# Build4People Project

**Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia**

**គម្រោងសាងសង់សម្រាប់ប្រជាជន ការលើកកម្ពស់ គុណភាពជីវិត របស់ អ្នកទីក្រុង ដោយ ការ បម្លែង ទៅជា ក្រុង មានចីរភាពនៅកម្ពុជា**

DEF 2019-2021

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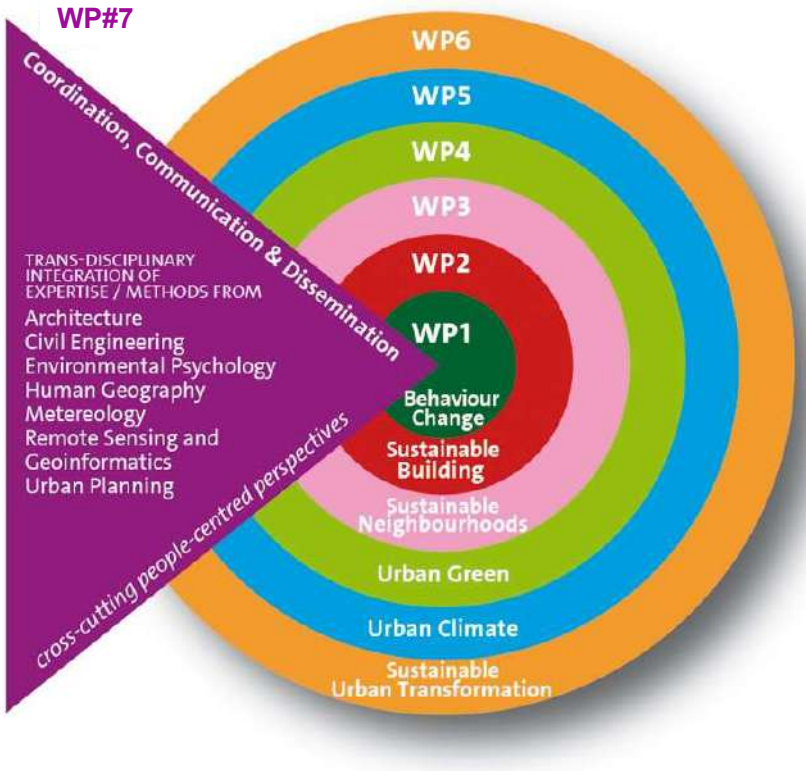


# SCIENCE WORKSHOP

## URBAN GREEN INFRASTRUCTURES IN PHNOM PENH

*organised by:*
*WP#4*

Eberswalde University for Sustainable Development

*26 January 2023, 14:50 - 16:55 (Cambodian time)*

**Research Partners**

**Implementation Partners**

**Dissemination Partners**

# Build4People Project

**Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia**

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## Build4People WP#4 Science Workshop, 26 January 2023

*Venue: B4P_WP4_Meetings room (https://bbb.hnee.de/b/gmo-cts-6eg-dp5 [Access code: 381569])*

## *AGENDA (all times are given in Cambodian time)*

| | |
|---|---|
| 14:50 - 15:00 | Informal joint exchange |
| **15:00 - 15:15** | **Welcome and introduction to the general approaches of the Build4People project during RD phase**<br>*Dr. Michael Waibel, Build4People consortium leader (10 Min + 5 Min Q&A)* |
| **15:15 - 15:30** | **Overall update on the ongoing activities of WP4**<br>*Dr. Jan-Peter Mund, Work Package Leader "Urban Green Infrastructures" (10 Min + 5 Min Q&A)* |
| **15:30 - 15:45** | **Urban forestry – concept and its application in Phnom Penh**<br>*Dr. Sanara Hor (10 Min + 5 Min Q&A)* |
| **15:45 - 16:00** | **The importance of green buildings in urban planning**<br>*Chea Chetha (10 Min + 5 Min Q&A)* |
| **16:00 - 16:15** | **Mapping urban impervious surface area from satellite imagery**<br>*Dr. Pok Sophak (10 Min + 5 Min Q&A)* |
| **16:15 - 16:30** | **Public participation for sustainable city**<br>*Rorn Naro (10 Min + 5 Min Q&A)* |
| **16:30 – 16:45** | **Long time series analytics of thermal satellite image data**<br>*Gulam Mohiuddin, HNEE, B4P project (10 Min + 5 Min Q&A)* |
| **16:45 - 17:00** | **Open discussion** *15 min* |
| **17:00 - 17:10** | **Closing remarks** 10 *Min*<br>*Dr. Jan-Peter Mund, Work Package Leader "Urban Green Infrastructures"* |

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# Welcome Address

## WP4 Science Workshop 2023

26 January 2023

**Dr. Michael Waibel**
**Build4People Representative**

*Hamburg University*

Build4People Project

Eberswalde University for Sustainable Development

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# Welcome Address


## UNEP-REPORT 2022
## Emissions in the global building sector

- ✓ **Building sector in total: 37% of carbon emissions worldwide**

- ➢ Sector is currently moving away from the targets set in the Paris Agreement to keep average global warming below two degrees Celsius
- ➢ A quick transition from conventional construction methods to more sustainability is required
- ➢ $CO_2$ emissions from buildings operations have reached an all-time high and becomes particularly problematic, e.g. in the case of mechanical cooling (use of AC), issue of user behaviour



WORLD GREEN BUILDING COUNCIL

SUSTAINABLE DEVELOPMENT GOALS

Build4People Project

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# Welcome Address


## UNEP-REPORT 2022
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- A quick transition from conventional construction methods to more sustainability is required
- $CO_2$ emissions from buildings operations have reached an all-time high and becomes particularly problematic, e.g. in the case of mechanical cooling (use of AC), issue of user behaviour

- **The building sector has been Germany's most successful policy field in terms of the reduction of carbon emissions due to a holistic governance approach!**

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# Welcome Address

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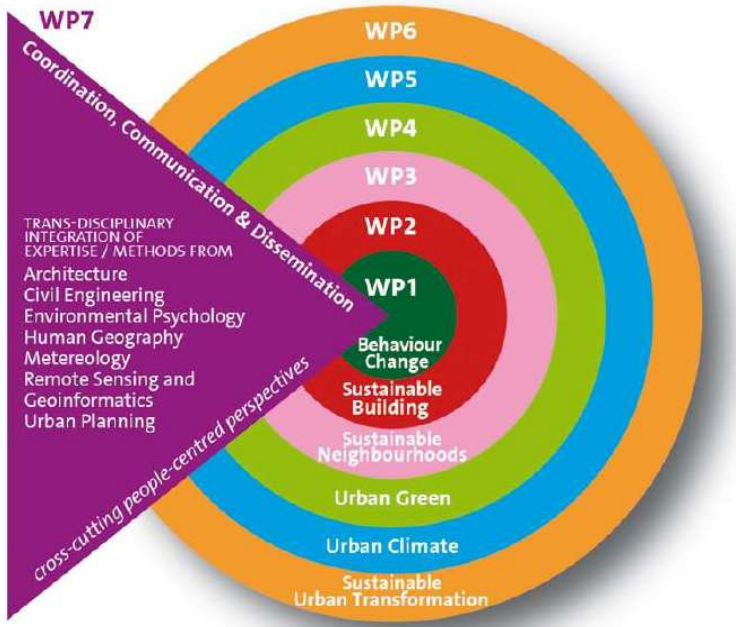


# Build4People Project

***Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia***

**German Research Partners & Project Management Partner**

Universität Hamburg – DER FORSCHUNG | DER LEHRE | DER BILDUNG
Work Package #7
Work Package #6

CIUS Cambodian Institute for Urban Studies
Local Project Management Partner

Otto von Guericke Universität Magdeburg
Work Package #1

Technische Hochschule Lübeck
Work Package #2

EBLE MESSERSCHMIDT PARTNER Architekten und Stadtplaner PartGmbB
Work Package #3

Eberswalde University for Sustainable Development
Work Package #4

INKEK institute for climate and energy strategies
Work Package #5

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EUROCHAM CAMBODIA

BOPHANA

Center for Khmer Studies Centre d'Études Khmères

DGNB

VON ZADOW INTERNATIONAL

UN environment programme

Global Alliance for Buildings and Construction

iea

# Overall update on the research activities of WP4

## WP4 Science Workshop 2023

26 January 2023

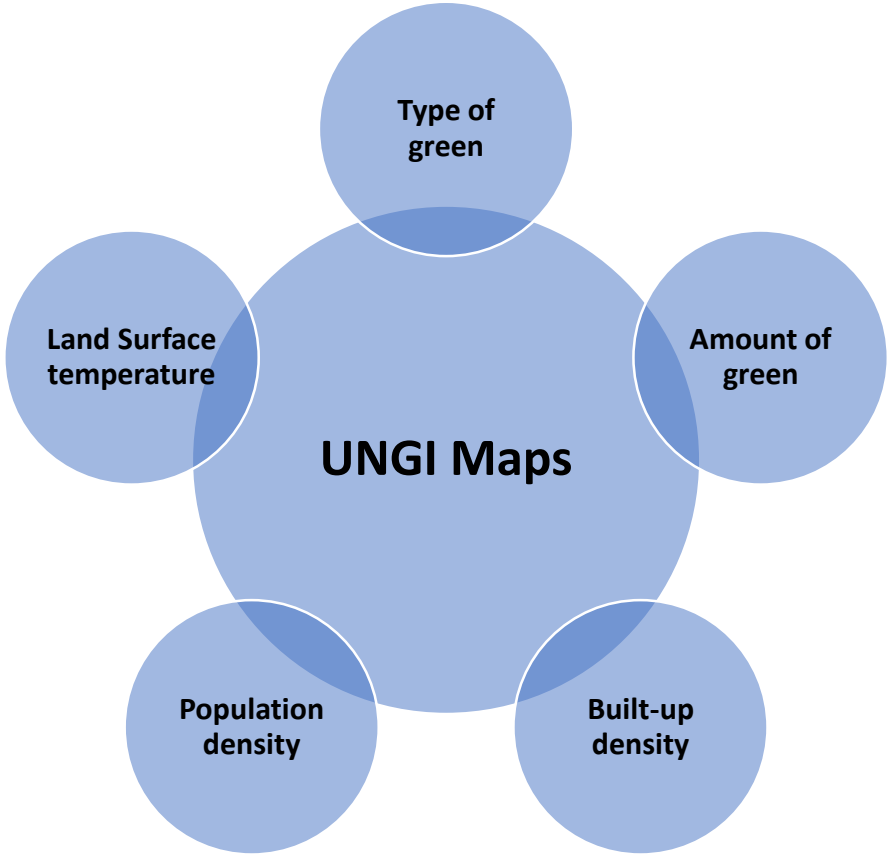
**Prof. Dr. Jan-Peter Mund**

*Eberswalde University for Sustainable Development*

# B4P WP#4 Research Milestones

- Milestone 1 : Updated bibliographic research and literature
- Milestone 2 : Conceptualisation of UNGI and data collection for the urban neighbourhood green index (UNGI)
- Milestone 3 : UNGI parameter operationalisation and spatial verification using mobile devices (Input App and UAV)


*https://www.teamly.com/blog/wp-content/uploads/2021/12/Project-milestones-examples.png*




*Adapted from Gupta et al., (2012)*

*Figure 1: Parameters of UNGI*

# Milestone 1: literature research

- The update list was published on September 2021 on Build4People website.

Available at: [https://build4people.org/wp-content/uploads/2021/09/Build4People_RD-Phase_Milestone-WP4_R1_Updated-bibliographic-research-and-literature.pdf](https://build4people.org/wp-content/uploads/2021/09/Build4People_RD-Phase_Milestone-WP4_R1_Updated-bibliographic-research-and-literature.pdf)

Work Package #4
*Urban Green*

**Milestone WP #4 R1: Updated bibliographic research and literature**

**BIBLIOGRAPHY OF THE MOST CURRENT AND RELEVANT PUBLICATIONS (Since 2020)**

**Urban Green Infrastructure (UGI) / Urban Green Spaces (UGS)**


Abdulateef, M. F., & Al-Alwan, H. A. (2021). The effectiveness of urban green infrastructure in reducing surface urban heat island. *Ain Shams Engineering Journal*.

Abu Ali, M., Alawadi, K., & Khanal, A. (2021). The Role of Green Infrastructure in Enhancing Microclimate Conditions: A Case Study of a Low-Rise Neighborhood in Abu Dhabi. *Sustainability*, *13*(8), 4260.

Dinda, S., Chatterjee, N. D., & Ghosh, S. (2021). An integrated simulation approach to the assessment of urban growth pattern and loss in urban green space in Kolkata, India: A GIS-based analysis. *Ecological Indicators*, *121*, 107178.

Heikinheimo, V., Tenkanen, H., Bergroth, C., Järv, O., Hiippala, T., & Toivonen, T. (2020). Understanding the use of urban green spaces from user-generated geographic information. *Landscape and Urban Planning*, *201*, 103845.

Nouri, H., Nagler, P., Chavoshi Borujeni, S., Barreto Munez, A., Alaghmand, S., Noori, B., ... & Didan, K. (2020). Effect of spatial resolution of satellite images on estimating the greenness and evapotranspiration of urban green spaces. *Hydrological Processes*, *34*(15), 3183-3199.

Pauleit, S., Vasquéz, A., Maruthaveeran, S., Liu, L., & Cilliers, S. S. (2021). Urban green infrastructure in the Global South. *Urban ecology in the Global South. Springer, Cham*, 107-143.

Siddique, G., Roy, A., Mandal, M. H., Ghosh, S., Basak, A., Singh, M., & Mukherjee, N. (2020). An assessment on the changing status of urban green space in Asansol city, West Bengal. *GeoJournal*, 1-23.

Verma, R., & Kundapura, S. (2020). Urban Weighted Green Index-A study of urban green space in relation to Land Surface Temperature for Lucknow city, India. *Remote Sensing Applications: Society and Environment*, *20*, 100429.

Zhang, J., Yue, W., Fan, P., & Gao, J. (2021). Measuring the accessibility of public green spaces in urban areas using web map services. *Applied Geography*, *126*, 102381.

Zou, H., & Wang, X. (2021). Progress and Gaps in Research on Urban Green Space Morphology: A Review. *Sustainability*, *13*(3), 1202.


*Figure 2: Snapshot of the bibliography*

# Milestone 2: UNGI data collection

- Application of Land Surface Temperature Analysis in Urban Green Spaces: Case Studies from South Asia (Figure 3)

Available at: https://austriaca.at/0xc1aa5576_0x003d25fa.pdf

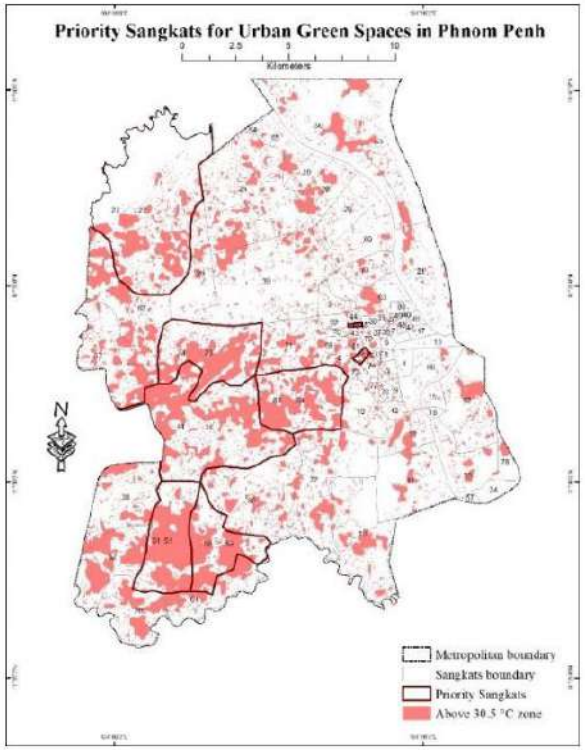



**Figure 9:** Priority areas of Phnom Penh

Mohiuddin et al

GI_Forum 2021, Issue 2
Page: 202 - 214
Full Paper
Corresponding Author:
gulam.mohiuddin@hnee.de
DOI: 10.1553/giscience2021_02_s202

**Application of Land Surface Temperature Analysis in Urban Green Spaces: Case Studies from South Asia**

Gulam Mohiuddin and Jan-Peter Mund
Eberswalde University for Sustainable Development, Germany

**Abstract**

This paper demonstrates the use of remote sensing in planning urban green spaces (UGSs). UGSs emerged as a popular solution to combat the effects of Urban Heat Island, especially in tropical cities. UGS projects often need to identify priority implementation areas due to limited funding for UGSs. This study includes two Asian cities, namely Phnom Penh (Cambodia) and Chittagong (Bangladesh). It is not comparative, but it has identified priority administrative areas for future UGSs in both cities. We used Landsat 8 data and the remote sensing technique Land Surface Temperature (LST) analysis using radiance, temperature brightness and emissivity. LST data were then intersected with the administrative boundaries of the study areas. The identification of priority administrative areas for UGS considered both the area coverage and the percentage of coverage in terms of maximum LST within the administrative units' boundaries. The result found 8 and 10 administrative units to be hotspots for UGSs, for Phnom Penh and Chittagong respectively. The proposed method will be useful to both government and non-government organizations alike, especially in tropical countries.

**Keywords:**

Land Surface Temperature (LST), urban green spaces (UGS), remote sensing

*Figure 3: Snapshot of the publication*

# Milestone 2: UNGI data collection

- Cooling Effect of Urban Green Infrastructure in Urban Areas: A Study using Land Surface Temperature (Figure 4).

Available at:
https://www.researchgate.net/publication/360919641_Cooling_Effect_of_Urban_Green_Infrastructure_in_Urban_Areas_A_Study_using_Land_Surface_Temperature

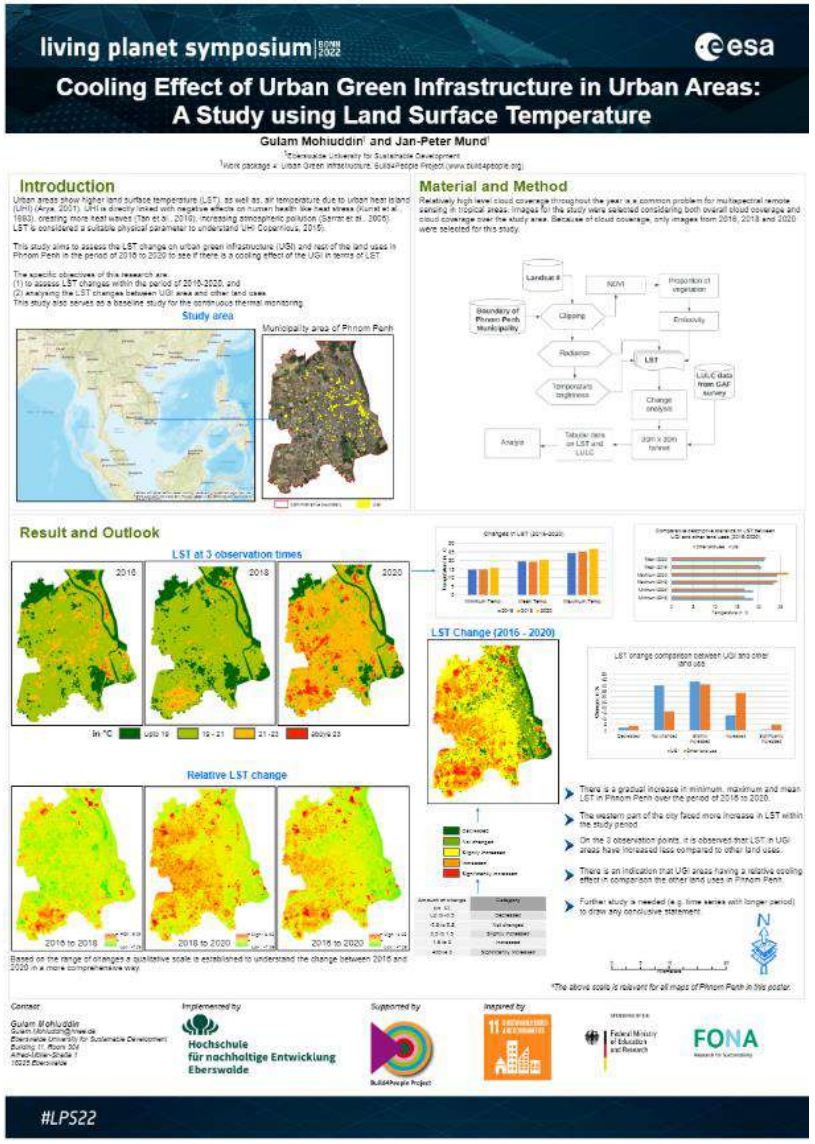



*Figure 4: Snapshot of the poster*

# Milestone 2: UNGI data collection

- Statistical Relation between Vegetation Cover and Land Surface Temperature in Phnom Penh City (Figure 5).

Available at:
https://www.researchgate.net/publication/357685636_Statistical_Relation_between_Vegetation_Cover_and_Land_Surface_Temperature_in_Phnom_Penh_City

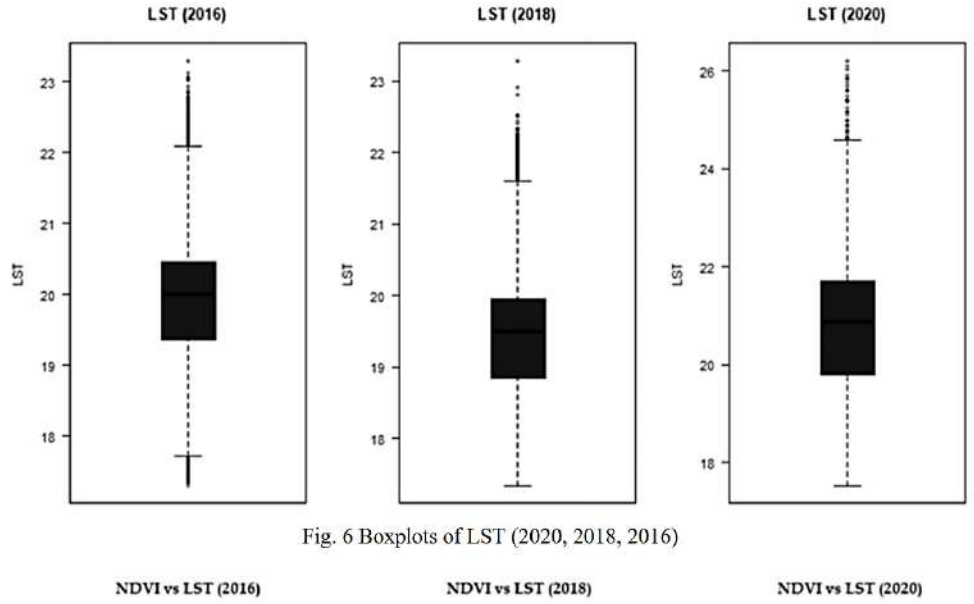



Fig. 6 Boxplots of LST (2020, 2018, 2016)

International Journal of Urban and Civil Engineering
Vol:16, No:10, 2022

## Statistical Relation between Vegetation Cover and Land Surface Temperature in Phnom Penh City

Gulam Mohiuddin, Jan-Peter Mund

***Abstract*—**This study assessed the correlation between Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) in Phnom Penh City (Cambodia) from 2016 to 2020. Understanding the LST and NDVI can be helpful to understand the Urban Heat Island (UHI) scenario, and it can contribute to planning urban greening and combating the effects of UHI. The study used Landsat-8 images as the data for analysis. They have 100 m spatial resolution (per pixel) in the thermal band. The current study used an approach for the statistical analysis that considers every pixel from the study area instead of taking few sample points or analyzing descriptive statistics. Also, this study is examining the correlation between NDVI and LST with a spatially explicit approach. The study found a strong negative correlation between NDVI and LST (coefficient range -0.56 to -0.59), and this relationship is linear. This study showed a way to avoid the probable error from the sample-based approach in examining two spatial variables. The method is reproducible for a similar type of analysis on the correlation between spatial phenomena. The findings of this study will be used further to understand the causation behind LST change in that area triangulating LST, NDVI and land-use changes.

***Keywords*—**Land Surface Temperature, NDVI, Normalized Difference Vegetation Index, remote sensing, methodological development.

brightness temperature using the infrared spectral channel of a satellite [7]. It is necessary to separate LST and air temperature based on their physical differences since they are different phenomena that are measured differently. Air temperature is measured at the height of about 1.2 m above the surface. Hence, it varies from the LST.

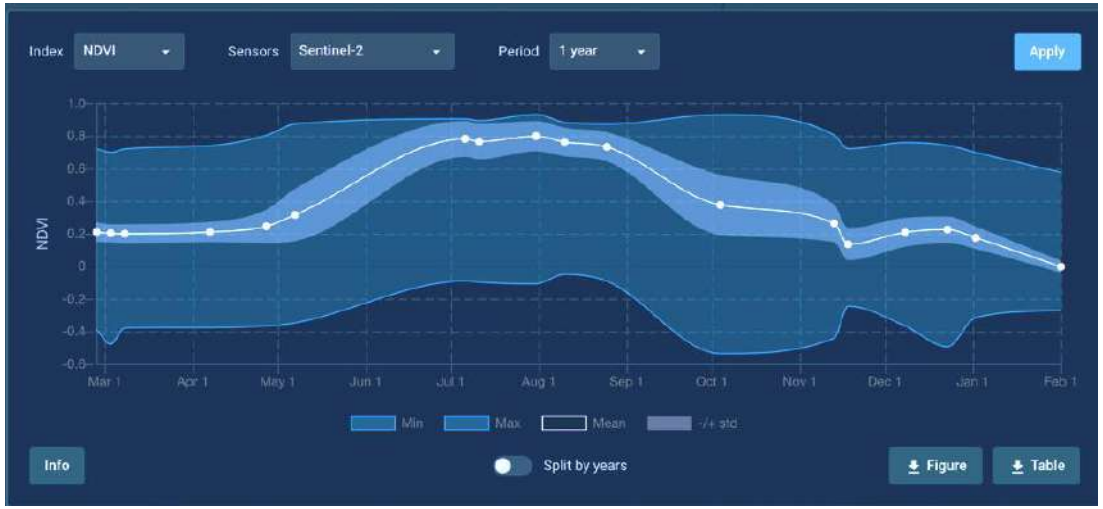
While urban agglomerations are beneficial to a place in terms of economy and growth but it has an inverted relationship when it comes to environmental qualities [8]. In other terms, the effects of urbanization and UHI will be higher in developing countries [9]. In this context, urban greening has emerged as one of the popular solutions in combating the impacts of UHI. Urban greening can contribute to mitigating the effect of UHI in the area mostly through evapotranspiration [10]-[12].

The relation between vegetation and LST is well established throughout the various literature in terms of both visual interpretation and statistical analysis. An early study was conducted in 1994 investigating the relation between NDVI and LST to identify the surface soil water content where they used NOAH-11 images, and they analyzed the relation using sample areas within their study area in eastern-central Pennsylvania [13]. Another study was conducted in 1997 to detect crop water

*Figure 5: Snapshot of the publication*

# Milestone 3: UNGI parameter operationalisation

- A detailed land cover mapping for Phnom Penh focused on the spatial distribution of urban green spaces has been started. Initially, the district Chbar Ampov has been completed, and similar work will be completed for the other districts of Phnom Penh in the next reporting year (Figure 6).



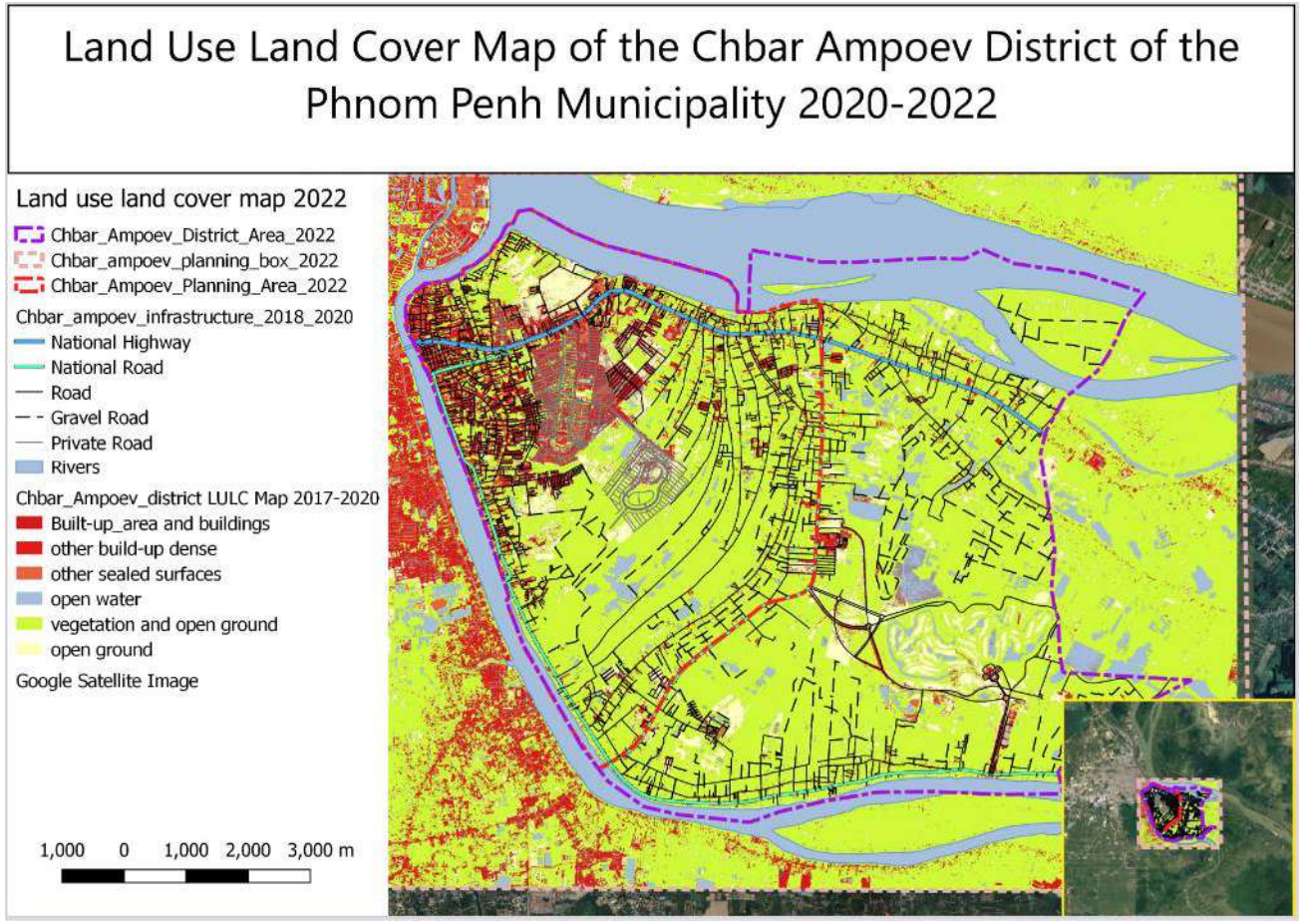
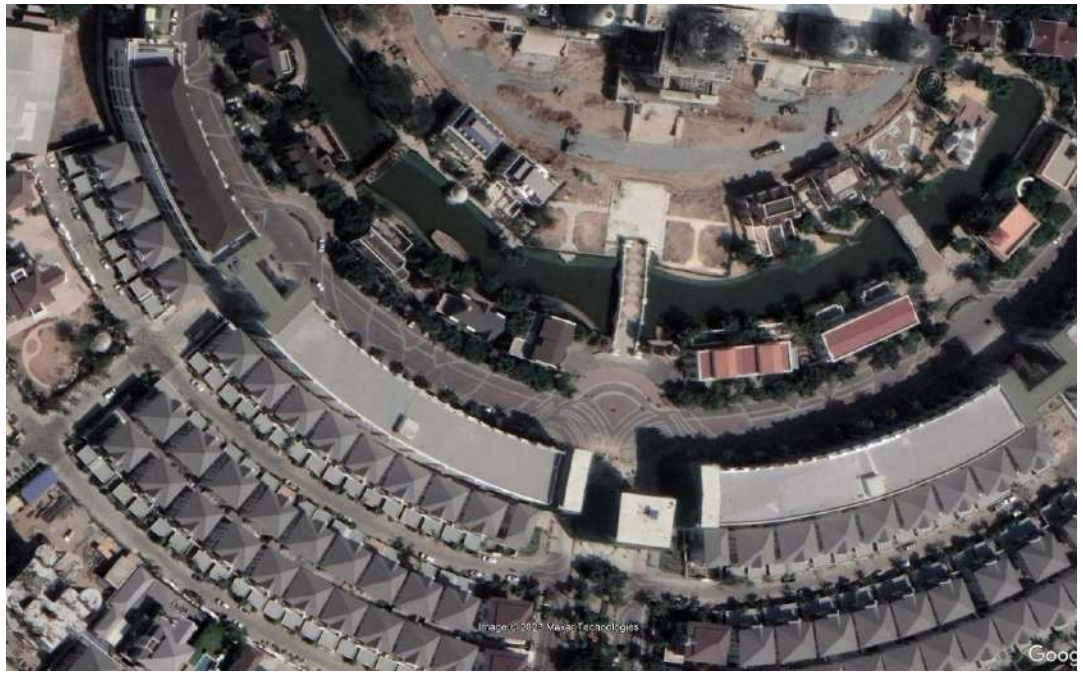




*Figure 6: LULC map of Chbar Ampov*

# Milestone 3: UNGI parameter operationalisation

- In October 2022 several thermal UAV flights were deployed in Phnom Penh to test very high resolution parallel multi-spectral and thermal data collection. The initial findings are promising and will be helpful in spatial verification of land surface temperature (LST) analysis (Figure 7).



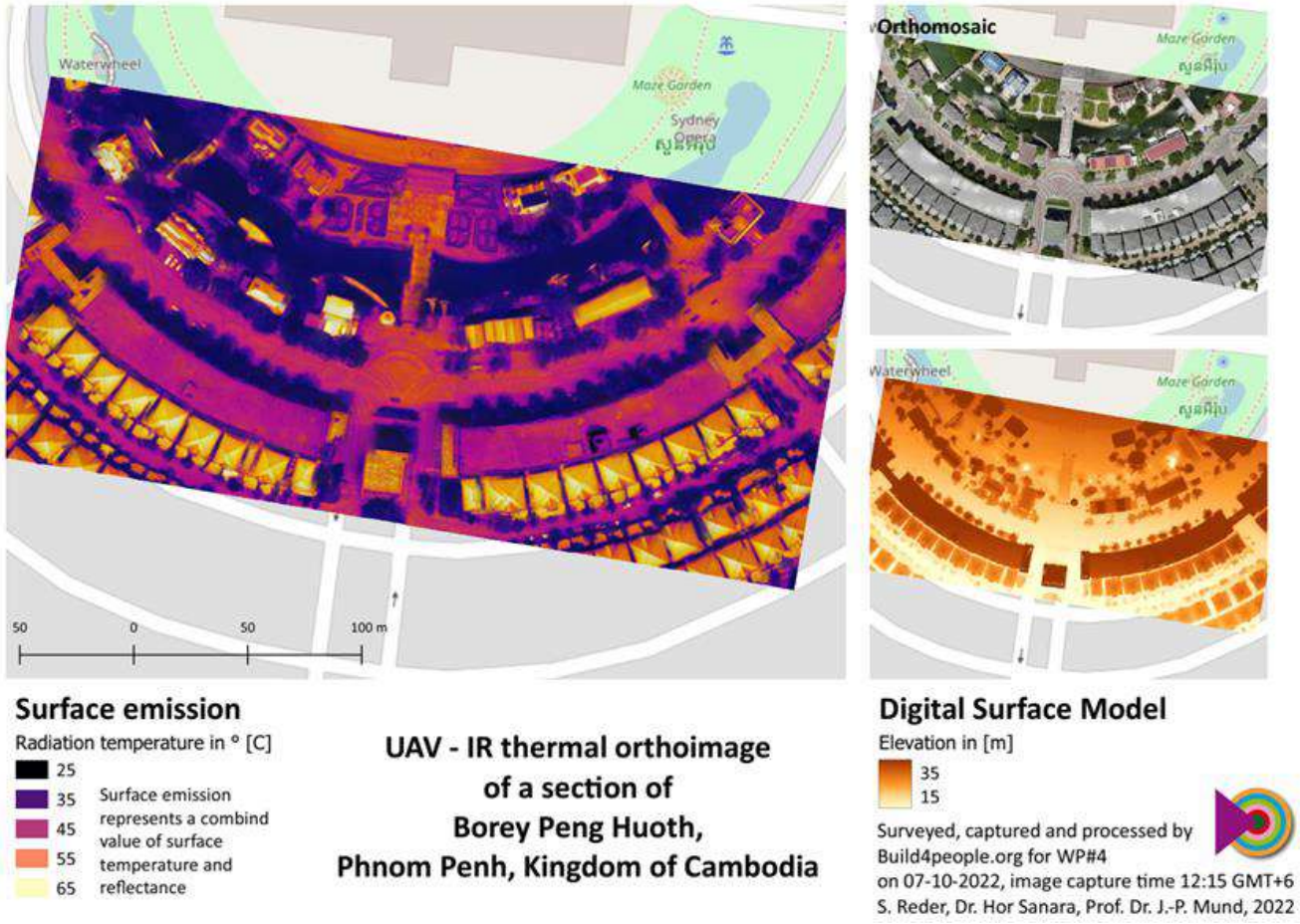
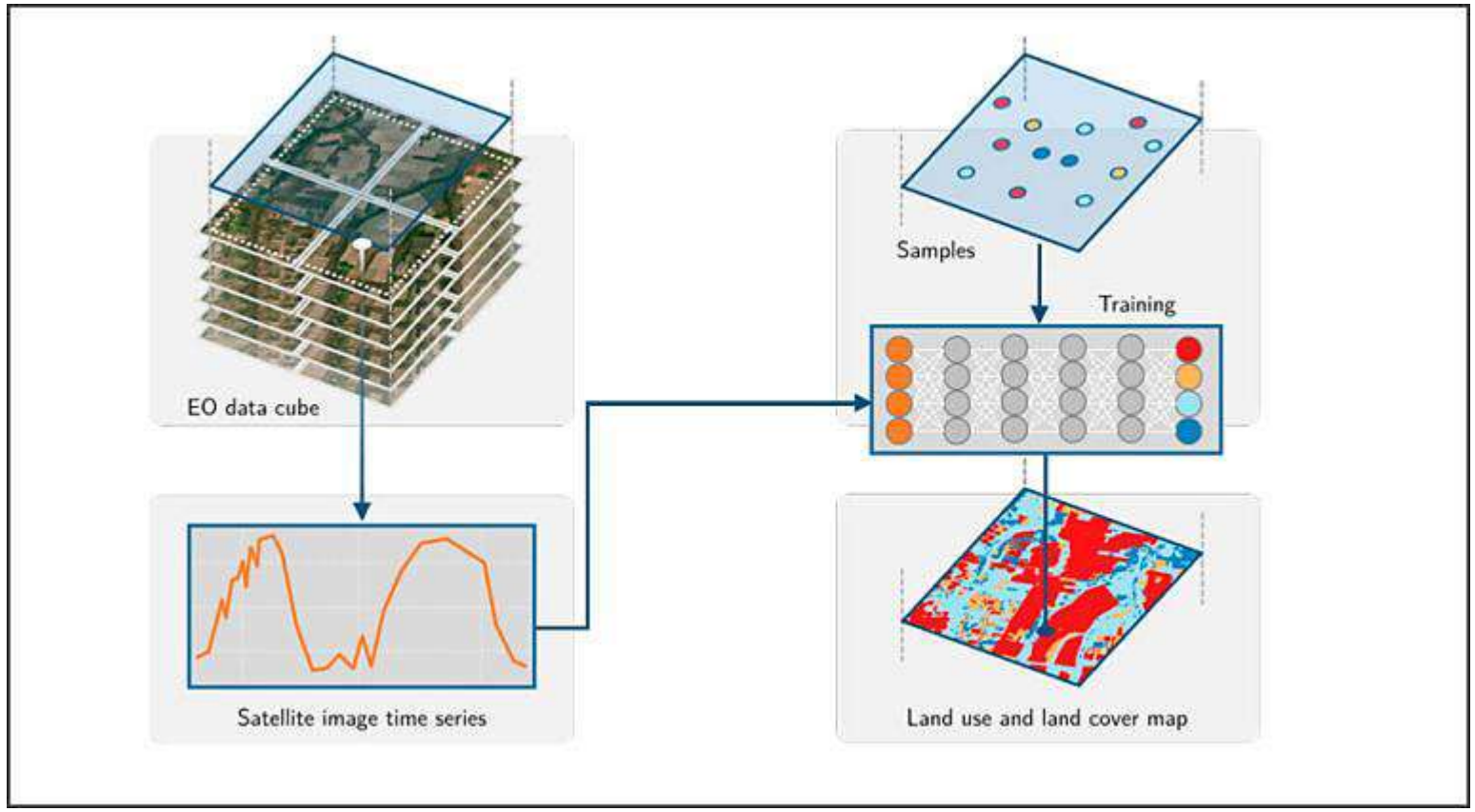



*Figure 7: Example of initial results from UAV*

# Upcoming research and studies

- Long time series analytics of thermal satellite image data in Phnom Penh
- Some of the initial results will be presented today from the area of Chbar Ampov.

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# Thank you!

***More info: build4people.org***

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# Urban Forestry
# Neutral Carbon Urban Design
# Concept and Its Application in Phnom Penh

## WP4 Science Workshop 2023

26 January 2023

**Hor Sanara, Jan Peter Mund, Walter Kollert, and Reinhold Glauner**

*Royal University of Agriculture*

# Introduction

- After civil war, the country has enjoyed growth in economics fostering changes in land use schema that could be found in both rural and urban areas.
- In the country' capital city of Phnom Penh, the urban footprint has increased significantly which urban green spaces have been replaced by build-up or developed areas between 1973 to 2020.
- The losses of urban green spaces, the most important components, could effect urban environment as an example of the increases in urban temperatures.
- Urban green spaces are also playing the most vital role to alleviate $CO_2$ from air through photosynthesis; in Cambodia, the country meets the highest Environmental Performance Index (EPI).
- Cambodian government commits to Marking cities and human settlements inclusive, safe, resilient, and sustainable by implement the green growth policies and establish land use master plans across the country.
- Therefore, urban forestry should be paid high attention toward neutral carbon urban design to meet SDG11 and RGC rectangular strategy.

# Definitions and Major Types Urban Forestry


City parks and urban forests found in Siam Reap

Peri-urban forests and woodlands

FAO 2016: Urban forestry is defined as the networks or systems that comprise all types of woodlands, group and individual types of tree species planted or naturally grow in both urban and peri-urban areas.

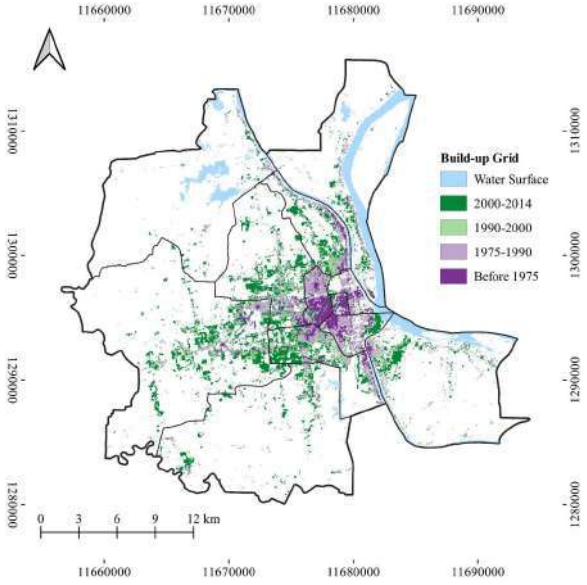
Pocket parks with trees found in Apsara Authority Campus and CDC

Road side trees or tree in public squares st. 110

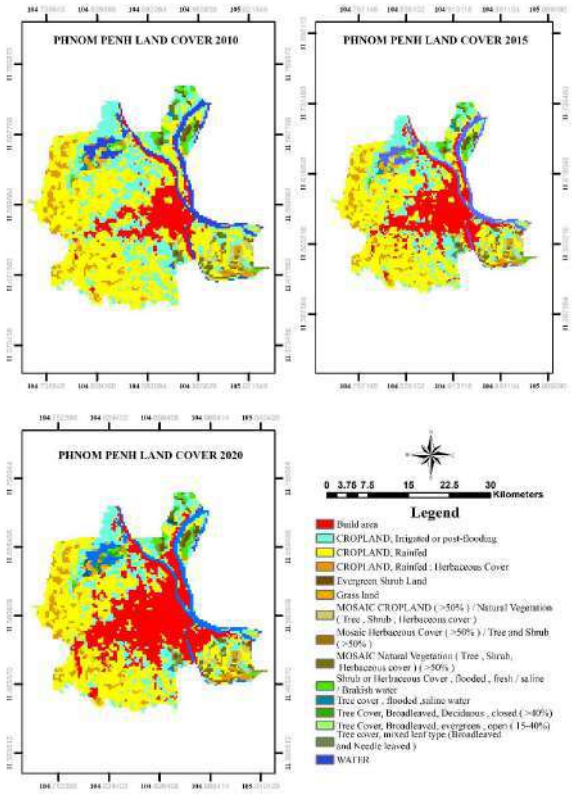
Other greens space with trees such as agricultural fields

# Why do we need to consider urban forestry?

The rapid growth of the Capital City (photo by Mol and Phath, 2022)




Changes in human settlement between 1975 and 2000 (Florczyk *et al.*, 2019)




ESA Land Use and Land Cover 2010 – 2020 (ESA, 2017)

To address rapid growth of Phnom Penh city to meet sustainable development goals of the Royal Government of Cambodia, the United Nations, and Rectangular Strategy.

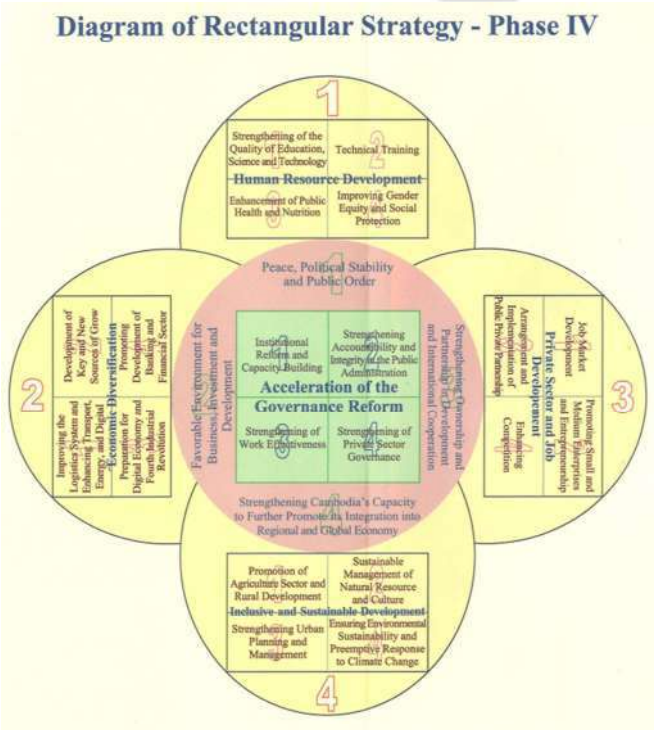
# Benefits of Urban and Peri Urban Forestry

| *Socio-economic benefits* | *Environmental benefits* |
|---|---|
| Enhance food security by providing consumable goods such as fruits, clean water and air; | Beautify urban landscapes and increase land and property values; |
| Mitigate energy and material shortages by providing wood fuel and construction material; | Prevent soil erosion and landscape degradation and Remove air pollutants and buffer urban noise; |
| Reduce urban poverty by creating jobs and increasing income; | Reduce hourly ozone, $SO_2$ and particulate matter and Remove large quantities of carbon dioxide from the atmosphere, and release oxygen; |
| Improve physical and mental health of residents; | Preserve and increase biodiversity and provide habitat for urban wildlife; |
| Increase the available green space and provide opportunities for recreation and environmental education. | Provide shade and shelter, reduce exposure to sun, wind and local overheating (heat island effect) |

# Application for Urban Forestry

| Goals | Suggestions |
|---|---|
| 1 | Put global and national policies into practices |
| 2 | Set urban forestry into municipal planning procedures for actions |
| 3 | Promote the role urban and peri-urban forestry for human health and well-being |
| 4 | Develop and implement sustainable forest and trees management plans |
| 5 | Ensure all urban residents access to urban green spaces |
| 6 | Strengthen urban trees and forests' health and diversity for long-term resilience |
| 7 | Develop incentive programs and diversify funding for sustainable urban and peri-urban forestry |
| 8 | Promote the active participation of private companies, institutions and local communities |
| 9 | Strengthen partnerships and collaboration for research, education, planning and policy development |

# 1. Put global and national policies into practices





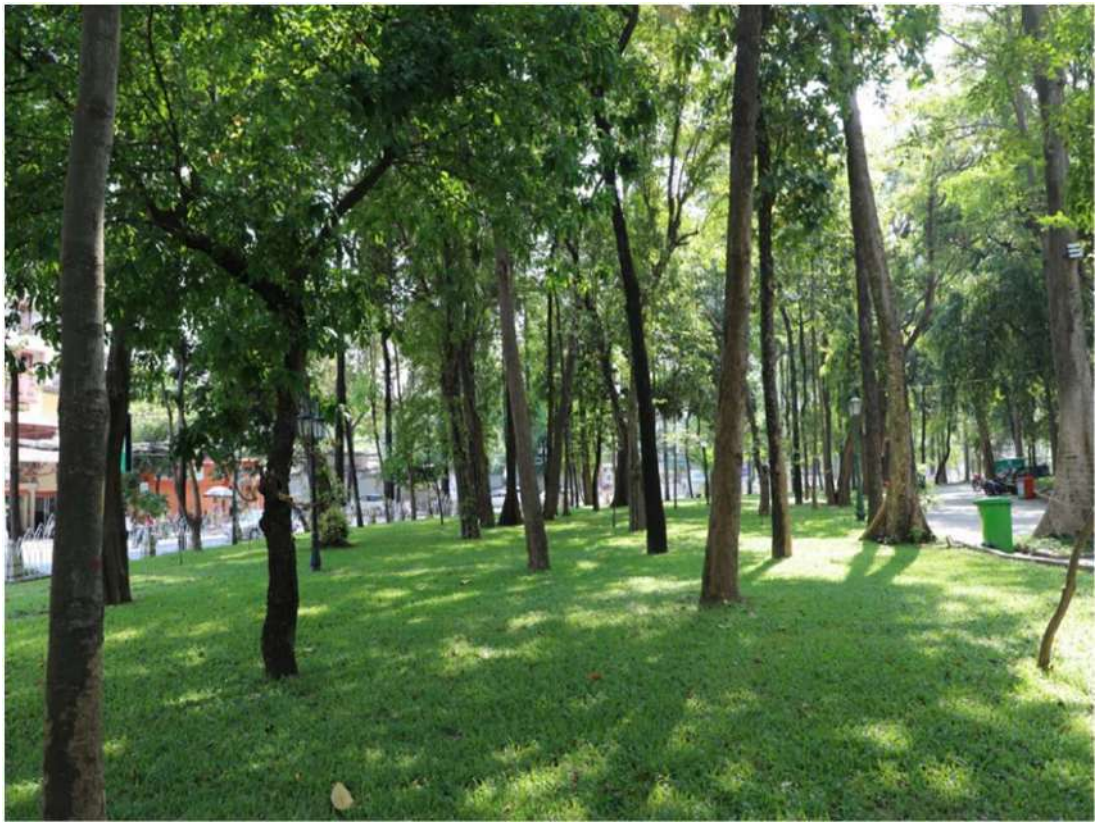

***Related to Policies to be consider***

- National Green Growth Roadmap
- Cambodia´s National Forest Program 2010-2029
- National Policy on Spatial Planning
- Sub-Decree on Environmental Impact Assessment Process
- Sub-Decree on the Control of Air Pollution and Noise Disturbance
- Sub-Decree on Water Pollution Control
- Law On Road Traffic
- Sub-degree on Urbanizing capital

- Inclusive and Sustainable Development: Strengthen Urban Planning, and Management
- Make the cities and human settlements inclusive, safe, resilient and sustainable
- Take urgent action to combat climate change and its impacts

# 2. Set urban forestry into municipal planning procedures for actions

- Increase the numbers of green spaces and them close to all residents
- Strengthen on land development sub degree.
- Trees are important elements for municipal planning and ensure at least 100000 inhabitants.



The urban old growth forest around Wat Phnom in Phnom Penh is well integrated in the municipal plan for green spaces. Photo: R. Glauner 2022

# 3. Promote the role urban and peri-urban forestry for human health and well-being


- Angkor Botanical Garden opened by Apsara Authority conducting the business related to green cover to attract tourists. Photo: S. Hor (22 May 2022)
- Establish botanical garden for the municipal by linking this urban green spaces to publish investment project
- Promote local people understand on benefits of urban green spaces esp. urban forestry that necessary for human health and well-being
- Launching appropriate campaigns with private, industry, and publish partner to enhance green coverage

# 4. Develop and implement sustainable forest and trees management plans


Google Maps View Over Downtown Phnom Penh

- Access and evaluate development of urban and peri urban
- Develop, implement, and monitoring trees in urban and peri urban by using green cadastre or tree inventory procedure
- Develop spatial protocol for mapping trees local and sharing information with stakholders

# 5. Ensure all urban residents access to urban green spaces


UNECE/FAO, 2021: 3-30-300 rule for greener

- Assess the existing urban tree cover applying the 3-30-300 rule to identify priority areas for urban green development
- Every resident should see at least three trees from their home
- 30% should be covered by trees in each community.
- Every tree should cultivate within 300 metres

# 6. Strengthen urban trees and forests' health and diversity

- Consider to grow appropriate tree species in the urban areas in which focused on economic, environment, habitat ect.
- Control invasive specie, consider heat stress at appropriate location to grow trees
- Support local communities to introduce communal land use planning in the appropriate aspects

Hornbill found in Royal University of Agriculture. There is an opportunity to make Phnom Penh to bird habitats for tourist destination

# 7. Develop incentive programs and diversify funding 8. Promote activities participation and 9. publish awareness on urban forestry and urban green spaces



- Participate with urban green program like Urban Green Oases (by FAO), Sustainable Cities Initiative (by World Bank), Green Cities (by ADB), and other sources for financing the municipal greening agenda.
- Encourages private and publish institute to grow trees by creating pocket parks in the institutes.
- Ensure all school in Phnom Penh are at least 30% covered trees and all students can access to green environment.

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# Thank you!

# The importance of green buildings in urban planning

## WP4 Science Workshop 2023

26 January 2023

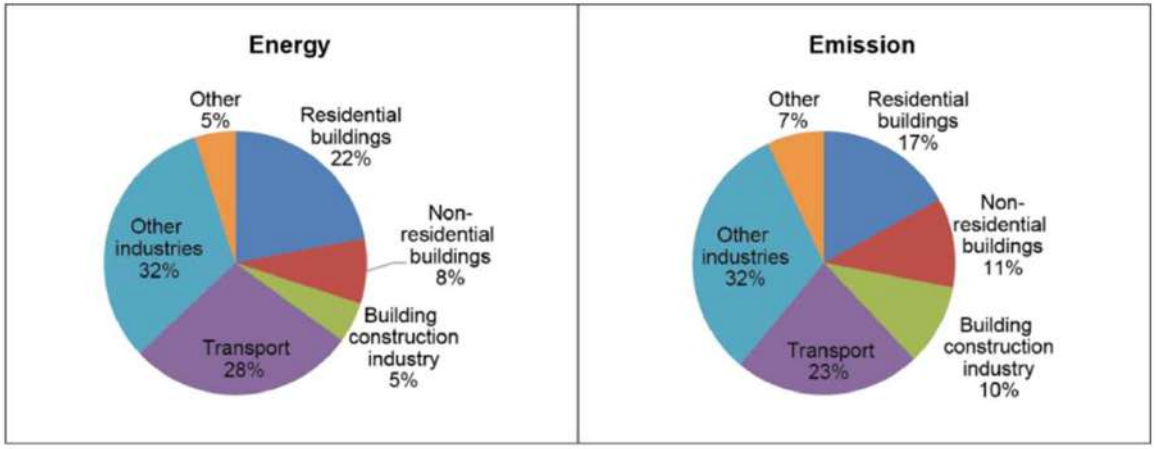
**Chea Chetha**

*Royal University of Agriculture*

# Greenhouse Gas Emissions in the Building Sector

- The **Asia and the Pacific region** is currently responsible for over **50%** of global GHG emissions (Asakawa 2021).
- Many large cities in developed country in Asia **suffer** from **high levels** of **air pollution**, especially in winter. Decreasing waste pollution and the destruction of the environment is one of the key goals of the **WHO Clean Air Mission** to reduce air pollution by **70%** by 2030. (CCAC 2020)
- **Concrete and steel** are the **top** contributors to **GHG emissions** (two-thirds) among construction materials, followed by bricks (18%), and aluminum (8%).
- **Asia** is the **largest contributor** of GHG emissions from construction materials, and India will overtake the PRC by 2053. (Zhong et al. 2021).

**Global Share of Energy Consumption and Emissions in 2019**




Source: United Nations Environment Programme (2020).

# What is Green Building

**Green buildings** are constructed in a variety of ways that lessen their negative effects on human health and the natural world.

- Utilizing energy, water, and other resources
- Decreasing waste pollution and the destruction of the environment
- **Energy Efficient, Green, and Net-Zero Carbon Buildings**

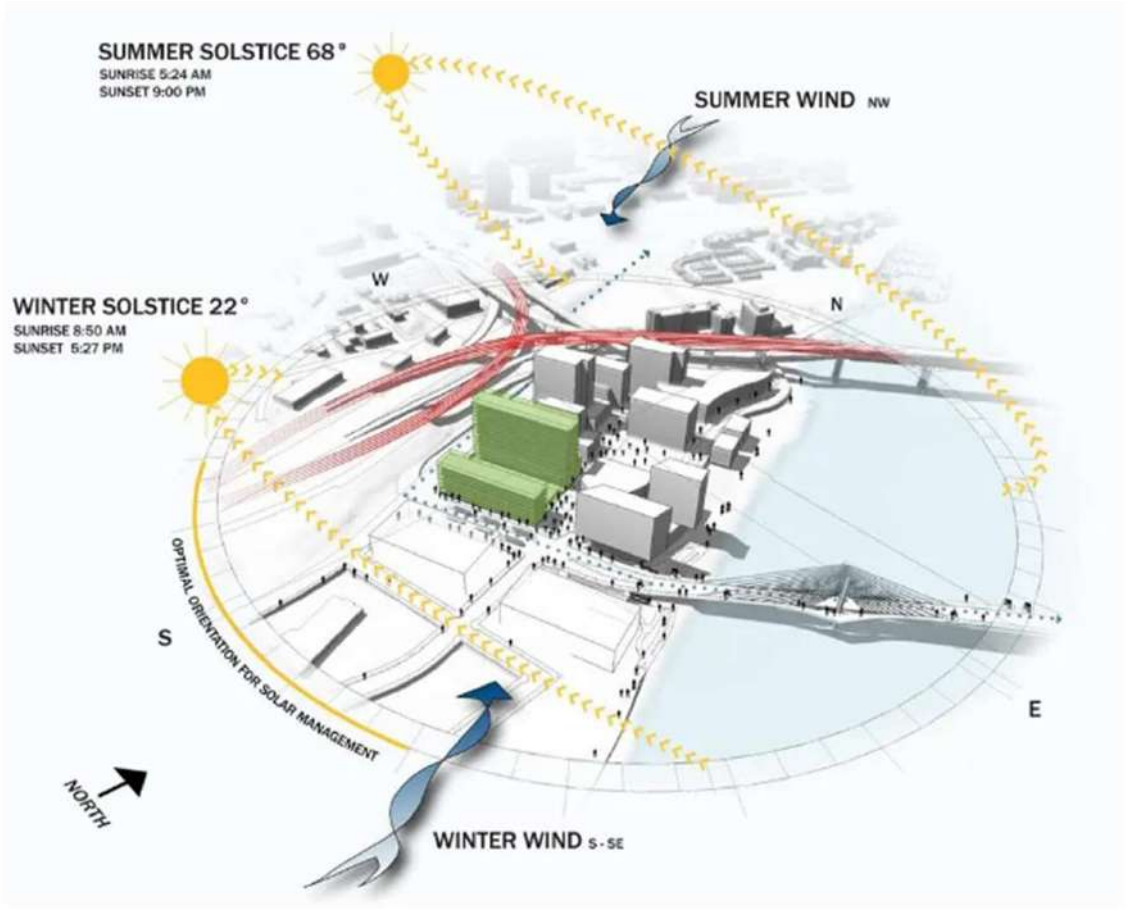

ADB 2022


Parkroyal on Pickering. Photography courtesy of Skyshot Pte Ltd.

# Fundamental Principles

## Fundamental Principles


- **Site:** Every decision about a building can be affected by its location.
- Priorities for green building site selection include:
  - Reduce urban sprawl and protect land, habitat, and open space.
  - Increase urban density to preserve green space.
  - Examine each location to preserve environmental assets.



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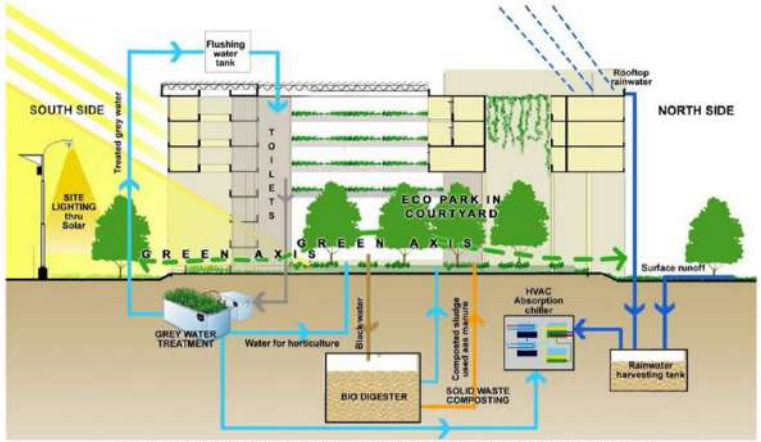
- **Water**
  - Preserve the existing natural water cycle and design the site so that they closely emulate the site's natural hydrological systems
  - Emphasis on retention of stormwater and on-site infiltration as well as ground water recharging
  - Reduce site water waste and maximize rainwater collecting, stormwater, and grey water reuse.




SECTION SHOWING WATER MANAGEMENT STRATEGIES
Recycling of waste water through sewage treatment plant; sensor urinals and dual flow cisterns; rain water harvesting.

Water management strategies in indira paryawan bhawan ©nzeb.in

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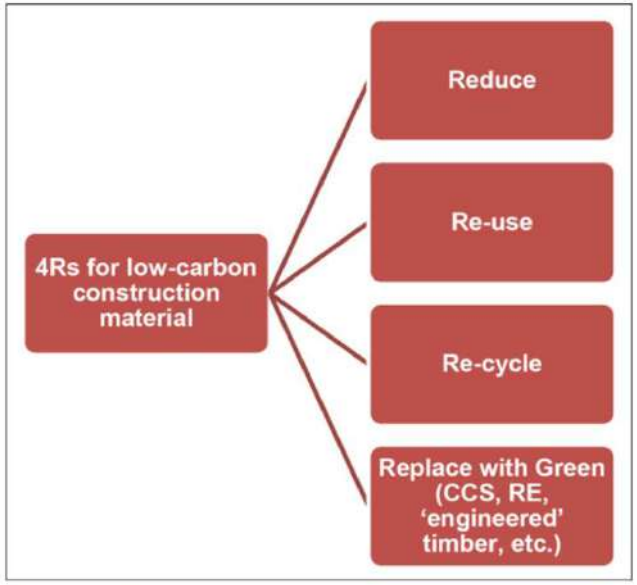
  - Use recycled materials, energy-efficient engineered materials, resource-efficient composite structural systems, and sustainably managed biomass materials.




Note: CCS = Carbon capture and storage; RE = Renewable energy.

# Fundamental Principles

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  - Maximize the use of renewable energy and other low impact energy sources

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- **Energy**
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  - Maximize the use of renewable energy and other low impact energy sources
- **Indoor Air Quality**
  - Provide a healthy, comfortable and productive indoor environment for building occupants
  - Utilize the best possible conditions in terms of indoor air quality, ventilation, and thermal comfort, access to natural ventilation and day lighting

# The benefit of the green buildings

- Green building isn't just a passing trend; it's a way of building that fits the needs of the time and will only continue to grow in re levance

and importance (USGBC)

- **Comfort**
  - Green building is not only about energy efficiency, but also about creating an environment that is comfortable and enjoyable for the occupants
- **Economy**
  - Users reduce operational costs
  - Better worker productivity and attendance result from healthier buildings.
  - Government can avoid the expense of building additional energy/water infrastructure.
- **Environmental**
  - Protect existing natural spaces
  - Enhance existing ecology
  - Reduce water use
  - Reduce material use and use low-impact materials
  - Reduce emissions to air
- **Environmental and Community Benefits**
  - reduced smog and urban heat island effect, conserved resources, and lowered carbon footprint.

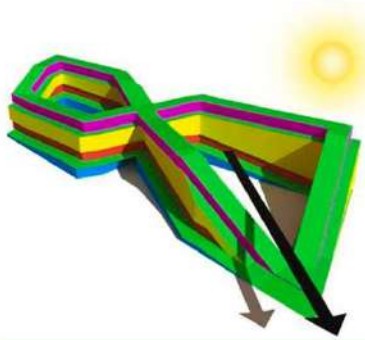
# What is preventing us from constructing green buildings?

- Green buildings are attractive, environmentally friendly, and reduce GHG emissions and protect the environment, but they face several challenges to adoption.

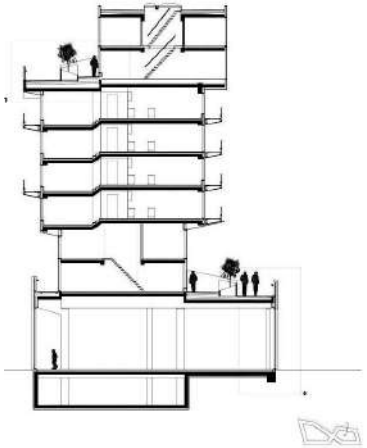
- **Component 1: Financial Barriers**
  - The fear of higher investment cost
  - Long pay back period
  - Lack of financial resources
- **Component 2 : Political Barriers**
  - Lack of government policy and commitment
  - Lack of building codes on sustainability
- **Component 3 : Management or leadership Barriers**
  - Lack of leadership
  - Lack of market segmentation
  - Lack of motivation
- **Component 4 :Technical Barriers**
  - Lack of environmentally sustainable materials
  - Lack of technical ability and chronic skills and labor shortages
- **Component 5 :Socio- Cultural Barrier**
  - Lack of demand for sustainable products and cultural change resistance
- **Component 6 :Awareness Barrier**
  - Lack of awareness professional
  - Lack of awareness of clients
  - Ignorance or misunderstanding about sustainable design

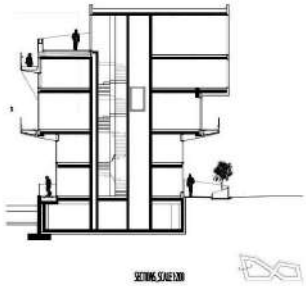
# Case Studies

archdaily.com ( 2010)



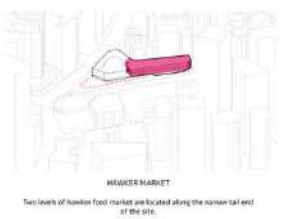
- **8 house**
  - Architect: BIG –Bjarke Ingels Group
  - Location: Copenhagen, Denmark
  - Client: St. Frederikslund Holding
  - Project Area: 61,000 sqm, 476 residences
  - Project Year: 2010



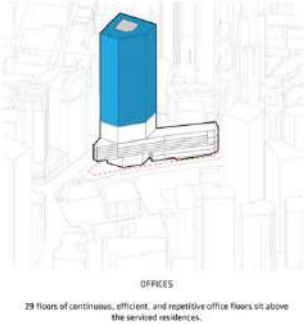


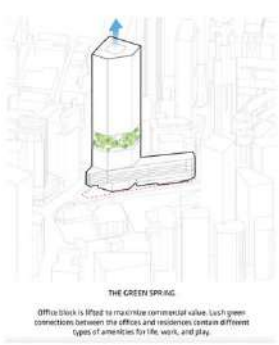
# Case Studies

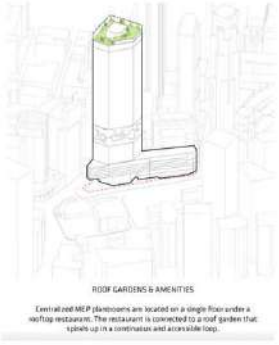
- **CapitaSpring**
  - Architect: BIG + Carlo Ratti Associati
  - Location: at the heart of Singapore's financial district on the site of a former public car park and a hawker center
  - Project Height:
  - Project Year: 2022

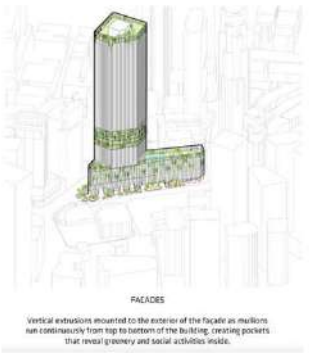




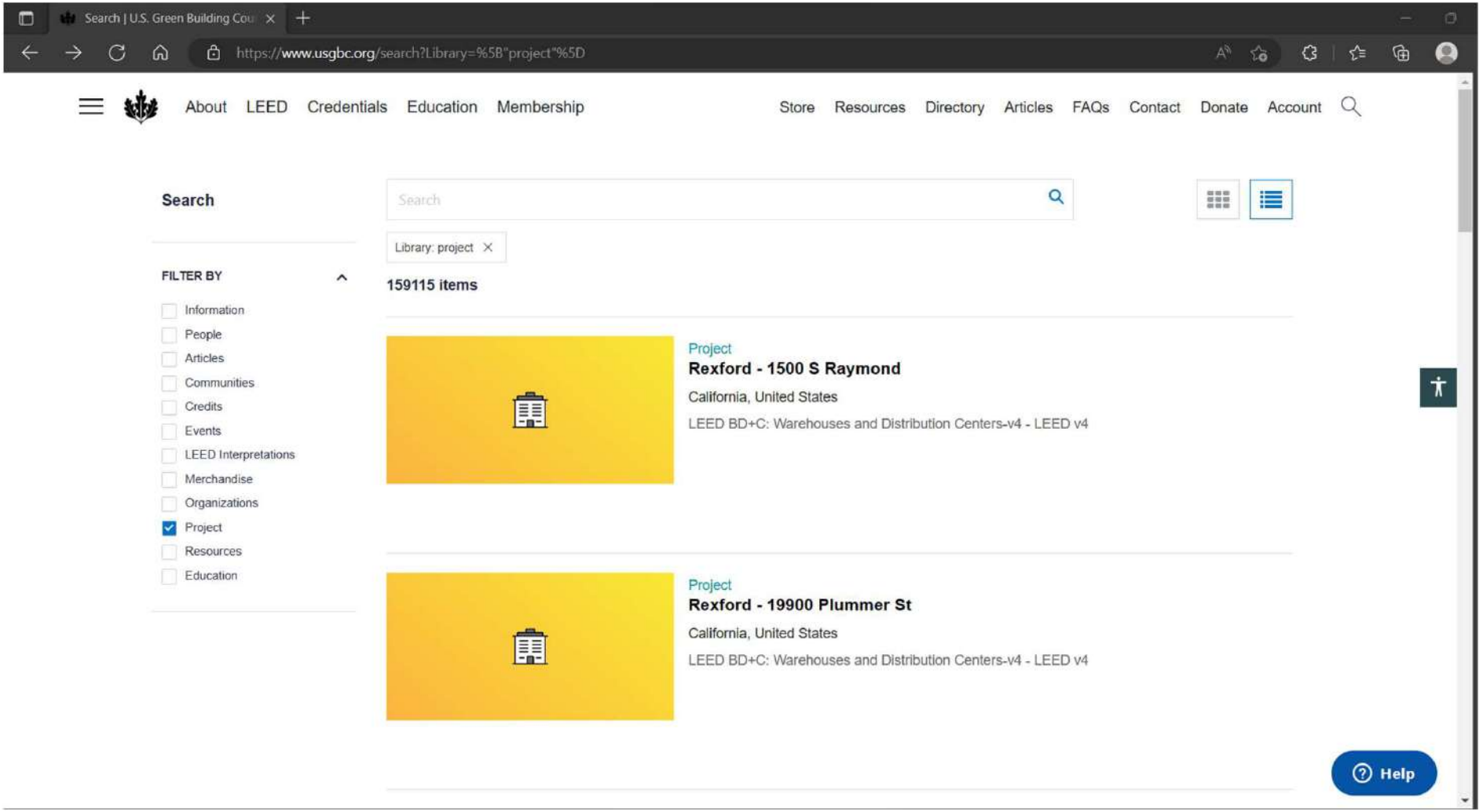



archdaily.com ( 2022)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LEED BD+C: Warehouses and Distribution Centers-v4 - LEED v4
Project
Rexford - 19900 Plummer St
California, United States
LEED BD+C: Warehouses and Distribution Centers-v4 - LEED v4
Help

# Mapping Impervious Surface Area from Satellite Imagery

## WP4 Science Workshop 2023

26 January 2023

**Sophak Pok**

*Royal University of Agriculture*

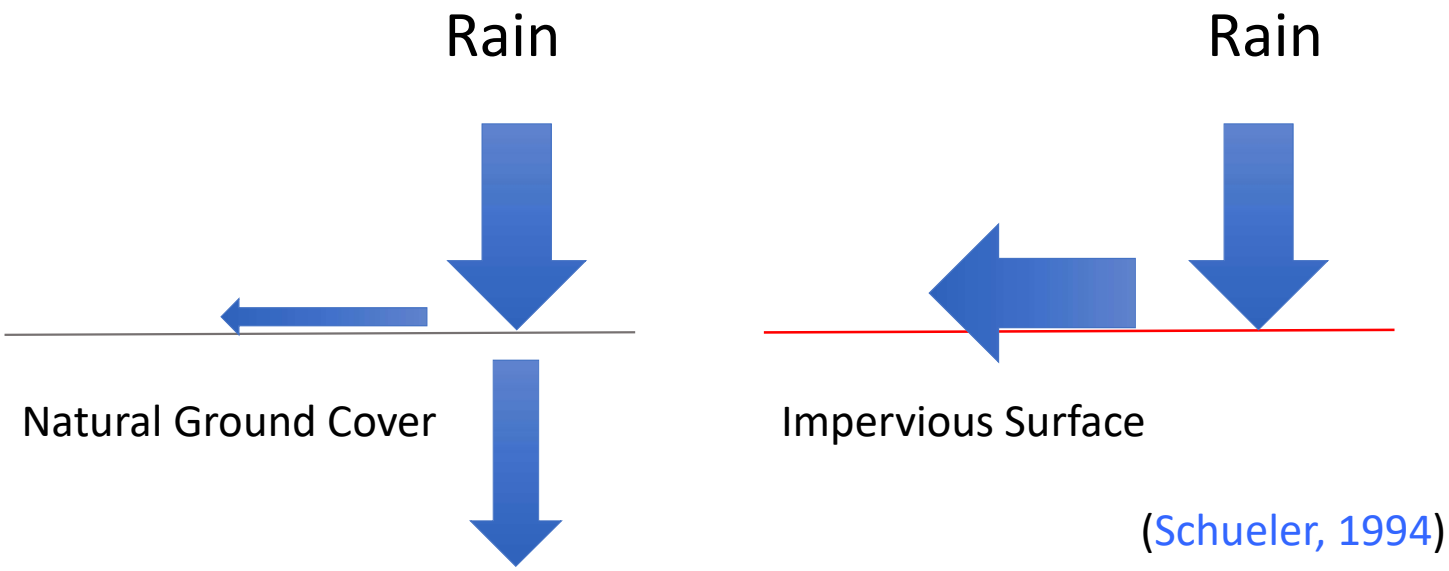
# Outline

- What is impervious surface area (ISA)?
- Impacts of ISA
- Urbanization and increasing ISA
- ISA estimation methods
- Merits and demerits
- ISA change
- Considerations

# What is Impervious Surface Area (ISA)?

- Impervious surface area (ISA) is defined as the man-made surfaces where water cannot infiltrate into the soil (e.g. buildings, roads, sidewalks, parking lots).

# Impact of ISA on Water Environment

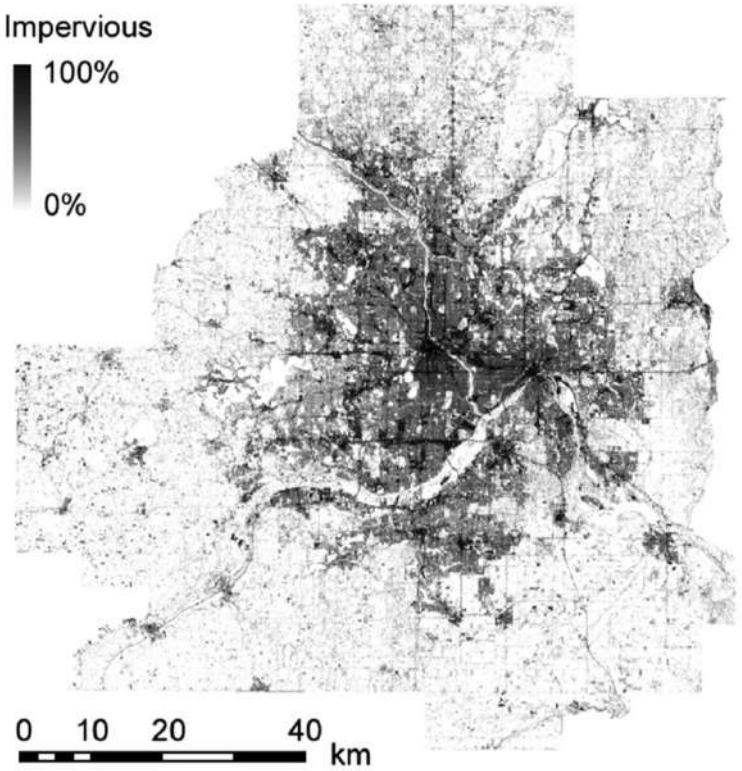


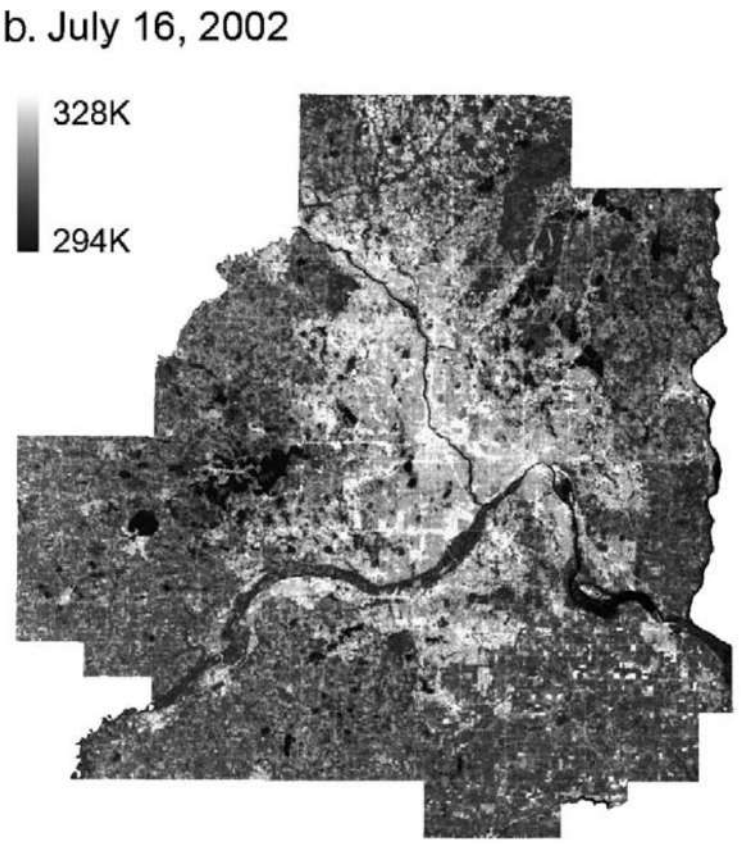

(Schueler, 1994)

Since water cannot infiltrate the ISA surface, the hydrological characteristics of the drainage basin will be changed, and the pollutants on the Earth surface will be taken into the rivers at the same time.

# Impacts of ISA on Heat Balance (1)

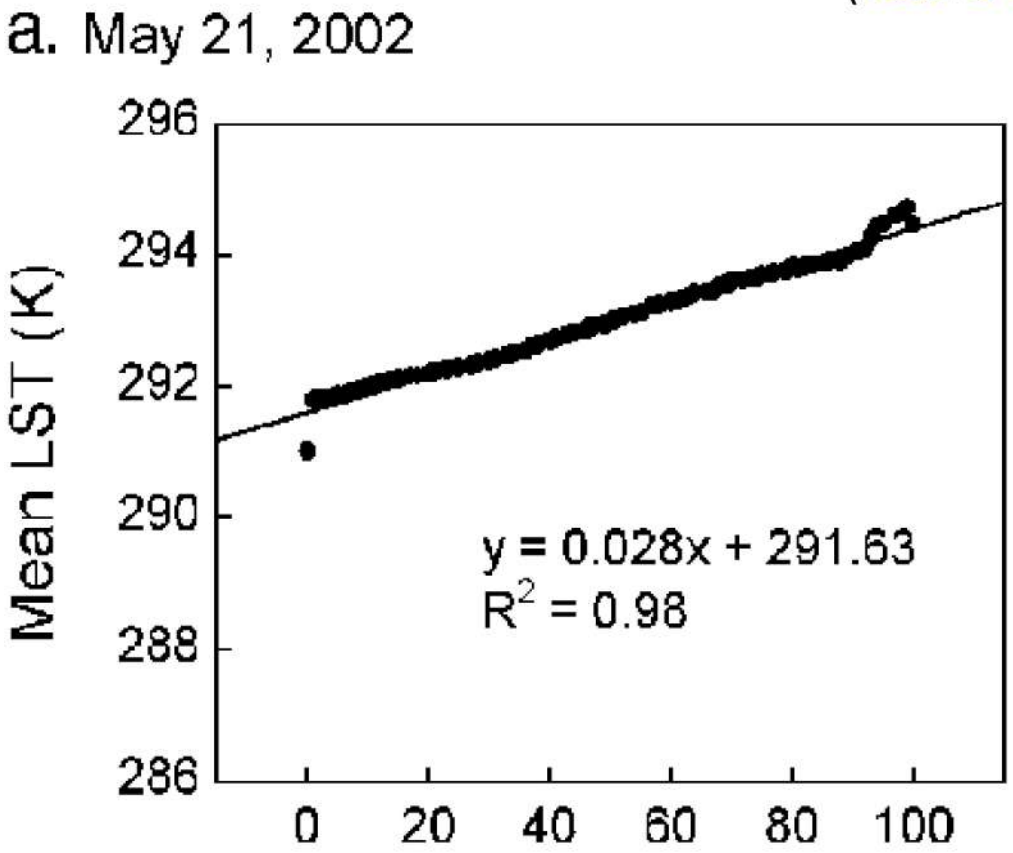
(Yuan & Bauer, 2007)



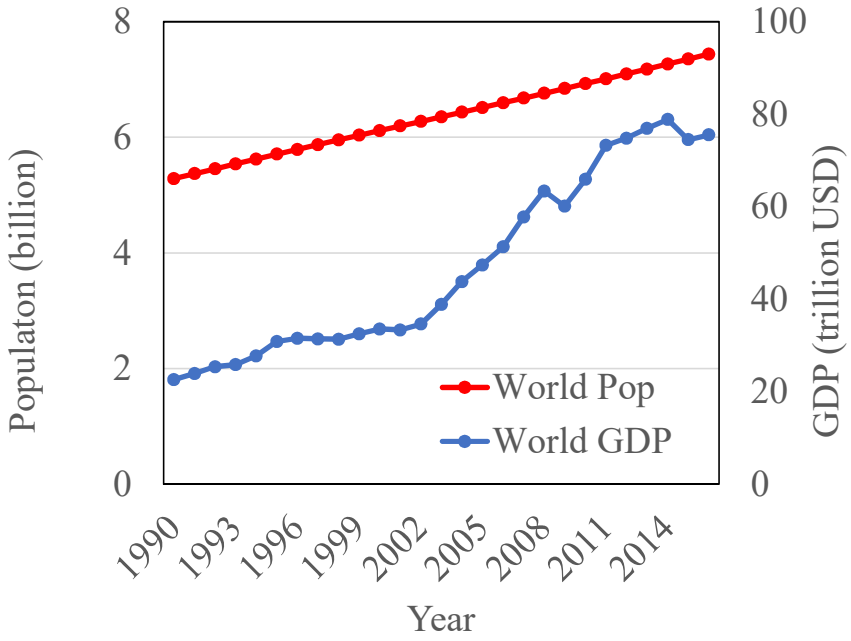
# Impact of ISA on Heat Balance (2)

(Yuan & Bauer, 2007)



# Urbanization and Increasing ISA

- World population: 7.4 billion in 2016
- Economic growth
- Urban population
  - 1950: 30% => 2014: 54%
  - 2050: 66%




Source: https://data.worldbank.org/

More demands for housings, buildings, roads, factories,…

Increased ISA

# ISA as an Important Indicator

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- A indicator to quantify the urbanization process. (Lu and Weng, 2006)

- An indicator of watershed quality. (Arnold and Gibbons, 1996)

Increased ISA can alter ecological, hydrological and thermal characteristics in watershed.

- ISA 1-10% => Stressed
- ISA 10-25% => Impacted
- ISA >25% => Degraded

Estimating ISA has become increasingly important for management of urban growth and environment.

# Major methods for estimating ISA

- Visual interpretation
  - aerial photos or high resolution satellite images
- Empirical methods
  - Vegetation distribution-based
  - Artificial Neural Network
  - Nighttime light-based
- Mixture analysis methods
  - Spectral mixture analysis (SMA): spectral info, medium resolution images.
  - Temporal mixture analysis (TMA): temporal info, coarse resolution images

# Merits and demerits

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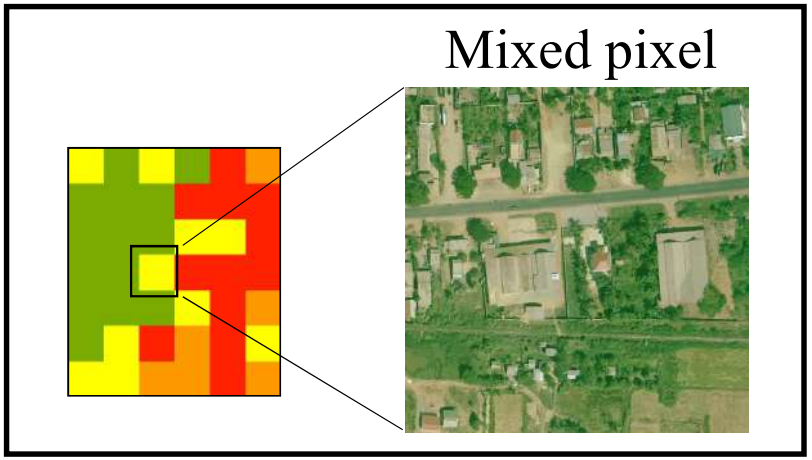
- Visual interpretation of aerial photos or high resolution images:
  - Need too many images, much time and labor, expensive.
- Empirical methods:
  - Model performance strongly depends on training data.
  - Need high/medium-resolution images to get training data.
- Spectral mixture analysis (SMA):
  - Spectral similarity among non-vegetation land cover types and spectral variability within endmembers.
- Temporal mixture analysis (TMA):
  - Temporal similarity among non-vegetation land cover types.

# Mixture Analysis

$$R_b = \sum_{i=1}^{N} f_i R_{i,b} + e_b$$

$$\sum_{i=1}^{N} f_i = 1\,,\ f_i \geq 0$$



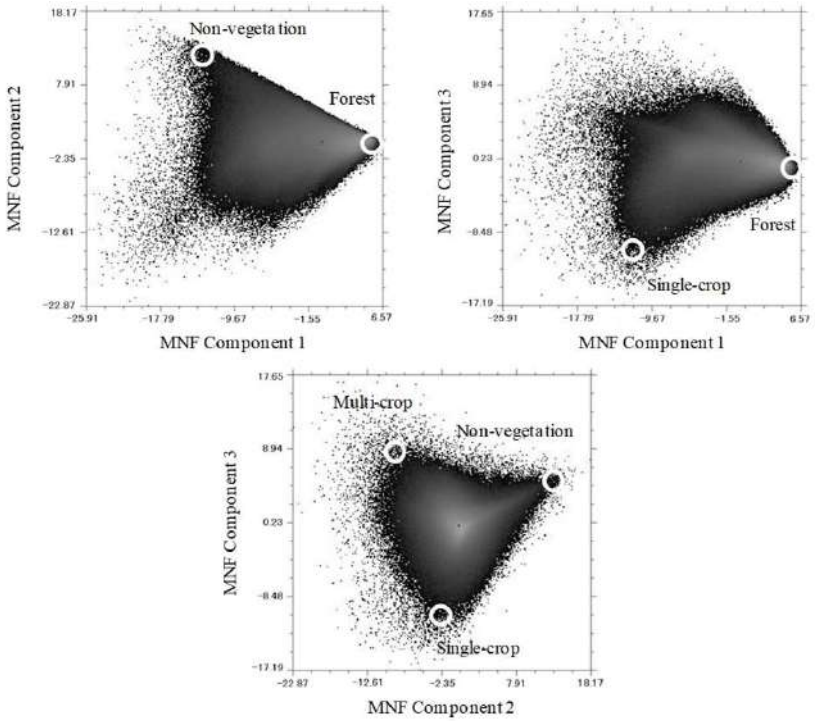

Spectral Mixture Analysis (SMA):

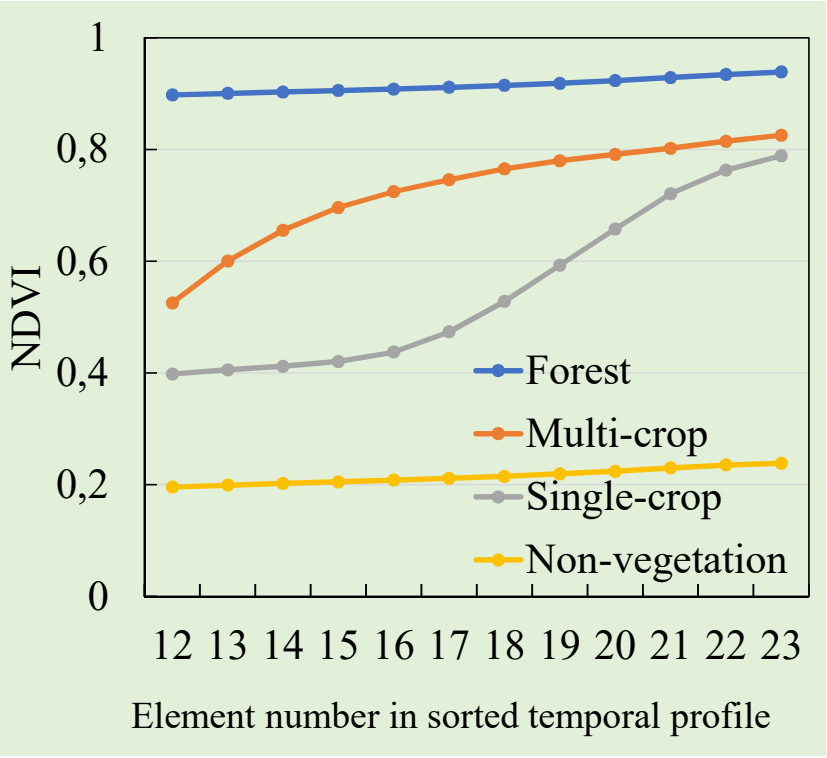
$R_b$, $R_{i,b}$ are the spectral data of the target pixel and endmembers

Temporal Mixture Analysis (TMA):

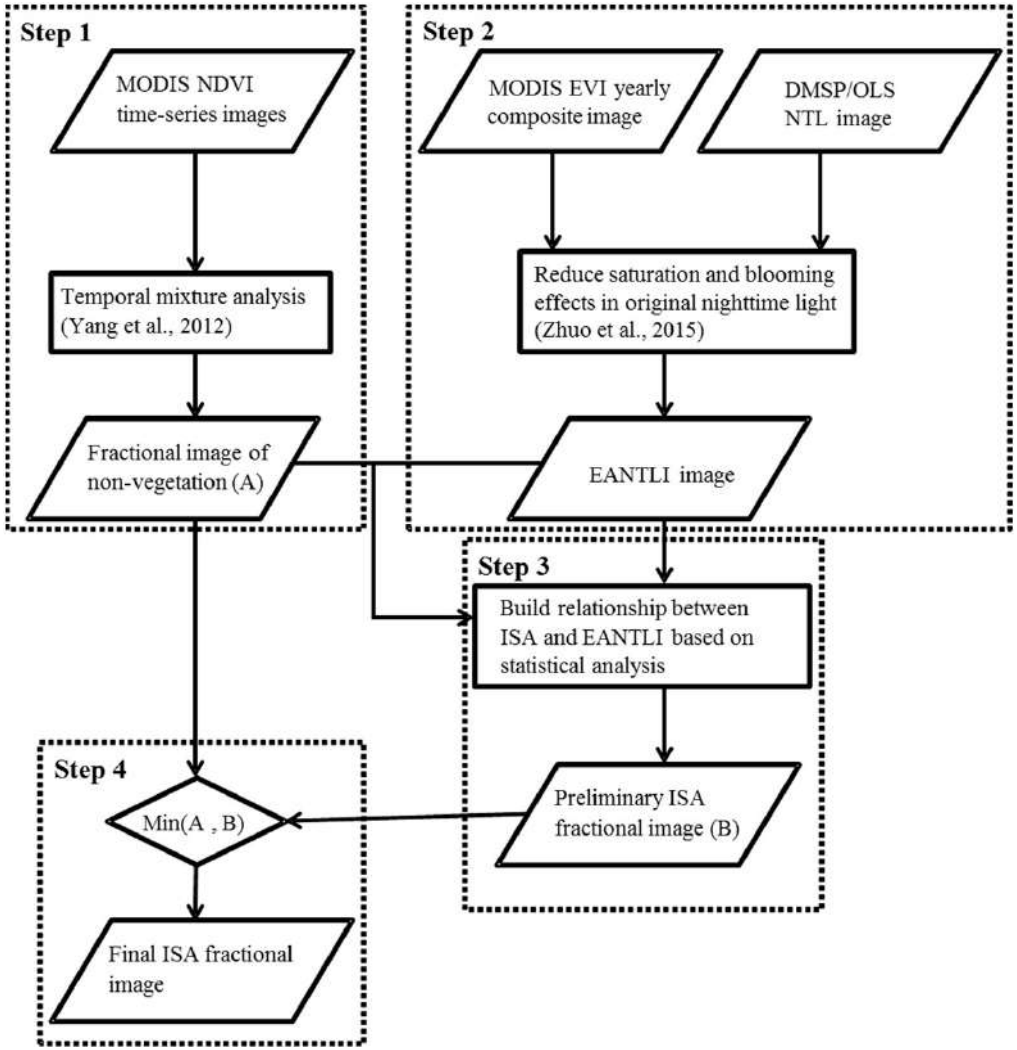
$R_b$, $R_{i,b}$ are the NDVI temporal data of the target pixel and endmembers in stable zone.

# Endmember selection

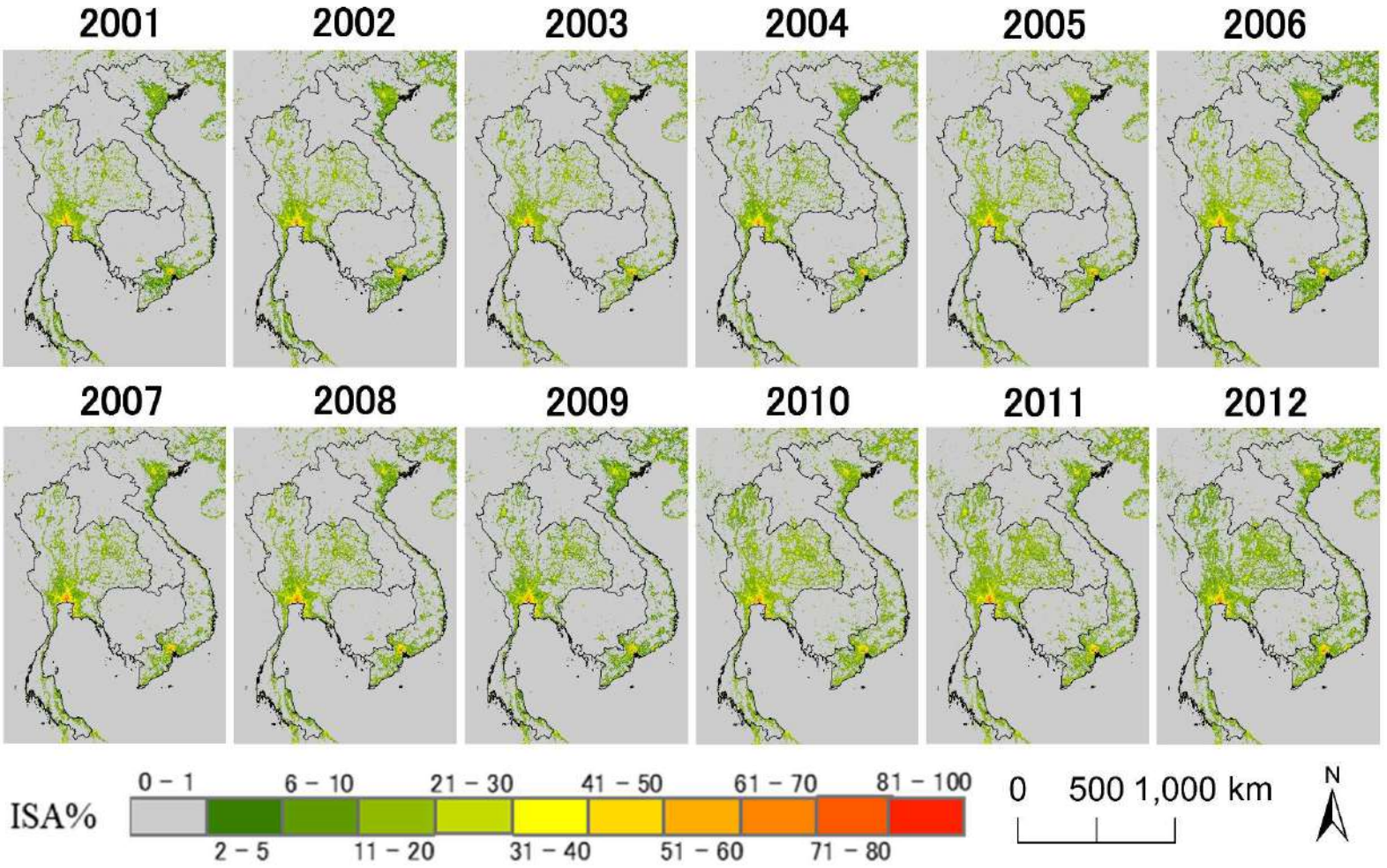


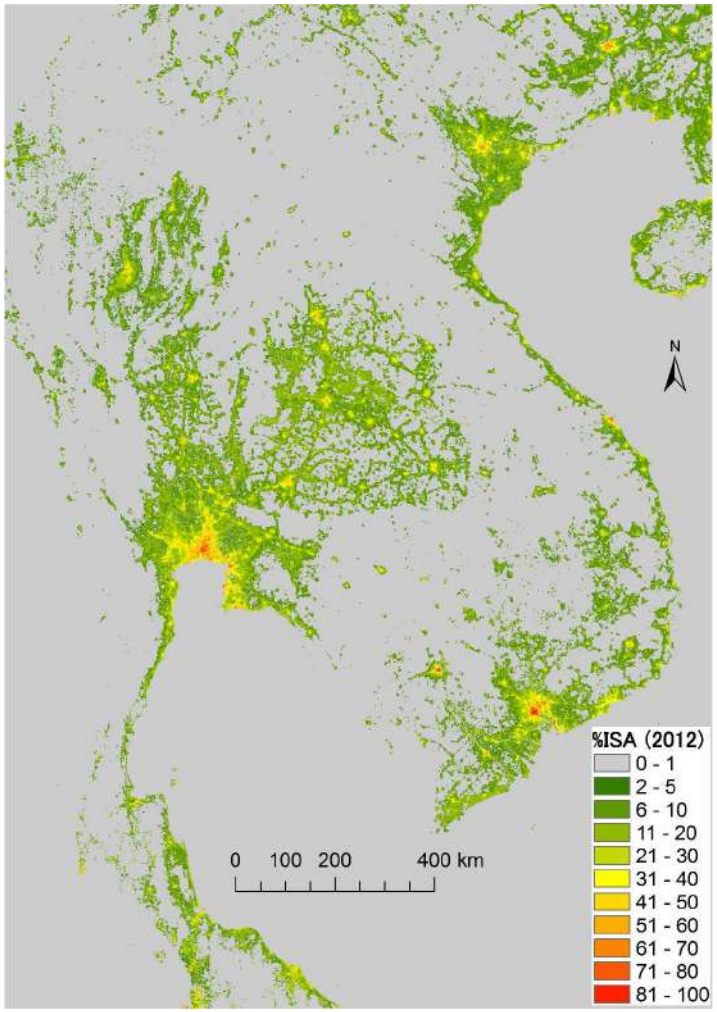
# Example: Method



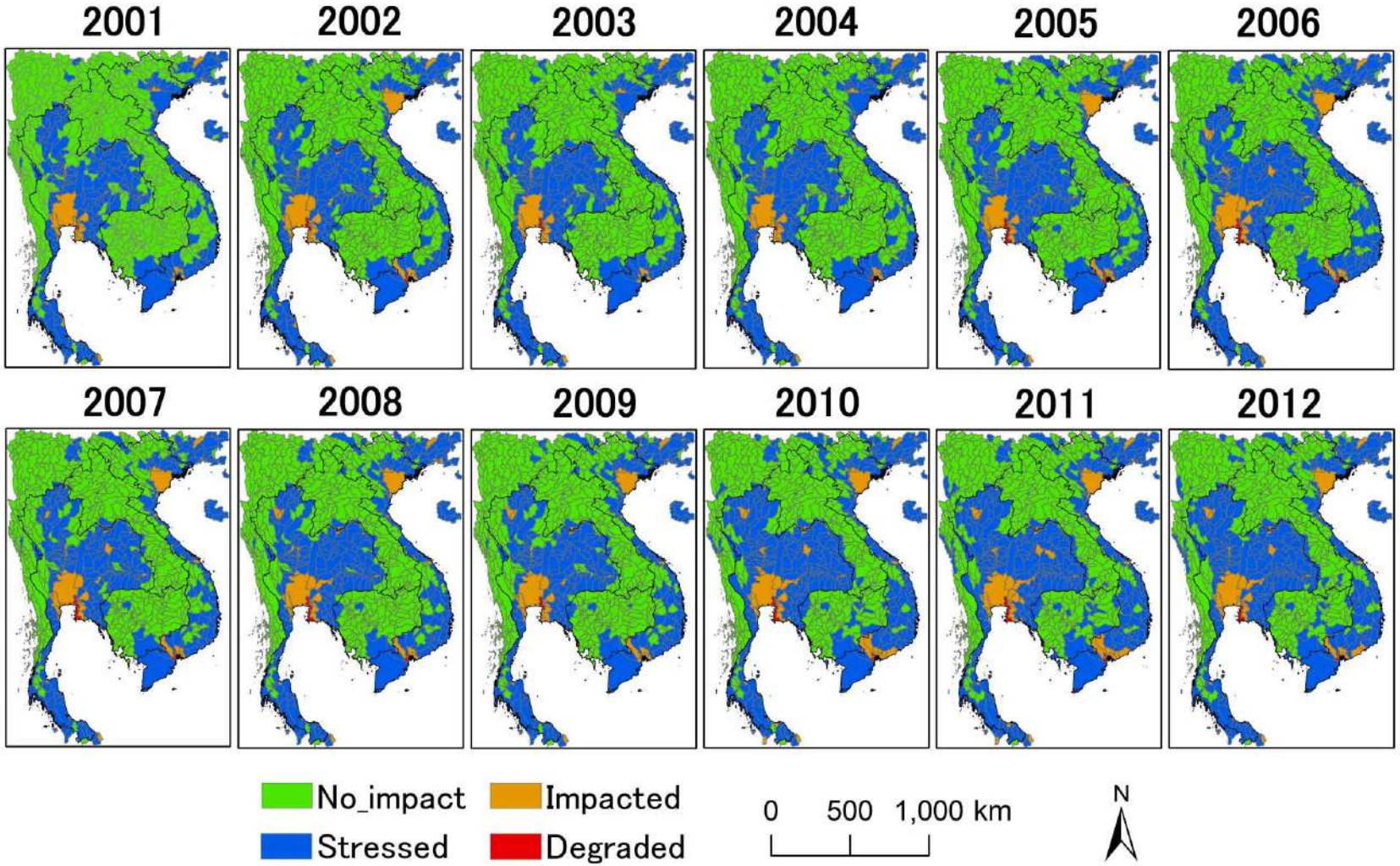
# ISA% maps


2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
ISA%
0 – 1
2 – 5
6 – 10
11 – 20
21 – 30
31 – 40
41 – 50
51 – 60
61 – 70
71 – 80
81 – 100
0 500 1,000 km
N

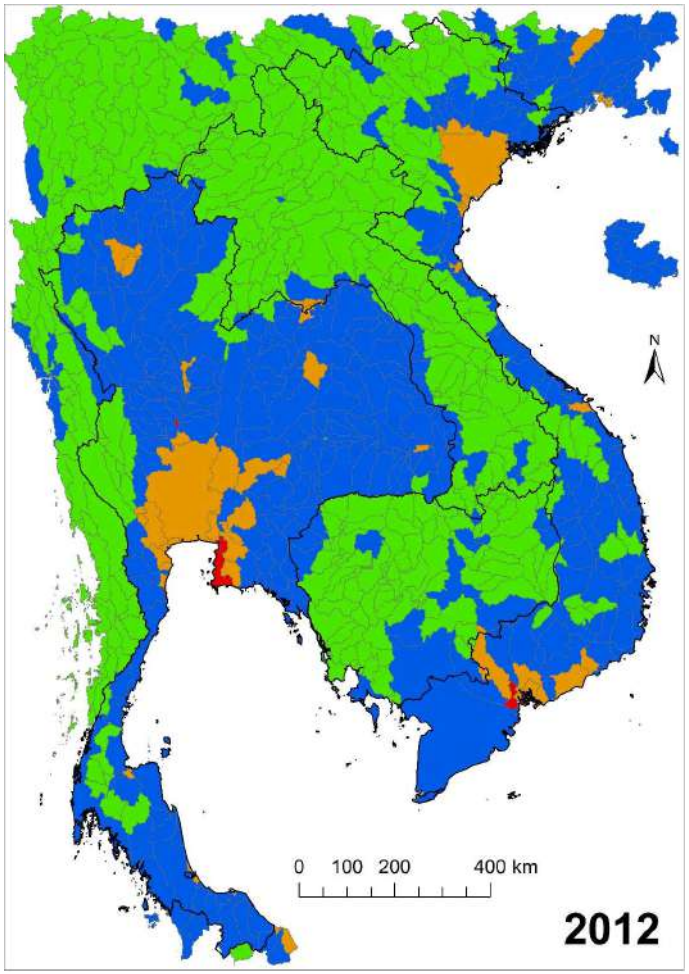
# ISA% maps


N
0 100 200 400 km
%ISA (2012)
0 - 1
2 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 100

# Impact of drainage basins



# Heading of the slide…




No_impact
Stressed
Impacted
Degraded

# Considerations

- The newly available Sentine-2A and -2B data can provide fine spatial resolution multispectral imagery at a 5-day temporal resolution, making it an important dataset for urban expansion monitoring.

- Use of ISA for study heat in cities.

# Public Participation in Sustainable City

## Case study: Commune Land Use Planning (CLUP)
## LASED III project

### WP4 Science Workshop 2023

26 January 2023

**Rorn Naro**

*Royal University of Agriculture*

NR1

Eberswalde University for Sustainable Development

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*"The right to the city is far more than the individual liberty to access urban resources: it is a right to change ourselves by changing the city. It is, moreover, a common rather than an individual right since this transformation inevitably depends upon the exercise of a collective power to reshape the processes of urbanization."*

*- Harvey (2008:23)*

## Folie 2

**NR1** Naro Rorn; 23.01.2023

# Public Participation

- PP is broadly defined as the involvement of people and organizations in government policy processes and decision-making. *(Barnes, 2007)*
- PP is based on the belief that those who are affected by a decision have a right to involved in the decision-making process. *(PIA, 2011)*

# Benefits of PP

- Identify solutions to complex problems
- Improve the efficiency and effectiveness of public spending and services
- Promote social cohesion and social justice, and overcome conflict
- Build the confidence and agency of individuals and communities
- Improve well-being and reduce social problems

*(NCOSS, 2014)*

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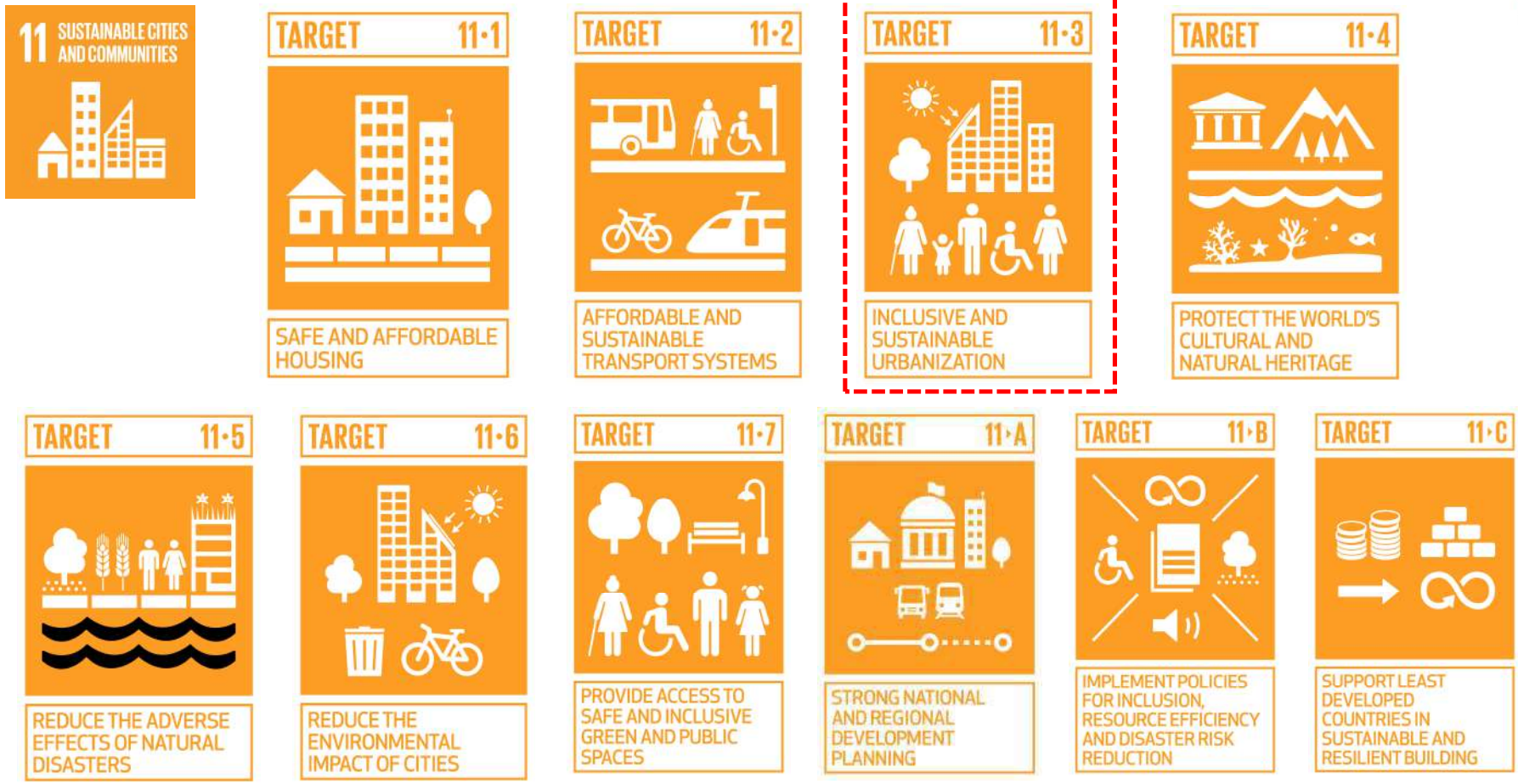
# United Nation Sustainable Development Goals - SDGs


11 SUSTAINABLE CITIES AND COMMUNITIES
TARGET 11·1
SAFE AND AFFORDABLE HOUSING
TARGET 11·2
AFFORDABLE AND SUSTAINABLE TRANSPORT SYSTEMS
TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION
TARGET 11·4
PROTECT THE WORLD'S CULTURAL AND NATURAL HERITAGE
TARGET 11·5
REDUCE THE ADVERSE EFFECTS OF NATURAL DISASTERS
TARGET 11·6
REDUCE THE ENVIRONMENTAL IMPACT OF CITIES
TARGET 11·7
PROVIDE ACCESS TO SAFE AND INCLUSIVE GREEN AND PUBLIC SPACES
TARGET 11·A
STRONG NATIONAL AND REGIONAL DEVELOPMENT PLANNING
TARGET 11·B
IMPLEMENT POLICIES FOR INCLUSION, RESOURCE EFFICIENCY AND DISASTER RISK REDUCTION
TARGET 11·C
SUPPORT LEAST DEVELOPED COUNTRIES IN SUSTAINABLE AND RESILIENT BUILDING

# Case Studies of PP in Cambodia's Planning

# Commune Land Use Planning procedures

- Step 1: Preparations and launch of the district/municipal spatial planning process
- Step 2: Data collection and data management
- Step 3: Situation analysis and envisioning the future
- Step 4: Draft the Land Use Master Plan
- Step 5: Review of the Draft Land Use Master Plan
- Step 6: Public Display
- Step 7: Review of technical report
- Step 8: Identification of priority projects
- Step 9: Approval of the Land Use Master Plan

Identification and gathering of stakeholders

Inter-ministries and authorities

PD draft Land Use Master Plan

*(Introduction to the Cambodian Spatial Planning System, 2016)*

# Land Allocation for Social and Economic Development, Phase 3 (LASED III)

Assessment and Management of Environmental and Social Risks and Impacts

Labor and Working Conditions

Resource Efficiency and Pollution and Management

Community Health and Safety

Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

Biodiversity Conservation and Sustainable Management of Living Natural Resources

Indigenous Peoples

Cultural Heritage

Stakeholder Engagement Plan

Source: World Bank

# Land Allocation for Social and Economic Development, Phase 3 (LASED III)

- Project outreach
- Stakeholder Engagement Plan
- Grievance Redress Mechanism

(affected people and Workers)

- Project Disclosure
- FPIC (Free, Prior, Informed Consent) for IPs

# Thank you!

# Long time series analytics of thermal satellite image data

## WP4 Science Workshop 2023

26 January 2023

**Gulam Mohiuddin**
**Prof. Dr. Jan-Peter Mund**

*Eberswalde University for Sustainable Development*

# Objectives and study area

Land surface temperature (LST) trend

Correlation between LST and landcover related spectral indices

**Study period: 2011 -2021**

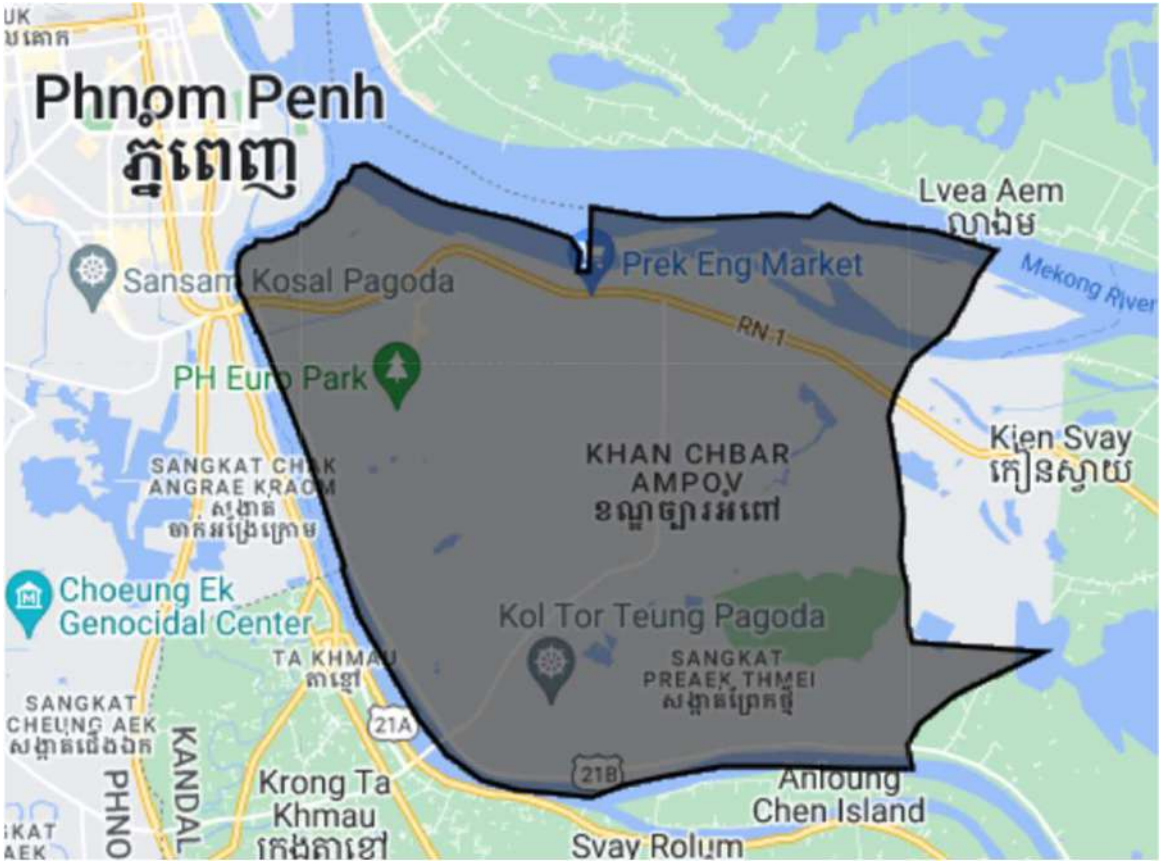



*Figure 1: Chbar Ampov, Phnom Penh, Cambodia*

# Material & method

Sattelite Image from Landsat 7 & 8

Google earth historical images

Google earth engine Python API

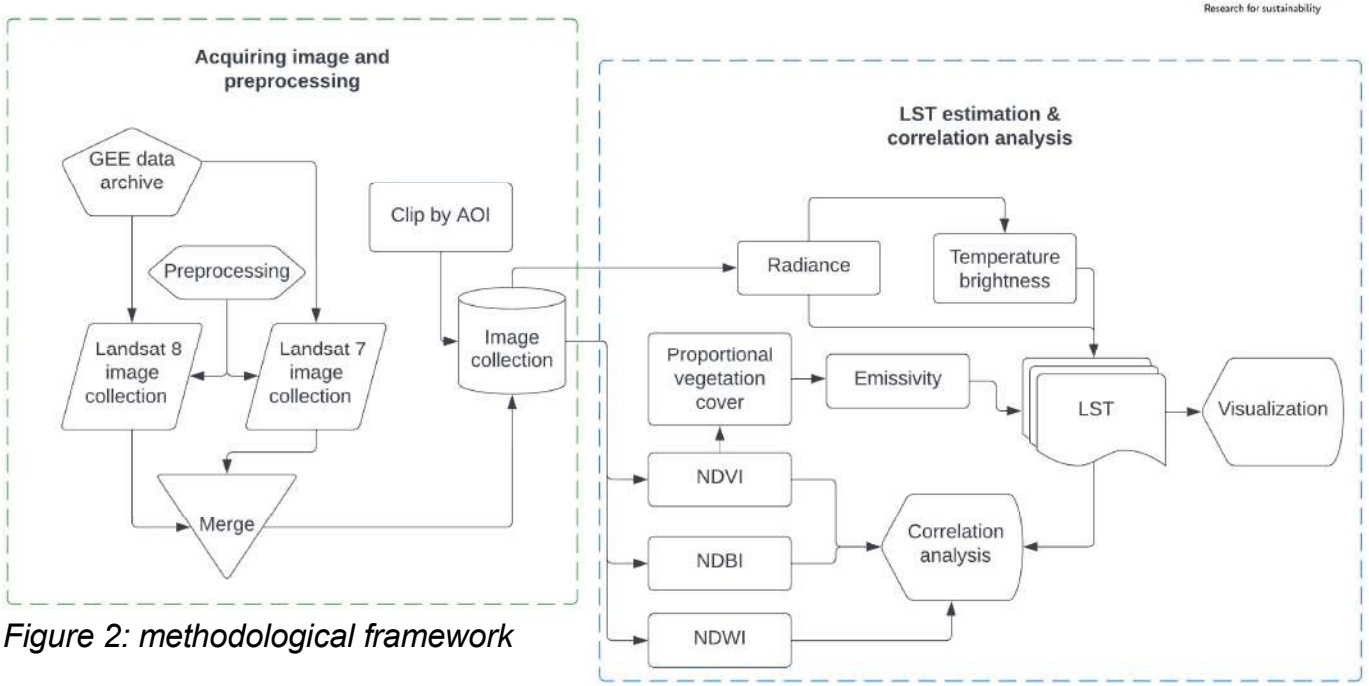



*Figure 2: methodological framework*

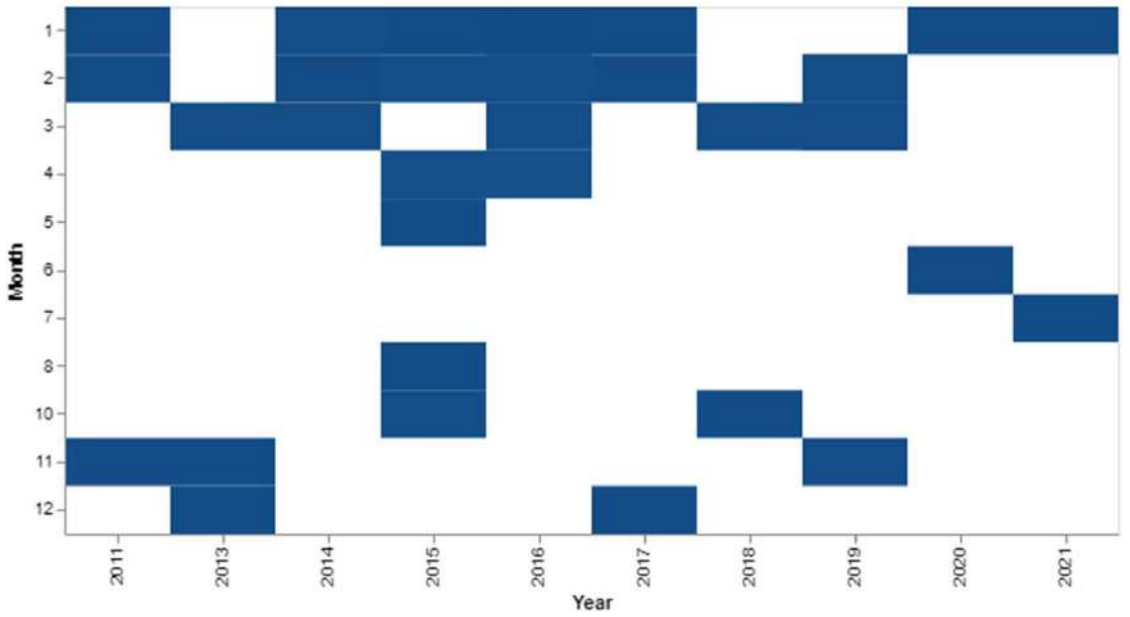
**Selected parameters:**

Maximum cloud cover = 5%

Minimum temperature threshold = 18 °C

# Dealing with cloud

**2015**

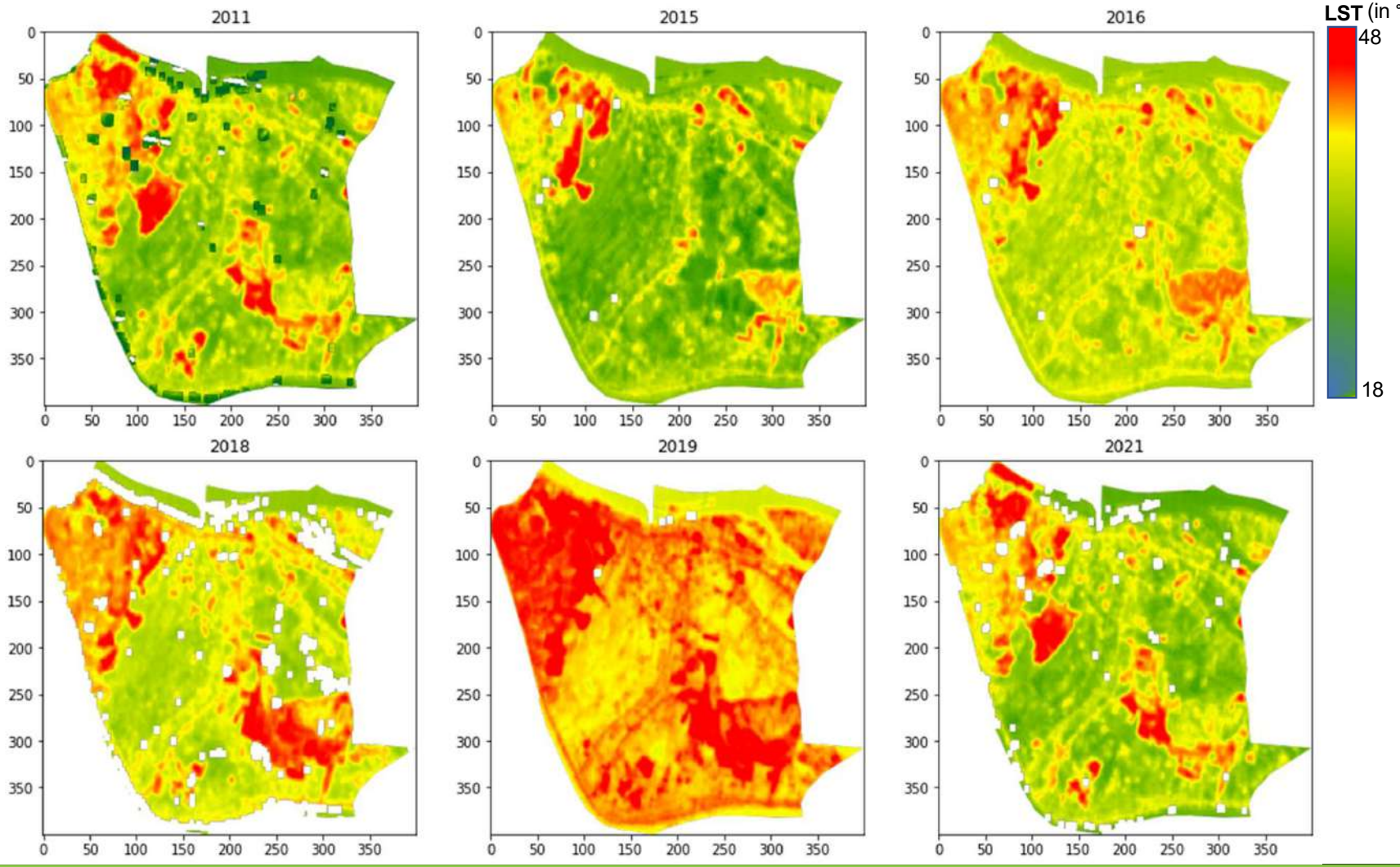



**January**

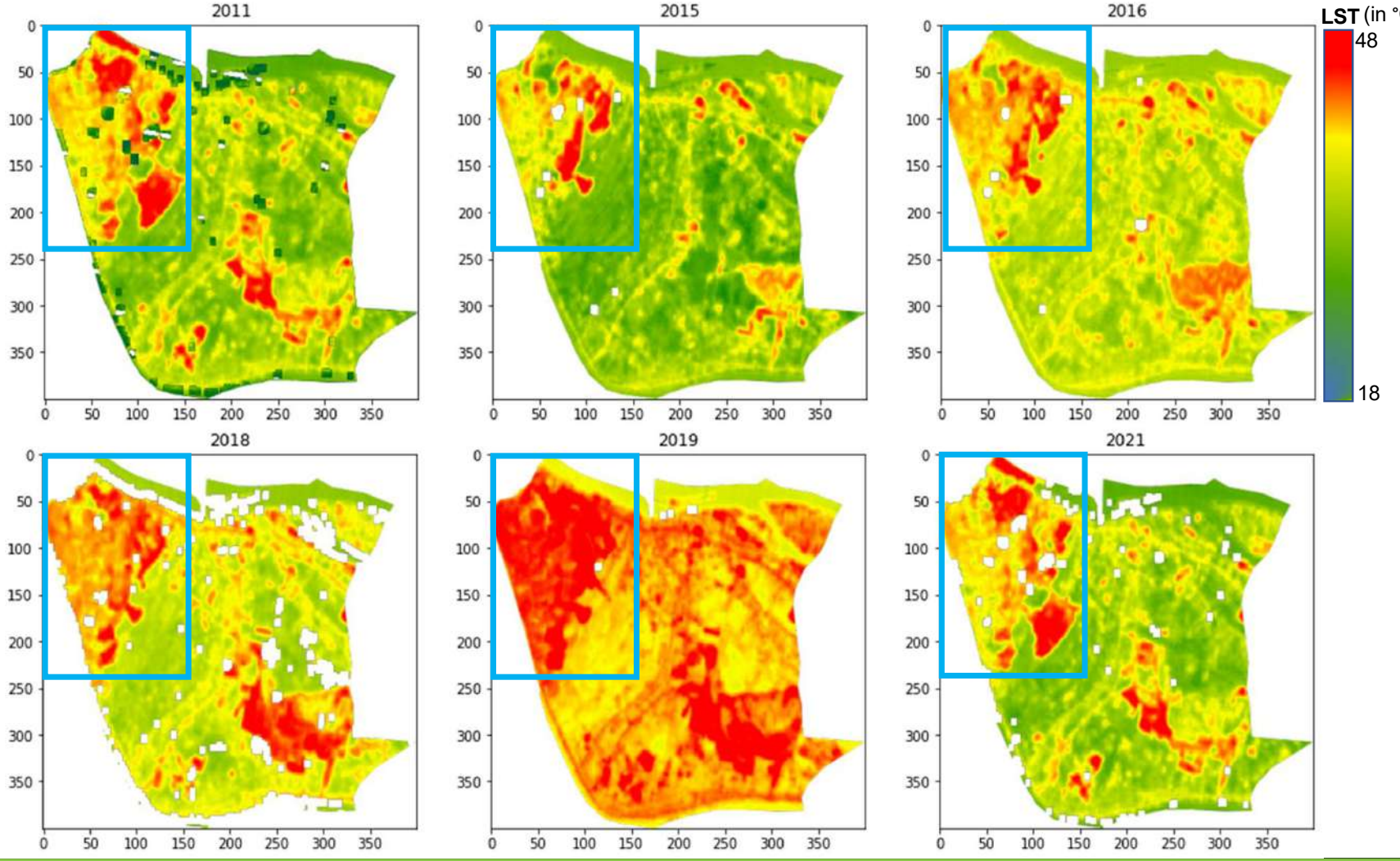
*Figure 3: Available cloud free image (with a maximum 5% cloud coverage)*

**Total number of images: 37**

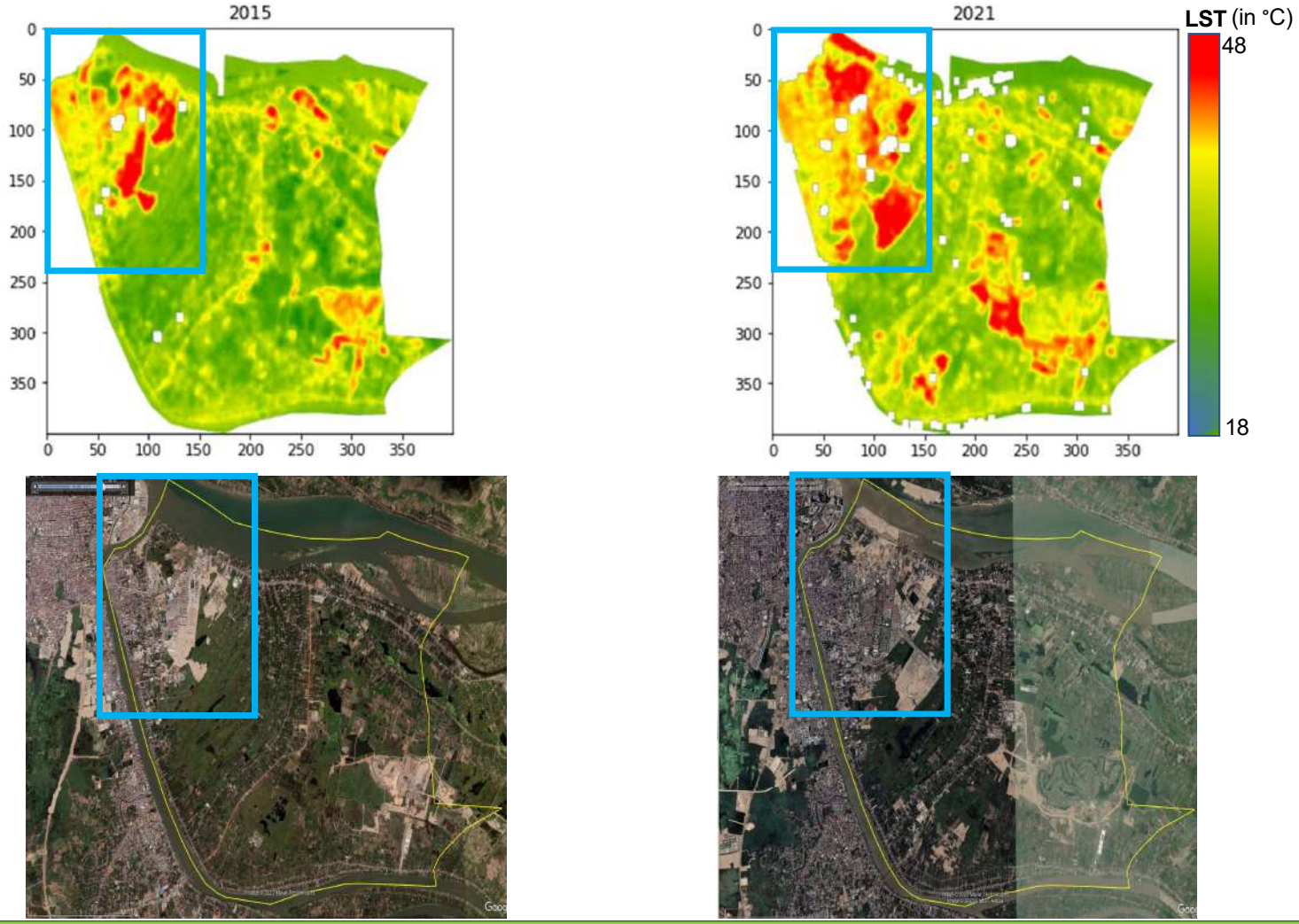
# Result: Visual change of LST



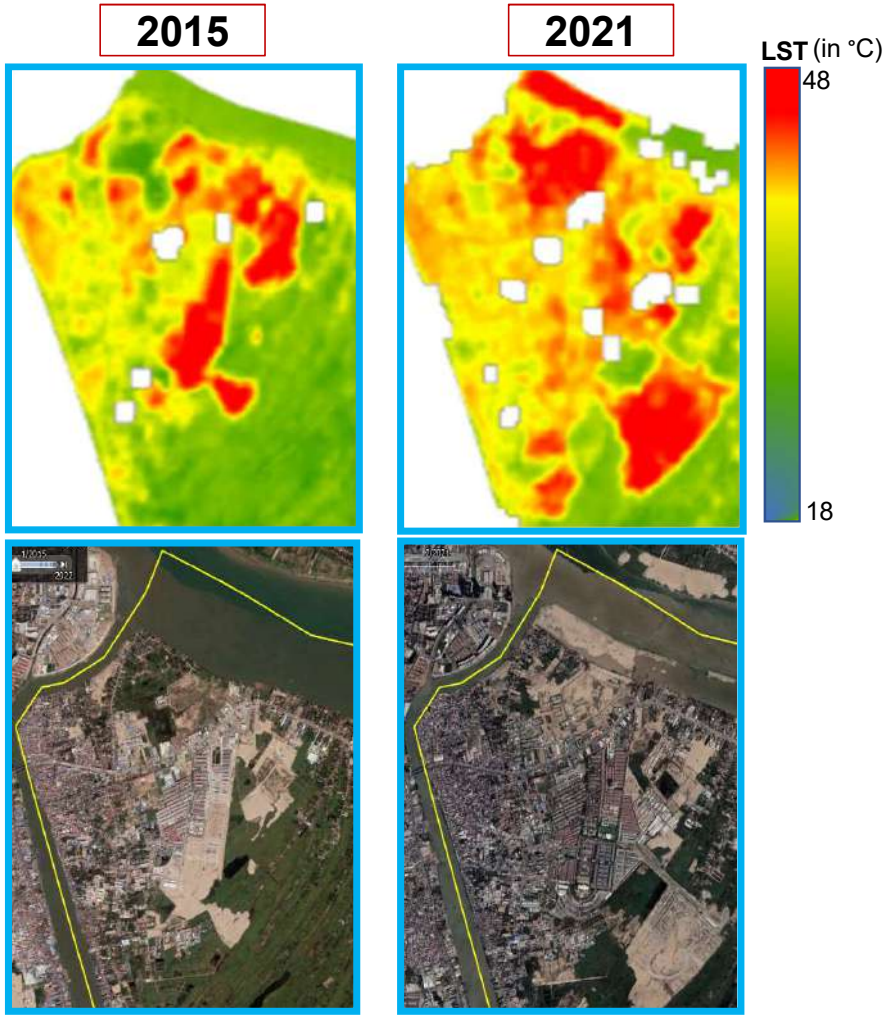
# Result: Visual change of LST



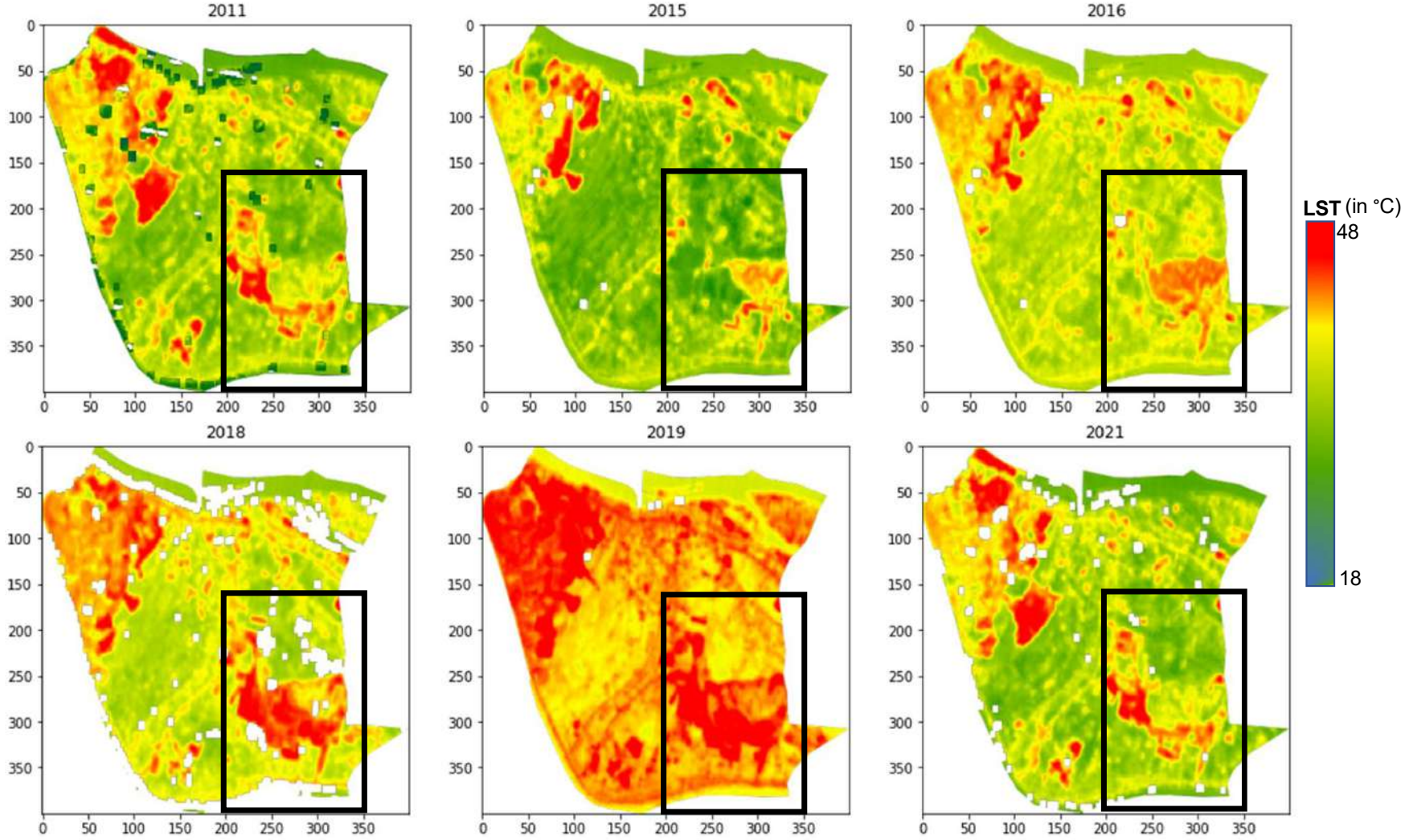
# Result: Visual change of LST



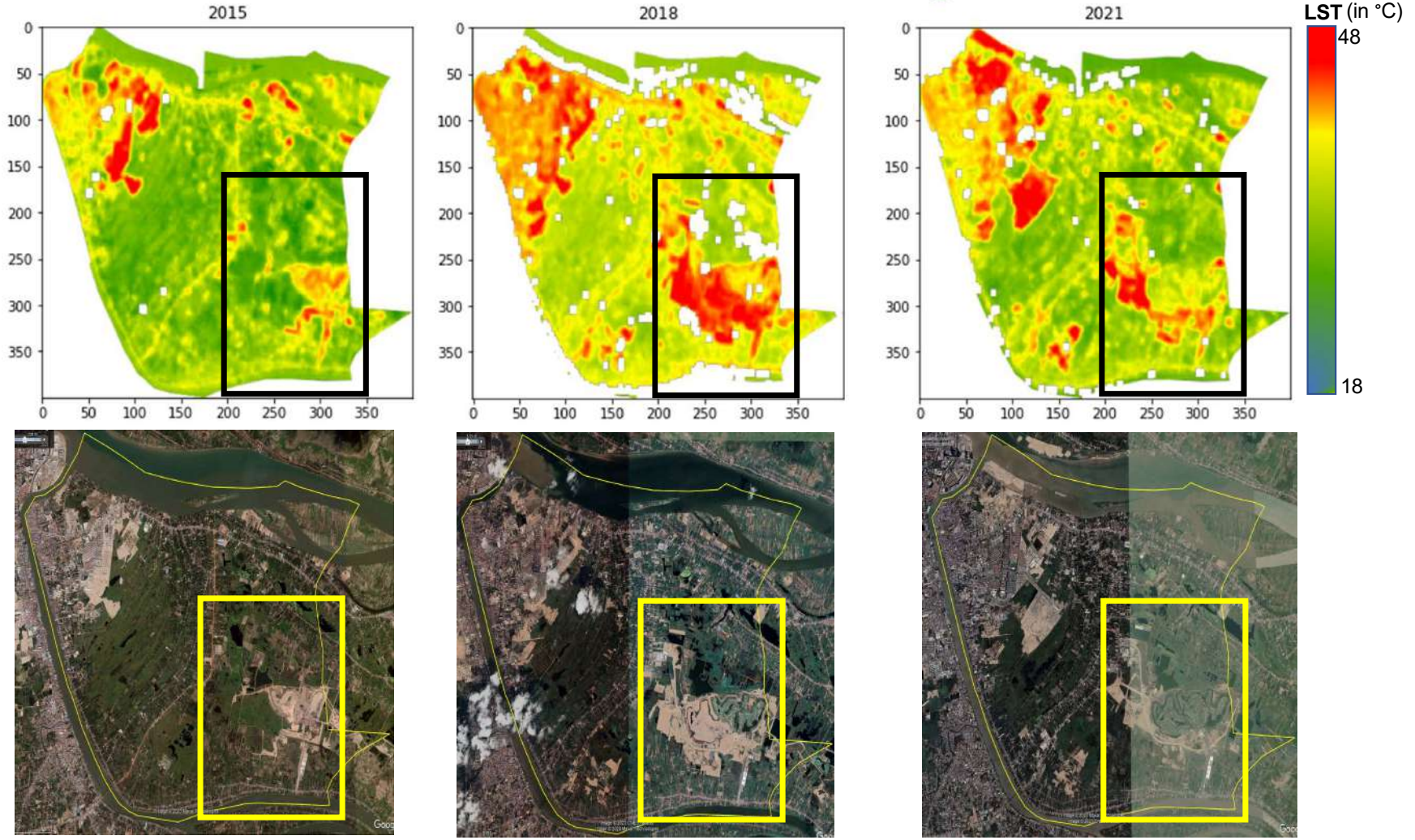
# Result: Visual change of LST



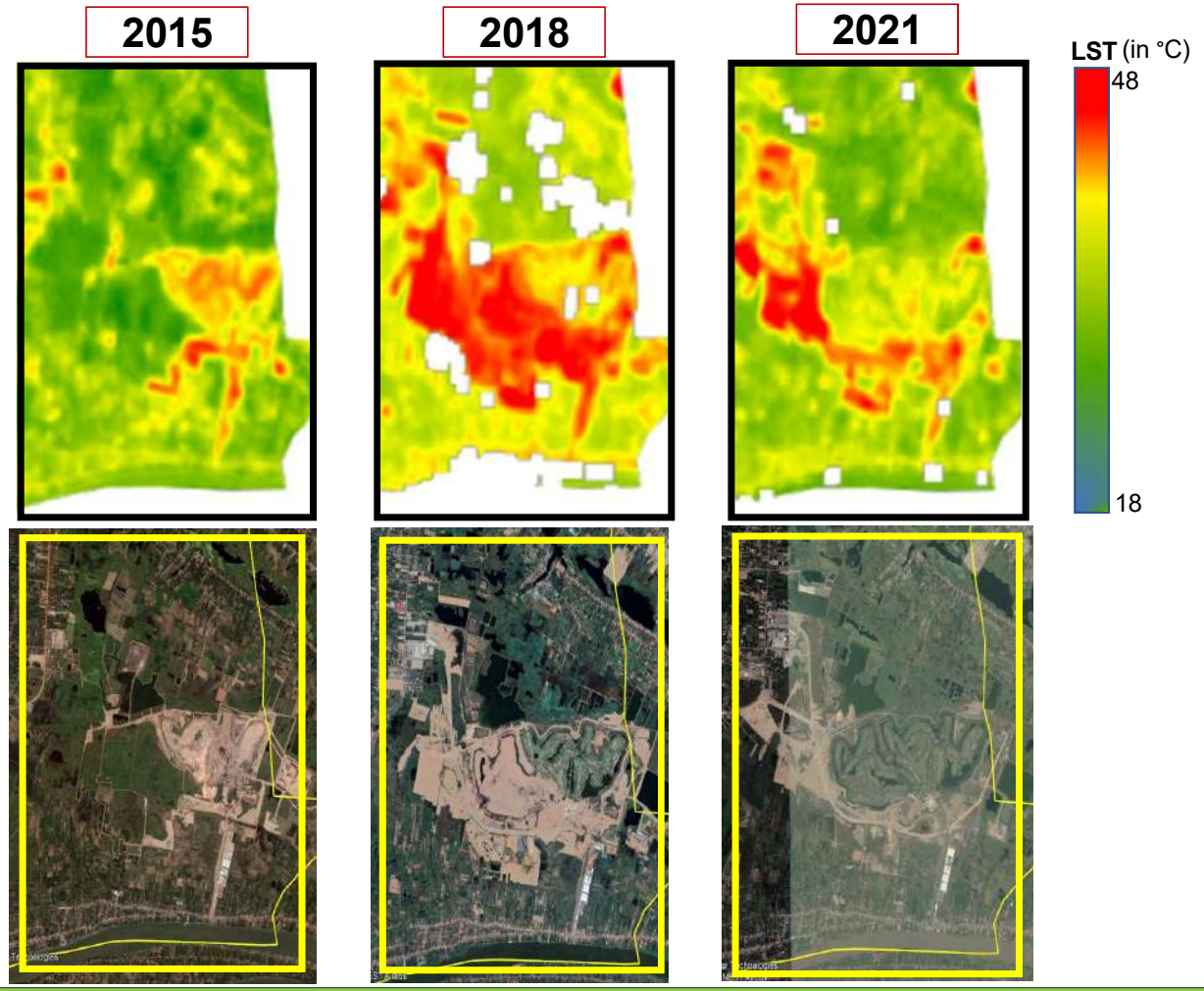
# Result: Visual change of LST



# Result: Visual change of LST



# Result: Visual change of LST



# Result: Trend of LST

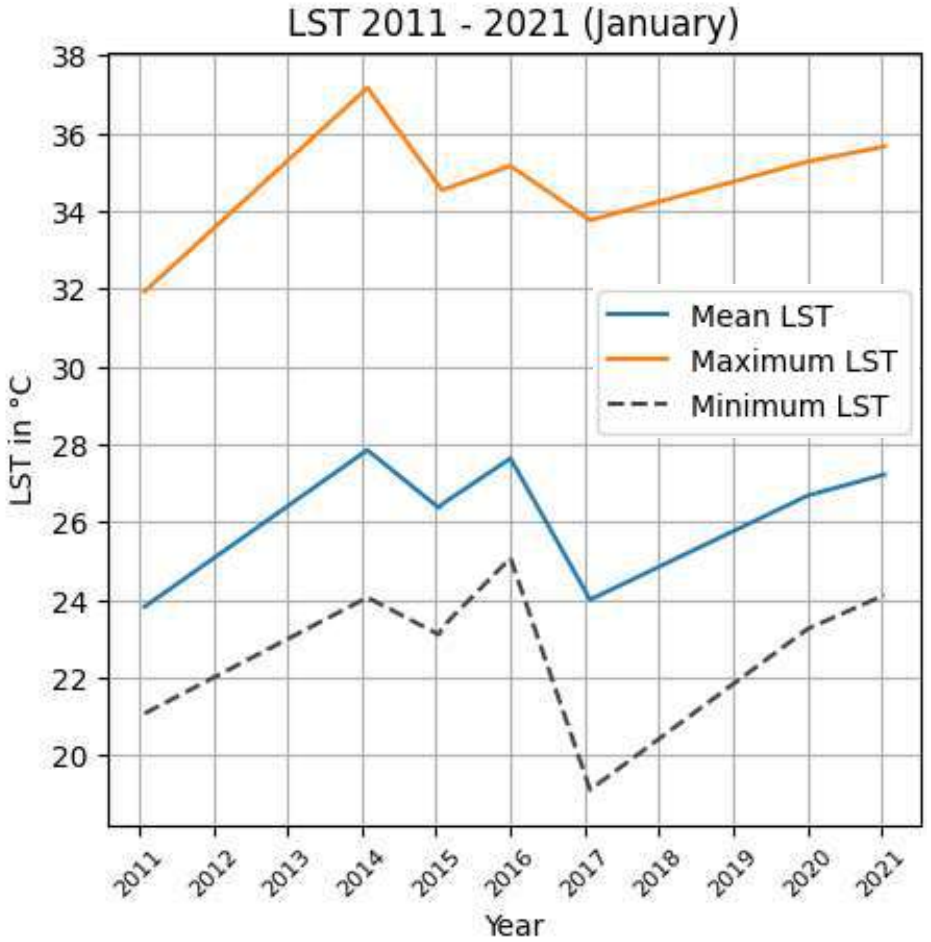



*Figure 4: LST change trend*

# Result: Correlation analysis

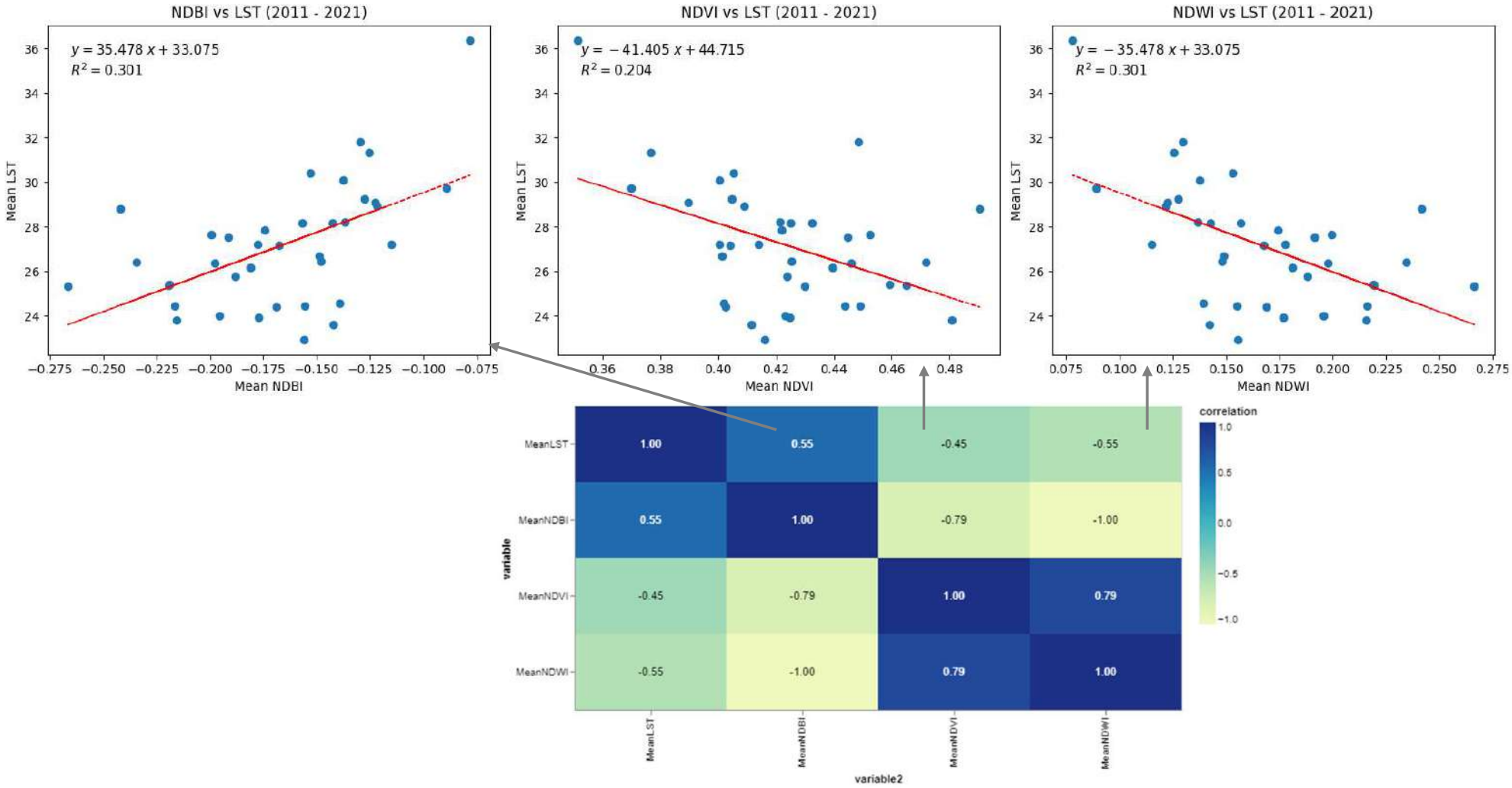



*Figure 5: Correlation matrix of LST and other spectral indices*

# Build4People Project

**Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia**

**គម្រោងសាងសង់សម្រាប់ប្រជាជន**
ការលើកកម្ពស់ គុណភាពជីវិត របស់អ្នកទីក្រុង ដោយ ការ បម្លែង ទៅជាក្រុង មានចីរភាពនៅកម្ពុជា

DEF 2019-2021

R&D 2021-2025

IMP 2025-2027

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## Thank you!

***More info: build4people.org***

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