JOHANNESBURG

For decades, the sprawling townships around Johannesburg, South Africa's largest city and economic hub, stood as a blazing testament to racial injustice. Established in the 19th century as camps for laborers in newly discovered gold mines, the townships did not come to world attention until they became the wellspring of protest against the apartheid system, imposed in the late 1940s.

The townships—most famously Soweto but also places like Tembisa, Vosloorus Katiehong, and Meadowlands—were symbols of racism—then a symbol of resistance. Today they may be a symbol of rebirth.

Under apartheid, the townships were officially little more than way stations. Until 1976, township population could have status only as temporary residents. Black laborers would inhabit the square, four-room brick dwellings derisively called "matchbox houses" only while their employment contracts were valid. They were supposed to live in the townships solely to work for white residents in Johannesburg and other nearby cities. The government gave little thought to providing infrastructure of any kind for township residents.

Elsewhere in the city, however, Johannesburg's residents had been busily remaking the landscape for generations. The city lies in a region known as the Highveld, a typical African savannah/grassland ecosystem with few trees. Early settlers planted trees for fodder, fuel, fruit, and wood production, but things changed dramatically with the gold rush in 1886. The miners needed thousands of wooden props for the tunnels, so they established huge plantations of Blue Gums, a species of Eucalyptus native to Australia. Over a million trees were planted in what is now Saxonwold, a suburb of Johannesburg.

As the city grew, the tree planting spread beyond the Blue Gum plantations and the streets and gardens of white Johannesburg filled with trees. In 1904, the first street trees were planted in Johannesburg's town square, and by the early 1990s, an estimated 6 million trees had been planted within the boundaries of the old Johannesburg and 10 million collectively within the modern city boundaries.

Today Johannesburg boasts 50,000 acres of green space and open space in more than 2,000 public parks. There are so many trees today that the oft-repeated claim is that Johannesburg is the largest man-made urban forest in the world. The data for that claim are slim, but it is beyond question that Johannesburg's 6 million trees make it a cool, pleasant, and shady. But not for everyone.

The green canopies that travelers see from the air are the wealthy, former white-only northern suburbs. The poorer townships are closely packed with houses and surrounded by the treeless veld.

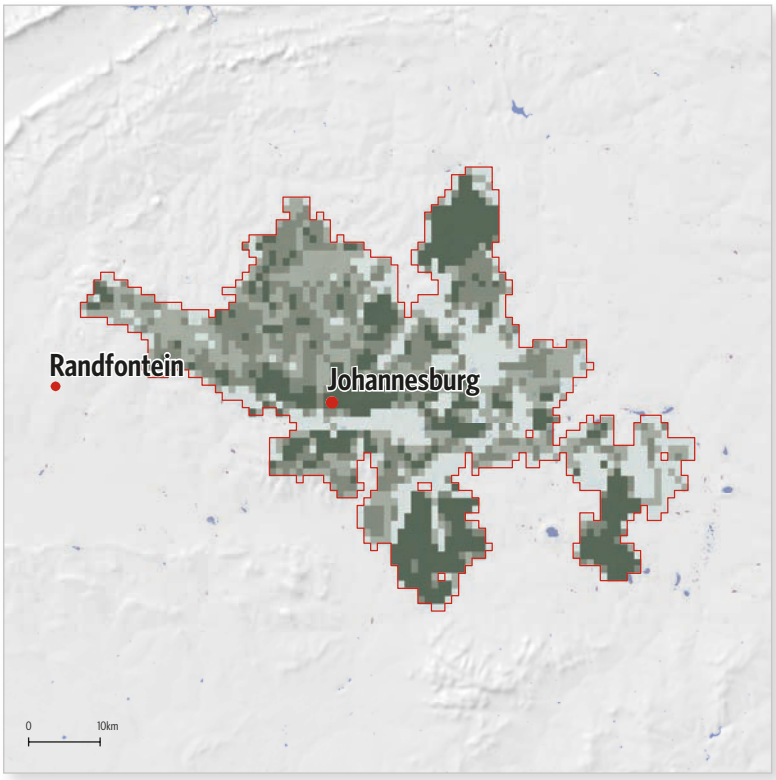
Few trees were planted in Soweto or any other township. But the need for more trees is becoming clearer every day. Climate model projections for Johannesburg indicate that the local climate is likely to become

both significantly hotter and more humid. The models suggest that temperatures for the city may increase by around 2.3° C by over the next 40 years and by more than 4° C over the next 70 years or so.

Since 2006, however, there has been a massive effort to extend Johannesburg's urban forest. The Soweto Greening Project, for example, began that year with 6,000 trees being planted. The aim is to plant 200,000 trees throughout the township.

Johannesburg has even more far-reaching plans to expand the amount of green space across the city. Our study did not include Soweto, but it does cover parts of other townships. Johannesburg is only moderate in ROI for tree planting, compared to other cities globally. However, there are scattered neighborhoods with very high potential. For an additional $500 thousand annually in street tree planting, more than 100,000 people could have a reduction of 1.5° C (2.7° F) in summertime temperatures.

Results from the Johannesburg study



Map 19. Neighborhood-level ROI for Johannesburg (PM reduction).

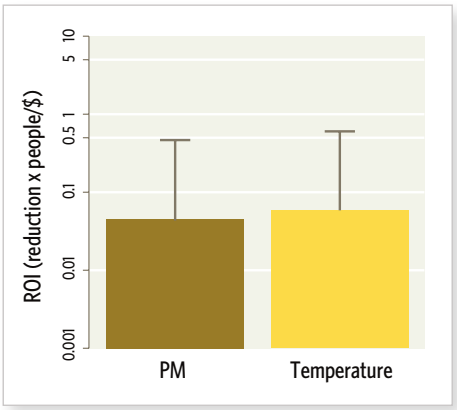


Figure 24. ROI for tree planting for Johannesburg.

Investment	Annual Cost ($)	> 1 ug/m² $PM_{2.5}$	1.5 deg C
10% of sites	488,000	127,000	140,000
20% of sites	899,000	157,000	191,000
Full Investment	2,970,000	211,000	258,000

Table 12. Temperature and PM reduction benefits under three investment scenarios for Johannesburg.

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