Annals of Tourism Research 100 (2023) 103572

Contents lists available at ScienceDirect

Annals of Tourism Research

journal homepage: https://www.journals.elsevier.com/annals-of-tourism-research

Research article

Evaluating policy complexity with Causal Loop Diagrams

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ARTICLE INFO

Article history:
Received 19 April 2022
Received in revised form 11 March 2023
Accepted 15 April 2023
Available online xxxx

Handling Editor: Matthias Fuchs

Keywords:
Policy instruments
Complexity science
Policymaking
Causal Loop Diagram
Sustainable tourism

ABSTRACT

Methods to capture the complexity of using policy instruments would allow us to better evaluate the reasons for their effectiveness. Drawing from complexity science, we produce a Causal Loop Diagram to analyse the implementation of two informational policy instruments in a tourism destination: the Global Sustainable Tourism Council criteria and the European Tourism Indicator Scheme. To interpret the emerging system structure, we use complexity theory concepts of emergence; interdependence and interconnectivity; co-evolution; self-organisation; feedback; historicity and path dependence. This qualitative methodology sheds light on the interplay of factors that facilitate and impede the continuous use of these policy instruments. It shows how adopting a complexity science approach to evaluation studies can be invaluable to making tourism policy interventions more impactful.
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Introduction

Attention on evidence-based policy has led to key performance indicators (KPIs) being adopted as effective informational policy instruments for sustainability improvement (Howlett, 2017). Nevertheless, the numerous studies conducted to evaluate the impact of sustainability KPIs have highlighted their minimal influence on policy and sustainability change (Bell & Morse, 2011; Font et al., 2021). Up until now, these studies have been conducted using linear methods of analysis that neglect to consider the complexity of governance and policymaking in this field (Ansell & Geyer, 2017; Boulton et al., 2015). The complexity stems from acknowledging that the use of these KPIs does not follow an undisturbed, linear trajectory that leads to policy change; instead, its trajectory is messy, resulting from multiple interactions with the various components that affect the policy system (Parkhurst, 2017). Therefore, a better understanding that accounts for such complexities is needed. The use of complexity science is increasingly being encouraged by tourism scholars as a framework to address the non-linearity that affects tourism governance and policymaking, as it goes beyond the reductionist and linear methods of analysis that have so often been used in tourism policy research (Farsari, 2021; McDonald, 2009; I. Pappas, 2019).

Despite complexity science being used increasingly to investigate tourism policy problems (Baggio et al., 2010; Farsari et al., 2011; Suno Wu et al., 2021), there are few tools available that systematically untangle multifaceted systems. Complexity science discards methods that focus on mechanical and singular causality to favour those that consider the interrelationships and the cir-

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https://doi.org/10.1016/j.annals.2023.103572
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cular patterns of interactions existing in complex systems (Boulton et al., 2015; Mitleton-Kelly et al., 2018; Stacey et al., 2000). In doing so, complexity science methods shift the analysis from understanding the individual parts of a system to explaining the system as a whole (Mitchell, 2009). These methods are relatively new to social science, with the majority of studies conducted using quantitative techniques (Gear et al., 2018). Hence, the aim of this study is to strengthen the knowledge around qualitative, complexity-informed research methods in tourism policy evaluation, using sustainable tourism indicator schemes as examples.

We present a complexity-informed methodology, that adopts a complexity theory philosophy and a soft modelling approach to the evaluation of tourism policy instruments. We base our analysis on the case study of Visit South Sardinia, a private-public partnership that implemented the Global Sustainable Tourism Council criteria and the European Tourism Indicator System as policy instruments between 2013 and 2016, receiving an award as best European sustainable tourism destination. We build a Causal Loop Diagram, a methodological tool that allows us to model system complexities in relation to the use of tourism policy instruments. We then interpret the generated system's model from the perspective of complexity theory, by focusing on issues of emergence; interdependence and interconnectivity; co-evolution; self-organisation; feedback; and historicity and path dependence (Eppel, 2012; Geyer & Cairney, 2015; Mitleton-Kelly, 2003; Room, 2011). We demonstrate the usability of this methodology and its benefits in evaluating tourism policy instruments.

Literature review

Informational instruments in tourism policy change

Tourism governance and policymaking have often been considered complex and messy (Farsari et al., 2011; Stevenson et al., 2009), while the instruments developed to guide policymakers in their decisions have been criticised for being reductionist and linear (Ansell & Geyer, 2017; Sanderson, 2009). This is particularly true with informational instruments, a typology of policy instruments created to fill 'information gaps' with the expectation that the production of information will lead to improved understanding and knowledge in the policy actors and ultimately, changes in behaviour or in ways of governing (Blackstock et al., 2021). In tourism, informational instruments are often voluntary and may include the use of sustainability KPIs and certification schemes (Ayuso, 2007). They are considered reductionist because they are based on the concepts of evidence-based-policy, defined as a "rigorous approach that gathers, critically appraises and uses high quality research evidence to inform policymaking and professional practice" (Davies, 2004, p. 3). As such, these tools assume policymaking to be a linear process whereby policymakers fully base their decisions on the evidence generated from these tools.

Various informational policy instruments have been developed for tourism destination policy improvement (Niavis et al., 2019). While scholars have found these instruments to be effective at highlighting previously unknown sustainability issues, they have found little evidence of their ability to influence policy change (Font et al., 2021; Gasparini & Mariotti, 2021), with some raising the question of whether sustainability indicator schemes are actually useful or potentially harmful (Lyytimäki et al., 2020). These evaluation studies have been conducted following the evidence-based-policy, step-by-step assumptions, providing little knowledge on the why and how these tools are actually being used in practice (Howlett, 2017; Jordan et al., 2015). Therefore, a further examination that digs deeper into the complexity of the policy system is needed. We argue that conducting a complexity science analysis can help us achieve that. This is because policy does not result from an intentional, isolated act of government; instead, it is the outcome of collective actions in which various actors collaborate and/or compete to pursue their own self-interests (Dredge & Jamal, 2015; Farsari et al., 2011; Morçöl, 2012). As such, the evidence from these instruments becomes just one of the many elements that contribute to bringing about policy change (Parkhurst, 2017).

The complexity science approach to policy instrument evaluation

Complexity science is a paradigm that challenges the reductionist views considering policymaking to be a rational, orderly, and linear process (Stevenson et al., 2009). In line with this philosophy, Morçöl (2012, p. 9) defines public policy as "an emergent, self-organisational, and dynamic complex system. The relations among the actors of this complex system are nonlinear and its relations with its elements and with other systems are coevolutionary". Thus, the focus shifts towards understanding the system as a whole and the interrelationships between the system's elements, as opposed to the rationalist approach, which explains the policy process as the sum of its individual components (Macintosh & Wilkinson, 2016). This allows us to understand the interrelations created from introducing policy instruments within a policy system. As such, a complexity science approach can provide a much deeper understanding of the effectiveness of policy instruments, in turn, allowing destination decision-makers to design and implement such instruments more effectively. Based on the definition of Morçöl (2012, p. 9), we present the key features of complexity theory – emergence, interdependence and interconnectivity, co-evolution, self-organisation, feedback, historicity and path-dependence (Byrne & Callaghan, 2013; Cairney, 2012; Geyer & Cairney, 2015) – which we argue can help us to study the use of informational policy instruments at tourism destinations.

First, *emergence* refers to behaviours that evolve from the interaction of various system components and, thus, cannot be simply explained by the sum of a system's parts (Mitleton-Kelly, 2003). In policy terms, we ought to study behaviour that develops at a local level, from the bottom up, rather than from a central direction (Cairney, 2012) because such behaviours cannot be controlled by any agent - they can only be influenced (Haynes, 2015; Stacey et al., 2000; Tosey, 2002). The concept of emergence is often applied to the study of governance and specifically to behaviours resulting from local interactions and to how governments struggle to maintain order in environments where they have limited control (Cairney & Geyer, 2017; Farsari, 2021). To explain how certain policy interventions come about, researchers can focus on the concept of emergence to seek evidence of emergent behaviours resulting from the interaction of different components in a tourist destination system.

Second, *interdependence and interconnectivity* refer to the relationships between elements of a system (Mitleton-Kelly, 2003). In complex systems, the more the elements in a system are interconnected and interdependent, the stronger the influence of each element, on the whole system, is likely to be. This means that the action taken by an entity (be it an individual, a group of people or an organisation) may affect other entities within the same system and other related systems. Consequently, policy changes undertaken to improve one aspect of a system often cause unexpected (and sometimes detrimental) snowball effects in other system dimensions (Daase et al., 2010; Mitleton-Kelly, 2015). Methodologically, it is important to identify positive and negative interdependencies between elements of the policymaking system, which can facilitate or hinder, respectively, the use of policy instruments.

Third, *co-evolution* refers to the reciprocal influence between interconnected elements in a system and related systems (Mitleton-Kelly, 2015). Interdependence and interconnectivity tell us that the actions of the different system elements are not isolated since they exercise either a positive or negative influence on each other or, even, on other related systems. The notion of co-evolution adds to this by saying that the behaviour of a certain element that has resulted from the influencing action of another interconnected element can, in turn, influence the first element's behaviour. Co-evolution can be observed when policies bring about completely different and unforeseen outcomes than the ones expected (Macintosh & Wilkinson, 2016). Analysing policy data for co-evolution patterns helps identify the various mechanisms facilitating or hindering the use of policy instruments.

Fourth, *self-organisation* refers to the characteristic of systems autonomously finding new order by modifying their internal structure without external interventions (Macintosh & Wilkinson, 2016; Mitleton-Kelly, 2015). Self-organisation is often used to show how organisations change spontaneously to respond to the environment and the interacting system (Burnes, 2005). It can help academics to clarify how policymakers engage with informational policy instruments, showing how such engagement does not occur because of their willingness to embrace an evidence-based policy culture but instead because of endogenous behaviours resulting from the various interactions between the elements of a system. Self-organisation can also help explain organic changes from institutionalising these informational policy instruments (Cairney, 2012).

Fifth, *feedback* explains how the non-linear dynamics of complex systems ignore some forms of energy while amplifying others. Depending on the type of feedback, dynamics can maintain order and stability (negative feedback), or drive change (positive feedback) (Mitleton-Kelly, 2003). In the policy literature, this is linked to the punctuated equilibrium theory (Baumgartner & Jones, 2009; Jones & Baumgartner, 2005), which explains how policymakers are only able to focus on a few signals and prioritise these as top of their agenda to create policy changes (positive feedback), while ignoring all the others (negative feedback). Overall, negative feedback maintains policy equilibrium, while positive feedback leads to policy change. Policy change occurs when positive feedback is of a certain magnitude, i.e., when disproportionate pressure to focus on a certain issue has been exercised on policymakers. Methodologically, identifying feedback can explain how policy-makers neglect or use informational policy tools to maintain equilibriums or to create policy change.

Lastly, *historicity* indicates that past actions and events influence the future behaviour of a system, creating path dependency (Cairney, 2012; Cairney & Geyer, 2017; Eppel, 2012; Mitleton-Kelly, 2003, 2015). Historicity explains how the dynamics arising after a certain policy has been established, produce a *path dependency*, such that making radical changes in the future is extremely difficult (Cairney & Geyer, 2017; Room, 2011). Routines can be challenged by “critical junctures” (Cairney, 2012, p. 350) that bring about radical change and set the beginning of a new regular pattern of behaviour or path dependence. Historicity links to both the concept of negative and positive feedback, and the creation of new order. In this regard, complexity theory can help to identify the dynamics that, first, push for path dependency and, second, hinder radical changes from happening. This can be used to study why the evidence produced by informational policy instruments rarely brings about policy changes (Font et al., 2021).

While complexity-informed approaches are increasingly being used in generic policy studies (Cairney & Geyer, 2017; Geyer & Cairney, 2015; Mitleton-Kelly et al., 2018), their implementation in tourism policy remains limited, with tourism research being predominantly framed from a non-dynamic, linear approach (N. Pappas, 2019). Complexity science is still considered a novel approach to investigating phenomena in the social sciences and, for this reason, has been deemed by some as too abstract and difficult to apply to real cases (Burnes, 2005; Cairney, 2012). This may be explained by research showing how human cognitive ability is more inclined to produce linear thinking mental models rather than models with complex causal patterns (Levy et al., 2018). Hence, we must direct attention to the methods that can help us visualise complexity; in that they need to capture the numerous factors, links and connections affecting systems, and the self-organising and emergent behaviour they create (Mitleton-Kelly et al., 2018).

Complexity-informed research often uses systems modelling techniques as a prime means to capture and visualise complexity (Scrieciu et al., 2022). The few tourism scholars who have done so, have predominantly used ‘hard’ or quantitative models, such as network analysis (Pforr, 2006; Valeri & Baggio, 2021) and agent-based modelling (Li et al., 2021); with a minority adopting ‘soft’ or qualitative modelling techniques, such as cognitive mapping (Farsari et al., 2011), participatory systems mapping (Suno Wu et al., 2021) and causal loop diagramming (Woodside, 2009). Soft modelling techniques are argued to be more practical, and more understandable by policy stakeholders than ‘hard’ models (Cavana & Maani, 2000). While it has been widely accepted that soft models are not designed to represent perfectly the complexity of the real world (Byrne & Callaghan, 2013), they have the ability to breakdown complex systems into comprehensible and structured sub-systems, providing a means to discover hidden behavioural patterns that would not otherwise be visible in traditional methodologies (Johnson, 2015). In this study, we seek to strengthen the application of complexity science approaches to tourism policy research by, first, modelling a system's behaviour with a Causal Loop Diagram and, secondly, by interpreting the generated model from the perspective of emergence; interdependence and interconnectivity; co-evolution; self-organisation; feedback; and historicity and path dependence (Eppel, 2012; Geyer & Cairney, 2015; Mitleton-Kelly, 2003; Room, 2011).

Methodology

In this paper, we introduce a complexity-informed methodology to capture the multidimensionality and complexity surrounding the use of informational policy instruments in a tourism destination. We use a Causal Loop Diagram, a soft modelling technique used in complexity-informed evaluations to model and enhance learning of complex systems (Barbrook-Johnson et al., 2021; Fredericks et al.,

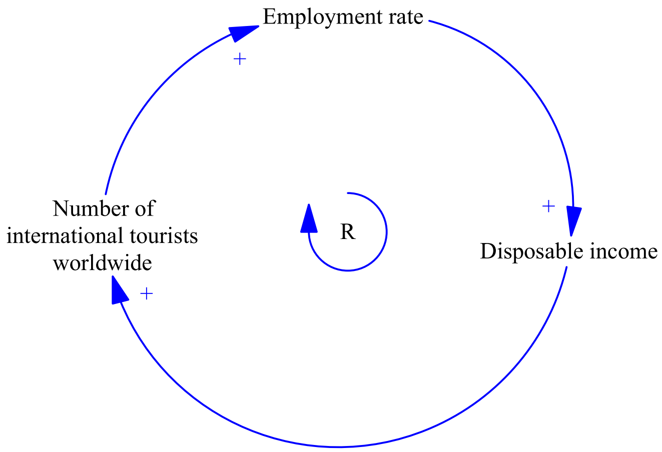

Fig. 1. Example of a reinforcing (R) feedback loop.

2008). Causal Loop Diagrams highlight the core elements of a system, and the system's behaviour emerging from their interactions. They visualise factors, their relationships and how they influence each other in a system. The relationships can be positive – when A increases, B also increases, or when A decreases, B also decreases – and illustrated with a blue arrow and a '+' symbol; or negative — when A increases, B decreases, or when A decreases, B increases– and illustrated with a red arrow and a '-' symbol. Factors and relationships form a series of close sequences of cause-and-effect relationships, referred to as 'feedback loops' (Kirkwood, 1998).

Feedback loops can be reinforcing and balancing. Reinforcing feedback loops occur when all factors respond to each other in the same direction. As illustrated in Fig. 1, when the number of international tourists worldwide increases (or decreases), the employment rate increases (or decreases), which leads to an increase (or decrease) of disposable income. This in turns leads to a further increase (or decrease) in the number of international tourists worldwide. Instead, balancing feedback loops have the opposite effects. Following Fig. 2, when a destination's attractiveness increases (or decreases), tourist arrivals increase (or decrease). This leads to an increase (or decrease) in destination crowdedness, which leads to a decrease (or increase) in the destination attractiveness. Sometimes the impact of one factor over another is not immediate and takes a while to be realised, generating delays in the system behaviour and making predictions difficult (Williams & Hummelbrunner, 2010). Such a delay may be seen, for example, between the destination crowdedness and attractiveness factors, and it is shown with a '//' symbol in the arrow. Reinforcing and balancing feedback loops constitute the building blocks of a Causal Loop Diagram. System behaviour emerges through the interaction of these feedback loops.

To date, Causal Loop Diagrams have been built either by using a participatory process (Eker et al., 2018) or by gathering textual data from traditional qualitative methods such as interviews and/or documents (Eker & Zimmermann, 2016; Kim & Andersen, 2012; Yearworth & White, 2013). While the former allows for a collective analysis process, helping stakeholders to find a shared understanding of the system complexity, the latter allows the research to maintain high degrees of validity by drawing from multiple sources, especially in situations in which participatory approaches are not feasible (Kim & Andersen, 2012). In this paper, we demonstrate the application of the latter approach in understanding the complexities surrounding the use of tourism informational policy instruments.

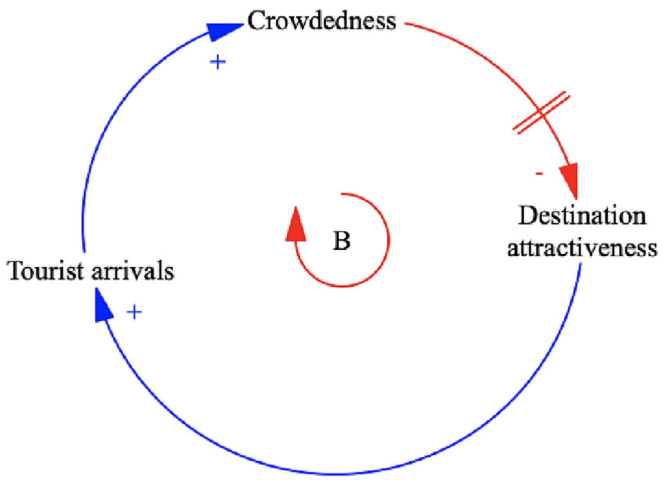

Fig. 2. Example of a balancing (B) feedback loop.

Visit South Sardinia: a case study to research complex dynamics in tourism policy

Our case study focuses on Visit South Sardinia (Italy), a partnership of five municipalities and four private sector consortia operating between 2013 and 16. In those four years, Visit South Sardinia implemented two sustainability monitoring schemes: i) the Global Sustainable Tourism Council's destination criteria, and ii) the European Commission's European Tourism Indicator System. The two projects were promoted by the University of Cagliari, who acted as project liaison and coordinator (Modica et al., 2018; Twining-Ward, 2013). The Global Sustainable Tourism Council is an international membership organisation that was established with the aim of developing a set of universal criteria for sustainable tourism. The Global Sustainable Tourism Council has developed two schemes of criteria: destination criteria for policymakers and destination managing authorities, and industry criteria for hotels and tour operators. Our review focuses only on the destination criteria. In 2013, the destination criteria were piloted in several destinations, as part of a programme known as the 'Early Adopter Programme' and of which Visit South Sardinia participated (Bushell & Bricker, 2017). The European Tourism Indicator System was launched in 2013 by the European Commission, following the direction of the 2010 political framework for tourism in Europe, which included the development of a common system of indicators for the sustainable management of destinations (European Commission, 2010). The European Tourism Indicator System was pilot tested across two phases (2013–2014 and 2014–2015) with over 100 destinations showing interest, among which was Southern Sardinia, which was later given an award, recognising it as the best sustainable tourism destination (European Commission, 2016).

Developing Causal Loop Diagrams based on textual data

Causal Loop Diagrams are usually constructed following four main steps. First, we *identify the system boundaries*, understood here as a situation of interest, such as a problem, issue or event (Ricigliano, 2012; Williams & Hummelbrunner, 2010). A Causal Loop Diagram is only useful when it addresses a specific problem, rather than attempting to map an entire system in detail (Sterman, 2000). For our study, the identified problem was: "Despite the considerable amount of resource spent in the development and implementation of sustainable tourism informational policy instruments, their use by tourism destinations seems sporadically dispersed and not continuous."

Second, we *identify a time horizon* long enough to allow the dynamics relevant to the situation of interest to occur, and short enough to allow such dynamics to be captured (Sterman, 2000). Our time horizon is 2013 to 2019. 2013 is the year when Visit South Sardinia was created and started to implement both schemes, while 2019 is the year when the data were collected. Most related activities ended in 2016, with only a few occurring from 2016 to 2019 and the latter being indirectly related to the Visit South Sardinia project. Hence, closing the time horizon in 2019 allowed us to capture a full cycle of system dynamics.

The third step focuses on *the collection of data*. This took place during four months of field study from April to July 2019, using various techniques: initial conversations with the local coordinator of the two monitoring schemes; 28 in-depth individual and group interviews; attendance at tourism planning meetings and events; and secondary data resulting from recordings of previous conferences and reports. Initially, secondary data were used to populate a timeline in an A0 sheet of paper with calendar dates of events and activities (see Fig. 3), creating a historical account of the implementation of the two schemes. Complexity-informed approaches use historical accounts in case study research to start to unfold the complex dynamics occurring in a system (Byrne & Callaghan, 2013), which start from the time of project inception, through its implementation, to its impact (Boulton et al., 2015). The timeline was used during interviews as a memory recall aid, encouraging deep narratives from past participants' experiences (Hope et al., 2013). Study participants were invited to distinguish between the types of activities and events that occurred under (green sticky notes), or beyond (blue sticky notes), their control or influence. The timeline was enriched gradually with each interview.

Once the data are collected, interviews are transcribed and the timeline is developed, the fourth and last step *constructs the Causal Loop Diagram*, following the guidelines presented in the complexity modelling literature (Eker & Zimmermann, 2016;

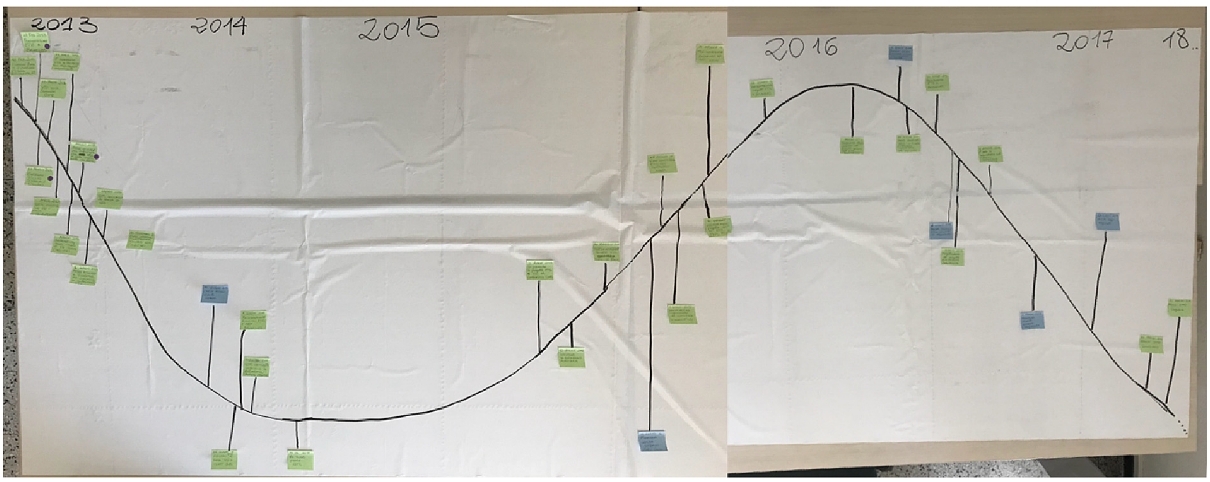

Fig. 3. Memory recall aid for individual and group interviews.

Table 1
Steps for constructing a Causal Loop Diagram. Adapted from Kim and Andersen (2012), and Eker and Zimmermann (2016).

Steps to construct a Causal Loop Diagram	Process description	Input	Output
a) Open coding	Reading through the collected data and discovering themes	Raw text data	A list of themes and concepts
b) Axial coding	Determining themes and connecting sub-themes	List of main concept and themes	A list of themes and sub-themes
c) Causality coding	Identifying factors and their relationships	A list of main themes and sub-themes	Relationship codebook
d) Causality mapping	Transforming the relationship codebook in aggregated causal loops	Relationship codebook	Final Causal Loop Diagram

Kim & Andersen, 2012; Yearworth & White, 2013). The sub-steps are shown in Table 1, starting from the raw text data and finishing with the final map. Accordingly, the coding stages incorporate the data analysis techniques from grounded theory and system dynamics. While grounded theory is a set of iterative techniques used to construct theory that is 'grounded' on the data (Corbin & Strauss, 2008), only the steps of open and axial coding are considered by complexity modellers, which enables linking the factors and their causal relations to the information collected (Eker & Zimmermann, 2016).

While *open coding* (a) consists of the identification of the main themes in the data, *axial coding* (b) is described as the process of hierarchically linking main themes to sub-themes to identify relationships between them (Corbin & Strauss, 2008). Their distinction is only artificial since they always tend to be conducted concomitantly, such as in this study. It is important to note that the links between open and axial coding do not represent causality but only contained relationships (Eker & Zimmermann, 2016). In our study, the main and sub-themes were organised in a way that facilitated the development of a clear storyline for the Causal Loop Diagram, in line with the historical accounts developed in the earlier stage. The aim was to organise the themes in a way that the reader could understand how and why the two sustainable tourism schemes had been implemented in Southern Sardinia and the kind of mechanisms they had triggered in the destination.

Based on the results from the open and axial coding, during *causality coding* (c), a series of cause-and-effect factors, the polarity (positive or negative) of their relationships, and the possibility of an existing delay are determined. In our study, this information was included in a relationship codebook, which tracked the full analysis process. At the end, the relationship codebook consisted of a full list of linear relationships and their polarity information. Additionally, a glossary was developed that included the definition of each factor included in the relationship codebook. A section of codebook is shown in Table 2, while the full codebook is available as Supporting material. In Table 2, the first two columns give the results of the open and axial coding, which were conducted together. The third column shows the results of the causality coding, with sub-columns for the cause-and-

Table 2
Section of the relationship codebook.

A) Open coding	B) Axial coding	C) Causality coding			D) Causality mapping
		Cause factor	Effect factor	Polarity of relationship (Positive/Negative	
1. Positive collaborative climate among stakeholders	1.a Economic Crisis as trigger	Severity of economic crisis	Undertourism	+	(1) Triggers to collective action
		Undertourism	Sense of urgency for action	+	
		Sense of urgency for action	Interaction among stakeholders	+	
		Interaction among stakeholders	Dialogue	+	
	1.b Decision to form Visit South Sardinia	Dialogue	Collective action	+	
		Collective action	Network and partnership building	+	
		Network and partnership building	Interaction among stakeholders	+	
	1.c Decision to invest in implementing the Global Sustainable Tourism Council and European Tourism Indicator System schemes	Collective action	Use of sustainable tourism indicator scheme	+	
		Use of sustainable tourism indicator scheme	Interaction among stakeholders	+	

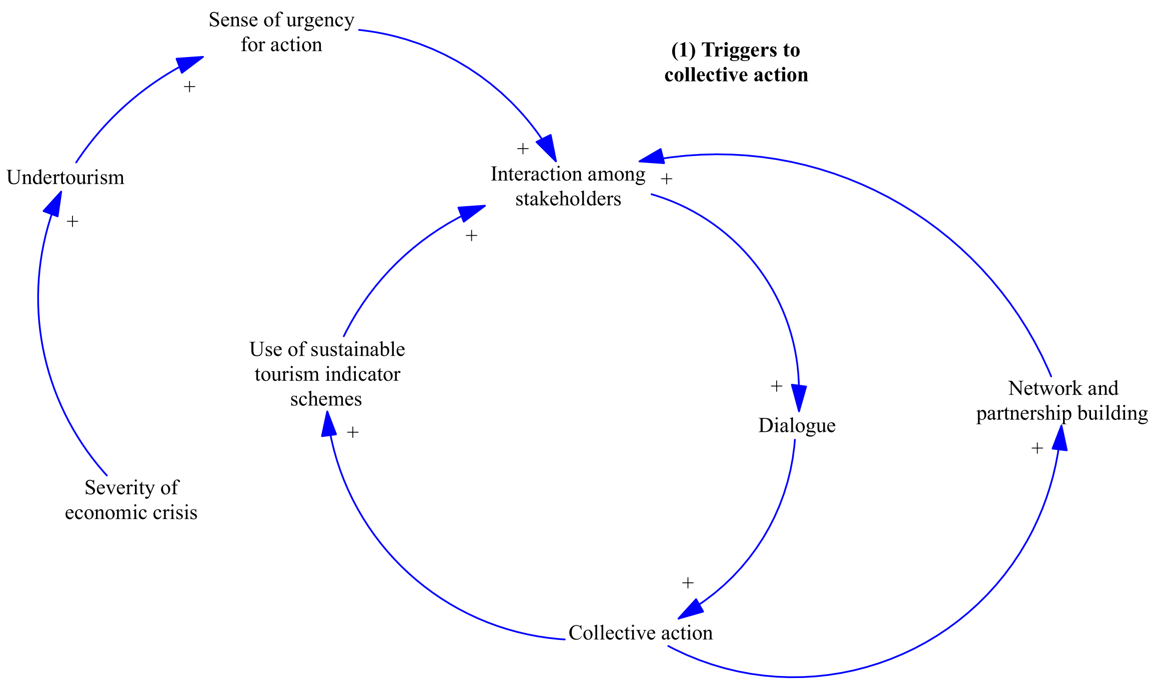

Fig. 4. An exemplary Causal Loop Diagram depicting the triggers to collective action in Visit South Sardinia.

effect factors and the polarity of the relationships. The last column includes the first activity of causality mapping and provides the name of the feedback loop(s) being created.

Causality mapping (d) focuses on aggregating first the cause-and-effect factors to form feedback loops, and secondly the feedback loops to develop the final Causal Loop Diagram (Eker & Zimmermann, 2016; Kim & Andersen, 2012). In our study, this consisted of transforming the information included in the relationship codebook into a complete Causal Loop Diagram by using Vensim PLE, a software designed to develop interactive relationship maps. The linear relationships from the codebook were aggregated to form one or more feedback loops – following Table 2, an example is shown in Fig. 4. Not all factors become part of a feedback loop. In fact, factors can have arrows coming in or out of feedback loops, referred to as input and output factors respectively. The process ends when all the feedback loops are aggregated into the final Causal Loop Diagram. Similar to the open and axial coding, the two final steps are conducted together (Eker & Zimmermann, 2016; Kim & Andersen, 2012). The whole process requires numerous stages of iteration to ensure there is a balanced compromise between map readability and system representation (Edmonds & Gershenson, 2015; Sterman, 2000). For this reason, after the first draft of the Causal Loop Diagram was created, we started a process of redrawing certain sections of the diagram, renaming and combining some factors, and adjusting the arrows' positions to reduce overlapping.

Results and discussion

The complete Causal Loop Diagram obtained following the steps of the coding approach is shown in Fig. 5. The full Causal Loop Diagram can be divided into sections, numbered from (1) to (11), to provide a structured order for how the Causal Loop Diagram should be read. In this section, we provide examples of how we followed the process and how we used the concepts of complexity theory to make sense of the data.

Emergence and self-organisation

The example illustrated in Fig. 4 outlines the first dynamics of project inception that occurred in Visit South Sardinia, which led to the stakeholders' joint decision to take part in the Global Sustainable Tourism Council early adopter programme. These dynamics explain an *emergence* and *self-organisation* process that is typical of situations that are far from equilibrium. The map shows how the 2008 world economic crisis was so severe (*severity of economic crisis*) that it led to Southern Sardinia experiencing the phenomenon of *undertourism* (Mihalic, 2020). This was perceived by stakeholders as a shared issue that could only be tackled collectively by joining forces. For example, a representative from the public sector mentioned: “The financial crisis has been an opportunity for us to reflect on whether the few numbers of tourists were to be only attributed to external forces or if in some way we were partly responsible”.

Before the crisis, the system was in equilibrium; tourist numbers were considered at an optimum level, which made stakeholders complacent of the situation as they believed nothing different needed to be done to maintain such stability. By contrast, the economic crisis led to a shock in the system, which moved it into a state of disequilibrium. During these situations, a system reaches a critical point that requires it to self-organise (Stacey et al., 2000). This was confirmed by a representative from the

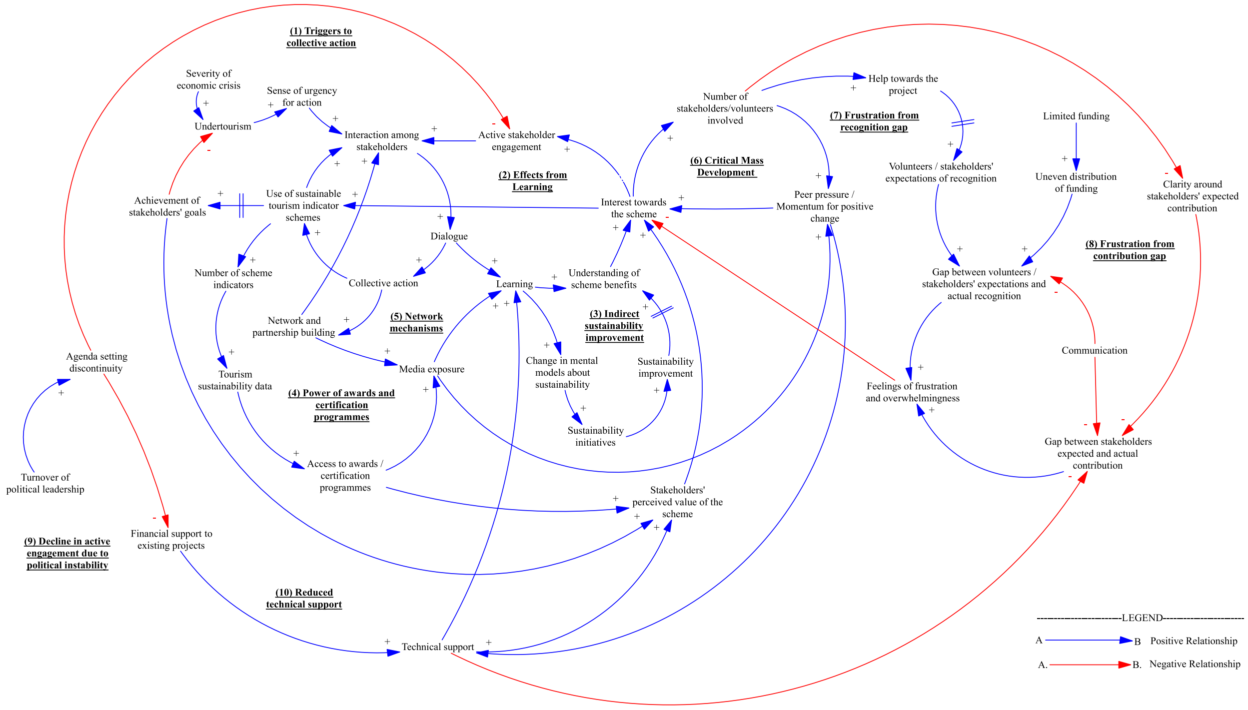

Fig. 5. Complete Causal Loop Diagram for Visit South Sardinia (2013–2019).

private sector who acknowledged that: “The financial crisis was the point when we realised how fragmented tourism management in Southern Sardinia was. It prompted us to organise a series of meetings with the five mayors to discuss how we could manage tourism together”. Following Fig. 4, *undertourism* in Southern Sardinia created a collective *sense of urgency for action* that prompted stakeholders to come together (*interaction among stakeholders*) and reconsider their current modus-operandi (*dialogue*).

When systems are in a state of disequilibrium, the entire ecosystem changes, and radical changes are needed to adapt to the new patterns and structures that emerge (Mitleton-Kelly, 2003). During these moments, stakeholders are prepared to explore the current space of possibilities. This was acknowledged by an academic representative who proposed to the stakeholders to jointly implement sustainable tourism indicators, stating: “We thought it was the right time for us to act during this positive moment […] What I can say is that they immediately welcomed the idea because of their current situation”. As a result, the interactions and positive dialogue created, led to a series of *collective actions*, among which were the signing of a Memorandum of Understanding to create the destination management organisation Visit South Sardinia (*network and partnership building*) and the adoption of the Global Sustainable Tourism Council destination criteria (*use of sustainable tourism indicator scheme*). These emergent behaviours occurred autonomously, i.e., without the intervention of any external top entity (Macintosh & Wilkinson, 2016). These decisions were, in fact, made by the local stakeholders who identified this critical moment as an opportunity to commit themselves to administering tourism together and to developing a single brand destination that could be recognised for its environmental and cultural preservation qualities.

Co-evolutionary dynamics

Moving to another section of the Causal Loop Diagram (see Fig. 6), we see how other principles of complexity theory can help us to explain the system's structure identified. For example, the principle of *co-evolution* is recurrent in the section shown in Fig. 6. The implementation of the Global Sustainable Tourism Council destination criteria (*use of sustainable tourism indicator scheme*) resulted in more interaction among stakeholders, through a process of *dialogue*. The continuous dialogue created a learning environment in which stakeholders influenced and learned from each other (Loop 2 – Effects from learning). An interviewee from the public sector stated: “It was then that we learned what our problems were”. Another one from the private sector added: “It was the first time that our good practices were validated with parameters. It allowed us to exchange experiences and maintain dialogue with the local governments”. In Visit South Sardinia, stakeholders learned about the lack of available and retrievable socio-economic tourism data (Modica et al., 2018), as well as the importance, and benefits, of collaboration. This led to an increased *understanding of sustainable tourism indicator schemes benefits*, which in turn resulted in higher *interest towards sustainability monitoring*.

The *understanding of sustainable tourism indicator schemes benefits* was further increased by Southern Sardinia receiving the certificate of achievement after completion of the Global Sustainable Tourism Council Early Adopter Programme; the certificate instilled hope that important achievements could be made by working collaboratively. Moreover, it nurtured the positive momentum that had emerged and ensured the stakeholders' continued active engagement in the process. In complexity theory

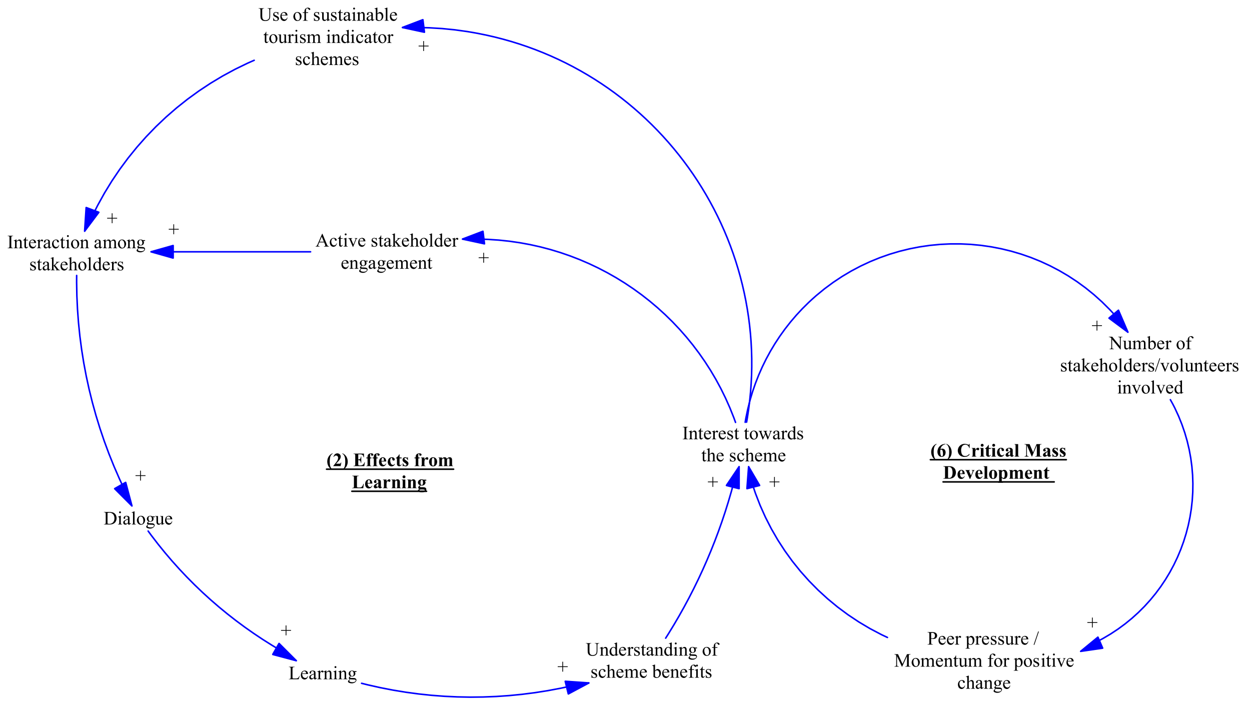

Fig. 6. Effects from learning and critical mass development.

terminology, the process described is referred to as co-evolutionary dynamics and occurs when two or more parts in a system reciprocally influence and change each other's behaviour. Ensuring and maintaining the presence of these dynamics is crucial to accelerating the process of change (Mitleton-Kelly, 2015). All these dynamics finally led to the stakeholders' decision to implement the European Tourism Indicator Scheme (*use of sustainable tourism indicator schemes*). A representative from the public sector stated: "The participation in the Global Sustainable Tourism Council Programme united us all […] when the call from the European Commission about the European Tourism Indicator Scheme came, we said – why not, part of the work had already been done, maybe it behoved us to participate not only to continue this work on measurement but also on collaboration".

The success of Visit South Sardinia led to increased interest in their activities among non-participating stakeholders, to a point that motivated some of these stakeholders to join the monitoring activities (*interest towards the scheme*) and to contribute to the Visit South Sardinia achievements. Such interest led to an increased *number of stakeholders and volunteers involved*, which in turn led to more *peer pressure* and *positive momentum* being created. Ultimately, a critical mass had been developed (Loop 6 - Critical mass development), with additional stakeholders showing their willingness to contribute to the European Tourism Indicator Scheme implementation during the launch conference. This was organised at a local level by 23 volunteer students from the University of Cagliari, the University of Bicocca, Cagliari Cooperative Confederation, LegaCoop Cagliari and the Italian Cooperative General Association. These dynamics created a positive and self-reinforcing loop, i.e., as more volunteers or stakeholders became involved, more influence was exercised, which led to more volunteers or stakeholders becoming involved and so on; thus, creating a critical mass of stakeholders involved in the project.

This type of system's behaviour is also referred to as social influence, defined as "the process by which individuals adapt their opinions, revise their beliefs, or change their behaviour as a result of social interactions with other people" (Moussaïd et al., 2013, p. 1). It can also be referred to as 'swarm-like behaviour', occurring when complex collective behaviours emerge from individuals who follow simple rules (Plowman et al., 2007). For such effects to be maintained over time, any obstructing factors that may interfere with the virtuous loops and reduce co-evolutionary dynamics over time, need to be avoided. Various obstructing factors came into play in Visit South Sardinia causing the critical mass to revert to its previous structure. The next section provides an example of how an obstructive factor contributed to transforming virtuous loops into vicious ones, impacting negatively on the success of the informational policy instruments used.

Lack of interconnectedness and path dependence

In Fig. 7, we show a section of the Causal Loop Diagram with a negative relationship to demonstrate how it can impact a system to the point where reinforcing loops that were virtuous when initially formed can act in reverse, as vicious loops, and entirely disrupt the system. This is only one of the examples of negative dynamics that contributed to the decision of some stakeholders to leave the European Tourism Indicator System monitoring project and cease to invest in Visit South Sardinia activities. We use the principles of interconnectedness and path dependence to give meaning to these dynamics. In this example, we illustrate how the politicisation of sustainable tourism indicator schemes impacted negatively on the smooth continuity of Visit South Sardinia projects (9 – Decline in active engagement due to political instability).

Throughout the implementation period of the European Tourism Indicator Scheme, political leadership changed in four of the five municipalities involved in the Visit South Sardinia activities (*turnover of political leadership*). Some of the new mayors chose to cease, or lower, the priorities of projects initiated under the previous government leadership. The *agenda setting discontinuity*, caused by an increasing change in political leadership, decreased (or ceased, in some instances) the levels of *active stakeholder engagement* and interest in the schemes, thus, impacting negatively on the smooth continuity of Visit South Sardinia activities. In line with this, one of the public sector interviewees stated: "Visit South Sardinia was just a protocol of intentions with no formal governance structure. It was only the willingness of the political actors of that moment, which after their change, the protocol dissolved, and municipalities went back to acting according to their juridical subjects".

Consequently, the three reinforcing loops shown in Fig. 7 changed from being virtuous cycles to acting as vicious ones. This is because the significant decline in *active stakeholder engagement* sparked a series of negative links that led to limited *dialogue* among stakeholders, less *collective actions*, less *learning* and less *interest towards the scheme*. The negative ripple effect continued, causing an even more reduced *number of stakeholders and volunteers involved*, which led to a lack of *momentum for positive change*. Ultimately, the majority of the stakeholders decided not to invest in the sustainable tourism indicator schemes and went back to governing tourism individually. To corroborate this, a private sector interviewee argued that: "If things are not maintained, they risk falling into total silence. They were all good propositions, (…) but when decision-makers do not consider them important, everybody stops speaking about it. After seven years, if I ask businesses whether or not they know about the experience and the awards, I'm sure that 99 % of them would say 'No'".

Overall, the decline in active stakeholder engagement contributed to a reduction of interconnectedness, with stakeholders developing a sense of individual survival and finding it difficult to think systemically (Mitleton-Kelly, 2015). Ultimately, this led to decreased stakeholder interest in the sustainable tourism indicator schemes and less willingness to actively collaborate (Burton & Mockett, 2018). These dynamics were so destructive that the system reached a tipping point. During tipping point systems can evolve into one the following forms: a) *chaotic* - where systems are characterised by minimal structure and uncertainty prevails; b) *locked-in* - where systems remain rigid and characterised by resistance to change and reluctance to explore new possibilities; or c) *self-organising* - a middle ground situation where systems are open to explore new possibilities and adapt to the best fit landscape (Boulton et al., 2015). In the example of Section 4.1 (emergence and self-organisation), Visit South Sardinia stakeholders found themselves in a middle ground situation; from the economic crisis they adapted and self-organised into a new emergent structure.

In contrast, when Visit South Sardinia stakeholders experienced the new tipping point, the system evolved into a lock-in state. The stakeholders locked themselves into their previous ways of operating and became unwilling to commit again to the collaborative implementation of sustainable tourism indicator schemes. For example, one of the municipality interviewees said: "I understand that unity is strength, but Visit South Sardinia is now a sinking ship and I don't want to be part of it. I can still say that I took part in Visit South Sardinia, to showcase the awards, but then when it comes to managing tourism I prefer to stand on my own feet". The decline in engagement represented one of the dynamics that contributed to Visit South Sardinia stakeholders' beliefs that the European Tourism Indicator System was no longer worth investing time and financial resources in. This lock-in effect created historicity and path dependency (Eppel & Rhodes, 2017; Mitleton-Kelly, 2015), where instead of being open to the emerging future, Visit South Sardinia stakeholders went back to their previous ways of acting by developing municipality-level Destination Management Organisations (e.g., Cagliari and Villasimius) and participating individually to sustainability monitoring activities. Scharmer (2018) uses the terms 'economies of destruction' or 'absencing' to refer to situations in which stakeholders recognise that a system is broken and react by going back to their old patterns of behaviour.

Change in political leadership is part of normal organic evolution that affects systems. Complex systems are dynamic, hence they continuously change over time (Cumming & Collier, 2005). It is important to acknowledge this key characteristic of complex

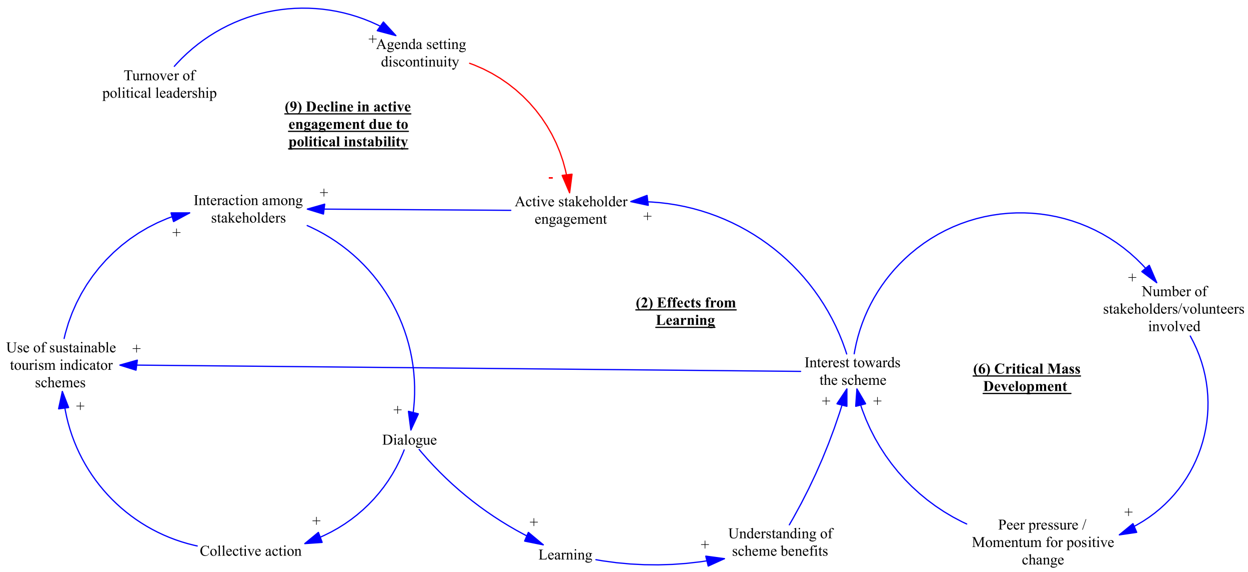

Fig. 7. Decline in active engagement due to political instability.

systems, to seizing opportunities for the system to move into a self-organising form and prevent it from taking a locked-in one; assuming that a system remains in static equilibrium over time may lead to failed implementation of sustainable tourism indicator schemes. For Visit South Sardinia, this is what happened; there was an assumption that the positive momentum would remain static over time even after the governmental changes. During sustainable tourism indicator scheme implementation, changes should be anticipated, so that managers can plan for systems to adapt to new forms that fit the new landscapes (Geyer & Rihani, 2010). This means identifying early on the various possible behaviours that a system could have (Mitleton-Kelly, 2003).

The value of a complexity approach to tourism policy evaluation

The findings above demonstrate that a complexity-informed lens provides a more nuanced understanding of the intended and unintended consequences of using informational policy instruments at tourist destinations, compared to those provided using linear methods of analysis. In the example of sustainable tourism schemes, we have seen that when evaluations of tourism interventions are designed with the latter methods, the less straightforward causal chains tend to be overlooked (Font et al., 2021; Gasparini & Mariotti, 2021). The complexity of tourism governance and policymaking offers very little room for their evaluation to be conducted according to an evidence-based policy trajectory. Overlooking the multitude of factors that affect the use of complex interventions can mislead evaluation conclusions, such as deeming sustainability indicators schemes not fit for purpose (Lyytimäki et al., 2020). It can also create what is often referred to as a 'blame culture' (Ricigliano, 2012) or 'blame game' (Cairney et al., 2019), i.e., blaming specific individuals and organisations when a certain intervention does not bring the expected results.

We need approaches that allow us to capture the complexity of tourism governance and policy, and which enable us to find adequate solutions. In this study, the use of a Causal Loop Diagram provided the means to visualise the numerous interactions and feedback mechanisms created when sustainability interventions are introduced in a tourism destination. Causal Loop Diagrams are a valuable decision support tool for tourism managers as they help them to navigate complexity, and to identify leverage points aimed at making tourism policy instruments more impactful. More impact is achieved by strengthening or weakening factors that contribute to amplify the virtuous feedback mechanisms and disrupt the negative cycles (Meadows, 2008). From the case of Visit South Sardinia, we learn that disruptive sustainability interventions are best implemented when there is positive energy in the system, i.e., by strengthening the sense of urgency for action the system can adopt a self-organising state where stakeholders become open to explore new opportunities. We also learn that it is crucial to create and nurture co-evolutionary dynamics during policy instrument implementation, i.e., by strengthening and creating opportunities for stakeholder interaction, dialogue and learning. Finally, we learn the importance for policy instrument implementers to operate in a continuous learning environment that enables them to sense possible disrupting changes in the system, i.e., by sensing possible changes in political leadership and weakening the agenda setting discontinuity.

Causal Loop Diagrams can be useful in both policy instrument evaluations and policy design, by mapping the multiple causal chains affecting complex issues and, accordingly, finding leverage points for policy intervention design. This complexity-informed tool has already helped policy analysts address issues holistically, with the obesity system in the UK being one of the most prominent examples (UK Government Office for Science, 2007). In tourism, it could assist policy analysts to design better policies by mapping the multiple, interconnected factors that contribute to wicked issues such as overcrowding, seasonality and short-term rentals.

While the method is well founded and brings various advantages, it is not free from limitations. The main objection of modelling approaches such as Causal Loop Diagrams is that they can oversimplify the reality of interconnections happening in complex systems (Baggio et al., 2010). Policy and governance systems are obviously more complex than is assumed in the model, but by using Causal Loop Diagrams we can reduce and understand the complexity in ways we are not able to do otherwise. As complexity evaluators put it, the goal of using complexity-informed approaches is not to provide perfect answers to complex problems but to avoid getting answers that are entirely wrong (Bicket et al., 2021). While case studies are considered the methodological equivalent of complex systems (Byrne & Ragin, 2013), a better understanding of complexity could be achieved by complimenting the modelling process with findings from a diversity of destinations. In addition, while the context of this case study did not allow it, future users of this approach, would benefit from adding a final step to the process, to validate the final map with study participants, when feasible. This would create more awareness about the benefits of complexity science with greater implications for impact.

Conclusion

This study contributes to the literature on complexity-informed research methods that have recently been used by tourism scholars (N. Pappas, 2019; Suno Wu et al., 2021; Valeri & Baggio, 2021). While these methods have usually focused on 'hard' quantitative approaches to model organisational complexity and social networks, this paper demonstrates that 'soft' qualitative approaches can also be applied in the study of tourism policy under a complexity lens. This study makes a methodological contribution by demonstrating how Causal Loop Diagrams, combined with insights from complexity theory, can help illustrate, and make sense of, an emerging system's behaviour when policy instruments, such as sustainable tourism indicator schemes, are introduced in a tourism destination.

This study initially constructed a historical account of the events and activities relating to, and influencing, the implementation of two tourism indicator schemes. These findings were then revisited from a complexity modelling perspective, during which a Causal Loop Diagram was presented and discussed in relation to the mechanisms that the two schemes sparked at the destination. By adding a systems lens to the conventional qualitative analysis techniques, researchers were able to gain in-depth insights into the emerging system's behaviour when complex interventions are introduced in a tourism setting.

We enriched the coding steps from Kim and Andersen (2012) and Eker and Zimmermann (2016) to include an additional layer of analysis in the initial phase of case study investigation, namely, a chronological construction of events and activities throughout the implementation of the schemes. This pre-step facilitated the Causal Loop Diagram construction process as it provided insights into the complexities, and the interconnectedness of the factors, that were affecting the smooth implementation of sustainable tourism indicator schemes in Southern Sardinia (Byrne & Callaghan, 2013). Further, and better, clarity in the Causal Loop Diagram construction process was then obtained through analysis of the raw text data using open coding, axial coding, causality coding and causality mapping.

Next, the research method was enriched by using key concepts from complexity theory to interpret the results. The concepts included: emergence; interdependence and interconnectivity; co-evolution; self-organisation; feedback; and historicity and path dependence (Cairney, 2012; Eppel, 2012; Geyer & Cairney, 2015; Mitleton-Kelly, 2003; Room, 2011). The use of these concepts shed light on the complexities of sustainable tourism interventions and allowed us to reflect on what can be done differently to embrace such complexities. From the case study, we learned that interconnectedness and co-evolutionary dynamics ought to be fostered when implementing sustainable tourism instruments, such as sustainable tourism indicator schemes. When these dynamics are in place, nurtured and maintained over time, emergent and self-organising processes that create positive change are visible. Furthermore, we learned the importance of embracing the dimension of time. As complex dynamic systems are in continuous change, it is important to capture and acknowledge possible changes in the system that, if not recognised, could disrupt the process of positive change and create lock-in effects and path dependence.

Overall, the presented methodology can guide tourism policy analysts to capture the unpredictable behaviour that happens when tourism interventions are introduced in a system. This unpredictable behaviour is what often hinders the successful implementation of policy instruments to advance sustainability change. This methodology opens the doors to both tourism policy evaluation and policy design, as it provides the means to understand and navigate the multitude of interconnections that affect wicked sustainable tourism issues. By reinforcing and counterbalancing specific factors and feedback loops, tourism managers can work with complexity to make policies and interventions more impactful.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.annals.2023.103572.

CRediT authorship contribution statement

Crabolu: 70%. Conceptualisation, investigation, data curation, data analysis, Writing - Original Draft, Writing - Review & Editing.
Eker: 15%. Methodological supervision, data analysis, Writing - Review & Editing.
Font: 15%. Project management, research supervision, Writing - Review & Editing.

Data availability

Supplemental materials available to download

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to than the University of Cagliari for hosting the first author of this paper during the data collection period in Sardinia, as well as providing initial access to Visit South Sardinia stakeholders.

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