**Greening Ahmedabad – Creating a resilient Indian city using a Green Infrastructure approach to investment**

**Abstract**

Ahmedabad is the commercial centre of the Indian state of Gujarat. With a population of 5.1 million it is subject to a range of socio-economic and ecological pressures which influence how the city’s landscape is planned. In 2013 the Ahmedabad Urban Development Authority (AUDA) released a second draft of the 3rd Development Plan for the city. This document outlined how the city plans to strategically deliver built infrastructure, as well as, enhance its landscape through green infrastructure (GI). Utilising ecological networks the plan explores the value of integrating landscape projects to facilitate a spatially functional landscape resource base. This paper evaluates the transitional from the rhetoric of the Development Plan to delivery. Drawing on commentary from local stakeholders it reflects on the form that GI is taking, and asks whether projects such as the Sabarmati Riverfront are meeting both the strategic, and more localised socio-environmental needs of the city.

**Key words:** urban greening, Indian cities, planning praxis, green infrastructure

**Research highlights:**

1. Ahmedabad is one of the first Indian cities to embark on a policy of GI investment
2. The Ahmedabad Development proposes a city-wide investment in ecological networks
3. Advocates and commentators argue that the AMC/AUDA are attempting to actively engage with a sustainable urban form agenda
4. Investment in GI is not universal or accessible to all

**Introduction**

India is facing some of the most extreme development pressures seen globally. Continual migration to cities will see its urban population increase to 590 million by 2030, and to over 700 million by 2050 (McKinsey Global Institute, 2010). An increased investment programme for water and sanitation systems, IT and communications, and public and private transport infrastructure is therefore needed to meet the needs of the growing population, whilst allowing the Indian economy to continue to expand (Nallathiga, 2010). Such large-scale migration has placed excessive stresses on existing residential, commercial and transport infrastructure leading to a more *reactive* form of development management (Roy, 2009). Where strong governance structures exist, such as in Chandigarh, development can be considered to be proactively planning for change, however, in a number of Indian cities, for instance in Mumbai and Hyderabad, this has proved difficult leading to more reactive planning (George et al., 2008; Zérah, 2007). Moreover, although evaluations of development in India have focussed frequently on the reaction of government, i.e. national/state/city authorities to development issues, in many cases at the expense of environmental concerns, there is a growing literature calling for parity in how *green infrastructure* can be utilised to influence development narratives (cf. Mell, 2016).

 Globally green infrastructure, hereafter GI, has been debated as offering a range of development options to address the changing infrastructure and socio-economic needs of cities (Siemens AG, 2011). Discussions identify that GI can deliver multi-functionality through increased accessibility to networks of green spaces, which in-turn provide socio-economic, health, education and business opportunities for communities (Austin, 2014). Whilst GI has been proposed by Benedict & McMahon (2006:1) as ‘providing a life-support systems for urban ecosystems’, there is a parallel discussion of how best to implement the heterogeneous conceptualisations of GI through delivery (Mell, 2014). This is exacerbated in Indian contexts as the pace of change in terms of the scale and function of the urban landscape is more rapid than in European or North American contexts. Moreover, although a number of Indian cities, including New Delhi, Bengaluru and Chandigarh, historically invested in GI in the 1800-1900’s (Mell, 2015), there are more pressing issues associated with balancing sanitation, access to affordable housing and employment, which often undermine the development and/or maintenance of urban green space (Nagendra & Gopal, 2010b; Narain, 2009).

 The analysis presented in this paper is therefore timely. With the release of the Draft 3rd Development Plan, the Ahmedabad Municipal Corporation (AMC) and Ahmedabad Urban Development Authority) (AUDA) (2013:9) are signalling their strategic objectives to promote GI in Ahmedabad as:

‘A livable, environmentally sustainable and efficient city for all its citizens; a city with robust social and physical infrastructure, vibrant economy and a distinct identity; a globally preferred investment destination'

As noted above Indian cities, like urban areas in many parts of Asia, are expanding rapidly (Merk et al., 2012). Therefore, if cities in ‘*developing*’ regions are to manage their environmental resources more efficiently, GI could provide an alternative to investment in other built infrastructure promoting a more holistic approach to climate change adaptation, protection of clean water, limiting the impacts of flooding and the urban heat island effect, as well as promoting health, well-being, and economic opportunities for local people and entrepreneurs, and local government officers/officials to achieve their strategic objective (Follmann, 2015; Nagendrael al., 2012; Sathaye, Shukla, & Ravindranath, 2006). GI is, as a consequence, considered to offer versatility enabling planners to address strategic climatic issues and align socio-economic and political influences within an ecologically focussed investment framework (Siemens AG, 2011).

 The following discussion of GI planning in Ahmedabad complements the research undertaken in other locations in Asia, for instance in Pakistan, China and Malaysia (Jim & Chen, 2003; Mansor & Said, 2008; Qureshi, Breuste, & Lindley, 2010), focussing on whether, and if so, how ecologically-focussed planning policy can support sustainable growth within an Indian context (Mell, 2013b; Siemens AG, 2011). To achieve this the following assesses how GI is discussed within planning praxis in Ahmedabad examining the complexities of balancing investment in GI with competing economic and social needs to promote liveability.

**Conceptualising Green Infrastructure**

To contextualise the following discussions the meaning of GI in this paper utilises the principles presented by Benedict & McMahon (2002: 6; 2006) and Natural England and Landuse Consultants (2009: 7), and synthesised by the Landscape Institute (2013:3) as:

‘GI is the network of natural and seminatural features, green spaces, rivers and lakes that intersperse and connect villages, towns and cities. Individually, these elements are GI assets, and the roles that these assets play are GI functions. When appropriately planned, designed and managed, the assets and functions have the potential to deliver a wide range of benefits – from providing sustainable transport links to mitigating and adapting the effects of climate change’

Each of these authors proposed that GI is a *strategic* approach to the planning of environmental resources applied at a *number of scales,* providing a *range of socio-economic and environmental benefits* - i.e. promoting multi-functionality. The academic-practitioner literature developed in the UK, North America and Europe emphasises that investment in green space supports access to nature and promotes a better understanding of ecosystem services, improves sustainable water management and enables ecological diversity to occur (cf. Davies et al., 2006; Kambites & Owen, 2006). GI has also been discussed as promoting human-environmental connectivity across physical, administrative and psychological boundaries (Allen III, 2012; Louv, 2005).

 Within this paper GI is positioned as an approach to urban planning that helps to deliver multi-functionality, and draws heavily on the promotion of ecological network capabilities. The paper also argues that GI provides a more adaptive approach to urban development that can be applied across India and elsewhere, as it optimises human-ecological interactions within accessible landscape systems, which are not solely focussed on economic outcomes (Reid, Walker, & Salt, 2006). Throughout the paper uses synonyms of GI including *urban greening* and *green space*, as they hold the similar characteristics as GI. These are also used, as there is currently no consensus of what GI is in India.

**GI development in India**

Compared to other locations engagement with GI praxis in India has been more diffuse (Zérah, 2007). Where cities in Europe and North America have promoted a growing use of GI over the last decade coinciding with the establishment of environmental sustainability as a prominent policy narrative, its application in India has proved more difficult to engineer (Beatley, 2000; Mell, 2015). Partially, this reflects the objectives of the Indian government who identify housing, transport and commercial infrastructure as key development priorities, for example meeting the needs of the expanding million-plus settlements of Gurgaon and Ghaziabad in the New Delhi National Capital Region (NCR) (McKinsey Global Institute, 2001). This illustrates one of the difficulties with establishing GI praxis in India: development is rapid, overtly responsive and competes with the provision of basic human needs (Mell, 2016). How planners balance development where support for environmental resource management is, potentially, undermined by market-led influences thus places constraints on the use of GI (Mell, 2015). A lack of continuity in how green infrastructure and green space terminology is used in India has also been identified.

GI can thus be considered as an emerging concept globally but especially in India, as green space management is more commonly used to describe a range of open space (including parks, gardens and other green spaces) management practices. The lack of a clear understanding of what GI *is* was exacerbated in 2015 when the Indian government renamed and refocused the work of the Indian Planning Commission, the agency who oversaw environmental management, as the National Institution for Transforming India Aayog (NITI Aayog); a centralised/top-down agency tasked with delivering the government’s growth agenda at a state level (Patnaik, 2015). This may, as a consequence,influencesthe proportion of existing and new GI in urban areas (calculated as the percentage of the urban land classified as GI including waterways) in India, which currently varies drastically between cities (McKinsey Global Institute, 2010; Meenatchi Sundaram, 2010; Mell, 2016). Such variation is reported as a response to the diverse climatic contexts of a nation, which impacts upon the nature and form of the ecological resources in urban areas and the lack of proactive environmental planning at a national and sub-national scale (Vidyarthi, Hoch, & Basmajian, 2013).

 To understand the ways in which responses to climatic variations and the speed of development impact upon urban areas, it is important to appreciate the influence that India’s political structures exert on the development (Williams, 2010). There are ongoing discussions of how alternative approaches can facilitate socio-economic and environment improvements, i.e. sustainable drainage (SuDS) or integrated transport, but they can be viewed as holding a dual narrative of the most efficient ways to manage growth (Sathaye et al., 2006). The first proposes an economically driven process of development that views the environment as a resource for utilisation (Mell, 2015). This interpretation permeates Indian planning and was a central tenant of Prime Minister Narendra Modi’s first budget speech in 2014; the budget which identified 7000 crore Indian Rupees (approximately $1.3 billion USD/£0.8 billion GBP) for the development of one hundred new ‘Smart Cities’. A second narrative promoted by environmental groups and academics argues that ecological resources should be considered as ‘*essential’* assets rather than expendable resources that should be used to aid the development of sustainable forms of urban growth (Balooni et al. 2011). Mell (2015) repositioned this debate from the simpler economic vs. socio-ecological debate towards a more politically orientated discussions identifying the neo-liberal influence of economic development as a ‘Nehruvian’ approach to planning. Moreover, he characterised locally led socio-environmental approaches to planning discourse as being closely aligned with the Gandhian Swadeshi Movement. Mell argued that this dual narrative providing alternative directions for the discussion of urban development, however, he also argued that it could be obstructive to sustainable development because there is a lack of complementarity between the two positions. The pace of growth, though, appears to support Nehruvian economic narratives superseding concerns over environmental capacity.

Attempts to rationalise these opposing views can be contextualised within the resilience literature, which discusses whether urban planning promotes an *efficient use* of resources or an *optimisation* of them; climatic variation and water/sanitation are key issues here (Reid et al., 2006). In light of such complexity there is a perception that the production of an integrated approach to environmental management in urban India is being undermined by economic imperatives (Vidyarthi et al., 2013). Achieving equilibrium between these competing influences has, invariably, led to variation in how cities perceive, and subsequently, manage their environments. However, if this debate is reframed as a dialogue which aligns *economic* and *ecological perspectives,* using GI as a mediating concept, there is scope to re-evaluate whether investments in GI can support a more sustainable form of planning (Mell, 2016).

 Variation in the approach to GI investments across the country should be expected in India because the rate of growth often outstrips the ability of city administrations to plan strategically for environmental resource management (McKinsey Global Institute, 2010). However, a number of cities have been more successful in their attempts to address this issue with the assistance of an engaged political and advocate arena. New cities such as Chandigarh built between 1912-1966, Gandhinagar (1965 onwards) and Bhubaneswar (1948 onwards) were planned to include higher proportions of public green space, integrating what is now considered GI into their designs (Kalia, 1994, 2004)[[1]](#footnote-1). Other cities including New Delhi have been subject to major urban changes including mass rural-urban migration, economic liberalisation and associated development, and increased housing, transport and service provision post-Independence leading to significant changes in the delivery of GI (Hall, 2002). Approximately 19% of the urban area of New Delhi is now classified as GI (Delhi Development Authority, 2007). In contrast Hyderabad has gradually reduced its GI resource base, and as a consequence the liveability of the city (George et al., 2008). Using a m2 metric it has been proposed that Chandigarh, a planned city, has 54m2 per person, New Delhi 21m2 (including a large green belt area), and Chennai an industrial city in the south-east 0.46m2; therefore not all cities compare favourably to the World Health Organisation’s recommended level of 9m2 per person (Mitra, 2013).

The case of Bengaluru - the ‘Garden City’ of India, with 17m2 of green space per person, is an extreme example where the rate of development has called into question its commitments to GI planning. Over the last fifty years the city’s water and green spaces have been significantly depleted to meet the needs of expanded transport, industrial and housing infrastructure (Nagendra & Gopal, 2010a). As a consequence, it was suggested by G.V. Sugar at the Urban Futures 2014 Conference (Bengaluru, November 2014) that the city’s green space cover had decreased from 68% in 1973 to approximately 23% in 2014. However, recent greening projects including water body improvements and street tree investments have attempted to reverse this trend (Gowda, Sridhara, & Rajan, 2013).

 A dynamism in the scope, scale, application and support for GI implementation is therefore evident across India (Siemens AG, 2011). Moreover, whilst a literature exists identifying comparable GI characteristics in the UK, North America and Asia, to those witnessed in India (cf. Austin, 2014; Jim & Chen, 2003; Mell, 2016; Qureshi, Hasan Kazmi, & Breuste, 2010), there is a growing consensus within the academy, government policy (cf. Balooni et al.2011, Chaudhry, Bagra, & Singh 2011; Nagendra et al., 2012) and the guidance of the Town and Country Planning Organisation & Government of India: Ministry of Urban Development (2014), arguing that investment in GI can be an effective mechanism of engaging planners with broader health, economic and climatic debates (Hostetler, Allen, & Meurk, 2011; Tzoulas et al., 2007). We could, however, consider the impact of the research noted above, as being potentially limited due to the changes to the Indian Planning Commission, the ending of the Nehru National Urban Renewal Mission (JNNURM) programme (cf. Vidyarthi et al., 2013), and the ongoing pressures placed upon urban landscapes and suggest that GI management is not a primary issue for developers or government in India. To investigate these changes an exploration of GI investment in Ahmedabad (Gujarat, India) is presented examining the various delivery mechanism used to promote landscape sustainability. The following sections outline the methodology supporting this investigating and an analysis of current praxis in the city.

***<INSERT TABLE 1 HERE>***

**Methodology**

To investigate the use of GI in Ahmedabad this paper followed a three-stage process: (1) documentary analysis of key local planning policy/guidance documents, (2) interviews with local actors, and (3) on-site observations of GI discussed in the city’s development plan. The aim of which was to generate a triangulated understanding of whether, and if so, how the greening rhetoric of the AMC and AUDA was being delivered in practice. Research was conducted between June-September 2014 in-situ. The first approach was an analysis of local planning documents. These documents were reviewed through a content analysis of key word and phrases, i.e. green space, water management, recreational amenities, parks/gardens, and riverfront regeneration developed in comparable investigations, (cf. Roe et al., 2009; Mell, 2010) and the identification of specific investment locations, i.e. Sabarmati Riverfront, to assess how different policies/developments represented the strategic objectives of the city’s planners and the extent to which GI was included in the city’s investment plans. Using documents produced by the AMC, AUDA and other agencies, i.e. Sabarmati Riverfront Development Corporation (SRFDCL), the analysis identified thematic development objectives and locations, which were used to (a) evaluate the commonalities and/or discrepancies between these documents and the material received from interview testimony and (b) select sites for on-site investigation.

To assess whether the strategic objectives presented in the AMC, AUDA and SRFDCL were being implemented a series of stakeholder interviews were conducted with city administrators, developers, academics and practitioners in Ahmedabad (Table 1). Stakeholders discussed the fluidity of development in Ahmedabad, how this has shaped its urban form and the extent to which the rhetoric of greening is translated into practice. This included discussions of the political and financial processes (and barriers) involved with delivering the city’s development plan illustrating positive and negative interpretations to it implementation. The paper’s interview analysis is drawn from a sample of local actors who were identified through existing contacts with local stakeholders. This limited the range of actors engaged, who are not presented as a representative sample of the city’s actors but did provide important contacts within the local government. Unfortunately, it was not possible to interview members of the local development sector, the Sabarmati Riverfront Development Corporation (SRFDCL) or other landscape professionals (i.e. landscape architects). Further informal engagement and feedback from faculty/students at CEPT University provided additional context to the commentary.

Finally, a series of on-site evaluations of Ahmedabad’s GI resources was made. These assessed the nature of investment in GI, the access to each site, and the available information/amenities associated with each site. This assessment is presented in Table 2, which outlines positive and negatives reflections on the physical landscape and the socio-economic and ecological benefits of each location. Table 2 also identifies links between the political/development environment of the city and the subsequent influences on investment. This discusses where good GI practice can be identified, but also indicates where barriers to implementation are visible. All three approaches focus on evaluating the *scale* (state, city or local), the *focus* of GI praxis, and the *governance/policy* structures supporting investment in GI. In the following sections where commentary is based on interviewee data it will be ascribed as such, similarly where discussions of planning policy are made it is based on an analysis of the application of policy objectives in practice. Any further analysis is based on on-site reviews.

**The development context of Ahmedabad**

The city of Ahmedabad is the largest urban area in the state of Gujarat. It lies within the hot semi-arid central climatic belt with an average annual temperature of 34oc (21oc min) and 784.3 mm of rainfall per year. It has a population of 5.1 million people in the AMC administered area, and 6.3 million in the broader AUDA area. Although Ahmedabad is not the legislative centre of the state, which is Gandhinagar, the city acts as its economic hub (Kalia, 2004). The city’s development was linked to the textile industry from the 19th century onwards. As industry grew the areas east of the Sabarmati River developed - the area considered as the oldest parts of the city. With further economic development the city expanded to the south and to the west (Adhvaryu, 2011b), and three specific periods of growth can be identified: 1932-1949, 1976-1996 and 1996-onwards. The first period reflected the city’s continuing importance as a textiles hub (linked to Gandhi’s Swadeshi Movement). This facilitated changes in the city’s urban form following continued rural-urban migration, and led the city’s government to reform their development objectives to prioritise economic growth and infrastructure development (Ahmedabad Urban Development Authority, 2013). Ahmedabad developed further as a strategic location following the bifurcation of the State of Bombay in 1960 when the states of Gujarat and Maharashtra were formed.

A second period of development occurred post-1976 when the first Gujarat Town Planning and Urban Development Act was passed (Dholakia, 2000). The Act mandated for the expansion of infrastructure across the city to meet housing, essential services infrastructure (i.e. water and sanitation) and transport needs. This proceeded the major period of investment (1996-onwards), when the city and state government rescinded several land use restrictions including the revocation of the Ahmedabad Green Belt policy (established in 1967), to facilitate a westward expansion of the city (Ahmedabad Urban Development Authority, 2013). Ahmedabad’s Green Belt was designated to limit expansion outside of an agreed urban growth boundary in line with the traditional principles proposed in the UK. It also acted as a visible ‘green belt’ for the city that helped focus GI investment within the city boundary. The Green Belt was not proposed as a multi-functional landscape features in the Act. Changes to planning restrictions were also reported as a response to the downsizing of the city’s textile industry and the move by city and state governments to expand Ahmedabad economically through commercial and knowledge industries (Adhvaryu, 2011a).

In 1987 the 1st Ahmedabad Development Plan was adopted and focussed on protecting Ahmedabad’s Green Belt, improving transport provision and delivering housing. City administrators subsequently attempted to streamline its development objectives within their 2nd Development Plan. The 2nd plan outlined a refined number of investment goals promoting the city as ‘liveable’ supporting mobility, inclusive urban design, and conserving the city’s heritage to create an environmentally sustainable and economically prosperous city (Ahmedabad Urban Development Authority, 2013:7-9). It also rescinded the protection afforded the Green Belt designation, as the enforcement of formal and informal expansion into these areas was considered to be legislatively and legally difficult due to the extensive complexities of litigation placed on development.

Whilst each of these development goals were given significant emphasis, the plan focussed predominately on economic development framed through the promotion of Ahmedabad as a liveable green city. This can be identified in the promotion of special planning development zones which optimise growth opportunities, the discussion of transit orientated development (ToD) and the development of the BRTS transit system[[2]](#footnote-2), as well as focussing on growth centres/hubs to allow contiguous investment across the city (Ahmedabad Urban Development Authority, 2013: 7-9, 11, and Section 3). In the period between the adoption of the 2nd and the release of the Draft 3rd Development Plan Ahmedabad continued to expand spatially and economically. Growth was overseen by the former Chief Minister of Gujarat, Narendra Modi, who established clear economically-centred development goals to strengthen the investment environment of Ahmedabad which was reflected in the development and promotion of the Sabarmati Riverfront redevelopment.

***<INSERT TABLE 2 – Ahmedabad GI analysis HERE>***

**GI investment in Ahmedabad**

The 3rd edition of the Ahmedabad Development Plan (Ahmedabad Urban Development Authority, 2013) proposed four main delivery mechanisms for GI, which differed in their size, spatial distribution, and the benefits allocated to each. The 3rd iteration of the plan built on the implementation of the 2nd, which was reported as achieving a 95% implementation rate for project delivery. Furthermore, whilst the Development Plan builds on the spatial conceptualisations of the previous two plans, the 3rd rescinded the Green Belt designation, as it was considered by the AMC and AUDA to be unenforceable through existing development control practices (Interviews 1 and 6). We can thus question whether the 95% completion rate is valid if a major landscape protection policy has been removed?

The Development Plan also presented a hierarchy of proposals reflecting the perceived value (to the socio-economic well-being) of the city of GI investments to AUDA and the AMC:

1. Development of a network of regional, city and local GI resources including investment in public parks, the Sabarmati Riverfront and neighbourhood/community GI;
2. Investment in lake, river and canal front redevelopment including the Sabarmati Riverfront, and Kankaria and Vastrapur Lakes;
3. Extension of existing ‘green streets’ investment on all major transport routes in the AMC area with significant additional investment on smaller roads
4. Investment in ‘urban groves’ and ‘meanwhile’, spaces to increase the proportion of GI visible/accessible GI across the city.

In practice investments in the Sabarmati Riverfront are currently being delivered with sections located around the Gandhi Bridge being opened in 2012 (Fig. 2). Other sections were still under construction in 2014, and remained incomplete in 2016. The Riverfront Park (Fig. 1) opened in 2012/13, whilst the redevelopment of Kankaria Lake (Fig. 3.) was completed in 2008. Investment in street trees, urban groves and meanwhile spaces is more piecemeal.

Table 2 provides a detailed analysis of how these four development options are discussed in the Development Plan and how they are being implemented. The table highlights positive commentary from stakeholders and on-site observations but also questions whether investment in GI has moved beyond rhetoric to the delivery of functional resources. Table 2 also illustrates the varied reasoning supporting/refuting each investment, which includes a number of comments on the aesthetic and socio-economic benefits that existing and new GI will deliver. However, these comments are in places contrasted to ecological values (and disvalues) attributed to GI investment. Table 2 and the following commentary should therefore be read as a reflection of GI practice which promotes attractive landscape development but aligns such practices with a better understanding of the wider societal and environmental benefits that GI can deliver. Examples of this variation include the contested responses to the Sabarmati Riverfront development, the Modi-led ‘politicised’ redevelopment of Kankaria Lake, and whether the planting of street trees has been delivered equitably throughout Ahmedabad.

Each of the four types of GI investment could be viewed as meeting either strategic development needs or alternatively be framed as politicised projects that meet the needs of specific groups, i.e. developers, upper-class residents, or local politicians. However, they can also be considered to form elements of a city-wide network of GI, which has the potential to connect Ahmedabad’s diverse ecological resource base. Linkages of this nature are critical to the long-term ability of Ahmedabad’s landscape to adapt and mitigate climatic and physical infrastructure changes. The following sections analyse how these objectives are being actualised, and debates the reception that they have received from commentators in Ahmedabad.

*Sabarmati Riverfront*

Investment in the Sabarmati Riverfront was identified within the Development Plan and by all interviewees as the most important GI investment in Ahmedabad. The Development Plan clearly delineates the potential value of this project to the city’s economy highlighting its positive effect on both the quality of life and its economic prosperity. Subsequent evidence from the Sabarmati Riverfront Development Corporation (SRFDCL) states that the riverfront development will provide Ahmedabad with an investment of ‘state-level’ significance that will raise the visibility of Ahmedabad regionally and nationally (Interview 1). There is also an assumption made by commentators (including Interview 2 and 6) that as the project was supported by the Modi led state government that it was (a) politically motivated and (b) would be completed regardless of any local objections to ensure positive outcomes for Ahmedabad (and its politicians). The SRFDCL also suggested that the development of a formal promenade, associated gardens and public GI developed in conjunction with new housing and commercial properties will provide a much stronger public realm to support the city’s economic development (Interview 1).

The scale of the investment (11km in length and 16km2 reclaimed land) makes it the most spatially significant project in the city. The Gujarat government gifted the land adjacent to the river, now reclaimed, to the project with no compensation fee being paid to existing land users (i.e. businesses) or owners (whether formal, informal or with dynamic tenure) (Interview 1, 2, 3 and 4). Having state support for the project enabled AUDA and the AMC to scope, consult and commence delivery of the project more quickly compared to other projects, which are subject to greater administrative scrutiny (Interview 6). Whilst the scale of the Sabarmati investment marks it out as a city/state scale project, the application of actual GI investment within the programme is less well defined. Although the development prioritises investment in a tree-lined promenade and two new public parks (see Fig. 1), the scope of GI has been considered disproportionately small compared to the overall size of the investment (Interview 2). The actual increase in GI could thus be considered limited. An alternative view suggests that GI is being used as part of the design aesthetic and not as a mechanism for the delivery of multi-functionality (Interview 2 and 6).

Interview 2 also argued that the manicured profile of the promenade (see Fig. 2) restricts its ecological functionality. Furthermore, whilst the SRFDCL (Interview 1) stated that the 16km2 of reclaimed would be used, at least in part for GI, the nature of this investment lacks specific detail. SRFDCL documentation presents illustrative proposals for the area but as of September 2014 no detailed investment programme had been released for public scrutiny. Where investments in GI have been made (see Fig. 3) funding has tended to be allocated to formal and city-managed GI projects with few opportunities for smaller/community led biodiversity projects. These ‘formal’ spaces have been designed to provide a range of controlled on-site activities (i.e. walking or programmed community activities), to be aesthetically pleasing and to introduce a managed form of ecological resource management to the riverfront (Interview 3). The use of additional water for maintenance of the site’s aesthetics quality was suggested as an unsustainable activity (Interview 6). It was also argued that the removal of the existing ecological resource base (including trees, grasses and shrubs) following floodplain clearance may have led to a greater ecosystem damage than the redevelopment will deliver (Interviews 2 and 5).

Furthermore, although the scale of the investment is significantly larger than the city’s other projects it is not, as noted above, universally viewed as positive. Whilst the AMC and AUDA both argue that a long-term investment in the riverfront will act as a catalyst for improvements in residential quality of life, some commentators i.e. Interviewees 2 and 4, report negative aspects associated with the proposal. They suggested that the changing socio-environmental functionality of the reclaimed floodplain makes it anomalous to consider this a successful investment in GI. Moreover, the influence of the state government was commented upon as the driving factor behind the project with less emphasis being placed on the rights or needs of local populations (Interview 6). They, and a range of authors (cf. Mathur 2012), also propose that the dislocation of communities with the river, has diminished its cultural value. The AMC and AUDA, however, stated that all residents were relocated to adequate sites in the west of the city; although this was considered as damaging community and economic ties with the river. Despite the promotion of the on-site ecological and socio-economic benefits by the AMC and AUDA, there remain those who question the validity of the scale, focus and management of the riverfront investment programme. The same commentators also raised doubts over the legitimacy of the investment process suggesting that there has been a lack of transparency in the scoping, consultation with local communities/businesses and development of the site. All of which challenged the AMC and AUDA’s proposals that the riverfront GI investment has been a wholly successful intervention (Interview 2).

***<INSERT FIGURE 1: Riverfront Park>***

***<INSERT FIGURE 2: Sabarmati Riverfront Promenade>***

***<INSERT FIGURE 3: Kankaria Lake>***

*Kankaria Lake*

The redevelopment of Kankaria Lake was completed in 2008 and was opened by the then Chief Minister Narendra Modi. The modifications were viewed as a key component in developing a greener, more attractive and liveable city, as Kankaria was and remains a destination park. Investment has improved the aesthetic quality of the site, as well as its amenity offer, which include a zoo, funfair, boating activities and a small passenger railway. The site is patronised extensively, especially in the evening and at weekends. It is, however, also heavily used from 6am-8am by walkers and joggers as there is no entrance fee. Redevelopment has improved the aesthetic quality of the park but we could argue that the on-site GI is not extensive. Kankaria Lake has a series of tree-planted walkways, however, the greening of the site is predominately managed grassed areas (maintained with water from the lake), with little additional biodiverse planting. The value of the site’s GI is potentially undermined by the extensive plaza style redevelopment. The majority of the site also lacks accessible greenery, and where GI exists it is managed extensively. Furthermore, it was suggested that the funding for Kankaria’s redevelopment was a political gesture to ensure the city and state government continued to receive public support (Interview 2 and 6). It has, therefore, been difficult for some commentators to disassociate the political nature of the development from the ongoing management of the city’s growth. The appropriateness of financial support for the project has been questioned in some quarters (i.e. Interview 5). However, it is more difficult to argue against the investment strategy of the city government, as despite reservations over the politicised nature of investment it provides the city with its largest publically accessible waterbody and amenity area (along with the riverfront).

*Street Trees*

Alongside the riverfront development the AMC/AUDA street tree programme provides the most spatially distinctive GI implementation programme in Ahmedabad (see Fig. 4 and 5), as it is both *visible* to the public and *spatially* extensive, as it covers all sectors of the city. The significance of the street trees project is its recognition that Ahmedabad has a growing population (and associated infrastructure needs), which is leading to changes in the city’s climate (Interview 1 and 4). The Development Plan argues that the expansion of roads and housing was compromising the city’s tree cover, thus. Investment is therefore located on all principle arterial roads, as well as in residential and suburban areas to help establish, and subsequently enhance the city-wide GI network. Both the AMC and AUDA (Interview 1 and 4) argue that such a spatial distribution promotes the city’s roads as ecological corridors addressing climatic variation and the pollution associated with traffic. There are though complications for the planting of street tree associated with the ongoing investment in Janmarg – the Ahmedabad BRTS rapid bus transport developments. New transport infrastructure, including central carriageway bus stops has required AUDA and the AMC to reconsider how it uses in-road street trees in some locations. To date where new BRTS infrastructure has been developed, for example close to Kankaria Lake and IIM Ahmedabad, street trees have been used to frame these investments.

Investments in street trees highlight the AMC and AUDA’s commitment to improving the quality of the environment in the city (ecologically/climatically, as well as, socio-economically). Moreover, Interview 5 and 6 both discussed the role of street trees in promoting urban cooling and rainfall interception, noting corresponding improvements in quality of life for resident’s post-investment. The AMC and AUDA also proposed that to improve the quality of place, and by extension, the quality of individual and communal life in Ahmedabad, that investments in street trees must continue to be spatially widespread. Evidence is though limited in terms of what new resources have been established across the city. In central areas investment in street trees appear established, however, it is more likely that new planting will occur in the western sectors of the city, as these areas are associated with new development. The lack of visible investment in street tress in all sectors does not appear to be a concern to the city’s government, as AUDA’s timeline to meet the increased proportion of GI in the city (4.5% to 15%) by 2021 is still considered achievable (Interview 4). Furthermore, AMC officials stated that even where roads required widening to meet the growing need for carriageway space that any trees removed were being replaced at the new road edge/boundary. Investments in grey infrastructure were therefore not considered to negatively impact on the overall GI coverage of the city. Alternatively, further investment in street trees are considered to have an enhancing effect on the aesthetic and social value people place on the city’s landscape (Interview 3).

***<INSERT FIGURE 4 Ashram Road Street Trees >***

***<INSERT FIGURE 5: Green infrastructure in Bhadra Plaza, Ahmedabad>***

***<INSERT FIGURGE 6: Parimal Gardens>***

*Urban groves and meanwhile space*

Potentially the most innovative proposal in the Development Plan is the promotion of urban groves and ‘meanwhile’ spaces, as a contemporary form of GI. Urban groves are discussed as a strategy to ensure that smaller spaces are not left vacant prior to development. Instead they be being used to plant small woodlands/groves to maintain the ecological functionally of investment sites, and are proposed as a short-medium term solution for areas with limited GI coverage. However, they have also been linked to a rethinking of ‘*meanwhile*’ spaces across the city. Meanwhile spaces are classified as those locations where development has been approved but construction has not yet begun. The AMC and AUDA have proposed that during this interim stage that the planting of urban groves improves the ecological value of the site prior to development. This has seen the AMC and AUDA work with developers to promote a scenario where groves are planted as an interim requirement of obtaining planning permission (Interview 4), and is applied on development sites of 100m2 or over requiring the planting of one tree per 10m2. Furthermore, the AMC indicated that post-development they require the additional GI to be maintained on-site to ensure the interim ecological and socio-economic benefits are not lost. However, despite assurances from the AMC that yearly site surveys will be undertaken to assess compliance, there is an uncertainty from local residents as to the longevity of this practice (Interviews 2 and 6). Thus, the long-term ecological, climatic and social benefits of investment in urban groves are open to debate.

**Discussion**

The overarching strategy for GI investment in Ahmedabad utilises a spatial distribution of ecological resources to generate a range of socio-economic and environmental benefits with the proposed network indicating that the AMC and AUDA are attempting to develop a more connective and functional landscape. The discussion of GI investments suggests that the city’s authorities have assessed the current capacity of the ecological resource base against development projections to support the GI network outlined in the 3rd Development Plan. Whilst a number of commentators questioned the approach to investment outlined in the Development Plan identifying specific socio-economic and environmental concerns, such as the relocation of communities from the riverfront, the approach taken by the AMC and AUDA is considered to be is spatially attuned to investment in functional GI aligned with the expansion objectives plans for the city (Interview 4).

The promotion of GI by the AMC and AUDA suggests that the city’s administration is taking progressive steps to create environmental enhancement projects that meet ecological, economic and social needs. This is highlighted by the depth of spatial analysis presented in the 3rd Development Plan, and the commentary provided by officials, practitioners and academics in Ahmedabad. Unlike in other Indian cities including Mumbai or Bengaluru (cf. Nagendra et al., 2012; George et al., 2008), the AMC and AUDA has used the 3rd Development Plan to marry the city’s ambitious growth plans with an understanding of the capacity of its environmental resource base; the revocation of the green belt designation being the noticeable exception[[3]](#footnote-3). As a result, the city is promoting GI as a key component of Ahmedabad’s long-term development positioning itself as a prosperous location for investment. However, the discussion presented above suggests that divisions exist between those who feel that the decision-making structures supporting Ahmedabad’s GI network are functioning strategically and collaboratively, and those who feel there is a lack of transparency to this process. Whilst it is difficult to rationalise these alternative positions given the complexity of proposals within the Development Plan, it could be argued that AUDA and the AMC’s analysis illustrates a spatially appropriate form of investment for GI. The development of a connective network of GI based on the city’s river and water resources linked by public parks and street trees supports such a view. Commentary presented by city officials also argues that the breadth of GI interventions proposed in the Development Plan provides a geographically diverse programme of investment that has been well-received in the city. However, the impact of entrance fees to new GI sites and the relocation of populations from riverfront areas questions the wider social functionality of the city’s green spaces. Therefore, although investment in a green network is receiving positive feedback from local government, as it facilitates the development of a liveable and multi-functional urban landscape, there have been calls for greater transparency in the development process.

These comments reflect the wider literature on GI development in India where the objectives of stakeholders influencing investment are rarely aligned (Balooni et al., 2011). As a result, conflicts arise between actors as they attempt to promote their priorities over other mandates as witnessed in Mumbai, Nagpur and Kolkata (Chaturvedi, Kamble, Patil, & Chaturvedi, 2013; Roy, 2009; Tarafdar & Bj⊘nness, 2010). In Ahmedabad this has been managed, to some extent, as the AMC and AUDA have controlled the involvement of government and non-government stakeholder input into the development plan (Ahmedabad Urban Development Authority, 2013). Whilst, this has led to criticism of the scope, rationale and implementation programme for the city’s GI, it has provided a legislative and administrative framework through which the AMC/AUDA have been able to direct investment. Moreover, positive commentary regarding GI focussed on the delivery of a varied investment portfolio of landscape resources, its spatial distribution across the city, and greater access to high-quality spaces for residents (Adhvaryu, 2011b; Ahmedabad Urban Development Authority, 2013). Where less complimentary comments have been reported they reflected upon the aesthetic quality but lack of socio-economic function of some spaces, the view being that new investments were not meeting the needs of low-income residents as they are exclusionary in nature due to lack of affordable access for some residents. The proposals were also thought to be too strategic or regionally focussed rather than meeting the needs of local communities (Mahadevia, 2011; Mathur, 2012).

The presentation of a structured investment programme within the Development Plan also indicates that the key principles of GI: connectivity, accessibility and multi-functionality are being utilised, which is a positive sign of strategic foresight (Mell, 2013a). Understanding the nuances of this, and the ability of the AMC and AUDA to apply these principles is therefore key to a longer-term and sustainable form of GI development (Benedict & McMahon, 2006). Furthermore, although a number of the city’s sites, including Kankaria Lake and the Riverfront Park may have access issues, they act as connecting hubs linking the city’s smaller green spaces into a GI network. The revocation of the green belt designation is though a significant aberration. Whilst the utility of green belts has been contested globally (cf. Amati, 2008), their ability to moderate expansion offered significant protection to Ahmedabad’s landscape. In India Green Belts were proposed to fulfil the same functions as those designations in the UK: offering protection to areas of green and open space for ecological and development control reasons. Rescinding the Green Belt thus limits the ability of the AMC and AUDA to shape strategic development within the city boundary in the same way, and it seems likely that further urban expansions will occur increasing the city’s footprint and placing increased pressures on its environmental resource base.

The AMC and AUDA can also be considered to have contemplated the long-term investment value of GI across the city. This is visible in the framing of investment outlined in the 3rd Development and in the deliberations of AMC and AUDA officials presented in this paper when reflecting on the nature of GI delivery. The main objectives outlined in the Development Plan, and discussed by city officials, highlight an appreciation of how the city will expand and the potential contribution that GI can make promoting liveability and limiting the negative impacts of growth. The location of street tree investments along major arterial roads, as well as in residential and suburban areas suggests that the AMC and AUDA are aligning GI (and the improved green network) with the distribution with future expansion (Ahmedabad Urban Development Authority, 2013). Within this the AMC and AUDA view GI as providing potential benefits to the city’s existing transport network/BRTS and suggest that they can form an important green network across the city. Such an interpretation supports a conceptual lineage between the street greening principles employed in Europe and North America, where investments in GI along key thoroughfares (as well as at strategic junctions/locations) have made a significant positive impact on environmental quality (Beatley, 2000).

In addition to the investments in street trees, the scale of the Sabarmati Riverfront development highlights the AMC and AUDA’s long-term vision for the city’s urban development. Their promotion of GI as a mechanism to develop Ahmedabad as a prosperous and liveable city within the latest Development Plan promotes the use of landscape investment as an indicator of a high quality socio-economic and environmental city. Moreover, the political support the project received from the AMC and AUDA, as well as the former Chief Minister Narendra Modi, has been proposed as ensuring that it will be effectively delivered. This could be viewed limiting the possibilities of any negative commentary being associated with the project due to fears of political reprisals. Its implementation has also been more efficient than otherwise may have been expected due to the support of regional and national actors (compared to other more local projects) (Mathur, 2012). Moreover, although the value of GI planned for the riverfront is contested, the scale of investment raises its visibility as an important urban regeneration tool. It has also been argued that the added aesthetic and economic value associated with the project has driven the investment process but may undermine the wider ecological benefits of redevelopment. Thus, although redevelopment of the Sabarmati may be viewed positively in terms of economic uplift and political support some still question its ability to provide GI and other socio-economic resources for the residents of Ahmedabad.

The riverfront could, as a consequence, be seen as a destination landscape that fulfils AUDA’s desire to bring economic investment and social functionality to a formerly undervalued location (Ahmedabad Urban Development Authority, 2013). However, in spite of the visibility that riverfront redevelopments have, for example in New Delhi and Shanghai (Follmann, 2015; Zhang, 2005), this does not necessarily equate to localised value. Moreover, other large-scale projects in Singapore (The Garden by the Bay) and London (Queen Elizabeth Olympic Park) highlight that investments in GI, potentially, has a much wider value due to their international prominence compared to local values (Siemens AG, 2011; Mell 2016). Each of these projects enabled their host cities to brand themselves as liveable and sustainable; a process that AUDA and the AMC are attempting to facilitate through the Sabarmati investment. However, there are conflicting agendas visible to these discussions. Specifically, commentators question the equity of access to attractive and high value landscapes where entrance fees or community clearances have significantly altered the relationship some residents have with the city’s landscape (Mahadevia, 2011). We can therefore argue that GI development in Ahmedabad presents a polarised narrative. Whilst, the AMC and AUDA’s approach to GI promotes the benefits of investment for the public, the business community and political support, the alternative suggests that although the proposed network shows a lack of understanding of how development focussed on the riverfront undermines its wider socio-economic and ecological benefits by marginalising part of the city’s population.

Despite the criticisms of the 3rd Development Plan, and its subsequent delivery, the GI proposals for Ahmedabad present a coherent policy framework for landscape enhancements. Depending on the interpretations of the current development programmes investments may be viewed as good practice locally, and indeed nationally[[4]](#footnote-4). Moreover, the use of a city-wide street tree investment programme replicates projects in North America and the UK highlighting the value of such strategic investment (Mell, 2016). Furthermore, although a number of commentators (cf. Manhur 2012) criticised the redevelopment of the Sabarmati Riverfront, it is seen as a successful example of large-scale GI investment by the AMC and AUDA, and more widely by the state and national government (including PM Modi). Mathur (2012) and Adhvaryu (2011a), however, query the validity of such claims arguing that the nature of the investment in terms of site clearance, relocation of communities and high quality (and high cist) investment, as well as the damage to ecosystems limits the resilience of the landscape undermining the added value of new green spaces.

The lessons we can take from GI investment in Ahmedabad include reflections on the value of environmentally focussed policy, how GI networks can be integrated into urban development objectives, and the varied delivery of broader socio-economic and ecological benefits. For example New Delhi’s Development Plan talks extensively about utilising the city’s Green Belt and street trees to manage urban climate and promote recreational use (Mell, 2016b). However, the nature of development in Delhi’s satellite cities of Gurgaon, Dwarka and Ghaziabad show a more limited uptake of such practices. Furthermore, Delhi under the guidance of PM Modi New Delhi is adopting a comparable model for the Yamuna redevelopment as on for Sabarmati Riverfront (Baviskar, 2011; The Times of Indian Online, 2015). Similar problems are also being witnessed in terms of floodplain redevelopment, displacement of existing populations, and the privatisation of formally public space due to investment in the Commonwealth Games village, gated gardens and residential buildings. Examples do exist however where comparable practices to Ahmedabad are highlighted. The cities of Gandhinagar and Chandigarh both highlight the economic and socio-ecological benefits of GI investment in terms of liveability (Kalia, 2004). Moreover, the rise of the ‘smart city’ concept in India has gone some way to embedding GI principles in development debates. Nevertheless, the technological focus of smart cities can downplay the role of connectivity, multi-functionality and access to nature in favour of smarter waste and transport infrastructure. Other cities in India are nonetheless more advanced in developing GI. For example, in Bengaluru the role of street trees and urban water management have become key development issues as the city aims to re-establish itself as a ‘garden city’, and concurrently support the city’s economy. This is being achieved through investment in sustainable drainage linked to the cities lakes and waterways, and financial investment in parks, gardens and street trees (Mell, 2015; Nagendra et al., 2012). The application of GI, and more importantly the understanding of its values in landscape and urban planning, are still though evolving in India, and as the momentum supporting GI increases through praxis in cities like Ahmedabad there is the potential for greater uptake in use. However, this will require strong leadership and foresight, financial support, and a willingness to place environmental issues at the centre of development discussion, as seen in Ahmedabad, if urban growth is to be more sustainable (cf. Town and Country Planning Organisation & Government of India: Ministry of Urban Development, 2014).

**Conclusion**

The promotion of GI in the 2nd and the 3rd Development Plan, along with the widening application of its principles (as shown in Table 2), suggests that the AMCs and AUDAs promotion of quality and functionality for the city’s environment are important factors in Ahmedabad’s development. The scale, spatial distribution, and proposed delivery options outlined in the plan indicate an understanding of GI principles, which are being employed through the riverfront investment and city-wide planting of street trees. This has been achieved through the creation of a spatially connective set of proposals that facilitate investment, maintenance and enhancement of a multi-functional urban landscape. However, the actual proportion of GI, access to new resources and the revocation of the green belt designation suggest that an equally strident, and less positive, alternative commentary exist within Ahmedabad. Moreover, although criticism of their approach to GI investment has being levelled at the AMC and AUDA, a supportive local government environment have enabled key aspects of the plan to be delivered. Whilst, the successes of development could be challenged as being aesthetic in nature rather than ecological, and failing to meet the needs of all citizens, i.e. in terms of costs, access and rights to use landscape resources, there are indications that the programme of GI investment could facilitate a more socio-economically prosperous city, which draws heavily on GI to promote liveability. We could therefore conclude that Ahmedabad is attempting to position itself as a forward-thinking city in terms of its understanding, promotion and monitoring of investment in GI to ensure that the city has a climatically, socially and economically sustainable urban future, and that is can be considered as an exemplar for other Indian cities to learn from.

**Acknowledgements**

Financial support for this paper was supported received from the Urban Knowledge Network Asia (UKNA). The fieldwork was facilitated by staff in the Faculty of Planning at CEPT University, Ahmedabad (June-September 2014).

**Bibliography**

Abbott, J. (2012). *Green Infrastructure for Sustainable Urban Development in Africa*. London: Routledge.

Adhvaryu, B. (2011a). Analysing evolution of urban spatial structure: a case study of Ahmedabad, India. *Environment and Planning B: Planning and Design*, *38*(5), 850–863.

Adhvaryu, B. (2011b). The Ahmedabad Urban Development Plan-making Process: A Critical Review. *Planning Practice and Research*, *26*(2), 229–250.

Ahmedabad Urban Development Authority. (2013). *Draft Comprehensive Development Plan 2021 (Second Revised)*. Ahmedabad: Ahmedabad Urban Development Authority

Allen III, W. (2012). Advancing Green Infrastructure at All Scales: From Landscape to site. *Environmental Practice*, *14*(1), 17–25.

Amati, M. (2008). *Urban Green Belts in the Twenty-first Century*. (M. Amati, Ed.). Farnham, UK: Ashgate.

Austin, G. (2014). *Green Infrastructure for Landscape Planning: Integrating Human and Natural Systems*. New York: Routledge.

Balooni, K., Gangopadhyay, K., & Mohan Kumarm, B. (2011). *Urban Sustainability and Changing Private Green Spaces: Some Insights from an Indian City. Asia Research Institute Working Paper Series No. 169*. Singapore: Asia Research Institute

Baviskar, A. (2011). What the Eye Does Not See: The Yamuna in the Imagination of Delhi. *Economic and Political Weekly*, *XLVI*(50), 45–53.

Beatley, T. (2000). *Green Urbanism: Learning from European Cities*. Washington DC: Island Press.

Benedict, M. A., & McMahon, E. T. (2006). *Green Infrastructure: Linking Landscapes and Communities*. *Urban Land* (Vol. June). Washington DC: Island Press.

Chaturvedi, A., Kamble, R., Patil, N. G., & Chaturvedi, A. (2013). City–forest relationship in Nagpur: One of the greenest cities of India. *Urban Forestry & Urban Greening*, *12*(1), 79–87.

Chaudhry, P., Bagra, K., & Singh, B. (2011). Urban Greenery Status of Some Indian Cities : A Short Communication. *International Journal of Environmental Science and Development*, *2*(2), 98–101.

Davies, C., Macfarlane, R., McGloin, C., & Roe, M. (2006). *Green Infrastructure Planning Guide*. Anfield Plain: North East Community Forest.

Delhi Development Authority. (2007). *Master Plan for Delhi 2021*. New Delhi: Delhi Development Authority.

Desai, R. (2012). Governing the Urban Poor: Riverfront Development, Slum Resettlement and the Politics of Inclusion in Ahmedabad. *Economic and Political Weekly*, *XLVII*(2), 49–56.

Dholakia, R. H. (2000). Liberalisation in Gujarat: Review of Recent Experience. *Economic and Political Weekly*, *35*(35-36), 3121–3124.

Dutta, S. S. (2000). Partnerships in urban development: a review of Ahmedabad’s experience. *Environment and Urbanization*, *12*(1), 13–26.

Fernandes, L. (2004). The politics of forgetting: class politics, state power and the restructuring of urban space in India. *Urban Studies*, *41*(12), 2415–2430.

Follmann, A. (2015). Urban mega-projects for a ‘world-class’ riverfront – The interplay of informality, flexibility and exceptionality along the Yamuna in Delhi, India. *Habitat International*, *45*, 213–222. http://doi.org/10.1016/j.habitatint.2014.02.007

George, B. A., Malano, H. M., Khan, A. R., Gaur, A., & Davidson, B. (2008). Urban Water Supply Strategies for Hyderabad, India – Future Scenarios. *Environmental Modeling & Assessment*, *14*(6), 691–704.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting Cities for Climate Change: The Role of the Green Infrastructure. *Built Environment*, *33*(1), 115–133. http://doi.org/5

Gowda, K., Sridhara, M. V., & Rajan, S. (2013). Planning and management of parks and green areas. *Management of Environmental Quality: An International Journal*, *19*(3), 270-282.

Hall, P. (2002). *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century, 3rd Edition*. Saffron Waldon: Blackwell.

Hansen, R., & Pauleit, S. (2014). From multifunctionality to multiple ecosystem services? A conceptual framework for multifunctionality in green infrastructure planning for urban areas. *Ambio*, *43*(4), 516–29.

Hostetler, M., Allen, W., & Meurk, C. (2011). Conserving urban biodiversity? Creating green infrastructure is only the first step. *Landscape and Urban Planning*, *100*(4), 369–371.

Jim, C., & Chen, S. (2003). Comprehensive greenspace planning based on landscape ecology principles in compact Nanjing city, China. *Landscape and Urban Planning*, *65*(3), 95–116.

Jim, C., & Chen, W. Y. (2006). Recreation–amenity use and contingent valuation of urban greenspaces in Guangzhou, China. *Landscape and Urban Planning*, *75*(1-2), 81–96.

Kalia, R. (1994). *Bhubaneswar: From a Temple Town to a Capital City.* Carbondale & Edwardsville: Southern Illinois University Press.

Kalia, R. (2004). *Gandhinagar: Building National Identity in Postcolonial India*. Columbia, South Carolina: University of South Carolina Press.

Kambites, C., & Owen, S. (2006). Renewed prospects for green infrastructure planning in the UK. *Planning Practice and Research*, *21*(4), 483–496.

Landscape Institute. (2013). *Green Infrastructure - An integrated approach to land use. Landscape Institute Position Statement*. London: Landscape Institute.

Lemma, A., & Overseas Development Agency. (2012). *Green Infrastructure in Fragile States*. London: Overseas Development Agency.

Lennon, M. (2014). Green infrastructure and planning policy: a critical assessment. *Local Environment*, *20*(8), 957–980.

Louv, R. (2005). *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. Chapel Hill: Algonquin Books of Chapel Hill.

Mahadevia, D. (2011). Branded and Renewed? Policies, Politics and Processes of Urban Development in the Reform Era. *Economic and Political Weekly*, *XLVI*(31), 56–64.

Mansor, M., & Said, I. (2008). Green Infrastructure Network as Social Spaces for Well-Being of Urban Residents in Taiping , Malaysia. In *Environmental Research* (pp. 28 – 30).

Mathur, N. (2012). On the Sabarmati Riverfront: Urban Planning as Totalitarian Government in Ahmedabad. *Economic and Political Weekly*, *XLVII*(47-48), 64–75.

Mayor of London. (2014). *London Infrastructure Plan 2050: A Consultation*. London: Mayor of London.

McKinsey Global Institute. (2001). *India: The growth imperative*. New Delhi: McKinsey Global Institute.

McKinsey Global Institute. (2010). *India’s Urban Awakening: Building inclusive cities, sustaining economic growth.* New Delhi: McKinsey Global Institute.

Meenatchi Sundaram, A. (2010). Urban green-cover and the environmental performance of Chennai city. *Environment, Development and Sustainability*, *13*(1), 107–119.

Mell, I. C. (2010). *Green infrastructure: concepts , perceptions and its use in spatial planning.* Newcastle: Unpublished PhD Thesis, University of Newcastle.

Mell, I. C. (2013a). Can you tell a green field from a cold steel rail ? Examining the ‘ green ’ of Green Infrastructure development. *Local Environment: The International Journal of Justice and Sustainability: The International Journal of Justice and Sustainability*, *18*(2), 37–41.

Mell, I. C. (2013b). Managing India’s urban green spaces: Translating global Green Infrastructure lessons to Indian cities. *urbaNature*, 14–17.

Mell, I. C. (2014). Aligning fragmented planning structures through a green infrastructure approach to urban development in the UK and USA. *Urban Forestry & Urban Greening*, *13*(4), 612–620.

Mell, I. C. (2015). Establishing the rationale for Green Infrastructure investment in Indian cities: is the mainstreaming of urban greening an expanding or diminishing reality? *AIMS Environmental Science*, *2*(2), 134–153.

Mell, I. C. (2016a). Financing Green Infrastructure in times of austerity: The case of Liverpool, UK. *Biotope City Journal*. Retrieved from http://www.biotope-city.net/gallery/financing-green-infrastructure-times-austerity, 24th October 2016.

Mell, I. C. (2016b). *Global Green frastructure: Lessons for successful policy-making, investment and management*. Abingdon: Routledge.

Mell, I. C., Henneberry, J., Hehl-Lange, S., & Keskin, B. (2013). Promoting urban greening: Valuing the development of green infrastructure investments in the urban core of Manchester, UK. *Urban Forestry & Urban Greening*, *12*(3), 296–306.

Merk, O., Saussier, S., Staropoli, C., Slack, E., & Kim, J.-H. (2012). *Financing Green Infrastructure: OECD Regional Development Working Papers 2012/10*. London: OECD.

Mitra, P. (2013, May 22). Open space shrinking, city gasps for breath. *The Times of India Online*. Retrieved from http://timesofindia.indiatimes.com/city/kolkata/Open-space-shrinking-city-gasps-for-breath/articleshow/20188789.cms, 24th October 2016.

Nagendra, H., & Gopal, D. (2010a). Street trees in Bangalore: Density, diversity, composition and distribution. *Urban Forestry & Urban Greening*, *9*(2), 129–137.

Nagendra, H., & Gopal, D. (2010b). Tree diversity, distribution, history and change in urban parks: studies in Bangalore, India. *Urban Ecosystems*, *14*(2), 211–223.

Nagendra, H., Nagendran, S., Paul, S., & Pareeth, S. (2012). Graying, greening and fragmentation in the rapidly expanding Indian city of Bangalore. *Landscape and Urban Planning*, *105*(4), 400–406.

Nallathiga, R. (2010). India Infrastructur Report 2010 - Infrastructure Development in a Low Carbon Economy. In 3iNetwork (Ed.), *India Infrastructure Report* (Vol. 000, pp. 355–373). New Delhi: Oxford University Press.

Narain, V. (2009). Growing city, shrinking hinterland: land acquisition, transition and conflict in peri-urban Gurgaon, India. *Environment and Urbanization*, *21*(2), 501–512.

Natural England & Landuse Consultants. (2009). *Green Infrastructure Guidance*. Peterborough: Natural England.

Patnaik, P. (2015). From the Planning Commission to the NITI Aayog. *Economic and Political Weekly*, *‘L’*(4), 10–12.

Qureshi, S., Breuste, J. H., & Lindley, S. J. (2010). Green Space Functionality Along an Urban Gradient in Karachi, Pakistan: A Socio-Ecological Study. *Human Ecology*, *38*(2), 283–294.

Qureshi, S., Hasan Kazmi, S. J., & Breuste, J. H. (2010). Ecological disturbances due to high cutback in the green infrastructure of Karachi: Analyses of public perception about associated health problems. *Urban Forestry & Urban Greening*, *9*(3), 187–198.

Reid, W. V., Walker, B., & Salt, D. (2006). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington DC: Island Press.

Roe, M., Selman, P., Mell, I. C., Jones, C., & Swanwick, C. (2009). *Establishment of a baseline for, and monitoring of the impact of, the European Landscape Convention in the UK. Defra Contract No. CR0401 (Comp. Code: WC0802)*. Bristol: Defra. Retrieved from http://landscapecharacter.org.uk/elc/baseline-monitoring-ELC

Roy, A. (2009). Why India Cannot Plan Its Cities: Informality, Insurgence and the Idiom of Urbanization. *Planning Theory*, *8*(1), 76–87.

Sathaye, J., Shukla, P. R., & Ravindranath, N. . (2006). Climate change, sustainable development and India: Global and national concerns. *Current Science*, *90*(3), 314–325.

Siemens AG. (2011). *Asian Green City Index: Assessing the environmental performance of Asia’s major cities.* Munich: Siemens AG.

Singh, V. S., Pandey, D. N., & Chaudhry, P. (2010). *Urban Forests and Open Green Spaces: Lessons from Jairpur, Rajasthan, India. RSPCB Occasional Paper No. 1/2010*. Jaipur: RSPCB.

Sudha, P., & Ravindranath, N. . (2000). A study of Bangalore urban forest. *Landscape and Urban Planning*, *47*(1-2), 47–63.

Tarafdar, A. K., & Bj⊘nness, H. C. (2010). Environmental premises in planning for sustainability at local level in large Southern cities: a case study in Kolkata, India and use of the PRETAB planning process model. *International Journal of Sustainable Development & World Ecology*, *17*(1), 24–38.

The Times of Indian Online. (2015). NGT notice on Ghaziabad green belt squatters. *The Times of India Online*. New Delhi. Retrieved from http://timesofindia.indiatimes.com/city/noida/NGT-notice-on-Ghaziabad-green-belt-squatters/articleshow/49082455.cms, 24th October 2016.

Town and Country Planning Organisation, & Government of India: Ministry of Urban Development. (2014). *Urban Greening Guidelines 2014*. New Delhi: Town and Country Planning Origanisation.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning*, *81*(3), 167–178.

Vandermeulen, V., Verspecht, A., Vermeire, B., Van Huylenbroeck, G., & Gellynck, X. (2011). The use of economic valuation to create public support for green infrastructure investments in urban areas. *Landscape and Urban Planning*, *103*(2), 198–206.

Vidyarthi, S., Hoch, C., & Basmajian, C. (2013). Making sense of India’s spatial plan-making practice: Enduring approach or emergent variations? *Planning Theory & Practice*, *14*(1), 57–74.

Williams, K. (2010). Sustainable cities: research and practice challenges. *International Journal of Urban Sustainable Development*, *1*(1-2), 128–132.

Williamson, K. S. (2003). *Growing with Green Infrastructure*. Doylestown: Heritage Conservancy.

Young, R. F. (2011). Planting the Living City. *Journal of the American Planning Association*, *77*(4), 368–381. http://doi.org/6

Young, R. F., & McPherson, E. G. (2013). Governing metropolitan green infrastructure in the United States. *Landscape and Urban Planning*, *109*(1), 67–75.

Zérah, M. (2007). Conflict between green space preservation and housing needs: The case of the Sanjay Gandhi National Park in Mumbai. *Cities*, *24*(2), 122–132.

Zhang, T. (2005). Uneven development amongst Shanghai’s three urban districts. In L. Ma & F. Wu (Eds.), *Restructuring the Chinese City: Changing society, economy and space* (pp. 124–139). Abingdon: Routledge.

**Table 1. Interviews**

|  |  |  |
| --- | --- | --- |
| **Interview No.** | **Position** | **Green Infrastructure role/activities**  |
|  |  |  |
| **1** | ‘Planner’ Sabarmati Riverfront Development Corporation (SRFDCL)Planners  | Development and implementation manager of Sabarmati Riverfront development with responsibility for consultation, planning and delivery of the project. |
| **2** | ‘Academic’ Indian Institute of Management, Ahmedabad (IIMA) | Academic researching socio-economic aspects of development in Ahmedabad with specific reference to the long-term implications (social, ecological and economic) of the riverfront redevelopment. |
| **3** | ‘Officer’ Ahmedabad Development Corporation (AMC) | Manager and planner overseeing the delivery of green spaces/parks in Ahmedabad with specific responsibility for Riverfront Park developments.  |
| **4** | ‘Planner’ Ahmedabad Urban Development Authority (AUDA) | Oversees scoping, consultation and delivery of the 3rd Ahmedabad Development Plan.  |
| **5** | ‘Academic’ CEPT University, Ahmedabad | Environmental Impact Assessment and Analysis of urban planning in Ahmedabad and other India cities.  |
| **6** | ‘Academic’ CEPT University, Ahmedabad | Socio-economic analysis of Sabarmati Riverfront development and participation in the planning process. |

**Table 2. Ahmedabad GI evaluation**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **GI resource** | **Ecological Issues** | **Economic Issues**  | **Social Issues** | **Political dynamic/benefits** | **Funding** | **Investment scale (R/C/S)** | **Identified network in policy and practice component** |
| **AHM Green Belt – positive aspects** | - Strategic conservation of fertile agricultural lands to ensure food production. - Key water and environment management context.  | - Retention of agricultural land and subsequent economic viability  | - Strategic control of city from and extent through limiting of expansion to the east and west. | Established in first AHM Development Plan (1967) to provide 400m wide buffer (200m inside AHM boundary and 200m outside). Policy rescinded in second Development Plan (2013) to lower restrictions on development at the city edge | AMC1967 - ✓2013 - X | Regional | ✓ |
| **AHM Green Belt – negative aspects** |  | - Limits growth and city expansion | - Loss of recreational and amenity space- Lack of development opportunities/restrictions for local land owners |
| **Street trees (road side) – positive aspects** | - Temperature and climate change moderation- Rainfall interception and release- Pollution control - Habitat for bird, mammal and insect species  |  - Locations for small-scale commerce (food/retail)- Aesthetic quality leading to potential investment based on AUDA/AMC view of AHM as a liveable and sustainable city | - Locations for communal gathering- Locations for recreation/leisure activities and food- Health and quality of life improvements due to shade/cooling- Aesthetic quality  | Investment in street trees along major arterial roads is outlined in the AHM DP to aid the control of the city’s climate. A call for further investment in street trees on the majority of the city’s road is a priority. | AMC | City / Site  | ✓ |
| **Street trees (road site) – negative aspects** | - Potential damage to trees if moved and replanted- Potential loss of habitat if moved  | - Loss of additional space for development - Loss of existing buildings/homes or commercial activities- Cost of maintenance | - Potential loss of parking |
| **Street trees (in-road)** | - Pollution control - Temperature and climate change moderation- Rainfall interception and release | - Aesthetic quality leading to potential investment based on AUDA/AMC view of AHM as a liveable and sustainable city | - Aesthetic quality | Strategic element of AUDA/AMCs AHM Development Plan to create liveable, environmentally sustainable and efficient city that promotes liveability and investment | AMC | City | ✓ |
| **Street trees (in road) – negative aspects** | - Long-term health of trees  | - Cost of investment- Cost of maintenance  |  |  |  |  |
| **Urban Groves – positive aspects**  | - Conserved/increased ecological resource base- Promotion of habitat and biodiversity with different species- Climate mitigation (temp, rainfall, pollution) | - Uplift in land prices due to aesthetic quality  | - Aesthetic quality- Potential increase in land/home value due to ‘greener’ environment  | The protection of urban groves are written into the AUDA Development Plan as a smaller delivery objective that looks to retain remnant urban woodland from development (or at a minimum incorporate it within development) | N/A | Site | X |
| **Urban Groves – negative aspects**  | - Less visible attempts by AMC/ADUA to connect these resources to the wider GI network of the city | - Cost to developers and home/building owners for ongoing maintenance- Loss of m2 for future development is trees need to be retained |  |
| **Sabarmati Riverfront (promenade) – positive aspects** | - Investment in trees along the promenade- Climate mitigation (temp, rainfall and pollution)- Development of a 11-12km greenway through the heart of the city - Development of at least two parks along the river  | - Creation of an attractive investment location - Public-Private investment opportunities from AMC and other businesses- Creation of commercial/economic opportunities | - Improved recreational/leisure amenities - Provision of large-scale walking/cycling route through the centre of the city | Sabarmati Riverfront is the main investment objective of the AMC/AUDA GI programme. The riverfront development is viewed as being central to promoting AHM as a liveable, sustainable and efficient city that attracts internal and external investment. It is, however, viewed by others as a highly political investment, as it is supported by PM Modi and may not be the most suitable form of investment for the city’s ecological resource base. | AMC / AUDA / SRFDCL | Regional  | ✓ |
| **Sabarmati Riverfront (promenade) – negative aspects**  | - Removal of existing floodplain ecosystem- Lack of diversity in the greening of the promenade  |  - High costs of investment - High costs of subsequent land and lack of rationale for economic returns to the city’s population  | - Restricted access to a number of points on the promenade due to construction of gated parks- Parks are gated and have entrance fees - Loss of informal recreational space for local people |
| **Sabarmati Riverfront (floodplain) – positive aspects**  | - Development of a series of gated parks along both sides of the river- Improved water quality and flood management - Increased level of biodiversity and management of ecological resources  | - Sale of 14% of reclaimed floodplain for private development creating opportunities for investment in new housing, transport infrastructure, and commercial enterprises- Development of a formal platform to market/brand investment in AHM | - Improved recreational/leisure amenities (creation of Paris-like riverfront)- Development of housing, transport and commercial facilities to meet public needs | Sabarmati Riverfront is the main investment objective of the AMC/AUDA GI programme. The riverfront development is viewed as being central to promoting AHM as a liveable, sustainable and efficient city that attracts internal and external investment. It is, however, viewed by others as a highly political investment, as it is supported by PM Modi and may not be the most suitable form of investment for the city’s ecological resource base.  | AMC / AUDA/ SRFDCL | Regional  | ✓ |
| **Sabarmati Riverfront (floodplain) – negative aspects**  | - Removal of existing ecosystems and channelization of natural floodplain dynamics- Reclaiming of 16km2 of land from seasonal floodplain and the changes to the physical nature of the river system  | - Lack of compensation paid to city or existing land owners (formal and informal) for the gifting of land from Gujarat government- Cost of reclamation and development works could have been used to facilitate development in other places (expert commentary in AHM) - Concerns over whether it will alleviate the flooding pressures during monsoon season- Removal of informal commercial/residential activity which were viewed by the AMC/AUDA as not feeding into the city’s economy | - Eviction of 16,000 informal residents, informal businesses and associated services to - Loss of recreational space- Loss of employment and commercial opportunities for some communities/people linked to (a) evictions and (b) privatisation of formally public spaces. |
| **Kankaria Lake – positive aspects**  | - Improved and managed biodiversity resource base- Development and management of a number of new gardens and specialist nature resources- Management of the water body- Extensive use of resources to ensure management (and aesthetic) regimes are maintained.  | - Redevelopment of major city and tourist attraction- Investment in environmental quality to ensure visitors and further investment- Strategic location for supporting and ancillary development projects- Focus for investment from internal and external Public-private organisations  | - Improved recreational/leisure amenities (creation of Paris-like riverfront)- Development of housing, transport and commercial facilities to meet public needs- Redevelopment supports local (on-site and surrounding) businesses- Site is a major attraction locals and external visitors to the city | The redevelopment of Kankaria Lake by the AMC is part of the strategic investment in the city to provide an attractive living, investment and visitor product to market. The diversification of activities available on-site does however outweigh the ecological value of the site, where the level/breadth of biodiversity has been improved but is mostly aesthetic in value.  | AMC / Private investment  | City | ✓ |
| **Kankaria Lake – negative aspects** | - Poor water quality in the lake and the monocultural maintenance regime of its and the site’s grounds | - Cost of entrance - Cost of redevelopment for the city - Politicised nature of the development under the Modi administration  | - Exclusionary nature of entrance fees- Loss of accessible communal space |  |  |  |  |
| **Canals – positive aspects** | - Improved processes of water quality management and flood control proposed- Climate change adaptation - Improved habitat for biodiversity | - Greater control over city’s water resource base- Creating a location for internal and external investment  | - Creation of new leisure/recreational facilities  | The management of the city’s canals is viewed by the AMC/AUDA as assisting its strategic water management and investment objectives.  | AMC / Private investment | City / Site | ✓ / X |
| **Canals – negative aspects** | - Potential for negative ecological changes to the water network - Loss of species due to managed nature - Potential lack of delivery of new/improved water management techniques/processes | - Cost of investment - Ongoing costs of maintenance  |  |
| **Parks & Gardens – Riverfront Park, Parimal, Law Garden, Rasala Nature Garden (city) – positive aspects**  | - Temperature and climate change moderation- Rainfall interception and release- Pollution control - Habitat for bird, mammal and insect species | - Contribute to promotion of city as a site for investment based on liveability indicators- Location for small-scale/informal economic activity- Location for formal economic activity (entrance fees) - Improved property/real estate values | - Provision of recreational/leisure amenities - Act as centres for community/family activities- Site is a major attraction locals and external visitors to the city- Aesthetic qualities - Employment opportunities for small-scale businesses and/or public workers (i.e. gardeners) | The city’s parks and gardens are used to promote AHM as a green and liveable place. They are located across the city (often in clusters) and provide a mixture of social, economic and ecological benefits for the locales (and for the city)  | AMC / Private investment | City | ✓ |
| **Parks & Gardens – Riverfront Park, Parimal, Law Garden, Rasala Nature Garden (city) – negative aspects** | - Manicured nature of gardens could limit biodiversity | - Costs of development and management  | - Entrance fees can be exclusionary - Formalisation of activities could limit informal recreation and entrepreneurial activities  |
| **Parks & Gardens (site) – positive aspects** | - Small-scale temperature and climate change moderation- Small-scale habitat for bird, mammal and insect species | - Location for small-scale/informal economic activity- Improved property/real estate values | - Act as centres for community/family activities- Aesthetic qualities  | Smaller and localised parks and gardens are located throughout the city and form part of the wider fabric of the urban environment. Whilst the AMC/AUDA has policies to manage/develop larger sites of city importance there is less prescribed for local sites.  | AMC / Local communities | Site | X |
| **Parks & Gardens (site) – negative aspects**  | - Manicured nature of gardens could limit biodiversity | - Costs of development and management as public funds may not meet all capital/revenue costs | - Entrance fees can be exclusionary - Formalisation of activities could limit informal recreation and entrepreneurial activities  |
| **Meanwhile spaces – positive aspects** | - Tree planting on all spaces (100m2+) where development is delayed/planned, with retention following investment.  | - Short-term economic opportunities for commerce subject to access and security  | - Short-term use for social/community activities of spaces prior to development, which could be up to 10 years.  | AMC/AUDA views the planting of tree in meanwhile spaces as a solution to spaces being left vacant. With investment in GI they consider the spaces to be contributing to the city’s environmental management.  | AMC / AUDA | Site and City | ✓ |
| **Meanwhile spaces – negative aspects**  | - Lack of permanence of environmental resources- Changes to urban ecosystems  | - Potential for long-term economic value of land to decrease if GI on site. As removal and/or maintenance of GI could lower the overall m2 available for development. Developers may respond negatively to this,  | - Protest if spaces are redeveloped from GI to built infrastructure- Loss of land for recreation, social and commercial activities |

1. The development of new cities was also an overtly political process which was promoted post-Independence from the British, and was viewed as a mechanism to illustrate India’s architectural, economic and social strength as a newly independent nation. [↑](#footnote-ref-1)
2. The Janmarg or Ahmedabad BRTS is a rapid bus transit system and is managed by the AMC. Its network covers over 89kms/59 miles and has been recognised as national and international good practice in integrating public transport with more sustainable forms of urban development. [↑](#footnote-ref-2)
3. Commentator reflections on the management of New Delhi’s green belt illustrates that attempts to limit formal and informal development in these designations is highly variable and difficult (Mell, 2016b). The AMC and AUDAs decision to rescind the designation may therefore be viewed as pragmatism rather than purposefully anti-environmental. [↑](#footnote-ref-3)
4. At the time of writing the Indian government led by Prime Minister Narendra Modi (former Chief Minister of Gujarat) had announced that funding would be allocated to the redevelopment of the Yamuna River in New Delhi because of the perceived success of the Sabarmati Riverfront Development project. [↑](#footnote-ref-4)