Comparing apples and oranges? Accounting for project diversity in monitoring and evaluation programs for river restoration

Mélanger des choux et des carottes ? Prise en compte de la diversité des projets dans les programmes de suivi de la restauration des cours d'eau

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RÉSUMÉ

La plupart des projets de restauration des rivières sont mis en œuvre dans un contexte complexe et incertain en ce qui concerne l'exploitation des bassins versants, les attentes sociétales et les contraintes financières. Ce contexte, avec ses défis et opportunités particuliers, doit être pris en compte lors de l'élaboration d'un programme de suivi s'appuyant sur des échantillonnages standardisés et une comparaison systématique entre projets. Je présenterai un cadre conceptuel pour saisir cette diversité selon huit dimensions principales qui sont en partie liées entre elles, impliquent à la fois des opportunités et des défis, peuvent varier en importance relative entre les projets et dans le temps et sont donc souvent imprévisibles et incertaines. Je discuterai de la façon dont la diversité des projets se traduit par la comparabilité entre les projets et la transférabilité des résultats. Je conclurai avec les implications pour la science et la pratique de la restauration des rivières.

ABSTRACT

Most river restoration projects are implemented in a complex and uncertain context regarding catchment exploitation, societal expectations and financial constraints. This context with its particular challenges and opportunities has to be considered when developing a framework for programmatic monitoring and evaluation building on standardized surveys and systematic cross-project comparison. I will present a conceptual framework to capture this diversity along eight major dimensions that are partly interlinked, involve both opportunities and challenges, can vary in relative importance across projects and over time, and are therefore often unpredictable and uncertain. I will discuss how project diversity translates into comparability across projects and transferability of results. I will conclude with implications for river restoration science and practice.

KEYWORDS

Collaborative learning, complexity, comparability, transferability

1 SYNTHESIZING A COMPLEX CONTEXT

The planning, implementation, evaluation and maintenance of river restoration projects represent a complex environmental management problem (Allan 2007). Complexity can be expressed along eight major dimensions that (i) are partly interlinked, (ii) involve both opportunities and challenges, (iii) can vary in relative importance across projects and over time, and (iv) are therefore often unpredictable and uncertain (Figure 1; Weber et al. 2017).

1. Biophysical setting: Rivers are highly dynamic ecosystems, with biotic and abiotic processes interacting in complex ways across multiple spatio-temporal scales. Organisms have developed a myriad of strategies to cope with these environmental dynamics and many are dependent on them, leading to an extraordinary and often locally very distinct biodiversity – from genes to assemblages and from a functional and structural perspective.
2. Human pressures: Rivers are among the most intensively used ecosystems of the world. Human activities exert multiple pressures on structure and function of rivers, be it via historical legacies in the catchment or emerging impacts from global to local scale such as climate change or the presence of micropollutants. Pressures can interact with each other in many different ways and abiotic and biotic responses can follow complex spatio-temporal trajectories (e.g. threshold response, lag time).
3. Socio-economics: Socio-economic factors at the local to regional scale influence the context in which restoration happens such as the financial resources, economic development, population growth or the political composition. Furthermore, the provision of ecosystem services from rivers is of socio-economic relevance and interest (e.g. recreational use, flood protection, drinking water supply).
4. Policy framework: Different countries have different priorities in river management, with some policy frameworks explicitly promoting restoration (e.g. European Water Framework Directive) or providing funding for monitoring (Swiss Water Protection Act). The policy and management process is often cyclic, allowing for revisions after a review phase at a predefined time.
5. Stakeholder diversity: River restoration is a truly transdisciplinary endeavour where specialists and non-specialists from different fields of work and with various disciplinary backgrounds interact. Inherent in this is a diversity of interests, expectations, approaches, vocabularies, knowledge and experiences.
6. Project characteristics: Restoration projects differ a lot among each other, e.g. in their size, the techniques used, the objectives set or the intensity of restoration. Furthermore, projects can be organized in various ways regarding institutional responsibilities, volunteer involvement, or duration of implementation.
7. Technological opportunities: Continuous technological advances influence all phases of river restoration, from the construction phase with GPS-controlled caterpillars for channel excavation to the monitoring phase where remote sensing, genetic approaches and many other novel techniques offer new mechanistic insights at increasingly cheap prices.
8. Available knowledge and experience: River restoration is a rather young activity, both from a science and management perspective. Some aspects have been intensively studied over the past three decades such as biotic and abiotic structure of restored reaches, whereas other domains have been considerably understudied (e.g. recovery trajectory, size of restoration, ecosystem functions, ecosystem services).

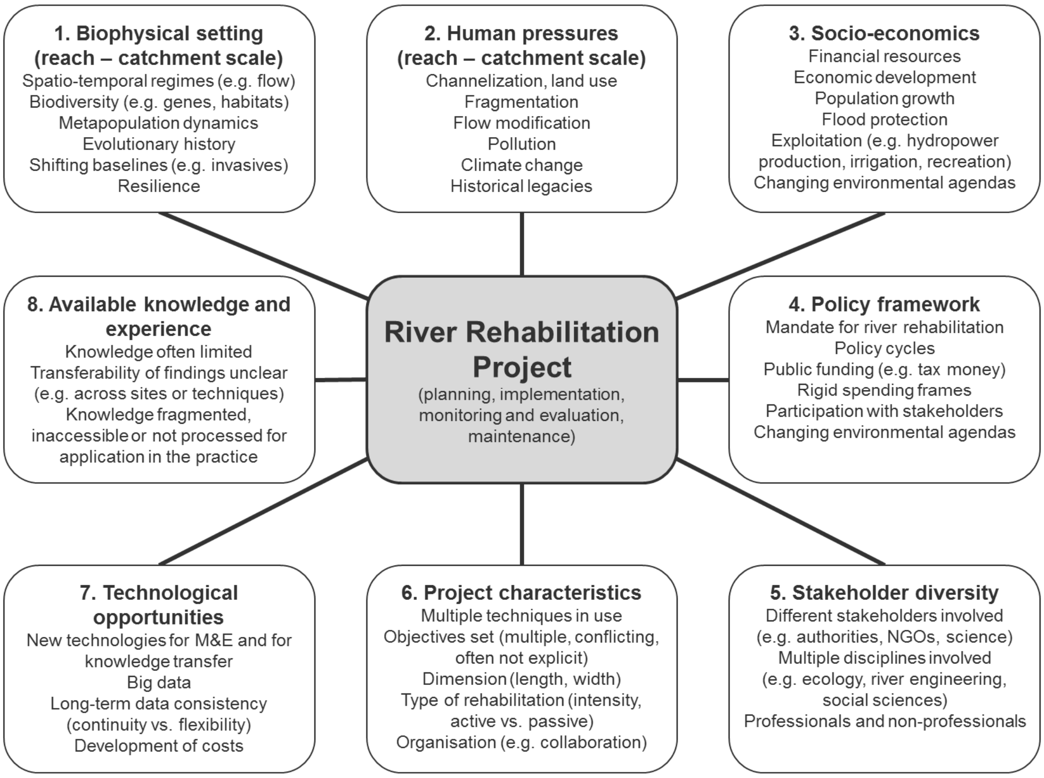

Figure 1: Conceptual model illustrating the complexity involved in planning, implementation, evaluation and maintenance of river restoration projects. Complexity can be expressed along eight dimensions (1-8). These dimensions are partly interlinked (not shown). Modified from Weber et al. 2017.

2 CONSIDERATION OF CONTEXT IN MONITORING AND EVALUATION

Awareness of and sensitivity to the complex context described above is needed to frame appropriate and sound monitoring and evaluation (M&E) surveys for river restoration, in particular if individual projects should be compared within a larger program at the regional or federal scale. In such programmatic M&E three questions become relevant. (i) Comparability: When do we consider two projects comparable, i.e. under which preconditions and to what extent are cross-project comparisons possible and meaningful? (ii) Transferability of findings: to what extent and under what conditions can findings gained at a subset of projects be transferred to other projects/ project contexts? (iii) Implications for science and management: what are the consequences of the points discussed above for collaborative learning and evidence-based management?

Contextual information can be considered in programmatic M&E in two ways (Weber et al. 2017) – by means of explanatory variables or by grouping projects in the sampling design (= stratification).

- Explanatory variables: Explanatory variables represent key environmental attributes, including stressors, that can influence the recovery trajectory in the restored reaches, even when operating outside the restoration area. Explanatory variables can be collected as part of the implementation monitoring (Roni et al. 2015) and can be included in the statistical analysis at the program scale.
- Stratification: Sampling design should consider stratification of projects by contextual information, e.g. by river type, restoration technique or project size, ensuring that relevant indicators are surveyed and that there is sufficient sampling size for analysis (Roni et al. 2015).

Programmatic M&E must facilitate a better understanding of why the observed effects were manifested. This goal refers to the inherent challenge of studying real-world trajectories. Many unforeseen and unknown factors can interact with the implemented measures in complex ways (synergistic, antagonistic), leading to complex ecological feedbacks and surprises. Such interactions cannot be inferred from only measuring the size and direction of change. Well-designed and well-executed M&E has the potential to identify the driving factors, to reduce or at least quantify uncertainty and to improve our ability to forecast potential outcomes. It will also provide information to increase our understanding of causal relationships and to make generalizations from site-specific M&E, which in turn can feed into adaptation (Allan 2007).

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