

OPINION ARTICLE

An opinion on adaptive governance and management in water resources restoration projects

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This opinion article presents arguments to sustain the inclusion of local actors in the governance and management of water resource restoration projects. There is a lack of knowledge regarding this issue, and we propose that governance and management must be adaptive because of the complexity and constant modification of the local systems. Our proposal has theoretical, methodological, and management impacts on the network governance of local projects. We present a matrix of variables to facilitate research and management plans.

Key words: local actors, network structure, social inclusion

Implications for Practice

- The evidence about governance and management models for water resource restoration projects is incomplete, which may lead to insufficient outcomes.
- By not considering local actors, water resource restoration projects underestimate their importance in achieving the objectives.
- Group members may consider local actors to be participants in the governance creation process.
- Group members may consider local actors to be participants in project management.
- This article proposes an operational variables matrix of adaptive governance and management to guide research on water resource restoration projects.

Introduction

This opinion article presents arguments about including local actors in the governance and management of water resource restoration projects. The effort is justified based on bibliographical research and evidence collected by the authors on the reasons for success or failure in local water resource recovery projects. We define water resources as stretches of rivers, dams, lagoons, and coastal areas, characterizing a geographically limited area. The oceans or groundwater do not enter, for example.

We present arguments based on network governance and management principles that justify a deeper examination of the mechanisms for including local actors, such as residents, traders, government agents, and participants of local associations.

In addition to the discussion, we present a matrix of network governance and management variables in water resource restoration to guide research and management programs. The main characteristic of the matrix is the adaptability to create and recreate governance, to enable the participation of local actors, and to adapt the management process to achieve group

efficiency and results. That is why we use the expression adaptive governance and management (AGM).

Theoretical Assumptions and Proposition

Articles on the academic and managerial production on restoration and preservation projects for water resources show the dominance of technical variables, such as cataloging living beings and documenting water quality (Xu et al. 2018). They rarely discuss how the project participants, especially the researchers, local actors, and government, coordinate the governance regarding roles and functions and how local actors could help the management process “Empirical studies remain few and fragmented” (Johannessen et al. 2019, p 1).

The governance and management of water resource restoration projects are worthy of further attention. Such projects have heterogeneous participants, including researchers, local agents, traders who explore and depend on the ecosystem resource, residents, Non-governmental organizations (NGO) volunteers, and possibly tourists, all of whom have distinct interests, which creates a challenge in organizing the working group.

While researching articles on water resource restoration, we found several mentions of the importance of governance and management, but attempts to present action models were rare. Two examples of those attempts pointed to the role of adaptability:

- (a) *Instead, public-private partnerships, strategic pacts, dialog groups, consultative committees, and inter-organizational*

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networks, etc., have been discussed as alternative forms of achieving inclusive, collective, and binding governance of resource exploitation (Albornoz & Glückler 2020, p 2).

- (b) *Uncertainty regarding the consequent effects of large-scale kelp removal, along with concern regarding ecosystem effects, and as a “blue carbon” habitat with a role in climate regulation requires sustainable management and necessitates an adaptive governance approach* (Greenhill et al. 2021, p 1).

We propose that the adaptability and flexibility of mechanisms characterize the governance and management of water resource restoration projects under local characteristics and human resources, such as knowledge and capabilities of local actors and local business activities.

The discussion is justified when considering the growing importance of planning and actions to recover water resources, including global plans like The Ocean Decade (<https://oldialogues3rded.colcoalition.ca/>). To support the discussion, we briefly present the concepts of adaptive network governance and adaptive management in local restoration projects.

There are multiple definitions of governance and management in academia. This discussion does not fit within the scope of our article. We use concepts that clearly distinguish the two expressions. Governance is the rules, norms, and practices that organize collective actions (Knox & Arshed 2022). Management refers to obtaining the results intended by the group using human and material resources (Piatak et al. 2018). One of the resources at the manager's disposal is the set of governance rules, which help achieve cohesion and efficiency in the group.

The main question related to governance concerns by whom and how the mechanisms of collective actions are created and recreated. The main question related to management concerns by whom and how the actions to achieve results are organized. We propose that both processes must be collective, including local actors who know the specificities of the water ecosystem, for example, tides, fish, and bird migrations, seasonal effects, seasonality of tourist visitation and use by tourists, and culture of practice of local users.

Following the convergence of statements from the literature review, our proposal is based on the interaction between actors, which leads to the social network approach in that relationships are the axis of structuring networks (Spalter-Roth et al. 2018). So, we have the three principles that define the proposal under discussion: social relations determine the structure and functioning of networks; governance and management must adapt to local conditions; and including local actors is one of the keys to the success of the water resource recovery projects. The following paragraphs detail the evidence that led to the proposition.

Evidence and Analysis

The first evidence supporting the necessity of adaptive governance and management processes (AGM), especially the inclusion of local actors, comes from academic publications on water resource restoration projects. We searched the Scopus portal using the search expressions of adaptive governance,

adaptive management, water ecosystem, water resource, and ecosystem management, combining them in groups of two, three, and finally, all together. Each isolated expression results in thousands of indications (e.g. 5846 for adaptive governance and 94,443 for adaptive management). Combining two expressions reduced the indications to hundreds (e.g. 259 for adaptive governance and water systems). Applying other filters, like a date range of 2016–2024, and eliminating the areas of biology, Earth, energy, genetics, computer, medicine, and biochemistry, we arrived at a selection of 139 articles. Reading the titles and abstracts indicated that 12 articles adhere to the topic.

These articles agreed on the value of local actors' participation through collaborative management and adaptive governance. Figure 1 shows the title and first author of the selected articles.

The expression adaptive governance is dominant in the 12 articles (e.g. Bagherzadeh et al. 2024), stating the need for formal governance to be flexible. Cheng et al. (2022) carried out a literature review on the expression. They found an association with the expression of adaptive management in the sense of norm flexibility (governance) and modes of action (management). This flexibility concerns resolving stakeholder conflicts (Deitch et al. 2021; Handayani et al. 2023).

Regarding management, there is convergence in stating the need for adaptation, especially mapping and using local resources (Kekulandala et al. 2023). Regarding local resources, the actors' knowledge about the resources and community awareness stand out (Yu et al. 2017). Authors comment that local actors adapt according to climate changes or economic activities, suggesting that water resources managers use this knowledge (Nixon et al. 2022). For this local actors' inclusion, the authors suggest actions to survey the learning capacity and awareness of the collective action of local actors (Moghimi Benhangi et al. 2020).

Some articles, especially the most recent ones, value the actors' learning in sharing knowledge and creating a social network of research actors, managers, and local actors (Johannessen et al. 2019; Pollard et al. 2023). Complementing this line of discussion, authors (Pandeya et al. 2021) comment that management based on citizen science, that is, on the participation of local actors, still lacks an established methodology.

The result aligns with our proposal. Regardless of the location, political, or economic situation, the success stories show the governance and management categories with flexibility characteristics. Another observation is that the articles did not focus on specific proposals or models of governance and adaptive management in water resource restoration projects; instead, they described management and governance situations.

The second evidence supporting the proposal came from examples of secondary documentation. To select a few cases, we applied the following rules: (a) It is not a temporary and isolated action, (b) Researchers are participating (not only local initiative), and (c) There is government support.

- (i) The Ribeira das Jardas Linear Park project seeks to restore the stream's water quality in this stretch in Sintra. The

>  Adaptive management as a foundational framework for developing collaborative est...	Deitch et al.
>  Adaptive water governance research in social sciences journals: a bibliometric analysis	Cheng et al.
>  Assessing the learning capacity of water users—Adoption a social learning framework	Moghim Benhan...
>  Designing citizen science for water and ecosystem services management in data-po...	Pandeya et al.
>  Exploring social networks in a small tank cascade system in Northcentral Sri Lanka: Fi...	Kekulandala et al.
>  Incorporating institutions and collective action into a sociohydrological model of flo...	Yu et al.
>  Normative Assessment of Enabling Factors for Adaptive Water Governance; Evidenc...	Bagherzadeh et al.
>  Reframing socio-hydrological research to include a social science perspective	Xu et al.
>  Social influence shapes adaptive water governance: empirical evidence from northw...	Nixon et al.
>  Toward adaptive water governance: An examination on stakeholders engagement a...	Handayani et al.
>  Toward adaptive water governance: the role of systemic feedbacks for learning and ...	Pollard et al.
>  Transforming urban water governance through social (triple-loop) learning	Johannessen et al.

Figure 1. Selected articles about adaptive governance and management in water resources.

project was financed by the Portugal 2020 program (<https://portugal2020.pt/projetos-aprovados/lista-de-operacoes-aprovadas/>), with a deadline of 2018–2023. Participants were students from the university bathed by the river, the population, and the researchers. The positive results allowed the creation of a leisure park around the recovered section. News about the project states that the success was mainly due to the support of the local population, who stopped polluting the river and became water inspectors (<https://sintranoticias.pt/2024/05/11/acao-de-limpeza-voluntaria-na-ribeira-das-jardas-foi-um-sucesso/>).

- (ii) In Bangladesh, local actors created a recovery plan for a mangrove swamp (Khan et al. 2020). Despite different interests from stakeholders, like the government, institutions, and local representations, there was a convergent common objective (depollution and preservation) in the Sundarbans mangrove forests project, facilitating conflict resolution and creating ways of managing collective actions.
- (iii) On the island of Himeshima, in Japan, the coastal area recovery project was successful after the research team added the local population, considering their culture of practice (their rituals of use and relationship with the resource). This inclusion in decisions and management enabled group cohesion, which resulted in the project's success (Chakraborty & Gasparatos 2019). An important point in this project was the consideration of fishermen's rituals.
- (iv) The importance of considering local actors, such as those carrying out economic activity, was also found in a case in Jamaica. In this case, the Fishermen's Group was included and became the leader of decisions and actions (Chan et al. 2019). The case occurred in the Bluefields community. Interviews with local fishermen indicated that they felt marginalized and unwilling to help at the beginning of the project. However, with the evolution of relationships

between local actors and project managers, commitment and the condition for collective actions emerged. With the decision of the fishermen to be the project managers, all resistance was resolved.

The literature presents other examples along the same lines, of which we present a sample (Vince & Hardesty 2017; Greenhill et al. 2021; Salamessy et al. 2021; Granco et al. 2022; Huang et al. 2022; Tucker et al. 2023). The evidence of the data converging in the following points: (1) the importance of considering the local culture; (2) the central point to share the decisions and management; and (3) the importance of considering the sociological impact beyond sustainability. To carry out these tasks, governance and adaptive management are necessary.

Having gathered evidence, we present our proposal for specific governance and management characteristics for local water ecosystem restoration projects.

Characteristics of Adaptive Governance and Management to Include Local Actors

Based on the literature review and case reports, we selected the variables that consistently and repeatedly appeared in the water resource governance and management discussion. The following paragraphs describe the result of this selection.

The logic of the facts indicates that the governance of water resource restoration projects must be an adaptive model system of mechanisms concerning the structure of roles and functions and the dynamics of the group's functioning.

Regarding roles and functions, project leadership is particularly crucial. We affirm that this leadership must be rotating, depending on the task. For example, suppose the action is to verify fishermen's techniques. In that case, the leader must know the characteristics of this task, such as tide, fish behavior, and fishermen practices; that is, they must be a local leader.

Regarding the mechanisms for carrying out tasks, the principle is to merge subgroups to optimize the exchange of information and work modes. For example, to create the rules for meeting times and agendas, it is necessary to know the schedules of local people, such as local leisure practices and family time.

Adaptability means that rules can and should be modified depending on changes in the situation, such as weather events, the arrival of volunteers, and intense tourism on weekends (in tourist areas). Adaptability is not mismanagement. Group dynamic theories state that when people participate in creating and adapting rules, they are more likely to commit to following them (Long 1992). Local actors' participation in governance is meaningful in achieving this commitment.

An essential function of governance is to resolve or minimize conflicts of interest and knowledge. Consistent with the previous paragraph's statement, we highlighted the importance of local participation so that asymmetries are recognized and resolved as quickly as possible, creating synergy in the group.

These results of adaptive governance are essential for group management. The manager(s) need to ensure that each group member knows their roles and functions, leadership is

recognized and legitimized, and rules and practices for carrying out tasks are established so they can use all available social capital to obtain results.

A crucial point regarding adaptive management is the consideration of local cultural practices and the knowledge about the recurring habits of local actors regarding their relationship with the ecosystem, whether preservation or exploration. By acting to obtain the adhesion and cooperation of these local actors, including participation in the project stages, such as collection and analysis, the manager can count on an important knowledge resource for the recovery of the water resource and the elimination of unsustainable exploitation practices.

Table 1 presents the summary matrix of the main variables in water ecosystem restoration projects, with a brief description of each.

As can be seen, governance and management constitute a system with complementary processes, reciprocal influences, and sometimes with areas of intersection, for example, when management indicates the need to change governance rules that make it challenging to obtain results.

It is important to mention that the concept of adaptive governance is neither traditional nor dominant in network management.

Table 1. Variables regarding water resource restoration projects.

Variables	Adaptive governance	Adaptive management
Relationship: trust, commitment, power games	Rules are based on equity, inclusion of diversity, respect, seeking to resolve conflicts of interest, and power games. Adaptation is based on signs of possible relationship changes in the group (e.g. the emergence of a power struggle situation).	Actions regarding meetings and tasks are constantly adjusted to enable the discovery of possible conflicts of interest and solutions. Action adjustments result in actors' trust and commitment, which facilitate decision-making and efforts to achieve objectives.
Network structure: roles, functions, leadership, rules of entrance to and exit from the group	Creates and adjusts member entry and exit mechanisms, rules for determining task leaders, and rules for determining roles and functions.	Seeks to obtain participation from local actors, constantly updates human resources to adjust roles and functions, ensures leadership rotation occurs according to task, and uses network centrality to disseminate information.
Network functionality.	Adapts rules on schedules, work groups, the sequence of operations, the collective use of resources, forms of production control, and forms of decision-making.	Adjusts and controls task flow, including using local actors' resources.
Conjoint operations	Creates rules and standards to control inappropriate practices by local actors.	It aims to eliminate resistance to changing practices contrary to the sustainability objectives and to reinforce sustainable actions.
Culture of practice and environmental education	Creates rules for disseminating environmental education. Mechanisms to include local practices as knowledge in the project team.	Promotes meetings and other forms of communication to disseminate environmental education. Uses sustainable local practices to obtain results.
Objectives	Achieve group cohesion, create a task production model with minimal conflicts, and control opportunistic behaviors. Governance needs to adapt in accordance with the task's complexity and the actors' diversity, especially by including local actors and their resources.	The manager's actions aim to achieve results. All governance rules that contribute to this purpose will be used. The group adjusts the rules that offer resistance. Management is adaptive, considering the task complexity and the actors' diversity.
The operation	Interactions with local actors drive project actions (relationship category), and roles and functions must be defined for these actors (structure category). In collective operations (functionality category), local knowledge and local practices must be considered (culture category and environmental education). Each of these factors will lead to adjusting the project's mechanisms, hence the expression <i>adaptive governance</i> .	We suggest following the network management steps: (a) Attract local actors to the project. (b) Raise awareness of collective action. (c) Align interests and objectives. (d) Create an action schedule. (e) Control the flow of actions. (f) Make the necessary adjustments according to changes.

The dominant concept is to create a framework for mechanisms that are as rigid as possible under the assumption that change implies disorder (Batory & Svensson 2020). Our understanding is that this does not happen. Adjusting the rules is necessary for group cohesion and functionality. Dynamic group theory asserts that refusing to change rules brings disorder because it results in the emergence of parallel, informal governance and interest conflicts (Gash 2017).

Tasks involving dynamic systems, such as water ecosystems, or extreme phenomena, such as catastrophes, require a different approach than the classical literature on the governance of stable networks. This article presents a possible answer to a governance matrix for water resource restoration projects.

Final Comments

There is a lack of studies and knowledge about governance and management in water resource restoration projects. It turns out that this task is complex because specialists need to work together. This joint work includes local actors, residents, traders, government agents, representatives of diverse associations, and, ultimately, tourists, all active in the ecosystem's degradation and recovery. In summary, a project's success is directly related to including local actors in project activities, especially by using their tacit knowledge and solving conflicts of interest.

For example, in a mangrove cleaning action in which the authors of this article participated, the participants' roles and tasks had to be reordered based on information from local fishermen about tidal movements and mangrove animals. Consequently, a change of leadership was necessary.

We propose that the governance and management of recovery projects must be guided by adaptability, both in the governance mechanisms and the management strategy of actions.

We present arguments and evidence supporting the above statement and offer a matrix describing specific governance and management variables for restoration projects. The matrix can be a starting point for studies and plans for managing people and tasks.

Our proposal significantly impacts some assumptions of administration sciences and network management. Firstly, we promote the concept of adaptive governance, which is not the standard in this field. It involves continuously reconstructing the mechanisms that regulate and guide collective actions while always considering the inclusion of local actors.

Secondly, we challenge the traditional concept of leadership. Generally, researchers and managers state that established, legitimized, and perennial leadership is essential for forming and developing networks. In the matrix presented here, the mechanisms that define leaders and leadership are variable, depending on the task and available human resources.

Including local actors in a project's actions is a valuable contribution to the theme of responsible, transparent, inclusive citizen science. The increasing academic discourse involves making applied science available to the affected population (Roszczynska-Kurasinska et al. 2023).

This opinion article opens up a discussion about water resource recovery projects. Our analysis, examples, and scope of coverage are restricted to this field of action, with no intention

of generalization. We hope the proposal will result in more discussion on the organization and operation of ecosystem recovery projects, which is an absent point in articles, reports, and presentations that focus more on technical aspects.

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