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Rain and the city: Pathways to mainstreaming rainwater harvesting in Berlin

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ABSTRACT

Rainwater harvesting has long been part of the standard repertoire of the aspiring sustainable city. The multiple benefits of on–site retention, infiltration and use of rainwater have been illustrated with a plethora of successful pilot projects in industrialized cities across the globe. The leap from niche to mainstream has, however, proved largely elusive. Recent research has provided important explanations for such impeded transitions in terms of unfavourable institutional contexts and obdurate sociotechnical regimes. Little attention has been paid, however, to the urban dimensions of rainwater harvesting. Despite many case studies of rainwater harvesting in cities, we know very little about how the 'urban' shapes, and is shaped by, rainwater management policies and practices. This paper draws on recent contributions to transitions research from human geography and urban studies in order to explicate the dynamic interactions between rainwater harvesting and the city. Taking the city of Berlin – an early pioneer of such technologies – as a case study, it conducts a long-term analysis of the policies and projects implemented to promote rainwater harvesting in the city. The paper's findings demonstrate huge variety regarding not only the instruments applied and schemes developed, but also the political motives and priorities over the past 30 years. This is interpreted spatially and temporally in terms of shifting contexts and contingent events in (and beyond) Berlin. The paper argues for a more nuanced understanding of how the 'urban' permeates sociotechnical transitions in general, and pathways to reconfigure rainwater management in particular.

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 conventional storm- and rainwater management using large-scale, piped infrastructures towards more decentralized, nature-based solutions (e.g. Cettner et al., 2014; Brown et al., 2013; Ward et al., 2012; Sharma et al., 2010; Brown and Farrelly, 2009). These alternative solutions for harvesting rainwater – involving such technologies as green roofs, artificial wetlands, permeable pavements and infiltration trenches – are deemed to be better suited to manage rainwater in densely-populated cities, even more so in the wake of climate change. They are accredited with providing multiple benefits such as groundwater replenishment, flood control, aesthetic and leisure value (Cettner et al., 2014; Sharma et al., 2010), being more readily adapted to local conditions (Petrucci et al., 2013; Sharma et al., 2010) and reducing water use (Ward et al., 2012; Domènech et al., 2015).

The arguments stacked up in favour of rainwater harvesting are, however, not translating into a serious challenge to conventional centralized systems. Although many cities of the global South continue to rely on local rainwater collection and use (Furlong, 2014; Meehan, 2014), in the global North the transition of urban rainwater harvesting (URWH) from niche to mainstream is not happening (Ward et al., 2012). Only a handful of developed cities, such as Melbourne (Brown et al., 2013), have reconfigured existing rainwater infrastructures around URWH principles. Elsewhere, there is generally “a consistent failure to go beyond *ad hoc* demonstration projects” (Brown and Farrelly, 2009: 839). This implementation gap is widely attributed in the literature to non-technical factors, primarily to unfavourable institutional contexts and obdurate socio-technical regimes. Recent social science contributions at the interface of urban water management and socio-technical transitions have significantly broadened our understanding of the multiple factors involved in mainstreaming URWH, drawing attention to the role of visions, leadership, path dependencies, regulatory frameworks, risks, expertise and bridging organisations (Brown and Farrelly, 2009; Brown et al., 2013; de Haan et al., 2015). Although this research is often founded on city-based case studies, it

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rarely explores the nature of the 'urban' in URWH policies and projects. The cities studied are treated merely as sites of innovation (or counter-innovation), rather than constituent factors behind URWH trajectories. This is rather odd, given that scholars of human geography and urban studies have over recent years made a concerted effort to rectify the spatial blindness of early transitions research (Hodson and Marvin, 2009, 2010; Bulkeley et al., 2011a, 2011b; Coenen et al., 2012; Wolfram and Frantzeskaki, 2016). Essentially, this body of work makes the case that sociotechnical transitions in cities – such as towards URWH – cannot be understood fully without appreciating how they get caught up in, and infused by, urban structures and processes, politics and practices.

The following paper draws on this relational understanding of urban infrastructures to analyse the complex and dynamic relationship between rainwater management and the city. As a case study for this analysis it uses the city of Berlin. Berlin lends itself well to a study of the urban trajectories of rainwater harvesting for two principal reasons. First, it was originally a pioneer of urban sustainable rainwater systems in industrialized cities in the late 1980s and has since spawned abundant and varied pilot projects. This permits a long-term analysis of URWH in a single city spanning 30 years. Second, Berlin has today lost this pioneering status to other cities, notably in Australia, the United States and Brazil (Brown et al., 2013; Meehan and Moore, 2014). Despite the large numbers of URWH schemes in operation across the city, the transition from niche to mainstream has proven more elaborate and elusive than the pioneers had originally hoped.

This raises questions about the relationship between rainwater technologies, sociotechnical transitions and urban contexts. Four guide the research on this paper: (1) To what ends and by what means has URWH been promoted in Berlin since the 1980s? (2) What kinds of URWH projects emerged during this period? (3) How can these policies and projects be understood in terms of interactions between urban development and rainwater management? (4) How can the findings advance knowledge on the role of the 'urban' in sociotechnical transitions? The analytical focus of the paper is, therefore, on the shifting urban contexts of policy mechanisms and project dissemination. Informal norms and practices of rainwater use – although highly relevant to URWH in general – are not pertinent to this study of policy adaptation within a universalized and centralized urban rainwater regime.

The following Section 2 positions the paper within scholarly debates on urban rainwater harvesting, sociotechnical transitions and reconfiguring urban infrastructures, highlighting its contribution to the interfaces between these fields and to human geography. The subsequent sections address the four core questions in turn. Section 3 identifies and analyses the policies, plans and programmes designed to promote URWH in Berlin, looking at multiple types of instruments (regulatory, planning, financial, organizational), policy sectors (water management, environmental protection, urban development) and geographical scales (EU, federal, state, borough) and setting them in the context of the city's shifting political economy. Section 4 presents a database of over 250 URWH projects in Berlin, analysing these in terms of their timing, geographical location, technical design, size and purpose (residential, public or commercial). Section 5 then interprets the empirical findings through the lens of rainwater-city interactions, drawing on analytical categories developed in Section 2. The concluding Section 6 summarizes the main arguments and discusses their relevance for research at the interface between urban geography and sociotechnical transitions.

2. Transitions towards urban rainwater harvesting

Local, small-scale rainwater harvesting was the norm across the world prior to the dissemination of large technical systems designed to remove rainwater from conurbations via neworks of sewers. Whilst rainwater harvesting has never been displaced in many communities of the global South (Furlong, 2014; Meehan, 2014), it was largely discarded in industrialized cities from the mid-nineteenth century onwards (Melosi, 2000). Today, however, the multiple benefits of URWH, summarized above, are encouraging urban planners to promote and even prioritize URWH technologies over incumbent systems. Much has been written about the gap between the rhetoric and the realities of mainstreaming rainwater harvesting that does not need to be repeated here (see Stahre, 2002; Rauch et al., 2005; Roy et al., 2008; Brown and Farrelly, 2009; Winz et al., 2011; Karvonen, 2011; Barbosa et al., 2012; Cettner et al., 2012, 2014). This section targets not this general debate on URWH but, rather, two strands of the literature which set out to interpret URWH in terms of transitions research (Section 2.1) and sociotechnical transitions in terms of the 'urban' (Section 2.2).

2.1. Understanding transitions to urban water management

Much of the work by social scientists on the implementation problems of URWH has been powerfully informed by institutionalist and/or agency-based frameworks. It is only very recently that some of these scholars have begun to explore how the literature on sociotechnical transitions (with its related fields of transition management, strategic niche management and sustainability transitions) could be used to enrich the debate on URWH. The water research community in general has been slow to pick up on transitions research (de Haan et al., 2015), in marked contrast to the energy research community. Today, though, there is an emergent debate on urban water transitions explicitly applying transitions research approaches and this is being led by scholars of URWH (Bos and Brown, 2012; Ward et al., 2012; Brown et al., 2013; de Haan et al., 2015).

What intrigues these scholars is how transitions research explains change (and obduracy) to sociotechnical systems in terms of multi-level and multi-phase dynamics (Brown et al., 2013). Transitions are conceived here as a shift from one sociotechnical regime to another (Geels and Schot, 2007). The 'regime' refers to a particular configuration of material and social elements that has, over time, become self-reinforcing and is, consequently, difficult to change. True transitions – i.e. regime shifts – occur in response to pressures from either experimental 'niches' or external forces ('landscape' in the transitions terminology). How these three levels – regime, niche and landscape – interact is elaborated in the so-called Multi-Level Perspective, an explanatory model developed out of numerous case studies and continuously refined (Geels, 2011). The multi-phase dynamics of socio-technical systems is generally explained by way of a common evolutionary pattern, starting with 'predevelopment' and proceeding to 'take-off', 'acceleration' and 'stabilization' phases. This has been applied, for instance, to Brown et al.'s study of Melbourne's shift to sustainable urban water management and found, by and large, to be an accurate representation of the transition process there (2013). In Melbourne, 'pre-development' involved landscape shifts and niche emergence prior to the mid-1990s, 'take-off' the emergence of shared understandings around the new urban water paradigm during the late 1990s, 'acceleration' the dissemination of knowledge and policy around urban rainwater harvesting in the 2000s and '(pre)stabilization' the embedding of stormwater quality practices in a new regime (ibid.) A second study has, with the help of the transitions management literature, identified three phases of experimentation in the urban water sector in Sydney 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 subsequently alterations to the governance structure ('scaling-up') (Bos and Brown, 2012).

These and other contributions (e.g. Ward et al., 2012; de Haan et al., 2015) are valuable not only for introducing transitions concepts to the water research community and demonstrating how they can be applied, but also – conversely – in bringing a more robust and nuanced understanding of governance, agency and institutions to the transitions debate in general. Nevertheless, from the perspective of our own research