

The Great Potential of Bangalore's Waterways

neglected



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I. Keywords

Waterways, non-motorized transportation, environment, life quality, livelihood

II. Abstract

Bangalore's interlinked system of waterways and water-bodies constitutes a unique feature of – and a huge potential asset for – the city and its citizens. Cleaning up and maintaining the waterways clean is a precondition for having clean water-bodies, and doing so could also serve to provide livelihood opportunities for poor people living there while making these areas attractive to other segments of society, also. Clean waterways could be used to promote “healthy mobility” by providing connectivity for pedestrians and cyclists between home and work, as well as connectivity to mass transit hubs and other important points in the city; and they could be used to promote “healthy lifestyles” by providing recreational facilities and spaces for social interaction. Apart from being important storm water drains that help prevent flooding, the waterways could also be used to enhance biodiversity in the city and to create wildlife corridors.

III. Credits

This study was initiated with co-authors Radha Chanchani, Jaya Dhindaw and Kadambari Badami from the Center for Infrastructure, Sustainable Transportation and Urban Planning, the Indian Institute of Science, who were involved in conceptualizing, researching and developing the content. Helpful advice was provided by Prof. H.N. Chanakya and Prof. T.V. Ramachandra from the Indian Institute of Science. The illustrations were created in collaboration with Harman Preet and Sameera Sneha, architecture students at the Indian Institute of Technology, Roorkee. The proposal has been inspired by other projects like Oasis Designs' *The South Delhi Greenway*.

IV. Author

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1. Objectives

The objectives of this study are to assess the potential benefits of revitalizing the waterways of Bangalore and to propose possible scenarios for the future use of these waterways, including the possible creation of a citywide network for “healthy mobility”.

The study is intended to raise awareness and to encourage dialogue among the public, the stakeholders and the decision-makers.

2. Scope and limitations

While several initiatives focus on the preservation of the water-bodies – the lakes and the tanks – of Bangalore, not much focus has been aimed at the waterways that feed into these water-bodies.

Unless the waterways – the rivers, the canals and the storm water drains – are cleaned up, it will not be possible to keep the water-bodies clean. And cleaning up the waterways may offer many additional benefits.

This study seeks to provide an overview of those benefits, an overview that is based on existing knowledge, reading, interviews and case studies, and seeks to come up with a proposal to realize those benefits by creating a citywide network for “healthy mobility” – walking, jogging and bicycling – around the waterways, including scenarios for the specific use of the waterways and their immediate surroundings.

The study is conceptual in nature.

3. Methodology

The study was conducted in the following phases:

1. Field survey of two major waterways and their immediate surroundings
2. Literature review, interviews with experts and research into the “best” practices
3. Discussion and development of proposals
4. Creation of maps and scenarios, write-up and review

4. Background

“In an age when man has forgotten his origins and is blind even to his most essential needs for survival, water along with other resources has become the victim of his indifference.”¹

“A continuous social landscape”

Bangalore is said to have evolved around a system of interconnected water-bodies; this system was presumably developed in response to the lack of any major surface water source, such as a nearby river with continuous water-flow throughout the year.

Water-bodies would form naturally in the undulating landscape of this region and only minimal human effort was needed to turn these water-bodies into “tanks” for the collection and storage of rainwater that could be used for multiple purposes, including the irrigation of agricultural land.

It has been assumed that the first people settled around these water-bodies and that the region of Bangalore therefore consisted, initially, of many smaller settlements located at different altitudes, with wetlands providing connections through which water could be distributed from one settlement to another.

While each settlement may have grown various crops for the consumption of its own inhabitants, the individual quality of soil and the availability of water in each settlement may have allowed for a certain level of specialization, with different crops being traded among the settlements.²

The high level of interdependency between these settlements, in terms of both food and water, would have been further strengthened through intermarriages and through various forms of social interaction.

Such a landscape could be referred to as a “continuous social landscape”,³ in contrast to the

¹ Quoted from: *Silent Spring*; Rachel Carson; 1962.

² In low-lying areas, the soil would be richer – and the crops grown here would require more water.

³ Quoted from: *Interdependence Between Man and Environment in Making the Region of Bangalore*; Ashwin Karjatkar; 2007.

discontinuous and anti-social modern landscape typified by gated communities and expressways.

Expansion of the water network

The self-organized system of interdependent settlements was replaced with central control in the 16th century, when Magadi Kempegowda is believed to have founded the city of Bangalore.

With the rule of the Kempegowdas and later the Wodeyars of the Mysore kingdom, the natural/partially man-made network of water-bodies and waterways was extended through the digging of wells and channels for purposes of increasing water availability and for purposes of bringing larger land areas under cultivation.

From the ridges running through the territory, small natural streams that were carrying surface run-off during rains would merge to form larger streams or wetlands in the valleys between the ridges. Tanks were constructed by damming these larger streams or wetlands at suitable locations, creating a “cascading” chain of reservoirs within each of the three major valleys.⁴

Thus, the landscape of Bangalore was dotted both by naturally formed ponds and lakes and by man-made tanks or reservoirs, which were connected by streams, wetlands and man-made canals that are called *nullahs* (in Hindi).

The city image

During the British reign, streams and wetlands were put into canals in order to increase distribution efficiency and to provide land for urban development.

The network of water-bodies and waterways helped to effectively drain the city region and functioned as an extensive “rainwater harvesting system” while also playing an essential role in the recharging of groundwater and in ensuring a high water table in the region. The “tanks” were the main sources of water for drinking, domestic and irrigation purposes, supporting a rich assortment of farmlands, orchards, nurseries, urban parks, gardens and trees.

⁴ The three valleys are Hebbal Valley, Vrishabavathi Valley and Kormangala Challaghatta Valley.

Tanks and canals had a beneficial effect on the microclimate of the region by preserving ambient temperatures and by making the city naturally “air-conditioned”, with open spaces and picturesque settings that also brought flora and fauna into the city.

By contributing to its pleasant climate and supporting its omnipresent greenery, water played a crucial role in the construction of Bangalore’s identity (self-image) as “City Beautiful” and “Garden City”.

Fading relevance

As the expanding city swallowed up more and more agricultural land, the need for irrigation water was reduced and with the arrival of piped water supply, following the creation of the Hessarghatta (1894) and later the Tippagondanahalli (1933) reservoirs on the Arkavati River, a tributary to the Cauvery River, the network of tanks and canals gradually lost its relevance.

Around 1940, a comprehensive underground water supply and drainage scheme for the entire city was put into action. As a consequence of this, many of the open canals began to be used as wastewater and sewage drains and some of the tanks were drained and put to other uses.

Neglect and destruction

The situation has since worsened dramatically in synch with the rapid industrialization and unplanned urbanization of the post-Independence era.

With water being sourced directly, since 1974, from the Cauvery River,⁵ the network of waterways and water-bodies lost any relevance as a source of water as well as its earlier religious, socio-cultural and occupational importance, leading to its steady deterioration and neglect.

The waterways have been narrowed, encroached or completely blocked up and built upon, leading to a loss of drainage connectivity between the water-bodies. Instead, the water channels, which were meant to carry storm water, have been turned into dumps for sewage, wastewater and garbage, which flow directly into both lakes and tanks, contaminating and

⁵ Today, the Cauvery River, located about 135 kilometers from the city, provides 80 percent of Bangalore’s water, according to information obtained at the Sri. M. Visvesvaraya Rain Water Harvesting Theme Park; 2012.

choking them, destroying aquatic ecosystems and turning them into breeding grounds for mosquitoes. Lake- and tank-beds have also been used as dumping grounds for garbage, construction debris and have been encroached upon by unauthorized cultivation, constructions or settlements – destroying the soil and peripheral vegetation. This, in turn, has led to erosion and silting, reducing the lakes' and tanks' water-storing capacity until they eventually dry up.

Draining and breaching the waterways and water-bodies have been proposed by the city's municipal authorities with an eye toward “creating” land for the development of new roads, residential layouts and other purposes – often in violation of existing legislation.

Transformation of the urban landscape

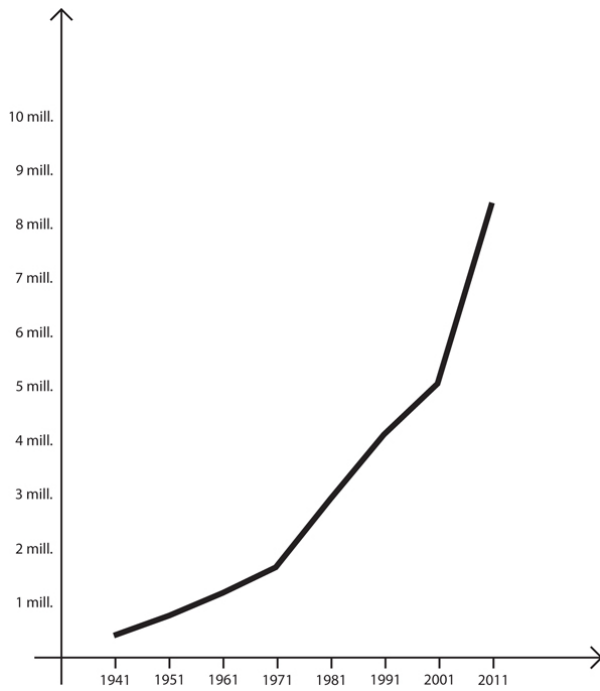
Over a period of only fifteen years, the number of water-bodies in Bangalore city was more than halved, from 38 water-bodies in 1992 to 17 water-bodies in 2007, with the total wetland area correspondingly being reduced from 207 to 87 hectares in the same period.⁶

In Greater Bangalore (the Bruhat Bengaluru Mahanagara Palike area), the total wetland area has shrunk from 2,324 hectares in 1973 to a mere 617 hectares in 2010 – a reduction of almost three-quarters. Furthermore, a field survey conducted in 2007 showed that about two-thirds of the lakes were sewage fed.⁷

In this same period, the population of Bangalore has grown exponentially: from 1,654,000 in 1971 to 8,425,970 in 2011.

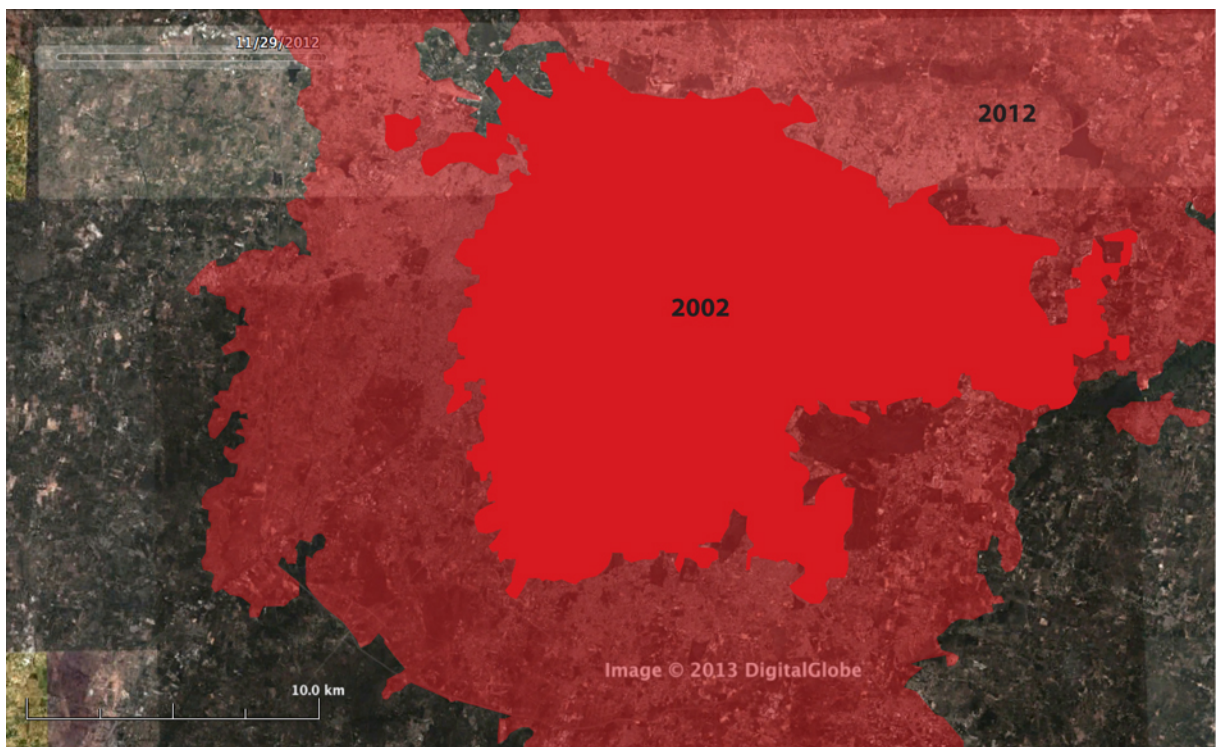
⁶ Source: *Wetlands of Greater Bangalore, India: Automatic Delineation through Pattern Classifiers*; T.V. Ramachandra and Uttam Kumar; 2008.

⁷ Source: *Conservation and Management of Wetlands: Requisite Strategies*; T. V. Ramachandra; 2012.



Population growth in Bangalore since 1941. Source: *Bangalore*; Wikipedia: <https://en.wikipedia.org/wiki/Bangalore> (accessed July 15, 2013).

The land area of Bangalore has correspondingly increased, with the built-up area now covering at least twice as much land as it did only a decade ago.



The urbanized area of Bangalore in 2002 and 2012. Source: Google Earth (March 10, 2002 and November 29, 2012).

The water crisis

As a result of the aforementioned developments, Bangalore is now facing a major water crisis, with the per capita water demand in the city being 150-200 liters per day while the actual per capita supply available is only 100-125 liters per day.⁸ The demand for water has resulted in the rampant sinking of bore wells, which have depleted the groundwater table (which is now more than 1,000 feet below the surface in many parts of the city). The shrinkage and pollution of water bodies has resulted in the loss of alternate sources of water and in a decline in the recharging capacity of groundwater, in mosquito menace and in other health hazards, in the destruction of aquatic ecosystems and the loss of biodiversity and wildlife, in frequent flooding, in changes in micro-climate and in rising temperatures, which are further exacerbated by the reduction in vegetation and the loss of natural open/green spaces in the city. Finally, it has caused the loss of livelihood opportunities for many traditional users, including farmers, cattle herders, fishermen and *dhobi* (people who make a living doing other people's laundry).

Of particular concern are the untreated wastewater, the sewage and the solid waste that flows through the waterways into the water-bodies, which contaminate not only the surface water of these water-bodies but also the groundwater.

The mobility crisis

With more than two million motor vehicles having been added to the streets of Bangalore during the past decade, increasing from 1.6 million in 2001 to 3.8 million in 2011,⁹ the city is also facing a major mobility crisis in terms of severely increased traffic congestion,¹⁰ another consequence of which is that space for traditional small-scale economic activities and social interaction in the streets has vanished.

⁸ According to information obtained at the Sri. M. Visvesvaraya Rain Water Harvesting Theme Park; 2012.

⁹ Source: *Road Transportation Year Book (2009-10 & 2010-11)*; Ministry of Road Transport & Highways, Government of India; 2012.

¹⁰ According to the government's infrastructure department, over 5,000 roads in the city have surpassed their carrying capacity." Quoted from: *One vehicle for every two Bangaloreans*; The New Indian Express; July 29, 2012: <http://www.newindianexpress.com/states/karnataka/article578656.ece>

In large parts of the city, there is no safe space set aside for walking and cycling, and according to a comprehensive traffic and transportation study for Bangalore that was prepared in 2007, only about 2 percent of all trips in the city were made on bicycles and only about 8 percent were made by walking.¹¹ These numbers are alarmingly low when compared to many other cities.¹²

Motorized transportation may also have adverse effects on human health, on the environment and on development opportunities.

The health crisis

The negative human health effects related to motorized transportation in cities range from sudden death to shorter life expectancy, reduced fertility, cognitive decline, chronic suffering and poorer quality of life. The causes include accidents, air pollution, noise, stress and physical inactivity.

The lack of green spaces for recreation and social interaction may have further detrimental effects on human health.

Possible solutions

One possible solution to the water crisis, the mobility crisis and the health crisis may be seated in the revitalization of Bangalore's unique network of water-bodies and waterways.

It has been found that while the city of Bangalore is turning its back on its waterways, which have become unhygienic “backyard” spaces of the city or are being put underground, the neglected waterways in many other cities around the world are now being restored – in order to improve both the ecological balance of the city and the quality of its citizens' lives.

¹¹ Source: *Policy Paper for Pedestrian Movement in the Bangalore Metropolitan Region*; Directorate of Urban Land Transport, Bangalore; 2008.

¹² Delhi: 21% walking and 12% cycling; Shanghai: 27% walking and 20% cycling; Tokyo: 23% walking and 14% cycling; Munich: 28% walking and 17% cycling. Source: *Model share*; Wikipedia: https://en.wikipedia.org/wiki/Modal_share (accessed July 15, 2013).

Submerging Bangalore's waterways underground may indeed solve certain immediate and pressing problems, like the dumping of garbage and sewage but it may also impede solutions to other more serious problems – and it may prove to be irreversible.

There is a good reason to stop and think about all of this!

5. Benefits

The restoration and renewal of urban waterways in many other cities serve to illuminate a wide range of possible benefits.

Environmental benefits

Keeping the waterways clean and healthy by preventing the dumping of garbage and sewage, by reducing erosion and silting, and by naturally filtering contaminants may vastly improve water quality in the water-bodies from where groundwater is replenished.

While the dumping of garbage and sewage should be avoided, the waterways may still serve as storm water drains to prevent flooding in the city, with biological wastewater treatment plants being set up at regular intervals.

Restoration and protection of natural green spaces along the waterways may support and promote biodiversity in the city and may provide corridors for wildlife.¹³ The waterways themselves may provide open freshwater habitats while soft banks, lower banks and shallows may provide marginal waterside habitats.

Trees may grow along the waterways to provide shading for humans and habitats for wildlife. This may also have a positive effect on the local microclimate while contributing to improved urban air quality through the production of oxygen and the absorption of pollution. The creation of safe and attractive pathways for emission-free transportation along the waterways, such as walking and cycling, may further improve urban air quality.

Mobility benefits

A network of pedestrian and cycling paths along the waterways, and in other places where needed to make the network continuous, may reduce people's dependency on automobiles by providing critical "last mile" connectivity to public transportation and making it safer and more attractive to walk and cycle, accordingly reducing traffic congestion and travel time as

¹³ Studies indicate "that urban drainage systems, such as ditches and canals, can help maintain the same level of biodiversity as rural waterways". Source: *Urban waterways provide important home for wildlife*; European Commission DG ENV News Alert Issue 150, May 2009.

well as the negative effects on the environment, on human health and on social conditions that are connected with motorized transportation.

Such a network for non-motorized transportation may also provide alternative routes and shortcuts between home and work as well as links to and between cultural and historic sites, green and recreational areas.

Social benefits

The revitalization of the waterways may bring nature into the city and reinforce the citizens' connection to nature by encouraging them to enjoy the outdoors. At the same time, valuable public land is being preserved and high quality public spaces can be created, for the benefit of all the citizens.

The provision of meeting spaces, leisure facilities and walking trails along the waterways may provide opportunities for social interaction and inclusiveness, which may be further stimulated by the provision of opportunities for small-scale businesses and community activities, etc.

Walking and cycling paths along the waterways may provide an amenity to people who do otherwise not have direct access to green and recreational areas as well as improved accessibility to and connectivity between neighborhoods.

The preservation of the city's heritage and the provision of access to this heritage may enhance a sense of community identity, may stand as a catalyst for community revitalization and may serve as a source of community pride.

Educational benefits

Revitalized waterways may also serve an educational purpose by providing hands-on environmental "classrooms" for children to experience and learn about flora and fauna.

In fact, informative signage and environmental awareness programs, religious spaces, community nurseries and kitchen gardens along the waterways can serve to enlighten all age groups.

Human health benefits

Revitalizing the waterways may ensure long-lasting health benefits for generations to come.

The creation of safe and attractive pathways for walking, jogging and cycling along the waterways may stimulate physically active outdoor lifestyles that will greatly benefit the health of the citizens. Such pathways offer widely accessible spaces for regular exercise and may also provide access to other green and recreational areas in the city.

By providing alternative connections from home to work, school and other destinations, these pathways may help people incorporate physical exercise into their daily routines. At the same time, being in nature is mentally stimulating and has a positive de-stressing effect.

More outdoor activities may lead to increased human contact and social interaction, which are also beneficial to human health.

Economic benefits

The promotion of “healthy mobility” and “healthy lifestyles” may reduce both private and public health and transportation costs.

Safe-commuting alternatives and spaces for relaxation, leisure and exercise, as well as access to green areas and historic sites and monuments, will not only enhance life quality, which is not only a critical factor in attracting highly-qualified human resources, sophisticated businesses and institutions but may also stimulate tourism.

The revitalization of the waterways may also offer poorer people a range of livelihood opportunities, including service-sector jobs like fishing up solid waste from the waterways in much the manner of street sweepers who keep the streets clean, and jobs managing local wastewater treatment plants and other services such as, for example, bicycle-sharing systems, while simultaneously providing opportunities for small-scale businesses like boating operations and guided tours, flower markets and nurseries.

Local people may grow vegetables, flowers and other plants in community kitchen gardens and nurseries located next to the waterways, using recycled water (including rainwater) and re-using local organic waste as compost.

6. Proposal

The *Pagdandi*

We propose to give the waterways of Bangalore a new *raison d'être*, as the principal structural elements of a new infrastructural network for non-motorized transportation in this city.

We call it the *Pagdandi*. In Hindi, *pag* means foot and *dandi* means path, so the *Pagdandi* is, literally, a footpath.

It will follow the existing open waterways but will extend through green areas and residual space along railway lines and power lines, on calmer local roads and in the form of segregated paths on busier main roads, where it will be needed in order to create a coherent network that will connect living and work areas with transit hubs, recreational spaces, market places, educational facilities, historical sites, places of worship and other points of attraction in the city.

It will thus also provide critical “last mile” connectivity for public transportation throughout the city.

Implementation

The *Pagdandi* can be implemented in a piecemeal way, but the more “pieces” that are implemented, the more successful it will be. As with any other network, its efficiency will increase with the number of nodes being connected.

Challenges

The proposal presents several challenges although none of these are considered insurmountable.

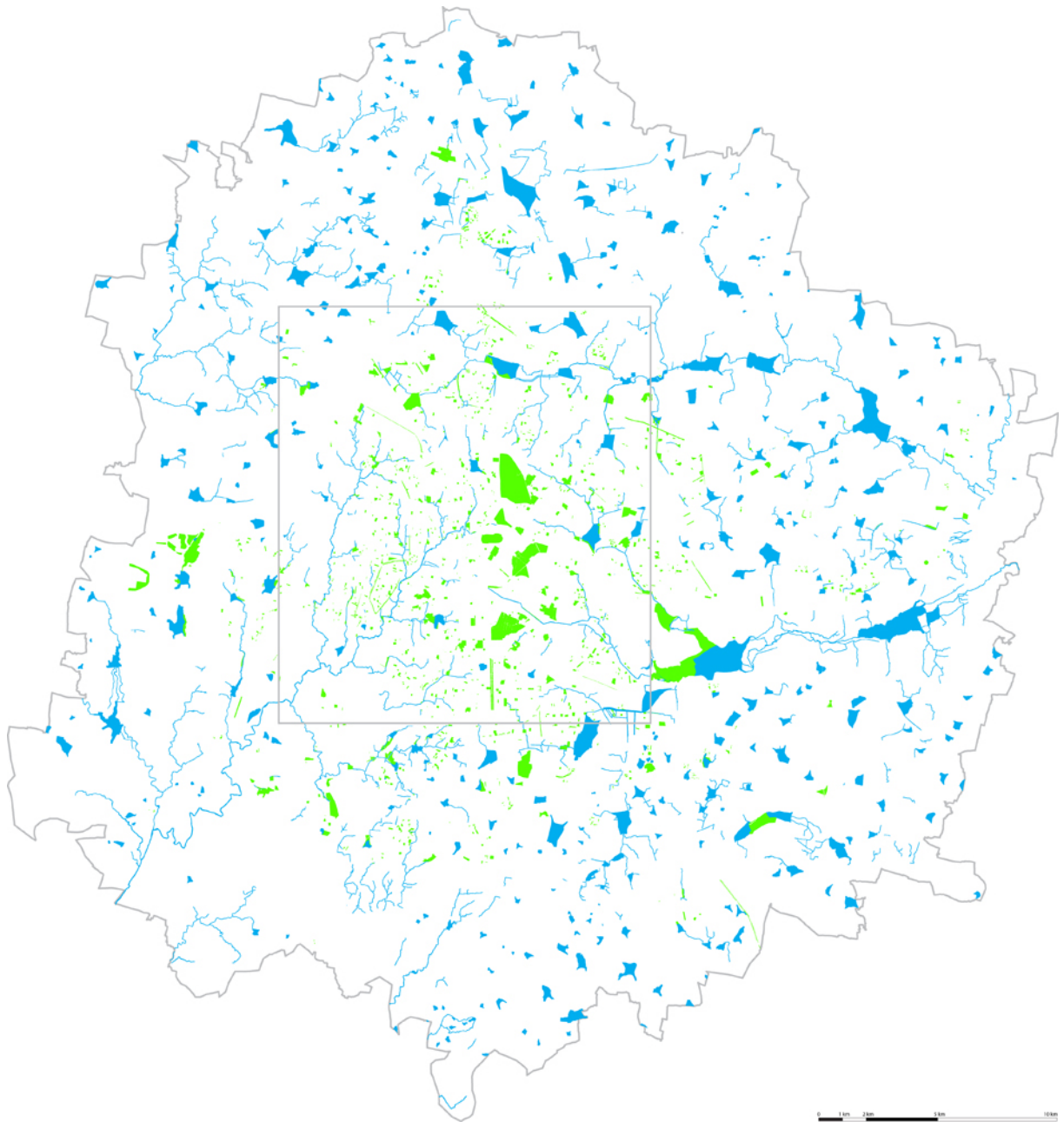
Preserving the areas around the waterways as public land, as the law stipulates, in order to provide space for the *Pagdandi*, for wastewater treatment plants, for vegetation and for community facilities, will necessarily entail the removal of unauthorized constructions and other forms of encroachment, including certain officially sanctioned encroachments.

Preventing the dumping of sewage and solid waste in the waterways will necessitate a change of mindset and will require reliable alternatives, such as a proper system of municipal solid waste collection and a formal sewerage system, which needs to be properly maintained.

Cleaning up and maintaining the waterways clean will require efficient administrative co-ordination between various departments and co-operation with local people, activists and others.

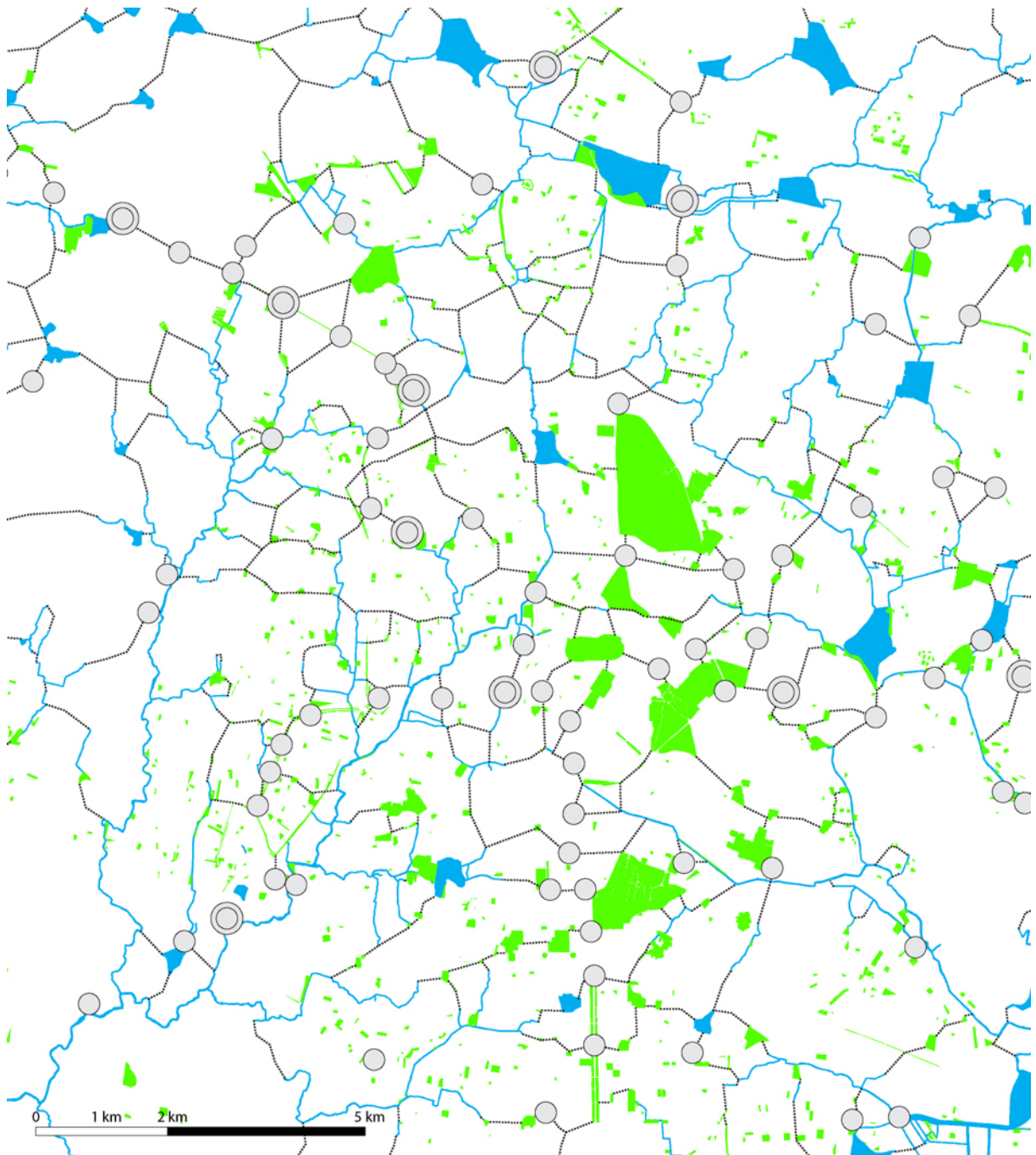
Special design solutions need to be developed in congested urban areas with built-to-edge conditions, at intersections with major arterial roads and through ecologically sensitive areas.

Existing landscape



The Greater Bangalore area – with green areas, waterways and water-bodies. Based on Google Maps and map by Sky Group, Bangalore.

The *Pagdandi* (conceptual)



The central areas of Bangalore – with green areas, waterways and water-bodies, mass transit hubs (represented here by circles) and additional connections for non-motorized transportation.

7. Scenarios

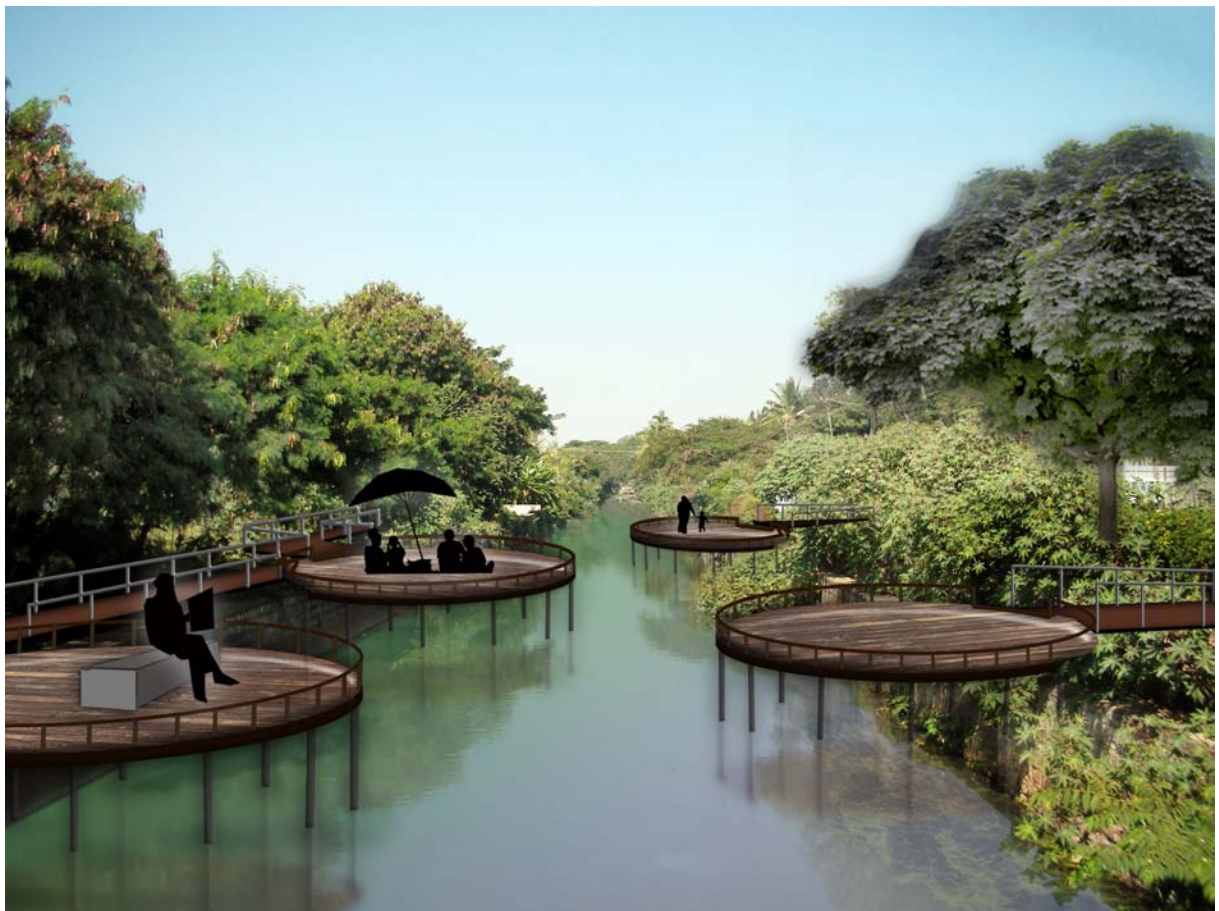
The revitalization of the waterways of Bangalore will necessitate individual solutions that range from new constructions to modifications and small improvements of existing structures.

Enjoying nature

Quiet places along the waterways may provide opportunities to enjoy nature – alone or together with others.



Existing situation



Scenario: Platforms are constructed on the waterway and connected to walking and cycling paths located behind the trees and along existing roads.

Connecting neighborhoods

The *Pagdandi* may cross over from one neighborhood to another, thus creating new connections while leaving natural habitats untouched.



Existing situation



Scenario: The neglected, existing pathway for pedestrians is converted into a bicycle track, while a new elevated pathway for pedestrians is constructed above the waterway and around a wildlife habitat.

Facing the waterway

If the waterways are cleaned up and maintained clean, the housing that is positioned along their extent could conceivably be turned around, which would greatly increase the value of these dwellings. Instead of turning their backs to the *nullahs*, as is now the case, they could be opened up to the *nullahs*. Literally, windows, doors and balconies could be added to their often blank “back” facades.



Existing situation



Scenario: Doors, windows and balconies are added to existing slum dwellings facing the waterway. Opposite, an elevated pathway allows people to walk and cycle along the waterway.

Creating livelihood opportunities

Creating pathways along the waterways will provide numerous opportunities for small-scale business for the poor people who are living there and wage-paid jobs for cleaning up and maintaining the waterways in a clean condition.



Existing situation



Scenario: A simple pathway is created along the waterway and a small-scale business offering boat rentals is established there.

Integrating water and religion

Many religious practices include water. By opening up existing places with religious significance to the waterways and by integrating water from the waterways into the religious practices, people might begin to pay more respect to the waterways.



Existing situation



Scenario: *Ghats* are created in front of a temple, thus providing space for religious practices related to the water and for the small-scale business operation of selling flowers and garlands.

8. Recommendations

Why?

As has been demonstrated in many cities around the world, there are numerous possible benefits associated with the revitalization of urban waterways. But while these benefits, in many cases, have to do with urban beautification, in Bangalore, there are other – and more urgent – reasons, which have to do with water security for a rapidly growing population and with the increasingly chaotic and harmful traffic.

Cleaning up and maintaining the waterways clean

An efficient solid waste collection service and sewage system must be provided to everyone living in the vicinity of the waterways. Biological wastewater treatment plants should be established along the waterways, roughly every two kilometers, for purposes of treating storm water runoff.

In this way, a large-scale citywide system of rainwater harvesting can be implemented with the waterways, feeding the water-bodies with clean water that will help replenish groundwater (rather than contaminate it, as is so often the case today) and will help prevent flooding in the city.

Instead of trying to protect the waterways with fences, which are often broken, we suggest involving the people who are living around the waterways in the process of cleaning them up and maintaining them clean, because we believe that they would be the very best caretakers of the waterways. This can be accomplished by providing wage-paid jobs to the “economically weaker sections” and “low-income groups” in these areas, and by voluntary community activities that could be organized by civil society and non-governmental organizations.

Wage-paid jobs may include the surveillance of the waterways and the collection of solid waste, as well as the monitoring and maintenance of wastewater treatment plants.

The cleaning up of the waterways should commence from the highest points in the city and proceed towards the low-lying areas: for example, from Lalbagh or Sankey Tank down towards the Bellandur Lake.



Water flow from Sankey Tank (via Ulsoor Tank) and Lalbagh Tank to the Bellandur Lake. Source: Google Earth (January 20, 2014).

Constructing the *Pagdandi*

Once the waterways are cleaned up, pathways for walking, jogging and cycling should be constructed along and across the waterways. In some areas, new constructions will be required while in other areas, simple improvements are going to suffice.

In addition, new pathways should be constructed and existing ones should be upgraded on roads leading through green areas and residual spaces, wherever this might be needed in order to create a coherent and continuous network that will connect populous residential areas with work place areas, transit hubs, recreational areas, historical sites and monuments.

Creating opportunities and facilities

Once the *Pagdandi* – or at least part of it – has been established, various facilities can be created along the waterways, including small-scale commercial, recreational and religious facilities.

Many of these facilities can be run and can be taken care of by the poor people who are living around the waterways. This may also give them a sense of “ownership” of the waterways, which we believe would be the very best method for keeping the waterways clean.

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