Wetlands INTERNATIONAL

URBAN WETLANDS FOR COOLER AND CLIMATE-PROOF CITIES

WETLANDS HELP CITIES TO REDUCE URBAN HEAT ISLAND EFFECT (UHI) AND ADAPT TO CLIMATE CHANGE

Wetlands help cities to reduce Urban Heat Island Effect (UHI) and adapt to climate change

Urban wetlands for cooler and climate-proof cities

In an already urbanised world, cities are suffering from Urban Heat Island Effect, (UHI) – higher temperatures in built up areas – due to reduced green space, increased paved surfaces and more frequent heat waves stemming from climate change. Urban wetlands, especially in a healthy state, with high biodiversity values and ecosystem functioning, help to cool cities and adapt to climate change. We therefore call upon local governments to safeguard urban wetlands by integrating them into urban planning and investing in restoration (and in some cases construction of) urban wetlands for local climate action.

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Introduction

Cities are expected to account for nearly 7 billion people or two-thirds of the total global population by the year 2050[1]. This growing urban population has a huge impact on cities, their surroundings and their micro-climates. This urbanisation process drives wetland loss, absorbing rural wetlands into the city and landfilling existing urban wetlands for industry or housing. For example, in India, for each km² of newly urbanised surface, 25 hectares of wetlands are lost[2].

This degradation of wetland can lead to loss of biodiversity habitat, reduces water supply, increased risk of flooding, waterlogging, and carbon emissions, it also limits the capacity to absorb heat and regulate local climates. The urbanisation of the landscape can result in alteration of local climates, particularly causing Urban heat Island effect (UHI), in which cities experience higher temperatures than their surrounding areas[3].

With climate change leading to more severe and frequent heat waves[4], cities can manage these by protecting, restoring and (in some cases) constructing urban wetlands and integrate them with other blue-green infrastructure such as bioswales, rainwater gardens, blue roofs and UHI measures like increased tree and vegetation coverage, and green roofs. While tackling UHI in the dry season, these can also reduce urban flooding during monsoons or rainy seasons.

What are the factors affecting UHI and how does it work?

Scientific studies positively co-relate rapid urbanisation with urban thermal environment. This has a remarkable effect and influence on local climate, environment and affects the quality of life for its residents[5,6]. In addition, frequently and widely occurring heat waves further make cities vulnerable to risks of vector borne diseases and increasing energy demand while intensifying the effect of UHI.

As urban areas develop, their wet and green open spaces and permeable surfaces are covered with dry and impermeable construction materials like asphalt on roads, concrete of buildings and pavements. These absorb heat during the day time and warm the urban area, affecting the micro-climate in comparison to adjacent areas, forming a canopy or island of higher temperatures. Other factors that affect UHI are geographic location, population density, planning and infrastructure as shown in the figure below.

On a warm day, exposed urban infrastructure stores the heat and delays the natural cooling of the area during the night, keeping the areas warmer than the surrounding areas. Cities of at least 1 million people or more can have an annual mean air temperature 1-3°C higher than its surrounding areas during day time, up to 12°C in the evening (Oke, 1997). Studies done for night time temperatures in Oklahoma City[7] and Delhi[8] documented a maximum UHI intensity of around 4.5°C and around 8.3°C respectively. There is also scientific evidence available from mega cities that support this correlation like Bangkok (Thailand)[9], Adelaide (Australia)[10] and Bucharest (Romania)[11]. This correlation between higher UHI for larger cities is lower for less dense or more stretched and asymmetrical cities have relatively lower UHI[12].

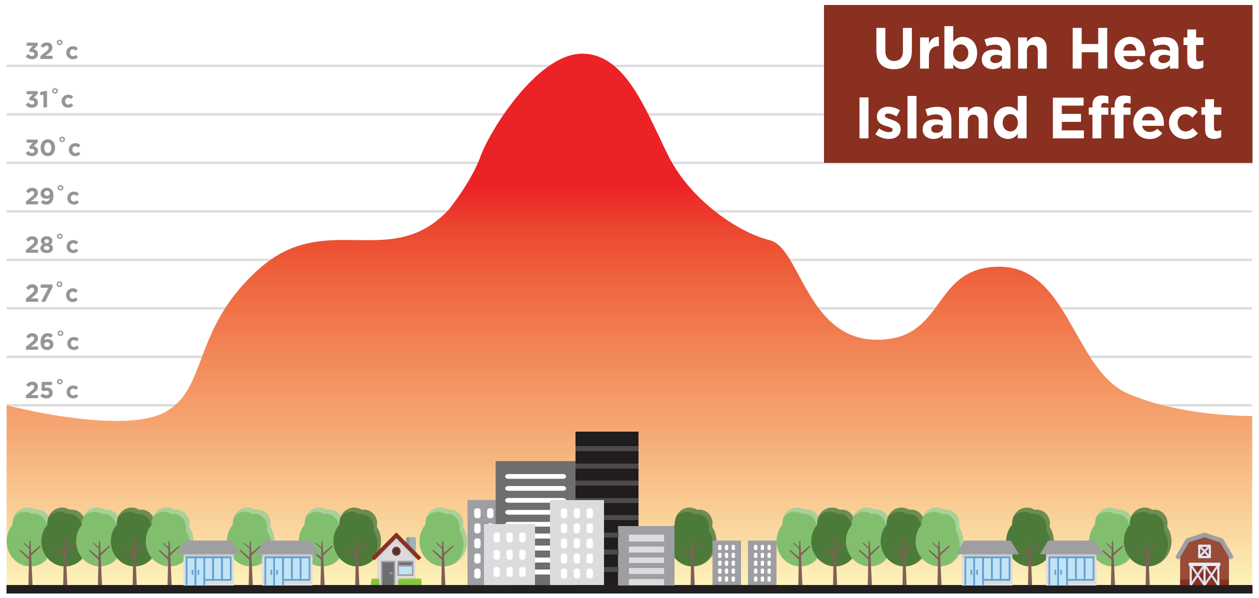

Illustration 1: *Urban Heat Island (UHI. Source: Red Cross Red Crescent Climate Centre - Heat Wave Guide for Cities*

How do healthy urban wetlands reduce UHI?

Water has high specific heat capacity which also helps to regulate the rate at which air changes temperature. This means, that water will absorb more heat before it begins to get warmer and subsequently evaporates. Furthermore, water bodies also reflect solar radiation, especially at a low sun angle. Purely terrestrial cities without water bodies, therefore remain warm and take longer time to cool down than the cities with water bodies, such as wetlands.

Poor management of wetlands leads to shrinking of wetlands and conversion into waste dumping grounds further affecting the heat trapping and cooling mechanism. Eutrophied water bodies covered in algae have a less UHI reduction service than larger open water bodies such as rivers or lakes. This is similar to urban parks, which at 10 ha size also have a cooling effect on their surroundings[13], small urban water bodies like canals or ponds, as concluded by the "Really cooling water bodies in cities – REAL-COOL" research project in the Netherlands for smaller cities[14] have a small UHI reduction effect.

Urban wetlands need to have a size of at least one hectare to generate strong UHI reduction. The bigger the wetland, the better. Nevertheless, smaller water bodies may contribute to reduced urban heat problems if the immediate surroundings have shading from trees, if wind can flow unobstructed along or across the water body, it has natural ventilation and when fountains or water mists are introduced in expedient locations. This combination is also more effective in combination with larger urban water bodies, further increasing their UHI reduction function.

Illustration 2: *An urban area without wetlands is 3-10˚C warmer than its surrounding areas*

Illustration 3: *An urban area with well-managed healthy wetland is relatively cooler and proposed solution for urban heat island reduction*

A need for greater recognition of urban wetland's role in addressing UHI

Green spaces are well-recognised as a nature-based solution to alleviate urban heat island effect (UHI)[15]. However, the role of urban wetlands is overlooked in UHI-related reports, strategy documents, manuals and guidelines.

International organisations have addressed UHI from the perspective of improving infrastructural planning and designs by integrating some green infrastructure elements, such as enhancing green cover through trees and parks, and making use of reflective surfaces like white roofing[16,17,18]. The vital role and services of urban wetlands in regulating air temperatures and maintaining micro-climate is largely unrecognised as an UHI mitigation strategy. Incorporation of wetlands into urban planning can significantly enhance the natural temperature mechanism of the urban areas and is thus recommended.

Bridging the knowledge gap-policy divide

There is available scientific evidence that documents urban wetlands' relation to UHI mitigation. In Melbourne, Australia constructed storm water wetlands in urban areas prone to extreme heat waves, provided the evidence of reduced UHI effects during an observed heat wave event[19]. A study conducted in Pearl River Delta Metropolitan Region (PRD) China, shows that natural cooling processes of the assessed blue spaces like wetlands and water bodies proved that a 10% increase in water body coverage lead to 11.33% reduction of UHI intensity[20]. In Colombo, Sri Lanka, the wetlands and surrounding areas are on average 10°C cooler than non-pervious areas (e.g. parking areas) at the hottest time of the day, resulting in energy savings for artificial cooling systems, like air conditioning[21].

Further evidence comes from observed changes in temperature due to urbanisation in the valley of Mexico City. The study conducted under the Mayor's Task Force[22] proved that the north-eastern area which is rapidly urbanised, showed 2°C higher temperatures than other areas.

A study conducted by Wetlands International in 2019-2020 in the Mexico City of the two major urban wetlands of lake Chalco and Xochimilco UNESCO World Heritage Site and protected area, also recorded higher temperatures in the inland city areas compared to the wetland adjacent areas. Lake Chalco which is more eutrophied, recorded 4°C lower temperature than Xochimilco with partial open water bodies. Xochimilco recorded 8°C lower temperatures than the rest of the city. An average increase of ± 2°C was measured for 35 meter intervals further away from the wetlands deeper into the fully paved and built-up city.

Wetlands International has been working with urban planners and international organisations like Red Cross Red Crescent Climate Centre to emphasise the importance of urban wetlands in dealing with their study and guidelines on heat waves. The preliminary research conducted in Mexico City by Wetlands International is partially funded under the collaboration of Partners for Resilience. Through the collaboration and partnership, management of urban wetlands to address the issue of climate change and biodiversity loss is focussed on strengthening community resilience. Management of urban wetlands for improved ground water levels and integration with other green-blue solutions like vegetation, green roofs, etc is also suggested for regional planning and policy. See: Urban Wetlands - Compendium Guide in the Partners for Resilience library.

Advancing the role of wetlands in addressing the UHI effect

We call on researchers, knowledge institutes and international organisations to join us in developing an 'urban wetlands for UHI' programme, in which research and field demonstration can be linked to global policy and practice.

How can urban planners make use of wetlands to address UHI?

Urban planners and policy-makers can focus on mainstreaming the ecosystem services provided by urban wetlands in mitigating urban heat island effect (UHI) in rapidly urbanising areas, as follows:

- Include urban wetlands and their ecosystem services in the assessment and planning of Urban Heat Island (UHI) mitigation.
- Engage local residents, community-based organisations, NGOs and others by raising awareness and including them in planning for conservation and restoration of wetlands and surrounding green spaces to maximize UHI reduction.
- Urban wetlands should be an integral component of urban planning, resilience strategies and measures to tackle surface temperature intensities and the regulation of street air flow, in addition to tree and vegetation planting, green roofs, vertical and horizontal green coverage, reflective measures on roofs and construction of green and blue spaces in built infrastructure.
- Restoration programmes can revitalise degraded urban wetlands to maximise UHI reduction function and also ensure urban biodiversity for a sustainable city.
- Assessing the water needs of wetlands, which require sufficient water to maintain the desired level of their ecological health. Without water, UHI reduction remains limited.
- Developing capacity of stakeholders involved in urban planning to integrate wetlands in their sectoral plans, stimulate knowledge institutes to assess the UHI reduction service of their local urban wetlands and influence policy.

Illustration 4: *An urban area with a eutrophied and mis-managed wetlands is 2-7˚C warmer than the surrounding areas*

Illustration 5: *An urban area with well-managed healthy wetland is relatively cooler and proposed solution for urban heat island reduction*

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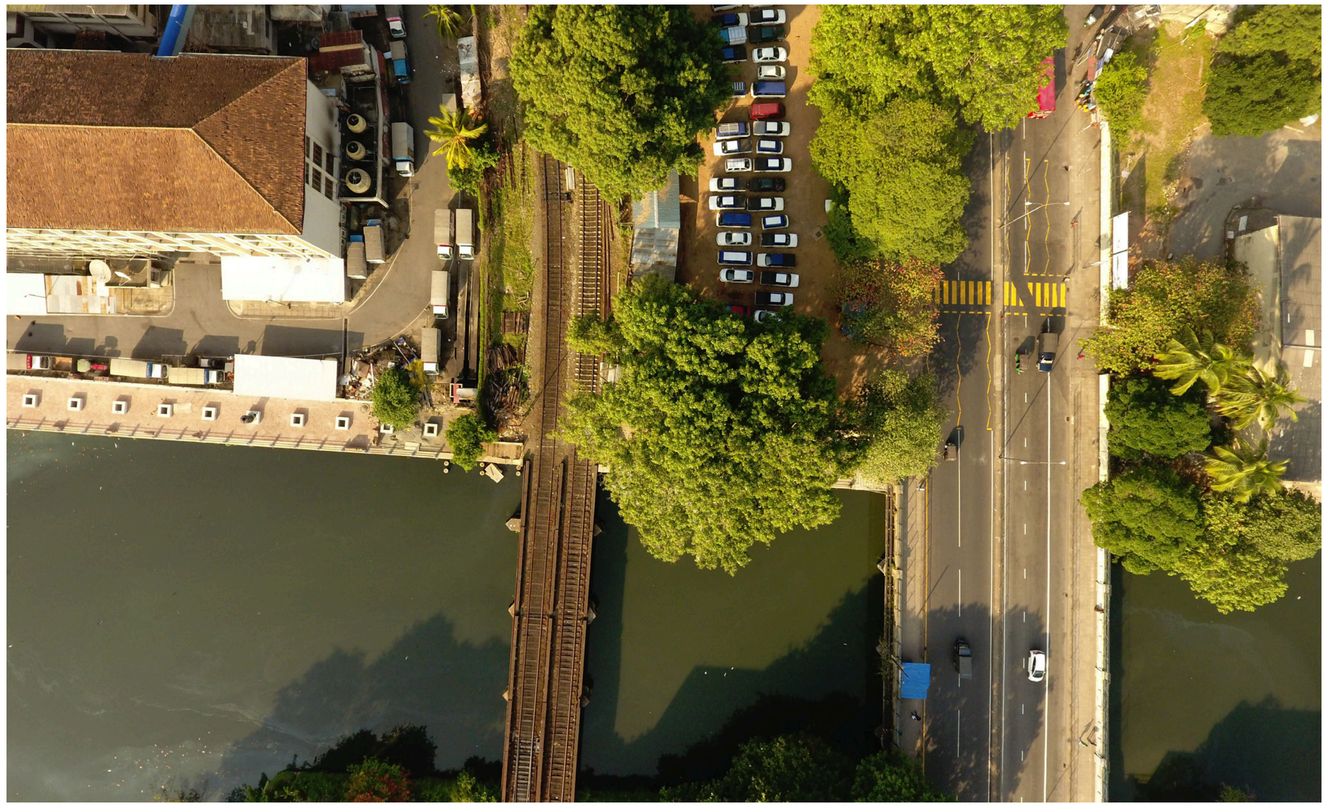

Citation:
Jain, N. & Carpay, S. (2020). Urban wetlands for cooler cities. Wetlands International, Wageningen.
http://www.wetlands.org/urban

Published by Wetlands International
P.O. Box 471
6700 AL Wageningen
The Netherlands

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This publication is made possible by:

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Wetlands International is supported by the National Postcode Lottery of the Netherlands.

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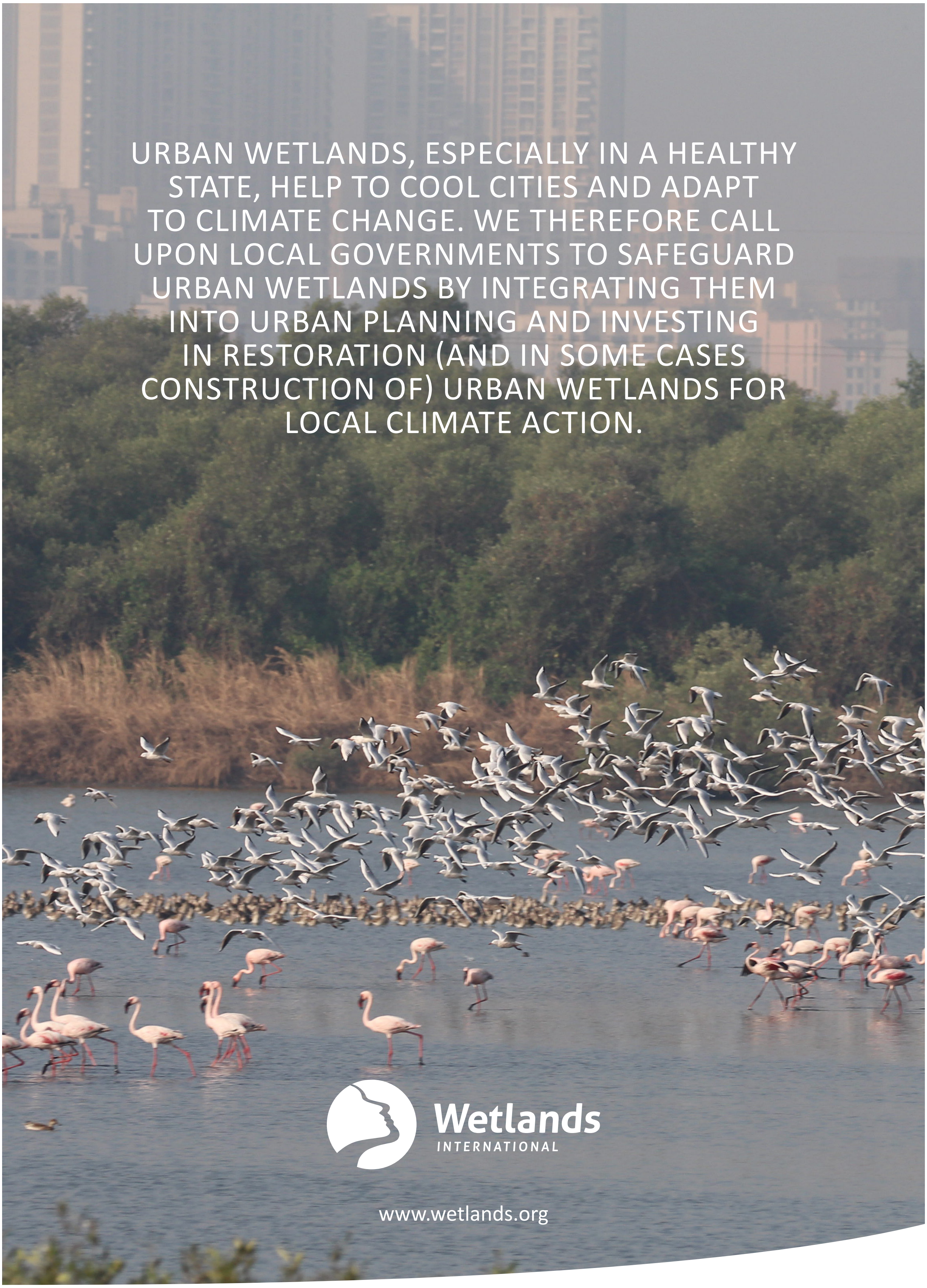

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