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# Rain and the City: Pathways to Mainstreaming Rainwater Harvesting in Berlin

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***ABSTRACT:*** ***Rainwater collection has long been a staple of the aspirant sustainable city's toolkit. A multitude of successful pilot projects in industrialized cities throughout the world have shown the many advantages of on–site rainwater retention, infiltration, and utilization. The transition from specialized to mainstream, on the other hand, has been mainly elusive. In terms of unfavorable institutional settings and obstinate sociotechnical regimes, recent research has given significant reasons for such stymied transformations. However, the urban aspects of rainwater collecting have received little attention. We know relatively little about how the 'urban' influences, and is influenced by, rainwater management policies and practices, despite numerous case studies on rainwater harvesting in cities. To explain the dynamic connections between rainwater harvesting and the city, this article relies on recent contributions to transitions research from human geography and urban studies. It provides a long-term examination of the policies and initiatives undertaken to encourage rainwater harvesting in the city of Berlin, which was an early pioneer of such technology. The results of the study show a great deal of variation over the last 30 years, not only in terms of the tools used and plans created, but also in terms of political motivations and priorities. This is understood in terms of changing settings and contingent occurrences in (and beyond) Berlin, both geographically and chronologically. The article makes a case for a more nuanced view of how the 'urban' pervades sociotechnical changes in general, and rainwater management routes in particular.***

***KEYWORDS:*** ***Harvesting, Management, Rainwater, Technical, URWH.***

## 1. INTRODUCTION

The literature on sustainable urban development in general, and on sustainable urban rainwater management in particular, frequently emphasizes the importance of moving away from traditional storm water management using large-scale, piped infrastructures and toward more decentralized, nature-based solutions. Alternative rainwater harvesting methods, such as green roofs, artificial wetlands, permeable pavements, and infiltration trenches, are thought to be more adapted to managing rainfall in densely populated cities, especially in light of climate change. Groundwater replenishment, flood control, aesthetic and recreational value, being more easily adapted to local conditions, and reducing water use are all claimed benefits. The arguments in favor of rainwater collecting, on the other hand, aren't translating into a significant threat to centralized systems. Although many cities in the global South continue to depend on local rainwater collection and utilization, urban rainwater harvesting (URWH) is still a minority practice in the global North.

Only a few established cities, like as Melbourne, have redesigned their current rainwater systems to include URWH principles. There is a widespread inability to move beyond ad hoc demonstration initiatives elsewhere. Non-technical variables, mainly unfavorable institutional settings and obstinate socio-technical regimes, are frequently blamed in the literature for the implementation gap. Recent social science contributions at the intersection of urban water management and socio-

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technical transitions have greatly expanded our understanding of the multiple factors involved in mainstreaming URWH, highlighting the importance of visions, leadership, path dependencies, regulatory frameworks, risks, expertise, and bridging organizations. Although most of this research is focused on case studies in cities, it seldom delves into the essence of the 'urban' in URWH programs and initiatives. The cities investigated are simply regarded as locations of invention, rather than as component elements in URWH trajectory formation[1]–[5].

Given that scholars of human geography and urban studies have made a concerted effort in recent years to correct the spatial blindness of early transitions research, this is rather odd. Essentially, this body of work argues that sociotechnical changes in cities – such as those leading to URWH – cannot be completely understood without understanding how they are entangled in and infused by urban structures and processes, politics, and practices. The following article examines the complex and dynamic connection between rainwater management and the city using this relational view of urban infrastructures. The city of Berlin is used as a case study for this research. For two main reasons, Berlin lends itself nicely to a study of urban rainwater collecting trajectories.

First, in the late 1980s, it was a pioneer of urban sustainable rainwater systems in industrialized cities, and it has since generated a plethora of pilot projects. This allows for a 30-year long-term study of URWH in a single city. Second, other cities, especially in Australia, the United States, and Brazil, have surpassed Berlin in terms of innovation. Despite the huge number of URWH schemes operating across the city, the move from niche to mainstream has proved more complicated and difficult than the pioneers had anticipated. This begs the issue of how rainfall technologies, sociotechnical changes, and urban settings are related. Although informal rainwater usage norms and practices are important to URWH in general, they are not relevant to our research of policy adaptation within a universalized and centralized urban rainwater regime.

The following is a list of resources. The paper's contribution to the interfaces between these disciplines and to human geography is highlighted, which situates it within academic discussions on urban rainwater harvesting, sociotechnical transformations, and reconfiguring urban infrastructures. The four key questions are addressed in turn in the following sections. Section 3 looks at a variety of instruments (regulatory, planning, financial, organizational), policy sectors (water management, environmental protection, urban development), and geographical scales (EU, federal, state, borough) to identify and analyze policies, plans, and programs aimed at promoting URWH in Berlin. Section 4 examines a database of more than 250 URWH projects in Berlin, examining their chronology, geographical location, technical design, size, and purpose (residential, public or commercial). Section 6 highlights the major points and examines their implications for research on urban geography and sociotechnical changes[6]–[8].

*1.1 Transitions to rainwater collecting in cities:*

Prior to the spread of major technological systems intended to remove rainfall from conurbations through sewage networks, local, small-scale rainwater collecting was the standard all over the globe. While rainwater collecting has never been phased out in many parts of the world, it has been mostly abandoned in industrialized cities since the mid-nineteenth century. Today, however, the many advantages of URWH, as outlined above, are prompting city planners to advocate and even prioritize URWH technology over existing systems. Have written extensively on the gap between

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the rhetoric and the reality of mainstreaming rainwater collecting. This section focuses on two lines of study that attempt to understand URWH in terms of transitions research and sociotechnical transitions in terms of the 'urban'.

*1.2 Transitioning from rural to urban water management:*

Institutionalism and/or agency-based theories have influenced most of the work done by social scientists on URWH implementation issues. Some of these academics have just lately started to look into how the literature on sociotechnical transitions (and its associated disciplines of transition management, strategic niche management, and sustainability transitions) may be utilized to inform the URWH discussion. In contrast to the energy research community, the water research community has been reluctant to embrace transitions research. Today, however, there is an emerging discussion on urban water transitions that uses transitions research methods and is driven by URWH academics[9], [10].

What interests these researchers is how transitions research explains sociotechnical system change (and obduracy) in terms of multi-level and multi-phase dynamics. The author has define transitions as a change from one sociotechnical system to another. The term "regime" refers to a set of material and social components that has become self-reinforcing through time and, as a result, is difficult to alter. True transitions, or regime changes, happen as a result of pressures from either experimental 'niches' or external factors (referred to as the 'landscape' in transitions language).

The so-called Multi-Level Perspective, an explanatory model built out of many case studies and continually improved, elucidates how these three levels – regime, niche, and landscape – interact. The multi-phase dynamics of socio-technical systems may be described using a common evolutionary pattern that begins with "predevelopment" and progresses through "take-off," "acceleration," and "stabilization." research .'s of Melbourne's transition to sustainable urban water management, for example, was determined to be a fairly realistic depiction of the transition process there (2013). In Melbourne, 'pre-development' included landscape shifts and niche emergence prior to the mid-1990s, 'take-off' during the late 1990s of shared understandings around the new urban water paradigm, 'acceleration' of knowledge and policy around urban rainwater harvesting in the 2000s, and '(pre)stabilization' of storm water quality practices in a new era (ibid.) With the help of the transitions management literature, a second study identified three phases of experimentation in the Sydney urban water sector from 2002 to the present, involving first local knowledge acquisition around urban water issues ('deepening'), then replication of the alternative approach to managing rainwater ('broadening'), and finally governance changes.

These and other contributions are useful not only in introducing transitions concepts to the water research community and demonstrating how they can be applied, but also in bringing a more robust and nuanced understanding of governance, agency, and institutions to the transitions debate in general. Nonetheless, in the context of our own research,

There are two fundamental flaws in the fledgling literature on urban water transitions: one is chronological, and the other is geographical. On the one hand, it seems to view transition as a mainly linear process involving a change from one sociotechnical regime to another in a series of well-defined stages, as shown above. This unidirectional pattern of change may well be true in the cases studied, but it should not blind us to the possibility or even probability that transitions are

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far messier in general, characterized by abrupt setbacks and periods of stagnation as well as shifts toward more sustainable regimes. This is in response to critiques that the transitions literature portrays regimes as monolithic, overemphasizes niches as change drivers, and ignores political contestation. As Furlong has pointed out, thinking of transition as a change from one sociotechnical regime to another obscures alternative possibilities, such as the coexistence of two or more sociotechnical configurations.

Even publications based on case studies of particular cities (e.g., Melbourne, Sydney) consider the city as a location where innovations occur rather than as an integral component of the transition process. Because it focuses mostly on northern cities and nations, this study – like other transition studies – may be critiqued for assuming assumptions about transitions that may or may not apply to other global settings (Furlong, 2014). Both of these critiques indicate that current research on the urban aspects of sociotechnical transitions may greatly assist the emerging discussion on urban water transitions. We now look to this corpus of scholarship, mainly from the fields of human geography and urban studies, for further inspiration.

*1.3 In sociotechnical changes, what does it mean to be 'urban':*

One of the most common criticisms leveled against transitions research is that it has been "geographically naive" in the past. Studies on sustainability transitions have showed minimal interest in spatial elements and define space in a simple way, focusing mainly on national innovation processes. The Multi-Level Perspective's 'levels' do not relate to geographical scales; thus, misunderstanding with the notion of multi-level governance must be avoided. Transition studies typically ignore the locations where transitions occur. Transitions are often ignored because of how socio-spatial connections and dynamics drive them. Cities are either regarded as a place where particular kinds of innovation occur – as seedbeds of national changes or as a homogeneous actor with relative autonomy, if they are addressed at all.

Recent research on transitioning urban infrastructures, driven by discussions in human geography and urban studies, is laying out an interesting research agenda in this area. These researchers are showing the many ways in which location and scale are essential to sociotechnical development in urban settings using relational notions of the 'urban' and of sociotechnical systems based on empirical case studies.

To begin with, the formation of sociotechnical niches and regimes is extremely place-specific, necessitating a relational understanding of niche-regime combinations that are locally formed. In human geography, place-based methods stress the significance of proximity, identity, and local difference in the urban environment. As a result, scholars are advocating for a more nuanced understanding of how cities react to change pressures in place-specific ways that reflect these aspects. Second, cities and the infrastructural systems that support them are inextricably linked. That is, urban circumstances – physical, political, socioeconomic, and cultural – form sociotechnical systems like a rainwater network, but they also affect urban structures and behaviors.

As a result, we must pay more attention to how attempts to reorganize a sociotechnical system get enmeshed in larger urban transformations. From this viewpoint, urban growth patterns are an integral component of urban water transitions. Third, cities may be both centers of innovation and

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local expressions of sociotechnical regimes. As a result, there are inherent conflicts to be explored between attempts to bring about systemic change on the one hand and efforts to maintain existing institutions on the other. In one city, competing water management logics may coexist. We must disclose "the manner in which obduracy and flux in urban systems is generated, perpetuated, and contested. Fourth, the connection between cities and sociotechnical systems is profoundly political as a result of this.

Transitions are always contesting grounds for incumbents and challengers. They are not politically neutral, but are often controlled by urban elites or community organizations with specific social goals. Fifth, in order to address "the apparent inevitability in certain historical narratives of changes," more attention to the fluctuating histories of transitions in cities is required. This requires a more complex knowledge of how temporal circumstances and contingent events impact and modify routes, rather than the linear pathways from niche to regime change that underlie most transitions research.

These five dimensions of the 'urban' – the significance of place, the co-constitution of cities and infrastructures, forces for change and continuity in urban systems, transitional urban politics, and nonlinear urban histories – are used to frame the following empirical investigation and will be drawn upon in Section 5 to interpret the case study findings. It will be argued that the novel contribution to urban geographic theory is in combining these multiple dimensions of the 'urban' – developed separately elsewhere – into a single analytical framework and demonstrating its utility in studying the interdependence of urban and sociotechnical transitions.

*1.4 Rainwater collecting policies, strategies, and programs in Berlin:*

The next two parts of the URWH in Berlin study look first at the policy environment and then at the initiatives that emerge. Both stages are unique in that they take a 30-year look at the evolution of URWH in one city, include a wide variety of URWH-promoting instruments and schemes, and aim to integrate URWH policies and initiatives into urban development more broadly.

The first step was to look at the policies, plans, and programs in Berlin that have supported URWH since the 1980s. In Germany, the literature on URWH has mainly focused on the technical viability and cost-effectiveness of these alternative rainwater systems. With a few exceptions, the policy context of URWH, its relationship to water management and urban development, and its potential for mainstreaming has received little academic attention. We examine policies, strategies, and programs in this article to explain the urban political and institutional context within which URWH has been promoted – or opposed – in various ways at various periods. A content study of a broad variety of documents on policies, plans, and programs relevant to URWH in Berlin was used as part of the approach. These mainly included legislation, local statutes, financing programs, policy guidelines, and urban planning standards.

## 2. DISCUSSION

The author has discussed many successful pilot projects in industrialized cities throughout the globe have shown the many benefits of on-site rainwater retention, infiltration, and use. On the other hand, the move from specialist to mainstream has proven mostly elusive. Recent research has identified major causes for stalled transitions in terms of adverse institutional contexts and

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stubborn sociotechnical regimes. The urban features of rainwater collection, on the other hand, have received less study. Despite many case studies on rainwater collecting in cities, we know very little about how the 'urban' affects and is affected by rainwater management laws and practices. This essay draws on recent contributions to transitions research from human geography and urban studies to understand the dynamic links between rainwater collecting and the city. It examines the regulations and efforts that have been implemented to promote rainwater harvesting in Berlin, which was an early adopter of the technology. The study's findings reveal a significant degree of difference in the tools used and plans produced throughout the past 30 years, not just in terms of political motives and objectives, but also in terms of tools utilized and plans created.

## 3. CONCLUSION

Recent social science research has pointed to institutional constraints that are hindering the mainstreaming of rainwater collecting technology in cities, and sociotechnical ideas are increasingly being used to understand urban water transitions. What these analyses generally lack is a sense of how certain geographical and temporal settings influence URWH trajectories. As a result, the focus of this study has been on unpacking the ‘urban' in URWH and investigating the dynamic interdependencies of rainwater infrastructures and urban growth, using Berlin as an example. To inform a study of the changing policy environment and project landscape of URWH in Berlin from the mid-1980s to the present, it drew on two bodies of scholarship: urban water management in transition and urban aspects of sociotechnical changes.

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