

An aerial satellite view of a densely populated urban area in Lagos, Nigeria. The image shows a complex network of narrow streets and numerous small, closely packed buildings. A large, open, light-colored area, possibly a sports field or a cleared lot, is visible in the upper right quadrant. The overall scene depicts a typical high-density urban environment in a developing city.

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Summary

This report presents findings from a tree census conducted to determine the ecological and environmental impact of tree felling in two alternative proposals by the BMRCL to acquire land from All Saints Church, Hosur Road for temporary use for the Bengaluru METRO construction.

Previously, a parcel of land measuring roughly an acre, leased by All Saints Church to various lessees, was permanently acquired by BMRCL. This report does not discuss the impact of that acquisition, but confines its scope to the two new options proposed

Option 1: 1140 sq metres for Temporary Acquisition by BMRCL

Option 2: 656 sq metres for Permanent Acquisition by BMRCL

Our census indicates that the number of trees to be felled in option 1 is 50, and in option 2, 38. These trees are very diverse, coming from **18 species**, many of which have important biodiversity value (e.g. Atti mara, Jackfruit, Indian Walnut). Many are very large, tall and wide trees which have taken decades to grow (Annexure 1: Details of trees to be felled: Species and numbers).

These stretches were analyzed based on data provided by the All Saints Church community. This report further describes the impact that this proposed tree felling will have in terms of **1) increasing air pollution 2) exacerbating urban heat island effects 3) impacting biodiversity and 4) impacting carbon sequestration**. In particular, this report emphasizes that 1) large trees are very important in a city like Bengaluru. Research demonstrates that the benefits provided by a large tree cannot be compensated for by even 8 small trees, as further described in the report. 2) All Saints Church, as shown in the Google Map in the report, is embedded in a concrete island in Hosur Road and provides one of the few remaining spots of greenery in this high-pollution, dust-filled area. The trees here do a critical service of pollution reduction and combat urban heat-island effects. They are irreplaceable, and the services they provide cannot be restored by planting saplings or transplantation. If acquired by the BMRCL, this tree felling will **severely impact the environmental quality and health of the neighbourhood, extending well beyond the limits of the Church itself**.

Introduction

The inhabitants of the settlements in and around present day Bengaluru were well aware of the importance of trees and green spaces in their daily lives. This city, once called the Garden City of India, located in a semi-arid zone where water and tree cover was scarce, was assiduously planted, watered, greened and nurtured by successive kings, administrators and citizens. Sadly, through the centuries, we have lost the awareness of how important these resources are for the sustainability of Bengaluru. This report provides an independent scientific ecological and environmental assessment of the proposed tree felling for the land acquisition of part of the All Saints Church area by BMRCL.

Details of trees to be felled

Option 1: 1140 sq metres for Temporary Acquisition by BMRCL

In this section, we find 50 trees belonging to 18 species. More than 50% of these are large trees, with a girth greater than 1 m. Of these, some are extremely large. They include two tall silver oaks, of 12.40 and 11.50 meters in height, and two *Polyanthia* (false Ashoka) trees, five badminton ball trees and one Akasha Mallige tree with heights greater than 9 m. Some are extremely wide in girth. These include two Gulmohur and Wood Apple trees with a girth greater than 2.5 m, two Tamarind and one Gulmohur tree with a girth greater than 2 m, and several other large trees. Prominent amongst this is a *Ficus* tree - this is a genus of keystone species that support incredibly rich biodiversity and are of critical importance to urban spaces. This *Ficus racemosa*, Cluster Fig or Atti Mara, is also very large, with a diameter of 1.9 m and a height of 9.3 m and an impressive tree which is irreplaceable.

Option 2: 656 sq metres for Permanent Acquisition by BMRCL

In this option as well, 38 trees belonging to 18 species will be felled. Over 50% of these are large sized, with a girth greater than 1 m. 40% of these are tall trees, with a height greater than 8 meters. Most of the large trees in the previous section are also in danger of being felled here, including the very large silver oaks, badminton ball trees, Akash Mallige and the very critical keystone *Ficus* species, the Atti Mara or *Ficus racemosa*.

The next section describes the importance of this patch of trees for Bengaluru.

1. The importance of large trees

As described in a report of the US Forest Service,

https://www.fs.fed.us/psw/topics/urban_forestry/products/cufr_511_large_tree_argument.pdf

large trees have very large canopies, provide shade and reduce pollution, and harbor many local birds, insects and wildlife species. From the sizes of these trees, it is clear that many of them are several decades old, and some of them are very old and extremely large in size. Cutting these trees will have major impacts on biodiversity, air pollution and temperature in this area.

Quoting from the US Forest Service report "We now know that, dollar for dollar, large-stature trees deliver big savings and other benefits we can't ignore. In fact, research at The Center for Urban Forest Research shows that their (small sized tree) benefits are up to eight times less. Compared to a small-stature tree, a strategically located large-stature tree has a bigger impact on conserving energy, mitigating an urban heat island, and cooling a parking lot. They do more to reduce stormwater run off; extend the life of streets; improve local air, soil and water quality; reduce atmospheric carbon dioxide; provide wildlife habitat; increase property values; enhance the attractiveness of a community; and promote human health and well being. When it comes to trees, size really does matter."

2. Environmental impacts from loss of trees and surrounding ecosystems

As shown in the Google Earth image below, All Saints Church is embedded in an island of concrete. Bengaluru has lost most of its green cover in the past few decades. All Saints Church, in the bottom right corner, provides one of the last remaining green islands of tree cover. This tree cover, as described in further detail below, is important for decreasing air pollution, reducing urban heat island effects, protecting biodiversity, and carbon sequestration. Our research in Bengaluru over the past 15 years, published in international peer-reviewed scientific publications and books (e.g. Nagendra 2016, *Nature in the City; Bengaluru in the Past, Present and Future*), has demonstrated the importance of such green pockets. The importance of such green pockets extends well beyond the boundaries of the Church. The protective influence of these trees on the environment indeed extends to the commercial and residential neighbourhood in this area. Thus, the removal of these trees will further worsen air quality, heat waves and aggravate breathing disorders and other health outcomes in this already polluted area. Over half of these trees are large, and as described above, the environmental effects of such large trees cannot be replaced by

small-sized trees, transplantation (when most of the branches are cut), or replacement planting by saplings even if done in the same area.



Image: All Saints Church, providing one of the last remaining patches of green space in the concrete islands of the surrounding neighbourhood. Image from Google Earth.

2a. Increased Air Pollution

Air pollution has become a leading cause of debilitation and death in many Indian cities. Green spaces are very important to act as lungs for the city, producing oxygen and removing carbon dioxide. Trees in Bengaluru help to reduce levels of harmful air pollutants such as sulphur dioxide and Suspended Particulate Matter substantially, bringing these within permissible limits.

Our previous research has found that street trees have a significant impact on air pollution in Bangalore, reducing Suspended Particulate Matter levels by as much as 75% on roads (thus reducing the likelihood of asthma and other pollution related health disorders). Sulphur dioxide levels in road segments with tree cover are kept within permissible limits (Vailshery et al 2013)

Trees mitigate the impact of dust pollution: a product of the incessant construction along these stretches. All stretches of the roads see continuous vehicular traffic, and the presence of the trees help keep the pollution from vehicular exhaust in check. Suspended Particulate Matter and air quality of Bengaluru has been a cause for concern in recent years (Rukmini 2015), and loss of tree cover as a result of the two proposed projects will severely compound

the problem. Bengaluru will soon have to suffer a fate similar to that of the capital New Delhi, where the city was described as a 'gas chamber' owing to high levels of air pollution compounded by firecrackers during the annual Diwali festival (BBC 2016).

2b. Urban heat islands

Trees help to reduce the temperature on road surfaces and surrounding areas considerably. As shown in our previous research in Bengaluru, trees on roads reduced ambient air temperatures by as much as 5.6°C, and reduced road asphalt surface temperatures by as much as 27.5°C in Bengaluru (Vailshery et al 2013). Cutting trees on these roads for the proposed projects will mean an irreversible loss of this free temperature regulation provided by nature even as temperatures in Bengaluru are soaring every year. In April 2016, Bengaluru recorded its hottest summer in 85 years with the temperature rising to 39.2°C (The Indian Express 2016).

2c. Loss of biodiversity

Trees even along congested roads, especially the fruiting varieties, provide food and nesting habitat for birds. The one-time loss of these trees will reduce the available habitat for several species of birds, not to mention insects and other mammals such as bats. The keystone *Ficus* species also serves as habitats for a wide variety of biodiversity. Our previous research (Jaganmohan et al. 2018) has shown the importance of sacred spaces in Bengaluru for protecting biodiversity - sacred spaces like the All Saints Church are marked out in this research as prominently adding to the biodiversity of Bengaluru city as a whole.

2d. Carbon sequestration

Trees act as sinks or reservoirs that sequester carbon for long periods thereby playing a critical role in addressing global warming and impacts of climate change. Trees store carbon that is referred to as biomass, and while roots, debris and litter all contribute to the biomass, the portion of the trees above the ground comprises the predominant portion of the carbon stock. While young trees are known to absorb carbon in their growing stage, recent research has also shown that older trees fix large amounts of carbon (Stephenson et al 2014). Many of the trees that are to be affected by the projects are old, and cutting them would drastically reduce carbon absorbed and contribute to climate change.

The green cover of Bengaluru is fast diminishing, especially in its public spaces. What little greenery the city has that contributes positively to maintaining the micro-climate, mitigating the dust and noise pollution is often situated in

pockets such as those in churches and other sacred spaces (Nagendra et al 2012). These last green lungs of Bengaluru need to be protected.

Conclusion and Recommendations

Quite apart from the other effects of the proposed land acquisition on All Saints Church, there will be a major environmental and ecological impact caused by tree felling of 38-50 trees, many of which are very large.

Government reports often identify areas for compensatory planting of saplings. Previous experience with compensatory plantation of trees in Bengaluru does not give us much confidence that this replantation will be conducted, or that it will result in the survival and growth of a majority of the saplings planted. If this were to be the case, the tens of thousands of trees that have been cut in Bengaluru over the past decade or so should have been replaced with millions of trees, resulting in a substantially greener city by now!

We should by now disabuse ourselves of the notion that the environmental and ecological benefits provided by a large mature tree can be easily replaced in a short time frame by planning a number of small saplings. It takes years for a sapling to reach the size of a large mature tree, and provide similar ecological and environmental benefits. Also, the survival rates of saplings planted in the urban context is often quite poor, and many of these saplings may not survive to maturity in the first place.

The proposed replanting of saplings is in localities away from the site of this project. This fails to address the problem of air and noise pollution, heat islands, and biodiversity impact within this area. The existing trees on this stretch are large wooded trees that have been standing here for decades mitigating the impacts of pollution and high temperatures: planting saplings in far off sites cannot replace this service provided.

With the disappearance of hundreds of thousands of trees in the last two decades from the central areas of the city, the few remaining wooded stretches of trees - of which the trees in all Saints Church are a stellar example - are very important for Bengaluru. Trees provide the following services

- ❖ Air pollution has become a leading cause of debilitation and death in many Indian cities. Green spaces are very important to act as lungs for the city, producing oxygen and removing carbon dioxide. Trees in Bengaluru help to reduce levels of harmful air pollutants such as sulphur dioxide and

Suspended Particulate Matter substantially, bringing these within permissible limits.

- ❖ During the summer, the city experiences severe urban heat island effects. Street trees can help to reduce the heating of concrete and asphalted surfaces by over 20°C, and reduce air temperature by at least 3-5°C in Bengaluru.
- ❖ Trees are also very important habitats for urban biodiversity. Many varieties of birds, butterflies, reptiles, bats, primates and many other fauna are found in abundance around wooded stretches.
- ❖ Bengaluru is facing a severe ground water crisis. Trees are critical to increase water retention, absorb water and slow down the rate of run-off, providing effective ground water recharge. Trees also help to stabilise soil and channel water safely, reducing the intensity of rainfall on roads in the monsoon and reducing incidences of flash flooding.

The ecological and environmental integrity of the areas around Hosur Road are threatened by the spectre of massive tree felling which will create noise, pollution, heat and fragment the urban habitat. The green section of trees in all Saints Church provides a rare and important haven for nature, and an important lung space for the city. It needs to be protected for posterity from the challenges of urbanization: both for the survival of the thriving biodiversity around the area, and for the thousands of local residents and congregation members who benefit from the green surroundings through clean air, comfortable ambient temperatures, and the mental and physical benefits that come from access to nature and greenery in a frenetic city.

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Annexures

Option 1: Temporary acquisition

<i>Scientific name</i>	<i>Common name</i>	<i>Height</i>	<i>Girth</i>

Option 2: Permanent acquisition

<i>Scientific name</i>	<i>Common name</i>	<i>Height</i>	<i>Girth</i>