Urban Climate Adaptation

- The case of Penang island

- The climate-resilient street tree species study for Malaysia

Sofia Castelo

Lead, Environmental Resilience & Climate change

Hari Landskap Negara 2021

thinkcity

Outline

1. **The role of landscape architecture** in the climate crisis

2. **The climate adaptation programme for Penang island**

3. **The climate-resilient street tree species study for Malaysia**

We declare clearly and unequivocally that planet Earth is facing a climate emergency.

Statement published in the journal BioScience (Jan 2020) endorsed by 11,000 scientists from 153 nations

thinkCITY

Climate change is already impacting Malaysia

malaymail

SATURDAY 11 JULY 2020

Dramatic warming projected in world's major cities, including KL, by 2050

Scientists have predicted the likes of Kuala Lumpur, Jakarta, and Singapore will experience unprecedented climate conditions by 2050. — AFP pic

TheStar

MONDAY 14 DECEMBER 2020

Wet weather affecting greens

Prolonged poor weather and a lack of farmlands has caused the prices of vegetables to rise sharply.

TheStar

SUNDAY 29 NOVEMBER 2020

Monsoon rains wreak havoc in Ipoh

Southeast Asia is one of three regions in the world which will be hardest hit by climate change in the near future.

Special Report on Global Warming of 1.5°C, IPCC, October 8th, 2018

Malaysia's urban areas were not at risk from heat stress in 2000 but will be in 2050.

Impact 2050 – The Future of Cities, Technical report, UCCRN, 2018

More extreme weather events

Rise of temperatures

Flooding

Heat waves

Impact on health

Increased costs

Damage to infrastructure and private property

Negative impact in human and ecosystem health

Agriculture production losses

Less livability conditions

Increased costs of food

Increased energetic costs

Climate and Health Country profile - 2015
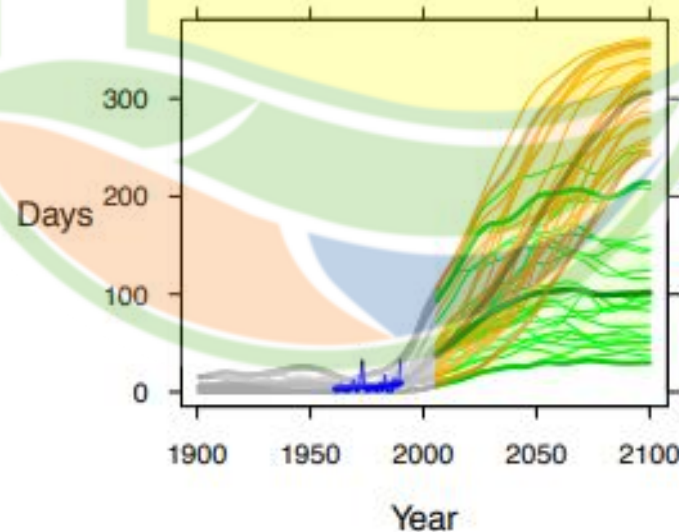
MALAYSIA

COUNTRY-SPECIFIC CLIMATE HAZARD PROJECTIONS

The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).ª The text boxes describe the projected changes averaged across about 20 models [thick line]. The figures also show each model individually as well as the 90% model range [shaded] as a measure of uncertainty and, where available, the annual and smoothed observed record [in blue].b,c

MEAN ANNUAL TEMPERATURE
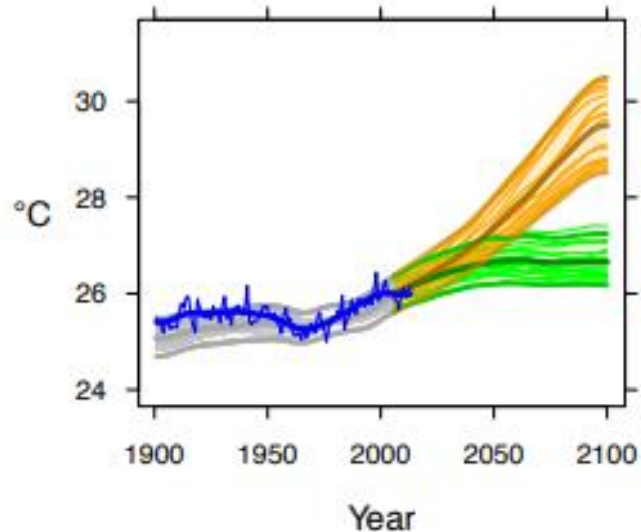
DAYS OF WARM SPELL ['HEAT WAVES']

20 days/year with heatwaves in 1980
200 days/year with heatwaves in 2050

World Health Organization

United Nations Framework Convention on Climate Change

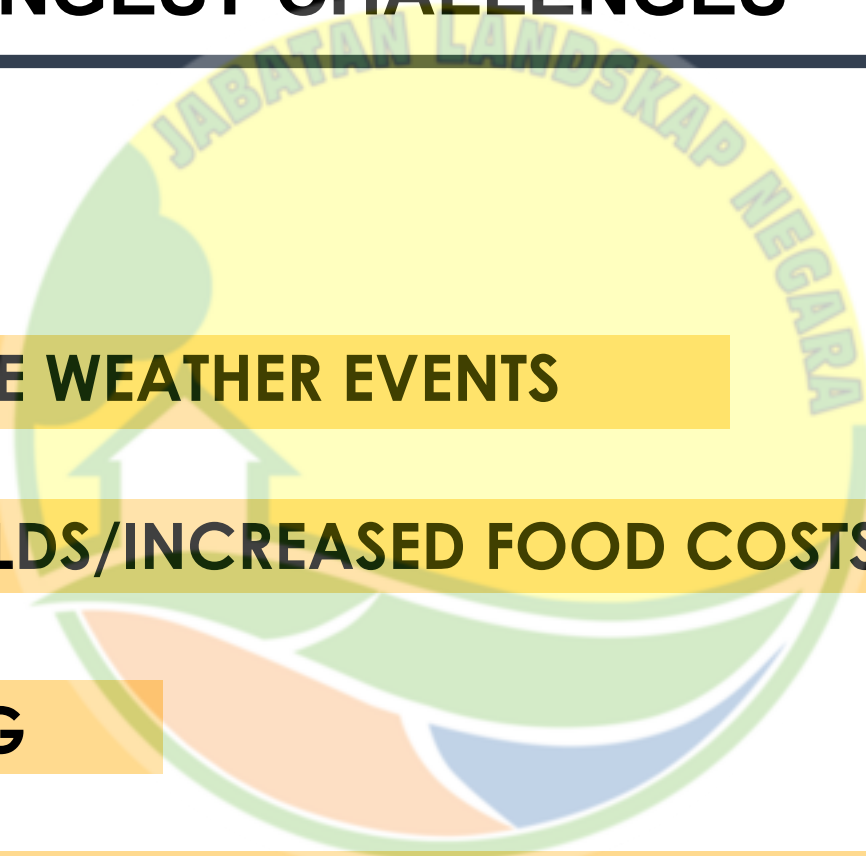# MALAYSIA - STRONGEST CHALLENGES

HEAT STRESS

INCREASED EXTREME WEATHER EVENTS

REDUCED CROP YIELDS/INCREASED FOOD COSTS

COASTAL FLOODING

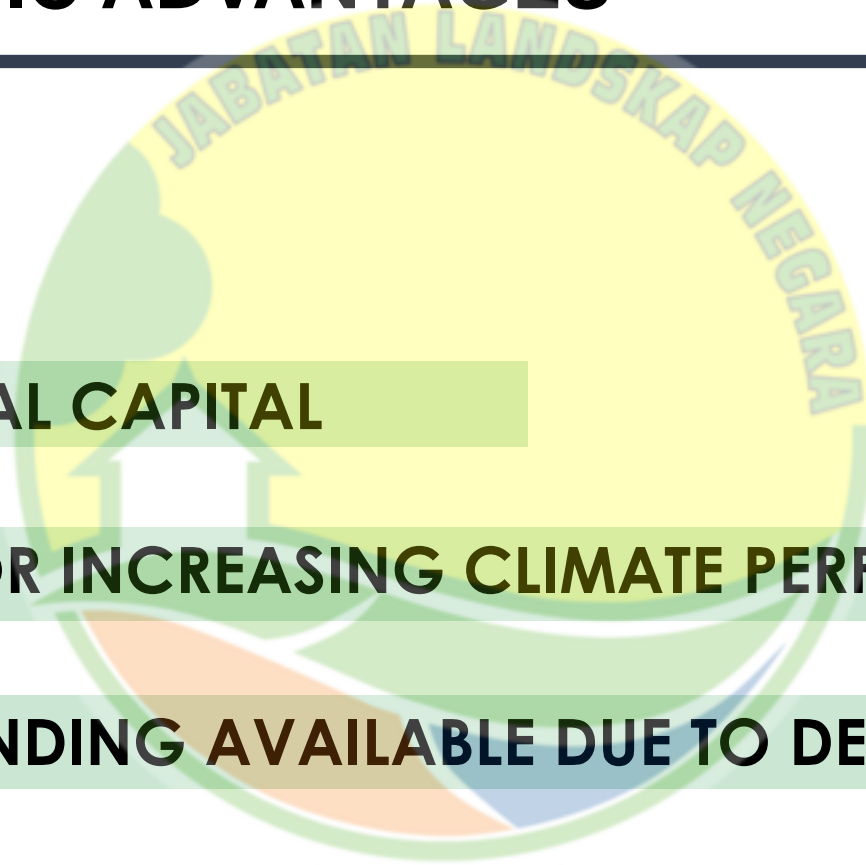REGIONAL INSTABILITY/INCREASED NUMBER OF MIGRANTS, REFUGEES

COUNTRY-SPECIFIC ADVANTAGES
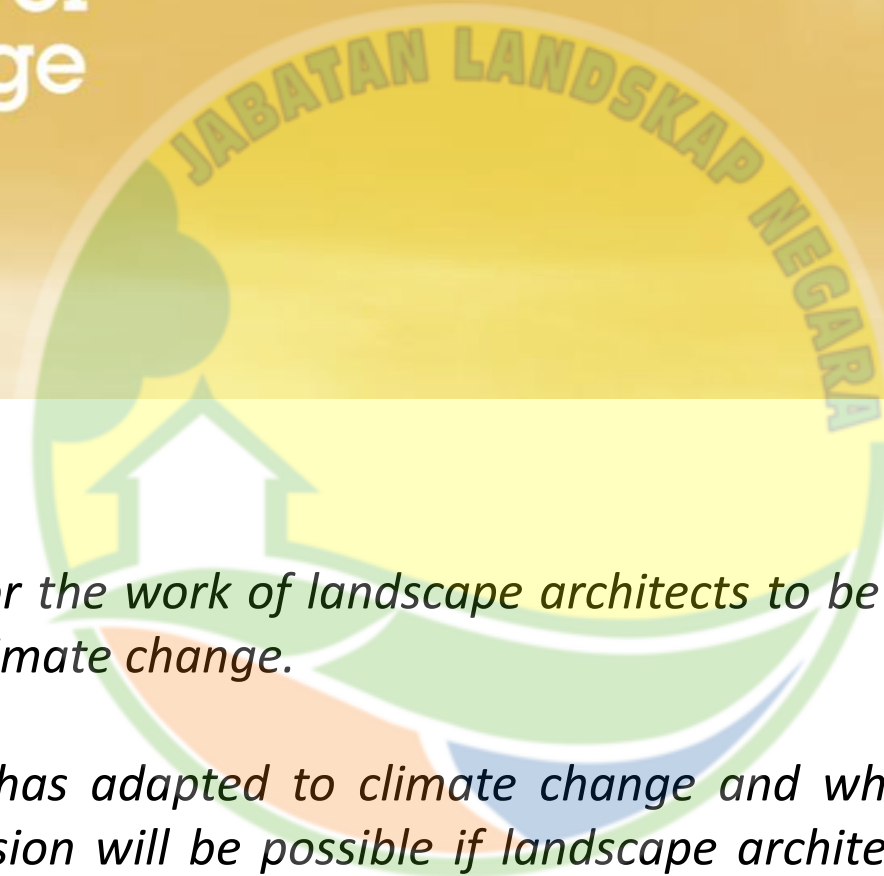
VERY HIGH NATURAL CAPITAL

HIGH POTENTIAL FOR INCREASING CLIMATE PERFORMANCE

INTERNATIONAL FUNDING AVAILABLE DUE TO DEVELOPING STATUS

Landscape architecture and the challenge of climate change

Landscape Institute
Position statement

The Landscape Institute calls for the work of landscape architects to be recognised as critical in the fight against climate change.

Our vision is of a world that has adapted to climate change and where further changes are mitigated. This vision will be possible if landscape architects provide leadership and are given opportunities to exert this both now and in the future.
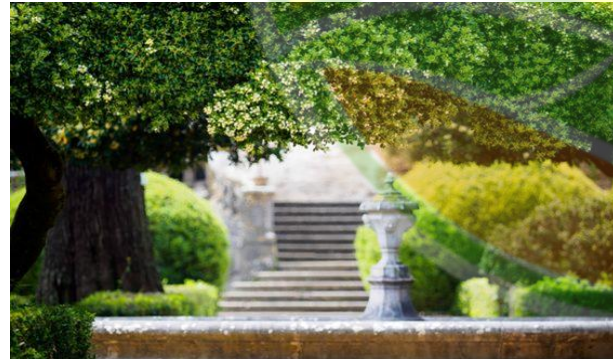
NATURE BASED SOLUTIONS (NBS) HAVE PROVEN TO BE THE MOST EFFECTIVE STRATEGY TO REDUCE TEMPERATURES IN THE CITY

NBS can cool cities between 2ºC and 8ºC

Shading

Through evapotranspiration

Enhancing wind flows

Combining green spaces with water surfaces

Surface cooling can be achieved through increased wind speed, coverage with surface water and shading. The first and last of these, of course can be provided by suitably placed vegetation.

(*Guide to Urban Cooling Strategies*, 2017, p.11)

NBS can effectively protect cities from both sea level rise and flooding

Sponge cities are effectively reducing and almost eliminating floods in China

AND DELIVER ADDITIONAL RECREATIONAL AND ECOLOGICAL CO-BENEFITS

COVID19 has highlighted the importance of urban green spaces and their importance for the wellbeing of the population
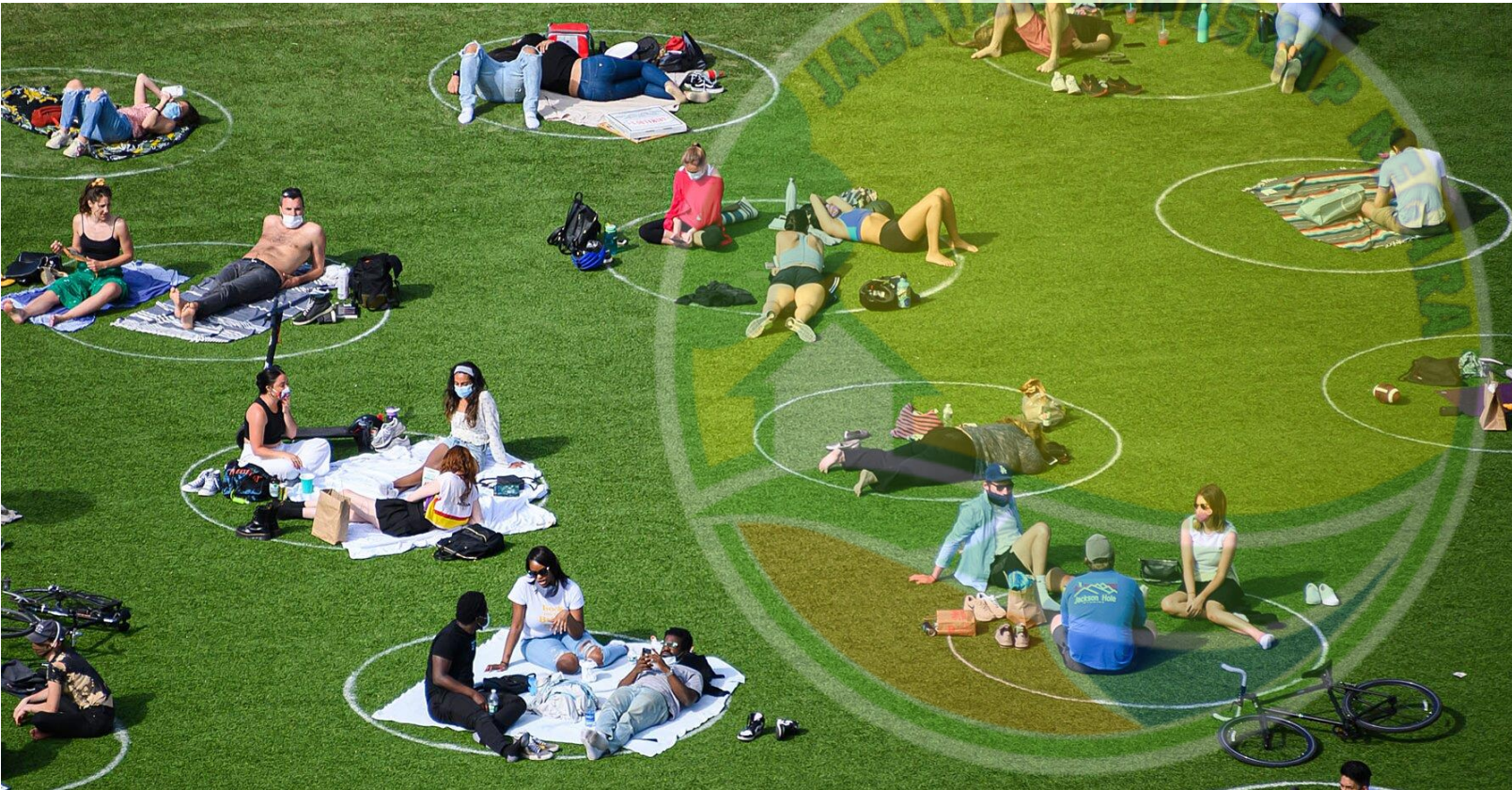
Maintaining positive mental health and well-being to relieve the stress of COVID-19 is seen as critical to avoid longer term psychological costs from the pandemic.

THE NATURE-BASED CLIMATE ADAPTATION PROGRAMME FOR THE URBAN AREAS OF PENANG ISLAND

SCIENCE-DRIVEN:
- DESIGN
- RESULTS/ IMPACT ASSESSMENT

THE NATURE-BASED CLIMATE ADAPTATION PROGRAMME FOR THE URBAN AREAS OF PENANG ISLAND

THE PROBLEM

High vulnerability due to location and development stage

HEAT STRESS

Penang is expected to experience a minimum temperature rise of 1.5ºC (up to 6ºC in heat waves) by 2030, compared to 2018.

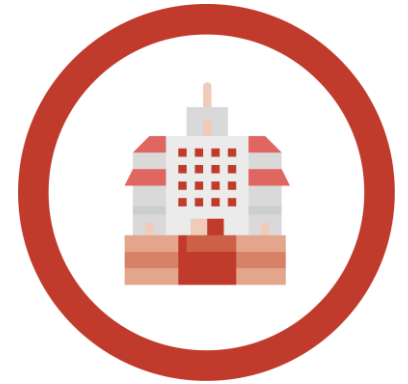Hospitals do not identify heat stress/stroke.

FLOODING

15% increase in the volume of rainfall since 1980. In Nov '17, the heaviest rainfall registered in Penang's history led to flooding of urban areas, causing the loss of 7 lives and more than 1 billion RM in damages.

SOCIAL

Vulnerable communities, women and girls are disproportionally impacted by climate change.

Youth is unengaged.

INSTITUTIONAL

Most hospitals do not identify heat stress/stroke.

No municipality adaptation framework has been developed yet.

There is no unit for disaster risk reduction.
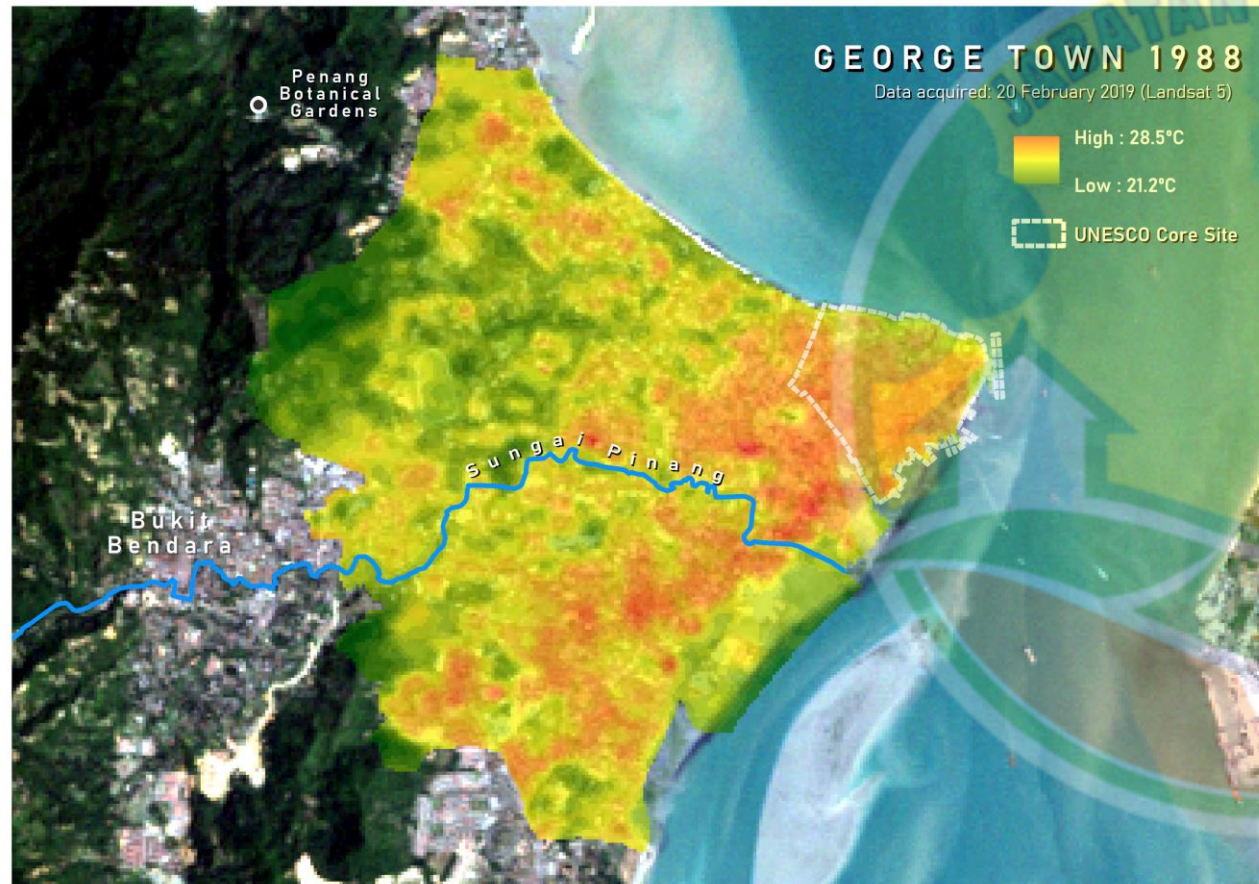
GEORGE TOWN AREA

Increase of temperature in the last 32 years
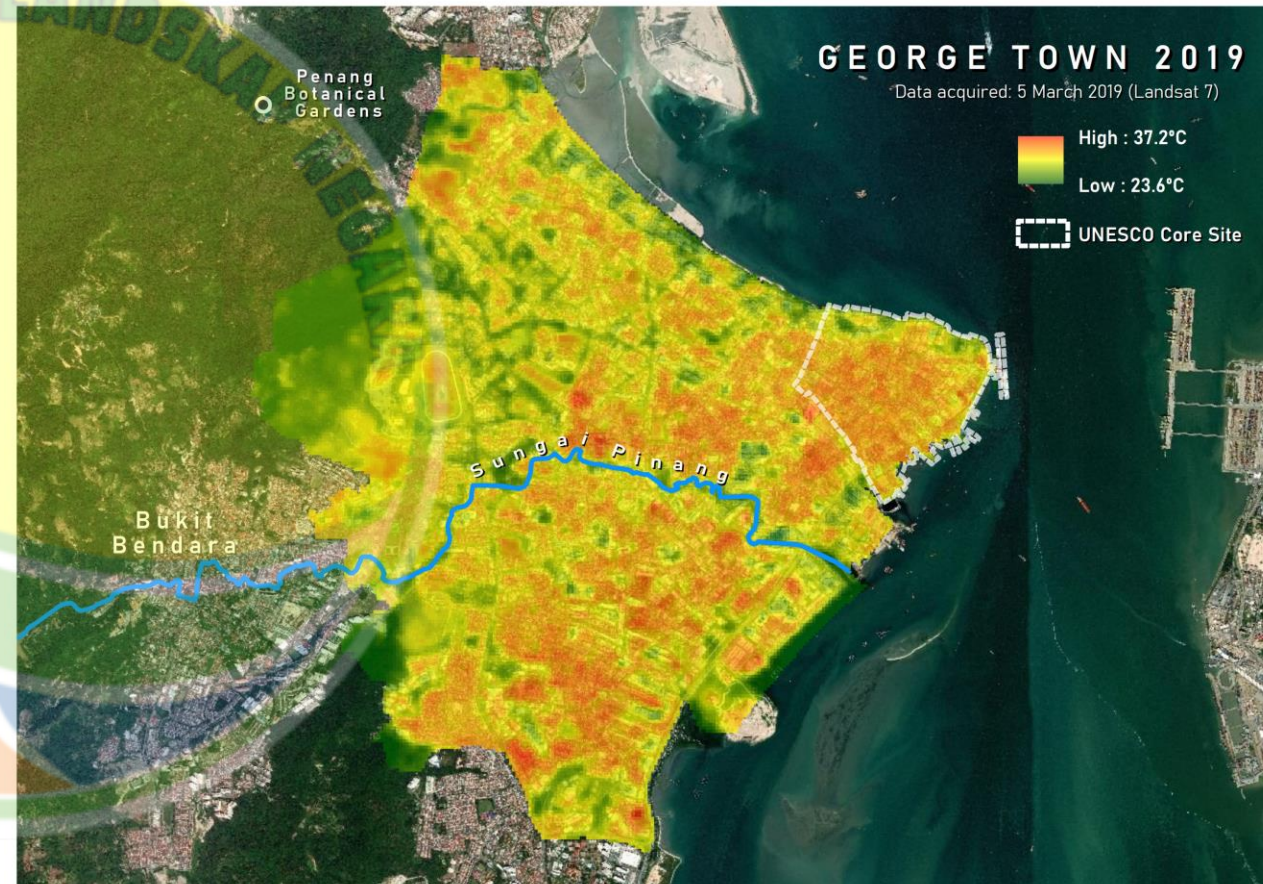(verified by remote sensing data on surface temperatures - Landsat 8)

↑↑ **Max. 8.7°C**
↑↑ **Min. 2.4°C**

1988

2019

GEORGE TOWN 1988
Data acquired: 20 February 2019 (Landsat 5)

High : 28.5°C
Low : 21.2°C

UNESCO Core Site

GEORGE TOWN 2019
Data acquired: 5 March 2019 (Landsat 7)

High : 37.2°C
Low : 23.6°C

UNESCO Core Site

Penang Botanical Gardens
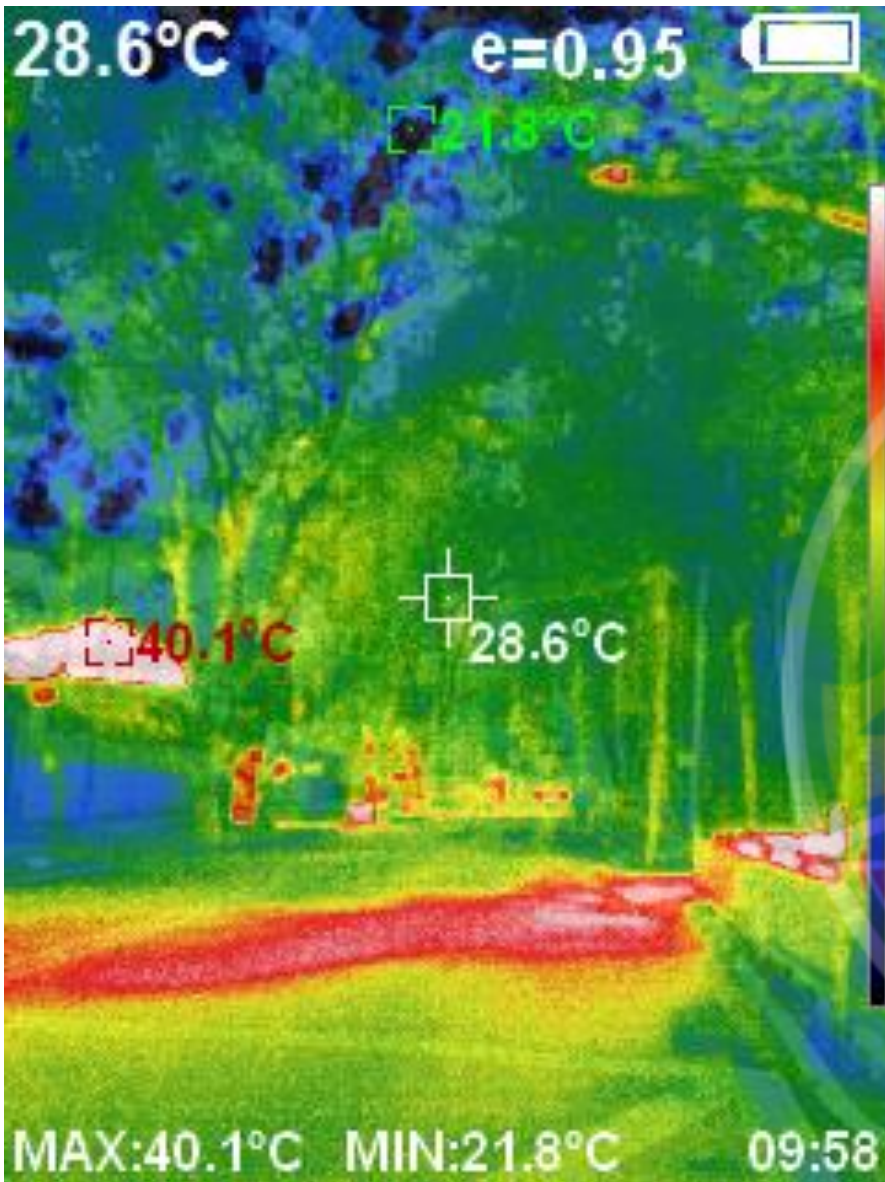
Bukit Bendara

Sungai Pinang

Max. 28.5 °C
Min. 21.2 °C

Max. 37.2 °C
Min. 23.6 °C

Penang Botanical Gardens

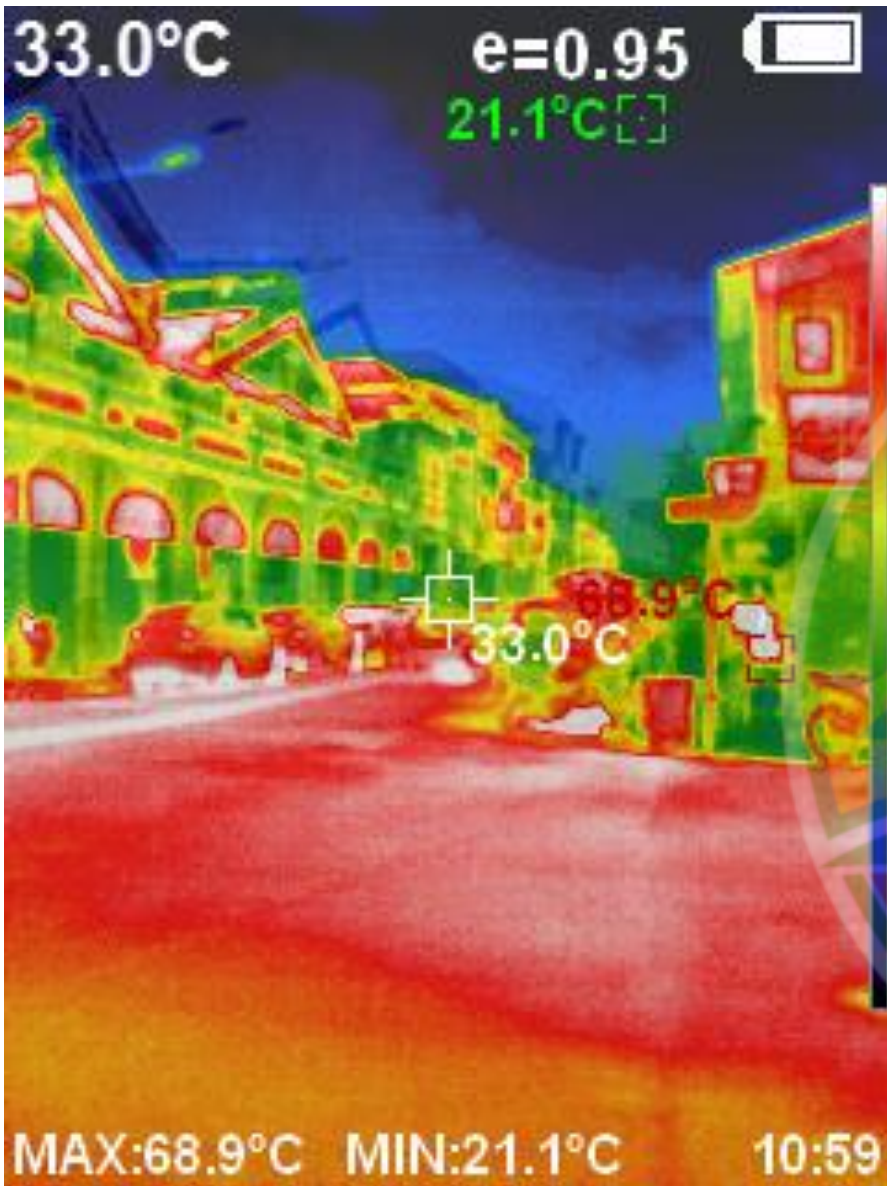Green spaces significantly reduce temperatures and the UHI effect

Sungai Pinang
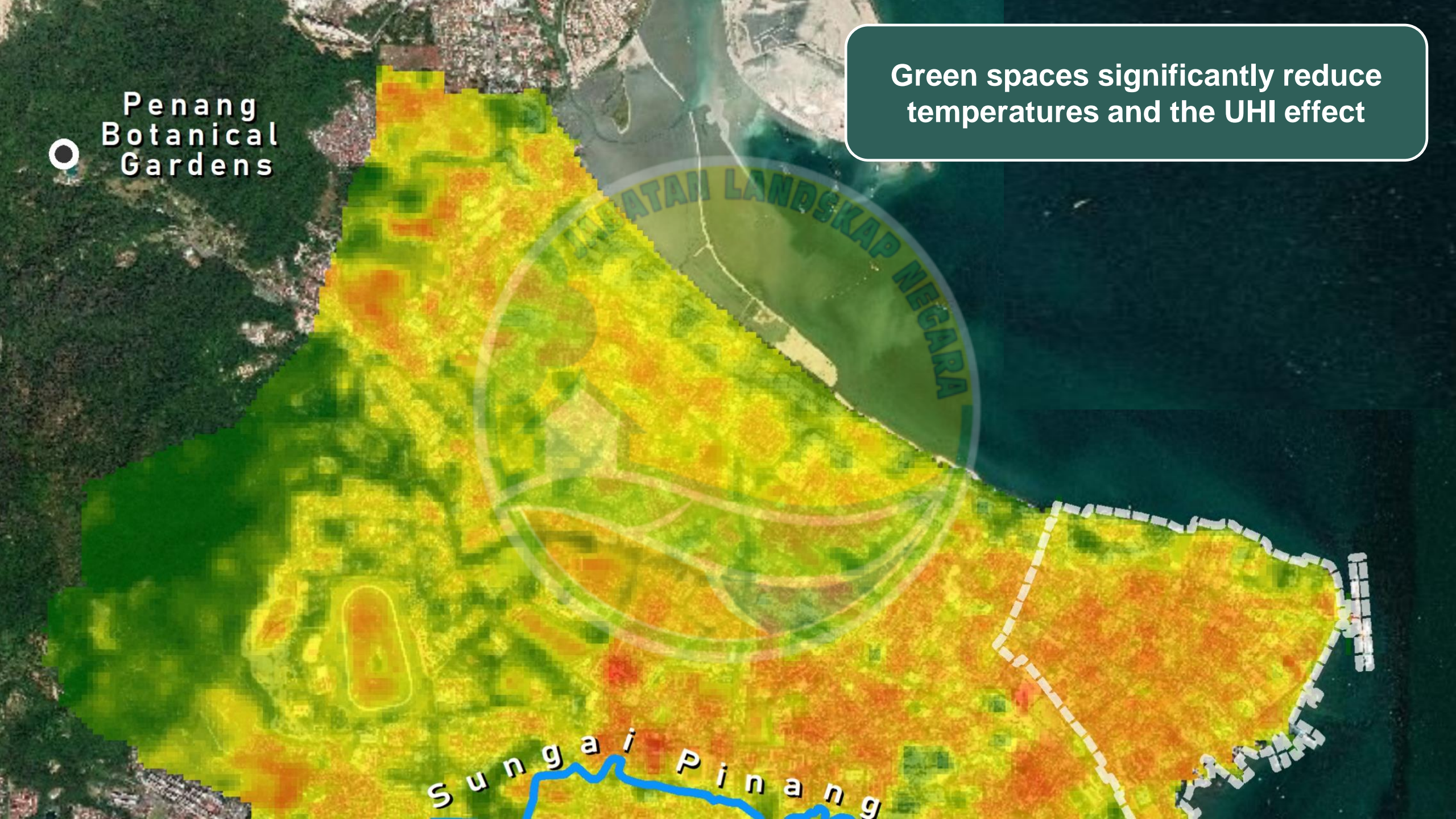
Jalan Brown
12.07.2019
9.58am

Thermal imaging

Source: Produced by Think City with Perfect Prime IR0006 Thermal Imager Camera.

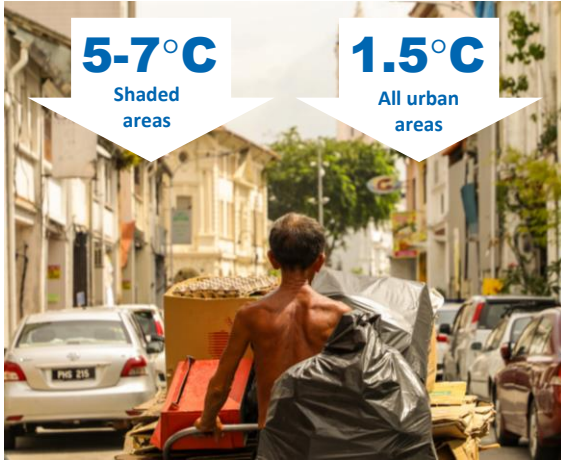An increase of almost **30°C**

Lebuh Gereja
12.07.2019
10.59am

Thermal imaging

Source: Produced by Think City with Perfect Prime IR0006 Thermal Imager Camera.

THE PROGRAMME

GOAL 1

5-7°C
Shaded areas

1.5°C
All urban areas

Reduce temperatures and UHI effect by strategically planting trees and introducing green spaces in the city

GOAL 2

Reduce and if possible eliminate the number of flooding events

GOAL 3

Strengthen social resilience, vulnerable communities, women and girls empowered

GOAL 4

Institutional capacity in public health reinforced

Knowledge management platform created for municipal adaptation

Climate-resilient street trees study developed
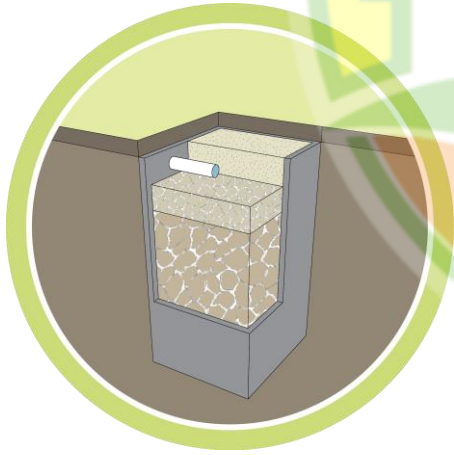
Industrial areas
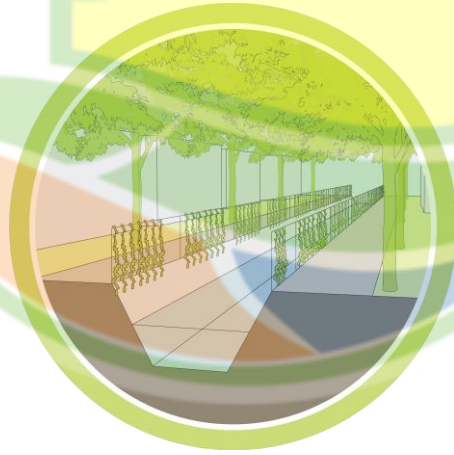
Backlanes

Pocket parks

Green facades

Connected canopies

New tree-lined streets

Infiltration wells

Blue corridors
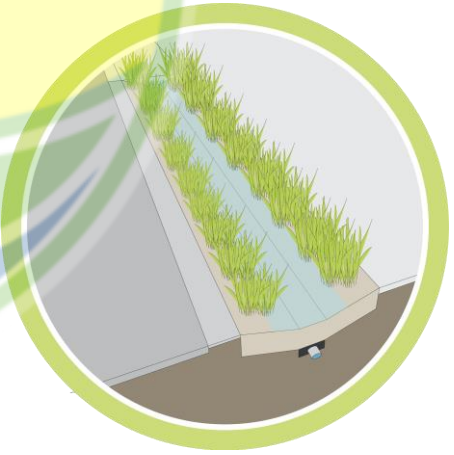
Swales

Retention areas upstream

Nature-Based Climate Change Adaptation Programme for the Urban Areas of Penang island

EXPECTED OUTCOMES

Reduction of 1.5°C in temperatures in urban areas and 5-7°C in shaded areas 6 to 8 years after completion of the plan

Reduced impact on public health

Reduced flooding and GDP losses

Reduced vulnerabilities

Improved community readiness

All impacts will be assessed

Climathon Global Cities Award 2020 — 5 shortlisted climate programmes

| Miami, USA | Karthoum, Sudan | Dublin, Ireland | Penang, Malaysia | Salvador, Brazil |

malay mail — 1 metre — COVID-19

HOME / MALAYSIA

Penang's nature-based approach to tackling climate change wins Climathon Global Awards

Monday, 03 Feb 2020 02:20 PM MYT
BY OPALYN MOK

A view of one of the decorated backlanes located at Lebuh Pantai in George Town
February 3, 2020. — Picture by Sayuti Zainudin

eit Climate-KIC

JANUARY 2020

ADAPTATION FUND

The Penang programme was endorsed by the Adaptation Fund in October 2020 for funding of US$10,0000

Contents lists available at ScienceDirect

Science of the Total Environment

ELSEVIER

journal homepage: www.elsevier.com/locate/scitotenv

Substantial declines in urban tree habitat predicted under climate change

Hugh Burley [a,*], Linda J. Beaumont [a], Alessandro Ossola [a], John B. Baumgartner [a], Rachael Gallagher [a], Shawn Laffan [b], Manuel Esperon-Rodriguez [c], Anthony Manea [a], Michelle R. Leishman [a]

[a] Department of Biological Sciences, Macquarie University, NSW 2109, Australia
[b] School of BEES, The University of New South Wales, UNSW, Sydney, NSW 2052, Australia
[c] Hawkesbury Institute of Environment, Western Sydney University, NSW 2751, Australia

HIGHLIGHTS

- Climate change likely to cause declines in suitable habitat for urban trees.
- New urban habitat likely gained by some tree species due to climate change.
- Tree species in warmer cities likely to decline more than trees in cooler cities.
- Industry and government need climate-ready tree species selection.

GRAPHICAL ABSTRACT
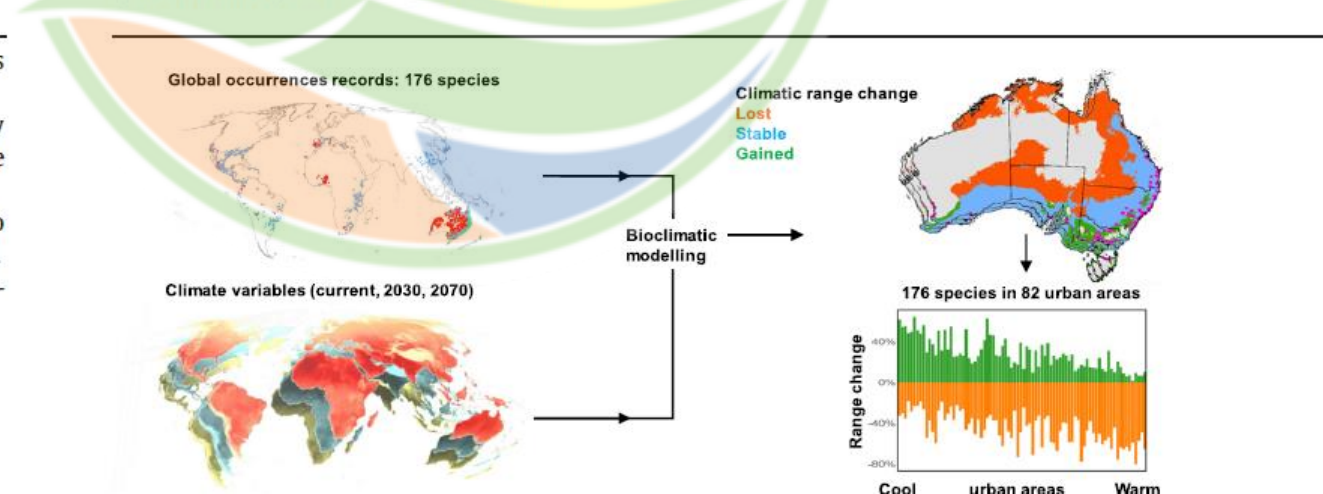
CLIMATE-RESILIENT STREET TREE SPECIES STUDY FOR MALAYSIA

Sponsored by the Climathon Global Cities Award

1. Research paper

2. Policy report

3. Online collaborative database

4. Public outreach campaign

Researchers

Jamie Carr; Dr Shamsul Kamis; MLA Landscape architects; Sofia Castelo; Ramasamy Guna; Tai Messina

The Climate-resilient street tree species study for Malaysia seeks to identify species that will be able to withstand the coming changes in weather patterns in the country.

The development and publishing of research for climate-resilient tree species will include:

- the main climate-related challenges for urban trees;

- selection criteria and methodology;

- full list of species;

- standard construction details (including typical tree pits);

- specifications for construction;

- specifications for maintenance.
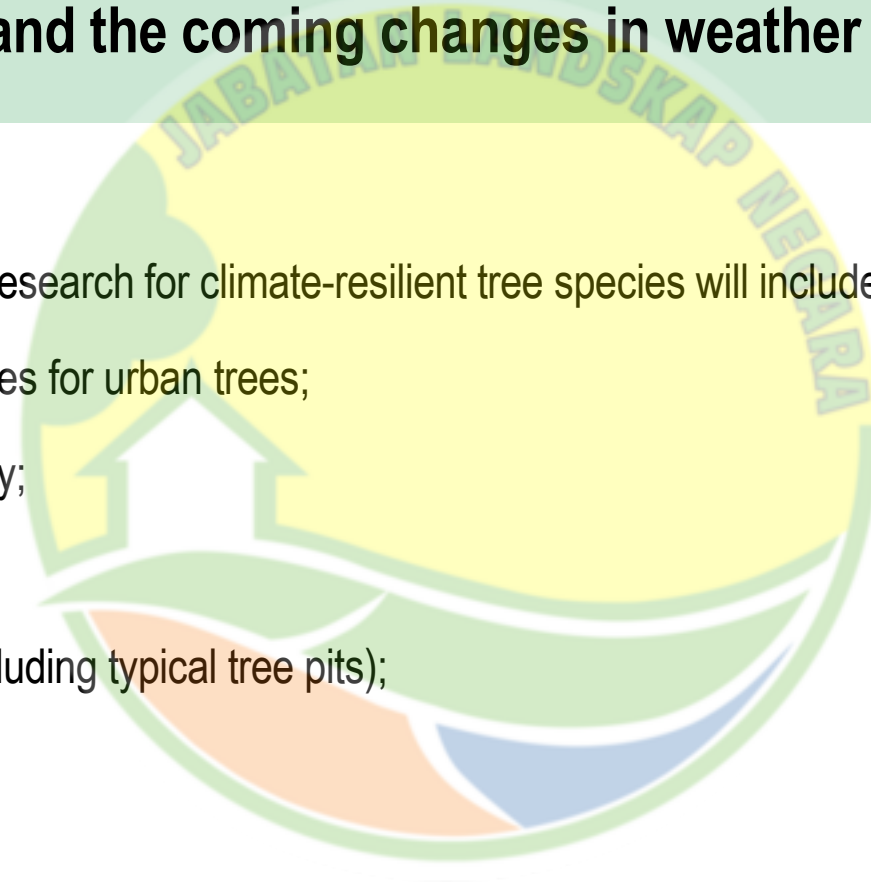
An online workshop for the

Climate-Resilient Street Tree Species Study for Malaysia

EXPERTS WORKSHOP

7 - 8
December
2020

9.00 am - 1.00 pm

Hosted by
thinkCITY
REJUVENATING THE CITY TOGETHER

Sponsored by

Climathon

In partnership with

Participants

Dr Saw Leng Guan, Expert Botanist/Curator, Penang Botanic Gardens

Mr Gunasilan Ramasamy, Certified Arborist/CRSTS Study

Mr Elango Velautham, Deputy Director, Singapore Botanic Gardens' Arboriculture and Plant Resource

Mr Badrol Hisham, Horticulturist, MLA Landscape Architects/CRSTS Study

Dr Elizabeth Philip, Manager, Unit Reducing Emissions from Deforestation and Forest Degradation (REDD Plus) - KETSA

Mansor bin Mohamad, Former Certified Arborist/Director, Jabatan Landskap Negara (JLN)

Md Zaimi bin Zainudin, Certified Arborist/Senior Assistant Director, Jabatan Landskap Negara (JLN)

Fariza Firdaus Certified Arborist, Raintree Arborist Sdn Bhd

Ezeti Fazriah, Certified Arborist, Johor Bahru City Council (MBJB)

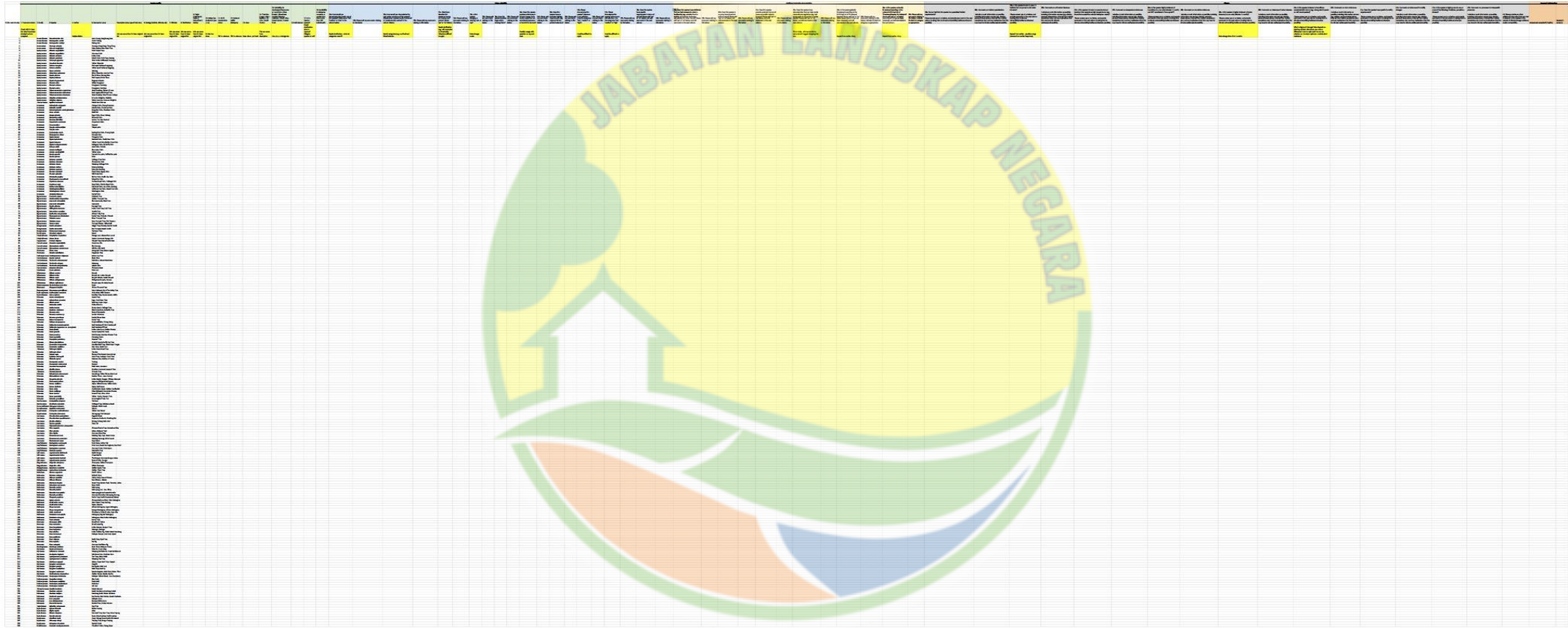Tainan Messina, Botanist/CRSTS

Observers

Irda Zulfa (Jabatan Landskap Negara)

Chandra Sagaran a/l Vadiveloo (MBPP)

Muhammad Farazuddin Syah Zafarain (MBPP)

LAr. Mustika Ally (city council of Johor Bahru - MBJB)

Climate Resilient Street Tree Species List

239 species, approx. 43 criteria

Climate Resilient Street Trees List: Species Profile

1. Taxonomic status
2. Family
3. Species
4. Vernacular name
5. Description
6. Ecology
7. Altitude
8. Distribution
9. Origin
10. Malay Peninsular endemism
11. IUCN conservation status
12. National Red List
13. Uses
14. Tree size (Large: >15m / Medium: 10-15 m / Small: 4-10 m)
15. Landscape suitability (Urban streets / blue-green corridors / small urban green spaces / coastal front)
16. Salt tolerance
17. Is it a riparian species?
18. Availability in Malaysian nurseries or market (are there >100 individuals)

Climate Resilient Street Trees List: Urban Suitability

1. How would you characterize the growth rate of this species? Please enter 'fast', 'medium' or 'slow'
2. How would you characterize the root system structure of this species? Please enter 'predominantly horizontal' or 'predominantly vertical'
3. Would you describe this species as having an invasive root system? Enter 'yes' or 'no' below
4. Is this species damaging or does it contain a staining resin/sap?
5. Does this species produce large and/or staining fruits?
6. Does this species produce substances in its bark, leaves, fruits and/or seeds that are considered poisonous or harmful to humans?
7. Does this species have any particular lighting requirements (e.g. requires full sun, partial shade, etc.)?
8. Please characterize this species' tolerance to air pollution (use the categories 'low', 'medium' or 'high')
9. Please characterise this species' tolerance to soil pollution (use the categories 'low', 'medium' or 'high')
10. Does this species have specific requirements in terms of soil pH? Please add 'yes' or 'no' below

Climate Resilient Street Trees List: Climate

1. Do you feel that this species has specialised habitat requirements?
2. Is this species known to occur in habitats that are prone to salt water intrusion?
3. Is this species known to occur/survive at locations that experience high temperatures (e.g. those that exceed the national Malaysian mean)?
4. Is this species highly intolerant of inundation (i.e. can only tolerate <1 month and NOT considered a 'true aquatic')?
5. Is this species highly intolerant of water absence (i.e. can only tolerate <1 month)?
6. Is this species intolerant of conditions associated with storms (e.g. strong wind impacts on soft wood species)?
7. Does this species have specific humidity requirements?
8. Is this species highly prone to one or more of the following: predation, parasitism or disease?
9. Comments on proneness to interspecific pressures

Climate Resilient Street Trees List: Additional Desirable Characteristics

1. Does this species have attributes that you feel increase its value to biodiversity?
2. Does this species in any way have important cultural values?
3. Does this species provide products that are of some use and/or value to humans?
4. Does this species have characteristics that can help provide microclimate regulation?
5. Is this species globally threatened according to the IUCN Red List of Threatened Species?
6. Is this species nationally threatened according to the national IUCN Red List of Threatened Species for Malaysia?

Open-collaborative online database (OCOD)

Documenting climate impacts in the different tree species in the country

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BANGUNAN U. A. B

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