

Can Bhubaneswar's smart city infrastructure withstand summer heat stress?

URBAN HEAT ISLANDS

May 30, 2019 Basudev Mahapatra



High temperature and heat wave can exacerbate challenges for Bhubaneswar by accelerating aging and deterioration of infrastructure. Pic: Basudev Mahapatra

Cyclone Fani in early May was one more reminder for Bhubaneswar of its vulnerability to extreme weather events, and the massive damage to urban infrastructure that such events could bring about, even in an upcoming 'smart' city.

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Fani left Bhubaneswar in shambles in its trail, with uprooted trees all around falling on roads and buildings, disrupting major services like supply of water and electricity as well as Internet connectivity. Life in the city remained miserable for weeks. Last year too, life in the city had been severely disrupted, as it almost went under water following unusually heavy rainfall of nearly 200 mm in a day.

However, extreme weather events faced by Odisha's capital city Bhubaneswar are not limited to cyclonic storms and rains only. Every summer, the city emerges as the hottest city in the

country for several days at a stretch, and so it was on April 16 2019, with a temperature of 43.7 degrees Celsius and humidity of 70 percent. In fact, since March, Bhubaneswar has recorded the highest temperature on several days.

If one goes by the precedent set in past years, the city could well experience the heat island effect for days together. As the trend goes, experts believe, such hot summer days and heat waves are only going to become more common, as temperatures keep rising in Bhubaneswar under the impact of global warming and climate change.

According to research carried out by faculties from Indian Institute of Technology (IIT) Bhubaneswar and University of Southampton (UK), rapid urbanisation combined with changes in land use pattern has led to about 1.8 degree Celsius warming of Bhubaneswar, compared with surrounding non-urban areas, leading to an urban heat island (UHI) effect.

Owing to rapid urbanization, changes in LULC (Land Use Land Cover) has translated to a massive decrease of about 89% and 83% in dense vegetation and crop fields respectively. Such changes due to over-exploitation of natural resources, and the related spatio-temporal variations in LST (Land Surface Temperature) are major factors behind the UHI effect over Bhubaneswar, the research finds.

Higher stress under high “wet bulb temperature”

According to a study titled Temperature and humidity based projections of a rapid rise in global heat stress exposure during the 21st century, heat stress is projected to intensify throughout the 21st century as a result of global increases in temperature and specific humidity. “Consequently, there is the potential for widespread exposure to wet bulb temperatures that approach, and in some cases exceed, postulated theoretical limits of human tolerance by mid to late century,” the study underlines.

Calculated from temperature, humidity and pressure, wet bulb temperature is the lowest temperature to which air can be cooled by the evaporation of water into the air at a constant pressure. While wet bulb temperatures above 35 degree Celsius is considered beyond the theoretical limit for human tolerance (which scientists believe is unlikely to occur in the current climate) the aforesaid study cites that recent heat waves with lower wet bulb temperatures between 29 and 31 degrees Celsius have caused tens of thousands of deaths.

Cut to Bhubaneswar, and wet bulb temperature in this city fluctuates between 30 and 33 degrees Celsius during the summer months. This year, since the month of April till date, wet bulb temperature in the city has remained higher than 30 degrees Celsius on many days. On any day with temperature at 37 degrees Celsius, which is very common for Bhubaneswar during summer, combined with 60 percent humidity and 1000 millibars of barometric pressure, wet bulb temperatures may rise above 30 degrees Celsius, according to this calculator.

Scientists apprehend that continued urbanization will make more people in the cities vulnerable to urban heat island (UHI) effect, which can raise air temperatures by several degrees Celsius. As a result, regardless of whether wet bulb temperatures regularly reach 35 degree Celsius (or not), extreme heat is poised to become one of the most significant and directly observable impacts of climate change in the coming decades. This can lead to

economic impacts “affecting agriculture, construction, energy demand, emergency services, recreation, and the military.”

As Bhubaneswar goes through a transitional phase on its journey towards becoming a smart city, and looks forward to a complete transformation evident in new buildings and infrastructure, the pertinent question is whether the city and its existing infrastructure are capable of withstanding the increasing heat stress under the influence of global warming and climate change.

With the brunt of climate change and rising temperature being widely felt across Odisha, talking about its possible impact on smart city Bhubaneswar has become highly important, feels Mayarani Praharaj of the department of architecture at Bhubaneswar based College of Engineering and Technology (CET). Especially so, as it may lead to high economic burden and deficient service provisions making life miserable for citizens.

“Post cyclone Fani, heat stress remains a bigger concern for Bhubaneswar as the city has lost most of its trees and the green cover, which could have acted as an atmospheric cooling agent through evapotranspiration,” says Akshay Kumar Pradhan, Lecturer (Physics) in the city-based Biju Pattnaik College of Science and Education.

Possible infrastructural casualties

Cities are already subject to higher surface temperatures, because of the urban heat island effect, which is projected to get stronger. The NCA4 reports on built environment, urban systems and cities cautions against the vulnerability of the built environment — infrastructure such as residential and commercial buildings, transportation, communications, energy, water systems, parks, streets, and landscaping) — to such changes, and its implications for how people live, study, recreate and work.

Similar projections can be found in the fifth assessment report (AR5) from the Intergovernmental Panel on Climate Change (IPCC).

More specifically, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia’s national science research agency, warns that a changing climate will alter environmental conditions concrete is exposed to, particularly over the relatively long lifetime of most structures. The increasing rate of deterioration of concrete will affect the safety, serviceability and durability of infrastructure.

An Asian Development Bank (ADB) report says that countries of Asia will be among the worst affected by rising temperatures, extreme weather patterns and floods caused by climate change. The development bank of the region has subsequently claimed to have screened its investments for climate change implications, questioning if new cities, bridges and roads will be able to cope with more severe flooding and other threats.

All of this holds significance for Odisha, where urban centres are vulnerable to natural hazards, as acknowledged by the Odisha State action plan on climate change for the period of 2018-2023. Rising temperatures and extended heat wave periods expedite damage to roads and pavements. Higher temperatures also affect rail networks through thermal expansion, the action plan confirms.



The State Climate Action Plan confirms that extreme heat strongly affects roads and pavements in urban Odisha. Pic: Basudev Mahapatra

Actions initiated

Among the plans to mitigate the impacts of climate change in the urban regions, the State envisages to improve urban infrastructure by prioritising non-motorised transport in the city. Developing a comprehensive development plan (CDP) by incorporating measures to combat climate change and implementing it are also in the mitigation plan.

The Bhubaneswar Smart City project in particular is covered under German government-commissioned projects such as Climate Smart Cities and the Integrated Sustainable Urban Transport Systems for Smart Cities. Bhubaneswar Smart City Limited (BSCL) works in collaboration with German development agency Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, or GIZ in short, for implementation of these projects.

While the climate smart cities project attempts to anchor climate-friendly solutions, the other project aims to improve the planning processes and the implementation of sustainable and integrated urban transport systems and solutions. Both the projects focus on bringing down per capita environment impact in the city by reducing green-house gas (GHG) emission as actions for resilience building.

However, according to sources at BSCL, it's only an initial stage, and there is still a long way to go on climate change action.

Wake-up call

Bhubaneswar Smart City authorities and planners need to integrate climate change while planning new projects, says Ramesh Swain, leading architect and town planner of the city. Swain, however, doesn't see heat wave events, increasing temperature and humidity as immediate threats to the city's infrastructure.

Rising temperature and humidity may pose bigger threats to our infrastructure in the second half of this century, according to Uma Charan Mohanty, visiting professor to the School of Earth, Ocean and Climate Sciences at IIT Bhubaneswar. As Smart City infrastructure is built to serve for a longer period, Mohanty urges, it is essential that all projected threats from temperature and humidity are given due consideration since the planning stage.

Expressing his concern, city-based architect Sagar Mohapatra says that the crisis we talk about may come sooner than our expectations if the city doesn't wake up to these issues and

act promptly, especially in view of increasing concretisation and dwindling green cover. Landscape planning must be a priority for city planners, Mohapatra believes.

According to experts, increased frequency and severity of extreme weather events have cost the world over 1.5 trillion USD in natural disaster impact since 1980. Add to this the fact that cumulatively, such weather events could well be the single biggest factor contributing to a 4 trillion-dollar (US) deficit in infrastructure funding needs by 2025.

With several global cities already facing huge economic losses due to extreme climatic conditions, and global scientific communities raising deep concerns over it, Bhubaneswar should take it as an urgent wake-up call. “We need to think and plan in a holistic manner,” says Uma Charan Mohanty.