts to inform residents and tourists about the presence of the plants in the area, so as to invite them to watch their steps and allow CM to take root and grow without harm. Particularly, such a strategy was effective in protecting the growing CM population in those reinforcement sites located in seaside areas as they attract a high volume of people and vehicles during the summer season.

Finally, an improvement in the performance driver "collaborative platform deliberations' legitimacy" positively impacts the change of involved stakeholders, thus extending the number of partners joining the environmental governance.

As the analysis has illustrated, embracing an "outside-in" view of stakeholders collaboration enhances environmental performance governance as it helps decision-makers identify the performance drivers (i.e. key success factors) impacting relevant community outcomes. Table 1 reports the performance drivers characterizing the DPG analysis for the "LiFeCalMarsi" project. Such measures have been operationalized through a methodological process aimed at identifying "measurable facts or events that could turn a conceptual construct (i.e. the first-level performance driver) into a meaningful system of observations" (Vignieri, 2022, p. 134) through quantitative measures (Hatry, 1999).

Performance drivers play a crucial role in DPG analysis as they causally relate end results with the strategic resource endowments required to generate the expected policy outcomes. By doing so, an outcome-based DPG insight model may help local area policymakers to pursue specific policy goals as it reveals effective leverage points on which to act to influence performance drivers and improve policy outcomes.

By following such causation logic, Table 2 reports descriptions and measures for the final and intermediate outcomes discussed in the DPG analysis.

Gauging the whole causal chain – from decisions to outcomes – is critical to foster learning in collaborative platforms as it supports a shift of mind from a "static" to a "dynamic" perspective of performance governance. From a dynamic perspective, governance decisions impact the flows (i.e. local area performance) that change the corresponding strategic resource endowments, building the potential for future performance.

Adopting DPG as a methodological framework for performance analysis may sustain a culture of collaboration (Bianchi, 2022; Cooper *et al.*, 2006), create "common ground" (Gray, 1989) and allow "facilitative leadership" (Ansell and Gash, 2007, p. 554) to emerge. Such elements can be a vehicle to enhance collaborative platforms for climate change adaptation policy implementation.

Table 1. Operationalizing performance drivers: description, definition and unit of measure

Performance driver	Description	Definition	Unit of measure
Anthropogenic pressure	Evidence of human disturbance of coastal habitats that are beyond the CM sustainability threshold	Human disturbance of coastal habitats/ anthropogenic pressure sustainability threshold	%
Coastal area exploitation ratio	Information on the current level of exploited coastal area by human activities as compared to the total coastal area surface	Exploited coastal area/coastal area	%
Biological threats for CM population ratio	Evidence of risks of extinction due to alien species presence or hybridization via introgression	Alien species density × congeners density/ CM biological risk threshold	*Dimensionless* (on a scale from 0 to1)
Alien species density	Evidence of a high presence of alien species in the CM distribution area	Alien species population/CM distribution area	*No. of plants per square meter*
Congeners density	Evidence of a high presence of congeners species in the CM distribution area	Congeners species population/CM distribution area	*No. of plants per square meter*
Coastal biodiversity ratio	Information on the effects of introgression on coastal biodiversity	CM population/ (CM population + hybrid Calendula population)	%
Environmental governance effectiveness	Information on the productivity of interactions among local stakeholders measured as the number of priority issues addressed per meeting	Stakeholder priorities/involved stakeholders/number of initiatives	*Priority per meeting*
Collaborative platform deliberations' legitimacy	Information on the level of stakeholder convergence and consensus on adopted solutions and implemented activities	Environmental governance effectiveness/ stakeholders expected deliberations	*Dimensionless* (on a scale from 0 to1)

Source: Author's own elaboration

Table 2. Biodiversity preservation policy outcomes: description and measures

Outcome	Description (and level)	Measure
Change in CM population	The number of new CM plants per year (final outcome)	*Plants/year*
Change in human disturbance of coastal habitats	The tons of abandoned waste collected per year	*Tons/year*
	The volume of cars and scooters transiting on coastal area per year	*Vehicles/year*
	The number of construction sites initiated per year	*Constructions/years*
Change in hybrid CM population	The number of new hybrid Calendula plants per year (intermediate outcome)	*Plants/year*
Change in environmental governance initiatives	The number of meetings aimed at designing and implementing concrete initiatives to address environmental issues per quarter (intermediate outcome)	*Meetings/quarter*
Alien species eradication rate	The monthly removal flow of alien species from CM coastal habitats	*Plants/month*
Change in concrete conservative actions	The number of conservative actions implemented per month (intermediate outcome)	*Actions/month*
Change in CM distribution area	The variation in the coastal habitats where CM has been introduced or reinforced per quarter (intermediate outcome)	*Square meters/per Quarter*
Change in exploitable land area	The variation in the coastal area surface where human activity is allowed	*Square meters/per year*
Change in exploited land area	The annual variation in the coastal area surface that has been used for human activities through construction or transit for residential, commercial or tourism purposes or occupied by abandoned waste	*Square meters/per year*

Source: Author’s own elaboration

7. Discussion and conclusion

This paper has illustrated how DPG enhances environmental performance governance by focusing on the role of active community in collaborative platforms for climate change adaptation. Such arrangements for the governance of environmental issues have been conceptualized as a complex adaptive system, implying that the collective knowledge fostering stakeholder's adaptation emerges from network interactions and exchanges. Such relationships go beyond the traditional environmental governance mainly directed by the formal prerogatives of the public authority, perhaps melted with civic engagement of participatory democracy. Instead, in collaborative platforms, stakeholders interactions pave the "route to active citizenship and active community" (Osborne *et al.*, 2012, p. 639) by leveraging specialized knowledge (Ansell and Miura, 2020; Kilelu *et al.*, 2013; Steins and Edwards, 1999).

As discussed in this study, a community is active when individuals and groups participate in deliberative arrangements and take a step in collective actions (Cooper, 2005, p. 53). Such kind of community activism has been found crucial for successful climate change policy implementation since it ensures that adopted solutions shape future patterns of behavior of individuals, groups and organizations. In this way, active community leads to institutional adaptations (i.e. prescriptions) and triggers cultural changes in society (i.e. awareness); both patterns alleviate human disturbance and ecosystem degradation. Examples of active community initiatives include people volunteering at the seashore to inform tourists and residents that their actions may harm coastal biodiversity, teachers with students participating in environmental governance initiatives (e.g. deliberative meetings, conferences and discussions in governmental bodies), other local stakeholders (e.g. associations) developing cultural initiatives to illustrate how adapting to climate change is critical for our common future. From a practical perspective, undertaking such initiatives may make community awareness of climate concerns pervasive throughout society.

As the DPG analysis has illustrated, such aspects characterize the "LifeCalMarsi" case, i.e. an example of climate change adaptation policies implemented with the significant involvement of community stakeholders. By focusing on the role of community activism in environmental governance, this study has found that prior knowledge is an enabling condition of adaptation processes in collaborative platforms leading to the adoption of prescriptions and cultural changes. Such community-driven policy patterns help society deal with super wicked problems if involved stakeholders focus on how local area performance impacts the shared strategic resource endowments. Through an "outside-in" perspective of collaboration, they can address together imbalances in the use of natural resources, share the burden of effective intervention among a plurality of actors and intervene on multiple policy domains (e.g. financial, environmental and social). Such findings provide insights into the role of active community in collaborative platforms for climate change adaptation (i.e. research question n. 1).

The described methodological perspective has been applied to the investigated context to frame the major factors that have determined CM population regression over time (i.e. research question n. 2). It has also identified key leverage points on which the "LiFeCalMarsi" environmental governance may intervene to counteract biodiversity loss. Performance drivers like "anthropogenic pressure," "biological threats for CM population ratio" and "coastal biodiversity ratio" can well be adopted by local stakeholders for monitoring purposes, according to the responsibilities outlined in the project "after-life plan." This suggests on which shared strategic resources environmental governance should focus to reduce harmful factors for biodiversity. Also, such causality can help stakeholders understand how to contribute to interinstitutional performance through individual actions. This is a major benefit of the use of DPG as a methodological framework to enhance performance governance in collaborative settings.

Similarly, measures like "environmental governance effectiveness" and "collaborative platform deliberations' legitimacy" enable policymakers and their stakeholders to assess the quality of decisions and the level of stakeholder's support toward the ambitions of collaborative undertakings. Such short-term measures can be regarded as proxies of governance implementation capacity in terms of ability to make decisions (i.e. what solutions have been adopted?) and relative level of stakeholder's consent on negotiation (i.e. to what extent are adopted solutions in accordance with stakeholder values and interests?). Such measures may also foster facilitative leadership for policy implementation by improving stakeholders commitment to environmental concerns.

From a performance governance perspective, DPG has provided methodological guidance on how to develop interinstitutional routines to enhance collaborative platforms for climate change adaptation. In fact, by operationalizing performance drivers and outcomes, this study offers an inventory of short- and long-term performance indicators integrating natural-science targets into accounting measures providing meaningful information to policymakers operating in other contexts to implement climate change adaptation policies. Though such measures may require some adjustment to fit with the peculiarities of the environmental issue affecting other contexts, the logic behind performance driver's design can provide methodological guidance to define measures capable of delivering material information to support performance governance. These findings provide an answer to the third research question (i.e. what measures does the DPG provide to govern and assess environmental performance outcomes?).

The use of performance information of this kind may foster policy learning and sustain tension for performance improvement at the governance level (Bianchi and Rivenbark, 2014; Kroll, 2015; Moynihan and Kroll, 2016). In fact, through performance drivers, policymakers, community members and groups may understand how they are positively contributing to achieve the specific climate adaptation policy outcomes which have motivated the collaborative endeavor. This feedforward mechanism "corroborates the traditional control feedback" (Bianchi, 2016, p. 35), mainly based on outputs and outcomes measures. Given these implications, the insight DPG model illustrated in Section 6 is an example of how "qualitative system dynamics based on stocks and flows" (Wolstenholme, 1999, p. 423) may enhance performance governance in collaborative settings.

Qualitative system dynamics modeling applied to performance management and governance does not pretend to portray detailed cause-and-effect relationships that can be turned into a simulation model without any further data search. A qualitative modeling approach, alike DPG, is a preliminary phase to move toward a quantitative simulation model that, however, requires more empirical research, particularly in terms of quantitative data gathering for populating the initial value of model variables and parameters. Another potential avenue for advancing such research is applying the conceptual framework illustrated in Section 4 and the set of performance measures developed in Section 6 to other contexts so as to further contribute to understanding the role of active community in collaborative platforms for climate change adaptation policies implementation.

Notes

1. A feedback loop exists when information that results from an action goes through the system structure and eventually returns to its point of origin, influencing future courses of action. The multiplication of the signs characterizing the relationships among the involved variable determines whether the loop is positive or negative. A positive loop portrays a source of exponential growth or collapse over time, while a negative loop generates a goal-seeking behavior toward a point of equilibrium or an inertial decay toward zero.

2. “LIFE-CalMarSi” is the acronymous for “Measures of integrated conservation of ‘Calendula maritima Guss.’ (i.e., a rare, threatened plant of the Sicilian vascular flora).” It is a project cofunded by the EU www.lifecalmarsi.eu (accessed on 07 January 2022).
3. The project targeted the area comprised by the municipality located along the Sicilian West coast, between Marsala and mount Cofano to the south, in the province of Trapani, in southern Italy (Sicily).
4. The International Union for Conservation of Nature and Natural Resources has included CM in the IUCN red list among the 50 species seriously threatened in the Mediterranean area www.iucnredlist.org/species/61618/12524417 (accessed on 07 January 2022).
5. The life program is the EU’s funding instrument for the environment and climate action (https://cinea.ec.europa.eu/life_en).
6. These actions are: E5 “Territorial animation for stakeholders” and E10 “Involvement of public and private stakeholders in participatory planning procedures” (https://lifecalmarsi.eu/en/il-progetto/ accessed on 19 February 2022).
7. Depending on the nature of the act, a DPRS is a decree having a legal or administrative content that is issued by the President of the Sicilian Region.
8. “Next – Nuove Energie X il Territorio” (translated in English as Next – new energy for the local area) is a professional organization with expertise in the field of social innovation, community development and impact assessment.
9. The variable reduction rate increases at each time interval.
10. The DPG model in Figure 6 arrays several factors contributing to increase the strategic resource “human disturbance of coastal habitats.” The use of arrays, graphically represented as multiple variables, one on top of the other, provide a simple yet powerful mechanism for managing the visual complexity without replicating the same model structure multiple time. In many modeling instances, by “encapsulating” parallel model structures through arrays, the essence of a situation can be presented in a simple diagram. Beneath the scenes, of course, arrays retain the richness of the disaggregated structure, which accounts for different dimensions of the same concept, alike in the case at hand where the human disturbance is generated by tons of waste, number of vehicles and the number of active construction sites.

References

Alexander, J.A., Comfort, M.E. and Weiner, B.J. (1998), “Governance in public-private community health partnerships: a survey of the community care NetworkSM demonstration sites”, *Nonprofit Management and Leadership*, Vol. 8 No. 4, pp. 311-332.

Ansell, C. and Gash, A. (2007), “Collaborative governance in theory and practice”, *Journal of Public Administration Research and Theory*, Vol. 18 No. 4, pp. 543-571.

Ansell, C. and Gash, A. (2018), “Collaborative platforms as a governance strategy”, *Journal of Public Administration Research and Theory*, Vol. 28 No. 1, pp. 16-32.

Ansell, C. and Miura, S. (2020), “Can the power of platforms be harnessed for governance?”, *Public Administration*, Vol. 98 No. 1, pp. 261-276.

Axon, S. (2016), “‘The good life’: engaging the public with community-based carbon reduction strategies”, *Environmental Science and Policy*, Vol. 66, pp. 82-92.

Banister, D. (2008), “The sustainable mobility paradigm”, *Transport Policy*, Vol. 15 No. 2, pp. 73-80.

Banister, D. and Berechman, J. (1999), *Transport Investment and Economic Development. Transport Investment and Economic Development*, Routledge, London, doi: 10.4324/9780203220870.

Beinhocker, E.D. (1997), “Strategy at the edge of chaos”, *The McKinsey Quarterly*, Vol. 1, pp. 24-39.

Beinhocker, E.D. (2006), *The Origin of Wealth: Evolution, Complexity, and the Radical Remaking of Economics*, Harvard Business School Press, Boston, MA.

Bell, S. and Morse, S. (2013), *Measuring Sustainability: Learning from Doing*, Taylor and Francis, London, available at: https://books.google.it/books?id=MxGxNyeVnLEC

Bianchi, C. (2016), *Dynamic Performance Management*, Vol. 1, No. 1, Springer International Publishing, Cham, doi: 10.1007/978-3-319-31845-5.

Bianchi, C. (2021), "Fostering sustainable community outcomes through policy networks: a dynamic performance governance approach", in Meek, J.W. (Ed.), *Handbook of Collaborative Public Management*, Edward Elgar Publishing, London, pp. 333-356.

Bianchi, C. (2022), "Enhancing policy design and sustainable community outcomes through collaborative platforms based on a dynamic performance management and governance approach", in Peters, G. and Fontaine, G. (Eds), *Handbook of Policy Design*, Edward Elgar, Cheltenham, UK, pp. 411-433.

Bianchi, C. and Rivenbark, W.C. (2014), "Performance management in local government: the application of system dynamics to promote data use", *International Journal of Public Administration*, Vol. 37 No. 13, pp. 945-954.

Bianchi, C. and Vignieri, V. (2020), "Dealing with 'abnormal' business growth by leveraging local area common goods: an outside-in stakeholder collaboration perspective", *International Journal of Productivity and Performance Management*, Vol. 70 No. 3, pp. 613-634.

Bianchi, C., Bereciartua, P., Vignieri, V. and Cohen, A. (2021), "Enhancing urban brownfield regeneration to pursue sustainable community outcomes through dynamic performance governance", *International Journal of Public Administration*, Vol. 44 No. 2, pp. 100-114.

Bianchi, C., Bovaird, T. and Loeffler, E. (2017), "Applying a dynamic performance management framework to wicked issues: how coproduction helps to transform young people's services in Surrey County Council, UK", *International Journal of Public Administration*, Vol. 40 No. 10, pp. 833-846.

Biesbroek, R., Dupuis, J. and Wellstead, A. (2017), "Explaining through causal mechanisms: resilience and governance of social–ecological systems", *Current Opinion in Environmental Sustainability*, Vol. 28, pp. 64-70.

Biesbroek, R., Peters, G. and Tosun, J. (2018), "Public bureaucracy and climate change adaptation", *Review of Policy Research*, Vol. 35 No. 6, pp. 776-791.

Bivona, E. and Cosenz, F. (2018), "Designing outcome-based performance management systems to assess policies impacting on caesarean section rate: an analysis of the Sicilian maternity pathway", in Borgonovi, E. Anessi-Pessina, E. and Bianchi, C. (Eds), *Outcome-Based Performance Management in the Public Sector*, Springer International Publishing, Cham, pp. 63-77, doi: 10.1007/978-3-319-57018-1_4.

Bollen, J., van der Zwaan, B., Brink, C. and Eerens, H. (2009), "Local air pollution and global climate change: a combined cost-benefit analysis", *Resource and Energy Economics*, Vol. 31 No. 3, pp. 161-181.

Booher, D.E. and Innes, J.E. (2010), "Governance for resilience: CALFED as a complex adaptive network for resource management", *Ecology and Society*, Vol. 15 No. 3.

Bovaird, T. and Löffler, E. (2009), "Understanding public management and governance", in Bovaird, T. and Loeffler, E. (Eds), *Public Management and Governance*, 2nd ed., Routledge, London.

Brink, E. and Wamsler, C. (2018), "Collaborative governance for climate change adaptation: mapping citizen-municipality interactions", *Environmental Policy and Governance*, Vol. 28 No. 2, pp. 82-97.

Bryman, A. (1989), *Research Methods and Organisation Studies*, Unwin Hyman, London.

Burdon, R.D. and Libby, W.J. (2006), *Genetically Modified Forests: From Stone Age to Modern Biotechnology*, The Forest History Society, Durham, NC.

CNR-IBBR (2022), *LIFE15 NAT/IT 000914 – Final Report Covering the Project Activities from 01/11/20161 to 30/04/2022*, CNR, Palermo.

Canadell, J.G., Le Quere, C., Raupach, M.R., Field, C.B., Buitenhuis, E.T., Ciais, P., Conway, T.J., Gillett, N.P., Houghton, R.A. and Marland, G. (2007), "Contributions to accelerating atmospheric CO_2 growth from economic activity, carbon intensity, and efficiency of natural sinks", *Proceedings of the National Academy of Sciences*, Vol. 104 No. 47, pp. 18866-18870.

Capra, F. (1996), *The Web of Life: A New Scientific Understanding of Living Systems*, Anchor Books Doubleday, New York, NY.

Choi, I. and Moynihan, D. (2019), "How to foster collaborative performance management? Key factors in the US federal agencies", *Public Management Review*, Vol. 21 No. 10, pp. 1538-1559.

Cilliers, P. (1998), *Complexity and Postmodernism: Understanding Complex Systems*, Routledge, New York, NY.

Cooper, T.L. (2005), *Neighborhood Government: The Local Foundations of Political Life*, Lexington Books, Lanham, MD.

Cooper, T.L., Bryer, T.A. and Meek, J.W. (2006), "Citizen-centered collaborative public management", *Public Administration Review*, Vol. 66 No. s1, pp. 76-88.

Davidsen, P. (1991), *The Structure-Behavior Graph. The System Dynamics Group*, MIT, Cambridge.

Dicey, A.V. (1979), *Introduction to the Study of the Law of the Constitution*, Palgrave Macmillan, London, doi: 10.1007/978-1-349-17968-8.

Donatti, C.I., Harvey, C.A., Hole, D., Panfil, S.N. and Schurman, H. (2020), "Indicators to measure the climate change adaptation outcomes of ecosystem-based adaptation", *Climatic Change*, Vol. 158 Nos 3/4, pp. 413-433.

Emerson, K. and Murchie, P. (2010), "Collaborative governance and climate change: opportunities for public administration", in Kim, S. O'Leary, R. and Van Slyke, D. (Eds), *The Future of Public Administration, Public Management, and Public Service around the World: The Minnowbrook Perspective*, Lake Placid, New York, NY, pp. 141-161.

Emerson, K. and Nabatchi, T. (2015), *Collaborative Governance Regimes*, Georgetown University Press, Washington, DC.

Forestry economics and policy division (2009), "State of the world's forests 2009", Rome, Italy, available at: www.fao.org/3/i0350e/i0350e.pdf

Feist, A., Plummer, R., Baird, J. and Mitchell, S.J. (2020), "Examining collaborative processes for climate change adaptation in New Brunswick, Canada", *Environmental Management*, Vol. 65 No. 5, pp. 665-677.

Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005), "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources*, Vol. 30 No. 1, pp. 441-473.

Forrester, J.W. (1961), *Industrial Dynamics*, M.I.T. Press, Cambridge, MA, available at: https://books.google.it/books?id=KDPgngEACAAJ

Forrester, J.W. (1969), *Urban Dynamics*, MIT Press, Cambridge, MA, Vol. 114.

Forrester, J.W. (1980), *Industrial Dynamics*, MIT Press, Cambridge, MA, available at: https://books.google.it/books?id=gpA5nwEACAAJ

Forrester, J.W. (1992), "Policies, decisions and information sources for modeling", *European Journal of Operational Research*, Vol. 59 No. 1, pp. 42-63.

Freeman, R. (2008), *Learning in Public Policy*, in Moran, M., Rein, M. and Goodin, R.E. (Eds), Oxford University Press, doi: 10.1093/oxfordhb/9780199548453.003.0017.

Fung, A. (2004), *Empowered Participation: Reinventing Urban Democracy*, Princeton University Press, Princeton, Oxford, doi: 10.2307/j.ctt7rp4r.

Genovart, M. (2009), "Natural hybridization and conservation", *Biodiversity and Conservation*, Vol. 18 No. 6, pp. 1435-1439.

Gerring, J. (2006), "Single-outcome studies", *International Sociology*, Vol. 21 No. 5, pp. 707-734.

Ghaffarzadegan, N., Lyneis, J. and Richardson, G.P. (2011), "How small system dynamics models can help the public policy process", *System Dynamics Review*, Vol. 27 No. 1, pp. 22-44.

Gray, B. (1989), *Collaborating: Finding Common Ground for Multi-Party Problems*, Jossey-Bass, San Francisco, CA.

Gunton, T.I. and Day, J.C. (2003), "The theory and practice of collaborative planning in resource and environmental management (1)", *Environments*, Vol. 31, p. 5, available at: https://link.gale.com/apps/doc/A111855596/AONE?u=anon~6da9d66a&sid=googleScholar&xid=ea386b62

Hall, P.A. (1993), "Policy paradigms, social learning, and the state: the case of economic policymaking in Britain", *Comparative Politics*, Vol. 25 No. 3, p. 275, doi: 10.2307/422246.

Hatry, H.P. (1999), *Performance Measurement: Getting Results*, The Urban Institute, Washington, DC.

Head, B.W. and Alford, J. (2015), "Wicked problems", *Administration and Society*, Vol. 47 No. 6, pp. 711-739.

Hemphill, L., McGreal, S. and Berry, J. (2004), "An indicator-based approach to measuring sustainable urban regeneration performance: part 2, empirical evaluation and case-study analysis", *Urban Studies*, Vol. 41 No. 4, pp. 757-772.

Hofstede, G. (1978), "The poverty of management control philosophy", *The Academy of Management Review*, Vol. 3 No. 3, p. 450.

Hoskins, B.L. and Mascherini, M. (2009), "Measuring active citizenship through the development of a composite indicator", *Social Indicators Research*, Vol. 90 No. 3, pp. 459-488.

Ingram, P. (1985), "Maintaining the rule of law", *The Philosophical Quarterly*, Vol. 35 No. 141, pp. 359-381.

Innes, J.E. and Booher, D.E. (2000), "Indicators for sustainable communities: a strategy building on complexity theory and distributed intelligence", *Planning Theory and Practice*, Vol. 1 No. 2, pp. 173-186.

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I, Intergovernmental Panel on Climate Change (2021), "Climate change 2021: the physical science basis", Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, in Huang, M., Leitzell, K., Lonnoy, E., Matthews, J.B.R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu, R. and Zhou, B. (Eds).

Mussari, R. (2022), *Performance e Valore Pubblico*, Cedam, Padova.

Kauffman, S. (1993), *The Origins of Order: Self-Organization and Selection in Evolution*, Oxford University Press, New York, NY.

Kauffman, S. (1995), *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*, Oxford University Press, New York, NY.

Khatibi, F.S., Dedekorkut-Howes, A., Howes, M. and Torabi, E. (2021), "Can public awareness, knowledge and engagement improve climate change adaptation policies?", *Discover Sustainability*, Vol. 2 No. 1, p. 18.

Kilelu, C.W., Klerkx, L. and Leeuwis, C. (2013), "Unravelling the role of innovation platforms in supporting co-evolution of innovation: contributions and tensions in a smallholder dairy development programme", *Agricultural Systems*, Vol. 118, pp. 65-77.

Kleinmuntz, D.N. (1985), "Cognitive heuristics and feedback in a dynamic decision environment", *Management Science*, Vol. 31 No. 6, pp. 680-702.

Knoepfel, P., Larrue, C., Varone, F. and Hill, M. (2011), *Public Policy Analysis*, The Policy Press, Bristol, UK.

Kroll, A. (2015), "Explaining the use of performance information by public managers: a planned-behavior approach", *The American Review of Public Administration*, Vol. 45 No. 2, pp. 201-215.

Kruger, L.E. (2005), "Community and landscape change in southeast Alaska", *Landscape and Urban Planning*, Vol. 72 Nos 1/3, pp. 235-249.

Lægreid, P. and Rykkja, L.H. (2014), "Governance for complexity – how to organize for the handling of wicked issues?", Policy and Politics conference, Bristol.

Laihonen, H. and Mäntylä, S. (2017), "Principles of performance dialogue in public administration", *International Journal of Public Sector Management*, Vol. 30 No. 5, pp. 414-428.

Lassen, I., Horsbøl, A., Bonnen, K. and Pedersen, A.G.J. (2011), "Climate change discourses and citizen participation: a case study of the discursive construction of citizenship in two public events", *Environmental Communication*, Vol. 5 No. 4, pp. 411-427.

Levin, K., Cashore, B., Bernstein, S. and Auld, G. (2012), "Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change", *Policy Sciences*, Vol. 45 No. 2, pp. 123-152.

Levinthal, D.A. and Warglien, M. (1999), "Landscape design: designing for local action in complex worlds", *Organization Science*, Vol. 10 No. 3, pp. 342-357.

Lynn, L.E. (2009), "Restoring the rule of law to public administration: what frank goodnow got right and Leonard white didn't", *Public Administration Review*, Vol. 69 No. 5, pp. 803-812.

McDaniel, R.R. (2008), "Management strategies for complex adaptive systems sensemaking, learning, and improvisation", *Performance Improvement Quarterly*, Vol. 20 No. 2, pp. 21-41.

Mallet, J. (2007), "Hybrid speciation", *Nature*, Vol. 446 No. 7133, pp. 279-283.

Margerum, R. (2001), "Organizational commitment to integrated and collaborative management: matching strategies to constraints", *Environmental Management*, Vol. 28 No. 4, pp. 421-431.

Marinetto, M. (2003), "Who wants to be an active citizen?", *Sociology*, Vol. 37 No. 1, pp. 103-120.

Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W.W. (1972), *The Limits to Growth; a Report for the Club of Rome's Project on the Predicament of Mankind (I)*, Universe Books, New York, NY.

Meadows, D.L., Behrens, W.W., Meadows, D.H., Naill, R.F., Randers, J. and Zahn, E. (1974), *Dynamics of Growth in a Finite World*, Wright-Allen Press, Cambridge, MA.

Mermet, L. (2020), "Knowledge that is actionable by whom? Underlying models of organized action for conservation", *Environmental Science and Policy*, Vol. 113, pp. 39-46.

Mermet, L., Homewood, K., Dobson, A. and Billé, R. (2013), "Five paradigms of collective action underlying the human dimension of conservation", in McDonald, D. and Willis, K. (Eds), *Key Topics in Conservation Biology*, Wiley, pp. 42-58, doi: 10.1002/9781118520178.ch3.

Mitchell, G. (1996), "Problems and fundamentals of sustainable development indicators", *Sustainable Development*, Vol. 4 No. 1, pp. 1-11.

Mohring, H. (1993), "Maximizing, measuring, and not double counting transportation-improvement benefits: a primer on closed- and open-economy cost-benefit analysis", *Transportation Research Part B: Methodological*, Vol. 27 No. 6, pp. 413-424.

Mohring, H. and Williamson, H.F. (1969), "Scale and "industrial reorganisation" economies of transport improvements", *Journal of Transport Economics and Policy*, Vol. 3, pp. 251-271.

Morecroft, J.D.W. (2015), *Strategic Modelling and Business Dynamics: A Feedback Systems Approach*, Wiley, Cornwall, UK, available at: https://books.google.it/books?id=2xezCQAAQBAJ

Morecroft, J.D.W., Sanchez, R. and Heene, A. (2002), *Systems Perspectives on Resources, Capabilities and Management Processes*, Pergamon, Oxford, UK.

Moxnes, E. (2004), "Misperceptions of basic dynamics: the case of renewable resource management", *System Dynamics Review*, Vol. 20 No. 2, pp. 139-162.

Moxnes, E. and Saysel, A.K. (2009), "Misperceptions of global climate change: information policies", *Climatic Change*, Vol. 93 Nos 1/2, pp. 15-37.

Moynihan, D. (2005), "Goal-based learning and the future of performance management", *Public Administration Review*, Vol. 65 No. 2, pp. 203-216.

Moynihan, D. (2008), "Advocacy and learning: an interactive-dialogue approach to performance information use", in Van Dooren, W. and Van de Walle, S. (Eds), *Performance Information in the Public Sector*, Palgrave Macmillan.

Moynihan, D. and Kroll, A. (2016), "Performance management routines that work? An early assessment of the GPRA modernization act", *Public Administration Review*, Vol. 76 No. 2, pp. 314-323.

Nalbandian, J. (1991), *Professionalism in Local Government: Transformations in the Roles, Responsibilities, and Values of City Managers*, Jossey Bass, San Francisco.

Nalbandian, J. (1999), "Facilitating community, enabling democracy: new roles for local government managers", *Public Administration Review*, Vol. 59 No. 3, p. 187.

Naselli, S. (2021), "Implementing collaborative governance for the pursuit of climate change policy outcomes: a dynamic performance governance analysis of the 'Calendula maritima' biodiversity preservation policies", University of Palermo Italy.

Nash, C. (1993), "Cost-benefit analysis of transport projects", in Williams, A. and Giardina, E. (Eds), *Efficiency in the Public Sector: The Theory and Practice of Cost- Benefit Analysis*, Edward Elgar Publishing, Aldershot, pp. 83-105.

North, D. C. (Ed.). (1990), "The path of institutional change", *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge, pp. 92-104.

Noss, R.F. (2001), "Beyond Kyoto: forest management in a time of rapid climate change", *Conservation Biology*, Vol. 15 No. 3, pp. 578-590.

Noto, G. (2020), *Strategic Planning for Urban Transportation: A Dynamic Performance Management Approach*, Springer International Publishing, Cham, Vol. 3, doi: 10.1007/978-3-030-36883-8.

OECD (2000), *Urban Renaissance*, OECD, Paris, doi: 10.1787/9789264180901-en.

OECD (2002), *Impact of Transport Infrastructure Investment on Regional Development*, OECD, Paris, doi: 10.1787/9789264193529-en.

OECD (2017), *Systems Approaches to Public Sector Challenges*, OECD, Paris, doi: 10.1787/9789264279865-en.

O'Leary, R. and Bingham, L. (2003), *Promise and Performance of Environmental Conflict Resolution*, in O'Leary, R. and Bingham, L. (Eds). RFF Press, doi: 10.4324/9781936331741.

Osborne, S., Radnor, Z. and Nasi, G. (2012), "A new theory for public service management? Toward a (public) service-dominant approach", *The American Review of Public Administration*, Vol. 43 No. 2, pp. 135-158.

Ostrom, E. (1990), *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge.

Otley, D. (1999), "Performance management: a framework for management control systems research", *Management Accounting Research*, Vol. 10 No. 4, pp. 363-382.

Pasta, S., Troía, A. and Garfì, G. (2017b), "Calendula maritima", in Pasta, S. Perez-Graber, A. Fazan, L. and Montmollin, B. (Eds), *The Top 50 Mediterranean Island Plants UPDATE 2017*, IUCN/SSC/ Mediterranean Plant Specialist Group, Neuchâtel, SW, pp. 1-5.

Pasta, S., Garfì, G., Carimi, F. and Marcenò, C. (2017a), "Human disturbance, habitat degradation and niche shift: the case of the endemic Calendula maritima Guss. (W Sicily, Italy)", *Rendiconti Lincei*, Vol. 28 No. 2, pp. 415-424.

Peters, G., Jordan, A. and Tosun, J. (2017), "Over-reaction and under-reaction in climate policy: an institutional analysis", *Journal of Environmental Policy and Planning*, Vol. 19 No. 6, pp. 612-624.

Peters, G., Pierre, J. and King, D.S. (2005), "The politics of path dependency: political conflict in historical institutionalism", *The Journal of Politics*, Vol. 67 No. 4, pp. 1275-1300.

Pettengell, C. (2010), "Climate change Adaptation – Enabling people living in poverty to adapt", *Oxfam International. Nairoby*.

Pierson, P. (2000), "Increasing returns, path dependence, and the study of politics", *The American Political Science Review*, Vol. 94 No. 2, pp. 251-267, available at: www. jstor.org/stable/2586011

Plume, O., Raimondo, F.M. and Troia, A. (2015), "Hybridization and competition between the endangered sea marigold (Calendula maritima Asteraceae) and a more common congener", *Plant Biosystems – An International Journal Dealing with All Aspects of Plant Biology*, Vol. 149 No. 1, pp. 68-77.

Pollitt, C. (2015), "Wickedness will not wait: climate change and public management research", *Public Money and Management*, Vol. 35 No. 3, pp. 181-186.

Prest, A.R. and Turvey, R. (1965), "Cost-benefit analysis: a survey", *The Economic Journal*, Vol. 75 No. 300, pp. 683-735.

Raimondo, F.M., Scialabba, A., Zecca, G., Grassi, F., Casazza, G. and Minuto, L. (2012), "Genetic diversity in the endangered Sicilian endemic Brassica rupestris: proposals for a conservation strategy", *Plant Biosystems – An International Journal Dealing with All Aspects of Plant Biology*, Vol. 146 No. 4, pp. 847-856.

Rajala, T. and Laihonen, H. (2019), "Managerial choices in orchestrating dialogic performance management", *Baltic Journal of Management*, Vol. 14 No. 1, pp. 141-157.

Rajala, T., Laihonen, H. and Vakkuri, J. (2020), "Exploring challenges of boundary-crossing performance dialogues in hybrids", *Journal of Management and Governance*, Vol. 24 No. 3, pp. 799-820.

Richardson, G.P. (1997), "Problems in causal loop diagrams revisited", *System Dynamics Review*, Vol. 13 No. 3, pp. 247-252.

Rittel, H.W.J. and Webber, M.M. (1973), "Dilemmas in a general theory of planning", *Policy Sciences*, Vol. 4 No. 2, pp. 155-169.

Ritter, T., Wilkinson, I.F. and Johnston, W.J. (2004), "Managing in complex business networks", *Industrial Marketing Management*, Vol. 33 No. 3, pp. 175-183.

Rivkin, J.W. and Siggelkow, N. (2002), "Organizational sticking points on NK landscapes", *Complexity*, Vol. 7 No. 5, pp. 31-43.

Rosenbloom, D.H. and O'Leary, R. (1997), *Public Administration and Law*, Marcel Dekker, New York.

Sabatier, P. (1988), "An advocacy coalition framework of policy change and the role of policy-oriented learning therein", *Policy Sciences*, Vol. 21 Nos 2/3, pp. 129-168.

Sabatier, P. and Jenkins-Smith, H. (1993), *Policy Change and Learning: An Advocacy Coalition Approach*, Westview, Boulder, CO.

Sabatier, P. and Jenkins-Smith, H. (1999), "The advocacy coalition framework: an assessment", in Sabatier, P. (Ed.), *Theories of the Policy Process*, Westview Press.

Saunders, M., Lewis, P. and Thornhill, A. (2007), *Research Methods for Business Students*, Financial Times/Prentice Hall, New York.

Schuckman, M. (2001), "Making hard choices: a collaborative governance model for the biodiversity context", *Washington University Law Review*, Vol. 79 No. 1, pp. 343-365.

Sewell, W. (1996), "Three temporalities: toward an event sociology", in McDonald, T.J. (Ed.), *The Historic Turn in the Human Sciences*, University of MI Press, Ann Arbor, pp. 245-280.

Sherry, M., Ghaffar, A. and Bishai, D. (2017), "Community platforms for public health interventions", in Jamison, D.T., Gelband, H., Horton, S., Jha, P., Laxminarayan, R., Mock, C.N. and Nugent, R. (Eds), *Disease Control Priorities (Volume 9): Improving Health and Reducing Poverty*, The World Bank, Washington, DC, pp. 267-283.

Simon, H.A. (1947), *Administrative Behavior: A Study of Decision-Making Process in Administrative Organization (First)*, Macmillian, New York.

Singh, C., Ford, J., Ley, D., Bazaz, A. and Revi, A. (2020), "Assessing the feasibility of adaptation options: methodological advancements and directions for climate adaptation research and practice", *Climatic Change*, Vol. 162 No. 2, pp. 255-277.

Smith, M. (2022), *Research Methods in Accounting*, SAGE Publications, London.

Steins, N.A. and Edwards, V.M. (1999), "Platforms for collective action in multiple-use common-pool resources", *Agriculture and Human Values*, Vol. 16 No. 3, pp. 241-255, doi: 10.1023/A:1007591401621.

Sterman, J. (1989), "Modeling managerial behavior: misperceptions of feedback in a dynamic decision making experiment", *Management Science*, Vol. 35 No. 3, pp. 321-339.

Sterman, J. (1994), "Learning in and about complex systems", *System Dynamics Review*, Vol. 10 Nos 2/3, pp. 291-330.

Sterman, J. (2000), *Business Dynamics: Systems Thinking and Modeling for a Complex World*, Irwin/McGraw-Hill, Boston, MA, available at: https://books.google.it/books?id=CCKCQgAACAAJ

Sterman, J. and Sweeney, L.B. (2007), "Understanding public complacency about climate change: adults' mental models of climate change violate conservation of matter", *Climatic Change*, Vol. 80 Nos 3/4, pp. 213-238.

Stern, N., Patel, I. and Ward, B. (2021), "Covid-19, climate change, and the environment: a sustainable, inclusive, and resilient global recovery", *BMJ*, p. n2405.

Sutton, S.G. and Tobin, R.C. (2011), "Constraints on community engagement with great barrier reef climate change reduction and mitigation", *Global Environmental Change*, Vol. 21 No. 3, pp. 894-905.

Thissen, W. and Walker, W.E. (2013), *Public Policy Analysis*, in Thissen, W. and Walker, W.E. (Eds), Springer, Boston, MA, Vol. 179, doi: 10.1007/978-1-4614-4602-6.

Thornton, P.H., Ocasio, W. and Lounsbury, M. (2012), *The Institutional Logics Perspective*, Oxford University Press, doi: 10.1093/acprof:oso/9780199601936.001.0001.

Tilman, D. (1999), "The ecological consequences of changes in biodiversity: a search for general principle", *Ecology*, Vol. 80 No. 5, pp. 1455-1474, doi: 10.1890/0012-9658(1999)080.

Troia, A. (2011), "Strategie di gestione delle popolazioni di Calendula maritima Guss. (Asteraceae)", *Il Naturalista Siciliano*, Vol. 35 No. 1, pp. 51-63.

Troía, A. and Pasta, S. (2006), *Calendula Maritima*, The IUCN Red List of Threatened Species.

Vedung, E. (1997), *Public Policy and Program Evaluation*, Routledge, Boca Raton, FL, doi: 10.4324/9781315127767.

Vignieri, V. (2019a), "Framing the sources of image of a local area through outcome-based dynamic performance management", *Public Organization Review*, Vol. 19 No. 2, pp. 249-271.

Vignieri, V. (2019b), "Destination governance at stake: fostering policy coordination among decision-makers of a small town", *Tourism Planning and Development*, Vol. 16 No. 5, pp. 556-574.

Vignieri, V. (2020a), "Co-produzione di valore nei servizi museali e performance multidimensionali: un approccio dinamico a supporto del management culturale", *Sinergie Italian Journal of Management*, Vol. 38 No. 3, pp. 215-237.

Vignieri, V. (2020b), "Leveraging collaborative governance: how co-production contributes to outcomes and public value in a small town", in Bianchi, C., Luna-Reyes, L. F. and Rich, E. (Eds), *Enabling Collaborative Governance through Systems Modeling Methods*, Springe, Cham, Zurich, pp. 47-71, doi: 10.1007/978-3-030-42970-6_3.

Vignieri, V. (2022), *Enhancing Performance Regimes to Enable Outcome-Based Policy Analysis in Cross-Boundary Settings*, Springer International Publishing, Cham, Vol. 6, doi: 10.1007/978-3-031-07074-7.

Vignieri, V., Bianchi, C., Pietrosi, A. and Provenzale, G. (2019), "Il contributo delle reti sanitarie "spontanee" al miglioramento degli outcome: opportunità e sfide nella prospettiva della progettazione dei sistemi di programmazione e controllo", *MECOSAN*, Vol. 109 No. 109, pp. 83-104.

Vignola, R., Klinsky, S., Tam, J. and McDaniels, T. (2013), "Public perception, knowledge and policy support for mitigation and adaption to climate change in Costa Rica: comparisons with North American and European studies", *Mitigation and Adaptation Strategies for Global Change*, Vol. 18 No. 3, pp. 303-323.

Waldrop, M. (1992), *Complexity: The Emerging Science at the Edge of Order and Chaos*, Simon and Schuster, New York.

Walker, W.E. (2000), "Policy analysis: a systematic approach to supporting policymaking in the public sector", *Journal of Multi-Criteria Decision Analysis*, Vol. 9 Nos 1/3, p. 11.

Weick, K.E. (1995), *Sensemaking in Organizations*, Sage, Thousand Oaks, CA.

Weisbrod, G. and Weisbrod, B. (1997), *Assessing the Economic Impact of Transportation Projects: How to Choose the Appropriate Technique for Your Project*, Transportation Research Board, Washington.

Wellstead, A.M., Howlett, M. and Rayner, J. (2013), "The neglect of governance in forest sector vulnerability assessments: structural-functionalism and 'black box' problems in climate change adaptation planning", *Ecology and Society*, Vol. 18 No. 3, p. art23.

Welsh, I. (2010), *Climate Change, Complexity and Collaboration between the Sciences*, Routledge, London, pp. 34-45.

Wichowsky, A. and Moynihan, D. (2008), "Measuring how administration shapes citizenship: a policy feedback perspective on performance management", *Public Administration Review*, Vol. 68 No. 5, pp. 908-920.

Wolstenholme, E. (1999), "Qualitative vs quantitative modelling: the evolving balance", *Journal of the Operational Research Society*, Vol. 50 No. 4, pp. 422-428.

Worley, A.C., Sawich, L., Ghazvini, H. and Ford, B.A. (2009), "Hybridization and introgression between a rare and a common lady's slipper orchid, Cypripedium candidum and C. parviflorum (Orchidaceae)", *Botany*, Vol. 87 No. 11, pp. 1054-1065.

Wunder, S. (2005), "Payments for environmental services: some nuts and bolts", *Occasional Papers*, CIFOR, Bogor, Indonesia.

Xavier, J.A. and Bianchi, C. (2019), "An outcome-based dynamic performance management approach to collaborative governance in crime control: insights from Malaysia", *Journal of Management and Governance*, p. 0123456789, doi: 10.1007/s10997-019-09486-w.

Yaffee, S.L. and Wondolleck, J.M. (2003), "Collaborative ecosystem planning processes in the United States: evolution and challenges", *Environments*, Vol. 31, p. 59, available at: https://link.gale.com/apps/doc/A111855599/AONE?u=anon~b0d5ca8c&sid=googleScholar&xid=8d1ef39a

Yin, R.K. (2013), *Case Study Research: Design and Methods*, SAGE Publications, Thousand Oaks, CA, available at: https://books.google.it/books?id=OgyqBAAAQBAJ

About the author

Vincenzo Vignieri is an Assistant Professor at the Department of Law and Business Studies, University of Siena (Italy), where he teaches Business Administration at the School of Management and Economics. He holds a PhD in Public Management and Governance from the University of Palermo (Italy). He also has been visiting scholar at the University of Baltimore (USA) and the School of Government at the University of North Carolina at Chapel Hill (USA). His main research areas cover Business and Public Management with a priority focus on performance management and policy analysis in cross-boundary settings, public service coproduction, urban and rural regeneration and open innovation. Vincenzo Vignieri can be contacted at: vincenzo.vignieri@unisi.it