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Collaborations in environmental initiatives for an effective governance of social-ecological systems: What the scientific literature suggests.

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Abstract: Moving from the scientific literature on evaluation of environmental projects and programs, this study identifies how and under which conditions collaborations are considered effective for adaptive governance of SES. The method adopted is a systematic literature review based on the quantitative and qualitative analysis of 56 articles selected through specific queries on the SCOPUS database and published from 2004 to 2020. Results of the quantitative analysis underline conditions able to make collaborations effective for adaptive governance of SES: the importance of transdisciplinary research tackling both environmental and social sciences, the perceived urgency of stakeholders to tackle environmental challenges and consequently their inclusion in projects, the valorisation of different typologies of knowledge, and the adaptation to local culture and lifestyle. Results of the qualitative analysis provides specific recommendations for collaborations to be effective related to communication, equity, foresight, and respect, which need to be further strengthened. Multiplicity in visions and approaches should not be seen as a limit but as a resource able to stimulate creativity in social arrangements and environmental practices, making collaborations instrumental for the effectiveness of adaptive governance.

Keywords: collaboration, adaptive governance, sustainability transformations, social-ecological systems, evaluation, systematic literature review

1. Introduction

Human activities are exerting an increasing impact on the environment at all scales, from local to global, endangering the conditions of the ecosystems [1-11]. Emergencies that global society is fighting nowadays are evidence of this close connection. Specifically, the Covid-19 pandemic has reinforced this awareness within the scientific community [12], and probably diffused it to a broader public [13].

Nature and society coevolve through a reciprocal adaptation process based on interdependencies [8, 14-16]. Such interdependencies have been conceptualised through the Social-Ecological Systems (SES) conceptual framework proposed by [17], which clarifies that society -intended as people, communities, economies, and cultures [18]- is part of the biosphere and it is entirely dependent on nature.

Scholars recognise the necessity to integrate social and economic well-being with ecological quality [15, 19-21] to ensure long-term sustainability [8, 15], through transitions and transformations evidencing that business-as-usual cannot ensure safe spaces for future generations [22]. If sustainability transitions concern social, institutional, technological changes in social systems [23], sustainability transformations refer to changes in social and environmental interactions and feedbacks in all dimensions of SES by considering resilience and adaptation [24-26]. Adaptation is, indeed, viewed as a continuum of resilience, transition, and transformation [27]. More specifically, transformations are recognised as deliberative actions activated intentionally by actors to realise a significant change (i.e., radical and non-linear social changes able to cross thresholds into new development trajectories – [22, 26] to achieve adaptation in SES [28]. Furthermore, transformations can have different nature. [29] distinguish between ecological transformations (e.g., changes of landscape, ecosystem services, and assemblages of species) from social trans-

formations (e.g., new values, norms, institutions, as well as changes in governance arrangements and new everyday practices). Besides, the authors underline the continuous interplay between these two sets of transformations, one of which depends on the other. Focusing mainly on social transformations, the assumption at the basis of this study is that changes in social values, rules, and knowledge may impact decisions of individuals and organisations, fostering transformative adaptations based on shared solutions and learning by doing which can improve SES quality [24].

In this realm, governance -intended as the set of rules, structures, processes and traditions determining how people make decisions, share power, exercise responsibilities, and ensure accountability [30, 31] - and politics are "[…] inherently implicated in any intentional effort to shape transformations towards sustainability" [32] (p.2).

From the development of new social arrangements searching for a new or more desirable governance of SES emerges adaptive governance [33]. Adaptive governance has been defined as the set of interactions between actors, networks, organisations, and institutions that aim to facilitate transformations to achieve the desired state for SES [31, 33]. The concept highlights that adaptation requires the capacity of people to respond to change and transform SES into improved states. This can be achieved through an ongoing individual and collective adjustment aiming at revising environmental activities [24, 31]. Adaptive governance reaches its effectiveness if it is fit-for-purpose, that is when "(i) its structure enables multiple actors to purposely guide, control, manage or steer societies through network structures that fit with their social and ecological context, (ii) its processes fit with both the network structures in which they take place and the purposes for which they are being used" [34] (p.76). Consequently, adaptive governance should: "(i) provide information (science and local knowledge); (ii) deal with conflict; (iii) induce rule compliance; (iv) provide infrastructure for capacity building; and (v) be prepared for change" [33] (p.4). Adaptive governance is, indeed, characterised by participation, experimentation, and collective learning of the different stakeholders involved in diverse phases of collaborative activities, such as identification, formulation, implementation, and evaluation of environmental policies, programs, or initiatives [31].

Following the adaptive governance concept, the literature on sustainability transformations recognises the critical role played by individuals and their interactions in social transformations; these lasts are activated by multiple actors and social groups from politics, academia, market, and civil society [23, 25, 35]. Actors are not passive rule-follower, but they can be active agents in systemic changes, i.e., changes in the institutional structure such as thinking, everyday habits, management practices, and resources flow [25]. Actors can exert power and influence the magnitude and effectiveness of transformations through their agency [25, 36]. Specifically, [37] identify four actor categories involved in sustainability transformations: the State, market actors, community, and the third sector (e.g., labour unions, NGOs, and science). Different interests, perspectives, needs, knowledge, resources, collaboration, and conflicts characterise actors involved in adaptive governance and sustainability achievement [35, 38-41]. Adaptive governance needs collaborations among multiple actors to be fit-for-purpose [34, 35, 42]. The literature reports examples of projects which are characterised by good performances in term of effectiveness due to collaboration between different types of stakeholders, such as in biodiversity conservation projects [40], land use planning [43], and protected areas management projects [44].

Collaborative activities, characterised by accountability and transparency, contribute in building knowledge, solving conflicts, developing trust or trustworthiness among actors, connecting different types of actors and sectors that previously worked in isolation to identify common solutions [39, 42, 45, 46]. Shared objectives and flexibility on rules encourage creativity and, consequently, the development of experimentations through the identification of new ideas, innovative organisational models, new social and environmental practices, novel arrangements, and agreements that potentially could contribute to the achievement of sustainability [25, 47]. Innovative activities can be seen as opportunities for learning and improvement fostered by evaluation processes [48]. The process of continuous learning from past experiences characterising adaptive governance sets the premises for increasing the effectiveness of environmental actions and adjusting actions to the new needs emerging over time by identifying previous failures and successes [49, 50].

Evaluation of environmental policies, programs, or projects appears instrumental to facilitate this learning process [31, 49, 51-54]. Furthermore, evaluation outputs can track project results, allowing stakeholders to access lessons learned from the evaluated actions [55]. In this way, evaluation, and more specifically self-evaluation, could enhance the performance of future initia-

tives – through an individual and collective practice of reflection on the process undertaken during the project – if its results pave the way to changing community routines, individual and collective practices and behaviours. Consequently, evaluation is pivotal to adaptive governance, offering new insights for future decisions on environmental management for all actors involved [49, 53]. Its findings, indeed, can help both policymakers to reform or re-design policy instruments, but also for practitioners and generally all the stakeholders to identify the most relevant and critical aspects for promoting and making valuable and successful their entrepreneurial and social initiatives in the environmental realm [56]. In this perspective, the role of the evaluation further strengthens if innovative policy initiatives can have a clear transformative impact and become utilised and available to the entire society by proposing evidence-based examples on transition practices [57].

Collaboration and partnerships between different stakeholders are recognised as fundamental for linking scientific knowledge to sustainability actions with real-world impact [58]. Accordingly, [59] further speculates on the sustainability concept by observing how sustainability, in the end, is a set of shared community practices aimed at reaching an equal delivery of development benefits. Nevertheless, the literature highlights weaknesses in the transposition of scientific knowledge in real-world practices facing environmental challenges and, consequently, difficulties in operationalising adaptive governance [34,53, 60]. Based on these premises, this study identifies how and under which conditions collaborations are considered instrumental for adaptive governance to be effective. Otherwise, collaboration could be seen as a sort of panacea solution that can have no value or even make counterproductive effects [34, 42]. Specifically, the study analyses collaborative relations among different actors involved in environmental programs and projects as analysed in the scientific literature on environmental evaluation. Identifying and classifying findings emerging from evaluations of real experiences allows understanding why some collaborations are effective for the governance of SES, while others fail or collapse [61, 62].

The paper is organised into five sections. After this introduction, the theoretical framework is presented in section 2, then materials and methods are specified in section 3. Quantitative and qualitative results are described in section 4 and further discussed in section 5 with concluding remarks in section 6.

2. Theoretical Framework

Analysing how and in which conditions collaborations contribute to the achievement of effectiveness in governance processes requires focusing on behaviours, decisions, and activities at individual and collective level which determine effects on the biosphere [8]. The literature recognises that sustainability transformations are usually multi-actor processes fostered by activities that involve different types of stakeholders [23, 36, 63] and agrees in considering collaborative relationships the most suitable means to support sustainability transformations [64-69]. Collaboration can be seen as "a set of organisational and interpersonal relationships shaped by the nature of the problems being addressed, the predispositions and capabilities of key actors, and the characteristics of the places in which the problems occur" [65] (p.85). Collaborative relationships are characterised by strong interactions between all types of actors involved in the process and by trust and honesty [70]. Collaboration concretely happens through the creation of partnerships. Partnerships arise when different actors share their resources in order to achieve a common goal. Accordingly, creating collaborative partnerships composed of multiple actors is considered an essential tool to face uncertainties and complexities characterising environmental challenges [71].

By discussing the sustainability transition literature and specifically the governance perspective on transition, [37] identify four different groups of actors, each of them is characterised by specific roles, meaning "a set of recognisable activities and attitudes used by an actor to address the recurring situation" [36] (p.49). The role appears because of interactions between different social groups and implies expected behaviours, rights and duties [72]. The categories of actors are conceptualised as State, Market, Community and Third Sector. Different features typify them following the axes: (i) informal-formal, (ii) profit-non-profit, (iii) public-private. The State is formal, public, and not-for-profit; the market is formal, private and for-profit; the community is informal, private, and not-for-profit; and the Third Sector is conceptualised as an intermediary form between the three axes [37], allowing including different organisational forms such as social entrepreneurs, social enterprises, cooperative organisations. Collaborative interactions between

these different typologies of actors create new hybrid forms of governance and evidence the change of the conventional role attributed to a specific actor needed to compensate for limitations of other social agents [36, 37]. Needs, ideas, and actions that emerge from such collaborative relationships trigger the coevolving process between society and nature by establishing new social arrangements [33], intended as new roles and interactions of actors [73]. Besides, interacting actors define and guide governance processes necessarily impacting (positively or negatively) on nature because they are related transversally with natural components of SES through their decisions and activities [8, 75, 76]. Such interactions between society and nature constitute SES [8] and are shown in figure 1.

[Insert figure1]

If the ecological system can be conceptualised as an interdependent system of organisms or biological units [76] - represented in figure 1 as green nodes connected through ties-, then, actors that constitute the social system – represented in figure 1 as red nodes connected through relations – could be defined as individuals or organisations intended to generate changes through environmental activities [77]. The social and ecological systems are connected through interactions occurring at multiple levels of adaptive governance [78]. By implementing project activities (P), individuals and organisations exert a pressure on the SES, which determines feedbacks on both the social and ecological systems represented in figure 1 as interactions (the orange lines). These interactions influence both the flows among resources composing the ecological system (the green lines) and the collaborative relations within the social system (the red lines).

Effective collaborations in adaptive governance require that agents guide, control, manage and steer environmental resources by considering both the components of the SES. By increasing the social connectivity in SES, collaborative activities can improve effective management of the ecological component through the creation of flexible connections among stakeholders formalised in joint agreements [42, 79]. Accordingly, connections require sharing of material and non-material resources, facilitating trust-building relations needed to resolve conflicts [80]. Hence, connections can sustain adaptation and trigger sustainability transformations [8, 25]. In this way, adaptive governance activities could be much more fit-for-purpose [34] in producing outputs, outcomes, and impacts[1] (fig.1) [82, 83]. The ongoing learning-by-doing process fostered by evaluations allows identifying improvements in governance activities through an adaptive cycle (fig.1) [25].

3. Materials and Methods

To understand how and in which conditions collaborations could contribute to effective governance of SES, we perform a systematic literature review through both a quantitative and qualitative analysis [84]. The systematic review is performed to collect and synthesise evidences emerging from the evaluations of environmental activities and extrapolate knowledge on effective collaborations in adaptive governance of SES [85]. We opted for a systematic review because it summarises existing and fragmented knowledge discussed in multiple scientific articles in order to handle the research questions in a sounder way [86]. The systematic review of scientific articles has been performed by using the SCOPUS database. The use of the SCOPUS database is justified by the most extensive availability of journals from all the world [87] and articles, especially on environmental science, and the possibility to have easy access to abstracts for the majority of papers compared to other academic research database such as Web of Science [88-90]. In addition, SCOPUS assures the extraction of reliable data through the analysis of scientific articles subjected to peer review process, compared to Google Scholar whose citations derive from multiple sources [91]. Steps constituting the literature review process are listed in figure 2.

[Insert Figure 2]

[1] [81] defines outputs as the tangible results made by activities that are relevant for the achievement of outcomes. Outcomes are defined as likely or achieved short-term or medium-term effects. Impacts are defined as positive or negative long-term effects produced by activities.

The first step of a systematic literature review is the selection of articles using keywords. In this study, we selected as keywords: "environmental evaluation" AND "governance OR institution" AND "social AND ecological", in order to gather a collection of environmental evaluations of programs or projects aiming at fostering sustainability transformations in both the social and the ecological dimensions of SES, with a focus on governance arrangements.

The second step is the identification of abstracts that fit the purpose of the research using a specific set of criteria as proposed by [92]. The selected abstracts have to:

(i) deal with social and ecological variables
(ii) provide an evaluation of completed environmental programs or projects
(iii) describe activities aiming to foster sustainability transformations
(iv) be oriented on a governance approach.

The third step is the extraction of relevant data for the quantitative analysis done through a Sankey diagram [93]. We first identify the year of publication of articles, in which journal articles are published, and in which scientific areas articles are included. To identify the last criterion of classification, we refer to the subject areas specified by the journals. After then, we classify articles based on the following scales detailed into different levels:

(i) type of evaluation, i.e., Assessment based on indicators or indices, Pure qualitative evaluations, and Integrated evaluations [94]
(ii) scale of intervention of projects or programs evaluated, i.e., Local, Sub-national, National, International, Global [78]
(iii) geographical localisation, i.e., Africa, America, Asia, Europe, Oceania (https://unstats.un.org/unsd/methodology/m49/)
(iv) human pressures on environmental resources, i.e., Agriculture, Forestry, Fishing and hunting, Tourism, Industry, Transport, Urban areas, Waste, Energy, and Climate change [95],
(v) environmental issues, i.e., Biodiversity, Freshwater, Land and soil, Ocean and coasts, and Air [95]
(vi) sustainability transformations addressed, i.e., Sustainable food, land, water and oceans, Health, well-being and demography, Sustainable cities and communities, Energy decarbonisation and sustainable industry, Digital revolution for sustainable development, Education, gender and inequality [15].

The fourth step is the extraction of relevant data for the quantitative analysis by extrapolating pieces of evidence on interactions between different types of actors as categorised by [37], e.g., in the case of the article proposed by [39], State actors are the federal and provincial fisheries departments, market actors are local fishers and aquaculture operators, community actors are local and aboriginal communities, and third sector actors are research institutions and multiple NGOs. All statements related to pieces of evidence on interactions are collected in an excel spreadsheet file, clarifying:

(i) who are the actors involved in relationships (i.e. the State, market, community, third sector)
(ii) if and how the relationship has been effective or not in resolving the environmental challenge in the analysed SES (e.g., resolution of conflicts around multiple uses of marine space through the development of a new institution [39]).
(iii) Finally, the qualitive analysis reviews and summarises the heterogeneous knowledge by grouping the qualitative statements with an equal or similar meaning into homogeneous categories able to summarise a broad concept.

3. Results

The selection of articles on the SCOPUS database identifies 194 articles, which are consequently filtered, considering only articles and reviews written in the English language (147). After analysing abstracts, 56 papers fit with all the four criteria identified to address the research purposes (Appendix A). After identifying suitable articles, we analyse the text through quantitative and qualitative analyses.

4.1 Quantitative analysis

The analysis reveals that selected articles are recent (the oldest is published in 2004). Figure 3 shows that evaluations of environmental governance activities fitting with the research criteria are mostly published after 2010, with a maximum value in 2016 (9 articles published). Then, the number of articles reaches stability with 5-6 papers published every year.

[insert figure 3]

As reported in Appendix B, articles selected by the review are published in several journals and subject areas, which mainly belong to the environmental sciences (54 articles). Environmental sciences are followed by Social Sciences (22) and Agricultural and Biological Sciences (17). Besides, the classification identifies other subject areas such as Medicine (7), Economic, econometrics and finance (9) and Energy (4), evidencing the transdisciplinary nature of the SES concept.

The Sankey diagram (fig.4) shows relationships between all the scales and levels used for classification purposes. Each paper can be part of multiple classification scales and levels at the same time. Thus, the total numbers specified for each scale and for each level do not align with the total number of 54 articles.

[insert figure 4]

Starting from the scale "Type of evaluations" as reported in the articles, we observe that evaluations using indices or indicators make 27 relationships, evaluations using pure qualitative methods make 19 relationships, and evaluations using a combination of participative approaches and multicriteria assessments make 15 relationships.

Moving to the "Scale of intervention", it is possible to observe that indicator assessments and pure qualitative methods are used transversally for all the levels from local to global, while integrated assessments are mostly used in evaluations at a minor scale, mostly sub-national and local. The 77% of relationships constituting the Sankey diagram focuses on program or project activities implemented at the sub-national and local level. A minor number of relationships focuses on a national (14%) or international scale (3%), and only one article refers to a global scale (it makes 5 relationships because it relates with all continents).

Focusing on the "Geographical localisation", it is possible to observe that studies are mostly localised in developed countries. In fact, the geographical area with the highest number of activities analysed is Europe with 68 relationships (34%). The review selects articles that analyse initiatives placed in all continents: Africa (8%), America (28%), Asia (17%), Oceania (13%), but it reveals that the poorest areas remain understudied (e.g., Sub-Saharan Africa or the Middle East).

Observing the "Human pressures" scale, it emerges that Agriculture is the pressure most recurrent in terms of relationships (72), followed by Fishing and Hunting (55), Industry (46), Urban Areas (45) and Climate Change (44). Forestry (35), Tourism (35), Waste Production (32) and Transport (36) are less investigated, and Energy receives a little attention (13).

Moving to "Environmental issues", the analysis reveals that Land and Soil counts 124 relationships (30%), while Freshwater and Biodiversity total 97 and 96 relationships respectively (23% both). Then, Ocean & Coasts attest 70 relations (17%), followed by Air with 26 relations (6%).

More specifically, if Agriculture, Climate Change and Fishing & Hunting seem transversal pressures impacting all the most addressed environmental issues, from the Sankey diagram emerges that Forestry and Tourism mainly impact on Biodiversity and Land & Soil, while Industry and Urban Areas mainly impact on Freshwater and Land & Soil. Transport, Waste and Energy production are mainly related to Land & Soil and Freshwater, but it is also possible to appreciate a relevant number of relationships having as a target the environmental issue Air.

Finally, focusing on the framework proposed by [15] on sustainability transformation, the classification highlights that most of the initiatives relate to the achievement of sustainability in food production, land use, water use and oceans (115), followed by initiatives aimed to improve community health and well-being (45), and by initiatives which aim at achieving sustainability in cities and communities (30). A minor amount of relationships is related to energy decarbonisation

and sustainable industry and education, gender and inequality (16 both), then digital revolution for sustainable development follows (8).

4.2 Qualitative analysis

Selected articles offer several examples of evaluations of interventions dealing with the improvement of adaptive governance of SES through the identification of novel solutions. Examples of evaluations undertaken are: (i) ex-ante evaluations of the impact caused by specific types of land use in protected areas [96]; (ii) participative evaluations aimed at making awareness on environmental issues [97]; and (iii) identification of best practices for resilient environmental management [98]. The following paragraphs summarise recommendations on how and under which conditions collaborations contribute to the effective governance of SES as highlighted and suggested by evaluation results. In order to facilitate the comprehension, qualitative results are grouped into 4 categories having a common conceptual significance.

4.2.1 Communication

Most of the selected articles highlight the importance of clear communication among multiple stakeholders, where individuals, groups, and organisations can express their values and perceptions. Developing a common language, specifically if informal and not technical, helps to avoid misunderstandings among actors [39, 96, 99, 100]. Instrumental for effective collaborations is the use of visual tools - more user-friendly and for all types of people (also for illiterates) - in communicating environmental issues or in participative evaluation processes [44, 98]. Therefore, evaluations recommend clearness and transparency in communicating the contents of regulations, recommendations, directives, and so on from public bodies to all the other types of stakeholders, especially on the subjects of policy objectives both general and specific [43, 101-105]. Besides, scientific communication is fundamental for community education. Third sector actors as proposed by [37]- especially researchers, but also NGOs and generally all public actors - play a fundamental role in the transmission of scientific knowledge to all other actors [104, 106-108]. To be effective, the content of scientific communication has to be clear and make use of tools able to be applied by non-experts [40, 109, 110], especially by policymakers who normally steer, guide, control and manage natural resources. Moreover, public actors are invited to increase the number of communicative initiatives and tools aimed to make the community aware of environmental challenges and to propose everyday practices able to foster sustainable behaviours through the awareness that sustainable actions are more convenient for their well-being [100, 111, 112].

4.2.2 Equity

The integration of different typologies of actors, especially underprivileged stakeholders, and the respect of equity also within participative initiatives are essential for establishing relationships based on trust and respect [39, 40, 43, 49, 60, 96, 98, 100, 103, 106, 109, 113-115]. In participative processes, there is always the risk that interests of the élites prevail or that some groups of relevant actors are excluded in the decision-making processes [43, 98, 99, 104, 116]. Therefore, moderators or facilitators have the fundamental role in assuring equity through an objective and impartial management of trade-offs on interests and needs among actors [49, 109, 114]. The need for equity explains why collective initiatives are often sustained by external groups of experts, mostly NGOs and universities [108, 117] who involve local stakeholders through, e.g., citizen-science tools, trips, workshops, and practical exercises of participative multicriteria assessments [49, 97, 98, 101, 103, 108, 118, 119]. In order to guarantee equity in participative decision-making processes, facilitators and moderators have to assure the respect of privacy and allocate time allowing all actors to equally express their opinions and values [39, 96]. Also, to public and third sector actors are requested to coordinate and stimulate people to think and act for the good of all community and to recognise in local stakeholders valuable allies [100, 105, 107, 116, 115, 120-122]. Besides, public authorities are required to devolve some power and autonomy to bottom-up initiatives that emerge from adaptive governance processes [39, 97, 107, 108, 123]. Be-

sides, all actors are invited to share material and non-material resources by considering a self-help perspective [104, 106] in order to overcome limits that could preclude sustainability transformations, (e.g., the creation of ecotourism infrastructures in Amazon villages as suggested by [98]). Specifically, private actors are invited to avoid influencing scientific activities and research themes through the allocation of private funds on specific research themes that do not positively impact on the society [101].

4.2.3 Foresight

Sustainability transformations require interventions producing effects on the long term, which contrast with individual needs focused on short-term outputs. Following this view, [124] underline that several environmental projects are funded on a short-term period. To address this weakness, public bodies are requested to maintain the attention and the support on environmental initiatives in the long term by developing solid and coherent planning instruments. Institutional stability seems able to reduce the "stakeholder apathy" [40] and to assure continuity in environmental adaptive governance initiatives [39, 40, 44, 99, 104, 125-127]. Considering public actors, [107] highlight the need to support collaboration between partners also after the end of the project through the creation of a stable network of actors sharing common objectives and working together for a more extended period. This could be fostered by programs having a long or medium-term vision that can promote the resilience of ecosystems [107, 110, 128-132]. Experiences highlight the strategic nature of proposing tools to motivate private actors to be involved in sustainability transformations. Accordingly, private actors are more likely to act when it is easy and convenient to do the right thing [49]. Sustainability transformations need to be proposed as means able to increase their well-being through, for example, the introduction of incentives [49, 105, 114, 133]. The incentive has not to be only monetary (e.g., payments, subsidiaries) but also of a different nature (e.g., new job opportunities) [43, 99, 125]. To sustain innovations that foster sustainability transformations, donors are invited to sustain transdisciplinary research [102, 194]. On the other side, third sector and State actors are invited to create common spaces for boosting innovations [40, 134]. Equally, private actors, and in particular market actors, must be encouraged to sustain scientific research, especially for the development of innovative eco-friendly technologies [135]. Besides, they are invited to trust in science and accept changes in their everyday lives, even if it is difficult to see short-term advantages [136].

4.2.4 Respect

Relevant and suitable sustainability transformations need dynamic and flexible regulations and policies that take into consideration social and ecological characteristics and the scale where interventions take place in order to address specific emerging needs that continuously evolve among time and space [49, 103, 105, 126, 137-139]. This is why, the State and third sector actors are requested to comprehend real problems dealt by local stakeholders (both community and market) [100, 108, 117]. Besides, public interventions need to be culturally contextualised, and they have to respect traditions (e.g., everyday practices and taboos) of communities where they are placed, especially in non-western countries, in order to build trust and legitimation [39, 98, 99, 106, 107, 115, 118, 136, 140]. To do so, the literature invites to promote participative evaluations processes [115, 141]. Accordingly, evaluations need to provide specific information on both the environmental and social contexts and to include indicators related to the quality of life of locals, especially of indigenous communities, which very often appear as the most marginalised group [101, 102, 104, 113, 130, 137, 142-144].

4.3. Figures, Tables and Schemes

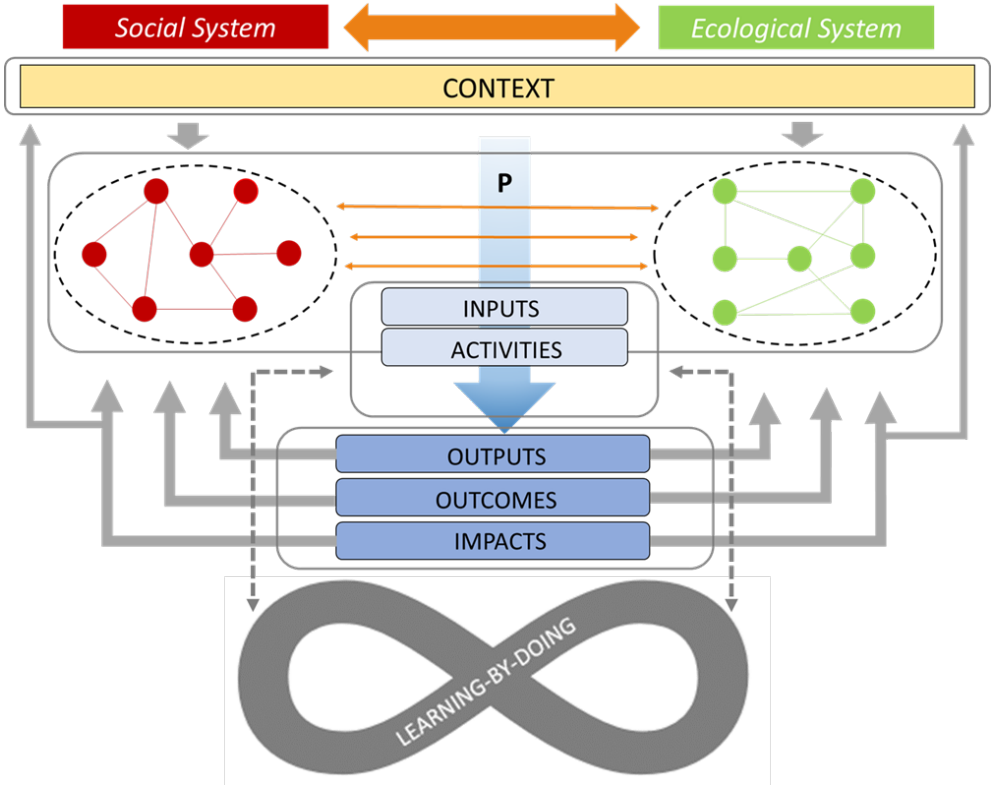

Figure 1: Result chain of adaptive governance activities in SES

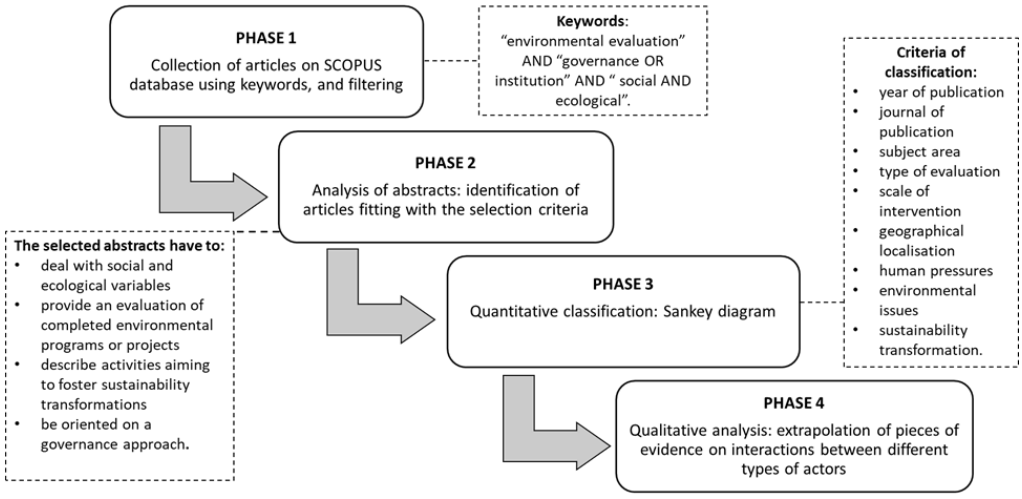

Figure 2: Schematisation of the sequence of steps constituting the literature review.

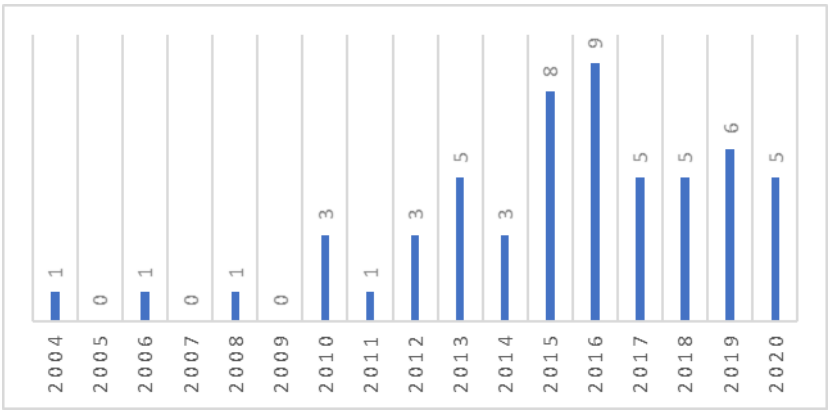

Figure 3.: Numerosity of articles selected by the systematic literature review per year.

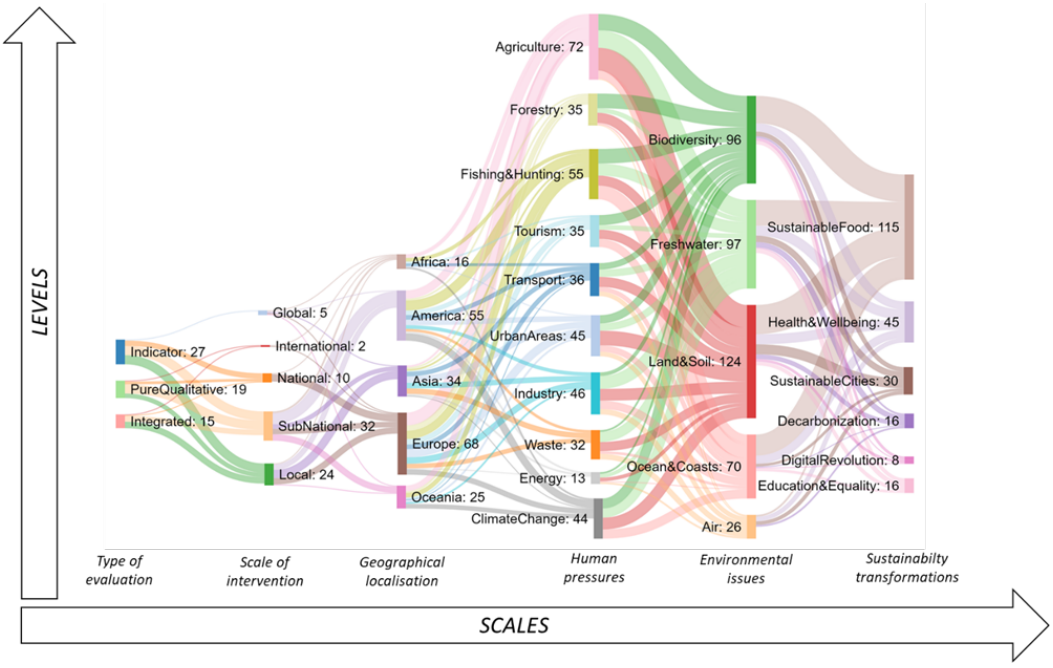

Figure 4: Classification of articles by Sankey diagram.

5. Discussion

Experiences evaluated in articles selected by the systematic literature review report how and in which conditions collaborations are instrumental for effective governance of SES, making adaptive governance initiatives fit for purpose. Evaluations presented in the 54 articles highlight: (i) how effective governance of SES is difficult to achieve due to complexities and uncertainties which characterise environmental challenges presented in the different contexts analysed, (ii) a specific and context-based environmental issue is typically characterised by multiple social and institutional stakeholders interconnected through different ties with a set of interrelated environmental resources, as already pointed out by e.g., [31, 42].

Results of the quantitative and qualitative analysis show respectively what conditions are instrumental to (i) assess, (ii) foster effective collaborations in the governance of SES. The following discussion firstly presents specific indications on how to assess the effectiveness of collaborations, and secondly examine how to foster them. We follow this sequence in the presentation.

(i).1 All typologies of evaluations should adopt a transdisciplinary approach when dealing with evaluating effective collaborations for adaptive governance.

The analysis of evaluations reported in articles demonstrate that articles use basically a transdisciplinary approach. This is corroborated by results showing that the majority of articles selected by the review (41 out 54) are published in journals belonging to multiple subject areas. In addition, the analysis identifies two main approaches used to assess adaptive governance initiatives: (i) articles dealing only with social variables (18), (ii) transdisciplinary articles dealing with both social and ecological variables (36). Heterogeneous variables used in the analysed 54 articles attests that transdisciplinary research is instrumental to provide a transversal knowledge fitting all dimensions of sustainability [145], as reported by e.g., [109, 118]. Nevertheless, transdisciplinary approaches involve difficulties in their operationalisation, specifically related to the diversity of interests, values, and perceptions of actors involved in adaptative governance initiatives [53].

(i).2 Evaluations normally centred on secondary data should also use participative techniques for primary data collection. This will allow to reach a better understanding of real situations of evaluated contexts, which is a necessary pre-condition for effective collaborations.

The scientific literature recognises the central importance of using participative approaches in all the phases of the project cycle, e.g., [43, 44, 122] in order to determine a real impact in the context. Nevertheless, moving to the classification of evaluations reported in articles, we observe that articles using social and environmental indicators or indices limit the use of participative approaches in evaluations, e.g., [123, 135]. Pure qualitative articles can be subdivided into two categories: on one side, some articles use participative approaches in projects, e.g., [97, 108], to the other side articles focus on analyses of policy, e.g., [101, 127]. Conversely, articles based on integrated assessments reveal that the involvement of the community by using participatory approaches plays a determinant role in (i) the identification of needs or environmental challenges tacking local communities, e.g., [96, 98, 116]; (ii) the implementation of project activities, e.g., [44, 60, 113]; (iii) the evaluation of undertaken actions, the successful reaching of their objectives, and consequently, the impacts of the initiatives, e.g., [40]. Experiences demonstrate that knowledge sharing among local actors helps identify the specific needs of local communities and the interlinks among environmental and social problems, which are not immediately visible to the external managers, who adopts typically a sectorial problem-solving approach. Besides, ex-ante participative evaluations allow discussing local problems permitting people to take consciousness of the importance of the environmental challenge and identify context-based solutions that local community supports [46, 96]. Results support the need to enlarge the use of participative approaches in all types of evaluations, specifically in evaluations based on indicators and indices that normally rely on secondary data to better represent real situations of evaluated contexts.

(i).3 Evaluations of adaptive governance initiatives should involve actors from multiple spatial scales to foster effective interventions and collaborations.

The scale of intervention of articles shows that evaluations are mainly focused on sub-national or local levels. Conversely, the systematic literature review evidences a low number of evaluations implemented at national, international, and global scales. Evaluations related to sub-national and local scales are characterised by a high frequency of activities based on participative approaches also implemented through multicriteria assessments, e.g., [43, 107]. The reduced scale of intervention probably fosters the generation of effective collaborations in SES [146, 147]. Consequently, evaluations based on sub-national and local scales would be more prone to assess these collaborations.

Nevertheless, the literature highlights the need to avoid inward-looking approaches because the majority of SES does not limit to the narrow boundaries of the SES analysed but is open and susceptible to external changes [43, 148]. Consequently, [149] propose to involve actors from multiple scales in participative approaches, combining together different interests to compensate for this weakness. Equally, multiple evaluations selected by the review adopt the same approach, involving stakeholders from different spatial scales, e.g., [60, 107].

(i).4 Evaluations on effective collaborations for adaptive governance should enlarge the context of analysis to countries that, at present, are most vulnerable to climate change and natural resources depletion.

The geographical analysis of articles reveals a high concentration of evaluations in Europe, America, and Australia. Sub-Saharan Africa and the Middle East, which are most vulnerable to climate change effects and natural resources depletion, do not attest to a scientific discussion on the research topic. Studies placed in poor areas mainly deal with activities related to Western countries activities such as wildlife tourism, e.g., [60, 99, 116]. Thus, the geographical analysis of articles denotes a Western-centric vision in scientific research related to sustainability issues and environmental challenges. This evidence is confirmed by multiple other studies related to sustainability analysis, e.g., higher education for sustainable development in [150] and resilience thinking in [151].

(i).5 Evaluations are more inclined to assess effective collaborations if they are focused on environmental and social challenges clearly perceived by people.

The focus on human pressures addressed by initiatives evidence that activities mainly concern environmental and social challenges as clearly perceived by people. Sustainability practices in food supply chain and in actions undertaken in urban areas are the challenges mostly recurrent in the selected articles. Agriculture and Fishing and Hunting, followed by Urban Areas and Industry are human pressures with the highest number of relationships within the Sankey diagram. This could be explained because one of the most critical challenges that humanity must deal with in the future years will be the exponential increase of global population and the consequent increasing demand for food to assure food security for all people [95, 152], and the migration of people from rural to urban areas [153]. Accordingly, most of the adaptive activities reported in this study focus on (i) food production in rural and urban areas, e.g., [114, 119], (ii) fishing activities, e.g., [39, 113] and (iii) evaluation of sustainable practices in urban areas, e.g., [111, 129].

(i).6 In order to assess effective collaborations within interventions, evaluations have to focus on synergies and trade-offs among multiple environmental challenges determined by human actions at the same time. Therefore, they need to be multi-sectorial.

Environmental issues dealt by articles are mostly related to the use of (i) Land and Soil, (ii) Freshwater, and the conservation of (i) Biodiversity, and (ii) Oceans and Coasts. Little attention is devoted to the Air. Evaluations analysed by the literature review demonstrate the necessity to consider simultaneously multiple environmental issues, like interdependencies between land use and biodiversity as pointed out by, e.g., [46, 60]. Accordingly, the literature highlights the need to consider synergies and trade-offs among multiple environmental issues generated by implementing human activities [15]. For example, in the case of agricultural activities negatively impacting on the environment, the evaluation should consider the interactions among food supply, water use, and biodiversity loss [154, 155]. Consequently, the generation of effective collaborations, able to cope multiple negative effects determined by human actions, can be stimulated by the inclusion of actors of multiple sectors, as evidenced, e.g., by [156, 157]. The systematic literature review provides examples of cross-sector collaborations, e.g., participative evaluations which involve fishers and tourist operators, e.g., [40, 107, 116].

(i).7 Evaluations of SES governance initiatives should consider the role of effective collaborations to promote community well-being.

Moving to sustainability transformations, it is possible to observe that articles selected by the literature review are mainly focused on transformations related to the sustainable use of natural resources such as land and oceans, followed by transformations aimed at fostering human well-being and the sustainability of urban areas. Results show that evaluations should focus on interventions not only in terms of assessment of the quality of ecosystems, but also as opportunities to foster community well-being through the catalysation of multiple facts such as inclusiveness, equality, trust, education of the community, respect of rights and cultures which can lead to the achievement of a thriving global society [158, 159]. Accordingly, selected articles provide multiple examples of environmental evaluations which consider environmental interventions as means able to foster community well-being. For example, [44, 98] demonstrate how effective management requires the involvement of indigenous communities and the respect of their cul-

tures and lifestyles. [114] show that environmental projects placed in post-industrial cities make impacts not only on the environmental quality, but they also accelerate environmental justice and social equity.

(ii).1 A clear communication fosters community support to environmental activities, and consequently, it increases the possibility to foster effective collaborations through community awareness on environmental challenges.

The qualitative analysis of articles shows that a clear communication empowers locals, it helps in resolving conflicts, and helps a community defining good practices contributing to sustainability transformations. In addition, a transparent information on activities and outputs can favour the reliability of actions undertaken by the promoters of adaptive governance initiatives, facilitating community trust [99, 144]. Clear communication fosters community awareness on environmental challenges and its support on environmental activities, e.g., [97, 111, 115], especially in contexts of poverty and marginalisation, where people have little chances to be empowered through traditional channels, e.g., schooling [98, 129]. For example, [114] observe that a clear communication in relation to urban community gardening has the possibility to include the most marginal groups in community activities, to empower them, and foster their pro-environmental behavior, and, consequently, their support to the objectives of the initiative.

(ii).2 Equity fosters the emergence of a conscious and shared environmental responsibility through the identification of common strategies by multiple stakeholders that support effective collaborations.

Evaluations analysed by the qualitative analysis highlight that equity in participative processes stimulates the emergence of a conscious and shared environmental responsibility among all stakeholders who have different rights and duties related to the environmental issue to be tackled [39]. Adaptive governance initiatives characterised by equity are more prone to generate meaningful dialogue between different actors, and, consequently, the identification of strategies in agreement with all parts involved, which considerate needs and opportunities for all actors, also the less powerful (e.g. [96, 98, 111, 113-116, 122, 136].

(ii).3 Foresight in governance initiatives fosters a constant process of adaptation, supporting effective collaborations in the long run.

The qualitative analysis reveals that foresight is necessary for sustaining the transformative process that essentially constitutes adaptive governance as described by the adaptive cycle [25]. Accordingly, foresight is crucial in fostering changes in natural resource management through the introduction or development of new tools or novel approaches that could lead to the implementation of innovations [44, 46, 97, 117, 131, 136, 140]. Forward-looking initiatives can assure continuity in the transformative process also after the end of projects through the creation of networks of actors who continue to collaborate in order to stimulate additional improvements of the governance of SES (e.g., through the creation of new governance arrangements like alliances and spin-offs as reported by [97]). The continuity of collaborations in the long-term period through, e.g., regular periodical meetings [40] is, in turn, instrumental in avoiding the stakeholder apathy characterised by the declining of exchange of knowledge, engagement of stakeholders and leadership [40, 104].

(ii).4 Respect of social and ecological contexts leads to the design and implementation of relevant activities, building trust and legitimation, and, consequently, fostering effective collaborations.

Initiatives described in articles show that the respect of both ecological and social context is a prerequisite for implementing effective initiatives and collaborations. Context-based approaches lead to the design and implementation of relevant initiatives that consider both: (i) the ecological conditions evolving in time and space and (ii) local cultures and lifestyles. From articles selected by the literature review emerges the fundamental role of policies able to adapt to every specific area and social need, which, consequently, can support new governance arrangements generated

by adaptive governance initiatives [97, 101, 104, 108]. Relevant projects can build trust and legitimacy, helping for the generation of effective collaborations between the local community and external actors proposing initiatives, e.g., [44, 98, 107].

6. Conclusions

The quantitative analysis of evaluations makes evidence that transdisciplinary, multi-scale and multi-sector approaches are needed to assess effective collaborations in SES. In addition, results show that participative approaches are instrumental in understanding the context where initiatives are placed and demonstrate that environmental actions implemented through effective collaborations should promote social well-being.

The qualitative analysis resumes in four broad concepts the conditions able to catalyse effective collaborations in the governance of SES. Clear communication, equity, foresight, and respect are characteristics able to incentive the inclusion of stakeholders, their trust, and consequently, their support in the definition and implementation of relevant initiatives, and to assure the continuing of the transformative process that constitutes the adaptive governance of SES.

Results show that the effectiveness of adaptive governance initiatives is essentially based on processes established through the involvement of multiple actors and the consequent emergence of social networks. Future studies could better analyse connectivity between actors. A quantitative analysis of relationships constituting networks through the Social Network Analysis (SNA) could be helpful in the identification of central actors and the assessment of connectivity between actors of adaptive governance initiatives, e.g., [60, 79, 160].

Despite the abundance of recommendations that emerge from the analysis of articles related to interactions among different actors, evaluations mainly focus on the role of public actors (i.e., State and third sector), with little attention on the contribution of private actors (market and community). To address this weakness, future studies could focus on the side of private actors and develop user-friendly tools to foster sustainability in everyday behaviours.

Besides, this analysis highlights the need to valorise the most marginal voices embedded in adaptive governance activities. Evaluations about adaptive governance placed in developing countries could be opportunities for the creation of new knowledge through the sharing of both scientific and traditional/indigenous knowledge, which could propose new effective solutions and approaches useful for sustainability transformations to be also implemented in different contexts [44, 98].

Limitations of this study refer to the selection of articles written only in English language in the SCOPUS database, limiting the numerosity of articles dealing with evaluations of SES governance, which could be written in other languages or published in other scientific databases.

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Appendix A

Appendix A: list of articles selected for the systematic review.

Ancuta, C., Olaru, M., Popa, N., Isfanescu, R., Jigoria-Oprea, L. Evaluation of the sustainable development of rural settlements. Case study: Rural settlementd from romanian Banat. Carpath. *J. Earth Env.* **2015**, *10(3),* 67 – 80.

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Appendix B

Table showing journals where selected articles are published and their subject areas.

Journals	n. of articles	Subject areas			
Ambio	1	Environmental Science	Medicine	Social Sciences	
Carpathian Journal of Earth and Environmental Sciences	1	Earth and Planetary Sciences	Environmental Science		
Ecological Economics	3	Economics, Econometrics and Finance	Environmental Science		
Ecological Indicators	2	Agricultural and Biological Sciences	Decision Sciences	Environmental Science	
Ecology and Society	10	Environmental Science			
Ekoloji	1	Agricultural and Biological Sciences	Environmental Science		
Environment and Planning C: Government and Policy	1	Environmental Science	Social Sciences		
Environment, Development and Sustainability	1	Economics, Econometrics and Finance	Environmental Science	Social Sciences	
Environmental Education Research	1	Social Sciences			
Environmental Management	2	Environmental Science	Medicine		
Environmental Monitoring and Assessment	1	Environmental Science	Medicine		
Environmental Policy and Governance	1	Environmental Science	Social Sciences		
Environmental Science and Policy	2	Environmental Science	Social Sciences		
Erdkunde	1	Earth and Planetary Sciences	Environmental Science	Social Sciences	
Fish and Fisheries	2	Agricultural and Biological Sciences	Earth and Planetary Sciences	Environmental Science	
Fisheries Oceanography	1	Agricultural and Biological Sciences	Earth and Planetary Sciences		
Forest Policy and Economics	1	Agricultural and Biological Sciences	Economic, Econometrics and Finance	Environmental Science	Social Sciences
Frontiers in Marine Science	1	Agricultural and Biological Sciences	Earth and Planetary Sciences	Engineering	Environmental Science
Global Environmental Change	1	Environmental Science	Social Sciences		
Integrated Environmental Assessment and Management	1	Environmental Science	Social Sciences	Medicine	
International Journal of Agricultural Sustainability	1	Agricultural and Biological Sciences	Economics, Econometrics and Finance		

International Journal of Environmental Research and Public Health	1	Environmental Science	Medicine		
Journal of Environmental Management	4	Environmental Science	Medicine		
Journal of Environmental Planning and Management	1	Chemical Engineering	Environmental Science	Social Sciences	
Journal of Environmental Studies and Sciences	1	Environmental Science	Social Sciences		
Journal of Sustainable Forestry	1	Agricultural and Biological Sciences	Energy	Environmental Science	Social Sciences
Marine Policy	2	Agricultural and Biological Sciences	Economic, Econometrics and Finance	Environmental Science	Social Sciences
Ocean and Coastal Management	1	Agricultural and Biological Sciences	Earth and Planetary Sciences	Environmental Science	
Regional Environmental Change	1	Environmental Science			
Regional Studies	1	Environmental Science	Social Sciences		
Resources Policy	1	Economics, Econometrics and Finance	Environmental Science	Social Sciences	
Science of the Total Environment	2	Environmental Science			
Shengtai Xuebao/ Acta Ecologica Sinica	1	Agricultural and Biological Sciences	Environmental Science		
Sustainability (Switzerland)	3	Energy	Environmental Science	Social Sciences	
Water Policy	1	Environmental Science	Social Sciences		

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