Challenges and Opportunities in Upscaling Room for the River: A Conversation about Large-scale Change through Small-scale Interventions

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DOI
10.24404/6151d869b3dd970008eaf672

Publication date
2022

Document Version
Final published version

Published in
The Evolving Scholar

INTERNATIONAL FORUM ON URBANISM
TU Delft OPEN

From dichotomies to dialogues -
connecting discourses for a sustainable urbanism

The 14th conference of the International Forum on Urbanism (IFoU), 25-27 November 2021

Type of the Paper: Peer-reviewed Conference Paper / Full Paper

Track title: Political ecology and adaptive and transformative framework

Challenges and Opportunities in Upscaling Room for the River: A Conversation about Large-scale Change through Small-scale Interventions

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Taneha Bacchin

Journal: The Evolving Scholar
DOI:10.24404/6151d869b3dd970008eaf672

Submitted: 27 September 2021
Accepted: 01 June 2022
Published: 10 October 2022

Citation: Recubenis Sanchis, I. & van der Meulen, G. (2021). Challenges and Opportunities in Upscaling Room for the River: A Conversation about Large-scale Change through Small-scale Interventions. The Evolving Scholar | IFoU 14th Edition.

Abstract: Highlighted by the recent 2021 flood events in Europe, this research takes the momentum to underline the necessity for radical solutions that embrace uncertain and extreme discharges at the core of planning and design frameworks. Building upon existing Adaptive Management practices in the Netherlands, this research takes the experience of the Room for the River programme to discuss the challenges and opportunities arising from its (eventually inevitable) upscaling in the context of the Netherlands. It does so by means of two spatial and two managerial inquiries to draw conclusions on the complexities and entry points to shift towards large-scale change through small-scale interventions.

Keywords: design-thinking, climate adaptation, flood risk management, Room for the River

1. Introduction

In July 2021, Europe experienced floods caused by extreme rainfall events and consequential rapidly fluctuating stormwater discharges. Rising climate change awareness and the preceding occurrence of similar flood incidents globally underline the necessity for the (continuation of the) advancement of flood risk management. For the affected area, such catastrophes can, in fact, provide the decisive tipping points prompting adaptation, whereas outside of this area, the catastrophe regularly serves merely as a reality check, commonly insufficiently capable of (re-)generating the need for adaptation (Rosenzweig & Solecki, 2014; Van der Meulen, 2018).

While the repercussions of the July 2021 floods were most devastating in German and Belgian lands in the Rhine-Meuse watershed, in 1993 and 1995, the same watershed was the stage of similar high discharge volumes in the Netherlands. Despite repercussions then being limited to large-scale evacuations, the near flood, together with an increased concern with the environment and a better understanding of the effects of climate change, triggered a transition in flood risk management (Portugali et al., 2016). With the conviction of improving water safety and robustness alongside spatial and environmental qualities, this transition was translated, in 2005, in the national planning policy project "Room for the River" (RfR) (Portugali et al., 2016).

In light of recent events, this paper takes the successful RfR to discuss the challenges and opportunities arising from its (eventually inevitable) upscaling in the context of the Netherlands. It does so by means of two spatial and two managerial inquiries to draw conclusions on the complexities and entry points to shift towards large-scale change through small-scale interventions.

2. Theories and Methods

Room for the River is an exemplary programme and stepping stone in Adaptive Management, an approach that integrates scientific knowledge into environmental decision-making by adopting cycles of improvement, understanding, and management (Armitage et al., 2008; Zevenbergen et al., 2015). As such, the programme is guided by the adoption of a systems approach, participatory decision-making, learning, and experimentation (Zevenbergen et al., 2015). Both from a narrative point of view – accommodating water and living with water – and from a policy approach point of view – multi-actor network governance, the programme signifies the end of an era of battling against water in an authoritarian government style (Roth et al., 2021).

In this sense, RfR is considered a solid foundation upon which to build the necessary upscaling of flood risk management. On the bases of recent RfR experience review (Roth et al., 2021; den Boer et al., 2019; Edelenbos et al., 2017), the paper synthesizes (and updates) some of the conclusions of a year-long thesis on the Dutch Upper Delta (or Waterschap Rivierenland) (Recubenis Sanchis, 2020). To do so, it takes four spatial and managerial lines of inquiry targeting key aspects in dealing with flood dynamicity and extremes, time-pressure, preparedness, and uncertainty, namely: floodplain area, size, and number of interventions, social engagement, and long-term goals. As seen in Table 1, each spatial and managerial aspect is supported by theory notions and/or reported experience, being, in order: flood robustness (Klijn et al., 2018), implementability and citizen involvement (by Roth et al., 2021; Forrest et al., 2020; Den Boer et al., 2019; Edelenbos et al., 2016), flood preparedness (Davoudi et al., (2013), spatial redundancy (Roggema, 2021), and dynamic adaptive policy pathways (Haasnoot et al., 2012).

Table 1. Supporting theory notions and research.

Critical conditions	Spatial inquiry	Managerial inquiry	Supporting research
Flood dynamicity and extremes	Floodplain area	-	Flood robustness, Klijn et al., (2018)
Time-pressure	Size and number of interventions	-	(Reported) implementability, Roth et al., (2021), Forrest et al., (2020), den Boer et al., (2019), Edelenbos et al., (2016)
Flood preparedness	-	Stakeholder engagement	(Reported) citizen involvement, Roth et al., (2021), Forrest et al., (2020), den Boer et al., (2019), Edelenbos et al., (2016),
Uncertainty	-	Long-term goals	spatial redundancy, Roggema, (2021) & Dynamic Adaptive Policy Pathways, Haasnot et al., (2012)

By means of *what if* questions and scenario-building, a process of design-thinking is activated, enabling the start of an inventory of challenges and opportunities in moving towards an upscaling of RfR's scope.

- In light of extreme events, how to increase the robustness of the system? What if the full urbanized delta could be, by design, floodable?
- In light of accelerated climate change, how to accelerate the pace of implementation? What if flood risk management was implemented by means of an increased number of small transformations?
- In light of the inevitable floods, how can flood preparedness be drastically increased? What if flood risk management was implemented by means of a cooperation of top-down and self-organised initiatives?
- In light of highly dynamic and uncertain discharges and weather-events, how can a a system be delivered that is adaptable to future demands? What if the proposal could embrace a water-accommodation capacity that could adapt and evolve in time?

3. Results

With a recurrent structure, each line of inquiry guides an alternative perspective (line of opportunity) and subsequent cultural and managerial premises for the implementation of a more radical approach to give room to rivers.

3.1. Upscaling the scope of RfR by increasing the floodplain area

The first inquiry revolves around the current meaning – in spatial and managerial terms – of floodplains. In RfR, 34 projects increase room for the river by effectively executing a new, confined wider and deeper floodplain. In this sense, the management of floods is restricted to the areas outside the relocated, improved and/or heightened dykes, whereas the urbanised floodplain within dykes is meant to remain dry, unchanged, and unaware. The physical definition (or confinement) of floodplains has a strong management implication, namely, the existence of protecting/active areas – outside dykes – and protected/passive areas – inside dikes. However, given the recognised dynamicity of river discharges and extreme weather events, the costs of keeping this assumption can be very high, including: risk of critical damage if the dykes were to break (Klijn et al., 2018); unprepared inhabitants within the so-called "safe and dry areas" (De Bruijn et al., 2017; Terpstra, 2010).

In light of extreme events, how can the robustness of the system be increased? What if the full urbanised delta could be, by design, floodable?

Envision a river with a multitude of ramifications, a network of floodable pathways and depressed areas designed to be flooded when needed and an urbanised delta designed to respond collectively during extreme river discharges (see Figure 1).

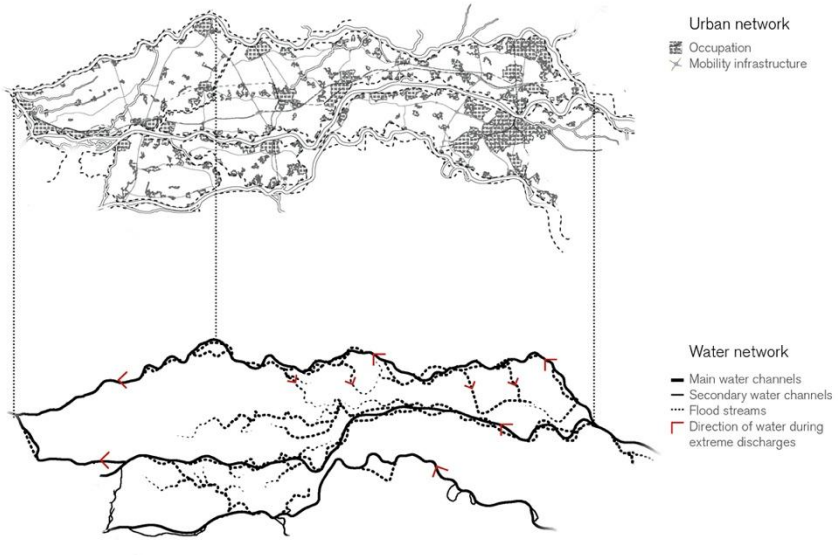

Figure 1. Rivierenland flood network

This vision would work along with:

- A shift of agricultural land values focused on soil health. The inquiry would require moving away from intensive agricultural practices, crop "efficiency," and "productivity" responsible for the critical soil state (Orgiazzi et al., 2016), and instead transitioning towards the notion of crop resilience. In this sense, the eventual flood of agricultural land would be seen as part of a process of soil renewal with the associated lateral exchange of nutrients and organisms – flood pulse (Junk et al., 1989; Tockner et al., 2000) – which, together with the adoption of regenerative practices (Murakami, 1991), would improve soil health, ensuring crop resilience against extreme weather events, pests, and pathogens (Moebius-Clune et al., 2016);
- The cultural acceptance of small floods. According to Klijn et al., (2018) people value large consequences as more important than frequency of occurrence. Therefore,

despite psychological limitations in climate change mitigation and adaptation which decelerate the cultural process of acceptance (Scheffer & Wesley, 2007), the initial unwillingness to accept small floods could, in time, be reversed, as means to avoid major disasters.

3.2. Upscaling the scope of RfR by downscaling the scale of interventions

Continuing with the previous vision, namely, unlocking the full urbanised delta extension as floodplain, the second inquiry discusses the road to its spatial (and managerial) implementation. In RfR, the enlargement of the floodplains takes place through the development of a few big projects. This *modus operandi* involves a series of challenges, namely: an uneven distribution of affected people and municipalities (Edelenbos, 2017; Roth et al., 2021); and a valuable amount of time in executing big projects which are not performative/operative until completion.

In light of accelerated climate change, how can the pace of implementation be accelerated? What if flood risk management was implemented by means of an increased number of small transformations?

I a series of small patches of lowered land spread throughout the agricultural land. In a cumulative process of transformation, the aggregation of patches would form regional clusters, eventually taking part of the river system as a ramified flood network (see Figure 2). In this sense, the interventions could be performative from the beginning, moving from a water storage function during extreme weather-related events, to a buffer function during extreme river discharges as the network increased (in flood capacity). From an executional point of view, this approach would entail a series of small investments spread throughout the territory, shortening implementation times. From a financial point of view, the investment dedicated to the implementation of the programme interventions could be redirected directly to the affected farmers, now also executioners of the programme.

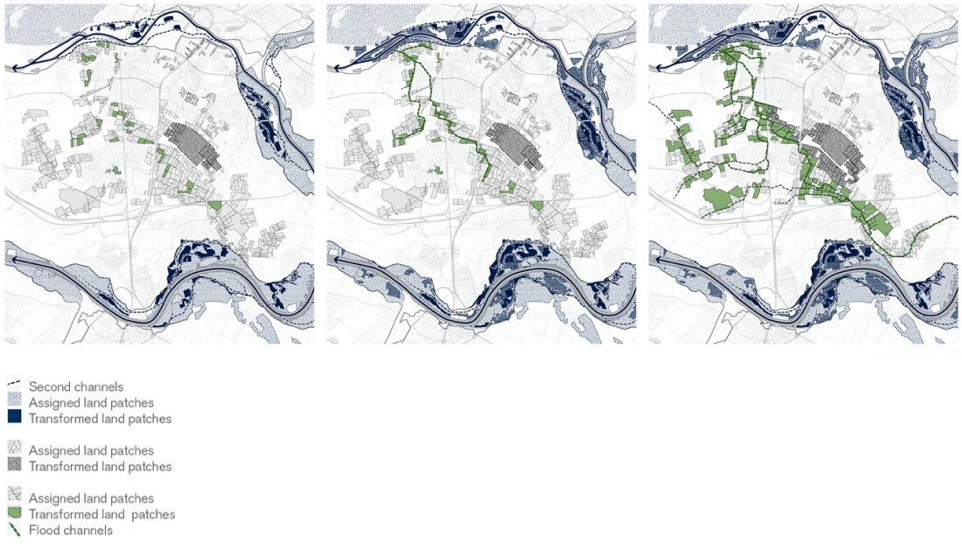

Figure 2. Flood network implementation example between Arnhem and Nijmegen.

This vision would work along with:

- A widespread landowner engagement to execute and maintain floodable patches of land. From a cultural perspective, the Dutch have a strong tradition in taking issues into their own hands, even when it comes to flood risk management. Looking at the RfR experience review, both Edelenbos et al., (2016) and Roth et al., (2021) report stakeholder/citizen initiative, self-organisation, and local self-responsibility, especially when reacting to proposed government policies. The resources needed to support this motivation and engagement could be monetary (economic incentives), but also as internal knowledge and expertise in the areas of safety (see the Kampen case in Roth et al., 2021).

- Unlocking the need to fully control a growing network, changing in size and shape and involving an incremental number of stakeholders and available land (see following section).

3.3. Upscaling the scope of RfR by increasing stakeholder engagement

Inquiries 1 and 2 imply the key role of stakeholder and social engagement, both for citizens with and without land ownership, participating in the transformation. In RfR, social engagement happens through participatory decision-making. However, according to Roth et al., (2021), experts determine which risks are acceptable and, therefore the decision-making remains basically top-down and technocratic, highlighting a desynchronisation between breakthrough policy narrative and the necessary but non-sufficient flood risk awareness; the lack of clarity regarding citizens' responsibilities and scope of action; a governance arena increasingly difficult to grasp for citizens; and the co-optation of critical citizens for an orchestrated participation that conceals rather than deals with conflicts (e.g., citizens as a powerless "sounding-board" council). All of which demonstrate an increasing gap between climate action and citizen involvement, the distancing of citizens from an active involvement (and understanding) of future challenges; and the non-involvement of citizens in deciding which risks are acceptable to them. In this way, the inquiry hints at the close interconnection between social engagement and flood-preparedness, which, as explored by Davouidi et al., (2013), is key in tying together persistence, transformability, and adaptability to Climate Adaptation.

In light of the inevitable floods, how can flood preparedness be drastically increased? What if flood risk management was implemented by means of a cooperation of top-down and self-organised initiatives?

Imagine the partial lowering of fields to start as a self-organised, self-served initiative where regional and national bodies take their part by connecting the dispersed patches into a regional network (see Figure 2). In this vision, order is enabled by the articulatory role of these entities, setting guidelines in designing and executing regional corridors connecting the (already) executed patches to an upgraded network with the river system.

This vision would work along with:

- A coordination of formal and self-organised initiatives through communication, monitoring, and reassessment. In this sense, the experience of RfR with the Programme Directorate (PDR) and the nomination of an external team for the assessment and monitoring (Q-TEAM) (Van Twist et al., 2011), could be directly transposable. The continuous monitoring and reassessment of the transformation would, on the one hand, serve as means to maintain the incentives system, while at the same time be used to adopt cycles of improvement (Armitage et al., 2008). In practice, Forrest et al., (2020) has recently reported the emergence of citizen contribution and interactions with public authorities in Dutch pluvial flood risk management in Arnhem.
- An advancement of societal limits to adaptation (Adger et al., 2008). Adaptation is commonly confined by economic, ecological, physical, and technological limits, beyond which it is considered impossible. Adger et al. (2008), however, argue that adaptation is confined by a society's attitude to ethics, culture, knowledge, and risk, which means limits are society-dependent and therefore mutable. This implies that adaptive capacity can be enhanced by increased citizen involvement and awareness, changing a society's perception.

3.4. Upscaling the scope of RfR by enabling an evolutionary water-accommodation capacity

As a result of the previously discussed inquiries, this one comes as the ultimate consequence (or goal, depending on the perspective), of the envisioned upscaling. The inquiry challenges the RfR long term adaptability through fixed long-term goals, namely, a water safety objective of 16,000 m3/s in 2018 (Van Twist et al., 2011; Klijn et al., 2018), and proposes to reach similar future goals with a sequence of short-term perspectives.

In light of highly dynamic and uncertain discharges and weather-events, how can a system that is adaptable to future demands be delivered? What if the proposal could embrace a water-accommodation capacity that could adapt and evolve in time?

Considering the aforementioned vision (previous inquiries), imagine the upscaling of the flood network to occur progressively, as new land patches were to become available and added into the network. The existence of multipurpose "voids" would enable the accommodation of different needs, turning the Rivierenland landscape into different degrees of a "water world" according to the level of discharge, intensity, and the amount of precipitation.

This vision would work along with:

- Redundancy, a defining feature of all metabolic networks (Sambamoorthy et al., 2019). As a design principle, it has been used to enhance the adaptive capacity of urban environments, as seen in the water square project(s) in Rotterdam or the "Floodable Eemsdelta" project in the northern part of the Netherlands, where parts of the urban and agricultural landscape were made redundant to accommodate different uses according to the type of emergency (see Roggema, 2021). In this case, the multiple available/pre-prepared floodable land patches, could be activated as water-accomodation ponds, allowing for the necessary space for adaptation.
- Dynamic adaptive policy pathways (DAPP) (Haasnoot et al., 2012), a method favored by policy advisors and policymakers (EEA, 2012) and key to major flood risk management programmes (e.g., Dutch Delta Programme (Haasnoot, 2013), the New York metropolitan region (Rosenzweig & Solecki, 2010), and Thames's estuary (Reeder & Ranger, 2011)). DAPP presents all possible scenario-specific flood risk management actions and interventions in parallel, as a road map following tipping points, continuously scoping, and anticipating possible options for change and efficiency as future development unrolls. By doing so, DAPP allows the consideration of both transitional and long-term, and short-term and incremental interventions side by side.

Table 2 summarizes the key points of the results section.

Table 2. Summary of research results.

Inquiries	RfR	Opportunity	Premises	Supporting research
Flood plain area	confined	*Extremely robust system?* Unconfined floodplain	• Shift of agricultural land values focused on soil health; • Cultural acceptance of small floods	• Flood of agricultural land as a process of soil renewal (Junk et al., 1989; Tockner et al., 2000) Crop resilience through soil health (Moebius-Clune, 2016); • Willingness to accept small floods as means to avoid major disasters (Klijn et al., 2018)
Size and number of projects	Few, big projects	*Quicker to implement?* Many, small projects	• Widespread landowner engagement to execute and maintain floodable patches of land; • Let go of need to fully control a growing network	• RfR reported stakeholder initiative, self-organization and local self-responsibility in flood risk management (Roth et al., 2021; Edelenbos et al., 2016) • RfR experience in monitoring and reassessment (Van Twist et al., 2011)

Stakeholder engagement	Local stakeholders as 'sounding-board'	*Universal flood preparedness?* Local stakeholders as actors of change	• Coordination of top-down and self-organised initiatives; • Advancement of societal limits to adaptation	• RfR experience of emerging citizen contribution, roles and interactions with public authorities in Dutch pluvial flood risk management (Forrest et al., 2020) • The adaptive capacity can be enhanced by increased citizen involvement and awareness since limits to adaptation are society-dependent and mutable (Adger et al., 2008)
Long-term goals	fixed	*Adaptable to future demands?* Open-evolutionary	• Spatial Redundancy • Short-term and incremental interventions together with transitional long-term change	• Dutch experience with spatial redundancy shows it as a strategy to accommodate emergencies (Roggema, 2021) • Dynamic adaptive policy pathways as a favored policy method to adapt to uncertainty (Hassnoot et al., 2012)

4. Discussion

To enable the reflection on the potential of the radical upscaling of Dutch flood risk management, design, and planning practice, this paper uses abstraction as a way of design thinking to address the highly complex, multi-scalar (spatially and temporally), and multidisciplinary challenge. Abstraction can, however, provoke oversimplification and both over- and underestimation of future conditions (Stolk, 2015). The authors therefore acknowledge the limitations of the reflection and the disregard of topics of relevance to the lines of inquiry. Such topics include the current and future influence of political and economic stability and the compartmentalisation of flood risk management bodies and responsibilities, among others.

By means of a framework of open questions that follow the current state of affairs and state of the art, the paper initiates and unlocks a discussion on the implementability and operationalisation, and challenges and opportunities of upscaling in line with the conference format "from dichotomies to dialogues." Ultimately, this exploratory and design-thinking nature of the paper allows us to question and reflect on the validity of prior assumptions (such as the meaning of "floodplain" in the Dutch Delta). As such, it taps into the strength of design to initiate collective behavioral change (Brugmans, 2018) and accelerate the necessity of change by mobilising a longing for change (Alkemade et al., 2018). The paper sets the arena to address the present state of Crisis as the passage from one particular mode of functioning to another (Valery, 1925), as part of the evolutionary cycles of adaptation, as a moment of deconstruction and disassembly of meanings and values to enable the construction of new ones (Holling, 1995).

5. Conclusion

Learning from Dutch history, different trends in flood risk management have been accompanied by different forms of governance, citizen involvement, policy narratives, and spatial interventions (Roth et al., 2021; Hooimeijer, 2014). In the need to continue upscaling flood risk management, the Netherlands is, from a policy, narrative, and even a technological point of view, at the forefront. However, as discussed in the paper, a technocratic definition of adaptation limits and risk, and the confinement of flood risk management to the areas outside the dykes, are some of the barriers that have been containing a more radical approach to the upscaling task, effectively containing the co-production of nature and society.

In addressing flood dynamicity and extremes, time-pressure, preparedness, and uncertainty, the proposed lines of inquiry target: floodplain area, size, and the number of interventions, social engagement, and long-term goals. By looking into them, the paper questions the aforementioned spatial, cultural, and policy assumptions and guides the collective imagination of a vision in which large-scale change (the increased room for rivers) is designed to unfold through small-scale interventions (repurposed agricultural land patches).

While the paper's aim is not solution-driven, the vision exercise highlights key aspects and principles for the upscaling, namely: interconnectedness among political and ecological change and non-hierarchy among spatial and managerial takes of the issue. As seen in Table 2, a decentralised network of localised floodable ponds spread throughout the watershed goes hand in hand with a widespread landowner engagement, the cultural acceptance of small floods, and, ultimately, flood preparedness. At the same time, by means of widespread stakeholder engagement, increasing parts of the territory can be activated, enlarging the flood network while making it adaptable to uncertainty and extremes through spatial redundancy. By being interconnected and non-hierarchical, the explored spatial and managerial inquiries act, in fact, as four different entry points to trigger the upscaling task.

In this sense, from a political ecology perspective, the paper highlights the fundamental nature-society dialectic to upscale room for rivers, where: the cultural take (acceptance of small floods) enables (or is enabled by) the spatial take (decentralized flood network), which triggers (or is triggered by) a managerial take (stakeholder engagement), and a policy take (society-dependent adaptation limits).

Contributor statement

Conceptualization: Author 1, Author 2
Resources: Author 1, Author 2
Visualization: Author 1
Writing - Original Draft: Author 1
Writing - Review & Editing: Author 1, Author 2

Acknowledgments

This paper synthesizes some of the conclusions of a year-long graduation thesis at TU Delft (Recubenis Sanchis, 2020), under the valuable mentorship of Diego Andres Sepulveda Carmona (TU Delft), Taneha Kuzniecow Bacchin (TU Delft) and Geert J.M. van der Meulen (TU Delft). Their support and guidance were key in the development of the thesis, setting the basis for the synthesis effort done in this paper.

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