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# There's always the river: social and environmental equity in rapidly urbanising landscapes in India

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## ABSTRACT

In the pursuit of sustainable and liveable cities, Indian built environment practitioners and policy-makers are understandably focused on aspects of infrastructure, sanitation and health, given the significant urban problems of pollution and environmental degradation. However, there is limited empirical examination of Indian towns and cities as changing urban landscapes. To explore this, the paper examines the rivers in two rapidly urbanising Indian cities. It calls on interviews with practitioners, residents and users in Madurai and Ahmedabad, focusing on access and use of the river to explore social and environmental equity. The findings suggest that free, public and safe access to the rivers have reduced over time in both cities, for different reasons. Perceived environmental quality of both rivers has also worsened and the associated cultural meanings, held by riparian users, have changed. We suggest that urban river infrastructure should be reconceptualised to explore the feasibility and acceptability of a more holistic approach to understanding Indian riparian urban landscapes.

## KEYWORDS

Urban rivers; India; rapid urbanisation; social equity; environmental equity

## Introduction

Between 2014 and 2050, India will add 404 million people to its current urban population (United Nations, 2014). This urbanisation brings complex changes to landscape ecology and human society (Chaturvedi, Kamble, Patil, & Chaturvedi, 2013), putting pressure on existing infrastructure which is subject to challenges from climate change including flooding, drought and associated health risks. Practitioners and policy-makers have a significant challenge to address these issues to help create healthy and safe places. However, there is a dearth of evidence about how this might be achieved in the varied urban settings in India which range from mega-cities to peri-urban landscapes. This research explores whether urban rivers in Indian cities are socially and environmentally equitable landscapes. Rivers are selected as an element for study given they are present in most cities, often what drives urbanisation in the first place (e.g. as a resource and for energy generation). Water is also important in the Indian landscape due to its religious and cultural underpinnings. In this vein, the objectives of this paper are to examine the social and environmental benefits of riparian landscapes in urban India—this is reported in the following sections which provide a broad review of current theory and evidence. We then identify the barriers to achieve social and environmental equity in the cities of Madurai and Ahmedabad through the empirical evidence presented and analysed in the later sections. The paper ends with recommendations for future research and practice of the planning, design and management of riparian landscapes in urban India.

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## Social and environmental dimensions of the urban river

There is a long-standing assumption that landscapes can accommodate both human and natural needs, and that those which are more natural can bring real benefits for users (Gobster, 2012; Manning, 1979; Sadler, Bates, Donovan, & Bodnar, 2011). Åberg and Tapsell (2013, p. 95) list benefits around aesthetics, wildlife and recreation, noting that where these are enhanced, 'an emotional, caring feeling is often created which helps to reconnect people with nature'. There has been growing empirical interest in the river as an ecological network which brings social and environmental benefits (Briffett, 2001; Douglas & Ravetz, 2011). Many cities have developed on and around rivers (Dengle, 2010) due to their strategic importance for transportation, trade and the fishing industry (Spodek, 1980). Chaudhry, Sharma, and Singh (2013, p. 65) describe non-market and multiple benefits of rivers, including 'water flow regulation, climate amelioration, carbon sequestration, recreational, educational and aesthetic benefits'. Rivers are also significant in people's everyday lives due to their religious and cultural importance, and are associated with traditions such as pilgrimages and funeral rites in India (Sinha, 2014).

The river is a landscape element which can be considered on a continuum charting degrees of nature at one end and human influence at the other (after Briffett, 2001). At the human influence 'end', we can see how urbanisation has fundamentally changed how water flows in cities in a variety of ways including canalisation, hydro-electricity generation, culverting, damming and reservoir creation. Cities are based on processes of intense production and consumption (Grimm et al., 2008), and the natural ecosystem of a river can be irrevocably altered in urban settings (Martínez-Paz, Pellicer-Martínez, & Colino, 2014; Walton, Salling, Wyles, & Wolin, 2007) by the effects of wastewater discharge, industrial discharge and agricultural contaminants as well as pollutants from buildings and roads (Grimm et al., 2008). Species diversity and richness also decline when 'naturally functioning river systems' are changed (Hauer & Lorang, 2004, p. 389).

Within the ecosystem services paradigm, we can see that there is an increasingly well-formed body of knowledge around the river as a provisioning, regulating and supporting system (Douglas & Ravetz, 2011). In the global South, restricted access to water bodies can jeopardise the right to clean water and in this way is an indicator of mortality (Basole, 2007). The health problems of poor water quality, hygiene and sanitation are well-understood, for example causing 90% of child diarrhoea (Harpham, 2009). Such health issues can threaten livelihoods and economic mobility of riparian residents which might be a result of, for example, industrial effluents and water contamination (Anguelovski & Martínez Alier, 2014). As knowledge about the detrimental effects of urbanisation on water bodies improves, riparian restoration and rehabilitation to improve river ecology occurs as a part of urban regeneration (Kozak, Lant, Shaikh, & Wang, 2011). However, we argue that this knowledge does not currently inform practice in Indian urban river management. Before exploring this through our empirical study reported later, we provide a conceptualisation of social and environmental equity for the Indian context.

## Conceptualising social and environmental equity in the rapidly urbanising context

There are different conceptualisations of the relationship between social and environmental equity within the context of rapid urbanisation in the global South. Broadly speaking, these include positive conceptualisations, for example *environmental justice* posits actors are driven by environmental inequality to mobilise socially, or may demonstrate their social cohesion and capital by acting to improve environmental equity (after Anguelovski & Martínez Alier, 2014). They also include negative conceptualisations, for example in *urban political ecology* where social and environmental inequality are understood to be the result of political-economic processes and, for example, capitalism results in urbanisation which causes environmental injustice (Heynen, 2006). Without wanting to overly simplify the Indian context, urban development tends to be driven by political goals, which under Prime Minister Modi's current administration are neoliberal in nature (Kaur, 2015). Neoliberal city development involves a reconfiguration of place—here, the river—which is described as exclusionary, representing power struggles which often result in keeping the poor out (Connell, 2007). In India, this has manifested itself

in policies that are badged as for the common good (or in Modi's election campaign for 'good times' (Kaur, 2015)) but in reality are often underpinned by the displacement of 'encroachers' (Banerjee-Guha, 2009; Sampat, 2010).

Within this context, we look to Velicu and Kaika's (in press) research on the Rosia Montana anti-mining movement which highlights how environmental justice is limited when conceptualised within the parameters of market-based neoliberalism. They found that any subjects and behaviour contradicting the 'market logic' are readily discounted or ignored as irrelevant (p. 3). This is found in the Indian context with many examples of the enforced displacement of communities on land acquired and developed in the name of public purpose but to the ultimate benefit of private stakeholders (Desai, 2012; Sampat, 2010).

Forsyth highlights how the evidence base is growing within *critical* political ecology which challenges the prevalent ideas in urban political ecology that environmental degradation, say, soil erosion, will always threaten livelihoods and damage ecosystems (2001, p. 1). Supporting this view, Benjaminsen, Aune, and Sidibé (2010) highlight that only when specific examples are explored in detail (e.g. mangroves in the Philippines) can political ecologists move beyond an assumption that human communities are homogenous units to understand the complex implications of a specific political context (after Vayda & Walters, 1999). Where Benjaminsen et al. (2010, p. 648) conducted 'natural science-based investigations of those changes' including measuring soil nutrients, we conducted a qualitative study asking questions about perceptions held by different actors affected by the two cities' rivers of how the rivers have changed over time. Our examination of the urban rivers—which acknowledges the neoliberal context and the heterogeneity of the actors affected—heeds Basole's warning (2007) that to divorce the interlinked relationships between ecology and society (and also economic progress) is short-sighted in the Global South. It also responds to recent calls for researchers to address this gap in knowledge by examining the social aspects of river systems, such as the effects of river flow on wellbeing and use of the river by local people (Dissanayake & Smakhtin, 2007). We reflect on the contribution that this research makes to environmental justice and critical political ecology at the end of the paper. Next, we outline the research methodology adopted in our work.

## Methodology

The preceding sections provided a broad overview of the inter-related dimensions of social and environmental equity. This paper explores these dimensions to shed light on the extent to which they occur in two Indian cities, and examines the barriers therein. Ahmedabad and Madurai are very different Indian cities but are (to some extent) representative of a number of cities around the country. Ahmedabad is classed as a 'megacity' (as are Mumbai, Delhi and Kolkata). Madurai is a much smaller, historic city and place of pilgrimage (as are Varanasi, Allahabad, Amritsar and Ajmer). Both cities were built along their rivers, which have been subject to considerable change over time. We will explore how the rivers have changed, and how the decision-making involved serves as important markers of social and environmental equity.

We utilised a mixed-method approach, a well-used method of studying social phenomena (Bryman, 2012) allowing data collected from different sources to be triangulated to provide us with a 'better, more substantive picture of reality' (Berg, 2007, p. 5). This research project is cross-sectional, providing a "snapshot" approach where data are collected at one point in time' (Gray, 2004, p. 31). While there are limitations to this approach (outlined later), not least given the rapidly changing nature of Indian cities, it was considered to be an effective use of our available time and resources.

Secondary data included limited access to maps, policy documents, books, journal articles as well as local Masters dissertations available only in the two cities. Primary data collection methods consisted of site surveys, which included on-site observations of how the sites were used, and interviews with academics and practitioners, including planners, architects and landscape architects, totalling 25 in both cities (coded AP [Ahmedabad Practitioner] and MP [Madurai Practitioner], respectively, in the analysis). Interviews were also conducted in Madurai with 30 residents and users of the river (coded

MR). Questions were asked about interviewees' *perceptions of access* to the river, and *how the river is/was used*, to understand how it contributed to everyday aspects such as livelihoods, recreation and health. The data were analysed using content analysis to align them with dimensions already identified in the literature but also to draw out other emerging themes (Bryman, 2012).

It was not feasible to interview residents and users in Ahmedabad because of the restricted nature of access to and use of the riverfront due to the ongoing Sabarmati Riverfront Development project (outlined below). Residents had been relocated and no new housing has been built (at time of publication). We collected data about Ahmedabad's relocation programme from secondary sources as well as an unanticipated interview with two slum resettlement site residents thanks to one of the practitioners. 'Riparian users' in Ahmedabad were scarce—either working on inaccessible construction sites, or herding cattle. We were unable to conduct interviews in a lingua franca with this latter group. Despite this limitation, the data amassed from the range of sources provides a valuable (albeit initial) contribution to our knowledge of equity of Indian riparian landscapes.

## Madurai and Ahmedabad: distinct cities, distinct rivers

The cities of Madurai and Ahmedabad are located in the states of Tamil Nadu and Gujarat, respectively, both built on the banks of rivers with quite different urban development processes. Madurai is divided by the *River Vaigai* with the historical core in the south and rapid urban growth has been occurring in the north since India's Independence (Manonmani, 2010). Ahmedabad is split east-west by the *Sabarmati River* with the Old City in the east and the ongoing and very rapid urbanisation in the west (Yagnik & Sheth, 2011). Different approaches have been taken in these cities to managing the rivers as the analysis will show.

### Ahmedabad

The Sabarmati River is 371 km long and 'has always been the defining feature of Ahmedabad' (Yagnik & Sheth, 2011, p. 298). The city was founded on the eastern bank of the river in the 1400s (Forrest, 1977), and until the mid-late 1800s, crossing the river was considered mostly unnecessary,<sup>1</sup> until the Ellisbridge was opened in 1870. This was Ahmedabad's first bridge (of nine, at present) to connect the city across the Sabarmati. The river was perennial and it dried up in summer months (Bhatt, 2003; Figure 1). The river has been significantly changed (Figure 2), in part due to an upstream dam project and also the ongoing riverfront project (discussed below).

Ahmedabad is Gujarat state's largest city and designated as one of India's seven mega-cities by the government (Dhar, Sen, & Kumar, 2006). The urban population has increased by 34% from 3.31 million in 1991 to 4.5 million in 2001 and the average density (in 2011) is 890 persons/km<sup>2</sup> (Census of India, 2011). Ahmedabad has been described as a pre-industrial city with post-industrial segments (Nath, 2007). Dutta (2000) describes three Ahmedabads: (1) the old walled city, on the eastern bank of the river, dating back to the fifteenth century; (2) the industrial areas which emerged outside the walled city in the nineteenth century where chawls, or 'multi-storeyed concrete slums', prevail; and (3) the west of the city which has been developing since the 1900s as a residential area as richer residents moved out of the Old City to gain more space (Jaffrelot & Thomas, 2012).

The ongoing Sabarmati Riverfront Project, started in 1997, stretches over 11 kilometres on both of the riverbanks (Katakam, 2010). The project aims to provide 'an accessible and inclusive waterfront environment along the river banks and to redefine an identity for Ahmedabad around the Sabarmati River' (SRDCL, 2014). The upper River Promenade will be tall enough to withstand 1 in 100 year floods. The lower promenade is built with basic infrastructure (paving, benches and trees) to allow for flooding and the concrete walls are claimed to stop riverbank erosion and protect property (Figure 3). To achieve this, significant land reclamation has occurred and sand has been dredged from the riverbed (Ahmedabad Municipal Corporation & Ahmedabad Urban Development Authority [AMC & AUDA], 2006). This reclamation involved the forced eviction of over 14,000 families living in informal

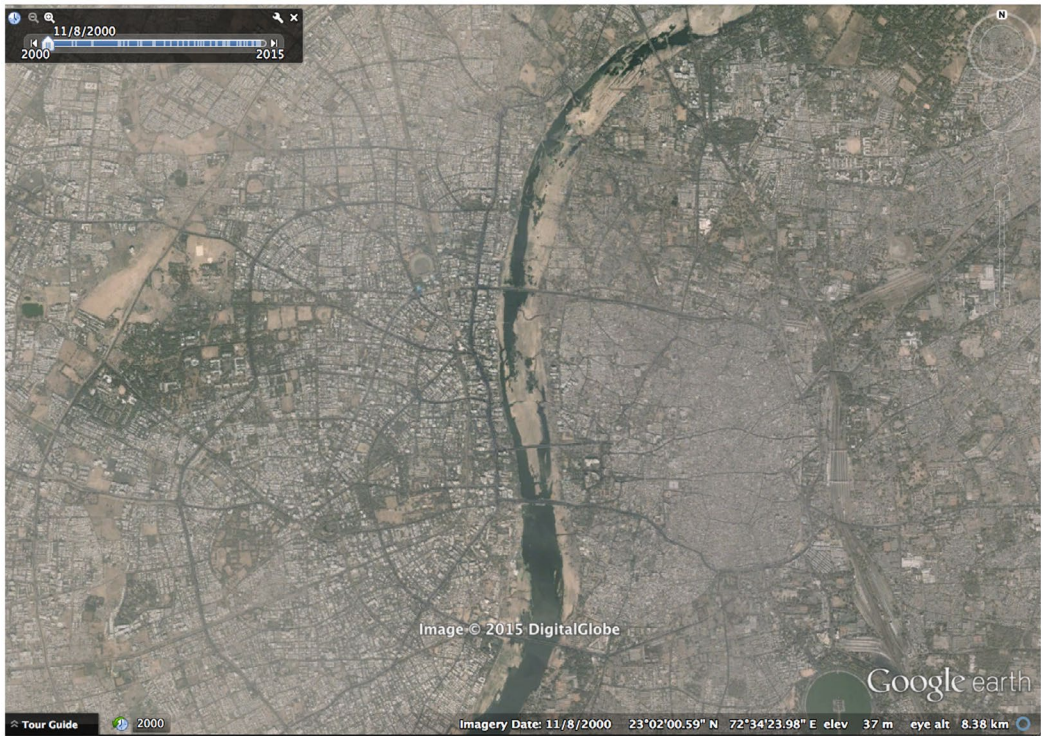


Figure 1. Aerial map of Ahmedabad, 2000. Source: Google maps.

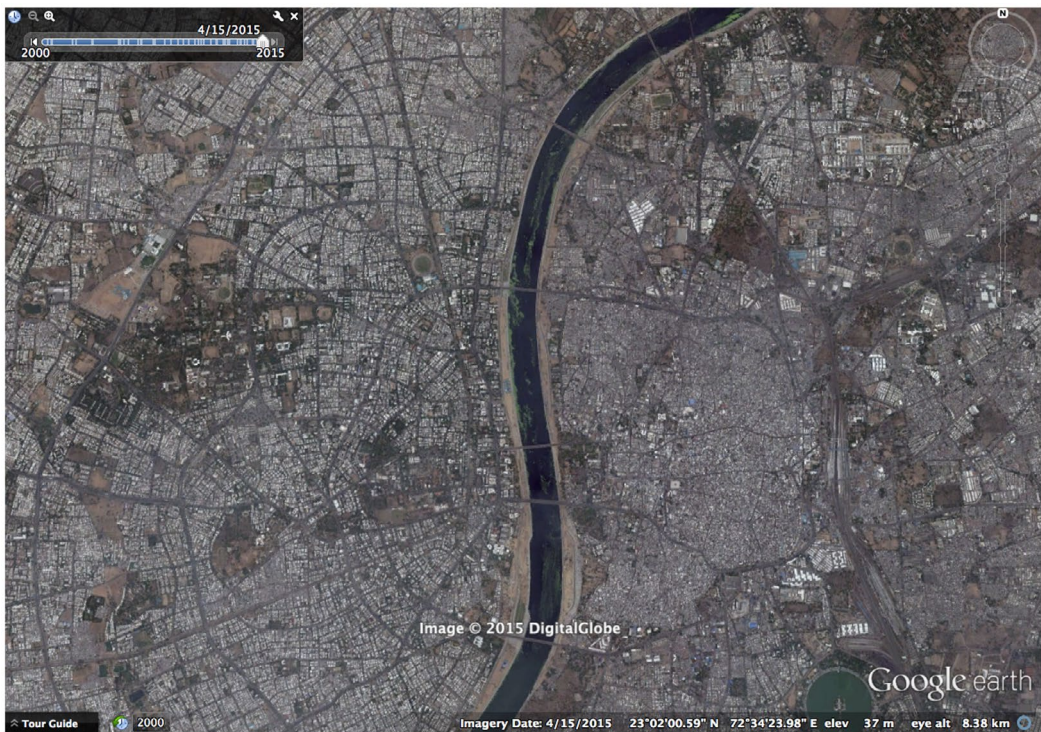


Figure 2. Aerial map of Ahmedabad, 2015. Source: Google maps.



Figure 3. The Sabarmati Riverfront, Ahmedabad.

slum settlements along the riverfront, which has been written about extensively by Desai (2012) and is returned to in the findings.

The Sabarmati Riverfront Development Corporation Limited state that untreated sewage and industrial effluents which flowed into the river will be diverted to new pumping stations (SRDCL, 2014). It should be noted that in the 1960s, the architect Bernard Kohn envisioned the river as part of an ecological river valley, with tree planting and farming which involved local people (Katakam, 2010)—this idea was not adopted by the Municipal Authority.

### ***Madurai***

The perennial River Vaigai is 240 km long and runs through the historical core of Madurai. The city developed around the Sri Meenakshi temple to the south of the river and is an important destination for Hindu pilgrimage. Significant and more recent urbanisation has taken place in the north where groundwater availability and quality of agricultural land are better (Manonmani, 2010). The river forms a significant cultural element in the city; Hindu mythology describes how the river was created to quench the thirst of a guest at Meenakshi's wedding (Eck, 1987). The banks of the Vaigai were once the Kadambavanam Forest, which provided the setting for other Hindu myths (Raghunathan & Sinha, 2006). In 1895, the Vaigai was part of a large-scale inter-basin transfer project as a treaty agreement was signed by the states of Tamil Nadu and Kerala to divert waters from the Periyar River to the Vaigai to maintain a constant water supply for irrigation in the area (World Bank, 1998). Like Ahmedabad, the River Vaigai has been affected by dam construction, which has provided irrigation and drinking water for the city's population (Vedanayagam, 1965).

Madurai's urban form has been described as historically forming part of a 'political, religious and cultural capital' city (Lewandowski, 1977, p. 210). The population of Madurai has steadily increased since 1951, with an average density of 823 persons/km<sup>2</sup> (in 2011) (Maheswari, 2012). More recent increases have been attributed to various industry-related government initiatives (Gulf Indian Weekly [GIW], 2015); Google Earth images (Figures 4 and 5) show how infill urbanisation has increased between 2002 and 2014.

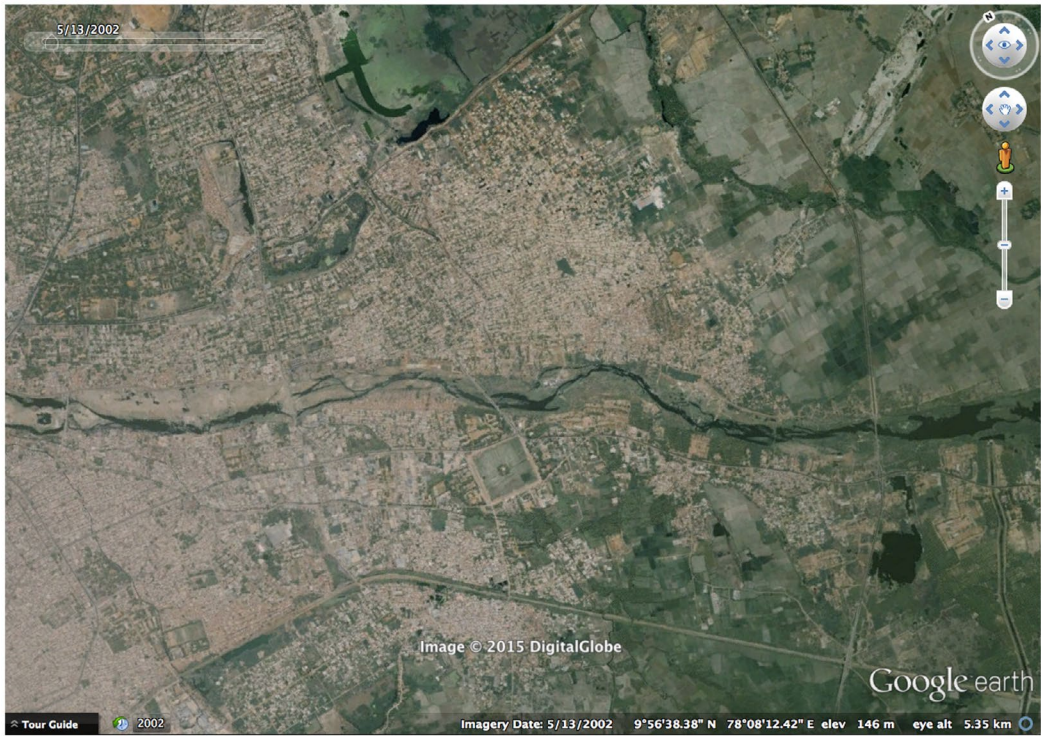


Figure 4. Aerial map of Madurai, 2002. Source: Google maps.

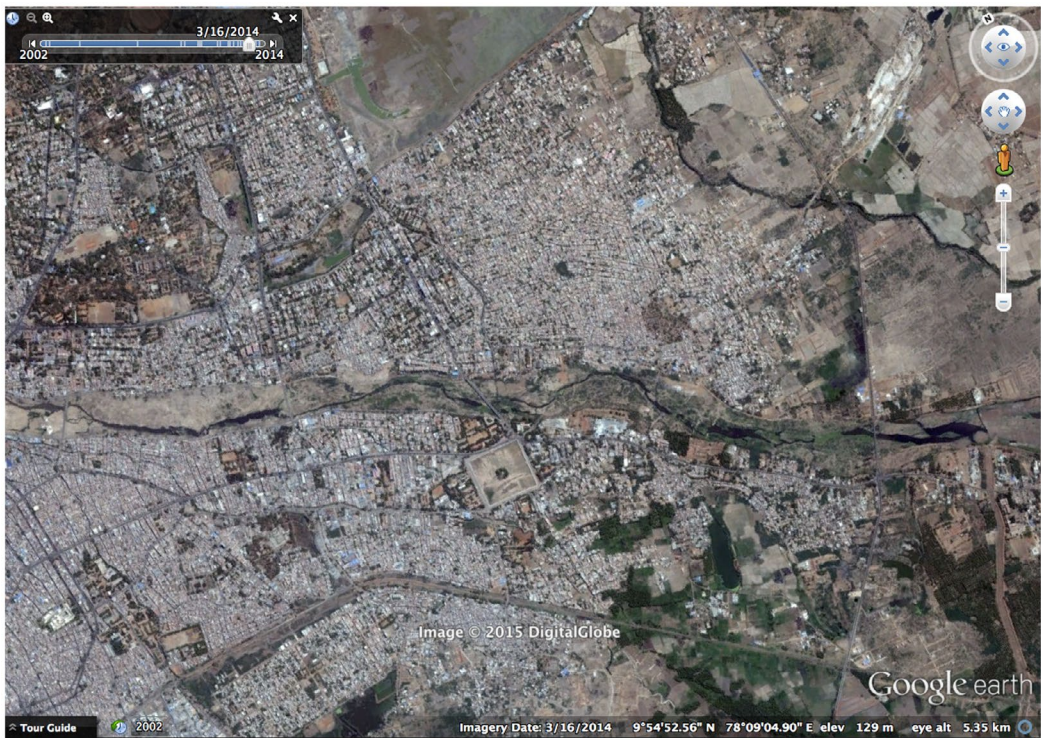


Figure 5. Aerial map of Madurai, 2014. Source: Google maps.



## Findings: river users and access

In *Ahmedabad*, the riverbank's diverse land uses include a long-standing Sunday market at the Ellisbridge ghats on the eastern riverbank, Mahatma Gandhi's ashram (north-west), crematorium, temples located on the outskirts of the city (various locations) as well as a now-relocated dhobi ghat (laundry). Interviewees describe the river as important for people in terms of religious rituals which are permitted at certain parts of the river. One interviewee described the river near the old city as a river heritage area, the river near the Ashram a religious/ spiritual place, and the south area of the river urban forest (AP18).

Until relatively recently, there was a significant amount of informal slum housing along the city centre riverfront. There was limited farming here as the river changed seasonally before the urban renewal programme began (AP16), but this activity is no longer permitted (AP2–4). The informal housing was described as riverbed encroachment (AP13/AP5) which destroyed the land (AP16) and caused water catchment blockages along the river (AP20).

The city's urban renewal programme cites among its objectives the 'environmental improvement and provision of housing for the poor' whose living conditions were precarious on the riverbed (AMC & AJDA, 2006, p. 153). There has, however, been severe criticism of the way in which the development is taking shape (AP2–4; Desai, 2012). Interviewees described families earmarked for relocation being promised riverfront dwellings but once the potential economic value of the riverfront land was realised, alternative sites were found, some on the outskirts of the city (AP8–11). Several interviewees discussed the urban renewal programme at length, describing access to the river as 'exclusionary', particularly for people on lower incomes (AP15), reiterating Desai's findings (2012). Some interviewees mentioned the entry fee for the recently created Sabarmati Riverfront Park (AP2–4). Other interviewees described paying to access an once public part of the city as unpalatable (AP12&16), particularly when the AMC was willing to waive the entry fee before 8am following pressure from middle-class early morning daily walkers—at all other times everyone has to pay (AP9). One interviewee mentioned how specialist activities could be a way of raising income, rather than charging all users (AP12). Interviewees described management costs as part of the reason for charging entry fees, which was seen as a negative intervention on 'public' spaces, already happening elsewhere (Kankaria Lake) and equally controversially (AP2,8,12).

*Madurai's* riverbank is home to a number of diverse land uses which require direct access to the water, including a weavers' community, potters' community, dhobi ghat (clothes washing) and crematorium where mourners use the river to bathe and to immerse the ashes after the cremation. The riverbed grass (Korai) is used to make mats and sleeping materials, and duck breeders and cattle grazers also use the riverbed. Canals from the river are used for farming fruits including bananas and coconut replacing crops such as groundnut and coarse cereals due to groundwater scarcity (World Bank, 1998). This scarcity has in part been attributed to the Vaigai dam upstream, hindering the share of downstream farmers' water (World Bank, 1998). Older residents interviewed recalled the beautiful river that 'flowed to its brim' most of the year round, with little or no pollution and a lot of sand (MR4 (Madurai Resident interviewee 4). Younger residents commented that the river used to be a source of inspiration to poets as 'it must have been a scenic sight' (MR2–3).

An empirical study (2009–2010) concluded that the Vaigai river water which runs into the city from the west is suitable for drinking and irrigation (Vanitha & Shunmugavelu, 2012), reiterated by the professionals interviewed. However, once in the city, untreated sewage and industrial effluent discharge into the river leading to groundwater contamination (Jesu, Prabudoss Kumar, Kandasamy, & Dheenadayalan, 2013). Partly this is due to direct users including grazing livestock farmers as Figure 6 shows. Other users include children and young adults who swim and play games such as cricket on the riverbed. Anti-social behaviour also occurs along/ in the riverbed, which residents and users describe as petty crime, illegal activities, drinking, as well as significant accumulations of litter (Figure 6). The illegal looting of sand detrimentally affects the riverbed (MR11), a problem mentioned by the majority of interviewees. Most residents interviewed described the river as not useful and only a few mentioned



Figure 6. Cattle grazing in the riverbed, River Vaigai, Madurai.

the riparian users discussed above. Only one resident mentioned the importance of the river for religious festivals, despite this being a significant visitor attraction (MR18).

### Poor river quality

The *Sabarmati* riverbank has changed considerably through land creation based on taking sand from the riverbed to fill the space behind raised retaining walls on both sides (Davy, 2012) from the Narmada main canal to the Vasna barrage downstream. The river has been described as an important but neglected feature of the city and a 'stressed riverfront' (CEPT & Gujarat Ecology Commission, 2002). This has been attributed to sustained negligence, unplanned and rapid urbanisation, and its main role of carrying sewage when the river is not dry (CEPT & Gujarat Ecology Commission, 2002). Around a third of the sewage generated in the city is discharged, untreated, into the Sabarmati through storm water outlets (AMC & AUDA, 2006). The river today compared to the early 2000s is quite a different place as Figures 1 and 2 show. Hard engineering has narrowed the river channel, reclaiming land of approx. 200 ha (Pandya & Mitra, 2014). According to AP17, the river was a natural place but now the water is now pumped in from elsewhere, 'there is nothing natural about the riverfront'. One interviewee argued that 'the riverfront is a product of ignorance' because current practitioners do not care about ecology, rather thinking about the river as a 'flat, metal plate'. This is reiterated by Kohn (2015) who describes the new Sabarmati as a lake of stagnant water, contradicting the climate and the cultural habits of Ahmedabad's residents.

These sentiments are reiterated by other interviewees who describe 'missed opportunities' by the municipal authorities, harking back to Kohn's unadopted vision for the river valley (Jha, 2013). The notion of green infrastructure is not considered by the municipal authorities who do not acknowledge natural systems as infrastructure (AP21). For example, AP17 describes how the city's green belt crosses the river without natural connections across it. For others, it is the design of the riverfront which is the problem. AP15 states that 'it has been designed so people can't get down to the river' and there is 'too much concrete' (AP8; Figure 3), while AP17 suggests that 'the Sabarmati River project could have been an urban forest with natural characteristics but the option was missed'. For AP16, the 8 m high wall is unnecessary—'the development could have been planned better if it was accepted that the river dries up, and some of the natural course of river was kept'. Nearby Gandhinagar (also in Gujarat State) was

mentioned (AP21) as an example of good practice where a ‘no development belt’ exists around the river. Some interviewees attributed what they described as an inappropriate approach to river management to a widespread loss of knowledge and subsequent disconnection with nature. AP13 highlights a wider issue around city planning, in which he argues people on lower incomes are significantly disadvantaged as they cannot participate fully as they cannot read or write, or fill in forms without help of some sort.

The *Vaigai* was described by residents, users and professionals as an once perennial and now seasonal river. When asked to describe the river today, residents referred to it as ‘a ditch’ (MR22) and ‘a riverbed ravaged and destroyed by our people’ (MR4). This was attributed to road encroachment by some interviewees as a detrimental influence on the river, and all interviewees commented on the negative impacts of river pollution. Some residents mentioned people bathing and washing livestock in the river as a source of pollution, while others described the main causes as sewage inlets into the river, domestic effluents, human waste and the looting of sand.

Most residents did not believe that the dam upstream influenced the river, but all residents agreed that a perennial, flowing river would be preferable and could eradicate the water shortage problems in the city. Professionals agreed, arguing that this would help relieve South India of its water scarcity. One interviewee commented that ‘the flow ... of the river is determined by nature and it would be better if humans didn’t interfere’ (MR16). The vast majority (28) of the resident/user interviewees did not believe the *Vaigai* could sustain useful ecosystems because of the lack of water. Users commented how fish and bird numbers had decreased (MR10, 18) suggesting the river ecosystem is not currently capable of sustaining the species it once did.

Concern was voiced about sand-mining which was attributed to the construction work happening in the city, and the proliferation of the invasive weed *Prosopis juliflora* which provides no food and can become impenetrable, restricting access to the water. While secondary sources highlight the issue of mosquitos on the stagnant water in the riverbed, this was not mentioned by residents/users. Regardless of how polluted the water is, users all found the river to be useful for drinking water, bathing and washing clothes.

The *Vaigai* was described by interviewees as ‘a legendary river’, of ‘importance in Tamil literature’ (MP1) and an ‘age-old river but now without any water’ (MR13). All interviewees lamented the changes to the river—‘it would be lovely to have the old *Vaigai* back’—which professionals believe could happen, described by MP2 as ‘pathetic, but not irrecoverable’. The need for restoration was discussed by all interviewees, to clean the water, remove the invasive weeds and use some species including the water hyacinth for river restoration (MP4). Users also mentioned tree planting as part of restoration, and maintenance programmes were discussed by a number of residents as was spreading awareness of the river’s importance. All interviewees expressed support for such action if proposed by the government. However, according to most residents, the main problems faced in the *Vaigai* were due to government, as well as citizen, indifference. According to one public sector official, the government had initiated numerous river projects but were consistently subject to problems of lack of funding and workforce.

## Discussion and recommendations

The findings show that in both Madurai and Ahmedabad, the river is no longer as freely and publicly accessible. Much of this was attributed to development, both formal (e.g. Ahmedabad’s urban renewal project) and informal (e.g. sand-mining and road encroachment in Madurai). While in Ahmedabad, this has led to issues of social exclusion of some citizens (e.g. those unable to pay entry fees, forced relocation of slum dwellers), in Madurai this has led to a poorer quality landscape which has attracted anti-social problems. In addition, it has been argued that these rivers are not as culturally symbolic as they once were due to development and/or poor (or no) river management. Poor water quality had detrimentally affected our sample’s propensity to spend time at the river. This is associated with the loss of knowledge and connection with the river and its natural functions, which emerges as a theme in both Ahmedabad and Madurai. In this way, our research did not reflect Aberg and Tapsell’s findings (2013) that riparian landscapes necessarily have positive social benefits for users in terms

of recreation and relaxation, in light of the poor perceived quality of both rivers. The residents/users interviewed in Madurai described how anti-social behaviour has prevailed along the river when not managed, detrimentally influencing use and people's sense of personal safety. Research is required to explore users's recreation and relaxation in Ahmedabad given the criticism levelled at the design and management of its riverfront, and the impact of the entry fee on levels of use by different sectors of society—which we were unable to do here.

The findings in Ahmedabad support what Anguelovski and Martínez Alier (2014, p. 172) describe as 'environmental gentrification' as a programme of urban renewal conducted in the name of environmental improvements which has involved the forced relocation of low-income residents well away from their original riparian settlement. We would argue that Ahmedabad's river design and management controls have led to restricted access to the water. This may disadvantage people who have long used the river for religious ceremonies and cultural traditions, but more research is required to understand the effect fully. In Madurai such gentrification is not occurring, but the lack of management and policing of activities such as sand-mining is damaging the riverbed. The decisions made by the relevant governing bodies in both cities have therefore adversely influenced environmental quality of the rivers and social equity for residents and users. In this way, our findings concur with Basole's identification of the interlinked relationships between ecology and society (and also economic progress). The river is a setting for Madurai workers who depend on it for their livelihood. In Ahmedabad, the urban renewal programme has changed the river as home and source of livelihood for slum dwellers to a symbol of the city's identity, now explicitly linked to the city's economic development. Our findings suggest Desai's work (2012) that the poorer in society—here, those dependent on the river in Madurai and those excluded from the river in Ahmedabad—are detrimentally influenced by poor environmental river quality.

The ways in which both rivers have been planned and managed concur with Hauer and Lorang's (2004) argument that species diversity and richness decline when naturally functioning river systems are changed. This was particularly acute in Madurai where reductions of bird and fish species were reported. In Ahmedabad this was not explicitly mentioned, however, interviewees reported disappointment that green infrastructure was not embraced as part of the riverfront's design and management. Ahmedabad's ongoing urban renewal development does not chime with Yokohari and Amati's findings (2005) that recent urban regeneration efforts are often focused on restoring nature in cities. Indeed there was significant criticism of how opportunities were missed to take design and manage the Sabarmati River in a more naturalistic way. We do, however, recognise that the project is ongoing, and suggest that future research should explore how a more ecologically oriented treatment may be developed in the future in light of how the current riverfront fares over time.

We can make sense of the perceptions of the river in both cities through an urban political ecology reading of the situations (Heynen, 2006). Inequality has been exacerbated by government intervention, which differs in both cities. We summarise this as *indifference* in Madurai and *inappropriateness* in Ahmedabad, and suggest that nature is political in India. The market-based aims of decision-makers in Ahmedabad means little priority has been given to an ecologically sensitive intervention on the riverfront, suggesting how, in Ahmedabad, the definition of environmental improvement is not ecologically driven. The findings suggest that the non-market values of the river are not being realised in either city to any great extent, certainly beyond some recreation (e.g. bathing and cricket) enjoyed by some people in Madurai (after Chaudhry et al., 2013). The decisions made in Ahmedabad and Madurai have led to inequalities in economic terms, with no current benefit to residents or (legitimate) users, except to sand-miners in Madurai and future real-estate developers in Ahmedabad. In both cities, interviewees demonstrated an appetite for change in the local government's approach to the rivers. In Madurai this was expressed as support for, and potential involvement in, a government-led river regeneration programme.

We believe that the cross-sectional nature of this research means that, certainly for Ahmedabad, our analysis of equity is as yet unfinished. While our findings suggest that positive social benefits (e.g. recreation and relaxation) are not met at the moment, we are cautious when we report this. This should be explored in more detail once the Sabarmati Riverfront is fully opened and users can be interviewed.

This will build on Desai's work into the effects of the Riverfront development to pose a question: will the painful memories of the redevelopment process be remembered by residents, or forgotten as the city decision-makers redefine Ahmedabad's identity around the Sabarmati River? This would allow us to conduct a fuller analysis within a conceptualisation of critical political ecology (after Forsyth, 2001).

In conclusion, the findings lead us to suggest that Indian urban river infrastructure should be rethought so the river is considered by decision-makers as an ecosystem which supports both human and non-human needs. The findings challenge the engineering-led approach taken to the Sabarmati River, which so far has reduced access to the water. This raises questions about how the river can form an important part of a larger green infrastructure linking up spaces across a wider and rapidly urbanising area. These ideas should be explored in detail for India's changing urban cities, to examine how acceptable/feasible they are for professionals and citizens (after Mell, 2015). This research is based on two cities alone, indicating a need to review existing practice and examine current approaches to river planning and management more widely in India. There also needs to be more research to explore how existing and future governance structures might permit this rethinking of urban infrastructure. Alongside this, further research should examine what is meant by 'nature' in the Indian urban context and to what extent it plays a part in everyday urban life in India. It is hoped that this research may prompt others in the pursuit of a better understanding of the role of the river within the context of rapid urbanisation in India.

## Note

1. French traveller Jean Tavernier (1677, cited in Yagnik & Sheth, 2011) recorded the use of floating clay pots to transport children across the river while parents swam.

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