

Diverse Urban Landscapes and Monsoon Climates in Antananarivo, Madagascar

Madagascar is one of the most precious sources of biodiversity on the entire planet. According to the World Wildlife Fund, approximately 95% of reptiles, 89% of plant life, and 92% of mammals exist nowhere else on Earth.¹ Since the arrival of humans on the island roughly 2,000 years ago, 90% of the primary rainforest has been lost, with 40% of forest cover disappearing between 1950 and 2000.² The convergence of these precious environmental resources with rampant human overconsumption and destruction of the vital ecosystems and habitats is nothing short of an emergency.

The capital of Madagascar, Antananarivo (Tana), is situated in the central highlights of the country in a subtropical monsoon climate, with annual seasonal rains. The city's official population is almost 1.3 million, likely an undercount given limited government resources and large populations living in informal settlements.³ Primary rainforest in the capital region is long-gone, replaced with housing and other urban structures, rice paddies, agroforestry (primarily eucalyptus and pine trees used for fuel), and barren hillsides. The landscape adjusts seasonally with the monsoon rains, as lakes, streams, canals, and rice fields throughout the region flood during the rainy season from November to March, when over 85% of the average annual rainfall occurs (13.65m).⁴



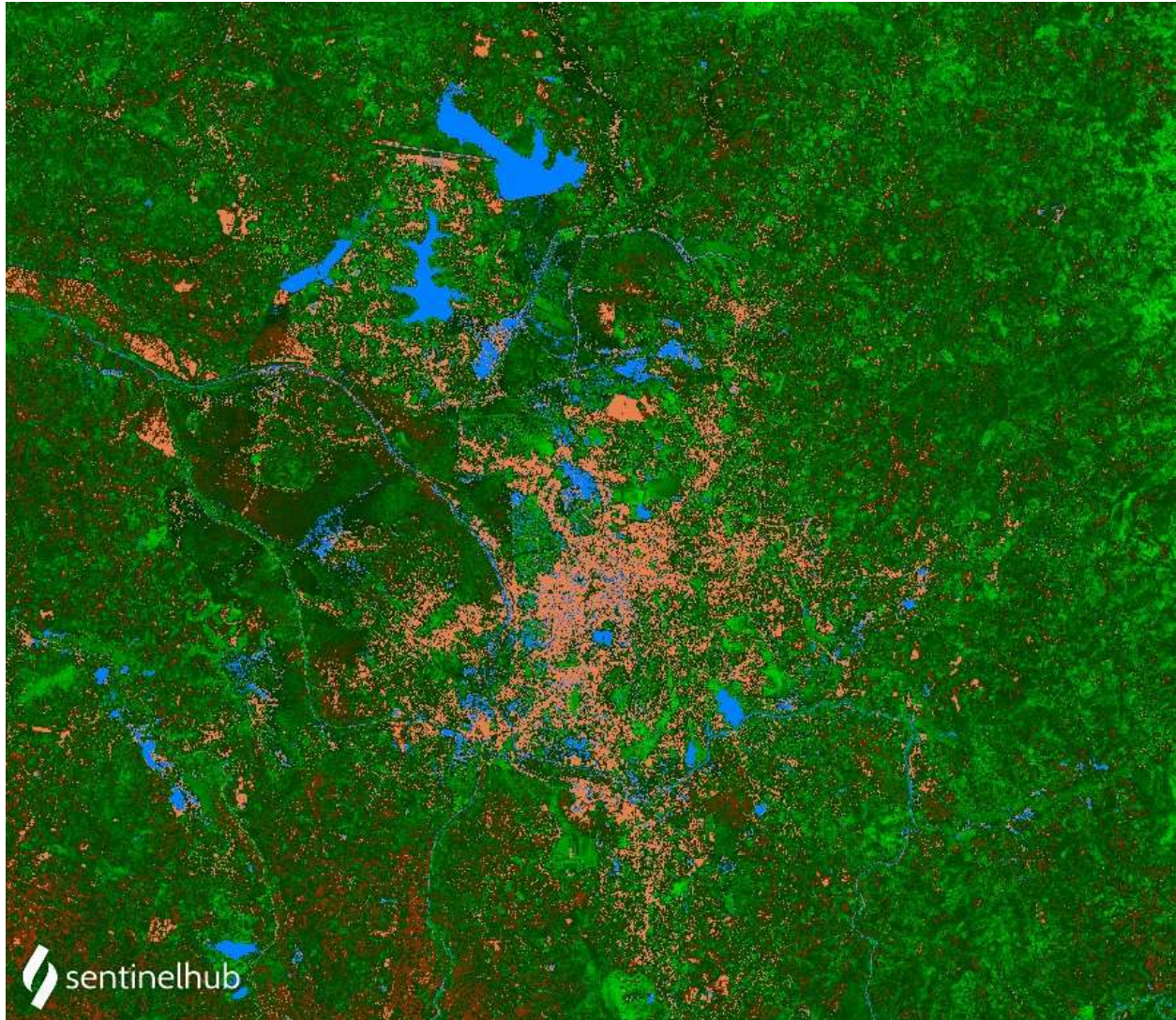
Even Madagascar most iconic species, such as the ring-tailed lemur are endangered due to the habitat loss and poaching.



Antananarivo, Madagascar's capital city, is defined by a diverse landscape of urban structures, agroforestry, rice farming, and deforested hillsides. [Source](#)

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Enhanced satellite imagery can highlight the diverse landscapes of the Tana region, as well as the intensity of the season changes brought about by the annual monsoon rains. Here, the urban core is shown in light orange, with dense structures in the center sprawling primarily to the south but also to the northwest and far north. Water is dispersed through the region in larger lakes, smaller streams, and manmade canals. Rice agriculture is visible near water sources, given the extremely intense water consumption of rice and lack of irrigation infrastructure.

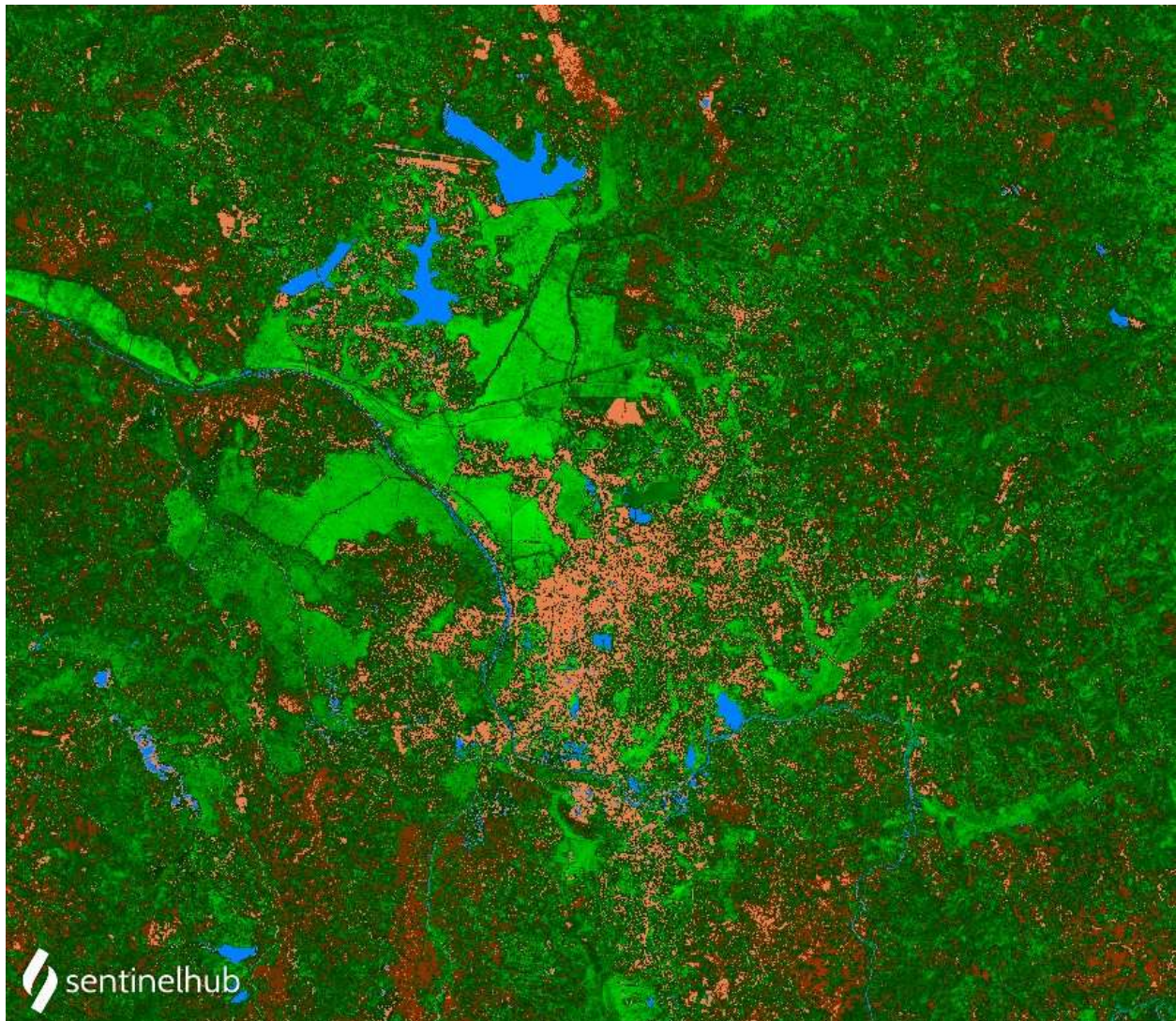


Antananarivo is characterized by its urban sprawl (light orange), rice agriculture (bright green), lakes and canals (blue), and the surrounding region's agroforestry (dark green) and barren hillsides (dark brown). [7/17/20 Image Link](#)

Particularly notable is the interspersal of rice paddies throughout the urban core – Tana is a global capital where multistory apartment or office buildings are located adjacent to rice fields. The darker green highlights trees and forests, which quickly dominate the landscape outside the urban core, especially in the east. These trees are primarily pine and eucalyptus, fast growing trees that are used as home fuel sources primarily for cooking, either as timber or processed into charcoal. Finally, the dark brown highlights the barren hillsides that exist throughout the central region of the country.

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The expansion of the water sources and water-intensive rice fields from the dry season (July) to the rainy season (January) highlights the volume of water the city absorbs during several months each year. As monsoons bring a foot of rain per month, streams and canals fill with water, irrigating the rice fields and creating a massive increase in vegetation within the urban core, highlighted in bright green in the central and northwestern areas of the January 2021 image below, taken during the peak of rainy season. Especially given the hilly topography of the city, monsoon rains can often result in flooding of homes and buildings, sometimes forcing people to evacuate.



The seasonal monsoons bring intense rains to Tana. Streams and canals flood daily, resulting in the massive proliferation of highly water-dependent rice paddies (bright green) throughout the city and region. [1/9/21 Image Link](#)

The satellite imagery used in this analysis provides an extremely valuable understanding of the diverse environment that exists in Tana, and highlights some of the city's unique features as compared to many other cities and capitals around the world. Importantly, much of Madagascar is not captured by the high-quality, cloud-free imagery that can be used to monitor geographically precise environmental changes. Imagery for much of the eastern coast of the country, where the vast majority of remaining primary rainforest remains, is difficult to use because of the persistent cloud cover. Governments and

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private entities responsible for the deployment and operations of image-capturing satellites must prioritize the region for consistent and reliable imagery to facilitate clear understandings of the country's rapid environmental changes.

References:

¹ <https://www.worldwildlife.org/places/madagascar>

² <https://www.lcluc.umd.edu/hotspot/deforestation-madagascar#:~:text=Having%20impacted%20approximately%2094%25%20of,90%25%20of%20its%20original%20forest.>

³ <https://www.instat.mg/accueil/madagascar-en-chiffre/>

⁴ <https://www.climatestotravel.com/climate/madagascar>